Equipment Environmental Qualification Review

Responses to

Draft Interim Technical Evaluation Report

for

Zion Station - Units 1 & 2

September 19, 1980

Prepared by: Sargent & Lundy Engineers, Chicago, Illinois

Table of Contents

3.3.1.1 Limit Switch Within Containment
NAMCO Controls, Model DX-2400

Plant ID Numbers: MOV-RC8001 A, B, C, D (RC loop isolation)
MOV-RC8002 A, B, C, D (RC loop isolation)
MOV-RC8003 A, B, C, D (RC loop bypass)
MOV-SI8803 A, B, C, D (Accum. tank isolation)

Response:

Limit switches used for indication only do not require environmental qualification. The limit switches for valves MOV-SI8808 A, B, C, D are used for indication only. MOV-RC8001 A, B, C, D and MOV-RC8002 A, B, C, D and MOV-RC8003 A, B, C, D were incorrectly referenced here. These limit switches, which are used for control, have the qualified NAMCO, Model EA180 and will be addressed in response to item 3.3.2.3.

3.3.2.1 Valve Motor Actuator Located Within Containment

Submittal page references: 1, 2, 4, 5, 7, 8, 9, 13

References 10, 14

Valve ID Numbers: MOV-RC8000A,B (Pressurizer relief block valves)
MOV-RC8001A-D (RC loop isolation)
MOV-RC8002A-D (RC loop isolation)
MOV-RC8003A-D (RC loop bypass)
MOV-RH8701 (to RHR pump from loop hot leg)
MOV-RH8702 (to RHR pump from loop hot leg)
MOV-RH8703 (to loop hot leg from RHR pump)
MOV-SI8800A-D (from BIT to loop cold leg)
MOV-SI8808A-D (Accum. tank isolation)

Response:

Valves MOV-RC8001 A-D, MOV-RC8002 A-D, MOV-RC8003 A-D, MOV-RH8703, MOV-SI8800 A-D, and MOV-SI8808 A-D are not required to operate in the event of a LOCA or MS/FW line break, as shown in the Zion FSAR. These valves do not change position and since the starter is located outside containment (at motor control center in auxiliary building), an accident in the containment will not cause the valve to fail and change position. No qualification is necessary.

Valves MOV-RH8701 and MOV-RH8702, which are used to establish normal letdown, are required to operate long-term after a LOCA or MS/FW line break inside containment to achieve cold shutdown. Limitorque test report 600198 can be applied to these valve actuators which utilize a Reliance motor with Class H Insulation. As an alternative, it is anticipated by the Licensee that the valves can be operated manually when the containment atmosphere becomes accessible.

3.3.2.1 cont'd

In the event of a small LOCA, it may be beneficial for valves MOV-RC8000 A & B to remain operational long-term. Limitorque test report B0003 can be applied to these valve actuators which utilize a Reliance motor with Class B Insulation. It should be noted that the environmental conditions will be less severe for a small LOCA than for a design basis LOCA. Therefore, long-term qualification should not be required for the worst case LOCA environmental parameters presented in the Zion FSAR.

3.3.2.2 Solenoid Valves Located Within Containment:

Submittal page references: 6, 10 for item 3 & 4;
15 for item 7

Items 3 & 4 ID numbers: PCV-455C, 456 (Pressurizer relief valves)
AOV-VC8149B (Normal letdown isolation)

Response:

Valve AOV-VC8149B is not required to operate after a LOCA or MS/FW line break. This valve is backed up by containment isolation valves VC8152 and VC8153 which are in series. No qualification is necessary.

Valves PCV-455 C & 456 may be required to operate long-term depending on the specific types of accident. The Licensee is reviewing the possibility of replacing these solenoids with the qualified NP-1 solenoids.

Item 7 ID numbers: SV-RV091 thru 105 (RCFC damper solenoid valves)

Response:

The ASCO solenoid valves in question are those for the RCFC dampers. They are model 8300 series valves. The valves have stainless steel, metal-to-metal seats, and all metal internals. The only part which is susceptible to failure under high radiation or temperature environments are the rubber sealing O-rings. Any time this O-ring would fail

3.3.2.2 cont'd

during normal operation the solenoid will vent and shift to the accident mode. In event of a LOCA or MS/FW line break the valves are required short term and will function before an O-ring failure would occur. Once the solenoid has shifted there would not be a reason to want to change the position of the dampers and therefore functional capability of the solenoid long term after the accident does not have to be addressed.

No qualification is necessary.

Note: Reference 24, which refers to the NP-1 series solenoids, was not used by the Licensee and therefore the comment pertaining to this item is not applicable.

3.3.2.3 Limit Switch Located Within Containment

Submittal page references 11, 12

NAMCO EA-180

References: 23

Valve ID numbers: LCV-RC459 (Regen. Heat Exchanger Isolation from loop cold leg)
LCV-RC460 (Regen. Heat Exchanger Isolation from loop cold leg)
MOV-RC8001 A, B, C, D (RC loop isolation)
MOV-RC8002 A, B, C, D (RC loop isolation)
MOV-RC8003 A, B, C, D (Accum. tank isolation)

Response:

The above referenced limit switches are used for control. Commonwealth Edison Company has agreed to seal these limit switches with qualified seals. They are currently in the process of obtaining qualified seals and will seal the switches at the first refueling outage for each unit after the qualified seals arrive on site.

3.3.2.4 Reactor Containment Fan Cooler Motor Located Within Containment

Westinghouse Electric Corporation, 585.5 - CSP
1 Fram 200/200 hp/1200/300 rpm
References: 12 and 15

Response:

A letter has been sent to Westinghouse requesting additional information to qualify the RCFC motors for a 40-year life plus accident and to qualify lubricants with respect to the combined effects of steam/chemical spray and radiation exposure. Also, Westinghouse was requested to supply evidence that their test specimen was identical to the installed equipment.

In response to the above reference letter on the RCFC motors, Westinghouse has replied that WCAP-7829 provides the additional information requested. Westinghouse also stated that it was not possible to secure the traceability requested in such a short time, but that this effort has been initiated.

Franklin Research Center stated that the qualification of the motor-lead-splices and lead-to-cable splices with respect to radiation was not addressed in the submittal qualification reports. Westinghouse Test Report WCAP-7410-L, Volume II of II, page 6-3 (submitted to Franklin Research

3.3.2.4 cont'd

Center) states that the splices were thermally aged followed by a radiation exposure prior to being exposed to the post-accident environment inside the containment.

3.3.2.5 Electronic Flow Transmitter Located at C1
Submittal Page Reference 16
Qual. Reference 9, 20, 21

FT924	FT926
FT925	FT927

Cold Injection Flow Rate (Model 10B2496)

Response:

These transmitters are backed up by FT934 which measures the total flow and is located outside of containment in a non harsh area when FT924, 925, 926, and 927 are in a harsh environment. Therefore, FT924, 925, 926, and 927 are provided with redundancy which will not be subjected to the containment environment.

Electronic Pressure Transmitter Located at C1
Submittal Page Reference 17
Qual. Reference 9, 20, 21

PT960	PT964
PT961	PT965
PT962	PT966
PT963	PT967

Accumulator Press. (Model 50EP1031)

Response:

These transmitters are not required to work following a LOCA or HELB since they only indicate whether or not the accumulators have injected.

3.3.2.6 Electronic Transmitter Located at C1
Submittal Page Reference 19
Qual. Reference 9, 20, 21

FT512	FT513
FT522	FT523
FT532	FT533
FT542	FT543

Steam Generator Steam Flow (Model 10B2491)

Response:

These transmitters are only required to work immediately following an accident for safeguards actuation. For available qualification refer to the generic reply on Fischer & Porter transmitters attached to these responses.

Electronic Transmitters Located at C1
Submittal Page Reference 20
Qual. Reference 9, 20, 21

LT517	LT518	LT519
LT527	LT528	LT529
LT537	LT538	LT539
LT547	LT548	LT549

Steam Generator Level (Model 13D2495)

Response:

These transmitters are required for long term operation after MS/FW line break. For available qualification see generic reply on Fischer & Porter transmitters attached to these responses.

3.3.2.6 cont'd

Electronic Transmitter Located at C1
Submittal Page Reference 22
Qual. Reference 9, 20, 21

FT414	FT415	FT416
FT424	FT425	FT426
FT434	FT435	FT436
FT444	FT445	FT446

Reactor Coolant Flow (Model 10B2491)

Response:

These transmitters are not required to operate after an accident.

Electronic Transmitters Located at C1
Submittal Page Reference 23
Qual. Reference 9, 20, 21

PT455	PT457
PT456	PT458

Pressurizer Pressure (Model 50EP1041)

Response:

These transmitters are only required to work immediately following an accident. Post-accident indication is provided by new TMI qualified transmitters (TMI MOD M22-1-80-3) which are the best transmitters available as of April 1980. These transmitters, PT403 and PT405, are the Reactor Coolant Wide Range Pressure transmitters (Barton 763).

3.2.7 Equipment Item No. 16
Electrical Penetrations Located
Within and Outside of
Containment
D. G. O'Brien, Type 4.1
(Submittal Page References 2 and 17)

Response:

1. The attached xerox copies of portions of the D. G. O'Brien Instruction Manual No. 1019 for Type 4.1 and 4.1A Electrical Penetrations identify the materials used, including jacket and insulation materials for cable leads. It should also be noted that the environmental test referenced in Section 4 of Test Report C19QA032 was a saturated steam atmosphere of 46 psig pressure, 273°F temperature, for a 48-hour period.

2. The Type 4.1 penetration contains instrumentation type cables, No. 16 AWG twisted pairs and quads and No. 20 AWG thermocouple leads, which will all carry currents of less than 1 amp (generally in the range of 10 to 50 milliamps or 4 to 20 milliamps for the No. 16 AWG and much less for the thermocouple leads) which will not affect the loading conditions imposed on the cables during a LOCA.

3. We are still attempting to obtain information from the Vendor, D. G. O'Brien, to determine a qualified life.

Instruction Manual (1019)

For

REACTOR CONTAINMENT STRUCTURE

ELECTRICAL PENETRATION ASSEMBLY

TYPES 4.1 AND 4.1A

(Serial Numbers 4.1Z1 - 4.1Z5 and 4.1AZ1-4.1AZ5)

September, 1971

Prepared For Use On

ZION STATION UNITS I AND II

(Commonwealth Edison, Co., Contract 113967)

Prepared by:

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Framingham, Mass.

Approved by:

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R. S. Butters, Project Mechanical Engineer — 9/17/71

H. P. Hilberg, Manager of Nuclear Power Plant Systems — 9/17/71

INTRODUCTION

The Electrical Penetration Assembly described herein was designed and manufactured by D. G. O'Brien, Inc., Framingham, Mass. for use in the construction of Nuclear Power Plant - Zion Units I and II, Commonwealth Edison Co., Zion, Illinois.

This manual is for use in the installation, test, calibration, and operation of Type 4.1 penetration assemblies. This penetration is designed for low voltage shielded instrumentation cable service. Penetration assemblies of Type 4.1 (instrumentation) are identical for both Zion Units (I and II). Types 4.1 and 4.1A are identical but the 4.1A designation applies to the assembly used with Zion, Unit II.

Information pertaining to other types of penetrations also designed and manufactured by D. G. O'Brien, Inc. for Zion Units I and II can be obtained from other Instruction Manuals. This manual is applicable only to Type 4.1 and 4.1A.

Quality Assurance data is included under a separate cover. This penetration assembly is furnished for use with applicable design data of the following Sargent and Lundy drawings:

ES-42 - Typical Electrical Penetration, Physical Requirements, Dated 10-1-69

B-213 - Reactor Building Containment, Liner Plate Sections and Details, Sheet 2 Rev. T. Dated 10-3-69

B-214 - Reactor Building Containment, Penetration Schedule, Rev. L, Dated 10-3-69

B-216 - Reactor Building Containment, Elevation Electrical Penetrations, Rev. G, Dated 10-3-69

The penetration assembly described herein is furnished by D. G. O'Brien, Inc. as part of an ASME, Class B Nuclear Vessel.

The electrical penetrations for Nuclear Generating Power Plants manufactured by D. G. O'Brien, Inc. are engineered to meet the stringent requirements of the electrical power industry and the Atomic Energy Commission. The careful integration of many scientific and technical disciplines has gone into the development of a state-of-the-art product that is reliable, rugged, dependable, efficient, and economical. Careful control of manufacturing processes and materials plus extensive in-process and final testing ensures that the finest product is delivered to the customer.

This manual is prepared to give the customer, in readily available form, the information necessary to efficiently install and maintain the purchased equipment. References throughout this manual to type 4.1 assembly are also applicable to type 4.1A assemblies, unless otherwise specified.

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LIST OF ILLUSTRATIONS

1.0 GENERAL DESCRIPTION

1.1 Low Voltage Shielded Instrumentation Cable Penetration Assembly (D.G. O'Brien, Inc. Part No. R19D2227P) herein referred to as the penetration assembly will be used as an interface for passing the Purchaser's low-voltage instrumentation cables, from the outside containment to the inside containment. As such, it will become a critical portion of the cabling system associated with the reactor nuclear instrumentation and control system.

1.2 The penetration assembly will service electronic instrumentation loads of up to 120 VAC. The assembly will provide the interface between instruments located inside the containment and monitors located outside of the containment that indicate status of operation.

1.3 The assemblies are designed and constructed for installation in 12-inch diameter steel pipe containment penetration nozzles that are 3 feet, 6 inches long. Each penetration assembly is identical in basic physical configuration and consists of the assembly having one mechanical seal permanently attached. The second mechanical seal, required for field installation, is furnished separately in the same shipping carton.

1.4 The penetration assembly must be inserted into the containment structure nozzle from inside the containment and is permanently installed by means of field welding at the site. Mechanical supports are necessary to position the assembly during the welding operation. The past experience of D. G. O'Brien, Inc. in the Nuclear Power Plant Penetration Assemblies and in underwater and military

applications provides the necessary background experience to assemble and weld penetration assemblies without detrimental heat transfer to the components of internal conductors.

1.5 Each assembly is designed to restrain loading due to electrodynamic forces or mechanical stressing. Internally, this is achieved, where required, by groups of tubular cable guides extending the full length of the penetration assembly.

1.6 Every penetration assembly is permanently identified by a serial number. Every wire, external to the assembly, is marked at each end with an identification number as specified by the purchaser. Wire numbers in any one multiconductor cable are not repeated.

1.7 Sealing and Pressurization. The penetration assemblies provide a dual gas barrier by means of steel header flanges and hermetically glass-sealed electrical contacts. Each of the two gas barriers meet the service environmental conditions individually, providing an overall performance safety factor of two. The double-pressure barrier is formed, at installation, by welding that is in accordance with the ASME Boiler and Vessel Code, Section III, Class B Vessels. Both the internal volume of the penetration assembly and that between it and the penetration nozzle may be pressurized through a pressurization port in the outside containment mechanical seal and holes in the

canister. The canister assemblies are pressurized to 15 psig with dry nitrogen prior to shipment. Gross pressure differential of the penetration assembly in transit and storage can be observed on the pressure gauge that forms part of the assembly.

CAUTION

PRIOR TO INSTALLATION, THE PENETRATION ASSEMBLY SHOULD BE DEPRESSURIZED AND THE PRESSURE GAUGE ASSEMBLY AND PURGING PORT PLUGS REMOVED. REFER TO SECTION 4.0 OF THIS MANUAL.

1.8 Safety Factors in Production. Pneumatic testing is performed on the prototype and on each production assembly in accordance with the latest revision of Paragraph N-710 in Section III of the ASME Boiler and Pressure Vessel Code and as covered in detail in the Quality Assurance Instruction Data. The allowable leak rate of both penetration gas barriers in series, in prototype testing, is equal to, or better than, 1×10^{-6} standard cc/sec. of dry helium at 298°F and 54 PSIG. In production, each penetration assembly is subjected to a leak rate test at 54 PSIg and 78°F $\pm$5°F and will not exceed 1×10^{-6} standard cc/sec. through both penetration gas barriers in series. Due to controlled production processes, hermetically glass-sealed headers or gas barriers consistently better the leak rate of 1×10^{-6} by two orders of magnitude.

1.9 Cable Description

1.9.1 Internal Cables. The internal cables and external pigtails are directly terminated to glass-sealed contacts in connectors (pucks) welded into the gas barriers. The electrical characteristics of the internal cables are identical to the purchaser's cables within the tolerances allowed.

1.9.2 External Cable Terminations. External cable terminations are made to the pigtail leads on each puck. The pucks are a related part of the penetration assembly gas barrier. All cables are soldered. They are designed and built to function in accordance with the requirements of the circuits they service. All conductors are insulated from each other and from ground.

1.9.3 The prototype and all production models are tested to the following:

A. Insulation:

1. Test Voltage - 500 VDC
2. Minimum Insulation Resistance

Conductor-to-conductor 1×10^8 ohms-feet

Conductor-to-shield 1×10^8 ohms-feet

Conductor and Shield to Ground 1×10^8 ohms-feet

B. Dielectric Strength:

Prototype:

Conductor-toconductor 1500 VAC RMS

Conductor-to-shield 1500 VAC RMS

Conductor and Shield to Ground 1500 VAC RMS

Production:

Conductor-to-conductor	600 VAC RMS
Conductor-to-shield	600 VAC RMS
Conductor and shield to ground	600 VAC RMS

Table 1-1 summarizes the technical and design parameters and provides a ready reference of data.

4.1 - CONTROL ELECTRICAL PENETRATOR DESIGN PARAMETER SUMMARY

1.	Number of Conductors	360- 60 twisted shielded jacketed quads, 16 AWG Boston Insulated Wire P/N 7934-H-004 50 twisted shielded jacketed pairs, 16 AWG Boston Insulated Wire P/N 7933-H-002 10 Twisted shielded jacketed thermocouple pairs, 20 AWG Insulated Wire P/N 7938-H-002
2.	Material and Size of Conductors: Current or signal:	#16 AWG tin plated copper stranded 7/24 #20 AWG Thermocouple wire solid chromel & constantan
	Ground or shield:	Copper Mylar tape wrap with #16 AWG bare copper 7/24 strand for pairs & quads #20 AWG solid bare copper for thermocouple pair
3.	Conductor Insulating Material:	Chlorosulfonated Polyethylene *Hypalon "Bostrad 7"
	Temperature Rating:	+90°C
4.	Provision for connection of Purchaser's external cable	Pigtails
5.	High Potential Test on production assemblies for 10 seconds:	Conductor-to-conductor 600 VACRM Conductor-toshield 600 VAC RMS Conductor and shield to ground 600 VAC RMS

*Hypalon is a registered trademark of E. I. DuPont DeNamours & Co. "Bostrad 7" is a registered trademark of Boston Insulated Wire & Cable Co.

6.	Assembly Body Material	10" I.P.S. Sch. 20 Pipe, ASTM, A-333 GR-1 Carbon Steel
7.	End Header Plate Material	ASTM, A-442, GR-60 Carbon Steel or ASTM A-516, GR-70
8.	End Header Plate Conductor Material	Leaded Carbon Steel Per AISI, C1213 (Tin plated)
9.	End Header Plate Conductor Insulating Material	9010 Glass
10.	Assembly Dimension	
	Body Outer Diameter	10 3/4"
	Body Length	$4'6\frac{1}{2}"$
11.	Maximum Integrated Radiation Exposure	1.7×10^{8} Rad (1.5 MEV Gamma Rays)
12.	Maximum Total Assembly	2.24×10^{-5} cc. (Air) Min.
13.	Minimum Insulation Resistance @ 500 VDC:	1×10^{8} ohms-feet
14.	Total Assembly Calculated Weight	425 pounds
15.	Shipping Pressurization	15 PSIG Dry Nitrogen
	Testing Pressurization	54 PSIG Dry Nitrogen
16.	Design Current Rating	1 AMP

6.0 WIRING

The following drawing (Figure 6-1) depicts the wiring diagram electrical connections of the Zion I and II Electrical Penetrations, Type 4.1 Low Voltage Shielded Instrumentation Cable Service for normal plus post-accident duty.

7.0 TERMINATION INFORMATION

Prior to assembly of any hardware on the penetration assembly, a review of D. G. O'Brien, Inc. Drawing R19D2227G (Sheets 1 and 3) should be made to ascertain layout and sequence for splicing of wires. This drawing also illustrates the location of puck assemblies and electrical connection sequence. The required hardware and material for termination are included in the shipping carton, Kit P/N 115-302.

CAUTION

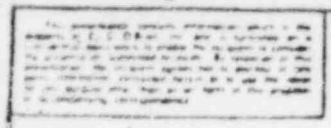
PRIOR TO ASSEMBLY CHECK PIGTAILS AND POTTING WITHIN PUCKS FOR INDICATIONS OF DAMAGE.

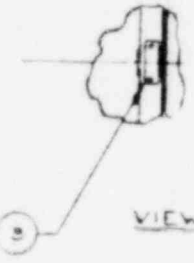
All work should be done in as clean an area as possible, well ventilated, and free from moisture and work hazards.

Purchaser's Field Cables shall be prepared as outlined in D. G. O'Brien, Inc. Drawing R19D2227G for termination to the Burndy or AMP wire splices and the Thermo Electric thermocouple connectors.

PARTS LIST	O. G. O'Brien, Inc. FRAMINGHAM, MASS.	REV. DATE	P.L. 115-302	REV. LTR.
TITLE FIELD TERMINATION KIT ZION 4.1	AUTHENTICATION	CHGE. CONT. NO.	CODE IDENT. NO. 17476	SHT OF

ITEM NO.	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD.	IDENTIFYING NO. (DRAWING NO.)	DESCRIPTION	REMARKS
						J.O. 62004 Item 4.1 Outside Cont.	
						J.O. 62004 Item 4.1 Inside Cont.	
01	450	450			YSV14	Splice, Crimp, 14 AWG, Burndy	
	450	450			31819	Splice, Crimp, 14 AWG, AMP	(Alternate)
02	12	12			#42223	Jack, No. T3JBSS Thermo Electric	
03	12	12			#42123	Plug No. T2PSS Thermo Electric	
04	1	1			Y9M or Y10M	Tool, Crimp, Burndy	
	1	1			49900 or 49935	Tool, Crimp	(Alternate)
05	45	45			2" x 4"	Pad, Air Seal Kearney	
06	385	385			1/4" I.D. x 2-$\frac{1}{2}$"long	Tubing, Heat Shrink, Raychem RT876	
07	385	385			3/8" I.D. x 3-$\frac{1}{2}$"long	Tubing, Heat Shrink Raychem RT876	
08	2roll	2roll			S1024	Tape, Heat Sealable 3/4" Wide Raychem	
09	38	38			1" I.D. x 12" long	Tubing, Heat Shrink, Raychem RT 876	
10	5	5			1 1/8" I.D. x 12"long	Tubing, Heat Shrink, Raychem RT 876	
11	6	6			1 $\frac{1}{2}$" I.D. x 6" Long	Tubing Heat Shrink, Raychem RT 876	



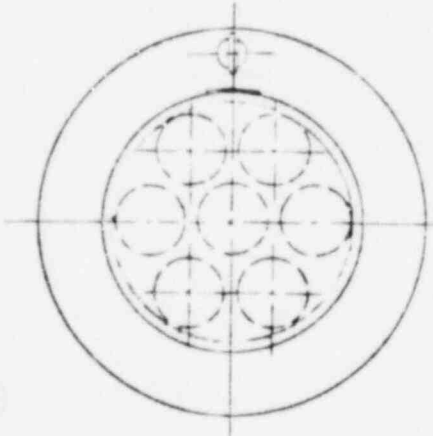


VIEW C-C

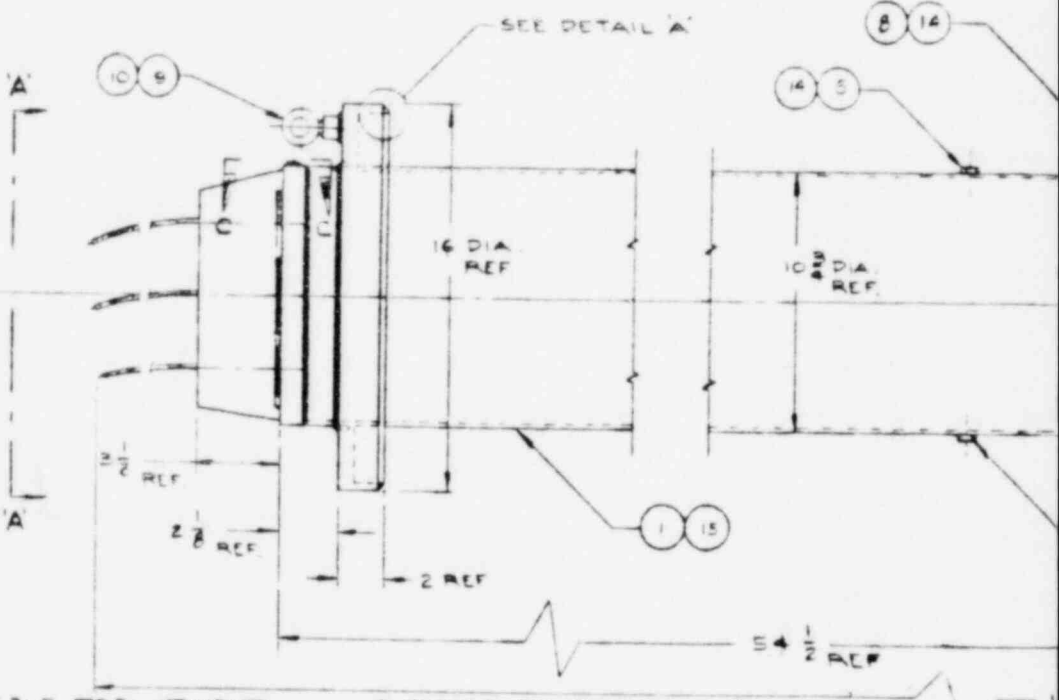
DETAIL 'A'
SCALE 1:2

D.G. O'BRIEN, INC. MFD 1971
MOD NO R18P2227G01
ZION * 1 → SER NO 4181 THRU 4185
ZION * 2 → SER NO 4182 THRU 4185
600 V 5M INSTR SERVICE

NAMEPLATE DATA
ITEM 3



VIEW A-A

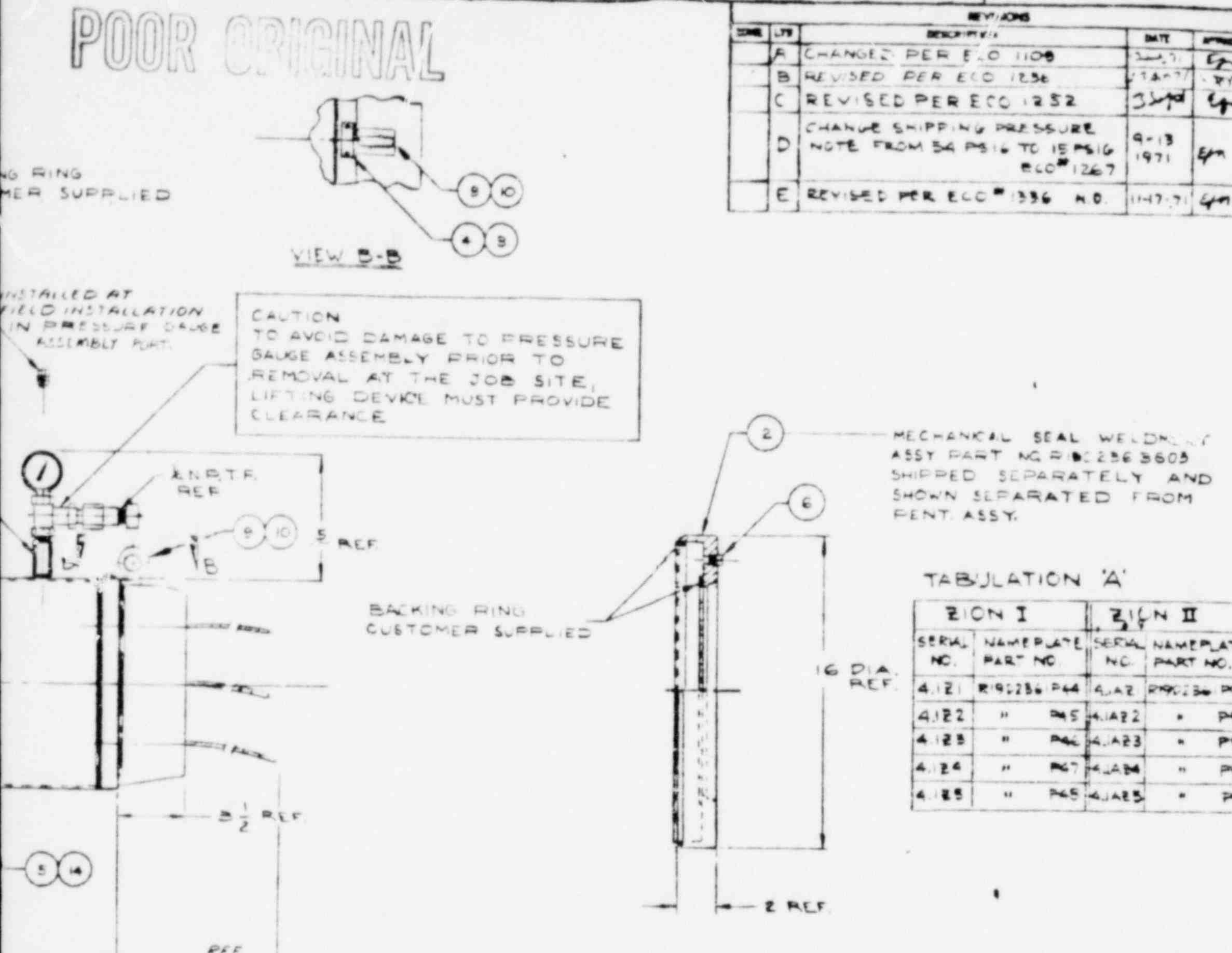


NOTES

1. THIS PENETRATION SHALL MEET THE REQUIREMENTS OF THE ASME BOILER AND PRESSURE VESSELS CODE, SECTION III, CLASS B VESSELS.
2. DESIGN PRESSURE : 54 PSIG.
3. DESIGN TEMPERATURE : 298°F FOR 1 HOUR FOLLOWED BY 271°F FOR 48 HOURS.
4. MINIMUM DESIGN TEMPERATURE : 30°F
5. DESIGN RADIATION LEVEL : 1.7×10^8 RADS (1.5 MEV. GAMMA RAYS) TOTAL INTEGRATED DOSE
6. RELATIVE HUMIDITY MAX DURING THE 40 YEAR LIFE INSIDE AND OUTSIDE CONTAINMENT 50%
7. PENETRATION SEISMIC TEST .25 G'S AT 5 TO 55 HERTZ
8. FOR INSTALLATION WELDING ASSEMBLY, SEE INSTALLATION ASSEMBLY DRAWING * R1P2247G06
9. REFER TO SARGENT & LUNDY SPECIFICATION X-2308 DATED OCT. 1, 1969 INCLUDING ADDENDA 1&2 AND DGO QUALITY ASSURANCE METHOD SHEET "QA-TM-153-6 FOR SPECIFIC TEST PROC
10. PROTECTIVE COAT ALL EXTERNAL CARBON STEEL SURFACES PER D.G.O. PROC MP-PC-100, USING ITEM
11. APPROXIMATE WEIGHT : 425 LBS.
12. FOR CABLE TERMINATION ITEMS, SEE CUSTOMER FIELD CABLE TERMINATION PROCEDURE DGO N
13. USE ONLY BAKER SEAL THREAD SEALING COMPOUND ON ALL DRYSEAL PIPE THREAD ASSEMBLIES.
14. PENETRATION INTERNAL SHIPPING PRESSURE, 15

POOR ORIGINAL

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	CHANGED PER ECO 1108	[illegible]	[illegible]
	B	REVISED PER ECO 1236	[illegible]	[illegible]
	C	REVISED PER ECO 1252	3 Sept	[illegible]
	D	CHANGE SHIPPING PRESSURE NOTE FROM 54 PSIG TO 15 PSIG ECO# 1267	9-13 1971	[illegible]
	E	REVISED PER ECO# 1336 H.D.	11-17-71	[illegible]



TABULATION 'A'

ZION I SERIAL NO.	ZION I NAMEPLATE PART NO.	ZION II SERIAL NO.	ZION II NAMEPLATE PART NO.
4.121	R19D236 P44	4.JA2	R19D236 P95
4.122	" P45	4.JA22	" P96
4.123	" P46	4.JA23	" P97
4.124	" P47	4.JA24	" P98
4.125	" P45	4.JA25	" P99

...FTG 1/2 IN.
...METERS
...L
...M NO 15
...R
...D 115-302
...OUND
...PSIG.

ITEM NO	GROUP QTY REQD	QTY REQD	QTY REQD	QTY REQD	IDENTIFYING NO (DRAWING NO)	DESCRIPTION	REMARKS
1	1				R19F2362C-09	Canister Weldment Assem.	
2	1				R19F2362C-03	Mech. Seal Assembly	
3	2				R19C2361P	Nameplate (Zion I and II)	SEE TABLE 'A'
4	4				P500C2A0002	[illegible] Screws	
5	2				P50C1BD0001	1/8" Pipe Plug	
6	1				P50C1BD0004	1/4" Pipe Plug	
7	1				P50C1BD0005	1/8" Pipe Plug Weldable [illegible]	
8	1				R19F2483.01	Pressure Gauge Assem.	
9	2				P500C2A0027	Eyebolt, Lifting	
10	A/R				P500C2M0013	Washer, 5/16 I.D. x [illegible]	
14	A/R				[illegible]	Thread Sealing Compound	
15	A/R				No. 1700	Protective Coating (Coricene)	
11	1				115-302	FIELD TERMIN. MAT'L & PROCED.	SEE P.L. 115-302

NEXT ASSY	USED ON
R19D2227G	CONTAINMENT...
ZION	
1 & 2	
APPLICATION	

MATERIAL / HEAT TREAT / FINISH: SEE PARTS LIST R19P2227

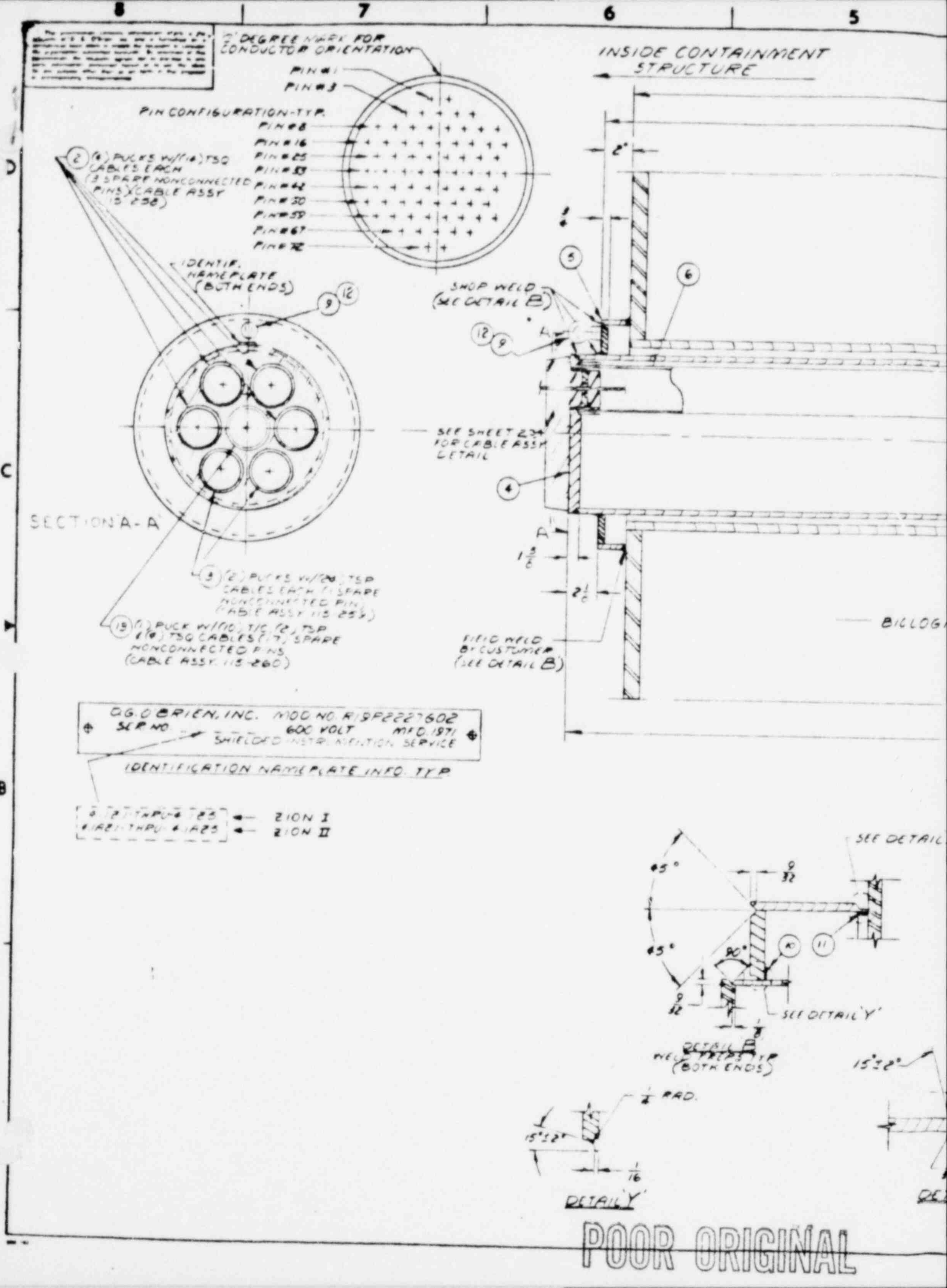
DRAWN: A.F.B. 6-5-71
CHECKED: E.J. [illegible]
[illegible]: R.S. [illegible]

D. O. O'Brien, Inc.

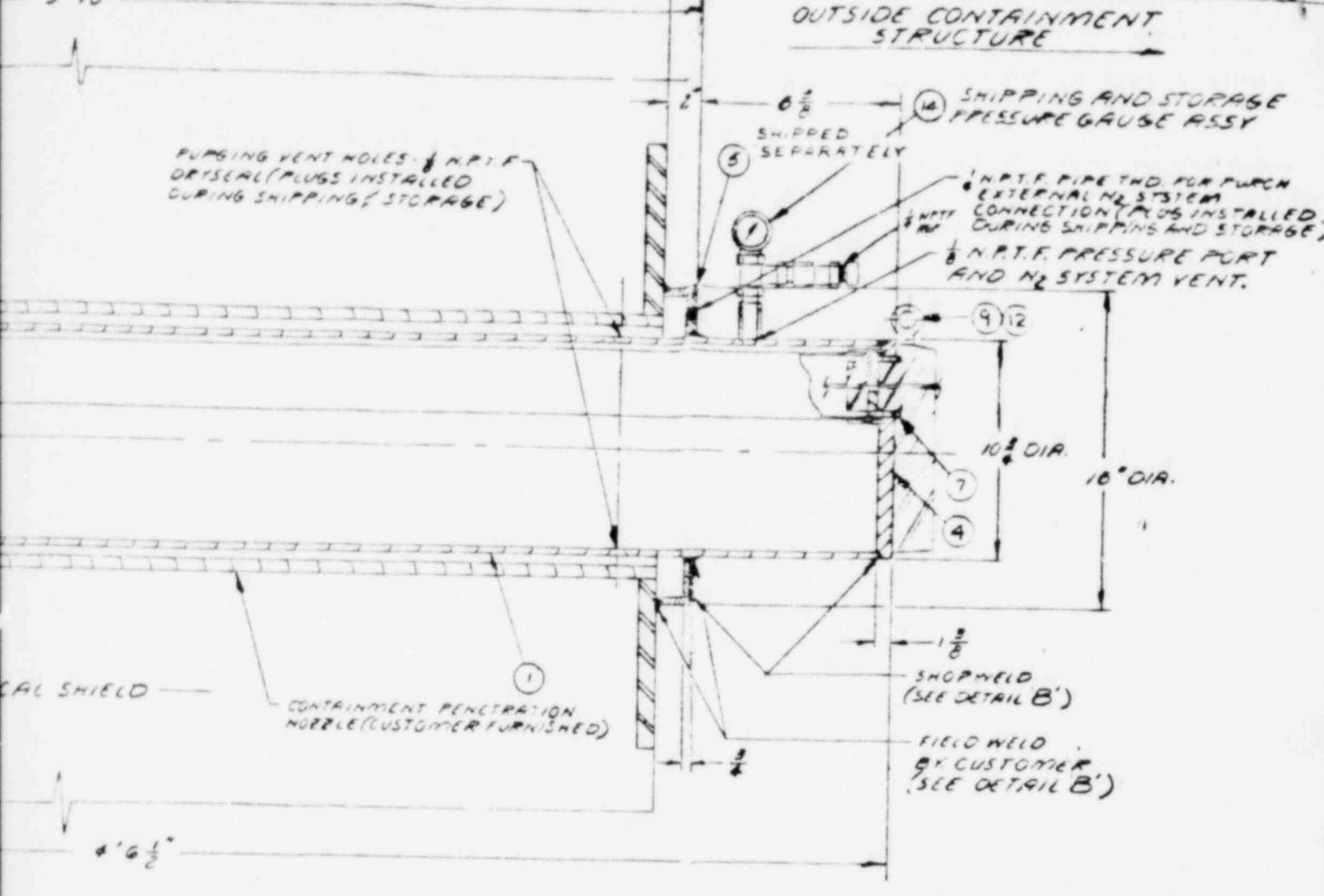
PENETRATION ASSEMBLY ITEM 4.1 & 4.1A

SIZE D | CODE IDENT NO. 17476 | DWG NO. R19D2427G | REV E

SCALE 1/4 | SHEET 1 OF 1


0° DEGREE MARK FOR CONDUCTOR ORIENTATION
PIN #1
PIN #3
PIN CONFIGURATION-TYP.
PIN #8
PIN #16
PIN #25
PIN #33
PIN #42
PIN #50
PIN #59
PIN #67
PIN #72
INSIDE CONTAINMENT STRUCTURE
IDENTIF. NAMEPLATE (BOTH ENDS)
SHOP WELD (SEE DETAIL B)
SEE SHEET 2 FOR CABLE ASSY DETAIL
SECTION A-A
FIELD WELD BY CUSTOMER (SEE DETAIL B)
BIOLOGI
O.G. O'BRIEN, INC. MOD NO. R19P2227602
SER NO.
600 VOLT
MFD. 1971
SHIELDED INSTRUMENTATION SERVICE
IDENTIFICATION NAMEPLATE INFO. TYP.
ZION I
ZION II
SEE DETAIL
SEE DETAIL 'Y'
DETAIL B
WELD PREPS TYP (BOTH ENDS)
DETAIL 'Y'
POOR ORIGINAL

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	REVISED & REDRAWN ECO # 114	[illegible]	[illegible]
	E	REVISED ECO # 209	[illegible]	[illegible]
	F	REVISED ECO # 1237	[illegible]	[illegible]



NOTES:
1. ALL EXTERNAL CARB. STEEL SURFACES WILL BE PROTECTIVE COATED WITH CORICONE 1700, MFG. BY THE CORICONE CORP. LONG BEACH, CALIF.
2. ALL DIMENSIONS ARE REFERENCE DIMENSIONS UNLESS OTHERWISE NOTED.

QTY.	DESCRIPTION	ITEM
1	SHIPPING AND STORAGE PRESSURE GAUGE ASSY D.O.O. NO. R19PE4886	14
137 FT.	THERMOCOUPLE CABLE, CHROMEL-CONSTANTAN (BOSTON INS. WIRE CO. P/N 7938-H-002) (.285 [illegible])	13
A/R	WASHER D.O.O. NO. P500C2M0013	12
2	CUSTOMER'S WELDING BACK-UP RING	11
2	WELDING BACK UP RING (ONE FURNISHED BY CUSTOMER)	10
2	LIFTING EYEBOLT (CARB. STL.) P500C2A0089	9
A/R	POTTING COMPOUND GE RTV 511	8
14	PACK ASSY 'A' D.O.O. NO. R19PE204 001 (1018 CARBON STEEL & 304L STAINLESS STEEL)	7
7	CABLE GUIDE, ALUMINUM [illegible] O.D., .049 WALL	6
1	MECH SEAL ASSY. (333 GR1 & 442 GR60 CARB STL)	5
2	GAS BARRIER (A.S.T.M. A-442 GR 60 OR A.S.T.M. 516 GR 70 CARBON STEEL)	4
685 FT.	T.S.P. CABLE - B.I.W. # 7933-H-002 (.385 O.D. MAX.) HYPALON INS. & JACKET.	3
622 FT.	T.S.C. CABLE - B.I.W. # 7930-H-004 (.690 O.D. MAX.) HYPALON INS. & JACKET.	2
1	PENETRATION ASS'Y CANISTER (SEAMLESS PIPE) 10" I.P.S. SCHED. 60 (333 GR1 CARBON STEEL)	1

POOR ORIGINAL

R19022276

(SEE ABOVE AND SHEET 2)

COMMONWEALTH EDISON CO.
ZION 1 & 2

NEXT ASSY | USED ON
APPLICATION

R.S. BUTTERS 7-12-71

D.G. O'Brien, Inc.

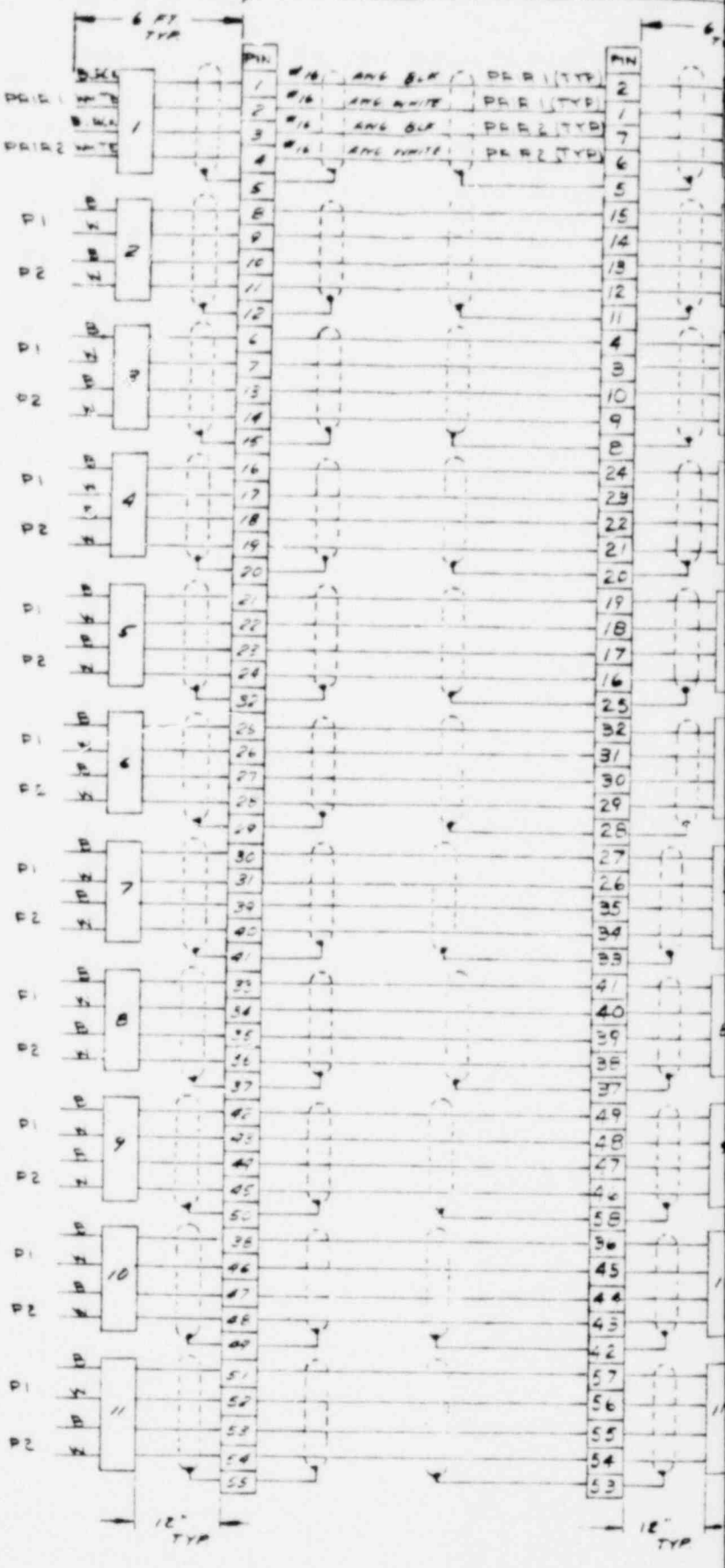
ELECTRICAL PENETRATOR ASSY
TYPE 41 & 41P 600 VOLT
INSTRUMENTATION (NORMAL PLUS POST ACCIDENT DUTY)

D | 17476 | R19022276 | H

SCALE NONE

1 OF 2

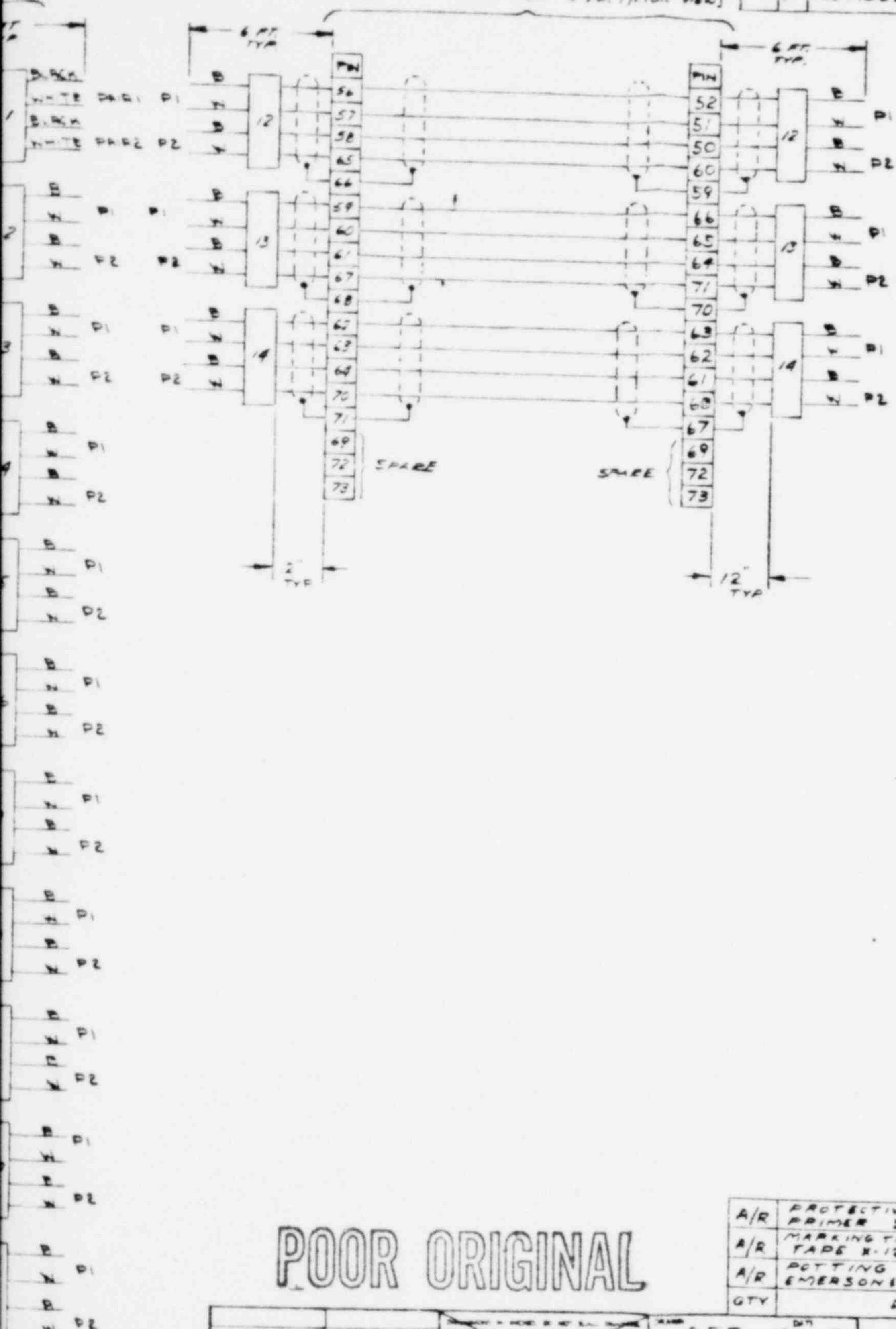
WIRING DIAGRAM
PUCKS 1, 2, 3, & 6
(REF. 115 - 258)



ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
	G	REVISED PER ECO 1251	[illegible]	[illegible]
	H	REVISED PER ECO # 1331 N.D.	11-17-71	[illegible]

WIRING DIAGRAM

PUCKS 1 2 3 & 6 CONT'D
(SEE SHEET 4 FOR TYPICAL VIEW)



POOR ORIGINAL

A/R	PROTECTIVE COATING, TILE CLAD II PRIMER SHERWIN-WILLIAM Co.	17
A/R	MARKING TAPE SCOTCH ELECTRICAL TAPE X-1266 3M Co.	16
A/R	POTTING COMPOUND EMERSON & CUMING STYCAST 2651 MM	15
QTY	DESCRIPTION	ITEM

NEXT ASSY	USED ON
	R19D2227G
	COMMONWEALTH EDISON CO ZION 1 & 2

APPLICATION

MATERIAL/HEAT TREAT/FINISH: SEE ABOVE & SHT. 1

DRAWN: A.F.B. 10 July 71
CHKD: EJN 12 July 71
ENGR: F. G. Hurault 13 July 71
APPROVED: [signature] 7/14/71
APPROVED: [signature] 7/14/71

D. G. O'Brien, Inc.

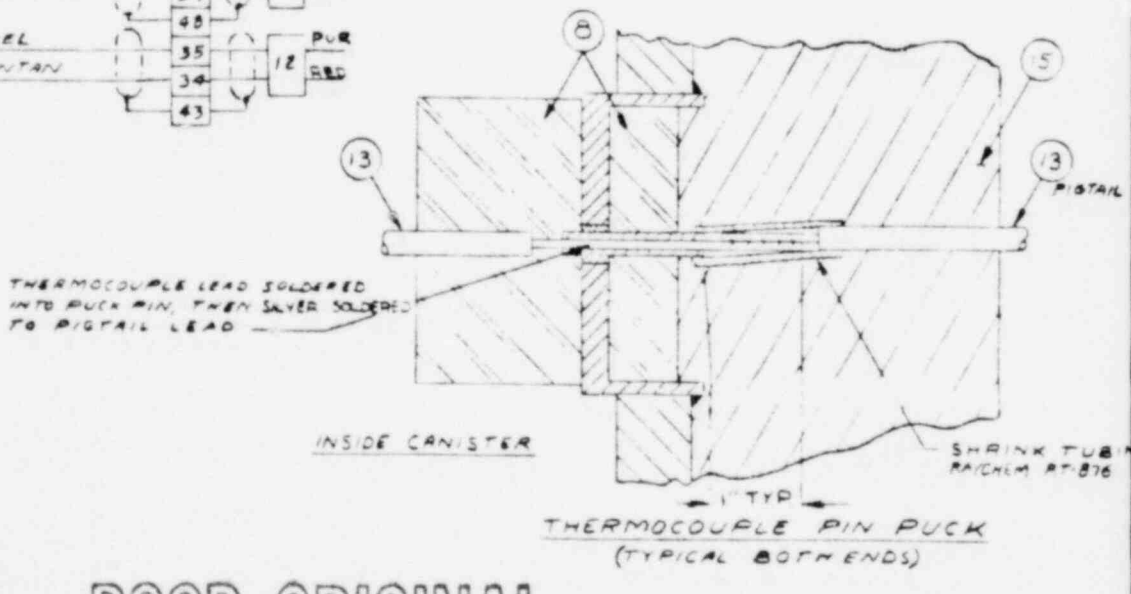
ELECTRICAL PENETR. ASS'Y
TYPE 4.1 & 4.1A
600 VOLT INSTRUMENTATION
(NORMAL PLUS POST ACCIDENT DUTY)

SIZE	CODE IDENT NO.	DWG NO.	REV
D	17476	R19D2227G	H

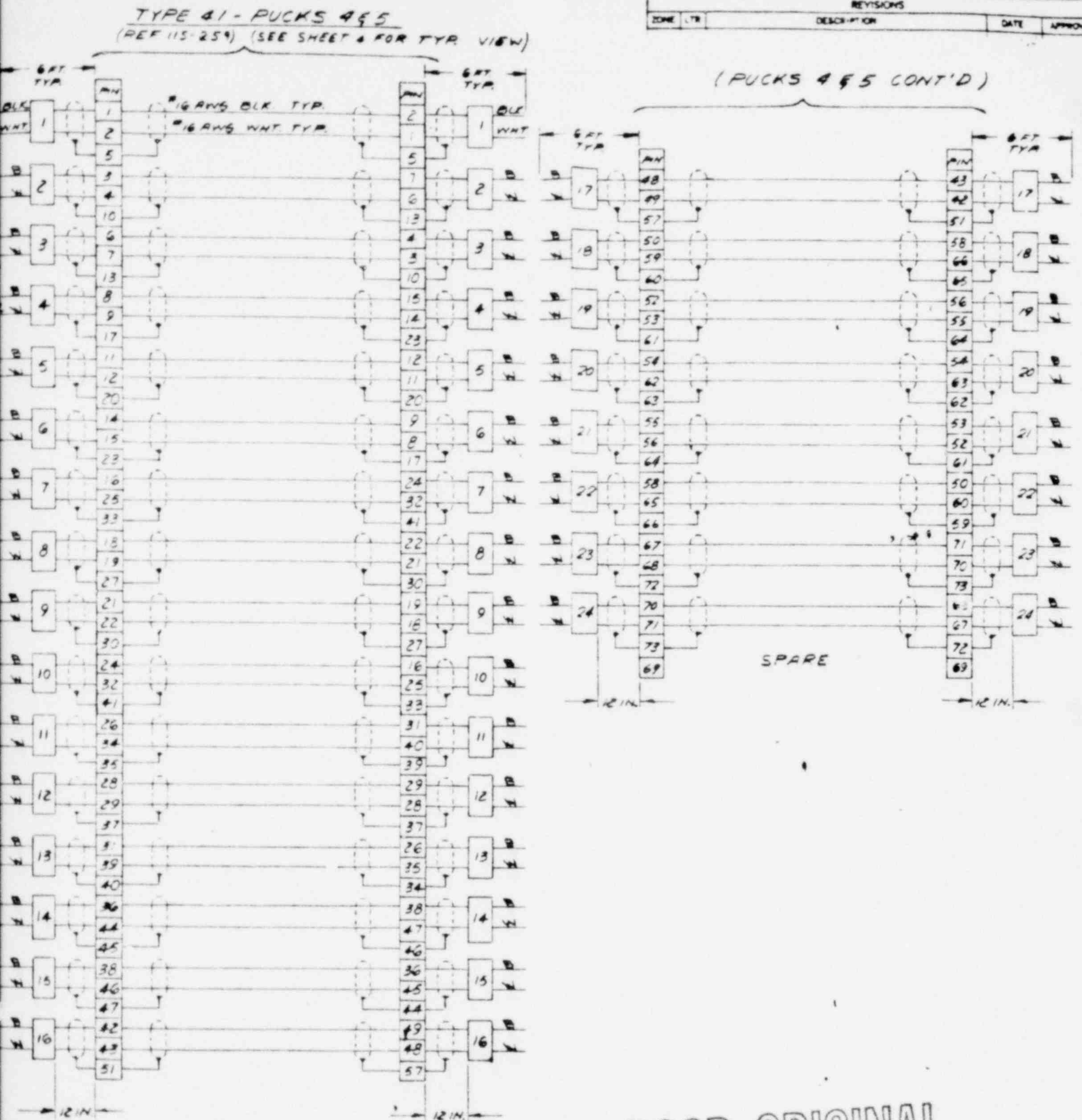
SCALE N.T.S. SHEET 2 OF 4

WIRING DIAGRAM

PUCK #7 (PER 115-260) (SEE BELOW | SHEET 4 FOR TYP VIEW)



THERMOCOUPLE PIN PUCK
(TYPICAL BOTH ENDS)



REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

POOR ORIGINAL

	R19D2227G
	Commonwealth Edison Co
	ZION 1 & 2
NEXT ASSY	USED ON
APPLICATION	

MATERIAL/HEAT TREAT/FINISH: SEE ABOVE, AND SHT.S 1 & 2

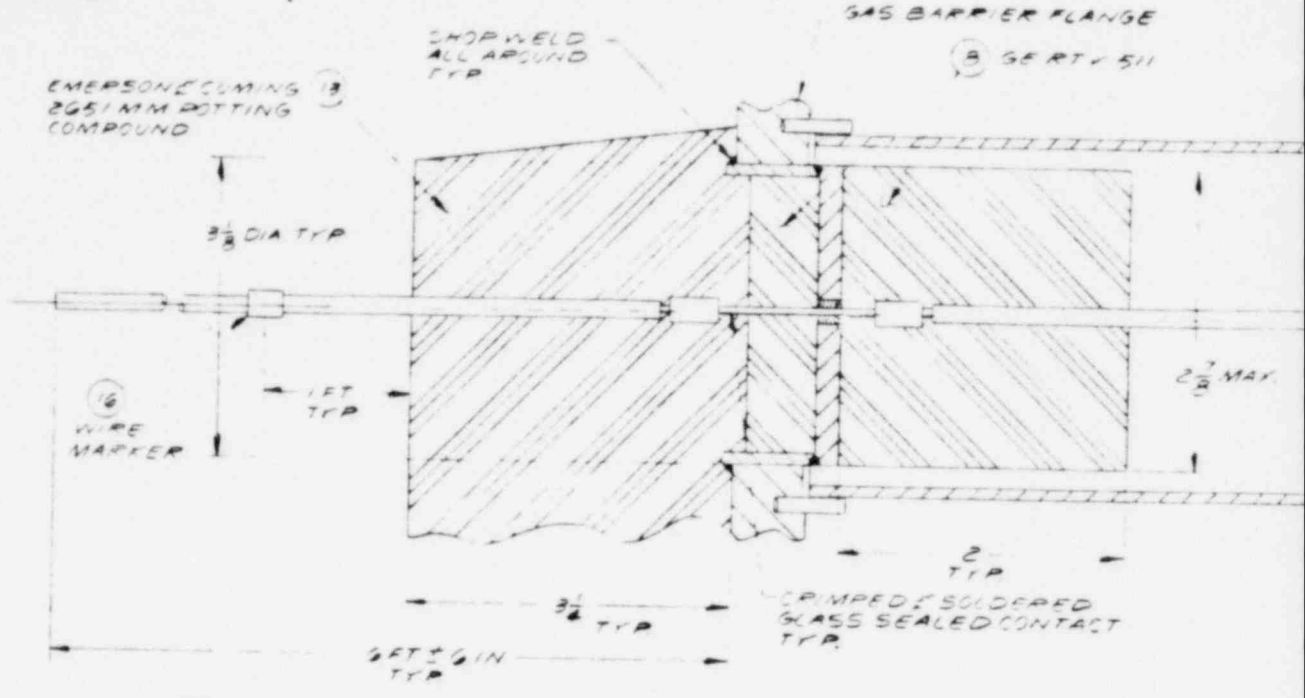
DRAWN [illegible] — CHKD EJN — ENGR D.R. Howard

O. O. O'Brien Co.

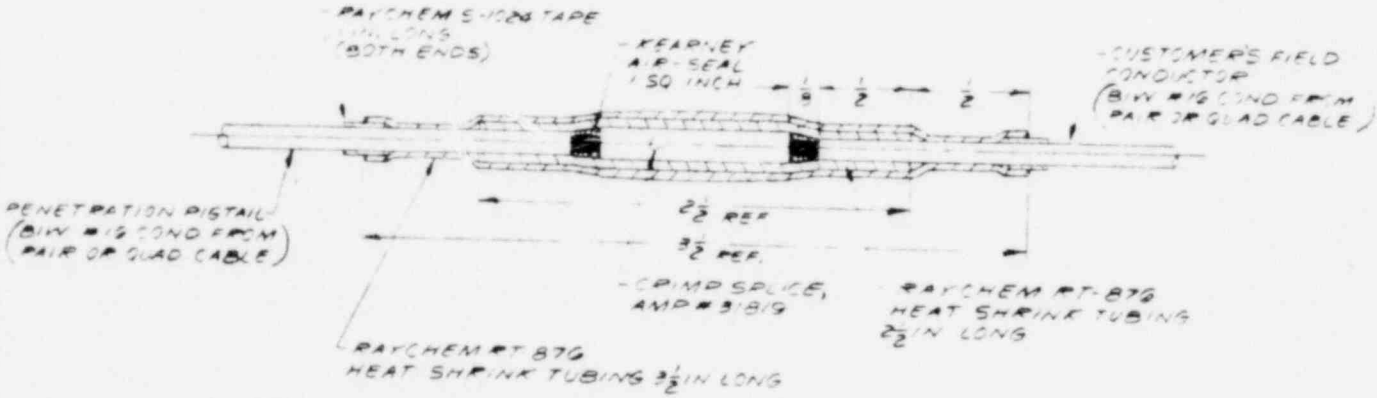
ELECTRICAL PENETR ASSY TYPE 4.1 & 4.1A 600 VOLT INSTRUMENTATION (NORMAL PLUS POST ACCIDENT DUTY)

SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D2227G	H

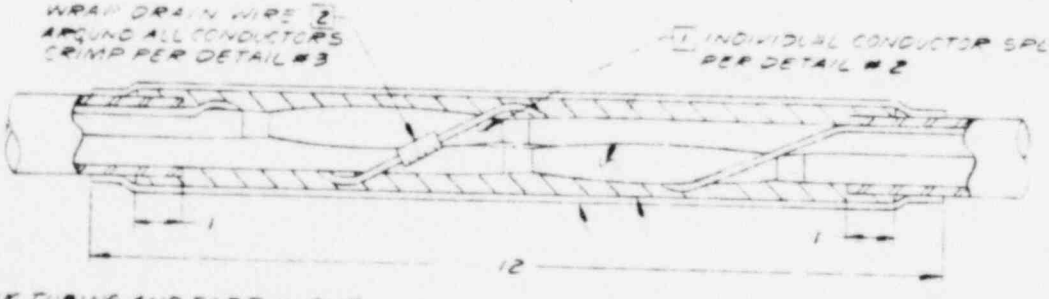
SHEET 3 OF 6



INSIDE CONTAINMENT



DETAIL #2 CUSTOMER'S CONDUCTOR SPLICE (TYP) BOTH ENDS
(NON-DBA)



NOTES:

A SHRINK TUBING AND TAPE IN ONE OPERATION.

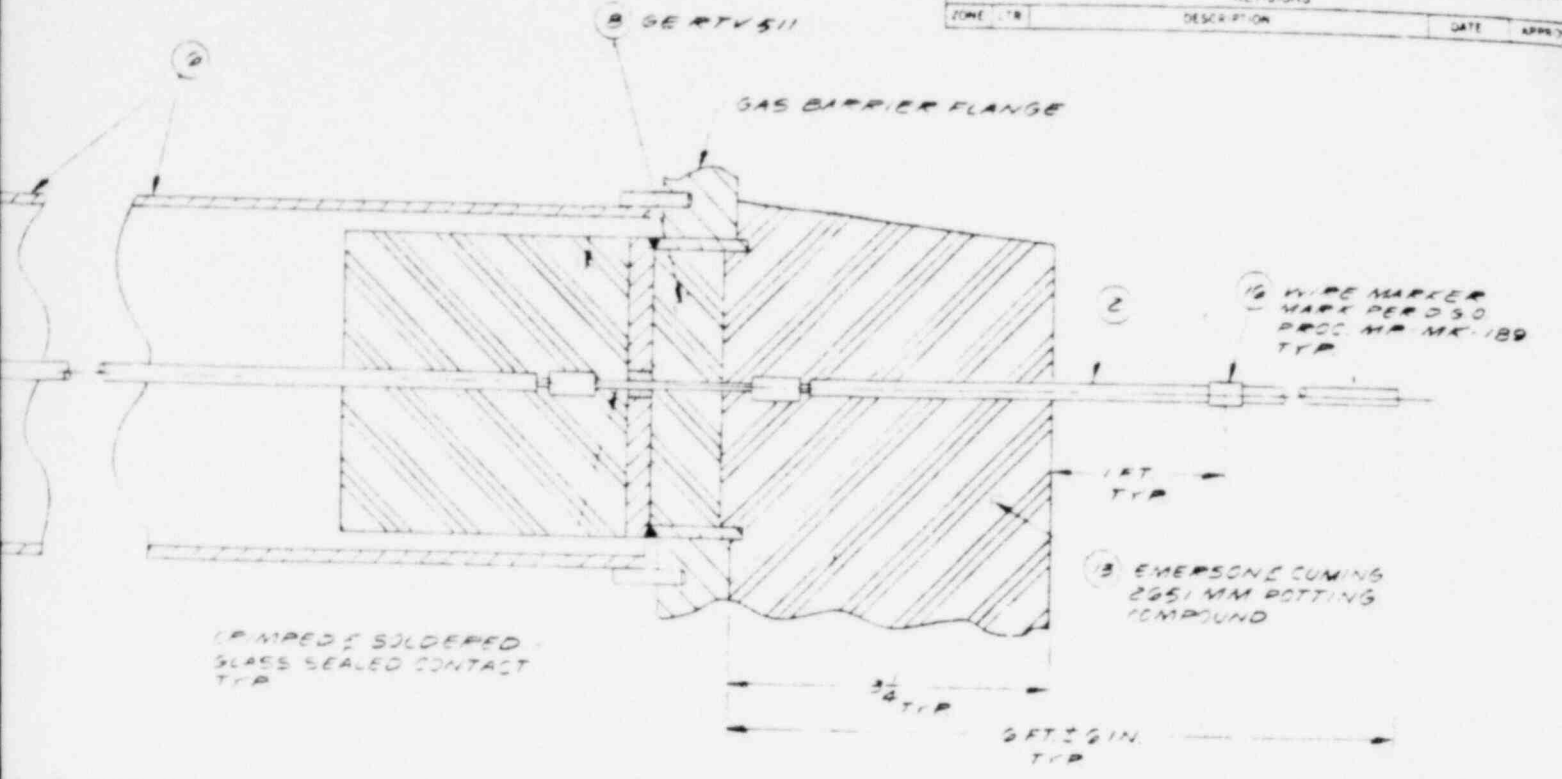
B NON-DBA TERMINATION IS IDENTICAL TO DBA TERMINATION EXCEPT DELETE (3) FOR NON-DBA.

(3) DOUBLE LAYER OF RAYCHEM S-1028 TAPE 1/2 LAPPED (OMIT FOR NON-DBA TERMINATIONS) SEE NOTE A

(4) 1" DIA RAYCHEM VITON 120 HEAT SHRINK TUBING SEE NOTE A

DETAIL #1 CUSTOMER'S SHIELDED MULTI-CONDUCTOR SPLICE (TYP)
(DBA OR NON-DBA, SEE NOTE B)

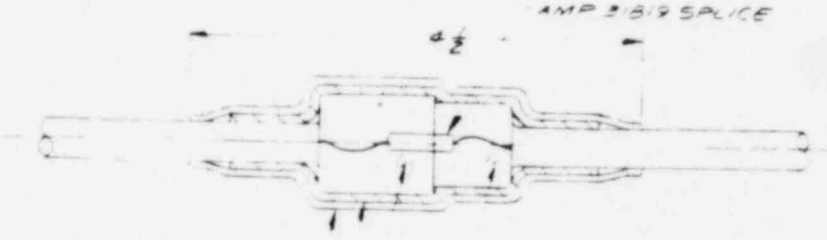
REVISIONS			
ZONE	LTR	DESCRIPTION	DATE	APPROVED



BLE ASSY -

OUTSIDE CONTAINMENT

(1) #3 CUSTOMER'S DRAIN WIRE SPLICE (TYP) (DBA OR NON-DBA, SEE DETAIL #1)



DETAIL #3 CUSTOMER'S THERMOCOUPLE CABLE SPLICE (NON-DBA) (TYP)

POOR ORIGINAL

				D. G. O'Brien, Inc.	
				ELECTRICAL PENETRATOR ASSY TYPE 8 1/2 & 1A 600 VOLT INSTRUMENTATION/NORMAL PLUS POST ACCIDENT DUTY	
				SIZE: D	CODE IDENT NO: 17476	DWG NO: R19D2227G	REV: H
				SCALE: NONE		SHEET 6 OF 6	

MATERIAL, HEAT TREAT, FINISH (SEE SHEET 1)

NEXT ASSY | USED ON

APPLICATION

3.3.2.8 Equipment Item No. 17
Electrical Penetrations Located
Within and Outside of
Containment
D. G. O'Brien, Type 3.1
(Submittal Page References 2 and 3)

Response:

1. The attached xerox copies of portions of the D. G. O'Brien Instruction Manual No. 1016 for Type 3.1 and 3.1A Electrical Penetrations identify the materials used, including jacket and insulation materials for cable leads.

   The environmental test referenced in Section 4 of the Test Report C19QA051 was a saturated steam atmosphere of 70 psig pressure, 298°F temperature, 100% RH for a 1-hour period, followed by 47 psig pressure, 271°F temperature, 100% RH for a period of 48 hours.

2. We are still attempting to obtain information from the Vendor, D. G. O'Brien, to determine the effects of maximum normal and short circuit loads on the conductors simultaneous with and during a postulated LOCA.

3. We are still attempting to obtain information from the Vendor, D. G. O'Brien, to determine a qualified life.

Instruction Manual (1016)

For

REACTOR CONTAINMENT STRUCTURE

ELECTRICAL PENETRATION ASSEMBLY

TYPES 3.1 AND 3.1A (Serial Numbers 3.1Z1 - 3.1Z6 and 3.1AZ1-3.1AZ6)

September, 1971

Prepared For Use On

ZION STATION UNITS I AND II

(Commonwealth Edison Co., Contract 113967)

D. G. O'Brien, Inc.

500 Cochituate Rd., Framingham, Mass.

Approved By:

P. R. Henault — Date 9/7/71

P. R. Henault, Project Electrical Engineer

R. S. Butters — 9/7/71

R. S. Butters, Project Mechanical Engineer

H. P. Hilberg — 9/7/71

H. P. Hilberg, Manager of Nuclear Power Plant Systems

INTRODUCTION

The Electrical Penetration Assembly described herein was designed and manufactured by D. G. O'Brien, Inc., Framingham, Mass. for use in the construction of Nuclear Power Plant - Zion Units I and II, Commonwealth Edison Co., Zion, Illinois.

This manual is for use in the installation, test, calibration, and operation of Type 3.1 penetration assemblies. This penetration is designed for low voltage control cable service. Penetration assemblies of Type 3.1 and 3.1A (Zion I and Zion II designations respectively) are identical for both Zion Units.

Information pertaining to other types of penetrations also designed and manufactured by D. G. O'Brien, Inc. for Zion Units I and II can be obtained from other Instruction Manuals. This manual is applicable only to Type 3.1.

Quality Assurance data is included under a separate cover.

This penetration assembly is furnished for use with applicable design data of the following Sargent and Lundy drawings:

ES-42	Typical Electrical Penetration, Physical Requirements, Dated 10/1/69
B-213	Reactor Building Containment, Liner Plate Sections and Details, Sheet 2 Rev. T, Dated 10/3/69
B-214	Reactor Building Containment, Penetration Schedule, Rev. L, Rev. L, Dated 10/3/69
B-216	Reactor Building Containment, Elevation Electrical Penetrations, Rev. G, Dated 10/3/69

The penetration assembly described herein is furnished by D. G. O'Brien, Inc., as part of an ASME Class B Nuclear Vessel.

The electrical penetrations for Nuclear Generating Power Plants manufactured by D. G. O'Brien, Inc., are engineered to meet the stringent requirements of the electrical power industry and the Atomic Energy Commission. The careful integration of many scientific and technical disciplines has gone into the development of a product that is reliable and efficient. Careful control of manufacturing processes and materials plus extensive in-process and final testing ensures that the finest product is delivered to the customer.

This manual is prepared to give the customer, in readily available form, the information necessary to efficiently install and maintain the purchased equipment. References throughout this manual to the Type 3.1 assembly also are applicable to type 3.1A assemblies, unless otherwise specified.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 GENERAL DESCRIPTION

1.1 Low Voltage Control Cable Penetration Assembly (D.G. O'Brien, Inc. Part No. R19D2226G01) herein referred to as the penetration assembly will be used as an interface for passing the Purchaser's low-voltage control cables from outside the containment to inside the containment. As such, it will become a critical portion of the cabling system associated with the reactor nuclear control system.

1.2 The penetration assembly will extend low voltage control power from outside the containment to circuits and elements located inside the containment.

1.3 The assemblies are designed and constructed for installation in 12-inch diameter steel pipe containment penetration nozzles that are 3 feet, 6 inches long. Each penetration assembly is identical in basic physical configuration and contains the inside mechanical seal permanently attached. The outside mechanical seal, required for field installation, is furnished separately in the same shipping carton.

1.4 The penetration assembly must be inserted into the containment structure nozzle from inside the containment and is permanently installed by means of field welding at the site. Mechanical supports are necessary to position the assembly during the welding operation.

1.5 Each assembly is designed to restrain loading due to electrodynamic forces or mechanical stressing. Internally, this is achieved, where required, by groups of tubular cable guides extending the full length of the penetration assembly.

1.6 Every penetration assembly is permanently identified by a serial number. Every wire, external to the assembly, is marked at each end with an identification number as specified by the purchaser. Wire numbers in any one multiconductor cable are not repeated.

1.7 Sealing and Pressurization. The penetration assemblies provide a dual gas barrier by means of steel header flanges and hermetically glass-sealed electrical contacts. Each of the two gas barriers meet the service environmental conditions individually, providing an overall performance safety factor of two. The double-pressure barrier is continued at installation by welding the mechanical seals as required. Both the internal volume of the penetration assembly and that between it and the penetration nozzle may be pressurized through a pressurization port in the outside containment mechanical seal and vent holes in the canister. The canister assemblies are pressurized to 15 PSIG with dry nitrogen prior to shipment. One day prior to installation, the assembly should be uncrated and any gross pressure differential of the penetration assembly in transit and storage may be observed on the pressure gauge that forms part of the assembly. Prior to assembly, the canister must be

pressurized to 54 PSIG and observed for a period of one day. If there is no indication of leakage at the end of this period of time installation procedures should be initiated.

CAUTION

PRIOR TO INSTALLATION, THE PENETRATION ASSEMBLY SHOULD BE DEPRESSURIZED AND THE PRESSURE GAUGE ASSEMBLY AND VENT PORT PLUGS REMOVED. REFER TO SECTION 4.0 OF THIS MANUAL.

1.8 Safety Factors in Production. Pneumatic testing is performed on the prototype and on each production assembly in accordance with the latest revision of Paragraph N-110 in Section III of the ASME Boiler and Pressure Vessel Code and as covered in detail in the Quality Assurance Instruction Data. The allowable leak rate of both penetration gas barriers in series in prototype testing is equal to, or less than, 1×10^{-6} standard cc/sec. of dry helium at 298°F and 54 PSIG. In production, each penetration assembly is subjected to a leak rate test at 54 PSIG and 78°F ±5°F and will not exceed 1×10^{-6} standard cc/sec. through both penetration gas barriers in series. Due to controlled production processes, hermetically glass-sealed headers or gas barriers consistently better the leak rate of 1×10^{-6} by two orders of magnitude.

1.9 Cable Description

1.9.1 Internal Cables. The internal cables and external pigtails are directly terminated to glass-sealed contacts in connectors (pucks) welded into the gas barriers. The electrical characteristics of the internal cables are identical to the purchaser's cables within the tolerances allowed.

1.9.2 External Cable Terminations. External cable terminations are made to the pigtail leads on each puck. The pucks are a related part of the penetration assembly gas barrier. All cables are soldered. They are designed and built to function in accordance with the requirements of the circuits they service. All conductors are insulated from each other and from ground.

1.9.3 The prototype and all production models are tested to the following:

A. Insulation:

1. Test Voltage - 500VDC

2. Minimum Insulation Resistance

Conductor-to-conductor	1×10^8 ohms-ft.
Conductor-to-ground	1×10^8 ohms-ft.

B. Dielectric Strength:

Ten Seconds, 60 HZ

2200 V AC RMS

Table 1-1 summarizes the technical and design parameters and provides a ready reference of data.

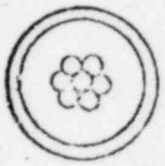
TYPE 3.1 CONTROL ELECTRICAL PENETRATOR DESIGN PARAMTER SUMMARY

1.	Number of Conductors	402-1KV 14 AWG, (7/.0242) Kerite 3/64" FR Insulation & 3/64" FR Jacket
2.	Material & Size of Conductors: Current or Signal	#14 AWG (7/.0242")Tinned Coppe 10 AMP
3.	Conductor Insulating Material Temperature	Kerite Type FR Synthetic Rubbe Insulation & Jacket 90°C
4.	Provision for Connection of Purchaser's External Cable	Pigtail Leads
5.	High Potential Test On Production Assemblies for One Minute	2200 vrms
6.	Assembly Body Material	10" I.P.S. Sch. 20 Pipe, ASTM, A-333, GR-1, Carbon Steel
7.	End Header Plater Material	ASTM, A-442, GR-60 Carbon Stee or ASTM A-516, GR-70
8.	End Header Plate Conductor Material	Leaded Carbon Steel Per AISI, C1213 (Tin Plated)
9.	End Header Plate Conductor Insulating Material	9010 Glass
10.	Assembly Dimension: Body Outer Diameter Body Length	10 3/4" 4' $6\frac{1}{4}$"
11.	Maximum Integrated Radiation Exposure	1.7×10^{8} Rad (1.5 MEV gamma rays)
12.	Maximum Total Assembly	2.24×10^{-5} cc. (Air) Min.

13.	Minimum Insulation Resistance @ 500 VDC:	1×10^8 ohms-ft
14.	Total Assembly Calculated Weight	600 pounds
15.	Shipping Pressurization Storage Pressurization	15 PSIG Dry Nitrogen 54 PSIG Dry Nitrogen
16.	Design Current Rating	10 amperes, nominal 20 amperes, 1 minute overload

6.0 WIRING

The following drawings (Figures 6-1, 6-2) depict the wiring diagram electrical connections of the Zion I and II Electrical Penetration, Type 3.1 Low Voltage Control Service for Normal Non-Accident Duty plus Post-Accident Operation on no greater than 10 percent of the conductors.



CABLE 1KV
14 AWG Kerite

CONDUCTOR:	14 AWG 7 Strand (7/.0242) Tin plated copper	OD 0.072"
INSULATION:	Rubber Kerite 3/64" Wall "FR" Insulation Black	OD 0.170"
JACKET:	Rubber, Synthetic, Kerite "FR" Black 3/64" Wall	OD 0.274"

Figure 6-2 1KV CABLE (Kerite)

7.0 TERMINATION INFORMATION

Prior to assembly of any hardware on the penetration assembly, a review of D. G. O'Brien, Inc. Drawing R19D2226G (Sheets 1 and 3) should be made to ascertain layout and sequence for splicing of wires. This drawing also illustrates the location of puck assemblies and electrical connection sequence. The required hardware and material for termination are included in the shipping carton, Kit P/N 115-301.

CAUTION

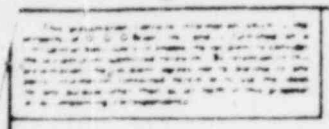
PRIOR TO ASSEMBLY CHECK PIGTAILS AND POTTING WITHIN PUCKS FOR INDICATIONS OF DAMAGE.

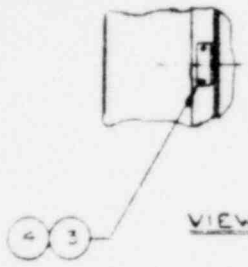
All work should be done in as clean an area as possible, well ventilated, and free from moisture and work hazards.

Purchaser's Field cables shall be prepared as outlined in D. G. O'Brien, Inc. Drawing R19D2226G for termination to the Burndy or AMP wire splices.

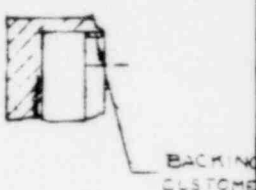
PARTS LIST	D. G. O'Brien, Inc. FRAMINGHAM, MASS.	REV. DATE	P.L. 115-301	REV. LTR.
TITLE FIELD TERMINATION KIT ZION 3.1	AUTHENTICATION	CHGE. CONT. NO.	CODE IDENT. NO. 17476	SHT OF

ITEM NO.	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD.	IDENTIFYING NO. (DRAWING NO.)	DESCRIPTION	REMARKS
						J.O. 62004 Item 3.1 Outside Cont.	
						J.O. 62004 Item 3.1 Inside Cont.	
01	402	402			YSV14	Splice, Crimp, 14AWG, Burndy	
	402	402			31819	Splice, Crimp 14AWG, AMP	(Alternate)
02		2			DS-1001	Splice Kit, Kerite	
03	2				DS-1133	Splice Kit, Kerite	
04	1	1			Y9M or Y10M	Tool, Crimp, Burndy	
	1	1			49900 or 49935	Tool, Crimp, AMP, Inc.	(Alternate)
05	45	45			2" x 4"	Pad, Air Seal, Kearney	
06	360	360			3/8" I.D. x 3" long	Tubing, Heat Shrink, Raychem RT876	
07	360	360			1/2" I.D. x 4" Long	Tubing, Heat Shrink, Raychem RT876	
08	½ roll	½ roll			S1024	Tape, Heat Sealable 3/4" wide Raychem	

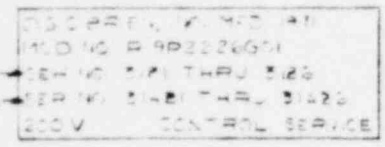




VIEW A-A

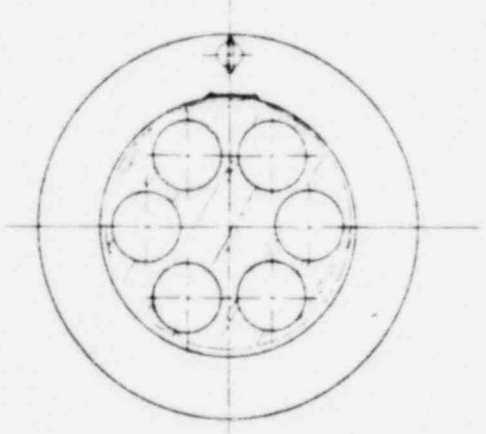


DETAIL 'A'

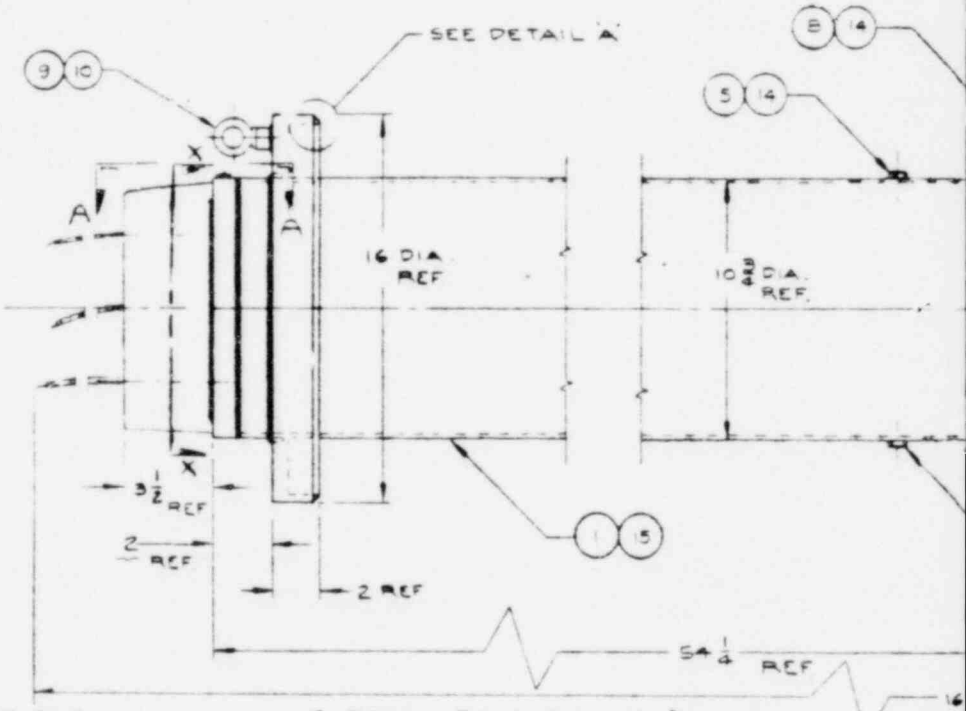


NAMEPLATE DATA
ITEM 3

7
INSTALLED AT
FIELD INSTALLATIO
IN PRESSURE GAUG
ASSEMBLY PORT



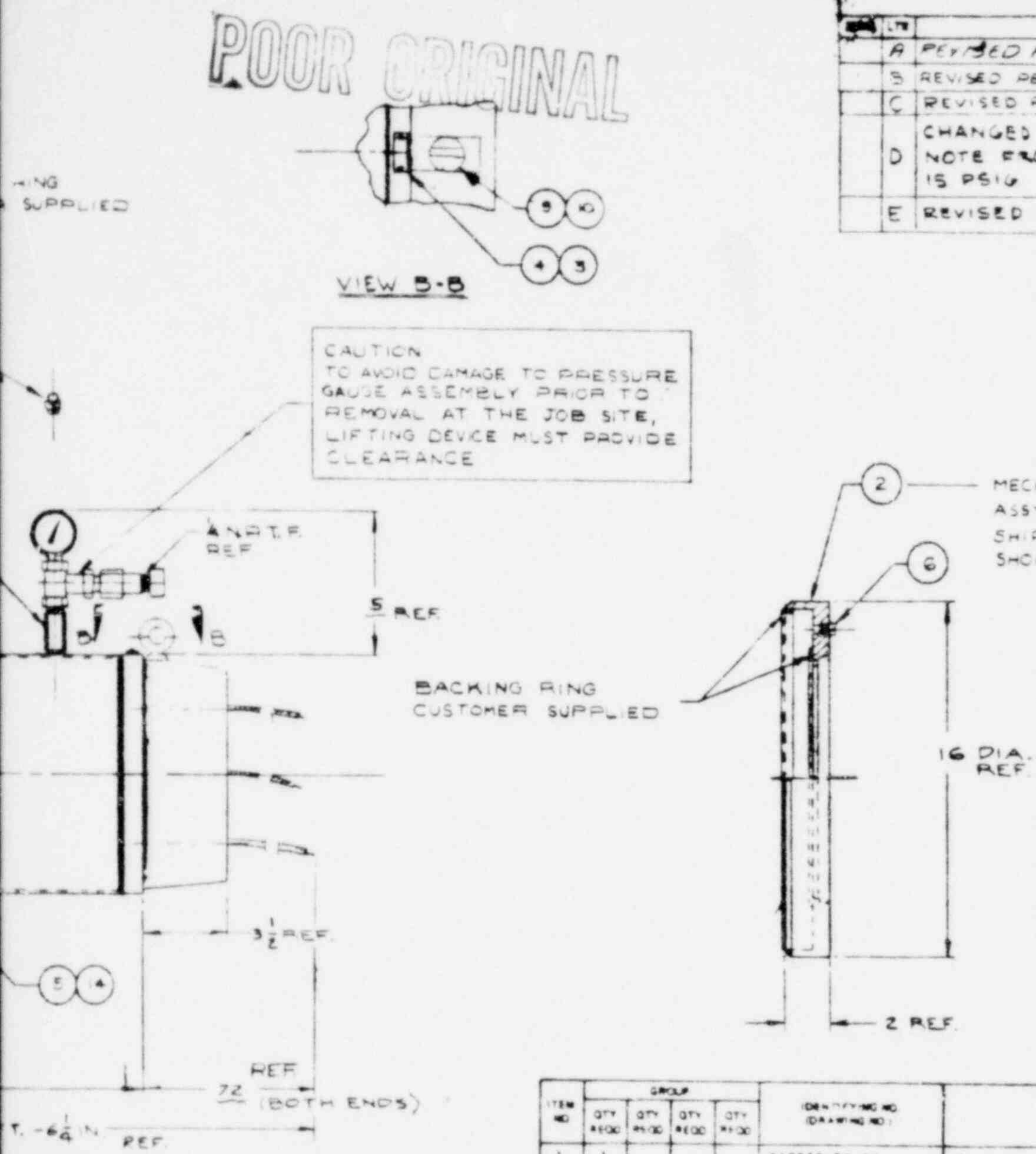
SECTION 'X-X'



NOTES

1. THIS PENETRATION SHALL MEET THE REQUIREMENTS OF THE ASME BOILER AND PRESSURE VESSELS CODE, SECTION III, CLASS B VESSELS.
2. DESIGN PRESSURE : 54 PSIG.
3. DESIGN TEMPERATURE : 298°F FOR 1 HOUR FOLLOWED BY 271°F FOR 48 HOURS.
4. MINIMUM DESIGN TEMPERATURE : 30°F
5. DESIGN RADIATION LEVEL : 1.7×10^8 RADS (1.5 MEV. GAMMA RAYS) TOTAL INTEGRATED DOSE
6. RELATIVE HUMIDITY MAX DURING THE 40 YEAR LIFE CYCLE AND OUTSIDE CONTAINMENT 50%.
7. PENETRATION SEISMIC TEST : 2.2G AT 6 TO 55 HERTZ
8. FOR INSTALLATION WELDING ASSEMBLY SEE INSTALLATION DRAWING *RIRDZA76605
9. REFER TO SARGENT & LUNDY SPECIFICATION X-2308 DATED OCT. 1, 1969 INCLUDING ADDENDA 1 & 2 AND D&O QUALITY ASSURANCE METHOD SHEET *A-TM-153-5 FOR SPECIFIC TEST PARA
10. PROTECTIVE COAT ALL EXTERNAL CARBON STEEL SURFACES PER D&O PROC. MP-
11. APPROXIMATE WEIGHT 600 LBS.
12. FOR CABLE TERMINATION ITEMS, SEE C.S. FIELD CABLE TERMINATION PROCEDURE, DG
13. USE ONLY "BAKERSEAL" THREAD SEALING C ON ALL DRYSEAL PIPE THREAD ASSEMBLIE
14. PENETRATION INTERNAL SHIPPING P 15 PSIG.

REVISIONS				
LTR	DESCRIPTION		DATE	APPROVED
A	REVISED PER ECO 1102		7-6-71	E.J.U
B	REVISED PER ECO 1234		7-23-71	EJM
C	REVISED PER ECO 1249		9-2-71	EJM
D	CHANGED SHIPPING PRESSURE NOTE FROM 54PSIG TO 15 PSIG	ECO #1267	9-13-71	EJM
E	REVISED PER ECO #1329		11-4-71	EJM



TABULATION 'A'

ZION I		ZION II	
SERIAL NO.	NAMEPLATE PART NO.	SERIAL NO.	NAMEPLATE PART NO.
3.121	R19D2361P38	3.1A21	R19D2361P89
3.122	" P39	3.1A22	" P90
3.123	" P40	3.1A23	" P91
3.124	" P41	3.1A24	" P92
3.125	" P42	3.1A25	" P93
3.126	" P43	3.1A26	" P94

-ING
SUPPLIED

METERS

N
PC-100. USING ITEM NO 15

TOMER
#115-301
MPOUND

ESSURE

ITEM NO	GROUP QTY REQD	QTY REQD	QTY REQD	QTY REQD	IDENTIFYING NO (DRAWING NO)	DESCRIPTION	REMARKS
1	1				R19P23626-08	Canister Weldment Assem.	
2	1				R19P23636-03	Mech. Seal WELDMENT ASSEM.	
3	2				R19D2361P	Nameplate (Zion I & II)	SEE TAB'N 'A'
4	4				P500C2A0002	#0 Drive Screws	
5	2				P50C3D0001	1/8" Pipe Plug	
6	1				P50C3D0004	1/4" Pipe Plug	
8	1				R19P2483001	Pressure Gauge Assem.	
9	2				P5002A0029	Eyebolt, Lifting	
10	A/R				P5002M0013	Washer, 5/16	
14	A/R				Sealersol	Thread Sealing Compound	
15	A/R				No. 1700	Protective Coating (Caricane)	
7	1				P50C 3D0005	1/8 PIPE PLUG (WELDABLE)	
11	1				115-301	CUSTOMER FIELD TERMINATION HDW (PKGD)	SEE PL 115-301

DRAWN	A.F. BIUSO 6-23-71
CHECKED	F.X. HENAULT 7-10-71
	R.S. BUTTERS 6-30-71
APPROVED	7/1/71
	7/1/71

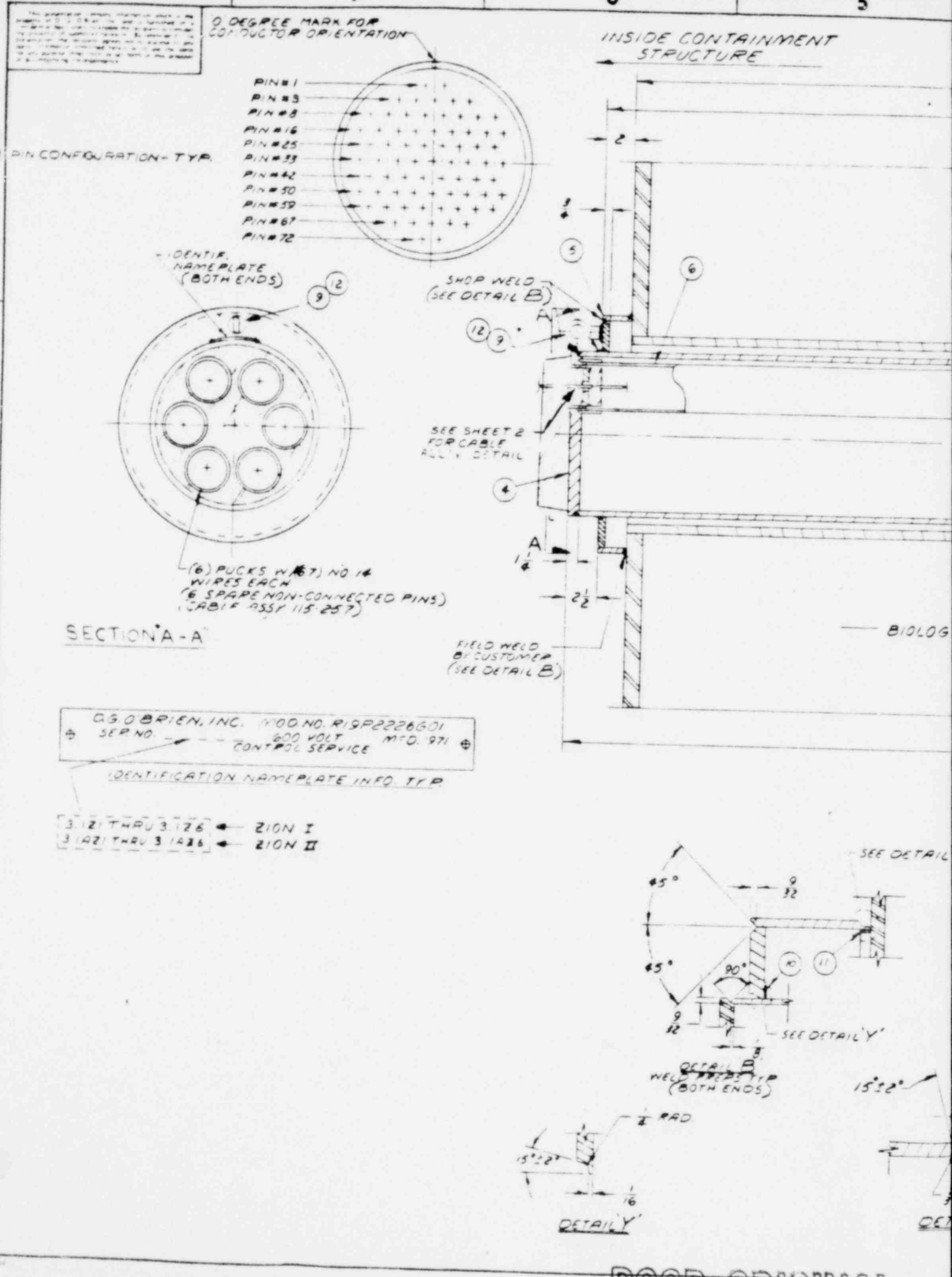
R19D2226G
COMMONWEALTH
ED. CON
ZION
1 & 2
NEXT ASSY | USED ON
APPLICATION
MATERIAL / HEAT TREAT / FINISH

D.O. O'Brien, Inc.

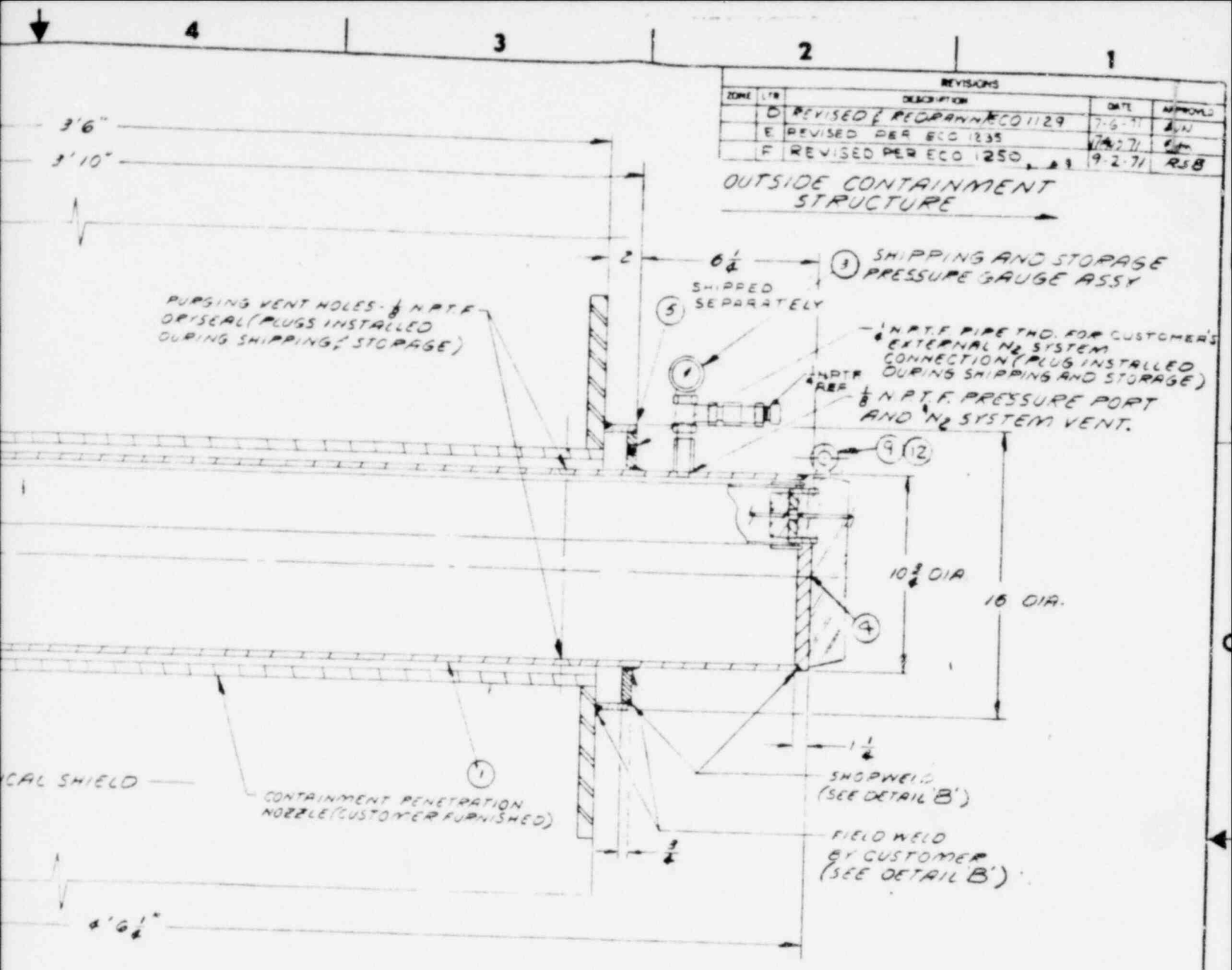
PENETRATION ASSEMBLY
(ITEM 3.1 & 3.1A)

SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D24266	E

SCALE 1/4 | SHEET 1 OF 1



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	REVISED & RECRANN ECO 1129	7-6-71	[illegible]
	E	REVISED PER ECO 1235	7-27-71	[illegible]
	F	REVISED PER ECO 1250	9-2-71	RSB



ITEM	QTY	DESCRIPTION
15	A/R	MARKING TAPE, SCOTCH ELECTRICAL TAPE #[illegible] 3M CO.
14	A/R	PROTECTIVE COATING, TILE CLAD II OR M&M SHERWIN WILLIAMS CO
13	A/R	POTTING COMPOUND, EMERSON & CUMING STYCAST R-3114
12	2	WASHER, CGC #PS 00C2M0013
11	2	CUSTOMER'S WELDING BACK-UP RING
10	2	WELDING BACK-UP RING (ONE FURNISHED BY CUSTOMER)
9	2	LIFTING EYEBOLT (CARB STL.) PS00C2A0029
8	A/R	POTTING COMPOUND, GE ATV511
7	12	PICK ASSY A', O&O, NO #[illegible] (1018 CARBON STEEL & 304L STAINLESS STEEL)
6	6	CBL GUIDE, 6061-T6 ALUM. 3½ OD, .049 WALL
5	2	MECH SEAL ASSY. 333 GR1 & 442 CR60 CARB STL.
4	2	GAS BARRIER (ASTM A-442 GR 60 OR ASTM 516, GR 70 CARBON STEEL
3	1	SHIPPING AND STORAGE PRESSURE GAUGE ASSY, O&O #R19[illegible]
2	6&10 FT.	NO. 4 600 V WIRE 7 STRAND, 3/64 FR. INSUL, 3/64 FR JACKET (KERITE CORP.)
1	1	PENETRATION ASS'Y CANISTER (SEAMLESS PIPE) 10" IPS. SCHED. 80/333 GR. 1 CARBON STEEL)

NOTES:
1. ALL EXTERNAL CARB. STEEL SURFACES WILL BE PROTECTIVE COATED WITH CORICONE 1700, MFG. BY THE CORICONE CORP. LONG BEACH, CALIF.
2. ALL DIMENSIONS ARE REFERENCE DIMENSIONS UNLESS OTHERWISE NOTED.
3. TYPICAL CABLE PIGTAIL MARKING
   PUCK NO
   CONDUCTOR NO
   1-1
   1-2
   ETC

RAD. T6
AIL 'X'

R19022266	
ELISON CO.	
ZION ILL	
NEXT ASSY	USED ON
APPLICATION	

MATERIAL HEAT TREAT FINISH (SEE ABOVE)

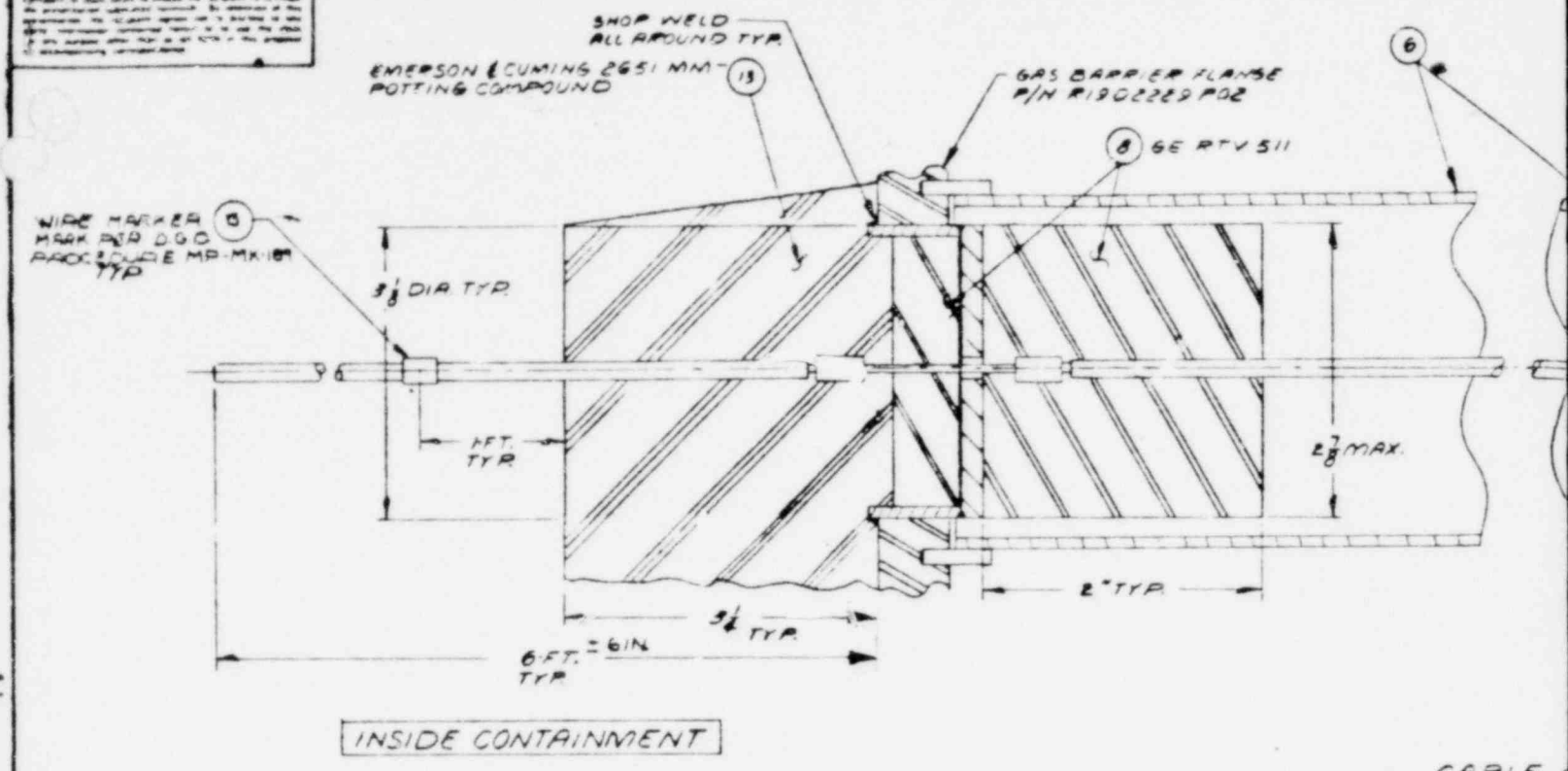
DRAWN	DATE 6-8-71
CHKD P. HAULT	DATE 7-7-71
ENGR R. E. BUTTERS	DATE 7-30-71
QA	DATE
ISSUED	DATE
APPROVED	DATE 7-30-71
APPROVED	DATE 7/30/71

O. O. O'Brien, Inc.

ELECTRICAL PENETRATOR ASSY. TYPE 3.1 & 3.1A, 600 VOLT CONTROL SERVICE (NORMAL DUTY PLUS 10⁶ OF CONC POST-ACCIDENT DUTY)

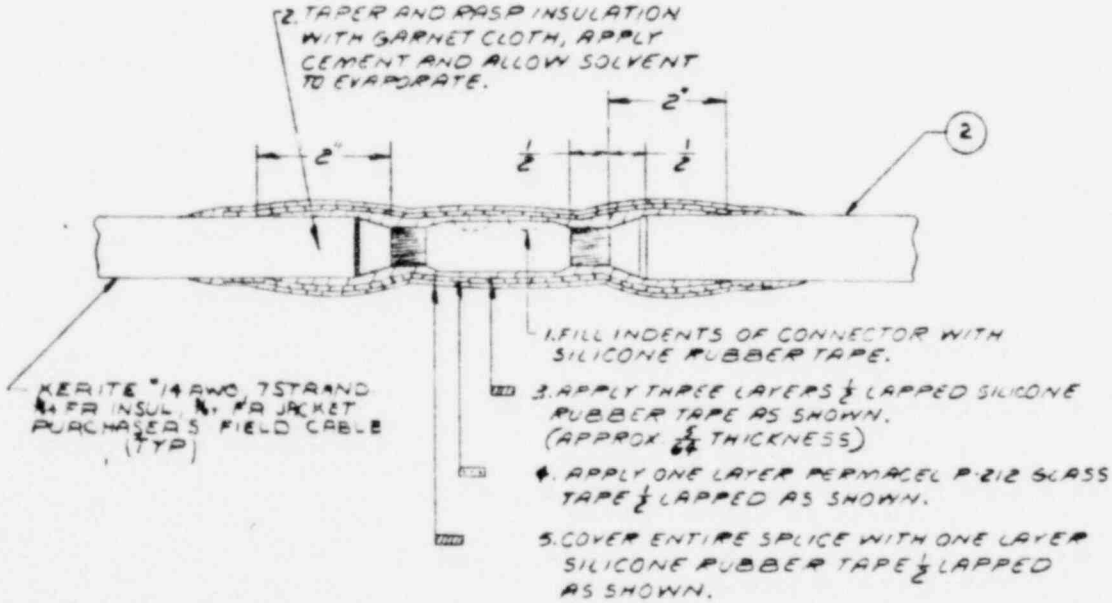
SIZE	CODE IDENT NO.	DWG NO.	REV
D	17476	R19022266	G

SCALE NONE SHEET 1 OF 8



INSIDE CONTAINMENT

— CABLE

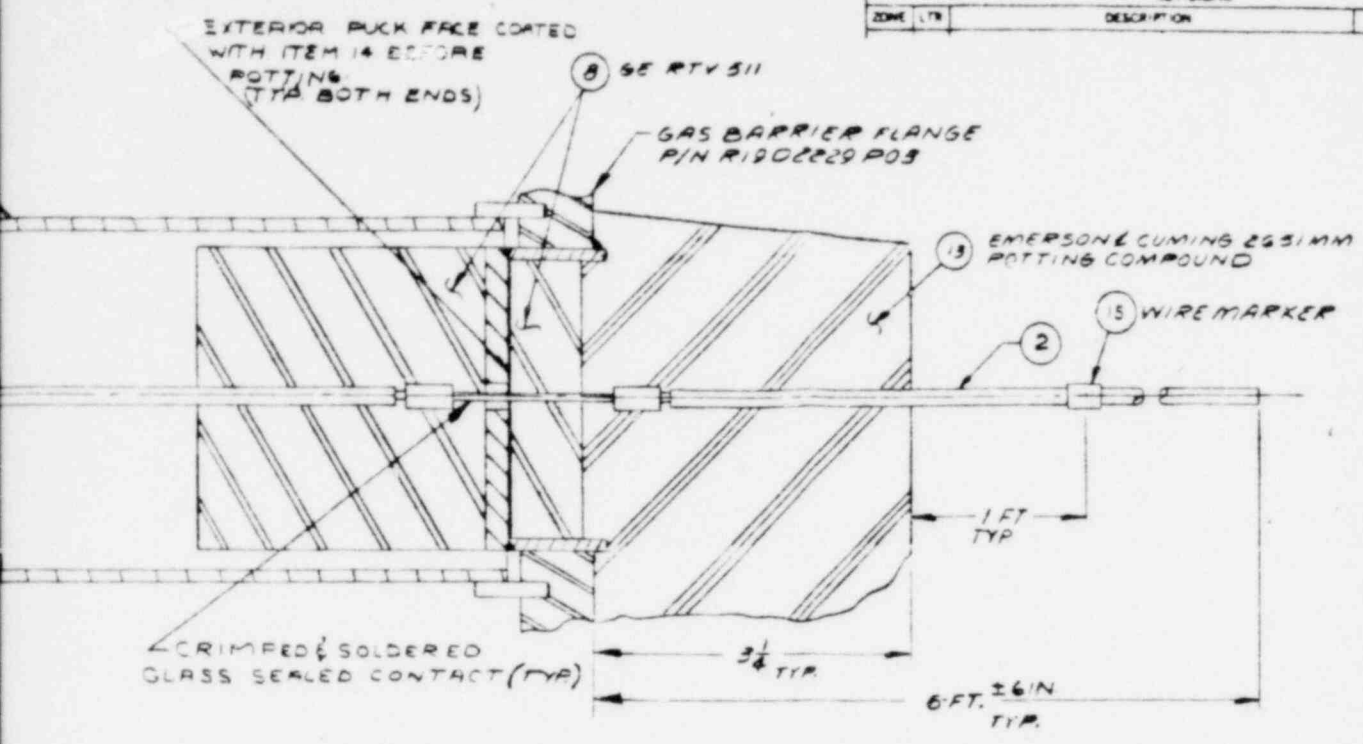


SPLICE FOR NORMAL PLUS POST-ACCIDENT DUTY (FOR INSIDE OF CONTAINMENT SPLICES ONLY)

DETAIL #2

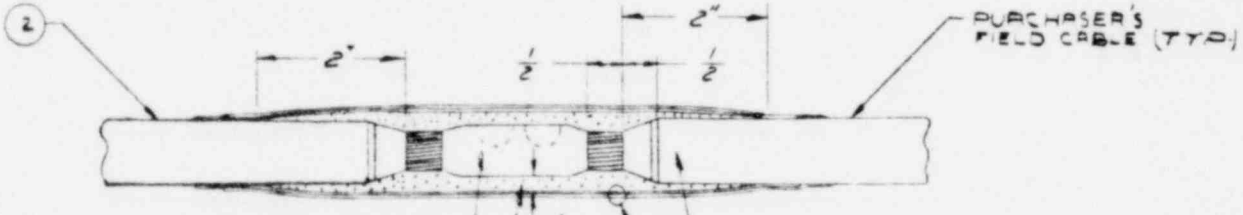
KERITE KIT NUMBER CS-1001

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



OUTSIDE CONTAINMENT

SSY —



1. FILL INDENTS OF CONNECTOR WITH PUTTY OR SPLICING COMPOUND
3. SPLICING COMPOUND TAPE TO INSULATE JOINT AS SHOWN. (6 TO 7 LAYERS, ½ LAPPED, REQUIRED FOR BUILD-UP OVER CONNECTOR)
2. RASP CLEAN ALL BARE INSULATION OR JACKET WITH GARNET CLOTH. APPLY CEMENT AND ALLOW SOLVENT TO EVAPORATE.
4. OUTER COVER OF ONE LAYER FRICTION TAPE. COVERED WITH ONE LAYER OF VINYL ELECTRICAL TAPE.

SPLICE FOR NORMAL NON-ACCIDENT DUTY (BOTH INSIDE AND OUTSIDE OF CONTAINMENT AND FOR POST-ACCIDENT DUTY OUTSIDE OF CONTAINMENT ONLY)

DETAIL "1

KERITE KIT NUMBER S-1133 (FOR NON-ACCIDENT DUTY)
KERITE KIT NUMBER DS-1133 (FOR POST-ACCIDENT DUTY OUTSIDE OF CONTAINMENT)

COMMONWEALTH EDISON CO ZION 1&2	
NEXT ASSY	USED ON
APPLICATION	

MATERIAL / HEAT TREAT / FINISH (SEE SHEET 1)

DRAWN J. Daniels 6/11/71
CHECK R. S. BUTTERS 6/24/71
ENGR E. R. HENAULT 6/30/71
MFG DATE
ISSUED DATE
APPROVED Q1 7/7/71
APPROVED R. Anderson 7/8/71

O. C. O'Brien, Inc.

ELECTRICAL PENETRATOR ASSY. TYPE 3.1 E3.1A 600 VOLT CONTROL SERVICE (NORMAL DUTY PLUS 10% OF COND POST-ACCIDENT DUTY)

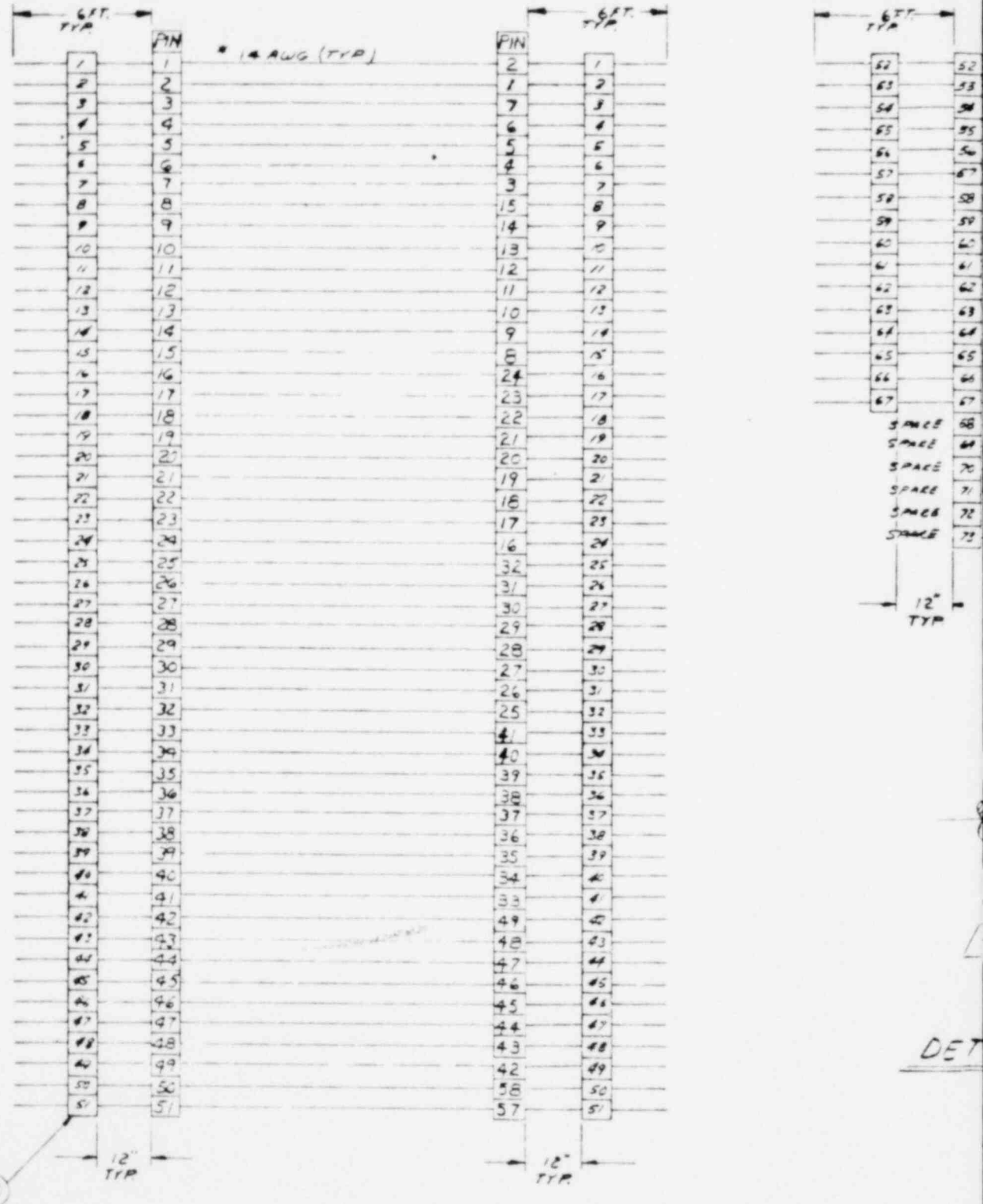
SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D2226G	F

SCALE NONE SHEET 2 OF 3

8 7 6 5

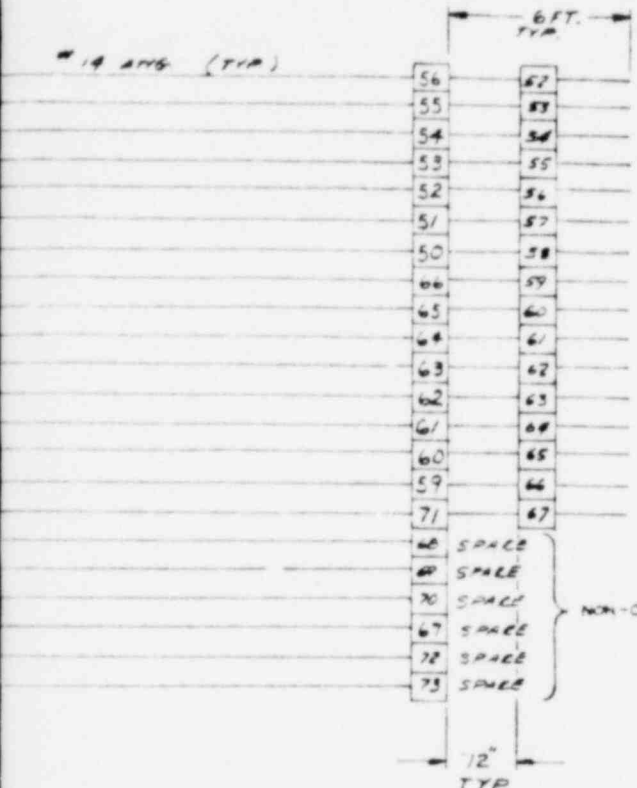
D C B A

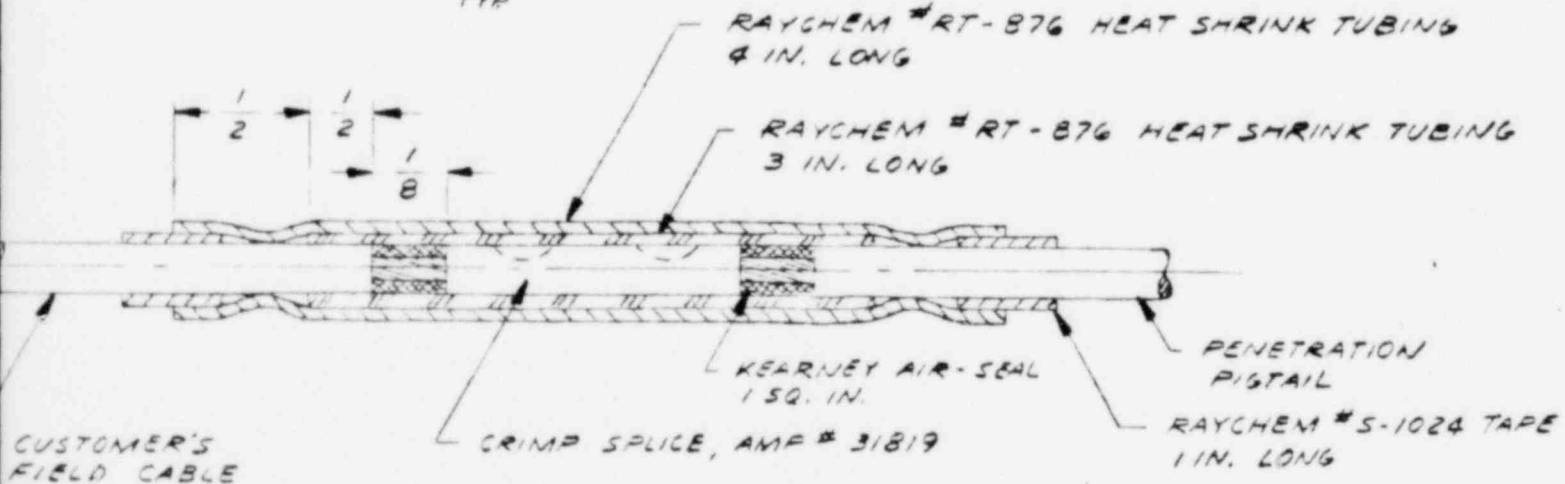
WIRING DIAGRAM (TYP PUCKS #1 THROUGH #6)



DET

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED





AIL #3

SPLICE FOR NORMAL NON-ACCIDENT DUTY (90% OF CONDUCTORS) (FOR INSIDE & OUTSIDE CONTAINMENT SPLICES)

		DRAWN P.SIIRA 6-24-71	D.O.O'Brien, Inc.
		CHKD R.S. SUTTER 6-30-71	ELECTRICAL PENETR. ASS'Y. TYPE 3.1 & 3.1A, 600 VOLT CONTROL SERVICE (NORMAL DUTY PLUS 10% OF COND POST ACCIDENT DUTY
		ENG D.R. HENAULT 6-30-71	
		MFG DATE	
		ISSUED DATE	
		APPROVED 7/1/71	SIZE D | CODE IDENT NO 17476 | DWG NO R19D2226G | REV G
		APPROVED 7/1/71	SCALE NONE | SHEET 3 OF 3
	EDISON CO.	MATERIAL/HEAT TREAT/FINISH SEE ABOVE. SHTS 1 & 2	
NEXT ASSY	USED ON ZION 1&2		
APPLICATION			

3.3.2.9 Equipment Item No. 18
Electrical Penetrations
Located Within and Outside
of Containment
D. G. O'Brien, Types 2.1, 2.2 and 2.3
Submittal Page References 2 and 13

Response:

1. The attached xerox copies of the D. G. O'Brien Instruction Manual No. 1030 for Type 2.2 and 2.2A Electrical Penetrations identify the materials used, including jacket and insulation materials for cable leads.

   The environmental test referenced in Section 4.8 of the Test Report C19QA058 was a saturated steam atmosphere of 46 psig pressure, 273°F temperature for a 48-hour period. Following the environmental test, a leak rate test using helium at approximately 275°F was conducted with specified leak rate being met (reference Section 4.09 of Test Report C19QA058).

   Thermal aging and radiation exposure of the cable leads are covered by Franklin Institute Test Report FC-2737 and the attached letter to Mr. H. K. Stolt from Mr. R. M. Bowman (Kerite Company) dated August 28, 1980.

   We are attempting to obtain copies of the Instruction Manuals for Types 2.1, 2.1A, 2.3 and 2.3A penetrations to be able to indicate the materials used. It should be noted that Types 2.1, 2.1A, 2.3 and 2.3A are not used for safety functions but have been included in the report because they form a part of the containment pressure boundary.

2. We are still attempting to obtain information from the Vendor, D. G. O'Brien, to determine the effects of maximum normal and short circuit loads on the conductors simultaneous with and during a postulated LOCA.

3. We are still attempting to obtain information from the Vendor, D. G. O'Brien, to determine a qualified life.

Instruction Manual (1030)

For

REACTOR CONTAINMENT STRUCTURE

ELECTRICAL PENETRATION ASSEMBLY

TYPES 2.2 AND 2.2A

(Serial Numbers 2.2Z1 - 2.2Z5 AND 2.2AZ1 - 2.2AZ5)

JANUARY, 1972

Prepared For Use On

ZION STATION UNITS I AND II

(Commonwealth Edison Co., Contract 113967)

D. G. O'Brien, Inc.

500 Cochituate Road., Framingham, Mass.

Approved by:

1/27/72

H. P. Hilberg, Engineering Manager
Nuclear Power Plant Systems

INTRODUCTION

The Electrical Penetration Assembly described herein was designed and manufactured by D. G. O'Brien, Inc., Framingham, Mass. for use in the construction of Nuclear Power Plant - Zion Units I and II, Commonwealth Edison Co., Zion, Illinois.

This manual is for use in the installation, test, calibration, and operation of Type 2.2 penetration assemblies. This penetration is designed for low voltage power cable service. Penetration assemblies of Type 2.2 and 2.2A (Zion I and Zion II designations respectively) are identical for both Zion Units.

Information pertaining to other types of penetrations also designed and manufactured by D. G. O'Brien, Inc. for Zion Units I and II can be obtained from other Instruction Manuals. This manual is applicable only to Type 2.2.

Quality Assurance data is included under a separate cover.

This penetration assembly is furnished for use with applicable design data of the following Sargent and Lundy drawings:

ES-42 Typical Electrical Penetration, Physical Requirements, Dated 10/1/69

B-213 Reactor Building Containment, Liner Plate Sections and Details, Sheet Rev. T, Dated 10/3/69

B-214 Reactor Building Containment, Penetration Schedule, Rev. L, Dated 10/3/69

B-216 Reactor Building Containment, Elevation Electrical Penetrations, Rev. G, Dated 10/3/69

The penetration assembly described herein is furnished by D. G. O'Brien, Inc. as part of an ASME, Class B Nuclear Vessel.

The electrical penetrations for Nuclear Generating Power Plants manufactured by D. G. O'Brien, Inc. are engineered to meet the stringent requirements of the electrical power industry and the Atomic Energy Commission. The careful integration of many scientific and technical disciplines has gone into the development of a state-of-the-art product that is reliable, rugged, dependable, efficient, and economical. Careful control of manufacturing processes and materials plus extensive in-process and final testing ensures that the finest product is delivered to the customer.

This manual is prepared to give the customer, in readily available form, the information necessary to efficiently install and maintain the purchased equipment. References throughout this manual to type 2.1 assembly are also applicable to type 2.1A assemblies, unless otherwise specified.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 GENERAL DESCRIPTION

1.1 Low Voltage Power Cable Penetration Assembly (D.G. O'Brien, Inc. Part No. R19D2224G01) herein referred to as the penetration assembly will be used as an interface for passing the Purchaser's low-voltage power cables from outside the containment to inside the containment. As such, it will become a critical portion of the cabling system associated with the reactor nuclear power system.

1.2 The penetration assembly will extend low voltage power from outside the containment to circuits and elements located inside the containment.

1.3 The assemblies are designed and constructed for installation in 12-inch diameter steel pipe containment penetration nozzles that are 3 feet, 6 inches long. Each penetration assembly is identical in basic physical configuration and contains the inside mechanical seal permanently attached. The outside mechanical seal, required for field installation, is furnished separately in the same shipping carton.

1.4 The penetration assembly must be inserted into the containment structure nozzle from inside the containment and is permanently installed by means of field welding at the site. Mechanical supports are necessary to position the assembly during the welding operation.

1.5 Each assembly is designed to restrain loading due to electrodynamic forces or mechanical stressing. Internally, this is achieved, where required, by groups of tubular cable guides extending the full length of the penetration assembly.

1.6 Every penetration assembly is permanently identified by a serial number. Every wire, external to the assembly, is marked at each end with an identification number as specified by the purchaser. Wire numbers in any one cable are not repeated.

1.7 Sealing and Pressurization. The penetration assemblies provide a dual gas barrier by means of steel header flanges and hermetically glass-sealed electrical contacts. Each of the two gas barriers meet the service environmental conditions individually, providing an overall performance safety factor of two. The double-pressure barrier is continued at installation by welding the mechanical seals as required. Both the internal volume of the penetration assembly and that between it and the penetration nozzle may be pressurized through a pressurization port in the outside containment mechanical seal and vent holes in the canister. The canister assemblies are pressurized to 15 PSIG with dry nitrogen prior to shipment. One day prior to installation, the assembly should be uncrated and any gross pressure differential of the penetration assembly in transit and storage may be observed on the pressure gauge that forms part of the assembly. Prior to assembly, the canister must be

pressurized to 54 PSIG and observed for a period of one day. If there is no indication of leakage at the end of this period of time installation procedures should be initiated.

CAUTION

PRIOR TO INSTALLATION, THE PENETRATION ASSEMBLY SHOULD BE DEPRESSURIZED AND THE PRESSURE GAUGE ASSEMBLY AND VENT PORT PLUGS REMOVED. REFER TO SECTION 4.0 OF THIS MANUAL.

1.8 Safety Factors In Production. Pneumatic testing is performed on the prototype and on each production assembly in accordance with the latest revision of Paragraph N-110 in Section III of the ASME Boiler and Pressure Vessel Code and as covered in detail in the Quality Assurance Instruction Data. The allowable leak rate of both penetration gas barriers in series in prototype testing is equal to, or less than, 1×10^{-6} standard cc/sec. of dry helium at 298°F and 54 PSIG. In production, each penetration assembly is subjected to a leak rate test at 54 PSIG and 78°F ±°F and will not exceed 1×10^{-6} standard cc/sec. through both penetration gas barriers in series. Due to controlled production processes, hermetically glass-sealed headers or gas barriers consistently better the leak rate of 1×10^{-6} by two orders of magnitude.

1.9 Cable Description

1.9.1 Internal Cables. All the internal cables and external pigtails on #6 AWG Conductors only are directly terminated to glass-sealed contacts in center connector (puck) welded into the gas barriers. The electrical characteristics of the internal cables are identical to the purchaser's cables within the tolerances allowed.

1.9.2 External Cable Terminations. External cable terminations are made to the pigtail leads on the center puck only. The pucks are a related part of the penetration assembly gas barrier. All cables are soldered on the center puck only. All other contacts in the outer periphery are crimped. They are designed and built to function in accordance with the requirements of the circuits they service. All conductors are insulated from each other and from ground.

1.9.3 The prototype and all production models are tested to the following:

A. Insulation Resistance

1. Test Voltage - 500 VDC

2. Minimum Insulation Resistance

Conductor-to-conductor 1×10^8 ohms-ft.

Conductor-to-ground 1×10^8 ohms-ft.

B. Dielectric Strength:

Prototype:

Conductor-to-conductor 750 MCM 5,000 VAC RMS

Conductor-to-conductor #6 AWG 3,000 VAC RMS

Time: 5 minutes

Production:

Conductor-to-conductor 2,200 VAC RMS

TYPE 2.2 LOW VOLTAGE POWER CABLE PENETRATOR DESIGN PARAMETERS

1.	Number of Conductors:	6 #750 MCM, 1000V rated, 61 Strands, plated copper wire, 7/64" wall of Kerite HTK insulation with a 5/64" wall of Kerite "FR" synthetic rubber jacket
	Plus:	18 #6 AWG, 1000V rated, 7 strands, plated copper wire, 4/64" of Kerite HTK Insulation with a 4/64" wall of Kerite "FR" synthetic rubber jacket.
2.	Material & Size Of Conductors:	750 MCM - 61/.1109" Tin Plated copper wire 6 AWG - 7/.0612" Tin Plated Copper Wire
	Current	750 MCM - 250 AMP 6 AWG - 40 AMP
3.	Conductor Insulating Material	750 MCM - 7/64" Wall of Kerite "HTK" synthetic rubber insulation and 5/64" Wall of Kerite "FR" synthetic rubber jacket 6 AWG - 4/64" wall of Kerite "HTK" synthetic rubber insulation and 4/64" wall of Kerite "FR" synthetic rubber jacket.
	Temperature Rating:	90°C
4.	Provisions for connection of Purchaser's external cable	750 MCM - threaded stud connector #6 AWG - Pigtail leads
5.	High Potential Test On Production Assemblies For One Minute	Conductor-to-conductor 2,200 VAC RMS
6.	Assembly Body Material	10" I.P.S. Sch. 20 Pipe, ASTM, A-333, GR-1, Carbon Steel
7.	End Header Plater Material	ASTM, A240, 304L Stainless Steel
8.	End Header Plate Conductor Material	Copper, Oxygen Free, CDA Type 102 (Hard Temper)
9.	End Header Plate Conductor Insulating Material	9010 Glass

10.	Assembly Dimension: Body Outer Diameter Body Length	 10 3/4" 4' 5 1/4"
11.	Maximum Integrated Radiation Exposure	1.7×10^{8} Rad (1.5 MEV gamma rays)
12.	Maximum Total Assembly	2.24×10^{-5} cc. (Air) Min.
13.	Minimum Insulation Resistance @ 500 VDC:	Conductor-to-conductor 1×10^{8} Ohm-ft. Conductor-to-ground 1×10^{8} Ohm-ft.
14.	Total Assembly Calculated Weight	450 pounds
15.	Shipping Pressurization Test Pressurization	15 PSIG Dry Nitrogen 54 PSIG Dry Nitrogen
16.	Design Current Rating	250 Amperes - 750 MCM 40 Amperes - #6 AWG

6.0 WIRING

The following drawing depicts the wiring diagram electrical connections of the Zion I and II Electrical Penetration, Type 2.2 Low Voltage Power Service for Normal Non-Accident Duty plus Post-Accident Operation on no greater than 10 percent of the conductors.

7.0 TERMINATION INFORMATION

Prior to assembly of any hardware on the penetration assembly, a review of D. G. O'Brien, Inc. Drawing R19D2224G should be made to ascertain layout and sequence for splicing of wires. This drawing also illustrates the location of puck assemblies and electrical connection sequence. The required hardware and material for termination are included in the shipping carton, Kit P/N 115-299.

CAUTION

PRIOR TO ASSEMBLY CHECK PIGTAILS AND POTTING WITHIN PUCKS FOR INDICATIONS OF DAMAGE.

All work should be done in as clean an area as possible, well ventilated, and free from moisture and work hazards.

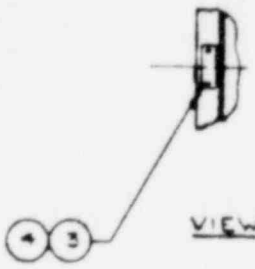
Purchaser's Field Cables shall be prepared as outlined in D. G. O'Brien, Inc. Drawing R19D2224G for termination to Burndy or AMP Wire Splices.

PARTS LIST	D. G. O'Brien, Inc. FRAMINGHAM, MASS.	REV. DATE	P.L. 115-299	REV. LTR. —
TITLE FIELD TERMINATION KIT ZION 2,2	AUTHENTICATION	CHGE. CONT. NO.	CODE IDENT. NO. 17476	SHT 2 OF

ITEM NO.	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD	GROUP QTY. REQD.	IDENTIFYING NO. (DRAWING NO.)	DESCRIPTION	REMARKS
	X					J.O. 62004 Item 2.2 Outside Cont.	
		X				J.O. 62004 Item 2.2 Inside Cont.	
			X				
				X			
01	6	-			QD6534T14	Connector, Stud to Cable Burndy	
02	-	6			QD6540T14	Connector, Stud to Cable Burndy	
03	15	15			YS6C-L	Splice, #6 AWG to 6 AWG Burndy	
					328180	Splice, #6 AWG to 6 AWG AMP	Alternate
04	15	15			YRV6CV10-L	Splice, #6 AWG to 10 AWG - Burndy	
					328182	Splice, #6 AWG to 10 AWG - AMP	Alternate
05	10	-			DS1133	Splice Kit, Kerite	
06	-	2			DS1001	Splice Kit, Kerite	
07	2	-			DS1219	Splice Kit, Kerite	
08	-	2			DS1220	Splice Kit, Kerite	
09	1	1			MY29	Crimp Tool - Burndy	
	1	1			69120-1	Crimp Tool - AMP	Alternate
	1	1			47206	Crimp Head Coupling - AMP	Alternate
	1	1			59220-2	Valve, 3 Way, Multi Directional	Alternate
	1	1			59512-7	Handle Control & Hose Assy.	Alternate
	1	1			69134-1	Die Set - AMP	Alternate
	1	1			69133-1	Die Set-AMP	Alternate

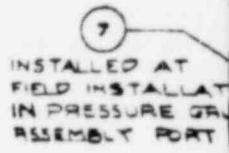
D.G. O'BRIEN, INC. MFD. 1971
MOD. NO. R19F2224601
SER. NO. 22281 THRU 22285
600 V. PWR. 150 AMPS, 3 PHASE

NAMEPLATE DATA
ITEM 3

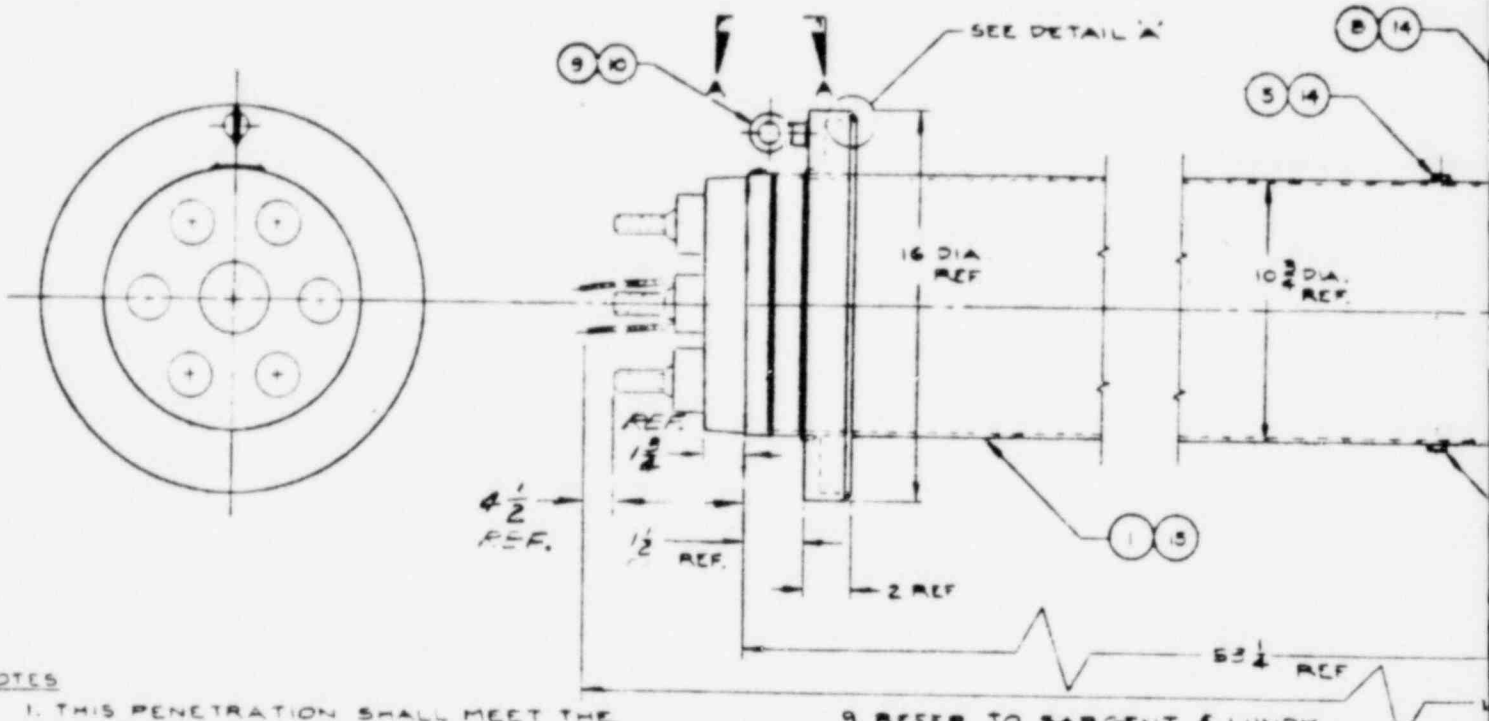


VIEW A-A

DETAIL 'A'



INSTALLED AT
FIELD INSTALLAT
IN PRESSURE JA
ASSEMBLY PORT



NOTES

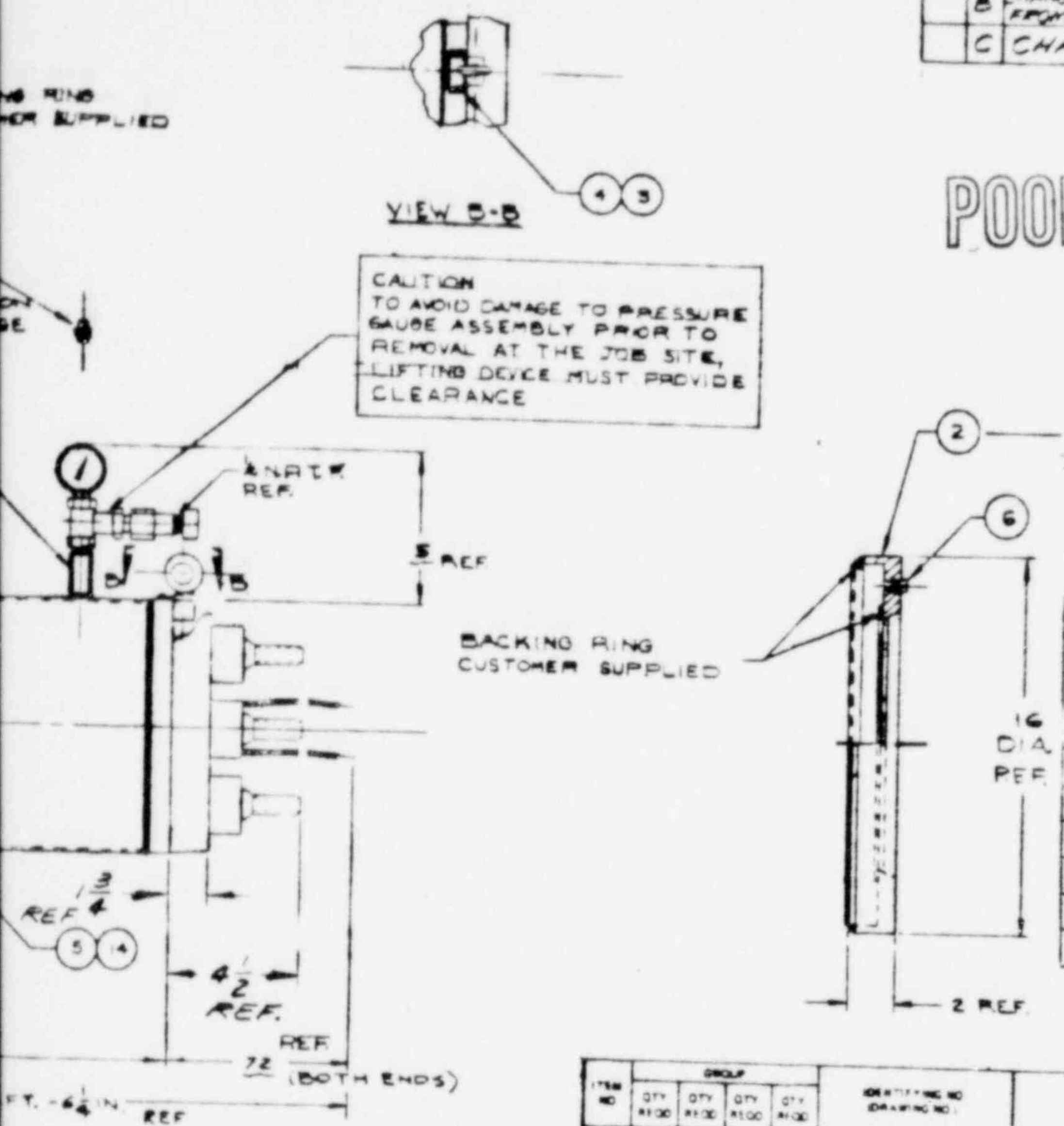
1. THIS PENETRATION SHALL MEET THE REQUIREMENTS OF THE ASME BOILER AND PRESSURE VESSELS CODE, SECTION III, WINTER 1969 ADDENDA, PARA. N-122 FOR AN "APPURTENANCE"
2. DESIGN PRESSURE : 54 PSIG.
3. DESIGN TEMPERATURE : 298°F FOR 1 HOUR FOLLOWED BY 271°F FOR 48 HOURS.
4. MINIMUM DESIGN TEMPERATURE : 30°F
5. DESIGN RADIATION LEVEL : 1.7×10^8 RADS (1.5 MEV. GAMMA RAYS) TOTAL INTEGRATED DOSE
6. RELATIVE HUMIDITY MAX DURING THE 40 YEAR LIFE INSIDE AND OUTSIDE CONTAINMENT 50%
7. PENETRATION SEISMIC TEST : .256'S AT 0 TO 33 HERTZ
8. FOR INSTALLATION WELDING ASSEMBLY, SEE INSTALLATION DRAWING #R19D2476603
9. REFER TO SARGENT & LUNDY SPECIFICATION X-2508 DATED OCT. 1, 1969 INCLUDING ADDENDA 1 & 2 AND DGO QUALITY ASSURANCE METHOD SHEET #QA-TM-133-3 FOR SPECIFIC TEST PRO
10. PROTECTIVE COAT ALL EXTERNAL CARB STEEL SURFACES PER DGO PROC. MA
11. APPROXIMATE WEIGHT 450 LBS.
12. FOR CABLE TERMINATION ITEMS. SEE CU FIELD CABLE TERMINATION PROCEDURE, D
13. USE ONLY "BAKERSEAL" THREAD SEALING ON ALL DRYSEAL PIPE THREAD ASSEMBLIE
14. PENETRATION INTERNAL SHIPPING P 15 PSIG.

4	3	2	1

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO 1185	10 [illegible]	[illegible]
B	CHANGED SHIPPING PRESSURE NOTE FROM [illegible] PSIG TO 15 PSIG/ECO 1267	15 [illegible]	[illegible]
C	CHANGED/ECO 1448	15 [illegible]	[illegible]

POOR ORIGINAL



NAMEPLATE P/N PENET. R19D2361P

PENET.	SERIAL NO.	ZION
P16	2.2Z1	I
P17	2.2Z2	I
P18	2.2Z3	I
P19	2.2Z4	I
P20	2.2Z5	I
P67	2.2AZ1	II
P68	2.2AZ2	II
P69	2.2AZ3	II
P70	2.2AZ4	II
P71	2.2AZ5	II

AMETERS

ON
PC-100 USING ITEM NO 13

TOMER
O. 115-299
OMPOUND
S

RESSURE

ITEM NO	GROUP QTY REQD	QTY REQD	QTY REQD	QTY REQD	IDENTIFYING NO (DRAWING NO.)	DESCRIPTION	REMARKS
1	1				R19P2362010	Canister Weldment Assem.	
2	1				R19P23636-03	Mech. Seal WELDMENT ASSEM.	
3	2				R19D2361P	Nameplate (Zion I & II)	
4	4				PSOOC2A0002	#0 Drive Screws	
5	2				PSOC 300001	1/8" Pipe Plug	
6	1				PSOC 300004	1/4" Pipe Plug	
8	1				R19P2483601	Pressure Gauge Assem.	
9	2				PSOOC2A0029	Eyebolt, Lifting	
10	A/R				PSOOC2H00 3	Washer, 5/16	
14	A/R				[illegible]	Thread Sealing Compound	
15	A/R				No. 1700	Protective Coating (Silicone)	
7	1				PSOC 300008	1/8 PIPE PLUG (WELDABLE)	
13					115-299	CUST. FIELD TERM. KIT	SEE [illegible] 15

R19D2424-3	
29.50N	SEE ABOVE AND PL R19P2224-9
NEXT ASSY	USED ON
APPLICATION	

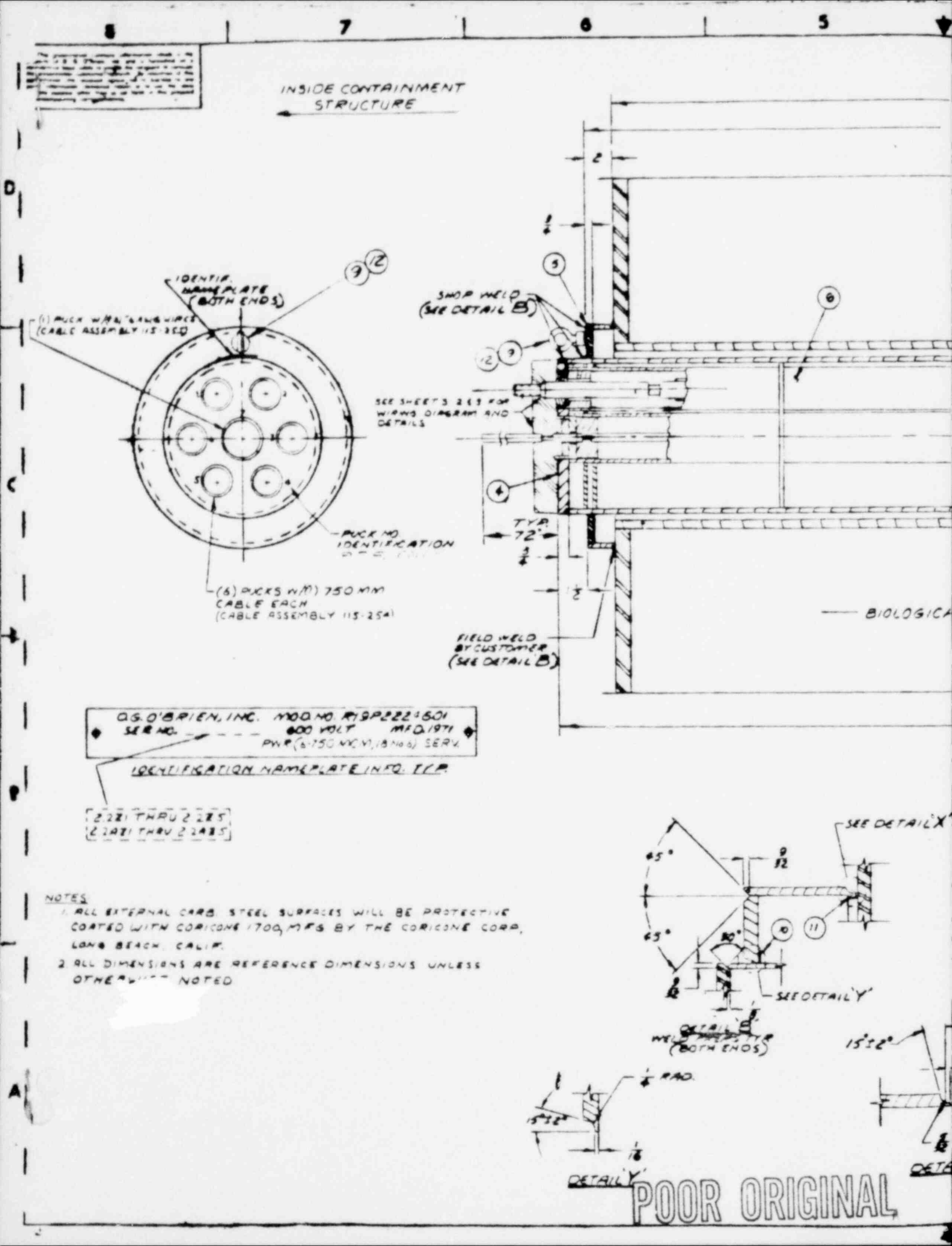
P. RITTERS 7.23.91

D. O. O'Brien, Inc.

PENETRATION ASSEMBLY (ITEM 2.2 & 2.2A)

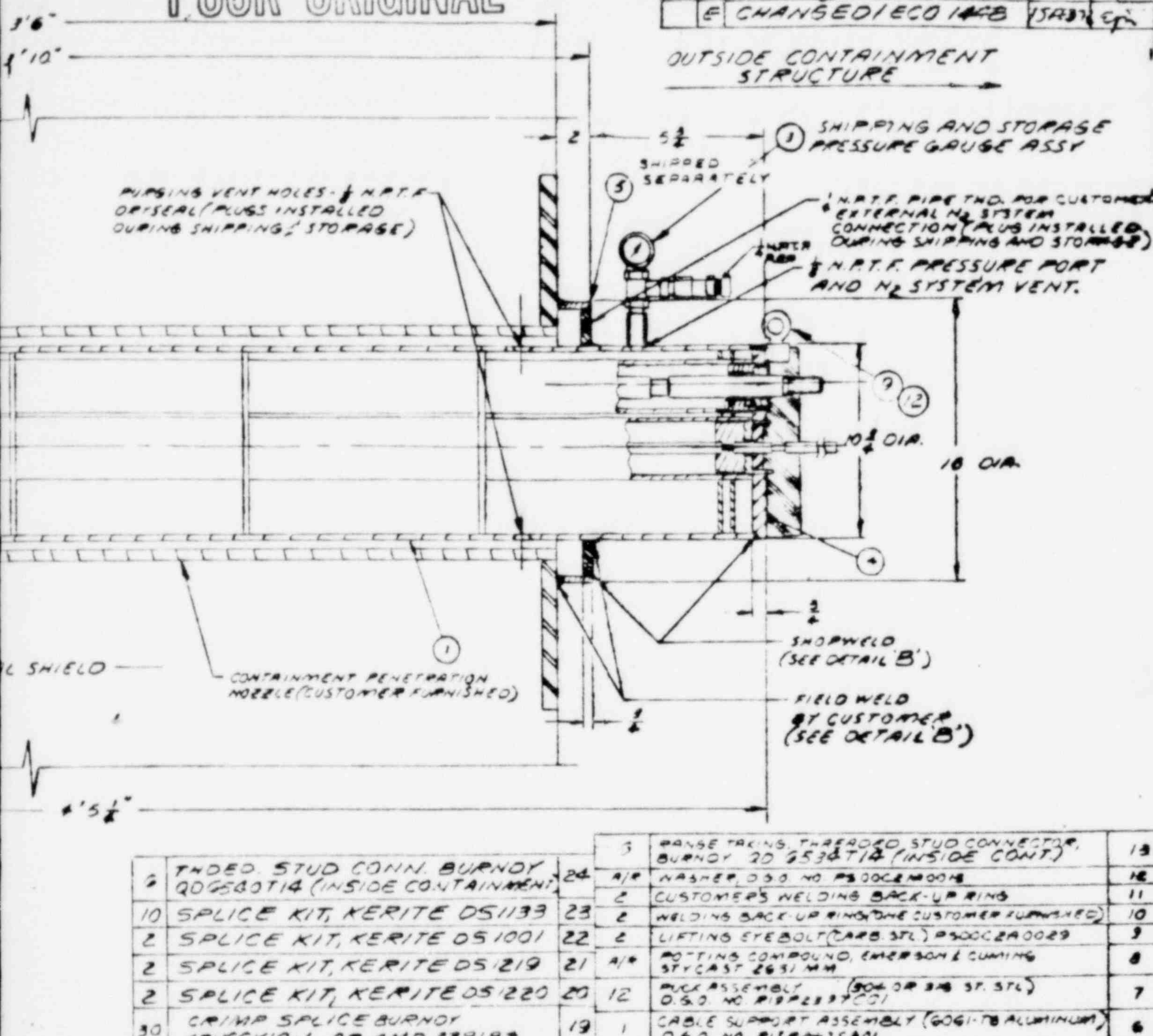
SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D24246	C

SCALE 1:4 SHEET 1 OF 1



POOR ORIGINAL

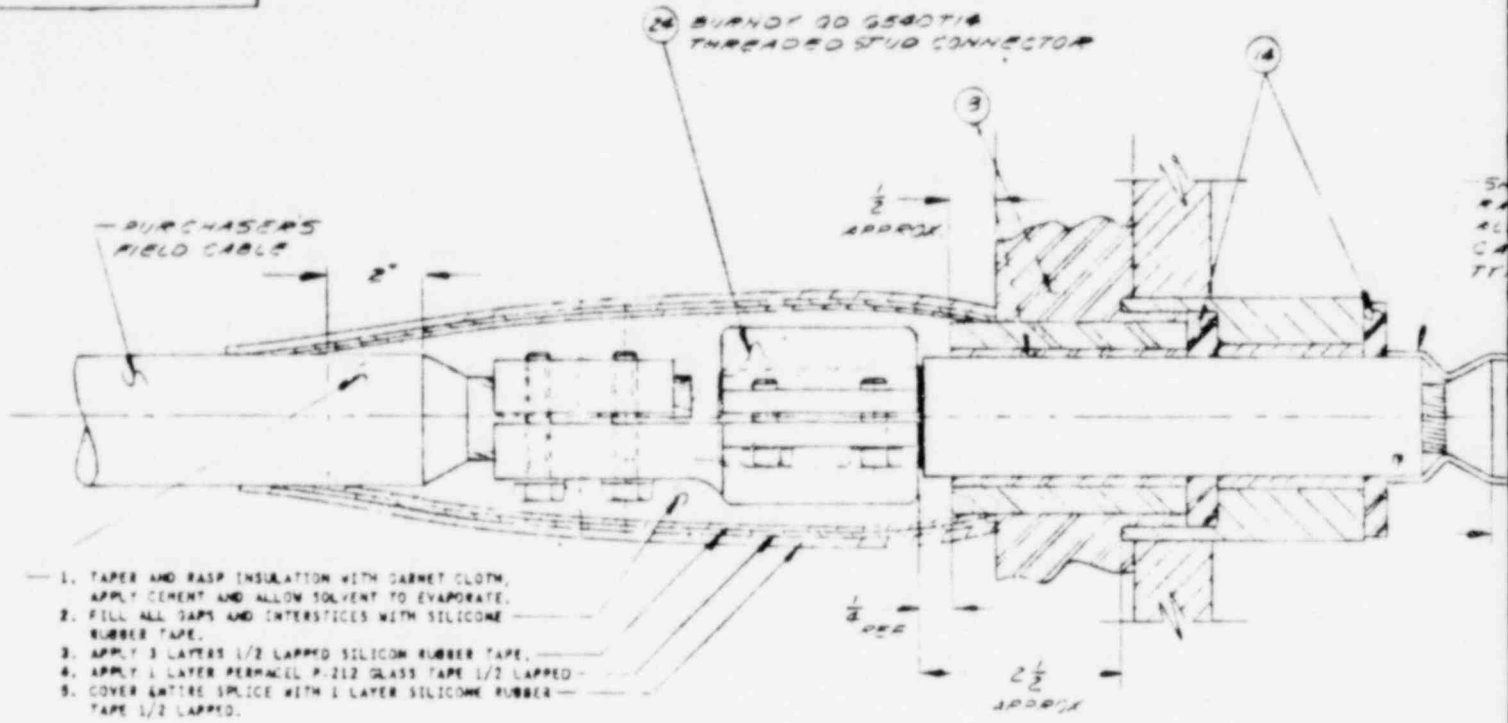
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	REVISED [illegible] ECO 64	7-24-71	[illegible]
	E	CHANGED / ECO 1468	15A37	[illegible]



QTY	DESCRIPTION	ITEM
2	THDED. STUD CONN. BURNDY QQG5GOT14 (INSIDE CONTAINMENT)	24
10	SPLICE KIT, KERITE DS1133	23
2	SPLICE KIT, KERITE DS1001	22
2	SPLICE KIT, KERITE DS1219	21
2	SPLICE KIT, KERITE DS1220	20
30	CRIMP SPLICE BURNDY YRVGCV10-L OR AMP 328182	19
A/R	MARKING TAPE, SCOTCH ELECTRICAL TAPE X-1249, 3M Co.	18
30	CRIMP SPLICE, BURNDY Y36C OR AMP 3[illegible]30 (SHIPPED LOOSE) (FOR NO. 6 AWG)	17
301 FT.	#6 AWG 600 V. CABLE, 7 STRAND W/ 2/64 HTK INS. & 4/64 FR JACKET (KERITE)	16
2	PUCK ASSEMBLY 304 OR 316 ST. STL. OGO No. R19P2406G02	15
A/R	POTTING COMPOUND GE RTV 511	14

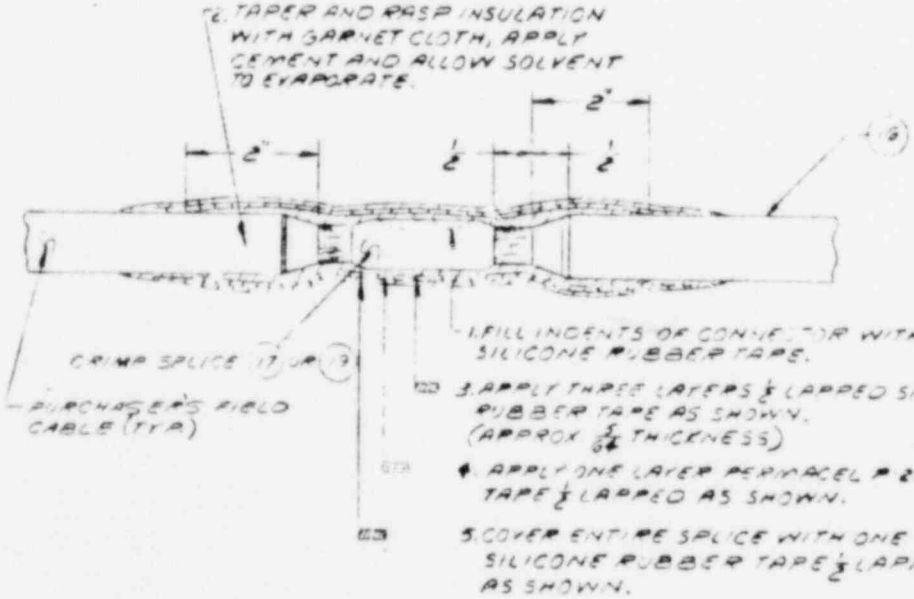
QTY.	DESCRIPTION	ITEM
3	RANGE TAKING, THREADED STUD CONNECTOR, BURNDY 2D G534T14 (INSIDE CONT.)	13
A/R	WASHER, OGO NO. P300C2M00[illegible]	12
2	CUSTOMER'S WELDING BACK-UP RING	11
2	WELDING BACK-UP RING (ONE CUSTOMER FURNISHED)	10
2	LIFTING EYEBOLT (CARB. STL.) P300C2A0029	9
A/R	POTTING COMPOUND, EMERSON & CUMING STYCAST 2651 MM	8
12	PUCK ASSEMBLY (304 OR 316 ST. STL.) O.G.O. NO. R19P2397G01	7
1	CABLE SUPPORT ASSEMBLY (6061-T6 ALUMINUM) O.G.O. NO. R19P2415G01	6
2	MECH SEAL ASSY (333, GR1 & 442, GR50 CARB. STL.)	5
2	GAS BARRIER (304 L STAINLESS STEEL PER ASTM A-240)	4
1	SHIPPING AND STORAGE PRESSURE GAUGE ASSY. O.G.O. #R19P0628G01	3
29 FT.	NO. 750 MCM 600 VOLT CABLE 61 STRAND W/7/64 HTK INS. & 5/64 FR JACKET (KERITE)	2
1	PENETRATION ASSEMBLY CANISTER 10" IPS. SCHED. 20 (333, GR1 CARBON STEEL)	1

R19D2424G	MATERIAL (SEE ABOVE)	MPE 7-23-71	D. G. O'Brien, Inc.	
COMMONWEALTH EDISON CO. ZION 1 & 2		E+ 7-23-71	ELECTRICAL PENETRATION ASSY TYPE 2.2 & 2.2A 600 VOLT POWER (6-750 MCM 18 No. 6) SERVICE (NORMAL PLUS POST ACCIDENT DUTY)	
NEXT ASSY / USED ON		M.S. BUTTERS 7-23-71		
APPLICATION		[signature] 7/23/71	D 17476 R19D2224G	E
		R. [signature] 7/6/71	SCALE NONE	SHEET 1 OF 3



750 MCM TERMINATION FOR NORMAL PLUS POST-ACCIDENT DUTY
(INSIDE CONTAINMENT SPLICES ONLY)

USE KERITE KIT
DS-1219 WHICH INCLUDES
SUFFICIENT MATERIAL FOR
3 TERMINATIONS



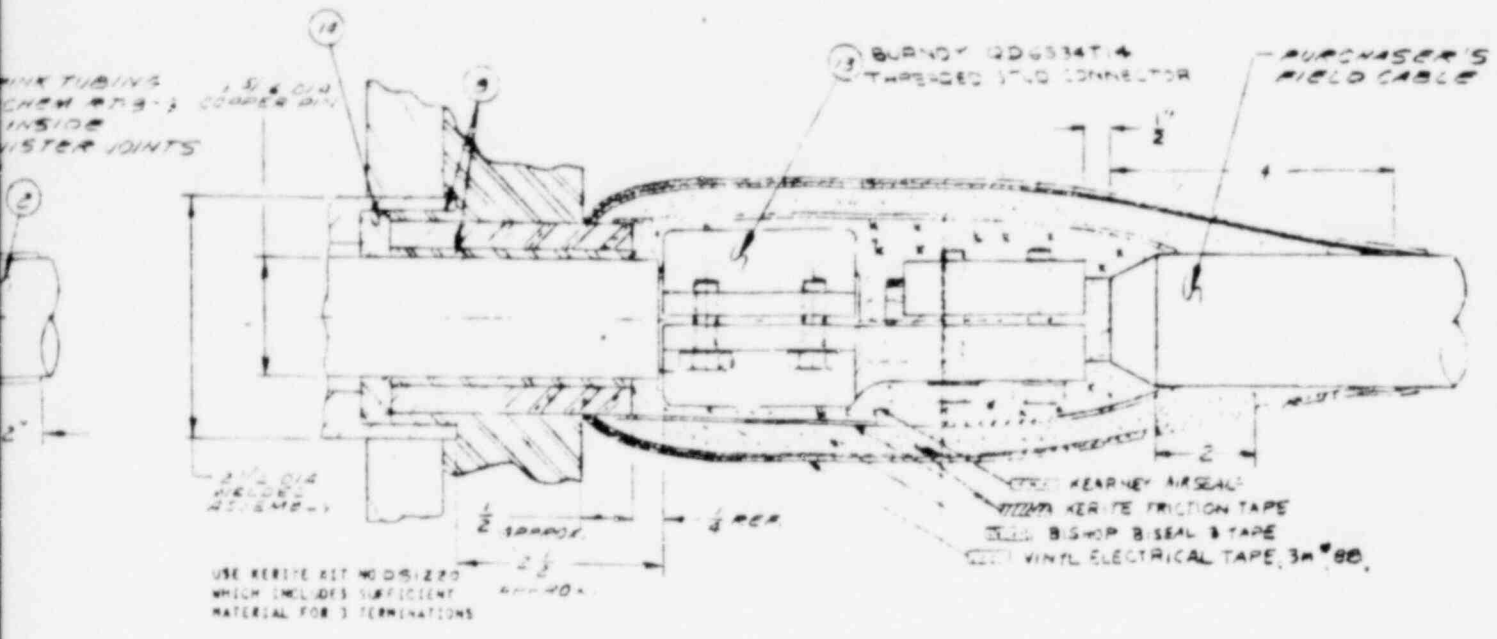
SPLICE FOR NORMAL PLUS POST-ACCIDENT DUTY (FOR INSIDE OF CONTAINMENT SPLICES ONLY)

KERITE KIT NUMBER DS-1001

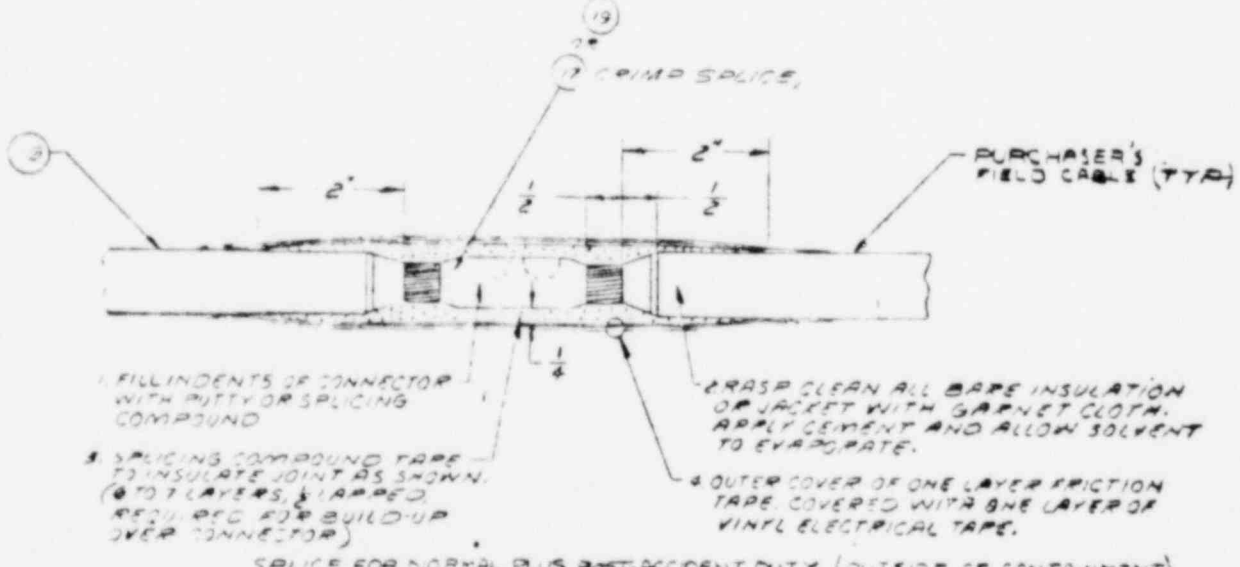
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

PROCEDURE:

1. RASP JACKET FOR 2" BACK FROM TAPER, APPLY BISHOP 55-C ADHESIVE
2. FILL ALL GAPS AND INTERSTICES WITH KEARNEY AIRSEAL.
3. APPLY ONE LAYER OF FRICTION TAPE, HALF-LAPPED.
4. APPLY FOUR LAYERS OF BISEAL 3 TAPE, HALF-LAPPED, TO FORM A SMOOTH, TAPERED SEAL.
5. APPLY OUTER COVER OF ONE LAYER OF FRICTION TAPE, HALF-LAPPED AND ONE LAYER VINYL ELECTRICAL TAPE, HALF-LAPPED.



750 MCM TERMINATION FOR NORMAL PLUS POST-ACCIDENT DUTY
(OUTSIDE CONTAINMENT SPLICES ONLY)



SPLICE FOR NORMAL PLUS POST-ACCIDENT DUTY (OUTSIDE OF CONTAINMENT SPLICES ONLY)

KERITE KIT NUMBER DS-1133

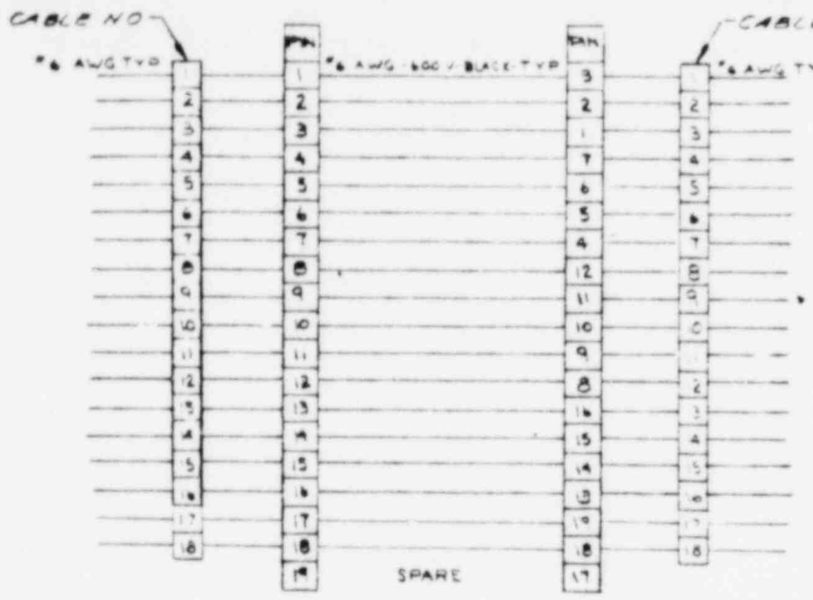
			DRAWN DANIELS 2-7-72	O'Brien, Inc.
	R19022246		CHKD	ELECTRICAL PENETRATION ASSY 225, 224 600V PWR SERVICE (6-750 MCM, 18 NO 6) NORMAL PLUS POST-ACCIDENT DUTY
	COMMONWEALTH EDISON	MATERIAL/HEAT TREAT/FINISH SEE ABOVE & SH 1 & 3	ENGR	
	BIONICS		MFG	
NEXT ASSY	USED ON		ISSUED	
APPLICATION			APPROVED	SIZE D, CODE IDENT NO 17476, DWG NO R19022246, REV E
				SCALE NONE, SHEET 2 OF 3

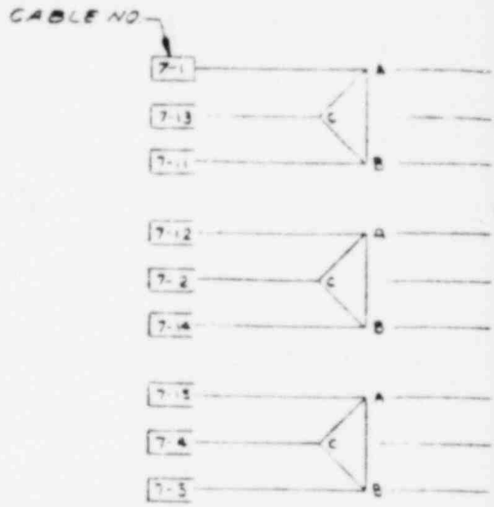
8 | 7 | 6 | 5

PUCK & CABLE ASSEMBLY NO. " ONLY
(REF 115-257) SEE BELOW FOR DETAIL

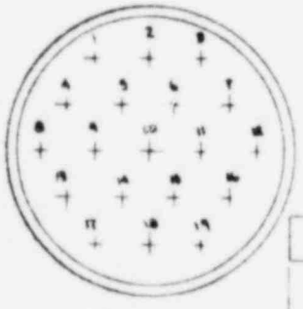
PHASING
PUCK - CUND - CODE (PUCK 7 ON

INSIDE CONTAINMENT | INSIDE CANISTER | AIR ANNULUS

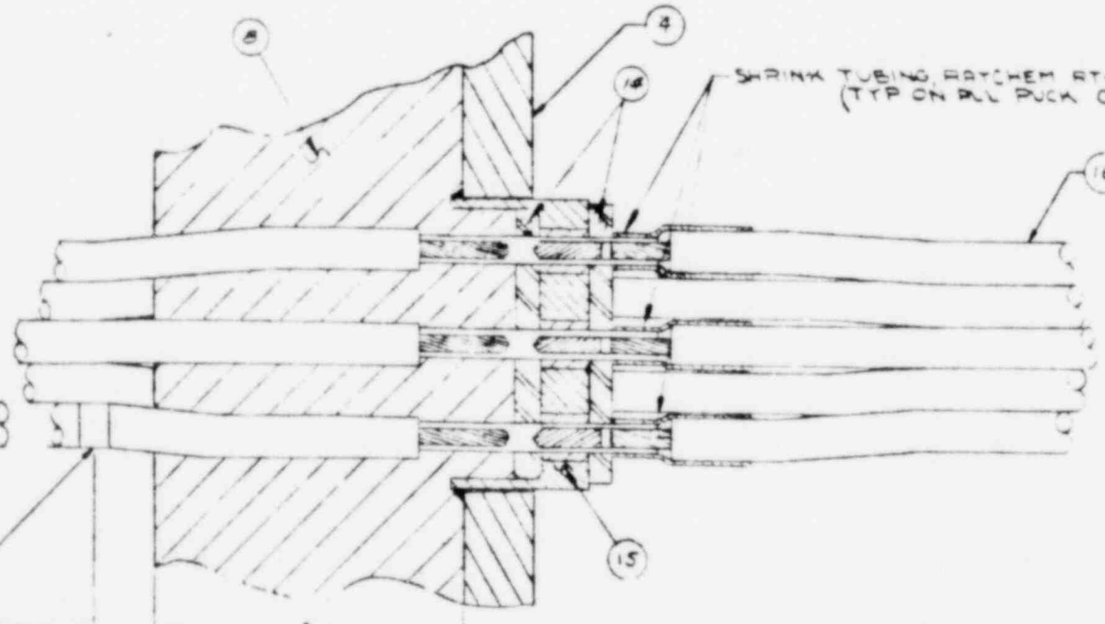




NOTE:
CUSTOMER MUST TERMIN
THAT EACH PHASE OF EVERY
TO MINIMIZE MECHANICAL FO
SEE PHASING DIAGRAMS FOR



"C" PUCK
19 PIN ASSEMBLY



WARE MARKER TAPE (18)
SCOTCH TAPE X-1244 MADE
PER DGD PROCEDURE
MP-MK-1BA
(SEE SHEET 1 NOTE 3)

1 FT TYP
BOTH ENDS

1 1/2 REF

6 FT ± 6 IN
PIGTAILS

INSIDE CANIS

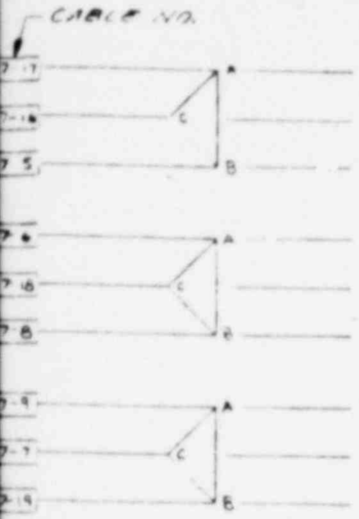
INSIDE CONTAINMENT

POOR ORIGINAL

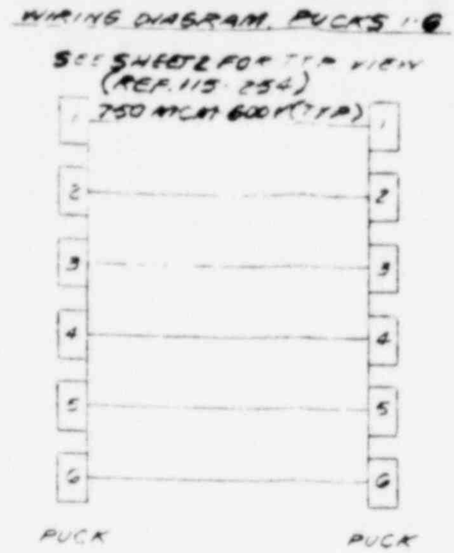
4 3 2 1

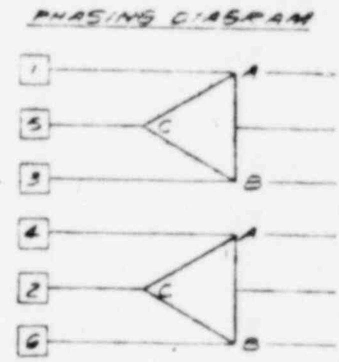
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

DIAGRAM

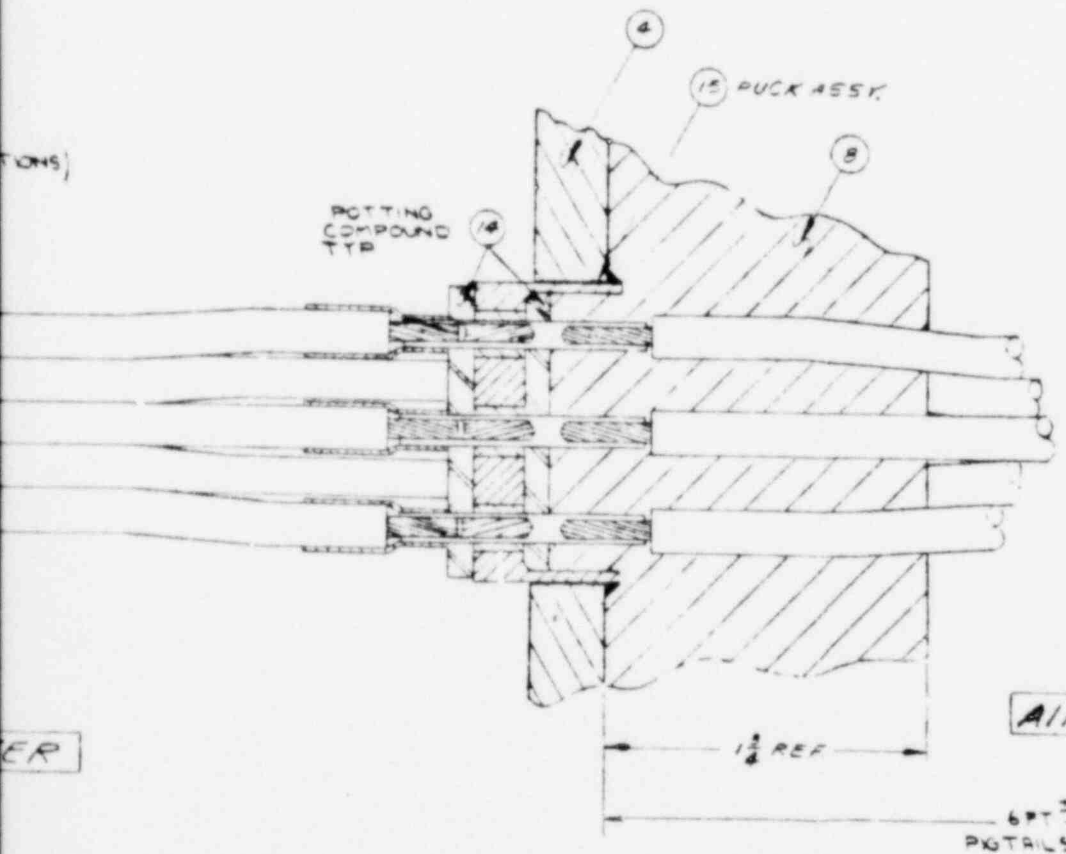


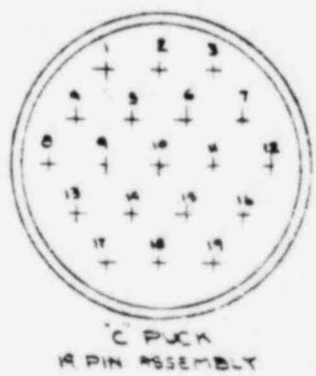
ATE FIELD CABLES SUCH
PHASE CIRCUIT IS LOCATED
CES DUE TO FAULT CONDITIONS
PREFERRED LOCATIONS.





TIONS)





	R19D2424G	MATERIAL HEAT TREAT FINISH	DRAWN MDF 7-22-71; CHKD 7-26-71; ENGR P R HENAULT 7-23-71; ISSUED; APPROVED	D. O. O'Brien, Inc. — ELECTRICAL PENETRATION ASSY. TYPE 22 & 224 600 VOLT POWER (6-750 MCM, 18 No. 6) SERVICE (NORMAL PLUS POST-ACCIDENT DUTY)
	COMMONWEALTH EDISON CO.			SIZE D; CODE IDENT NO. 17476; DWG NO. R19D2224G; REV E
	ZION 1 & 2			SCALE; SHEET 3 OF 3
NEXT ASSY	USED ON			
APPLICATION				

POOR ORIGINAL

3.3.2.10 Equipment Item No. 24
Instrument and Thermocouple
Cables Located Within
Containment
Boston Insulated Wire and Cable Co.
Submittal Page References 4, 5 and 11

Response:

a) Reference 4, Pages 12 and 13 clearly indicate that the cables tested were single pair #16 AWG Instrument Cable with Bostrad^{7} and Bostrad^{75} insulation and jacket. Bostrad^{7} and Bostrad^{75} are BIW tradenames for Hypalon insulating material. The Bills of Material, Items A-104 and A-105 clearly indicate the cables purchased from BIW as being insulated with Hypalon and having Hypalon jackets. While the jacket material of each test specimen was not clearly indicated, the statement is made that both Hypalon and PVC jackets are compounded to meet the test requirements of Section VI and VII of Report B901.

Adequate records exist and are available at Zion Station to provide complete traceability for the cable manufactured by BIW and subsequently installed at Zion Station. These records consist of shipment invoices from BIW referencing specific cable reels, BIW Part Numbers, Test Reports for each cable reel referencing cable type (conductor, insulation, jacket material) and cable pull cords referencing individual cables pulled from specific cable reels.

b) Information addressing thermal aging of the specified cable has been requested from BIW. The effects of radiation exposure are addressed in Report B901.

Franklin Research Center indicated in the August 27, 1980 meeting at Bethesda that electrical loading of the instrument cables was not a concern.

Information on the combined effects of preaging and radiation exposure has been requested from BIW.

c) BIW has also been requested to address the subject of how the test specimens would react if subjected to gamma irradiation, simulated-LOCA steam environment and chemical spray (submergence).

3.3.2.11 Equipment Items No. 25 and 28
Cables Located Within Containment
Kerite Corporation (Various Types)
(Licensee references 8 and 11)

1. Insufficient evidence has been presented to identify the tested cables as identical in materials or construction to any of those installed. The Guidelines require that the test specimens must be the same as the equipment being qualified. The licensee did not present an analysis comparing the impact of deviations between the test specimen's specific design features, materials, and production procedure to those of the installed equipment. Therefore, an independent conclusion can not be reached regarding the extent to which there is similarity. Hence, the validity of the test as evidence of qualification has not been established.

   Response

   The attached letter to H.K. Stolt from R.M. Bowman (Kerite Co.) dated August 28, 1980 states that all of the cable supplied to Zion Station was fabricated using the same insulation and the same jacketing materials and further that these were the same compounds which are covered by the Franklin Institute Test Report FC-2737.

   The only difference between the Zion cable and those tested is that there are cables at Zion which have different numbers of conductors, the size of the conductors are different for the various size cables and the insulation and jacket thicknesses are different depending on the size of the cable.

   Since all the Kerite cable at Zion, medium and low voltage power and control cable, is of the same family and the cable insulation and jacket materials are the same as those tested in Report FC-2737, this test report documents qualification for all the Kerite cable at Zion.

2. The absence of preaging prior to testing together with the identification of the material as subject to thermal degradation requires that a period of qualified life be established. The licensee should provide such analysis.

   Response

   The attached letter from R.M. Bowman (Kerite Co.) to H.K. Stolt dated August 28, 1980 states that samples B and D as listed in Report FC-2737 were thermally preaged. The report also identifies samples B and D as having been thermally preaged, but it does not state the parameters.

3. The test conditions of steam pressure do not fully envelop the licensee's design test conditions; the design conditions call for 60 psig steam for the first 2.8 hours and 20 psig steam for the next 22.2 hours. However, the test pressure exceeded the predicted conditions, and the test duration with the most severe conditions exceeded the test design by a factor of 4.7. Hence, this deviation is judged acceptable.

   Response

   Item 3 has been found acceptable by the FRC review team.

4. The Guidelines require that equipment located within containment and subject to submergence be qualified with actual submergence during testing. The licensee should provide evidence of submergence testing for those installed cables which are subject to it.

   Response

   We are still attempting to obtain information from the Vendor, Kerite Company, to determine if the cables were tested for submergence.

Suite 2005
122 South Michigan Avenue
Chicago, Illinois 60603
312-939-2250

the kerite company

August 28, 1980

Mr. H. Stolt
Station Nuclear Engineering Department
Commonwealth Edison Company
P O Box 767
Chicago, Illinois 60690

Re: Zion Nuclear Generating Station

Dear Mr. Stolt:

Confirming our several recent telephone conversations, we have looked into the matter of whether or not the samples covered by Franklin Institute Report FC-2737 were preaged.

We have found that the samples identified as Samples B and D were preaged at 150°C in a circulating hot air oven for 168 hours prior to radiation exposure.

These cable samples were described as follows:

B- 1/C #6 - 5/64 HTK (N-98) 3/64 FR (HC-711)

D- 2/C #12 - 3/64 FR (HI-70) 4/64 FR (HC-711)

The compounds identified by numbers above are those compounds used in all cables supplied by Kerite to the Zion Station, and are in fact, the identical compounds being used by Kerite today.

We hope the above information will be helpful.

Sincerely,

Robert M. Bowman
Regional Engineer

3.3.2.12 Equipment Item No. 26
BIW Cable Splices Located
Within Containment
Raychem Corporation
Submittal Page References 1 and 2

Response:

1. Section 1.1, Page 1 of Report ER272 identifies the materials of the D. G. O'Brien splice kits used for terminating instrumentation cables at Zion Station. D. G. O'Brien Drawing R19D2227G, Sheet 4 of 4, Revision H identifies these same materials as being used for splicing the instrument cables. This drawing plus other reference documents are enclosed as an attachment to our response to TER Item 3.3.2.7.

2. Information has been requested of the Vendor, D. G. O'Brien, to address the concern over aging and submergence.

3.3.2.13 Equipment Item No. 27
Kerite Corporation Cable Splices
Located Within Containment
Kerite Corporation
Submittal Page Reference 8

Response:

1. The splice kits (Kerite Splice Kit DS-1001) used for 600 Volt Control Service are shown on D. G. O'Brien Drawing R19D2226G, Sheet 2, Revision F (see attachment to our response to TER Item 3.3.2.8).

   The splice kits (Kerite Splice Kits DS-1001) used for 600 Volt Power Service are shown on D. G. O'Brien Drawing R19D2224G, Sheet 2, Revision E (see attachment to our response to TER Item 3.3.2.9).

2. Report F-C2737, Page 14 indicates that samples B and D were preaged but did not indicate the parameters. The letter from R. M. Bowman (Kerite Co.) to H. K. Stolt dated August 28, 1980 (see attachment to our response to TER Item 3.3.2.11) indicates that the samples were preaged at 150°C for 168 hours prior to radiation exposure.

4. We do not expect the Electrical Penetration, where the installed splices are located, to be subject to submergence due to their location. The postulated flooding of the containment will remain approximately 40+ feet below the penetrations, therefore submergence testing is not applicable.

3.3.2.14 Electric Motor Valve Actuator Located in the Auxiliary Building (A-8)

Submittal page references: 24, 26, 31, 32

References: 10, 14

Valve ID numbers:

MOV-FW0050 thru 57	(Aux. FW throttle valves)
MOV-FW0074 thru 76	(Isolation between condensate FW supply and Essential SW supply to aux. FW Pumps)
MOV-SW0100	
MOV-SW0115	
MOV-SW0101 thru 107	(Aux. FW Pump Isclation from Essential Service Water)

Response:

Valves MOV-FW0050 through MOV-FW0057 were incorrectly referenced here and will be addressed in response to item 3.3.2.19. The remaining valves are not required to operate after a high energy line break in the auxiliary building. This is the only accident in which the valves would see a harsh environment.

No qualification is necessary.

3.3.2.15 Electronic Transmitter Located at Zone A8
Submittal Page Reference 41
Qual. Reference 9, 20, 21

FT-FW03

Aux. FW Flow (Model 10B2495)

Response:

After a LOCA or MS/FW line break in the containment, this transmitter is located in a non-harsh area. Therefore, qualification is by experience. After a high energy line break in the auxiliary building (HELB), this transmitter is located in a harsh area. However, there are three other aux. FW flow transmitters which remain in non-harsh environments after the HELB. These transmitters measure auxiliary FW flow to the other three steam generators. Decay heat load can be handled by two steam generators only. Therefore, only two of the remaining three transmitters in non-harsh environments are required to operate to safely shut down the plant after the HELB in the auxiliary building. Qualification is by experience.

3.3.2.16 Equipment Item No. 37
Remote Shutdown Control
Panels Located in the
Auxiliary Building (A-8)
Fischbach-Hatfield Contractor
Submittal Page Reference 16

Response:

a) The materials used in the construction of the Remote Shutdown Panels (1LP57, 1LP58, 1LP59, 1LP60, 2LP57, 2LP58, 2LP59 and 2LP60) are listed on electrical drawings 22E-1-4626, 22E-1-4629, 22E-2-4628, and 22E-2-4629. We have enclosed copies of these drawings for your reference and have also prepared the attached table which compares the equipment tested with the equipment installed on the panels.

b) These panels are normally not subjected to a harsh environment when they may be used if the control room becomes inhabitable. If a HELB occurs in the Auxiliary Building, subjecting these panels to a harsh environment, the panels will not be used.

3.3.2.17 Electric Motor Valve Actuator Located in the Auxiliary Building (A-9)

Submittal Page References 1, 18

References: 10, 14

Item 39A Valve ID Numbers: MOV-SI8809A, B (To RC loop cold leg from RHR Heat Exchanger)

Note: Item 39A is in Zone A12, not A9.

Response:

These valves are only required to function after a LOCA or MS/FW line break in containment. The only potentially harsh environment is radiation. Qualification for radiation has been provided (see generic reply on Limitorque operator attached to these responses). All other parameters remain non-harsh. Qualification is by experience for these parameters.

Item 39B Valve ID Numbers: MOV-VC-LCV112B, C (to charging pumps from volume control tank)

Response:

These valves located in the auxiliary building are required to close upon safety injection initiation after a LOCA or MS/FW line break in containment. These valves are not required to operate (i.e., close) after a high energy line break in the auxiliary building. These valves are located in a non-harsh area during the period that they are required to operate (LOCA and MS/FW line break in containment). Therefore, qualification is by experience.

3.3.2.18 Electronic Transmitter Located at A9
Submittal Page Reference 49
Qual. Reference 9, 20, 21

PT PP16	PT PP18
PT PP17	PT PP19

PP Pressure (Model 50EP1017)

Response:

These transmitters are located in a non-harsh area during the period that they are required to operate (LOCA and MS/FW line break inside of containment). Therefore, qualification is by experience.

3.3.2.19 Electric Motor Valve Actuator Located in the Auxiliary Building (A-12)

Submittal Page References: 2-5, 7, 12, 13, 19-21, 27, 28

References: 10, 14

Valve ID Numbers:

1. MOV-SI8801A, B
   MOV-SI8802
   MOV-SI8803A, B
   MOV-SI9011A, B
   MOV-SI8814
   MOV-SI8813
   MOV-RH9000
   MOV-CC9413A, B
   MOV-CC9438
   MOV-CC685
   MOV-VC8105
   MOV-VC8106
   MOV-FW0016
   MOV-FW0017
   MOV-FW0018
   MOV-FW0019
   MOV-VC8100
   MOV-CC9414
   MOV-CC9412A, B

2. MOV-VC-LCV112D, E (from RWST to charging pumps)

3. MOV-VC8105 (containment isolation
   MOV-VC8106 valves)
   MOV-VC8100

4. MOV-FW0050 (aux. FW throttle valves)
   MOV-FW0051 (aux. FW throttle valves)
   MOV-FW0052 (aux. FW throttle valves)
   MOV-FW0053 (aux. FW throttle valves)
   MOV-FW0054 (aux. FW throttle valves)
   MOV-FW0055 (aux. FW throttle valves)
   MOV-FW0056 (aux. FW throttle valves)
   MOV-FW0057 (aux. FW throttle valves)

Note: Valves MOV-CC9412 A, B are in non-harsh zone A15, not A12.

Response:

Category 1

These valves are required to operate in the event of a LOCA or MS/FW line break in containment. Valves MOV-SI8802, SI9011 A&B, and RH9000 are required long-term after the accident - the remaining valves are only required for short-term operation. For a LOCA the only harsh parameter is radiation. Qualification for radiation is provided (see generic reply on Limitorque operators attached to these responses). All other environmental parameters remain

3.3.2.19 cont'd

nonharsh. Qualification is by experience. Limitorque Report B0058 provides documentation concerning applicability of an SMB-0 test to the whole family of actuators.

Category 2

These valves, which are required for medium term operation after LOCA or MS/FW line break, were incorrectly located in Zone A12. Their actual location is in Zone A11. This is a nonharsh zone and therefore qualification is by experience.

Category 3

These ID numbers were duplicated in the VC system and have now been deleted from the system. Refer to Category I for their response.

Category 4

These valves are required only for design basis MS/FW line break. For this accident Zone A12 is nonharsh. In both the LOCA in containment and the HELB outside of containment, the valves do not have to change position. The valves are normally in the required throttled position to provide adequate auxiliary FW flow to the steam generators and consequently to allow safe shutdown of the plant.

3.3.2.20 Solenoid Operated Valve

Submittal Page References: 6, 8-11, 14

References: 18, 19

ID numbers: Containment Isolation Valves
(Please refer to the report for their listing)

Response:

These valves are all used for containment isolation following a LOCA or MS/FW line break in containment. After a LOCA the only harsh parameter in Zone A12 is radiation. These valves are required to operate immediately after the LOCA (short-term) before any degradation due to radiation could occur. The Licensee has replaced or will replace all the internal parts in the solenoid with those which are contained in the qualified NP-1 series. The replaced internal parts will now consist of high temperature/ radiation resistant material. Documentation on the ASCO list will be presented at a later date. This ASCO kit prevents the problem of the stem sticking in the valve and holding the valve open.

Once the valve is closed for containment isolation, it does not have to remain functional since it will not be required to reopen.

3.3.2.21 Motor Valve Actuator Located in the Auxiliary Building (A-14)

Submittal Page Reference: 17

Licensee References: 10, 14

Valve ID Numbers: MOV-VC8110) To seal water heat exchanger
MOV-VC8111) from charging pumps

Response:

These valves are required to function during accidents inside containment. For these accidents the only harsh parameter is radiation. Qualification for radiation has been provided (see generic reply on Limitorque operators attached to these responses).

Limitorque Report B0058 addresses applicability of testing one model for a whole generic family of valves. This we consider sufficient justification for using the test reports referenced.

These valves will not affect the ability to reach cold shutdown after HELB in the auxiliary building.

3.3.2.22 Electric Motor Valve Actuator Located in the Upper Safety Valve Room (T-2)

Submittal Page Reference: 30

Licensee's References: 10, 14

Plant ID numbers: 1MOV-MS017)
1MOV-MS018) (Atmospheric relief valves)
1MOV-MS019)
1MOV-MS020)

Response:

These valves are not required to mitigate the consequences of an accident. Long-term operation is required to achieve cold shutdown. One hour or more after the accident it may be desirable to open these valves to cool down the primary system. By the time they are needed, the area will be significantly cool to allow an operator to open the valves using the handwheel. Only one of the four valves is needed for cooldown. The steam dumps to the condenser is a non-qualified backup to these valves. Note that these valves can also be operated by instrument air.

Some degree of physical separation exists. The four valves can be divided into two pairs. One pair of valves is about 200 feet from the other pair. While a major steam line break would cause a temperature increase for all four valves, it is likely that one pair would not feel the full effect of the accident. Only one valve is required for the cooldown since each valve can handle 10% of full power. Steam flow and decay heat is less than 2% of full power shortly after the accident.

3.3.2.23 Electronic Transmitter Located at T3

Submittal Page Reference 42

Qual. Reference 9, 20, 21

PT514	PT524	PT534	PT544
PT515	PT525	PT535	PT545
PT516	PT526	PT536	PT546

Steam Generator Pressure (Model 50EP1041)

Response:

Short-term operation is required after an accident. CECo is studying methods to either relocate these transmitters or cool them. A more detailed response on the intended plan of action will be supplied later.

3.3.2.24 Feedwater Flow Transmitter Located in the Steam Tunnel (T-4)

Submittal Page Reference: 39

Qual. Reference: 9, 20

1FT-510	1FT-530
1FT-511	1FT-531
1FT-520	1FT-540
1FT-521	1FT-541

Response:

For a main steam line break (MSLB) outside containment, these transmitters are not used by the automatic circuitry which initiates safety injection and main steam isolation following a MSLB. They are not useful to the operator following MSLB since feedwater is automatically terminated after the trip.

For a feedwater line break (FWLB) upstream of the isolation valve, these transmitters are not required since reactor trip results from low steam generator level.

For a FWLB downstream of the isolation valve, the response is the same as for MSLB.

No qualification is required for these transmitters.

Licensee is investigating radiation level in steam tunnel (see Appendix B of report) and will submit results by September 27, 1980.

RESPONSE TO GENERIC QUESTIONS RAISED BY

FRANKLIN INSTITUTE ON VALVE MOTOR OPERATORS

Part a) We are submitting portions of Limitorque Qualification Report B0058 as well as a letter from J. Oliver of Limitorque to M. D. Rauckhorst of Sargent & Lundy on the item of generic qualification.

Part b) The motor manufacturer has been listed on the data sheet where available. For those that are blank, we are currently investigating the motor manufacturer with Limitorque and the station. Testing was done with the valve actuator in its worst possible orientation so orientation at the field was not addressed.

Part c) This test report was referenced before we had received a response from Limitorque regarding which actuator was associated with which test report. We now have the following information:

1. For containment valve actuators, a letter stating which test report is applicable to which actuator.
2. For valves outside containment, a verbal response, to be followed up by a letter stating that Reports B0003 and F-C3271 are applicable to Zion valves. Report F-C3271 is for motors with brakes and B0003 for those without brakes. Although B0003 may not

Part c) cont'd

entirely envelope the temperature, pressure profile, we feel that the test duration at elevated temperature and pressure will provide enough to satisfy the qualification.

Part d) Report B0003 includes radiation to the same actuator prior to the LOCA simulation and will be used in later issues of the report when applicable.

Conclusion:

The Licensee feels that with the presentation of the new reports and the inclusion of operating time, we have given sufficient credence to the continued operation of Limitorque valves.

The following is a generic response to comments submitted by Franklin Research Center (FRC) concerning Fischer & Porter transmitters. Specifically the following paragraph refers to FRC's comments on pages 14 and 15. FRC's comments on subsequent transmitters were almost identical and therefore, the comments should apply to subsequent sections which address transmitters. Specific comments on each section follows the generic reply.

a) Fischer & Porter Report 2205-51-B006 (Reference No. 21) does list model numbers. Additionally we have contacted Fischer & Porter (F&P) to determine the model numbers of the transmitters which were tested in the Franklin Institute Report. They are as follows:

SERIAL NO. IN REPORT	F&P MODEL NO.
6907A117A2	50EP1041
6907A117A1	50EP1041
6907A117A4	50EQ1031
6907A117A6	10B2496
6907A117A3	50EP1031
6907A117A5	10B2496

A letter has also been sent to F&P requesting verification that the Zion transmitters are identical to the test specimen. Fischer & Porter has informed us verbally that if the serial numbers are known, they can make this determination. A list of serial numbers was included in the letter to F&P.

Westinghouse WCAP-9157 dated September 1977 specifically mentioned F&P transmitter model 10B2496 and the serial numbers of the models tested.

b) Commonwealth Edison Company has verified that part no. 805B241U01 oscillator-amplifier is used in the electronic circuits of the F&P transmitters.

According to Fischer & Porter Report DP#2224-1-004, the oscillator-amplifier can oper satisfactorily up to a total gamma radiation of 1.2×10^8. Since the noraml radiation dose is much smaller than this amount, the oscillator-amplifier will not have to be replaced every ten years.

c) Franklin's Institute comment concerning non-sequential testing appears to be correct based upon the documents which were submitted. However, sequential testing of these transmitters is covered in WCAP 9157, dated September 1977.

d) Attached is a temperature/pressure profile of the F&P Test Report 2204-51-B006 with test conditions superimposed upon the anticipated temperature/pressure profile. It appears that the temperature profile (up to 24 hours) is acceptable. The test pressure profile does not completely envelope the expected pressure profile. However, the initial test pressure is considerably higher than the expected pressure and experience has indicated that transmitter failure is generally not related to environmental pressure.

Also, WCAP-9157 indicates that the F&P transmitters will perform their mandatory trip and initiation functions based on the report's environmental testing results.

e) F&P Test Report 2204-51-B006 indicated errors of 3.5% WCAP-9157 indicated errors within 2.1%. While these figures appears low compared to test reports that we have seen on other transmitters, the test transmitter 6907A1174A5 of the Franklin Institute report, appears to have an abnormally high error considerably above the other F&P transmitters test by Franklin Institute.

Although this is no proof that the transmitters at Zion will not have this large error, it is an indication that most of the transmitters will probably not experience this large error.

f) All of the Reactor Protection System transmitters will have performed their function within a few seconds after an accident. Although no detail studies regarding containment flood level versus time have been performed, it is inconceivable that the RPS transmitters (mounted 2 feet above the containment floor) will be flooded before they send out the RPS signal.

See Appendix E for those safety related containment instrument that are mounted below the fluid level. If the maximum flood level (3-1/2 feet) is reached, there will still be at least one instrumentation channel (those transmitters mounted above the flood level) available for those variable which requires medium or long term operation.

g) On November 1979 letter from R. L. Kelly of Westinghouse to N. E. Wandke of CECo. addresses chemical sprays. Westinghouse WCAP-9157 also addresses chemical sprays.

PRESSURE VS TIME
TEMPERATURE VS TIME
FROM F.P.P. REPORT 2204-51-B-006 DEC 1968

FISCHER & PORTER TRANSMITTERS

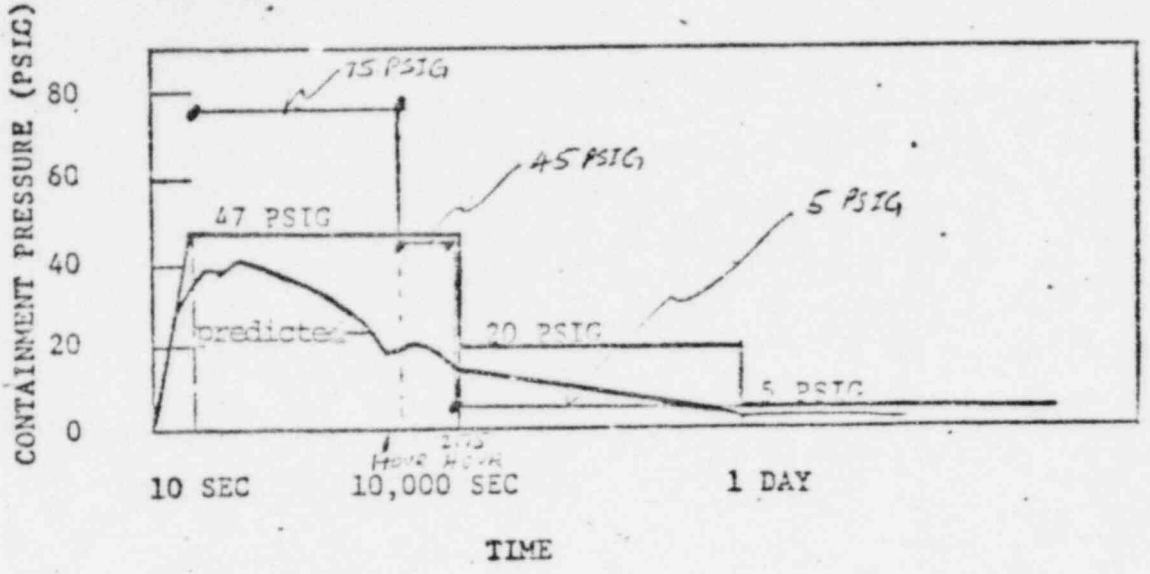


Figure 6.3-1 Post Accident Environmental Conditions for Equipment Design: Pressure versus Time (See Note below)

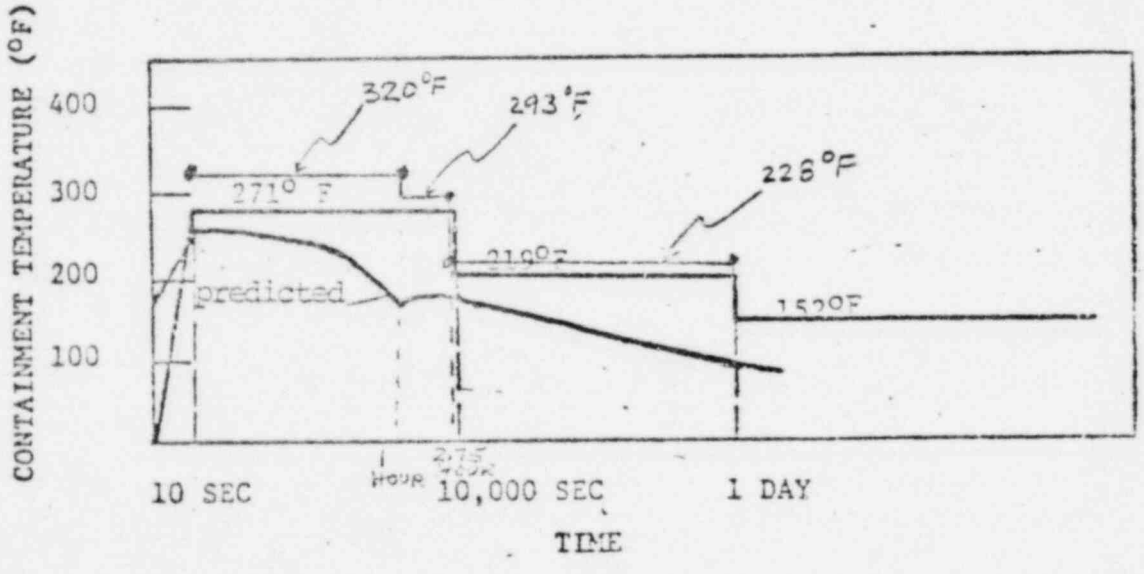


Figure 6.3-2 Post Accident Environmental Conditions for Equipment Design: Temperature versus Time (See Note below)

NOTE: The predicted containment pressure and temperature response curves superimposed in Figures 6.3-1 and 6.3-2 are obtained from Chapter 14 of Zion FSAR for the complete blowdown of the reactor coolant through any rupture of the reactor coolant system up to and including the hypothetical double end severence of a reactor coolant pipe.

The design pressure (47 psig) and temperature (271°F) of the containment are in excess of the peak pressure (42 psig) and temperature (263°F) predicted from the Safety Analysis (Chapter 14 of Zion FSAR).

3.3.3.1 Equipment No. 9
Magnetrol Level Switch: A-153-FEP/VPX-Y-3x-TDM-SIM3H-SIM3H-SIM3h
Containment Recirculation Sump Level
Submittal Page Reference 18

LT-940A	LT-941A
LT-940B	LT-941B

Response:

These switches are required for long term operation after a LOCA. They are used for indication and alarm. Backup is by containment level transmitter-wide range :

(LT-CS46, LT-CS47) (TMI MOD. M22-1-79-37)

(Barton 764) These were the best transmitters available as of April 1980.

Wyle Test Report 43235-1 dated May 2, 1977 includes

1. Nuclear radiation damage Threshold tests.
2. Regression Analysis.
3. Baseline functional and hydrostatic pressure tests.
4. Nuclear radiation aging.
5. Elevated temperature/humidity/cycling aging.
6. Test set-up.

This Wyle Test Report was not used as a reference in the June 1980 submittal to Franklin Institute for review.

Sargent & Lundy has sent Magnetrol the serial number of the above switches so that magnetrol can verify if the test report covers that switch model. Sargent & Lundy has also requested test reports for chemical spray and submergence. Magnetrol will supply all available information by the end of September 1980. This information will be reviewed for applicability and submitted as appropriate by November 1, 1980.

3.3.3.2 Equipment Item No. 11
ITT Barton Level Transmitter Model 386
Pressurizer Level
Submittal Page Reference 21

LT-459
LT-460
LT-461

Response:

These transmitters are required for long term operation after LOCA, MSLB, and FWLB.

Franklin Institute Test Report F-C2667 (Westinghouse WCAP-2410-L, Volume I Appendix B) describes a temperature, pressure, and humidity test for Barton 332 transmitter.

A letter from Barton to Mr. John Awal of Commonwealth Edison dated April 30, 1975 said the Barton 386 has been qualified to post-accident steam environment; and that the above F-C2667 test report also apply to Barton 386. This test report was not used as a reference in the June 1980 submittal to Franklin Institute for review.

A letter has been sent to Westinghouse requesting available test report documentation and traceability documentation. Therefore, Westinghouse has replied as follows:

> "Barton Model 386 transmitters were tested and reported in WCAP-7410L. (Section 4 and App B - at time of the test the 386 was still a 332 mod.). These tests show good performance during radiation and steam tests to 286°F (maximum errors around -5%)."

Westinghouse also stated that Barton is being contacted for comparison between units that were tested and units actually installed at Zion.

3.3.3.3 Equipment Item No. 12
Sostman Resistance Temperature Detectors
Reactor Coolant Hot Leg and Cold Leg Temperature
Submittal Page Reference 24

TE-411A	TE-411B
TE-421A	TE-421B
TE-441A	TE-441B

Response:

These RTD's are required for short term operation after MSLB and FWLB.

Westinghouse Test Report WCAP-9157 provides adequate qualification of Sostman RTD's for short term accident environment.

With regard to traceability for the RTD's, Westinghouse has replied as follows:

"Both the Sostman Model 118348-1 (bypass line) and the Sostman Model 11901B-2 (wide range) RTD's are reported in WCAP-9157. Although both are not specifically mentioned in the WCAP, the only difference between these models is in the length of the stainless steel housing. These tests demonstrate the performance capability of the Sostman RTD's during and following HELB conditions. While direct traceability of materials is impossible, (due to the fact that Sostman is out of business), the Sostman RTD's were purchased over a short period of time and the materials are identified in WCAP-9157."

3.3.3.4 Equipment Item No. 13
Taylor Humidity Sensor Model 10H5
Containment Relative Humidity
Submittal Page Reference 25

ME-RV42
ME-RV43
ME-RV44

Response:

These humidity sensors are not required to operate after an accident. Therefore, no qualification is required.

3.3.3.5 Equipment Item No. 14
Electric Thermometers, Resistance Temperature
Detectors, 3-wire
Model Containment Temperature
Submittal Page Reference 26

TE-RV42
TE-RV43
TE-RV44

Response:

These Resistance temperature detectors are not required to operate after an accident. Therefore, no qualification is required.

3.3.3.7 Equipment Item No. 19
Electrical Penetrations Located
Within Containment
D. G. O'Brien Type 5.1*

(*Penetration Types 1.1 and 5.2 are addressed at the end of the response for Type 5.1)

Response: (Type 5.1 only)

Documentation relating to the prototype testing for Type 5.1 Electrical Penetrations is contained in D. G. O'Brien Report No. C19QA041, dated April 9, 1971 and D. G. O'Brien Report ER192 which have been submitted by letter to Mr. S. J. Crane, dated June 9, 1980.

Enclosed with this transmittal are xerox copies of portionsof the D. G. O'Brien Technical Manual No. 1002, dated May, 1971 which indicates materials used and drawings applicable to the Type 5.1 penetration.

Since this type of penetration is not used for LOCA or post LOCA duty, the electrical features do not have to function during or after the accident, only the containment pressure boundary features must remain functional which is documented on Sheet 1 of Report C19QA041, Paragraph 1.3.

Response: (For Types 1.1 and 5.2)

Documentation relating to the prototype testing for Types 1.1 and 5.2 Electrical Penetrations is contained in D. G. O'Brien Report No's. C19QA055 and C19QA062 (copies of these documents will be furnished as soon as we obtain them from D. G. O'Brien). D. G. O'Brien Report ER192 is also applicable to Types 1.1 and 5.2.

We are enclosing xerox copies of portions of the D. G. O'Brien Technical Manual 1044, dated January, 1972 which indicates materials used and drawings applicable to Type 5.2 penetrations.

We will send copies of the instructions for Type 1.1 as soon as we obtain it.

Since these types (1.1 and 5.2) of penetration are not used for LOCA or post LOCA duty, the electrical features do not have to function during or after the accident, only the containment pressure boundary features must remain functional which are documented in Reports C19QA055 and C19QA062.

3.3.3.7 (Cont'd)

A printout listing of all types of penetrations and designating those used for Engineered Safety Functions (ESF), Non-Engineered Safety Functions and the spare steel sleeves provided for future used was given to Mr. S. J. Crane at the August 27, 1980 meeting in Bethesda.

Instruction Manual
For
REACTOR CONTAINMENT STRUCTURE
ELECTRICAL PENETRATION ASSEMBLY
TYPE 5.1-TRIAXIAL INSTRUMENTATION
CABLE SERVICE
ZION STATION UNITS I AND II

May 1971

D. G. O'Brien, Inc.
Framingham, Massachusetts

Technical Manual No. 1002

For Serial No's. 5.1Z1 thru 5.1Z4
and 5.1AZ1 thru 5.1AZ4

Prepared By:
R. S. Butters, Proj. Engr. Mech.(5/12)
P. R. Henault, Proj. Engr. Elec.(5/12)

Approved By:
R. B. Henderson, Mgr. of Engr. (5/12)

References:
Sargent & Lundy
Specification
X-2308

D. G. O'Brien, Inc.
Contract No. 113967

Zion Stations I & II
Commonwealth Edison Co.

TABLE OF CONTENTS

INTRODUCTION

The Electrical Penetration Assembly described herein was designed and manufactured by D. G. O'Brien Inc., Framingham, Mass. for use in the construction of Nuclear Power Plant - Zion Units I and II, Commonwealth Edison Co., Zion, Illinois.

This manual is for use in the installation, test, calibration, and operation of Type 5.1 penetration. This penetration is designed for triaxial instrumentation cable service. Penetrations of Type 5.1, D. G. O'Brien, Inc., Part No. R19D2228P are identical for both Zion Units I and II.

Information pertaining to other types of penetrations also designed and manufactured by D. G. O'Brien, Inc. for Zion Units I and II can be obtained from other Instruction Manuals. This manual is applicable to Type 5.1 only.

Quality Assurance data is included under a separate cover.

This penetration assembly is furnished for use with applicable design data of the following Sargent & Lundy drawings:

ES-42 - Typical Electrical Penetration, Physical Requirements, Dated 10-1-69

B-213 - Reactor Building Containment, Liner Plate Sections and Details, Sheet 2 Rev. T, Dated 10-3-69

B-214 - Reactor Building Containment, Penetration Schedule, Rev. L, Dated 10-3-69

B-216 - Reactor Building Containment, Elevation Electrical Penetrations, Rev. G, Dated 10-3-69

The penetration assembly described herein is furnished by D. G. O'Brien, Inc. as part of Class B Nuclear Vesse

The electrical penetrations for Nuclear Generating Power Plants manufactured by D. G. O'Brien, Inc. are engineered to meet the stringent requirements of the electrical power industry and the Atomic Energy Commission. The careful integration of many scientific and technical disciplines has gone into the development of a state-of-the-art product that is reliable, rugged, dependable, efficient, and economical. Careful control of manufacturing processes and materials plus extensive in-process and final testing insures the finest

product is delivered to the customer.

This manual is prepared to give the customer in a readily available form the information necessary to efficiently install and maintain the purchased equipment.

SECTION I

GENERAL DESCRIPTION

SECTION I

General Description

Type 5.1 D. G. O'Brien, Inc. Shielded Instrumentation Triaxial Cable Penetration Assembly Part No. R19D2228P.

General:

The penetration assembly is to be used as an interface for passing the Purchaser's triaxial cables, Type RG 1'/U, Essex P/N 21-529 from the inside containment to the outside containment and as such will become a critical portion of the cabling system associated with the reactor nuclear instrumentation system.

It will extend high voltage, low current instrumentation power to neutron detectors located inside the containment and extend high frequency pulse signals from the detectors to remote monitoring instrumentation location outside of the containment.

The assemblies are designed and constructed for installation in 3 foot 6 inch long, 12 inch steel pipe containment penetration nozzles. Each penetration assembly is identical in basic physical configuration and consists of the assembly with one weld ring permanently attached. The second mechanical seal required for field installation is to be installed by the Customer.

The Assembly must be inserted into the containment structure nozzle from inside the containment.

The Penetration Assemblies are to be permanently installed by means of field welding at the site. A maximum of three field welds are required for installation. Mechanical supports are necessary to position the Assembly during the welding operation. The past involvement of D. G. O'Brien, Inc. in the Nuclear Power Plant Penetration Assemblies and in underwater and military applications has provided a great deal of experience in assembly and welding of Penetration Assemblies without detrimental heat transfer to the components of internal conductors.

Each Assembly is designed in a manner that will restrain loading due to electrodynamic forces or mechanical stressing. Internally this is achieved, where required, by groups of tubular cable guides extending the full length of the Penetration Assembly. External supports protect and strain relieve the cable and conductor terminations where required.

Each Penetration Assemnly is permanently identified by a serial number. Each wire beyond the Assembly is

marked at each end with an identification number as specified by the Purchaser. Wire numbers in any one multiconductor cable are not repeated.

Sealing and Pressurization:

The Penetration Assemblies provide a dual gas barrier by means of steel header flanges and hermetically glass-sealed electrical contacts. Each of the two gas barriers meet the service environmental conditions individually, providing an overall performance safety factor of two. The double-pressure barrier is formed, at installation, by welding the two weld rings to the containment structure liner plate. Weld preparation and all welding is in accordance with ASME Boiler and Vessel Code, Section III, Class B Vessels.

Both internal volume of the Penetration Assembly and that between it and the penetration nozzle may be pressurized through purging holes in the canister. The canister assemblies are pressurized to 54 psig with dry nitrogen prior to shipment. Gross pressure differential of the penetration assembly in transit and storage can be observed on the pressure gauge that is part of the assembly.

CAUTION: Prior to installation, the Penetration Assembly should be depressurized and the pressure gauge assembly and purging port plugs removed. Refer to Section IV of this manual.

Pneumatic testing was performed on the prototype and each production assembly in accordance with the latest revision of Paragraph N-110 of Section III in the ASME Boiler and Pressure Vessel Code and as covered in detail in the Quality Assurance Instruction Data. D. G. O'Brien, Inc. has achieved an excellent reputation in man-safety rated equipment and this equipment is a further indication of maintaining this concept.

The allowable leak rate of each penetration gas barrier prototype testing is equal to or less than 1×10^{-6} standard cc/sec. of dry helium at 298°F. and 70 PSI. In production, each penetration assembly is subjected to a leak rate test of 70 PSIG at 78°F. and will not exceed 1×10^{-6} standard cc/sec. through each penetration gas barrier or a total assembly. Due to controlled production processes hermetically glass-sealed headers or gas barriers consistently better the leak rate of 1×10^{-6} by two orders of magnitude or 1×10^{-8} cc/sec. helium. The usage of dual gas barriers add an additional leak rate factor of safety of two.

Cable Description:

Internal triaxial cables are Type RG 11/U with polyethylene insulation and outer jacket and match the electrical and physical characteristics of the external cable. Each RG 11/U cable is terminated in hermetic, environmental connector plugs which mate with the glass-sealed receptacles in the gas barrier. The internal cables are directly terminated to these receptacles, and the external cables to the positive engagement plugs. The electrical characteristics are identical to the Purchaser's cables within the tolerance allowed.

External cable terminations are to be made to D. G. O'Brien, Inc. triaxial connector plugs. These plugs are designed and built to positively engage with the D. G. O'Brien, Inc. triaxial connector receptacles. The receptacles are a structural part of the Penetration Assembly gas barrier and the internal interconnecting cables are terminated at D. G. O'Brien, Inc. One of the design features of the true triaxial connectors is the ease of cable terminations. All attachments are done by crimp type contacts, thus reducing the the installation time and perplexity of termination.

The cable shielding is continuous and concentric around the center conductor over the entire length of the penetration assembly. In the gas barriers, hermetically glass-sealed conductor contacts and inner and outer shields provide a pressure seal. A positive engagement receptacle plug in a true triax configuration is supplied for the connection of the Purchaser's triax cable. Each cable is terminated in its individual connector. All conductors and shields are insulated from each other and from ground.

Insulation resistance was tested between each conductor, conductor to shield, conductor to ground and shield to ground and meets the 500 VDC withstand test without arc over or breakdown.

The prototype and all production models were tested to the following:

1. Test Voltage - 500 VDC

2. Minimum Insulation Resistance:

   1×10^{12} Ohms - Center Conductor to Inner Shield

   1×10^{10} Ohms - Inner to Outer Shield & Outer Shield to Ground

The penetration assembly was tested to the following:

1. Center Wire to Inner Shield - 3,000 VDC for 1 Min.
2. Inner Shield to Outer Shield - 500 VDC for 1 Min.
3. Outer Shield to Ground - 500 VDC for 1 Min.

The following tabulation of technical and design parameters provides a ready reference of data. Additional information is provided in each Section of this manual to supplement the above general description.

TYPE 5.1 TRIAX INSTRUMENTATION ELECTRICAL PENETRATOR DESIGN PARAMETER SUMMARY

1.	Number of Conductors	20 Triax RG-11/U
2.	Material & Size of Conductors:	
	Current or Signal	#18 AWG Tinned Copper
	Ground or Shield	Bare Copper Braid
3.	Conductor Insulating Material	Polyethylene
	Temperature	+75° C.
4.	Provision for Connection of Purchaser's External Cable	D. G. O'Brien, Inc. Model No. R19P1010G01
5.	High Potential Test On Production Assemblies for One Minute	Conductor to First Shield - 3000 VDC Shield to Shield and Shield to Ground - 500 VDC

6.	Assembly Body Material	10" I.P.S. Sch. 20 Pipe, ASTM, A-333 Gr-1, Carbon Steel
7.	End Header Plate Material	ASTM, A-442, Gr-60 Carbon Steel or ASTM A-516, Gr-70
8.	End Header Plate Conductor Material	Leaded Carbon Steel Per AISI, C1213
9.	End Header Plate Conductor Insulating Material	9010 Glass
10.	Assembly Dimension:	
	Body Outer Diameter	10 3/4 In. Nom.
	Body Length	4 1/2 Ft. Nom.
11.	Maximum Integrated Radiation Exposure	6×10^{8} Rads
12.	Maximum Total Assembly Air Leakage Rate When Subjected to the Maximum Post DBA Environment	2.24×10^{-5} cc. (Air) Min.
13.	Minimum Insulation Resistance @ 500 VDC:	
	Conductor to Shield	10^{12} Ohms
	Shield to Shield or to Ground	10^{10} Ohms
14.	Total Assembly Calculated Weight	250 Lbs.
15.	Shipping & Storage Pressurization	54 Psi, Dry Nitrogen

16.	Design Current Rating	1×10^{-11} AMPS to 3×10^{-2} AMPS
17.	Design Pulse Signal Rating	Pulses with 10^{-8} rise time, 10^{-7} sec. width and 10^{-7} pulses per second repetition rate

SECTION VI

Wiring

Introduction:

The following drawings depict the wiring diagram electrical connections of the Zion I and II Electrical Penetrations, Type 5.1 "Triaxial Instrumentation Service" for Normal Non-Accident Duty.

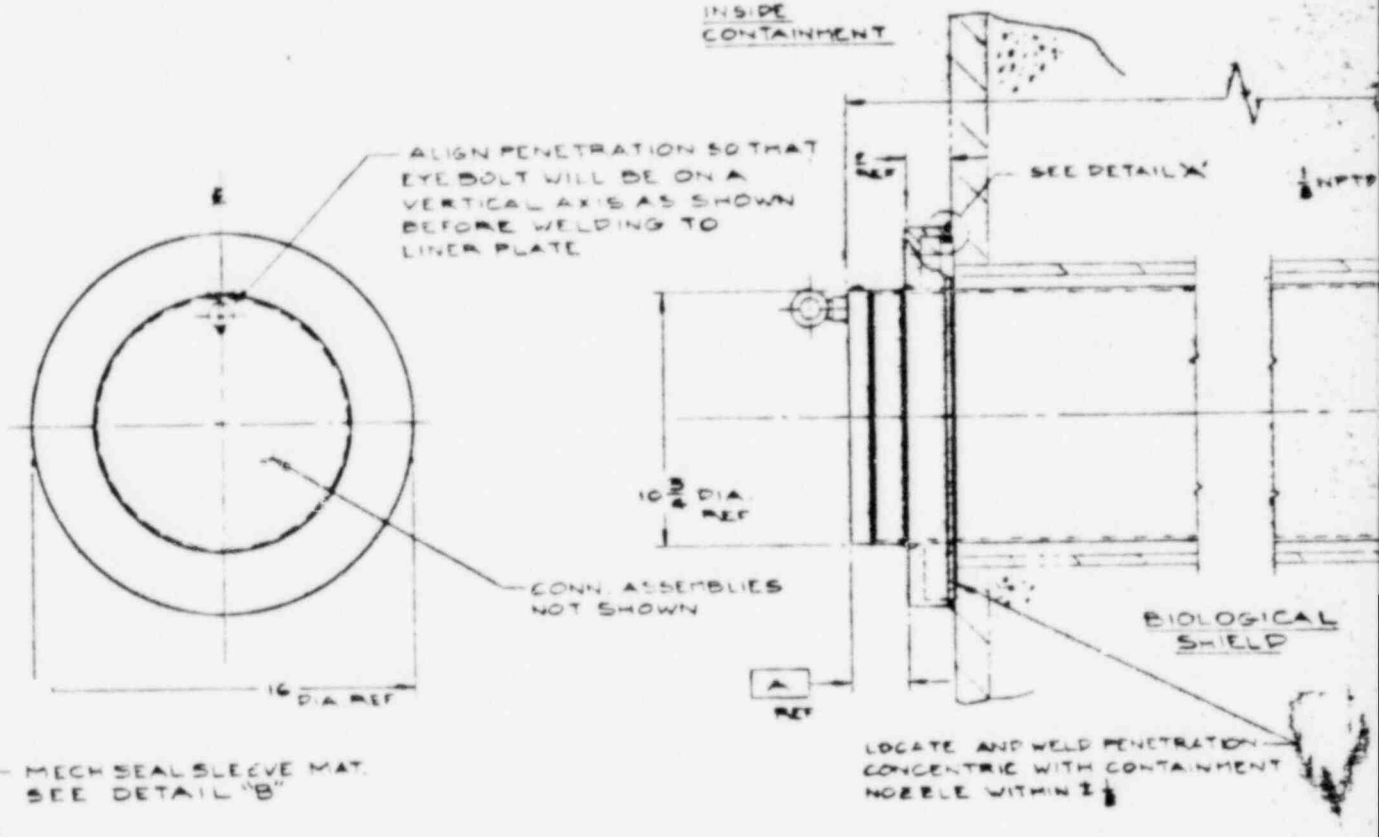
Refer to Section VII for Termination Instructions.

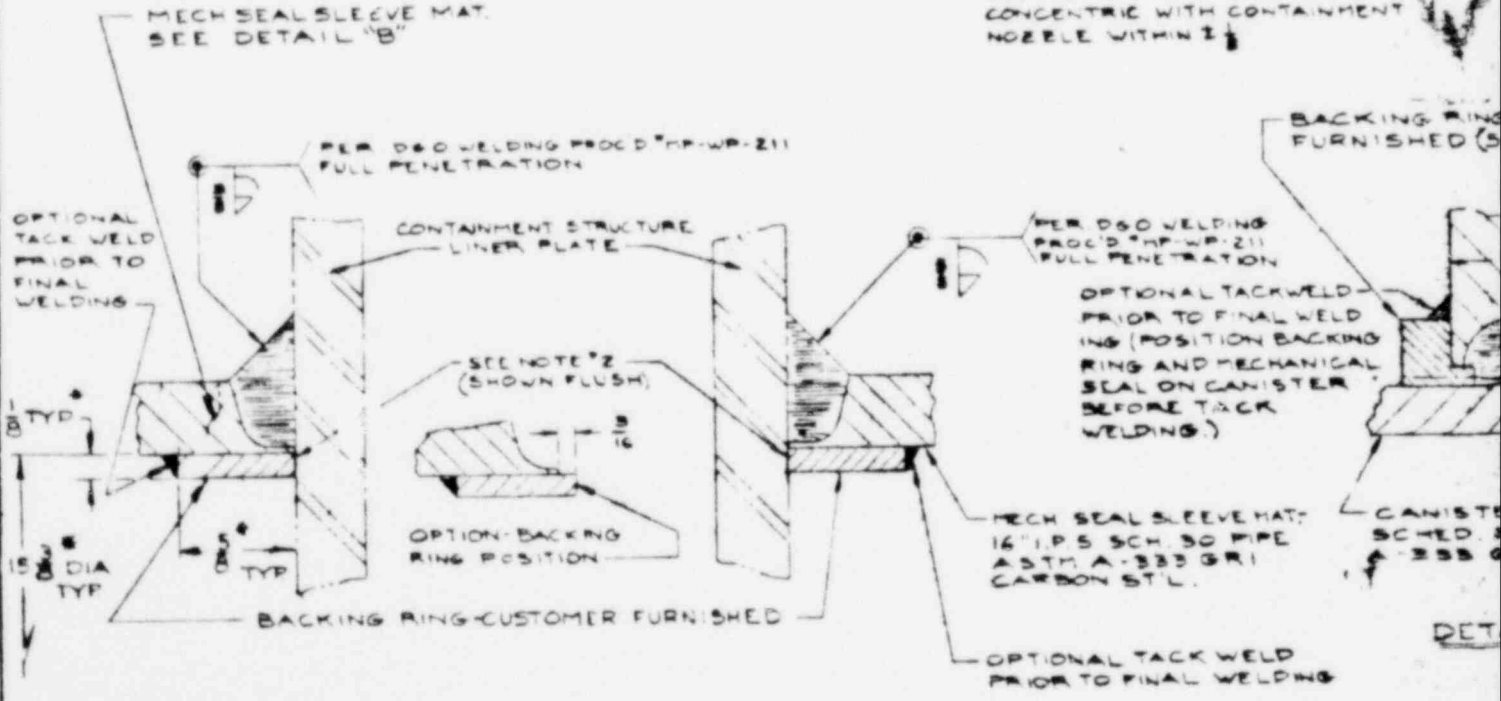
8 7 6 5

D C B A

NOTES

1. WELD PER DGO WELD PROCEDURE "MP-WP-211
2. BACKING RING IN DETAILS 'A' AND 'B' MAY BE POSITIONED FLUSH WITH EDGE OF MECH SEAL ASS'Y. OR WITH UP TO $\frac{5}{16}$ PROTRUSION. IF NOT POSITIONED FLUSH, 'C' DIMENSION WILL VARY BY THE AMOUNT OF PROTRUSION ON EACH END.



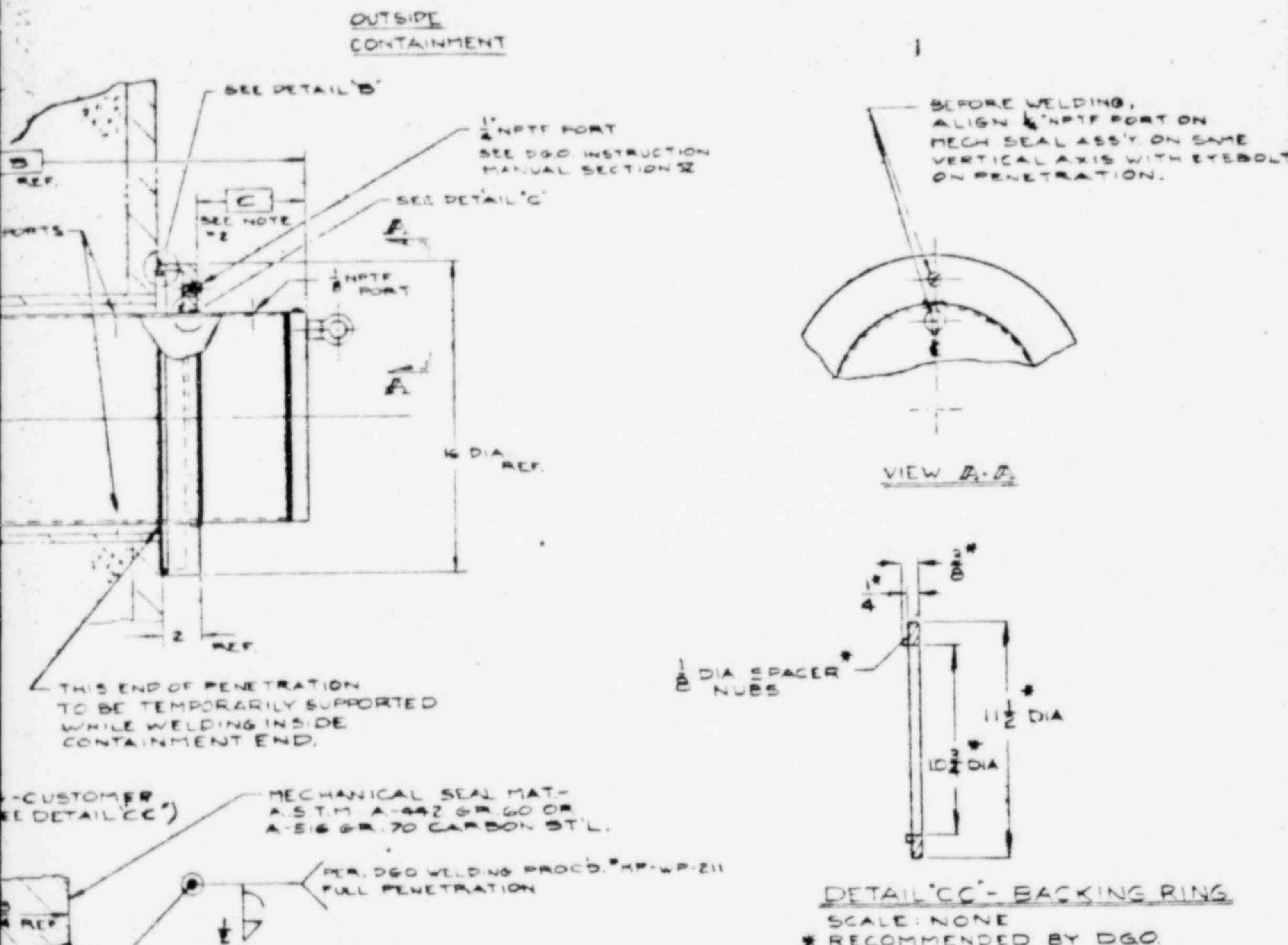


DETAIL 'A'
SCALE 2:1

DETAIL 'B'
SCALE 2:1

* RECOMMENDED BY DGO

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER ECO#1088	5-25-71	RSB



DETAIL 'CC' - BACKING RING

SCALE: NONE

* RECOMMENDED BY DGO.

DETAIL 'C'

SCALE 2:1

GROUP NO.	PENET. ITEM	A ± 1/16	B ± 1/8	C REF		
07	5.1	1 1/2"	53 3/4"	5 3/4"		
06	4.1	2 3/8"	54 1/2"	6 3/8"		
05	3.1	2"	54 1/4"	6 1/2"		
04	2.3	1 1/2"	53 1/4"	5 3/4"		
03	2.2	1 1/2"	53 1/4"	5 3/4"		
02	2.1	1 1/2"	53 1/4"	5 3/4"		
01	1.1	2 1/2"	53 1/4"	6 3/4"		

POOR ORIGINAL

COMMONWEALTH EDISON CO. ZION 1 & 2

NEXT ASSY | USED ON

APPLICATION

MATERIAL / HEAT TREAT / FINISH

DRAWN ANTHONY F. BUDO 4-27-71

CHECKED P. SIIRA 5-3-71

ENGR. R. J. BUTTERS 5-10-71

ISSUED

APPROVED [signature] 5/11/71

APPROVED

D. G. O'Brien, Inc.

TYPICAL ELECTRICAL PENETRATION INSTALLATION ASSEMBLY

SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D2476G	A

SCALE 1:16 | SHEET 1 OF 1

8 7 6 5

D

P G O'BRIEN, INC MFD 1971
MOD No M-SPEEEB-501
ZION # 1 SER No 5121 THRU 5184
ZION # 2 SER No 5 IA21 THRU 5 IA84
TO MAX INST + SERVICE

NAMEPLATE DATA
ITEMS #11 AND #35

VIEW A-A

DETAIL A
SCALE 1

C

SEE DETAIL A

16 DIA REF

10 3/8 DIA REF.

RECEPTACLE CAP TYP.

1 1/2 REF.

2 REF

55 1/4 REF

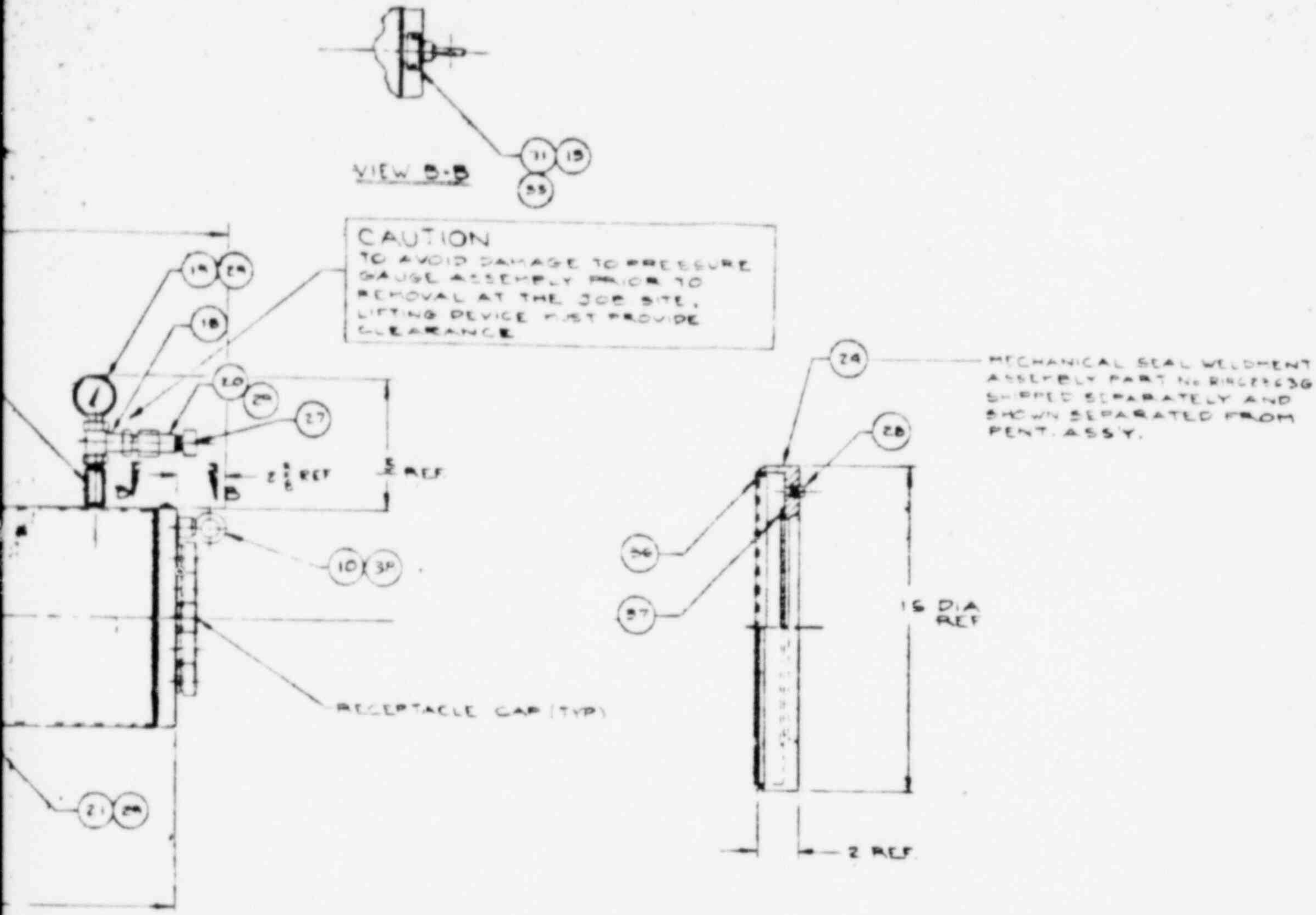
B

NOTES

1. THIS PENETRATION SHALL MEET THE REQUIREMENTS OF THE ASME BOILER AND PRESSURE VESSELS CODE, SECTION III, CLASS B VESSELS
2. INTERNAL STORAGE PRESSURE: 54 PSIG.
3. DESIGN TEMPERATURE: 298°F FOR 1 HOUR FOLLOWED BY 271°F FOR 48 HOURS.
4. MINIMUM DESIGN TEMPERATURE: 50°F
5. DESIGN RADIATION LEVEL: 1.7×10^8 RADS (5 MEV. GAMMA RAYS).
6. RELATIVE HUMIDITY MAX. DURING THE 40 YEAR LIFE INSIDE AND OUTSIDE CONTAINMENT 50%.
7. PENETRATION SEISMIC TEST: .25 G'S AT 55 CPS.
8. REFER TO SARGENT & LUNDY SPECIFICATION X-2308 DATED OCT. 1, 1969 INCLUDING REVISIONS, AND THE PGO QUALITY ASSURANCE METHOD SHEETS, PROTOTYPE 5.1 SHT #QA-TM-152-1 PRODUCTION 5.1 SHT #QA-TM-153-7 FOR SPECIFIC TEST PARAMETERS.
9. PROTECTIVE COAT PER. PGO. PROCED MP-PC-100
10. APPROXIMATE WEIGHT: 249 LBS
11. FOR INSTALLATION WELDING ASSEMB SEE INSTALLATION ASSEMBLY DRAWING #1-1DE-706.
12. FOR CABLE TERMINATION ITEMS, SEE CABLE TERMINATION DRAWING #
13. ALL DRYSEAL PIPE THREADS SHOULD BE TAPPED PER PGO PROC MP-MP-100 USE ONLY "BAKER SEAL SEALING COMPOUND"

A

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER ECO #1082	5-25-71	A.S.B



ITM	QTY	DESCRIPTION
38	A/R	5/16 ID · 1/16 THICK WASHER P500C2M0013
37	1	BACKING RING · CUSTOMER FURNISHED
36	2	BACKING RING · CUSTOMER FURNISHED
35	2	NAMEPLATE 2 ON 2 HALF HARD BRASS
31		FINAL PROTECTIVE COATING PROCEDURE MP-PC-100
30	A/R	FINAL PROTECTIVE COATING CORICONE 1700
29	A/R	THREAD SEALING COMPOUND BAKERSEAL
28	1	PIPE PLUG 1/4 DRYSEAL MALLEABLE IRON (P50C13D0C04)

ITM	QTY	DESCRIPTION
27	1	PIPE CAP, 1/4 DRY SEAL MALLEABLE IRON (P50C13D0003)
24	1	MECH SEAL WELD ASSY. P/N R19C22636, ASTM A-442, GR60 OR A-516, GR70 CARBON STL SLEEVE - 16" IPS SCH 30 PIPE ASTM A-333, GR1 CARBON STEEL
21	2	PIPE PLUG 1/8 CARBON STEEL (P50C3D0C01)
20	1	CHECK VALVE (SCHRADER No. 3047 PLATED STEEL (P50H3A43001)
19	1	GAUGE 0-100 PSI (ASHCROFT) TYPE #1 2" FACE (P50H3B10001)
18	1	TEE PIPE (CARBON STEEL) (P50C13B0002)
17	1	REDUCER PIPE NIPPLE CARBON STEEL (P50C13D0002)
13	4	DRIVE SCREWS No 0 x 3/16 LG CASE HARDEN STL (P500C2A0002)
11	2	NAMEPLATE 2 ON 1 HALF HARD BRASS
10	2	LIFTING EYEBOLT 5/16-18UNC-2A THD CARBON STL (P500C7A0029)

R19P2228
2 ON
1 & 2

SEE PARTS LIST R19P2228

A.F. BASSO 5-24-71
P SURA 5-24-71
R.J. BUTTERS 5-25-71
J.C.B 5-25-71

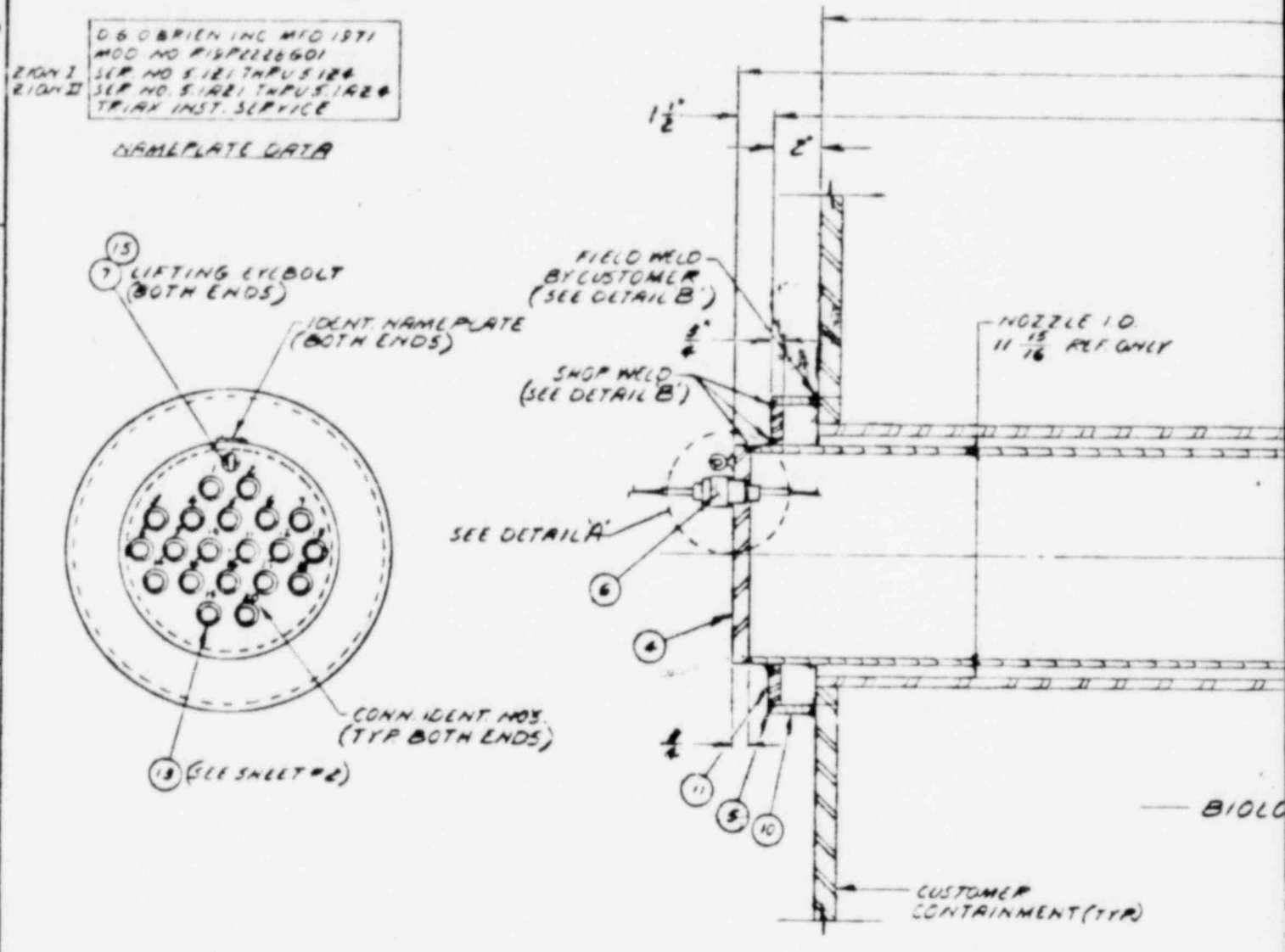
D. O. O'Brien, Inc.

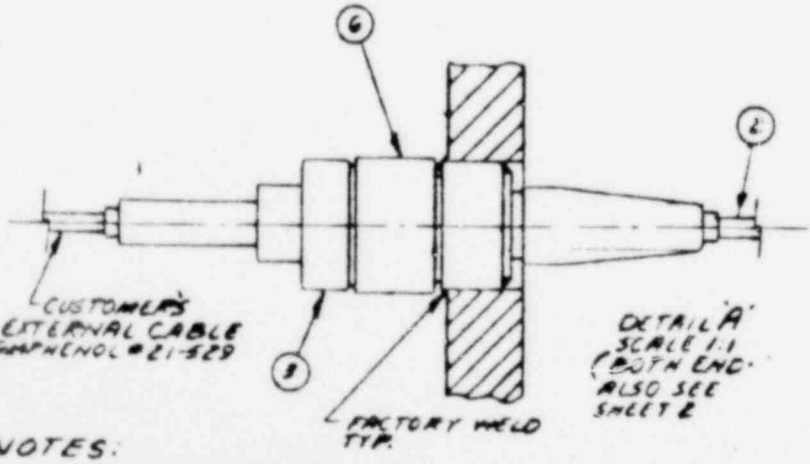
ELECTRICAL PENETRATION ASSEMBLY TYPE 5.1 TRIAX INSTRUMENTATION SERVICE

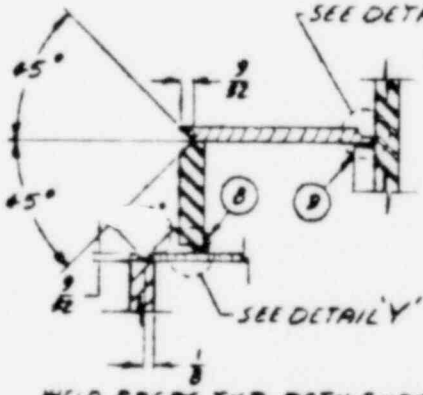
SIZE	CODE IDENT NO.	DWG NO.	REV
D	17476	R19D2428P	A

SCALE 1:4 SHEET 1 OF 1

POOR ORIGINAL







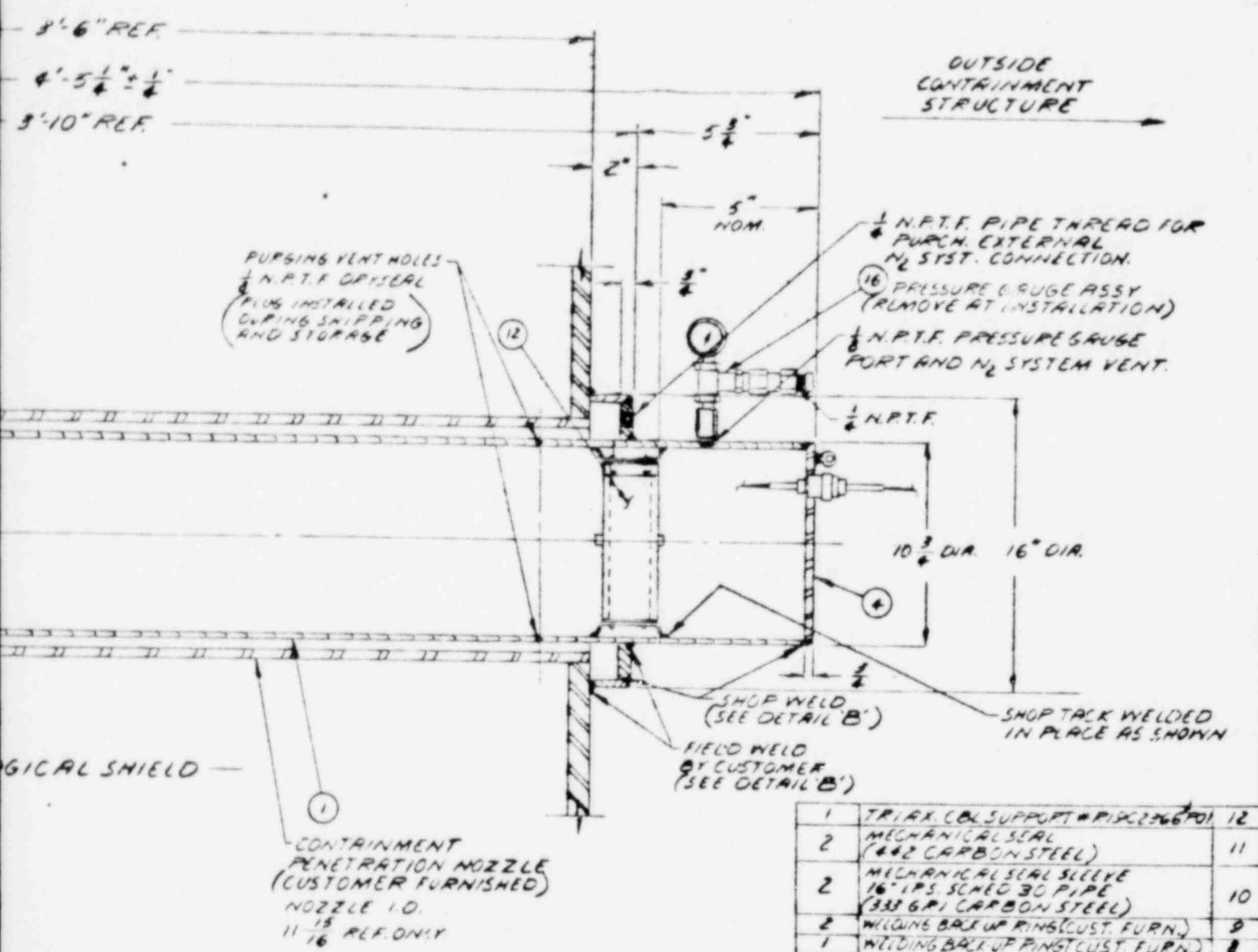
NOTES:

1 ALL EXTERNAL CARB STEEL SURFACES TO BE PROTECTIVE COATED WITH CORICONE 1700 PER DGO PROCEDURE NO PC-100 (MFG. THE CORICONE COMP LONG BEACH, CALIF)

2 TOTAL ESTIMATED WEIGHT 249 LBS.

POOR ORIGINAL

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	REDRAWN & REVISED	5-11-71	RSB
	E	REVISED PER ECO # 1082	5-25-71	RSB



QUAN.	DESCRIPTION	ITEM
1	TRIAX. CBL SUPPORT # P19C2366P01	12
2	MECHANICAL SEAL (442 CARBON STEEL)	11
2	MECHANICAL SEAL SLEEVE 16" I.P.S. SCHED 30 PIPE (333 GPI CARBON STEEL)	10
2	WELDING BACK UP RING (CUST. FURN.)	9
1	WELDING BACK UP RING (CUST. FURN.)	8
2	LIFTING EYE BOLTS (P5006B...) (CARBON STEEL) ... 3/8-16 UNC 2A	7
40	TRIAXIAL CONNECTOR 737 STEEL (CARB STEEL) DGO # P19P1010601	6
1	MECHANICAL SEAL ASSY (333 & 442 CARB STEEL) DGO # P19C23636	5
2	GAS BARRIER (442 CARBON STEEL)	4
A/R	HEAT SHRINK TUBING THERMOFIT VITON -120 TUBING	3
95 FT.	COAX CABLE AMPHENOL # 21-529	2
1	PENETRATION ASSY CANNISTER 18" I.P.S. SCHED 20 (333 CARBON STL.)	1

(19024766)

NEXT ASSY	USED ON
COMMONWEALTH EDISON CO.	
ZION 1 & 2	

APPLICATION

MATERIAL HEAT TREAT FINISH: 1. SEE BILL OF MATERIAL 2. FOR CONTINUATION OF PARTS LIST SEE P19D2228P SHT. 2

DRAWN: H.D.D.
CHKD: P. SWRA
ENGR: R.S. BUTTERS 5-10-71
APPROVED: [signature]

D. O. O'Brien, Inc.

ELECTRICAL PENETRATION ASSY OUTLINE TYPE 6.1 TRIAX INSTRUMENTATION SERVICE (NORMAL NON-ACCIDENT DUTY)

SIZE	CODE IDENT NO.	DWG NO.	REV
D	17476	P19D2228 P	E

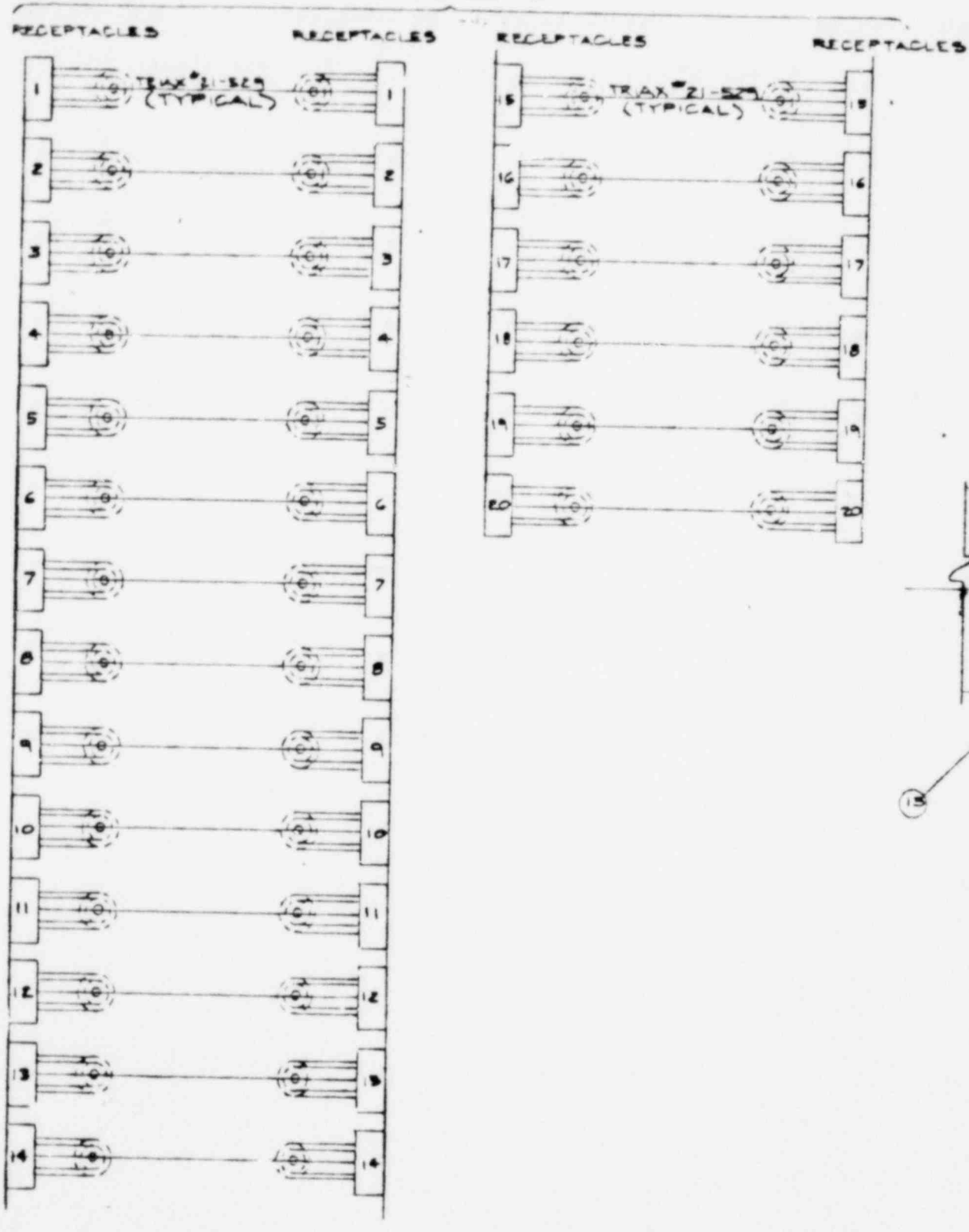
SCALE: NONE — SHEET 1 OF 2

8 7 6 5

D C B A

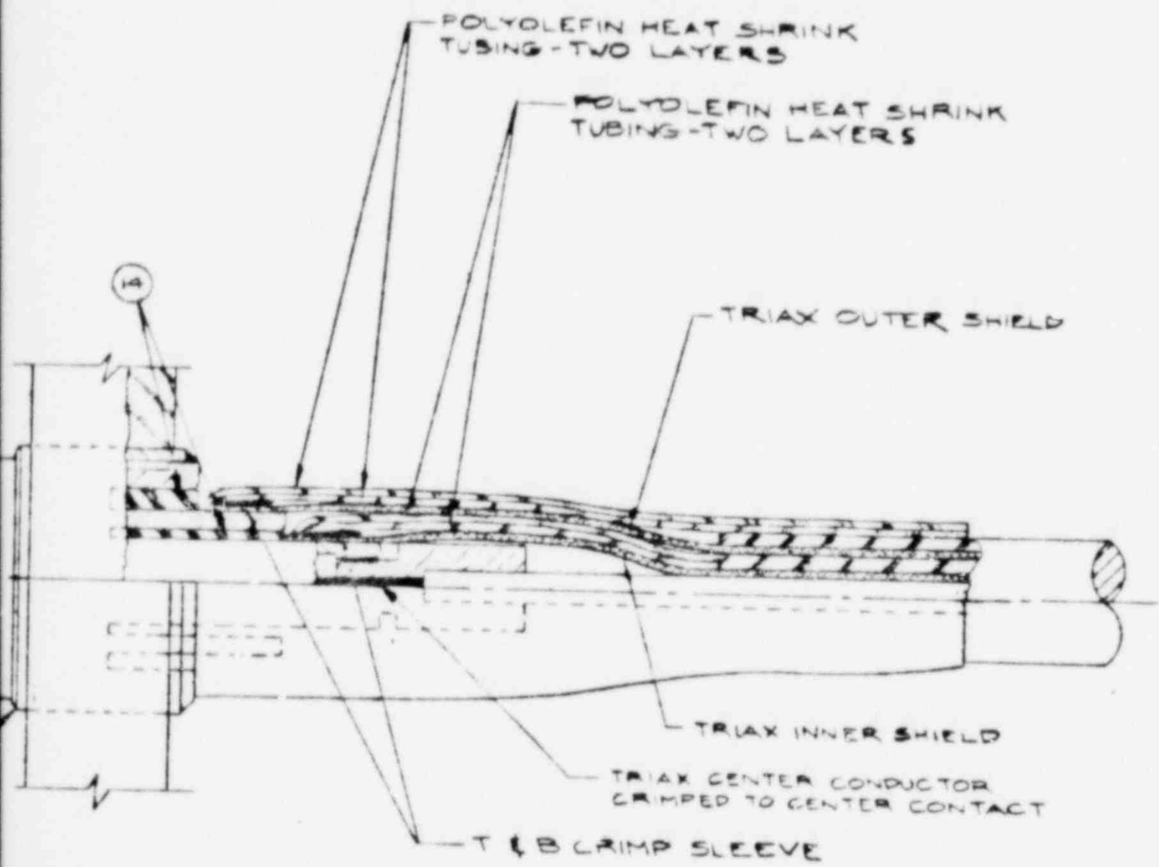
TYPE 5.1

TRIAXIAL CABLES
(RECEPT. ASSMT STAMPED ON GMS BANNERS)
(SEE SHEET #1)



4	3	2	1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



TRIAXIAL RECEPTACLE CABLE TERMINATION (TYP)

NOTES

1. ALSO SEE TERMINATION INSTRUCTIONS DGO #113-290 FOR PLUG ASSY.
2. TRIAXIAL RECEPTACLE SEQUENCE INSIDE THE CANISTER.

POOR ORIGINAL

QTY	DESCRIPTION	ITEM
1	PRESSURE GAUGE ASSEMBLY R19F2483G01	16
A/R	5/16 ID x 1/16 THICK WASHER PS 0022M0013	15
A/R	R.T.V - 511 SILASTIC POTTING COMPOUND	14
20	TRUE TRIAXIAL FEED THRU CONNECTORS WITH (1) RG 11/U TRIAX CABLE EACH PART No. R19C0010G01	13

COMMONWEALTH ED SON CO	
ZION 1 & 2	
NEXT ASSY	USED ON
APPLICATION	

MATERIAL HEAT TREAT FINISH: SEE ABOVE & SHT. #1

DRAWN	AFB	10-23-70
CHKD	PSIIRA	5-6-71
ENGR	[illegible]	5-8-71
APPROVED	[signature]	

D. O. O'Brien, Inc.

ELECTRICAL PENETR. ASS'Y. OUTLINE TYPE 5.1 TRIAX INSTRUMENTATION SERV. (NORMAL NON - ACCIDENT DUTY)

SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D2278P	E

SCALE NONE SHEET 2 OF 2

Duplicate D.O

Instruction Manual (1044)

For

REACTOR CONTAINMENT STRUCTURE

ELECTRICAL PENETRATION ASSEMBLY

TYPES 5.2 AND 5.2A

(Serial Numbers 5.2Z1 AND 5.2AZ1)

JANUARY, 1972

Prepared For Use On

ZION STATION UNITS I AND II

(Commonwealth Edison, Co., Contract 113967)

Prepared by:

D. G. O'Brien, Inc.

500 Cochituate Road

Framingham, Mass.

Approved by: Harold P. Hilberg 1/27/72

H. P. Hilberg, Engineering Manager
Nuclear Power Plant Systems

INTRODUCTION

The Electrical Penetration Assembly described herein was designed and manufactured by D. G. O'Brien, Inc., Framingham, Mass. for use in the construction of Nuclear Power Plant - Zion Units I and II, Commonwealth Edison Co., Zion, Illinois.

This manual is for use in the installation, test, calibration, and operation of Type 5.2 penetration assemblies. This penetration is designed for Radiation Monitoring instrumentation cable service. Penetration assemblies of Type 5.2 are identical for both Zion Units (I and II). Types 5.2 and 5.2A are identical but the 5.2A designation applies to the assembly used with Zion, Unit II.

Information pertaining to other types of penetrations also designed and manufactured by D. G. O'Brien, Inc. for Zion Units I and II can be obtained from other Instruction Manuals. This manual is applicable only to Type 5.2 and 5.2A.

Quality Assurance data is included under a separate cover. This penetration assembly is furnished for use with applicable design data of the following Sargent and Lundy drawings:

ES-42 - Typical Electrical Penetration, Physical Requirements, Dated 10-1-69

B-213 - Reactor Building Containment, Liner Plate Sections and Details, Sheet 2 Rev. T. Dated 10-3-69

B-214 - Reactor Building Containment, Penetration Schedule, Rev. L, Dated 10-3-69.

B-216 - Reactor Building Containment, Elevation Electrical Penetrations, Rev. G, Dated 10-3-69.

The penetration assembly described herein is furnished by D. G. O'Brien, Inc. as part of an ASME, Class B Nuclear Vessel.

The electrical penetrations for Nuclear Generating Power Plants manufactured by D. G. O'Brien, Inc. are engineered to meet the stringent requirements of the electrical power industry and the Atomic Energy Commission. The careful integration of many scientific and technical disciplines has gone into the development of a state-of-the-art product that is reliable, rugged, dependable, efficient, and economical. Careful control of manufacturing processes and materials plus extensive in-process and final testing ensures that the finest product is delivered to the customer.

This manual is prepared to give the customer, in readily available form, the information necessary to efficiently install and maintain the purchased equipment. References throughout this manual to type 5.2 assembly are also applicable to type 5.2A assemblies, unless otherwise specified.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 GENERAL DESCRIPTION

1.1 Radiation Monitoring Instrumentation Cable Penetration Assembly (D. G. O'Brien, Inc. Part No. R19P2438G01) herein referred to as the penetration assembly will be used as an interface for passing the Purchaser's Radiation Monitoring instrumentation cables, from the outside containment to the inside containment. As such, it will become a critical portion of the cabling system associated with the reactor nuclear instrumentation system.

1.2 The penetration assembly will service electronic instrumentation loads of up to 120 VAC. The assembly will provide the interface between instruments located inside the containment and monitors located outside of the containment that indicate status of operation.

1.3 The assemblies are designed and constructed for installation in 12-inch diameter steel pipe containment penetration nozzles that are 3 feet, 6 inches long. Each penetration assembly is identical in basic physical configuration and consists of the assembly having one mechanical seal permanently attached. The second mechanical seal, required for field installation, is furnished separately in the same shipping carton.

1.4 The penetration assembly must be inserted into the containment structure nozzle from inside the containment and is permanently installed by means of field welding at the site. Mechanical supports are necessary to position the assembly during the welding operation. The past experience of D. G. O'Brien, Inc. in the Nuclear Power Plant Penetration Assemblies and in underwater and military

applications provides the necessary background experience to assemble and weld penetration assemblies without detrimental heat transfer to the components of internal conductors.

1.5 Each assembly is designed to restrain loading due to electrodynamic forces or mechanical stressing. Internally, this is achieved, where required, by groups of tubular cable guides extending the full length of the penetration assembly.

1.6 Every penetration assembly is permanently identified by a serial number. Every wire, external to the assembly, is marked at each end with an identification number as specified by the purchaser. Wire numbers in any one multiconductor cable are not repeated.

1.7 Sealing and Pressurization. The penetration assemblies provide a dual gas barrier by means of steel header flanges and hermetically glass-sealed electrical contacts. Each of the two gas barriers meet the service environmental conditions individually, providing an overall performance safety factor of two. The double-pressure barrier is formed, at installation, by welding that is in accordance with the ASME Boiler and Vessel Code, Section III, Class B Vessels. Both the internal volume of the penetration assembly and that between it and the penetration nozzle may be pressurized through a pressurization port in the outside containment mechanical seal and holes in the

canister. The canister assemblies are pressurized to 15 psig with dry nitrogen prior to shipment. Gross pressure differential of the penetration assembly in transit and storage can be observed on the pressure gauge that forms part of the assembly.

CAUTION

PRIOR TO INSTALLATION, THE PENETRATION ASSEMBLY SHOULD BE DEPRESSURIZED AND THE PRESSURE GAUGE ASSEMBLY AND PURGING PORT PLUGS REMOVED. REFER TO SECTION 4.0 OF THIS MANUAL.

1.8 Safety Factors in Production. Pneumatic testing is performed on the prototype and on each production assembly in accordance with the latest revision of Paragraph N-110 in Section III of the ASME Boiler and Pressure Vessel Code and as covered in detail in the Quality Assurance Instruction Data. The allowable leak rate of both penetration gas barriers in series, in prototype testing, is equal to, or better than, 1×10^{-6} standard cc/sec. of dry helium at 298°F and 54 PSIG. In production, each penetration assembly is subjected to a leak rate test at 54 PSIg and 78°F $\pm$5°F and will not exceed 1×10^{-6} standard cc/sec. through both penetration gas barriers in series. Due to controlled production processes, hermetically glass-sealed headers or gas barriers consistently better the leak rate of 1×10^{-6} by two orders of magnitude.

1.9 Cable Description

1.9.1 Internal Cables. The internal cables are directly terminated to glass-sealed contacts in receptacle connectors welded into the gas barriers. The electrical characteristics of the internal cables are identical to the purchaser's cables within the tolerances allowed.

1.9.2 External Cable Terminations. External customer cables are terminated to the plug connectors which mate with the appropriate receptacles welded to the gas barrier. All cables are crimped. They are designed and built to function in accordance with the requirements of the circuits they service. All conductors are insulated from each other and from ground.

1.9.3 The prototype and all production models are tested to the following:

A. Insulation:

1. Test Voltage - 500 VDC
2. Minimum Insulation Resistance

Conductor-to-conductor 1×10^9 ohms-feet

Conductor-to-ground 1×10^9 ohms-feet

Coaxial Cable

Conductor-to-inner shield 1×10^9 ohms-feet

Inner shield-to-ground 1×10^9 ohms-feet

B. Dielectric Strength:

Production:

Conductor-to-conductor 1500 VAC RMS

Conductor-to-ground 1500 VAC RMS

Coaxial cable

Conductor-to-inner shield 2000 VDC

Inner shield-to-ground 1500 VAC RMS

Table 1-1 summarizes the technical and design parameters

Type 5.2 - Containment Area Radiation Monitor Penetrator Design Parameter Summary

---

1. Number of Conductors	10 Times Wire & Cable P/N MI-31285 A) Two twisted shielded jacketed pairs Conductors: 22 AWG, 7/30 T/C PVC insulated .010" wall. Pair Twisted with #36 AWG T/C Braid and overall tape wrap. Color Code: Pair 1 1) White 2) White/Brown Pair 2 1) White 2) White/Red B) Coaxial Cable Conductor #26 AWG Tinned Copper weld insulation foam polyethylene shield #38 AWG T/C braid Jacket: Nylon Clear C) High Voltage Wire Conductor #22 AWG 7/30 T/C Insulation: PVC .025" wall D) Four single wires Conductor #22 AWG 7/30 T/C Insulation: PVC .010" wall Cable twisted together with tape wrap, braid shield #34 T/C and overwall PVC jacket. Finished O.D. .380"
2. Material and Size of Conductors: Signal	Coaxial cable: #26 AWG Solid Tin Plated Copper covered steel. All other conductors #22 AWG Stranded Tin Plated Copper (7/.010")
3. Conductor Insulating Material:	Coaxial Cable: Foam Polyethylene All other Conductors: Polyvinylchloride
Temperature Rating:	Coaxial Cable - 80°C All others - 85°C

4.	Provisions for Connection of Purchasers external cable	Receptacles
5.	High Potential Test on Production Assemblies for 10 seconds:	Coaxial Conductor-to-shield 2000 VDC Shield-to-ground 1500 VAC RMS All others: Conductor-to-conductor 1500 VAC RMS Conductor-to-ground 1500 VAC RMS
6.	Assembly Body Material	10" I.P.S. Sch. 20 Pipe, ASTM, A-333 GR-1 Carbon Steel
7.	End Header Plate Material	ASTM, A-442, GR-60 Carbon Steel or ASTM A-516, GR-70
8.	End Header Plate Conductor Material	Leaded Carbon Steel Per AISI, C1213 (Tin plated)
9.	End Header Plate Conductor Insulating Material	9010 Glass
10.	Assembly Dimension Body Outer Diameter Body Length	 10 3/4" 4' 5 1/4"
11.	Maximum Integrated Radiation Exposure	1.7×10^{8} Rad (1.5 MEV Gamma Rays)
12.	Maximum Total Assembly	2.24×10^{-5} cc. (Air) Min.
13.	Minimum Insulation Resistance @ 500 VDC:	1×10^{8} ohms-feet
14.	Total Assembly Calculated Weight	275 pounds
15.	Shipping Pressurization Testing Pressurization	15 PSIG Dry Nitrogen 54 PSIG Dry Nitrogen

6.0 WIRING

The following drawing (Figure 6-1) depicts the wiring diagram electrical connections of the Zion I and II Electrical Penetrations, Type 5.2 Radiation Monitoring Instrumentation Cable Service for normal non-accident duty.

7.0 TERMINATION INFORMATION

Prior to assembly of any hardware on the canister a review of D. G. O'Brien Drawing No. R19D2438G Pages 22 & 24 should be made to ascertain layout of the receptacles and sequence of the assembly on each canister furnished on Zion 1 and Zion 2, Item 5.2 & 5.2A "Containment Area Radiation Monitor Service" Normal Non-Accident Duty. This drawing illustrates location of receptacles and electrical connection sequence.

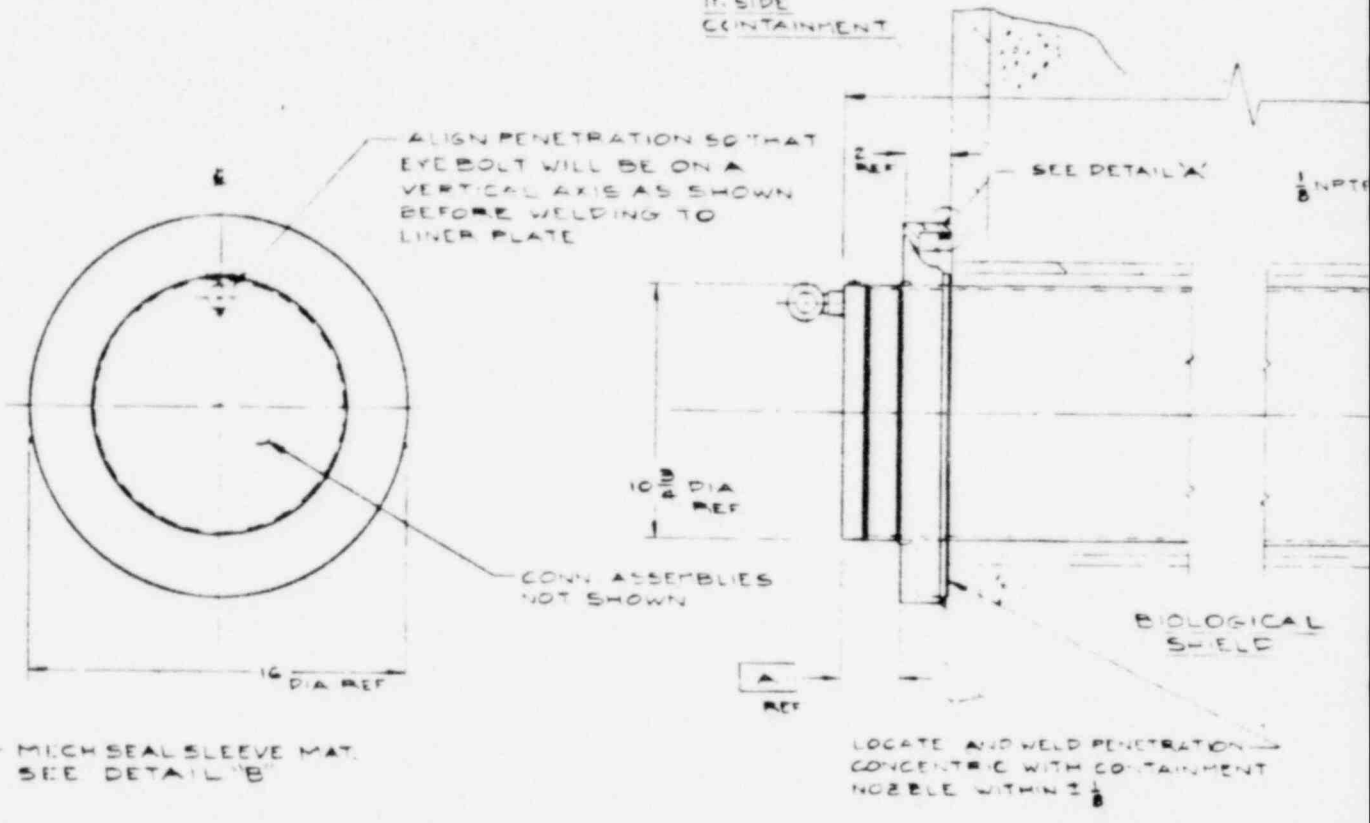
The hardware and material required to terminate each plug are included in the carton, Kit P/N 115-317, with each plug. Prior to any assembly work the plug should be inspected to ascertain that all parts are included within the kit and that the plug has not been damaged.

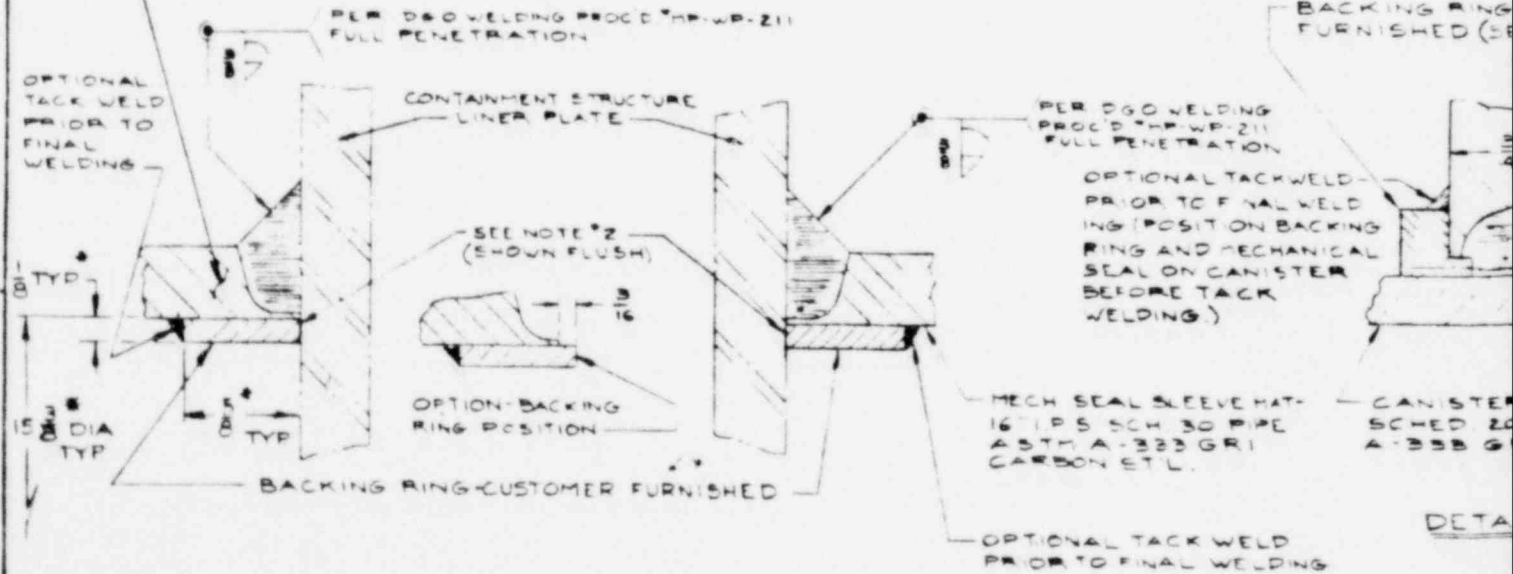
Purchasers Field Cables shall be prepared as outlined in D. G. O'Brien Inc. procedure No. 115-317 (Appendix E) for termination to the D. G.O'Brien Plug, Part No. R19C1002G04.

This Procedure should be read thoroughly prior to proceeding with any actual assembly. Tools should be assembled and prepared for installation including dies, heads, and handles. All work should be done in as clean an assembly area as possible. It should be free from any moisture, corrosive vapors and work hazards. The work area should be a well vented area since cleaning solvents will be required.

NOTES

1. WELD PER DGO WELD PROCEDURE "MP-WP-211
2. BACKING RING IN DETAILS 'A' AND 'B' MAY BE POSITIONED FLUSH WITH EDGE OF MECH SEAL ASS'Y. OR WITH UP TO 2/16 PROTRUSION. IF NOT POSITIONED FLUSH, C DIMENSION WILL VARY BY THE AMOUNT OF PROTRUSION ON EACH END.



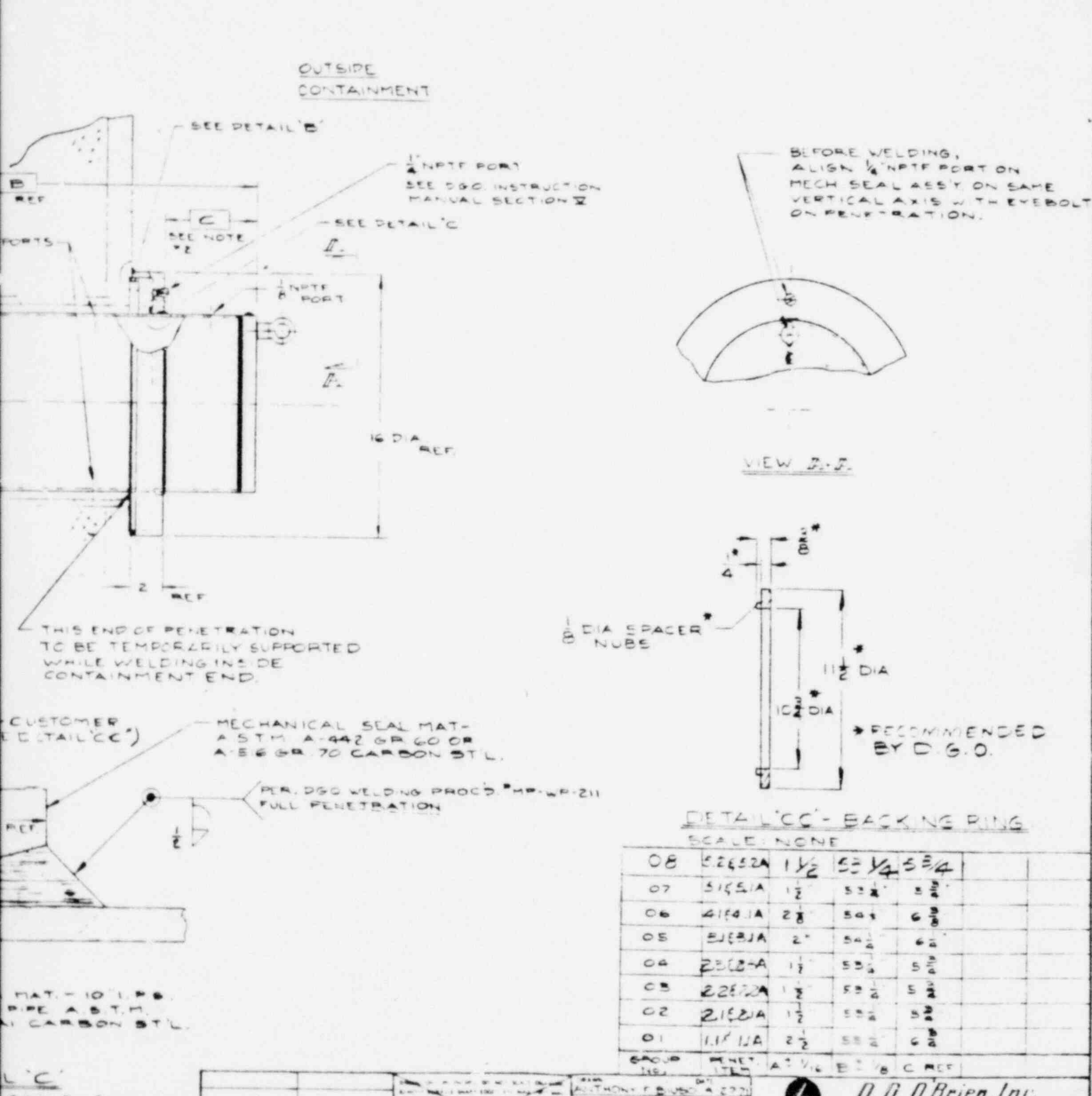


DETAIL 'A'
SCALE 2:1

DETAIL 'B'
SCALE 2:1

* RECOMMENDED BY DGO

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER ECO #1082	5-25-71	RSB
	B	REVISED PER ECO 1222	5-29-71	RSB



DETAIL 'CC' - BACKING RING

SCALE: NONE

08	5.2&5.2A	1 1/2	53 1/4	5 3/4		
07	5.1&5.1A	1 1/2	53 1/4	5 3/4		
06	4.1&4.1A	2 1/8	54 1/4	6 3/8		
05	3.1&3.1A	2"	54 1/4	6 1/4		
04	2.3&2.4A	1 1/2	53 1/4	5 3/4		
03	2.2&2.2A	1 1/2	53 1/4	5 3/4		
02	2.1&2.1A	1 1/2	53 1/4	5 3/4		
01	1.1&1.1A	2 1/2	53 1/4	6 3/4		
GROUP NO.	PENET. ITEM	A ± 1/16	B ± 1/8	C REF		

DRAWN	ANTHONY F BUSO 4-27-71
CHK	F SIIRA 5-8-71
ENGR	F S BUTTERS 5-10-71
APPROVED	[signature]
	COMMONWEALTH EDISON CO. ZION 1 & 2
NEXT ASSY	USED ON
APPLICATION	
MATERIAL/HEAT TREAT/FINISH	

D. G. O'Brien, Inc.

TYPICAL ELECTRICAL PENETRATION INSTALLATION ASSEMBLY

SIZE	CODE IDENT NO	DWG NO	REV
D	17476	F-19D2476G	B

SCALE 1:4 SHEET 1 OF 1

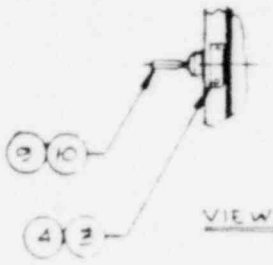
POOR ORIGINAL

8 | 7 | 6 | 5

D

DESIGNED, MFD
AND INSPECTED BY
GILBERT ASSOCIATES, INC.
READING, PENNSYLVANIA
DESIGN NO. 5281-SH-INSTR RM SERV.
DESIGN NO. 5281

NAMEPLATE DATA
ITEM 9



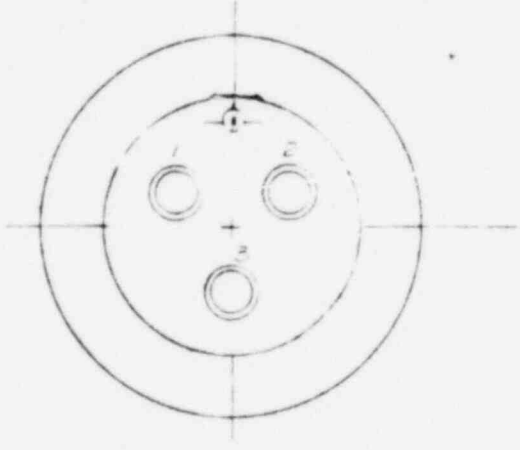
VIEW A-A

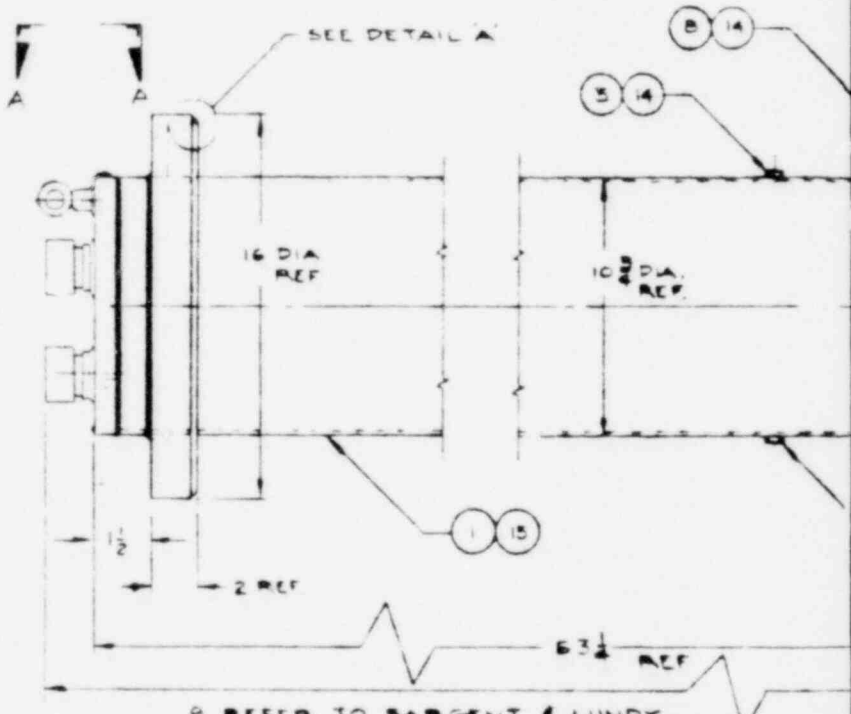
BACKING
CUSTOME

DETAIL 'A'

7
INSTALLED AT
FIELD INSTALLATION
IN PRESSURE GAUGE
ASSEMBLY PORT

C



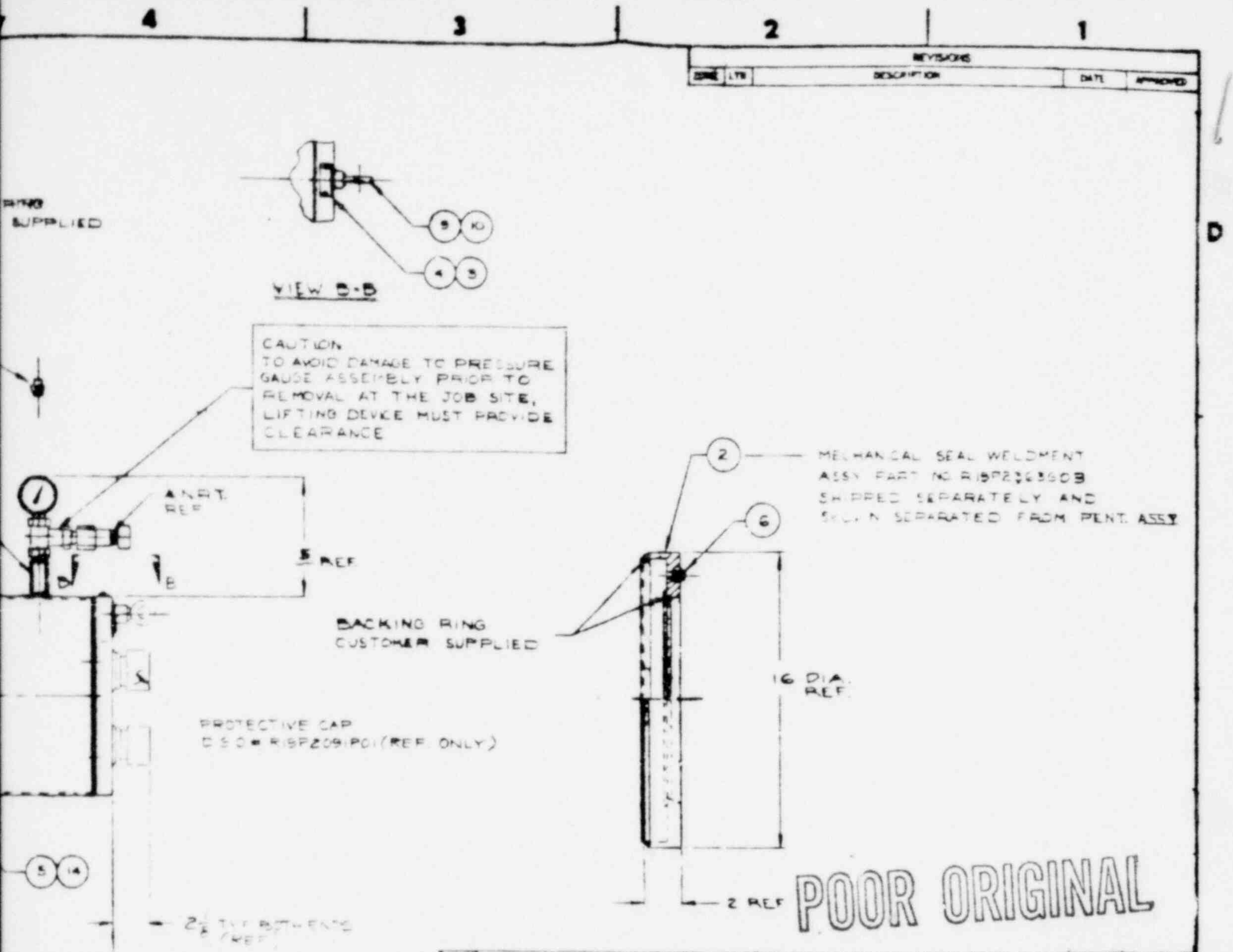


B

NOTES

1. THIS PENETRATION SHALL MEET THE REQUIREMENTS OF THE ASME BOILER AND PRESSURE VESSELS CODE, SECTION III, CLASS B VESSELS
2. DESIGN PRESSURE : 54 PSIG.
3. DESIGN TEMPERATURE 288°F FOR 1 HOUR FOLLOWED BY 271°F FOR 48 HOURS
4. MINIMUM DESIGN TEMPERATURE : 30°F
5. DESIGN RADIATION LEVEL : 1.7×10^8 RADS (1.5 MEV GAMMA RAYS) TOTAL INTEGRATED DOSE
6. RELATIVE HUMIDITY MAX DURING THE 40 YEAR LIFE INSIDE AND OUTSIDE CONTAINMENT 50%
7. PENETRATION SEISMIC TEST : 2 G'S AT 0 TO 33 HERTZ
8. FOR INSTALLATION WELDING ASSEMBLY SEE INSTALLATION DRAWING RSD2476GCB
9. REFER TO SARGENT & LUNDY SPECIFICATION X-2308 DATED OCT. 1, 1969 INCLUDING ADDENDA 1 & 2 AND DGO QUALITY ASSURANCE METHOD SHEET NO. TM-133-B FOR SPECIFIC TEST PARA
10. PROTECTIVE COAT ALL EXTERNAL CARBO STEEL SURFACES PER DGO PROC. MP-
11. APPROXIMATE WEIGHT 275 LBS.
12. FOR CABLE TERMINATION ITEMS USE CUS FIELD CABLE TERMINATION PROCEDURE, DES
13. USE ONLY "BAKERSEAL" THREAD SEALING CO ON ALL DRYSEAL PIPE THREAD ASSEMBLIES
14. PENETRATION INTERNAL SHIPPING PR 15 PSIG.

POOR ORIGINAL



ITEM NO	GROUP QTY REQD	QTY REQD	QTY REQD	QTY REQD	IDENTIFYING NO (DRAWING NO)	DESCRIPTION	REMARKS
1	1				R19P2367G11	Canister Weldment Assem.	
2	1				R19P2363G03	Mech. Seal WELDMENT ASSEM.	
3	1*				R19D[illegible]G06	[illegible]	SEE [illegible]
4	4				PS00C2A0002	[illegible] Screws	
5	2				PS0C3P0001	1/8" Pipe Plug	
6	1				PS0C3P0004	1/4" Pipe Plug	
8	1				[illegible]2483G01	Pressure Gauge Assem.	
9	1				PS0C02A0029	Eyebolt, Lifting	
10	A/R				PS00C1F0013	Washer, 5/16	
14	A/R				[illegible]	Taped Sealing Compound	
13	A/R				[illegible] 1700	Protective Coating (Corrocote)	
7	1				PS0C3P0005	1/8 PIPE PLUG (WELDABLE)	
11	6				13-317	CUSTOMER FIELD TERMINATION KIT	
3A	2*				R902861P119	NAME PLATE #ZION II ONLY	

R19D25446

COMMONWEALTH EDISON CO.

SEE PL R19P2438G6 ABOVE

ZION 1 & 2

D.G.O'Brien Inc.

PENETRATION ASSEMBLY TYPE 5.2 & 5.2A

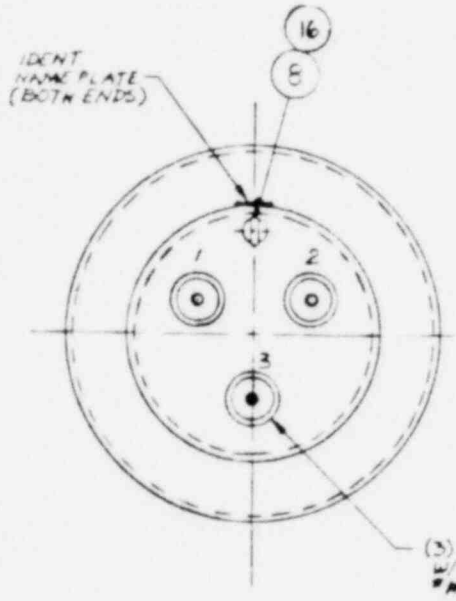
D 17476 R19D25446 —

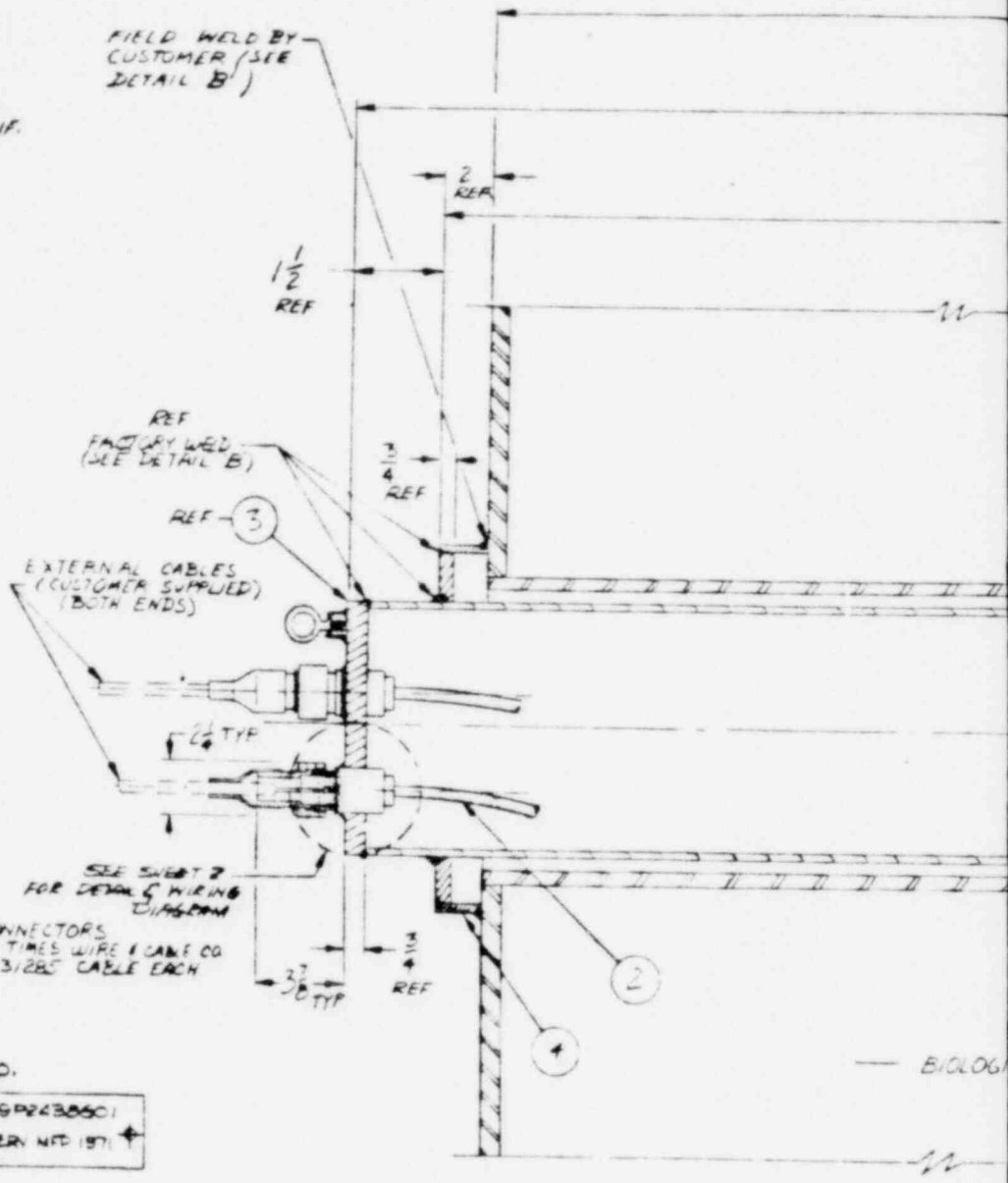
SCALE 1:4 SHEET 1 OF 1

INSIDE CONTAINMENT STRUCTURE

NOTES

1 ALL EXTERNAL CARBON STEEL SURFACES WILL BE PROTECTIVE COATED PER MFR PC-100 WITH CORICOVE NO. 1700 MFD BY THE CORICOVE CORP, LONG BEACH, CALIF.

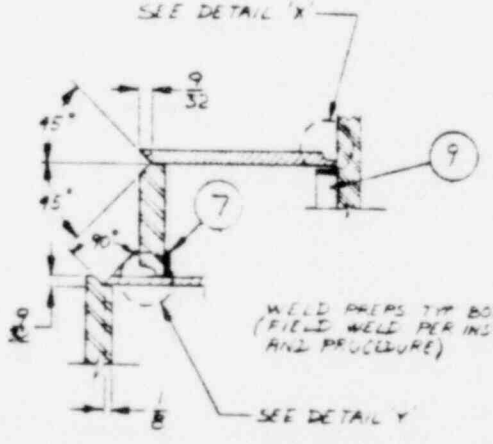




IDENT NAMEPLATE INFO.

D.G. OBRIEN INC. MODEL NO RSP2438SC1
SER NO [ ] SH. INSTR RM SER NO. 1971

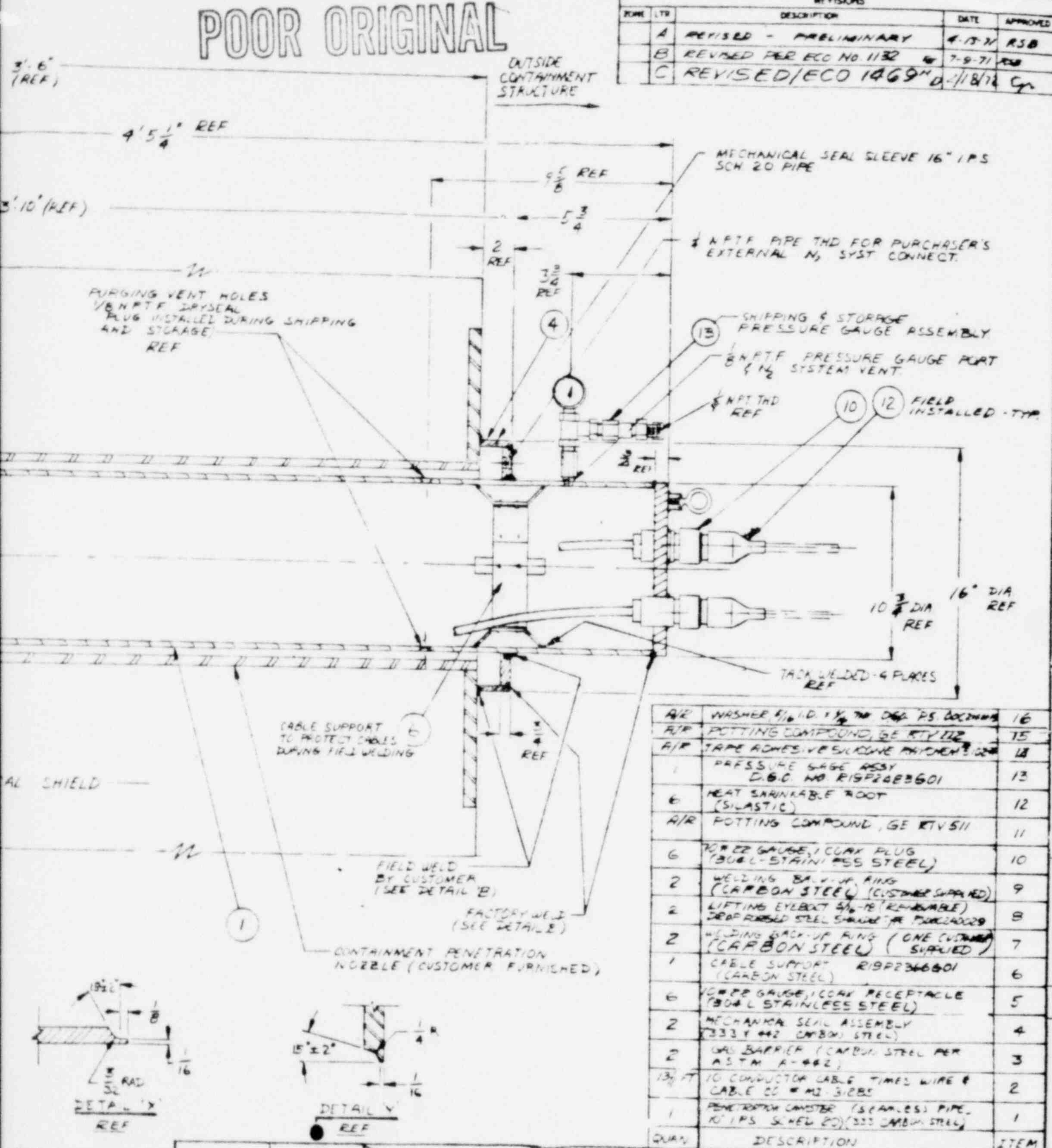
5.27 ± .01 DIA 1
5.24 ± .01 DIA 2



DETAIL 'B'

POOR ORIGINAL

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED - PRELIMINARY	4-13-71	RSB
	B	REVISED PER ECO No. 1132	7-9-71	RSB
	C	REVISED/ECO 1469	2/18/72	



QUAN	DESCRIPTION	ITEM
A/R	WASHER 5/16 I.D. x 1/4 ... P.S. ...	16
A/R	POTTING COMPOUND, GE RTV 112	15
A/R	TAPE ADHESIVE SILICONE ...	14
1	PRESSURE GAGE ASSY D.G.O. NO. R19F2483601	13
6	HEAT SHRINKABLE BOOT (SILASTIC)	12
A/R	POTTING COMPOUND, GE RTV 511	11
6	10 # 22 GAUGE, 1 COAX PLUG (304L-STAINLESS STEEL)	10
2	WELDING BACK-UP RING (CARBON STEEL) (CUSTOMER SUPPLIED)	9
2	LIFTING EYEBOLT 5/16-18 (REMOVABLE) DROP FORGED STEEL ...	8
2	WELDING BACK-UP RING (CARBON STEEL) (ONE CUSTOMER SUPPLIED)	7
1	CABLE SUPPORT R19F2366601 (CARBON STEEL)	6
6	10 # 22 GAUGE, 1 COAX RECEPTACLE (304 L STAINLESS STEEL)	5
2	MECHANICAL SEAL ASSEMBLY (333 Y 442 CARBON STEEL)	4
2	GAS BARRIER (CARBON STEEL PER ASTM A-442)	3
13 1/2 FT	10 CONDUCTOR CABLE TIMES WIRE & CABLE CO # MI-3128S	2
1	PENETRATION CANISTER (SEAMLESS PIPE, 10" IPS SCHED 20) (333 CARBON STEEL)	1

NEXT ASSY	R19D2506G
USED ON	
APPLICATION	
MATERIAL HEAT TREAT FINISH	SEE ABOVE
DRAWN	E.J.N. 20 APR 71
CHECKED	E. NAIMAN 3-27-71
ENG	R.S. BUTTERS 3-30-71
ISSUED	3-29-71
APPROVED	10/14/71
APPROVED	10/14

D. O. O'Brien, Inc.

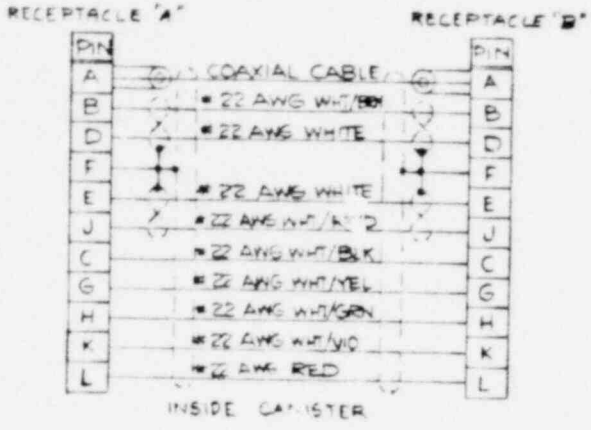
ELECTRICAL PENETRATION ASS'Y (TYPE E2 (E2A)) SHIELDED INSTRUMENTATION (CONTAINMENT AREA RADIATION MONITOR SERVICE) NORMAL NON ACCIDENT DUTY

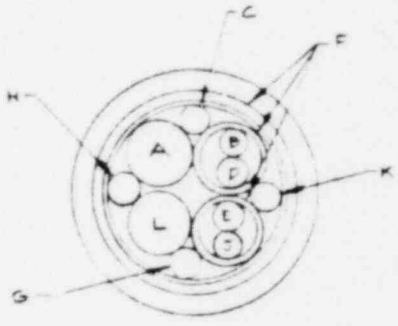
SIZE	CODE IDENT NO	DWG NO	REV
D	17476	R19D2438G	C

SCALE NONE — SHEET 1 OF 2

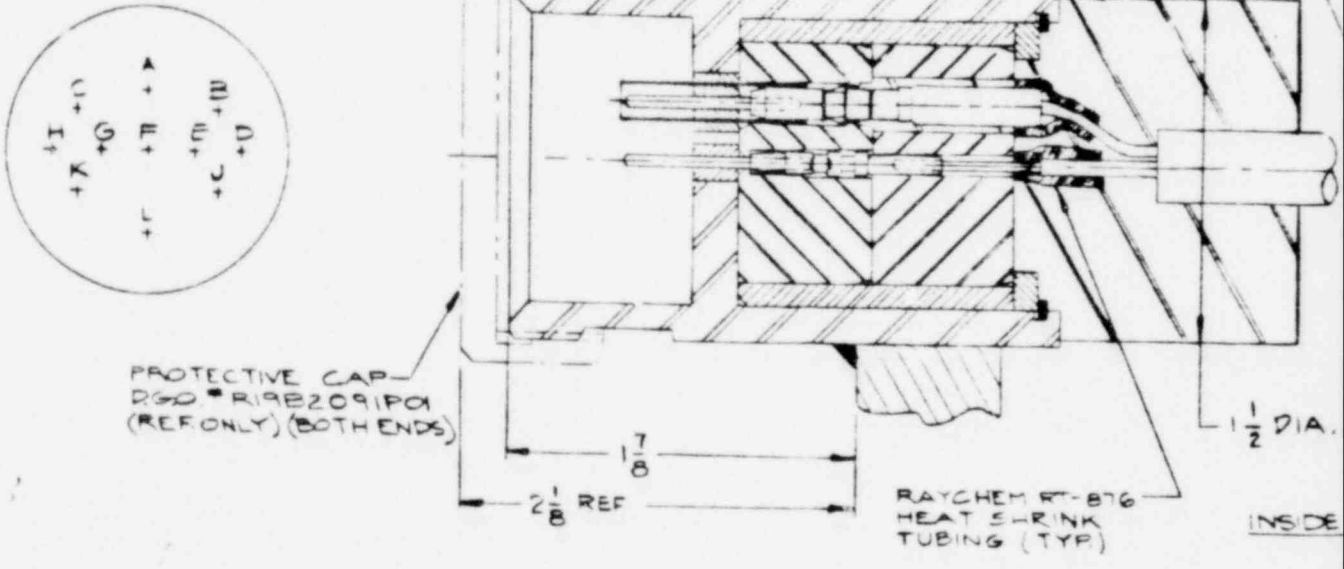
8 | 7 | 6 | 5

PUCK & CABLE ASSEMBLY
(REF 115-304)
SEE BELOW FOR TYPICAL VIEW





CABLE, TIMES WIRE
P/N MI-3285 REF

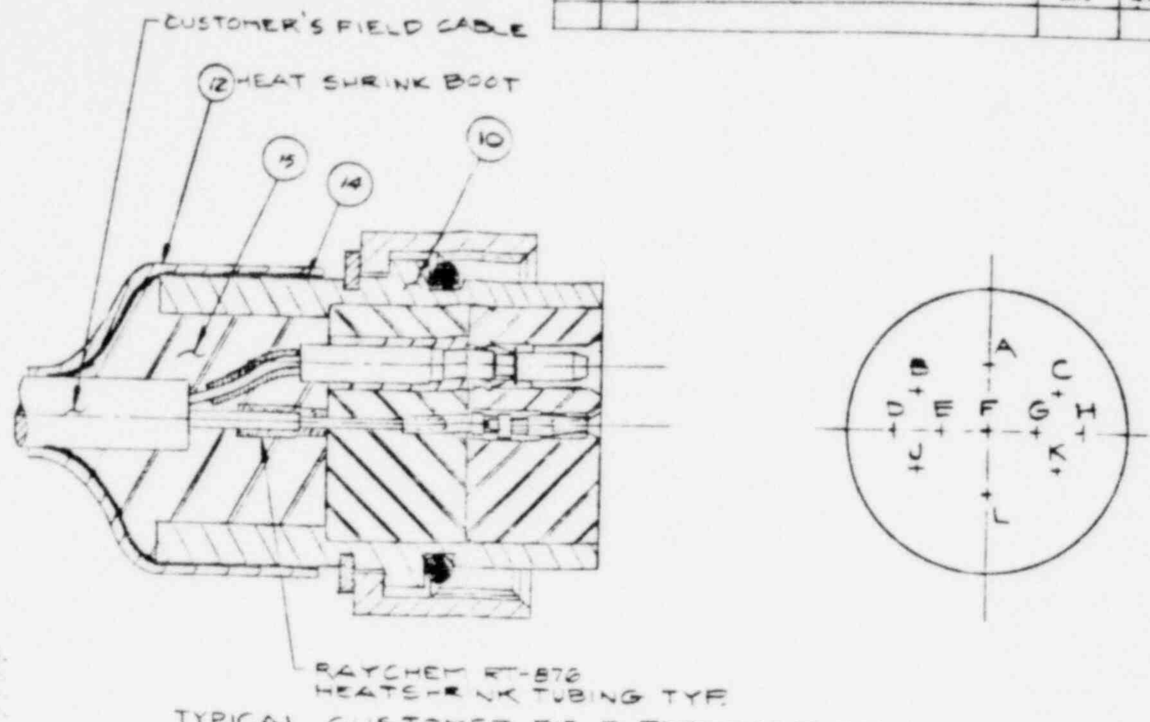


INSIDE CONTAINMENT

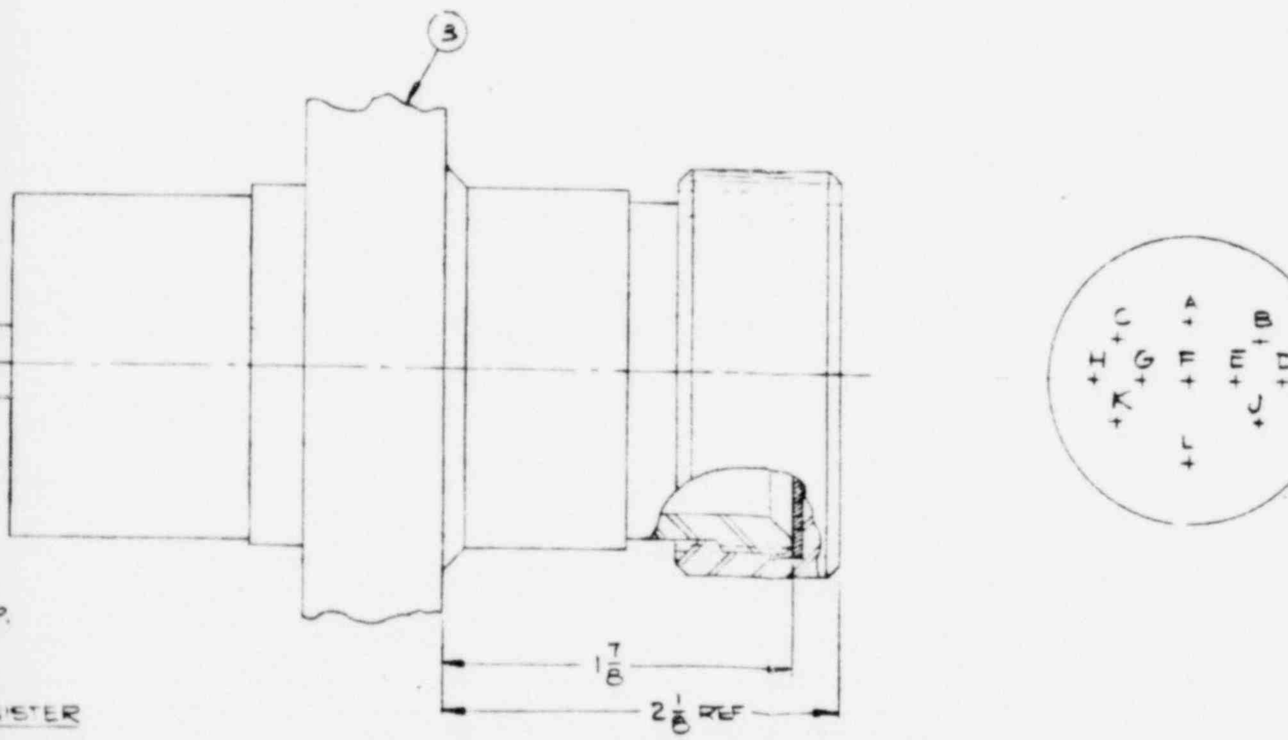
REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

n point shielded jacket #22 AWG
#22AWG 7/30 T/C .010"
VC (.020) .050"
#30 T/C Braid (Pin F) .135"
White/Brown (Pin B)
White (Pin D)
White (Pin E)
White/Red (Pin J)
Conductor (Pin A)
#26AWG Tinned Copper Weld .016"
Polyethylene .100"
#36AWG T/C .118"
lon (Clear) .129"
Lead (Pin L)
22AWG 7/30 T/C .030"
C (.025") .080"
Red
nductors
22AWG 7/30 T/C .030"
C (.010") .050"
White/Brn. (Pin C)
White/Violet (Pin K)
White/Yellow (Pin G)
White/Green (Pin H)
ctors twisted together
above .292" O.D.
Mylar .001" .296" O.D.
AWG T/C (Pin K) .315" O.D.
VC .360" O.D.



TYPICAL CUSTOMER FIELD TERMINATION
(REF. PROCEDURE 115-317)



YP.

NISTER

OUTSIDE CONTAINMENT

	R19D25446	DRAWN	D. G. O'Brien, Inc.
	COMMONWEALTH EDISON Co	MATERIAL/HEAT TREAT/FINISH	ELECTRICAL PENETRATION ASSY. TYPE 5.2 & 5.2A (3 SHIELDED INSTR'N) (CONTAINMENT AREA RADIATION MONITOR SERVICE) NORMAL NON-ACCIDENT DUTY
	BCN 1 & 2	APPROVED 10/14/71	SIZE D · CODE IDENT NO 17476 · DWG NO R19D24386 · REV C
NEXT ASSY	USED ON	APPROVED 10/14	SCALE — · SHEET 2 OF 2
APPLICATION			

3.3.3.8 Equipment No. 20
Reactor Building (Containment)
Junction Box
(Manufacturer not stated)
Model: Type EB-215
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.9 Equipment No. 21
Reactor Building (Containment)
Junction Box
(Manufacturer not stated)
Model: Type EB-214
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.10 Equipment No. 22
Reactor Building (Containment)
Junction Box
(Manufacturer not stated)
Model: Type EM-47150
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.11 Equipment No. 23
Nuclear Instrumentation - Junction Box
(Manufacturer not stated)
Model: Not stated
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.12 Equipment Item No. 28
Cables Located Within Containment
Kerite Corporation (Various Types)
Submittal Page References 6 and 11

Response:

The response to TER Item 3.3.2.11 is also applicable to this item. The Bill of Material was incorrectly interpreted as to the type of insulation and jacket materials. Page 3 of Bill of Material A-101, indicates the actual cable purchased, with Kerite "HT" insulation and Kerite "FR" and "NS" jackets. It should be noted that the Bill of Material as originally drafted suggested five specific combinations of insulation and cover while encouraging the bidder to submit qualified alternatives (refer to Item A-101, Paragragh 5, Page 1. The Bill of Material was subsequently revised to reflect the actual purchased insulation-cover combination. Adequate records exist and are available at Zion Station to provide complete traceability for the cable manufactured by Kerite and subsequently installed at Zion Station. These records consist of shipment invoices from Kerite referencing specific cable reels, Test Reports for each cable reel referencing cable type (conductor, insulation, jacket material) and cable pull cords referencing individual cables pulled from specific reels.

Franklin Research Center in our August 27, 1980 meeting at Bethesda, raised a concern about the compounds used in the Zion cables being identical to the compounds used in the cables tested and covered by Franklin Institute Test Report FC-2737.

The attached letter to H. K. Stolt from R. M. Bowman (Kerite Company) dated August 28, 1980 states that the same compounds were used in the Zion cables and test specimen cables.

The concern of preaging the cables prior to LOCA testing is also addressed in the above referenced letter.

3.3.3.13 Motor Located in the Auxiliary Building (A-8)

Submittal Page References: 23, 24

Plant ID Numbers: FW004
FW005
FW006

Response:

These are the auxiliary feedwater pump motors. A letter has been sent to Westinghouse requesting available documentation regarding qualification tests for specific environmental parameters and traceability documentation. FSAR Q10.16 gives the motor nameplate data and justification for operability during adverse environmental conditions. The turbine-driven auxiliary feedwater pump will be operable without the lube oil pump motor. Therefore, the pump will be available for use after a high energy line break in the auxiliary building.

With regard to motor insulation, Westinghouse has replied as follows:

"The thermal and radiation endurance of the thermalastic epoxy insulation system described in WCAP-8754 is also representative of the thermal and radiation endurance of motors supplied with this system prior to the establishment of IEEE 323-1974. Westinghouse has verified that the HSDP Motor Driven Auxiliary Feedwater Pump Motors and HSDP Centrifugal Charging Pump Motors at Zion utilize the thermalastic epoxy insulation system."

3.3.3.14 Equipment Item No. 34
Westinghouse Electric Indicator Model VX-252
Reactor Coolant Pressurizer Pressure and
Pressurizer Level
Submittal Page Reference 45
Qualification Reference 20 does not apply to this indicator.

PI-455B LI-459B

Response:

These indicators are located in a non-harsh environment for LOCA. Qualification is by experience. These indicators are not required to function after high energy line break. Therefore, no qualification is required.

3.3.3.15 Equipment Item No. 35
United Electric Pressure Switch Model J110-164
Service Water Pumps Start
Submittal Page Reference 49

1PSL-SW13 - Service Water Pump 1A
1PSL-SW14 - Service Water Pump 1B
1PSL-SW15 - Service Water Pump 1C

Response:

These switches do not perform a safety function and are not required to operate after an accident. The service water pumps are started automatically by engineering safety feature actuation.

The control circuit for the service water pump 1A is shown on Drawing 22E-1-4840, Page SW1 (attached). The control circuit for service water pumps 1B and 1C are shown on Drawing 22E-1-4840, Pages SW2 and SW3 respectively. Since the control circuit is identical for pumps 1A, 1B and 1C (likewise for Unit 2) the following analysis is equally applicable to all service water pumps.

The three possible failure modes for the pressure switches are 1) contacts shorting together, 2) contacts failing to close, and 3) contacts shorting to ground.

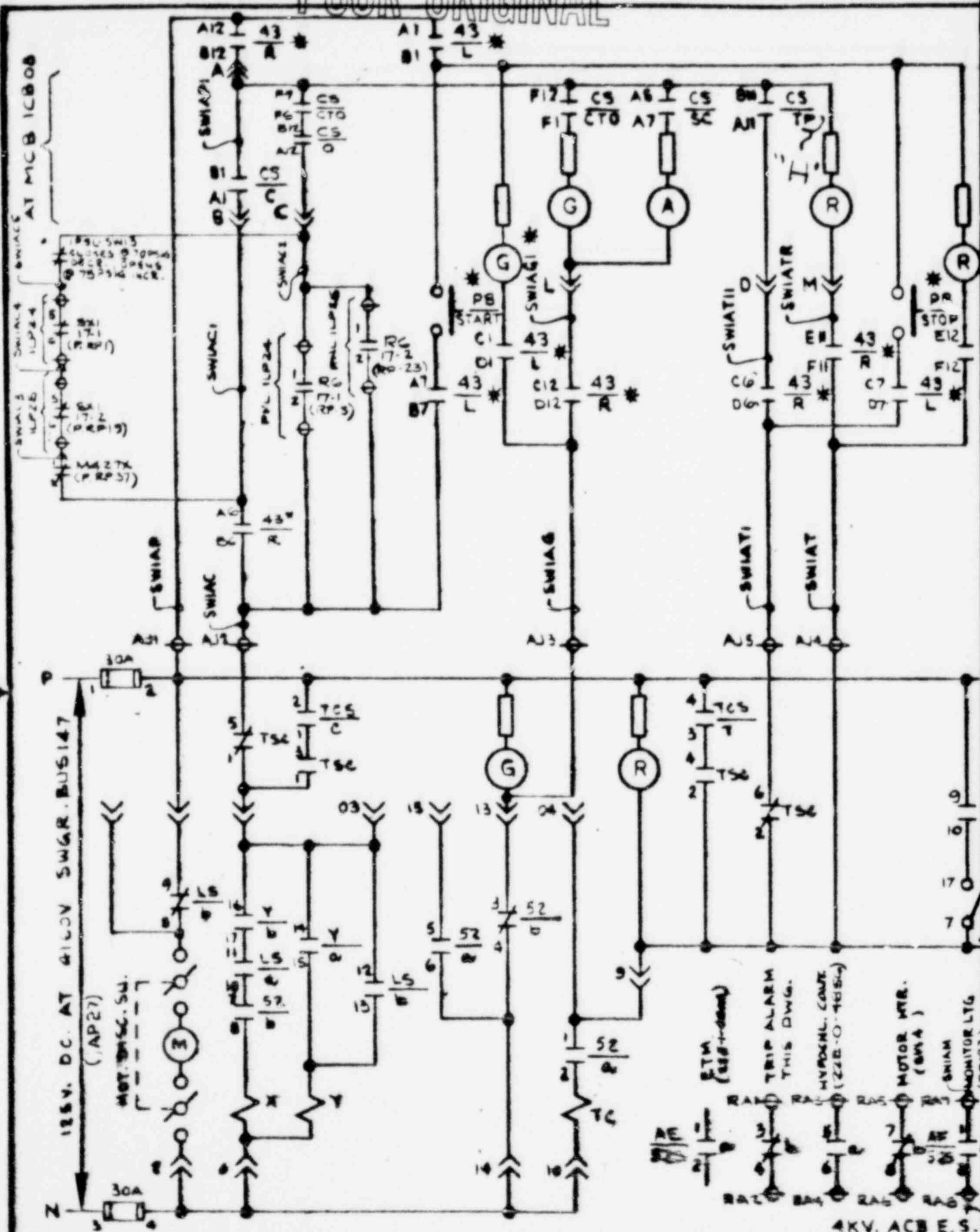
For the failure mode of the contacts shorting together, the service water pump would be started (assuming the remainder of the control functions are aligned for auto-start) thereby giving additional service water pumping capacity.

For the failure mode of the contacts failing to close, the service water pump would remain in its standby state of readiness and would be started by the automatic safety actuation circuits.

For the failure mode of the pressure switch contacts shorting to ground, an alarm would be sounded (in the control room) indicating a ground on the normally ungrounded 125V DC system. No control action of the service water pump would be affected since both polarities of the 125V dc control circuit are ungrounded, and the fuses will not "blow" until a second ground occurs in the opposite polarity. Zion Procedure ("DC Ground Location Procedure") calls for locating and removing all grounds on the DC systems as soon as detected.

3.3.3.15 (Cont'd)

Therefore, no failure mode exists which will degrade the service water pump control circuitry due to the use of an unqualified pressure switch.

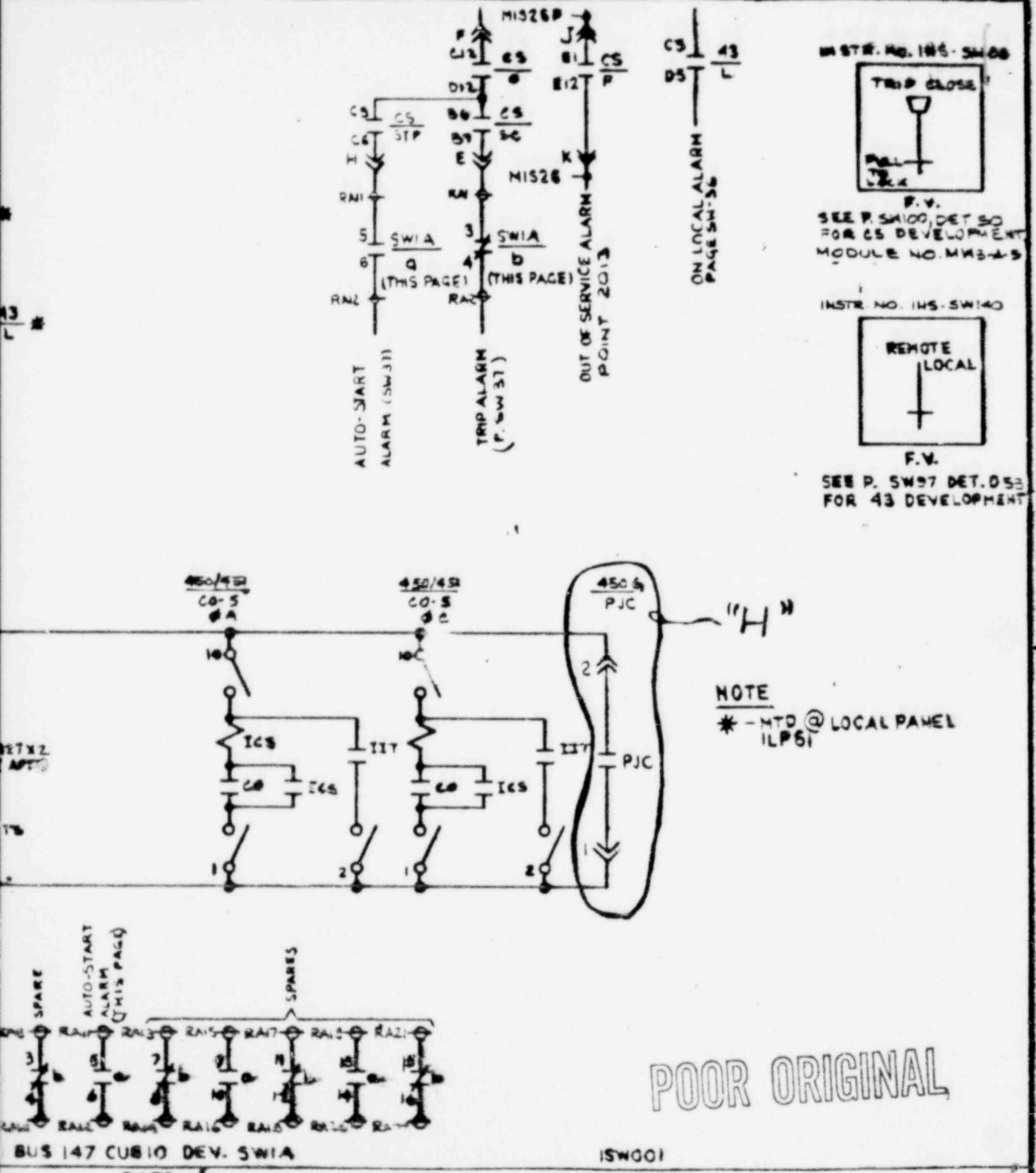


REVISIONS

A	3-24-71	G.H.	PDG CONSTRUCTION SPEC. X-2523	E	3-15-72	G.H.	REV. 1PSL-SW14 INTK CONNECTION
B	10-18-71	J.S.	ADDED TEST SWITCH	F	4-24-72	G.H.	[illegible]
C	11-23-71	A.S.	REV. CONT. SW. & RLY CON.	G	6-9-72	B.S.	ADDED AUTO-START ALARM
D	5-1-72	MM	[illegible] REVISED DESCRIPTION	H	3-30-73	MLS	[illegible]

DRAWN L. SMI[illegible]
CHECKED A. SA[illegible]
ENGINEER [illegible]

214



POOR ORIGINAL

	DATE
DRA	2-26-72
CHK'D	3-1-71
APPD	3-29-71

SERVICE WATER PUMP 1A

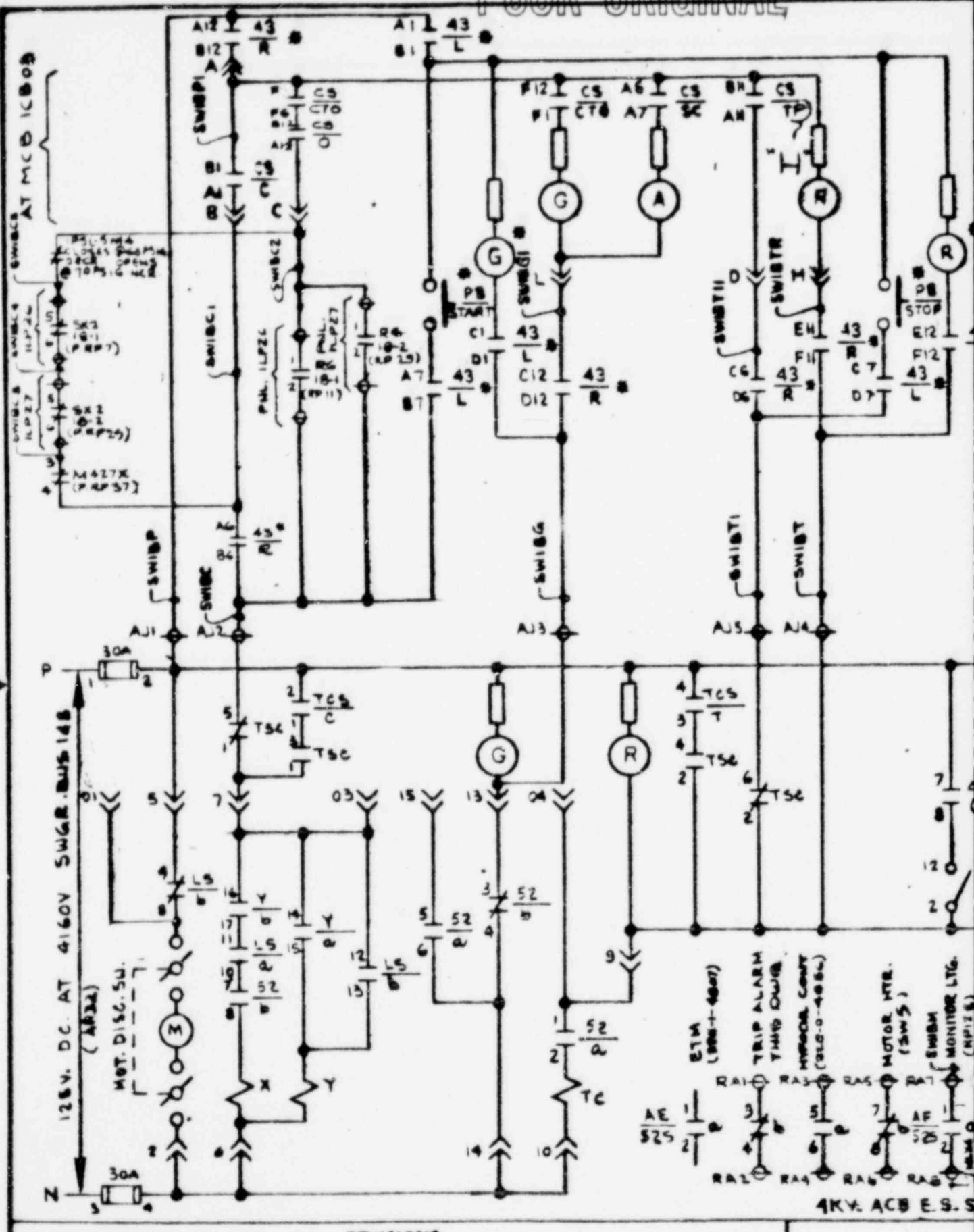
SCHEMATIC DIAGRAM
ZION STATION
UNIT 1
COMMONWEALTH EDISON CO
CHICAGO ILLINOIS

JOB NO. 3782

DWG NO. 22E-1 [illegible]

PAGE SW1

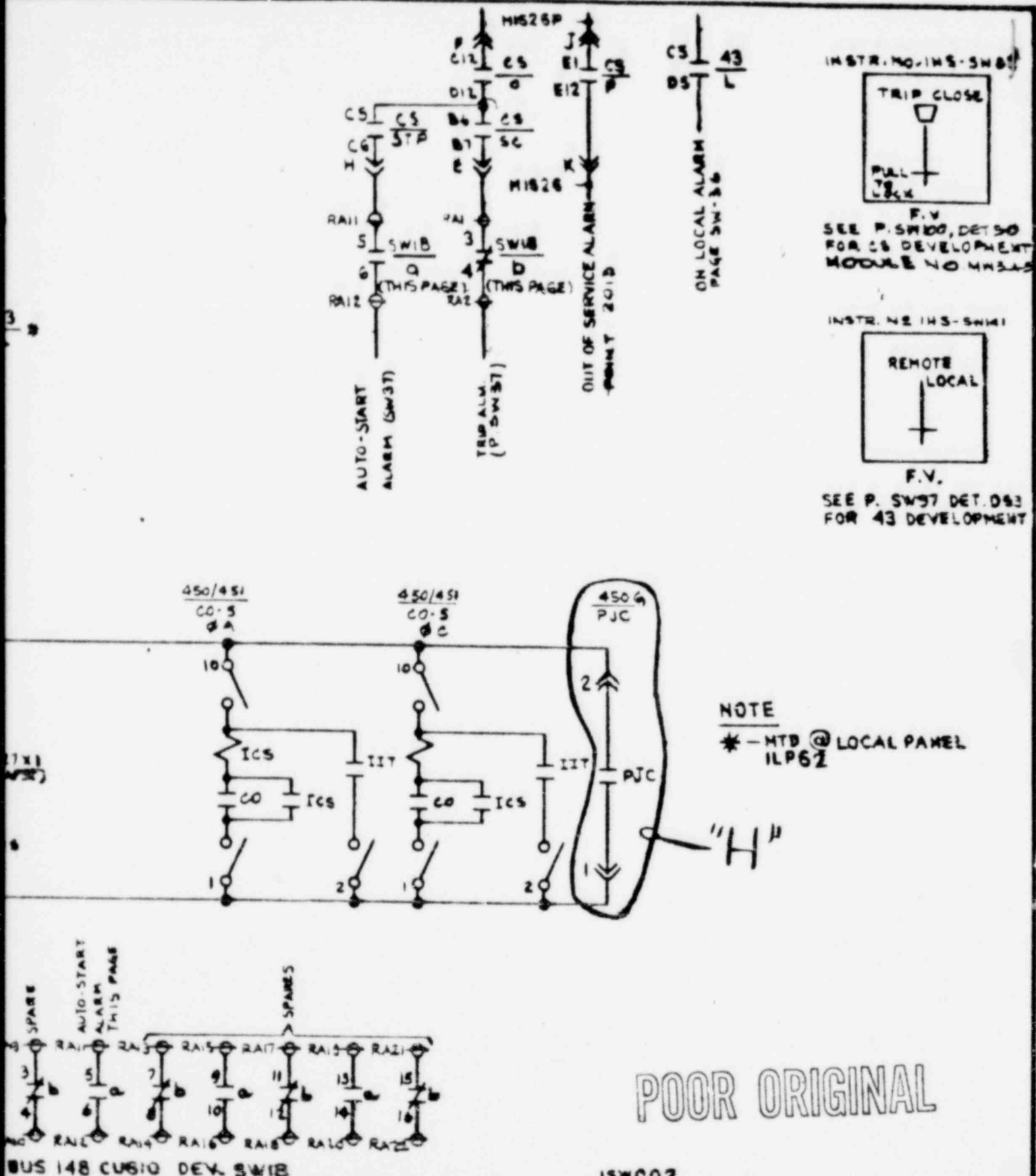
ERASE WITH WATER



REVISIONS							
A	8-31-71	G.H.	FOR CONSTRUCTION	E	3-16-72	C.R.	
B	10-18-71	V.S.	ADDED TEST SWITCH	F	4-24-72	G.H.	
C	11-22-71	A.S.		G	6-9-72	B.S.	ADDED AUTO-SYNC ALARM
D	3-1-72	M.M.		H	3-30-73	M.L.S.	

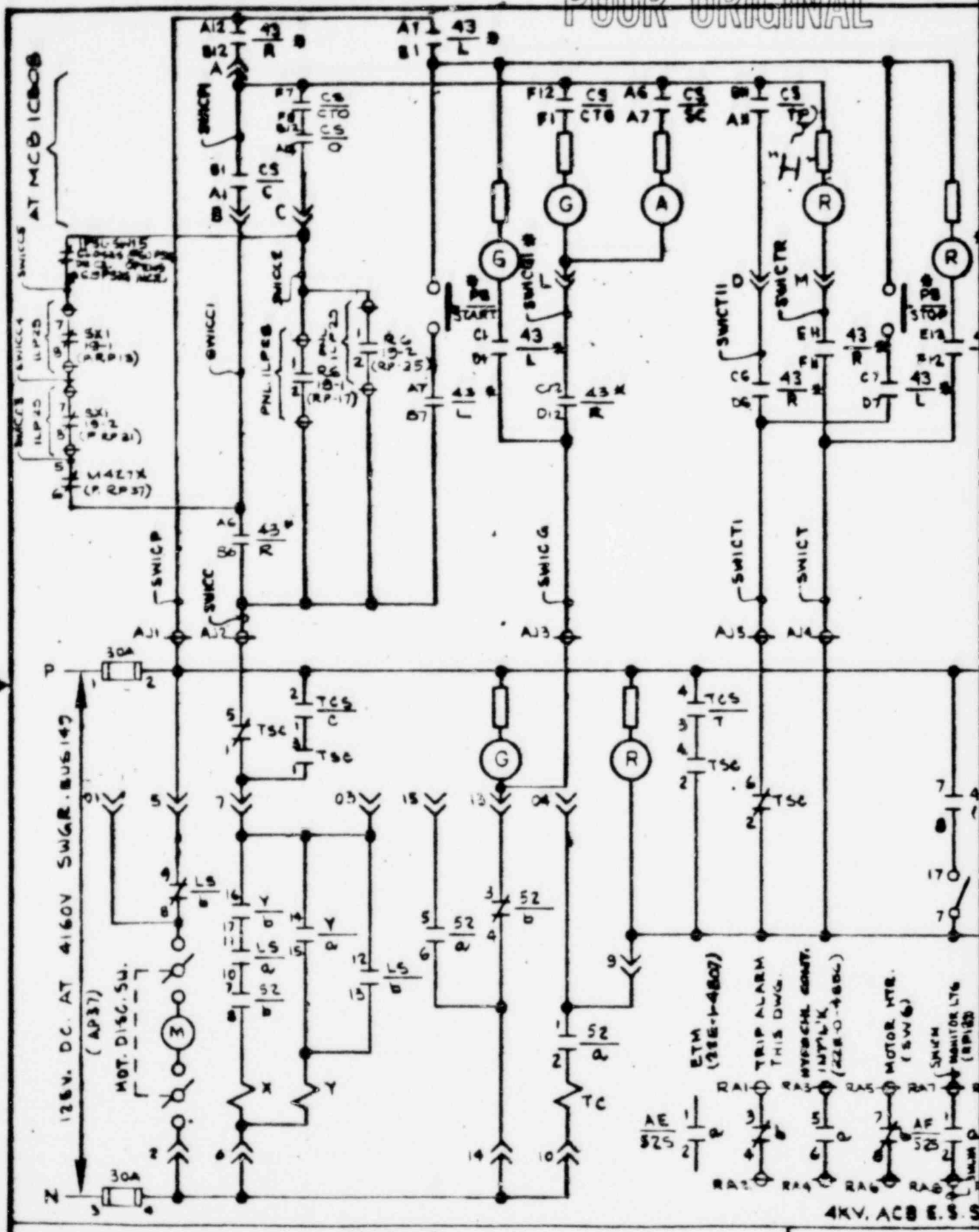
DRAWN L. SIMIA
CHECKED A. SAN
ENGINEER C. C

5/12



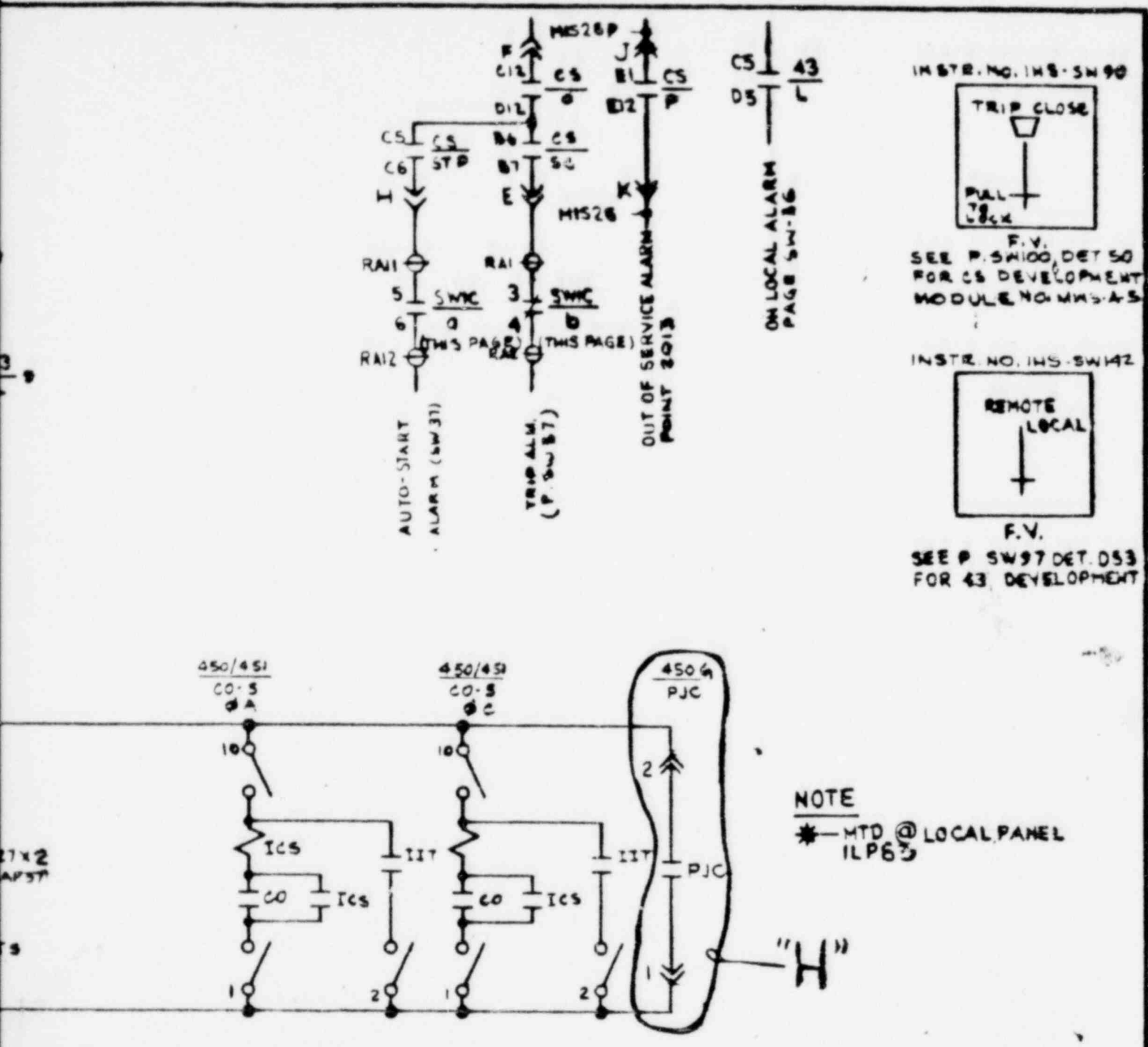
DATE	SERVICE WATER PUMP 1B		
DRA 2-26-71	SARGENT & LUNDY CHICAGO	SCHEMATIC DIAGRAM ZION STATION UNIT 1 COMMONWEALTH EDISON CO CHICAGO ILLINOIS	JOB NO. 3782
CHKD 3-1-71			DWG. NO. 22E-1-4840
APPD 3-29-71			PAGE SW2

ERASE WITH WATER



REVISIONS							
A	8-24-71	G.R.	[illegible]	E	2-15-72	GH.	REV. [illegible]
B	10-18-71	J.S.	ADDED TEST SWITCH	F	4-24-72	GH	[illegible]
C	11-22-71	A.S	REV CONT SW / RLY CONTACT	G	6-9-72	B.S.	ADDED AUTO-START ALARM
D	8-1-73	MM	REMOVED [illegible]	H	3-30-73	MLS	[illegible]

DRAWN L. SI[illegible]
CHECKED A. S[illegible]
ENGINEER C. [illegible]



POOR ORIGINAL

DATE				
SKA	8-26-71	SERVICE WATER PUMP 1B		
CHGS	9-1-71	SCHEMATIC DIAGRAM ZION STATION UNIT 1 COMMONWEALTH EDISON CO CHICAGO ILLINOIS	JOB NO. 3782	DWG NO. 22E-4-4840
Seattle	3-29-71	SARGENT & LUNDY CHGO		PAGE SW3

3.3.3.16 Equipment Item No. 36A (Unit 1 only)
Distribution Panel Located in the Auxiliary
Building (A-8)
Fischbach-Hatfield B/M C458
Submittal Page Reference 53 and 54

Response:

This equipment was incorrectly included in the report. The equipment involved are distribution panels for Motor-operated Valve (MOV) heaters. Since the MOV heaters do not perform a safety function the distribution panels are not needed.

3.3.3.17 Equipment Item No. 36B (Unit 2 only)
Motor Control Center (MCC 2383B) Located
in the Auxiliary Building (A-8)
General Electric 7700 Line,
480 Volt
Submittal Reference Page 50

Response:

This motor control center while supplying loads (services) which may be used to mitigate the consequences of a LOCA or HELB inside the containment will not be subjected to a harsh environment at that time. For a HELB (Auxiliary Steam Line Break), outside of containment, the motor control center will be subjected to a harsh environment. The Licensee is currently identifying the electrical components and instrumentation required to operate to mitigate the consequences of the postulated HELB. This list of components will be submitted as part of Appendix F, "Equipment Required To Operate After High Energy Line Break In Auxiliary Building" on September 27, 1980.

The complete list of loads (services) served by motor control center MCC 2383B is shown on Drawing 22E-2-4000AN. A copy of this drawing was given to Mr. S. J. Crane at Bethesda on August 27, 1980, as our response to Appendix D concerns.

3.3.3.18 Equipment Item No. 38 (Unit 1 only)
Junction Boxes Located in the
Auxiliary Building (A-8)
General Electric 7700 Line,
480 Volt
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.19 Motor Located in the Auxiliary Building (A-9)

Submittal page references: ??

Plant ID number: 1PP001

Response:

This is the penetration pressurization air compressor motor. The equipment is required only after a LOCA or main steam/feedwater line break inside containment. For these accidents the equipment is located in a non-harsh environment. Qualification by experience.

3.3.3.20 Hydrogen Recombiner Located in the Auxiliary Building (A-9)

Submittal Page Reference: 33

Plant ID Number: RV050

Response:

This equipment is required to function following a LOCA. However, for the LOCA zone A-9 is considered a non-harsh zone and will not see elevated parameters. Qualification is by experience.

Due to its service, the motor in the blower assembly may see high radiation. The Licensee is performing calculations to verify that the radiation exposure to the motor following a LOCA does not exceed 10^4 rads. Results will be submitted by September 27, 1980.

A letter has been sent to Rockwell requesting available test report documentation and traceability documentation.

3.3.3.21 Hydrogen Purge Fan Motor Located in the Auxiliary Building (A-9)

Submittal Page Reference: 36

No Licensee reference

Equipment ID numbers: RV020
RV021

Response:

This equipment is required to function following a LOCA. However, for the LOCA Zone A-9 is considered a non-harsh zone and will not see elevated parameters. Qualification therefore is by experience.

Due to its service, the motor may see high radiation. The Licensee is performing calculations to verify that the radiation exposure to the motor following a LOCA does not exceed 10^4 rads. Results will be submitted by September 27, 1980.

3.3.3.22 United Electric Temperature Switch Model C300

Hydrogen Purge Charcoal Filter Temperature

Equipment Item No. 43A

Plant ID Numbers: PS-RV128 A,B
PS-RV129 A,B

Response:

These switches are required to function following a LOCA. However, for the LOCA zone A-9 is considered a non-harsh zone and will not see elevated parameters. Qualification is by experience.

Due to their service, the switches may see high radiation. The Licensee is performing calculations to verify that the radiation exposure to the switches following a LOCA does not exceed 10^4 rads. Results will be submitted by September 27, 1980.

3.3.3.23 Equipment Item No. 43B (Unit 2 only)
Junction Box Located in the
Auxiliary Building (A-9)
Type EB-214
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.24 Equipment Item No. 44
Magnetrol Level Transmitter 82-1212-002
Spray Additive Tank Level
Submittal Page Reference 40

LIS-CS44
LIS-CS45

Response:

These level transmitters are located in a non-harsh environment after LOCA. Therefore, qualification is by experience.

These transmitters are not required to operate after HELB. Therefore, no qualification is required. These Magnetrol switches have replaced the Endress-Houser switches which were used in the June 1980 submittal to Franklin Institute.

3.3.3.25 Equipment Item No. 45
Nuclear Measurement Corporation Radiation
Detectors Models

GM-912, SC-2-15, SC-2B

Auxiliary Building Radiation
Submittal Page Reference 46, 47, 48

ORE-AR08 ORE-AR09

Response:

These radiation detectors are not required to operate after LOCA or HELB. Therefore, no qualification is required.

3.3.3.26 Equipment Item No. 47
Control Panel Located in the
Auxiliary Building (A-9)
Powers Regulator Company
Submittal Page Reference 59

Response:

These panels, 1LP22 and 2LP22, serve the Containment Ventilation System. These panels will not be subjected to a harsh environment due to a LOCA or HELB inside containment and also do not contain any components required to mitigate a HELB outside the containment.

3.3.3.27 Equipment Item No. 48
Junction Box Located in the
Auxiliary Building (A-9)
Type EM-47150
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.28 Equipment Item No. 49
United Electric Pressure Switch J302-358
Penetration Pressurization
Submittal Page Reference 50

OPSL-PP01A	1PSL-PP23
OPSL-PP10B	2PSL-PP22

Response:

These switches are located in a non-harsh environment after LOCA and HELB inside containment. Therefore, qualification is by experience.

3.3.3.29 Equipment Item Nos. 50, 51
Junction Boxes Located in the
Auxiliary Building (A-9)
Types EM-47159 and EB-214
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.30 Equipment Item No. 54A (Unit 1 only)
Control Panel Located in the Auxiliary
Building (A-12)
Westinghouse, Waste Gas and
Recovery Panel
Submittal Page Reference 60

Reference:

This panel is not needed to mitigate the consequences of a LOCA or HELB and should not be included in report.

3.3.3.31 Equipment Item No. 54B
Junction Boxes Located in the
Auxiliary Building (A-12)
Type EB-214
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.32 Equipment Item No. 55
Junction Boxes Located in the
Auxiliary Building (A-12)
Type EM-47150
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.33 Pump Motor Located in the Auxiliary Building (A-14)

Submittal Page References: 15, 16

No Licensee reference

Pump ID Numbers:		
	VC006	Centrifugal Charging Pump
	VC007	Centrifugal Charging Pump
	VC008	Reciprocal Charging Pump

Response:

Long-term operation is required for LOCA or main steam/feedwater line break for VC006 and VC007. For the LOCA the only harsh parameter is radiation. Also, these pumps are required long-term for a high energy line break in the auxiliary building. A letter has been sent to Westinghouse requesting test report documentation and traceability documentation. Justification for pump operability is provided in the FSAR, Q10.16.

VC008 is not required to operate after a LOCA or main steam/feedwater line break. Qualification not needed.

With regard to the motor insulation for the centrifugal charging pumps, Westinghouse has replied:

"The thermal and radiation endurance of the thermalastic epoxy insulation system described in WCAP-8754 is also representative of the thermal and radiation endurance of motors supplied with this system prior to the establishment of IEEE 323-1974. Westinghouse has verified that

3.3.3.33 cont'd

the HSDP Motor Driven Auxiliary Feedwater Pump Motors and HSDP Centrifugal Charging Pump Motors at Zion utilize the thermalastic epoxy insulation system."

3.3.3.34 Unit Cooler Fan Motors Located in the Auxiliary Building (A-14)

Plant ID Numbers: AV010
AV011
AV012

Response:

Long-term operation is required after an accident. A letter has been sent to Westinghouse to obtain available qualification test reports and traceability documentation.

3.3.3.35 Equipment Item No. 59 (Unit 1 only)
Thermostat Located in the
Auxiliary Building (A-14)
Penn Model A-28-AA37
Submittal Page Reference 38

0TS-AV99 - Residual Heat Removal Pump 1A
0TS-AV100 - Residual Heat Removal Pump 1B
0TS-AV101 - Residual Heat Removal Pump 2B
0TS-AV102 - Residual Heat Removal Pump 2A
0TS-AV103A - Containment Spray Pump 1A
0TS-AV103B - Containment Spray Pump 1B
0TS-AV104 - Safety Injection Pump 2A
0TS-AV105 - Safety Injection Pump 2B
0TS-AV106A - Containment Spray Pump 2A
0TS-AV106B - Containment Spray Pump 2B
0TS-AV107 - Safety Injection Pump 1B
0TS-AV108 - Safety Injection Pump 1A
0TS-AV109 - Charging Pump 2C
0TS-AV110 - Charging Pump 2B
0TS-AV111 - Charging Pump 2A
0TS-AV112 - Charging Pump 1C
0TS-AV113 - Charging Pump 1B
0TS-AV114 - Charging Pump 1A

Response:

These components are not required to operate after a LOCA or HELB. The cubicle coolers are started automatically, whenever their associated safety system pump is started. The control circuit for the cubicle coolers associated with Centrifugal Charging Pump 1A (shown on Drawing 22E-1-4840, Page AV7) is typical of the control circuit for all the pumps listed above.

Schematic Diagrams for the Residual Heat Removal Pump 1B unit cooler and the Safety Injection Pump 1A unit cooler are shown on Drawing 22E-1-4840, Pages AV2 and AV3 respectively. Copies of these drawings are enclosed for your use.

Note: The control circuit for the Centrifugal Charging Pump 1A Unit Cooler will be discussed. All other coolers are similar.

The thermostat (0TS-AV114), as well as the push-button shown on the schematic (Page AV7), do not perform a safety function and their failure will not impair the operation of the cubicle coolers. The possible failure modes for the thermostat, as well as the pushbutton, are 1) contacts short together, 2) contacts fail to close (remain open), and 3) contacts short to ground.

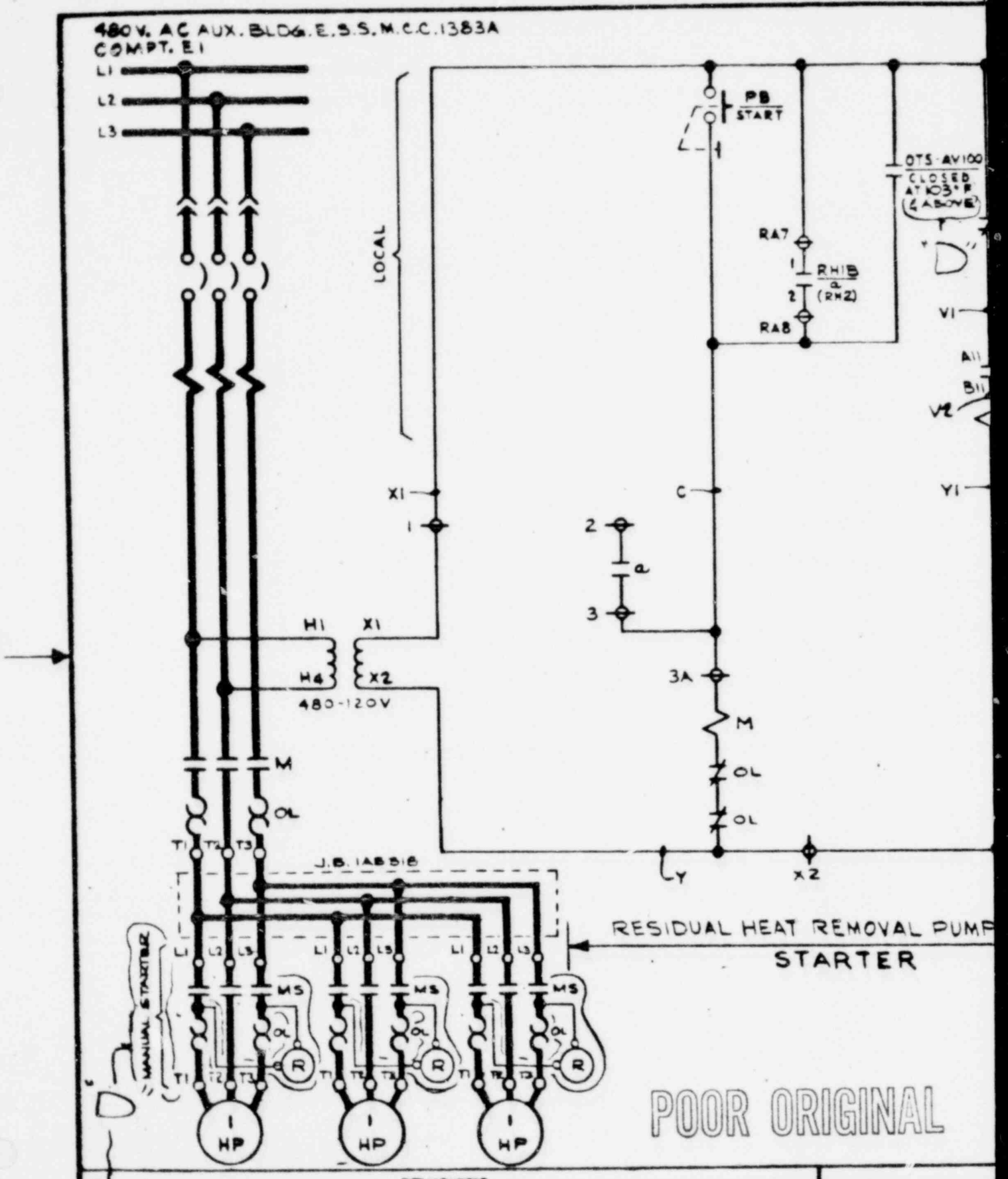
1. If the contacts short together, the cubicle cooler will be started and therefore will not impair the function of the cooler to cool the safety pumps.

2. If the c ıtacts remain open, the starting circuit, ʼrough the start signal from the safety pump, will still start the cooler and perform its function.

3. If the contacts short to ground, the control of the cooler will not be affected due to the control circuit be ungrounded and unfused. The cooler can still be started by the auto-start signal in the presence of a short to ground by the thermostat (or pushbutton).

The control of the solenoid valve 0SV-AV99 is also not impaired enough to defeat the function of cooling the safety pumps. The solenoid valve controls a damper to normally maintain the pump cubicle at 0.5" H_2O negative pressure with respect to the surrounding area. If the thermostat contacts short together, the damper will maintain the 0.5" H_2O negative pressure. If the thermostat contacts open, the damper will fail to open, allowing the room to assume the same pressure at the surrounding area. This will not affect the ability of the coolers to cool the pumps.

Based on the above analysis, no qualification is necessary.



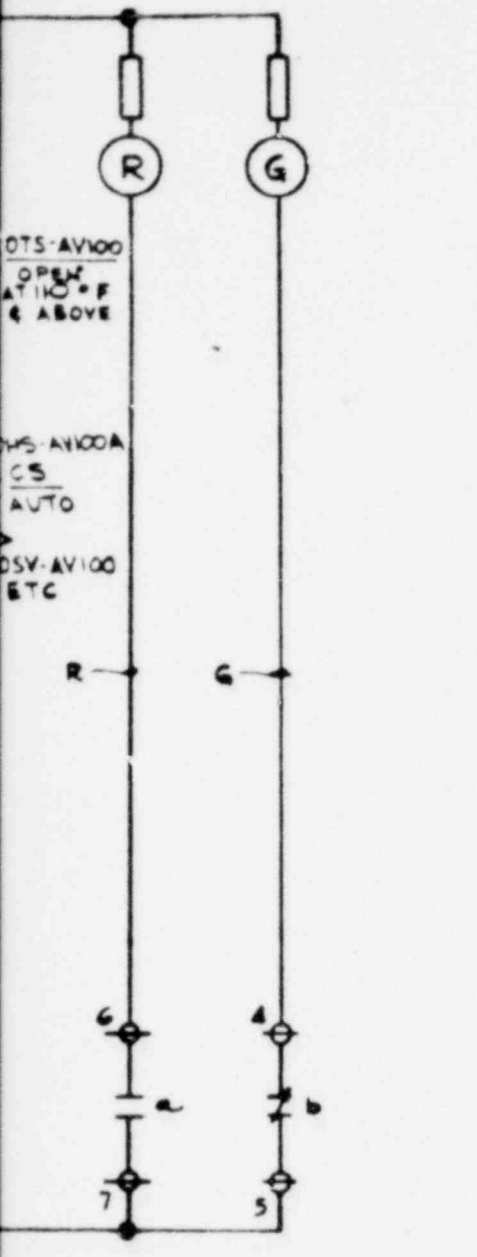
REVISIONS								
A	9-10-71	J.S	FOR CONSTRUCTION					
B	5-26-72	J.S.	REVISED WIRE CODE					
C	6-16-72	J.S	ADDED TEMP SW SETTING RANGES					
D	3-30-73	MMA	[illegible]					

DRAWN F. HO
CHECKED JRH SE
ENGINEER

INSTR. NO. OHS-AV100A

F.V.

SEE P. AV100, DET. D15
FOR CS DEVELOPMENT



IB UNIT COOLER

"D"

NOTES

1. ETO - ENERGIZE TO OPEN
2. ETC - ENERGIZE TO CLOSE
3a. ENERGIZE REFERS TO SOL. VALVE COIL CONDITION
3b. "OPEN" OR "CLOSE" REFERS TO ACTION OF DEVICE CONTROLLED BY THE SOL. VALVE

1AV002

	DATE
VTK	8-31-71
STA	9-10-71
Pacesetter	9/10/71

RESIDUAL HEAT REMOVAL PUMP 1B UNIT COOLER

SARGENT & LUNDY CHICAGO

SCHEMATIC DIAGRAM
ZION STATION
UNIT 1
COMMONWEALTH EDISON CO
CHICAGO ILLINOIS

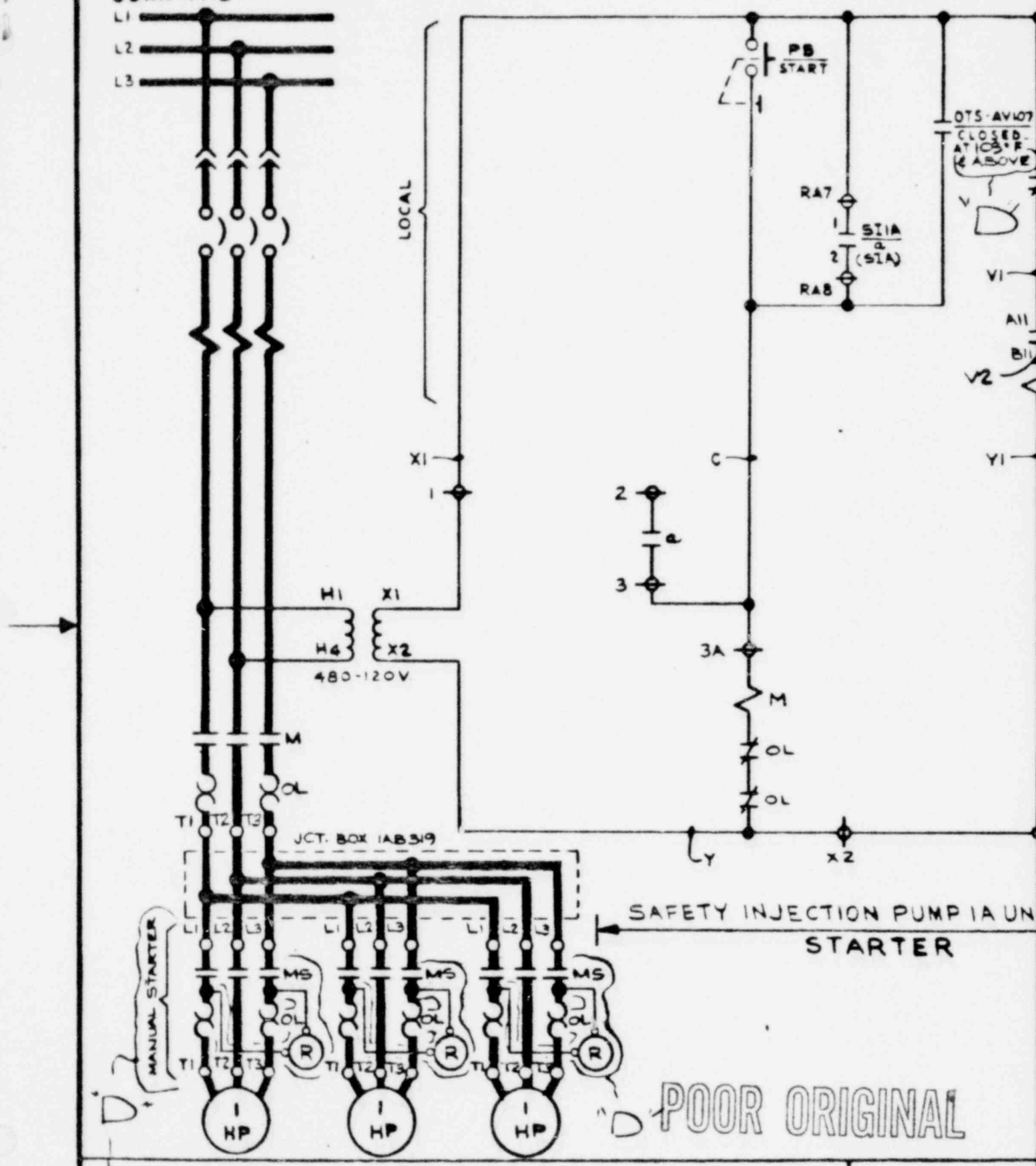
JOB NO. 3782

DWG. NO. 22E-1-4840

PAGE AV2

ERASE WITH WATER

480V. AC AUX. BLDG. E.S.S. M.C.C. 1372
COMPT. A2

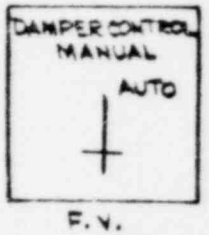


POOR ORIGINAL

REVISIONS								
A	9-10-71	J.S	FOR CONSTRUCTION SERIES 3 LEADS					
B	5-26-72	J.S.	REVISED WIRE CODE					
C	6-16-72	J.S.	ADDED TEMP SW SETTING RANGES					
D	8-30-75	MM	[illegible]					

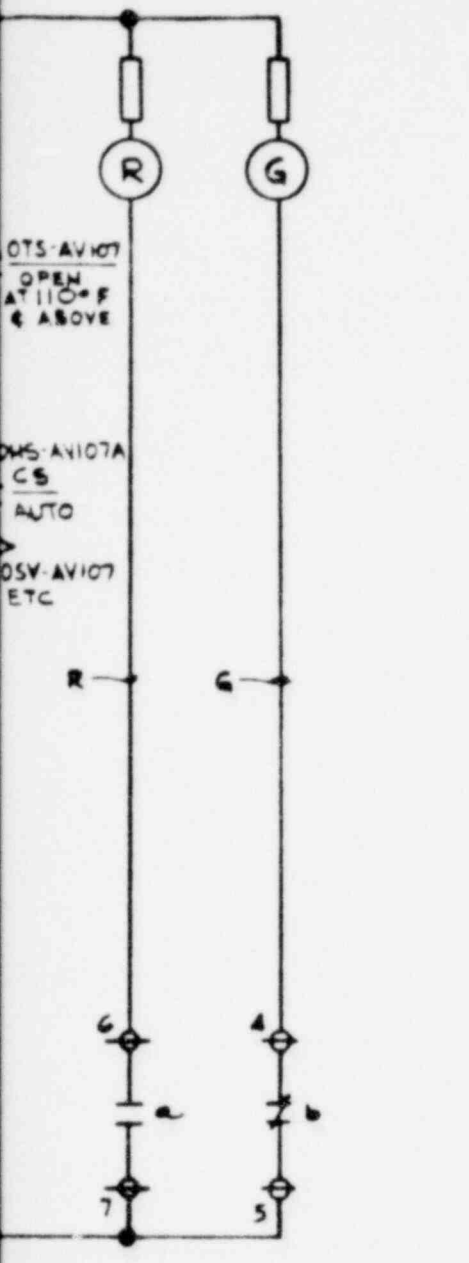
DRAWN F. HOR
CHECKED JRH SE
ENGINEER

INSTR. NO. OHS-AV107A



F.V.

SEE P. AV100, DET. D15
FOR CS DEVELOPMENT



T COOLER

"D"

NOTES-

1. ETO - ENERGIZE TO OPEN
2. ETC - ENERGIZE TO CLOSE
3a. ENERGIZE REFERS TO SOL. VALVE COIL CONDITION
3b. "OPEN" OR "CLOSE" REFERS TO ACTION OF DEVICE CONTROLLED BY THE SOL. VALVE

1AV007

	DATE
VIK	8-31-71
ESTA	9-10-71
Pacan	9/10/71

SAFETY INJECTION PUMP 1A UNIT COOLER

SARGENT & LUNDY CHICAGO

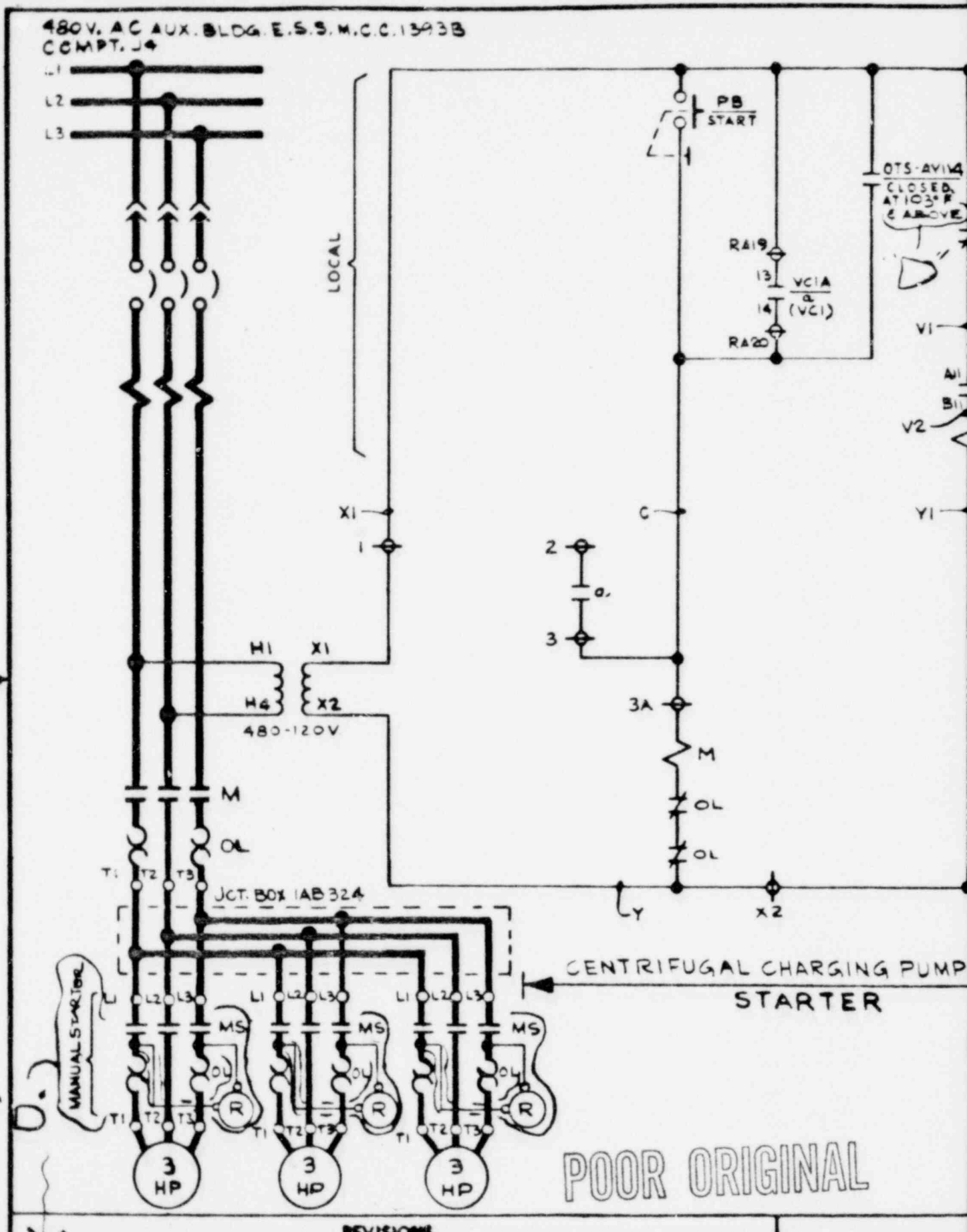
SCHEMATIC DIAGRAM
ZION STATION
UNIT 1
COMMONWEALTH EDISON CO
CHICAGO ILLINOIS

JOB NO. 3782

DWG. NO. 22E-1-4840

PAGE AV3

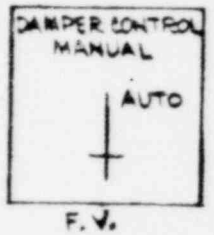
ERASE WITH WATER



REVISIONS							
A	9-18-71	J.S	FOR CONSTRUCTION SPEC. X 1329				
B	5-26-72	J.S.	REVISED WIRE CODE				
C	6-16-72	J.S.	MOTOR TEMP SW. SETTING RANGES				
D	3-30-73	MM	[illegible]				

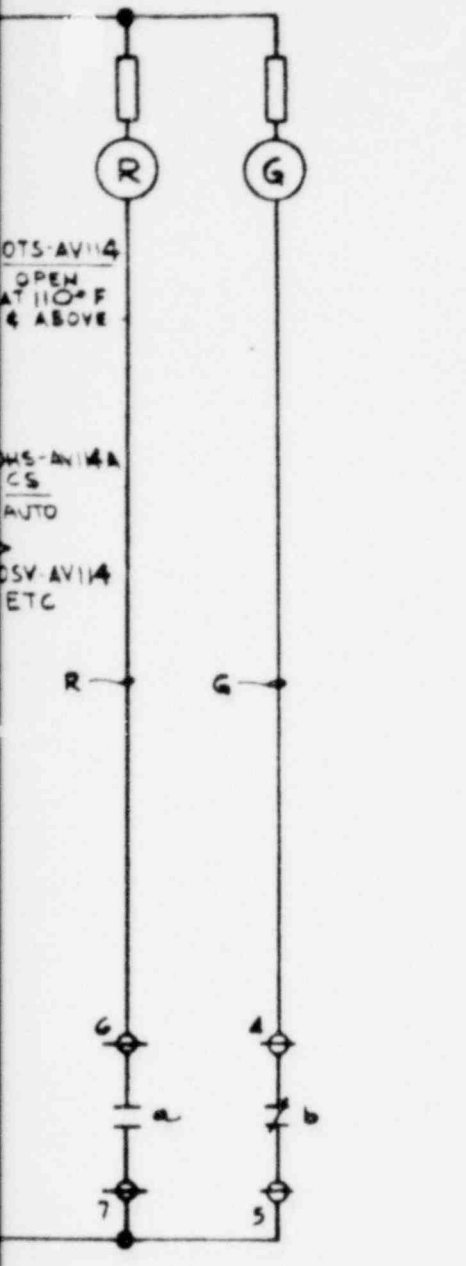
DRAWN F. HOR
CHECKED JRH SE
ENGINEER

INSTR. NO. CHS-AV114A



F.V.

SEE P. AV100, DET. D15
FOR CS DEVELOPMENT



IA UNIT COOLER

"D"

NOTES-

1. ETO - ENERGIZE TO OPEN
2. ETC - ENERGIZE TO CLOSE
3a. ENERGIZE REFERS TO SOL VALVE COIL CONDITION
3b. "OPEN" OR "CLOSE" REFERS TO ACTION OF DEVICE CONTROLLED BY THE SOL VALVE

1AV012

	DATE
VIK	8-31-71
STA	9-10-71
	9/10/71

CENTRIFUGAL CHARGING PUMP 1A UNIT COOLER

SARGENT & LUNDY
CHICAGO

SCHEMATIC DIAGRAM
ZION STATION
UNIT 1
COMMONWEALTH EDISON CO
CHICAGO ILLINOIS

JOB NO. 3782

DWG. NO. 22E-1-4840

PAGE AV7

ERASE WITH WATER

3.3.3.36 Motors Located in the Lower Safety Valve Room (T-3)

Westinghouse Model TBFC

Plant ID Number: MS016
MS017
MS018
MS019

Response:

These are the hydraulic units for the main steam isolation valves. Short-term operation is required. However, the referenced motor is not required if the hydraulic accumulator is charged. Also, once the MSIV valve closes it should remain closed due to steam pressure.

The MSIV's operate following a safeguards actuation in order to isolate steam flow from the steam-generator to the turbine. The MSIV's are equipped with the following:

1) Pump: During normal operation this pump maintains both the opening and closing side pressure at close to 800 and 1800 psig respectively. This piece of equipment is not required to operate following safeguards actuation signal.

2) Pressure Switch: Sends startup signal to pump should the pressure in either side of line fall below setpoint. Not required to operate following safeguards actuation signal.

3.3.3.36 cont'd

3) Accumulator: Both on opening and closing side of valve. The closing side must discharge in order to close MSIV.

4) Pilot Operated Check Valve: Two on either side of MSIV. These valves must open to allow the accumulator to discharge on the closing side of the MSIV and also to allow flow from the open side of the valve to discharge into the reservoir tank.

5) 125 VDC 3-way Solenoid Valve: This is the operator for the check valve. These solenoids (2 per MSIV) must provide the signal to open the check valves. Their operation will ensure that the accumulator closes the MISV.

CONCLUSION: Only the solenoids must operate electrically in the harsh environment in order to shut the MSIV's. They operate a short period of time (5 seconds) after the actuation signal to allow the accumulators to close the valve. Westinghouse has been contacted to provide available qualification for the solenoids.

3.3.3.37 Equipment Item No. 64 (Unit 2 only)
Junction Boxes Located in the
Lower Safety Valve Room (T-3)
Type EB-215
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.

3.3.3.38 Equipment Item No. 65 (Unit 2 only)
Junction Boxes Located in the
Steam Tunnel (T-4)
Type EB-215
(No Licensee reference cited)

Response:

All junction boxes included in report contain either terminal blocks or in-line splices. Licensee is attempting to obtain and review possible applicable documentation to qualify configurations as they exist in plant.