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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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SUPPORTING DOCUMENT

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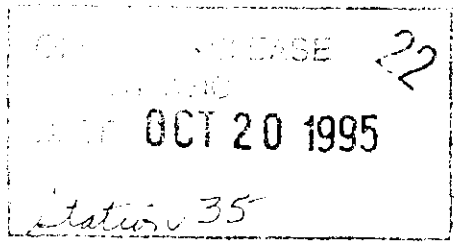
7. Abstract

The Light Duty Utility Arm (LDUA) Cold Test Facility, located in the Hanford 400 Area, will be used to support cold testing (pre-operational tests) of LDUA subsystems. Pre-operational testing is composed of subsystem development testing and rework activities, and integrated system qualification testing. Qualification testing will be conducted once development work is complete and documentation is under configuration control. Operational (hot) testing of the LDUA system will follow the testing covered in this plan and will be covered in a separate test plan.

8. RELEASE STAMP



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LIGHT DUTY UTILITY ARM SYSTEM PRE-OPERATIONAL (COLD TEST) TEST PLAN

1.0 INTRODUCTION

The Light Duty Utility Arm (LDUA) System is being developed to support DOE Underground Waste Storage Tank work at Hanford, Idaho National Engineering Laboratory, and Oak Ridge National Laboratory. At the Hanford Site are 177 underground waste tanks that contain over 60 million gallons of radioactive chemical waste. Surveillance and inspection of the tank interior, waste sampling and in situ characterization must be performed remotely to minimize the risk of personnel exposure or release of hazardous material. The LDUA is a robotic arm being developed to carry special sensors to examine the tanks and the waste materials. After the LDUA arm and supporting subsystems are designed and built, several LDUA systems will be delivered to DOE's Hanford Site for validation and qualification testing. The testing program will be conducted in the Cold Test Facility located at Hanford in the 400 Area.

This testing program will be referred to in this test plan as the pre-operational test (or cold test) program. This means that the testing will be performed in a non-tank environment. The equipment will not be subject to radiological, high temperature, etc., conditions during the pre-operational tests. Follow-on testing will be referred to as the operational test (or hot test). Deployment of a baseline system into a Hanford single shell waste tank is currently planned to be the first operational test. The baseline test program test results, will be provided INEL and ORNL and used to form a foundation for qualification of LDUA units at those sites. This approach is expected to be cost effective and to shorten the overall schedule for testing and qualification at INEL and ORNL.

This plan was prepared following the guidelines found in WHC-CM-6-1, Standard Engineering Practices, EP 4.2, Testing Requirements. This test plan is a LDUA program integration and control document as defined in the LDUA Work Breakdown Structure, 3.3.5.3, Pre-Operational (Cold) Test Plan.

2.0 OBJECTIVE

The objectives of this pre-operational testing program are to verify that the LDUA system meets the design criteria established in the LDUA Functions and Requirement document WHC-SD-TD-FR-001, performs its functions safely, and support contractual terms for acceptance of vendor equipment. In addition to qualifying the equipment, this pre-operational testing program supports qualification of procedures, and training of personnel in the safe operation and maintenance of the LDUA system.

Operational (hot) testing in a single shell tank is a subsequent test program and will be covered in a separate test plan. The Operations Training Program will also be part of a separate plan. EM-30 personnel will provide the lead for all personnel and procedure qualification activities.

3.0 SCOPE

This pre-operational test plan is applicable from the time the LDUA subsystems are delivered to the Hanford Site through completion of LDUA system level testing required to support operational readiness reviews for the hot deployment of the LDUA system. Lead responsibility for the LDUA operational tests in a hot tank will be assumed by the "Designated Tank Farms Organization" at completion of cold tests. The "Designated Tank Farms Organization" will have the lead role in procedure and operator qualification activities. The pre-operational (cold test) test program will be performed in the following phases. These test phases will generally be conducted in the sequence given. Since delivery of equipment to the Cold Test Facility (CTF) may be staggered, the test sequences within a test phase may be adjusted to accommodate the delivery of equipment and retest after modifications, if it does not impact the operation of a subsystem. The following test phases are described in section 6.4 of this plan.

Development Testing Phase

a) LDUA System Setup
b) Vendor documentation and training
c) Calibration, Grooming and Alignment (CG&A)
d) Post Delivery Acceptance Test
e) Equipment and Software Integration Tests

Qualification Phase

f) Equipment Qualification Testing
g) LDUA Operational Procedure Qualification Test
h) LDUA Operations and Maintenance Qualification

A separate test plan was written, subordinate to this test plan, for the control and data acquisition system software (Reference 4). It establishes documentation, verification, and validation requirements on LDUA software. The Software Test Plan requires a functional test of software acting as a part of an integrated CTF system test.

TEST PLAN DOCUMENTATION REQUIREMENTS SUMMARY

DOCUMENT NAME	TEXT REFERENCE
LDUA CTF Test Schedule	see 10.0
Vendor Acceptance Test	see 6.4.4
Post Delivery Acceptance Test Procedure	see 6.4.4
Calibration, Grooming and Alignment (CG&A) procedures	see 6.4.3
Test Data Sheets - CG&A	see 4.4/6.1
Test Logs - CG&A	see 6.2

DOCUMENT NAME	TEXT REFERENCE
Test Reports - CG&A	see 6.2.2
Calibration Procedures	see 6.1
System Drawing	see 6.1
System Design and Description	see 6.1
Equipment Integration Test Procedures	see 6.4.4
Test Data Sheets - Intgration Test	see 4.4/6.1
Test Logs - Integration Test	see 6.2
Test Reports - Integration Test	see 6.2.2
Corrective Action and Retest Procedures	see 6.3
Software Verification Validation Document	see 6.4.5
Off-normal Operations/Recovery Procedure	see 6.4.7
Operations and Maintenance Procedures	see 6.4.8
Operations and Maintenance Training Plan	see 6.4.8
Weekly/Monthly Status Report	see 6.2.1
Testing Corrective Action Database	see 6.3
Qualification Testing Procedures	see 6.4.6
Test Data Sheets - Qualification Test	see 4.4/6.1
Test Logs - Qualification Test	see 6.2
Test Reports - Qualification Test	see 6.2.2

4.0 DESCRIPTION OF TEST

4.1 TEST ITEMS

This test plan is applicable to the LDUA system components that will be tested in the CTF. The baseline system is defined in Reference 12. Test procedures will define the specific components, functions, and configurations that will be tested at the CTF. Not all LDUA end effectors and sensors will be tested under this test plan. Testing and qualification of new end effector systems is expected to continue as new system applications are identified (Reference 5).

The LDUA system will use the Fuels and Materials Examination Facility (FMEF) utilities to operate the LDUA system in the CTF for most testing. (Vendor acceptance testing may exempt a subsystem from cold test requirements described in this test plan. The requirements for exemption based on vendor

acceptance testing is given in WHC-CM-6-1, "Standard Engineering Practices.")

Each LDUA Subsystem Cognizant Engineer shall establish and maintain configuration control of the subsystem until it is ready for the qualification test. Before qualification tests begin on the subsystem the documentation shall be submitted to the WHC Documentation Control System. The Cognizant Engineer and Cold Test Coordinator will determine readiness of a Subsystem for Qualification Testing.

4.2 TEST ENVIRONMENT

Major parts of the pre-operational test program will be performed indoors in a controlled atmosphere. The LDUA system is designed to operate outdoors year round, but performing the initial testing indoors will allow testing to concentrate on the performance of the system without the variables of the outdoor and tank environments. Limited training and testing of the, Decon System, Mobile Deployment System (MDS), Vertical Positioning Mast (VPM), and LDUA will be conducted outside during pre-operational testing. The operational testing (hot test) in a tank will be the first use of the LDUA in both a tank and outdoor environments.

In-tank environmental conditions that will not be tested during this pre-operational test program are: radiological exposure, temperatures above normal room temperature and high humidity. Outdoor environmental conditions that will not be tested during this pre-operational test program are: wind, temperature extremes, rain, snow, hail, seismic conditions and lightning.

4.3 FACILITIES AND EQUIPMENT

4.3.1 Facilities and Equipment Description

The majority of the pre-operational test program is planned to be performed in the LDUA CTF. The CTF is in the east end of the (FMEF) which is located in the 400 Area on DOE's Hanford Site. Pre-operational outdoor activities will be in the 400 Area near the CTF.

The drawings in Appendix A show the general arrangement of the equipment within the FMEF to support LDUA testing. In the east end of the FMEF is a large truck bay that is designed to handle large equipment that is transferred in and out of the FMEF. The LDUA Operations Control Trailer (OCT) will be located in the truck bay during CTF testing. The floor of the truck bay is at ground level (0'-0") and the ceiling height is approximately 95 ft from the floor. A 75-ton crane is available to handle heavy equipment that is brought in and out of the building. Above the ground level in the truck bay is a mezzanine at the 42'-6" level. Below the mezzanine is a large room (LDUA Test Cell, originally designated as the Decon Cell - room 351) with a floor size of 30 ft by 40 ft and a ceiling height of 37 ft 6 in. The top of the LDUA Test Cell is accessed through several penetrations in the floor of the mezzanine.

The floor of the mezzanine will be used to simulate the ground level of the tank farm and the LDUA Test Cell will simulate the Waste Tank. Penetrations in the ceiling of the LDUA Test Cell have been modified to

install simulated waste tank risers. This includes a simulated 12 inch riser and three 4 inch risers. The 12 inch riser will be used to deploy the LDUA manipulator arm into the Test Cell and the 4 inch risers will be used deploy the in-tank cameras and waste mapping devices. The 12 inch riser is designed to tilt to simulate riser "out of plumb" conditions that will be expected at the tank farms, and is instrumented to measure loads imposed on it by the LDUA.

The floor level of the Test Cell below is at the 0'-0" elevation, or at a distance of 42'-6" below the LDUA vehicle on the mezzanine, closely approximating the maximum distance below ground of the waste in an underground tank. A test bed fixture will be provided on the floor of the Test Cell which can simulate a portion of a tank wall for test purposes, and features several containers for waste simulants. Viewing areas with personnel barriers are provided to limit access to the test area during operation of the arm. The LDUA will be operated remotely from the control system trailer located on the ground (0'-0") level of the truck bay.

During setup of the LDUA system in the CTF, the LDUA deployment vehicle must be lifted from the truck bay (at 0'-0" elevation) to its simulated ground level test position on the mezzanine (at 42'-6" elevation), using the 75-ton overhead crane. Once in position on the mezzanine, the LDUA VPM is raised and the arm is deployed for testing through a tank riser interface confinement enclosure (TRIC). The LDUA arm will be lowered into the Test Cell through the simulated 12 inch tank riser. A viewing area for test observers and demonstration audiences can be set up in the mezzanine test area and Test Cell below.

An office area will be provided for LDUA program participants. A small room (room 505) off the 42'-6" level mezzanine is planned to be used as a office area and can be equipped with desks, table and a telephone. Access to HLAN is available on the mezzanine or in the OCT.

An outside training and testing site, near the LDUA cold test facility, will provide LDUA operators with realistic, hands-on experience in the techniques involved with positioning the LDUA deployment vehicle near a tank riser and the erection and alignment of the LDUA mast housing with the riser. The outside site features two different full scale simulated tank risers, each buried in soil with a topography much like that around actual tanks. One riser simulates ideal "best case" risers to be encountered, the other is designed to simulate more adverse conditions. A simulated Tank Riser Interface and Confinement (TRIC) enclosure has been fabricated to make the training more prototypic of an actual tank farm LDUA operation. Testing of the water decon system at these outside risers will eliminate water handling problems inside the CTF.

4.3.2 Cold Test Facility Support Equipment

A list of the required facilities and test equipment is found in Appendix C, Cold Test Facility support equipment.

4.4 DATA

Data taken during the cold test program will be both quantitative and qualitative. The qualitative data will be in the form of observations of the performance and operation of the LDUA and its supporting systems. Quantitative data will support design verification of the LDUA Function and Requirements document and various specifications that specify the detailed requirements of the LDUA System and subsystems. Quantitative data will also be required to establish system capabilities in the areas of accuracy, resolution, repeatability, time periods, speed, etc. for follow-on engineering activities. Data gathering will include data obtained from the operation of the LDUA control and data acquisition system in normal and off-normal conditions. Test data will be documented in test reports. All test data will serve as part of the basis for the operational readiness review that will be held before the LDUA system is deployed into a waste tank for operational (hot) testing. The test data will also be input for the development of operations procedures and an operator training qualification program, while demonstrating the safety features of the LDUA system. Specific parameters to be measured, operational requirements, etc., shall be specified in the detail procedures. The procedures shall also specify instrumentation required to take measurements and the data gathering requirements such as personnel qualification or equipment status.

4.5 COLD TEST FACILITY CRITERIA/CONSTRAINTS

Cold Test Facility (CTF) selection criteria included items like space to achieve full extension of the LDUA, all weather work space, no radioactive contamination, existing facility, and ease of access for support equipment and personnel. An engineering study was conducted to select the optimum site for the test facility from among the various sites available at Hanford. This study is found in WHC-SD-TD-ES-003, *LDUA Cold Test Facility Preparations, Engineering Study*.

Based on this study, the FMEF building 427 in the 400 Area was selected from five candidate sites identified as having potential to satisfy the requirements of the test facility. Candidate sites were compared on the basis of essential geometrical features to meet established test needs, implementation costs, cleanliness, accessibility, and availability. The FMEF was selected as the site for the LDUA CTF after each of the five candidate sites were ranked by applying an objective, weighted evaluation technique to their common attributes. The FMEF was determined to be the preferred facility, not only for its geometrical features, but also because it is of recent construction and very clean, having never been contaminated by radiological materials as have some of the other candidate sites. The FMEF is not currently scheduled to support any other Hanford operations, thereby making it available full-time as a dedicated LDUA test facility. In addition, the FMEF is not within a secured perimeter containing radiological materials, resulting in much less complications for site access by workers and visitors. The implementation cost for the FMEF was determined to be moderate relative to that of the other sites.

An information bulletin was issued that summarizes the environmental impacts that were considered for the proposed CTF in the FMEF. This summary concluded that the proposed CTF will not cause any environmental impacts. The

environment impact summary is found in the NEPA document, "National Environmental Policy Act Categorical Exclusion Determination: Cold Testing and Evaluation of Tank Waste Remediation Technologies in the 400 Area, Hanford Site, Richland, Washington," Correspondence No. 9400618, dated July 29, 1993.

5.0 EXPECTED RESULTS

The purpose of CTF testing activity is to verify the LDUA system performance and operation functions and requirements have been achieved. This includes meeting or exceeding the baseline criteria found in WHC-SD-TD-FRD-003, *Functions and Requirements for the Integrated Light Duty Utility Arm System* and in detail specifications for the various subsystems. Results of this testing program are also expected to verify the safety features of the LDUA system and verify the safety analysis documentation where practical. If during the testing the expected results are not achieved, then corrective action and retest must be documented. See section 6.3 for corrective action.

The LDUA pre-operational test program will result in qualified equipment, qualified procedures, and qualified personnel that will operate and maintain the LDUA system in the tank farms.

6.0 TEST PROCEDURE

Detailed test procedures and system documentation will be developed by each of the LDUA system and end effector suppliers. This document-action will be combined into LDUA cold test procedures for each of the test phases. The test procedures shall contain information in sufficient detail for the test operator to perform the operation of each subsystem and operate the LDUA system as an integrated system. Before the test operators run the LDUA system, they shall undergo the appropriate training in the operation of each of the systems. A list of personnel qualified to perform the various CTF functions shall be maintained by the cold test coordinator. The test procedures should be flexible so that some changes can be accommodated without causing undo delay in conducting the tests. They should also support equipment modification and retest when that is found necessary without requiring procedure rewrites and repeating unaffected parts of the test.

6.1 TEST PROCEDURE CONTENTS

The test procedures shall include as a minimum the following:

1) Identification - Identify by system/subsystem number(s), equipment numbers, drawing numbers, or other suitable identification
2) General description
3) Instruments and calibration as required
4) Facilities, equipment, and materials
5) Safety
6) Personnel qualification
7) Detail procedural steps
8) Test configuration
9) Acceptance criteria where required

10) Standard tests where required; for example, standard tests could include leak tests, calibration, etc.
11) Retest requirements
12) Data sheets
13) Approvals

6.2 REPORTS

It is planned to write reports on the progress of the testing for individual components and subsystems and a final report at the conclusion of each test phase and the entire cold test program. Test logs will be kept during tests to record necessary information required to document test results in a test report.

6.2.1 Progress Reports

Weekly and monthly progress reports will be written on the status and progress of the testing program and will be the responsibility of the test coordinator. Input to these reports will be required from the test performers. The contents of these reports may be gleaned from the test logs and data sheets. It may be desirable to develop a data base to track the status and to document required corrective actions and open items of the testing program.

6.2.2 Final Reports

Test reports shall be written after each test phase (subsystem development and system qualification). The subsystem development report will include set up of the LDUA subsystem in the CTF, checkout tests, test data, modifications, etc. After the completion of the system qualification test program, a final test report will be produced to document the tests. These reports will be submitted for design and operational verification for the operational readiness review. The test reports will include, but are not limited to, the following contents:

1) Description of test
2) Test method (including configuration) and test equipment
3) Test results (Data sheets and test logs)
4) Conclusions and recommendations
5) Modifications that were required
6) Test basis/test specification
7) Reference to the test procedures

6.3 CORRECTIVE ACTION

If expected results are not achieved during the testing, the testing should be stopped and an assessment should be taken to determine the next action to be taken to continue the testing. Problems may be the result of equipment or component failure; if so, repair or replacement may be required and the appropriate documents generated to restore the system. Other causes will require the appropriate action and documents to bring the operation to the expected level of performance. The corrective actions will be tracked on a corrective action database. The corrective action database shall include, but not limited to the following: a unique number for each action item; brief

description of the action required; responsible person for the action; dates for initiation of the action; and date the action was closed.

6.4 TEST SCENARIOS

The test scenarios will be based on the operating scenario for the deployment of the LDUA in a waste tank. The current operating scenario can be found in the WHC-S-0233, *Maintenance and Operations Specification for the Light Duty Utility Arm (LDUA) Integrated System.* The specific test scenarios will depend on the type of test that will be performed. Figure 1 provides the general flow of testing activities for each subsystem. Lead responsibilities and key deliverables are shown. See Appendix B, "LDUA System Setup in CTF," for an outline of testing activities for each subsystem.

6.4.1 Setup of the LDUA Subsystem

This is the first phase of the LDUA test program which is the setup of the LDUA subsystems in the CTF after delivery to the Hanford Site. The setup activities include placement and installation of individual components and mating and connection of these components into an integrated system.

Depending on when the equipment arrives relative to other equipment, the equipment may be installed in its testing position or placed in a temporary area within the FMEF. The exact sequence may be different from the outline in Appendix B and may also depend on the actual arrival of the equipment. Details of the test configurations will be defined in the test procedures.

6.4.2 Vendor Training

Vendor training on selected systems will be provided to LDUA personnel during the testing phase. This training will include presentation of system documentation, demonstration of equipment setup/operation/and maintenance, and performance of a Acceptance Test Procedure.

6.4.3 Calibration, Grooming and Alignment (CG&A)

Each subsystem cognizant engineer shall document CG&A activities as each subsystem has been setup in the CTF and the system interfaces connected. CG&A work includes checking out circuits in the system to verify that each circuit is correctly installed and that circuit continuity, power, and signal levels are correct. Alignment of interfaces will be performed to verify proper interfacing and alignment of equipment where required.

During this test, each sensor and effector (motors, hydraulic systems, etc.) may be exercised to show that each of these components are operable before the integrated system is operated. The mechanical components and electrical circuits are verified against designs and the equipment is adjusted and prepared for operation. Software may be used as required to verify operation of components. Software testing is part of the integrated qualification testing phase. When problems are identified, resolution shall be documented and a retest documented. After the CG&A test is complete, the subsystem is ready for ATP or Integration test activites.

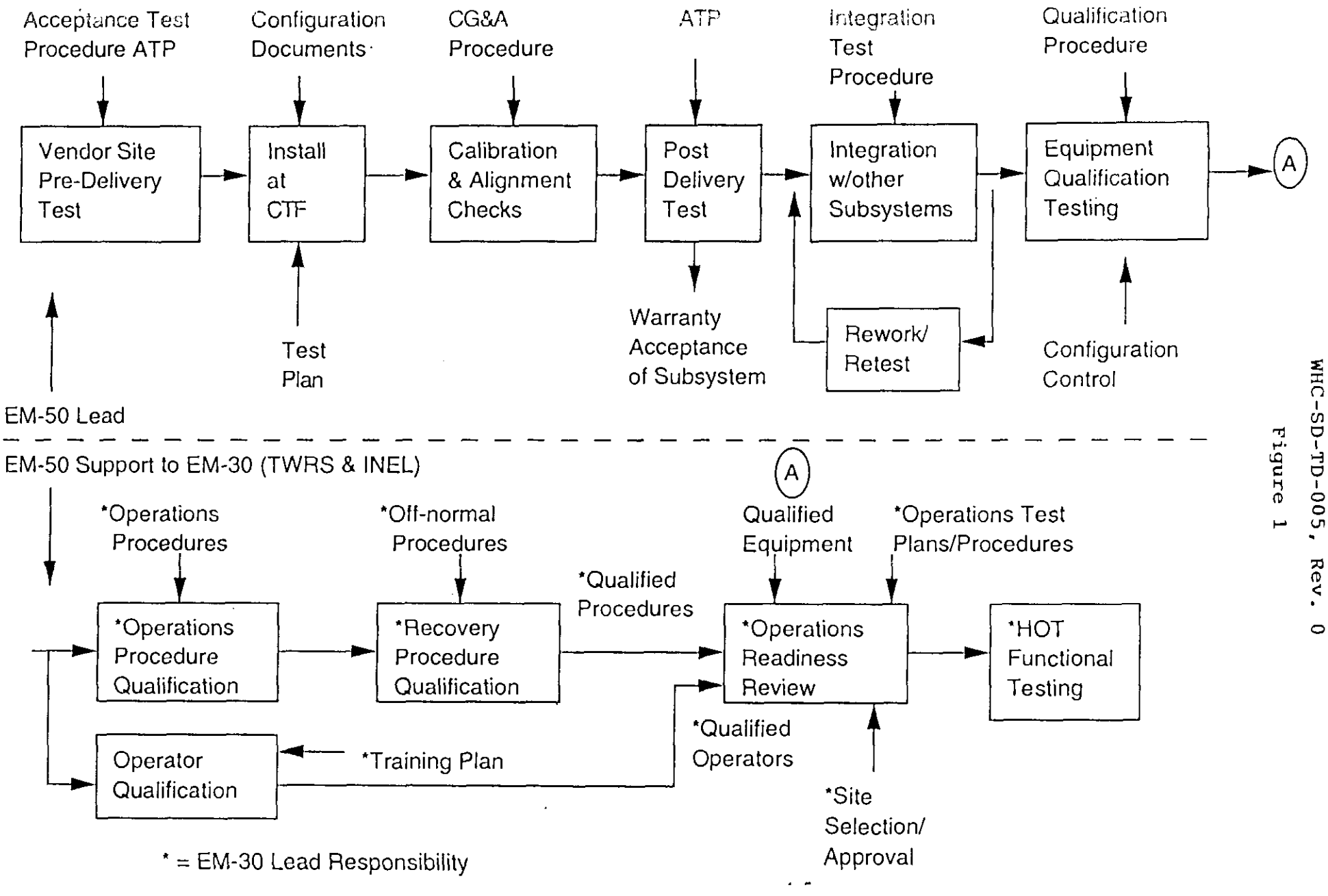


Figure 1

Cold Test Facility Pre-Operational Testing & Training

6.4.4 Post Delivery Factory Acceptance Tests

After CG&A is completed, the performance of the post delivery acceptance tests of the LDUA subsystems will be conducted. (Pre-delivery acceptance tests of the LDUA subsystems are performed at the supplier's facility.) The subsystems are operated to verify the subsystem meets the acceptance requirements in the applicable specifications. Generally, these tests will be the same tests that were performed at the supplier's facility. These tests will be repeated in the CTF to identify any transportation damage, verify that equipment meets the specified acceptance test requirements as tested at the supplier's facility, and train personnel at Hanford on the system as covered by the ATP. After these tests are performed for the subsystem, the equipment is now ready to begin integration testing of the equipment and subsystem operations.

The equipment will be tested in unloaded and loaded conditions and accuracy and repeatability will be evaluated for various loading and operating scenarios, and safety tests will be performed. The specific acceptance test requirements for the LDUA deployment system are found in the LDUA Technical Specification for the Light Duty Utility Arm, WHC-S-124, latest revision. Acceptance test requirements for decon and End Effector subsystems are found in the specifications issued by the LDUA participant supplying the subsystem.

Major software components will be delivered to the CTF from various suppliers. The suppliers will have performed factory acceptance tests per procurement specifications. For software supplied by DOE labs, documentation of acceptability in accordance with the software development plan, shall be provided. After arrival at the CTF, post factory acceptance tests will be performed. These software components will then be integrated during the next test phase to verify proper interface and functionality.

6.4.5 Equipment and Software Integration Testing

The next phase in the testing program is to integrate the equipment and software of each of the subsystems in stages so that the subsystems will ultimately operate as a system. Each cognizant engineer shall document the integration tests in an Integration Test Procedure. This Integration Test Procedure shall be part of the LDUA system level qualification tests after successful completion/resolution during this developmental test activity. The integration tests will include operational integration of the LDUA manipulator arm and deployment system, the Tank Riser Interface Confinement (TRIC) enclosure, the End Effector Exchange System (EEES), overview sensors, decon subsystems, the control and data acquisition subsystems, and deploying and integrating the surveillance and inspection end effectors that will be carried by the LDUA into the waste tanks.

The integration tests will also be conducted to validate the software that will be implemented for the integrated control and data acquisition system. The software test plan for the integrated control and data acquisition system Light Duty Utility Arm, *LDUA Control System Software Development and Test Plan*, WHC-SD-TP-006, defines the software test program. These tests will be implemented by conducting software component tests to verify basic component function and proper interface function of their defined interfaces. After the software component tests, tests will be performed to

integrate the software components in stages to assure correction function of the integrated components. Equipment must be operational to perform this series of tests.

After all software components have been integrated, the fully integrated control and data acquisition system will be tested. This testing will require that the LDUA system be set up and operating, since this testing requires hardware for the control software to operate.

These integration tests must be completed before starting the next testing phase, which will be conducted to qualify the integrated system.

6.4.6 Equipment Qualification Tests - Normal Operations

Before beginning qualification testing on an LDUA subsystem as part of these qualification tests, the cold test coordinator shall assure the documentation for that subsystem is under formal WHC Documentation Control.

Qualification tests will be performed to verify that each subsystem of the LDUA system meets the requirements of the WHC-SD-TD-FRD-003, *Functions and Requirements for the Integrated Light Duty Utility Arm System*, and any other specified performance requirements. It will include operation of the LDUA manipulator arm and deployment system, the TRIC enclosure, the EEES, decon subsystems, the control and data acquisition subsystems, and the surveillance and inspection end effectors as an integrated system.

This test will be performed in two parts. The first part of the test will verify "normal" integrated deployment operation of the equipment. The second part of this test phase will perform various "off normal" operation scenarios, where practical, to verify safety features and other operational conditions that may be defined later.

The normal operation sequence will include LDUA setup and installation, deployment and operation of selected end effectors, and LDUA system "take down" and removal. This test phase will be performed by the LDUA team with assistance from the TWRS Operations personnel for their learning experience. During this phase, operating procedures will be fully developed and verified for normal operation. Normal operations may be performed as follows.

6.4.6.1 LDUA Setup. Setup of the LDUA system will follow the sequences as found in Section 6.4.1. This includes setting up of the TRIC, decon system, LDUA arm and deployment system. This setup operation should include using the alignment equipment to align the TRIC and the LDUA deployment mast to the riser.

6.4.6.2 LDUA Operation. The operational sequences and details will be found in the detail test procedures prepared after the design of the LDUA system is complete. The operational sequences will be adhered by providers and suppliers of the LDUA system.

The successful completion of this test will qualify the LDUA system equipment to be deployed in a selected single shell waste tank for operational testing. The results of this qualification test will be a major input to the operational readiness review that will be performed prior to "hot testing" of

the LDUA system in a waste tank. After the LDUA system equipment is qualified, the operational procedures must be qualified next.

6.4.7 Equipment Qualification Tests-Off-Normal Operations

These tests will be similar to normal operations except "off-normal" operation will be performed to verify the performance of safety systems and features of the LDUA system. The test will be based on the hazards analysis and safety assessment of the LDUA system. Not all hazards can be practically tested, but will be checked out where practical. Verification of key hardware and software interlocks will be made during Qualification Tests. Procedures for recovery from off-normal events shall be developed and verified during this testing phase. The results of these off-normal tests will be major input to the LDUA operational readiness review.

6.4.8 Operational Procedure Qualification Tests

During the equipment qualification tests, the operational procedures will have been fully developed. This test phase will then be conducted to qualify these LDUA operational procedures. These will be the procedures that will be used to set up, deploy the arm and end effectors in a waste tank, and maintain the LDUA equipment in a tank farm. The results of this test will be a major input to the LDUA operational readiness review.

6.4.9 LDUA Operations and Maintenance Qualification

Tank Farm Operations will conduct a training program to qualify the operators in the operation of the entire LDUA system. The training program will qualify operators and maintenance personnel for the operational (hot) test of the LDUA system. Details of this training program will be specified in a separate training plan and will be developed by TWRS Operations and Engineering. The results of this personnel qualification program will be major input to the LDUA operational readiness review.

7.0 SAFETY/SECURITY

7.1 SAFETY

The LDUA pre-operational test program will be testing equipment which has the potential to injure personnel and to damage other equipment. Potential hazards include setting up the LDUA system in the CTF, the moving manipulator arm, electrical and hydraulic power supplies, and laser hazards. Methods will be used to mitigate safety hazards associated with equipment that pose the potential safety hazards. These methods shall be specified in the detail test procedures. To insure a safe testing environment, the guidelines found in WHC-CM-1-10, "Safety Manual," will be followed. Whenever work on electrical equipment is performed, the WHC lock and tag procedures shall be followed where required. Noisy equipment shall use noise abatement devices as required to reduce the noise levels to meet the requirements in WHC-CM-1-10. A test program safety plan shall be prepared covering specific safety requirements and mitigation action measures.

The LDUA Safety Program (Reference 8) defines a number of steps that will insure hazards are identified and minimized. It covers such things as preparation of a Job Hazard Analysis (JHA), and a pre-job safety briefing at the beginning of each testing operation and whenever a new person joins the activity.

Safety Engineering shall review test procedures and test setup for the compliance to WHC safety requirements.

Each individual that will be connected with the cold test program shall go through a facility briefing before starting work in the CTF. Selected members of the LDUA staff shall undergo qualification training to become certified as a "Person-in-Charge" (PIC). These individuals will oversee testing activities in the CTF to ensure compliance to procedures and safe conduct of operations. A PIC shall be present at all times during testing operations.

7.2 SECURITY

There are restrictions as to the type of equipment that can be brought into the FMEF protected area. The following privately owned items are prohibited in the FMEF:

- Recording equipment (audio, video, data)
- Cellular phones
- Cameras
- Computers and media

If any of these items need to be brought into the CTF, a property pass needs to be obtained beforehand.

8.0 QUALITY ASSURANCE

8.1 QA FOR TESTING

This test program shall follow the guidelines of WHC-SD-WM-QAPP-021 that apply to testing of the LDUA system. Approved WHC procedures shall guide the preparation/review/performance/documentation of test procedures. Quality Assurance personnel shall be available for data verification, calibration, inspection or other activates as required by the test procedures and other situations.

The testing shall be fully documented for LDUA system design verification, safety documentation verification, and as major input to the Operational Readiness Review that will performed prior to the operational (hot) testing in a waste tank. After the pre-operational (cold) testing program is complete, all test documentation shall be archived.

8.2 SOFTWARE CONFIGURATION MANAGEMENT

The software configuration will be controlled by the Configuration Management in WHC-SD-TD-SDP-001, "Light Duty Utility Arm Software Development Plan." This section sets controls such as identification of software, physical control, configuration control, and roles of responsible individuals to insure software configuration during each phase of testing is controlled.

9.0 RESPONSIBILITIES

Specific roles and responsibilities of those responsible for the LDUA cold test program are found in Appendix C.

1) LDUA Program Management Organization (Remote System and Sensor Applications)
2) Cold Test Coordinator
3) Person In Charge (PIC)
4) Test Performer
5) Quality Engineer
6) Safety Engineer
7) Cog Engineer Support
8) Craft Support
9) Other Responsibilities
10) TWRS Operations

10.0 SCHEDULE

The LDUA subsystem (LDUA, MDS,& VPM) will be one of the last LDUA system components to arrive at the cold test facility. Most other subsystems of the baseline configuration will have arrived and completed integration testing with each other before the LDUA subsystem arrives. As soon as time permits after the arrival of a system component, testing and integration activities will begin. Completion of some integration tests may be delayed until the LDUA system is completely configured.

The following is an example of high level activities for the LDUA cold test. The LDUA schedule will identify LDUA testing activities in more detail:

Operations Control Trailer at Hanford	Mar 95
Baseline End-Effectors at Hanford	Sep 95
Baseline End-Effectors integrated with SDAS	Nov 95
Receive 1st LDUA at Hanford	Mar 96
Complete SDAS integration with 1st LDUA	Apr 96
Integrated system test complete	May 96
Begin qualification tests of 1st LDUA	Jun 96
Complete qualification tests for 1st LDUA	Jul 96

11.0 REFERENCES

1. WHC-SD-TD-FRD-003, "Functions and Requirements for the Integrated Light Duty Utility Arm System," Westinghouse Hanford Company, Richland Washington.

2. WHC-SD-TD-ES-003, "LDUA Cold Test Facility Preparations, Engineering Study," Westinghouse Hanford Company, Richland Washington.

3. Letter, "National Environmental Policy Act Categorical Exclusion Determination: Cold Testing and Evaluation of Tank Waste Remediation Technologies in the 400 Area, Hanford Site, Richland, Washington," No. 9400618, dated July 29, 1993.

4. WHC-SD-TD-TP-006, "Software Test Plan for the Integrated Control and Data Acquisition System Light Duty Utility Arm," Westinghouse Hanford Company, Richland Washington.

5. WHC-TD-ICD-001, "Interface Control Document Plan," Westinghouse Hanford Company, Richland, Washington.

6. WHC-S-124, "LDUA Procurement Technical Specifications," Westinghouse Hanford Company, Richland Washington.

7. WHC-S-0233, "Maintenance and Operations Specification for the Light Duty Utility Arm (LDUA) Integrated System," Westinghouse Hanford Company, Richland Washington.

8. WHC-SD-WM-WP-231, "LDUA Safety Program Plan," Westinghouse Hanford Company, Richland Washington.

9. WHC-SD-WM-QAPP-021, "Quality Assurance Project Plan Light Duty Utility Arm (LDUA) - [WHC QA Plan]," Westinghouse Hanford Company, Richland Washington.

10. Letter, "Transmittal of the INEL's Input to LDUA Cold Test Plan, TTP #ID-442001 LDUA Decontamination System and End Effector, Milestone #8 - TLN-35-95," dated April 18, 1994, Westinghouse Hanford Company, Richland Washington.

11. WHC-SD-TD-SDP-001, "Light Duty Utility Arm Software Development Plan" Westinghouse Hanford Company, Richland Washington.

12. WHC-SD-TD-ER-006, "Baseline Configuration Description for the Light Duty Utility Arm System," Westinghouse Hanford Company, Richland, Washington.

13. Internal Memo, B. A. Carteret, et al. to W. C. Miller, "Light Duty Utility Arm System - Memorandum of Understanding," dated September 12, 1995.

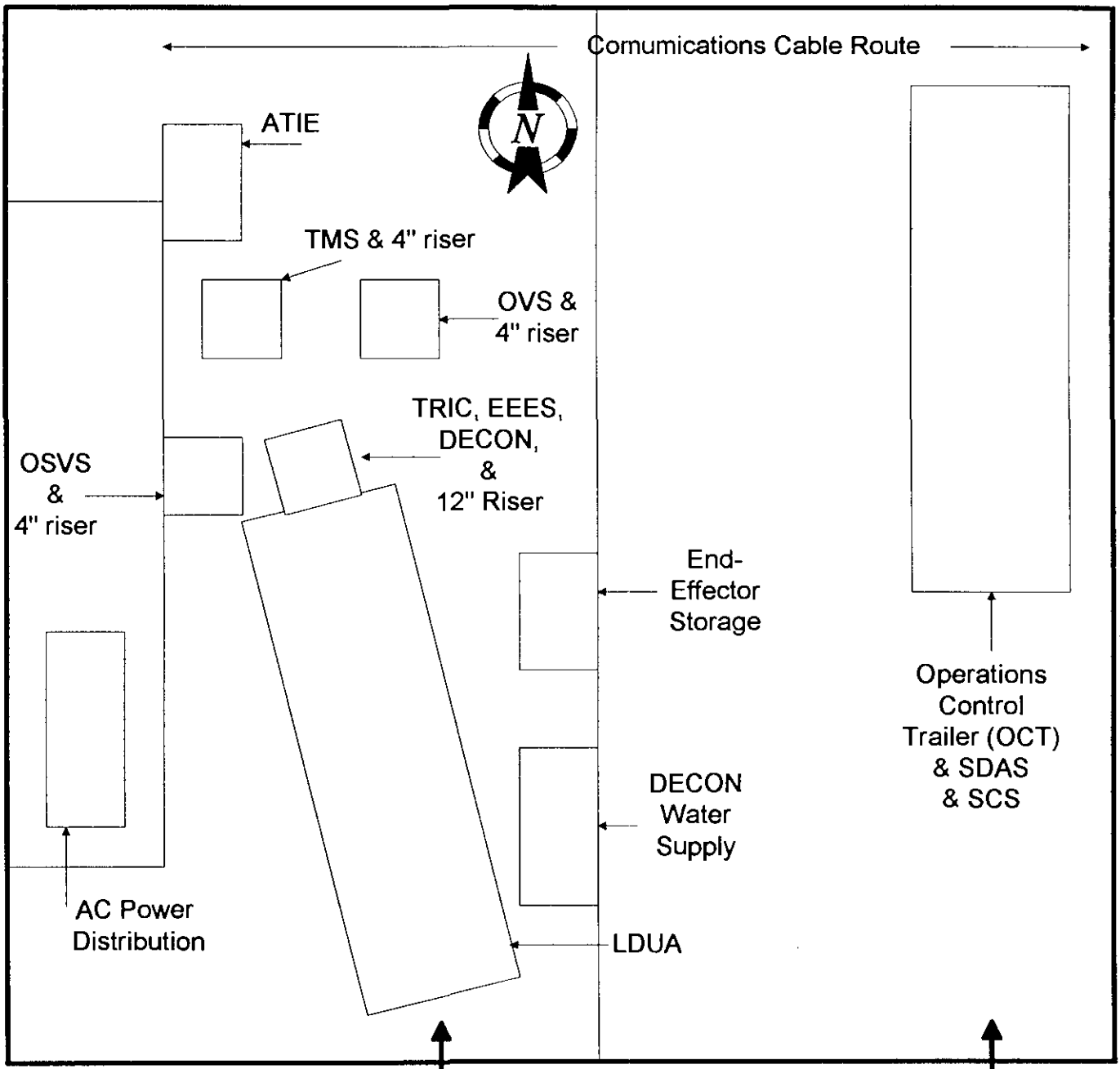
12.0 LIST OF ACRONYMS

ATIE	At-Tank Instrumentation Enclosure
CTF	Cold Test Facility
DOE	U.S. Department of Energy
EE	End Effector
EEES	End Effector Exchange System
FMEF	Fuels Maintenance and Examination Facility
HLAN	Hanford Local Area Network
HRSVS	High Resolution Stereo Video System
ICF-KH	ICF - Kaiser Hanford
JCS	Job Control System
LDUA	Light Duty Utility Arm
MDS	Mobile Deployment System
OAS	Optical Alignment Scope
OVS	Overview Camera System
OSVS	Overview Stereo Camera System
OCT	Operations Control Trailer
ORNL	Oak Ridge National Laboratory
PIC	Person in Charge (follows JCS work, i.e., facility mods.)
PNL	Pacific Northwest Laboratory
SCS	Supervisory Control System
SDAS	Supervisory Data Acquisition System
SNL	Sandia National Laboratory
SSPS	Stereo Still Photography System
TIP	Tool Interface Plate
TMS	Topographical Mapping System
TRIC	Tank Riser Interface and Confinement
TWRS	Tank Waste Remediation System
UPS	Uninterruptable Power Supply
UST	Underground Storage Tank
VPM	Vertical Positioning Mast
WHC	Westinghouse Hanford Company
WSRC	Westinghouse Savannah River Company

APPENDIX A

COLD TEST FACILITY EQUIPMENT LAYOUT

APPENDIX A



LDUA COLD TEST FACILITY GENERAL ARRANGEMENT

APPENDIX B

LIGHT DUTY UTILITY ARM

SUBSYSTEM SETUP IN CTF

APPENDIX B

LIGHT DUTY UTILITY ARM SUBSYSTEM SETUP IN CTF

The following setup sequence outline is provided for general high level guidance. The actual test procedures used in CTF will provide detailed setup and test instructions.

The following assumes the equipment has been delivered to the FMEF truck lock and is ready for installation and testing to start. Most end effectors and support equipment will arrive, be installed, and complete most integration testing before the LDUA subsystem arrives. Much of the subsystem integration and testing can be done in any order. The outline below lists subsystems in the order they are expected to arrive and be integrated into the CTF.

Qualification testing is an integrated system test that assumes that all subsystems have demonstrated any required functionality in previous tests.

1) Operations Control Trailer (OCT) - System 2000

   Set up in truck lock
   Apply power
   Complete post-delivery ATP
   Place system documentation in configuration control

2) Supervisory Data Acquisition System (SDAS)- part of System 4200

   Setup system
   Install network
   Establish configuration under Cog Eng Control
   Integrate with other subsystems
   Test functions as part of subsystem tests
   Place system documentation in configuration control

3) Control Network - System 4400

   Install and test as required to integrate subsystems
   Place system documentation in configuration control

4) Four inch riser cameras - part of System 6000

   Establish configuration under Cog Eng Control
   Setup system
   Integrate with SDAS
   Complete CG&A
   Perform Acceptance Test Procedure
   Complete Integration tests
   Document test results
   Integrate with ATIE
   Place system documentation in configuration control

5) End Effector cameras - part of System 6000

Establish configuration under Cog Eng Control
Complete temporary setup
Integrate with SDAS
Complete CG&A
Perform Acceptance Test Procedure without arm/tip
Integrate with LDUA and ATIE subsystem
Complete Integration tests
Document test results
Place system documentation in configuration control

6) Topographical Mapping System - part of System 6000

Establish configuration under Cog Eng Control
Set up system
Integrate with SDAS
Complete CG&A
Perform Acceptance Test Procedure
Integrate with ATIE
Complete Integration tests
Document test results
Place system documentation in configuration control

7) TRIC, end effector exchange system, and Decon System - System 3000

Establish configuration under Cog Eng Control
Install over 12 inch riser on mezzanine
Integrate with SDAS and ATIE
Complete CG&A
Perform Acceptance Test Procedure
Complete Integration tests
Document test results
Place system documentation in configuration control

8) Power Distribution Skid - System 5100

Establish configuration under Cog Eng Control
Install on mezzanine
Complete CG&A
Perform Acceptance Test Procedure
Complete integration tests
Place system documentation in configuration control

9) At Tank Instrument Enclosure ATIE - System 4300

Establish configuration under Cog Eng Control
Install on mezzanine
connect to other subsystems
Complete CG&A
Perform Acceptance Test Procedure
Complete Integration tests
Place system documentation in configuration control

10) Radiation Monitoring System - System 3520

Establish configuration under Cog Eng Control
Install on mezzanine
Integrate with SDAS and ATIE
Complete CG&A
Perform Acceptance Test Procedure
Complete integration tests
Document test results
Place system documentation in configuration control

11) Supervisory Control System - part of System 4200

Establish configuration control
Install system software and hardware
Complete integration tests
Perform Acceptance Test Procedure
Document test results
Place system documentation in configuration control

12) LDUA (arm and deployment system) - System 2000

Establish configuration under Cog Eng Control
Install on mezzanine
Connect to utility feeds
Interface with SDAS and ATIE
Complete CG&A
Perform Acceptance Test Procedure
Complete SPAR training at CTF
Complete integration tests
Place system documentation in configuration control
Complete qualification testing
Provide qualification report to ORR
Archive all test data and test reports
Support procedure and operator qualification

APPENDIX C

LIGHT DUTY UTILITY ARM

COLD TEST PROGRAM RESPONSIBILITIES

APPENDIX C

LIGHT DUTY UTILITY ARM (LDUA) COLD TEST PROGRAM RESPONSIBILITIES

1.0 LDUA PROGRAM MANAGEMENT ORGANIZATION (REMOTE SYSTEM AND SENSOR APPLICATIONS)

- Has responsibility for the overall conduct of the pre-operational testing phase for LDUA process equipment.
- Establishes testing requirements, schedules, and determines the need for a pre-operational readiness review.
- Assigns test related responsibilities commensurate with goals, funding, and manpower levels.
- Approves the test plans, test procedures, and test reports.
- Has the responsibility to ensure testing is conducted in accordance with WHC safety and conduct of operations requirements.
- Responsibility for providing cold test facility and test equipment.

1.1 COLD TEST COORDINATOR

- Overall responsibility for maintaining and controlling the cold test program.
- Provides pre-operational testing liaison between the designated LDUA and FMEF organizations.
- Reports status of test documentation activities and provides input to support testing schedule development.
- Provides liaison between Safety and QA organizations for testing activities. Reviews subsystem Job Safety Analysis (JSA) related to testing.
- Prepares and issues test advisories.
- Maintains the cold test documentation data base.
- Reviews cold test procedures prior to submission for approval.
- Approves pre-operational test procedures.
- Publishes and assembles cold test logs.
- Issues cold test documentation identification numbers.
- Reviews and approves all test related sub-tiered test plans, test procedures, and test reports.
- Establishes training requirements and coordinates training of cold test participants.
- Prepares CTF safety plan for cold testing.
- Provides interface with operations organizations for operational test planning and qualification tasks.

1.2 TEST ENGINEER

- Prepares and approves test procedure to be included in the pre-operational test log. NOTE: Test procedures may also be prepared by the test performer.
- Schedules the cold test readiness reviews (as required).
- Reviews the test results and prepares and issues the completed pre-operational test log.

- Directs and/or monitors testing for compliance with cold testing requirements and procedures.
- Perform maintenance, calibration, adjustment, modification of equipment during CG&A and integration testing using appropriate resources when required.

1.3 PERSON IN CHARGE (PIC)

- Conducts pre-job briefing.
- Oversees testing and rework activities at CTF.
- Ensure compliance with procedures and safety.
- Prepare work packages, etc., required to implement testing and other activities.
- Arrange and oversees craft and technician work at CTF.
- Maintains the test log.

1.4 TEST PERFORMER

- Prepares the test procedure as assigned and per the test plan requirements.
- Performs the test in accordance with the test plan and test procedure.
- Reports test status and results for tracking testing.
- Maintains a file of documented information pertinent to the test.
- Implements QA requirements.
- Participates in all required training and pre-job briefing activities.
- Reports details about testing in the test log.

1.5 QUALITY ENGINEER

- Approves test procedures.
- Ensures that quality requirements are defined and satisfied for tests.
- Ensures that inspection planning is adequate for test.
- Monitors test activities and approves test reports.
- Reviews and approves the pre-operational test log for completeness.

1.6 SAFETY ENGINEER

- Approves test procedures.
- Ensures that safety requirements are defined and satisfied for tests.
- Reviews and approves the CTF safety plan for cold (pre-operational) testing.

1.7 COG ENGINEER

- Approves test procedures, modifications, and subsystem documentation.
- Provides technical advice on the design and operation for the subsystem of responsibility.
- Obtains detailed test procedures from providers of the subsystem of responsibility.
- Reviews test logs for the subsystem of responsibility.
- Contributes and reviews test reports for the subsystem of responsibility.
- Resolves non-conformance issues and determines corrective action.
- Prepares modification documentation as required.
- Oversees CG&A and integration testing activities.

- Establishes operator qualification requirements and maintains a list of qualified operators.

1.8 CRAFT SUPPORT

- Craft support will be supplied by ICF-Kaiser Hanford (ICF-KH).
- Craft support will generally include: Instrument technicians, millwrights, pipe fitters and electricians.
- Craft support will make major modification to the facility and test equipment as required.
- Craft support will assist in the initial LDUA system equipment setup work.
- Craft support will be used for maintenance and modification system when development activities are complete and documentation is in configuration control.

1.9 OTHER RESPONSIBILITIES

- Suppliers and other DOE site participants shall provide test procedures for their systems and equipment through the designated subsystem cognizant engineer.
- FMEF Operations shall provide the required utilities and facilities, and work control support to conduct the LDUA pre-operational testing.
- Clerical support will be required for logbook tracking, testing data base entries and any other required clerical duties in support of the cold test program.
- Mechanical and I&C technician to support equipment operation and maintenance through system development.
- UNIX System Administrator to administer the UNIX System.

1.10 TWRS

- TWRS Operations will be supplying personnel to support LDUA testing in the cold test facility. These TWRS personnel will be supporting the operation of the LDUA at the tank farms in the future. The purpose of TWRS personnel at the cold test facility is for the purpose of training them in the operation and maintenance of the LDUA system.
- Aid in the performance of the cold test program.
- Provide "hands on" experience in the operation of the LDUA system. The extent of the "hands on" experience will increase as the testing progresses.
- Prepare operations test(hot deployment) procedures.
- Establish the LDUA training plan and training procedures for hot deployment personal qualification.
- Participate in the training and final phase of the LDUA cold test program.
- Contribute to the cold test procedures.
- Provide certain subsystems and documentation for integration testing in the CTF per the EM50/EM30 memorandum of understanding.

APPENDIX D

COLD TEST FACILITY AND TEST EQUIPMENT LIST

APPENDIX D

COLD TEST FACILITY AND TEST EQUIPMENT LIST

FACILITIES:

a) Truck bay in the east end of FMEF which includes the 0'-0" level (Room 300) and the mezzanine on the 42'-6" level (Room 431).
b) Decon cell (351) on the 0'-0" level directly below the truck bay 42'-6" level mezzanine.
c) Facility modifications.
d) Utilities to operate the LDUA System during cold testing program.
   - Electrical - 110 VAC - Qty 4 - 20amp outlets in cell 351 for lights and test equipment.
   - Electrical - 110 VAC - Qty 6 - 20amp outlets on the 42'-6" level truck bay mezzanine (Required for I&C, computers, etc. that will be used during setup of the end effectors)
   - Electrical - 480 VAC/3phase - 150amp (Operations Control Trailer on 0'-0" level in truck bay)
   - Electrical - 480 VAC/3phase - 200amp Power Distribution Skid, 42'-6" level truck bay mezzanine.
   - H_2O (A water decontamination system is planned for this pre-operational test program. The decon system that will be used at the tank farm will be used for this test)
   - Air (90psi) 42'-6" level truck bay mezzanine
   - Telephones - Minimum qty 2 on the mezzanine, minimum qty 1 in the corridor out side the entrance to the decon cell (351), minimum qty 2 for the control trailer.
   - HLAN - Qty 1 line to the 42'-6" level truck bay mezzanine. (Qty 1 line to the Operations Control Trailer)
   - Instrument Air (2.5 CFM at 60 to 100psi)
   - 75 ton overhead crane.

EQUIPMENT:

This following lists equipment that will be required to conduct the cold test program. Also, refer to the general arrangement drawing of the LDUA System and equipment in the CTF.

a) Fabricate and install one 12" simulated waste tank riser in the mezzanine floor. The length of the simulated risers are 10 ft.
b) Simulated tank wall section. This is an existing item that was used for the robotics demonstration program in the 337 building high bay.
c) A tank to hold waste simulant.
d) Special lifting fixtures to transfer LDUA deployment vehicle, TRIC, and decon equipment from the 0'-0" level mezzanine.
e) Miscellaneous items. Many of the detail equipment that will be needed will be determined during the detail planning and preparation of the cold test activities. Equipment that will be included in this category are: table, desks, chairs, lights, electrical cords, danger and caution tape, etc.
f) Three 4" simulated tank risers in the mezzanine floor above room 351.

g) Miscellaneous test equipment, personnel protective equipment, communications equipment, and tools, to calibrate, trouble shoot, and repair LDUA subsystems (will be specified in test procedures).
h) Outside 12" risers(16 foot long).

APPENDIX E

LDUA CALIBRATION, GROOMING, AND ALIGNMENT INSTRUCTIONS

APPENDIX E

LDUA CALIBRATION, GROOMING, AND ALIGNMENT INSTRUCTIONS

TABLE OF CONTENTS

LDUA CALIBRATION, GROOMING, AND ALIGNMENT INSTRUCTIONS

1.0 PURPOSE

This document defines a Calibration, Grooming, and Alignment (CG&A)program for newly constructed LDUA equipment.

The LDUA program is a Technology Development Program. It is anticipated that when a LDUA subsystem arrives at the Cold Test Facility it will require verification by the Cognizant Engineer that the LDUA subsystem is complete and will perform the required functions. The purpose of the LDUA Calibration, Grooming, and Alignment program is to provide a program in which hardware, software, and documentation for an LDUA subsystem is verified to be complete before the system is released for integrated testing with other LDUA subsystems.

CG&A will be completed on each LDUA subsystem to prepare it for Integrated Tests with other LDUA subsystems. At the completion on CG&A activities for a given LDUA subsystem, LDUA personnel will have:

Received all subsystem components from the supplier.
Documented any open items that need to be completed before accepting the subsystem from its supplier and beginning Qualification Tests.
Verified setup and Power-up/down procedures by demonstration.
Verified Calibration Procedures by using them to complete calibration.
Verified subsystem interfaces are ready for Integration tests with other LDUA subsystems.
Verified that the subsystem documentation is complete and correct.
Verified operability of the subsystem functions.

2.0 SCOPE

This document applies to all LDUA hardware arriving at the LDUA Cold Test Facility (CTF). Requirements for LDUA CG&A are established in the body of WHC-SD-TP-005, "Light Duty Utility Arm System Pre-Operational (Cold Test) Test Plan".

3.0 DEFINITIONS

Calibration. Calibration is that activity which compares actual responses of a device or system, to a selected range of input stimuli, with the desired responses. This data may then be used to adjust the device or system to within acceptable tolerances; or provide corrections for future reference.

CG&A Logbook. The CG&A Logbook is a notebook reviewed and approved by the Cognizant Engineer for the system that will be used in the field to document planed and completed CG&A work on the system. It contains calibration procedures, acceptance criteria, configuration documentation, power up/down procedures, and functional test procedures.

Cognizant Test Engineer. The Cognizant Test Engineer (CTE) is the Cognizant Engineer or an individual assigned by the Cognizant Engineer to have lead responsibility for a given test. This person shall be certified as an FMEF Person-in-Charge (PIC).

Cold Test Facility Coordinator. An individual assigned by LDUA Line Management to coordinate and approve all activities in the Cold Test Facility.

Device Calibration. Device Calibration is the calibration of any device within an instrumentation or control system. Included are devices used to measure, transmit, indicate, record, alarm, control, or actuate; and such passive elements as wires, fibers, and terminal blocks required to complete the instrument function.

LDUA Cognizant Line Manager. The LDUA Cognizant Line Manager is the line manager responsible for activities within the LDUA Cold Test Facility.

Grooming and Alignment. Grooming and Alignment is the term applied to the functional check-out of instruments and equipment during the initial CTF receipt inspection and installation. This activity ensures adequate preparation of equipment and provides early identification and resolution of equipment, documentation, or procedural problems.

Interlocks. Interlocks are defined as devices and associated circuits designed to prevent one or more parts of a system from being energized, or from continuing to operate when related parts of the system have failed to operate or have reached and operational limit.

Integration Test. The Integration Test for a LDUA subsystem is a testing phase that follows CG&A completion. It is used to demonstrate functionality of LDUA subsystems working together. This test includes a more formal repeat of some CG&A activities and completes the system development/rework tasks and prepares the equipment for the formal Qualification Test.

Line-out. Line-out is a method of highlighting or marking a drawing to indicate that the equipment, device, or component so marked is properly installed and correctly performs it intended functions. A semi-transparent marking pen(high-lighter) is used to overlay all circuits and items verified by test to be functioning correctly.

Loop Calibration. Loop calibration is the verification of acceptable responses of all devices within a control loop to inputs applied to the initial instrument in the loop, when all components are connected in the specified configuration.

Person-in-Charge. The Person-in-Charge (PIC)is the person responsible for managing a specific work activity in the LDUA CTF. The PIC must be qualified by attending the FMEF PIC training program.

Redline. Redline is the process of marking the field copy of system documents to show "as built" or "as found" configuration.

Subsystem. The term subsystem is used in this document to mean a component of a complete LDUA system. Within the LDUA project each of the major functional components/subsystems has an assigned LDUA "system number".

4.0 RESPONSIBILITIES

4.1 COGNIZANT ENGINEER

The Cognizant Engineer is responsible for the overall conduct of the CG&A including:

1. Prepare/Approve CG&A functional test procedures.

2. Maintain a CG&A Logbook for field use.

3. Evaluating completed instrument calibration data for acceptability.

4. Maintain configuration control during CG&A.

5. Prepare/Approve Integration Test procedures

6. Review the design of the LDUA subsystem and any calibration devices, or apparatus.

7. Maintain an "Open items/Test Exceptions List".

8. Approve rework/modifications and retest procedures required to complete CG&A and Integration Tests.

9. Submit system documentation for formal configuration control previous to Qualification Testing, as soon as the subsystem development activities are complete.

10. Review CTF activities for proper use of Personal Protective Equipment.

11. Establishes operator qualification requirements and maintains a list of qualified operators.

4.2 COGNIZANT TEST ENGINEER

The Test Engineer(may be Cognizant Engineer) is responsible for:

1. Scheduling resources required to complete testing or rework activities (including technicians, crafts, test equipment, safety, QA, Lock & Tag, other engineering support, etc.).

2. Maintain the CG&A Logbook to reflect status of testing.

3. Preparing for and document a Pre-Job briefing defining safety hazards, PPE, and work scope for those involved in all work evolutions.

4. Insuring Calibration Equipment and Transfer Standards are in calibration and are documented in the CG&A Logbook.

5. Document nonconformances and recommend corrective action for approval of the Cognizant Engineer.

6. Completing Line-out and redline of system documentation as components and functions are verified.

7. Operation of LDUA equipment during CG&A/Integration testing.

8. Isolating system or equipment before starting activities that would endanger personnel, or equipment. (NOTE: The FMEF Lock and Tag system will be used for all tags that are hung in the CTF.)

4.3 COLD TEST FACILITY COORDINATOR

The Cold Test Facility (CTF) Coordinator responsible for overall CTF coordination of activities. These responsibilities include:

1. Review of Pre-job briefing documentation.

2. Review of CG&A Logbooks, procedures, and documentation.

3. Preparing and maintaining the CTF master schedule.

4. Releasing CG&A or Integration activities for work.

5. Ensure system documentation is under configuration control before Qualification Tests begin.

6. Document monthly safety walk-through of the CTF.

7. Organize regular CTF coordination/planning meetings.

8. Allocate physical space within the CTF for all LDUA activities.

4.4 LDUA COGNIZANT LINE MANAGER

The LDUA Cognizant Line Manager is responsible for the overall safe conduct of all activities in the Cold Test Facility.

1. Approve documentation released for formal WHC configuration control.

2. Maintain access to PPE for use by CTF support staff.

3. Participate in monthly safety walk-through of the CTF.

5.0 REQUIREMENTS

5.1 INTRODUCTION

Calibration, Grooming and Alignment is a program used to demonstrate proper installation and functional performance, and to provide early identification of problem areas. Timely resolution of "open issues/test exceptions" during CG&A provide a method to prepare the LDUA subsystems for Integration Tests and Qualification Tests with minimum impact on the CTF schedule.

During CG&A all protective and control devices and all instruments should be tested, adjusted and/or calibrated to verify readiness for Qualification Testing. All wiring, including vendor supplied wiring shall be inspected to verify adequacy of installation. To the extent that is practical, all mechanical components should be inspected, cleaned, lubricated, and adjusted as necessary to ensure proper operation. CG&A documentation needs to be in a form that with be easily transferable to others for development of, the subsystem Integration Test Procedure, LDUA Qualification Test Procedure, EM-30 operations/maintenance training, EM-30 Maintenance/Calibration Procedures. Configuration control of all CG&A

documentation is the responsibility of the Cognizant Engineer. Release of documentation into the formal WHC configuration control system is not required until the LDUA subsystem configuration is stable and ready for Qualification Testing.

All CG&A activities shall be performed in accordance with safety practices outlined in WHC-CM-4-3, Industrial Safety Manual.

5.2 CG&A PREPARATIONS

Preparation for the CG&A of a specific LDUA subsystem, or portion thereof, shall consist of the following activities:

1. Defining system test boundaries and interfaces, a test name, and defining the scope of activities for the equipment contained within the boundaries. (Identify any components/interfaces that should not be energized, limits for values, support requirements, modularity/separation of components, special tools)

2. Obtaining or preparing calibration information and corresponding system/component documentation. (Resolution, range, accuracy, Component and assembly numbers)

3. Identifying required mechanical grooming activities. (Lubrication type, allowable adjustments, acceptable criteria for such things as temperature/vibration/force/pressure/distance, tools)

4. Developing a CG&A package, which outlines the required activities and provides for necessary data recording and approval. Tagged requirements for electrical and mechanical equipment shall be specified when appropriate for the tasks to be preformed.

5. Arranging for the preparation of calibration procedures. (Procedures that can serve as an outline for input to EM-30 Maintenance Procedures are needed)

5.3 CG&A SCHEDULES

LDUA subsystem CG&A activities are to be coordinated with the Cold Test Facility Coordinator. The Cold Test Facility Coordinator will resolve conflicts in resource priorities and interface testing schedules.

Dependent on the equipment involved, the Cognizant Engineer may conduct calibration or equipment grooming in the sequence that is appropriate for the subsystem.

5.4 APPROVAL OF CG&A PROCEDURE

The Cognizant Engineer shall prepare the CG&A procedure for review by the Cold Test Facility (CTF) Coordinator. The Cognizant Engineer shall also route for approval or hold a review meeting with additional individuals the Cognizant Engineer determines to be appropriate such as the LDUA Cognizant Line Manager, Industrial Safety, QA, or peer individuals.

5.5 CONDUCT OF CG&A

The Cognizant Test Engineer shall communicate with other individuals working in the CTF, and post appropriate notices to insure that the subsystem testing is not disturbed by others working in the CTF, and others are not

subjected to unknown safety hazards.

The Cognizant Test Engineer shall maintain a Test Log that documents test activity, progress, problems, nonconformances, delays, significant issues, etc.. Information of a general nature shall be noted in the LDUA CTF logbook on the CTF level where work is being done. Entries shall be made in the CG&A Logbook indicating completion of CG&A outline section and steps as appropriate.

All interlocks and functions of a subsystem should be verified during CG&A.

CG&A activities shall not go beyond the scope of the CG&A procedure outline(see "Changes to CG&A procedure outlines" section below).

During the performance of the CG&A activities, the schematics, wiring diagrams, block diagrams that document the subsystem configuration in the CG&A Logbook are to be lined out as the work progresses (line out, uses highlighting to indicate that the component/interlock/circuit is in place or terminated as shown and operates as shown). Tests are to be performed on all circuits to confirm function, response , and operability in accordance with the diagrams/drawings. Redline entry of "as found" condition shall be used to define discrepancy from the documentation provided (Redline, indicates corrections that should be made in final documentation).

The Cognizant Engineer directs the CG&A activities, evaluates test results, resolves nonconformance, approves modifications, establishes retest requirements, and maintains the official CG&A files.

CG&A activities shall be as systematic as practical (testing all inputs, outputs, actuators, functions) and performed in the final configuration if possible.

The Cognizant Test Engineer shall verify that the calibration of all test equipment is current.

Calibration accuracy, resolution, and acceptance criteria shall be available to the person responsible for equipment calibration.

5.6 CHANGES TO CG&A PROCEDURE OUTLINES

Activities that expand the scope of the original plan shall be approved by the Cognizant Engineer and the Cold Test Facility Coordinator or the LDUA Cognizant Line Manager.

The scope change approval shall be documented in the CG&A Logbook before beginning activities that are part of the change in scope.

The Cognizant Engineer shall add additional documentation to the CG&A Logbook as required to support changes in scope or documentation of modifications.

5.7 DOCUMENTATION

During performance of the CG&A activities on the LDUA subsystem the Cognizant Engineer shall maintain the official copy of the CG&A Logbook (procedure outlines, scope revision approvals, data sheets, line-out/redline drawings, calibration sheets, etc.). The Cognizant Engineer shall issue an Integration Test Procedure for the subsystem before CG&A activities can be

considered complete. When the CG&A activities are complete the CG&A logbook shall be entered into the LDUA official project files.

6.0 PROCEDURES

Checklist for CG&A Logbook. (See section 8. for typical format.) The following items shall be part of the CG&A logbook before CTF activities begin.

1. Test boundaries clearly defined.
2. Required sequential activities clearly listed.
3. Hazards identified.
4. Tagouts/isolation clearly listed.
5. Subsystem test configuration been clearly defined.
6. PPE requirements listed.
7. Special tools and fixture/jigs listed.
8. Subsystem documentation(drawings/sketches are included.
9. Prerequisites identified.
10. Accuracies/resolutions/limits clearly listed.
11. Acceptance criteria defined.
12. Assemblies/components to be tested are identified.
13. Space to record results/completion.
14. Space to log test progress/exceptions/retest information.

7.0 CG&A COMPLETION CHECKLIST

CG&A on a LDUA system is complete when the Cognizant Engineer has:

1. Verified that all subsystem components have been received from the supplier.

2. Verified Calibration Procedures by completing calibration.

3. Verified setup and Power-up/down procedures by demonstration.

4. Verified operability of the subsystem functions by performing the CG&A procedure.

5. Verified that the subsystem documentation is complete and correct.

6. Completing an Integration Test Procedure for the system.

7. Verified subsystem interfaces are ready for Integration Tests with other subsystems.

8. Corrected all significant "Open Items/Test Exceptions" discovered during CG&A activities.

8.0 OUTLINE OF TYPICAL CG&A

The CG&A Logbook provides guidance and a checklist for the conduct of CG&A, a means of describing the intended scope, sequence of activities, and associated equipment isolation requirements.

The CG&A Logbook contents and sequences will vary with each LDUA subsystem. The intent is that all equipment to be tested shall be identified,

and test sequences which promote the efficient completion of the work consistent with safe operations be listed.

A Typical CG&A Logbook includes the following:

1.0 TABLE OF CONTENTS

2.0 PURPOSE AND SCOPE
The scope description should reference a set of boundary drawings or sketches to clarify the work scope. Boundary drawings are aids and need not be updated in the CG&A Logbook.

3.0 TEST OUTLINE
Signature pages
Prerequisites before testing
Isolation before and during testing
Test Sequence order (such as, Electrical components, mechanical components, logic/interlocks, Calibration, functional verification)

4.0 TEST INSTRUCTIONS AND DATA SHEETS
Electrical/Mechanical inspection
Electrical/Mechanical Documentation verification
Electrical/Mechanical verification of functions
Logic and Interlock tests
Electrical/Mechanical Calibration

5.0 TEST EXCEPTION/OPEN ITEMS LIST

6.0 TEST LOG

7.0 TECHNICAL DOCUMENTATION
Required Drawings (Line-out drawings)
Reference Drawings
O&M manuals/Vendor Information

9.0 OPEN ITEMS/TEST EXCEPTIONS LIST TYPICAL FORMAT

The following items will appear in a typical CG&A Open Items/Test Exceptions List.

1. Item #
2. Date
3. Problem description
4. Corrective action reference (Documentation #, comment)
5. Date of retest
6. Date closed/Initials of Cog Eng.