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Page 1 of 1

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**This document was reviewed following the procedures described in WHC-CM-3-4 and is:**

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Christine Willingham

March 2, 1995

KAI 3/2/95

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7. Abstract

Data quality objectives for deactivation flushing of the PUREX vessel and piping interiors. This DQO documents the agreements between DOE-RL, WHC, Ecology, and the EPA.

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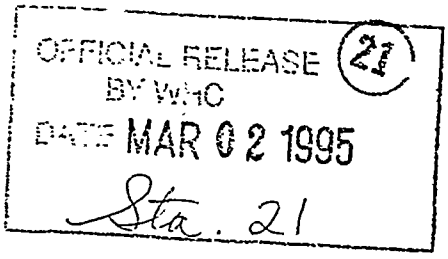

Document Title: Data Quality Objectives for PUREX Deactivation Flushing

We, the undersigned, certify that the information contained within identifies and documents the agreed upon sampling and analysis requirements for the PUREX Deactivation Flushing DQO meetings.

Approved by: _____ 1/27/95
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U.S. Department of Energy,
Richland Operations Office

Approved by: _____ 2/14/95
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Approved by: _____ 27 JAN 95
G. J. LeBaron Date
Westinghouse Hanford Company
PUREX Regulatory Compliance

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# DATA QUALITY OBJECTIVES FOR PUREX DEACTIVATION FLUSHING

## 1.0 INTRODUCTION

This Data Quality Objective (DQO) defines the sampling and analysis requirements necessary to support the deactivation of the Plutonium-Uranium Extraction (PUREX) facility vessels that are regulated pursuant to WAC 173-303. Specifically, sampling and analysis requirements are identified for the flushing operations that are a major element of PUREX deactivation. Deactivation flushing of the vessel and piping interiors will ultimately lead to closure of the PUREX vessels that are regulated by WAC 173-303. It is intended that upon completion of deactivation activities, no future flushing will be performed on the vessel and piping interiors.

The PUREX Facility (commonly referred to as PUREX) is located in the 200 East area of the Hanford Site. The PUREX Facility was operated to provide supplemental fuel reprocessing capability at the Hanford Site and to separate uranium and plutonium products from irradiated reactor fuel. The 202-A Building (commonly referred to as PUREX) operated from 1956 to 1972. In 1972, PUREX was placed in a standby mode because it was no longer economical to process fuel from only one operating reactor at the Hanford Site. The PUREX Facility resumed operations in 1983 when a backlog of irradiated fuel from the N-Reactor was accumulated. In 1991, PUREX ceased operations and was placed again in a standby mode.

The U.S. Department of Energy (DOE) notified Westinghouse Hanford Company (WHC) in December 1992 that PUREX would operate no longer and directed WHC to deactivate the facility. A draft plan (*PUREX/UO3 Deactivation Project Management Plan*) was submitted to the U.S Department of Energy, Richland Operations Office (DOE-RL) in February 1994 for review and comment. The scope of the project plan is oriented toward technical and regulatory issues surrounding PUREX deactivation. The PUREX Closure Plan will be integrated with the *Comprehensive Environmental Response Compensation and Liability Act of 1980* (CERCLA) remediation of the past-practice units and any potential soil or groundwater contamination, and decontamination and decommissioning (D&D) activities.

Irradiated reactor fuel was processed at PUREX to extract, purify, and concentrate uranium and plutonium produced from reactor fuel. Major process components include decladding and dissolution of the fuel elements, and separation and purification of uranium and plutonium by solvent extraction. Some process systems used recycled nitric acid and organic solvents. Other process systems handled, treated, and disposed of gaseous, liquid, and solid waste.

This document develops the data requirements for deactivation flushing of the PUREX vessels that are regulated pursuant to WAC 173-303. At the discretion of PUREX operations, vessels that are not regulated pursuant to WAC-173-303 may also be flushed.

The DQO Process has been used to identify and document the agreed upon sampling and analysis requirements for deactivation flushing of vessel and piping interiors. A list of participants and their respective organizations is presented in Table 6. Five meetings have been held to determine the sampling and analysis requirements. Meeting dates and the attendance of the participants is also presented in this table.

## 2.0 DQO STEP 1: STATE THE PROBLEM

This DQO identifies the criteria for ensuring that vessels have been flushed and dangerous waste constituents have been removed, based on the designation limits of WAC 173-303-070, from a population of tanks and vessels that are identified as treatment, storage, and/or disposal (TSD) facilities in the PUREX *Resource Conservation and Recovery Act of 1976* (RCRA) Part A permit. Removal of the dangerous waste solutions is necessary to ensure that PUREX can be left in a state of minimum surveillance and maintenance until subsequent closure of the vessels identified in the PUREX Plant Part A permit occurs.

A simplified illustration of the PUREX process flow sheet and identification of waste tanks and vessels is presented in Figure 1. The system components that are addressed by this DQO are: Head End, Solvent Extraction, U-Cell, the Aqueous Make-Up area (AMU), the 211-A tanks, and the 203-A Area P-Tanks.

### 2.1 FACTORS AFFECTING DEACTIVATION FLUSHING

There are three factors that impact the identification of sampling and analysis requirements for deactivation flushing. These factors are identified below and outlined in detail in Table 1.

**Factor 1: Sufficiency of Process Knowledge**

Because of the operational requirements and controls placed on PUREX operations organization, process knowledge and historical records are associated with the facility operation. The use of process knowledge is considered the basis to address the needs of PUREX operations personnel during deactivation flushing. Whenever process knowledge is used as a decision variable, written justification will be provided for approval by Ecology prior to implementation of the decision.

**Factor 2: Deactivation Time Period and PUREX Ownership**

The PUREX facility will transition from EM-60 responsibility to EM-40 responsibility at the completion of PUREX deactivation, which is expected to occur in fiscal year (FY) 1998. EM-40 will assume responsibility for all

Figure 1. Simplified PUREX Waste Tank and Process Vessel Flow Sheet.

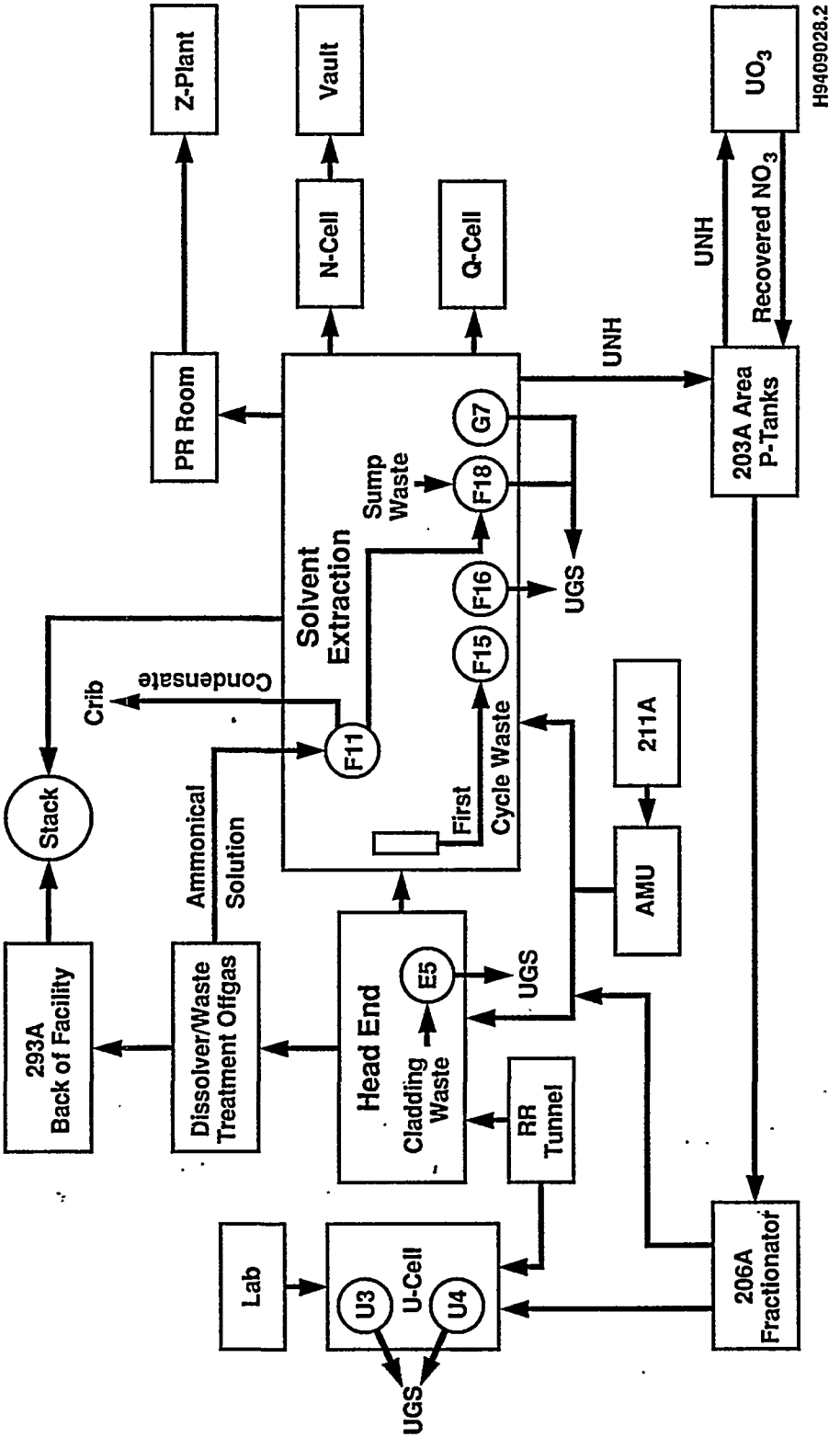


Table 1. PUREX Deactivation Issue Identification.

| Issue | Assumptions[a] | Constraints[b] | When data is required[c] | How data will support issue resolution |
|---|---|---|---|---|
| Sufficiency of process knowledge (Section 2.1) | Process knowledge and records associated with the PUREX process form the basis for determining the constituents that might be found in the plant. | Process knowledge addresses all waste associated with the resultant plutonium and uranium products, waste streams (flows to high-level radioactive waste double-shell tanks). | Flushing<br>S&M<br>D&D | Validation of process knowledge |
| Deactivation time period and PUREX ownership responsibility | The PUREX facility will transition from EM-60 responsibility to EM-40 | New and/or additional procedural requirements will occur | S&M<br>D&D | Provide database for historical use |
| Presence of radionuclide activity levels | Canyon waste treatment and storage tank systems exhibit high activity levels | Personnel protection measures are required for all sampling activities | Flushing<br>S&M<br>D&D | [d] |

[a]Assumptions used in issue identification.
[b]Physical, technological, and schedule constraints.
[c]S&M: Surveillance and maintenance
D&D: Decontamination and decommissioning.
[d]Radionuclide activity levels taken to determine whether samples are analyzed at an onsite or offsite laboratory based on the activity levels of the sample(s) in question and to meet tank farms process control limits.

surveillance and maintenance (S&M) activities. Following the completion of S&M, decontamination and decommissioning (D&D) of PUREX will be undertaken. The time duration of D&D is unknown. The final disposition of PUREX will be achieved when integration with CERCLA, D&D, and closure activities have been completed.

**Factor 3: Presence of Radionuclide Activity Levels**

The radioactive solutions associated with PUREX canyon dangerous waste treatment and storage tank systems will require special personal protection and/or remote handling equipment for sampling activities. Information on radionuclide activity levels that determine if the samples are analyzed at an onsite or offsite laboratory will be provided. Information that determines if the tank farms process control limits (WHC-SD-WM-ANAL-020, Rev. 1) have been met also will be provided.

## 3.0 DQO STEP 2: IDENTIFY THE DECISION

The decisions to be examined in this DQO relate to deactivation flushing criteria that will meet the requirements for RCRA closure of the PUREX TSD units. There are four decisions to be considered.

1. Is the process loop flushed and ready for RCRA sampling?
2. Did the final sample meet the RCRA flushing criteria?[1]
3. Can a waste transfer to tank farms be initiated?
4. Can the samples be analyzed at an offsite laboratory, or must the samples be analyzed onsite due to activity levels?

The first decision is a process control decision. It relates to the number of flushes a loop requires before it is considered adequately flushed and ready to be sampled for RCRA compliance.

The second decision is a RCRA decision. When a single loop is considered adequately flushed from a process control perspective, RCRA sampling is performed.

The third decision is a process control decision and deals with the presence and concentration of plutonium, uranium, and nitrites in the loops. These limits are specified by tank farms personnel and must be met in order to initiate a waste transfer to tank farms.

---

[1]The DQO discussions referred to RCRA 'flushing' criteria, though the term 'designation' is more appropriate. Because the purpose of this document is to reflect the discussions that occurred, the term will not be changed.

The fourth decision is also a process control decision and deals with radioactivity levels that determine if the samples can be analyzed at an offsite laboratory or if the sample must be analyzed onsite due to high radioactivity levels.

Table 2 presents the decisions that must be made and the possible outcomes of the decisions.

## 4.0 DQO STEP 3: IDENTIFY THE INPUTS TO THE DECISION

The decision variables that address the decisions and the questions are presented in Table 3. If the variable is used to support a decision to continue or not to continue flushing, the basis is process control. If the variable is used to support a decision to support RCRA acceptance of the flushing activity, the basis is RCRA compliance. Other parameters required to estimate the value of the decision variable are also provided.

## 5.0 DQO STEP 4: DEFINE THE STUDY BOUNDARIES

The study boundaries are relevant vessels within the PUREX canyon, and other vessels contained in the Part A permit application that have been previously been taken out of service and are available for deactivation flushing operations. There are 72 vessels in 13 loops in the PUREX canyon. However, not all the vessels identified in these loops are/will be included in the Part A revisions. These vessels are in the process loop with vessels containing dangerous waste and are included in order to complete a flushing circuit in the loop.

Table 4 summarizes the flushing loops that will be used during the deactivation flushing campaign.

The sequence of vessels in the loops above may be changed as required to efficiently perform the deactivation flushing operations.

## 6.0 DQO STEP 5: DEVELOP A DECISION RULE

The decision logic for deactivation flushing activities is summarized in Figure 2.

It was agreed that analysis for the analytes in Table 5 will be performed using the methods described in SW-846. The full list of target analytes as a result of the SW-846 methods in Table 5 will also be documented in the data package.

Table 2. PUREX Deactivation Decision Identification.

| Decision or Question | Possible Outcomes or Answers |
|---|---|
| Are flushing operations complete from a process control perspective? | Single Flush Loop<br>a. Loop is adequately flushed and ready for RCRA sampling, or<br>b. Loop is not adequately flushed, and the loop must be reflushed<br><br>All Loops<br>a. All loops are adequately flushed and ready for RCRA sampling, or<br>b. Remaining loops are not flushed and RCRA samples must still be taken from the remaining loops |
| Are flushing operations complete from a RCRA perspective? | Single Loop<br>a. Samples meet designation criteria, and loop is deactivated, or<br>b. Samples do not meet designation criteria, loop must be reflushed and resampled<br><br>All Loops<br>a. Samples meet designation criteria and all loops are deactivated, or<br>b. Samples do not meet designation criteria, loops must be reflushed and resampled |
| Are flushing operations complete from a waste transfer-process control perspective? | All Loops[1]<br><br>a. Samples meet tank farms waste acceptance criteria; transfer initiated, or<br>b. Samples do not meet tank farms acceptance criteria; water dilution required |
| For onsite/offsite laboratory selection purposes what is the activity level within the loop? | Single Loop and All Loops<br>Activity levels of each single loop and all loops are obtained for purposes of laboratory selection:<br>- onsite<br>- offsite |

[1]Not applicable to a singular loop since the flush water from a system of loops will be transferred to tank farms.

Table 3. PUREX Deactivation Decision Variables Identification.

| Decision or Question | Primary Decision Variable [units] | Basis for Variable[a] | Additional Parameters[b] |
|---|---|---|---|
| Are flushing operations complete from a process control perspective? | ICP Metals [ppm]<br>Cadmium<br>Chromium<br><br>Corrosivity<br>pH | Process Control | Physical parameters required to compute volumes |
| Are flushing operations complete from a RCRA perspective? | Metals [ppm]<br>Lead (ICP)<br>Barium (ICP)<br>Silver<br>Arsenic<br>Selenium<br>Mercury<br><br>TOC [wt% dry basis]<br><br>VOA [ppm] | RCRA | Physical parameters required to compute volumes |
| Are flushing operations complete from a waste transfer perspective? | Nitrites [M]<br><br>Criticality [g/L]<br>Plutonium<br>Uranium | Process Control | Physical parameters required to compute volumes |
| What is the activity level within the loop? | Specific Activity [nCi/g]<br>Total Uranium [g] | Process Control | None |

[a]If the variable is used to support a decision to continue flushing, or to support acceptability of the waste transfer, or to determine onsite or offsite laboratory analysis based on activity analysis, the basis is process control. If the variable is used to support a decision to support RCRA acceptability of the flushing activity, the basis is RCRA compliance.

[b]Other parameters required to estimate value of the decision variable

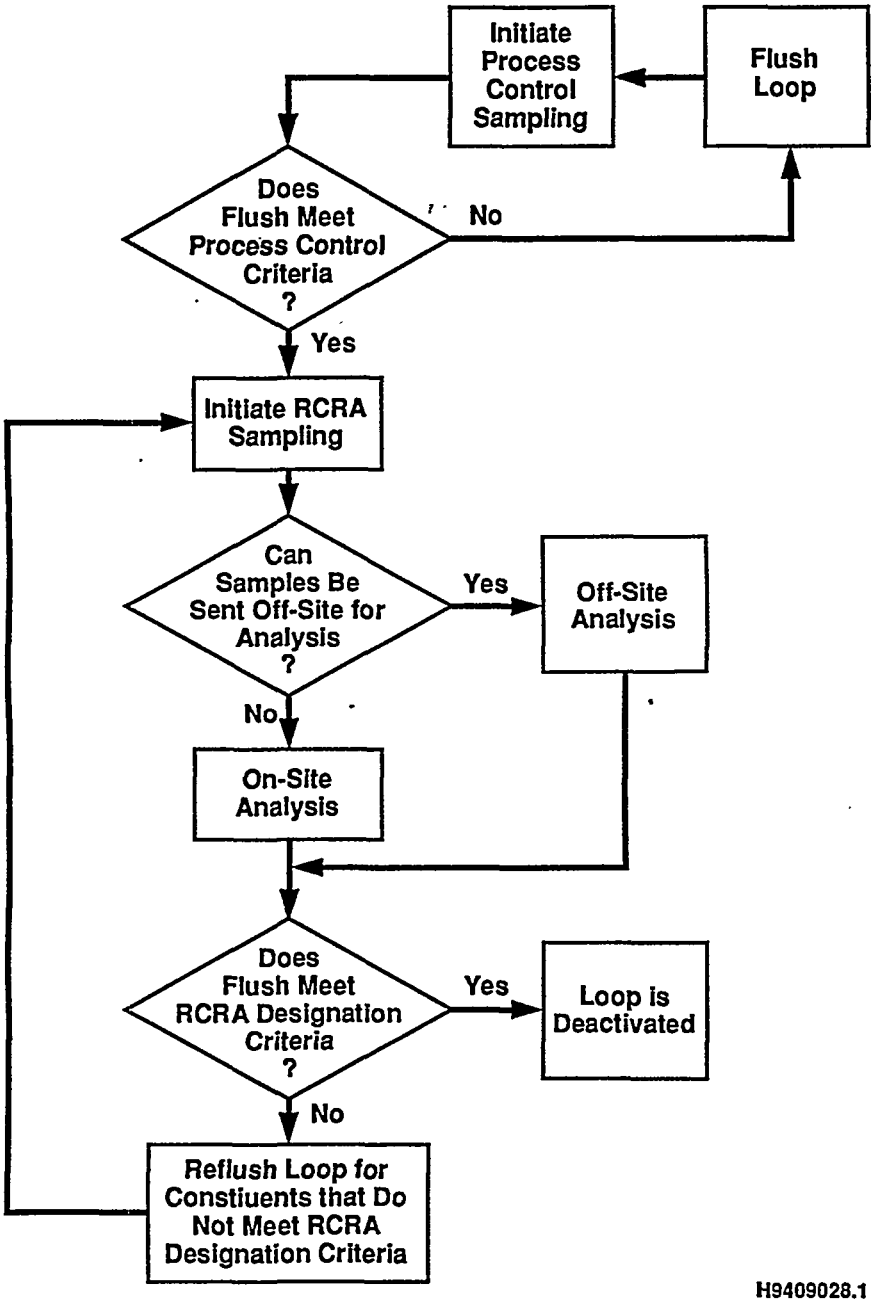
ICP: Inductively coupled plasma
ppm: Parts per million
RCRA: *Resource Conservation and Recovery Act of 1976*
TOC: Total organic carbon
IC: Ion chromatography
M: moles per liter
g/L: grams per liter
nCi/g: nanocuries per gram
g: gram

Table 4. Flushing Loops for the PUREX Canyon and Vault System Deactivation.

| | System | No. of tanks | No. of columns | No. of misc. vessels |
|---|---|---|---|---|
| 1 | Flush K-Cell Vessels (T-J7, E-J8, TK-K1, T-K2, T-K3, E-K4, TK-K5, TK-K6) | 3 | 3 | 2 concentrators |
| 2 | Flush L-Cell Vessels (T-J6, T-J4, TK-J5, T-L1, T-L2, TK-L3, T-L4, T-L5) | 2 | 6 | 0 |
| 3 | Flush Headend Feed Vessels and H1, H2 and F-Cell Vessels (TK-E1, TK-D4, TK-D3, TK-H1, T-H2, TK-F7, E-F6, TK-F26) | 6 | 1 | 1 concentrator |
| 4A | Flush F and R Cell Vessels (Part A) (T-R1, TK-G1, T-G2, TK-G2, TK-G8) | 4 | 1 | 0 |
| 4B | Flush G and R Cell Vessels (Part B) (T-R2, TK-R2, TK-R8, TK-R5, D-R6, TK-R7, TK-G5, D-G6) | 5 | 1 | 2 decanters |
| 5 | Flush Backcycle Waste and Neptunium Package Vessels (E-H4, TK-J1, TK-J21, T-J22, T-J23, TK-J3) | 3 | 2 | 1 concentrator |
| 6 | Flush U-Cell Vessels (TK-U8, T-F5, TK-F3, TK-U5, E-U6-2, T-U6, TK-U4) | 4 | 0 | 2 towers 1 reboiler |
| 7 | Flush Cladding Waste Vessels (Dissolvers A3, B3, C3 and TK-D1, TK-D2, TK-E3, G-E2, G-E4, and TK-E5) | 4 | 0 | 2 centrifuges 3 dissolvers[1] |
| 8 | Flush M1 Vessel | 1 | 0 | 0 |
| 9 | Flush J2 Vessel | 1 | 0 | 0 |
| 10 | Flush U3 Vessel | 1 | 0 | 0 |
| 11 | Flush D5, E6, F8, F13, F15, and F16 Vessels | 6 | 0 | 0 |
| 12 | Flush F11 System Vessels (TK-F10, E-F11, TK-F12, TK-F18) | 3 | 0 | 1 concentrator |
| | TOTAL VESSELS (72) | 43 | 14 | 15 misc. vessels |

[1]The three dissolvers will be flushed however, passivated zirconium heels will remain.

Figure 2. PUREX Deactivation Flushing Logic.



## 7.0 DQO STEP 6: SPECIFY ACCEPTABLE LIMITS ON SAMPLING AND ANALYSIS DECISION VARIABLES

The acceptable limits on the decision variables are specified in Table 5.

## 8.0 DQO STEP 7: OPTIMIZE THE DESIGN

This DQO is considered to be optimized because it allows for deactivation of a loop that achieves the designation limits of Table 5. A single sample will be collected from each loop to verify that the limits of Table 5 have been met.

For certain loops the constituent list in Table 5 could be limited even further based on process knowledge. All parties agreed that in order to gain approval for limiting the constituent list in a particular loop, justification for the limiting rational will have to be provided for approval by Ecology prior to sampling and analysis.

Ecology will be provided with copies of the flushing workplans and will be notified prior to collecting the final flush sample so that they may take a split sample for their analysis.

In the event that analytes from Table 5 are detected above acceptable limits the loop will be reflushed and samples will be analyzed for only the analytes that failed. Any information that is obtained on other target analytes as a result of the additional analysis will also be reported to Ecology.

All radiological data for the final flush sample will also be provided to Ecology.

Table 5. Sampling and Analysis Methods for Decision Variables.

| Decision Variable | Sample Matrix | Analysis Method[a] | EPA Method | 222 S Method LA- | Designation Limit [mg/L] unless specified | Range of Indifference [mg/L] unless specified |
|---|---|---|---|---|---|---|
| **Process Control** | | | | | | |
| pH<br>Cadmium<br>Chromium | Liquid | pH<br>ICP-AES<br>ICP-AES | | | 2 ≥ pH ≥ 12.5<br>≥ 1<br>≥ 5 | 2 < pH < 12.5<br>< 1<br>< 5 |
| **RCRA Compliance Samples** | | | | | | |
| ICP Metals<br>Cadmium<br>Chromium<br>Lead<br>Barium<br>Silver | Liquid | ICP-AES | 6010A | 505-151 | <br>≥ 1<br>≥ 5<br>≥ 5<br>≥ 100<br>≥ 1 | <br>< 1<br>< 5<br>< 5<br>< 100<br>< 1 |
| Arsenic | Liquid | HYAA/GFAA | 7061A | 355-131 | ≥ 5 | < 5 |
| Selenium | Liquid | HYAA/GFAA | 7741A | 365-131 | ≥ 1 | < 1 |
| Mercury | Liquid | CVAA | 7470A | 325-102 | ≥ 0.2 | < 0.2 |
| TOC | Liquid | TOC | 9060A | 344-106 | ≥ 10 wt % (wet basis) | < 10 wt % (wet basis) |
| VOA | Liquid | GC/MS | 8240 | 523-405 | | |
| Benzene | | | | | ≥ 0.5 | < 0.5 |
| Carbon tetrachloride | | | | | ≥ 0.5 | < 0.5 |
| Chlorobenzene | | | | | ≥ 100 | < 100 |
| Chloroform | | | | | ≥ 6 | < 6 |
| 1,2-Dichloroethylene | | | | | ≥ 0.5 | < 0.5 |
| 1,1-Dichloroethane | | | | | ≥ 0.7 | < 0.7 |
| Methyl Ethyl Ketone | | | | | ≥ 200 | < 200 |
| Tetrachloroethylene | | | | | ≥ 0.7 | < 0.7 |
| Trichloroethylene | | | | | ≥ 0.5 | < 0.5 |
| Vinyl Chloride | | | | | ≥ 0.2 | < 0.2 |
| **Tank Farms Acceptance Sampling** | | | | | | |
| Nitrites | Liquid | IC | | | > 0.011 M | |
| Plutonium | Liquid | Pu | | | > 0.13 g/L | |
| Uranium | Liquid | U | | | > 40 g/L | |
| **Laboratory Selection Sampling** | | | | | | |
| Specific Activity<br>Uranium | Liquid | <br>U | | | > 50 uCi/g<br>> 0.10 g | |

[a]Primary and Confirmatory.
ICP-AES: inductively coupled plasma-atomic emission spectroscopy
HYAA/GYAA: hydride/graphite furnace atomic absorption
CVAA: cold vapor atomic absorption
TOC: total organic carbon
GC/MS: gas chromatography/mass spectroscopy
IC: ion chromatography

Table 6. PUREX Deactivation DQO Participants. (sheet 1 of 2)

| Name | Organization | 4/26/94 | 4/28/94 | 5/03/94 | 5/12/94 |
|---|---|---|---|---|---|
| Krekel, Randall<br>RCRA Closures Program Manager | DOE-RL | | x | x | x |
| Senat, Gene<br>PUREX Deactivation Program Manager | DOE-RL | x | x | x | x |
| Jaraysi, Moses<br>PUREX Deactivation Program Manager | Ecology | x | x | x | x |
| Russell, Laura<br>Regulatory Support | Ecology | | x | x | x |
| Stone, Alex<br>Chemist | Ecology | | x | x | x |
| Uziemblo, Nancy<br>Chemist | Ecology | | x | x | x |
| Duncan, Dan<br>PUREX Deactivation Region X | EPA | | x | x | |
| Bhatia, Ravi<br>Program Engineer | WHC | x | | x | |
| Griffin, Paul<br>D&D Projects | WHC | x | x | x | x |
| LeBaron, Greg<br>PUREX Deactivation Program Manager | WHC | x | x | x | x |
| Robertson, Julie<br>Regulatory Support | WHC | x | x | x | x |
| Ruck, Fred<br>RCRA Closures Program Manager | WHC | x | | | x |
| Smith, Ed<br>Regulatory Support | WHC | | x | x | x |
| Stephenson, Mike<br>Regulatory Support | WHC | x | x | x | x |

Table 6. PUREX Deactivation DQO Participants. (sheet 2 of 2)

| Name | Organization | 4/26/94 | 4/28/94 | 5/03/94 | 5/12/94 |
|---|---|---|---|---|---|
| Strobhen, Bill<br>Analytical Services | WHC | | | | x |
| Weiss, Richard<br>Analytical Services | WHC | x | x | x | |
| Winters, Bill<br>Chemist | WHC | | | | x |
| Cook, John<br>Program Engineer | MACTEC | | x | x | x |
| Redus, Kenneth<br>Facilitator | MACTEC | | x | x | x |
| Sheriff, Jennifer<br>Facilitator | MACTEC | x | x | x | x |

DOE-RL = U.S. Department of Energy, Richland Operations Office.
EPA = U.S. Environmental Protection Agency.
Ecology = Washington State Department of Ecology.
WHC = Westinghouse Hanford Company.
MACTEC = MAC Technical Services Company.