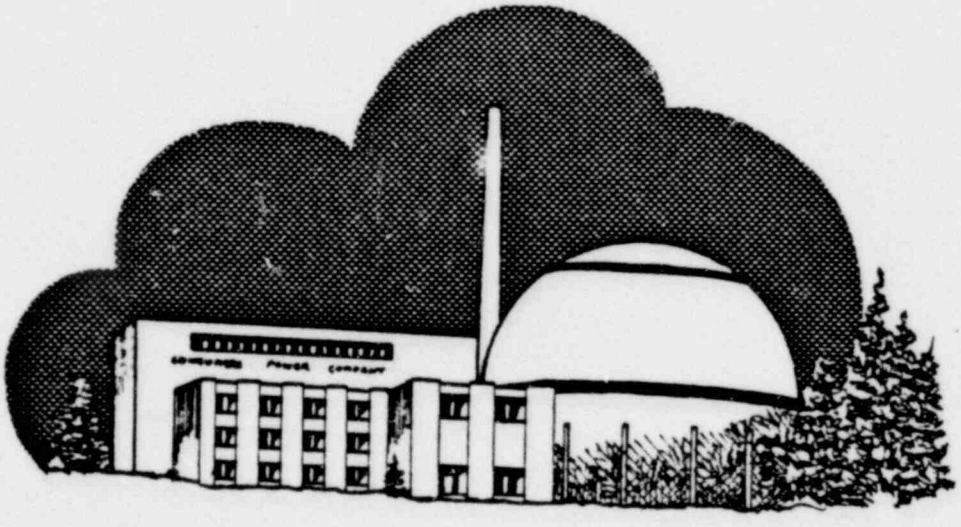
SYSTEM DESIGN AND FUNCTIONAL DESCRIPTION OF BIG ROCK POINT PLANT STEAM DRUM/REACTOR VESSEL LEVEL INSTRUMENT MODIFICATION FD-CPW-002, REV. 1



ENERGY INCORPORATED

SYSTEM DESIGN AND FUNCTIONAL DESCRIPTION OF BIG ROCK POINT PLANT STEAM DRUM/REACTOR VESSEL LEVEL INSTRUMENT MODIFICATION

FD-CPW-002, REV. 1

PREPARED FOR

CONSUMERS POWER COMPANY
G.W.O. 8424
FC 497

BY

ENERGY INCORPORATED
CONTRACT NO. CPW-13127-000

SEPTEMBER 9, 1980

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SYSTEM DESIGN AND FUNCTIONAL DESCRIPTION OF BIG ROCK POINT PLANT STEAM DRUM/REACTOR VESSEL LEVEL INSTRUMENT MODIFICATION

1.0 INTRODUCTION

A modification will be made to the presently-installed Yarway constant head level chambers that are the primary elements in the steam drum and reactor vessel level measurement systems at the Big Rock Point Plant.

This report discusses the design criteria used for the modification and describes the modification and its implementation.

2.0 DESCRIPTION OF THE MODIFICATION

2.1 Purpose

This modification is being undertaken to stabilize the density of the water in the reference column of each level element. By doing this, plant level instrumentation and alarms can be calibrated with fixed temperature compensation. Instrument errors will be reduced. The net results of the modification will be a reduction of the probability of nuisance plant trips and restoration of operator confidence in reactor instrumentation.

2.2 Design Bases

The design of the modification to the steam drum and reactor vessel level elements is based on the following constraints and information:

2.2.1 The modification must not change the qualification of presently-installed pipe systems.

2.2.2 The piping of the steam drum level elements (LE-RE08A and LE-RE08B) will not be modified, since temperatures measured on the reference columns of those level elements during plant operation are well below 250°F.

2.2.3 The reference columns of the reactor vessel level elements must be replaced with columns designed to minimize heat transfer into the reference column from the coolant in the reactor.

2.2.4 Each reference column shall be electrically heated and the average temperature over the heated portion of the column shall be controlled to 200°F ±5°F. Each reference column shall be equipped with a primary and a spare heater. Each heater shall be terminated in a safe area to allow changeover to the spare if the primary heater should fail.

2.2.5 Each reference column shall be insulated to minimize heater requirements and reduce ambient temperature effects on level measurement.

2.2.6 Failure of the temperature control system shall result in more conservative plant operation. That is, if a temperature control loop should fail off, the corresponding reference column will become cooler. The effect of a cooler reference column is to cause the measured fluid level to appear to be lower (closer to low level setpoints) than it actually is, resulting in more conservative plant operation.

2.2.7 Abnormally high or low reference column temperature shall set an alarm on an annunciator in the main control room.

2.2.8 Each channel of the temperature control system shall have additional built-in safety features:

(a) Controller shutdown in case of input thermocouple burnout;

(b) Adjustable transformer to limit the maximum voltage that can be applied to a heater if the controller fails full on; and

(c) Automatic interruption of power to the heater if reference column temperature reaches a value 10°F higher than the setpoint.

2.2.9 Piping modifications shall conform to the ANSI B31.1 Power Piping Code. 1967 Edition. Heater elements and temperature controls shall conform to codes and standards concerned with Class 2 systems and separation from and protection of Class 1E systems and circuits.

2.2.10 The temperature control panel shall be installed inside containment to reduce the number of electrical penetrations required for the modification.

2.3 System Functions and Design Description

2.3.1 Reference Column Piping Modifications

The four level elements on the reactor vessel (LE-RE09A, B, C, and D) each are to have a new reference column installed as shown on Drawing 9223-A. presently-installed reference column is to be removed and the opening in the constant head chamber plugged. The design of the new pipe spool piece is such that heat transfer from the steam/water interface in the constant head chamber to the fluid in the reference column is minimized. The level element supports will not be modified since the new reference column is not significantly different from the existing column other than the bent shape.

The reference columns of the steam drum level elements (LE-RE08A and B) operate at low enough temperatures that the piping of the reference columns of those level elements will not be altered.

2.3.2 Reference Column Heaters

In order to stabilize the density of the water in the reference columns, each column will be heated electrically and the temperature controlled to 200°F ±5°F. Nelson Electric Company mineral-insulated, stainless-steel-sheathed heating elements have been selected for use on the columns. They will be banded to the reference column as shown on Drawings 9223-A and 9494. Each reference column will be fitted with a primary and a spare heating element. The power cable to each heater will be extended to a terminal box outside the reactor and steam drum shielding enclosure in order to permit changeover from the primary to the spare heater during plant operation.

2.3.3 Heat Element Watt Density

The power density required to maintain the desired reference column temperature is 3.5 watts per foot of pipe. The heaters selected can operate as

high as 15 watts per foot at 200°F. Variable autotransformers will be used to reduce the voltage applied to the heaters so that the maximum power density output is 8 watts per foot. At 8 watts per foot, the reference column can be maintained at a temperature of 200°F with the heater operating 50% of the time. The autotransformers may be adjusted to a different voltage setting to improve the system performance or further restrict the power density of the heaters.

2.3.4 Reference Column Temperature Control

Temperature control will be provided for each individual reference column. The controllers selected for use are manufactured by Research Incorporated. They are three-mode (proportional plus integral plus derivative) electronic controllers, with type K thermocouple input and time proportioned 5 VDC output. The controller output will control the switching of a solid state relay in the heater circuit. Additional features of the controller include digital temperature setpoint, deviation meter, deviation alarm, and downscale thermocouple burnout protection. Figure 2-1 depicts a typical temperature control loop, and Drawing 9479, Sheets 1 through 3, is the wiring diagram for the complete six-loop reference column temperature control system.

2.3.5 Temperature Measurement

The temperature of a reference column will be measured by four type K thermocouples. Average temperature measurement will be achieved by installing the four thermocouples at different points along the column and then connecting the thermocouple leads in parallel. A swamping resistor in each thermocouple circuit will compensate for differences in thermocouple and extension cable resistances. Refer to Drawings 9223-A, 9494, and 9479 for details of the installation and wiring of the thermocouples and resistors. The temperature measuring scheme allows operation of the controller with 1, 2, 3, or all 4 thermocouples functional. The thermocouple signals will be averaged in pairs and then the pair of averaged signals from one level element will be averaged again. By the

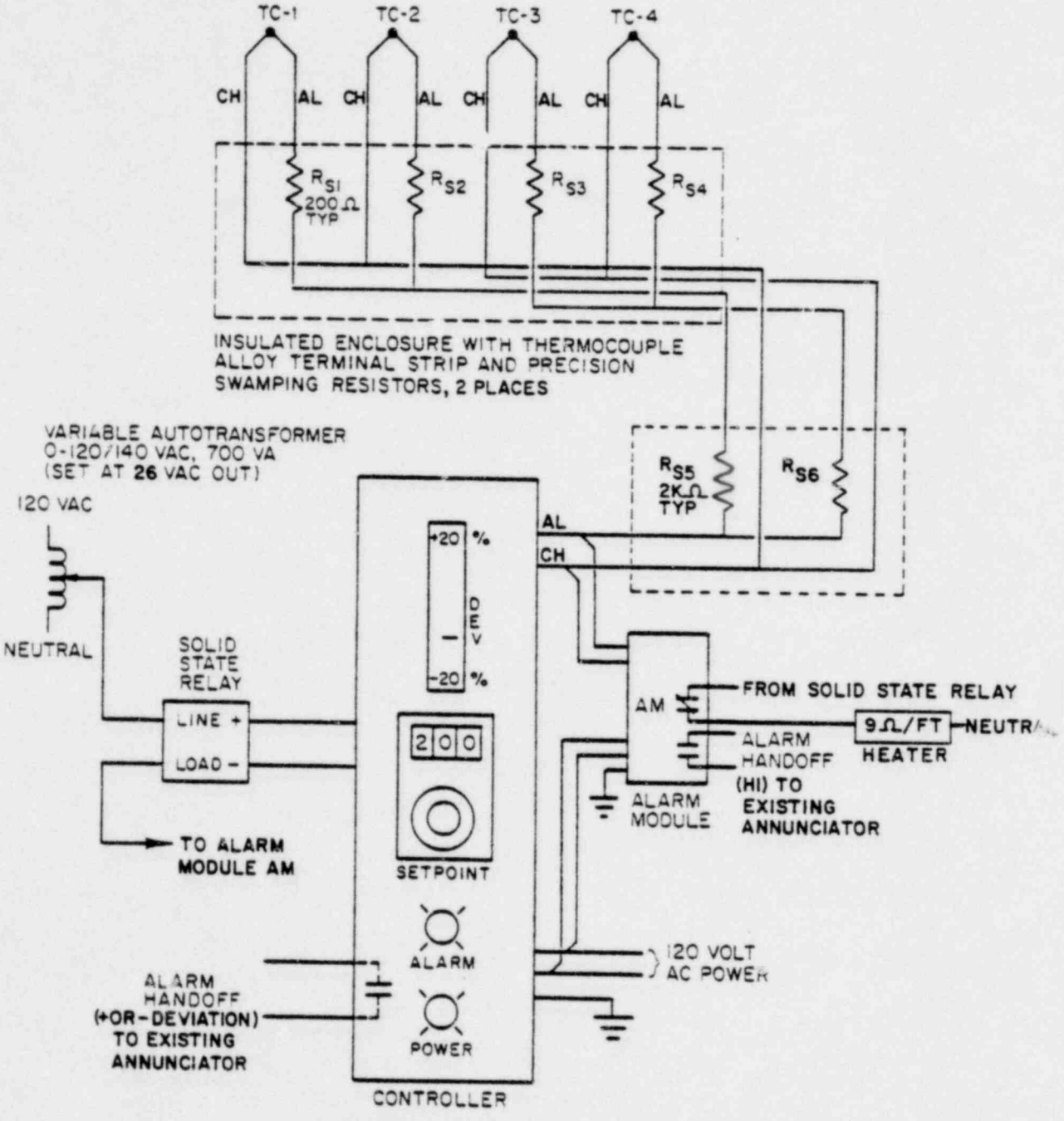


FIGURE 2-1

TYPICAL HEATER CONTROL LOOP

double averaging scheme, the single failure of a thermocouple or extension cable will not completely disable a control loop.

2.3.6 Reference Column Insulation

Each reference column will be insulated over its heated length with one-inch-thick preformed chloride-free fiberglass insulation (MIL-I-24244). The insulation will be sheathed with a .010-inch stainless steel jacket. All joints in the jacket will be sealed with clear silicone sealant to keep moisture out of the insulation. Drawings 9223-A and 9494 show the method of installation of the insulation and sheathing.

2.3.7 Alarms and Interlocks

Each of the six temperature controllers (ref. Section 2.3.4) will have an integral adjustable deviation alarm. The alarm contacts will close when the preset deviation above or below the temperature setpoint is exceeded.

Each temperature control loop will also have an electronic temperature alarm module which monitors the same temperature input as the controller. The alarm output contacts will operate when reference column average temperature exceeds the setpoint of the alarm module.

Simultaneously, another set of contacts in the alarm module will operate to disconnect power from the reference column heater.

The alarm signals from each of the six temperature controllers and the six alarm modules are to be connected in parallel to a unit in the Reactor Building Ventilation System annunciator panel inside the containment building. All of the alarms from that panel are retransmitted to a unit in an annunciator panel in the main control room.

2.3.8 Control Panel

All of the temperature controllers, alarm modules, autotransformers, electrical protective devices, and terminal strips are to be installed in a dust tight instrument enclosure inside the containment sphere. The base of the enclosure is to be bolted to floor grating, and brackets near the top of the rear of the enclosure will be used to attach it to the wall. Drawing 9480 shows the panel assembly and details.

2.3.9 Power and Grounding

The power source selected for the heat trace system is Motor Control Center Bus 2B in the Station Power Area. The 480 volt-to-120 volt transformer and electrical protective devices are to be installed in the "A" stack of Motor Control Center 2B. An analysis of the loading of Motor Control Center 2B (MCC-2B) has been made and addition of the reference column heating will not result in an overloaded condition. Coordination of the circuit breakers and fusing has been done to assure that faults in the heater circuits will not cause the MCC-2B to be tripped.

Equipment is to be grounded to the station ground bus. No grounding conductors will be carried through electrical penetrations.

2.3.10 Electrical Penetration

120-volt power from outside containment will be passed through general-purpose power penetration assembly H45 to the heat trace temperature control panel.

2.3.11 Raceways and Cables

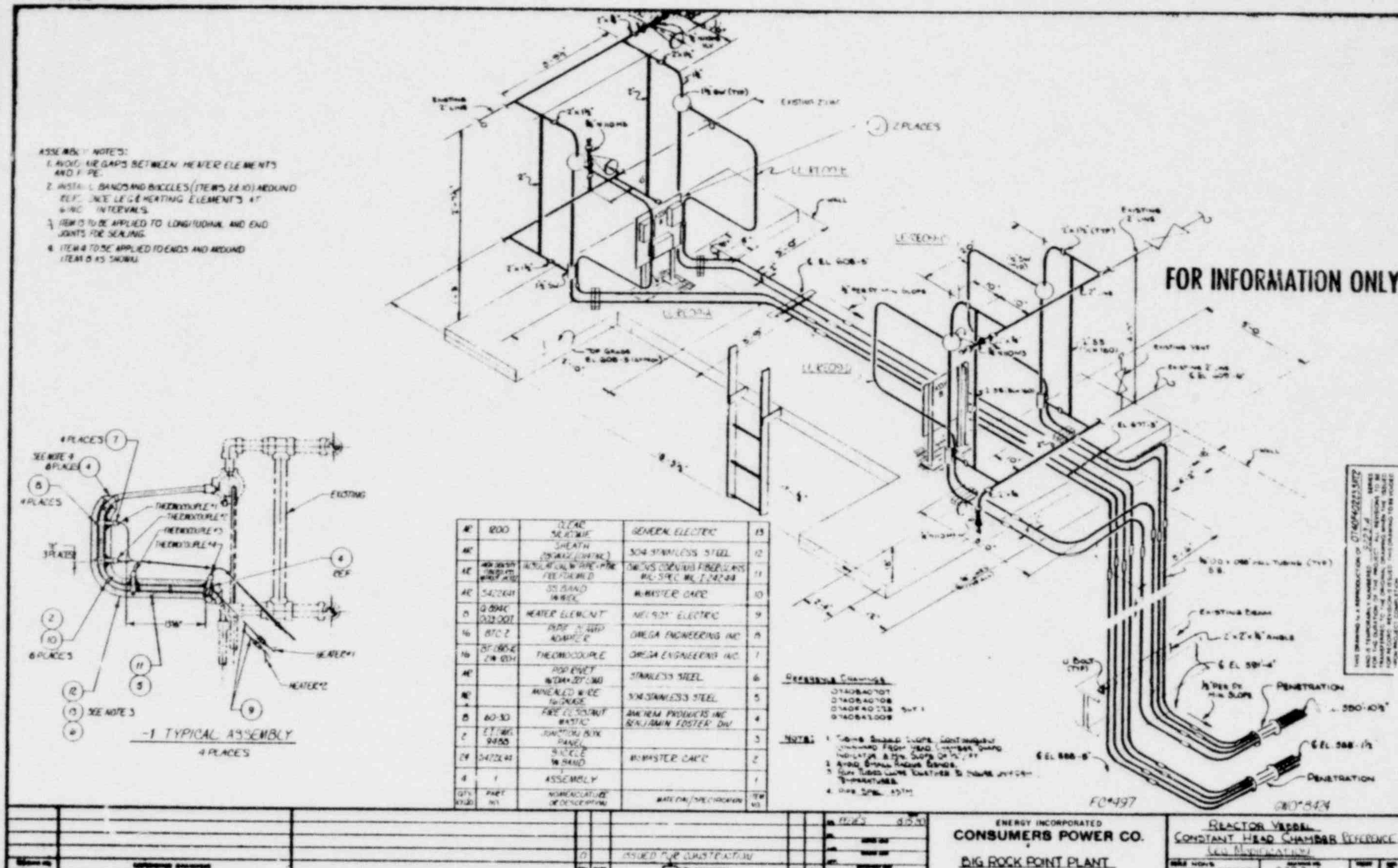
All thermocouple extension cables will be run in dedicated galvanized steel conduits. Heater and supply power cables will be laid in existing cable trays where it is convenient to do so; otherwise, galvanized steel conduits will be used. Conduits are sized for 40% fill at initial installation.

Conduits will be supported by steel channel brackets with pipe clamps. The brackets will be anchored to concrete walls or ceilings or clamped to existing building structural members.

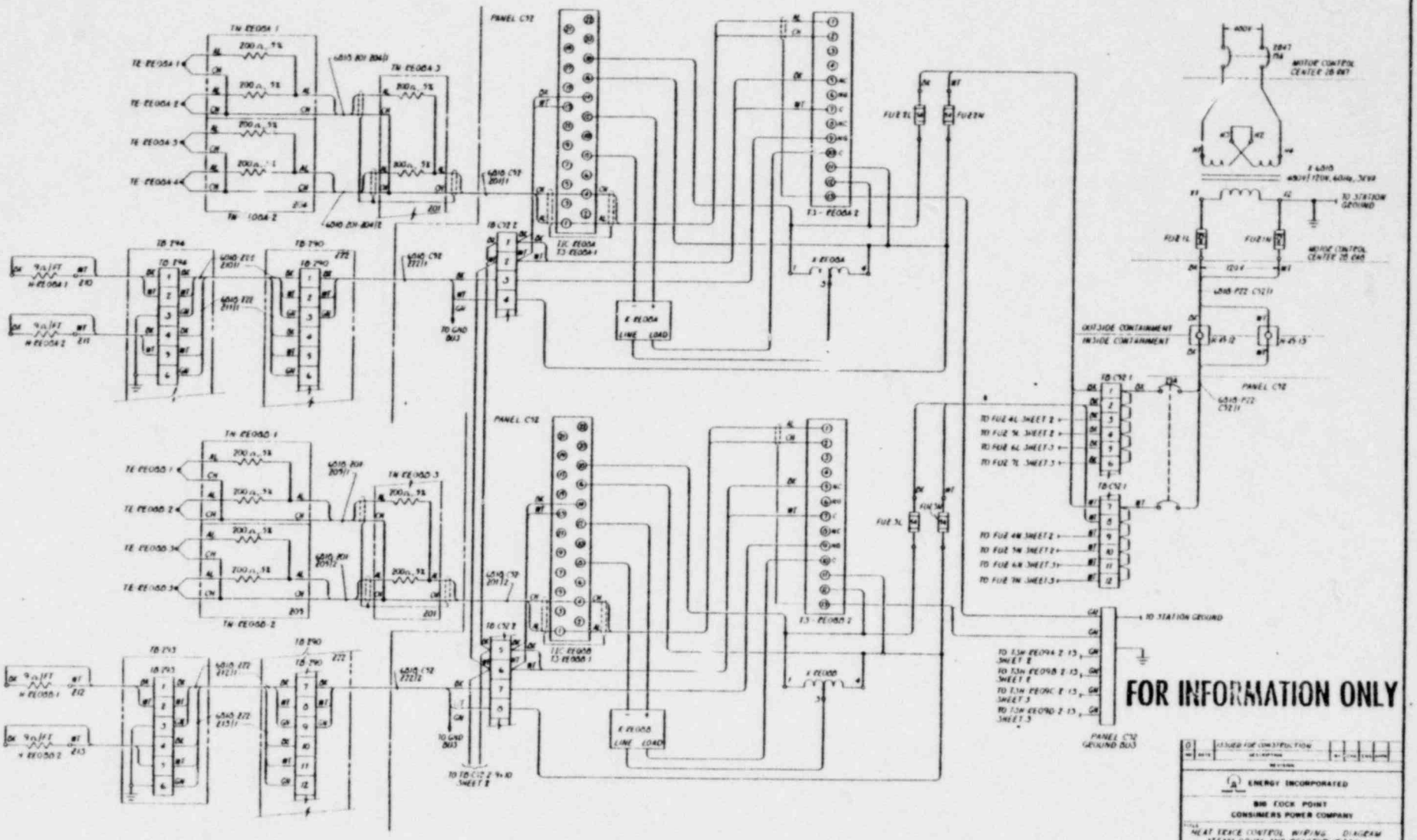
All cables will have radiation-cured cross-linked polyethylene insulation and flame retardant jackets.

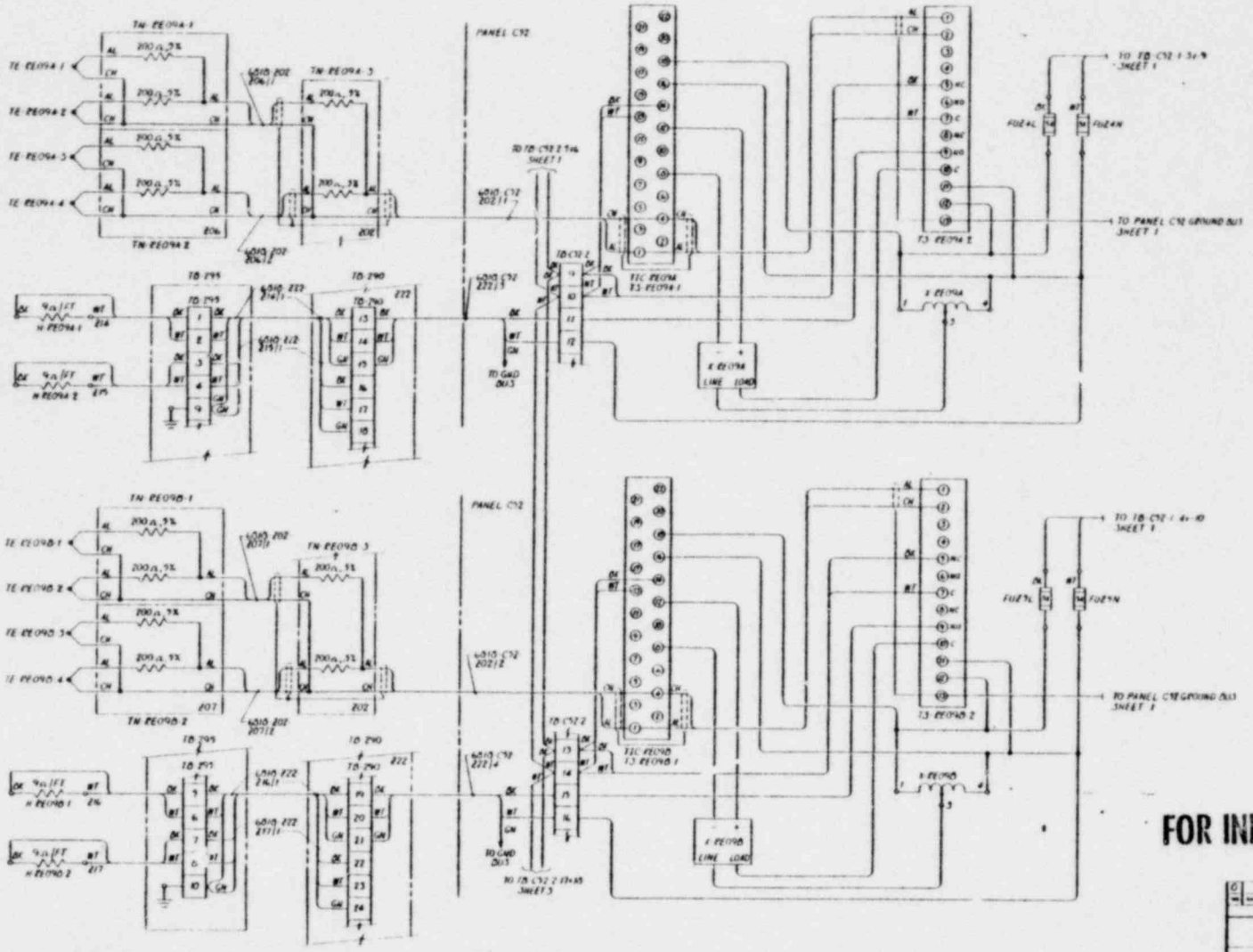
2.3.12 Junction and Terminal Boxes

All junction box and terminal box enclosures will have a gasketed clamp cover and galvanized steel finish. The enclosures will be anchored to concrete walls or bolted to specially constructed steel structures.



QTY. REQD.	PART NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ITEM NO.
AR	1200	CLEAR SILICONE	GENERAL ELECTRIC	13
AR		SHEATH (DRAINAGE COATING)	304 STAINLESS STEEL	12
AR	[illegible]	INSULATION W/ PIPE-FIBER PREFORMED	OWENS CORNING FIBERGLAS MIL-SPEC MIL-I-24244	11
AR	5422K41	SS BAND	McMASTER CARR	10
8	Q-894C 003-001	HEATER ELEMENT	NELSON ELECTRIC	9
16	BTC-2	PIPE [illegible] ADAPTER	OMEGA ENGINEERING INC	8
16	BT-085-E 24 [illegible]	THERMOCOUPLE	OMEGA ENGINEERING INC	7
AR		POP RIVET	STAINLESS STEEL	6
AR		ANNEALED WIRE 16 GAUGE	304 STAINLESS STEEL	5
8	60-30	FIRE RESISTANT MASTIC	AMCHEM PRODUCTS INC BENJAMIN FOSTER DIV	4
2	ET DWG 9455	JUNCTION BOX PANEL		3
24	5472K41	BUCKLE BAND	McMASTER CARR	2
4	1	ASSEMBLY		1





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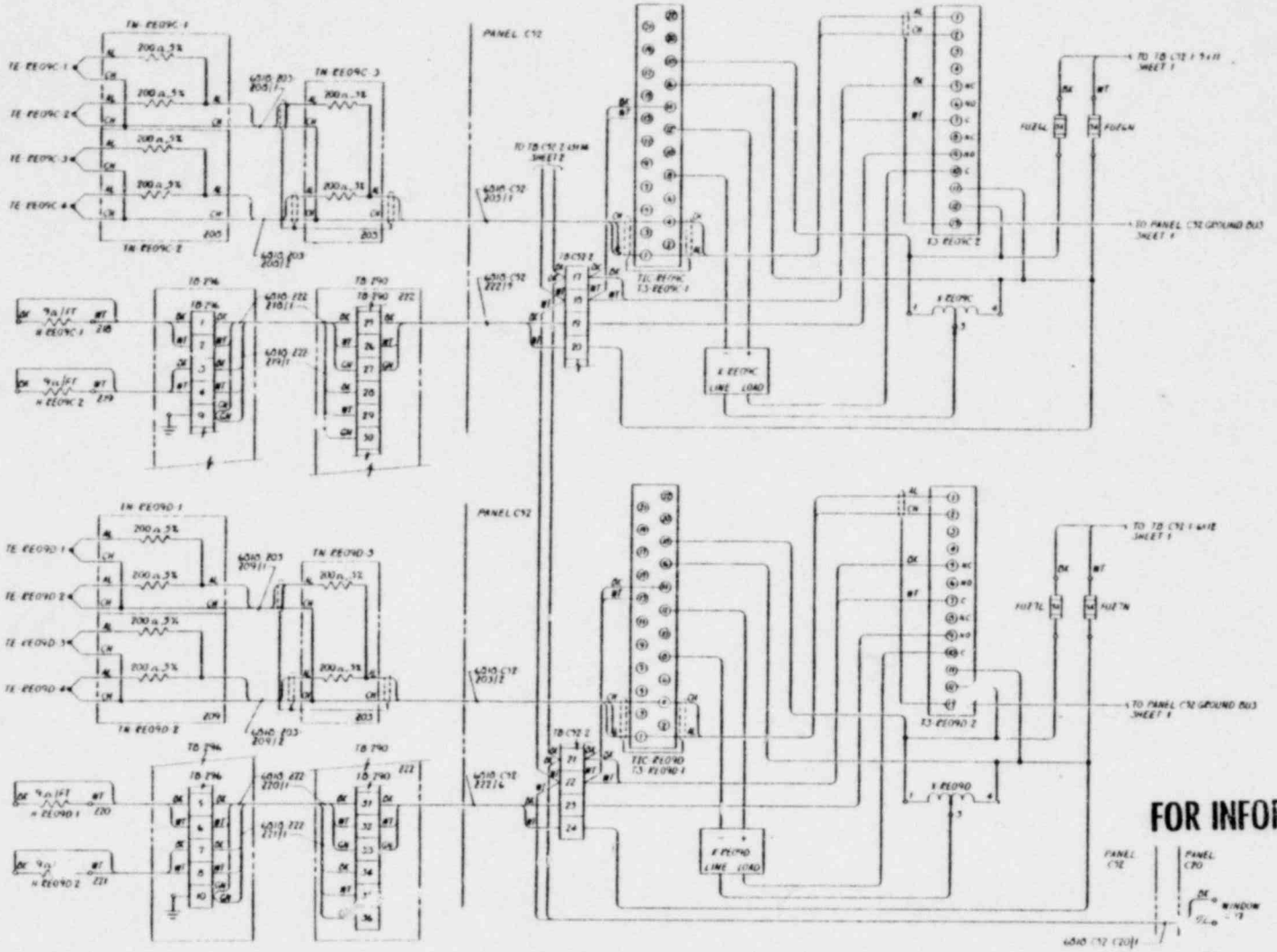
ENERGY INCORPORATED

BIG ROCK POINT
CONSUMERS POWER COMPANY

HEAT TRACE CONTROL WIRING DIAGRAM
STEAM DRUM AND REACTOR VESSEL
LEVEL INSTRUMENT MODIFICATION

6424	CPW	9479 SH 1 of 3	C



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HEAT TRACE CONTROL WIRING DIAGRAM
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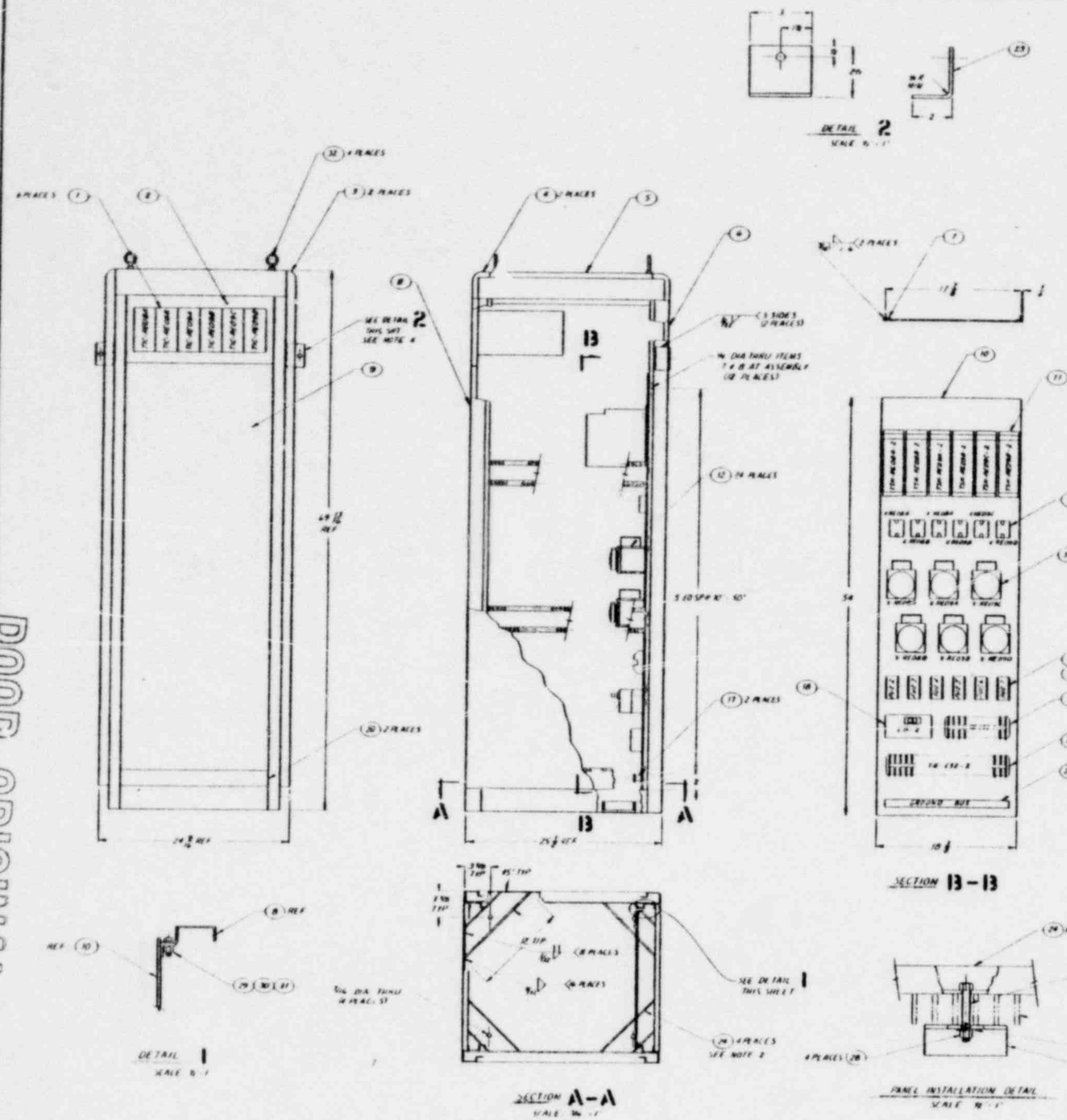
LEVEL INSTRUMENT MODIFICATION

8424 | CPW | 9479 SHT 3 OF 3 | 0



ITEM	QTY	DESCRIPTION	VENDOR
1	6	TEMPERATURE INDICATING CONTROLLER, #43911 AR10 AR	RESEARCH INC
2	1	FRAME, RACK MOUNT, 19 FOR 6 MODULES, #61006	RESEARCH INC
3	2	PANEL, SIDE #SGP 25	AMCO ENG CO
4	2	COWLING, TOP #CE90 195	AMCO ENG CO
5	1	PANEL, TOP #PS 21 19	AMCO ENG CO
6	1	PANEL, REAR #PGT 19	AMCO ENG CO
7	2	L ¾ × ¾ × ⅛ × 34 LG CARBON STEEL	STOCK
8	1	FRAME, SEMI CUSTOM #F7GT 19 25	AMCO ENG CO
9	1	PANEL, FRONT #PSZ 19	AMCO ENG CO
10	1	MOUNTING PLATE, 12 GA CARBON STEEL	STOCK
11	6	TEMPERATURE ALARM MODULE, #ET 1084	ACCUTEST (?) SYSTEMS INC
12	24	STANDOFF, 3½ LG, ½ HEX, #2138 1032 S O	R&F ELECTRONIC HARDWARE INC
13	6	SOLID STATE RELAY # D1210	CRYDOM
14	6	VARIABLE AUTOTRANSFORMER #501	STACO
15	6	FUSE BLOCK, 2 POLE #2808	BUSSMANN MFG CO
16	12	FUSE, FUSETRON DUAL ELEMENT FNA 5	BUSSMANN MFG CO
17	2	SPACER, 1 LG PHENOLIC #1291 50 PH 0	R&F ELECTRONIC HARDWARE INC
18	1	CIRCUIT BREAKER, 2 POLE #FAL 22025	SQUARE D
19	1	TERMINAL STRIP, #M 75012	STATES DIV MULTI AMP CORP
20	2	COWLING, BASE #CBX 19	AMCO ENG CO
21	1	TERMINAL STRIP #M 25024	STATES DIV MULTI AMP CORP
22	1	BUS BAR, ⅛ THK × 1 × 17 LG, COPPER	STOCK
23	2	BRACKET, ANCHOR 3/16 THK PLATE	STOCK
24	4	BRACKET BASE (3 × 4)	STOCK
25	4	⅜ 16 UNC × 2 LG HEX HD BOLT	STOCK
26	4	⅜ STANDARD FLAT WASHER	STOCK
27	4	L 1½ × 1½ × 3/16 × 6 LG CARBON STEEL	STOCK
28	4	HEXNUT, SELF LOCKING ⅜ 16 UNC	STOCK
29	12	#10 32 UNF × ⅝ LG HEX HD CAP SCREW	STOCK
30	12	#10 STANDARD FLAT WASHER	STOCK
31	12	#10 32 UNF HEX NUT, SELFLOCKING	STOCK
32	4	LIFTING EYES, #LEX 1	AMCO ENG CO

NOTES:

1. WELD PER AWS D1.1
2. PAINT WITH ENAMEL TO MATCH PANEL STRUCTURE AFTER WELDING.
3. PAINT WITH WHITE ENAMEL AFTER WELDING. DRILL AND TAP HOLES FOR MOUNTING EQUIPMENT TO PANEL.
4. NOTCH PANEL SIDE, ITEM 3, AS NECESSARY TO ACCOMMODATE BRACKET ITEM 23. PAINT WITH ENAMEL TO MATCH PANEL STRUCTURE AFTER WELDING.
5. WIRE PER WIRING DIAGRAM CPW 30478
6. LACE ALL WIRING IN THE PANEL WITH NYLON LACING TAPE, NYLON LACING TWINE, OR NYLON CABLE TIES. SECURE BUNDLES TO PANEL AT 8" INTERVALS WITH PANDUIT TIE MOUNTS NE 1M-C6B #8 32 SCREW AND PANDUIT CABLE TIE BY SST2S-C?

FOR INFORMATION ONLY

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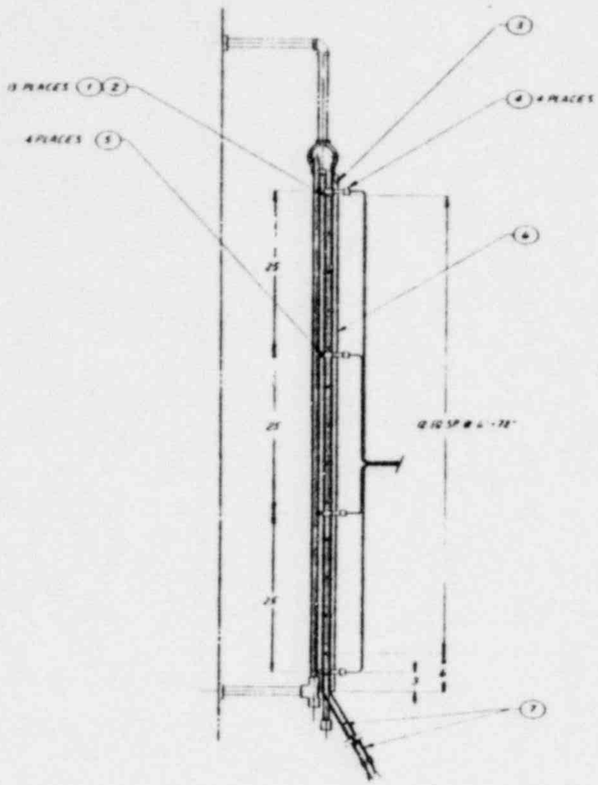
	ENERGY INCORPORATED
	BIG ROCK POINT CONSUMERS POWER COMPANY
TITLE	STEAM DRUM AND REACTOR VESSEL LEVEL INSTRUMENT MODIFICATION HEAT TRACE CONTROL PANEL ASSEMBLY AND DETAILS
SCALE	NOTED
	8424
	CPW
DRAWING NO	9480

			DESCRIPTION	VENDOR
26	1	13	BUCKLE BAND, ½ #5422K44	McMASTER CARR
26	2	13	BAND, ½" WIDE SS #5422K41	McMASTER CARR
AR	3	AR	INSULATION, PREFORMED: THK MIL SPEC MA I 24244	OWENS CORNING FIBERGLASS
8	4	4	THERMOCOUPLE #BT-090-E-24-120-1	OMEGA ENG CO
8	5	4	ADAPTER, PIPE CLAMP #BTC-2	OMEGA ENG CO
AR	6	AR	SHEATH, 28 GA 304 SS	STOCK
4	7	2	HEATER ELEMENT #D-8944-007-010	NELSON ELECTRIC



TYPICAL ASSEMBLY
2 PLACES
LE RE08A & LE RE08B

NOTES
1. AVOID AIR GAPS BETWEEN HEATER ELEMENTS AND PIPES.

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POOR ORIGINAL

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ENERGY INCORPORATED

BIG ROCK POINT
CONSUMERS POWER COMPANY

TITLE: LEVEL INSTRUMENT MODIFICATION

DRAWN BY: A. AARALA