UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406

OCT 23 1991

[redacted]

Dear [redacted]

The NRC Region I office evaluated the concern that you brought to our attention on October 1, 1991 regarding the Millstone Unit 2 steam jet air ejector (SJAE) radiation monitor. Our resolution of this concern is discussed below.

You asserted that a new SJAE radiation monitor was installed but not placed into service to replace the existing monitor (RM-5099) because Northeast Utilities did not want to use this more sensitive instrument with the old steam generators in service. The NRC did an inspection and found that the new monitor was installed and operational for approximately two months. The new monitor is substantially different than the old monitor and requires a test and evaluation period before it is placed into service as a permanent replacement for the old monitor. When we did our inspection, Northeast Utilities was considering doing a comparative study of the two monitors. Following resolution of issues identified during the comparative study, Northeast Utilities intends to use the new monitor in lieu of the old monitor for Control Room indication and process computer inputs.

Based on the above described inspection, the allegation was not substantiated. Therefore, the NRC plans no further action. Thank you for informing us of your concerns.

Sincerely,

Eugene M Kelly
for Edward Wenzinger, Chief
Reactor Projects Branch 4

J/194

9503030060 940809
PDR FOIA
HUBBARD92-162 PDR

[redacted]

bcc:
Allegation file, RI-91-A-0261
E. Conner files.
E. Kelly (Section Chief)
W. Raymond
T. Shedlosky
Contractor's office files (REAGAN)
RI:DRP

concurrences:

RI:DRP	RI:DRP	RI:DRP
Conner	Kelly	Wenzinger
_/_/_	10/23/_	_/_/_

Tom S. 203 444 5615

(186)

ALLEGATION UPDATE INFORMATION REQUESTED
BY OCTOBER 9, 1991 PANEL

Date/Time Initially
Received: October 1, 1991 1140 Allegation No. RI-91-A-0261
(Information Update)

Name: Address:

Phone: City/St./Zip:

Confidentiality:
Was it requested? No

Alleger's Employer: NNECO Position/Title: Instrumentation and Control Department Technician

Facility: Millstone Unit 2 Docket No.: 50-336

Allegation Summary: **The licensee has deliberately delayed placing a new turbine condenser steam jet air ejector radiation monitor in service.**

Number of Concerns: 1

Employee receiving allegation: J. T. Shedlosky
Employee updating allegation: J. T. Shedlosky

Detailed Description of Allegation: **A new steam jet air ejector radiation monitor has been installed but not yet placed into service to replace the existing monitor, RM-5099. The alleger stated that he does not believe that the licensee wishes to use this more sensitive instrument with the old steam generators because of their problems.**

Reference:
[redacted] Issue No. 2 only.

Inspectors Follow-up Information: **The Allegation Panel requested DRP to obtain the status of the air ejector radiation monitor system. The inspector found that the new monitor has been installed and has been operating for about two months. The new monitor is substantially different than the old monitor and therefore requires a test and evaluation period before it is placed into service permanently replacing the old monitor. The licensee presently is considering operating the two monitors with their outputs simultaneously recorded on the same device for a comparison study.**

Following the resolution of issues discovered during a test and evaluation period the new monitor will replace the old control room indication and process computer inputs.

T/172

ALLEGATION UPDATE INFORMATION REQUESTED
BY OCTOBER 9, 1991 PANEL

Date/Time Initially
Received: October 1, 1991 1140 Allegation No. RI-91-A-0261
(Information Update)

Name:

Design issues may have to be corrected. A deficiency which will probably require a design change relating to the temperature stability of the detector which is temperature sensitive by its nature. It presently operates at an elevated temperature; additional control may be required.

The licensee presently has three steam jet air ejector radiation monitors in operation in addition the main steam line N-16 gamma monitors. The original monitor is being replaced for reasons of reliability. Its detector is easily damaged by moisture. Efforts to control moisture in the sample stream have not been totally effective. The new monitor seeks to correct this and other reliability issues; it employs a detector located on the outside of the off-gas process flow pipe. (A third, temporary monitor, uses a chemistry sample point.

The licensee plans to evaluate the sensitivity of the new monitor, which may not have the sensitivity of the original monitor because their detector configurations.

Inspector's Recommendation: Allegation program inspection on site; do not turnover to licensee.

0261

ALLEGATION RECEIPT REPORT

Date/Time Received: October 1, 1991 1140

Allegation No. RI-91-A-0261

Name:

Address:

Phone:

City/St./Zip

Confid
Was it requested? No

Alleger's Employer: NNECO

Position/Title: Instrumentation and Control Department Technician

Facility: **Millstone Unit 2**

Docket No.: 50-336

Allegation Summary: **The licensee has deliberately delayed placing a new turbine condenser steam jet air ejector radiation monitor in service.**

Number of Concerns: 1

Employee receiving allegation: J. T. Shedlosky

Type of regulated activity: Reactor

Functional Area(s): Operations

Detailed Description of Allegation: **A new steam jet air ejector radiation monitor has been installed but not yet placed into service to replace the existing monitor, RM-5099. The alleger stated that he does not believe that the licensee wishes to use this more sensitive instrument with the old steam generators because of their problems.**

Reference:
[redacted] **Issue No. 2 only.**

Information in this record was deleted in accordance with the Freedom of Information Act, exemptions 7C
FOIA- 92-162

T/173

0262

18

ALLEGATION RECEIPT REPORT

Date Time
Received: **October 2, 1991 1115** Allegation No.

Name: [redacted] Address: [redacted]

Phone: [redacted] City/St./Zip: [redacted]

Confidentiality:
Was it requested? No

Alleger's Employer: NNECO Position/Title: Instrumentation and Control Department Technician

Facility: **Millstone Unit 2** Docket No.: 50-336

Allegation Summary: **Instrument and Control Department Library does not have the correct technical manual for the Emergency Diesel Generator local annunciators.**

Number of Concerns: **1**

Employee receiving allegation: J. T. Shedlosky

Type of regulated activity: Reactor

Functional Area(s): Operations

Detailed Description of Allegation: **The alleger discovered that the I&C Department Library does not have the correct technical manual for the Emergency Diesel Generator annunciators.**

The alleger has informed the licensee.

Attachments: [redacted]

Information in this record was deleted
in accordance with the Freedom of Information
Act, exemptions 7C
FOIA- 92-162

T/125

LIST OF EFFECTIVE CHANGES

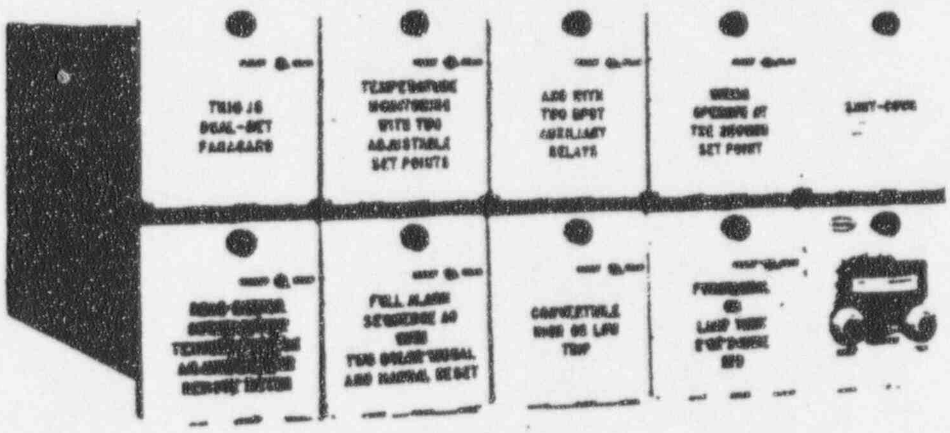
VENDOR TECHNICAL MANUAL (VTM) UPDATES

REVISION # OR INSERT	DATE	SIGNATURE
001A (original)	2-14-90	Todd Perrelli

INSTRUCTION AND OPERATING MANUAL

PANALARM®

MODEL 11P DUAL SET PANAGARD TEMPERATURE MONITOR



INDEX:

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DIVISION OF THE RILEY CO.
SKOKIE, ILLINOIS U.S.A.

SIOC LIMITED
MISSISSAUGA,
ONTARIO, CANADA

Document No. 900081
May, 1975

THEORY OF OPERATION AND DESCRIPTION

1.1 EQUIPMENT DESCRIPTION

1.2 Physically, the Dual-Set PANAGARD System for temperature monitoring consists of four major elements. These are:

1. A point module (Model 11-PGDS) for each temperature to be monitored.

2. A master module (11-PM) for each system.

3. A Panalarm Model 11P annunciator cabinet of a size suitable to accommodate the total of items number 1 and number 2 above.

4. An integral or remote power supply.

1.3 One master module can accommodate up to 300 point modules, although if the temperatures to be monitored extend over a wide range, it will generally prove desirable to divide the monitoring system into several narrow ranges each with separate master modules in order to provide more accurate temperature indication. Note that trip-point accuracy will not be affected even though a wide range must be accommodated. It is only for convenience of calibration and accuracy of readout that additional master modules, each covering a particular range of temperature, may be desirable.

1.4 A unique feature of the Dual-Set PANAGARD System is its compatibility (both electrically and mechanically) with the Panalarm De-Line Annunciator System. Any given horizontal row of a De-Line annunciator cabinet may be devoted exclusively to Dual-Set PANAGARD or exclusively to annunciation.

1.5 THEORY OF OPERATION

1.6 Essentially, the Dual-Set PANAGARD System for temperature monitoring uses a Resistance-Temperature-Detector (RTD) in a bridge circuit and compares the resistance of the RTD against one of two known resistances in the opposing arm of the bridge. The resulting difference signal is modulated (chopped) and greatly amplified. It is then demodulated and applied to the appropriate output amplifier which, in turn, controls the various output devices, such as lamps, an auxiliary relay, and the audible signal as shown in Figure 1. The "trip-point" always occurs at (or very near) a balanced condition, thereby eliminating inaccuracies due to lead error in the RTD circuit, changes in gain in the amplifier itself, and adverse affects from variation in ambients and the supply voltage. In practice, then, the set point resistors are adjusted to values equal to that of the RTD at the trip temperatures.

1.7 Again referring to Figure 1, note that with appropriate switching, the elements of two bridges can be set up: one in the point module, and one in the master module. The bridge in the point module provides the temperature monitoring function as previously described. The bridge in the master module provides for indication of either the operating temperature (by comparing the RTD with a known precision resistor) or of the temperature to which the trip-point has been adjusted (by comparing the trip-point adjusting resistor to the same known resistor). Switching necessary to set up these circuits is provided within the Dual-Set PANAGARD System.

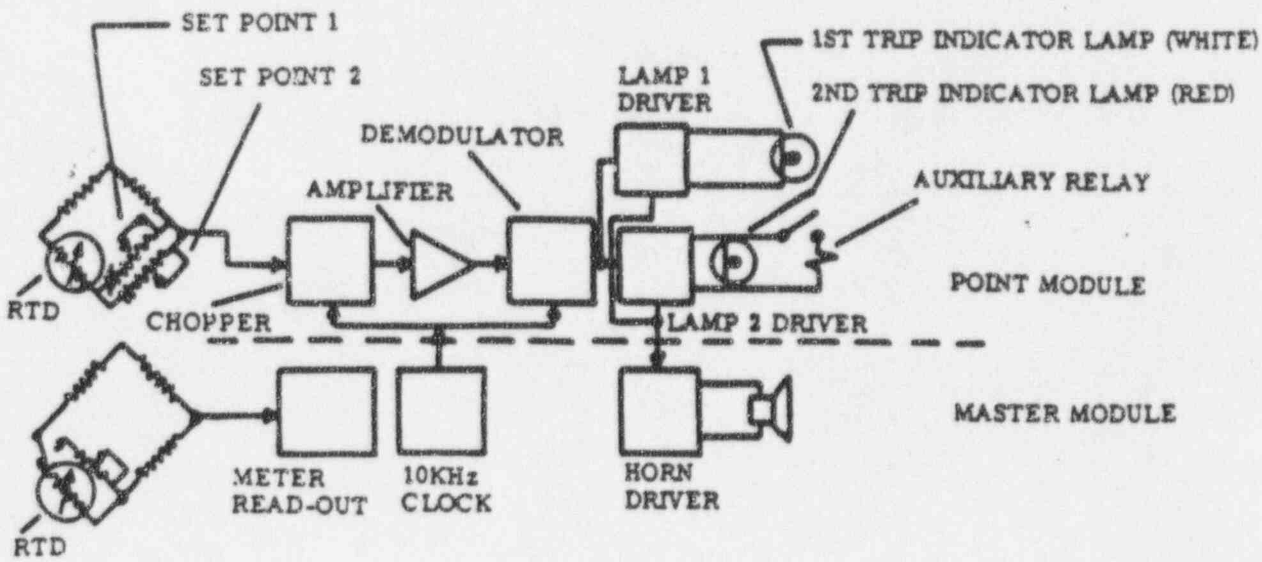


Figure 1.

2.1 INSTALLATION

2.1.1 Select desired position for master module. (see steps 2.1.6 and 2.1.7 below for discussion of limitations).

2.1.2 Assure that the De-Line cabinet is installed and wired in accordance with the drawing which is furnished with the equipment.

2.1.3 Either 2-wire or 3-wire RTD's may be employed(refer to paragraph 2.2 for installation procedures). For maximum accuracy and ease of calibration, the 3-wire RTD is recommended. Wiring should follow good commercial practice with either solder or screw-type connections being employed. If the 2-wire RTD is used, an error proportional to the resistance of the wire will be introduced in both the trip-point and the indicated temperature. If a 3-wire RTD is used, no error due to the resistance of the wire will be introduced in trip-point, but some error may be incurred in the temperature indication (see steps under Calibration Procedures for discussion of error due to lead wire). In general, it is desirable to use the largest gauge of wire which can be handled conveniently. It is recommended that a minimum of 14 gauge wire be used. This is especially true if a long run is required. Care should be taken to avoid grounding the RTD input, and the resistance to ground of the RTD leads at the PANAGARD terminals should be at least 2 megohms.

NOTE

The Dual-Set PANAGARD System has been carefully engineered to provide maximum immunity to electrical noise. For this reason, shielded wire is not generally required. It is, however, good practice to run the RTD signal wire in wire-ways separate from power wiring. This is especially true if the runs are of considerable length, above about 1,000 ft. If extreme electrical noise is anticipated, or if circumstances require that the signal wires be run in wire-ways also occupied by power wiring, shielded leads should be used. The capacitive effect of such shielding does not degrade Dual-Set PANAGARD operation.

2.1.4 If the Dual-Set PANAGARD point modules are equipped with the optional auxiliary relay, refer to paragraph relating to auxiliary relay under Operating Instructions prior to installing these modules.

2.1.5 Before installing the point modules in the Dual-Set PANAGARD cabinet, they should be examined to assure that they are high-trip or low-trip as appropriate. The units may be changed from one mode of operation to another in the field by operation of a selection switch located on the circuit board. Refer to Figure 2 for the location and orientation of this switch.

2.1.6 In the event that the Dual-Set PANAGARD System has been supplied in combination with the De-Line annunciation equipment, the chassis rows intended for Dual-Set PANAGARD will be identified by red decals at the rear of the chassis. The connectors used in the Dual-Set PANAGARD modules are not compatible with the receptacles which are used in those positions intended for De-Line annunciation.

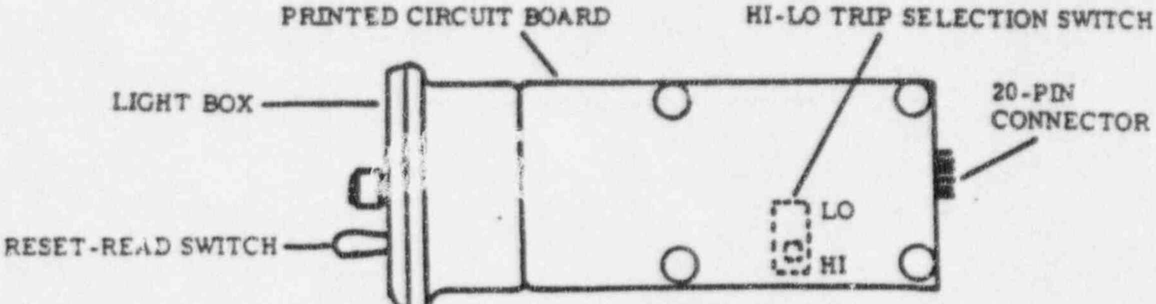
CAUTION

Attempting to force a Dual-Set PANAGARD module into a position intended for annunciation can result in damage to the Dual-Set PANAGARD connector.

2.1.7 The master module(s) may be inserted in any position in any row which is intended for Dual-Set PANAGARD operation. (Refer to Schematic 11450-PGDS-* for wiring details relating to the master module terminals.) In the event that more than one master module is employed, only one may be placed in a given row and must be inserted in the row covering the temperature range for which it is calibrated.

2.2 RTD INSTALLATION PROCEDURES

2.3 All Dual-Set PANAGARD cabinets are equipped with "dummy" resistors between terminals R1 and R2 and a jumper between terminals R2 and R3. Do the following procedure when installing the RTD.



TOP VIEW OF POINT PLUG-IN MODULE

Figure 2.

2.3.1 3-Wire RTD (see Figure 3)

1. Remove resistor between R1 and R2 terminals.

2. Remove jumper between R2 and R3 terminals.

3. Install RTD wire extension leads in accordance with appropriate Drawing Number 11450-PGDS-*.

CAUTION
DO NOT remove resistor if an RTD is not to be installed. Damage to the meter may result if the READ push-button is depressed and the resistor (or RTD) is not in place.

2.3.2 2-Wire RTD (see Figure 3)

1. Follow steps 1 and 3. Also heed CAUTION above. Do not remove jumper between R2 and R3 terminals. This jumper is required for proper system operation.

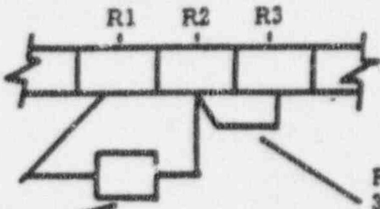


Figure 3.

OPERATING INSTRUCTIONS

3.1 OPERATING INSTRUCTIONS

3.2 AUXILIARY RELAY

3.3 The Dual-Set PANAGARD point modules may be optionally provided with an auxiliary relay. When this relay is provided, it will operate in parallel with the 2nd trip-point alarm. That is, it will be de-energized when the temperature being monitored is normal and energized when the temperature being monitored is abnormal, relative to the 2nd set point. The relay may be disabled by moving the slideswitch located in the center of the point light box, behind the nameplate, to the down position so as to preclude relay operation during test or trip-point adjustment. In this position, the relay will be disabled regardless of the status of the Dual-Set PANAGARD System. In many instances, it will prove desirable to disable this relay when the Dual-Set PANAGARD System is first being installed and the trip-points have not yet been established. Such disabling does not affect the operation of the alarm lamps.

3.4 TRIP-POINT(S) ADJUSTMENT

3.5 The Dual-Set PANAGARD System is provided with a means for setting or checking the trip-points from the front of the panel without the necessity for elaborate calibration equipment. While the accuracy of these adjustments are limited by the readability of the indicating instrument, and is subject to some inaccuracy depending on the type of RTD used (2 or 3 wire), it is usually satisfactory to the requirement. The procedure below outlines the technique for setting the trip-points using the circuitry contained within the Dual-Set PANAGARD. For a more precise technique which takes into account lead wire errors and other variables, refer to the section of Calibration Procedures.

3.5.1 A momentary double-throw, center-off toggle switch (RESET-READ) located in the upper right hand corner of the point module determines whether the module is in the monitoring mode, reset mode, or in the read mode. Place the toggle to the right (READ position) and hold it for the duration required to establish the trip-point setting.

3.5.2 A toggle switch located in the lower center of the master module (the READ-SET switch) determines whether the indicating instrument will read the actual operating temperature or the trip-point (1st or 2nd) temperature to which the point module is adjusted. Move this to the right or SET position.

3.5.3 Two (2) multi-turn screwdriver operated potentiometers located in the inside-upper-right corner of the point module light-box sets the trip-points. The potentiometer on the left is for the first trip-point while the one on the right is for setting the second trip-point. Clockwise rotation of either of these potentiometers increases their respective trip-point temperature. The 1st trip-point will be monitored by the meter when the point module is in the normal condition. The 2nd trip-point will be monitored by the meter when the point module is in an off-normal condition. To set the 1st trip-point, hold the RESET-READ switch of the point module in question in the READ position when the module is normal and adjust the left potentiometer to the desired trip-point temperature as indicated on the meter. To set the 2nd trip-point, hold the RESET-READ switch of the point module in question to the READ position while the module is off-normal and adjust the right-hand potentiometer to the desired temperature as indicated by the meter.

3.6 READOUT

3.7 With all of the RESET-READ selector switches of the point modules in their normal (monitor) position, no indication will be seen on the meter of the master module. When the selector switch is placed to the right (READ position) on any one of the point modules, the meter will indicate either the actual operating temperature of that point, or the 1st or 2nd trip-point (depending on point status) to which the specific point has been adjusted, depending on the position of the READ-SET switch immediately under the meter.

3.8 During the time that the RESET-READ selector switch of a given point is placed to the right (READ position), the input circuitry to that point is disabled and the point is unable to receive an alarm signal. Operating the selector switch to the READ position during any alert condition (temperature beyond either trip-point) will not, however, extinguish the lamp(s) nor change the state of the auxiliary relay.

3.9 FUNCTIONAL TEST

3.10 The TEST button in the lower right hand corner of the master module is used to inject a false alarm-signal at the input of each of the point modules controlled by that master. All points amplify this signal and lock into a steady alert with the lamps on and the auxiliary relay energized. If it is not desirable to have this relay operate during the functional test, the relay must first be disabled on each such point by moving the cutout switch on that point to the down position (see paragraph 3.3).

3.11 LAMP TEST

3.12 If the optional LAMP TEST pushbutton has been provided, it is possible to test all lamps, independent of the measurement circuitry and independent of the auxiliary relay, by operating the LAMP TEST pushbutton. This is a momentary test without lock-in. Lamp test does not operate the auxiliary relay.

3.13 POINT RESET

3.14 The Dual-Set PANAGARD System is provided with lock-in as a standard feature so that an alert, even momentary, will be displayed until the point in alert has been reset. If, after full functional test or after an alert, the point RESET switch is used, the lamp(s) on that point, if not then in alert, will be extinguished. If the 1st trip-point is then in alert, the system will momentarily return to normal and then go into realarm at the first set point. If the 2nd trip-point is then in alert, its lamps will not be affected nor will the condition of the auxiliary relay.

3.15 HORN

3.16 A remote accessory horn is triggered each time a point goes into alarm. This horn is normally silenced when the RESET pushbutton on the master module is depressed. This RESET pushbutton can also be located remotely. The drawings accompanying the equipment define the appropriate connections for either alternate.

3.17 RESPONSE

3.18 The tabulation below summarizes the response of the Dual-Set PANAGARD System to those situations which might be expected to occur in normal usage.

Status	RESET-READ Selector Switch	Meter	White Lamp	Red Lamp	Audible Signal
Point Normal	Monitor (Center)	No Indication	Off	Off	Off
Point Off-Normal 1st Trip	Monitor (Center)	No Indication	On	Off	On
Point Off-Normal 2nd Trip	Monitor (Center)	No Indication	On	On	On
Point Normal	*READ (Right)	RTD Temperature or Trip-Point Setting	Off	Off	Off
Point Off-Normal 1st Trip	*READ (Right)	RTD Temperature or Trip-Point Setting 1st Trip	On	Off	On
Point Off-Normal 2nd Trip	*READ (Right)	RTD Temperature or Trip-Point Setting 2nd Trip	On	On	On
Functional Test	Monitor (Center)	No Indication	On	On	On
Reset, Point Normal	RESET (Left)	No Indication	Off	Off	Off
Reset, Point Off-Normal 1st Trip	RESET (Left)	No Indication	On	Off	On
Reset, Point Off-Normal 2nd Trip	RESET (Left)	No Indication	On	On	On

*Operation of the selector switch to READ position will not change existing status of lamp(s).

CALIBRATION PROCEDURES

4.1 GENERAL DISCUSSION

4.2 The Dual-Set PANAGARD System provides, within its own circuitry, a means for establishing the trip-point. The procedure for establishing these trip-points is outlined in paragraph 3.4 under Operating Instructions. This technique provides an accuracy which is usually sufficient to the needs of the application. The paragraphs below define a procedure which takes into account those application variables which cannot be anticipated in the basic design of the circuitry.

4.3 In essence, the Dual-Set PANAGARD compares the resistance at its input terminals with that of a known resistance in an opposing arm of the bridge, under the assumption that this resistance represents that of the Resistance-Temperature-Detector (RTD) only. In practice, however, this assumption is often not fulfilled with absolute accuracy. In the case of a 2-wire RTD, the resistance at the input terminals consists of the resistance of the RTD at a given temperature, plus the resistance of the two lead wires. Obviously, the resistance of the lead wires will contribute an error, since the system is calibrated with the assumption that no such resistance exists. It is possible, however, as discussed in the paragraphs below, to "calibrate out" this resistance for any selected trip-point temperature. A second order error also exists, however, due to the temperature coefficient of the lead wire itself. This can be calibrated out only if the ambients surrounding the lead wires are constant and predictable.

4.4 CALIBRATION, USING 2-WIRE RTD

4.4.1 From the chart (see Table 1), determine resistance of RTD at the desired (1st and 2nd) trip-point temperatures.

4.4.2 Calculate or measure the resistance of the lead wires. To measure the resistance, a good V.O.M. (volt, ohm, milliammeter) is usually sufficiently accurate. To calculate the resistance, obtain the resistance per foot from any handbook, for the gauge used, and multiply by the number of feet used, remembering that there are two wires effectively in series. Listed below are resistances for some of the more commonly used wire sizes at 25° C (77°F).

AWG Gauge No.	Resistance, Ohm/1000 Ft.
20	10.35
18	6.510
16	4.094
14	2.575
12	1.619

If the ambient temperature will be significantly different than 25° C, the resistance at the operating ambient may be calculated from the formula:

$R_T = R_{25}(1 + 0.0039\ dT)$, where:

R_T is resistance at the operating temperature

R_{25} is resistance at 25°C

dT is operating temperature minus 25°C

Table 1. Calibration Data For 100 Ohm Platinum RTD.

°F	R (ohms)	°F	R (ohms)	°F	R (ohms)	°F	R (ohms)
-328	16.996	50	103.979	440	187.305	830	265.121
-320	18.942	60	106.183	450	189.369	840	267.044
-310	21.374	70	108.386	460	191.430	850	268.962
-300	23.788	80	110.583	470	193.486	860	270.880
-290	26.198	90	112.777	480	195.540	870	272.790
-280	28.591	100	114.969	490	197.589	880	274.700
-270	30.984	110	117.156	500	199.637	890	276.604
-260	33.362	120	119.340	510	201.678	900	278.505
-250	35.732	130	121.519	520	203.718	910	280.402
-240	38.096	140	123.698	530	205.752	920	282.296
-230	40.448	150	125.869	540	207.783	930	284.187
-220	42.779	160	128.039	550	209.811	940	286.072
-210	45.135	170	130.203	560	211.835	950	287.957
-200	47.468	180	132.366	570	213.857	960	289.835
-190	49.792	190	134.524	580	215.873	970	291.712
-180	52.110	200	136.249	590	217.888	980	293.583
-170	54.421	210	138.831	600	219.896	990	295.451
-160	56.725	220	140.977	610	221.902	1000	297.316
-150	59.026	230	143.123	620	223.905	1010	299.175
-140	61.316	240	145.262	630	225.904	1020	301.035
-130	63.607	250	147.399	640	227.899	1030	302.888
-120	65.886	260	149.531	650	229.890	1040	304.741
-110	68.163	270	151.660	660	231.878	1050	306.586
-100	70.433	280	153.786	670	233.861	1060	308.430
- 90	72.703	290	155.908	680	235.845	1070	310.268
- 80	74.961	300	158.027	690	237.821	1080	312.104
- 70	77.218	310	160.140	700	239.796	1090	313.937
- 60	79.470	320	162.254	710	241.765	1100	315.765
- 50	81.717	330	164.361	720	243.731	1110	317.591
- 40	83.963	340	166.466	730	245.694	1120	319.411
- 30	86.201	350	168.565	740	247.653	1130	321.231
- 20	88.438	360	170.661	750	249.609	1140	323.043
- 10	90.669	370	172.755	760	251.560	1150	324.854
- 0	92.896	380	174.844	770	253.510	1160	326.660
10	95.120	390	176.931	780	255.453	1170	328.464
20	97.339	400	179.011	790	257.394	1180	330.264
30	99.557	410	181.092	800	259.330	1190	332.060
40	101.768	420	183.166	810	261.264	1200	333.852
		430	185.238	820	263.195	1202	334.211

4.4.3 At the temperature(s) selected, the resistances at the input to the Dual-Set PANAGARD is then the sum of the RTD resistance as determined in step 4.4.1 and the lead resistance as determined in step 4.4.2. This resistance value may be generated using either a precision decade box or resistors calibrated on a laboratory bridge. Assure that connections are made in accordance with the drawing supplied for the 2-wire RTD.

4.4.4 With the known resistance value connected as described above, adjust the appropriate set point resistor in the point module until an alert signal is obtained. This operation should be performed with the RESET-READ selector switch in the monitor (normal) position. In making this adjustment, some care will be needed to fully realize the inherent accuracy of the Dual-Set PANAGARD. It is important that the potentiometer be adjusted to precisely that position which will cause an alert. As a check on the accuracy of the setting, the RTD (decade box) may be adjusted away from the trip-point (lower resistance for a high trip unit) and then be brought to the calibrated value in small increments. The 2nd alert adjustment can only be performed while the point module is in an alert condition.

4.4.5 After the point module has been adjusted for either alert condition, the RESET-READ selector switch may be put into the READ position and the set-point temperature readings on the meter noted for future reference. In general on 2-wire RTD's, it can be expected that this temperature reading will be somewhat higher than that for which the trip-point has been calibrated since the resistance of the leads has been introduced, although for short lead lengths the difference may not be discernible.

4.5 CALIBRATION, USING 3-WIRE RTD

4.6 When a 3-wire RTD is employed, equal resistances are, by the nature of the hook-up, inserted in both the RTD and the calibration legs of the bridge. This greatly reduces the error inherent in the lead resistances and when the bridge is balanced (trip-point), renders the system virtually immune to changes in ambient temperature as well as to the absolute magnitude of lead resistance. Further, the readout of trip-point setting is unaffected, since the leads to the remotely located RTD are not involved in this circuit. There is, however, a limitation in the readability of the indicating instrument. For this reason, it may still be desirable to calibrate the system for maximum accuracy. The paragraphs below outline the technique for such calibration.

4.6.1 Using a precision decade resistor box or bridge calibrated resistances, connect a resistance equivalent to the resistance of the RTD at the desired trip-points between the R1 and R2 terminals of the appropriate monitor point and jumper R2 to R3 (refer to drawing furnished with equipment). Note that, in the case of the 3-wire RTD, it is NOT necessary to calculate (or measure) and insert the lead resistance.

4.6.2 With the connections established as described above, proceed as with calibration procedures for the 2-wire RTD, steps 4.4.4 and 4.4.5.

4.7 MASTER MODULE CALIBRATION

4.8 Each master module must be calibrated periodically to maintain the accuracy of the Dual-Set PANAGARD System. To perform this procedure, a precision resistance decade is required. Refer to Table 2 for the meter scale(s) to be used.

4.8.1 If a remote meter is used, unplug the master module connected to it and adjust the zero setscrew on the meter. Integral meters have no mechanical zero adjustment. Re-install the master module.

4.8.2 Disconnect the RTD from terminals R1 and R2 (see Figure 3) of one of the point modules. Connect the precision resistance decade to these terminals. Set the decade to a value that matches the resistance of the RTD type being used at the lowest temperature reading on the meter scale. Use Table 2 to find the resistance value that corresponds to this lowest (no meter deflection) end of the scale. The resistance decade may be connected to any point module that is used with the master module being calibrated.

4.8.3 Push the RESET-READ selector switch on the point module connected to the decade to the READ position. Move the READ-SET switch on the master module to the READ position and open the front panel. Identify the two screwdriver adjusted pots behind the upper holes. The one on the left is the ZERO adjust and the one on the right is the FULL-SCALE adjust. Set the ZERO adjust pot to a point where the meter reads exactly at the lowest scale marking.

4.8.4 Set the decade box to the resistance listed on Table 2 corresponding to the full scale marking on the meter scale. Set the FULL-SCALE pot to calibrate this point.

4.8.5 Repeat steps 4.8.3 and 4.8.4 until the meter is calibrated at both ends of the scale. Check the calibration by adjusting the resistance decade to a few values corresponding to intermediate scale marking points and reading the meter.

4.8.6 Re-connect the RTD.

Table 2. Typical Sheet Showing Scale Data Information.

Temp	V(Open)	Z(Short)	RTD(Ohms)	Microamps
0	0	197.771	120.00	0
150	1.14668	271.421	248.97	500

Value Desig.	Input Data	Percent Scale Length
0*	120.00	0
10	127.17	6.744
20	134.52	13.484
30*	142.06	20.223
40	149.79	26.954
50	157.74	33.697
60*	165.90	40.434
70	174.27	47.161
80	182.85	53.870
90*	191.64	60.555
100	200.64	67.211
110	209.86	73.840
120*	219.30	80.437
130	228.96	86.995
140	238.85	93.518
150*	248.97	100.000

* denotes large divisions (30°C); all others to be medium divisions (10°C).

Series Meter Resistor R(X)= 1721.95 Ohms
Meter Resistance= 300 Ohms
Full Scale Meter Current= 500 Microamps
Line Resistance= 0 Ohms
R(1)= 562 Ohms
R(2)= 562 Ohms
Supply Voltage= 8.75 Volts

TROUBLESHOOTING PROCEDURES

5.1 TROUBLESHOOTING

5.2 Check for proper voltages at the annunciator main block.

5.2.1 Terminal (+) to terminal (-) should read 12V.

5.2.2 Terminal (+) to terminal (CN) should read 11.5V.

5.2.3 Terminal (+) to terminal (LC) should read 6V.

5.2.4 Terminal (+) to terminal (RE) should read 12V with meter module installed.

5.2.5 Terminal (+) to terminal (K) should read 12V with meter module installed.

5.2.6 Terminal (-) to terminal (R2) of meter module position should read 12V with meter module installed.

5.2.7 Terminal (+) to terminal (CD) should read 6V (10 KHz output of master module).

5.3 Check for proper voltage at RTD input terminals of each point.

5.3.1 Terminal (-) to terminal (R3) should read 12V.

5.3.2 Terminal (-) to terminal (R2) should read 12V.

5.3.3 Terminal (-) to terminal (R1) should read 12V.

5.4 Check for proper wiring of RTD's, including opens and shorts. The RTD must be across R1 and R2. Terminals R2 and R3 must be the two common wires of the 3-wire RTD. If a 2-wire RTD is used, a jumper must be between R2 and R3.

5.5 If on an operational test, none of the points alarm, check for a 10 KHz signal on CD terminal with an oscilloscope. If the 10 KHz signal is missing, replace the master module with a known good one.

5.6 If only certain points do not work on operational test, replace the points with known good ones. If the point still does not operational test, check for:

5.6.1 A shorted RTD at that point (30 ohms or less)

5.6.2 Absence of jumper or common RTD wires between R2 and R3.

5.6.3 Grounds on RTD wiring.

5.7 If inaccuracies occur in readout, again check for grounds on any of the RTD wires. Also consult the Calibration Procedures outlined in Section 4. Be sure the system is not underpowered, that is, 60 points maximum on (1) 100 point power supply, or 20 points maximum on (1) 25 point power supply.

5.8 If grounds are found on the RTD wiring, a good starting point is at the RTD. Check inside the weatherproof terminal head assembly. There must not be any electrical contact between the RTD wiring and enclosure.

5.9 If the meter circuit is inoperable for certain points, check that the R3 to R2 jumper or the (2) common wires of the RTD between R3 and R2 are in place. If any RTD errors are suspected, remove the RTD wiring and install a resistor of proper value between R1 and R2 and a jumper between R2 and R3. This action will make certain that the point module and the associated position is OK.

5.10 If the audible does not operate, check for contact closure at the master position on alarm. If OK, then the problem is external wiring. If the relay does not close, do the following steps:

5.10.1 Check for -12V on R2 terminal of the master position. If it is missing, check the K jumper.

5.10.2 Change the 11PX2 relay in the meter module.

5.10.3 Change the master module.

5.11 If an RTD is open and R2 to R3 jumper OK, the following can be expected:

5.11.1 The point cannot be reset.

5.11.2 The meter will peg upscale on read.

5.11.3 Set point reading will be OK.

5.12 If an RTD is shorted (under 30 ohms) and R2 to R3 jumper is OK, the following can be expected:

5.12.1 The meter will peg downscale on read.

5.12.2 The point will not operational test.

5.12.3 Set point reading will be OK.

5.13 If all RTD wiring is open, that is terminals R1, R2, and R3, the following can be expected:

5.13.1 Meter circuits will not work.

5.13.2 Operational test will work.

5.14 In the previous steps, it is stated that a short of 30 ohms or less will cause a point not to operational test. With certain models, when this short reaches approximately 10 ohms, it will alarm to give a short indication.