WHC-SA-3024-FP

Report on the Design of Freeze Protection for Hanford Nuclear Reservation Fire Suppression Systems

S. M. Korslund

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Assistant Secretary for Environmental Management

Westinghouse Hanford Company
P.O Box 1970
Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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D. Document Title

REPORT ON THE DESIGN OF FREEZE PROTECTION FOR THE HANFORD NUCLEAR RESERVATION FIRE SUPPRESSION SYSTEMS

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PSS/HFD/FP

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8. Author/Requestor

STEVEN M KORSLUND (Print and Sign) Steven M Korslund 2/28/96 Date

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1. (Award) Contract No. DE-AC06-87RL10930

2. Title Report on the Design of Freeze Protection for Hanford Nuclear Reservation Fire Suppression Systems

3. Product/Report Description

☐ a. Report *(Complete all that apply)*

(1) ☐ Print ☐ Nonprint *(specify)* _____

(2) ☐ Quarterly ☐ Semiannual ☐ Annual ☐ Final
☐ Topical ☐ Phase I ☐ Phase II
☐ Other *(specify)* _____

Dates covered _____ thru _____

☒ b. Conference/Meeting/Presentation *(Complete all that apply)*

(1) ☒ Print ☐ Nonprint *(specify)* _____
☐ Published proceedings
☐ Other *(specify)* _____

(2) Conference Title *(no abbreviations)* DOE Fire Protection Conference

Location *(city/state/country)* Chicago, Il

Date(s) *(m/d/y)* 4/29/96 thru *(m/d/y)* 5/2/96

Sponsor DOE

☐ c. Software - Additional forms are required. Follow instructions on the back of this form.

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C. Contact *(Person knowledgeable of content)*

Name S. M. Korslund

Phone 509-373-1639

Position Author

Organization Westinghouse Hanford Company

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2. Funding Office(s) *(NOTE: Essential data)* EM

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(Date) 11-25-96

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REPORT ON THE DESIGN OF FREEZE PROTECTION FOR HANFORD NUCLEAR RESERVATION FIRE SUPPRESSION SYSTEMS

S. M. Korslund
Fire Systems Administrator, Hanford Fire Department

BACKGROUND

The National Fire Protection Association (NFPA) 72 (1993) requires using temperature sensing equipment to monitor water supplies for fire suppression and water-based fire extinguishing systems for freezing temperatures based on the requirements of NFPA 13 (1994). NFPA 72 also requires that testing of freezing temperature detection equipment to verify that the sensor causes a supervisory signal at 40 degrees Fahrenheit (°F) (± 5 °F). The required test method must ensure operation of the device at 40 °F. NFPA 72 requirements and test methods cannot reasonably be interpreted to allow an unmeasured temperature lowering agent to cause operation of the device as a valid test of the device.

Commercial Equipment supplied as cold temperature sensors includes a variety of single-point spot detectors described as actuating at 40 °F. However, there is no manufacturer-recommended, field-usable procedure compliant with NFPA 72 that can provide proper actuation point verification within the test method requirements of NFPA 72. The manufacturer does not recommend a suitable test to verify point of actuation, except to place the detector in a temperature controlled environment and verify that it trips at or higher than 40 °F. This test, which consumes time, manpower, equipment and money, is less than satisfactory.

Cold temperature detection at the Hanford Site is used to monitor the temperature in riser rooms for dry sprinkler systems and to monitor portions of wet sprinkler systems that pass through unheated areas.

TEST METHODS

The current, widely used test method is to apply a freezing spray of canned "air" to the device. The "air" consists of 100 percent chlorodiflouromethane, an inert gas. By inverting the can and releasing the gas propellant, temperatures as low as −30 °F can be obtained. Although this method actuates the device, the extremely low temperature and rapid rate of descent do not prove the device actuated at 40 °F. In addition, the possible ill effects of the extreme cold temperature on the device have not been ascertained. These shortcomings have been issued as an audit finding by the Department of Energy-Richland Operations. The finding cites that NFPA 72 requires room temperature switches be tested to verify that the device operates and results in a signal that indicates the room temperature decrease to 40 °F and restoration to above 40 °F. The Fire Protection Manual (WHC-CM-4-41) for the

Westinghouse Hanford Company specifies that testing activities for high and low temperature switches verify that an alarm occurs within ± 7 percent or 5 °F, whichever is greater, of the desired setpoint in the direction that the switch would alarm.

It is important to note that single-point devices currently available to the industry are not Underwriters Laboratory (UL) listed for freeze protection for fire suppression systems. They may, however, contain UL listed components.

EXISTING TYPES OF FREEZING TEMPERATURE DETECTORS

The main supplier of freezing temperature detectors has provided three types of devices in recent years.

The first type was the Model RTD-G, a mercury-thermometer type not available in a normally open configuration to comply with NFPA 72 (1993). For this reason, apparently they were discontinued. (ATT. 5)

The second type, designated Model RTD-N.O. or RTD-N.C., operated on the thermistor semi-conductor principle. The operation of this model partially depended on the control equipment. Because the electrical resistance of the device lowers as the sensed temperature decreases, the control panel determines the point of actuation. It is possible that one manufacturer or type of control panel would trip at 50 °F while another would not trip until 30 °F. (The data sheet for this specific device refers to it as a bimetallic disk, but field tests indicate otherwise.) This potential controversy introduces quality control questions. These devices are no longer available through the fire systems component distributor. (ATT. 7)

The third and currently available type is a simple bimetallic strip, Model RTS-0 or RTS-C. (ATT. 9)

There is no apparent consensus on the construction or mode of operation of these devices.

RECENT TECHNOLOGY

An exception to the poor test ability of cold temperature devices is the recent development of analog systems which use linear temperature sensors to supply the control panel with temperature information. The control panel is programmed to determine whether the condition sensed is a heat increase within the parameters of a fire alarm device or a temperature decrease within the parameters of an incipient freeze condition. These sensors (detectors) are UL listed for freeze protection for fire alarm suppression systems, but they must be used with their specific control panel thus precluding universal application.

The lack of UL listed equipment, which can be readily tested to verify the actual point of actuation has become a nationwide end user concern.

NEW EQUIPMENT AT THE HANFORD SITE

The Hanford Fire Department Fire Systems Testing and Maintenance Engineering Division has adapted an application using a currently manufactured industrial process temperature controller which fully complies with the intent of NFPA requirements including the following:

Supervision of the power supply

Monitoring of sensing circuits

Tests to verify the point of actuation

Programmable to a single point of actuation, with the set point protected from unauthorized alteration

Readily visible local annunciation with a digital readout of actual detected or monitored temperature and local indication of off-normal condition

This controller is a Red Lion Model TCU temperature controller with an optional relay output that connects to a local fire alarm control panel. The relay provides normally open contacts for systems in compliance with NFPA 72 (1993) and normally closed contacts for systems complying with earlier codes of record.

A supervisory (off-normal) signal is generated when there is an open circuit or shorted circuit for the sensing element, loss of primary power, or a temperature lower than device set point.

The Hanford Fire Department Fire Systems Testing and Maintenance Engineering Division wrote procedure FS-0025 to program and test the unit. This procedure is attached to this article for information purposes.

The controller can be installed in approximately four hours. The cost of materials is approximately $275.

The temperature controller includes a 5 amp fuse housed in a safe electrical inline fuse holder. The fuse holder pulls apart with the energized portion insulated and shielded from accidental contact in compliance with 29 CFR 1910 for personnel protection during maintenance.

The Hanford Nuclear Reservation has installed 70 of these systems in 55 locations with a zero failure rate during the first six months of operation. The ability of these systems to detect a failure in the area or pipe heating system prior to dropping to 40 °F is an added benefit. A surveillance program can monitor and track the sensed temperature during inclement weather as it continually displays on the digital readout.

The Red Lion Company has been contacted about submitting the Model TCU unit to UL for listing for freeze protection for fire suppression systems. The high quality unit is UL listed as a temperature monitor and controller for industrial and process control applications. Another model, whose design is under consideration, would receive power directly from a fire control panel and could operate as a supervisory initiating device. This would be similar to operating an alarm initiator that requires separately derived 24 vdc power, such as a duct smoke detector.

NEW TEST METHOD

The Hanford procedure for testing the Red Lion unit compares the sensed temperature reading with the programmed set point. Both temperature readings display, one above the other in a digital format. A front panel button is used to raise the set point to .2 °F above the sensed temperature, at which time the receipt of the supervisory signal is verified. Therefore, by interference, the sprinkler system is protected at the set point level of 40 °F. The set point is programmed to prevent the temperature from being lowered below 40 °F, and it can be password protected. Leaving the set point raised provides a higher degree of protection. See Attachment 11 for the formal programming and testing procedure.

COMPARING TEST COSTS

The previous test method required two persons: one to monitor the control panel for the supervisory signal, the other to apply the canned "air" to the temperature sensor. Because the device is frozen to −30 °F, the reset is delayed until the unit warms to more than 40 °F. It also may be necessary to remove insulation thereby adding personnel and costs to the testing. Therefore, in addition to being inefficient and inaccurate in certifying that a system is actually protected from freezing temperatures, the old method also waste manpower.

The test procedure associated with the Red Lion equipment can be performed by a single person in less than two minutes.

Costs associated with testing are reduced to a fraction because only one person is required and a shorter test time is required. This depends on specific application circumstances, but in no case is it less than half again. Thus, testing costs are reduced by 75 percent, or one quarter of the original cost. Recovery of procurement and installation costs is recovered in one or two test cycles.

In this case, meeting the code requirements is less expensive than not.

REFERENCES

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

NFPA 1994, *Standards for the Installation of Sprinkler Systems*, NFPA 13, National Fire Protection Association, Quincy, Massachusetts.

NFPA 1993, *National Fire Alarm Code*, NFPA 72, National Fire Protection Association, Quincy, Massachusetts

WHC-CM-4-41, *Fire Protection Program Manual*, Westinghouse Hanford Company, Richland, Washington.

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ATTACHMENTS

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CONTENTS

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POTTER

RTS-G
ROOM TEMPERATURE SWITCH GLASS

Potter Electric Signal Company
2081 Craig Rd./P.O. Box 28480
St. Louis, MO 63146
(314)878-4321 / (800) 325-3936

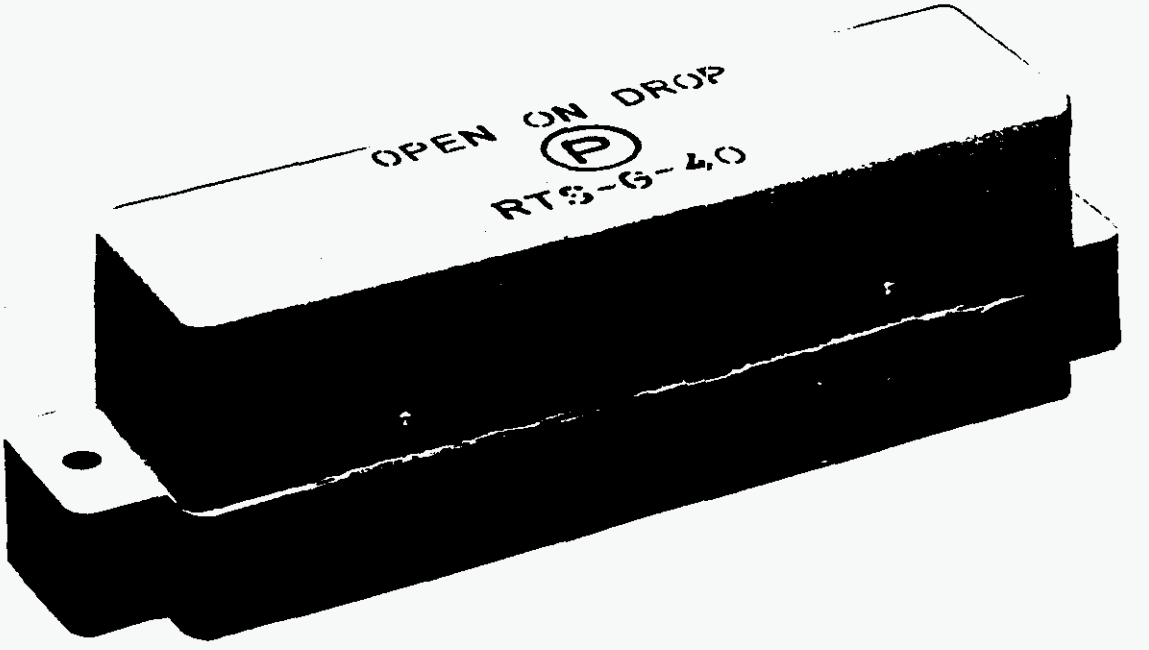
Potter Electric Signal & Mfg. LTD
1967 Leslie Street
Don Mills, Ontario, Canada M3B2M3
(416) 441-1833

Temperature Setting: 40°F

Accuracy: ± 1.5°F

Contacts: S.P.S.T. rated 100 MA 24V
AC OR 24V DC
Opens on temperature drop
Closes on temperature rise

Dimensions: 4 3/4"L x 1"W x 1 1/4"D



STK. NO. 1010036

The Model RTS-G is a mercury column type switch designed for use with a supervisory transmitter to monitor temperature. The unit is normally used in areas where there are wet sprinkler systems, so that an indication is given before the temperature drops to the freezing point.

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POTTER

RTD SERIES
ROOM TEMPERATURE DEVICE

Potter Electric Signal Company
2081 Craig Rd./P.O. Box 28480
St. Louis, MO 63146-4161
(314)878-4321 / (800) 325-3936

Potter Electric Signal & Mfg. LTD
1967 Leslie Street
Don Mills, Ontario, Canada M3B2M3
(416) 441-1833

RTD-N.O. STK. #1010108
RTD-N.C. STK. #1010109

Base: Molded White plastic

Dimensions: 1 7/8" diameter, 7/8" high

Sensor: Stainless steel cap, compression welded to brass shell with bimetallic operating mechanism nested within.

Contacts: Silver clad phosphor bronze, (normally open or normally closed)

Electrical Rating: 3A @ 125VAC, 1A @ 6 to 24VDC

Temperature Setting: 40° F fixed

Terminals: Dual brass screw terminals

Mounting: Semi-flush on standard electric box

The RTD Series Room Temperature Detectors are precision engineered, designed and manufactured for commercial or residential use.

Each unit consists of a bi-metal operating mechanism, featuring hermetically sealed precious metal contacts, N.O. or N.C., which automatically reset for repetitive operation, eliminating the need for sensing element replacement.

Small compact design, highly resistant to vibration and corrosion. Easily installed on standard electrical outlet boxes.

Available at factory preset temperature rating of 40° F. Designed to warn of potential sprinkler pipe freezing or other cold detection applications.

Dual screw terminals permit easy installation in single or multiple detector circuits.

ACCESSORY ITEMS: Protective covers for use where mechanical protection required.

FEATURES:

- Easily installed
- Completely sealed, moisture and vapor resistant
- Highly resistant to vibration and corrosion
- Highly sensitive to temperature changes
- No sensit vity loss due to aging
- Repetitive operation without the need to replace sensing elements
- Small compact design
- Precision and quality at low cost

Manufactured for Potter Electric Signal Co. by Therm-L-Matic, Hatboro, PA.

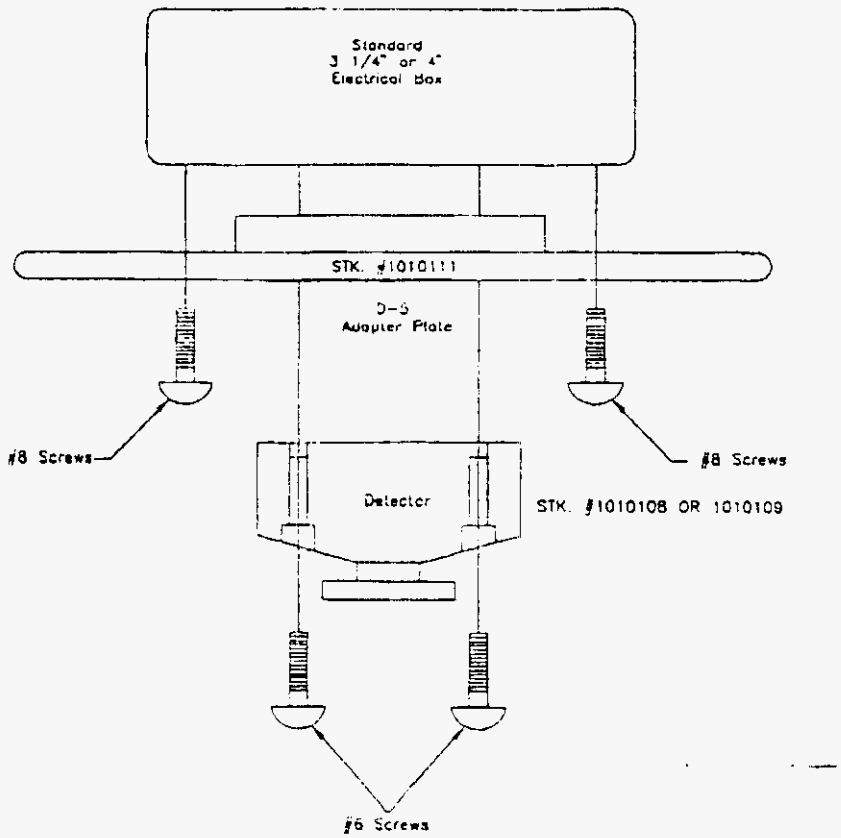
PRINTED IN USA
MKT. #6820008 - REV A
MFG. #5400537

POTTER

RTD SERIES
ROOM TEMPERATURE DEVICE

INSTALLATION

OPERATION: When the temperature at the detector drops to 40° the normally open contacts close and the normally closed contacts will open. The detector will automatically reset to the normal state when the temperature rises above 40°.



ORDERING INFORMATION

OPTIONAL EQUIPMENT:

Mounting plate, metal	1010109
Protective Cap	1010112
RTD-N.C.	1010108
RTD-N.O.	1010109
Mounting plate, plastic	1010110

PRINTED IN USA

MKT. #8820008 - REV A
MFG. #9-400537

POTTER

RTS-O / RTS-C
ROOM TEMPERATURE SWITCH

Potter Electric Signal Company
2081 Craig Rd., P.O. Box 28480
St. Louis, MO 63146-4161
(314) 878-4321 • (800) 325-3936

Potter Electric Signal & Mfg. LTD
1967 Leslie Street
Don Mills, Ontario, Canada M3B2M3
(416) 441-1833

Enclosure: White ABS

Dimensions: 2 1/16"W x 3 7/16"L x 1 1/4"H

Sensor: Epoxy sealed stainless steel case, bi-metallic operating mechanism.

Contacts: Silver clad, available normally open or normally closed.

Electrical Rating: 1A @ 24VDC

Temperature Setting: 40°±5°F, 5°±3°C

Terminals: Screw Terminals

RTS-O STK. #1010108
RTS-C STK. #1010109

Mounting: Surface

The RTS Series Room Temperature Sensors are precision engineered, designed and manufactured for commercial or residential use.

Available at factory preset temperature rating of 40° F. Designed to warn of potential sprinkler pipe freezing or other cold detection applications.

Each unit consists of a bi-metal operating mechanism, featuring hermetically sealed precious metal contacts, N.O. or N.C., which automatically reset for repetitive operation, eliminating the need for sensing element replacement.

Small compact design, highly resistant to vibration and corrosion. Easily installed using the enclosed hardware or adhesive mounting pad.

Screw terminals permit easy installation in single or multiple detector circuits.

FEATURES:

- Easily installed
- Completely sealed sensor, moisture and vapor resistant
- Highly resistant to vibration and corrosion
- Highly sensitive to temperature changes
- No sensitivity loss due to aging
- Repetitive operation without the need to replace sensing elements
- Small compact design
- Precision and quality at low cost

OPERATION

The normally open detector, RTS-O, will close the contact when the temperature drops below 40°F. The normally closed detector, RTS-C, will open the contact when the temperature drops below 40°F. The detector will automatically reset to the normal state when the temperature rises above 40°F.

PRINTED IN USA
MKT. #8820013 - REV B
MFG. #5401019 - 10/94

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FIRE SYSTEMS TESTING AND MAINTENANCE

(FST&M)

SITE-WIDE
TEST AND MAINTENANCE PROCEDURE

FS0025

Revision 0
Change 0

PERFORM COLD TEMPERATURE DETECTOR PROGRAMMING AND TESTING

Approval Level S

Prepared by:	FST&M	K.M Pittman, Engineer	
			DATE
Validated by:	FS Maintenance	E. Blankingship, Manager	08/03/95
Approved by:	Safety	P.J. McKenna, Engineer	08/08/95
	FST&M Manager	W.M. Knight, Manager	08/10/95
	Cog. Engineer	S.M. Korslund	08/03/95
Released by:	Procedure Coordinator	K.M. Pittman	

Release Date: 08/15/95

FST&M TEST & MAINTENANCE PROCEDURE PERFORM COLD TEMPERATURE DETECTOR PROGRAMMING AND TESTING	APPROVAL LEVEL S	PROC. NO. FS0025 REV. 0, CHG. 0 PAGE 2 OF 8

Change Record

Change Number	Date	Document	Page(s)	Description
Rev. 0	08/03/95	950060	ALL	New procedure.

FST&M TEST & MAINTENANCE PROCEDURE PERFORM COLD TEMPERATURE DETECTOR PROGRAMMING AND TESTING	APPROVAL LEVEL S	PROC. NO. FS0025 REV. 0, CHG. 0 PAGE 3 OF 8

1.0 PURPOSE AND SCOPE

1.1 This procedure provides instructions for a safe, uniform method to perform Cold Detector programming and testing.

2.0 REFERENCES

None.

3.0 PERSONNEL REQUIREMENTS

3.1 Hanford Fire Department (HFD) Testing and Services Personnel.

3.2 Health Physics Technician (HPT), as required.

3.3 FSM Electricians.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 If abnormal conditions occur, or deviation from specified work is required, stop all work and immediately notify Person-In-Charge (PIC). DO NOT go on without authorization from PIC.

4.2 If performance of any steps in this procedure is not required for procedure completion, steps not performed shall be shown as such by entering "N/A" in appropriate Data Sheet space and explained in COMMENTS/REMARKS section of Data Sheet.

4.3 Sections or steps within sections of this procedure may be done out of sequence, as required for testing or plant conditions.

4.4 HFD shall bypass all fans, dampers, interlocks, and accessories required to do maintenance and testing of system

FST&M TEST & MAINTENANCE PROCEDURE PERFORM COLD TEMPERATURE DETECTOR PROGRAMMING AND TESTING	APPROVAL LEVEL S	PROC. NO. FS0025 REV. 0, CHG. 0 PAGE 4 OF 8

5.0 TOOLS, EQUIPMENT AND MATERIALS

NOTE

All M&TE used for this working-level procedure shall meet the following requirements:

a. Be within its current calibration cycle, as evidence by an affixed calibration label.

b. Be capable of desired range and within input tolerance specified by Calibration Control authority.

5.1 Temperature probe for Multi Meter with 5% tolerance.

5.2 Calibrated Digital Multi Meters (DMM) with 5% tolerance.

6.0 PREREQUISITES

6.1 Notify Operations Manager/Building Administrator of intent to complete this Maintenance and Test Procedure (M&TP).

6.2 Notify all locations to which remote annunciators transmit.

6.3 HFD set the Fire Alarm System for Building/Zones tested in test form. Bypass functions necessary for test. List bypassed funtions on Data Sheet in space provided in Prerequisites Section. Initial Data Sheet when functions are bypassed.

6.4 Comply with building specific Lock and Tag requirements.

FST&M TEST & MAINTENANCE PROCEDURE PERFORM COLD TEMPERATURE DETECTOR PROGRAMMING AND TESTING	APPROVAL LEVEL S	PROC. NO. FS0025 REV. 0, CHG. 0 PAGE 5 OF 8

7.0 **INSTRUCTIONS**

NOTE

a. IF concurrent procedures existed, THEN system charging and restoration sections should be adjusted/performed when needed to setup for concurrent jobs or at their completion.
b. HFD shall verify all Fire Alarm Control Panel's (FACP) zone alarms generated by doing this procedure correspond with proper zone in Radio Fire Alarm Repeater (RFAR) Box, and first alarm per zone received at the Fire Station.
c. Capitalized abbreviations used after RECORD shows where to enter data on Data Sheet like (FNC).

7.1. Program Cold Temperature Detector for Installation/Replacement

7.1.1 PROGRAM the TCU by operating the control buttons. "PAR" will initiate and step through the parameter function. "Arrow Up" and "Arrow Down" will select the proper setting.

7.1.2 SET the programming per the following Table.

7.1.3 CHECK OFF the following programming information:

Table 1

PAR	PROP	0.0	
PAR	CNFP	NO	ARROW UP
	1-1N		PAR
	TYPE	TC-E	PAR
	SCAL	F	PAR
	DCPT	0.0	PAR
	FLTR	1	PAR
	SPAN	1.000	PAR
	SHIFT	0.0	PAR
	SPLO	40.0	PAR
	SPHI	100.0	PAR

	SPRP	0.0	PAR
	CNFP		ARROW UP
	1-IN		ARROW UP
	2-OP		PAR
	CYCLE	0	PAR
	OPAC	DRCT	PAR
	OPLO	100	PAR
	OPHI	0	PAR
	OPFL	0	PAR
	CHYS	.1	PAR
	TCOD	0	PAR
	CNFP		PAR
	END		

7.2 Testing

7.2.1 PRESS the "Arrow Up" button until the setpoint temperature exceeds the control temperature by .2 to .5 degrees.

7.2.2 VERIFY receipt of trouble signal.

7.2.3 RESTORE the setpoint temperature to 40 degrees F. by pressing "Arrow Down".

7.2.4 RECORD results on the Data Sheet.

7.2.5 VERIFY trouble signal clears on FACP.

7.2.6 RESET FACP and verify normal supervisory service condition.

8.0 RESTORATION

8.1 Restore system to normal.

8.2 Reset and restore building alarm bell switch and all applicable fans, dampers, interlocks and accessory functions to normal position; record restoration of equipment on Data Sheet under PREREQUISITES FUNCTIONS (RESTORED).

8.3 If RFAR box has Bell Card Module, reset and restore bell silence switch to normal position.

8.4 Verify no abnormal conditions exist inside RFAR box; shut and lock RFAR box.

8.5 Ensure no alarm or trouble LED's are lit on FACP.

8.6 Notify building personnel that HFD and Maintenance have completed testing and have returned alarm system to normal operation.

8.7 Notify HFD dispatcher testing has been completed and request all zones be restored, identify building and RFAR box number.

8.8 Request HFD dispatcher to bypass front button alarm on RFAR box.

8.9 After acknowledgement, press front button on RFAR box and verify three rounds of fire front button are received at fire stations. Initial Data Sheet (RESTORATIONS 1).

8.10 Notify HFD dispatcher RFAR box is restored and the test has been completed.

8.11 Remain at RFAR box until light goes out on front of RFAR and initial Data Sheet (RESTORATIONS 2).

9.0 TESTING AND ACCEPTANCE

None.

10.0 **DISPOSITION**

10.1 Advise Building Manager/Administrator of any system impairments or abnormal conditions, Initial Data Sheet (RESTORATIONS 3).

10.2 HFD personnel complete and return all Fire System Alarm Test Report forms to Fire Station #2 for file.

10.3 Report deficiencies or cause of early failure to Supervision.

10.4 Return Data Sheet(s) to Supervision and inform Supervision preventive maintenance is complete.

11.0 **BIBLIOGRAPHY**

11.1 WHC-CM-4-3, Industrial Safety Manual, Section TE, "Tools and Equipment", Standard No. PP-7, "Personal Protective Equipment", and Standard G-1, "Lock and Tag".

11.2 HSRCM-1, Hanford Site Radiological Control Manual, Chapter 2, Part 3, "Posting", and Chapter 3, Part 2, "Work Preparation."

11.3 WHC-CM-4-3, Vol. 1, Standard FS-2, "Fire Protection System Inspection, Testing, and Maintenance".

B O M Suppl _____

Page _____ of _____

BILL OF MATERIAL	Title/End Use: FREEZING TEMPERATURE DETECTION	Wk. Pkg. No.: 2G-95-550	ECN No.: 614272
Date: 09/01/95	Requestor: SM KORSLUND		Priority: 3

Item No.	Quantity / Unit	Material Description	Estimated Cost	Req./Store No. / Exp. Delivery Date	Safety Class	Approval Designator	QC Approval	Ordered / Received	Stock No. / Storage Location
1	70 / EA	RED LION TEMPERATURE CONTROL UNIT (TCU) P/N TCU0000.	186.00		3	S			
2	56 / ea	HOFFMAN ENCLOSURE, NEMA 4, 6X6X12	45.00		4	NA			
3	70 / EA	TYPE "E" THERMOCOUPLE P/N AX1008808	13.00		3	S			
4	70 / EA	FUSE HOLDERS; In-line Breakaway; p/n 6F453; with Insulating Boot; p/n 6F454	20.00		3	S			
5	70 / EA	RELAY MODULE FOR RED LION MODEL TCU; P/N OMD00000	9.30		3	S			
6	1000 / FT	THERMOCOUPLE EXTENSION CABLE, TYPE E; P/N E20-5-502	.27		4	NA			

Date Required: 09/01/95

☐ Mandatory ☒ Desired

Delivery Location: 2721EA

QA Clauses: E14,E22,C02

Suggested Vendor: BRANOM INSTRUMENTS PO BOX 80307 SEATTLE, WA 98108

Special Instructions

Emergency Justification:

Org Code/Cost Code: 3C600/MFMPM

	Date	MSIN	Phone No.
Material Coordinator			
Cognizant Engineer *(If applicable)*			
Cognizant Manager *(If applicable)*			
Planner			
Quality Assurance			

Material Released To and Received By: _____ Date _____

BC-5600-174.1 (02/94)

BILL OF MATERIAL

Continuation Sheet

Work Request No.

B.O.M. Suppl.

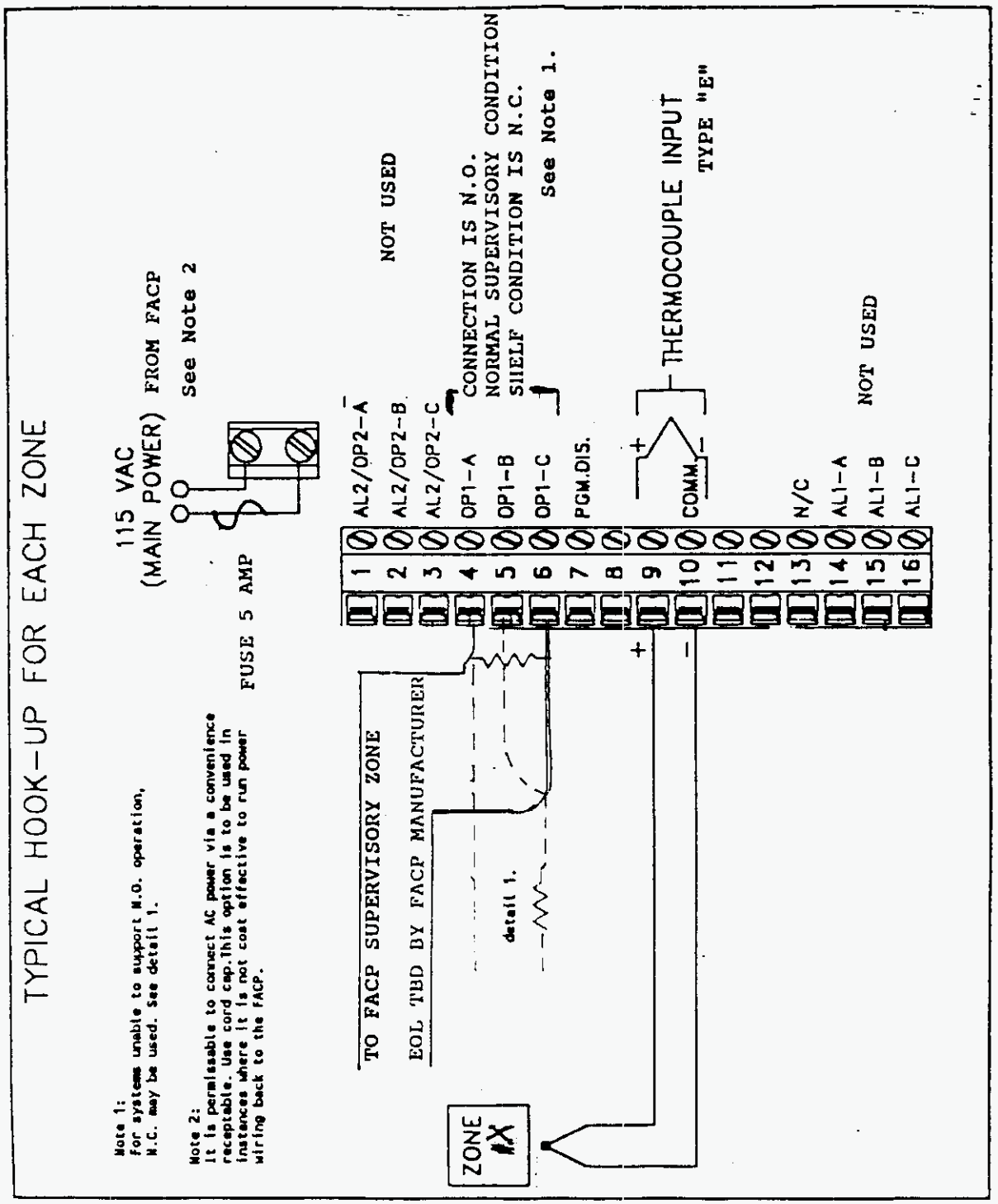
Page ______ of ______

Item No.	Quantity / Unit	Material Description	Estimated Cost	Req./Store No. / Exp. Delivery Date	Safety Class	Approval Desig-nator	QC Approval	Ordered / Received	Stock No. / Storage Location
7	70 EA	CONNECTOR, THERMOCOUPLE, MALE AND FEMALE MALE P/N 900E; FEMALE P/N 901E; TYPE E	5.00		4	NA			
8	70 EA	CABLE CLAMP, P/N 921	.85		4	NA			

BC-6600-174.2 (02/94)

CVI 12244, Sheet 69

TYPICAL CONNECTION DIAGRAM FOR FIRE SYSTEMS



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