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SALTWELL PIC SKID PROGRAMMABLE LOGIC CONTROLLER (PLC) SOFTWARE CONFIGURATION MANAGEMENT PLAN

Mike Koch

Prepared by Lockheed Martin Hanford Corp.

Richland, WA 99352

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Abstract: This plan describes the configuration management for the PIC Skid Programmable Logic Controller (PLC) software. It identifies the requirement, associated documents, and the software controls.

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**SALTWELL PIC SKID PROGRAMMABLE LOGIC CONTROLLER (PLC)
SOFTWARE CONFIGURATION
MANAGEMENT PLAN**

Prepared by:

F. M. Maiden

November 1999

**COGEMA Engineering Corporation
Richland, Washington**

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1.0 INTRODUCTION

Throughout the history of the single-shell tank (SST) farms, leaks have been confirmed in 67 of the existing 149 SSTs. All of the SST farms are now inactive (no SSTs receive waste from any operating facility.)

To minimize the potential for leakage of liquid radioactive waste from underground waste storage tanks, all liquid waste technically feasible and economically practical is being transferred from SSTs to double-shell tanks (DSTs)

The Saltwell Pumping, Instrumentation and Control (PIC) Skid provides a method for the removal of liquid waste from SSTs to DSTs.

Most surface liquid (supernatant) has been removed from most of the SSTs using high-volume turbine pumps. When the liquid remaining in the solids, termed interstitial liquor, flows into the saltwell slower than a specified rate, the turbine pumping is discontinued, and a jet pump is installed to complete the task of removing liquid. Jet pumps are designed to operate at much lower flow rates than the turbine pumps; jet pumps can run continuously at flow rates as low as 0.05 gallons per minute (gpm). Because of this low rate capability, the interstitial liquor can be continuously drained from the salt cake using this system.

The driving force causing the liquid to flow from the solid through the saltwell screen and into the well is the pressure head caused by the difference between liquid levels in the well and in the solids. The Saltwell PIC Skid keeps the liquid in the well at a continuously low level. The net effect is to pump out a greater volume of the interstitial liquor than can be pumped by intermittent operation of the turbine pumps at a greater overall rate than other pumping systems.

1.1 PURPOSE

This document provides the procedures and guidelines necessary for computer software configuration management activities during the operation and maintenance phases of the Saltwell PIC Skids as required by LMH-PRO-309, Rev. 0, *Computer Software Quality Assurance*, Section 2.6, *Software Configuration Management*. The software configuration management plan (SCMP) integrates technical and administrative controls to establish and maintain technical consistency among requirements, physical configuration, and documentation for the Saltwell PIC Skid Programmable Logic Controller (PLC) software during the Hanford application, operations and maintenance. This SCMP establishes the Saltwell PIC Skid PLC Software Baseline, status changes to

that baseline, and ensures that software meets design and operational requirements and is tested in accordance with their design basis.

**** NOTE:**

Requirements for the Software Configuration Management Plan (SCMP) were defined in HNF-PRO-555, *Software Practices – System Configuration Management Plan*.

HNF-PRO-555 has been cancelled and replaced by HNF-PRO-2778, *IRM Application Software System Life Cycle Standards*. HNF-PRO-2778 cross references to LMH-PRO-2778, *IRM Application Software System Life Cycle Standards*. LMH-PRO-2778 does not directly list the requirements for SCMP, but it does reference LMH-PRO-309, *Computer Software Quality Assurance Requirements*, which does list the requirements for a SCMP in Sections 2.6 and 2.7.

1.2 SCOPE

This plan applies to those organizations responsible for the operation and maintenance of the Saltwell PIC Skid PLC software. This plan applies to the operational phase (including maintenance and transition to deactivation) of the present Saltwell PIC Skid PLC software as well as any future software developed for new Saltwell skids PLCs. Specific scope objectives for the Saltwell PIC Skid PLC SCMP are the following:

1. Establish and maintain the requirements and associated documents to accurately reflect the Saltwell PIC Skid PLC software.
2. Identify and maintain the documents within the scope of the SCMP (see Section 6.1).
3. Control and status changes to software to ensure the continued quality of the requirements, physical configuration, and documentation.
4. Conduct assessments to ensure that the software configuration management plan is effective in establishing and maintaining the technical requirements.

1.3 OVERVIEW

The Saltwell PIC Skid control system is composed of three sub systems linked together: a programmable Logic Controller (PLC), an Allen Bradley Data Table Access Module (DTAM) interface, and a desktop personal computer (PC). The Allen Bradley PLC controls the Saltwell skid operations, the Allen Bradley DTAM interface provides local operator interface for the PLC, and the PC provides remote operator interface.

The PLC ladder logic software was initially written by Stone and Webster for Westinghouse Hanford Company (WHC) and was subsequently modified by WHC for each unique installation of the PIC Skids. The DTAM interface software is Allen Bradley DTAM Plus Version 9.0 and the Desktop PC Human Machine Interface (HMI) software is Wonderware Version 7.0.

1.3.1 Saltwell PIC Skid Control System Components and Associated Software

- i. SLC500 PLC
 - PLC Ladder Logic Software
- ii. Data Table Access Module (DTAM) Local Interface
 - DTAM Plus Software Version 9.0
- iii. Desktop Personal Computer (PC) Remote Interface
 - Wonderware Version 7.0 HMI Software

Figure 1. Basic Control Block Diagram

1.4 DEFINITIONS

SDD	- Software Design Description
SRD	- Software Requirements Document
DOE	- United States Department of Energy
DOE-RL	- DOE Richland Operations Office
FDH	- Fluor Daniel Hanford Corporation
HLAN	- Hanford Local Area Network
LMHC	- Lockheed Martin Hanford Corporation
LMSI	- Lockheed Martin Services Inc
ORP	- Office of River Protection
PHMC	- Project Hanford Management Contract
SCR	- Software Change Request
PLC	- Programmable Logic Controller
CVI	- Certified Vendor Information
DTAM	- Data Table Access Module

1.5 TERMS

- a. Application Software is the general term applied to the software covered by this software configuration management plan.
- b. Master Copy is the official copy of the PIC Skid PLC software. The master copy of the PIC Skid PLC software will be controlled by the PIC Skid PLC Software Custodian and reside in the Software file cabinet.
- c. PIC Skid PLC Software System Baseline, Initial Baseline for PIC Skid PLC Software will be set upon the release of SX-104 software package, each subsequent unique PIC Skid PLC software baseline will be set at the end of that particular skid's OTP.
- d. Program Elements refer to everything needed to justify, define, and describe the physical and operational configuration of a Structure, System, or Component (SSC). For the PIC Skid this includes the PLC and the associated software.
- e. Software Life Cycle is the period of time that starts when a software product is conceived and ends when the product is no longer available for use.

2.0 MANAGEMENT

Organizational roles and responsibilities are established to ensure that functional organizations are aware of the responsibilities required for implementation of this plan.

2.1 ORGANIZATION

This plan applies to the following:

- Tank Farm Interim Stabilization Engineering and Tank Farm Interim Stabilization Project Operations, currently performed by Lockheed Martin Hanford Corporation (LMHC),
- Nuclear Safety and Quality Assurance, currently performed by Lockheed Martin Hanford Corporation (LMHC)
- PIC Skid PLC Software Design Agent, currently performed by Lockheed Martin Hanford Corporation (LMHC).
- Software Custodian, currently performed by Lockheed Martin Hanford Corporation (LMHC)

2.2 RESPONSIBILITIES

The Department of Energy (DOE) Office of River Protection (ORP) oversees the Hanford Site's tank waste remediation systems. The ORP is responsible for developing and implementing requirements and procedures that establish management responsibilities and process methodologies. LMHC is the DOE contractor responsible for managing the Hanford tank farms and retrieving and disposing of the tank waste.

2.2.1 Interim Stabilization Engineering

LMHC Interim Stabilization Engineering is responsible for the following:

1. Establishing and managing the coordination and interfaces of the PIC Skid PLC software configuration management program elements defined in Section 6.1.
2. Initiating the software changes.

3. Assisting in the identification, definition, and control of programmatic and technical interfaces.
4. Ensuring that software configuration management controls are used in the conduct of operations.
5. Identifying, establishing, reviewing, and approving minimum testing criteria.
6. Assisting in the review/acceptance of vendor information.

2.2.1.1 Interim Stabilization Engineering – Cognizant Engineer

The Cognizant Engineer is the assigned owner of the PIC Skid PLC software and operational configuration and is responsible for the following:

1. Implementing and managing the SCMP (shared responsibility with Design Authority).
2. Ensuring that complete and accurate technical documentation is developed and maintained.
3. Providing engineering direction and oversight to ensure that design and modifications are consistent with technical baselines.

2.2.1.2 Interim Stabilization Engineering – Cognizant Manager

The Cognizant Manager is responsible for assuring that reviews and approvals appropriate to impact levels are obtained for software and other configuration items.

2.2.1.3 Interim Stabilization Engineering – Design Authority

The Design Authority is the assigned owner of the PIC Skid PLC software requirements, design baseline, and system configuration and is responsible for the following:

1. Controlling the evolving technical baseline.
2. Implementing and managing the software configuration management plan (shared responsibility with Cognizant Engineer).

3. Ensuring that complete and accurate technical documentation is developed and maintained.
4. Providing engineering direction and oversight to ensure that design and modifications are consistent with the technical baselines.

2.2.2 Interim Stabilization Project Operations

LMHC Interim Stabilization Project Operations (Operations) operates the Hanford waste tank farm Saltwells under the management direction of the ORP. Operations is responsible for assisting in the identification and establishment of minimum criteria to support changes to the PIC Skid PLC software.

2.2.3 Nuclear Safety

Nuclear Safety is responsible for addressing safety issues and reviewing and approving PIC Skid PLC software changes with an approval designator "S".

2.2.4 Quality Assurance

Quality Assurance is responsible for addressing site quality assurance issues and reviewing and approving PIC Skid PLC software changes with an approval designator "Q".

2.2.5 Design Agent

The PIC Skid PLC Design Agent is responsible for the following:

1. Implementing any specific software changes to the PIC Skid PLC software.
2. Maintaining a PIC Skid PLC software repository for application support under software configuration management.

2.2.6 Software Custodian

The LMHC Cognizant Engineer/Software Custodian will be responsible for maintaining the software and associated configuration files. The LMHC Cognizant Engineer may delegate custodial duties but will be ultimately responsible for proper maintenance of the

PIC Skid PLC software and associated configuration files. The PIC Skid PLC Software Custodian is responsible for the following:

1. Collecting and maintaining the approved PIC Skid PLC Software System Baseline including control of access to the software, distribution to others, control of media, and physical protection of the software.
2. Ensuring that appropriate approvals and reviews are obtained for the PIC Skid PLC Software System Baseline.
3. Assisting in the identification and establishment of minimum testing criteria to support changes to the PIC Skid PLC software.
4. Providing single point of contact for problem reporting.
5. Providing Engineering support for LMHC Interim Stabilization Project Operations.
6. Developing and maintaining the PIC Skid PLC software configuration management plan.

2.2.8 Documentation Control

Lockheed Martin Services Inc. (LMSI) is responsible for the following:

1. Establishing and managing document processing, distribution, record storage, and retrieval.
2. Providing vault storage for documentation.

2.3 IMPLEMENTATION

This software configuration management plan will be implemented immediately upon the release of the Saltwell PIC Skid Programmable Logic Controller (PLC) Software Configuration Management Plan, HNF-5034.

2.4 POLICIES AND PROCEDURES

FDH Policies used to implement this plan

- LMH-PRO-309 "Computer Software Quality Assurance Requirements"
- HNF-IP-0842 "Tank Farm Administration Procedure"
- LMH-PRO-2778 "Application Software System Life Cycle Standards"

FDH Procedures used as engineering documents

- LMH-PRO-224 "Document Control Program Standards"
- LMH-PRO-233 "Review and Approval of Documents"
- LMH-PRO-244 "Engineering Data Transmittal Requirements"
- LMH-PRO-440 "Engineering Document Change Control Requirements"
- HNF-PRO-604 "Hanford Document Number System"
- LMH-PRO-1819 "PHMC Engineering Requirements"

2.5 INTERFACE CONTROL

Interface and agreements between companies will be identified, defined and controlled per contracts with LMHC. Additional organizational or programmatic interfaces are defined in Section 2.2.

3.0 SOFTWARE CONFIGURATION MANAGEMENT ACTIVITIES

3.1 CONFIGURATION IDENTIFICATION

Software related documents that are defined in Section 6.1 will be controlled as Supporting Documents.

Supporting documents will be issued a document number according to HNF-PRO-604, "Hanford Document System," and released via an Engineering Data Transmittal (EDT) form according to LMH-PRO-244, "Engineering Data Transmittal Requirements." Changes to released supporting documents will be controlled via an Engineering Document Change Notice (ECN) according to LMH-PRO-440, "Engineering Document Change Control Requirements."

During changes to the software, the applicable Supporting Documents may be presented in an unreleased form at the review that verifies them but must be released immediately following incorporation of comments from that review. Prior to release, the LMHC Cognizant Engineer will control software documents.

3.1.1 Baseline Elements

Items that describe the physical attributes and function of the Saltwell PIC Skid PLC Software are the following:

- a) Documents:
 - Software Requirements
 - Software Design Description
 - Operational Test Report
- b) Computer Software:
 - SX-104 skid software is the baseline software for the PIC Skid PLC Software.
- c) Engineering Documents:
 - ECN list for individual PIC Skid installation is included in the IS PIC Skid Configuration Drawing H-2-829998.
- d) Graphical Representation:
 - IS PIC Skid Configuration Drawing H-2-829998.
- e) Vendor Information & Specifications:
 - Vendor information located in CVI File # 22726.

3.1.2 Labeling of Software Media

Upon successful installation of any PIC Skid PLC Software, a label will be affixed to the Master copy and system backup with the following displayed:

- PLC Software ID.
- PIC Skid ID (i.e. A, B, C, etc.).
- Tank I.D.
- IS PIC Skid Configuration Drawing number.
- Revision number/date for the software.
- Initial of Verifier/Validator.

3.2 CONFIGURATION CONTROL

3.2.1 Software Change Request (SCR)

During the Operations and Maintenance Phase of the PIC Skid PLC software life cycle, problems, errors, difficulties with the software, requests for changes, or requests for new services will be reported to the LMHC cognizant engineer and the designated Software Custodian.

The designated Software Custodian will fill out a Software Change Request (SCR) which will follow the guidelines in LMH-PRO-2778 (Each SCR will be numbered and entered into the "SCR" file maintained in the PIC Skid PLC Software file cabinet).

The LHMC Cognizant Engineer will assess the problem or change request and assign it for consideration to the Design Agent. The Design Agent will enter the SCR report into the PIC Skid PLC Software Custodian notebook.

The Design Agent will determine whether the problems require corrective action, whether corrective action requires changes to the baseline configuration, and how extensive the modification will be.

If no corrective action is needed, the SCR is closed at that point.

If corrective action is required, based upon the Design Agent determination, LMHC Interim Stabilization Engineering grants the authority to modify the affected software components, upgrade the system, or develop new software components to the appropriate individual.

3.2.2 New Tank Requirements

New or existing Skids being set up for tank installation will require modifying the original baseline software components (SX-104 Skid Software) to meet the new tank requirements. The Design Agent will distribute the working copy of the PIC Skid PLC software from their software repository for modification.

3.2.3 Documenting Changes

3.2.3.1 Existing Software

When changes/modifications to existing software components are complete and verified, an ECN is approved and issued for the new version of the software and any revised documents (see section 6.1). The ECN will reference the skid I.D., the tank I.D (e.g., PIC Skid "E", tank S-102) and the OTP # (e.g., OTP-200-004 Rev. A-09). The new version of the software is introduced into the Design Agent's software repository, delivered to the Software Custodian who introduces it into the software file cabinet, and the PIC Skid PLC software is certified by testing.

3.2.3.2 New Tank Software

After completion of the modifications to the original baseline software (SX-104) to meet the new tank requirements, the software will be tested and certified during the OTP for that skid. An OTR will be generated and released with the attached (completed) OTP and Ladder Diagram. The new tank software will be introduced into the Design Agent's software repository and delivered to the Software Custodian, who introduces it into the software file cabinet.

3.3 CONFIGURATION STATUS ACCOUNTING

The designated Software Custodian will prepare a status accounting file before each PIC Skid PLC software release. The status accounting will include a list of all software files that make or produce a release product. The status accounting file will include the following:

- Skid I.D. of individual PIC Skid PLC system where product/software is installed
- Software ID
- Software Revision Number/Revision Date

Instructions on how to build the software product from the files will include identification of support software. Support software includes compilers, assemblers, editors, operating systems, and other utility software.

3.3.1 Revision History

The contents of the status accounting file will include the revision history. The revision history will include a description of the initial field release and all subsequent changes to the file. The description will include the following:

- Revision number/revision date
- Nature of the change
- Identity of the requester
- Rationale for the change
- Identity of author making the change

3.4 QUALIFICATION TESTING

The PIC Skid PLC software will be verified and validated during the Operational Test Procedure (OTP) of each Skid. Existing skids in service on tanks have completed their OTPs.

3.5 MEDIA CONTROL

The form of media used to store approved release software will be 3 ½" diskettes. The software will be stored in at least two locations. One set of the software media will be stored in a locked fire resistant file cabinet drawer labeled "Software Records" in the file named "PIC Skid PLC Field software". This file cabinet will be located at a location specified by the manager of the Software Custodian. Each approved release software will bear a label with the information required in Section 3.1.2, *Labeling of Software Media*. The second set of software media is stored in the Design Agent's software repository and is controlled by configuration management.

3.6 AUDITS AND REVIEWS

OTPs will be used to verify and document that any upgrades to the PIC Skid PLC software are complete.

3.7 ACCESS CONTROL

PIC Skid PLC system hardware access will be controlled by tank farm access requirements when the system is installed within the farm boundaries. The Master backup of the software will be stored in a locked cabinet. The Hanford Site document control process will control all documentation.

3.8 BACKUP AND RECOVERY

Backups for each PIC Skid PLC software will be kept on 3 ½" diskettes for the duration of the Skid's active life on the tank.

3.9 OUTPUT TRACEABILITY

"IS PIC Skid Configuration Drawing Cross Reference Drawing" (H-2-829998) will provide traceability between the PIC Skid, the Tank, the software, and the OTP for each skid. The configuration drawing will list the following for each unique skid:

- Work Package #
- Tank ID
- PIC Skid ID
- PLC Software ID
- OTP #
- OTP Revision #
- OTP Completion Date
- OTR #
- ECNs
- Related ECNs

The IS PIC Skid Configuration Cross Reference Drawing will be updated at the completion of each unique skid's OTP and release of the OTR.

3.10 SOFTWARE RETIREMENT

Software Retirement for individual PIC Skid PLC software will be initiated after the Skid is removed from service on a tank and prior to being configured for use on another tank.

4.0 TOOLS, TECHNIQUES, AND METHODOLOGIES

None

5.0 SUPPLIER CONTROL

Pertinent vender technical information shall be identified, collected, and entered into the Hanford Site documentation control system as vender information.

Documents shall be written in a format that is compatible with Hanford Site Document Control.

6.0 RECORD COLLECTION AND RETENTION

Records handling will be as described in LMH-PRO-2778, "IRM Application Software System Life Cycle Standards." All PIC Skid PLC software documentation for each unique skid will be retained through the removal of that skid from active service on the tank and the retirement of that skid's PLC software. Any further record retention of the skid software documentation will be addressed at that time.

6.1 PIC SKID PLC SOFTWARE LIFE CYCLE DOCUMENTS

Configuration items include the following (6.1.1 through 6.1.4):

6.1.1 Software Requirements

Computer Software Requirements for the PIC Skid PLC system.

6.1.2 Test Documentation

Test Documentation consisted of:

- Test Procedure Specification
- Test Case Specification
- Test Results

All three of these items are covered in the Operational Test Procedures (OTP) for each unique skid.

6.1.3 Software Configuration Control Document

The Software Configuration Control Document is the Software Configuration Management Plan, this document (HNF-5034).

6.1.4 User Documentation

User Documentation consists of the following:

1. User's and Maintenance Manuals for PLC, DATAM Plus, and RS Logix editor located in the CVI file.
2. User developed documentation, e.g., Software Design Document and Software Requirements.

7.0 SAFETY, RELIABILITY, AND QUALITY ASSURANCE

7.1 SAFETY CLASSIFICATION AND SIGNATURE DESIGNATION

HNF-SD-WM-SAR-067, Final Safety Analysis Report (FSAR), identifies potential accident scenarios and the equipment necessary to prevent or mitigate these accidents. The equipment relevant to the saltwell pumping operation includes leak detection, service water pressure detection, and saltwell flow totalizers. Leak detectors and service water pressure detection systems are Safety Class (SC), and saltwell flow totalizers are Safety Significant (SS) as defined in the FSAR. The PLC Control System and Software used for the Hanford Saltwell Interim Stabilization are General Service, Defense in Depth. General design and quality assurance requirements for non-safety items shall be followed.

At a minimum, documentation must satisfy a (Q) documentation Approval with Safety (S) and Environmental Assurance (E) as deemed appropriate. An ESQ is a designator for documentation that impacts occupational safety (including "as low as reasonably achievable" [ALARA] principles) and environmental monitoring and requires quality assurance verification of conformance to requirements. These have been determined in accordance with LMH-PRO-233, *Review and Approval of Documents*.

7.2 QUALITY ASSURANCE AND QUALITY CONTROL

All work is conducted in accordance with the relevant quality requirements of LMH-MP-599, *"Project Hanford Directives: Quality Assurance Program Description."*

8.0 REFERENCES

HNF-IP-0842, *Tank Waste Remediation System Administration Procedure*, Vol. I, Section 2.1, Rev. 8, "Procedures Development and Maintenance," Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-IP-0842, *Tank Waste Remediation System Administration Procedure*, Vol. IV, Section 3.5, Rev. 1, "Engineering Documents," Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-IP-0842, *Tank Waste Remediation System Administration Procedure*, Vol. IV, Section 4.26, Rev. 0, "Supporting Document Requirements," Lockheed Martin Hanford Corporation, Richland, Washington.

LMH-MP-599, *Quality Assurance Program Description*, Lockheed Martin Hanford Corporation, Richland, Washington.

LMH-PRO-224, *Document Control Program Standards*, Lockheed Martin Hanford Corporation, Richland, Washington.

LMH-PRO-233, Rev. 0, *Project Hanford Policy and Procedure System, Review and Approval of Documents*, Lockheed Martin Hanford Corporation, Richland, Washington.

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