Appendix C—Extract from IES Utilities Drawing 1JX-105

Duane Arnold Energy Center
3277 DAEC Road
Palo, IA 52324
Telephone 319 851 7611
Fax 319 851 7611

IES UTILITIES

NUCLEAR GENERATION DIVISION
April 15, 1997
NG-97-0728

Mr. Gayland Bloethe
Sargent & Lundy LLC
Fifty Five East Monroe Street
Chicago, Illinois 60603-5780

RE: Duane Arnold Energy Center
SUBJECT: Transmittal of Ampacity Calculation Comments
FILE: A-351

Dear Mr. Bloethe:

Enclosed are the IES comments concerning the S&L calculation DA-IES-96-002: Verification of Ampacity for Darmatt-Wrapped Penetration Cables. Please review the comments and contact Steve Medanic (319-851-7259) or myself (319-851-7131) to resolve these open issues.

Please contact myself if you have any questions or would like to discuss the content of the enclosed information.

Sincerely,

Steven L. Haller

Steven Haller
Project Engineer

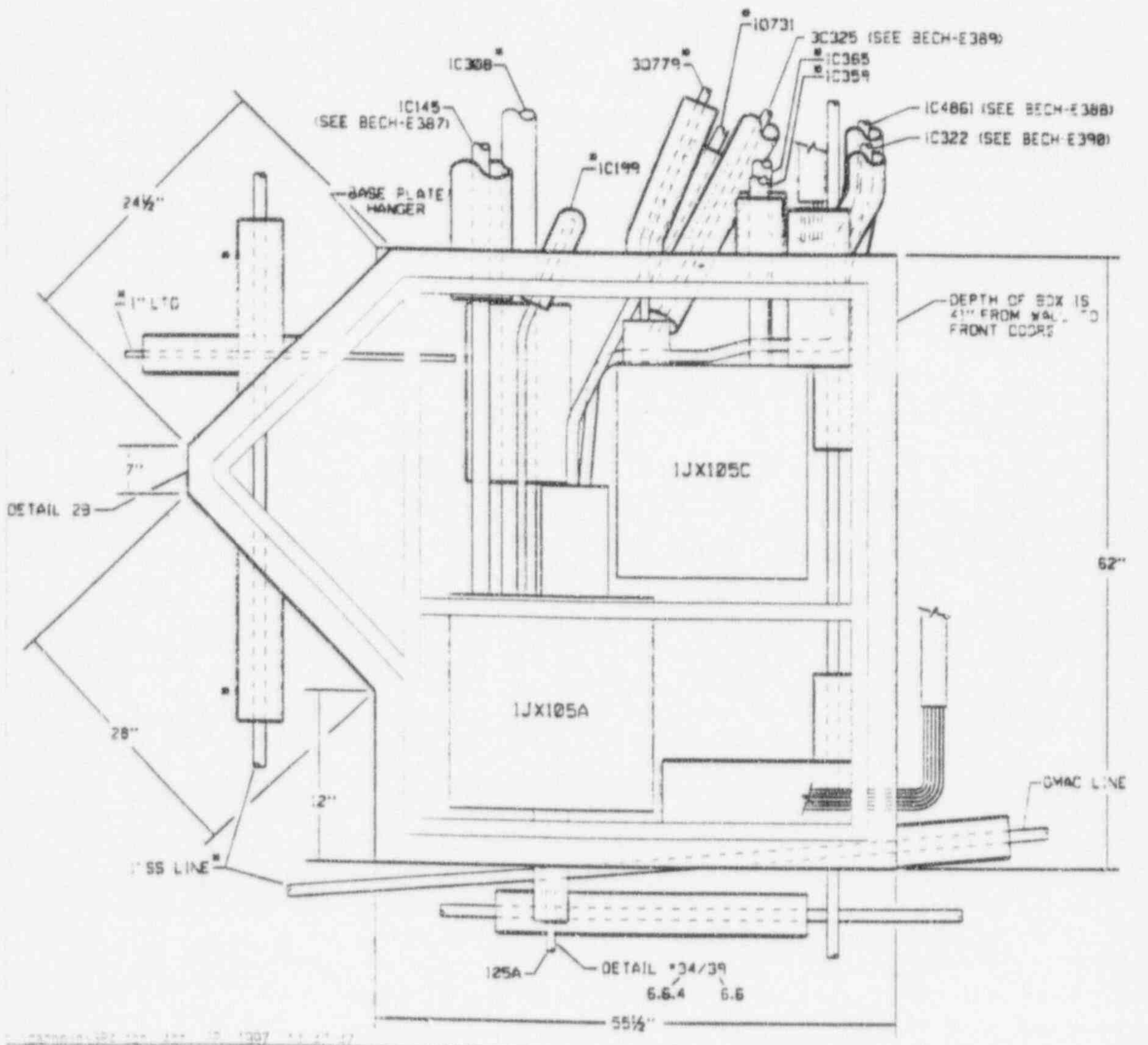
Attachment: 1) S&L Calculation DA-IES-96-002, Verification of Ampacity for Darmatt-Wrapped Penetration Cables, mark-up
2) As-Built Drawings for 1JX105A&C and Various Raceways Wrapped with 3 Hour Fire Barrier Material

cc: Kevin Hawks (Transco Products), DOCU

Sargent & Lundy

For Verification of Ampacity for Darmatt-Wrapped Penetration Cables		Calc. No. DA-IES-96-002
X Safety-Related	Non-Safety-Related	Rev. 2 Date
		Page C3 of C3

Client IES Utilities	Prepared by Date
Project Duane Arnold Energy Center	Reviewed by Date
Proj. No. 09977-000 Equip. No.	Approved by Date



Appendix D— Walk Down Information on the Penetration Area

Sargent & Lundy

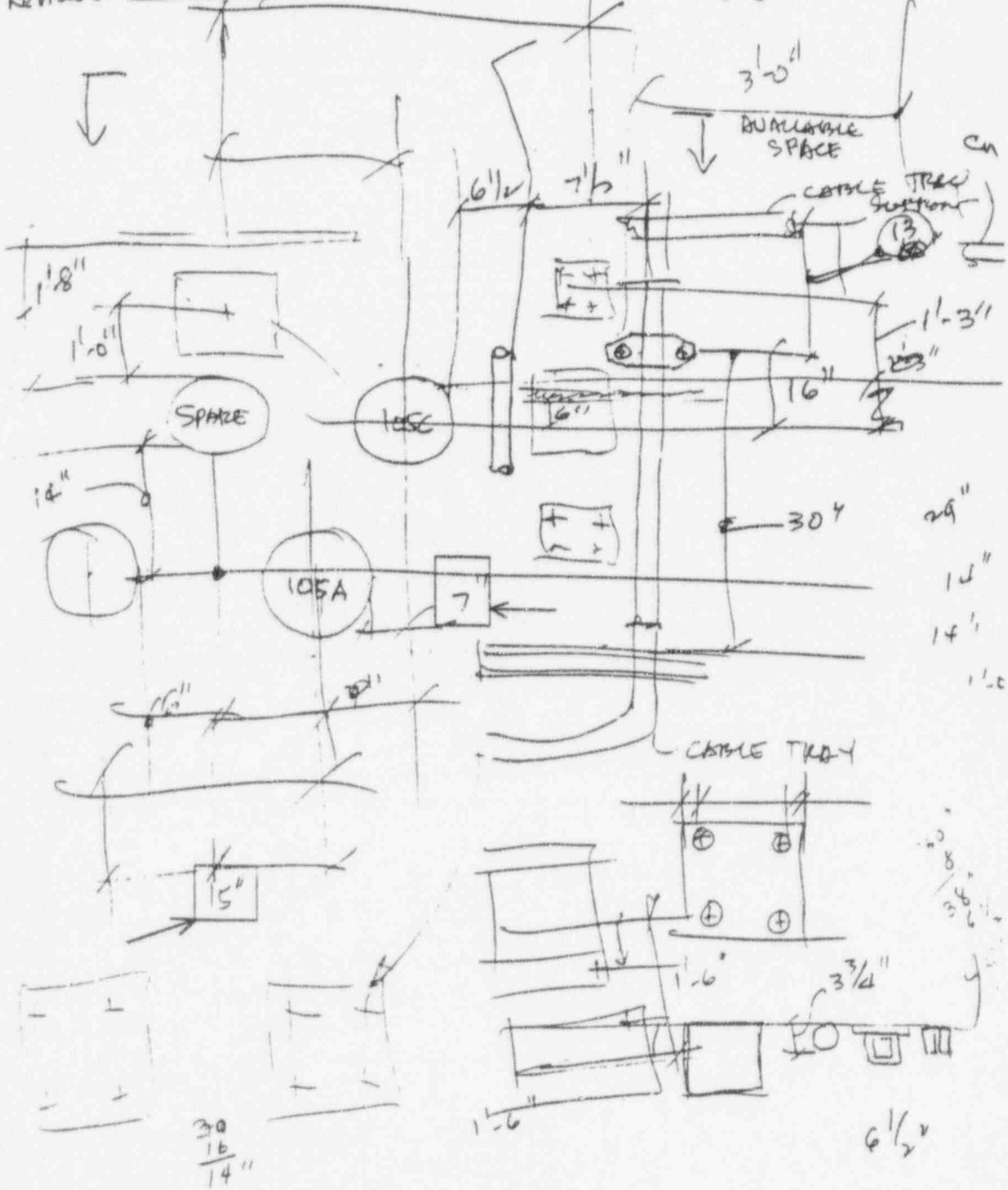
For Verification of Ampacity for Darmatt-Wrapped Penetration Cables			Calc. No. DA-IES-96-002
X	Safety-Related	Non-Safety-Related	Rev. 2 Date
			Page D2 of D2

Client IES Utilities	Prepared by	Date
Project Duane Arnold Energy Center	Reviewed by	Date
Proj. No. 09977-000 Equip. No.	Approved by	Date

DRYWELL WALL AS-BUILT BY JUNCTION BOXES

Prepared [signature] 9-13-96
Reviewed [signature] 13 Sept 96

1'-2"
1'-6
1'-0
3'-6"



Appendix E— Confirmation of the Dry Well Temperature

To: Steve Haller, IES Utilities, Duane Arnold Energy Center

From: W. G. Bloethe, Sargent & Lundy, Electrical Analytical Division

Subject: Ambient Temperature in the Dry Well Opposite the Penetration Area at Azimuth 270°, Elevation 757'

This is to confirm our previous telephone discussion. The ambient temperature in the dry well opposite the penetration area at azimuth 270°, Elevation 757' is 115°F during normal operation.

Please sign below to verify this information and return by fax at (312) 269-3156.

The above information is verified and approved for use.

[signature] 10-5-96

IES UTILITIES
PROJECT ENGINEER

Appendix F — Darmatt Characteristics

TRANSCO PRODUCTS INC.

INSTALLATION MANUAL FOR

FIRE PROTECTION SYSTEMS

TPI DOCUMENT NO: KM1-IM-1

ISSUE D, Rev. 3

MANUAL CONTROL # FP-009

Prepared by:	[signature]	7/15/96
Checked by:	[signature]	07/15/96
Approved by:	[signature]	7/16/96

CONTENTS

1. INTRODUCTION

This document is provided as a guide to assist in the process of installing the DARMATT Fire Protection System for electrical raceways. Also included is a description of the install of the protection of intervening elements and interferences of the electrical raceway.

The DARMATT KM1 Fire Barrier System is an endothermic fire barrier material whi available for both one and three hour protection applications.

The KM1 system can be supplied either as a partially pre-cut protection system (already c size and ready to install)or as raw panels and conduit sections which can be cut in the fie accordance with approved design drawings. In either case the system offers a flexible altern which can be field modified as needed, in accordance with the guidelines given in the ma erection procedure and drawings.

2. PRODUCT INFORMATION

2.1. Product Data Sheet

MATERIAL/SYSTEM PROPERTIES

1. Thermal Conductivity — 0.783 BTU in/hr sq ft °F @ 156 °F Mean

2. Emissivity: — 0.7

3. 1 Hour Tray System

   3.1 Nominal Thickness — 1.34"

   3.2 Nominal weight/sq ft — 6.5 (± 10%) lbs

4. 1 Hour Conduit System

   4.1 Nominal thickness — 1.25" 2" ≤ Conduit o.d ≤ 4½"; 1.53" Conduit o.d < 2"

   4.2 Nominal weight (1bs/lin ft) based on conduit O.D.

1"	(¾" nom. bore)	6.4 ± 10%
1¼"	(1" nom. bore)	6.9 ± 10%
1¾	(1½" nom bore)	7.9 ± 10%
2"	(2" nom. bore)	6.7 ± 10%
2½"	(2" nom. bore)	7.7 ± 10%
3"	(2½" nom. bore)	8.7 ± 10%
3½"	(3" nom. bore)	9.9 ± 10%
4½"	(4" nom. bore)	11.9 ± 10%
5½"	(5" nom. bore)	14.1 ± 10%
6½"	(6" nom. bore)	16.2 ± 10%

5. 3 Hour Tray System

5.1 Nominal thickness 2.68"

5.2 Nominal weight/ sq ft 12.6 ± 10%

6. Three Hour Conduit System

6.1 Nominal thickness 2.5" 2" ≤ Conduit o.d ≤ 4½"
2.78" Conduit o.d < 2"

6.2 Nominal weight (lbs/lin ft)
based on conduit O/D:

1"	(¾" nom. bore)	17.0 ± 10%
1¼"	(1" nom. bore)	17.8 ± 10%
1¾"	(1½" nom. bore)	19.4 ± 10%
2"	(1½" nom. bore)	18.7 ± 10%
2½"	(2" nom. bore)	20.6 ± 10%
3"	(2½" nom. bore)	22.8 ± 10%
3½"	(3" nom. bore)	25.1 ± 10%
4½"	(4" nom. bore)	29.7 ± 10%
5½"	(5" nom. bore)	33.9 ± 10%
6½"	(6" nom. bore)	38.2 ± 10%

Appendix G— Extracts from GE Penetration Manual (NEDP-20218)

NEDP-20218
January 1974

CONTAINMENT ELECTRICAL PENETRATIONS

IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: G2 of G8

NUCLEAR ENERGY DIVISION • GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA 95125

GENERAL ELECTRIC

49/150/NEM
WCC/1.74

SECTION 1
INTRODUCTION

This document contains the data and the description of Electric Penetration Assemblies for a nuclear power plant. All labor, materials and equipment, and the performance of all operations and incidentals necessary for the design, detailing, fabricating and factory testing of electrical penetration assemblies as outlined herein are furnished by General Electric.

More detailed information is contained in the sections that follow. They are:

Section 2 Technical Description — Contains a technical description of the electrical penetration assemblies.

Section 3 Tests and Analyses — Summarizes the tests and analyses General Electric has conducted and will conduct to assure quality of electrical penetration assemblies.

Section 4 Engineering and Application Data — Data to aid Purchaser in summarizing the quantity of conductors that can be accommodated with General Electric's penetration assemblies.

Section 5 Field Interface Accessories and Options — Contains a brief description of the accessories that can be supplied as a part of an electrical penetration assembly order.

Section 6 Quality Assurance Program — Contains quality assurance information.

EXPERIENCE SUMMARY

These penetrations have met with wide acceptance throughout the nuclear industry and have or will be supplied on the following plants:

Plant Name	Owner	Nuclear Steam Supply
Dresden 2	Commonwealth Edison	GE
Tsuruga	Japan	GE
Monticello	Northern States	GE
Nuclenor	Spain	GE
Millstone 1	Northeast Utilities	GE
Dresden 3	Commonwealth Edison	GE
Fukushima 1	TEPCO	GE
Vermont Yankee	V-Y Nuc.	GE
Quad Cities 1	Commonwealth Edison	GE
Muhleberg 1	AKM	GE
Quad Cities 2	Commonwealth Edison	GE
Cooper 1	Consumers Public Power	GE
Diablo Canyon 1	PG&E	W
3 Mile Island 1	JCP&L	B&W
Duane Arnold 1	Iowa EL&P	GE
Diablo Canyon 2	PG&E	W
Shimane 1	Chugoku	GE
Hatch 1	Georgia Power	GE
Pilgrim	Boston Edison	GE
Peach Bottom 2	Philadelphia Electric	GE
Peach Bottom 3	Philadelphia Electric	GE
Fitzpatrick	PASNY	GE
Browns Ferry 3	TVA	GE
Hatch 2	Georgia Power	GE

IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: G3 of G8

SECTION 3
TESTS AND ANALYSES

PREPRODUCTION TESTS

Electrical penetration assembly designs are qualified by the following preproduction tests:

Thermal Cycle Tests are performed on each type of module which simulate a typical reactor operating cycle. One typical cycle consists of a temperature change from 50°F to 150°F, then back to 50°F in a 24-hour period at 100% relative humidity. One hundred and twenty (120) cycles are performed.

Thermal Weld Tests, indicating the effects of welding on the penetration, are determined by instrumenting a penetration assembly and performing a standard installation weld. Criteria for acceptance are that the temperature of any module be no higher than 250°F during welding, and that there is no degradation of penetration assembly material.

Thermocouple Tests determine circuit calibration and limits of error by subjecting each type of thermocouple penetration to temperatures of 200°F, 350°F and 500°F and measuring the effects (or error). Acceptance is based on ANSI C.96.1 requirements.

Thermal I^2R Heating Test effects are determined at maximum current and temperature on the surrounding ambient temperature and on the module. The current is increased until a steady-state temperature of 190°F is reached on the wire insulation, or the outside of the header ring reaches a temperature of greater than 150°F. The current values measured during testing are used to obtain the maximum penetration voltage and current rating.

Accident Environmental Qualification Tests are run at the conditions listed in Table 3-1.

During testing, leakage, insulation resistance, and temperature are monitored. Thermal I^2R heating is supplied at a rate of 15 watts/foot through the No. 10 and No. 16 AWG modules during environmental testing.

Insulation Resistance Life Tests require insulated cables to be subjected to 160°F minimum, 90% to 100% relative humidity and electrical stressing. The test is continued until no significant decrease in insulation resistance is measured over a period of one month. Each cable is subjected to 120 measurements during this period. The cables are monitored for a period of five months after completion of the initial test without current loading.

Short Circuit (Fault Current) Tests employ three-phase testing of a group of three penetration conductors per test for values listed below.

Size	Asymmetrical Amperes	Duration (Cycles)
10 AWG	1,000	8
8 AWG	3,300	8
6 AWG	5,200	8
4 AWG	8,100	8
2 AWG	13,000	8
1/0 AWG	21,000	8
2/0 AWG	26,000	8
4/0 AWG	42,000	8
1000 MCM	80,000	10

Short-Term Overload (Motor Starting) Tests are performed on low-voltage modules, three conductors per test for a 30-second duration, 60-cycle input at ambient temperature in accordance with the following schedule:

AWG	Amperes
6	230
4	296
2	394
1/0	509
2/0	608
4/0	882

Table 3-1
CONDITIONS FOR ACCIDENTAL ENVIRONMENTAL QUALIFICATION TESTS**

Test Condition	1	2	3	4	5
Temperature (°F)	340	325	290	250	225
Pressure (psig)	125	62	62	25	20
RH (%)	100	100	100	100	100
pH (water spray)*			6 to 10	6 to 10	6 to 10
Duration (T)	4 hours	5 hours	10 days	24 days	1 year

*Inject water spray at duration (T) plus 7 hours for a duration of 20 minutes.
**Units subject to this test have been preconditioned for end-of-life characteristics, i.e., thermal cycling and radiation.

SECTION 4
ENGINEERING AND APPLICATION DATA

The data in this section are presented as an aid to the Purchaser for determining his total plant containment electrical penetration needs. The objective in presenting these data is to assist the Purchaser in determining the minimum quantity of penetrations required, having a maximum wire capacity per penetration.

Factors considered in satisfying this objective are:

- Conductor load-carrying requirements
- Conductor size and quantity
- Maximum head load (wattage) per penetration foot
- Maximum conductor density per module
- Maximum module density per penetration

Discussion regarding these factors and the use of the tabular data found in this section follows.

CONDUCTOR LOAD-CARRYING REQUIREMENTS

The total penetration load-carrying requirements are first established. These requirements will be used in determining conductor size and quantity, penetration heat loads, etc. Categories should be established as to function, i.e.:

Control and instrumentation

Shielded and unshielded signals

Low-voltage power

Low-voltage control

Medium voltage

High voltage

CONDUCTOR SIZE AND QUANTITY

The quantities and sizes of conductors should be based on the load-carrying requirements as determined above, derated for containment ambient temperature per Table 4-1 and derated for diversity per Table 4-2. The calculation method is:

$$Ia = \frac{I}{t \times d}$$

where:

Ia = allowable ampacity rating of wire

I = actual circuit load in amperes

t = temperature derating factor from Table 4-1

d = diversity derating factor from Table 4-2 (number of wires in a module).

Example:

-60°C

A low-voltage power need requires six wires carrying 120 amperes at 600 volts, and at 140°F containment ambient temperature. The minimum wire size is found by:

$$Ia = \frac{I}{t \times d} = \frac{120}{0.67 \times 0.80} = 223.88 \text{ amps}$$

Using Table 4-3 to determine the proper wire size, it is found that a No. 4/0 AWG wire would be the minimum required to meet the need.

Table 4-1
DERATING FACTORS FOR CONTAINMENT AMBIENT TEMPERATURE

Containment Ambient Temperature, °C (°F)	Derating Factor*
30 (86)	1.00
40 (104)	0.90
50 (122)	0.80
60 (140)	0.67
65 (149)	0.60
70 (158)	0.52

*Note these factors are to be applied on a per-module basis and not the whole penetration assembly.

Table 4-2
DIVERSITY DERATING FACTORS

Number of Wires in Use	Derating Factor*
Less than 4	1.00
4 to 6	0.80
7 to 24	0.70
25 to 42	0.60
43 above	0.50

*Note these factors are to be applied on a per module basis and not the whole penetration assembly.

Table 4-3
MAXIMUM WIRE AMPACITY
(At 30°C with Three Conductors in a Module)

Recommended Function	Wire Size	Maximum Current (amperes)	Resistance per Foot at 90°C (ohms)
Control	No. 18 AWG	14	0.00815
Control	No. 16 AWG	18	0.00513
Control	No. 14 AWG	25	0.00321
Control	No. 12 AWG	30	0.00203
Control	No. 10 AWG	40	0.00127
LV[a]	No. 8 AWG	50	0.000801
LV Power	No. 6 AWG	70	0.000513
LV Power	No. 4 AWG	90	0.000324
LV Power	No. 2 AWG	120	0.000203
LV Power	No. 1 AWG	140	0.000161
LV Power	No. 0 AWG	155	0.000128
LV Power	No. 2/0 AWG	185	0.000102
LV Power	No. 4/0 AWG	235	0.0000625
MV/HV[b] Power	1000 MCM	758	NA[c]

[a] Low-Voltage Power
[b] Medium-Voltage/High-Voltage
[c] Not Applicable

Table 4-4
MAXIMUM ALLOWABLE WATTS PER FOOT*

Nominal Size of Penetration	Maximum Allowable Watts per Foot — Containment Temperature 70°C	60°C	50°C	40°C
12 inches	12	18	25	32
10 inches	10	15	21	27
8 inches	8	12	17	21

* A maximum of 60 watts per foot is permissible if the penetration is vented on the end opposite the weld. This is applicable to all nozzle sizes greater than eight inches.

Table 4-5
DUTY CYCLE

Time on in Eight Hours	Effective Duty Cycle (D)
0 to 1/2 hour	0
1/2 to 2 hours	0.5
2 to 8 hours	1.0

MAXIMUM HEAT LOAD (WATTAGE) PER PENETRATION FOOT

The heat load per penetration foot is calculated on the heating effect of a one-foot length of each active conductor. If allowable watts-per-foot values are exceeded (see Table 4-4), wire may be paralleled or a larger conductor size may be selected. For control and instrumentation wires and power wires which have a low duty cycle, the heat load may be negligible and, therefore, eliminated from the heat load calculations. See Table 4-5 for effective duty cycle. The head load is calculated as follows:

$$W/ft = N \times I^2 \times R \times D$$

where:

W/ft = effective wattage (heat load) per foot for (N) number of wires

N = number of wires of same size, carrying the same current

I^2 = actual ampacity, squared

R = resistance of wire per foot at 90°C from Table 4-3

D = duty cycle (time on in eight hours) from Table 4-5.

Table 4-6 shows a format typically used to record the above data in an orderly fashion for total penetration heat loads. The following is a typical heat load calculation.

Required are:

90 — No. 8 AWG wires, on 1 hour in 8, at 15 amperes

9 — No. 4 AWG wires, on 1 hour in 8, at 35 amperes

9 — No. 4/0 AWG wires, on full time, at 120 amperes

$$W/ft = N \times I^2 \times R \times D$$

$$W/ft = 90 \times 15^2 \times 0.000801 \times 0.5 = 8.11$$

$$W/ft = 9 \times 35^2 \times 0.000324 \times 0.5 = 1.79$$

$$W/ft = 9 \times 120^2 \times 0.0000625 \times 1.0 = 8.10$$

W/ft total = 18.00

Referring to Table 4-4, it is noted that the calculated heat load is well within the allowable limit providing that the penetration is vented on the end opposite the weld, or that a 10-inch or larger penetration is used.

IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: G6 of G8

Table 4-6
CALCULATION OF HEAT LOADS*
(Typical Format)

Penetration Number	Module Number	Wire Size (AWG or MCM)	Number of Wires (N)	Amps per Wire (I)	Resistance of Wire per Foot at 90°C (R)	Duty Cycle (D)	Heat Load* per Foot (w/ft)

* Heat load = Effective watts/foot of wire(s): w/ft = N x I^2 x R x D.

MAXIMUM CONDUCTOR AND MODULE DENSITY

Using the same data as in the example above, check Table 4-7 for maximum wire density, or the quantity of wires allowable per module. Do not mix wire size or wire type within any one module. This check indicates a need for three modules with 30 No. 8 AWG wires in each, one module with 9 No. 4 AWG wires, ad three modules with 3 No. 4/0 AWG wires in each.

The total quantity of modules required is even. Checking Table 4-8 indicates the need for a 12-inch penetration/nozzle size.

Checking again with Table 4-7, it should be noted that there are some spares available. The resultant spares per module of the example is as follows:

3 modules with No. 8 AWG wire ....No spares available
1 module with No. 4 AWG wire..................5 spares available
3 modules with No. 4/0 AWG wire ....1 available spare in each module

The need for more available spares requires additional modules and, in this example, another penetration.

The foregoing calculation example and examples of the tabular data are of extreme simplicity. Often, several iterative calculations will be required to resolve the heat load and density requirements.

If difficulty in determining the total plant electrical penetration is encountered, the General Electric Marketing/Engineering staff is available for consultation and assistance.

IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: G7 of G8

Table 4-7
MAXIMUM CONDUCTOR DENSITY

Conductor Size	Conductors per Module	Total Conductors per Penetration
No. 18 AWG	136	952
No. 16 AWG	136	952
No. 14 AWG	77	539
No. 12 AWG	77	539
No. 10 AWG	77	539
No. 8 AWG	28	196
No. 6 AWG	19	133
No. 4 AWG	14	98
No. 2 AWG	10	70
No. 0 AWG	7	49
No. 2/0 AWG	7	49
No. 4/0 AWG	4	28
RG59	7	49
RG11/u	3	21
No. 16 STP[a]	40	280
No. 16 STT[b]	30	210
No. 16 STQ[c]	24	168
No. 14 STP	25	175
No. 14 STT	18	126
No. 14 STQ	15	105
No. 12 STP	23	161
No. 12 STT	17	119
No. 12 STQ	13	91
No. 18 T/C	44 triplets	308
No. 18 T/C	70 pair	490

[a] STP = Shielded twisted pair
[b] STT = Shielded twisted triplets
[c] STQ = Shielded twisted quads

Table 4-8
MAXIMUM MODULE DENSITY

Nozzle Size, Inches	Number of Modules LV, Signal, TC	Number MV[a]	Number HV[a]
12	7	6	
18			3
24 through 36[b]			3

[a] One electrical feed through per module
[b] Adapt 18-inch design with weld ring

TC = Thermocouple
MV = Medium Voltage
HV = High Voltage

Typical penetration installation drawings, included for reference, are found at the end of this section. They are:

Title	Drawing Number
Electrical Penetration Installation — Signal	127D1606
Electrical Penetration Installation — Low-Voltage Power	127D1590
Electrical Penetration Installation — Medium Voltage	127D1775
Electrical Penetration Installation — High Voltage	127D1884

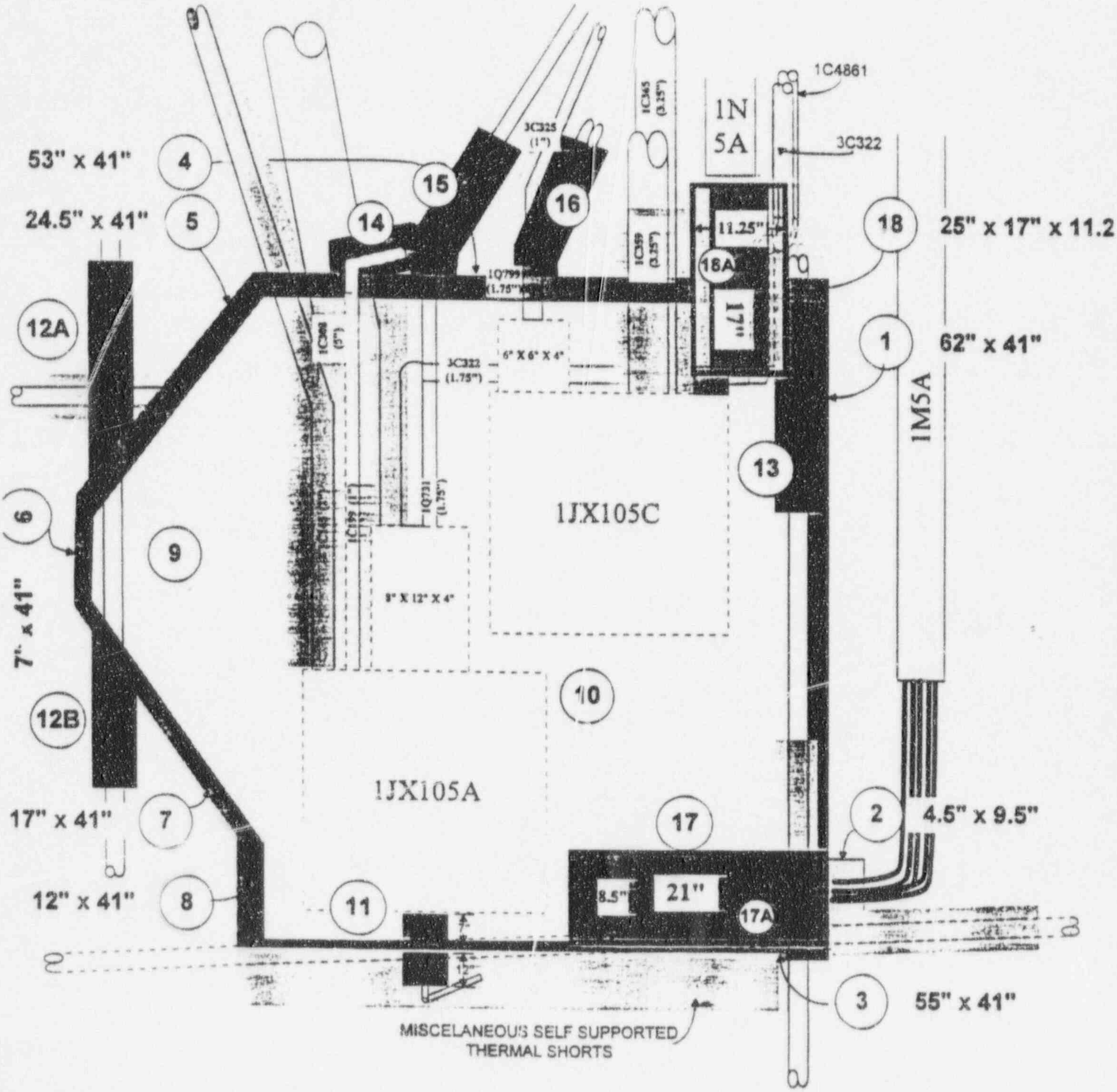
IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: G8 of G8

Sargent & Lundy	For Verification of Ampacity for Darmatt-Wrapped Penetration Cables	Calc. No.DA-IES-96-002
	X Safety-Related / Non-Safety-Related	Rev. 1 Date
		Page H1 of H2

Client IES Utilities	Prepared by / Date
Project Duane Arnold Energy Center	Reviewed by / Date
Proj. No.09977-000 Equip. No.	Approved by / Date

Appendix H - As built Darmatt Loads on Primary Frame Around Penetrations 1JX105A & C (Ref. XII.26).

Asbuilt Darmatt Loads on Primary Frame Around Penetrations 1JX105 A & C



IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: H2 of H2

THERMAL SHORT LOADS CARRIED BY MAIN SUPPORT FRAME

PRIMARY DARMATT BARRIER CARRIED BY MAIN SUPPORT FRAME

SELF SUPPORTED THERMAL SHORT LOADS

UPPER SILICONE SEAL LOAD SHARED BY MAIN SUPPORT FRAME AND 1JX105C (CONSERVATIVE)

Appendix I— E-Mail Massage Concerning the Conduits Inside the Darmatt Box (Ref. XII. 27).

Haller, Steve L -E08015

From: Haller, Steve L -E08015
To: gayland - S&L
Cc: Wohlers, Brian R -E08828; dan langel
Subject: 1JX105A & C, Electrical Penetration Boxes
Date: Monday, February 03, 1997 3:19PM

Mr. Gayland Bloethe, this note documents answers to the questions brought forth to IES on January 30, 1997 concerning conduits near and inside electrical penetrations 1JX105A & C.

Question #1: Topic - Concerning conduits near the penetration 1JX105A & C.

The conduits under question either enter 1JX105A or 1JX105C. Therefore all power cables have been previously accounted for in the list of power cables for the two penetrations.

Question #2: Topic - Concerning conduits inside the DARMATT box

The stainless steel pipe at the left side of the enclosure is a test connection for our loop 'A' jet pump sample. This line will be at ambient temperature and will not contribute significant heat load in the enclosure.

The conduit on the right hand side is '2C076' (conduit label). This conduit contains four cables for solenoid valves. No power cables exist in this conduit.

All power cables that enter the DARMATT structure around 1JX105A & C have been previously identified.

If you have any additional questions feel free to call me at (319) 851-7131.

Steven Haller
2/3/97

Ste L. Haller 2-24-97

IES Utilities Proj. No. 09977-000
Duane Arnold Energy Center
Calc. No. DA-IES-96-002
Page: 12 of 12

Appendix J— Extracts from Bechtel Drawing BECH-M401.

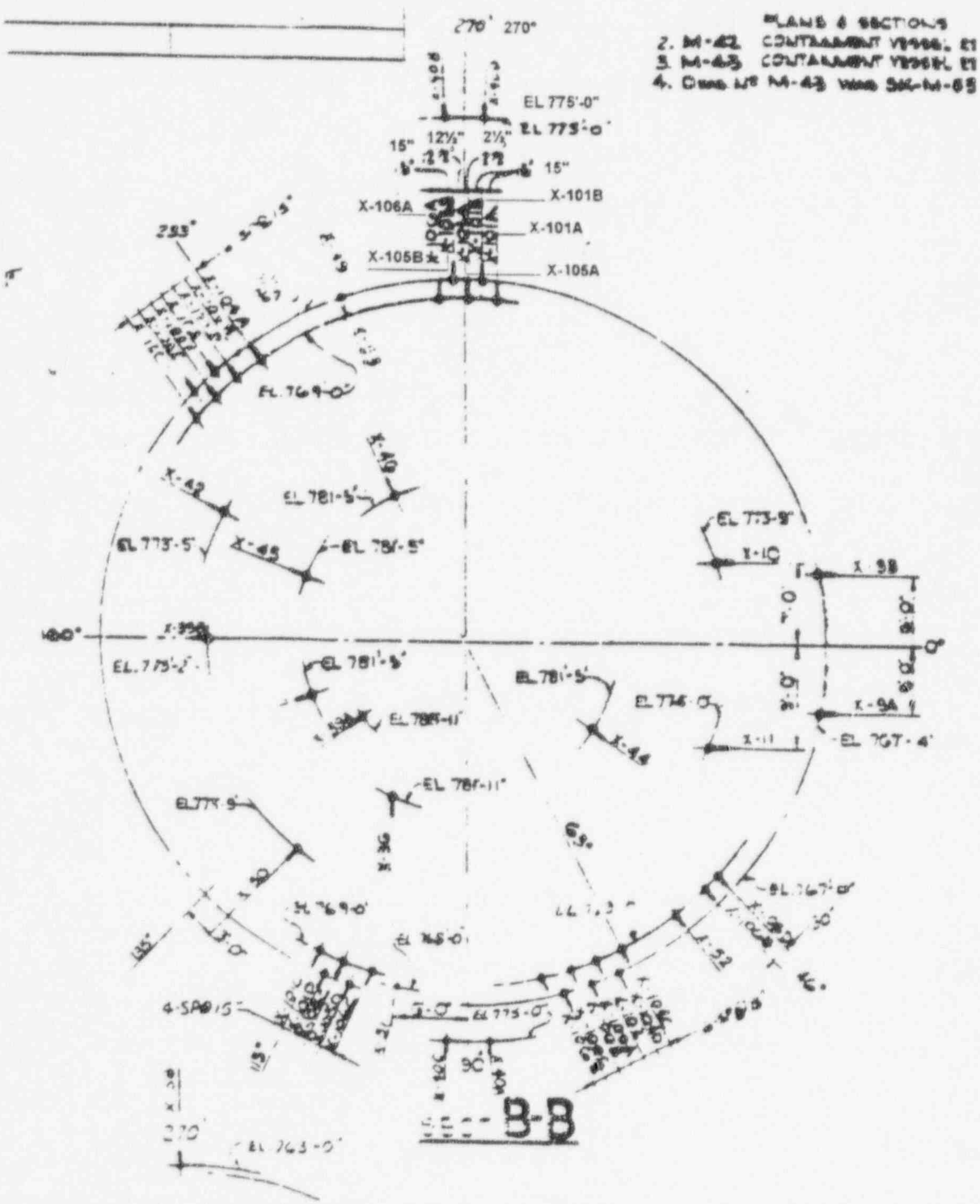
Sargent & Lundy

For Verification of Ampacity for Darmatt-Wrapped Penetration Cables			
X	Safety-Related		Non-Safety-Related

Calc. No. DA-IES-96-002	
Rev. 2	Date
Page J2	of J3

Client IES Utilities
Project Duane Arnold Energy Center
Proj. No.09977-000 Equip. No.

Prepared by	Date
Reviewed by	Date
Approved by	Date



Material necessary for use has been copied in a legible manner. The material on this page is accepable for use. William G Blalock April 24, 1997

Sargent & Lundy

For Verification of Ampacity for Darmatt-Wrapped Penetration Cables	Calc. No. DA-IES-96-002
X Safety-Related / Non-Safety-Related	Rev. 2 Date
	Page J3 of J3

Client IES Utilities	Prepared by / Date
Project Duane Arnold Energy Center	Reviewed by / Date
Proj. No. 09977-000 Equip. No.	Approved by / Date

PENE No	No REQ'D	NOM DIA	I.D. AT NOZZLE END	WALL THK	TYPE	℄ VESSEL TO NOZZLE END	ELEV	AZIMUTH	F_A	F_S	M_B	LINE SIZE	SERVICE	REMARKS
				DRYWELL NOZZLE								PROCESS PIPE		
X-58A&B	40	1"		SCH80	[illegible]	37'-2 3/4"	[illegible]	90° & 270°				1"	CRD WITHDRAW	SEE DET [illegible] M-42
X-59A&B	2	10"		"	[illegible]	A: 5'-0" B: [illegible]	[illegible]	A: 188° B: 180°				10"	CS SPRAY SYS.	[illegible]
X-60A&B	4	2"		"	4	37'-9"	725'-0"	[illegible]				1"	[illegible]	
X-61	1	3"		"	5	24'-0"	800'-0"	107°				[illegible]	[illegible] LOOP [illegible]	
X-62	1	4"		"	5	38'-3 1/2"	778'-8"	206°				4"	STANDBY L.Q. CONTROL	
X-65	1	30"		[illegible]	3	38'-9"	784'-5"	160°				—	SPARE	
X-66	1	26"		[illegible]	3	38'-4 1/2"	781'-5"	35°				—	SPARE	
X-45	1	36"		[illegible]	5	38'-9 1/2"	784'-8"	208°, 90°				—	SPARE	
X-46	1	2"		SCH80	5	38'-1 1/2"	781'-5"	245°				—		
X-47	1	6"			3	23'-11"	807'-0"	110°				—	SPARE	
X-48	1	6"		"	5	39'-9"	780'-9"	120°				3"	[illegible] DRAIN SUMP	
X-49	1	2"		"	4	38'-8"	767'-0"	250°				1"	[illegible]	
X-50	1	2"		"	4	38'-6"	778'-8"	SECT B-B				1"	[illegible]	
X-51	1	2"		"	4	38'-3"	768'-0"	198°				1"	SPARE [illegible] SAMPLE (B,C,D)	
X-52	1	2"		"	4	38'-8"	763'-0"	52°				1"	[illegible] LOOP [illegible] HPCI STM SUPPLY (B,F)	
X-53	1	6"		"	14	38'-8"	764'-8"	280°				—	POWER OPER TEST	
X-54	1	12"		SCH80	3	33'-1"	780'-3"	SECT C-C				4"	[illegible]	
X-55	1	12"		SCH80	2	33'-1"	750'-3"	SECT C-C				4"	[illegible]	
X-56	1	2"		"	4	36'-8"	763'-0"	270°				1"	[illegible]	
X-57	1	2"		"	4	34'-3"	745'-10"	3.8°				1"	[illegible]	
X-100A&B	7	10"		SCH80	4		A,C,E [illegible] B,D,F,G [illegible]	SECT. B-B					NEUTRON MONITORING [illegible] SPARE (A,D) [illegible]	
X-101A,B,D	4	[illegible]		"	4		[illegible] A,C [illegible]	" "					[illegible] PROBE [illegible] SPARE (B,D)	
X-102A&B	1	10"		"	5		768'-0"	" "					[illegible] (ABCU) SPARE (B?)	INSTRUMENTATION
X-103	1	10"		"	6	SEE DWG SK-M-62	767'-0"	" "					THERMOCOUPLES	
X-35A&D	4	10"		"	6		[illegible]	" "					CRD ROD POSITION INDIC.	
X-104A&D	4	10"		"	6		[illegible]	" "					POWER & CONTROL (B,D) SPARE (A,C)	
X-104A-E	5	10"		"	6		[illegible] 768'-8"	" "					[illegible] & CONTROL (A,C) SPARE (B,D,E)	
X-36A to [illegible]	6	6"	—	—	—	—	686'-[illegible]	SECT A-A					TIP STABILIZ [illegible]	[illegible]
X-107	1	6"		SCH80	6	23'-0"	818'-6"	200°30'				1"	[illegible]	SEE PM 10554
X-108	1	6"		SCH80	6	23'-0"	818'-6"	340°				1"	[illegible]	SEE PM-10554
X-106A to	4	10"		SCH	4	SEE DWG	B&D 767'-8"	SECT B-B					POWER & CONTROL (B,D)	
D				80		SK-M-62	A&C 768'-8"						SPARE (A, C)	
X-106A to	5	10"		SCH	4	SEE DWG	ABCDE -	SECT B-B					POWER & CONTROL (A, C)	
E				80		SK-M-62	768'-8"						SPARE (B,D,E)	

This line copied below.

SEE NOTE 1

770°

Material necessary for use has been copied in a legible manner. The material on this page is acceptable for use.

[signature] April 24, 1997