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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
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1	1	Cog. Eng. G. R. Kiebel		11/30/95	N1-21						
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G. R. Kiebel 11/30/95 Signature of EDT Originator Date	D. S. Dutt 12/13/95 Authorized Representative for Receiving Organization Date	D. S. Dutt 12/13/95 Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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Light Duty Utility Arm Software Test Plan

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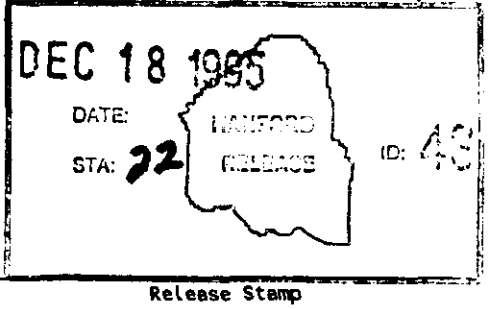
Abstract: This plan describes how validation testing of software will be implemented for the integrated control and data acquisition system of the Light Duty Utility Arm System (LDUA). The purpose of LDUA software validation testing is to demonstrate and document that the LDUA software meets its software requirements specification.



J C Perkins 12/18/95
Release Approval Date

Release Stamp

Approved for Public Release

SOFTWARE TEST PLAN FOR THE INTEGRATED LIGHT DUTY UTILITY ARM SYSTEM

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE

This plan describes how validation testing of software will be implemented for the integrated control and data acquisition system of the Light Duty Utility Arm System (LDUA). The purpose of LDUA software validation testing is to demonstrate and document that the LDUA software meets its software requirements specification (reference 3).

1.2 SCOPE

This plan applies to the validation testing of the LDUA control and data acquisition system software as single entity that is completely integrated with the complete LDUA Baseline System. It does not apply to any verification testing at the component or subsystem level (refer to section 15.2 for definition of the terms "validation" and "verification").

This plan is subordinate to the LDUA Subsystem Pre-Operational (Cold Test) Plan (reference 4) and was prepared in accordance with LDUA Software Development Plan (reference 2). The testing controlled by this plan will be part of the Equipment Qualification Tests as described by the LDUA cold test plan.

1.3 BACKGROUND

The LDUA System is being designed to deploy a family of tools, called end effectors, into underground storage tanks by means of a robotic arm on the end of a telescoping mast, and to collect and manage the data that they generate. The LDUA System uses a vertical positioning mast, referred to simply as the mast, to lower the arm into a tank through an existing 30.5 cm (12 in.) access riser. A Mobile Deployment Subsystem is used to position the mast and arm over a tank riser for deployment, and to transport them from tank to tank. The LDUA System has many ancillary subsystems including the Operations Control Trailer, the Tank Riser Interface and Confinement Subsystem, the Decontamination Subsystem, and the End Effector Exchange Subsystem. The LDUA is being designed to operate safely in the hazardous (high radiation, flammable gasses, corrosive chemicals) environment typical of the 177 underground storage tanks at the Hanford site and underground storage tanks located at other DOE sites.

The LDUA is being implemented by a consortium of DOE sites, National Laboratories, and commercial partners including Westinghouse Hanford Company (WHC), Sandia National Laboratories (SNL), Oak Ridge National Laboratory (ORNL), Pacific Northwest Laboratory (PNL), the Savannah River Site (SRS), the Idaho National Engineering Laboratory (INEL), and Spar Aerospace Ltd. (Spar)

The control and data acquisition system is made up of components supplied by these sites or by commercial partners under contract to them.

2.0 TEST ITEMS

The item to be tested under this plan is the entire LDUA control and data acquisition system software in its integrated form installed in the actual LDUA Baseline System. The configuration of the LDUA Baseline System is described in reference 6.

3.0 FEATURES TO BE TESTED

All the functions of the LDUA control and data acquisition system as defined by the LDUA Computer Software Requirements Specification (CSRS) (reference 3) will be tested under this plan. In practice, testing will focus on the controls and displays that make up the operator interface for will be tested. The specific functions to be tested are grouped according to the following list. Each entry in the list names the group of functions and the related section of the CSRS that defines the requirements for it.

CSRS Section	Feature to be Tested
3.1.1	LDUA Mast and Arm Control
3.1.2	LDUA Mobile Deployment Subsystem Control
3.2.3.2	LDUA Shoulder Camera Control
3.2.3.9	Tank Riser Interface and Confinement (TRIC)
3.1.4	World Model
3.1.3	Motion Preview/Collision Detection
3.2.1	Data File Log
3.2.2	Video Display and Recording
3.2.3.1	Topographical Mapping Subsystem
3.2.3.5	Optical Alignment Scope
3.2.3.4	Overview Video Camera System
3.2.3.5	Overview Stereoscopic Video Camera System
3.2.3.6	High Resolution Stereoscopic Video Camera System
3.2.3.7	Still/Stereoscopic Photographic System
3.2.3.8	Operations Overview Video Subsystem
3.2.3.10	Decontamination Subsystem - Water
3.6.1	Security
3.4.2	Number of Users Supported
3.4.3	On-line Storage

4.0 FEATURES NOT TO BE TESTED

Subsystems that are not in the LDUA Baseline System (reference 6), including new end effector subsystems, will not be tested under this plan. Their integration and qualification will be controlled as part of the on-going LDUA program for capability enhancements following the qualification of the LDUA Baseline System.

5.0 APPROACH

The validation testing of control and data acquisition system software controlled by this software test plan shall be performed by operating the completed LDUA System from its normal operator interfaces. Inputs described by a test case shall be applied to the control and data acquisition system and the response of the LDUA System to these items shall be captured and checked for correctness against the expected results described for the test case. There shall be one or more test cases for each feature to be tested as described in Section 4.0 that shall be collected together as part of a test specification for that feature.

Validation testing shall be performed as part of the Equipment Qualification Test LDUA Pre-operational (Cold Test) testing. It shall be performed according to documented and approved procedures, and the results shall be documented and approved. The testing shall be independent, that is, it shall be performed by individuals who are not responsible for the technical content of the software being tested. Exceptions shall be handled as specified in the LDUA Cold Test Plan (reference 4). Corrective changes to the software as a result of test exceptions shall be controlled as per the configuration management section of the LDUA Software Development Plan (reference 2).

6.0 ITEM PASS/FAIL CRITERIA

The LDUA control and data acquisition system integrated software must successfully execute all tests specified by this plan in order to pass.

7.0 SUSPENSION CRITERIA AND RESUMPTION REQUIREMENTS

The failure of the LDUA control and data acquisition system integrated software to pass a specific test shall cause suspension in the software testing. When a new, corrected version of the software is delivered and installed on the LDUA System, testing may resume.

8.0 TEST DELIVERABLES

1. Software Test Plan: This document.

2. Software Test Specifications: Describe all the testing for one of the features to be tested that are defined in Section 4. A test specification lists the particular features of the software that will be tested, refinements to the general testing approach that will be used for the test, and the pass/fail criteria that applies to the test. The test specification also contains a number of specific software test cases. Each software test case will describe the inputs to be applied to the system, the condition that the system must be in, and the outputs from system that are to be expected in response to the inputs. This test plan document provides a set of software test specifications as appendices. They are considered as guidelines. The final versions of the test specifications will be developed as part of the process of writing the software test procedures.

3. Software Test Procedures: A software test procedure will be written to implement the final version of each software test specification. The procedure will describe the actual sequence of actions, observations, and measurements which must be performed to do the test. The procedure will also describe prerequisites and the condition of the LDUA System that are required before the test can be performed. A copy of the final test specification will be included in the procedure that implements it.

4. Test Log: Will be created and maintained as defined by the Cold Test Plan (reference 4).

5. Software Test Report: Will summarize the software validation testing that was performed and the results.

9.0 TESTING TASKS

Task	Responsibility	
Prepare Software Test Plan	LDUA Software Cog Engineer	
Finalize Software Test Specifications	LDUA Software Cog Engineer	
Prepare Software Test Procedures	LDUA Software Cog Engineer	

Conduct Software Tests	Test Performer (may require assistance of approved LDUA operator for some tests)	
Write Software Test Report	LDUA Software Cog Engineer	

Under the provisions of the LDUA Software Development Plan (reference 2), the LDUA Software Cog Engineer shall be Custodian of the software under test and shall be the system manager for the computers in the LDUA System.

10.0 TESTING ENVIRONMENT

The software shall be tested in the final operational configuration of the LDUA integrated system as described in the LDUA Cold Test Plan (reference 4), with all system software installed and operating.

11.0 RESPONSIBILITIES

Organizational responsibilities are covered by the LDUA Cold Test Plan (reference 4).

12.0 STAFFING AND TRAINING NEEDS

The LDUA Software Cog Engineer will be required to support the testing activity full time. This individual will need to be familiar with the operating systems and key software packages in the LDUA System. Training may be required.

The Cog Engineers for the LDUA System will also participate in the software testing by reviewing test plans, software test specifications, and software test procedures. The LDUA Technical Lead will review the testing documentation and assist in resolving component integration issues.

13.0 SCHEDULE

The schedule for the testing described by this document shall be controlled and documented by the overall LDUA level III schedule document.

14.0 RISKS AND CONTINGENCIES

The LDUA System must be in actual operation for many of the tests controlled by this test plan. Appropriate equipment and operation safety procedures must be followed, which are identified by the LDUA Cold Test Plan (reference 4).

The LDUA System will not be in production operation during the testing period so there is no risk to any on-going production activities, nor is any contingency planning required to support any production activities.

15.0 DEFINITIONS

15.1 ACRONYMS

ANSI	American National Standards Institute
API	Application Programming Interface
ATIE	At-Tank Instrumentation Enclosure
BOFFO	Block Oriented Flexible File Organization
CDR	Conceptual Design Review
CG&A	Calibration, Grooming, and Alignment
CSDD	Computer Software Design Description
CSRS	Computer Software Requirements Specification
DDR	Detail (80%) Design Review
DOE	U.S. Department of Energy
EE	End Effector
EEES	End Effector Exchange Subsystem
FTP	File Transfer Protocol
GISC	Generic Intelligent System Controller
GUI	Graphic User Interface
HMI	Human-Machine Interface
I&C	Instrumentation and Control
INEL	Idaho National Engineering Laboratory
LDUA	Light Duty Utility Arm
MDS	Mobile Deployment Subsystem
NFS	Network File System
ORNL	Oak Ridge National Laboratory
ORR	Operational Readiness Review
PDR	Preliminary (25%) Design Review
PNL	Pacific Northwest Laboratory
SCS	Supervisory Control System
SDAS	Supervisory Data Acquisition System
SNL	Sandia National Laboratories
SRS	Savannah River Site
TCP/IP	Transmission Control Protocol/Internet Protocol
TIP	Tool Interface Plate
TRIC	Tank Riser Interface and Confinement Subsystem

V&V	Verification and Validation
VCR	Video Cassette Recorder
WHC	Westinghouse Hanford Co.

15.2 TERMS

Application Software Is software which performs or supports the performance of the primary service or function of the LDUA system. Application Software is the general term applied to the software covered by this software requirements specification.

Computer Software Media Is the different kinds of tapes, discs, etc. used by the computer for storing and retrieving software.

Computer Software Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system.

Configuration Management The process of identifying and defining the configuration items in a system, controlling the release and change of these items throughout the system life cycle, recording and reporting the status of configuration items and change requests, and verifying the completeness and correctness of configuration items.

Interactive refers to those applications where a user communicates with a computer program via a terminal, entering data and receiving responses from the computer.

On-line describes information or a function that is immediately available to the user from the computer, no preparatory work is required.

System Software - software which directly manages the physical computer resources on behalf of application software, and which supports it. For LDUA, this includes the computer operating system and its utility programs, data base management system, the language compiler.

Software Life Cycle The period of time that starts when a software product is conceived and ends when the product is no longer available for use.

Validation The process of evaluating software at the end of the software development process to ensure compliance with software requirements.

Verification The process of determining whether or not the products of a given phase of the software life cycle fulfill the requirements established during the previous phase. The act of reviewing, inspecting, testing, checking, auditing, or otherwise establishing and documenting whether or not items, processes, services, or documents conform to specified requirements.

16.0 REFERENCES

1. WHC-SD-TD-FRD-003, Functions and Requirements for the Integrated Light Duty Utility Arm System, Westinghouse Hanford Company. (Draft)

2. WHC-SD-TD-SDP-001, LDUA Software Development Plan, Westinghouse Hanford Co.

3. WHC-SD-TD-CSRS-001, Computer Software Requirements Specification For The Integrated Control And Data Acquisition System Light Duty Utility Arm System, Westinghouse Hanford Co.

4. WHC-SD-TD-TP-005, Light Duty Utility Arm System Pre-Operational (Cold Test) Test Plan, Westinghouse Hanford Co.

5. WHC-S-124, Specification For The Light Duty Utility Arm and Deployment System, Westinghouse Hanford Co.

6. WHC-SD-TD-ER-005, Light Duty Utility Arm Baseline System Description, Westinghouse Hanford Co. (Draft)

TEST SPECIFICATION TS-A: LDUA Mast and Arm Control

1. Features To Be Tested

a. Teleoperation (human-in-the-loop)
b. Automatic sequences
c. Joint mode and cartesian mode
d. Parameter settings

2. Refinements To Testing Approach

NOTE: The details of the basic mast and arm control are determined by the LDUA specification (reference 5). The LDUA manufacturer is required to develop and perform performance and acceptance tests for the LDUA and for the Vertical Positioning Mast. This test specification will be revised as the details of the LDUA manufacturer's test become known.

3. Test Case Outline

Number	Description
TS-A-C1	System Parameters - The operator shall enter the system parameters - riser length, height, and inclination - end effector length, weight, CG, ID
TS-A-C2	Pre-defined Autosequence - The operator shall load pre-defined autosequences from the LDUA Console and shall command each autosequence to be executed, first with simulation enabled and then with simulation disabled. The operator shall verify that the actual and simulated motion of the mast and arm match each other and match the expected motion. Autosequences will be in joint mode and cartesian mode (both world and tool space).
TS-A-C3	Teleoperation - The operator shall operate the mast and arm in teleoperation mode first with simulation enabled and then with simulation disabled. The operator shall change the settings for maximum tip and joint speeds and verify the effect on the mast and arm motion.
TS-A-C4	Define autosequence - The operator shall construct an autosequence by operating in teleoperation mode with simulation enabled in the LDUA Subsystem Controller. During the teleoperated motion of the

mast and arm, the operator shall designate positions of the arm that are to be part of the autosequence. When the autosequence is complete, the operator shall disable simulation and command the autosequence to be executed. The operator shall then construct an autosequence by entering the series of goal positions as numeric values at the LDUA Console. This autosequence shall be executed in a similar fashion to the one constructed by teleoperation.

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-B: LDUA Mobile Deployment Subsystem Control

1. Features To Be Tested

a. Control of translation and rotation axes
b. Minimum motion increment

2. Refinements To Testing Approach

NOTE: The details of the basic mast and arm control are determined by the LDUA specification (reference 5). The LDUA manufacturer is required to develop and perform performance and acceptance tests for the LDUA Mobile Deployment System. This test specification will be revised as the details of the LDUA manufacturer's test become known.

3. Test Case Outline

Number	Description
TS-B-C1	Range of motion - The operator shall operate the translational and rotational axes of the Mobile Deployment System over their full range of travel from the pendant and from the LDUA Console.
TS-B-C2	Rotational axes - move to predefined angle - The operator shall operate the rotational axes and shall monitor the inclinometers mounted on the Vertical Positioning Mast Housing in order to set each axis to a predefined angle. This shall be done from the pendant and from the LDUA Console.
TS-B-C3	Translational axes - move to predefined target - The operator shall operate the translational axes to position the centerline of the mast to a predefined target point. This shall be done from the pendant and from the LDUA Console.
TS-B-C4	Minimum motion increment (bump) - The operator shall "bump", that is, operate each translational and rotational axes to achieve the minimum incremental motion. This shall be done from the pendant and from the LDUA Console.

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-C: LDUA Shoulder Camera Control

1. Features To Be Tested

a. Camera Control
b. View Control

2. Refinements To Testing Approach

NOTE: The details of the LDUA shoulder camera control are determined by the LDUA specification (reference 5). The LDUA manufacturer is required to develop and perform performance and acceptance tests for the LDUA and for the Vertical Positioning Mast. This test specification will be revised as the details of the LDUA manufacturer's test become known.

3. Test Case Outline

Number	Description
TS-C-C1	Camera control - Focus (near/far) - Iris (open/close/auto) - Zoom (in/out) - Lights (on/off)
TS-C-C2	View Control - Pan (control, monitor position) - Tilt (control, monitor position)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-D: Tank Riser Interface and Confinement (TRIC)

1. Features To Be Tested

There are no features of the TRIC that are under control or monitoring of the LDUA control and data acquisition software. The absence of a test specification for the TRIC might have been construed as an omission rather than the fact that there were no software test required.

2. Refinements To Testing Approach

Not Applicable.

3. Test Case Outline

Not applicable.

4. Feature Pass/Fail Criteria

Not applicable.

TEST SPECIFICATION TS-E: World Model

1. Features To Be Tested

a. Tank interior surfaces
b. Tank internal structures
c. Tank frame coordinate system
d. Animated model of the LDUA mast and arm
e. Models of other LDUA in-tank equipment
e. Waste surface contour
f. Minimum approach distance
g. Operator viewing perspective

2. Refinements To Testing Approach

Since the LDUA System will be operated in the Cold Test Facility during the testing, a World Model of the Test Cell will be used. This test shall be performed from the Operations Workstation, the LDUA Console, and the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-E-C1	Test Cell interior surfaces - walls, dome, and floor present and position verified by inspection
TS-E-C2	Test Cell internal structures - risers, saltwells, and other structures present and position verified by inspection.
TS-E-C3	Operator viewing perspective - The operator shall observe the World Model on the Operations Workstation and shall verify that it can be viewed from any angle and with an acceptable range of magnification/reduction.
TS-E-C4	Tank Frame of reference - The origin of the coordinates for the world frame (tank frame) of reference will have been established somewhere on the floor of the Test Cell to correspond with the convention adopted for the tanks where the origin will be the bottom center of the tank. The operator shall establish this world frame for the Test Cell by entering the information at the LDUA Console.

TS-E-C5 Mast/Arm animated model

- The operator shall then operate the mast and arm from the LDUA Console and observe the motion and position of the animated model of them in the World Model on the Operations Workstation. The operator shall verify that the animated motion and position accurately represents the actual motion and position of the mast and arm.

TS-E-C6 Waste surface map conversion/merge

- The operator shall, from the Data Acquisition Workstation, command the Topographical Mapping System to scan the surface of the simulated waste in the tank wall test fixture and to save the scan in a data file (Note: This requires that the LDUA System has undergone the testing mandated by test specification I). The operator will then, from the Operations Workstation, command that the information from the data file be converted into a format (polygons) suitable for the World Model and merged into the World Model.

TS-E-C7 Collision Queue/minimum approach distance

- The LDUA Software Cognizant Engineer shall establish and enable the collision queue for the World Model. This queue shall include the mast and arm, and all parts of the Test Cell interior and internal structure that lie within the operating envelope of the mast and arm. The near-miss distance shall be set to 30 cm.

TS-E-C8 Tank World Model inspection/verification

- A World Model of the tank to be used for the initial hot deployment shall be available and shall be verified by inspection and comparison to Test Cell World Model.

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-F: Motion Preview/Collision Detection

1. Features To Be Tested

a. LDUA mast and arm motion preview
b. Collision detection
c. Previewed motion execution

2. Refinements To Testing Approach

NOTE: The tests created for test specifications TS-E and TS-A must be successfully completed before this any tests created for this test specification can be undertaken.

3. Test Case Outline

Number	Description
TS-F-C1	Pre-defined autosequence w/o collisions - The operator shall load pre-defined autosequences from the LDUA Console and shall preview them on the Operations Workstation with simulation enabled in LDUA Subsystem Controller. Collision checking shall be enabled in the World Model from the Operations Workstation. Following preview of an autosequence, the operator shall disable simulation at the LDUA Console and shall command the autosequence to be executed by the actual mast and arm. The operator shall verify that the actual motion matches the previewed motion. The pre-defined autosequences will include some that are in joint space and some that are in cartesian space in both world frame and tool frame.
TS-F-C2	Pre-defined autosequence w/ collisions - The operator shall load several pre-defined autosequences that will cause collisions to be detected during the preview. Preview shall halt at the point when the collision is detected indicate where. The operator shall verify that these collisions are properly detected and indicated.
TS-F-C3	Teleoperation - The operator shall operate the mast and arm in teleoperation mode and shall preview them on the Operations Workstation with simulation enabled in the LDUA Subsystem Controller. With collision checking disabled in the World Model from the Operations Workstation, the previewed motion should be as fast as the actual motion would be, and should be an accurate representation of it.

TS-F-C4 Define autosequence

- The operator shall construct an autosequence by operating in teleoperation mode with simulation enabled in the LDUA Subsystem Controller and collision checking disabled in the World Model from the Operations Workstation. During the teleoperated motion of the mast and arm, the operator shall designate positions of the arm that are to be part of the autosequence. When the autosequence is complete, the operator shall enable collision checking in the World Model from the Operations Workstation and shall preview the whole autosequence, and execute it when the preview is complete.

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-G: Data File Log

1. Features To Be Tested

a. Data File Log entry
b. Data File Log recall and display

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-G-C1	Make Data File Log entry - Video Tape - Water Decon System data log file - TMS data file
TS-G-C2	Examine Data File Log/verify correctness and references

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-H: Video Display and Recording

1. Features To Be Tested

a. Video Switcher
b. Video Cassette Recorders (VCRs)
c. Data Overlay
d. Split Screen

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation. Video signals from test sources may be used for inputs from external subsystems.

3. Test Case Outline

Number	Description
TS-H-C1	Video switcher - For each video monitor and VCR, switch signals from all appropriate sources
TS-H-C2	VCR control - Play, Record, Rewind, Fast Forward, Search - Display status
TS-H-C3	Split Screen - Four sources on one screen
TS-H-C4	Date/time/title overlay - Overlay date, time, and an appropriate title onto the video tape
TS-H-C5	Arm position overlay - Overlay mast and arm position onto the video tape

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-I: Topographical Mapping Subsystem

1. Features To Be Tested

a. Basic Operation/Scan Control
b. Data file format verification
c. Data file integrity

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-I-C1	Basic operation/Scan control - Various surface maps of the interior surfaces of the Test Cell shall be taken. The operator shall access the scan data files and display them on the Data Acquisition Workstation.
TS-I-C2	Data file format verification - The BOFFO file reader utility shall be used to verify that the scan data files are in the proper format.
TS-I-C3	Data file integrity - The scan data files shall be compared to versions made by the Topographical Mapping Subsystem when operating independently of the SDAS to verify that mapping performance (accuracy, etc) is not degraded.

4. Feature Pass/Fail Criteria

The software must successfully execute all test cases.

TEST SPECIFICATION TS-J: Optical Alignment Scope

1. Features To Be Tested

a. Boresight camera control
c. Alignment laser control
d. Riser clearance sensors (proximity detectors) control and monitoring

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-J-C1	Camera control - Focus (near/far) - Iris (open/close) - Zoom (in/out) - Lights (on/off)
TS-J-C2	Clearance (spot) laser - on/off
TS-J-C3	Alignment (line) laser - on/off
TS-J-C4	Clearance sensors - on/off - monitor distance readings

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-K: Overview Video Camera System

1. Features To Be Tested

a. Camera control
b. View Control
c. Deployment Control

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-K-C1	Camera control - Focus (near/far) - Iris (open/close/auto) - Zoom (in/out) - Lights (on/off)
TS-K-C2	View Control - Pan (control, monitor position) - Tilt (control, monitor position)
TS-K-C3	Deployment Control - Height (raise/lower, monitor position)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-L: Overview Stereoscopic Video Camera System

1. Features To Be Tested

a. Camera control
b. View Control
c. Deployment Control

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-L-C1	Camera control - Focus (near/far) - Convergence (in/out) - Magnification (rotate lens turret) - Lights (on/off)
TS-L-C2	View Control - Pan (control, monitor position) - Tilt (control)
TS-L-C3	Deployment Control - Height (raise/lower, monitor position)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-M: High Resolution Stereoscopic Video Camera System

1. Features To Be Tested

b. General control
b. High resolution camera control

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-M-C1	General control - Select camera set (normal/high resolution) - Lighting (on/off)
TS-M-C2	High resolution camera control - Focus (near/far) - Convergence (in/out)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-N: Still/Stereoscopic Photographic System

1. Features To Be Tested

a. Video viewfinder camera control
b. Photo camera control

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation. The operator shall operate the mast/arm from the LDUA Console to place the High Resolution Stereoscopic Video System in several positions using its video camera to achieve the exact view desired (visual targets may need to be provided for this). The operator shall, at each position, trigger the photo camera's shutter and frame advance from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-N-C1	Video viewfinder camera control - Lighting (on/off)
TS-N-C2	Photo camera control - Power (on/off) - Zoom (in/out) - Shutter (trip)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-O: Operations Overview Video Subsystem

1. Features To Be Tested

a. Camera control
b. View Control

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-O-C1	Camera control - Focus (near/far) - Convergence (in/out) - Magnification (rotate lens turret) - Lights (on/off)
TS-O-C2	View Control - Pan (control, monitor position) - Tilt (control)

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-P: Decontamination Subsystem - Water

1. Features To Be Tested

a. Pump control
b. Decon spray control
c. Radiation monitor display and recording

2. Refinements To Testing Approach

This test shall be performed from the Data Acquisition Workstation.

3. Test Case Outline

Number	Description
TS-P-C1	Pump Control - Water supply system pump (on/off) - Monitor pump status (running/off)
TS-P-C2	Decon spray control - Spray on/off
TS-P-C3	Radiation Monitors - Display reading of each monitor
TS-P-C4	Decon status log - Record and display log of Radiation Monitor readings - Record and display log of decon spray on/off - Save log to file and recall for display

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-Q: Security

1. Features To Be Tested

a. Password protection

2. Refinements To Testing Approach

The LDUA Software Cognizant Engineer (as system manager for the LDUA computer systems) shall establish consistent user accounts and passwords on the Operations Workstation, Data Acquisition Workstation, Auxiliary Workstation, and LDUA Console. The operator shall verify that access is granted with the proper account name and password, and denied otherwise.

NOTE: The LDUA manufacturer is supplying the LDUA Console with a second tier of protection in the form of requiring "supervisor" access in order to make changes to the system that affect its behavior. When the implementation details of this feature are better known, an appropriate test.case will be defined.

3. Test Case Outline

Number	Description
TS-Q-C1	Accounts/passwords for LDUA workstations
TS-Q-C2	Supervisor Mode on LDUA Console

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-R: Number of Users Supported

1. Features To Be Tested

a. Simultaneous users

2. Refinements To Testing Approach

This test shall be performed from the Operations Workstation, the LDUA Console, the Data Acquisition Workstation, and the Auxiliary Workstation.

3. Test Case Outline

Number	Description
TS-R-C1	3 user operation - Three operators shall be operate the LDUA system simultaneously as follows: The first operator shall move the mast and arm from the LDUA Console while observing the motion on the World Model on the Operations Work Station; the second operator shall operate the overview camera from the Data Acquisition Workstation in order to observe and track the motion of the mast and arm; and the third operator shall use the Auxiliary Workstation to search through the data file log and to examine the contents of a previously saved history file.

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

TEST SPECIFICATION TS-S: On-line Storage

1. Features To Be Tested

a. Minimum on-line storage

2. Refinements To Testing Approach

No separate tests shall be run. The LDUA I&C Test Engineer shall verify that the Supervisory Data Acquisition System is delivered with at least 1000 megabytes of disk space.

3. Test Case Outline

n/a

4. Feature Pass/Fail Criteria

This test specification will be satisfied by the successful completion of all the other test specifications.

TEST SPECIFICATION TS-T: Auxiliary Workstation

1. Features To Be Tested

a. Video display and recording
b. Data file log viewing

2. Refinements To Testing Approach

This test will be performed at the Auxiliary Workstation

3. Test Case Outline

Number	Description
TS-T-C1	Video display and recording - switch signals from any compatible video source to the video monitors and video recorder in the visitor area of the Operations Control Trailer
TS-T-C2	Data file log - view the data file log

4. Feature Pass/Fail Criteria

The software must successfully execute all the test cases.

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	G. R. Kiebel/Remote System and Sensor Applications	Date 12/13/95
Project Title/Work Order Light Duty Utility Arm WHC-SD-TD-TP-006 "Software Test Plan for the Integrated Light Duty Utility Arm System"		EDT No. 140942 ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
T. M. Amundson	N2-10	X			
B. A. Carteret	N1-21	X			
D. S. Dutt	N1-21	X			
J. E. Ellis	N1-21	X			
G. R. Kiebel	N1-21	X			
M. E. Riste	N2-11	X			
LDUA Project File 2.1.5.1 (10)	N1-21	X			
Central Files orig. + 1	A3-88	X			
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