

*John F. Q.*  
**FEB 28 2000**

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# AZ-101 Batch Transfer to the Private Contractor

**G. P. Duncan**  
CH2M Hill Hanford Group, Inc.  
Richland, WA 99352  
U.S. Department of Energy Contract DE-AC06-96RL13200

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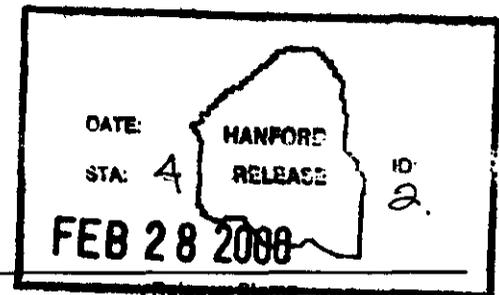
**Abstract:** This document summarizes the findings and recommendation of a process improvement team which modeled the first high level waste transfer to the private contractor.

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***Systems Integration***

*High Level Waste Feed Delivery*

*AZ-101 Batch Transfer to the Private Contractor*

*Transfer and Mixing Process Improvements*

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**Business Case**

**February 9, 2000**

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*Team Leader: Gary P. Duncan*

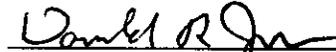
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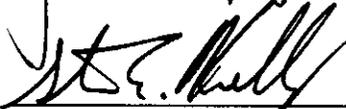
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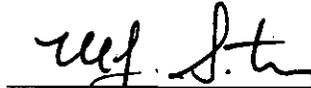
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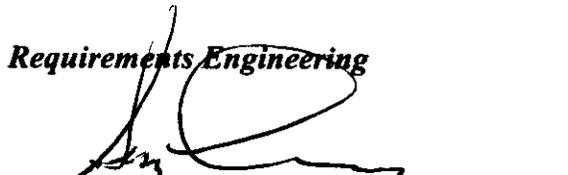
  
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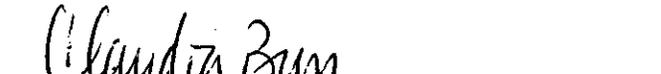
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## Systems Integration

## Table of Contents

|  |           |
|--|-----------|
| <b>I. EXECUTIVE SUMMARY</b> .....                                | <b>1</b>  |
| <b>II. SITUATIONAL ASSESSMENT AND PROBLEM STATEMENT</b> .....    | <b>3</b>  |
| <b>III. PROJECT DESCRIPTION</b> .....                            | <b>4</b>  |
| 3.1 THE KICKOFF.....   | 4         |
| 3.2 THE TEAM .....   | 4         |
| 3.3 SYSTEMS INTEGRATION METHODOLOGY.....                         | 4         |
| 3.4 PROJECT DEFINITION FORM.....                                 | 4         |
| 3.4.1 Reason for the Project.....                                | 4         |
| 3.4.2 Objective of the Project.....                              | 5         |
| 3.4.3 Expectations of the Redesigned Process.....                | 5         |
| 3.4.4 Boundaries of the Project.....                             | 5         |
| 3.5 "As Is" PROCESS FLOW .....                                   | 5         |
| 3.6 IMPLEMENTATION CHECKLIST.....                                | 5         |
| <b>IV. RETRIEVAL SYSTEM DESCRIPTION</b> .....                    | <b>7</b>  |
| 4.1 DOUBLE SHELL TANK TRANSFER SYSTEM .....                      | 7         |
| 4.2 HLW (AZ-101) RETRIEVAL EQUIPMENT .....                       | 7         |
| <b>V. "AS-IS" DIAGNOSTIC ACTIVITIES</b> .....                    | <b>8</b>  |
| 5.1 "AS-IS" PROCESS METRICS .....                                | 9         |
| 5.1.1 Equipment Calibration Checks.....                          | 9         |
| 5.1.2 Equipment Operability Checks .....                         | 9         |
| 5.1.3 Mixing Preparation and Pre-requisites.....                 | 10        |
| 5.1.4 Mixer Pump Operations .....                                | 10        |
| 5.1.5 Pre-transfer Valving.....                                  | 10        |
| 5.1.6 Pre-transfer System Checks.....                            | 11        |
| 5.1.7 Transfer System Start.....                                 | 11        |
| 5.1.8 Transfer .....   | 11        |
| 5.1.9 Transfer Monitoring and Material Balance Discrepancy ..... | 11        |
| 5.1.10 Transfer Line Flushing.....                               | 12        |
| 5.1.11 Post-mixing Operations.....                               | 12        |
| 5.1.12 Post-transfer Valving.....                                | 13        |
| 5.1.13 Procedure Close Out .....                                 | 13        |
| 5.2 BENCHMARKING.....  | 13        |
| 5.3 GAP ANALYSIS .....   | 14        |
| 5.4 EQUIPMENT VERIFICATION ANALYSIS.....                         | 14        |
| 5.5 EQUIPMENT RELIABILITY AND MAINTAINABILITY EVALUATION .....   | 15        |
| 5.6 SCHEDULE RISK.....   | 16        |
| <b>VI. SOLUTION OVERVIEW</b> .....                               | <b>19</b> |
| <b>VII. SOLUTION DETAIL</b> .....                                | <b>20</b> |
| 7.1 DOUBLE-VALVE ISOLATION .....                                 | 20        |
| 7.2 REDEFINE TSR EQUIPMENT "OPERABILITY CHECKS" .....            | 21        |
| 7.3 EXPAND THE SHIFT MANGER'S AUTHORITY .....                    | 21        |
| 7.4 TAKE CREDIT FOR TURNOVER EQUIPMENT STATUS.....               | 22        |

**Systems Integration**

|  |           |
|--|-----------|
| 7.5 SIMPLIFY PROCEDURES .....  | 22        |
| 7.6 ELIMINATE NON-REQUIRED CHECKS.....   | 23        |
| <b>VIII. SOLUTION ALTERNATIVES.....</b>  | <b>24</b> |
| 8.1 SYSTEM UPGRADES .....  | 24        |
| 8.2 MASTER PUMP SHUTDOWN (MPS).....  | 26        |
| 8.3 ADMINISTRATIVE LOCK .....  | 26        |
| 9.1 IMPLEMENTATION COSTS AND SCHEDULE IMPACTS OF THE "TO-BE" .....             | 27        |
| 9.2 AZ-101 BATCH TRANSFER TO PC TEAM COST .....                                | 28        |
| <b>X. BENEFITS.....</b>  | <b>29</b> |
| <b>XI. IMPLEMENTATION .....</b>  | <b>31</b> |
| <b>XII. CRITICAL ASSUMPTIONS AND RISK ASSESSMENT.....</b>                      | <b>32</b> |
| <b>XI. CONCLUSIONS AND FURTHER RECOMMENDATIONS.....</b>                        | <b>33</b> |
| REFERENCES .....   | 35        |
| ACRONYMS AND ABBREVIATIONS.....  | 35        |
| <b>APPENDICES.....</b>   | <b>37</b> |
| Appendix A - Project Definition Form.....                                      | A-1       |
| Appendix B - AZ-101 Batch Transfer Process Flow and ANSI Y15.3m Symbology..... | B-1       |
| Appendix C - Planned System Upgrades.....                                      | C-1       |
| Appendix D - Requirements.....   | D-1       |
| Appendix E - AZ-101 As-Is Process Analysis.....                                | E-1       |
| Appendix F - Benchmarking Gap Analysis.....                                    | F-1       |
| Appendix G - Off-Site Brainstorming.....                                       | G-1       |
| Appendix H - Implementation Plan.....  | H-1       |
| Appendix I - Communication Plan.....   | I-1       |

*Table of Figures*

|   |    |
|---|----|
| Figure 1. AZ-101 Proposed Improvement.....  | 2  |
| Figure 2. Operations and Maintenance Concept AZ-101 .....                                     | 3  |
| Figure 3. Sample of ANSI Y 15.3m Process Flow for AZ-101 Batch Transfer .....                 | 6  |
| Figure 4. 101-AZ HLW Batch Transfer Upper-Level Process Flow.....                             | 8  |
| Figure 5. Risk of Idle Facility Penalties, One of Nine HLW Batch Transfers to BNFL, Inc. .... | 16 |
| Figure 6. Scheduled Transfers Through 2018 (Case 3S3).....                                    | 17 |
| Figure 7. To-Be Alternative High Level Process.....   | 19 |
| Figure 8. Tangible Savings Realized from Improvements .....                                   | 29 |

*Tables*

|  |    |
|--|----|
| Table 1. Procedures Used for Modeling AZ-101 HLW Batch Transfer to the PC..... | 8  |
| Table 2. Equipment Operability/Functional/Calibration Checks.....              | 15 |
| Table 3. Transfer Duration Estimates.....                                      | 17 |
| Table 4. Number of Transfers During 30-Day Window.....                         | 18 |
| Table 5. Priority Solution and Alternative Costs.....                          | 27 |
| Table 6. Team Costs.....   | 28 |

## I. EXECUTIVE SUMMARY

The primary purpose of this business case is to provide Operations and Maintenance with a detailed transfer process review for the first High Level Waste (HLW) feed delivery to the Privatization Contractor (PC), AZ-101 batch transfer to PC. The Team was chartered to identify improvements that could be implemented in the field. A significant penalty can be invoked for not providing the quality, quantity, or timely delivery of HLW feed to the PC.

The established boundaries for this business case are from preparation and functional checks for mixing and transfer of AZ-101 feed through completion of a batch transfer of feed to the PC (BNFL). The transfer system used for the analysis is the system expected to be in place at the time transfers begins. The Team was responsible for providing process details and suggestions to enhance systems and processes in concert with the Integrated Safety Management System (ISMS) practices and requirements. Using Requirements Engineering and ISMS models, the team was asked to identify process improvements and develop an implementation plan to mitigate the risks associated with achieving the first HLW batch transfer to the PC.

A major portion of the analysis was the development of the "As-Is" process model. This model reflected how a transfer would be performed based on today's operational approach for the system expected to be in place for the first AZ-101 batch transfer to the PC. The team determined that 439 equipment checks would need to be performed (compared to an average of 188 today) during transfer setup. The number of functional/calibration checks to be performed was determined to be 322. The team also identified each event required for premixing and transferring the waste. The results of this compilation were used to develop a P3 schedule. The schedule captured the probability of occurrence and the maximum, minimum and expected duration for each event.

The team then used Requirement Engineering methodologies to produce a list of activities that could be implemented to improve the operating efficiency of the "As-Is" process. This methodology included the development of best practices for events identified by the team as critical or inefficient for the "As-Is" process. This work included interviews with companies and organizations performing processes similar to Waste Feed Delivery's (WFD), as well as discussions and meetings with site experts on Tank Farm operating practices.

Comparing the "As-Is" process to the best practices of the industry and brainstorming efforts lead to the development of six "priority" solutions.

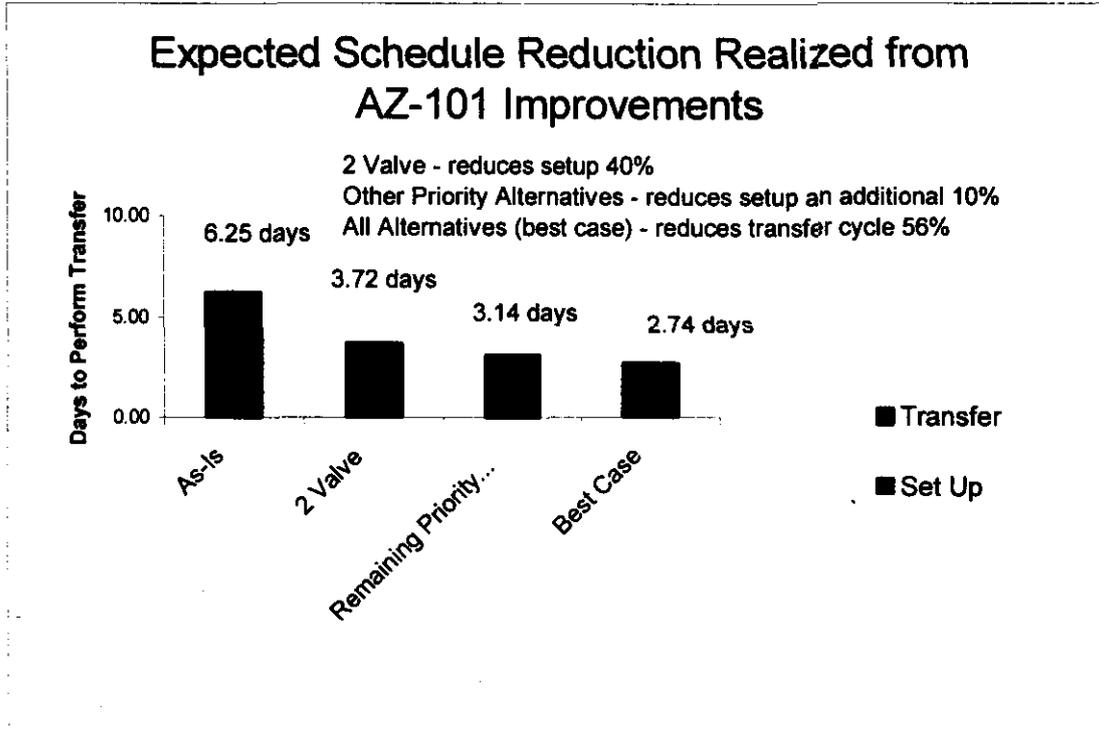
- Reevaluate the authorization basis to determine whether two-valve isolation can be credited. Taking credit for two-valve isolation (for this transfer) will reduce the number of checks from 439 to 31. This opportunity had been identified previously by another process improvement initiative, and its implementation is underway.
- Redefine how we demonstrate "operability". If a better understanding of the term is used, the number of field checks can be further reduced to include only that equipment that does not fail-safe or alarm remotely.
- Expand the Shift Manager authority to redline operating transfer procedures and restart transfers to reduce delays in startup by allowing the transfer to proceed if an insignificant error in the procedure is found.
- Take credit for equipment status through the use of a new status board and updated routing board. The board will show excavations and other up-to-date Tank Farm configurations. In addition, a revised routing board that includes operability status of barriers and cover blocks will reduce the number of field operability checks, reduce exposure, and drive greater efficiency into the transfer process.
- Simplify procedures to reduce size and complexity, increase efficiency of operation, create an environment of ownership, and take credit for the skill of the craft.
- Discontinue non-required checks that are based on a zero-risk culture and do not support system reliability, and interpretation of the requirements.

Although activities were analyzed for equipment setup, premixing, and transfer operations, only solutions for reducing equipment setup time were selected for implementation. This occurred for two reasons. First, most of the operational work performed for a transfer occurs during the setup portion. Second, once mixing or transfer operations start, barring system failure, time to complete these activities is fixed. However, the solutions outlined

**Systems Integration**

above will increase operating efficiency during both premixing and transfer portions of WFD operations. These "priority" solutions were used to create a new P3 schedule reflecting the "Proposed" process.

Figure 1 indicates how the estimated schedule transfer times, and therefore program risks, can be minimized through implementation of the "priority" solutions. These opportunities have the largest impact on reducing transfer setup time.



Note: These durations assume the transfer occurs directly following an Operational Readiness Review (ORR) (i.e., little rework is required).

**Figure 1. AZ-101 Proposed Improvement**

Based on the P3 schedules, the AZ-101 Team conducted Monte Carlo simulations on the two processes to estimate normal (not occurring directly following an ORR) transfer times. The results show a 50% probability of performing a transfer in 15 or less days with the "As-Is" process and 11 or less days with the "Proposed" process.

The AZ-101 Team developed an implementation plan for the six priority solutions. Implementation of several of the solutions is underway. With the support of RPP personnel, full implementation of the priority solutions is expected to be complete in FY 2001.

Other improvements that reduce the schedule an additional 6% are represented by the "Best Case" bar in Figure 1. Although not fully realized in schedule reduction, they do improve operations and are worth consideration. They include retrieval system upgrades for central monitoring, automation of material balance discrepancy calculations and communications, locking the position of encasement seal loop valves, preventive maintenance reporting enhancements, engineering protective barriers. In addition, evaluation of the diluent and flush system design for flush and transfer system pressure switches, modifications to the administrative lock program, and taking credit for the master pump shutdown expanded safety functions improve transfer efficiencies.

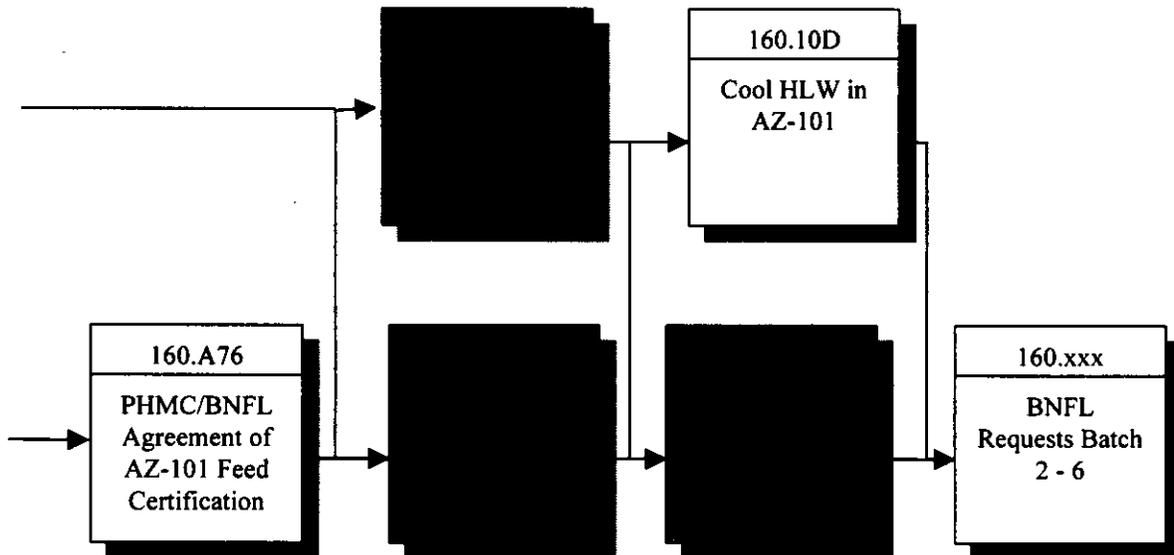
**Systems Integration****II. SITUATIONAL ASSESSMENT AND PROBLEM STATEMENT**

The AZ-101 Batch Transfer to Private Contractor Team (AZ-101 Team) was formed to analyze existing processes and new retrieval upgrades for the Phase I demonstration phase of the Waste Feed Delivery (WFD) Program. WFD's mission is to retrieve radioactive waste from the storage tanks and provide the waste as feed to the Privatization Contractor (PC) for treatment. Tank 241-AZ-101 will serve as the first feed staging tank for delivering High-Level Waste (HLW) to the PC.

The issues facing the team are two-fold: 1) what mitigating actions can be taken to reduce the risk of the Office of River Protection (ORP) incurring the PC idle facility penalty (approximately \$2.5M per day) and 2) what evidence can be produced to ensure WFD is within an acceptable risk. The \$2.5M penalty can be assessed if the transfer feed:

1. Is not delivered to the PC at the rates required by the contract and by DOE planning guidance, and/or
2. Is not delivered in the specified sequence, based on the Interface Control Document specifications.
3. Does not meet contractual limits for chemical and radioactive constituents based on the four, pre-established compositional envelopes
4. Does not meet the minimum order quantities, based on the Interface Control Document specifications

The WFD Technical Basis, Volume IV, Operations and Maintenance Concept, HNF-1939 provided the primary description of how the WFD physical system will be operated and maintained. The scope of AZ-101 team encompassed three specific areas of the Operations and Maintenance (O&M) Concept logic and is highlighted in Figure 2 below.



**Figure 2. Operations and Maintenance Concept AZ-101**

The AZ-101 Team was chartered to provide process details and ways to optimize systems and processes in concert with the Integrated Safety Management System (ISMS) practices and requirements. Using the Requirements Engineering (RE) and ISMS models, the team was asked to identify risks and implementation plans to mitigate the risks associated with achieving the first HLW batch transfer to the PC.

**Systems Integration**

**III. PROJECT DESCRIPTION**

**3.1 The Kickoff**

Mr. Ryan Dodd, Manager, Retrieval Support Operations, sponsored the AZ-101 process improvement team. Subject matter experts in the current transfer process and future project upgrades were identified and asked to participate on the AZ-101 process improvement team. From this group, the team leader, Mr. Gary Duncan, was appointed. At the team kick-off meeting, team members received their initial briefing in the SI methodology, which was used for completing the required task.

**3.2 The Team**

The subject-matter-expert team members are:

|                |  |
|----------------|--|
| Gary Duncan    | Retrieval Project Operations (Engineer), Team Leader                     |
| Yvonne Huffman | W-151 Project Operations (Nuclear Chemical Operator)                     |
| Donald Jones   | Retrieval Operations (Nuclear Chemical Operator)                         |
| Steve Kelly    | Engineering Support (Representing Retrieval Engineering and WFD Program) |
| Mike Sutey     | Facility Operations (Waste Transfer Manager)                             |
| John Bailey    | Tank Farm Upgrades (Cognizant Engineer)                                  |
| Katie White    | DST Engineering (Cognizant Engineer).                                    |

Claudia Burr, Requirements Engineering, served as the facilitator and Stephen Sanders, Requirements Engineering, assisted with facilitation in the discovery phase of the as-is process.

**3.3 Systems Integration Methodology**

The SI methodology is a structured approach to achieve dramatic improvement in business processes. This approach includes elements of total quality management such as "teaming" and "employee involvement". It also includes a set of specific tools and methodologies. Some of these are discussed below.

**3.4 Project Definition Form**

The Project Definition Form (PDF) serves as a "contract" between the sponsor and the team. Its purpose is to clearly outline the reason for the project, the project's objective, expectations of the redesigned process, boundaries ("start" and "stop" points) of the project, identification of departments involved in the project, and the respective systems/software/databases that will interface with the project. The development and consensus approval of the PDF is the Team member's first order of business. This allows the team to remain focused and stay within the defined scope of the project. See Appendix A for details.

**3.4.1 Reason for the Project**

The sponsor and team defined the reason for the project: "Old and new systems (and processes) installed or being installed by retrieval projects to support feed delivery to Privatization (BNFL) need to be analyzed to ensure we can deliver feed with a high-confidence level. In addition, there is a substantial potential penalty (~\$2.5M per day) for not being able to transfer waste feed to BNFL as scheduled."

## **Systems Integration**

### **3.4.2 Objective of the Project**

The sponsor and team established the objective of the project: **"To provide the River Protection Project (RPP) Tank Waste Operations (TWO) O&M with a detailed AZ-101 batch transfer process view to include vulnerabilities, potential improvement opportunities, and an implementation plan."**

### **3.4.3 Expectations of the Redesigned Process**

The sponsor defined and the team concurred with the expectations of the redesigned process and the team's deliverables. They are:

- 1) Deliver a detailed graphical process flow
- 2) Deliver a summary document with:
  - Activity duration
  - Major equipment requirements/checks
  - Key decisions
  - Resource analysis
  - Required documentation with recommended improvements
  - Risk analysis.

This business case serves as the summary document.

### **3.4.4 Boundaries of the Project**

The team established process boundaries of the project. They are:

- Start Point - Preparation and functional checks to transfer AZ-101 feed to PC, mixing AZ-101 feed to remobilize solids.
- End Point - Completion of batch transfer of AZ-101 high level waste (HLW) feed to PC and procedure close out.

## **3.5 "As Is" Process Flow**

Team members conducted an in-depth analysis of the "As-Is" process. The foundation for this analysis is a detailed process flow using ANSI Y 15.3m symbology (see Appendix B for "As-Is Process Flow and Symbology"). The detailed "As-Is" flowchart provided the team with a view of the total process, which allowed them to recognize, analyze and identify areas for improvement. This analysis also served as a periodic validation of the "As-Is" flowchart. Figure 3 is a pictorial of a section of the "As-Is" process flow. In this example, the Nuclear Chemical Operator has gone to the field to check that the caustic drum barrier is in place prior to the transfer. The operator then goes to each tank farm valve pit to perform the valve line up. Section 5 contains the details of the results of the "As-Is" analysis.

## **3.6 Implementation Checklist**

The implementation checklist is a tool that challenges the team to consider who is impacted and what actions need to occur to resolve or address potential roadblocks to successful implementation of the "To Be" process.

# AZ-101 BATCH TRANSFER TO PRIVATE CONTRACTOR

RPP-5560 Rev. 2

## Systems Integration

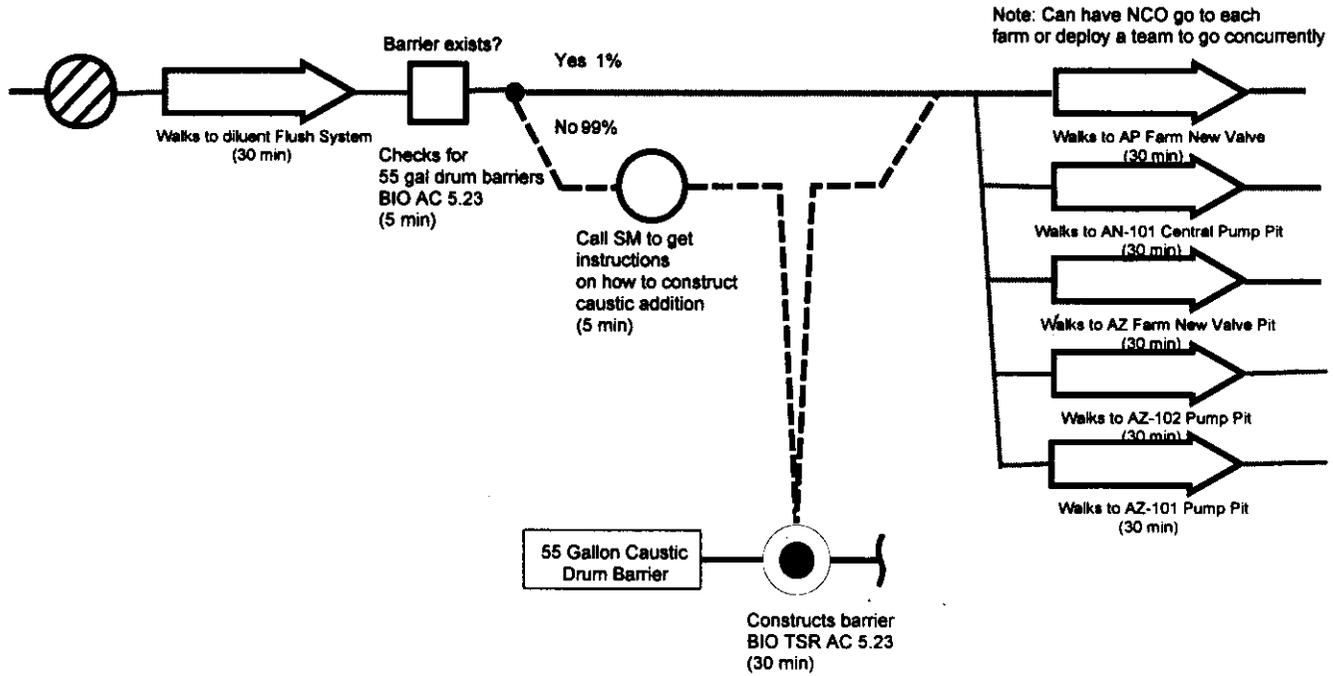


Figure 3. Sample of ANSI Y 15.3m Process Flow for AZ-101 Batch Transfer

**Systems Integration****IV. RETRIEVAL SYSTEM DESCRIPTION****4.1 Double Shell Tank Transfer System**

Planned upgrades of the DST transfer system by project W314, W-211, and W-314 will significantly improve transfer system reliability and operability. The planned upgrades are to be completed prior to the first HLW delivery of feed to the PC (AZ-101 batch transfer). The following structure, systems and components (SSCs) will be upgraded, replaced, or newly installed:

- Valve/pump pit and Clean out Box (COB) leak detectors
- Valve manifolds in AN/AZ/AW/AP farms
- Master Pump Shutdown (MPS) System
- Transfer valve position indication
- Transfer lines double encased with leak detection in the encasement
- Valve and pump pit cover blocks
- Two new valve pits in AN and AP farm.
- Four new pump pits in AN and AP farm.
- Three new diluent and flushing systems.

In addition to these SSCs, double-contained retriever tanks, catch tanks, retired facilities, and non-compliant transfer lines will be isolated from the new transfer system.

Upon completion of these upgrades, all of the double-shell tanks (DST) will be interconnected via jumper manifolds and a series of double-encased lines. Two HLW and two LAW pipe-in-pipe transfer lines will be installed providing a path for feed delivery from the East Area DST to the PC.

The MPS system is currently being designed to shutdown the transfer pump in the event a leak is detected or a transfer valve is out of position during the transfer.

**4.2 HLW (AZ-101) Retrieval Equipment**

The monitoring equipment and control functions listed below are in place or planned to be in place by fiscal year 2004 are described in detail in Appendix C. The descriptions provide the requirements associated with the need for the equipment or control function for the following:

- Tank Liquid Level Equipment
- Tank Leak Detection Equipment
- Tank Ventilation Equipment
- Mixer Pump
- In-tank Component Structural Integrity
- Tank Waste Temperatures
- Transfer Pump
- Process Transfer Jumper
- Transfer Pipe and Pit Leakage
- Diluent and Flush System.

Systems Integration

V. "AS-IS" DIAGNOSTIC ACTIVITIES

The "As-Is" diagnostic activities included a review of the applicable requirements, conducting interviews with subject matter experts on the current process, and data collection of the "As-Is" process. The team first developed an upper-level (Figure 4) view of the "As-Is" transfer process to establish the boundaries for who to interview and what requirements to consider.

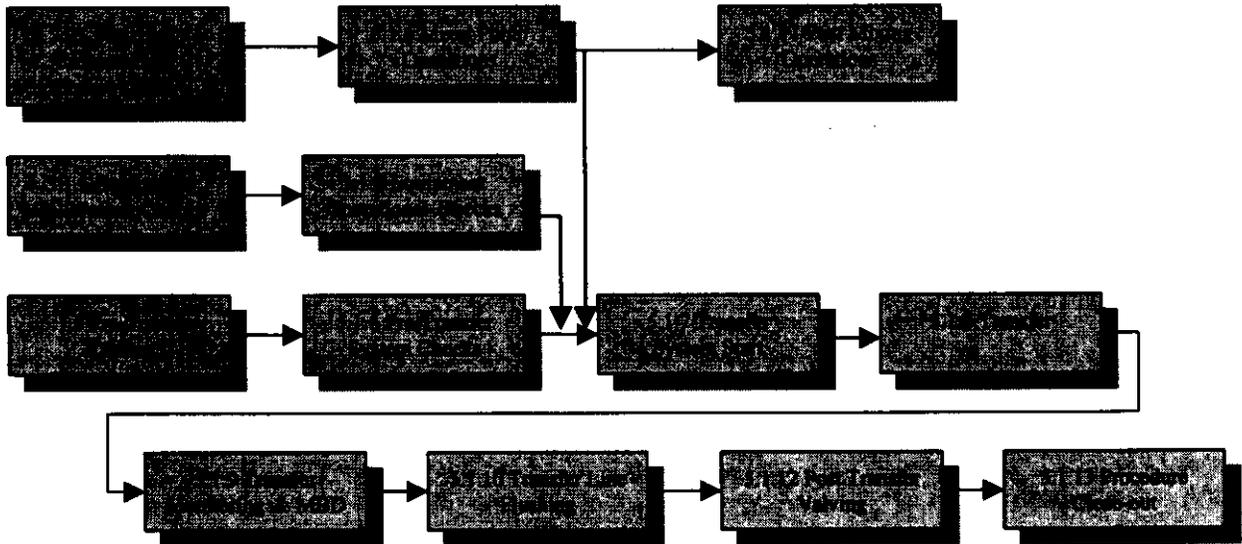


Figure 4. 101-AZ HLW Batch Transfer Upper-Level Process Flow

The team used the following procedures (Table 1) to model the current process. The team challenge was to develop the "As-Is" process flow, assuming the new systems are in place (see Section 4.1). The team agreed to draw on the expertise of those who currently perform transfers and use known planned design and system changes as part of the review against current procedures and practices.

| Control Number                              | Procedure Name  |
|---|---|
| HNF-IP-0842, I, Administration 2.11, Rev 2a | Technical Procedure Control and Use                               |
| HNF-IP-0842 II, Operations 4.13.1, Rev 0b   | Operational Aspects of Facility Chemistry and Technical Processes |
| HNF-IP-0842 II, Operations 4.8.2, Rev 0d    | Routing Boards  |
| HNF-IP-0842 II, Operations 4.10.1, Rev 3a   | Independent Verification  |
| HNF-IP-0842, IV, Engineering 5.4, Rev 11b   | Unreviewed Safety Questions                                       |
| TF-OTP-210-001, Rev B-0                     | Mixer Pump Operations   |
| TO-025-005, Rev A-23                        | Perform Equipment Verification for East Tank Farms                |
| TO-040-540, Rev E-11                        | Water Surveillance and Usage                                      |
| TO-320-005, Rev B-17                        | Waste Retrieval Sluicing System Startup and Process Control       |
| TO-430-500, Rev E-2                         | Cross-Site Transfer From TK-102-SY to TK-107-AP Via SNL-3150      |
| TO-260-069, Rev A-0                         | Flush and Rotate 241-AZ Mixer Pumps                               |
| TO-270-100, Rev A-2                         | Transfer Waste from TK-106-AW to TK-103-AP                        |

Table 1. Procedures Used for Modeling AZ-101 HLW Batch Transfer to the PC

As part of the team's analysis, over seventy requirements that are driven by the River Protection Project (RPP) Authorization Basis (AB), administrative procedures, retrieval documents, and the Office of River Protection (ORP) Interface Control Documents were identified. Greater than 90% of the requirements are

## **Systems Integration**

driven by the AB or operating specification documents. See Appendix D for specific requirements. The requirements were tied to specific steps and documented in the "As-Is" process flow (see Appendix B).

### **5.1 "As-Is" Process Metrics**

Upon completion of the interviews with transfer process experts, the team validated the process flow and conducted an analysis of the current process. A total of 715 process steps were reflected in the "As-Is" process. Appendix E summarizes the analysis of the "As-Is" process.

Analysis of the "As-Is" condition led to better understanding of significant potential delays in schedule. The greatest schedule impacts are associated with calibration, equipment and functional checks. In addition, initiation of work packages to calibrate or repair items used in the transfer process could also contribute to significant delays (from 4 hours to 5 days, depending on the problem). Procedure Change Authorization (PCA) changes and changes regarding AB issues could also significantly impact the schedule and cost of a transfer. The AZ-101 team made the assumption that the first batch transfer would have a recent Operational Readiness Review. This would reduce the initial risk. Current practices indicate there is a high risk of significant delays due to PCAs, especially when there are AB issues that must be addressed. The PCA and AB issue process step data were collected for the detailed process flow but were not included in the most likely schedule and cost data used for analyzing reductions in schedule for the first batch transfer.

The sections that follow summarize the "As-Is" process analysis results.

#### **5.1.1 Equipment Calibration Checks**

During the equipment calibration checks of the "As-Is" process and prior to starting a waste transfer, the Preventive Maintenance System (PMS) database is accessed. The Operations Engineer (or designee) checks PMS to verify that Limiting Condition of Operation (LCO)/Limiting Control Settings (LCS) equipment calibrations and functional tests are within their periodicity as specified in the Technical Safety Requirement (TSR).

#### **5.1.2 Equipment Operability Checks**

Equipment verifications and pre-transfer checks for East Tank Farm transfers are performed in accordance with Tank Farm Plant Operating Procedure (TO-025-005) and the applicable transfer procedure. The procedure applies to East Tank Farm physically connected waste transfer equipment. The procedure is conducted in parallel with the pre-transfer checks of the transfer procedure. It routinely takes 3-5 days to complete equipment verification and pre-transfer checks. These checks are expected to take 4.79 days for the AZ-101 batch transfer to PC.

The FSAR Technical Safety Requirement LCOs and LCSs impose a surveillance requirement (SR) on the following equipment/systems:

- Transfer Leak Detection Systems
- Primary Tank Leak Detection Systems
- Aging Waste Facility Leak Detection Pit Weight Factors
- Transfer System Covers and Entry Doors
- Supplemental Covers
- DST and AWF Tank Ventilation Systems
- Ventilation Stack CAM Interlock Systems
- Service Water Pressure Detection Systems
- 204-AR Backflow Prevention System.

**Systems Integration**

For the same equipment, we also conduct an operator field operability check. This check has an operator inspect the equipment for proper operation.

In addition to the LCO/LCS SR requirements, we also perform operability checks (PMS and field checks) on the following components/systems prior to starting a waste transfer:

- Primary tank liquid level (ENRAF/Manual Tape)
- Primary Tank High Pressure Alarms
- Primary Tank Temperature Monitoring System (Westronics)
- Primary Tank Leak Detection Systems - all leak detector probes and annulus CAMs (TSR only require one operable system (i.e. one leak detection probe or CAM).

Prior to waste transfer, the transfer route is physically walked down by an operator to ensure that the transfer system and physically connected lines have not been excavated.

Transfer line encasement seal loop drain valves on the active transfer line are field verified in the operable position and then independently verified prior to a transfer.

W-314 Project is currently designing a replacement Master Pump Shutdown (MPS). Preliminary design requirements include a safety class system. MPS will be able to detect a leak via the transfer leak detection system or an incorrect transfer valve position and automatically shutdown the transfer. The existing MPS system is not currently credited for compliance with the FSAR due to inadequately functional test procedures.

**5.1.3 Mixing Preparation and Pre-requisites**

It is expected to take one to two days to perform sludge measurements. A crew of five supports the work package for conducting sludge measurements and there are three approaches still under consideration. They include the gamma method, which is the most likely method based on current design, the Ultrasonic Interface Liquid Level Analyzer (URSILLA) method, or the sludge weights method.

The driver to perform sludge measurements is not well defined. Sludge measurements are part of the mixer pump test but may not be needed during WFD transfer operations. The sludge weights method is the least preferred as it requires the Nuclear Chemical Operator (NCO) to go to the tank farm riser and lower the weights into the tank to obtain the measurement. It is the most time consuming, taking over a shift to complete, and increases the exposure risk to the worker. If a justification can be made to mix predetermined duration, as opposed to predetermined solid levels, an opportunity exists to reduce schedule slips and worker exposure.

**5.1.4 Mixer Pump Operations**

Two mixer pumps are planned to operate in the oscillating mode for approximately 48 hours during waste mobilization. It may be required to operate the pumps in both the fixed and oscillating modes to mobilize the waste.

**5.1.5 Pre-transfer Valving**

There are approximately 20 transfer system valves on the direct transfer path that must be positioned properly for the transfer to begin. Valve line-ups routinely take from two to eight hours to perform, with

## **Systems Integration**

the most likely case taking eight hours. An independent verification takes four hours (on average) to conduct after the initial line up has been completed.

### **5.1.6 Pre-transfer System Checks**

Current practice for transferring slurry from C-106 is to conduct a radiation survey of the transfer line prior to starting the transfer and then compare it to the post transfer survey reading, however this is only required for direct buried transfer lines. The team is challenging the value of performing this survey for AZ-101 HLW slurry transfers.

There are seven types of system checks that must be properly verified before the transfer can begin (see Appendix C for details). These checks, as currently implemented, increase overall schedule, increase opportunities for schedule slips, and increase worker exposure.

### **5.1.7 Transfer System Start**

Immediately prior to starting the transfer, the NCO checks that the master pump shutdown is clear. The NCO returns to the Shift Office to obtain final approval to begin the transfer. The Shift Manager reviews the equipment functionality procedure to ensure there will be no lapses in equipment checks as the transfer begins. Temperature readings are also obtained, which may be a redundant step at this point because they have already been obtained for tank mixing. If all systems and checks are ready, the Shift Manager gives the administrative lock to the NCO and signs the procedure to authorize the transfer, noting the administrative lock number. The NCO checks for danger tags and ensures that the pump to be used is the correct pump. An electrician may be called in to plug in the power cable and the transfer pump switch is thrown to begin the transfer.

### **5.1.8 Transfer**

The initial waste volume contained in Tank AZ-101 will be pumped to the PC in a total of six batches. The first batch will consist of approximately 600,000 liters of waste slurry. Subsequent batches will also be approximately 600,000 liters with the final batch being approximately 450,000 liters. The transfer pump suction will be located close to the tank bottom, resulting in a waste heel of approximately 125 m<sup>3</sup> that will remain in the tank after the final batch has been transferred. It is not planned that in-line dilution of the feed will be required.

### **5.1.9 Transfer Monitoring and Material Balance Discrepancy**

During the transfer, the NCO monitors the transfer pump ammeter and discharge pressure for unusual fluctuations.

A requirement exists to monitor the transfer route for leaks and to ensure that the waste is not being misrouted. This is accomplished administratively by performing a waste transfer material balance and calculating the Material Balance Discrepancy (MBD) periodically during the transfer. MBD calculations are determined by comparing the combined levels (volume) of the sending and receiving tanks during the transfer, to the combined levels of these tanks at the start of the transfer and factoring in any raw water usage. MBD calculations are performed at intervals required by the TSR. The frequency of the calculations decreases as the time of transfer starts.

The liquid level detection devices currently being used are "ENRAFs", which are calibrated to 1/100<sup>th</sup> of an inch and have the ability to send a signal to a computer monitoring system. This level of accuracy is important since 2.54 cm (1 in.) of liquid in a DST is equivalent to 10,330 liters (2,750 gal.) volume. It is

## **Systems Integration**

uncertain whether AZ-101 tank liquid level can be measured using the ENRAF or manual tape accurately during simultaneous mixer pump and transfer pump operations.

An alternative method for calculating the material balance discrepancy would be to use the volumetric flow rate at the discharge of the pump versus measuring the sending tank liquid level to calculate the change in material inventory. This would require a redundant and reliable method of measuring volumetric flow rate to minimize impacts to transfer schedules due to component failure.

MBD calculations require the tank farm NCO to contact the PC every two hours to account for the receiving tank volume. This reading is converted into a standard level of measurement (i.e. gallons or liters) so that it can be compared to the sending tank level. This frequent communication will be difficult to orchestrate person-to-person without the PC dedicating an operator. This process is person dependent and could create potential problems if the PC facility manager or the operator is not available to provide MBD data at the appropriate time.

### **5.1.10 Transfer Line Flushing**

After each batch transfer, the transfer line is flushed with a volume of treated water not to exceed twice the transfer line capacity. The flush is required to:

- prevent the potential buildup of unacceptable flammable gas concentrations in the transfer pipeline,
- reduce personnel exposure during jumper changes
- remove any solids buildup in the transfer line.

Traditionally transfer line flushes are conducted within hours following the transfer. The first step is waiting for the waste to drain back to both the sending and receiving tank. The second step is flushing back from the valve pit through the pump into the sending tank. The third step is flushing forward from the valve pit to the receiving tank. With the added capability of in-line dilution at the suction of the pump, the transfer line could be flushed by slowly increasing the in-line dilution to match the flow rate of the pump. The team noted that it is difficult to prove that only water and no waste is being transferred. This process would require no delays due to the valving set-up and the drain back period, which would effectively minimize solid settling time.

Although it is not expected that in-line dilution will be used for the initial feed delivery to the PC, it may be used in subsequent batch transfers and during flushing operations.

Current system designs for performing in-line dilution use a single three-way isolation valve between the waste transfer discharge and the service water pressure switch. The service water pressure switch header is located on one side and the single three-way isolation valve is located between the in-line dilution system discharge and the same service water pressure switch header. Proper valve selection for the manifold is essential to minimize the potential for transfer pump shutdown due to leak-by.

### **5.1.11 Post-mixing Operations**

The mixing pump will be operated for a total of approximately 72 hours (48 hours of mobilization + 24 hours of mixing during the transfer). During this mixing period, tank heat-up rates will have to be monitored closely so as not to exceed Operation Specific Document (OSD) or TSR limits. Post-mixing operations consist of turning off the mixers at the end of the batch transfer, making an entry in the mixer pump run-time log and reviewing the mixing procedure at procedure close out.

**Systems Integration**

**5.1.12 Post-transfer Valving**

The valves are aligned for the flush and the raw water valve is opened for the designated volume flush. After the flush is complete, the NCO waits an additional hour for the lines to drain. During this time the final MBD is calculated and the procedure is taken to the Shift Office for a final review of the transfer. After the waiting period is over, the NCO aligns the valving in accordance with the post-transfer instructions.

**5.1.13 Procedure Close Out**

The NCO initials that the transfer is complete and the Shift Manager reviews the procedures for the equipment functionality, mixing operations, flushing and transfer. This usually takes about four hours and requires some follow up to ensure the procedures are complete and accurate.

**5.2 Benchmarking**

Benchmarking is the process of identifying and learning from best practices anywhere in the world. It serves as a powerful tool in the quest for continuous improvement and in the case of the AZ-101 team, the goal was to learn from other companies in order to improve processes that would lead to superior performance. The AZ-101 team used four categories of benchmarking when choosing the fifteen potential benchmarking partners. The categories are described below and are tied to the list of benchmarking partners (see below) that were used in this study:

1. Comparative analysis, the process of seeking information from competitors who may or may not be the leaders in the industry
2. Internal comparison, the process of seeking information from other organizations within Lockheed Martin Corporation
3. Competitive, the process of seeking information from direct competitors that are known as industry leaders, and
4. Functional or generic, the process of seeking information from dissimilar industries.

After learning more about their processes and availability, the team pared the list down to seven viable candidates. The benchmarking partners were:

- BNFL, England (competitive benchmarking partner)
- Cogema, France (competitive benchmarking partner)
- Lockheed Martin Energy Systems, Tennessee (internal comparison partner)
- Prodicta (Unocal), Washington (functional benchmarking partner)
- Westinghouse, North Carolina (comparative benchmarking partner)
- Solutia (Monsanto), Idaho (functional benchmarking partner)
- West Valley, New York (competitive benchmarking partner).

The team developed 13 lines of inquiry for operations and facilities, equipment and processes, and regulatory requirements. Interviews were conducted in person or by telephone.

**Systems Integration****5.3 Gap Analysis**

The best practices are:

**Best Practice 1:** Take 1-2 hours routinely to complete equipment verifications and pre-transfer checks.

**Best Practice 2:** Utilize remote system indications and routine surveillance readings to verify equipment operability.

**Best Practice 3:** Install safety equipment performing a safety function that addresses requirements of the authorization basis.

**Best Practice 4:** Verify system are operable by verifying preventive maintenance is current and system is not in alarm in lieu of field operability checks.

**Best Practice 5:** Ensure proper transfer valve line-up of manual valve systems was with a second independent operator verification.

**Best Practice 6:** Perform only those minimum pre-transfer checks that are required.

**Best Practice 7:** Keep process instrumentation systems simple.

**Best Practice 8:** Use dedicated transfer routes that don't require installation of temporary jumpers.

**Best Practice 9:** Utilize simple transfer procedures and reusable checklists.

**Best Practice 10:** Transfer lines are not buried in the ground but instead have access via cover blocks.

**Best Practice 11:** Department of Energy contractors ensure that the Authorization Basis allows for isolating a transfer system using multiple shut valves.

**Best Practice 12:** Design retrieval and transfer systems to be operated by Operations personnel only. No support personnel are required for a transfer.

The AZ-101 Team compared current practices to best practices. Of the best practices identified, there were only two of our current practices that had no gap. Appendix F identifies the gaps and the opportunities for improvement. The most significant gap was the best practice set up time of 1-2 hours compared to our 4.79 days. All other gaps indicated we incur longer setup time and complicate the transfer process.

**5.4 Equipment Verification Analysis**

Upon completion of the gap analysis, further information was collected and analyzed for equipment verification. The RPP AB interprets an "interconnected tank" as any tank that has a transfer line physically connected to the transfer route. "Physically connected" applies to any transfer line that is not separated from the active transfer line by a blank or an air space. One or more closed valves do not constitute a separation. All tanks and pits physically connected by the transfer line require surveillance prior to and during the transfer. Following the completion of W-314, W211, and W521 Project upgrades, all East Area DST's will be physically connected. 200 East Area interconnected tanks will include AN (seven tanks), AW (six tanks), AY (two tanks), AZ (two tanks), AP (eight tanks) waste tanks, the 204-AR storage tank (TK-01), and the 151-AZ catch tank.

An analysis was conducted to estimate the number of equipment verification checks that would be required to complete this AZ-101 to PC waste feed delivery. The estimates were then compared to the number of checks required today. The current average per transfer for equipment verification checks is 188. Data were reviewed from the twelve major transfers last year that used operating procedure entitled, *Perform Equipment Verification for East Tank Farm Transfers*, T0-025-005. Equipment verification checks include:

- Verifying transfer system leak detectors, service water pressure switches, transfer line encasement leak detectors, annulus and primary ventilation Continuous Monitoring (CAM's), primary ventilation stack CAM interlocks, annulus leak detectors, tank high pressure alarms and tank level indication have not exceeded their calibration and function test periodicity and field tested for operability by a NCO
- Field verify transfer system cover blocks and supplemental cover blocks are in place and operable.

**Systems Integration**

Post 2005/6 transfer system drawings were used to complete this analysis. The Team also reviewed records and conducted interviews with Operations personnel and determined that no equipment was identified as out of service, which was not already known to be inoperable, with the exception of a few burned-out strobe lights. The analysis findings are summarized in Table 2 below.

| <b>Equipment Operability/Functional/Calibration Checks<br/>Required Prior to Commencing a Transfer</b> |  |  |
|--|--|--|
|  | <b>Equipment<br/>Verification Checks</b> | <b>Functional/Calibration<br/>Checks Current</b> |
| <b>Today's Transfer Average</b>  | <b>188</b>                               | <b>Not Calculated</b>                            |
| <b>AZ-101 to BNFL Feed Delivery</b>  | <b>439</b>                               | <b>322</b>                                       |

**Table 2. Equipment Operability/Functional/Calibration Checks**

Transfer system excavation walkdowns and radiation surveys were not included in this analysis. Temperature monitoring, flammable gas monitoring, and process control equipment are required to conduct a transfer but currently are not verified as part of the pre-transfer equipment verification checks and were not included in this analysis. AZ-101 to PC Feed Delivery analysis assumed that in fiscal year 2005, non-compliant transfer lines, double contained receiver tanks, and valve pits and diversion boxes not part of the 2005/6 transfer system would be physically isolated from the new transfer line system.

Prior to starting the AZ-101 HLW waste feed delivery to the PC, 322 equipment functional and calibrations are verified as current and 439 pieces of equipment (in five tank farms and one facility) are field checked for operability. Equipment functional and calibration checks must be current for the duration of the transfer.

As previously stated, it takes approximately five days to complete pre-transfer checks. Pre-transfer check duration times will increase by 230% from an average of 188 to 439 as all the East DST's are physically interconnected as a result of project upgrades. This lengthy pre-transfer set-up period, coupled with the number of equipment that has to be operable, leads to a very narrow scheduling window to start and complete a transfer. If the scheduled transfer start date slips a day or two, last minute functional requirements are routinely required to keep the 322 equipment functional /calibration checks current. It is also noted that typically Operations personnel had to re-perform operability checks on half of the transfers because of delays for this last fiscal year. This narrow scheduling window greatly increases the complexity of executing transfers and with the increased operating tempo required for retrieval leads to an unacceptable schedule risk.

#### 5.5 Equipment Reliability and Maintainability Evaluation

This section is presented to give the reader an understanding of the known risks and potential delays with waste feed delivery to PC from a broader perspective.

The Operations and Maintenance Concept (HNF-1939-Volume V, Revision 0) evaluated the AZ-101 HLW to PC transfer using the Reliability and Maintainability (RAM) simulation. This model quantifies impacts of delays due to hardware failures, personnel error, and weather-related delays. The analyzed equipment only included equipment directly related to the AZ-101 HLW to the PC feed delivery. Analysis did not include interconnected tank equipment. A figure of merit was developed for the HLW batch transfer and the risk of incurring idle facility penalties was evaluated. Figure 5 shows the preliminary RAM simulation results.

## Systems Integration

The RAM simulation predicts a 10.8% probability of incurring idle facility penalties and an integrated schedule delay risk of 2.2 days for the 30-day waste transfer window. This window is being challenged and may be extended to 60 days, which would reduce the probability of incurring idle facility penalties to 2.4% and integrated schedule delay risk of 1.4 days. It is important to note that the RAM simulation did not include the 5 days of set-up time and assumed all equipment is operable and functional/calibration checks are current. No schedule risk was included due to delays in transfer and mixing setup. Experience tells us that many of the significant transfer delays are the results of problems discovered during the pre-transfer setup that result in approximately two false starts per transfer.

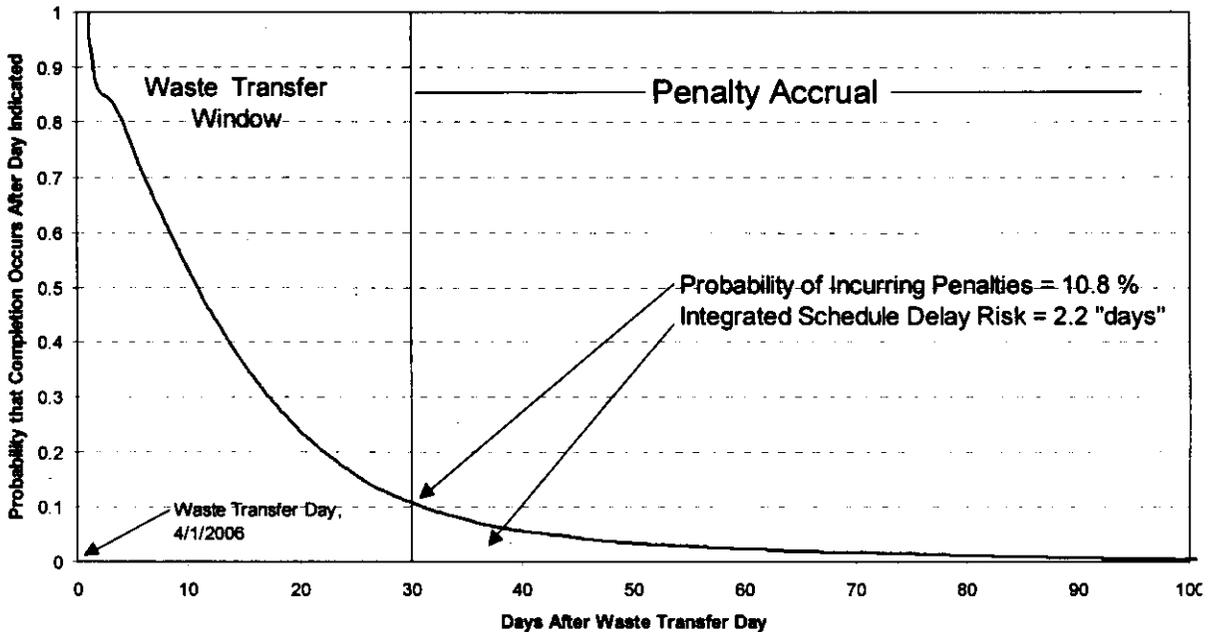


Figure 5. Risk of Idle Facility Penalties, One of Nine HLW Batch Transfers to BNFL, Inc.

### 5.6 Schedule Risk

Based on the equipment verification and reliability analyses, the team reviewed the schedule for the AZ-101 batch transfers. The retrieval transfer and feed delivery schedule, see Figure 6 below, ramps up through Phase I. The number of deliveries average 10 per year at the start of Phase I and increase to about 30 transfers by the end of Phase I. Monthly transfer estimates peak at 13, however these transfers will likely occur over a greater period. Most transfers support WFD but are not related to transferring waste as feed to the PC.

HLW feed deliveries will take approximately six days to complete, with LAW transfers requiring approximately 10-12 days to complete due to the larger transfer volume. These estimates assume no delays or off-normal events during the pre-transfer setup and subsequent transfer.

The agreement between ORP and the PC requires the RPP to delivery waste within a 30-day window. Thirty days may seem like plenty of time to complete a transfer, however the RAM analysis tells us that we

Systems Integration

have only about a 90% chance of completing the transfer without incurring penalties. The RAM analysis based its results on equipment and operator error, and external events, directly related to the transfer.

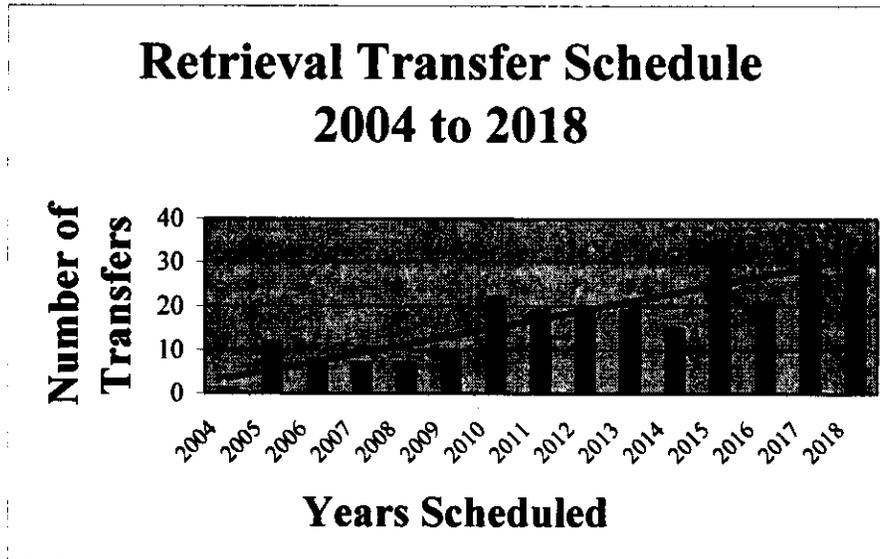


Figure 6. Scheduled Transfers Through 2018 (Case 3S3)

The AZ-101 team conducted two Monte Carlo simulations (see Section XII. for a description). The Monte Carlo was performed on the schedules developed by the team to simulate an actual WFD process. Operations occurrence and duration estimates determined inputs to the simulation. The time estimate starts when the Tank Farm plant manger hands a shift manager the orders to perform the transfer. The results cannot be correlated to the RAM analysis because the RAM analysis considers many other factors including environmental conditions and events prior to the shift manager receiving the order to initiate a transfer. The schedules developed could be incorporated into the next RAM analysis.

The first simulation used schedule risk from the “As-Is” scenario reflecting current operating habits and the complexity associated with the interconnected tank processing requirements. The result of this simulation indicates an 80% likelihood of completing a single transfer within 16 days. A second simulation was performed on the “proposed” process developed by implementing improvements recommended in this case. Results of proposed process simulation estimate that 80% of all transfers will be completed in 11 or fewer days.

| Processing Method | Arithmetic Ave. | Median Scenario <sup>1</sup> | 80% Scenario <sup>2</sup> | 1 <sup>st</sup> Transfer <sup>3</sup> |
|-------------------|-----------------|------------------------------|---------------------------|---------------------------------------|
| As-Is (current)   | 14 days         | 15 days                      | 16 days                   | <b>6 days</b>                         |
| Proposed          | 10 days         | 9.5 days                     | 11 days                   | <b>3 days</b>                         |

- Notes 1 – 50% of the transfers will require this or less time for their total duration.
- 2 – 80% of the transfers will require this or less time for their total duration.
- 3 – This represents the teams estimate for performing the transfer directly following an Operational Readiness Review (ORR).

Table 3. Transfer Duration Estimates

**Systems Integration**

The data in the second through fourth columns in the table above represent transfers made under normal operating conditions. However, the team was specifically chartered with looking at the first transfer from AZ-101 to BNFL. The first transfer will occur directly following an Operational Readiness Review (ORR). Starting with this assumption, the team went through the equipment setup, mixing, and transfer operations estimating the most likely path for both the current and improved processes. The resulting expected duration for both processes are shown in the fifth column, titled "1<sup>st</sup> Transfer". The team considers the normal transfer time to be a worst case scenario for the first transfer to BNFL.

Using the output from the simulations, models were produced for use in estimating the total time required for performing multiple transfers in series.

| Number<br>Of Transfers | Probability of Occurring |          |
|------------------------|--------------------------|----------|
|                        | As- Is                   | Proposed |
| 2                      | 42%                      | 99%      |
| 3                      | 0%                       | 29%      |
| 4                      | 0%                       | 0%       |

Note: This is for normal operating conditions.

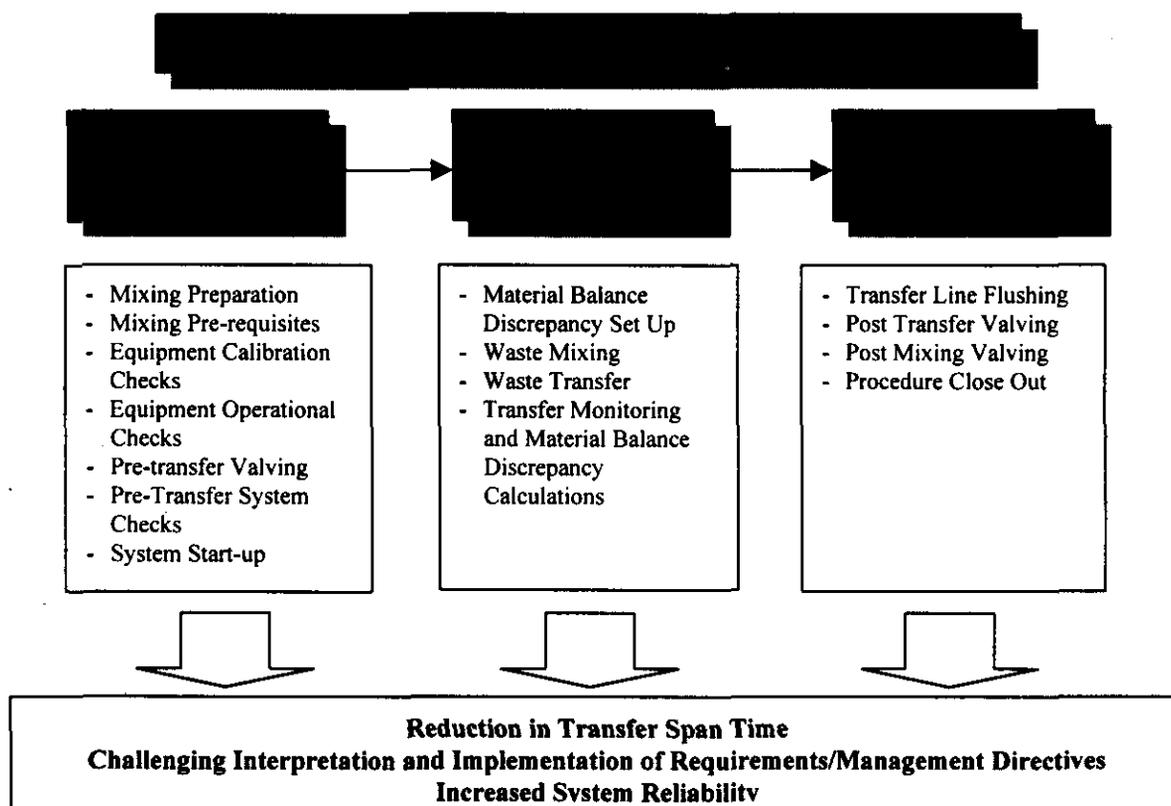
**Table 4. Number of Transfers During 30-Day Window**

With the two-valve rule fully implemented, multiple transfers could occur at the same time (depending on the routes), further increasing the Tank Farms' transfer capabilities.

Based on current requirements and practices, the retrieval transfer system will require greater than 11,000 operability checks and 700 functional checks per year. This would tax operation and maintenance staffing and scheduling capability.

**Systems Integration****VI. SOLUTION OVERVIEW**

RPP management concurred with the team on the selected alternative for the "To-Be" process. The selected redesigned process includes the key elements shown in Figure 7 below.



**Figure 7. To-Be Alternative High Level Process**

Proposed measures of success include:

1. Reduction in the number of reworks performed
2. Reduction in the set up cycle time (hours)
3. Reduction in the number of requirements in the AB and operating specifications
4. Number of established requirements reinterpreted to reduce process steps
5. Number of preventive maintenance equipment/items not completed as scheduled
6. Reduction in the number of days into transfer window before starting the transfer
7. Reduction in downtime due to personnel availability.

**Systems Integration****VII. SOLUTION DETAIL**

In evaluating the 151 ideas for improving the transfer process that were developed at the Team's off-site meeting, attended by 30 technical experts and creative thinkers, each idea was assessed for its cost and benefit (see Appendix G for details). Careful consideration of the possible solutions compared to best practices resulted in six key elements of the "priority" solution set.

To address, at a minimum, the avoidance of the \$2.5 million in idle facility penalties, and the ORP initiative to accelerate our schedule (target is 2X, doubled productivity), the AZ-101 Team recommends:

1. Reevaluate the AB inter-connected tank interpretation to allow for double-valve isolation
2. Redefine TSR Equipment "Operability Checks" and eliminate field operability checks
3. Expand the Shift Manger's authority to
  - Allow operating procedure redlining
  - Authorize TSR SR extensions
  - Restart a transfer following a unplanned shutdown
4. Take credit for what Operations personnel knowledge, e.g., daily surveillance
5. Simplify transfer procedures
6. Eliminate calibration and field operability checks not required by the AB.

Implementation of this solution set will cut the transfer set-up time by 65%, significantly reducing schedule risk and increasing the capability to respond to an accelerated transfer schedule if requested by our customer.

**7.1 Double-Valve Isolation**

**All the benchmarking companies took credit for isolating a transfer system with two valves (with some conditions) as a best practice.**

The most significant element is to reevaluate the AB inter-connected tank interpretation to take credit for multi-valve isolation of a transfer system. This entails identifying additional analysis, controls, and/or plant upgrades that must be put in place to effect this change. Additional controls an/or systems must ensure that we will improve operability and reduce schedule risk. This opportunity had been identified previously by other process improvement initiatives, and its implementation is underway.

Taking credit for isolating a transfer system with two shut valves reduces the required equipment checks by 93% (439 to 31) with a predicted 53% reduction in transfer set-up time from 4.79 days to 2.23 days. TSR equipment required to be operable is reduced by 90% (290 to 30), significantly reducing the risk of a transfer shutdown due to a TSR-related equipment failure. This would not only reduce schedule risk, but also reduce impacts to on-going maintenance and planned upgrades because the number of farms and tanks impacted during a transfer would be greatly reduced.

Fiscal Year 2000 Performance Incentive (ORP2.1.1), Performance Expectation (IIE) states: "(1) Develop criteria and identify conditions under which the double-valve isolation mechanism can be used for ensuring tank farm piping systems are physically disconnected when required by the FSAR controls. (2) Based on identified criteria and condition above, submit an AB amendment to modify applicable TSRs to allow use of double-valve isolation as an option to the current TSR requirements of PHYSICALLY CONNECTED as identified in Section 1.1 of the TSR document". The AB amendment is due by July 31, 2000.

## **Systems Integration**

This "priority" solution has the greatest impact on reducing schedule risk and improving transfer efficiency and execution (see Figure 1). With the short turn-around period required by the AB amendment Performance Incentive, Operations needs to actively participate with clear objectives to help in development of this ongoing effort.

### **7.2 Redefine TSR Equipment "Operability Checks"**

Redefining how we conduct operability checks and eliminating the requirement for field operability checks will also help reduce the set up time by an additional 10% from 4.79 days to 1.38 days. The AZ-101 team proposes the following redefinition: TSR equipment be verified "operable" by ensuring TSR surveillance requirements (PM's) are current and the component or system is not in alarm. This will require verification that the component of system is not in alarm. Verification can be accomplished remotely through a monitoring system or by relying on Operations personnel knowledge of plant status, operator surveillance rounds, shift operations turnovers, and operation logs. This practice is consistent with benchmarking best practices.

### **7.3 Expand the Shift Manger's Authority**

#### **Procedure Redlining**

The current practice, which is a self-imposed requirement, maintains that all changes to the procedure must have a USQ screening and then a formal review prior to authorization of the procedure. When insignificant (non-process impact-related) changes are required, the transfer process or set up time is delayed. Instilling greater discretion, accountability and authority to the Shift Manager by re-instituting redlining capability can reduce schedule slippage. For typos and other minor adjustments to the procedure, the Shift Manager needs to have the authority to move forward with the transfer or pre-transfer preparations without having the procedure updated, reviewed and reprinted. This capability will help to avoid delays up to one or two days in the preparation for the transfer. In addition to the redlining, increasing the number and scope of transfer-related categorical exclusions for USQ could potentially reduce significant delays inherent in the USQ screening and determination processes.

#### **TSR Surveillance Requirement (SR) Extensions**

Current practice is to have the Operations and/or Facility Manager approve the use of TSR Surveillance Requirement (SR) allowed (25%) Extensions. Transfer procedures need to be written to allow Shift Manager the authority to continue or re-start the transfer as long as the equipment does not exceed its SR extension. By doing this, start-up delays, which is at 20% chance of occurring, can be eliminated. Shift Manager use of the SR allowed extension is not intended for operational convenience, but instead allowed for use to restart a transfer, that has been delayed due to unforeseen and unplanned plant upsets.

#### **Transfer Restart**

With the exception of the cross-site transfer, current practice for pre-requisites is to redo them if the transfer is delayed. In the event the transfer is delayed or stopped, the transfer and mixing pre-requisites procedures need to allow re-entry at the Shift Manager's discretion. This will prevent extended delays in re-establishing pre-transfer preparations. Current operating practices average two false starts per transfer. In order to reduce the delays associated with redoing the procedure, the transfer and mixing procedures need to be written for repetitive and continued use. Additionally, clear guidance needs to be provided to the shift managers under what circumstances and what actions they must take to authorize restarting a transfer. This would allow the Shift Manager to make a decision on what portion, if any, of the procedure has to be redone to continue the transfer.

**Systems Integration**

**7.4 Take Credit for Turnover Equipment Status**

The Shift Office and Operations personnel have a tremendous amount of information available to them on the status of equipment and transfer processes at any tank farm. Using this information will reduce the number of checks, which will reduce the risk of not meeting the schedule.

To reduce the number of checks, status boards should be installed that are located near the shift offices. The transfer status boards would display TSR equipment status and a geographic map of the DST. The status of TSR and transfer-related equipment would be updated by shift personnel as part of their daily surveillance. Excavation and construction sites would also be tracked on the map, eliminating the requirement to perform excavation walkdowns of the transfer line. Updating status boards and equipment alarm status as part of daily operations replaces field equipment checks as a prerequisite to transfer start-up.

The current routing board would be modified to include tracking changes for the cover blocks and flammable gas barriers. The field operability check would no longer be required for either item so long as the status boards indicate that the cover blocks are operable, as defined by the AB, e.g., valve handles in place.

Periodic surveillance are currently performed to verify the transfer line encasement valves are in the "operate" or "drain" position. Valve position can be displayed on the routing board that will reduce the number of surveillance that are currently performed.

Heightened operational awareness during transfers should be sufficient and would minimize the number of checks and resources required prior to and during the transfer.

Finally, lessons learned and transfer performance metrics can be regularly utilized to increase operational knowledge.

**7.5 Simplify Procedures**

The procedures for transfers and other related activities are cumbersome (typically in excess of 100 pages) with a number of initials, signatures and dates required at various times and on various pages. Part of this is due to a risk averse culture that does not take credit for the skill of the craft. The procedures need to allow sufficient flexibility to ensure the knowledge and skill of the craft is evident. Signature lines need to be reduced to required signatures only, i.e., transfer valve line-ups and data sheets.

To better accommodate this approach, a checklist-style procedure best practice is already being developed by the Team. The procedures need to be designed so that the archived information requiring signatures will be separated from repetitive procedure steps. The use of laminated or reusable procedure checklists for field operations will be used to accommodate this approach.

Procedures are written with actions happening in series. Some procedures have parallel activities that are accomplished concurrently due to the difficulty in performing the functions in parallel. If the procedures are consolidated, coordinated, and written in parallel, the number of field entries will be reduced and greater efficiencies achieved in the utilization of resources.

As part of this effort, encasement seal loop valve checks will be incorporated into the transfer valving setup procedure.

***Systems Integration***

With these modifications to the procedures, at least a half-day reduction in total transfer time will be eliminated.

**7.6 Eliminate Non-required Checks**

We currently perform operability checks on equipment, e.g., tank liquid levels and tank high-pressure sensors that are not required by the AB. Elimination of these non-required checks reduces the number of calibration and field operability checks and the overall transfer process by 15%. Greater accountability is instilled through reliance on shift operations personnel plant knowledge, operator surveillance rounds, shift operations turnovers, and shift operations manager log to verify operability and plant status for non-TSR surveillance requirements. Best practice tells us that this is an unneeded check and should be eliminated.

**Systems Integration****VIII. SOLUTION ALTERNATIVES**

The solution overview and solution detail provided information about the "priority" solutions. Below you will find alternatives that did not provide a sufficient return on investment to consider as part of the "priority" solution. They address ease of operation, greater simplification of systems, and other requirements to challenge in the AB.

**8.1 System Upgrades****Remote Monitoring**

Monitoring of tank farm transfer systems is distributed among numerous non-integrated systems and locations, e.g., TMACS station, AWF ventilation station, Cross-site transfer MCS station, AZ-101 mixer pump control station, 242-A Evaporator control station. There is no one system or location to evaluate the transfer system operability. We must verify operability with lengthy field verification checks.

Our current practice is to verify equipment operability to ensure equipment calibration and functional tests are current. We then field verify each component. These field operability checks could be eliminated if systems could be verified operable (not in alarm) from a remote location.

Through centralized monitoring at a single, continually manned monitoring station, redundant field checks would be eliminated and an integrated view of the entire system could be monitored. Although only small increase in productivity could be realized providing operation personnel with an integrated view of the entire transfer system would greatly improve operational control.

The Team recommends automating the exchange of information with PC for the transfer and flush to include leak detector alarms, transfer pump status, and receiving tank liquid level readings.

**Diluent and Flush System**

Planned installation of the diluent and flush system has single, three-way valve isolation between the transfer system discharge pressure and the diluent discharge pressure. Leak-by on either three-way valve will result in shutdown of the transfer. Adding an additional isolation valve on both sides of the service-water pressure-switch header will reduce the schedule risk associated with transfer shutdown.

**Alternative Material Balance Discrepancy Calculations**

Use of highly accurate and redundant flow indication to calculate MBD instead of receiving and sending tank level will simplify MBD calculations, considering that the transfer to the PC will include in-line dilution at the suction of the pump and may require multiple receiving tank calculations. A 3% efficiency can be realized from automation. Further, it has not been shown that ENRAF will provide accurate level indication during mixing, especially at low tank levels. An automated system will help provide exacting level indications.

**Sludge Level Measurements**

The AZ-101 mixer pump test will test several sludge levels and solids/liquid interface measuring devices (Gamma Probe and URSLLA) that could be used during mixing operation. The gamma probe being proposed requires several dedicated operators through out the mixing process. The URSILLA would be a direct reading measurement requiring an expert interpretation to determine mixing efficiency. It is unclear

**Systems Integration**

to the team that there would be any value to the team to measure several sludge level and solids/liquid interface during mixing.

Sludge levels in AZ-101 are very low and there are very few operating parameters that could be adjusted to impact mixing efficiency (e.g., what would we change based on this information?). If Process Engineering requires data collection, it is recommended to install an application that can be operated by a single control room operator. If there is no requirement to have these data, we recommend not installing a system. If the system is essential for operations, the system should provide the capability to be easily operated and can be measurable and interpreted by a single control room operator.

Encasement Seal Loop Valve Locks

Current practice prior to waste transfer is to physically verify that all encasement seal loop drain line isolation valves associated with physically connected piping provide an open drain path to the pit. We then independently verify valve position. The encasement seal loops not locked would need to be tracked on status board and turnover sheets.

It is extremely rare to reposition these valves, and it is only done as a corrective or preventive maintenance action. The team recommends installing locking devices on transfer line encasement valves so that they can be locked in the "operate" position. A 13% efficiency would be gained from this improvement. To implement, prior to a transfer, the locks can be verified to be in place administratively. Periodic surveillance (quarterly) of the lock program could be performed to ensure locks are still in place.

Predefined Preventive Maintenance Module Checklist

The operations engineer or NCO will spend from 8-12 hours individually querying and verifying equipment calibrations and functional checks in order to record the information in the equipment verification procedure. It is recommended that a predefined list of calibration and functional checks be developed in the preventive maintenance module, specific to each transfer, that will allow a simple, sortable report that indicates whether the TSR surveillance are within periodicity. This improvement would cut the hours required to do these checks by 77%.

Transfer Line

Transfer lines are buried and placed under administrative control to ensure transfers lines are not severed during excavation. Best practice is to have transfer lines in accessible, shielded trenches. It is recommended that we build accessible and protective barriers around the transfer line to PC, i.e. concrete trench, to eliminate the concern about damaging a transfer pipe during excavation.

ACES

Current practice is to access training records at an ACES station by a Health Physics Technician prior to accessing any of the tank farms. The HPT issues a "Brick" that grants the worker access for up to one week. It has been known to take up to two hours to get a brick issued. It is recommended to use a smart card reader system that integrates with the training records to check qualifications access to the tank farms. The system would verify training and track entry and exit from the farm. Personnel would specify which RWP they were working to gain entry to the tank farm. The same controls could be given to vehicle access.

**Systems Integration****8.2 Master Pump Shutdown (MPS)**

Currently there is no way to perform a functional check of the MPS and we use "human" leak detectors in each of the interconnected farms, facility, and remote locations to monitor the local leak detection system. This is a resource intensive evolution that could be eliminated if we developed a functional check for the MPS. The new MPS that W-314 Project is developing will not be available for years. Recommend completing development of this current MPS functional check and eliminating "human" leak detection at local monitoring stations.

At significant cost, we are installing a new, more reliable safety class MPS system with expanded capabilities. These capabilities significantly reduce the response time for shutting down a transfer pump in the event a leak is detected. The MPS will immediately shut down the transfer pump if a leak detector is activated. It will prevent starting the transfer pump, if the transfer valves are not positioned correctly or a leak detector is active on the transfer route. Consider adding an interlock delay capability to the new MPS to allow Operations time to regain operability for spurious alarms.

We need to take credit in the AB addendum for the new MPS-expanded safety functions. Not only will this expand our operational capability, it should also allow us to reduce other administrative controls by replacing with LCO for MPS operability. This would also eliminate the current practice of "human" leak detectors during transfers. The recommendation above to challenge AB requirements can absorb some of the cost associated with taking credit for this functionality. The AB change should mandate a closure review for each update to the AB to relieve local leak detector monitoring requirements.

**8.3 Administrative Lock**

Our current practice is to place an administrative lock on all transfer pumps and verify, prior to removal, that the transfer system covers and supplemental covers, service water pressure detection systems and transfer leak detection systems are physically connected to a waste transfer route and are operable. Periodic surveillance are required after the removal of the administrative lock. It is recommended that the need for the transfer pump administrative lock be eliminated because the transfer pump breakers are procedurally controlled in the shut position and there is an inherent double check to energize the transfer pump. A 1% reduction in the overall schedule is expected from this improvement. The breaker is positioned "on" first and then the pump "on" switch is positioned to "on." Some of the cost of this alternative can be absorbed in the process for challenging other AB requirements mentioned above.

**Systems Integration**

**IX. COSTS AND SCHEDULE IMPACTS**

**9.1 Implementation Costs and Schedule Impacts of the "To-Be"**

The team collected the tangible costs based on the most likely schedule. The team rated each option on a scale of 1 to 10 for the cost and benefit and plotted the options on a graphic (see Appendix H). The "priority" solutions and other alternatives represent a combination of the options. Table 4 indicates the costs associated with the alternatives.

| Description   | Implementation Cost                                | Cost Avoidance                | Tangible Cost Savings Per Transfer | Schedule Impact (Aggregate reduction in transfer time)     |
|---|--|-------------------------------|------------------------------------|--|
| Most Likely "As Is" Transfer (Avg. Cost \$14,500)                     |  |                               |                                    | 6.25 Days  |
| <b>PRIORITY SOLUTIONS</b>   |  |                               |                                    |  |
| Implementation of Double-Valve Isolation                              | \$150,000 (for Operations support PI ORP 2.1.1)*** |                               | \$3,800                            | Reduced to 3.71 Days                                       |
| Redefine "Operability"  | \$6,000  |                               | \$3,300                            | Reduced to 3.73 Days                                       |
| Expand Redlining Authority  | \$1,000  | \$12,800                      |                                    | Avoid 2 or more day delays                                 |
| Take Credit for Operations Personnel Knowledge                        | \$26,000 (board)                                   | \$4,200                       | \$450                              | Reduced to .5 Days   |
| Simplify Procedures   | \$50,000 (0.5 FTE)                                 |                               | \$1,800                            | Reduced to 5.68 Days                                       |
| Eliminate Non-required checks   | Absorbed in challenging AB                         |                               | \$300                              | Reduced by .5 Day  |
| <b>TOTAL</b>  | <b>\$233,000***</b>                                | <b>\$17,000</b>               | <b>\$9,650</b>                     | <b>Reduced to 3.13 Days (50%)</b>                          |
| <b>OTHER ALTERNATIVES</b>   |  |                               |                                    |  |
| Alternative 1 - Remote Readings, MPS, and Taking Credit for PM checks | \$15,000 (estimate)                                | \$264 per transfer for rework | \$850                              | Reduced by .25 Day (3%)                                    |
| Alternative 2 - Predefined PM Module checklist                        | Not quantifiable                                   |                               | \$1,150                            | Reduced by .5 Day  |
| Alternative 3 - Challenging the Other AB and Internal Requirements    | \$50,000 in addition to "priority"                 |                               |                                    | Not quantifiable   |
| Alternative 4 - Improve ACES  | \$50,000 (estimate)                                | \$117 per transfer            |                                    | Reduced by .25 Day (3%)                                    |
| Alternative 5 - Encased Transfer Line                                 | \$2M   |                               |                                    | Possible change in recovery times due to a failed transfer |

\*\*\*Cost may already be absorbed by performance expectation (ORP 2.1.1) and Nuclear Safety & Licensing, which reduces implementation costs to \$83,000

**Table 5. Priority Solution and Alternative Costs**

**AZ-101 BATCH TRANSFER TO PRIVATE CONTRACTOR**

RPP-5560 Rev, 2

**Systems Integration**

**9.2 AZ-101 Batch Transfer to PC Team Cost**

The AZ-101 team kick-off was July 27, 1999. Table 5 reflects the cost of the AZ-101 team effort.

| Description  | Average Attendance | Total Meeting Hours | Average Hours per Individual | Total Number of Meetings | Total Cost |
|--------------|--------------------|---------------------|------------------------------|--------------------------|------------|
| Team Members | 5                  | 252.5               | 17                           | 17                       | \$73,326   |
| Facilitator  | 1.5                | 50.5                | 250                          | 17                       | \$13,934** |
| Total        |                    | 303                 |                              | 17                       | \$87,259   |

\*\* Absorbed by the RE Technical Basis Review (TBR)

**Table 6. Team Costs**

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X. BENEFITS

Individual improvements are noted in Figure 8 below and are based on the most likely schedule. A cost benefit ratio in excess of 1.0 has merit for implementation. All recommendations indicate at least a 1.01 cost benefit ratio.

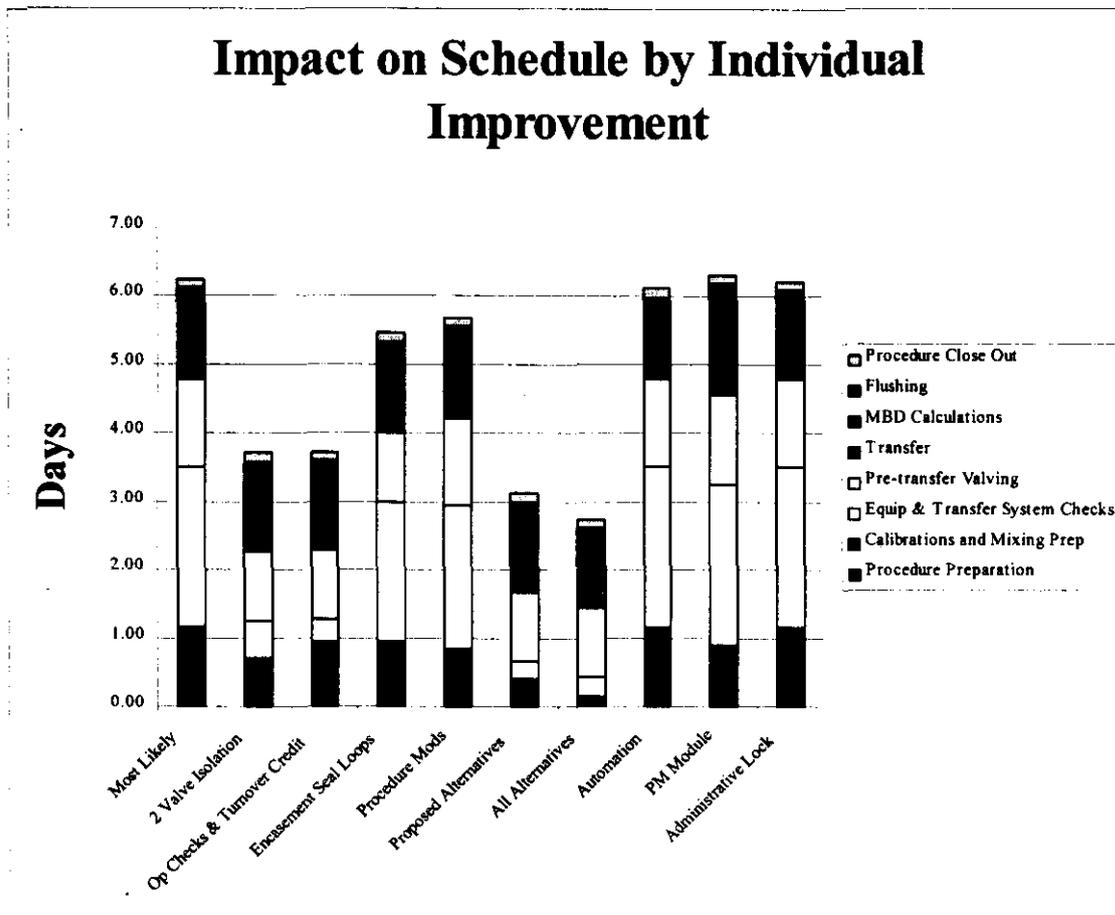


Figure 8. Tangible Savings Realized from Improvements

The implementation costs applied to AZ-101 batch transfers alone have a payback of nine AZ-101 transfers, which can be realized by mid FY2005. However, it is expected that these "priority solutions" improvements will favorably impact current-day transfers and therefore will be realized as a diminishing benefit by fiscal year 2004. It will continue to have a positive effect on tangible cost savings associated with transfer execution.

The cost benefit ratio (benefit divided by implementation cost) for all "priority" solutions is 1.99. Most of the credit can be given to implementation of 2 valve-isolation, which will reduce the required DST transfer equipment checks from 439 to 31 and equipment that has to be operable for any DST transfer from 408 to 30.

**Systems Integration**

Increased reliability and reduced manpower requirements are the main benefits for automating material balance discrepancy calculations and communications with the PC. It increases operational flexibility, eliminates redundant field checks, and provides an integrated view of the entire system through a centralized monitoring system. The cost benefit ratio for this improvement is 1.02.

Implementation of an administrative lock program realizes a cost-benefit of 1.00. It is at a break-even point and therefore falls out of the more viable "priority" solution set. In addition, the modification to the preventive maintenance module that generates predefined checklists and other reports have a cost-benefit ratio of .98. It will take a considerable amount of time to establish and maintain the predefined reports but if the PMS continues in its present state for a number of years, it is worth considering for reducing the amount of time preparing for any transfer. However, if all the alternatives (including the priority solutions) were implemented, the cost-benefit ratio is a 2.28. There is no one alternative that sufficiently negates the viability of any one option. For this reason, the Team presented the solution alternatives for future consideration.

**Systems Integration****XI. IMPLEMENTATION**

Implementation of the "to-be" has already begun with the development of a reusable checklist as a modification to the procedures. There are a number of independent activities ongoing for challenging requirements in the AB and the Team recommends that better coordination occur to minimize the costs of various studies and to integrate responses and tasks associated with performance expectations. Appendix G provides a detailed plan for the implementation of

|  | Fully Implemented by |
|--|----------------------|
| • Reducing the number of operability and non-required checks | Jun 2000             |
| • Expanding Shift Manager authority                          | May 2000             |
| • Taking credit for what Operations personnel knows, and     | Jun 2000             |
| • Challenging the AB for multi-valve isolation               | Mar 2001             |
| • Simplifying procedures                                     | May 2001             |

The Team expects to contribute to other related activities to provide details of realized gains and coordination of effort. Not reflected in the schedule is the immediate need to present the results of this process improvement activity to senior management. The sponsor presentation will be given January 1999 with expected follow-on meetings to share results and plans with senior management.

The Team has also developed a communication plan (see Appendix I) to keep the momentum of their effort going.

**Systems Integration****XII. CRITICAL ASSUMPTIONS AND RISK ASSESSMENT**

The following assumptions were made by the AZ-101 Team:

1. Planned upgrades will be in place by 2004.
2. Recent ORR will have been performed and approved prior to first batch transfer.
3. For computing total transfer times pre-transfer operability checks were conducted serially.
4. Coordination with NS&L is essential for the success of the "priority" solution set.
5. Communication with Operations personnel must be ongoing, timely and informative.
6. NCOs are well trained and capable of performing transfers.
7. Empowered Shift Managers and Operations personnel will contribute to ownership of work and greater efficiency/productivity.
8. For the Monte Carlo simulation, multiple transfers are performed in series and in the same manner and therefore look alike on a P3 schedule.

**Monte Carlo Explained:**

After completing the proposed AZ-101 transfer procedure, the team had a Monte Carlo analysis performed on the "As-Is" and "Proposed" (improved) P3 process schedules based on the worst case scenario for the first batch transfer to BNFL (Note: Worst case here refers to the expected worst case for the 1<sup>st</sup> transfer following an ORR or normal operating conditions). The Monte Carlo analyses were performed using a P3 add-on software package. Modifications were made to the schedules to simulate possible loops in the procedures (e.g., many failed checks require operators to restart the procedure from an earlier point or initiating a USQ screening for a change to a procedure). The simulation used the following input:

- The probability of an event occurring (as estimated by operators and shift management)
- The minimum duration of the event (as estimated by operators and shift management)
- The expected (average) duration of the event (as estimated by operators and shift management)
- The maximum time of the event (as estimated by operators and shift management)
- A minimum of 500 simulation runs are performed per analysis

A Monte Carlo analysis performs calculations on each event of the process in order. For each event, it determines if the event occurred (for this run) by using the events probability of occurring and a randomly generated number. Many events must occur. If the event was determined to have occurred, the duration of the event is manufactured by using the triangular distribution constructed from the minimum, average, and maximum expected durations and a randomly generated number. This is performed for every event in the process. Once the run is completed, the durations are summed to give a total time for the process for that run. By performing many runs, a distribution representing the range of possible values for the process time is estimated. Since there are over 700 steps in the transfer process, the likelihood that the Monte Carlo calculated the actual shortest possible run time is almost zero. The shortest run duration would require selecting events that optimize activities based on the minimum duration for each event, then using the minimum duration for each event. The same is true for the longest possible duration.

To estimate the number of transfers expected to occur during a 30-day window, durations for 5%, 50%, and 95% probability were obtained from the "As-Is" and "Proposed" process simulation data. This information was used to develop a new distribution triangle for each process. Each distribution was the repeated 2, 3, and 4 times to run simulations for 2, 3, and 4 transfers.

**Systems Integration****XI. CONCLUSIONS AND FURTHER RECOMMENDATIONS**

The AZ-101 Team was chartered to provide Operations and Maintenance with a detailed AZ-101 batch transfer process view. We were charged with determining the vulnerabilities and potential improvement opportunities that can be addressed and to develop a plan of action. This business case has provided a detailed transfer process view (Appendix B) of the "As-Is" process. Several Primavera Software (P3) schedules have been produced that reflect changes that would affect the "as-is" process. A detailed listing of the equipment verification checks and functional/calibration checks has been developed. These products satisfy the deliverable for a detailed transfer process view.

This business case has given evidence to support vulnerabilities in the planned AZ-101 batch transfers. These vulnerabilities include:

- Potential \$2.5M daily fine if Privatization does not have
  - Timeliness of waste
- RAM analysis states a 10.8% chance of incurring the penalty for the 30 days transfer window
  - Assumes pre-transfer checks do not contribute to the schedule delay risk for incurring penalty cost
  - Does not include operational checks (it fixed the setup time for transfers to 5 days)
- 439 equipment operability checks are unmanageable
- Conservative interpretation for equipment checks
  - Checks are done in an inefficient manner
  - Checks are performed that are not required
- Cumbersome procedures
  - PCA process for USQ screening creates false starts
  - Lengthy sections of the procedure are difficult to read and follow
- AB requirements
  - Interpretation is based on a risk averse culture.

This business case supports the deliverable to identify vulnerabilities and potential improvement opportunities. The AZ-101 HLW batch transfer to the PC, scheduled to begin in 2004, is in jeopardy without modifications to the AB and our interpretation of the AB requirements through administrative controls. A risk averse culture cannot support the planned transfer. We need to take credit for built-in redundancies of our systems to reduce the setup time for the transfer. In addition, we need to take credit for what Operations personnel knows through expanded use of the routing board and a newly designed status board. We need to empower the shift operations personnel to efficiently execute the transfer and preparations for the transfer without jeopardizing the health and safety of the worker or environment.

Best practice dictates simplicity of operations and for our purposes must include better design of procedures, automation where practical and possible, and reliance on remote readings. The "priority solutions" solution set will minimize the schedule risk. There is a possibility that the 30-day window will be extended to 60 days, which will also reduce the schedule risk. However, improvements outlined in this business case will support a number of current transfer operations and ensure the best possible outcome for the AZ-101 batch transfer to the PC.

***Systems Integration***

The final deliverable, the implementation plan, is found in Appendix H. In addition, the communication plan, Appendix I, provides guidance on how to sustain the message and demonstrate improvements that will reduce the schedule risk associated with the AZ-101 batch transfer.

For further consideration, the AZ-101 recommends the following process improvements that were of lower priority to the team but could provide incremental benefits over time:

- Preparing preplanned work packages for critical equipment
- Installing better valves to reduce the chances of failed equipment
- Schedule a maintenance rapid response team during transfers
- Clean up the AZ farm (already proposed for W-314 project) to reduce the time entering and exiting the farm.

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## Acronyms and Abbreviations

|      |  |
|------|--|
| AB   | Authorization Basis                            |
| ALC  | Air Lift Circulator                            |
| ANSI | American National Standards Institute          |
| BNFL | British Nuclear Fuels, Limited (Privatization) |
| CAM  | Continuous Air Monitor                         |
| CCTV | Closed Circuit Television                      |
| DOE  | Department of Energy                           |
| DST  | Double Shell Tank                              |
| ECR  | Effective Cleaning Radius                      |
| FSAR | Final Safety Analysis Report                   |
| HEGA | High-Efficiency Gas Absorber                   |
| HEME | High-Efficiency Mist Eliminator                |
| HEPA | High-Efficiency Particulate Air                |
| HLW  | High-Level Waste                               |
| ICD  | Interface Control Document                     |
| ISMS | Integrated Safety Management System            |
| LAW  | Low Activity Waste                             |
| LCO  | Limiting Conditions of Operation               |
| LCS  | Limiting Control Set-point                     |
| MBD  | Material Balance Discrepancy                   |
| MPS  | Master Pump Shutdown                           |
| NCO  | Nuclear Chemical Operator                      |
| O&M  | Operations and Maintenance                     |
| OPC  | Operator Personal Computer                     |
| OSD  | Operating Specification Document               |

**Systems Integration**

|         |                                     |
|---------|-------------------------------------|
| PC      | Privatization Contractor            |
| PDF     | Project Definition Form             |
| PMS     | Preventive Maintenance System       |
| RAM     | Reliability and Maintenance         |
| RE      | Requirements Engineering            |
| RPP     | River Protection Project            |
| SHMS    | Standard Hydrogen Monitoring System |
| SR      | Surveillance Requirement            |
| SSP     | Suspended Solids Profiler           |
| TOC     | Total Organic Compounds             |
| TSR     | Technical Safety Requirement        |
| URSILLA | Ultrasonic Interface Level Analyzer |
| VFD     | Variable Frequency Drive            |
| WCA     | Waste Compatibility Assessment      |



## Project Definition Form

Procedure Name: AZ-101 Batch Transfer to BNFL Process

Date: 7/27/99

### OBJECTIVE

Reason for the Project: Old and new systems (and processes) installed or being installed by retrieval projects to support feed delivery to Privatization (BNFL) need to be analyzed to ensure we can deliver feed with a high-confidence level. In addition, there is a substantial potential penalty (~\$2.5M per day) for not being able to transfer waste feed to BNFL as scheduled.

Objective Statement: To provide operations and maintenance with a detailed AZ-101 batch transfer process view to include vulnerabilities, potential improvement opportunities, and an implementation plan.

Expectations: 1) Deliver a detailed graphical process flow; 2) Deliver a summary document with activity duration, major equipment requirements/checks, risks analysis, key decisions, resource analysis, and required documentation with recommended improvements.

### BOUNDARIES

Start Point: Start of mixing operations, equipment functionality and transfer operations of AZ-101 feed to remobilize solids

End Point: Completed transfer procedure; complete batch transfer of AZ-101 HLW feed to Privatization (BNFL)

Departments Involved: Retrieval Operations Support, Facility Operations, Retrieval Engineering, Shift Operations, Maintenance and Operations, Engineering, ESH&Q (I&SH), BNFL, RadCon, ORP, RPP

Systems/Records Involved: Planned approved upgrades by project W-314, W-521;  
Existing transfer procedures and draft AZ-101 mixer pump operation procedure;  
Proposed transfer system drawings;  
Maintenance and Operations concepts  
Material Balance calculations and appropriate, related equipment

### APPROVALS:

#### Team Members/Functions

Gary Duncan, Team Lead  
Mike Sutey, Facility Operations Manager (Transfer)  
John Bailey, WFD Engineer (NHC)  
Steve Kelly, TWR Program Office Engineer  
Yvonne Huffman, Nuclear Process Operator  
Donald Jones, Nuclear Process Operator

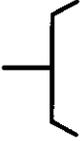
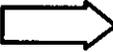
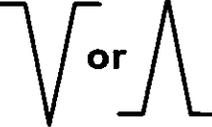
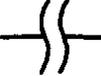
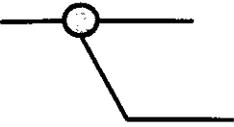
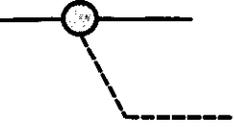
Project/Team Leader

  
Gary Duncan

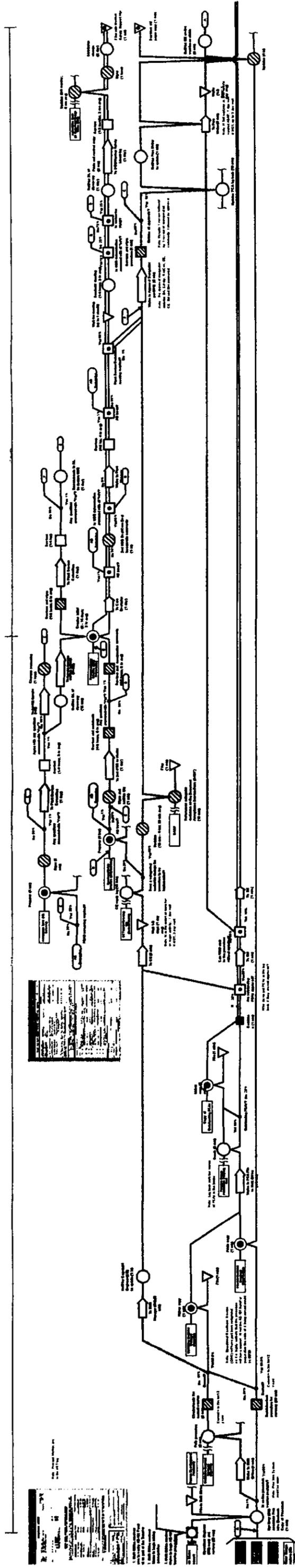
Project Sponsor

  
Ryan Dodd

**APPENDIX B**  
**AZ-101 Batch Transfer to PC**  
**ANSI Y 15.3m Symbology and "As-Is" Process Flow**

| <b>Requirements Engineering</b>  |   |
|--|---|
| <b>Symbols</b>   | <b>Conventions</b>  |
|  <b>Label</b>             |  <b>Destroy</b>           |
|  <b>Originate</b>         |  <b>Combine or Attach</b> |
|  <b>Process</b>           |   |
|  <b>Modify</b>            |  <b>End</b>                |
|  <b>Inspect</b>          |  <b>Bypass</b>            |
|  <b>Inspect/Modify</b>  |  <b>Separate</b>        |
|  <b>Inspect/Process</b> |   |
|  <b>Transportation</b>  |  <b>Effect</b>          |
|  <b>File/Delay</b>      |   |
|  <b>Time Passes</b>     |  <b>Alternate Path</b>  |
|  <b>Decision</b>        |   |
|  <b>Continue Left</b>   |  <b>Alternate Path</b>  |
|  <b>Continue Right</b>  |   |

Requirements Engineering  
AZ-101 Batch Transfer to BMT, Process Flow

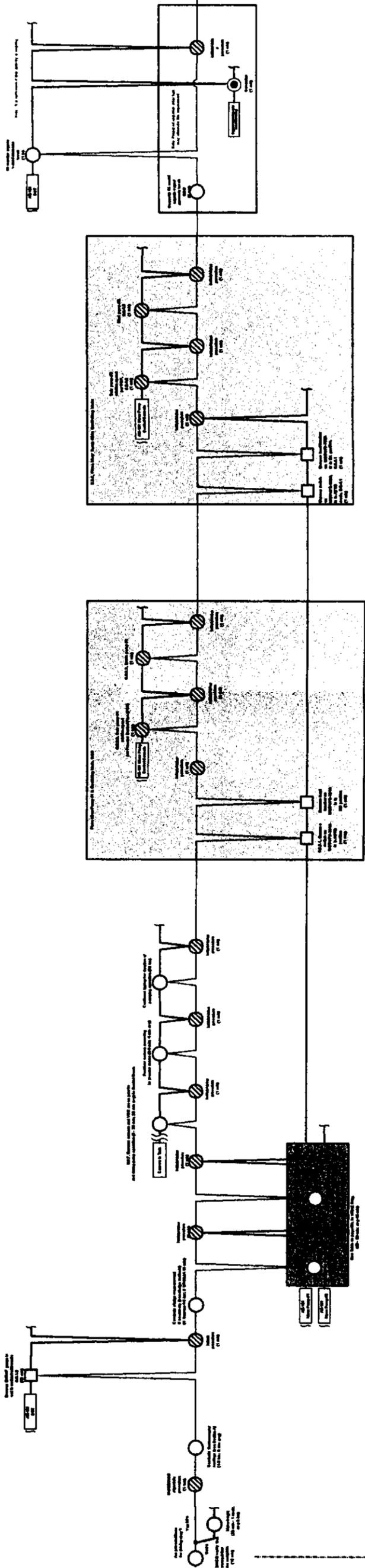
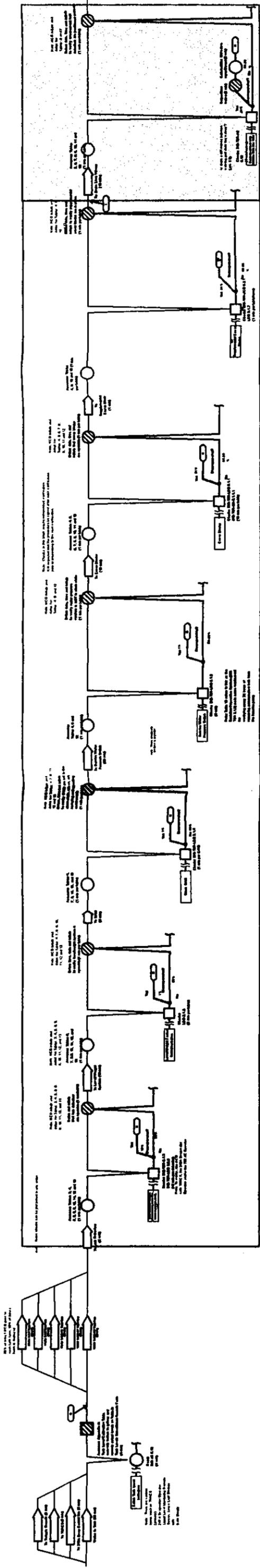


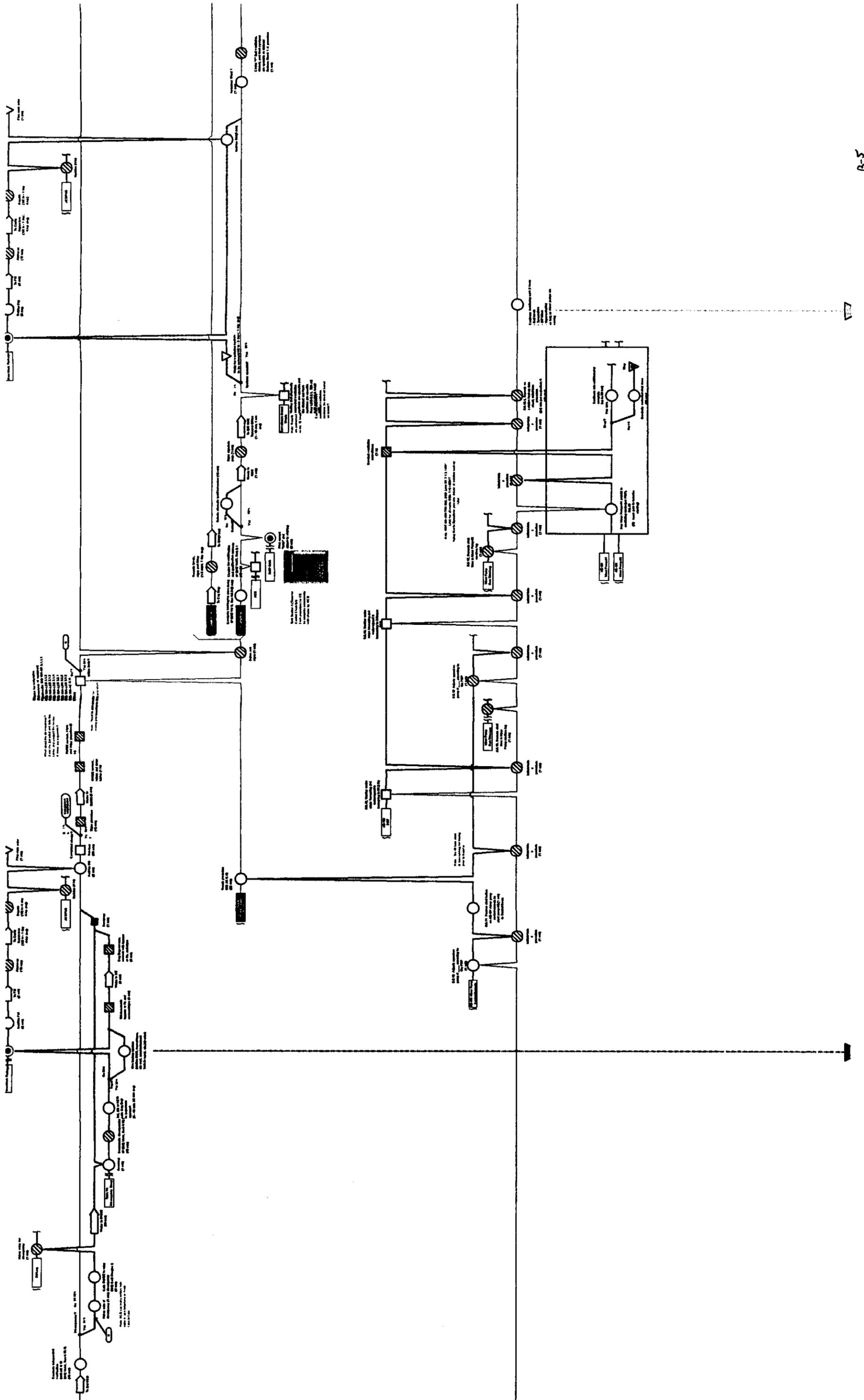
| Equipment | Notes                  |
|-----------|------------------------|
| Pump 101  | Capacity: 100 GPM      |
| Pump 102  | Capacity: 100 GPM      |
| Pump 103  | Capacity: 100 GPM      |
| Tank 101  | Capacity: 1000 Gallons |
| Tank 102  | Capacity: 1000 Gallons |
| Tank 103  | Capacity: 1000 Gallons |

| Equipment | Notes                  |
|-----------|------------------------|
| Pump 104  | Capacity: 100 GPM      |
| Pump 105  | Capacity: 100 GPM      |
| Tank 104  | Capacity: 1000 Gallons |
| Tank 105  | Capacity: 1000 Gallons |

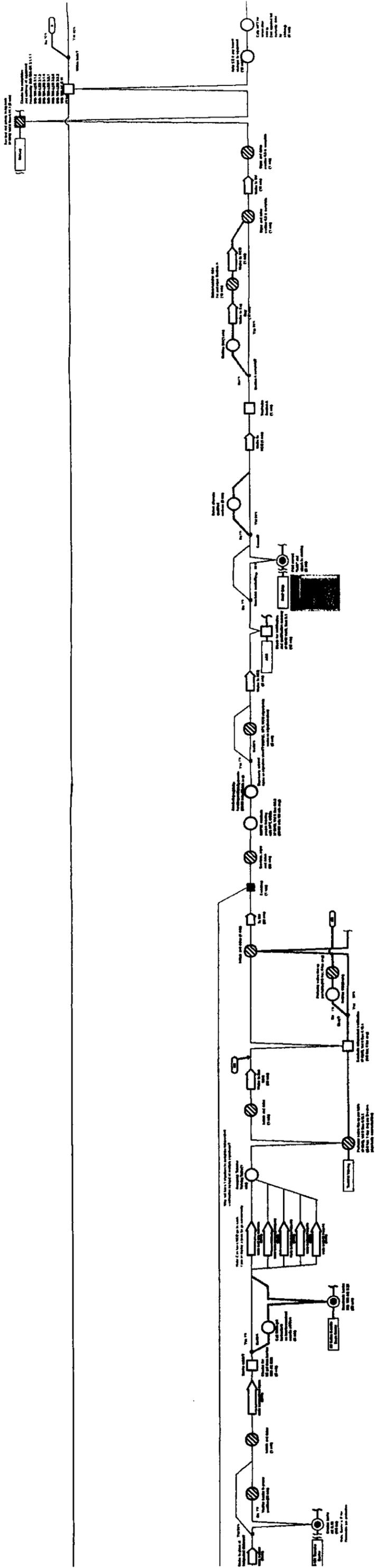
| Equipment | Notes                  |
|-----------|------------------------|
| Pump 106  | Capacity: 100 GPM      |
| Pump 107  | Capacity: 100 GPM      |
| Tank 106  | Capacity: 1000 Gallons |
| Tank 107  | Capacity: 1000 Gallons |

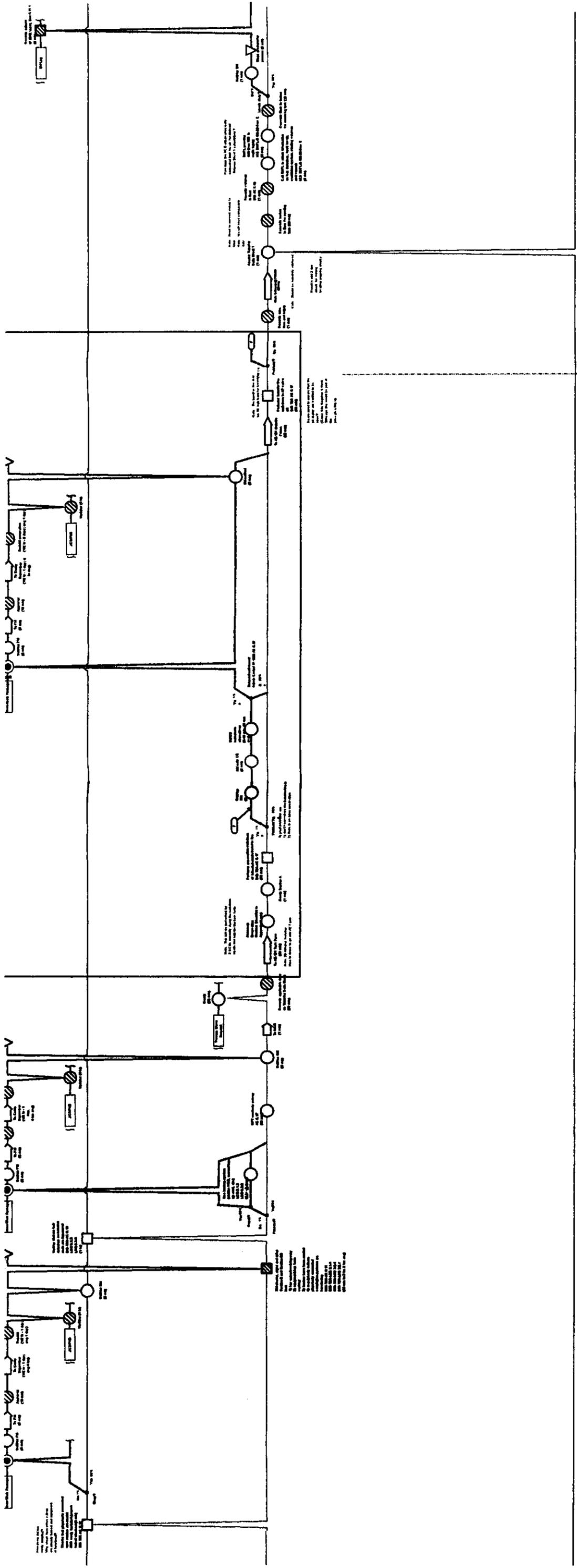


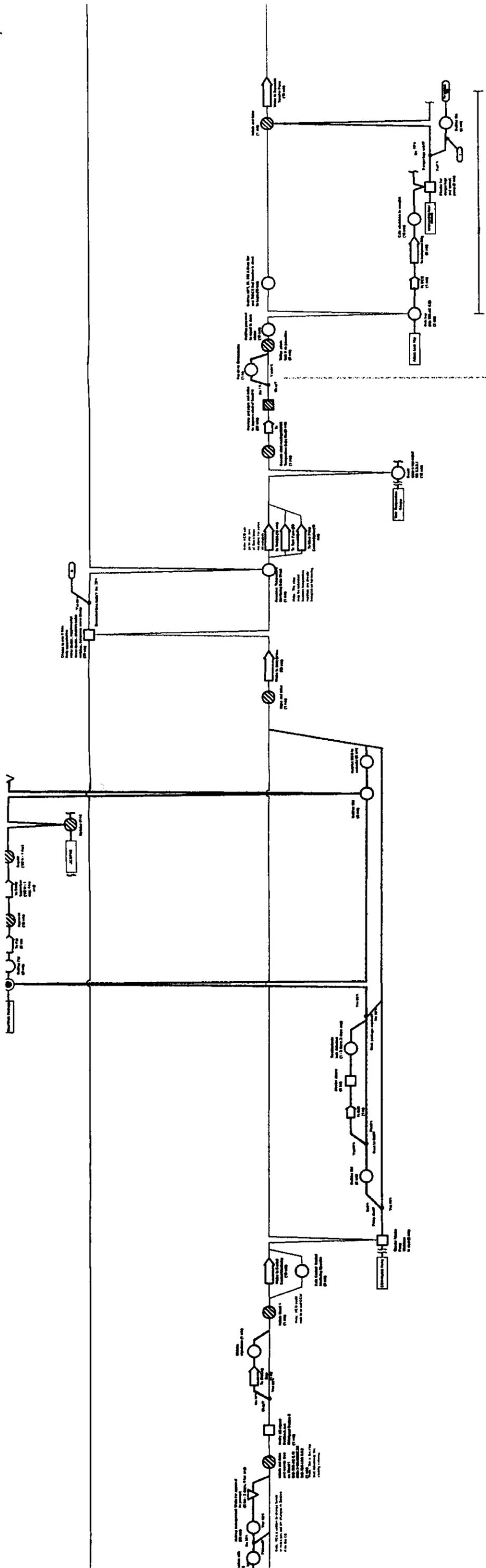


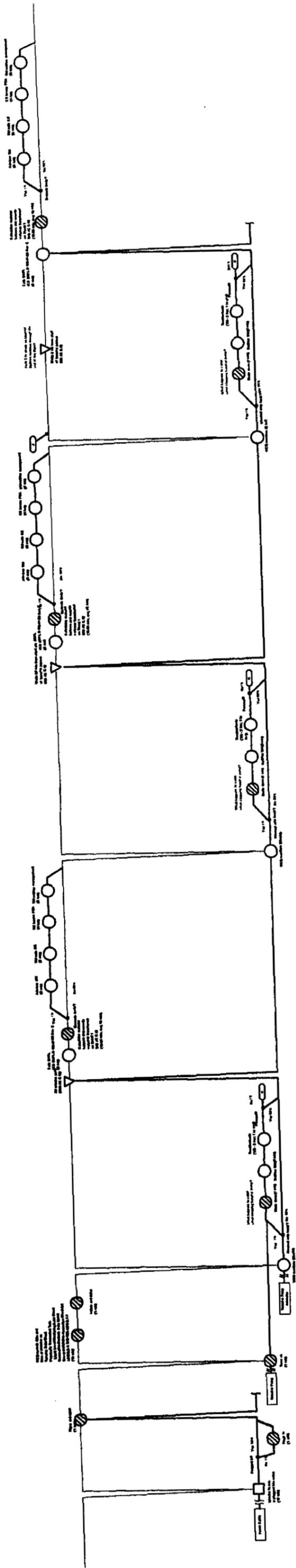


RPP-5560 Rev. 2

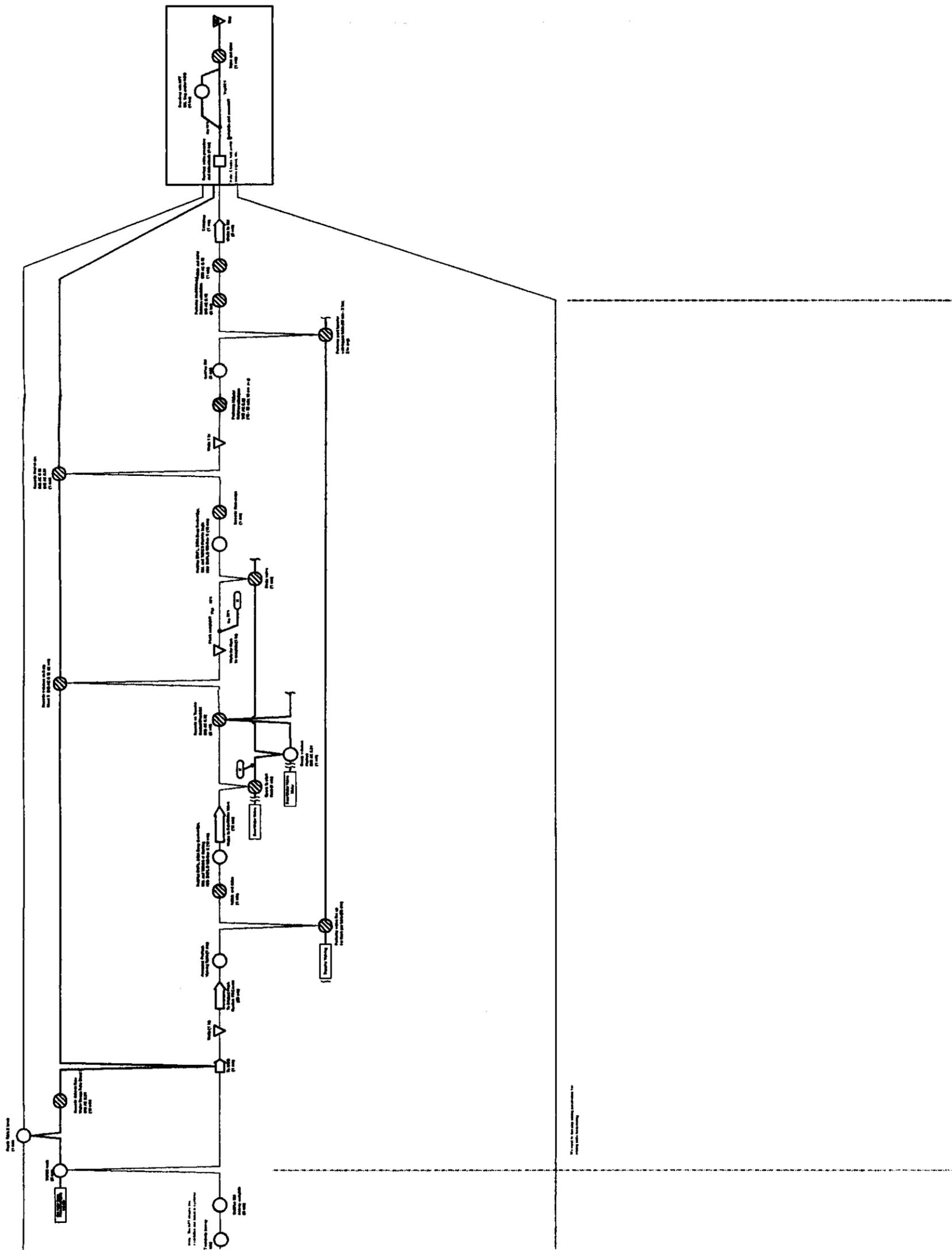












## APPENDIX C

### MONITORING EQUIPMENT, CONTROL FUNCTIONS AND PROCESS

#### *C.1 Tank Liquid Level*

The tank liquid level is measured during waste storage operations to establish a volume baseline before transfer operations and, when applicable, to ensure that the airlift circulators are covered and remain operational in the event high waste sludge temperatures need to be mitigated. Liquid level measurements in Tank AZ-101 are currently taken with the ENRAF liquid level-monitoring instrument. As a backup to the ENRAF instrument, tank liquid level can also be measured with a manual tape instrument. Minimum tank liquid-level requirements are generally not applicable during waste feed operations since the overall mission is to remove the waste from the tank. However, if the airlift circulators are used as a means of mitigating high waste temperatures, minimum liquid levels are required to submerge the air lift circulators (ALC) to keep them operable.

#### *C.2 Tank Leak Detection*

Leak detection instrumentation must be monitored throughout all phases of the HLW feed delivery process to alert operators of the presence of waste in the primary tank liner. Primary tank leak detection is performed by use of a continuous air monitor (CAM) in the annulus ventilation system, or by conductivity probes mounted in the tank annulus.

#### *C.3 Tank Ventilation*

Operation of the primary tank ventilation system is required for mitigation of both flammable gas building and tank over-pressurization as a result of flammable gas deflagration and "tank bump". In addition, the ventilation system maintains a negative pressure in the tank vapor space for containment and provides cooling. The primary process control strategy for verifying ventilation system operation is to monitor tank vapor pressure to ensure that it is less than zero inches on the water gauge. The ventilation system operation can also be verified by monitoring the airflow rate using airflow meters.

#### *C.4 Mixer Pump*

The two mixer pumps are relatively large 300-hp, single-stage, long-shaft, dual discharge centrifugal pumps. At maximum flow 10,400 gallons per minute with a jet velocity of about 60 ft/sec. At this flow, the pumps can theoretically "turnover" a million-gallon tank in less than two hours. The pumps operate from speeds of 700 rpm to a maximum speed of around 1,200 rpm. Each pump has two opposing submerged jets that discharge 180 degrees apart and approximately 18 inches above the tank bottom. The pumps can also be rotated at various speeds for 180 degrees in either direction about their vertical axis. The rotation speed is variable from 0.2 rpm to 0.5 rpm.

The mixer pump position is displayed on the control console in the AZ-156 building. Mixer pump operations will be monitored through a monitoring and control panel located in the AZ-156 building. Monitored parameters include pump column water pressure, pump column supply filter differential pressure, and motor-bearing temperature. Operation of the mixer pumps is controlled by variable frequency drives (VFD), also located in the AZ-156 building, which will indicate pump speed, frequency, current, and voltage.

#### *C.5 In-Tank Component Structural Integrity*

Tank AZ-101 contains several components within the tank that are supported from the tank dome and hang in the tank. These components include airlift circulators, dry wells, thermocouple assemblies, and a steam coil assembly.

**Requirements Engineering**

APP-5560, Rev. 2

The process control strategy for assuring the integrity of in-tank components during mixer pump operations is to monitor the components using a CCTV, and adjust mixer pump operation as required. If it is determined through monitoring that the structural integrity of a component is in question, mixer pump operations will be altered. Options for mixer pump operations include 1) running one pump instead of two, 2) "indexing" the pump so that the jet does not impinge directly on the component, 3) running the pump(s) only in the fixed mode, or 4) reducing the pump speed while passing the component.

**C.6 Tank Waste Temperatures**

Waste temperatures in Tank AZ-101 will increase due to the operation of the mixer pumps and/or the increased radiolytic heat load. It has been estimated that the mixer pumps will add heat at the rate of 0.15 °F for a full tank. The temperature of the slurry is predicted to be around 82°C (180 °F) after five days of operation with one mixer pump. The waste temperature will continue to rise after the mixer pump(s) has been turned off due to the sludge layer being fluffed.

During retrieval operations, tank waste temperatures and insulating concrete temperatures will be monitored. The observed temperatures will be correlated with heat balance data provided by the ventilation system airflow rates. From these measurements, steady state temperatures can be predicted and compared with the temperature limits, and the expected thermal behavior, as the retrieval progresses.

**C.7 Transfer Pump**

The transfer pump will be a vertical turbine-type stick pump, capable of transferring the waste from Tank AZ-101 to the PC facility at a maximum rate of 530 L/min (140 gpm). The pump unit will be driven by a VFD-controlled electric motor. The VFD controls pump rotation speed and reports pump rotational speed and amperage to the AZ-156 building control console. Pump speed and motor amperage are used in conjunction with other data to 1) verify that the pump is operating properly and 2) evaluate whether the transfer is going as expected.

The pump shall be capable of "in-line dilution," which allows the waste feed to be diluted during the pump operation. The pump will also be capable of "in-tank" dilution, which allows the addition of diluent directly to the tank. The transfer pump suction will be located as near as possible to the tank floor to allow for maximum retrieval of the waste.

**C.8 Process Transfer Jumper**

A process transfer jumper will be installed in the 241-AZ-01A pump pit for the purpose of directing the pump discharge flow to the transfer line or re-circulating it back into the tank, and providing in-tank or in-line dilution. Switching between the various modes, such as between transfer and recirculation modes, is accomplished through a three-way electric motor-operated valve. Instrumentation contained in the process jumper described below will monitor and control flow.

1. **Magnetic flow meter with low and low-low flow alarms.** This meter measures the volumetric flow rate of waste near the pump outlet. The data is used as a basis for setting pump speed and the diluent flow set point. It also provides material balance, flow rate and troubleshooting data to verify that the system is operating as expected.
2. **Pressure indicator transmitter near the pump outlet with high-high, high, low, and low-low pressure alarms.** This instrument provides troubleshooting and system operation data to verify that the system is operating as expected.
3. **Mass flow meter reports flow, stream density, and flow stream temperature.** The flow rate function provides verification of the magnetic flow meter data. The flow rate measurement function is used to set transfer flow rates. It provides the basis for establishing the diluent addition set point. The temperature indicator allows temperature compensation of density and viscosity estimates and shows that the system is working as expected.

**Requirements Engineering**

RAP-5560 Rev. 2

4. **Valve position indicators.** Valve position indication will be provided and displayed in the control room.

*C.9 Transfer Pipe and Pit Leakage*

Transfer pipes and transfer pits are required to have leak detection capability to determine a pipe or jumper leak or to determine misroutings. The AZ-01A pit has a separate leak detector with an alarm function, in addition to a four-inch pit drain. The leak detector is designed to detect any leak in the pit from a variety of sources, including transfer lines, new AZ transfer pit, transfer pump, and transfer pit jumper manifolds. If the leak detector alarms, the retrieval operation will enter a controlled shutdown. There are 4 Pit WF leak detectors planned (or in place) for the AZ-101 transfers.

A new waste transfer system installed by the W-314 Project will be used for transferring HLW feeds within the tank farms for staging and to the PC for processing. In the current HLW feed processing alternatives, wastes from other HLW feed tanks will be transferred to Tank AZ-101 via the SN-632 line.

*D.10 Diluent and Flush System*

The diluent and flush system can provide hot caustic water either to the suction of the transfer pump for in-line dilution, or the discharge of the pump for transfer-system flushing. The system is designed to deliver hot caustic solution at the same flow rate as the transfer pump 140 gpm.

**APPENDIX D  
AZ-101 Requirements Table**

Last Printed: 12/14/99  
Last Updated: 11/19/99

RPP-5560 Rev.2

| Procedure ID      | TYPE | Class | Description | Topic                                    | Requirement   |
|-------------------|------|-------|-------------|--|---|
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.1   | Cover blocks                             | Transfer system covers shall be OPERABLE.<br>VERIFY covers are OPERABLE. Once within 72 hours prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump AND Once per 10 days thereafter.     |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.1.1  | Cover blocks                             |   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.2   | Service water pressure detection systems | Service water pressure detection systems shall be OPERABLE.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.2.1  | Service water pressure detection systems | VERIFY service water pressure detection systems are OPERABLE. Once within 72 hours prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.2.2  | Service water pressure detection systems | Perform FUNCTIONAL TEST on the service water pressure detection systems and VERIFY a setpoint of $\leq 20$ psi on increasing pressure. Frequency 365 days.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.3   | Leak Detection                           | Transfer leak detection systems shall be OPERABLE.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.3.1  | Leak Detection                           | Perform FUNCTIONAL TEST on conductivity probe transfer leak detection systems. Once within 92 days prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump AND Once per 92 days thereafter |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.3.2  | Leak Detection                           | Perform FUNCTIONAL TEST on the weight factor leak detection systems used in AWF leak detection pits. Once within 182 days prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump          |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.4   | Ventilation                              | AND Once per 182 days thereafter<br>Ventilation Stack CAM Interlock Systems shall be OPERABLE   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.4.1  | Ventilation                              | Perform a FUNCTIONAL TEST on the ventilation stack CAM interlock and VERIFY the interlock is OPERABLE with a setpoint < 10,000 cpm. Frequency 92 days.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.4.2  | Ventilation                              | Perform a CALIBRATION on the ventilation stack CAM interlock loop. Frequency 365 days.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.6   | Service water backflow detection systems | The 204-AR Waste Unloading Facility backflow prevention system in the Waste Unloading Area shall be OPERABLE.   |

**APPENDIX D**  
**AZ-101 Requirements Table**

Last Printed: 12/14/99  
Last Updated: 11/19/99

RPP-5560 Rev. 2

| Procedure ID      | TYPE | Class | Description | Topic                                    | Requirement  |
|-------------------|------|-------|-------------|--|--|
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.6.1  | Service water backflow detection systems | VERIFY that the 204-AR Waste Unloading Facility backflow prevention system is OPERABLE.. Once within 72 hours prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump.                    |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.1.6.2  | Service water backflow detection systems | Perform FUNCTIONAL TEST on the 204-AR backflow prevention system.. Frequency 365 days.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.2.1.1  | Ventilation                              | VERIFY the active primary tank ventilation system is OPERABLE. Frequency 24 hours.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.2.6   | Leak Detection                           | One of the two primary tank leak detection systems listed below shall be OPERABLE. The annulus conductivity probe system. OR The annulus continuous air monitor (CAM) system   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.2.6.1  | Leak Detection                           | Perform FUNCTIONAL TEST on each primary tank leak detection system. Frequency 182 days   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.3.2   | Waste Temperature                        | The WASTE temperature shall be either: < 195F in all levels of the WASTE OR < 195F in the top 15 ft of the WASTE AND < 215F in the WASTE below 15 ft   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | SR 3.3.2.1  | Waste Temperature                        | VERIFY the WASTE temperature is either: 195 F in all levels of the WASTE. OR 195 F in the top 15 ft of the WASTE AND < 215 F in the WASTE below 15 ft. Frequency 10 days.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.3.4   | Tank 241-AZ-101 Air Lift Circulators     | The air lift circulators (ALCs) in aging waste facility (AWF) Tank 241-AZ-101 shall be OPERABLE at all times and operating when: Average WASTE solution temperature is > 190F AND WASTE temperature below 20 ft is > 230F. |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.3.4.1 | Tank 241-AZ-101 Air Lift Circulators     | Verify ALCs are OPERABLE and operating when 1. Average WASTE solution temperature is > 190F AND b. WASTE temperature below 20 ft is > 230F   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.3.4.2 | Tank 241-AZ-101 Air Lift Circulators     | Perform FUNCTIONAL TEST ON ALC's. Frequency 365 days   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.20     | Administrative Lock Program              | The administrative lock of a WASTE transfer pump is demonstrated by removing and securing the motive force from the pump (e.g., electrical power, steam, water, or air).   |

**APPENDIX D**  
**AZ-101 Requirements Table**

Last Printed: 12/14/99  
Last Updated: 11/19/99

RPP-5560 Rev.2

| Procedure ID      | TYPE | Class | Description | Topic             | Requirement  |
|-------------------|------|-------|-------------|-------------------|--|
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Establish and maintain controlled status of the WASTE transfer system as-built and jumper configuration  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Perform WASTE transfer system operations by approved procedures  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Isolate WASTE transfer paths connected to ACTIVE WASTE transfer pumps not under administrative lock by two closed valves (including 3-way valves), where the valves exist and where this practice is feasible. INDEPENDENTLY VERIFY the planned WASTE transfer route is proper for the intended transfer; piping is in place per configuration status controls; correct and OPERABLE pumps are specified; and valves are properly aligned prior to transfer. |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Open nozzles PHYSICALLY CONNECTED to jumpers shall be sealed with caps, process blanks, or equivalent to prevent misroutes of WASTE.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Newly installed jumpers shall be leak tested prior to use.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | 204-AR Waste Unloading Facility. VERIFY that the west exterior rollup door and the west exterior personnel access door are closed when the 204-AR Waste Unloading Facility is PHYSICALLY CONNECTED to an ACTIVE WASTE transfer pump not under administrative lock.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Material balance monitoring criteria based on planned WASTE transfer rates shall be documented. The transfer shall be stopped if periodic material balance calculations indicate a variance that exceeds the criteria.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Perform material balance calculations during each WASTE transfer through the WASTE transfer system. Calculations shall be performed at 30 and 60 minutes following WASTE transfer initiation and each 2 hours thereafter until the transfer is complete. This requirement does not apply to Waste Retrieval Sluicing System operations (Project W-320).  |

**APPENDIX D**  
**AZ-101 Requirements Table**

RPP-5569 Rev.2

| Procedure ID      | TYPE | Class | Description | Topic             | Requirement   |
|-------------------|------|-------|-------------|-------------------|---|
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | MONITOR for increasing level in all tanks (including catch tanks) PHYSICALLY CONNECTED to the WASTE transfer route, during WASTE transfer through a WASTE transfer system. MONITORING shall be performed at 30 and 60 minutes following WASTE transfer initiation and each 2 hours thereafter until the transfer is complete. This requirement does not apply to Waste Retrieval Sluicing System operations (Project W-320).                                |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | VERIFY that PHYSICALLY CONNECTED catch tanks which are not in the direct transfer route are < 50% full prior to WASTE transfer.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Perform WASTE transfers during excavation activities in accordance with AC 5.17, "Excavation Controls."   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Final Tank State Controls Application. Evaluate pumped and receiving tanks prior to WASTE transfers to ensure that controls for criticality, tank bumps, flammable gas deflagrations, organic solvent fires, and organic salt-nitrate reactions are applied to the final state of the tank. See also AC 5.15, "Moisture Controls."  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | Chemical Compatibility. Ensure chemical additions are pH of 8 prior to transfer into tank farms (excluding water additions and drums containing caustic chemicals).   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.12     | Transfer Controls | DST and AWF Tank Time to LFL Determination. VERIFY prior to any planned transfer(s) (including WASTE and other additions) into a DST and AWF tank, that the minimum time to reach 25% of the Lower Flammability Limit (LFL) for the tank vapor space, assuming loss of the primary tank ventilation, will remain 7 days, using the methodology contained in HNF-SD-WM-CN-117, Calculations of Hydrogen Release Rate at Steady State for Double-Shell Tanks. |

**APPENDIX D**  
**AZ-101 Requirements Table**

Last Printed: 12/14/99  
Last Updated: 11/19/99

| Procedure ID      | TYPE | Class | Description | Topic                         | Requirement  |
|-------------------|------|-------|-------------|-------------------------------|--|
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.13     | Encasement Seal Loop Controls | Program Key Element During WASTE transfers through a WASTE transfer system, all encasement seal loop drain line isolation valve associated with PHYSICALLY CONNECTED piping shall be in the "open", "drain", or "operate" position, as applicable to the particular valve to provide an open path.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.17     | Excavation Controls           | WASTE transfers are prohibited through lines uncovered by excavation activities unless compensatory controls are established (e.g., vehicle access limitations, concrete shielding system installed).  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.17     | Excavation Controls           | Prior to WASTE transfer and once per 24 hours during a transfer, VERIFY by surveying the WASTE transfer route that no excavation activities are in progress.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.18     | HEPA Filter Controls          | A program shall be maintained to limit the radioactive material inventories on high-efficiency particulate air (HEPA) filters and prefilters, high-efficiency gas absorber (HEGA) filters, high-efficiency metal filters (HEMFs), and high-efficiency mist eliminators (HEMEs) to protect the source term assumptions in the accident analyses. The program also ensures the capability of HEPA filters to mitigate the consequences of specific accident scenarios. |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.18     | HEPA Filter Controls          | VERIFY periodically that the HEPA filter and prefilter housing radiation level is < 200 mrem/h on contact. Replace the HEPA filters and prefilters before filter housing radiation levels exceed 200 mrem/h.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.18     | HEPA Filter Controls          | VERIFY periodically that the radiological dose contribution of the AWF 241-AZ-702 HEME housing radiation field is < 800 mrem/h on contact. Replace the HEME before housing radiation levels exceeds 800 mrem/hr.   |

**APPENDIX D**  
**AZ-101 Requirements Table**

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RFP-5500 Rev.2

| Procedure ID      | TYPE | Class | Description | Topic   | Requirement  |
|-------------------|------|-------|-------------|---|--|
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.18     | HEPA Filter Controls                            | Replace the AWF 241-AZ-702 HEPA filter before the upstream HEPA filter in the associated filter stream has been replaced 20 times. AND Replace the AWF 241-AZ-702 HEPA filter when the upstream filter in the associated filter train is determined to have a particular removal efficiency of , 99.95% by performance of an aerosol test, or other indication of degraded HEPA filter |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.20     | Transfer Pump Administrative Lock Controls      | The administrative lock of a WASTE transfer pump is demonstrated by removing and securing the motive force from the pump (e.g., electrical power, steam, water, or air).   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.21     | Tank Service Water Intrusion Monitoring Program | Monitor service water usage or tank levels every 24 hours to detect leaks. Monitoring service water usage requires reading each tank farm's flow totalizer to VERIFY that there has been no unaccounted for service water usage. Local inspection of the associated service pit or flush pit for leakage is also required when monitoring service water usage.                         |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.22     | Transfer System Cover Removal Controls          | Obtain management approval prior to removing a transfer system cover in accordance with this AC. Covers associated with structures PHYSICALLY CONNECTED to an ACTIVE WASTE transfer pump, not under administrative lock, and not controlled under this AC are required to be OPERABLE in accordance with LCO 3.1.1, "Transfer System Covers and Entry Doors."                          |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.22     | Transfer System Cover Removal Controls          | Provide continuous monitoring for WASTE leaks while covers are removed. Monitoring includes such methods as the use of continuous air monitors or other radiation monitoring devices near potential WASTE leak locations. See AC 5.20, "Transfer Pump Administrative Lock Controls."   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.22     | Transfer System Cover Removal Controls          | Establish procedures that identify required operator responses to the detection of a WASTE leak.   |
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.23     | Caustic Transfer Controls                       | Traffic barriers shall surround the carbon tank  |

**APPENDIX D**  
**AZ-101 Requirements Table**

APP-5360 Rev.2

| Procedure ID      | TYPE | Class | Description  | Topic                     | Requirement  |
|-------------------|------|-------|--|---------------------------|--|
| HNF-SD-WM-TSR-006 | TSR  | AB    | AC 5.23  | Caustic Transfer Controls | Polyethylene (or similar) sleeving around delivery piping  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.7  | Supplemental covers       | Supplemental covers shall be OPERABLE. VERIFY supplemental covers are OPERABLE. Once within 72 hours prior to removing an administrative lock from a PHYSICALLY CONNECTED WASTE transfer pump AND Once per 72 hours thereafter.  |
| HNF-SD-WM-TSR-006 | TSR  | AB    | LCO 3.1.7  | Supplemental covers       | Supplemental covers thereafter.  |
| OSD-T-151-00007   | OSD  | AB    | Unclassified Operating Specifications For The 241-AN, AP, AW, AY, AZ & SY Tank Farms | Liquid Level              | Minimum liquid level in AWT is 64 inches, when the annulus ventilation system is operating.  |
| OSD-T-151-00007   | OSD  | AB    | Unclassified Operating Specifications For The 241-AN, AP, AW, AY, AZ & SY Tank Farms | Liquid Level              | Maximum leak detection pit liquid level < 74 inches  |
| OSD-T-151-00007   | OSD  | AB    | Unclassified Operating Specifications For The 241-AN, AP, AW, AY, AZ & SY Tank Farms | Liquid Level              | Maximum encasement leak detection pit liquid level < 408 inches  |
| OSD-T-151-00017   | OSD  | AB    | Operating Specifications For Aging-Waste Operations                                  | Waste Temperature         | Maximum Solution Heat-up rate: for solution temp < 125/ F: <10/ F/h for solution temp > 125/ F: <3/ F/day or 24/ F/day provided the tank temperature is kept constant +3/ F for 8 days thereafter. Shutdown mixer pumps #1 and #2 if any of the following limits are exceeded: |
| OSD-T-151-00017   | OSD  | AB    | Operating Specifications For Aging-Waste Operations                                  | ALC's                     | Minimum level for operation of the Air Lift Circulators (ALC) is 306 inches for 22 ft ALC's and 246 inches for 17 ft ALC's   |

**APPENDIX D  
AZ-101 Requirements Table**

| Procedure ID                                 | TYPE | Class | Description   | Topic   | Requirement  |
|--|------|-------|---|---|--|
| OSD-T-151-00017                              | OSD  | AB    | Operating Specifications For Aging-Waste Operations                   | ALC's   | ALC's should supply a minimum total flow rate of 50 scfm of air to each active aging waste tank at all times. Period of downtime are allowed up to 20 hours cumulative in any 48 hour period   |
| OSD-T-151-00019                              | OSD  | AB    | Operating Specifications For The 241-AZ-702 Vessel Ventilation System | HEME (AZ-K1-9-1)  | Differential Pressure < 15.0 inches w.g.   |
| OSD-T-151-00019                              | OSD  | AB    | Operating Specifications For The 241-AZ-702 Vessel Ventilation System | ELECTRIC HEATERS (AZ-K1-2-1A and -1B)                     | Differential Temperature > 17F   |
| OSD-T-151-00019                              | OSD  | AB    | Operating Specifications For The 241-AZ-702 Vessel Ventilation System | HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS            | Differential Pressure < 6.0 inches w.g. across either the primary OR secondary filter  |
| OSD-T-151-00019                              | OSD  | AB    | Operating Specifications For The 241-AZ-702 Vessel Ventilation System | HIGH EFFICIENCY GAS ABSORBER (HEGA) (AZ-K1-10-1A and -1B) | Differential Pressure < 3.0 in. w.g.   |
| TWRS-P PROJECT ICD, BNFL-5-193-ID-20, Rev. C | ICD  |       | Pre-waste transfers checks  | Transfers   | Before initiating HLW batch transfer, Doe will contact BNFL facility manager for the following purpose: 1) Confirm leak detectors in the BNFL waste transfer line are operational, 2) Confirm liquid level and temperature instrumentation are operational in the HLW feed receipt vessels, 3) Confirm the ventilation system for the HLW feed receipt vessels is operational, 4) Obtain and record the starting volume of waste in the HLW feed receipt vessels, 5) Confirm the HLW feed receipt vessels are ready to receive the waste transfer. |

APPENDIX D

AZ-101 Requirements Table

Last Printed: 12/14/99  
 Last Updated: 11/19/99

RPP-5560 Rev. 2

| Procedure ID   | TYPE | Class | Description   | Topic                                   | Requirement   |
|--|------|-------|---|---|---|
| TWRS-P PROJECT ICD,<br>BNFL-5-193-ID-20, Rev. C      | ICD  |       | Flushing<br>Independent<br>Verification                                 | Flushing<br>Independent<br>Verification | Immediately following the transfer of the HLW feed batch, DOE will flush the transfer pipeline with a volume of inhibited water not more than twice the transfer line capacity. |
| HNF-IP-0842 Volume II,<br>Operations, Section 4.10.1 | COO  |       |   |   | Describes Actions Taken by Independent Verifier for Performance of Independent Verification   |
| HNF-IP-0842 Volume II,<br>Operations, Section 4.13.1 | COO  |       | Operational Aspects of<br>Facility Chemistry And<br>Technical Processes | Plant Control                           | Describes operations responsibilities   |

**APPENDIX E**  
**"As-Is" Process Analysis**

| Symbol/<br>Convention  | Number | Analysis/Comments   |
|------------------------|--------|---|
| Label                  | 69     | Labels represent various items in the process. The team opted to use a label for the type of equipment. Although only 9 types of equipment are listed for equipment and operability checks, there are 439 actual items that are checked (see Appendix I for details). The remaining 60 labels represented systems, barriers, and other equipment used in the process that is not checked as part of the TO-025-005 equipment verification procedure.  |
| Originate              | 21     | Origination represents items that were created in the process. There were 21 new items created during the process of which 8 were the creation of a new work package to repair or replace an item found to be out of calibration, faulty or non-functioning. Other items created were USQ screenings, PCAs and hard copies of the on-line procedures.   |
| Handling/<br>Process   | 175    | Items handled or processed most often add little value to the process because they do not change the item. However, in most cases, the transfer process involves monitoring equipment, gauges and systems. All other process steps involved contacting an individual to notify them of the status of an item.   |
| Modify/Add<br>To       | 167    | Modify or add to process steps change an item in the process. The critical element to consider is if the change is necessary and if so, what drives the change. Of the 167 modify symbols, 72 of these steps were to either initial the procedure (51 total) that a check or step had occurred or to sign off (21 total) a section of the procedure by either the Shift Manager or the NCO. Although it is good practice to note what has been done, there is a lot of time spent initialing and dating the procedure.  |
| Inspection             | 46     | Inspections comprise a review or check of some equipment and usually follow with a decision as to the condition of the check. These steps add value so long as they are not redundant checks.   |
| Inspect/<br>Process    | 11     | All of these steps were a review of an item that did not lead to any change in the item. It represents other individuals who get involved in a process that do not necessarily add value to the process but can stretch out the schedule while waiting for a response.  |
| Inspect/<br>Modify     | 5      | All of these signatures were for review and final authorization for an item to be implemented. In these steps, most often the Shift Manager and/or the Nuclear Chemical Operator (NCO) were reviewing the work they had accomplished and were signing the procedure to release work or to attest that the work had been completed.  |
| Transportation         | 103    | The transportation symbol identifies the number of trips taken from one location to another or hand-offs from one person to another. At various stages of the process, a transportation symbol identifies the NCO travelling back to the Shift Office to obtain a signature for some portion of the procedure. There are a significant number of trips that are taken to obtain signatures and it was determined that the procedure does not reflect the actual method for collecting signatures. The NCO will try to do as many checks and activities in the field before returning to the Shift Office to obtain the Shift Manager's signature but the procedure is not written to reflect that practice. Each trip to the AZ Farm adds time (40 minutes on average per trip) to don protective clothing to enter the farm. |
| File/Delay/<br>Storage | 25     | File, delay and storage steps add time to the process or close out an item indefinitely. There were 8 opportunities to generate Job Control System work packages due to calibrations expiring, failed or faulty equipment, or other miscellaneous reasons that added days up to weeks to the schedule. The  |

| Symbol/<br>Convention | Number   | Analysis/Comments  |
|-----------------------|----------|--|
|                       |          | remaining number were attributed to storing an original copy in its designated location or indicating the process stopped due to something going out of scope of the process.  |
| Decision              | 86       | Decisions can alter the length it takes to complete the process. Half of the decisions were asked as a result of performing an inspection. Four decisions were based on exceeding limits after completing the material balance discrepancy calculation. Twenty-two decisions could create delays or stoppages of the transfer due to exceeding limitations. Other decisions were based on a need for rework.               |
| Combine               | 3        | The combine convention brings items in the process together. It was used to bring Section A of the transfer procedure back into the bulk of the procedure after the Cognizant Engineer checks the transfer data and appropriate equipment configurations. The combine symbol was also used in the final review of the procedures during the close out of the transfer.   |
| Separate              | 1        | The separation convention breaks apart an item to follow separate, but parallel paths. There were few separations of documents however, each time equipment or functionality checks were needed, the procedure could have been separated out to deploy a team of NCOs to go to the appropriate tank farm instead of using just one NCO to complete the check for timeliness and efficiency.                                |
| Correction/<br>Rework | 43 paths | A dotted line is used for correction and rework. Potential delays can be avoided where rework is eliminated. Twenty-two of the 43 correction/rework paths caused delays up to 1 day due to problems found out in the field. The remaining 21 rework symbols were due to duplications caused by expired calibrations, equipment and functionality checks that could cause schedule delays up to 5 days for each occurrence. |
| Effect                | 187      | The effect convention represents the dependency and complexity of the process steps in relation to each other. Most of the 187 effects represent actions that have a precursor that initiates the next step.   |

**APPENDIX F  
Benchmarking Gap Analysis**

| Best Practice   | Gap   | Opportunity   |
|---|---|---|
| <p><b>Best Practice 1:</b> Take 1-2 hours routinely to complete equipment verifications and pre-transfer checks.</p>  | <p>3-5 days</p>   | <p>Begin or continue to allow the Shift Manager to conduct a transfer, as long the equipment does not exceed its surveillance requirement extension for the duration of the transfer.</p>   |
| <p><b>Best Practice 2:</b> Utilize remote system indications, reliable preventive maintenance program, and routine surveillance readings to verify equipment operability.</p> | <p>Our process requires field operability checks when there is no indication via operator rounds or a remote alarm that the system is not operable.</p> <p>Our process first ensures that the safety-related equipment SR are current and second, verifies the system is operable by verifying related transfer equipment alarms that are not usually activated from a remote location.</p> | <p>Take credit for operator rounds information, shift operator turnover logs, and equipment being remotely monitored. Track pit-cover-block operability status on a status board.</p> <p>Verify operability prior to removing administrative lock based on the status board (i.e. routing board).</p> <p>Eliminate the requirement for field operability checks. This would allow field checks to be considered for equipment that cannot be verified clear of alarms from a remote location.</p> |
| <p><b>Best Practice 3:</b> Install safety equipment performing a safety function that addresses requirements of the authorization basis.</p>                                  | <p>Our process does not take credit for the safety function of the Master Pump Shutdown (MPS) system.</p>   | <p>Improve functional test procedures and conduct analysis, assuming we will be operating a greatly improved transfer system with a safety class MPS system with the planned update to the FSAR for this year.</p> <p>Take credit for the MPS safety functions and the increased reliability of the transfer system to relax some of the operationally burdensome FSAR AC requirements that are currently in place.</p>   |
| <p><b>Best Practice 4:</b> Use the preventive maintenance system (PMS) for verification of equipment and operability in lieu of field operability checks.</p>                 | <p>Conduct field operability checks even though the same information is found in the PMS.</p>   | <p>Better define what "operability" means.</p>  |
| <p><b>Best Practice 5:</b> Ensure proper transfer valve line-up of manual valve systems was with a second independent operator verification.</p>                              | <p>No gap</p>   | <p>Use remote valve indication on a computer screen as the second independent verification</p>  |

| Best Practice   | Gap   | Opportunity   |
|---|---|---|
| <p><b>Best Practice 6:</b> Perform only those minimum pre-transfer checks that are required. Credit is taken for the skill of the craft.</p>                        | <p>In addition to the LCOs/LCS's SR requirements, we also perform operability checks (PMS and field checks) on the following components/systems prior to starting a waste transfer (currently required):</p> <ol style="list-style-type: none"> <li>1. Primary tank liquid level</li> <li>2. Primary Tank High Pressure Alarms</li> <li>3. Primary Tank Temperature Monitoring System</li> <li>4. Primary Tank Leak Detection Systems - all leak detector probes and annulus CAM's.</li> </ol> <p>The Shift Manager maintains a log of current plant status but redundant checks are performed.</p> | <p>Operability checks could be performed on only those components and systems required by the TSRs.</p> <p>Take credit for operation's personnel knowledge of current plant status.</p>   |
| <p><b>Best Practice 7:</b> Keep process instrumentation systems simple.</p>   | <p>The proposed process transfer jumper for the 241-AZ-01A pump pit will have the following instrumentation</p> <ol style="list-style-type: none"> <li>1. Magnetic flow meter with low and low-low flow alarms.</li> <li>2. Pressure indicator transmitter near the pump outlet with high-high, high, low, and low-low pressure alarms</li> <li>3. Mass flow meter reports flow, stream density, and flow stream temperature.</li> </ol>  | <p>Ensure process control instrumentation is used only for process control and not required for a safety function.</p>  |
| <p><b>Best Practice 8:</b> Use dedicated transfer routes that don't require installation of temporary jumpers.</p>  | <p>No Gap</p>   |   |
| <p><b>Best Practice 9:</b> Utilize simple transfer procedures and reusable checklists.</p>  | <p>Procedures are over 100 pages in length. Certain equipment tables and appendices as well as procedure steps must be initialed by the Nuclear Chemical Operator (NCO) and then reviewed by the Shift Manager at various stages of the procedure.</p>  | <p>Modify the procedures to show one review performed by the Shift Manager at the completion of the field trips and only require signatures that are hold points in the process. Utilize laminated checklists to reduce the size of the procedures. Establish fixed equipment lists for specific transfers.</p> |
| <p><b>Best Practice 10:</b> Transfer lines are not buried in the ground but instead are installed in concrete trenches with access via protective cover blocks.</p> | <p>Transfer lines are double encased covered with soil for shielding. Excavation walk-downs are required prior to any transfer.</p>   | <p>For new transfer lines, build transfer corridor trenches within which multi-transfer lines could be installed. This minimized the chance of damaging and/or severing a transfer line during</p>  |

| Best Practice   | Gap  | Opportunity   |
|---|--|---|
|   |  | constructions and allows for easier repair or replacement.  |
| <p><b>Best Practice 11:</b> Department of Energy contractors ensure that the Authorization Basis allows for isolating a transfer system using multiple shut valves.</p> | <p>Authorization Basis (AB) interprets an interconnected tank as any tank that has a transfer line physically connected to the transfer route. Physically connected applies to any transfer line that is not separated from the active transfer line by a blank or air space. One or more closed valves do not constitute a separation. All tanks and pits physically connected by the transfer line require surveillances prior to and during the transfer.</p> | <p>Take credit for two-valve isolation, substantially reducing the number of checks.</p>  |
| <p><b>Best Practice 12:</b> Design retrieval and transfer systems to be operated by Operations personnel only. No support personnel are required for a transfer.</p>    | <p>Current practice often requires the additional support craft to complete a transfer Health Physics Technician, Electricians, and Industrial Health Technician.</p>  | <p>Design the new retrieval system and upgrade existing systems so that it can be operated by Nuclear Chemical Operators without additional support craft</p> |

## Appendix G

### Off-Site Meeting Results and Recommendations

A number of cross-functional experts were invited to an off-site meeting to help the team generate a list of improvement opportunities and recommendations. A total of 178 ideas and recommendations were generated as a result of the off-site and the team interviews. The team first screened these recommendations against their project definition scope and removed from consideration those that were outside their scope. The remaining recommendations were grouped by category and further evaluated against the success criteria (Table 8) also generated at the off-site, those that did not contribute to these success factors were also removed. Finally the remaining recommendations were evaluated for cost and benefit impact and ease of implementation. The remaining recommendations were the ones considered by the team in detail and recommended for implementation.

**Table 7. Ideas from AZ-101 Batch Transfer Offsite 10/19/99 and Those Generated by the Team**

|                    | Instrument and Control People | Equipment | Maintenance | Cost and Schedule | Procedures and Training | Miscellaneous | AB Authorization |
|--------------------|-------------------------------|-----------|-------------|-------------------|-------------------------|---------------|------------------|
| <b>Overarching</b> |                               |           |             |                   |                         |               |                  |
| 1                  |                               |           |             |                   |                         |               | X                |
| 2                  |                               |           |             |                   |                         |               | X                |
| 3                  |                               |           |             |                   |                         |               | X                |
| 4                  |                               |           |             |                   |                         |               | X                |
| 5                  |                               |           |             |                   |                         |               | X                |
| 6                  |                               |           |             |                   |                         |               | X                |
| 7                  |                               |           |             |                   |                         |               | X                |
| 8                  |                               |           |             |                   | X                       |               | X                |
| 9                  |                               |           |             |                   |                         |               | X                |
| 10                 |                               |           |             |                   |                         |               | X                |
| 11                 |                               |           |             |                   |                         |               | X                |
| 12                 |                               |           |             |                   |                         |               | X                |

|    |  |   |   |   |
|----|--|---|---|---|
| 13 | Reduce the use of administrative controls for risk mitigation, e.g., walkdowns                   |   |   | X |
| 14 | Identify the true risks vs. risks, eliminating mitigating activities for imaginary risks         |   |   | X |
| 15 | Eliminate administrative lock procedure  |   |   | X |
| 16 | Have Engineering review AB for transfer concept and design before the first transfer             |   |   | X |
| 17 | Develop category exclusions USQs for transfers   |   |   | X |
| 18 | Replace quality levels with existing graded approach measures                                    |   |   | X |
| 19 | Manage to the measured source term, not the super tank source                                    |   |   | X |
| 20 | Implement the two-valve rule   |   |   | X |
| 21 | Manage to observed flammable gas concentrations, not the possible concentrations                 |   |   | X |
| 22 | Use USQ for safety and not requirements management   |   |   | X |
| 23 | Spread out transfers so to minimize peak demand  |   | X |   |
| 24 | Reduce the number of times we have to make transfers   |   | X |   |
| 25 | Provide enough money to get the job done   |   | X |   |
| 26 | Finalize programmatic requirements   |   | X |   |
| 27 | Establish a schedule based on expected duration for mileposts/sections and stick to the schedule |   | X |   |
| 28 | Establish incentive fee program for transfer team  |   | X |   |
| 29 | Identify which of the 715 process steps most impact cost and schedule risk                       |   | X |   |
| 30 | Adopt the "Nike" attitude of "Just Do It"  |   | X |   |
| 31 | Quit reorganizing  | X |   |   |
| 32 | Co-locate transfer team  | X |   |   |
| 33 | Resume loading to get the job done   | X |   |   |
| 34 | Automate material balance calculations   |   | X |   |
| 35 | Automate temperature collection  |   | X |   |
| 36 | Have an on-site fabrication facility for jumpers   |   | X |   |
| 37 | Fund spares  |   | X |   |
| 38 | Provide remote tools for pit work  |   | X |   |
| 39 | Clean up/decontaminate AZ farm   |   | X | X |
| 40 | Link maintenance management system to the transfer status system                                 |   |   | X |
| 41 | Develop run-to-failure strategy  |   |   | X |
| 42 | Decrease equipment calibration frequency   |   |   | X |
| 43 | Exercise valves on a regular basis   |   |   | X |
| 44 | Establish the minimum set of equipment that must be functional during operations and start       |   |   | X |

|    |   |   |   |
|----|---|---|---|
|    | up  |   |   |
| 45 | Use electronic check lists  |   | X |
| 46 | Take advantage of the skill-of-craft in procedures instead of spelling out all steps  |   | X |
| 47 | Remove half of the fiefdoms and three-fourths of the document reviews   |   | X |
| 48 | Make one single organization with all necessary resources   |   | X |
| 49 | Develop procedures with parallel steps, not just serial steps   |   | X |
| 50 | Delete word "verbatim" from procedure compliance policy   |   | X |
| 51 | Eliminate procedures by taking credit for SM/OE/NCO training/knowledge and hold them accountable  |   | X |
| 52 | Eliminate generic limits in the front of procedures   |   | X |
| 53 | Minimize paperwork  |   | X |
| 54 | Turn over full tanks to BNFL  |   | X |
| 55 | Establish contractual relationship with supporting companies to credit accountability and productivity mentality                            |   | X |
| 56 | Freeze dry solids for transfers   |   | X |
| 57 | Eliminate requirement to follow DOE 5480.20 Conduct of Operations   |   | X |
| 58 | Integrate Passport work control with AJHA, procedure control, requirements database, RAM analysis and configuration management Pre-Transfer |   | X |
| 59 | Form a dedicated transfer team  | X |   |
| 60 | Use Operators only  | X |   |
| 61 | Establish more flexible worker schedule to support O&M during time of transfer  | X |   |
| 62 | Widely communicate transfer plans/expectations and solicit buy in   | X |   |
| 63 | Install additional flow meters to allow simultaneous transfers and do MPS   |   | X |
| 64 | Eliminating sludge instruments  |   | X |
| 65 | Design density measurements to be taken from the Control Room   |   | X |
| 66 | Centralize monitoring to a single monitoring area   |   | X |
| 67 | Design/modify systems for two-thirds logic for alarms/trips   |   | X |
| 68 | Extend routing board concept to permanent structures  |   | X |
| 69 | Determine and mitigate cause of spurious alarms   |   | X |
| 70 | Install redundant accessible leak detection systems   |   | X |
| 71 | Minimize interfaces for unique Control Room   |   | X |

|    |  |   |   |
|----|--|---|---|
| 72 | Develop computer-based transfer route to include all procedures - automate transfer controls                                   | X |   |
| 73 | Establish CB transfer piping configuration status/routing  | X |   |
| 74 | Update AZ basic equipment to state-of-the art  | X |   |
| 75 | Replace manual administrative operations by remote   | X |   |
| 76 | Install pump discharge recycle jumpers with in-line sample   | X |   |
| 77 | Consider redundant exhausters in AY-AZ farms   | X |   |
| 78 | Have dedicated pipeline for transfer (tank to receiver)  | X |   |
| 79 | Utilize mobile mixer pumps   | X |   |
| 80 | Install rollable cover blocks to eliminate crane operation   | X | X |
| 81 | Standardize mixer/transfer pumps through out the tank farms  | X |   |
| 82 | Design a retrieval system that can be operated by operations only with no support organizations needed                         | X |   |
| 83 | Construct pump testing and storage facility  | X |   |
| 84 | Figure out how brainstorming to test the entire MPS interlock so we can get credit for it                                      | X |   |
| 85 | Develop a method to physically isolate the transfer route  | X |   |
| 86 | Define differences between necessary and real equipment and stuff that is engineering dreams - use only necessary and required | X |   |
| 87 | Install lockable covers on control switches Vs breakers  | X |   |
| 88 | Minimize the number of piping equipment  | X |   |
| 89 | Replace tripod leak detectors with cables (like car rentals)   | X |   |
| 90 | Use only new transfer systems  | X |   |
| 91 | Provide redundant pumps  | X |   |
| 92 | Build BNFL at the bottom of the 200 East and let gravity feed the waste down   | X |   |
| 93 | Consider steam jet transfer pumps instead of what we use   | X |   |
| 94 | Identify reliable test monitoring devices  | X |   |
| 95 | Allow pump bump for testing  |   | X |
| 96 | Use test facility to qualify all pumping equipment   |   | X |
| 97 | Keep a dedicated rapid response maintenance team on shift during transfers   | X | X |
| 98 | Operations maintain status of equipment at all times so that operational checks/calibration checks etc. are not necessary      |   | X |
| 99 | Schedule required maintenance during planned   |   | X |

|     |  |   |   |   |
|-----|--|---|---|---|
|     | transfer system outages  |   |   |   |
| 100 | Synchronize maintenance with the transfer cycle  | X |   |   |
| 101 | Spend a little bit more dollars up front on valves and manifolds                           | X | X |   |
| 102 | Provide training for tests at test facilities  |   |   | X |
| 103 | Keep outside people out of our procedures  |   |   | X |
| 104 | Use a different level of checks for initial and subsequent transfers                       |   |   | X |
| 105 | Change ACES card to a month at a time access card  |   |   | X |
| 106 | Provide a control room simulator for OMS   |   |   | X |
| 107 | Perform transfer procedure with live dress rehearsals before the first time                |   |   | X |
| 109 | Minimize signature requirements in procedures  |   |   | X |
| 110 | Coordinate procedure reviews so that there will only be one change instead of three        |   |   | X |
| 111 | Establish procedure review team when developing procedures and considering changes for PCA |   |   | X |
| 112 | Track, evaluate and minimize causes of procedure changes                                   |   |   | X |
| 113 | Eliminate redundancies in procedures   |   |   | X |
| 114 | Develop a small procedure for common tasks to/for different transfers                      |   |   | X |
| 115 | Put together a team to review and challenge every report, TSD and SAR                      |   |   | X |
| 116 | Ensure constant communication between the transfer from LMHC to BNFL; re: material balance | X |   |   |
|     | <b>PRE-REQUISITES</b>  |   |   |   |
| 117 | Use engine hoist to remove shield plugs  | X |   |   |
| 118 | Get fleet of ATV's for personnel to travel to different farms                              | X |   |   |
| 119 | Build a protective and accessible barrier around the transfer line                         | X |   |   |
| 120 | Fix and maintain equipment   | X |   |   |
| 121 | Maintain "run in" spare pumps for upcoming high risk transfers                             | X |   |   |
| 122 | Have pre-approved work packages for replacing failed, critical equipment                   |   | X |   |
| 123 | Write the pre-requisites for repetitive use  |   | X |   |
| 124 | Eliminate field excavation and ventilation checks  |   | X |   |
| 125 | Activate train on LLCE   |   | X |   |
| 126 | Take credit for data to reduce flammable gas controls                                      |   |   | X |
| 127 | Eliminate field cover block checks<br>Field and Operability Checks                         |   |   | X |

|                       |  |   |   |   |
|-----------------------|--|---|---|---|
| 128                   | Lock in encasement valves  | X |   |   |
| 129                   | Maintain control status of equipment   |   | X |   |
| 130                   | Establish on-call maintenance crews for all credible equipment failure scenarios                                 |   | X |   |
| 131                   | Eliminate the "me toos", combining too many tasks resulting in scope creep                                       |   |   | X |
| 132                   | Eliminate independent verifiers  |   |   | X |
| 133                   | Develop procedures as a check list   |   |   | X |
| 134                   | Eliminate the third operability checks   |   |   | X |
| 135                   | Rely on operator rounds to meet some operability requirements  |   |   | X |
| 136                   | Don't perform separate operability checks - just use Preventive Maintenance System (PMS)                         |   | X | X |
| 137                   | Use remote for second verification of transfer valves  |   |   | X |
| 138                   | Use laminated check list for operability checks  |   |   | X |
| 139                   | Verify operability by alarm panels   |   |   | X |
| <b>TRANSFER</b>       |  |   |   |   |
| 140                   | Allow for longer duration during between functional checks during transfer                                       |   | X |   |
| 141                   | Once a transfer begins extend the PMs to the end of the transfer   |   | X |   |
| 142                   | Just in time transfer readiness vs. windows  |   |   | X |
| 143                   | Perform transfers on days  |   |   | X |
| 144                   | Use continuous instead of batch transfers  |   |   | X |
| 145                   | Develop unique transfer SRIDs  |   |   | X |
| 146                   | Have managers available on call to approve procedures during transfers   |   |   | X |
| 147                   | Revise the PCA process to allow procedure changes in the field   |   |   | X |
| 148                   | Transfer from the source tank to BNFL  |   |   | X |
| 149                   | Coordinate flush with BNFL   |   |   | X |
| <b>After Transfer</b> |  |   |   |   |
| 150                   | Remove pumps during long non-use cycles  |   | X |   |
| 151                   | Issue transfer report and lessons learned  |   |   | X |
| <b>Miscellaneous</b>  |  |   |   |   |
| 153                   | Automate material balance calculations and heat up rates through screen on TMACS                                 |   | X |   |
| 154                   | Automate information to and from Privatization (BNFL) using TMACS instead of phone calls                         |   | X |   |
|                       | Automate raw water meter to remote reading instead of local indicator  |   | X |   |
|                       | Automate disabled alarms on the new master pump shutdown to allow for automated bypass of leak detection systems |   | X |   |

|     |  |   |   |   |   |
|-----|--|---|---|---|---|
|     | Replace card reader system at farm entrance and use ACES for high-risk work as it was designed   | X | X | X |   |
|     | Add monitor to determine if flammable gas exists to address intrinsically safe electrical system   |   | X |   |   |
| 155 | Make the Shift Manager's log electronic and put routing board and equipment status on line   |   | X | X |   |
| 156 | Eliminate redundant steps for checking equipment that is already in service  |   |   | X | X |
|     | Use a simple remote system for sludge readings that are life cycle solutions   |   |   | X |   |
| 157 | Eliminate field checks and use remote/alarm panels for all operability checks, liquid levels, waster system leak checks                                  |   |   | X |   |
| 158 | Upgrade the transfer line routing board for greater efficiency and configuration control   |   |   | X |   |
|     | Isolate catch tank valve pits and install double-valve isolations  |   |   | X |   |
| 159 | Upgrade temperature readings into TMACS or Westronics so that temperature readings can be taken in the Control Room instead of in the field at the riser |   |   | X |   |
|     | Install permanent equipment, e.g., recording VOCs to decrease service support reliance, cost and complexity  |   |   | X |   |
| 160 | Use Shift Manager redline for master copy of procedure for insignificant changes   |   |   |   | X |
| 161 | Use USQ for its intended purpose so that there are enough Cog Engineers available when required  | X |   |   | X |
| 162 | Eliminate pre-job sign off or initial at beginning of shift  | X |   |   | X |
| 163 | Review/revise administrative procedures that hinder streamlined processes, e.g., pre-job meeting   |   |   |   | X |
| 164 | Simplify procedures using reusable check lists, logs or hand-held devices  |   |   |   | X |
| 165 | Take credit for workers knowing lock and tag procedures and other training and qualification they possess  | X |   |   | X |
| 166 | Start in-line dilution without stopping the pump   |   |   |   | X |
| 167 | Modify procedures to eliminate non-value added signatures and have only critical points signatures   |   |   |   | X |
| 168 | Consolidate Process member and transfer control check list   |   |   |   | X |
| 169 | When transfer is going, identify the most limiting check and then check those instead of going through full equipment checks                             |   |   | X | X |
| 170 | Ensure PMS is reliable to reduce number of checks in the field   |   |   |   | X |
| 171 | Create or improve predefined PMS list that generates AZ-101 specific report to reduce the time to look up calibrations                                   |   |   |   | X |

|     |  |   |   |   |
|-----|--|---|---|---|
| 172 | Design equipment and facilities for the life cycle   | X | X |   |
| 173 | Enforce NCOs to energize 480 circuit breakers  | X |   |   |
| 174 | Utilize software engineering capability to evaluate software usability                                 |   |   | X |
| 175 | Use transfer system for physical checks and rely on Shift Manager log book                             |   |   | X |
| 176 | Challenge the AB and trust the routing board, e.g., blanks shall be installed                          |   |   | X |
| 177 | Challenge the Safety and Licensing requirement for barriers, e.g., put barrier status on routing board |   |   | X |
| 178 | Design caustic delivery system to not require temporary barriers                                       |   |   | X |

| Table 8. Off-Site Meeting Success Criteria |  |
|--|--|
| Success Criteria                           | Measures of Success  |
| Reduce transfer span time                  | 8-hour (maximum) shift set up                                      |
|  | Utilize remote Vs field verifications                              |
| Reduce schedule and cost                   | Redefine acceptable risk   |
|  | Reduce the number of requirements                                  |
|  | Reinterpret established requirements                               |
| Increase system reliability                | Reduce Preventive Maintenance affecting transfer cost and schedule |
|  | Establish operation efficiency measurement                         |

| ID | Task Name  | % Com | Start        | Finish       | 2000 |    | 2001 |    | 2002 |    | 2003 |    | 2004 |    | 2005 |    | 2006 |    |
|----|--|-------|--------------|--------------|------|----|------|----|------|----|------|----|------|----|------|----|------|----|
|    |  |       |              |              | H1   | H2 |
| 1  | Challenging AB for Multi-Valve Isolation                   | 2%    | Thu 12/2/99  | Fri 3/9/01   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 2  | Meet with NS&L   | 90%   | Thu 12/2/99  | Wed 12/8/99  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 3  | Define options, e.g., Ops role, criteria, conditions       | 50%   | Thu 1/20/00  | Thu 2/3/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 4  | Determine Ops funding to support effort                    | 0%    | Thu 2/3/00   | Fri 2/11/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 5  | Conduct analysis   | 0%    | Fri 2/11/00  | Wed 6/14/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 6  | Select option  | 0%    | Wed 6/14/00  | Tue 9/26/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 7  | Submit AB addendum to DOE for approval                     | 0%    | Mon 7/31/00  | Mon 7/31/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 8  | Obtain approval from DOE                                   | 0%    | Tue 8/1/00   | Thu 12/28/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 9  | Identify procedure impacts                                 | 0%    | Fri 12/29/00 | Thu 2/8/01   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 10 | Change procedures  | 0%    | Fri 12/29/00 | Thu 2/8/01   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 11 | Conduct training on changes                                | 0%    | Fri 2/9/01   | Thu 3/8/01   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 12 | Implement approved change                                  | 0%    | Fri 3/9/01   | Fri 3/9/01   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 13 | Operability and Non-required Checks                        | 11%   | Mon 11/29/99 | Tue 6/13/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 14 | Complete additional analysis on past transfers             | 100%  | Mon 11/29/99 | Fri 12/3/99  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 15 | Develop Presentation for Dale Allen's Staff and Jeff Rice  | 100%  | Mon 12/6/99  | Mon 12/13/99 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 16 | Presentation to Dale Allen Staff                           | 0%    | Mon 1/31/00  | Mon 1/31/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 17 | Allen Staff review   | 0%    | Tue 2/1/00   | Wed 2/2/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 18 | Schedule meeting with Maint and Shift Ops                  | 0%    | Wed 2/2/00   | Mon 2/7/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 19 | Discuss/review current interpretation/ implementation of " | 0%    | Mon 2/7/00   | Tue 2/8/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 20 | Conduct USQ Screening                                      | 0%    | Tue 2/8/00   | Tue 2/22/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 21 | Inventory local monitoring equipment                       | 0%    | Tue 2/22/00  | Wed 3/8/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 22 | Evaluate impacts/extent of changes required                | 0%    | Wed 3/8/00   | Thu 3/23/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 23 | Change procedures  | 0%    | Thu 3/23/00  | Tue 5/9/00   |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 24 | Conduct training   | 0%    | Tue 5/9/00   | Mon 6/12/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |

| ID | Task Name  | % Com | Start       | Finish      | 2000 |    | 2001 |    | 2002 |    | 2003 |    | 2004 |    | 2005 |    | 2006 |    |
|----|--|-------|-------------|-------------|------|----|------|----|------|----|------|----|------|----|------|----|------|----|
|    |  |       |             |             | H1   | H2 |
| 25 | Implement approved change                                  | 0%    | Mon 6/12/00 | Tue 6/13/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 26 | Expand Shift Manager Authority                             | 8%    | Thu 12/2/99 | Wed 5/10/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 27 | Review policy (IP-0842)                                    | 100%  | Thu 12/2/99 | Fri 12/3/99 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 28 | Review Reasons we rescinded this authority                 | 50%   | Thu 2/10/00 | Tue 2/15/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 29 | Review Maintenance use of reclining                        | 25%   | Thu 12/9/99 | Tue 2/22/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 30 | Change administrative controls/procedure                   | 0%    | Tue 2/22/00 | Fri 4/7/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 31 | Conduct training   | 0%    | Fri 4/7/00  | Tue 5/9/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 32 | Implement policy   | 0%    | Tue 5/9/00  | Wed 5/10/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 33 | Take Credit for Turnover Equipment Status                  | 0%    | Tue 2/1/00  | Thu 6/1/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 34 | Identify procedure impacts                                 | 0%    | Tue 2/1/00  | Mon 2/28/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 35 | Design and develop status board                            | 0%    | Tue 2/15/00 | Wed 2/23/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 36 | Obtain funding for status board                            | 0%    | Thu 2/24/00 | Wed 3/1/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 37 | Install status board                                       | 0%    | Thu 3/2/00  | Thu 3/2/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 38 | Engineering & Ops determine upgrades to routing board      | 0%    | Mon 3/6/00  | Fri 3/10/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 39 | Modify routing board                                       | 0%    | Mon 3/13/00 | Mon 3/13/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 40 | Write/modify procedures to reflect credit for Ops knowledg | 0%    | Tue 3/14/00 | Thu 4/27/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 41 | Conduct training   | 0%    | Mon 5/1/00  | Wed 5/31/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 42 | Implement change   | 0%    | Thu 6/1/00  | Thu 6/1/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 43 | Simplify procedures  | 9%    | Thu 12/2/99 | Fri 5/4/01  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 44 | Identify candidate procedures to modify based on team in   | 75%   | Thu 12/2/99 | Mon 1/10/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 45 | Engineering & Ops develop template                         | 75%   | Tue 1/11/00 | Wed 2/9/00  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 46 | Reach consensus on template                                | 0%    | Thu 2/10/00 | Mon 3/13/00 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 47 | Write procedures using new template using graded appro     | 0%    | Tue 3/14/00 | Thu 4/5/01  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |
| 48 | Conduct training   | 0%    | Fri 4/6/01  | Thu 5/3/01  |      |    |      |    |      |    |      |    |      |    |      |    |      |    |

| ID | Task Name                         | % Com | Start      | Finish     | 2000 |    | 2001 |    | 2002 |    | 2003 |    | 2004 |    | 2005 |    | 2006 |    |
|----|-----------------------------------|-------|------------|------------|------|----|------|----|------|----|------|----|------|----|------|----|------|----|
|    |                                   |       |            |            | H2   | H1 |
| 49 | Implement new transfer procedures | 0%    | Fri 5/4/01 | Fri 5/4/01 |      |    |      |    |      |    |      |    |      |    |      |    |      |    |

APPENDIX I

# **AZ-101 Batch Transfer to Privatization**

## **Communication Plan**

# AZ-101 Batch Transfer to Privatization Communication Plan

## Mission

The AZ-101 Batch Transfer to Privatization provides the waste feed to the private contractor for vitrification of HLW. As systems are installed by retrieval projects to support delivery to Privatization, analysis has been performed to address schedule risk and the associated potential \$2.5M penalty for not delivering the waste in the quantity, timeliness or quality specified by Privatization. A strategy has been developed to implement improvements to the AZ-101 transfer process. This plan has been developed to relay the status of the implementation process to mitigate vulnerabilities for the AZ-101 batch transfer. This plan will encompass the following areas: Operations Management meetings, tailgate meetings, 2XP reporting, Business Case distribution, and other items that may be added over time.

## Plan Details

### *I. CHGI Operations Management Meetings*

- A. Schedule: Monthly
- B. Length: 15 minute presentation
- C. Location: 2704HV
- D. Purpose: Update on progress toward implementation

### *II. CHGI Operations and Maintenance Tail Gate Meetings*

- A. Schedule: Bimonthly, at a minimum, beginning in July, 2000 or whenever the AB is updated, which ever occurs first
- B. Length: 15 minute presentation
- C. Location: Standard Operations, Maintenance and Support organization  
Tailgate Locations

D. Purpose: Facilitate understanding of changes that are to occur and solicit input from operators by management (to include occasional attendance by senior management)

### *III. 2X Productivity Reporting*

- A. Schedule: Monthly, or as required
- B. Length: One to two pages
- C. Format: Performance indicators, e.g., pareto or run chart
- Reduction in the number of reworks performed
  - Reduction in the set up cycle time (hours)
  - Reduction in the number of requirements in the AB and operating specifications
  - Number of established requirements reinterpreted to reduce process steps
  - Number of Preventive Maintenance equipment/items not completed as scheduled
  - Reduction in the number of days into transfer window before starting the transfer
  - Reduction in downtime due to personnel availability.
- D. Purpose: To inform DOE and other entities of progress toward achieving double productivity for transfers' reduced rework

### *IV. Business Case*

- A. Schedule: One time distribution
- B. Content: AZ-101 Batch Transfer to Private Contractor Business Case, supporting detailed data, and Implementation Plan