This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

WSRC-TR-2006-00114, Rev. 0

Key Words:
Tank 48H
Wet air oxidation
Tetraphenylborate

Retention:
Permanent

TASK TECHNICAL AND QUALITY ASSURANCE PLAN FOR OUT-OF-TANK DESTRUCTION OF TETRAPHENYLBORATE VIA WET AIR OXIDATION TECHNOLOGY: PHASE I – BENCH SCALE TESTS

Kofi Adu-Wusu
Daniel J. McCabe
Christopher J. Martino
William R. Wilmarth

March 31, 2006

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

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

DISCLAIMER

Printed in the United States of America

Prepared For
U.S. Department of Energy

Key Words:
Tank 48H
Wet air oxidation
Tetraphenylborate

Retention:
Permanent

TASK TECHNICAL AND QUALITY ASSURANCE PLAN FOR OUT-OF-TANK DESTRUCTION OF TETRAPHENYLBORATE VIA WET AIR OXIDATION TECHNOLOGY: PHASE I – BENCH SCALE TESTS

Kofi Adu-Wusu
Daniel J. McCabe
Christopher J. Martino
William R. Wilmarth

March 31, 2006

LIST OF ACRONYMS

3PB	triphenylborane
2PB	diphenylborinic acid
1PB	phenylboronic acid
AAS	Atomic Absorption Spectroscopy
AD	Analytical Development
COD	chemical oxygen demand
CsTPB	cesium tetraphenylborate
CS&T	Chemical Science and Technology
DSC	differential scanning calorimeter
EDTA	ethylenediamminetetraacetic acid
GC-MS	Gas Chromatography-Mass Spectroscopy
gpm	gallons per minute
HEDTA	N-(2-hydroxyethyl) ethylenediamminetetraacetic
HLW	High Level Waste
HPLC	High Performance Liquid Chromatography
ICP-ES	Inductively Coupled Plasma – Emissions Spectroscopy
ICP-MS	Inductively Coupled Plasma – Mass Spectroscopy
KTPB	potassium tetraphenylborate
LWD	Liquid Waste Disposition
MST	monosodium titanate
NaTPB	sodium tetraphenylborate
Purex	plutonium uranium extraction
RFP	request for proposals
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SVOA	semi-volatile organic analyses
TIC	total inorganic carbon
TPB	tetraphenylborate
TOC	total organic carbon
XRD	x-ray diffraction
VOA	volatile organic analyses
WAO	wet air oxidation

1.0 INTRODUCTION

Tank 48H return to service is critical to the processing of high level waste (HLW) at Savannah River Site (SRS). Liquid Waste Disposition (LWD) management has the goal of returning Tank 48H to routine service by January 2010 or as soon as practical.

Tank 48H currently holds legacy material containing organic tetraphenylborate (TPB) compounds from the operation of the In-Tank Precipitation process. This material is not compatible with the waste treatment facilities at SRS and must be removed or undergo treatment to destroy the organic compounds before the tank can be returned to Tank Farm service. Tank 48H currently contains ~ 240,000 gallons of alkaline slurry with about 2 wt % potassium and cesium tetraphenylborate (KTPB and CsTPB). The main radioactive component in Tank 48H is ^{137}Cs. The waste also contains ~ 0.15 wt % Monosodium Titanate (MST) which has adsorbed ^{90}Sr, U, and Pu isotopes.

A System Engineering Evaluation of technologies/ideas for the treatment of TPB identified Wet Air Oxidation (WAO) as a leading alternative technology to the baseline aggregation approach. Over 75 technologies/ideas were evaluated overall. Forty-one technologies/ideas passed the initial screening evaluation. The 41 technologies/ideas were then combined to 16 complete solutions for the disposition of TPB and evaluated in detail.

Wet Air Oxidation (WAO) is an aqueous phase process in which soluble or suspended waste components are oxidized using molecular oxygen contained in air. The process operates at elevated temperatures and pressures ranging from 150 to 320°C and 7 to 210 atmospheres, respectively. The products of the reaction are CO_2, H_2O, and low molecular weight oxygenated organics (e.g. acetate, oxalate).[1-4]

The basic flow scheme for a typical WAO system is as follows. The waste solution or slurry is pumped through a high-pressure feed pump. An air stream containing sufficient oxygen to meet the oxygen requirements of the waste stream is injected into the pressurized waste stream, and the air/liquid mixture is preheated to the required reactor inlet temperature. The reactor provides sufficient retention time to allow the oxidation to approach the desired level of organic decomposition. Typical reaction time is about 30 - 120 minutes.

Heat exchangers are routinely employed to recover energy contained in the reactor effluent to preheat the waste feed/air entering the reactor. Auxiliary energy, usually steam, is necessary for startup and can provide trim heat if required. Since the oxidation reactions are exothermic, sufficient energy may be released in the reactor to allow the WAO system to operate without any additional heat input.

After cooling, the oxidized reactor effluent passes through a pressure control valve where the pressure is reduced. A separator downstream of the pressure control valve allows the depressurized and cooled vapor to separate from the liquid.

Typical industrial WAO applications have a feed flow rate of 1 to 220 gallons per minute (gpm) per train, with a chemical oxygen demand (COD) from 10,000 to 150,000 mg/L (higher CODs with dilution). Note that catalysts, such as homogeneous copper and iron, their heterogeneous counterparts, or precious metals can be used to enhance the effectiveness (i.e., to lower temperature, pressure, and residence time as well as increase oxidation efficiencies) of the WAO reaction if deemed necessary.

The positive features about WAO are as follows.

1. Proven technology - WAO technology has been successfully commercialized for 50 plus years. Over 200 full-scale systems have been constructed and operated worldwide.
2. Continuous process with fairly short reaction times (30 to 120 minutes typical) and small plant footprints.
3. Generally requires no use of chemicals - hence no downstream chemical impacts and no increase in waste volume (unless the waste has to be diluted).
4. High thermal efficiency – essentially an autothermal operation.
5. Corrosion-resistant materials, if needed, are already available for the process.
6. Can be highly automated for unattended operation.
7. Able to deal with varying feed flow rates and compositions.

WAO is routinely used to destroy organics in spent caustic (high pH similar to SRS waste) waste streams generated by ethylene plants and oil refineries (petrochemical industry). It is also used to treat organic wastes in pharmaceutical and chemical industries as well as municipal/sewage sludges. Examples of organics destroyed include phenols, benzene, naphthenics, cresylics, etc.[1-4]

In the radioactive arena, bench-scale WAO was successfully tested in the 1990s for the destruction of organics [ethylenediamminetetraacetic acid (EDTA), formate, citrate, acetate, and N-(2-hydroxyethyl) ethylenediamminetetraacetic (HEDTA)] in both Hanford Site simulated and radioactive wastes. Organics destruction based on total organic carbon (TOC) was > 98% in most cases.[5,6]

The objective of this study is therefore to assess the ability of the WAO process to destroy TPB using Tank 48H simulated waste via bench-scale testing at a vendor’s facility. Specifically, the task will measure TPB decomposition and the off-gases generated, and determine suitable materials of construction. Note that the off-gas composition in a closed bench-scale test will not be the same as in a continuous flow-through system, where the flow of air through the waste tends to purge volatile organics.

The SRNL support will be provided by personnel in the Chemical Science and Technology (CS&T) Section and Analytical Development (AD). This plan addresses vendor procurement or pre-qualification strategy, simulant preparation, scope of the testing, analytical methods, and quality assurance aspects of the program.

This Task Technical and Quality Assurance Plan is derived from “Technical Task Request for Wet Air Oxidation of KTPB Slurry”[7] The deliverable from this task will be written final report containing vendor test results and recommendations for the work.

2.0 TASK DESCRIPTION

The major thrust of the task is as follows: (1) Development and execution of procurement strategy for testing at a vendor facility, (2) Preparation of Tank 48H slurry simulant for the tests, (3) Bench-scale testing at a vendor's facility, (4) Supplemental analytical measurements of samples taken during testing, (5) Documentation of vendor testing results in a technical report, and (6) Development of conceptual flowsheet for the WAO process.

2.1 DEVELOPMENT AND EXECUTION OF PROCUREMENT STRATEGY FOR TESTING AT A VENDOR FACILITY

SRNL and LWD personnel will consult with SRS site procurement personnel to develop vendor procurement or pre-qualification strategy for the bench-scale testing. The procurement strategy will be either sole-source or bidding approach. The pertinent actions in the development of vendor procurement or pre-qualification strategy include preparation of subcontract, issuing of request for proposals (RFP), reviewing of bids, and awarding of subcontract.

2.2 WASTE SIMULANT PREPARATION

The bench-scale testing will use Tank 48H simulated (nonradioactive) waste slurry. The simulated waste slurry will be prepared at SRNL per the recipe developed for the Fenton TPB destruction work and shipped to the vendor's facility.[8]

Table 1 gives the compositions of the salt solution and Table 2 gives the concentration of the trace metals and other compounds in the slurry simulant.[8] The compositions reflect the Tank 48H composition on October 31, 2003 (after addition of 6,424 gallons of 50 wt % caustic).[8,9] Even though the compositions are based on Tank 48H sampling analytical data as of October 31, 2003, they are consistent with the March 6, 2005[10] and August 23, 2004[11] Tank 48H sampling analytical data; and Best Estimate[12,13] data.

Samples (slurry and filtrate) of the prepared simulant will be analyzed or characterized. Table 3 gives the various analyses that will be performed. Shipment of simulant to vendor's facility will proceed if the analytical/characterization data are consistent with data in Tables 1 and 2, and also meet the acceptance criteria given in Table 3. Due to evaporation concerns, the benzene may be added to the simulant at the vendor's facility.

Table 1. Composition of Tank 48H Salt Solution

Component	Concentration, M
KTPB	0.0574
CsTPB	0.0001
NaOH	1.5973
$NaNO_2$	0.4551
Na_2CO_3	0.4560
$NaNO_3$	0.2042
$NaAlO_2$	0.0735
$Na_3PO_4 \cdot 12H_2O$	0.0053
Na_2SO_4	0.0028
NaCl	0.0034
NaF	0.0009
KNO_3	0.0068

Table 2. Concentration of Tank 48H Trace Metals and Compounds

Component	Metal Concentration, mg/L	Compound Added	Component	Concentration, mg/L	Compound Added
Pd	0.0801	$Pd(NO_3)_2$	Phenol	952	Phenol
Cu	1.9276	$Cu(SO_4) \cdot 5H_2O$	Biphenyl	618	Biphenyl
Mo	8.9957	$Na_2MoO_4 \cdot 2H_2O$	Benzene	55.0	Benzene
Cr	45.5981	Na_2CrO_4	Purex sludge[b]	435	Purex sludge[b]
Zn	7.7367	$Zn(NO_3)_2 \cdot 6H_2O$			
Pb	30.8228	$Pb(NO_3)_2$			
Sn	12.2313	$SnCl_2 \cdot 2H_2O$			
Ca	19.2765	$Ca(NO_3)_2 \cdot 4H_2O$			
Sr	5.5155	$Sr(NO_3)_2$			
La	0.9687	$La(NO_3)_3 \cdot 6H_2O$			
Cd	1.2916	$Cd(NO_3)_2 \cdot 4H_2O$			
Ce	5.4894	$Ce(NO_3)_3 \cdot 6H_2O$			
Rh	0.2251	$Rh(NO_3)_3$			
Ru	0.2476	$RuCl_3 \cdot xH_2O$			
Si	88.00	$Na_2SiO_3 \cdot 9H_2O$			
Hg	10.0	Diphenyl Hg			
Ti	759	MST[a]			

[a] MST (monosodium titanate) is added as slurry.
[b] Purex (plutonium uranium extraction) sludge is added as slurry.

Table 3. Constituents in Simulated Slurry Waste Targeted for Analysis along with Acceptance Criteria.

Analyte	Analytical Method	Acceptance Criterion
TPB	High Performance Liquid Chromatography (HPLC)	10%
OH^-	Titration	10%
CO_3^{2-}	Titration	10%
NO_2^-	Ion Chromatography (IC)	10%
NO_3^-	IC	10%
PO_4^{3-}	IC	50%
SO_4^{2-}	IC	50%
Cl^-	IC	50%
F^-	IC	50%
$(HCOO)^-$	IC	50%
$(C_2O_4)^{2-}$	IC	50%
Al	Inductively Coupled Plasma – Emissions Spectroscopy (ICP-ES)	10%
B	ICP-ES	50%
Ca	ICP-ES	50%
Cd	ICP-ES	50%
Ce	ICP-ES	50%
Cr	ICP-ES	50%
Cs	Atomic Absorption Spectroscopy (AAS)	50%
Cs	Inductively Coupled Plasma – Mass Spectroscopy (ICP-MS)	50%
Cu	ICP-ES	25%
Fe	ICP-ES	50%
Hg	AAS	25%
K	AAS	25%
La	ICP-ES	50%
Mo	ICP-ES	50%
Na	ICP-ES	10%
Na	AAS	10%
P	ICP-ES	50%
Pb	ICP-ES	50%
Pd	ICP-MS	25%
Rh	ICP-MS	50%
Ru	ICP-MS	50%
S	ICP-ES	50%
Si	ICP-ES	50%
Sn	ICP-ES	50%
Sr	ICP-ES	50%
Ti	ICP-ES	10%
Zn	ICP-ES	50%
Benzene	Volatile and Semi-Volatile Organic Analysis (VOA/SVOA)	50%
Phenol	HPLC and/or SVOA	10%
Biphenyl	HPLC	50%
TIC/TOC	Wet Chemistry	50%
Density	Gravimetric	10%
Total solids	Gravimetric	25%
Filtrate dissolved solids	Gravimetric	25%
Insoluble Solids	Gravimetric	50%

2.3 BENCH-SCALE TESTING AT A VENDOR'S FACILITY

The bench-scale testing will evaluate the viability of the WAO process to destroy TPB in a simulated (nonradioactive) waste slurry. SRNL personnel will support the vendor during testing regarding coordination, logistics, and resolution of technical and general issues that may arise etc. SRNL personnel will also observe the tests to ensure validity of the results as well as make sure stipulations in the contractual agreement with the vendor are followed.

The scope of work will be outlined in the contract award. Briefly, the scope of work will be scouting for/determining optimal ranges of temperature, pressure, reaction time, air/oxygen requirements, waste feed dilution (if deemed necessary) that will give desired percent destruction of TPB. Note that the desired percent destruction of TPB will be specified in the contract after discussions with LWD personnel. Lastly, the bench-scale testing will include materials-of-construction corrosion studies to identify alloys suitable for the equipment.

The test will also measure off-gases produced via collection of gas in an appropriate vessel (e.g. Tedlar® bag or syringe) and analyze the treated simulant. The off-gas analyses will include CO_2, CO, NO_x, volatile and semi-volatile organic compounds by Gas Chromatography-Mass spectrometry (GC-MS), VOA, and SVOA, etc. A comprehensive analysis of the treated simulant will allow meaningful comparisons with similar data from the untreated simulant (see Table 3). This will help assess transformations the material undergoes during the oxidation reaction, e.g., solids formation, increase/decrease of the constituents, residual organics, pH, etc. In addition to analyses in Table 3, the solids will be analyzed by x-ray diffraction (XRD) and differential scanning calorimeter (DSC), etc. to help identify any new solid formations/compounds.

Overall, the bench-scale testing will provide data that will be used to establish feasibility and preliminary design parameters for a full-scale system including the evaluation of process economics. Process economics basically deals with the potential to use the treated waste (i.e., effluent of the WAO reactor) to preheat the untreated waste feed (i.e., influent of the WAO reactor).

2.4 SUPPLEMENTAL ANALYSES OF TEST SAMPLES

WAO vendors typically use COD and TOC measurements of the waste and possibly oxygen content of the off-gas to track organic destruction. Discussions will be done with the vendor to ascertain additional analytical services vendor, or a subcontract laboratory, can provide. The balance of the required analyses will be provided by SRNL.

Product samples that will be shipped from the vendor's facility to SRNL will either be quenched with NaOH and/or stored at ~4 ^{o}C to retard any reaction that may be going on. Key supplemental analyses may include TPB and its degradation products [triphenylborane (3PB), diphenylborinic acid (2PB), phenylboronic acid (1PB)] by HPLC, other residual organics by GC-MS, VOA, and SVOA, etc. Should the vendor not be able to provide a full suite of gas analyses, off-gas samples will be collected with syringes or plastic bags for CO_2, CO, NO_x, volatile and semi-volatile organic compounds analyses at SRNL.

Note that for the purpose of determining percent TPB destruction, it may be expedient to complement the vendor's COD/TOC measurements with analysis of K in the product filtrate (also at the vendor's facility) to help reduce the number of samples that will be shipped to SRNL for analysis of TPB and its degradation products by HPLC. Note further that TOC (and/or K) analysis will also be needed at SRNL to compare with the vendor's TOC (and/or K) analysis to ensure that sample quenching and/or chilling are adequate. Also, The anticipated TPB detection limit for regular HPLC analysis based on prior testing is 10 ppm.[14] If deemed necessary to go below the 10 ppm detection limit, a specialized HPLC method will be used.[15]

2.5 DOCUMENTATION OF VENDOR TESTING RESULTS IN A TECHNICAL REPORT

See section 4.0.

2.6 DEVELOPMENT OF CONCEPTUAL FLOWSHEET FOR THE WAO PROCESS

Using information from the vendor's bench-scale testing, SRNL personnel will assist LWD personnel to develop a conceptual flowsheet for the WAO process.

3.0 RESPONSIBILITIES

The CS&T personnel will coordinate planning of activities, oversee the TPB destruction tests, and provide interpretation and documentation of results.

The AD and/or CS&T personnel will provide supplemental analysis of samples.

4.0 TASK DELIVERABLES AND ACCEPTANCE CRITERIA

The CS&T will provide a written final report containing vendor test results and recommendations for the work. This task will complete with approval of the final report by the Tank 48H Project Management, Salt Disposition Engineering and SRNL management. The report will receive review per WSRC Manual E7, Procedure 2.60.

5.0 DOCUMENTATION

The CS&T personnel performing work at SRNL will record all experimental instructions, results, and calculations in a numbered laboratory notebook (WSRC-NB-2005-00102) in accordance with Manual L1, SRNL Procedures Manual, Procedure 7.16. The authors will document all results pertinent to the objectives of this task in a numbered WSRC technical report (WSRC-TR-2006-xxxxx) with permanent retention. Preliminary documentation of results, when deemed necessary by the task leader and his manager will occur in non-permanent numbered memoranda. The task leader will provide a draft of the permanent report to selected personnel within CS&T, Tank 48H Project Management, and Salt Disposition Engineering for comments. A final report will be issued after disposition of the comments. The vendor will be responsible for documentation of work performed at their facility. Data from analyses performed at SRNL will be provided to the vendor to aid in interpretation of their test results.

6.0 WASTE DISPOSAL PLAN

An Environmental Evaluation Checklist (EEC) will be completed and sent to Environmental Compliance Authority (ECA) for approval. Disposal of aqueous solutions will be done in compliance with the guidance from the ECA.

Neutralization of the waste will generate NO_x from the acidification of sodium nitrite (< 0.5 M $NaNO_2$). The acid adjustment occurs over a period of 3 hours, thus limiting the production rate of NO_x. If solids are formed during neutralization of the waste, they will be quantified for hazardous components and an appropriate disposal route determined.

Contaminated laboratory materials (e.g., bottles, wipes, sample tubes, etc.) will be disposed in compliance with the EEC. Excess salt solution will either be archived for use in another program or will be disposed.

It will be specified in the Procurement documents that the vendor is responsible for compliance with all applicable regulations (e.g., chemical exposure, off-gas release, and waste disposal).

7.0 RISK REVIEW

Table 4 highlights the elements identified as programmatic risks. Where available, the authors list mitigating factors or actions. Equipment, analytical services, personnel, facilities, and emergent activities contribute to the programmatic risks associated with this task.

Table 4. Programmatic Risks and Mitigation

Risk Factor	Event	Mitigation
Personnel		
Lead Investigator	Illness/vacation	Backup researcher identified
Equipment		
Stirrer	Breakdown	Spare on hand
Pump	Breakdown	Spare on hand
Vessels/containers	Breakage/damage	Spare on hand
M&TE	Failure	Backup instruments are available
Simulant Preparation		
Toxic off-gas	Benzene generation	Preparation done in chemical hood.
Inadvertent spilling of simulant	During or after preparation	Additional waste simulant will have to be prepared. Delay of up to 4 weeks is possible.
Spilling or loss of simulant in transit	During shipment	Additional waste simulant will have to be prepared. Delay of up to 4 weeks is possible.
Electrical	Outage	Unplanned outages could result in short delays
Analytical Support		
Equipment	Failure	Some alternative instruments are available but delay of up to 2 weeks is

Risk Factor	**Event**	**Mitigation**
		possible if they have to be repaired.
Vendor Testing		
Inadvertent spilling of simulant	During testing	Additional waste simulant will have to be prepared. Delay of up to 4 weeks is possible.
Reactions not adequately quenched in sample bottles	Reaction extent underestimated due to continuing reaction in sample bottles	1. Add sodium hydroxide to and/or freeze the slurry samples to quench reactions. 2. Analyze for TOC in initial samples and compare with vendor's TOC data to determine whether quenching is adequate.
Testing unit malfunctioning	Failure	Backup instruments may be available. Will be addressed in the contract
Inadequate analytical services from vendor	Questionable analytical data	May need to collect backup samples for archiving and analyze them as needed
Electrical	Outage	Unplanned outages could result in short delays

8.0 SCHEDULE

The task leader will provide information on schedule logic, task duration, needed resources, and resource constraints to the cognizant SRNL and Tank 48H Project schedule development personnel.

Issue task plan	April 7, 2006
Complete chemicals purchase and simulant preparation setup	April 25, 2006
Prepare subcontract for vendor testing	April 18, 2006
Issue RFP for vendor testing	May 2, 2006
Receipt of bids for vendor testing	May 31, 2006
Review of bids for vendor testing	June 5, 2006
Award contract for vendor testing	June 7, 2006
Complete simulant preparation and characterization	June 21, 2006
Vendor completes preparations for testing	June 21, 2006
Complete shipping of simulant to vendor's facility	July 14, 2006
Complete bench-scale testing at vendor's facility	September 18, 2006
Complete post-testing supplemental analysis at SRNL	October 16, 2006
Draft report including evaluation of vendor 's report	October 23, 2006
Review/Approve report	November 21, 2006
Complete flowsheet development	December 6, 2006

9.0 QUALITY ASSURANCE

This section describes the controls necessary to ensure the quality of the data obtained in this program.

9.1 TASK QA PLAN CHECKLIST

See Attachment 1.

9.2 ADDITIONAL COMMENTS

Manual L1 Procedure 7.15 will govern obtaining chemical analyses. Handling of chemical samples will occur per the AD routine QA level. The AD uses Manual 1Q Procedures 2-7 for MS&E.

9.3 DOUMENTS REQUIRING CUSTOMER APPROVAL

1. Technical task and quality assurance plan (this report).
2. Final summary report.

9.4 RECORDS

The following items shall become records for this task:

1. Technical task and quality assurance plan,
2. Controlled laboratory notebooks,
3. Final summary report, and
4. Any other supporting documentation deemed appropriate by the task leader.

10.0 SAFETY

The task leader will review the safety aspects of the simulant preparation work described in this task plan to determine their impact on the safety of the facilities. The review will include evaluation of the checklist forms in the Conduct of Research and Development Manual, WSRC-IM-97-00024, Rev 3. The laboratory notebook will contain a copy of the completed documents. This work introduces no new chemicals. No new experimental hazards at SRNL (such as new electrical, significant quantities of combustible, explosive, or corrosive materials, elevated pressures or elaborate mechanical equipment) arise from the planned simulant preparation work. The vendor will be supplied with a simulant composition and Material Safety Data Sheets for all constituents added to the simulant. It will be the responsibility of the vendor to maintain safe handling of the simulant and product streams. It will be the responsibility of the vendor to maintain a safe working environment for SRS personnel visiting their facility.

11.0 REFERENCES

1. “Zimpro Wet Oxidation: Innovative Technology for Difficult Waste Treatment Problems,“ Unites States Filter Corporation, ZP-WAO-BR-0104, 2004.

2. T. M. S. Carlos, C. B. Maugans, “Wet Air Oxidation of Refinery Spent Caustic: A Refinery Case Study,” San Antinio, TX, ENV-00-193, NPRA Conference, September 12, 2000.

3. C. E. Ellis, R. J. Lawson, B. L. Brandenburg, "Wet Air Oxidation of Ethylene Spent Caustic," AIChE Annual Meeting and 6th Annual Ethylene Producers Conference, Atlanta, GA, Session # 25, Paper # 25C, April 17 – 21 1994.

4. J. P. Gallego, S. R. Lopez, C. B. Maugans, "The Use of Wet Air Oxidation and PACT® for the Treatment Propylene Oxide/Styrene Monomer (PO/SM) Industrial Wastewaters at the Repol PO/SM Plant in Tarragona, Spain," CHISA 2002, Praha, The Czech Republic, August 25–29, 2002.

5. R. J. Orth, A. J. Schmidt, M. R. Elmore, T. R. Hart, G. G. Neuenschwander, S. R. Gano, R. W. Lehmann, J. A. Momont, "Removal of Strontium and Transuranics from Hanford Waste via Hydrothermal Processing – FY 1994/95 Test Results," Pacific Northwest National Laboratory, PNL-10765, September 1995.

6. R. J. Orth, A. J. Schmidt, aA. H. Sacher, M. R. Elmore, T. R. Hart, J. C. Poshusta, G. G. Neuenschwander, E. O. Jones, S. R. Gano, "Organic Destruction Technology Development Task Annual Report – FY1993. Hydrothermal Processing of Hanford Tank Waste," Pacific Northwest National Laboratory, PNL-10108, September 1993.

7. S. C. Shah, "Technical Task Request for WAO of KTPB Slurry," SP-TTR-2006-00003, Rev. 0, March 6, 2006.

8. D. P. Lambert, "Tank 48H Simulant Recipe Development and Documentation," SRT-LWP-2004-00042, Rev. 1, June 29, 2004.

9. D. P. Lambert, T. B. Peters, M. E. Stallings, and S. D. Fink, "Analysis of Tank 48H Samples -- HTF-E-03-73 (June 03, 2003) and HTF-E-03-127 (September 17, 2003)," WSRC-TR-2003-720, Rev. 0, January 20, 2004.

10. F. F. Fondeur, D. P. Lambert, and S. D. Fink, "Analysis of Tank 48H Sample HTF-E-05-021," WSRC-TR-2005-00358, Rev. 0, October 3, 2005.

11. D. P. Lambert, T. B. Peters, M. J. Barnes, and S. D. Fink, "Analysis of Tank 48H Samples – HTF-E-04-049 and HTF-E-04-050 (August 23, 2004)," WSRC-TR-2004-00514, Rev. 0, November, 2004.

12. J. L. Thomas, "Tank 48 Radionuclide Characterization," CBU-PIT-2005-00046, Rev. 1, February 27, 2006.

13. E. T. Ketusky, "Tank 48 Best Estimate Chemical Characterization (as of March 17, 2005)," CBU-PIT-2005-00066, Rev. 0, March 17, 2005.

14. D. P. Lambert, T. B. Peters, and S. D. Fink, "In Tank Peroxide Oxidation Process for the Decomposition of Tetraphenylborate in Tank 48H," WSRC-TR-2005-00114, April 2005.

15. T. L. White, K. B. Martin, L. N. Oji, and W. R. Wilmarth, "Reducing the Detection Limit for Tetraphenylborate in Tank 50H Waste," WSRC-TR-2004-00157, Rev. 0, March 10, 2004.

12.0 APPROVALS

Authors:

4/7/06

K. Adu-Wusu, SRNL Chemical Science & Technology — Date

4/10/06

D. J. McCabe, SRNL Chemical Science & Technology — Date

4-10-2006

C. J. Martino, SRNL Chemical Science & Technology — Date

Quality Assurance:

S. R. Loflin — 4/10/06

S. R. Loflin, SRNL Quality Assurance — Date

SRNL Management:

4/10/06

M. A. Polochko, Manager, SRNL Analytical Development — Date

4/10/06

W. R. Wilmarth, Manager, SRNL Advanced Characterization & Process Research — Date

4/10/06

J. C. Griffin, Manager, SRNL Chemical Science & Technology — Date

Customers:

Dennis J. Conrad — 4/11/06

D. T. Conrad, Design Authority Manager, Salt Disposition Engineering — Date

4-11-06

R. H. Spires, Manager, Project Owner — Date

ATTACHMENT 1: CS&T TASK QUALITY ASSURANCE PLAN CHECKLIST

Task Technical Plan No: WSRC-RP-2005-00293 Task Title: Task Technical And Quality Assurance Plan For Out-Of-Tank Destruction of Tetraphenylborate Via Wet Air Oxidation Technology: Phase I – Bench Scale Tests
Listed below are the sections of WSRC QA Manual (1Q). Check the 1Q sections applicable to your task. Also, check procedures CS&T implements to control the task. This checklist identifies controls for task activities performed by CS&T only. (Form Revised 11/30/2005)

12.1 WSRC 1Q SECTION	Applies To Task	12.1.1 Procedures Implemented by CS&T	Procedure Used
Organization	X	1Q, QAP 1-1, Organization L1, 1.02, SRTC Organization	X X
		1Q, QAP 1-2, Stop Work	X
QA Program	X	1Q, QAP 2-1, Quality Assurance Program*	X
	X	1Q, QAP 2-2, Personnel Training & Qual. L1, 1.32, SRTC Read and Sign/Briefing Program	X X
	X	1Q, QAP 2-3, Control of R&D Activities* L1, 7.10, Control of Technical Work	X X
		L1, 7.16, Laboratory Notebooks and Logbooks	X
		1Q, QAP 2-4, Auditor/Lead Auditor Qual. & Cert. 1Q, QAP 2-5, Qual. & Cert. of Independent Insp. Personnel	NA for CS&T NA for CS&T
	X	1Q, QAP 2-7 QA Program Req. for Analytical Measurement Systems	X
Design Control		1Q, QAP 3-1, Design Control L1, 7.10, Control of Technical Work	
Procurement Document Control	X	1Q, QAP 4-1, Procurement Document Control E7, 3.10, Determination of Quality Requirements for Procured Items 7B, 3E (for reference only)	X
Instructions, Procedures and Drawings	X	1Q, QAP 5-1, Instructions, Procedures, & Drawings E7, 2.30, Drawings L1, 1.01, SRNL Procedure Administration	X X
Document Control	X	1Q, QAP 6-1, Document Control 1B, MRP 3.32, Document Control	X
Control of Purchased Items and Services	X	1Q, QAP 7-2, Control of Purchased Items & Services 7B & 3E (for reference only)	X
		1Q, QAP 7-3, Com. Grade Item Dedication E7, 3.46, Replacement Item Evaluation/Commercial Grade Dedication	
Identification & Control of Items	X	1Q, QAP 8-1, ID and Control of Items*	X
Control of Processes		1Q, QAP 9-1, Control of Processes	NA for CS&T
		1Q, QAP 9-2, Control of Nondestructive Exam.	NA for CS&T

		1Q, QAP 9-3, Control of Welding & Other Joining Proc.	NA for CS&T
		1Q, QAP 9-4, Work Processes 1Y, 8.20, Work Control Procedure	
Inspection		1Q, QAP 10-1, Inspection L1, 8.10, Inspection	NA for CS&T
Test Control		1Q, QAP 11-1, Test Control (applies to CS&T only for acceptance testing; R&D test activities are controlled by 1Q, QAP 2-3)	
Control of Measuring & Test Equipment	X	1Q, QAP 12-1, Control of Measuring & Test Equipment	X
		1Q, QAP 12-2, Control of Installed Process Instrumentation	
		1Q, QAP 12-3, Control & Calibration of Radiation Monitoring Equipment	
Packaging, Handling, Shipping & Storage		1Q, QAP 13-1, Pkg., Handling, Ship. & Storage*	
Inspection, Test, and Operating Status		1Q, QAP 14-1, Inspection, Test, & Operating Status*	
Control of Nonconforming Items & Activities	X	1Q, QAP 15-1, Control of Nonconforming Items*	X
Corrective Action System	X	1Q, QAP 16-3 Corrective Action Program 1.01, MP 5.35, Corrective Action Program	X X
QA Records	X	1Q, QAP 17-1, QA Records Management* L1, 7.16, Laboratory Notebooks and Logbooks	X X
Audits	X	1Q, QAP 18-2, Surveillance	
		1Q, QAP 18-3, QA External Audits	
		1Q, QAP 18-4, Management Assessment Program 12Q, Assessment Manual	X X
		1Q, QAP 18-6, Quality Assurance Internal Audits	
		1Q, QAP 18-7, Quality Assurance Supplier Surveillance	
Quality Improvement	X	1Q, QAP 19-2, Quality Improvement*	X
Software Quality Assurance		1Q, QAP 20-1, Software QA L1, 8.20, Software Management & QA	
Environmental QA		1Q, QAP 21-1, Quality Assurance Requirements for the Collection and Eval. of Environmental Data	NA for CS&T

Exceptions/Additions-Procedures identified on the checklist with an asterisk (*) are supplemented by a SRNL clarification in L1, 8.02, “SRNL QA Program Clarifications”. WSRC-IM-2002-00011, “Technical Report Design Check Guidelines,” will be used to help ensure the quality and consistency of the technical reviewer process for technical reports produced by SRNL Waste Treatment Technology.