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Accession #: D196012485

Document #: SD-WM-ATP-158

Title/Desc:

SOFTWARE ACCEPTANCE TEST PROCEDURE FOR SURFACE
MOISTURE MONITOR

Pages: 24

JAN 29 1996

ENGINEERING DATA TRANSMITTAL

Page 1 of 2

1. EDT 140821

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) Characterization Equipment Development		4. Related EDT No.: NA	
5. Proj./Prog./Dept./Div.: 72520		6. Cog. Engr.: GF Vargo, Jr		7. Purchase Order No.: NA	
8. Originator Remarks: For approval and release				9. Equip./Component No.: NA	
				10. System/Bldg./Facility: NA	
11. Receiver Remarks:				12. Major Assm. Dwg. No.: NA	
				13. Permit/Permit Application No.: NA	
				14. Required Response Date: 1/19/96	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-WM-ATP-158	ALL	0	Software Acceptance Test Procedure for Surface Moisture Monitor	QS	1/2	1	

16. KEY					
Approval Designator (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec. 12.7)		1. Approval	4. Review	1. Approved	4. Reviewed no/comment
		2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
		3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)									
(G)	(H)	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN
1/2	1	Proj. Eng. GF Vargo, Jr	<i>GF Vargo</i>	1/25/96	H5-09	SC Cantrell	<i>SC Cantrell</i>	1/25/96	S2-02
1/2	1	Cog/Proj Mgr. CE Hanson	<i>CE Hanson</i>	1/25/96	H5-09	Central Files			A3-88
1/2	1	QA ML McElroy	<i>ML McElroy</i>	1/24/96	S7-07				
1/2	1	Safety LS Krogsrud	<i>LS Krogsrud</i>	1/25/96	R3-08				
3	1	DR Deichelbohrer	<i>DR Deichelbohrer</i>		S7-12				
1/2	1	TI Stokes	<i>TI Stokes</i>	1/25/96	L7-36				
1/2	1	M Gimera	<i>M Gimera</i>	1/25/96	L7-36				

18. M. Gimera <i>M. Gimera</i> 1/25/96 Signature of EDT Originator		19. _____ Authorized Representative Date for Receiving Organization		20. _____ CE Hanson 1/25/96 Co-plant Manager Date		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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REVIEW COMMENT RECORD (RCR)

1. Date 1/3/96			2. Review No. CP96-007	
3. Project No. N/A			4. Page 1 of 1	

5. Document Number(s)/Title(s) WHC-SD-WM-ATP-158, SOFTWARE ATP FOR SMMS	6. Program/Project/ Building Number CHARACTERIZATION PROJECT	7. Reviewer M.L. MCELROY	8. Organization/Group CPQA/3E200	9. Location/Phone 2704HV/B122 373-5588
--	--	-----------------------------	-------------------------------------	--

10. Agreement with indicated comment disposition(s)		11. CLOSED	
---	--	------------	--

17. Comment Submittal Approval:	
Organization Manager (Optional) M.L. MCELROY Date 1/26/96 Reviewer/Point of Contact M.L. MCELROY Author/Originator	 M.L. MCELROY Date 1/26/96 Reviewer/Point of Contact M.L. MCELROY Author/Originator

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold Point	15. Disposition (Provide justification if NOT accepted.)	16. Status
1.	The % of error that will be allowed needs to be indicated in the document to establish the acceptance criteria, ie. the % of error as compared to the "calibration moisture."	MLM	The allowable percent error is $\pm$ weight % 0.5	CLOSED
2.	Need to have an "Exception Sheet" to record any exceptions or discrepancies.	MLM	Agreed	
3.	FVI---There are some grammatical TYPO's, that I can give over the phone if you wish.			

SOFTWARE ACCEPTANCE TEST PROCEDURE FOR SURFACE MOISTURE MONITOR

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U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 140821

UC: 2070

Org Code: 75250

Charge Code: N4H4F

B&R Code: EW3120074

Total Pages: 21

Key Words: Moisture, surface probe, neutron.

Abstract: Provides the software acceptance test plan and procedures for software that will perform data acquisition for the surface moisture measurement system.

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Jamie Bishop 1-29-96
Release Approval Date

Approved for Public Release

**SOFTWARE
ACCEPTANCE TEST PROCEDURE
FOR
SURFACE MOISTURE MONITOR**

IMPACT LEVEL QS

**Issued by
Michael Gimera**

January 1996

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SOFTWARE ACCEPTANCE TEST PROCEDURE FOR SURFACE MOISTURE MONITOR

1. INTRODUCTION

1.1. PURPOSE

This document presents both a test plan and acceptance test procedures for testing the software that was developed to operate the Surface Moisture Measurement System (SMMS). Together with the forthcoming acceptance test report, this document satisfies the requirements in EP 4.1, "Design Verification Requirements." The selected method of design verification is qualification testing.

1.2. SCOPE

The testing described in this document covers the software that acquires data for the SMMS. In addition to the software, this testing will verify and validate the data acquisition and control hardware for the SMMS. A separate ATP will be prepared for the mechanical features not related to software.

1.3. DEFINITIONS AND ABBREVIATIONS

ATP	Acceptance Test Procedure
EP	Standard Engineering Practice (WHC-CM-6-1)
FMEF	Fuels and Materials Examination Facility
MCA	Multi Channel Analyzer
OM&M	Operations and Maintenance Manual (Reference 3)
SMMS	Surface Moisture Measurement System
SRS	Software Requirements Specification
TMAD	Software developed by S. H. Finfrock. The name was derived from the phrase "tank moisture and anomaly detection".

2. SOFTWARE TEST PLAN

The software acceptance test that is the subject of this document will test the features of the software described in WHC-SD-WM-SFR-010, Rev. 0, "Software Requirements Specification for Surface Moisture Monitor," herein referred to as the SRS. A comprehensive test will test every software feature described in the SRS. These features are listed in Section 2.2, "Features to be Tested". Related hardware will be indirectly tested.

2.1. PERSONNEL REQUIREMENTS

Each organization participating in the conduct of this test will designate personnel to assume the responsibilities and duties as defined herein for their respective roles. The names and signatures of these people shall be provided to the Test Engineer for listing on the Test Engineer's copy of the Test Data Sheet prior to the performance of any part of this test.

2.1.1. Test Engineer

The Test Engineer's responsibilities are as follows:

- ^ Notify all interested parties when a change is made in the testing schedule.
- ^ Record exceptions and test steps which are not performed.
- ^ Notify the Test Performer of exceptions when the exception is made.

2.1.2. Test Performer

The Test Performer's responsibilities are as follows:

- ^ Verify instruments are in current calibration.
- ^ Shall perform the test as described in this document.
- ^ Stop any test which, in the judgment of the Test Performer, may cause damage to the system or present a unsafe condition.
- ^ Coordinate efforts with all other assigned test performance party members.
- ^ Observe tests and record test data (if any).

2.1.3. QA Witness

The QA Witness shall observe the testing and provide a signature that the test procedures were followed and results accurately recorded on the data sheets.

2.1.4. Other Witnesses

No further witnesses are required during testing but interested observers will be allowed.

2.2. FEATURES TO BE TESTED

This section lists each of the software features that will be tested. Inherent in testing the software is some hardware testing. The extent to which the hardware will be tested is explained in each subsection. Figure 1 shows the operator interface screen that will be helpful in understanding the descriptions and procedures that follow.

Figure 1. Operator Interface Screen

2.2.1. Operator Interface Controls

The SMMS instrumentation is controlled with a computer. The front panel uses only two controls, the "Take Measurement" button and the "Options" button. Each control

can be accessed by pressing its representative icon on the computer's touch screen monitor.

When the "Take Measurement" button is "pressed" the computer will acquire data from the MCA in the NIMBIN and the signal conditioners (temperature data). Testing will verify that the operation of the button results in screen updates of the detector graphs and a new data file.

Figure 2. Options Screen

When the "Options" button is pressed, a window will be presented to the operator as shown in Figure 2. This window allows the operator to change the threshold values for each of the three detectors and to change the sampling time when acquiring data.

2.2.2. Operator Interface Indicators

The operator interface indicators consist of a graphical display of the probe position, three detector graphs (one for each detector), a temperature stabilized indicator light and the moisture percentage readouts.

When each readout is tested, the hardware associated with acquiring the data for each readout will also be tested. When comparing the information displayed and recorded

to file with the reading from calibrated instruments, these tests will provide an overall assessment of system accuracy.

2.2.2.1. Probe Position

The probe position is displayed graphically. The display shows both the compass heading and the distance from the riser centerline on a polar plot.

The first test to be performed will verify the compass heading. This test must be performed with the deployment system suspended vertically.

A graphical display of this nature does not convey a great degree of accuracy, so the test for this indicator will only confirm approximate location of the probe. The exact location of the probe will be recorded in the data file and this is the information that will be checked for accuracy.

2.2.2.2. Detector Graphs

The detector graphs each display a response spectrum of data from the detectors in the probe. These graphs can be checked for proper response (pulse voltage height) with a pulse generator that is located in the NIMBIN. In addition, the operation of the detector graphs can be verified during operation of the probe.

2.2.2.3. Temperature Stabilized

The temperature stabilized indicator is an icon that is displayed on the computers monitor. The icon represents a LED (Light Emitting Diode) that is red if the temperature has not stabilized and is green if the temperature has stabilized. As described in the SRS, stabilization is defined as a change of less than one degree Celsius over a period of five minutes.

In addition to the temperature stabilized light, the computer display contains a digital readout of each of the two thermistors that are located in the probe

To test the temperature stabilization feature, the probe must be placed in a temperature stable environment. The software will be started and the response timed with a stop watch to verify the five minutes. The temperature is also recorded to file and is used to adjust the count rates for comparison in TMAD code.

2.2.2.4. Moisture Percentage

The data obtained from the detectors will be used to calculate the moisture content of the surface of the waste. This calculation will be post processed with the TMAD program developed for this purpose.

Unofficial results will be displayed on the computer screen for feedback to the operator. This result should closely approximate the official results obtained from post processing. The SMMS LabVIEW^{TM1} program calls TMAD "C" code to obtain these moisture values. TMAD code was developed, documented and tested separately from the SMMS code.

This ATP will not provide a second verification and validation of TMAD code, but will check to verify that the interfaces with the TMAD code operate properly. This will be done by testing with the probe over calibration standards of known moisture content.

2.2.3. Data Recording

While it is important to obtain accurate data, it is also necessary to save that data in a form that can be analyzed later. The data will be stored to a computer disk file in a text format. Both the ability to record and the information recorded must be tested.

The file created by asserting the "Take Measurement" icon may be viewed with a text editor. The contents of this file will be checked to verify that the contents comply with the requirements outlined in the SRS, WHC-SD-WM-SFR-010, Rev. 0, "Software Requirements Specification for Surface Moisture Monitor."

3. ACCEPTANCE TEST PROCEDURE

This section provides the instructions to perform acceptance testing on the SMMS software. Although these procedures usually provide step-by-step instructions, this section on occasion makes reference to the Operator's Manual and the Installation Instructions.

3.1. INSTRUCTION SECTION

3.1.1. System Setup

Testing will be conducted in the 306E Lab, 305 Lab and/or FMEF. The hardware should be setup in accordance with the instructions in Section 5.1, "DAV Startup Sequence" of the OM&M (Reference 3). A 110 VAC power source (15 Amp) will be connected to the data acquisition van. Software start-up is also covered in the OM&M.

3.1.2. Take Measurement Button and Detector Graphs

Test successful initialization.

¹LabView^{TM1} is a registered trademark of National Instruments, Austin, Texas.

- 3.1.2.1 Turn on power to instrumentation per Section 5.1 of the OM&M. Computer screen should show Windows^{TM1} interface.
- 3.1.2.2 Start LabVIEWTM program by double clicking on LabVIEWTM icon.
- 3.1.2.3 Close current LabVIEWTM window by selecting "Close" from the File menu. If unfamiliar with basic Windows commands refer to the manual that came with the Windows operating system.
- 3.1.2.4 Select "Open VI" from resulting dialog box.
- 3.1.2.5 Select "SMMS.vi" from the file selector dialog box.
- 3.1.2.6 The SMMS front panel should now be displayed on the computer screen (see Figure 1). Note the result on the test data sheet.
- 3.1.2.7 Press the "Options" button icon. A data entry screen should be displayed as shown in Figure 2. Verify that the sampling time is set to five minutes.
- 3.1.2.8 Click on the LabVIEWTM "run" icon.
- 3.1.2.9 Install source in probe per instructions in the OM&M.
- 3.1.2.10 Position the probe on a calibration standard. The calibration standard is an aluminum drum filled with sand and aluminum hydrate. It is sealed with a lid. The probe should be placed on the lid near the center of the drum.
- 3.1.2.11 Press the "Take Measurement" icon.
- 3.1.2.12 Record whether the detector graphs update (page 13). Updating of graphs can be detected by the change of numbering along the horizontal axis. Also the results of the moisture percentage calculation is displayed on a pop-up window when the graphs have finished updating.
- 3.1.2.13 Record the resulting moisture percentages (page 13). Also record the maximum pulse value for each of the detector graphs.
- 3.1.2.14 Press the "Options" button icon. A data entry screen should be displayed as shown in Figure 2.
- 3.1.2.15 Change the sampling time from the default five minutes to 2.5 minutes.
- 3.1.2.16 Press in the "OK" button icon to dismiss the Options window.
- 3.1.2.17 Press in the "Take Measurement" icon to begin recording data.

¹Windows^{TM1} is a registered trademark of Microsoft Corporation, Redmond, Washington.

- 3.1.2.18 Record the maximum pulse value for each of the detector graphs. The values should be one half the values recorded in Step 3.1.2.13.

3.1.3. Moisture Percentage

A moisture percentage has already been taken in Section 3.1.2.

- 3.1.3.1 Record the value obtained in Step 3.1.2.13 of Section 3.1.2 (page 13).
- 3.1.3.2 Each calibration standard represents a particular moisture percentage. Record the moisture percentage of the calibration standard used in Section 3.1.2. This value should be within one weight percent of the value from step 3.1.3.1.

3.1.4. Detector Graphs

- 3.1.4.1 Connect the pulse generator to the Multichannel Analyzer (MCA). The pulse generator is located in the NIMBIN inside the data acquisition van. Using a 50 Ω cable with BNC connectors, attach one end to the pulse out port of the pulse generator and connect the other end to the Port 1 input of the MCA.
- 3.1.4.2 If the SMMS software is not running, start the software per instructions in the OM&M.
- 3.1.4.3 Press the "Take Measurement" control on the front panel.
- 3.1.4.4 A peak should be displayed on the Detector One graph. Record this result to the data sheets.
- 3.1.4.5 Repeat steps 3.1.4.1 through 3.1.4.4 for detectors two and three. For detector two, the pulse generator is connected the Port 2 of the MCA. For detector three, the pulse generator is connected the Port 3 of the MCA.

3.1.5. Data File Content

- 3.1.5.1 Use a text editor to view the file "C:\DATA\SMMS\mm-dd-yy\mm-dd-yy.001".

- 3.1.5.2 Verify the header information in the file matches the following:

File: mm-dd-yy.001

[Date and time stamp]

Program: Surface.vi v1.0

Probe Position: Compass heading XXX° Radial Distance: XXX ft. Depth: XXX in.

Sampling Time: XXX Minutes

- 3.1.5.3 Record the results from Step 3.1.5.2 to the test data sheet.

- 3.1.5.4 Using the text editor, verify that three arrays of data exist (one spectrum for each detector). An array of data consists of 1,024 integers. Verify that two probe temperatures exist. Verify that the results of the moisture probe calculation are written to file.
- 3.1.5.5 Record the results from Step 3.1.5.4 to the test data sheet.

3.1.6. Probe Position

- 3.1.6.1 Suspend the deployment system in the vertical position.
- 3.1.6.2 The probe position is displayed on the screen of the computer. Record the position of the probe in degrees and feet from the computer screen.
- 3.1.6.3 Assert the "Take Measurement" icon.
- 3.1.6.4 Use a text editor to read the resulting data file. The file is located in the directory, "C:\DATA\SMMS\mm-dd-yy."
- 3.1.6.5 Record the position of the probe from reading the data file to the test data sheet.
- 3.1.6.6 Using a compass measure the compass heading of the deployment arm and record to the test data sheet.
- 3.1.6.7 Using a linear scale and plumb bob record the distance of the probe from centerline or riser. The centerline of the riser is the centerline of the deployment system mast. Record result to test data sheet.
- 3.1.6.8 Using a linear scale record the distance that the probe is below the deployment system arm.

3.1.7. Temperature Stabilized

This test should be performed in the 305 lab environmental chamber .

- 3.1.7.1 Place probe in environmental chamber.
- 3.1.7.2 Wait for temperature to stabilize in chamber.
- 3.1.7.3 Start SMMS software in accordance with Section 5.1 of the OM&M.
- 3.1.7.4 Record the length of time for the "Temperature Stabilized" icon to turn from red to green. The time should be five minutes.
- 3.1.7.5 Record the temperatures displayed on the computer screen.

- 3.1.7.6 Record the temperature of the environmental chamber. This temperature should not vary more than 3° C from the temperature displayed on the computer screen.
- 3.1.7.7 Change temperature in environmental chamber.
- 3.1.7.8 Record whether the color of the "Temperature Stabilized" icon returned to red.
- 3.1.7.9 Repeat steps 3.1.7.5 through 3.1.7.8 for two additional temperatures.

3.2. TEST EXECUTION SECTION

3.2.1. Test Data Sheets

The test data sheets are shown on the following pages.

Please print name of test personnel below:

Test Engineer _____

Test Performer _____

QA/QC Representative _____

Test 3.1.2 Take Measurement Button and Detector Graphs**Step 3.1.2.6**

Is SMMS front panel displayed on the screen?

Y N

Test Engineer _____

Date _____

QA/QC Rep _____

Date _____

Step 3.1.2.7

Is the sampling time set to five minutes?

Y N

Test Engineer _____

Date _____

QA/QC Rep _____

Date _____

Step 3.1.2.12

Do detector graphs update on the screen?

Y N

Test Engineer _____

Date _____

QA/QC Rep _____

Date _____

Step 3.1.2.13

Moisture Percentage 1: Percentage _____

Pulse height _____

Moisture Percentage 2: Percentage _____

Pulse height _____

Moisture Percentage 3: Percentage _____

Pulse height _____

Test Engineer _____

Date _____

QA/QC Rep _____

Date _____

Step 3.1.2.18

Moisture Percentage 1: Percentage _____

Pulse height _____

Moisture Percentage 2: Percentage _____

Pulse height _____

Moisture Percentage 3: Percentage _____

Pulse height _____

Test Engineer _____

Date _____

QA/QC Rep _____

Date _____

Test 3.1.3 Moisture Percentage

Step 3.1.3.1

Moisture Percentage 1: Percentage _____ Pulse height _____

Moisture Percentage 2: Percentage _____ Pulse height _____

Moisture Percentage 3: Percentage _____ Pulse height _____

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.3.2

Calibration Moisture: Percentage _____

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Test 3.1.4 Detector Graphs**Step 3.1.4.4**

Detector 1: Channel _____ Pulse height _____

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.4.5

Detector 2: Channel _____ Pulse height _____

Detector 3: Channel _____ Pulse height _____

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Test 3.1.5 Data File Content**Step 3.1.5.3**

Does data file contain the header information expected in Step 2)? Y N

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.5.5

Does data file contain the data information expected in Step 4)? Y N

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Test 3.1.6 Probe Position

Step 3.1.6.2

Probe position as determined from computer screen:

Compass Heading _____ degrees

Radial Distance _____ feet

Vertical Distance _____ inches

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.6.5

Probe position as determined from data file:

Compass Heading _____ degrees

Radial Distance _____ feet

Vertical Distance _____ inches

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.6.6

Probe position as determined from manual measurements:

Compass Heading _____ degrees

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.6.7

Radial Distance _____ feet

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.6.8

Vertical Distance _____ inches

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Test 3.1.7 Temperature Stabilized**Step 3.1.7.4**

Time for LED icon to turn from red to green _____ (expected 5 minutes)

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.7.5

Temperatures displayed on screen: _____ °C _____ °C

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.7.6

Temperature of environmental chamber: _____ °C

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.7.8

Does LED icon turn from green to red when temperature changes? Y N

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

Step 3.1.7.9

Temperatures displayed on screen: _____ °C _____ °C

Temperature of environmental chamber: _____ °C

Does LED icon turn from green to red when temperature changes? Y N

Temperatures displayed on screen: _____ °C _____ °C

Temperature of environmental chamber: _____ °C

Does LED icon turn from green to red when temperature changes? Y N

Test Engineer _____ Date _____

QA/QC Rep _____ Date _____

3.3. EXCEPTIONS TO ACCEPTANCE TEST

The test exception sheet is shown on the following page.

EXCEPTIONS TO SOFTWARE ACCEPTANCE TEST FOR SMMS SOFTWARE

[illegible]

TEST APPROVED WITH EXCEPTIONS

Test Engineer

Date _____

Quality Assurance

Date _____

4. REFERENCES

1. WHC-CM-6-1, "Standard Engineering Practices".
2. ANSI/IEEE Standard 829-1983, "IEEE Standard for Software Test Documentation".
3. Ritter, G. A., 1995, *Surface Moisture Measurement System Operation and Maintenance Manual*, WHC-SD-WM-OMM-024, Rev. 0, Westinghouse Hanford Company, Richland, Washington.