JUN 02 1997 Sta. 37 (20)

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 619513

2. To: (Receiving Organization) DISTRIBUTION	3. From: (Originating Organization) SESC - Remote Sensing and Sampling Equipment Engineering	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: Characterization	6. Design Authority/ Design Agent/Cog. Engr.: M.F. Erhart	7. Purchase Order No.: n/a
8. Originator Remarks: Approval/Release		9. Equip./Component No.: n/a 10. System/Bldg./Facility: 200G
11. Receiver Remarks:	11A. Design Baseline Document? [] Yes [X] No	12. Major Assm. Dwg. No.: n/a 13. Permit/Permit Application No.: n/a 14. Required Response Date: 05/31/97

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	HNF-SD-WM-OMM-028		O	Standard Hydrogen Monitoring System-D Operation and Maintenance Manual	SQ	1	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 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
		Design Authority	4	4	D. Tate D. Tate 5/12/97 L6-37
1	1	Design Agent T.C. Schneider TC Schneider 5-27-97 L6-37			
1	2	Cog.Eng. M.F, Erhart MF Erhart 5/19/97 R1-51			
1	2	Cog. Mgr. R.L. Schlosser RL Schlosser 5/19/97 R1-56			
1	1	QA W.L. Adams C.A. Sams for 5/19/97 S5-12			
1	1	Safety S.U. Zaman S.U. Zaman 5/28/97 R3-01			
		Env.			

18.	19.	20.	21. DOE APPROVAL (if required)
[signature] 5/12/97 Signature of EDT Originator Date	[signature] Authorized Representative Date for Receiving Organization	R.L. Schlosser 5/19/97 Design Authority/ Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-1

STANDARD HYDROGEN MONITORING SYSTEM-D OPERATION and MAINTENANCE MANUAL

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Numatec Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: No. 619513 UC: 2030
Org Code: [redacted] 8C460 Charge Code: N2022
B&R Code: EW3120072 Total Pages: ~~27~~ 28

Key Words: Standard Hydrogen Monitoring System (SHMS)

Abstract:

Standard-D operation manual for the Standard Hydrogen Monitoring System.

JUN 02 1997
DATE: HANFORD
STA: 37 RELEASE ID: 20

6-2-97
Release Approval Date Release Stamp

Approved for Public Release

STANDARD HYDROGEN MONITORING SYSTEM-D

OPERATION AND MAINTENANCE MANUAL

HNF-SD-WM-OMM-028

REV. 0

Impact Level SQ

Issued by

TWRS Safety Special Projects

May 1997

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1.0 GENERAL EQUIPMENT INFORMATION

1.1 Introduction

The purpose of this document is to provide information for the operation and maintenance of the Standard Hydrogen Monitoring System-D (SHMS-D) used in the 200E and 200W area tank farms on the Hanford Site. This provides information specific to the mechanical operation of the system and is not intended to take the place of a Plant Operating Procedure. However, it does provide more information on the system than a Plant Operating Procedure. The intent here is that the system is started up by a technician or engineer who has completed tank farms training course #351405, and then the only actions performed by Operations will be routine log taking. If any problems not addressed by the operating procedure are encountered with the unit, engineering should be contacted.

1.2 Equipment Description

Refer to WHC-SD-WM-SDD-059, Standard-D Hydrogen Monitoring System Design Description (Schneider) for a detailed description of the individual components.

2.0 FUNCTION DESCRIPTION

2.1 General

The primary function of the SHMS-D is to monitor specifically for hydrogen in the waste tank vapor space which may also contain (but not be limited to) unknown quantities of air, nitrous oxide (N_20), ammonia (NH_3), water vapor, carbon dioxide (CO_2), carbon monoxide (CO) and other gaseous constituents.

A valved inlet stub and a valved exhaust stub are provided to allow for additional gas monitoring equipment. These stubs are currently utilized for monitoring ammonia.

An electronically controlled grab sampler has replaced the manually operated sample system that was used in the original SHMS enclosure. Samples can now be operator or automatically initiated. Automatic initiation occurs based on the high hydrogen alarm level. Once a sample is obtained it is removed from the sampler and transported to a laboratory for analysis. This system is used to identify other gaseous constituents which are not measured by the hydrogen monitor.

The design does not include any remote data acquisition or remote data logging equipment but provides a 4-20 mA dc process signals, and discrete alarm contacts, that can be utilized for remote data logging and alarming when desired.

The system is designed to sample process gases that are classified by NEC code as Class I, Division I, Group B.

3.0 TERMS AND DEFINITIONS

3.1 AIR CONDITIONER UNIT (ACU)

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3.19 MANUAL VALVE (MV)

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3.23 STANDARD CUBIC FEET PER MINUTE (SCFM)

3.24 STANDARD LITER PER MINUTE (SLM)

3.25 STANDARD HYDROGEN MONITORING SYSTEM-D (SHMS-D)

3.26 TERMINAL BOARD (TB)

4.0 PRECAUTIONS

4.1 Personnel Precautions

4.1.1 In case of fire or other emergency in the monitoring enclosure, all power to the enclosure shall be secured by opening the local disconnect that serves the enclosure as identified in Tank Farm Plant Operating Procedure, T0-040-041.

4.1.2 If it becomes necessary to isolate the enclosure from the tank it can be accomplished by closing the respective sample and return valves as identified in Tank Farm Plant Operating Procedure, T0-040-041.

5.0 OPERATION

5.1 Introduction

This operating procedure is a generic procedure for several different units. Thus an asterisk (*) is used for part of the instrument and valve identifying numbers used. This asterisk is replaced by a unique identifier for each unit so that all instruments and valves will have a unique identifier.

5.2 Controls and Indicators

Refer to H-14-100298, Standard-D Hydrogen Monitoring System Cabinet Assembly for the location of the various components referred to in this section. Appendix B contains all of the SHMS-D alarm and control set points, normal expected values, tolerances, etc.

5.2.1 Sample Main Flow Loop

The sample main flow loop provides primary monitoring for hydrogen. The hydrogen sensors used (NE-*54 and NE-*55) are electrochemical cells that provide an electrical signal proportional to the hydrogen partial pressure in the gas sample.

A pressure gauge (PI-*51) displays the sample line pressure for system flow calculations and as a troubleshooting aid.

The main loop flow is continuously monitored. The sample gas flow monitoring system consists of an in-line laminar flow element (FE-*57) and a differential pressure transmitter (FIT-*57) which measures the pressure drop across the flow element. As sample gas flows through the flow element, the transmitter generates a 4-20 milliamp signal proportional to the gas flow rate.

The flow through the sample main flow loop can be manually controlled with a flow control valve (SV-*24). This valve, in conjunction with the sample gas flow monitor is provided as an aid to tank farm personnel to ensure that there is adequate flow through the main sampling loop.

Before the sample gas enters the hydrogen sensor it is first filtered through three series filters. The first filter is a 25 micron particulate and moisture filter, the next two are .2 micron particulate filters. These filters remove moisture and trap any potentially radioactive particulate contamination from entering the rest of the SHMS-D piping.

If a decrease in sample flow occurs, there are two possible causes: 1. No sample flow due to sample pump failure. 2. Sample flow reduction due to a plugged particulate filter. The decrease in flow due to plugged filters would most likely be a slow process, unless a tank event produced a large amount of airborne contaminants.

The differential pressure drop across the series combination of the three inlet filters is an indication of a plugged inlet filter. As the filters become clogged this pressure drop will increase. This pressure drop is measured by the differential pressure indicator (PDI-*51). Since it measures the pressure drop across all three filters it is not possible to determine which of the three filters has clogged. It is advisable to replace all three if a problem develops.

Replacing the inlet filters will require isolating the SHMS enclosure from the tank and disconnecting the filters from the associated piping. Health Physics technical support and a Radiological Work Permit will be required.

5.2.2 Gas Sample Stubs

In SHMS-D, a valved, 0.635 cm (1/4") sample tubing stub with a filter and port is provided after an entry moisture membrane filter from the main sample line. A valved sample return port is provided back into the main line after the first primary filter. These stubs are provided to allow for additional gas monitoring equipment. Note however, the pressure differential is minimal. Any gas monitoring equipment must come with their own sample pump.

This loop is currently used for analytical ammonia monitoring equipment. A multi-gas Photoacoustic Infrared Spectrometer with control computer is currently used with the sample stubs provided in the SHMS-D. The Spectrometer is a Brüel & Kjær (B&K) Multi-gas Monitor - Type 1302 with ammonia filters. It is used to measure ammonia over full range (ppm to 2%).

5.2.3 Gas Grab Sample Loop

A gas grab sample loop has been included in this design. It is composed of two series connected gas collection cylinders which are connected to the sample stream by two solenoid operated valves. This system allows operator initiated or automatic grab sampling. In operator initiated grab sampling, the operator collects gas specimens by depressing a push button. For an automatic grab sample, the Programmable Logic Controller (PLC) automatically initiates a grab sample cycle when the hydrogen concentration exceeds the high hydrogen alarm set point. In either case, once a grab sample is obtained it is important that the manual cylinder valves are shut as soon as possible once a sample is obtained. This will minimize any possible loss of sample from the cylinders. Note however that in the case of an automatically initiated grab sample cycle upon a high hydrogen alarm, the tank farm area is potentially unsafe. The operator should remotely verify low hydrogen levels before entry into the affected tank farm.

Once a sample is obtained, the sampler will not respond to future high hydrogen events or operator initiated sampling until manually reset by an operator. This feature was incorporated to prevent the loss of an automatic grab sample due to a subsequent hydrogen event or an operator initiated grab sample; however the Reset Sampler function may be implemented at any time terminating the current sample cycle.

Grab sampling is relatively easy. The gas cylinders are inserted in the assembly using O-ring seal vacuum tube fittings. Once installed the individual bottle isolation valves are opened and a leak check of the system is performed. This is done by shutting SV-*05 and noting the steady state pressure reading on PDI-*51. Once noted, SV-*16 and SV-*15 are closed and the pressure gauge is monitored for five minutes. Any pressure decrease is noted. Next, SV-*16 and SV-*15 are opened and the grab sample button is depressed. Again, the steady state pressure reading on PDI-*51 is noted and then SV-*16 and SV-*15 are closed. Again, the pressure gauge is monitored for five minutes and any pressure decrease greater than what was noted when the sample loop was isolated indicates that there is a leak in the sample loop between the solenoid valves.

Operator initiated grab sample collection is initiated by depressing the Grab Sample push button. This causes the electrically operated isolation valves (SOV-*50 and SOV-*51) to open and begin the sampling process. The flow rate through the cylinders is manually controlled with the flow control valve FIV-*52 with integral flow indicator. After five minutes the electrically operated isolation valves automatically close. To remove the cylinders for sample analysis, shut the individual gas cylinder isolation valves and then remove the gas cylinders under an appropriate Radiological Work Permit and Health Physics Technician supervision.

Once the cylinders are removed, a new set can be inserted into the assembly as discussed previously, the sampler is reset and a leak check is performed.

5.2.4 Calibration Gas System

Cylinders containing standard gasses are installed to support calibration and maintenance tasks of the Whittaker electrochemical cells. The cylinders are located in a gas bottle rack on the SHMS-D enclosure pad. A zero gas mixture of nominally 0.01% hydrogen and 99.99% air is used to adjust the low end of the hydrogen sensors. The span gas mixture of 5.0% hydrogen mixed with 95.0% nitrogen is used for the top end adjustment of the hydrogen sensors. The calibration procedure is contained in 6-TF-440. It is implemented through manually operated local valves (SV-*31, SV-*32, SV-*33, SV-*34). Flow indicator (FIV-*56) is included to ensure the proper flow rate to the hydrogen sensors. Pressure gauges (PI-*54, PI-*55, PI-*56) which are part of the low pressure regulators (PCV-*54, PCV-*55, and PCV-*56) are included to assure the proper supply pressure. In addition, a 15 micron filter (FLT-*55) filters the outside air when purging the hydrogen sensors and lines.

5.2.5 Alarm and Annunciator System

The design of the SHMS-D alarm and annunciation system provides system outputs based on system inputs. An output can be a control function, alarm, or information light. Table 1.0 lists the system inputs and their respective outputs.

Table 1.0 SHMS-D System Inputs and Outputs

SYSTEM INPUTS	SYSTEM OUTPUTS
Horn acknowledge	Silences horn (Indicating lamps showing the cause of the alarm condition are not affected)
Low hydrogen flow	Trouble beacon Trouble remote alarm Horn Low hydrogen flow lamp
Hi/Lo cabinet temp.	Trouble beacon Trouble remote alarm Horn Cabinet temp. lamp
Alarm test	Trouble beacon Trouble remote alarm High hydrogen beacon High hydrogen remote alarm Horn (All indicating lamps with the exception of Reset Sampler and Grab Sample Lamp)
Alarm reset	Allows resetting of indicating lamps if the alarm condition has previously cleared; (Will not effect Reset Sampler and Grab Sample Lamps)
High range high hydrogen	High hydrogen beacon High hydrogen remote alarm Horn High hydrogen lamp Grab sample solenoid Grab sample lamp Reset sampler lamp

Low range high hydrogen	High hydrogen beacon High hydrogen remote alarm Horn High hydrogen lamp Grab sample solenoid Grab sample lamp Reset sampler lamp
Low calibration gas temp.	Trouble beacon Trouble remote alarm Horn Gas temp low lamp
Low sample gas temp.	Trouble beacon Trouble remote alarm Horn Gas temp low lamp
Reset sampler	Resets the following: Grab sample solenoid valves Grab sample lamp Reset sampler lamp
Grab sample	(These outputs only occur while the Grab Sample button is depressed) High hydrogen lamp High hydrogen beacon High hydrogen remote alarm Horn (These output occurs for five minutes) Grab sample solenoid valves Grab sample lamp (This output is locked in until reset) Reset sampler lamp

The design philosophy for the system was that each input must be able to trigger multiple outputs. The device inputs activate the outputs on loss of power (fail safe condition). The remote alarms are also designed for fail safe operation. Furthermore, the alarm beacons, remote alarms, and horn will automatically reset on loss of alarm condition. However, the remaining outputs will retain their alarm state on loss of alarm condition until manually reset. During alarm conditions, the operator can silence the horn without disabling the ability for another system input to activate the horn. Also, an alarm test function to test the alarm outputs was also included.

This design philosophy was implemented by the control logic used in the PLC and by using active inputs to the PLC for normal conditions. The PLC is responsible for processing the inputs and triggering the appropriate outputs for local or remote annunciation.

Refer to drawing H-14-100297, Standard-D Hydrogen Monitoring System one-Line & Elementary Diagrams for the following discussion.

The inputs to the PLC are designed to activate the annunciators on loss of power (fail safe condition), with the exception of the strip chart recorder high hydrogen contacts. Loss of power to the hydrogen indicating transmitters (NIT-*54, NIT-*55) and the strip chart recorder will not produce a "false positive", i.e. a high hydrogen alarm will not be generated. Loss of power to the PLC will activate the remote annunciators and the local beacons. On loss of incoming power to the entire system, the remote alarm contacts (which are also designed for fail-safe operation) will open, generating a remote alarm if the system has been connected to a remote monitor.

The high hydrogen (red) beacon, the trouble (amber) beacon, the remote alarms, and the audible wavering horn automatically reset on loss of the alarm condition. Conversely, the enclosure alarm indicator lamps maintain their alarm state after the loss of the alarm condition, until manually reset.

The enclosure alarm indicator lamps are turned on directly by a PLC output. Conversely, on a high hydrogen alarm condition the PLC de-energizes a high hydrogen relay (CR-*55) to provide an open contact to a remote annunciator interface and to turn on the high hydrogen beacon (YAL-*55). Likewise, on any of the other alarm conditions, the PLC de-energizes a enclosure trouble relay (CR-*63) to turn on the trouble beacon and provide an open contact to a remote annunciator interface (XA-*63).

The enclosure alarm annunciator horn is activated with each alarm. The HORN ACKNOWLEDGE push button (PB-*50) allows the operator to disable the horn during an alarm condition without disabling the ability for another system input to activate the horn.

The ALARM RESET push button (PB-*51) clears all local alarm annunciator lamps, if the alarm condition has returned to normal.

For example, when a low gas temperature condition is reached the following occurs: The horn sounds, the trouble (amber) beacon is activated, the low gas temperature lamp is turned on and the remote enclosure trouble annunciator contacts open. An operator would be sent to investigate the problem. The operator would acknowledge the horn and proceed with troubleshooting. A few minutes later, a low hydrogen flow condition is reached. The horn sounds again, and now the low hydrogen flow enclosure lamp is turned on. After acknowledging the horn and correcting both problems, the trouble beacon and the remote enclosure trouble annunciator automatically reset. The operator then pushes the ALARM RESET button, to reset the gas temperature low and low hydrogen flow lamps.

The two beacons, horn, remote annunciation, and all enclosure lamps with the exception of the Grab Sample and Reset Sampler can be tested at the same time with the ALARM TEST (PB-*52) push button provided on the enclosure door. Consequently, the programmable logic controller output drivers are also verified with this test.

The grab sample system allows for both operator or automatic initiation of the grab sampler. When a high hydrogen event occurs or the GRAB SAMPLE push button (PB-*59) is depressed, a grab sample is initiated. The grab sample will sample for five minutes. Subsequent high hydrogen events or operator initiated grab samples will not retrigger the sampler until the system is manually reset.

The RESET SAMPLER (PB-*58) push button restores the capability of operator-initiated or automatic grab sampling after it has been locked out due to a prior grab sampling event.

5.3 Enclosure Power Distribution

A/C Power distribution for the sample pump, heater, air conditioner, heat trace, enclosure instrumentation, and a maintenance equipment outlet is via a 240/120 VAC enclosure feed. The power source for each enclosure is listed in Tank farms Plant Operating Procedure TO-040-041. The power needs for the Standard-D Hydrogen Monitoring System are nominally: 240 VAC at 9 Amps and 120 VAC at 15 Amps. Refer to Drawing H-14-100297 for the following:

The sample pump requires 240 VAC at 4 Amps with overcurrent protection provided via a two pole 15 Amp circuit breaker (CB-3/4).

The heater (HTR-*60) and air conditioner (AC-*60) both require 240 VAC at 5 Amps. A two pole 15 Amp circuit breaker (CB-1/2) provides overcurrent protection for both. A two pole relay is used in the circuit in such a way that simultaneous operation of both is not possible. A relay coil (CR-*60) is placed in parallel with the air conditioner condenser blower. When the air conditioner is operating, the relay coil will be energized, opening normally closed contacts (CR-*60-1, and CR-*60-2) in the heater power circuit, effectively cutting off power to the heater. Conversely, when the air conditioner is not operating, the relay coil is de-energized, closing contacts 1 and 2, effectively completing the heater power circuit.

Heat trace for the sample gas line (HT-*50) and the calibration gas line (HT-*56) requires 120 VAC at 8.3 Amps maximum. A single pole 15 Amp circuit breaker (CB-5) provides overcurrent protection for both heat trace power circuits. A temperature controller energizes a solid state relay (either JY-*50 or JY-*56) whenever the corresponding heat trace (HT-*50 and HT-*56) is needed. Energizing the relay will complete the heat trace power circuit by gating on a zero fired triac circuit, effectively providing power to the heat trace.

An enclosure light (LT1) and a ground fault interrupting receptacle are included in the enclosure for maintenance purposes. An intermittent load of 3 amps is anticipated for the receptacle. A single pole 15 Amp circuit breaker (CB-6) provides overcurrent protection for both. Light operation is via a hand switch (SW1) with a single pole double throw contact.

All of the enclosure instruments require 120 VAC at a maximum of 4 Amps. A single pole 15 Amp circuit breaker (CB-7) feeds a 750 VA isolation transformer which provides power to the 120 VAC Instrument Line. The transformer is included to protect the instruments from power line noise due to electrical disturbances such as lightning, utility network switching and the operation of electric motors. Each instrument that is fed off of this 120 VAC line is individually fused.

The 120 VAC Instrumentation Line also feeds a 24 VDC power supply. The Flow Indicating Transmitter (FIT-*57) requires 24 VDC at 0.02 Amp.

5.3.1 Heat Trace and Environmental Control

Sample and calibration gas line temperature control is needed for two reasons. The first is to keep the sample gasses above the dew point, since they may contain a relatively high concentration of water vapor. The second is to ensure the required response time from the electrochemical hydrogen monitor.

A temperature control set point of 29.4°C (85°F) has been established as the design temperature for all gas sample lines. The value of 29.4°C, (85°F) was established to provide a 5.4 degree C margin of error for the heat trace system above the worst case 23.9°C (75°F) dew point temperature (condensation temperature). The 23.9°C (75°F) temperature requirement was picked after reviewing wet/dry bulb temperatures taken for humidity measurements on the 101-SY exhaust header during the last two years. They showed a winter dew point of 14°C (57°F) and a summer dew point of 23.9°C, (75°F). Preventing condensation is important to achieving measurement accuracy. Some gasses chemically react very quickly with water. If this reaction with water occurs in the sample lines then the gasses presented to the instruments are not the same as the gasses at the sample point. Heat trace is provided to prevent this measurement error.

The second reason for heat trace is to provide the hydrogen sensors a gas sample between 24°C (75°F) and 49°C (120°F). The cell's response time to a step change in hydrogen increases as the sample temperature decreases below 21°C (70°F). Tests at 21°C (70°F) show a 120 second response to 90% of the final value for a step change in hydrogen. This response time shortens as the sample temperature increases to 21°C (120°F) where sample stream humidity then start to increase response time. Measurements of tank exhaust temperatures in 241-SY-101 have been as low as 4°C (40°F) when the average daily January ambient temperature was around -18°C (0°F). The heat trace system is needed to raise the temperature of the winter gas samples to 27°C (80°F) before the gas sample enters the enclosure. The calibration gas lines, in addition to the sample gas lines are heat traced due to the outdoor location of the calibration gas bottles.

Enclosure temperature control is needed for two reasons. The first is to maintain the sample and calibration gasses that have been heat traced at a minimum of 21°C (70°F) during the winter. The second reason is to maintain the instruments in their optimal operating temperature ranges which is usually above 16°C (60°F) but below 32°C (90°F).

6.0 OPERATING PROCEDURES

Tank Farms Operating Procedure TO-040-041 is the main source document for operating the SHMS-D Enclosure. The following is a listing of the various operating, troubleshooting, and emergency responses contained in the procedure:

OPERATING PROCEDURES

SHMS INITIAL STARTUP
SHMS SHUTDOWN
PERFORM SHMS GRAB SAMPLE
ISOLATE SHMS CABINET
RESTART SHMS CABINET FROM ISOLATION

SHMS OPERATOR ROUTINES

PERFORM WEEKLY SHMS SURVEILLANCE

SHMS TROUBLESHOOTING

TROUBLESHOOT SHMS TEMPERATURE SYSTEM
TROUBLESHOOT SHMS MAIN SAMPLE LOOP

EMERGENCY RESPONSE

RESPOND TO SHMS HIGH HYDROGEN STROBE LIGHT

ALARM RESPONSE

RESPOND TO SHMS TROUBLE STROBE LIGHT
RESPOND TO SHMS LOCAL PANEL ALARM LAMPS
RESPOND TO LOW HYDROGEN FLOW ALARM
RESPOND TO GAS TEMP LOW ALARM
RESPOND TO CABINET TEMP ALARM
RESPOND TO HIGH HYDROGEN PANEL LAMP

The following procedures are not required during normal operation, but are used during the initial start up or calibration of the system.

6.1 Perform Initial Instrument Programming

Note - This is done prior to field/facility calibration and operation.

6.1.1 PROGRAM the Newport Digital Voltmeter used as the Indicating Transmitter for the Whittaker Percent Hydrogen Monitor (NIT-*54/55) per CVI 22192 Supplement 22 and the configuration list in Appendix A.

6.1.2 PROGRAM the Strip Chart Recorder (NR-*54) per CVI 22192 Supplement 20 and the configuration list in Appendix A.

6.1.3 PROGRAM the Programmable Logic Controller (YYC-*-01) per CVI 22192 Supplement 11; WHC-SD-WM-CSDD-004, Computer Software Design Description, (Bender); WHC-SD-WM-CSCM-013, Computer Software Configuration Management, (Lopez) and H-14-100303, Standard D Hydrogen Monitoring System P.L.C. Ladder Diagram.

6.1.4 PROGRAM the Temperature Indicator (TIS-*62) and the Temperature Indicating Controllers (TIC-*50/56) per CVI 22192 Supplement 19 and the configuration list in Appendix A.

6.1.5 PROGRAM the Low flow alarm module (FSL-*57) per Appendix A.

7.0 SCHEDULED MAINTENANCE

7.1 Instrument Calibration Procedures

7.1.1 Whittaker Percent Hydrogen Monitor

Calibrate the Whittaker Hydrogen Monitor (NE/NIT-*54/55) per 6-TF-440 every 3 months.

7.1.2 Strip Chart Recorder

Calibrate the Yokogawa Strip Chart Recorder Model 4153 (NR-*54) per PSCP-4-141 every 12 months.

7.1.3 Sample System Pressure Indicator

Calibrate the Main Sample Loop Pressure Indicator (PI-*53) per 6-TF-509 every 12 months.

7.1.4 Filter Differential Pressure Indicator

Calibrate the Filter Differential Pressure Indicator (PDI-*51) per 6-TF-509 every 12 months.

7.1.5 Main Sample Loop Flow Transmitter

Calibrate the Main Sample Loop Flow Transmitter (FIT-*57) per 6-TF-259 every 12 months.

7.1.6 Multi-gas Analyzer

If installed, calibrate the B&K multi-gas analyzer (NIT-*52) per 6-TF-143 every 12 months.

8.0 GUIDE TO TROUBLE SHOOTING

The warning and indicating lights on the front of the SHMS-D enclosure provide valuable information on the status of the system. The following is a discussion of various troubleshooting methods that could be applied to diagnose a problem with the system.

8.1 Cabinet Temperature

The cabinet temperature trouble light will illuminate when the enclosure temperature exceeds the high limit or falls below the low limit. Items to check when this occurs would include the operation and set point of the heater and air conditioner unit, firmness of the door seal with the enclosure, and last, the actual alarm set points of the temperature monitor module.

Since the high and low temperature alarm functions are combined in a single light it may be difficult to determine which condition caused the problem if it is sporadic in nature. A portable battery operated temperature recorder can be used in the enclosure for a time history of enclosure temperature.

If adjustments are made to the air conditioning or heater thermostats set points, remember that the enclosure temperature will not change instantaneously. There will be a time delay for the temperatures to stabilize. Make all set point changes in small increments and wait for the system to respond following the adjustment. Also if the temperature outside the enclosure is extreme, try to minimize the length of time the door is open. This will reduce the stabilization time.

8.2 High Hydrogen

A high hydrogen warning should not be disregarded as an instrument failure. If it occurs, follow the appropriate high hydrogen response. If it can be independently shown later on that the instrument is malfunctioning the following steps can be used as an aid in troubleshooting the system.

The Infinity NIT-*54/55 displays should match the chart recorders digital display channel 1 and 2 respectively to within +/-.005. During operation, the Whittaker cells should track one another and read approximately the same number. Refer to the traces on the chart paper to determine if they are tracking.

To verify that a cell is responding, inject the high level calibration gas and observe the cells response on its associated infinity readout.

Finally, check the chart recorders alarm relay set points. Ensure that they are set to the appropriate value, listed in appendix B.

8.3 Low Hydrogen Flow

Check the pump and ensure that it is running. If not, check the status of CB-3/4 it may have tripped. After checking the pump, perform a valve line up to ensure that the system has been placed in operation properly. Note if any of the valves are found out of their normal position. Next check the filter differential pressure and the system pressure gauges. If the differential pressure gauge is off scale high and the system pressure gauge is indicating < -10" Hg, the filters are clogged and need to be replaced. If the pressure is very low, > -1" Hg, there may be a break in the system or a mechanical problem with the vacuum pump.

Check the digital display of the flow indicator. It should indicate the current pressure drop across the laminar flow element. The digital display should change in response to changes in the position of the flow control valve. Next check the calibration of the flow alarm module by performing 6-TF-259. If the flow alarm module cannot be calibrated then the transmitter/alarm module are suspect.

8.4 Gas Temp Low

The gas temp low trouble light will illuminate when either the sample or calibration gas temperature falls below the low limit set point. Items to check when this occurs would include the set point of the heat trace unit. Next, check the mechanical condition of the heat trace, thermocouple and associated insulation. They all need to be in close proximity to the heat traced line. Next, adjust the controller set point temperature above ambient and monitor the sensed temperature. If it does not increase, the problem is in the heat trace system and not in the sensing system.

Since both the sample and calibration gas low temperature alarm functions are combined in a single light it may be difficult to determine which system caused the problem if it is sporadic in nature. Possible solutions could include use of a portable battery operated temperature recorder that is coupled to the heat trace thermocouple.

8.5 Programmable Logic Controller

The PLC does not have an enclosure mounted door warning lamp, but it does have several LEDs on its front cover which can be a valuable diagnostic tool when problems occur. Prior to looking at the PLC, complete the applicable section for the respective warning /trouble light, then proceed as follows. Ensure that the green "RUN" and "PWR" lights are illuminated. If the red "CPU" light is illuminated, there is a fatal central processing unit error. The SHMS will not function properly and the PLC may need to be replaced. If an alarm or warning condition is being displayed but the respective system parameter is normal, such as a low gas temperature on a 100° day, check the PLCs input status LEDs. The inputs were designed to be fail safe. What this means is that under normal conditions, input monitoring LEDs zero through six would all be on. If one of these LEDs is off, there is an electrical problem between the item producing the alarm or trouble signal and the PLC.

9.0 REFERENCES

WHC-SD-WM-SDD-059, Standard-D Hydrogen Monitoring System, System Design Description, (Schneider)

WHC-SD-WM-CSDD-004, Standard Hydrogen Monitoring System Computer Software Design Description,(Bender)

WHC-SD-WM-CSCM-013 Computer Software Configuration Management, (Lopez)

H-14-100295, Standard D Hydrogen Monitoring System Piping & Instrumentation Diagram

H-14-100297, Standard D Hydrogen Monitoring System One Line, Elementary Diagram.

H-14-100298, Standard D Hydrogen Monitoring System Cabinet Assembly.

H-14-100299, Standard D Hydrogen Monitoring System Wiring Diagram.

H-14-100300, Standard D Hydrogen Monitoring System Interior Panels & Brackets.

H-14-100304, Standard D Hydrogen Monitoring System Instrument Panel Assembly.

H-14-100302, Standard D Hydrogen Monitoring System Loop Diagrams.

H-14-100301, Standard D Hydrogen Monitoring System Cabinet Modifications.

H-14-100303, Standard D Hydrogen Monitoring System P.L.C. Ladder Diagram.

H-14-100296, Standard D Hydrogen Monitoring System Equipment Arrangement.

CVI 22129

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APPENDIX A

CONFIGURATION OF PROGRAMMABLE INSTRUMENTS

LISTING OF NIT-*54/55 INITIAL SETUP CONFIGURATION

Verify the proper jumper selection for the 0-100mV range and FAST SCAN rate (S1A, S2A, S2F, and S2M)

The initial condition is to UNLOCK access to all the applicable program functions. Using the guidance of the Newport Infinity operations manual and the front panel pushbuttons, verify the setting of the following configuration:

L1C.1 through L1C.8 = 0
L2C.1 through L2C.8 = 0
L3C.1 through L3C.8 = 0
L4C.1 through L4C.6 = 1

INPUT - VOLT -	100mV
RDG.CNF:	RDG.1 = 0
	RDG.2 = 1
	RDG.3 through RDG.7 = 0
RDG SC:	1.00000
RDG OF:	000000.
IN CNF:	INP.1 = 0
	INP.2 = 1
	INP.3 = through INP.7 = 0
IN.SC.OF	NOT INITIALLY PROGRAMMED
DEC PT	FFFFFF.
CNT BY	001
FIL.CNF:	FIL.1 = 0
	FIL.2 = 1
	FIL.3 = 1
FIL TI	064
SP CNF:	SPC.1 through SPC.8 = 1
AL CNF:	ALC.1 through ALC.7 = 1 (N/A)
	ALC.8 = 0 (N/A)
AL FNC:	ALF.1 through ALF.4 = 0 (N/A)
AL RDG:	05 05 (N/A)
SP DB:	0010 (N/A)
AL DB:	0010 (N/A)
OUT.CNF:	OUT.1 = 1
	OUT.2 = 1
	OUT.3 through OUT.6 = 0
OT.SC.OF:	READ1 = 000000.
(NE-*-6-1)	OUTPT1 = 04.0000
	READ2 = 010000
	OUTPT2 = 20.0000
OT.SC.OF:	READ1 = 000000.
(NE-*-12-1)	OUTPT1 = 04.0000
	READ2 = 001000
	OUTPT2 = 20.0000
BAUD:	09600 (N/A)
SER CNF:	(N/A)
ADDRES:	(N/A)
DAT FT:	(N/A)
BUS FT:	(N/A)
SERCNT:	(N/A)

At the completion of the initial settings LOCKOUT the unused functions with the following settings:

L1C.1 through L1C.8 = 1
L2C.1 through L2C.3 = 1
L2C.4 through L2C.6 = 0
L2C.7 through L2C.8 = 1
L3C.1 through L3C.7 = 1
L3C.8 = 0
L4C.1 through L4C.6 = 1

RECORDER NR-*54 CONFIGURATION SETUP

The recorder associated with the SHMS is used to record the hydrogen sensors output and provides the alarm for a high hydrogen condition. The recorder is a microprocessor based unit that requires some initial setup for proper operation. The following will outline that programming with reference to appropriate sections of the Johnson/Yokogawa Model 4153 Instruction Manual. The setup will follow the 5-4-1 Setting Procedure flow chart of page 5-10:

I. Set the time of day per the Time Setting steps of 5-4-3 on page 5-12.

II. Set the year/month/day per the Date Setting steps of 5-4-4 on page 5-13.

III. Set the Chart Feed Speeds 1 and 2 to 10 mm/hr. and 200 mm/hr. respectively per the steps of 5-4-5 on pages 5-14 and 15.

IV. Set the Measurement/Recording (range) Settings for channels 1, 2, and 3 per the steps of 5-4-6 on pages 5-25 through 27, steps of (6) on pages 5-33 through 37, steps of (8) on page 5-41, and the following:

Channel Configuration Requirements:

FUNCTION	STEPS	CHANNEL 1	CHANNEL 2	CHANNEL 3
SET CODE	5-4-6	A (NORMAL)	A (NORMAL)	-
RANGE CODE	5-4-6	33	33	-
MINIMUM	5-4-6	1.000	1.000	
FULL SCALE	5-4-6	5.000	5.000	
SCALE VALUE MIN.	5-4-6	00.000	00.000	
SCALE VALUE MAX.	5-4-6	10.000	01.000	
UNIT	(6)	*	*	
SKIP	(8)	N/A	N/A	

NOTE:
* The UNIT values should be programmed in ASCII to indicate the tank and enclosure identifier for the Standard Hydrogen Monitor location, which is a subset of the system identifier.
Example: The first SHMS on SY-101 should be 101JSY.

V. Set the Alarm Settings for channel 1 and 2 per the steps of 5-4-7 on pages 5-42 through 43 and the following:

Channel Configuration Requirements:

FUNCTION	STEPS	CHANNEL 1	CHANNEL 2
ALARM RELAY	5-4-7	1 and 4	2 and 4
RELAY SETTING	5-4-7	H	H
ALARM SETTING	5-4-7	00.625	00.625

VI. Program the Tag Setting for channels 1 and 2 per the steps of 5-4-8 on pages 5-46 through 5-50 and the following:

Channel Configuration Requirements:

FUNCTION	STEPS	CHANNEL 1	CHANNEL 2
TAG SETTING	5-4-8	_NIT-54	NIT-55

TEMPERATURE CONTROLLER INITIAL CONFIGURATION

The Sample and Calibration Gas Heat Trace temperature controllers, TIC/TSL-*50/56, operate identically by driving a solid state zero crossing relay which in turn provides the heat trace heater with 120 Vac power. Set point 2 (SP2) of the temperature controllers provides the process alarm. The enclosure temperature indicator and alarm, TIS/TSHL-*62, provides no control function, but indicates the enclosure temperature and alarms high (SP1) and low (SP2) temperature conditions. The temperature controllers are primarily configured with factory default settings. Special configuration settings will be discussed below. The configuration of the controllers is accomplished through the front panel pushbuttons. The function of each button is as follows:

p	Selects Set-Up Mode which provides entry into Function and Option (F/O) selection. Refer to Operator's Manual for F/O descriptions.
*	Displays main (SP1) set point temperature.
*▲	Keyed together increases main set point temperature.
*▼	Keyed together decreases main set point temperature.
▲▼	When in the Set-Up Mode, indexes FUNCTION/OPTION number up or down in single digits.
*	When in Set-Up Mode, changes manipulation from FUNCTIONS to OPTIONS and visa-versa.

NOTE: The temperature controller set point 2 (SP2) is configured in the Set-Up Mode as Function 2.

The initial configuration sets the controllers to operate with a type K thermocouple input, sets the indicator to display in °F, limits the set point control range to between 32 and 150 °F, and adjusts the alarm set points to an initial value. Verify that the following FUNCTIONS/OPTIONS have been selected for each of the controllers/indicators:

FUNCTION	TIC/TSL-*54 OPTION/FUNCTION	TIC/TSL-*55 OPTION/FUNCTION	TIS/TSHL-*62 OPTION/FUNCTION
0	0.0	0.0	0.0
16	2.16	2.16	2.16
24	150	150	150
19	4.19	4.19	4.19
1	0.1	0.1	0.1
2	65	65	60
3	0.3	0.3	0.3
4	7.4	7.4	7.4
5	2.5	2.5	2.5
6	3.6	3.6	3.6
7	0.7	0.7	0.7
8	0.8	0.8	0.8
9	AS NECESSARY	AS NECESSARY	AS NECESSARY
10	0.10	0.10	0.10
11	0.11	0.11	0.11
12	0.12	0.12	0.12
13	SELECT THE ADVANCED FUNCTIONS FOR ALL UNITS		
26	0.26	0.26	0.26
27	0.27	0.27	0.27
28	0.28	0.28	0.28
29	0.29	0.29	1.29
30	1.30	1.30	1.30
31	1.31	1.31	1.31
32	0.32	0.32	0.32
33	0.33	0.33	0.33
34	0.34	0.34	0.34
35	AS NECESSARY	AS NECESSARY	AS NECESSARY
36	0.36	0.36	0.36
37	NOT USED	NOT USED	NOT USED
38	0.38	0.38	0.38
39-50	PERFORMANCE DIAGNOSTIC FUNCTIONS		
14	NOT USED	NOT USED	NOT USED
15	0.15	0.15	0.15
17	0.17	0.17	0.17
18	0.18	0.18	0.18
20	0.20	0.20	0.20
21	1.21	1.21	1.21
22	1.22	1.22	1.22
23	N/A	N/A	N/A
25	NOT USED	NOT USED	NOT USED

To operate the individual temperature controllers simply CLOSE the associated fused switches and breakers, and adjust the set points to achieve the temperature desired. If the controllers are unstable and will not control to the desired set point, special tuning parameters may be implemented to establish proper control characteristics.

Setting the Main Sample Loop Low Flow Alarm

NOTE The setting of the main loop flow alarm set point will be performed in conjunction with the setting of the main loop flow. Once the system dynamic pressures have been established it will be relatively easy to adjust the flow with the FCV to obtain the low flow value with one or two iterations. Once the low flow alarm value is established, the trip can be easily set and verified with the flow adjustment of the FCV.

VERIFY that the alarm module (FAL-*57) configuration is as follows:

1. ENSURE that the input jumper is in the MA position.
2. VERIFY that the RANGE and OFFSET switches are in the <2 and + positions.
3. PLACE INPUT RANGE selection switch in position 4 (20 MA).
4. SET trip A switch is to the LO position.
5. ENSURE MODE switches are in the N.L. (non-latching), F.S. (fail safe), and SINGLE positions.
6. ENSURE that the DEADBAND potentiometer is adjusted to the minimum deadband, fully CCW.
7. ESTABLISH the main loop flow to 5.6 ± 2.8 SLM (0.2 ± 0.1 SCFM).

   NOTE Use the procedure in 6-TF-440 as a guide for establishing the main loop flow.
8. NOTE the system pressure PI-*53 and the differential pressure FIT-*57.
9. VERIFY that the alarm is reset (green LED lit).
10. ADJUST the SET POINT potentiometer until the alarm relay just trips. (NOTE - If the power/alarm LED is alarmed, adjust the set point potentiometer CCW. If the power/alarm LED is reset, adjust the set point potentiometer CW.)
11. VERIFY that the green power/alarm LED goes from green (reset) to red (alarm).
12. INCREASE the flow by using SV-*24 until the alarm is reset.
13. SLOWLY DECREASE the flow using SV-*24 until the alarm is tripped.
14. VERIFY that the alarm trips at 5.6 ± 2.8 SLM (0.2 ± 0.1 SCFM).
15. REPEAT steps 7. through 14. as necessary until the alarm trips at the desired flow.

16. SET the low flow alarm trip deadband.

    16.1 ADJUST the DEADBAND potentiometer fully CW for 100% deadband.

    16.2 VERIFY the main loop flow and low flow set point are adjusted to low flow values.

    16.3 INCREASE the flow using FCV-*-1-1 until the FE differential pressure indicates 12.7 ± 2.5 mm (0.5 ± 0.1 in) H_2O above the trip value.

    16.4 SLOWLY ADJUST the DEADBAND potentiometer CCW until the alarm relay is energized.

    16.5 VERIFY the red alarm LED is changed to green.

    16.6 SLOWLY DECREASE the flow until the alarm trips.

    16.7 VERIFY that the alarm trips at 5.6 ± 2.8 SLM (0.2 ± 0.1 SCFM).

17. RESET the flow to 14.1 SLM (0.5 SCFM).

APPENDIX B

ALARM SET POINTS

STANDARD HYDROGEN MONITORING SYSTEM

PROCESS VALUES AND ALARM SET POINTS

MEASURED/CONTROLLED PROCESS	PROCESS RANGE	NOM. VALUE	TOLERANCE
Main Sample Flow Rate	0-45.3 SLM (0-1.6 SCFM)	14.1 SLM (0.5 SCFM)	± 2.8 SLM (± 0.1 SCFM)
Grab Sample Flow Rate	0-1130 SLH (0-40 SCFH)	226 SLM (8 SCFH)	± 2.8 SLM (± 0.1 SCFH)
Calibration Gas Flow Rate	0-70.8 SLH (0-2.5 SCFH)	56.6 SLH (2 SCFH)	± 2.8 SLM (± 0.1 SCFH)
Main Sample Gas Pressure	0 -254 mm-Hg (0 -10 "Hg)	-102 mm-Hg (-4 "Hg)	N/A
Sample Gas HT Cont. Temp.	4.4-65.6 °C (40-150 °F)	29.4 °C (85 °F)	± 1.1 °C (± 2 °F)
Cal. Gas HT Cont. Temp.	4.4-65.6 °C (40-150 °F)	29.4 °C (85 °F)	± 1.1 °C (± 2 °F)
Enclosure Heater Cont. Temp.	-17.8 37.8 °C (0-100 °F)	21.1 °C (70°F)	± 1.1 °C (± 2 °F)
Enclosure A/C Cont. Temp.	10-55 °C (50-131 °F)	26.7 °C (80 °F)	± 1.1 °C (± 2 °F)

PROCESS ALARM SET POINTS	NOMINAL VALUE	TOLERANCE
Main Sample Flow Rate (FASL)	11.3 SLM (0.4 SCFM)	± 2.8 SLM (± 0.1 SCFM)
High Hydrogen (NASH 54/55)	0.625% H_2	± 0.1% H_2
Sample Gas Low Temp. (TASL)	18.3 °C (65 °F)	± 1.1 °C (± 2 °F)
Calibration Gas Low Temp. (TASL)	18.3 °C (65 °F)	± 1.1 °C (± 2 °F)
Enclosure High Temp. (TASH)	29.4 °C (85 °F)	± 1.1 °C (± 2 °F)
Enclosure Low Temp. (TASL)	15.6 °C (60 °F)	± 1.1 °C (± 2 °F)

PROCESS INSTRUMENT RANGES

PROCESS INSTRUMENT	RANGE	CAL. ACCURACY
FE-*57	0-45.3 SLM (0-1.6 SCFM (Nom.))	± 0.5% FS (Cal. Not Req.)
FIV-*52	0-1132 SLH (0-40 SCFH)	± 2% FS (Cal. Not Req.)
FIV-*56	0-70.8 SLH (0-2.5 SCFH)	± 10% FS (Cal. Not Req.)
FIT-*57	0-254 mm H_2O (0-10 In H_2O)	± 0.5% FS
NR-*54/55	4-20 mA	± 1% FS
NIT-*54 (System)	0-10% H_2	± 0.25% H_2, ± 5% FS(Std Gas)
NIT-*54 (Output)	4-20 mA	± 0.5% FS
NIT-*55 (System)	0-1% H_2	± 0.25% H_2, ± 5% FS(Std Gas)
NIT-*55 (Output)	4-20 mA	± 0.5% FS
PDI-*51	0-1524 mm H_2O (0-60 In H_2O)	5% FS (Increasing)
PI-*53	0-760 mm Hg (0-30 In Hg)	± 5% FS

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