ENGINEERING CHANGE NOTICE

1. ECN 615456

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental [] Direct Revision [x] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	CC Scaief III I&C-7EA10 L7-06 376-0491		9-21-94
	5. Project Title/No./Work Order No.	6. Bldg./Sys./Fac. No.	7. Approval Designator
	TMACS/N2C4P	241-G/TMACS	Q
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.)	9. Related ECN No(s).	10. Related PO No.
	WHC-SD-WM-ATP-023, Revision 4		N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [x] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

This ECN revises the document to add testing of discrete inputs.

13a. Justification (mark one)							
Criteria Change	[]	Design Improvement	[x]	Environmental	[]		
As-Found	[]	Facilitate Const.	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

This design change is required in order to provide testing of discrete inputs.

Design review for this ECN was done by Informal Review Method. SCC

14. Distribution (include name, MSIN, and no. of copies)

See distribution sheet.

RELEASE STAMP

OFFICIAL RELEASE BY WHC DATE SEP 26 1994 Sta. 21

A-7900-013-2 (06/94) GEF095

A-6000-135 (12/87) (EF) WEF067 Distribution Sheet

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 615456

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[X] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[] No	Savings	[] $	Savings	[] $	Delay	[]

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]	None	[X]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. CC Scaief III C. C Scaief III	9-22-94	PE	
Cog. Mgr. CP Schroeder Verbal Auth for	9/22/94	QA	
QA AK Sharma All Concurred	9/22/94	Safety	
Safety		Design	
Environ.		Environ.	
Other		Other	
Informal Rev. SC Cantrell Steven C Cantrell	9-22-94		
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-ATP-023, Revision 5
Document Title:	Tank Monitor and Control System Sensor Acceptance Test Procedure
Release Date:	September 22, 1994

* * * * * * * * * * * * * *

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

* * * * * * * * * * * * * *

WHC Information Release Administration Specialist:

M. Boston — M. N. Boston — 9/22/94

(Signature) (Date)

SUPPORTING DOCUMENT

1. Total Pages 18

2. Title	3. Number	4. Rev No.
Tank Monitor and Control System Sensor Acceptance Test Procedure	WHC-SD-WM-ATP-023	5

5. Key Words	6. Author
TMACS, Temperature, ATP, Current, Sensor	Name: CC Scaief III C.C. Scaief III Signature Organization/Charge Code 7EA10/N3045

7. Abstract

This Acceptance Test Procedure is to verify the correct reading of analog points connected to the Tank Monitor and Control System (TMACS).

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9. Impact Level Q

10. RELEASE STAMP

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DATE SEP 26 1994
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M. Boston 9/22/94

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-ATP-023	Page 1 of 1

(2) Title
Tank Monitor and Control System Sensor Acceptance Test Procedure

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT - 127150 12/16/91		
1	Revised per ECN 163034. This revision replaces Revision 0.	CC Scaief III	CP Schroeder
2	Revised per ECN 190467. Revision are marked by black vertical bars in the left margin. This revision replaces Revision 1.	CD Acree	CP Schroeder
3	Revised per ECN 190463. Revision are marked by black vertical bars in the left margin. This revision replaces Revision 2.	SC Cantrell	CP Schroeder
4	Revised per ECN 602562. Revisions are marked by black vertical bars in the left margin. This revision replaces Revision 3.	CC Scaief III	CP Schroeder
5 RS	Revised per ECN 615456. Revisions are marked by black vertical bars in the left margin. This revision replaces Revision 4.	CC Scaief III C.C. Scaief III	CP Schroeder for 9/22/94

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this Acceptance Test Procedure (ATP) is to verify the correct reading of sensor elements connected to the Tank Monitor and Control System (TMACS). The system functional requirements are contained in WHC-SD-WM-RD-013, REV 1 (WHC 1992a). This ATP is intended to be used for testing of the connection of existing temperature sensors, new temperature sensors, pressure sensing equipment, new Enraf level gauges, sensors that generate a current output, and discrete (on/off) inputs. The TMACS operation was verified by the original ATP (WHC 1991c). It is intended that this ATP will be used each time sensors are added to the system. As a result, the data sheets have been designed to be generic.

1.2 SYSTEM DESCRIPTION

The TMACS has been designed in response to recommendations from the Defense Nuclear Facilities Safety Board primarily for improved monitoring of waste tank temperatures. The system has been designed with the capability to monitor other types of sensor input as well. Both hardware and software requirements are defined in WHC-SD-WM-013, REV 1 (WHC 1992a). The initial work planning is described in WHC-SD-WM-075 (WHC 1991a).

The TMACS is shown in block diagram form on Drawing H-2-81761. The system consists of local signal conditioning processors (Acromag 4000 Series) mounted at or near the sensors (Acromag 1990). These units communicate via a shared cable using a serial RS-485 format. This is linked to a Workstation in 2750E, Room B-105 via a modem on a dedicated telephone line. Expansion is accommodated by adding additional local signal conditioners on the existing RS-485 cable or by adding another modem to a different local area.

The Workstation executes commercial software for data acquisition and control. The software package is the G2 software package by GenSym. This package includes a software driver for communication with the Acromag 4000 processors. The software provides an operator interface via the CRT on the Workstation. The features include alarm processing, trend displays, custom graphic displays, logging to the printer, logging to the disk, and reporting to the printer.

The Acromag provides signal conditioning, linearization as required, and conversion to engineering units for each sensor input. Each Acromag 4000 can accept up to 16 analog inputs and 16 discrete inputs. In addition, each unit reads two temperature sensors located on the termination blocks. These sensors are used for reference junction compensation when reading thermocouples.

2.0 RESPONSIBILITIES

Several organizations will participate in conducting this ATP. The following is a list of the testing responsibilities and the organizations involved:

Test Coordinator

The Test Coordinator will be a representative from Instrumentation and Control (I&C) or a person designated by the manager of I&C. The Test Coordinator is responsible for scheduling the testing and the notification of all participants in the testing. The Test Coordinator is responsible for directing the testing, recording the test data, and ensuring that all required equipment and materials are provided. In addition, prior to the start of the ATP, the Test Coordinator will determine the sensors to be tested and record the following information on the data sheet(s) when applicable:

Tank Number, Riser Number, Selector Switch (upper or lower)
Sensor Type, ie. level, TC, PRT, P/I, pressure, or other with current output
Temperature Selector Switch Position
Current to Engineering Units Convertion Formula
Allowable Deviation Error
TMACS Tag Name
TMACS Terminal Box Number

Test Performers

The Test Performers will conduct the tests as described in the test instructions (Section 4). The following organizations may be involved in the performance of the tests:

o Tank Farm CASS Operations - will operate the TMACS as required by the test procedure.

o Instrumentation and Control - will coordinate the test.

o Chemical Processing and Waste Management Software Support - wll assist CASS Operations as required.

o Kaiser Engineers Hanford Construction Forces or Plant Forces - will conduct the field testing as directed by the Test Coordinator.

Test Witness

QA (QC) will supply a Test Witness to observe the test and assure overall compliance with the test procedure. The recommended location for the QA Test Witness is in the 2750E Control Room. The QA Test Witness will also indicate concurrence of the observed results and recorded data by signing the test data sheet.

The applicable Tank Farm Cognizant Engineer will observe overall testing and concur that the system is functional and installed correctly. The recommended location for the Tank Farm Cognizant Engineer Witness is also the 2750E Control Room.

Any Test Witness may decline to witness all or any part of the ATP by providing a written statement to the Test Coordinator.

Final Approval Parties

After completion of all tests, the Final Approval Parties indicate their approval by signing the appropriate space on the final approval page (Section 7.0). Representatives from the following organizations constitute the Final Approval Parties:

Tank Farm Operations
Instrument & Control
Chemical Processing and Waste Management Software Support
Quality Assurance

The final approval signature signifies that any test exceptions have been resolved to the approver's satisfaction. Alternately, it indicates that they are minor in nature and do not warrant a change in the procedure or the equipment.

3.0 EQUIPMENT REQUIRED

The testing may require test performance personnel in the tank farm, the instrument building and in the CASS Control Room in 2750E. An Operator, an electrician, and the test coordinator may be located in the tank farm or instrument building. The CASS Operator and a representative from CP/WMSS may be located in the CASS Control Room at 2750E. The test witnesses may elect to be at either of these locations.

The following equipment may be required in the field:

- Master copy of the ATP test sheets and pencil or pen
- Portable hand-held radio(s)
- Portable digital thermometer for Thermocouples

  The portable digital thermometer for thermocouples should be an Omega OMNI-CAL 8A or a unit with the following minimum specifications:

  * Measure temperature for thermocouple Types J, K, and E
  * Digital readout in degrees F
  * Range: 32 to 200 degrees F
  * Resolution: $\pm$0.1 degree F
  * Accuracy: $\pm$2.0 degrees F

  The specified accuracy includes reference junction compensation, linearization, and analog-to-digital conversion. It does not include errors associated with extension leads, connectors, the selector switch, or the thermocouple conformity.

- Portable Digital Thermometer for PRTs

  The portable digital thermometer for PRTs should be an Omega Model 860 or a unit with the following minimum specifications:

  * Measure temperature for three terminal PRTs
  * Digital readout in degrees F
  * Range: 32 to 200 degrees F
  * Resolution: $\pm$0.1 degree F
  * Accuracy: $\pm$1.0 degrees F

  The specified accuracy includes compensation, linearization, and analog-to-digital conversion. It does not include errors associated with extension leads, connectors, the selector switch, or the PRT conformity.

- Portable digital multimeter for measuring current

  The portable digital multimeter should have following minimum specifications:

  * Range: 0 to 20 ma
  * Resolution: $\pm$10 ua
  * Accuracy: $\pm$0.75% of reading + 1 digit

The equipment required at 2750E consists of temporary data sheets, pen or pencil, and a hand-held portable radio.

4.0 TEST INSTRUCTIONS

The master copy of the data sheet will be retained by the Test Coordinator. A temporary data sheet will be used by the parties at the CASS Control Room. Upon completion of the test, the Test Coordinator will transfer the TMACS readings to the master data sheet and the Test Witnesses will sign the master. Specific instructions for each data sheet are provided below.

4.1 TEMPERATURE SENSORS

For each temperature probe, measure the temperature of each sensor (element) using the portable electronic thermometer via the selector switch and temperature sensor connector provided either on the side of the TMACS enclosure or on some alternate enclosure.

Record the values on the data sheet in degrees F. At approximately the same time, record the temperature values read by TMACS.

Follow the steps below for each of the tanks.

4.1.1 Thermocouple Sensors

1. Connect the portable thermometer to the appropriate Temperature Sensor jack on the side of the TBX. Set the thermometer for the TC type, if required. Set the function selector on the thermometer for measure.

2. Using the selector switch on the TBX, select the points one at a time according to the data sheet for that tank and riser.

3. Read the value on the portable thermometer and record on the data sheet to the nearest 0.1 degree F.

4. Upon completion of the measurements at the tank, notify the CASS Operator by radio so that the TMACS values can be read and recorded.

5. At 2750E, display the temperature values and record the temperatures on the data sheet.

6. Compare each reading by radio communication. If any reading is not within the specified tolerance, read it a second time both in the field and on TMACS. If it is still not within the specified tolerance, record it as an exception.

4.1.2 Thermocouple Sensor Verification

For thermocouple sensors, verify that the two readings agree to within 9 degrees F. This value is taken from WHC-SD-WM-TI-483 (WHC 1991b) by simple summation of the errors in Table 3.0 of the referenced document and repeated below:

Source of Error	+/- °F
Terminal point conformity (A/D conv.)	0.9
Reference junction non-uniformity	0.9
Reference junction sensor	0.9
Sensor Linearization	0.9
Extension wire and termination	0.9
Total	4.5

It is expected that most readings will be much closer than this since, on the average, errors combine as the root mean square. However, the worst case error for each measurement is about $\pm$4.5 degrees F or a maximum difference between two readings of 9 degrees F. The errors above are not random with respect to time (short term) and therefore taking an average of several readings will not reduce the difference.

4.1.3 Platinum Resistive Thermometer (PRT) Sensors

.1. Connect the portable thermometer to the appropriate Temperature Sensor jack on the side of the TBX. Set the thermometer for the PRT type, as required. Set the thermometer for the appropriate matching alpha for the PRT. Set the function selector on the thermometer for measure.

2. Using the jack set on the TBX, connect the thermometer test lead plug to each point, one at a time, according to the data sheet for that tank and riser.

3. Read the value on the portable thermometer and record on the data sheet to the nearest 0.1 degree F.

4. Upon completion of the measurements at the tank, notify the CASS Operator by radio so that the TMACS values can be read and recorded.

5. At 2750E, display the temperature values and record the temperatures on the data sheet.

6. Compare each reading by radio communication. If any reading is not within the specified tolerance, read it a second time both in the field and on TMACS. If it is still not within the specified tolerance, record it as an exception.

4.1.4 Platinum Resistance Thermometer Verification

For PRT sensors, verify that the two readings agree to within 5 degrees F. This value is derived by a simple summation of the probable errors:

Source of Error	+/- °F
Terminal point conformity (A/D conv.)	0.9
Sensor Linearization	1.5
Extension wire and termination	0.1
Total	2.5

It is expected that most readings will be much closer than this since, on the average, errors combine as the root mean square. However, the worst case error for each measurement is about $\pm$2.5 degrees F or a maximum difference between two readings of 5 degrees F. The errors above are not random with respect to time (short term) and therefore taking an average of several readings will not reduce the difference.

4.2 PRESSURE TO CURRENT SENSORS

For each Pressure to Current (P/I) sensor, observe the corresponding pressure reading on the appropriate pressure indicator in the instrument building. Record the values on the data sheet in INWG (inches of water). At approximately the same time, record the pressure values read by TMACS. Compare each reading by radio communication. Compute the % Difference by subtracting the TMACS reading from the manual reading, multiply the difference by 100, then divide the product by the pressure indicator's Full

Scale (FS) range. If any reading is not within the specified tolerance (see 4.2.1), read it a second time both in the Instrument Building and on TMACS. If it is still not within the specified tolerance, record it as an exception.

4.2.1 Pressure to Current Sensor Verification

For Pressure to Current sensors, verify that the TMACS readings are within + or - 10% of the instrument building indicator's FS range.

4.3 SENSORS WITH CURRENT OUTPUT

For each sensor, place a Current Meter electrically in series with the current loop and measure the current flow. Record the values on the data sheet. At approximately the same time, record the corresponding values read by TMACS in Engineering Units. Using the "CURRENT TO ENGINEER UNITS FORMULA" convert the measured current value to the coresponding Engineer Unit value and record the value on the data sheet. Compare each reading by radio communication. If any reading is not within the specified tolerance, read the Current Meter and TMACS a second time. If it is still not within the specified tolerance, record it as an exception.

4.3.1 SENSORS WITH CURRENT OUTPUT VERIFICATION

For sensors with current output, verify that the TMACS readings are within + or - of the Specified Allowable Deviation Error.

4.4 ENRAF LEVEL GAUGES

For each level gauge, read the level on the local display and record the value on the data sheet. At approximately the same time, record the corresponding value read by TMACS. All readings are in inches with the number of decimal places indicated on the data sheet. Determine the difference in readings and compare to the allowable deviation. If the difference is not within tolerance, take the reading another time. If it remains out of tolerance, record it as an exception.

4.5 DISCRETE INPUTS

For each discrete input record the field state (on, off, hi, low, etc.) in the data sheet column labeled "FIELD STATE 1". Read the TMACS state as indicated on the Operator's console in 2750E and record in the data sheet column labeled "TMACS STATE 1". Verify that the two recorded states are consistent. Change the state of the field signal. This may require shorting contacts or opening the connection. Record the resulting TMACS state on the data sheet and verify that it is changed from STATE 1. If the TMACS and field states 1 do not agree or if the TMACS state does not change when the field signal is changed, record it as an exception.

5.0 TEST DATA SHEETS

The test data sheets are on the following pages.

TEMPERATURE SENSOR VERIFICATION DATA SHEET

Reference: Section 4.1

Tank Number:_____ Riser Number:_____ Sel. Sw _____

Sensor Type:_____ Terminal Box: TBX-TMACS-_____

Digital Thermometer Make and Model Number: _____

Standards Code Number: _____ Calibration Expiration: _____

SEL SWITCH OR JACK POSITION	TEMP. SENSOR NUMBER	TMACS TAG	MANUAL READING (°F)	TMACS READING (°F)	DIFFERENCE {MANUAL - TMACS} (°F)

Test Witnesses:

_____ _____
Test Coordinator Date

_____ _____
Quality Assurance Date

PRESSURE TO CURRENT SENSOR VERIFICATION DATA SHEET

Reference: Section 4.2

Tank Farm_____ Instrument Building_____

Sensor Type:_____

TANK	PRESSURE SENSOR NUMBER	TMACS TAG	MANUAL GAUGE READING (INWG)	TMACS READING (INWG)	% DIFFERENCE {((MANUAL - TMACS)*100)/FS

Test Witnesses:

_____ _____
Test Coordinator Date

_____ _____
Quality Assurance Date

SENSORS WITH CURRENT OUTPUT VERIFICATION DATA SHEET

Reference: Section 4.3

Tank Farm:_____

Digital Current Meter Make and Model Number: _____

Standards Code Number: _____ Calibration Expiration: _____

TANK	CURRENT SENSOR NUMBER	TMACS TAG	CURRENT LOOP READING (MA)	CURRENT TO ENGINEER UNITS FORMULA	CALCULATED MEASURED READING (ENG. UNITS)	TMACS READING (ENG. UNITS)	DIFFERENCE (TMACS READING - CAL. MEASURED) (ENG. UNITS)	ALLOWABLE DEVIATION ERROR (ENG. UNITS)

Test Witnesses:

_____ _____ _____ _____

Test Coordinator Date Quality Assurance Date

ENRAF LEVEL GAUGE DATA SHEET

Reference: Section 4.4

GAUGE WST-LIT-	TMACS TAG	LEVEL GAUGE READING (XXX.XX INCHES)	TMACS READING (XXX.XX INCHES)	DIFFERENCE {TMACS -GAUGE} (X.XX INCHES)	ALLOWABLE DEVIATION ERROR (INCHES)

Test Witnesses:

_____ _____

Test Coordinator Date

_____ _____

Quality Assurance Date

DISCRETE INPUT DATA SHEET

Reference Section 4.5

TMACS TAG	TMACS DESCRIPTION	FIELD STATE 1	TMACS STATE 1	TMACS STATE 2

Test Witnesses:

Test Coordinator _____ Date _____ Quality Assurance _____ Date _____

6.0 EXCEPTIONS TO ACCEPTANCE TEST

EXCEPTION NUMBER	DESCRIPTION	ACTION

7.0 FINAL TESTING APPROVAL

Instrumentation and Control	Date
Chemical Processing and Waste Management Software Support	Date
Tank Farm Operations	Date
Quality Assurance	Date

8.0 REFERENCES

Acromag, 1990, *Series 4000 I/O Processor User's Manual*, Acromag Incorporated, Wixom, MI.

WHC, 1991a, *Engineering Work Plan for Ferrocyanide Tank Temperature Monitoring*, WHC-SD-WM-WP-075, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *Temperature Measurement Error Analysis*, WHC-SD-WM-TI-483, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991c, *Continuous Temperature Monitoring System Phase 1 Acceptance Test Procedure*, WHC-SD-WM-ATP-020, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992a, *Functional Requirements for Ferrocyanide Tank Temperature Monitoring*, WHC-SD-WM-RD-013, REV 1, Westinghouse Hanford Company, Richland, Washington..