

# CALCULATION COVER SHEET

SHEET 1 OF 40

<b>TITLE/DESCRIPTION:</b>  FIRE ENDURANCE EVALUATION OF THERMO-LAG FIRE BARRIER IN FIRE ZONE CB-1f.	<b>DEPT/DIV</b> M/NSED	<b>CALCULATION NO.</b> IP-M-0340		
	<b>QUALITY RELATED</b> (Q or N) Q	<b>SYSTEM CODE</b> (or NA) XD	<b>TOPIC</b> H98	<b>BLDG/ELEV/AREA</b> (or NA) CNTR/762

**APPROVALS - NAME/SIGNATURE/DATE**

<b>PREPARED BY</b> Simon R. Wilson 10/17/95 <i>[Signature]</i> <small>DATE SIGNATURE</small>	<b>CORP PREPARING THIS REV.</b> IP	<b>REVISION</b> 1	<b>VOLUME</b> NA	<b>READY FOR INCORPORATION:</b> <input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> N/A
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		<b>MOD.</b> NA	<b>ECN</b> NA	<b>CR</b> NA
<b>REVIEWED BY</b> Brian T. Ford 10/19/95 <i>[Signature]</i> <small>DATE SIGNATURE</small>		<b>COMMENTS:</b> NRC GL 92-08		<b>MWR</b> NA

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NF-161-1 (12/94)

# CALCULATION COVER SHEET

SHEET 3 OF 38 40  
5/10/1995

TITLE/DESCRIPTION:  FIRE ENDURANCE EVALUATION OF THERMO-LAG FIRE BARRIER IN FIRE ZONE CB-1f.	DEPT/DIV M/NSED	CALCULATION NO. IP-M-0340		
	QUALITY RELATED (Q or N) Q	SYSTEM CODE (or NA) XD	TOPIC H98	BLDC/ELEV/AREA (or NA) CNTR/762

## APPROVALS - NAME/SIGNATURE/DATE

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REVIEWED BY <u>BRIAN T. FORD</u> 12/1/94 <u>Brian T. Ford</u>	COMMENTS:			MOD. PKG., FIELD ALT, CR, TECH SPEC (or N/A) NA
APPROVED BY <u>RAM P. BHAT</u> 12/1/94 <u>RPBhat</u>	NRC GL 92-08			

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NF-161-1 (10/92)

# REVISION HISTORY

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Dept./Div. M/NSED Calc. # IP-0340

Revision 01 Volume (if applicable) NA

Objective: To provide clearer and more detailed information regarding results of the NEI Hose Stream test, and to correct editorial errors.

Reason: It is understood that the reference to NEI-Test Report 2-10 would entail the results of the Hose Stream Test since this is part of the test plan. However, based on questions asked by the NRC regarding Hose Stream Test, it was determined that this subject needed to be addressed in more detail in the calculation.

List of Affected Pages: ALL

Revision Volume (if applicable)

Objective:

Reason:

List of Affected Pages:

Revision Volume (if applicable)

Objective:

Reason:

List of Affected Pages:

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ATTACHMENTS:	
A) AS-BUILT CABLE TRAY CONFIGURATION THAT IS PROTECTED BY THERMO-LAG 330-1 FIRE BARRIER (The original installation drawings were marked up for this calc. to show additional dimensional details)	( 2 pages)
B) APPLICABLE INSTALLATION DETAILS FROM VENDOR MANUAL K-10003-0002 AND BISCO INSTALLATION MANUAL	( 7 pages)
C) THERMO-LAG MATRIX (EXCERPT FROM REFERENCE 2)	( 1 page)
D) TABULATION OF CABLE PROTECTED BY THERMO-LAG IN FIRE ZONE Cb-1f	( 8 pages)
E) RECORD OF COORDINATION ( R O C ) Y-104476	( 1 page)



## 1.0 OBJECTIVE:

As noted in NRC Generic Letter 92-08 and 92-08 Supplement 1, Thermo-Lag 330-1 firewrap material produced by Thermal Science, Inc. (TSI), has repeatedly failed to meet the manufacturer's claims with regard to fire rating. Additionally, baseline qualification tests performed by TSI have been discredited due to lack of pertinent detail and testing QA control. Subsequent tests of Thermo-Lag have been performed for Nuclear Energy Institute (NEI) which have the necessary controls and configuration details, and these tests provide very detailed installation drawings and temperature data which can be used to determine a minimum expected fire endurance rating of installed Thermo-Lag.

The purpose of this analysis is to qualify the minimum expected fire endurance rating of the Thermo-Lag fire barrier system installed on cable trays P2E, C2E, and K2E in CPS Fire Zone CB-1f. The original design intent was to provide a 3-hour rated fire barrier for these trays.

## 2.0 DEFINITIONS:

1. Exposure fire - A fire initiated and propagated by some fuel source other than the referenced item.
2. Maximum allowable temperature limit - From Reference 6, similar thermocouples are allowed to rise an average of 250° F above ambient, and any one thermocouple is allowed to rise 325° F above ambient.
3. Reference 1 defines industry terms applicable to Thermo-Lag.
4. Reference 2 defines CPS-specific terms applicable to Thermo-Lag.
5. Reference 3 defines CPS-specific Safe Shutdown Methods.

## 3.0 ASSUMPTIONS:

1. Where exact determination of commodity or barrier parameters cannot be accomplished without barrier dismantling, the more-limiting value for the parameter is assumed. These individual assumptions are identified as such in the evaluation sections.
2. As documented in CPS Thermo-Lag turnover packages, certain parameters were inspected by QA personnel upon installation. These parameters will be assumed to be unchanged from their inspected status when no other source (i.e., design, walk down document, etc.) can positively determine the parameter's value.

### 3.0 ASSUMPTIONS (Continued)

3. Although the Vendor Manual states that the prefabricated Thermo-Lag 330-1 used at CPS contained V-Ribs at 6" centers, it is not possible to verify this statement without destructive examination. It is therefore conservatively assumed that V-Ribs are not used in the CPS installation.

### 4.0 METHODOLOGY:

1. Define individual fire barrier system segments of the subject item.
2. For each individual fire barrier system segment of the subject item, use the methodology from Reference 1 to perform a detailed comparison of as-installed parameters from Reference 2 to as-tested parameters from References 4 & 16. Determine the minimum fire endurance rating of each fire barrier system segments by limiting parameter, where the rating is the time just before the measured temperature exceeds its maximum allowable limit.
3. Determine the minimum fire endurance rating of the fire barrier system for this item by the limiting segment.

### 5.0 REFERENCES:

- 1.0 NSED Standard ME-09.00 Rev. 1 dated 7/27/94, "Thermo-Lag 330-1 Fire Endurance Application Guide", Nuclear Energy Institute.
- 2.0 U-602250, Illinois Power's Response to the Nuclear Regulatory Commission's Request for Additional Information Regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," dated 2/9/94.
- 3.0 NSLD Calculation CL-FP-SS-1 Rev. 2, Identification of Safe Shutdown Systems, dated 1/21/86.
- 4.0 NEI Test 2-10, Fire Endurance Test of Thermo-Lag 330-1 Fire Protective Envelope (Two 24 in. Aluminum Cable Tray and Two 6 in. Aluminum Cable Tray Assemblies), Omega Point Laboratories, dated April 11, 1994.
- 5.0 NSED Calculation IP-M-0182 Rev. 2, Heat Content Values for Cable Insulation (SLICE cable trays and free-air).
- 6.0 ASTM E119-88, Standard Test Methods for Fire Tests of Building Construction and Materials, American Society for Testing and Materials.

**5.0 REFERENCE (Continued)**

- 7.0 B-Line Systems, Inc. Catalog No. CT3 (1990), Cable Tray Systems.
- 8.0 USAR Appendix F Section 3.1.1.
- 9.0 BISCO Report 748-79 ( Fire Test Embedded Conduit Sleeves), dated May 31, 1983.
- 10 Vendor Manual K-10003-0002 [BISCO- Fire Barrier ( Thermo-lag) Installation], Rev.0, dated 8-14-91.
- 11 K-2999 Electrical Installation Specification, amendment 15, 05-30-86.
- 12 BISCO - Turn over package for CB-1f Fire Zone in Control Building, elevation 762'-0" , dated 04-18-86.
- 13 S&L Calculation: SD-Q45-00DG02, Rev. 0 (Cable Tray-Construction Loading) for weight of cable tray plus T-Lag wrapping.
- 14 S&L Calculation: SD-Q45-00DG02, Rev. 4 (Fire Proof Wrap Detail & Panel Weights)
- 15 K-2980 Cable Tray and Supports Amendment 6, 04-25-86.
- 16 Sandia Report SAND94-0146, " An evaluation of the Fire Barrier System Thermo-Lag 330-1", printed September 1994.
- 17 AISC Manual of Steel Construction, 7th edition.
- 18 Record of Coordination ( R O C ) Y-104476, " Telephone conversation dated November 14 and 21 1994 between R.P. Bhat and S. R. Wilson of IPC with Mr. C. Banning of Vectra", Attachment E.
- 19 FECN 11720, K2944-0002, Typical masonry wall details drawing A21-1062 Rev.H.
- 20 ME-08.00 Rev. 0 "Thermo-Lag 330-1 Combustibility Evaluation Methodology Plant Screening Guide".

## 6.0 EVALUATION / ANALYSIS:

Thermo-Lag Barrier System: P2E (Division 2 Power), C2E (Division 2 Control), and K2E (Division 2 Instrumentation) Cable Trays and associated thermal shorts (includes supports).

Location: Fire Area CB-1, Fire Zone: CB-1f, elevation 762 feet 0 inch, Division 1 cable trays are located on the southwest side of the zone. Division 2 cable trays are routed along the north wall 39 feet from the Division 1 trays, and Division 2 cable risers are found along the south wall 19 feet from the Division 1 trays. All or some of these trays contain safe shutdown cables.

Purpose of Thermo-Lag: In order to separate the Division 1 shutdown cables from those of Division 2, and preclude the possibility of a fire destroying both Division 1 and 2 cables that serve safe shutdown equipment. Division 2 cable trays were protected with a material that has a 3-hour fire rating.

Basis: In order to preclude the possibility of a fire destroying both Division 1 and 2 cables that serve safe shutdown equipment, the Division 2 cable trays were protected with a material that has a 3-hour fire rating.

An automatic wet-pipe sprinkler system was installed around the west pipe hatch to prevent hot gases from propagating to elevation 825 feet 0 inch (Fire Zone CB-1i).

Several walkdowns of the accessible areas in Fire Zone CB-1f revealed that the structural integrity of the fire barrier wrappings on cable trays P2E, C2E, and K2E appear to be intact.

### Cable Tray Application ( Procedure No. SP-FBI-01 Rev. 3 dated 3-28-86, ref. 11)

This is a description of the installation method used to install the principal commodity (i.e., Fire Barrier for Cable Tray) at CPS.

Installation of the Thermo-Lag prefabricated panels to cable trays involved cutting the number of sections required to form the Fire Barrier from one or three hour fire rated Thermo-Lag Prefabricated Panels, forming the Fire Barrier sections by making 90 degree bends, and than mounting the sections on the cable tray to be protected using 14 ga. minimum stainless steel tie wire or 0.75x0.025 inch minimum Stainless Steel banding material.

## 6.0 EVALUATIONS/ANALYSIS (Continued)

The one hour design consists of an inner layer of Thermo-Lag Stress Skin Type 330-69 and an outer layer of 0.500 inch minimum dry film thickness of the Thermo-Lag 330-1 Subliming Material.

The three hour design consists of an inner layer of Thermo-Lag Stress Skin Type 330-69, a center layer of 1.00 inch minimum dry film thickness of the Thermo-Lag 330-1 Subliming Material, and an outer layer of Thermo-Lag Stress Skin Type 330-69. This was the material used in the CP5 3 hour rated installations.

The forming of the fire barrier sections is accomplished using one of several methods. Three and four sided one piece sections are formed by scoring, in the case of one hour fire rated panels, or by cutting a "V" groove, in the case of the three hour fire rated panel, along the lines where bends are to be made and then making the required 90 degree bends. The sections are then completed by tying or banding the sides together and filling in the scored or "V" cut corners with Thermo-Lag 330-1 Subliming Trowel Grade Material.

In the other alternative method, individual top, bottom and side pieces are either butt or miter cut from the one or three hour fire rated panel and are then tied or banded together. The seams and joints of the section are then filled using Thermo-Lag 330-1 subliming trowel grade material.



## 6.0 EVALUATIONS/ANALYSIS (Continued)

The applicable commodity tested, its fire resistive barrier construction and its tested acceptance basis are as described in Reference 4 and are tabulated below:

Commodity Tested	Fire Resistive Barrier Construction	Test Acceptance Basis
24" x 4" Aluminum Ladder Back with Radial Bend (4 piece design)  (Tray A)	1 in. (nominal) V-rib panels with pre-buttered joints (4 piece design), V-ribs parallel to tray rails on top and bottom of tray. Separate mitered panel pieces on inside and outside face of radial bend. Baseline application with no upgrades applied.	Satisfactory bare conductor temperatures when test stopped at 86 minutes. Raceway temperature requirements exceeded at 86 minutes, through openings in barrier developed. Following the Hose Stream test no additional openings were observed, most of the Thermo-Lag pieces remained affixed and the stainless steel banding was sagging slightly.
24" x 4" Aluminum Ladder Back with Radial Bend (Score & Fold)  (Tray D)	1 in. (nominal) V-rib panels with pre-buttered joints. Score and fold single panel for bottom and sides on horizontal and vertical tray segments with separate top panel. V-ribs parallel to tray rails. Separate mitered panel pieces on inside and outside face of radial bend. Baseline application with no upgrades applied.	Bare conductor temperatures requirements exceeded at 85 minutes when barrier opened. Raceway temperature requirements exceeded at 86 minutes, through openings in barrier developed. Following the Hose Stream test no additional openings were observed, most of the Thermo-Lag pieces remained affixed and the stainless steel banding was sagging slightly.

The Reference 16 Test Report describes fire endurance and ampacity derating tests performed by Sandia National Laboratories (SNL) under the sponsorship of the U.S. Nuclear Regulatory Commission (USNRC). These tests evaluated Thermo-Lag 330-1 3 hour rated fire barrier cladding system. Four test articles were tested and evaluated, each of the test articles was based on a "U"-shape section of cable tray protected by a nominal three hour protected envelope, comprised of two layers of nominal 1/2" thick Thermo-Lag 330-1 prefabricated panel sections. This SNL Test Report was reviewed against the CPS 3 hour rated fire barrier installation on fire zone CB-1f, however, it was concluded that NEI Test Report 2-10 offered similar or more comparative characteristics than the SNL test.



## 6.0 EVALUATIONS/ANALYSIS (Continued)

Comparative characteristics under consideration in this determination were in the areas of : cable tray size (12" wide SNL, 24" wide NEI, 24" & 36" wide CPS), contents/total enclosed mass (<8 #/ft. SNL, > 12 #/ft. NEI, >14 #/ft. CPS) material type (two ½" thick panels SNL, 1" thick panel NEI, 1" thick panel CPS), orientation ("U" shape horizontal orientation SNL, "L" shape horizontal & vertical orientation NEI, horizontal & vertical orientation CPS), and fastener type (stainless steel tie wire SNL, stainless steel banding and wing seals NEI, stainless steel banding and wing seals CPS).

### 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION:

1. Evaluation of segments CB1FP2E-01, CB1FC2E-01, and CB1FK2E-01.

Identification of Unique Segment for **P2E** Cable Tray in CB-1f Fire Zone (See sketch on Attachment A, page 1 ).

Segment ID	Segment Description
CB1FP2E-01	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, 18'-0" straight vertical run, from the floor at El. 762'-0" to the ceiling at the bottom of floor EL.781'-0" in the Control Building. Two wall supports F1 and F2. Floor penetration CB-762-15-5178 and ceiling penetration CB-781-03-5008. 500MCM ground strap, total coverage of one layer of 3 hr. rated preformed conduit 5" max unsupported span.

Identification of Unique Segment for **C2E** Cable Tray in CB-1f Fire Zone (See sketch on Attachment A, page 1 ).

Segment ID	Segment Description
CB1FC2E-01	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, 18'-0" straight vertical run, from the floor at El. 762'-0" to the ceiling at the bottom of floor EL.781'-0" in the Control Building. Two wall supports F1 and F2. Floor penetration CB-762-15-5178 and ceiling penetration CB-781-03-5008.

Identification of Unique Segment for **K2E** Cable Tray in CB-1f Fire Zone (See sketch on Attachment A, page 1 ).

Segment ID	Segment Description
CB1FK2E-01	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, 18'-0" straight vertical run, from the floor at El. 762'-0" to the ceiling at the bottom of floor EL.781'-0" in the Control Building. Two wall supports F1 and F2. Floor penetration CB-762-15-5178 and CB-781-03-5008.

These three segments are evaluated as one combined segment, due to the construction of the fire protective barrier installation.

## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

This combined segment consists of three vertical runs of 24" wide cable tray risers (see attachment B page 1), protected/wrapped by a three sided Thermo-Lag 330-1 enclosure bolted to a 3 hour rated concrete wall to form a complete fire protected barrier enclosure.

The following is a more detailed description of the installation procedure utilized for this enclosure, this information was extracted from the Reference 10 vendor instruction manual:

A three sided and flanged section is cut from three hour rated prefabricated panels, the minimum flange width is to be 5" to accommodate concrete fasteners.

The side pieces are mounted to the cable tray using 14 ga. minimum stainless steel tie wire or 3/4" x .025" minimum stainless steel banding material. For multiple cable tray enclosures as in this case, the side pieces are mounted to the outermost cable trays only.

The flanged pieces are flanged to the wall using approved concrete fasteners installed per BISCO procedure SP-103 at a maximum of 12" intervals. The concrete fasteners are of sufficient length to ensure 3/4" penetration. Sufficient amounts of Thermo-Lag is applied to cover the bolt heads of the concrete fasteners with the minimum envelope thickness of 1".

The front pieces to the cable trays are mounted using 14ga. minimum stainless steel tie wire or 3/4" x .025" minimum stainless steel banding material ( banding was used in these installations). The maximum spacing of the bands do not exceed 12". For multiple cable tray enclosures as in this case, the front is banded to each cable tray separately.

Additional side, front and flanged pieces are attached to the previously installed pieces by precoating the edges with 330-1 Thermo-Lag trowel grade material and butt joining them together at their ends. The installation is completed by filling in the edges and joints with Thermo-Lag 330-1 subliming trowel grade material.

The CPS configuration / installation described above was not specifically tested, however, a comparison can be made to the configuration tested (Ref. 4, NEI 2-10 Test Report) by comparing the similarity between the thermal and structural attributes.

## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

Segments:	CB1FP2E-01 CB1FC2E-01 CB1FK2E-01			
Commodity Parameters	Description	CPS Installation	NEI 2-10 Test Report	Commodity Comparison. B = Bounded B/J = Bounded with Justification.
Size	Cable Tray Width	Three 24"	24"	B/J2 (see pages 15 & 16)
Material	S = Steel A = Aluminum	S	A	B (Lower thermal capacity & higher thermal conductivity of Aluminum)
Contents/Total Enclosed Mass	Raceway WT: LBS/LF	P2E = 6.20 C2E = 6.20 K2E = 6.20	2.94	
	Cable WT: LBS/LF	P2E = 43.436 C2E = 54.600 K2E = 1.024	9.80	
	Total Weight LBS/LF	⇒ 117.66	12.74	B/J2 (see pages 15 & 16)
Orientation	H = Horizontal V = Vertical	V	V (Thermocouples 191-193, 207-209, 287-289, & 303-305)	B
Material Type	PPV = Prefabricated Panels (V-Rib) PPF = Prefabricated Panels (Flat)	PPF (Assumed)	PPV	B/J1 (see page 15)
Material Thickness	A = 1.00" + .25-0 A' = 1.00" min.	A'	A	B (R O C. Y-104476 ) ( Attachment. E.)
Stiffeners (V-Rib) location / Orientation	A/B A=I=Internal V-Ribs E = External V-Ribs B = Perp=Perp. to Tray rails PAR=Parallel to Tray rails	None (Assumed)	I/PAR	B/J1 (see page 15)
Stress Skin Location	NA = No Stress Skin I = Internal E = External B = Both Faces	B	B	B
Joint Type	A/B A = PRB = Prebuttered PB = Post Buttered B = B = Butt Joint SF = Score & Fold M = Mittered	PRB/B  PRB/SF,B (Flanged Area)	Tray A ⇒ PRB/B  Tray D ⇒ PRB/SF,B	B
Joint Gap	Size	Flush	Flush	B
Unsupported Barrier Spans	Dimension of Boxed Commodities	24"	24"	B
Internal Support Mechanism	P = Prebanding S = Shims (Thermo-Lag)	P	Tray D ⇒ P Tray A ⇒ Non	B

## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

Segments:	CB1FP2E-01 CB1FC2E-01 CB1FK2E-01			
Commodity Parameters	Description	CPS Installation	NEI 2-10 Test Report	Commodity Comparison. B = Bounded B/J = Bounded with Justification.
Fastener Size/Material	A/B A = B = Bands W = Tie Wires S = Staples B = Size	B/3/4"x0.025"	B/1/2"x0.020"	B
Fastener Spacing	Distance between fasteners (Max)	12"	12"	B
Fastener Distance From Joints	Distance of Fastener from Butt Joints	2"	2"	B
Structural Support and Intervening steel Protection	N = No Coverage 9 = 9" Rule 18 = 18" Rule T = Total Coverage	T (includes ground strap)	T	B
Boxed Enclosure Location	C1 = Concrete 1 Side	C1	N/A	B/J2 (see pages 15 & 16)

### 2. Evaluation of Segments CB1FC2E-02 and CB1FK2E-02.

Identification of Unique Segment for C2E Cable Tray in CB-1f Fire Zone (See sketch on Attachment A, page 1 ).

CB1FC2E-02	36" wide, 12" deep Cable Tray Ventrib (solid) bottom, 11'-9" straight vertical run, from the floor at El. 762'-0" to F21 wall support at El. 773'-9", Floor penetration CB-762-15-5028. 1"Ø steel ground conduit thermal short wrapped for approximately 9 linear feet, 18" min. coverage from the protective envelope. Aux. steel (TS 10x2x1/4) (Ref. FECN 11720) covered with 3 hr. fire proofing material "Cafcote 560", in accordance with UL design no. D902, total coverage intervening steel
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Identification of Unique Segment for K2E Cable Tray in CB-1f Fire Zone (See sketch on Attachment A, page 1 ).

CB1FK2E-02	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, 11'-9" straight vertical run, from the floor at El. 762'-0" to F21 wall support at El. 773'-9", Floor penetration CB-762-15-5028. 1"Ø steel ground conduit thermal short wrapped for approximately 9 linear feet. Aux. steel (TS 10x2x1/4) (Ref. FECN 11720) covered with 3 hr. fire proofing material "Cafcote 560", in accordance with UL design no. D902, total coverage intervening steel
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These two segments are evaluated as one combined segment, due to the construction of the fire protective barrier installation.

## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

This combined segment consists of two vertical runs of cable tray risers , one 36" wide and the other 24" wide (See Attachment B page 2), protected/wrapped by a three sided Thermo-Lag 330-1 enclosure, bolted to a 3 hour rated concrete wall to form a complete fire protected barrier enclosure.

( See proceeding item 1 discussion for further detail ).

Segments:	CB1FC2E-02 CB1FK2E-02			
Commodity Parameters	Description	CPS Installation	NEI 2-10 Test Report	Commodity Comparison. B = Bounded B/J = Bounded with Justification.
Size	Cable Tray Width	36" and 24"	24"	B/J2 (see pages 15 & 16)
Material	S = Steel A = Aluminum	S	A	B (Lower thermal capacity & higher thermal conductivity of Aluminum)
Contents/Total Enclosed Mass	Raceway WT: LBS/LF	C2E = 7.93 K2E = 6.20	2.94	B
	Cable WT: LBS/LF	C2E = 68.036 K2E = 3.899	9.80	B/J2 (see pages 15 & 16)
	Total Weight LBS/LF	⇒ = 86.065	12.74	B/J2 (see pages 15 & 16)
Orientation	H = Horizontal V = Vertical	V	V (Thermocouples 191-193, 207-209, 287-289, & 303-305)	B
Material Type	PPV = Prefabricated Panels (V-Rib) PPF = Prefabricated Panels (Flat)	PPF (Assumed)	PPV	B/J1 (see page 15)
Material Thickness	A = 1.00" + .25-0 A' = 1.00" min.	A'	A	B (R O C. Y-104476 )
Stiffeners (V-Rib) location / Orientation	A/B A = I = Internal V-Ribs E = External V-Ribs B = Perp = Perp. to Tray rails PAR = Parallel to Tray rails	None (Assumed)	I/PAR	B/J1 (see page 15)
Stress Skin Location	NA = No Stress Skin I = Internal E = External B = Both Faces	B	B	B
Joint Type	A/B A = PRB = Prebuttered PB = Post Buttered B = B = Butt Joint SF = Score & Fold M = Mitered	PRB/B  PRB/SF,B (Flanged Area)	Tray A ⇒ PRB/B  Tray D ⇒ PRB/SF,B	B
Joint Gap	Size	Flush	Flush	B
Unsupported Barrier Spans	Dimension of Boxed Commodities	C2E = 36" K2E = 24"	24"	B/J2 (see pages 15 & 16)



## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

Segments:	CB1FC2E-02 CB1FK2E-02			
Commodity Parameters	Description	CPS Installation	NEI 2-10 Test Report	Commodity Comparison. B = Bounded B/J = Bounded with Justification.
Internal Support Mechanism	P = Prebanding S = Shims (Thermo-Lag)	P	Tray D $\Rightarrow$ P Tray A $\Rightarrow$ Non	B
Fastener Size/Material	A/B A = B = Bands W = Tie Wires S = Staples B = Size	B/1/4" x 0.025"	B/1/2" x 0.020"	B
Fastener Spacing	Distance between fasteners (Max)	12"	12"	B
Fastener Distance From Joints	Distance of Fastener from Butt Joints	2"	2"	B
Structural Support and Intervening steel Protection	N = No Coverage 9 = 9" Rule 18 = 18" Rule T = Total Coverage	T (support), 18" for 1" $\varnothing$ steel ground conduit.	T	B, testing has demonstrated that intervening steel members protected for 18" from the protective envelope adequately prevent significant heat conduction into the protective envelope.
Boxed Enclosure Location	C1 = Concrete 1 Side	C1	N/A	B/J2 (see pages 15 & 16)

B/J1 The location on the top and bottom of the tray is where orientation of V-Ribs is most critical from a structural view point. When structurally comparing configurations where the V-Ribs are oriented parallel to the tray run with configurations where the V-Ribs have been pounded out, under similar joint supporting conditions ( i.e., support on the tray rails on the top of the tray, or by the groove joints/stress skin at the bottom of the tray), it is concluded that these configurations are structurally equivalent, because the Thermo-Lag panel will have the tendency to bend along the weakest link which is the area of the panel where the V-Ribs is absent (flat area).

B/J2 The size of the three sided box formation used to wrap the combined cable tray segments CB1FP2E-01, C2E-01, and K2E-01 is approximately 84" wide by 1'-6" deep, and for CB1FC2E-02, and CB1FK2E-02 it is approximately 66" wide by 1'-6" deep. However the maximum unsupported span that is produced by this configuration is 22" and 34" respectively.

This is due to the banding criteria specified in the Ref. 10 Vendor Manual i.e., " for multiple cable tray enclosures, the front is banded to each cable tray". Additionally prebanding of the side pieces is utilized for added structural rigidity (see Attachment B pg. 1 & 2).



## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

This prebanding and because the electrical installation specification requires a cover over all the instrumentation cable trays (K2E's) and a cover extending 12' up from the floor on the Power (P2E) and Control (C2E) cable tray risers, produces further support and ensures the structural rigidity of the CPS installation.

In Reference 4 (NEI Test 2-10), openings were noticed on the bottom and on the outside bottom of the radial bend of Tray A, and a large opening was present on the outside bottom of the radial bend in Tray D as the stainless steel bands had broken and a section of barrier had fallen into the furnace. The thermocouples installed in the areas of barrier breaches were the ones that exceeded the temperature criteria at 86 minutes. These thermocouple numbers are 292, 293, and 309. Based on the location of these thermocouples, no comparison is made to the segments (i.e., CB1FP2E, C2E, & K2E-01 and 02) under evaluation in this calculation, because thermocouples 292, 293, and 309 are located in the radial bend area, while the segments under evaluation are vertical oriented segments.

No barrier breach was noted in the areas (thermocouple 191-193, 207-209, 287-289, and 303-305) under consideration in this evaluation, following the hose stream test no additional opening were observed. Since the test was terminated at 86 minutes into the test due to barrier breach in a region of the tested trays where the configuration transitions between differing construction techniques at radial bends (i.e., separate "mitered" panel pieces) it is reasonable to deduce that the vertical segments of the trays (i.e., thermocouples 191-193, 207-209 on tray A, 287-289, and 303-305 on tray D) of the trays would have remain within the temperature criteria of the test for a much longer duration, it is therefore conservative to conclude that the installed configuration which is a straight vertically constructed barrier is bounded by the NEI Test 2-10 in size and unsupported span and that the structural and thermal integrity of these segments is acceptable.

The various other critical attributes of the three sided box formation are justified below per comparison to the tested attributes and engineering judgments:

- a. The little slots made in the Thermo-Lag panels to accommodate the banding and prebanding are very small, and are covered/filled with Thermo-Lag subliming trowel grade material of sufficient envelope and thickness to make it comparable to the "V" groove and/or butt joint formations of the Ref. 4 NEI tests.
- b. The bolting of the flange pieces to the wall insures the integrity of the joint between the flange and box side pieces. This joint is further protected by the Thermo-Lag pieces that form a two sided box around the bolt heads. The bolts on the flange pieces are subjected to negligible forces (tension or shear) due to the vertical orientation of the flange pieces and because they are sandwiched between the top and bottom horizontal flanges.

## 6.1 COMBINED CABLE TRAY SEGMENTS EVALUATION ( Continued)

Hence the structural and thermal integrity of these attributes are conservatively supported by the test until temperature criteria were exceeded at 85 minutes.

## 6.2 C2E CABLE TRAY EVALUATION:

CB1FC2E-03	36' wide, 12" deep Cable Tray Ventrib (solid) bottom, 2'-6" short straight vertical run, with a vertical radial bend, from wall support F21 at El. 773'-9" to top of cable tray bend at El. 776'-3".
CB1FC2E-04	36" wide, 6" deep Cable Tray Ventrib (solid) bottom, straight horizontal runs and two horizontal lateral bends, hangers H63, H64, H65, H74, and H59. 1.5"Ø steel conduit (C0610) thermal short 4 linear feet coverage. 3"Ø pipe (11A04A) thermal short 8 linear feet coverage.
CB1FC2E-05	36" wide, 12" deep Cable Tray Ventrib (solid) bottom, vertical radial bend, one wall hanger F19.

<b>FIRE BARRIER SYSTEM:</b>	C2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FC2E-03			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 20ga Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity and lower structural integrity ( $S_x$ 1.44 in <sup>3</sup> vs 2.0 in <sup>3</sup> ) of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	36" wide 12" deep	24" wide 4" deep	Smaller tested tray size bounds larger tray due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 7.93 #/ft Cables = 68.036 (At. D) <hr/> Total = 75.966 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Vertical straight run with vertical radial bend	Vertical straight run with vertical radial bend	Same.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel. 3 Hr. rating	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating	Same, except no V ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> C2E <b>FIRE ZONE:</b> CB-If (Control Bld'g El. 762", 3 Hr. rating) <b>SEGMENTS:</b> CB1FC2E-03				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L., since installed thickness is at least same as test. ( See R O C. Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent.	V-Ribs, positioned parallel to run of cable tray on top and bottom, and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel.	Inside and outside faces of the panel.	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend.	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick, SS Banding with 204 SS wing seals, 1/2"x .020" with 1/2" wing seals #202SS 12" O.C. Max. spacing, 2" max spacing from joints. #304SS Bright Annealed Wire .080, 14ga.	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> C2E <b>FIRE ZONE:</b> CB-If (Control Bld'g El. 762", 3 Hr. rating) <b>SEGMENTS:</b> CB1FC2E-03				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 34" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray.	See section 7 for acceptance justification.	85 minutes.
BARRIER JOINT REINFORCEMENT	None specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops).	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage. No intervening steel.	Same, except no V-ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	C2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762', 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FC2E-04			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 20ga Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. Catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity and lower structural integrity ( $S_x$ 1.44 in <sup>3</sup> vs 2.0 in <sup>3</sup> ) of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	36" wide 6" deep	24" wide 4" deep	Smaller tested tray size bounds larger tray due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 7.93 #/ft Cables = 68.036 (Att. D)  Total = 75.966 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Horizontal, & Lateral radial bend.	Horizontal, & Vertical radial bend.	Bounded, Equivalent barrier and joint type.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel. 3 Hr. rating.	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating.	Same, except no V ribs.	See other parameters.



<b>FIRE BARRIER SYSTEM:</b>	C2E			
<b>FIRE ZONE:</b>	CB-If (Control Bld'g El. 762', 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FC2E-04			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref: 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal, ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L., since installed thickness is at least same as test. ( See R O C, Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent.	V-Ribs, positioned parallel to run of cable tray on top and bottom , and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel.	Inside and outside faces of the panel.	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend.	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick ,SS Banding with 204 SS wing seals, 1/2"x.020" with 1/2" wing seals #202SS 12" O.C. Max. spacing, 2" max spacing from joints. #304SS Bright Annealed Wire .080, 14ga.	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> C2E <b>FIRE ZONE:</b> CB-If (Control Bld'g El. 762', 3 Hr. rating) <b>SEGMENTS:</b> CB1FC2E-04				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 34" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray.	See section 7 for acceptance justification.	85 minutes.
BARRIER JOINT REINFORCEMENT	Non-specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops)	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel.  All intervening steel that penetrate the envelope was firewrapped a minimum of 18" for a 3 hour fire rating.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage on support steel.	Testing has demonstrated that support and intervening steel members protected as described and installed at CPS adequately prevent significant heat conduction into protective envelopes, (Ref. 1.0 page 27).	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	C2E			
<b>FIRE ZONE:</b>	CB-lf (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CBIFC2E-05			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 20ga Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity and lower structural integrity ( $S_x$ 1.44 in <sup>3</sup> vs 2.0 in <sup>3</sup> ) of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	36" wide 12" deep	24" wide 4" deep	Smaller tested tray size bounds larger tray due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 7.93 #/ft Cables = 67.867 (Att. D)  Total = 75.797 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Vertical straight run with vertical radial bend	Vertical straight run with vertical radial bend	Same.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel. 3 Hr. rating	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating	Same, except no V ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	C2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FC2E-05			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal, ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L., since installed thickness is at least same as test. ( See R O C. Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent.	V-Ribs, positioned parallel to run of cable tray on top and bottom, and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel.	Inside and outside faces of the panel.	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend.	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick, SS Banding with 204 SS wing seals, 1/2"x.020" with 1/2" wing seals #202SS 12" O.C. Max. spacing, 2" max spacing from joints. #304SS Bright Annealed Wire .080, 14ga.	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> C2E <b>FIRE ZONE:</b> CB-lf (Control Bld'g El. 762", 3 Hr. rating) <b>SEGMENTS:</b> CB1FC2E-05				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 34" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray.	See section 7 for acceptance justification.	85 minutes.
BARRIER JOINT REINFORCEMENT	None specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops)	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage no intervening steel.	Same, except no V-ribs.	See other parameters.

### 6.3 K2E CABLE TRAY EVALUATION:

CB1FK2E-03	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, 2'-6" short straight vertical run, with a vertical radial bend, from wall support F21 at El. 773'-9" to top of cable tray bend at El. 776'-3".
CB1FK2E-04	24" wide, 6" deep Cable Tray Ventrib (solid) bottom, straight horizontal runs and two horizontal lateral bends, hangers H63, H64, H65, H74, and H59. 1.5"Ø steel conduit (C0610) thermal short 4 linear feet coverage. 3"Ø pipe (11A04A) thermal short 8 linear feet coverage. 36" wide, 6" deep cable tray (P1B) 4 linear feet coverage. 500 MCM ground strap 1.5 linear feet coverage.
CB1FK2E-05	24" wide, 12" deep Cable Tray Ventrib (solid) bottom, vertical radial bend length, one wall hanger F19.

Calculation of flat cover weight. 18ga. (.0478") (Ref. 15) x 24" wide (uncoated sheet steel, 490 #/ft<sup>3</sup> ref. 17, AISC, 7th edition pg. 614),  $1.1472 \text{ in}^2 \times 1 \text{ ft}^2 / 144 \text{ in}^2 = 0.00796 \text{ ft}^2 \times 490 \text{ #/ft}^3 = 3.9 \text{ #/ft}$ .



<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-03			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 14ga Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	24" wide 12" deep	24" wide 4" deep	Smaller tested tray size bounds larger tray due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 6.20 #/ft Cables = 3.899 (Att. D) cover = 3.900 Total = 14.00 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Vertical straight run with vertical radial bend.	Vertical straight run with vertical radial bend.	Same.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel. 3 Hr. rating.	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating.	Same, except no V ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-03			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref: 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal, ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L, since installed thickness is at least same as test. ( See R O C. Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent.	V-Ribs, positioned parallel to run of cable tray on top and bottom , and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel.	Inside and outside faces of the panel.	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend.	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick ,SS Banding with 204 SS wing seals, 1/2"x.020" with 1/2" wing seals #202SS 12" O.C. Max. spacing, 2"max spacing from joints. #304SS Bright Annealed Wire .080, 14ga	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-If (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-03			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 22" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray	Same.	See other parameters.
BARRIER JOINT REINFORCEMENT	None specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops).	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage no intervening steel	Same, except no V-ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-lf (Control Bld'g El. 762', 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-04			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 14ga Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. Catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	24" wide 6" deep	24" wide 4" deep	Smaller tested tray size bounds larger tray due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 6.20 #/ft Cables = 3.899 (Att. D) cover = 3.900 Total = 14.00 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Horizontal, & Lateral radial bend.	Horizontal, & Vertical radial bend.	Bounded, Equivalent barrier and joint type.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel. 3 Hr. rating.	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating.	Same, except no V ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-If (Control Bld'g El. 762', 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-04			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal, ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L, since installed thickness is at least same as test. ( See R O C. Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent.	V-Ribs, positioned parallel to run of cable tray on top and bottom , and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel	Inside and outside faces of the panel	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick ,SS Banding with 204 SS wing seals, 1/2"x.020" with 1/2" wing seals #202SS 12" O.C. Max spacing, 2" max spacing from joints. #304SS Bright Annealed Wire .080, 14ga.	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> K2E <b>FIRE ZONE:</b> CB-1f (Control Bld'g El. 762', 3 Hr. rating) <b>SEGMENTS:</b> CB1FK2E-04				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 22" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray.	Same.	See other parameters.
BARRIER JOINT REINFORCEMENT	Non-specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops)	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage no intervening steel.	Same, except no V-ribs.	See other parameters.



<b>FIRE BARRIER SYSTEM:</b> K2E <b>FIRE ZONE:</b> CB-If (Control Bld'g El. 762", 3 Hr. rating) <b>SEGMENTS:</b> CBIFK2E-05				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Cable Tray 142a Ventrib bottom (Husky Products Inc., model PSX1)	Cable Tray Ladder Back (B-Line Systems, Inc. Catalogue No. 24A-09-24-144)	Ladder Back tested tray bounds the installed solid ventrib bottom tray, due to lower thermal capacity, higher thermal conductivity of the Ladder Back Tray.	See other parameters.
COMMODITY SIZE	24" wide 6" deep	24" wide 4" deep	Smaller tested tray size bounds larger trav due to lower thermal capacity, lower thermal resistance, and larger external surface area to thermal capacity ratio. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY MATERIAL	Steel, Pregalvanize, ASTM A-525-G90	Aluminum Alloy 6063-T6	Aluminum tested cable tray bounds installed steel tray due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
COMMODITY CONTENTS	Cable Tray = 6.20 #/ft Cables = 3.899 (Att D) cover = 3.900 Total = 14.00 #/ft	Total = 12.74 #/ft	Thermal mass of installed configuration is greater than tested configuration, and is therefore bounded, due to its higher internal thermal capacity.	See other parameters.
COMMODITY ORIENTATION	Vertical straight run with vertical radial bend	Vertical straight run with vertical radial bend	Same.	See other parameters.
BARRIER TYPE	Thermo-Lag 330-1, one layer preformed panel, 3 Hr. rating	Thermo-Lag 330-1, one layer preformed V-ribbed panel, 3 Hr. rating	Same, except no V ribs.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b>	K2E			
<b>FIRE ZONE:</b>	CB-1f (Control Bld'g El. 762", 3 Hr. rating)			
<b>SEGMENTS:</b>	CB1FK2E-05			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION( Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1.0" Max. unknown	1.0" Nominal, ( 1.0 +0.250 -0.0)	Installed Thermo-Lag is bounded by tested T.L., since installed thickness is at least same as test. ( See R O C. Y-104476 )	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	The presence of V-ribs is unknown, and is therefore assumed to be non-existent	V-Ribs, positioned parallel to run of cable tray on top and bottom , and perpendicular to length of tray along sides of tray.	The location on the top and bottom of the tray is where orientation of the V-ribs is most critical from a structural view point. Orientation parallel to the run does not add to the structural capability of the wrapped system, hence the tested bounds installed since orientation parallel to tray is limiting.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside and outside faces of the panel.	Inside and outside faces of the panel.	Same.	See other parameters.
BARRIER JOINT TYPE	Precoated edges with 330-1 Thermo-Lag trowel grade material and butt joined at ends (Pre-Buttered butt joints) on straight run sections, and individual top & bottom and side pieces miter cut on radial bend.	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections, and separate panel pieces on inside and outside face of radial bend.	NEI Test 2-10 Thermo Couples 191-199, 207-215 Tray A, and 287-295, 303-311 Tray D.	85 minutes -thermocouples 292, 293 & 309 exceeded temperature limits after 85 minutes.
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	#SC312SS, 3/4" X .025" thick ,SS Banding with 204 SS wing seals, 1/2"x .020" with 1/4" wing seals #202SS 12" O.C. Max. spacing, 2" max spacing from joints. #304SS Bright Annealed Wire .080, 14ga.	1/2" wide Stainless Steel band 0.020" thick, wing seals, 2" on each side of panel butt-joint at 12" interval.	Tested bounds installed in width, other parameters are same.	See other parameters.

<b>FIRE BARRIER SYSTEM:</b> K2E <b>FIRE ZONE:</b> CB-1f (Control Bld'g El. 762", 3 Hr. rating) <b>SEGMENTS:</b> CB1FK2E-05				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION UTILIZED FOR EVALUATION	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	Max. 22" across the bottom & top of the tray.	Max. 22" across the bottom & top of the tray.	Same.	See other parameters.
BARRIER JOINT REINFORCEMENT	None specified in installation or inspection details.	This was a base-line test, no upgrades in the form of joint re-enforcement was performed.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION ( Ground Straps, Hangers, Non-Dedicated Conduits, Fire Stops)	Hanger⇒ wrapped per detail 24 Attachment B, using 330-1 T.L. subliming material 1" min. thickness from the point where the hanger supports the cable tray all the way to the point the support attaches to the auxiliary steel , and extending so as to maintain an 18" coverage from cable tray envelope on the intervening steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material, total coverage no intervening steel	Same, except no V-ribs.	See other parameters.

## 7.0 JUSTIFICATION ANALYSIS:

The following are justification analysis for the performance parameters that were found to be unbounded or configurations that were not specifically tested.

1. The installed barrier unsupported span of 34" is not bounded by the tested (NEI Test 2-10) span of 22", however, the installed configuration offers equivalent if not better structural integrity than the tested configuration, for the following reasons:

The NEI test on tray "A" of the Ref. 4 test report was performed without any pre-banding (i.e., internal support mechanism). This produces a configuration in which the only support provided to prevent sagging under self-weight and/or to prevent damage due to impact caused by falling debris through out the tray run for the Thermo-Lag panels pieces on the top and on the inside of the radial bend is provided by the side rail flanges of the cable tray. This configuration produces a min. unsupported area of 22"x 48" ( 1056 in<sup>2</sup> ), the installed configuration as verified by walkdown and per reference 11, utilizes 3/4" min. wide banding on the straight cable tray runs and radial bends at 12" min. interval to provide additional support to the top panels to prevent them from excessive sagging under self-weight. This configuration produces a max. unsupported area of 34"x12" ( 408 in<sup>2</sup> ). Due to the structural behavior of the two configurations, the 22"x48" panel area will produce bending moment along the axis parallel to the tray since its only support joints are on the tray rails, while the 12"x34" panel area will produce bending moment along the axis perpendicular to the 12" long sides since it is supported on four joints ( the tray rails on two sides and the banding on the other two sides), the installed configuration is therefore considered structurally to be superior to the tested configuration.

In reference 4 (NEI Test 2-10) openings were noticed on the bottom and on the outside bottom of the radial bend of Tray A, and a large opening was present on the outside bottom of the radial bend in Tray D as the stainless steel bands had broken and a section of barrier had fallen into the furnace. The thermocouples installed in the areas of barrier breaches were the ones that exceeded the temperature criteria at 86 minutes. These thermocouple numbers are 292, 293, and 309. Following the Hose Stream test no additional openings were observed. At CPS cable trays are steel Ventrib bottom (solid bottom) versus aluminum Ladder Back tray used in the test. The CPS trays offer higher thermal capacity (lower thermal conductivity) which should retard the heat transfer into the tray and therefore provides better protection to the cables. The CPS solid bottom trays are better capable of withstanding fire fighting activities in that the force exerted by the hose stream will tend to push the Thermo-Lag panel pieces against a solid backing hence distributing the force over a wider area and therefore reducing the possibility of damage to the panels.

## 7.0 JUSTIFICATION ANALYSIS (Continued)

Hence it is concluded that the structural integrity of the installed configuration in which the unsupported span is unbounded, can be conservatively supported until temperature criteria were exceeded (i.e., 65 minutes), including the external forces imposed by Fire fighting activities.

- 2 The installation of the interface between the cable trays and the BISCO ceiling and floor Penetration Seal (Attachment B pages 7 & 8) is as follows:

- a) The cable tray is covered with Thermo-Lag 330-1 prefabricated panel as previously described in section 6.1 and illustrated in Attachment B, is flush to the Penetration Seal.
- b) A piece of prefabricated Thermo-Lag panel is cut large enough to cover the face of the penetration plus 3" flange for concrete fasteners. Holes for cable trays that penetrate the Penetration Seal are cut out from the panel piece as required. The sections created by the cutting out of the one piece are such that each piece can be fastened to the concrete wall using  $\frac{1}{4}$ " x  $1\frac{1}{4}$ " Tapcon Screws of sufficient length to ensure  $\frac{3}{4}$ " concrete penetration, and carbon steel washer/plates.
- c) The sections are mounted to the concrete floor or ceiling using the fasteners at a maximum 12" interval with one fastener per section and two fasteners per flange minimum.
- d) Sufficient amount of Thermo-Lag is applied to cover the bolt heads of the concrete fasteners with the 1" min. envelope thickness.
- e) The installation is then completed by filling in all edges and joints with Thermo-Lag 330-1 Subliming Trowel Grade material.

The weight of 1" thick Thermo-Lag panel is approximately 10.50 Lbs/ft<sup>2</sup> (Ref. 21). It is calculated that the maximum force per screws is approximately 6.5 lbs. This force produces negligible stresses compare to the tensile and shear stress allowables of the  $\frac{1}{4}$ " screws.

The Thermo-Lag cover of the penetration is not impacted by fire fighting or interaction of falling debris due to its mounting flush against the ceiling and floor penetrations.

Of critical importance in this evaluation is the structural integrity of the horizontal sections of Thermo-Lag panel to ensure that the joints surrounding the trays where the Firewrap trays penetrate the Penetration Seal will remain intact during a fire.

## 7.0 JUSTIFICATION ANALYSIS (Continued)

The construction of the joint interface between the horizontal ceiling and floor mounted panel pieces is an overlapping of two panel pieces ( see attachment B detail 16 ) and as such it exhibits better thermal protection characteristics than the Score and Fold, or the Butting of pieces of Thermo-Lag together methods used in the Reference 4 NEI tested cable trays.

The installation process for the interface between the cable trays and the BISCO ceiling/floor penetration seal ( see attachment B detail 16 ) is similar to the above installation for the wall penetration interface, however, in this configuration the anchor bolts are subjected to tensile forces due to the weight of the Thermo-Lag panel pieces for the ceiling penetration. The largest piece of panel is considered to be 84" x 6" = 504 in<sup>2</sup> or 3.5 ft<sup>2</sup> held together by approximately 6 screws . Lbs/screw is calculated to be < 6.5 in tension , the punching shear effect of the bolts trying to punch/pry through the Thermo-Lag is minimize due to the double layer of stress skin and the washer/plate arrangement utilized in this installation. Hence the bolts are considered adequate to support the Thermo-Lag pieces and therefore maintained the butt joints and seams together.

It is therefore concluded that the structural and thermal integrity of the installed configuration is at least supported by the test until temperature criteria were exceeded (i.e., 85 minutes).

## 8.0 RESULTS / CONCLUSIONS:

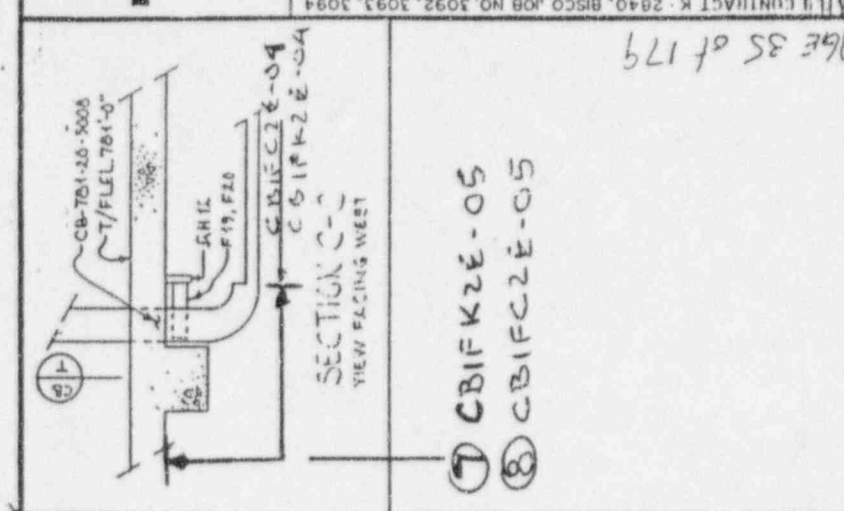
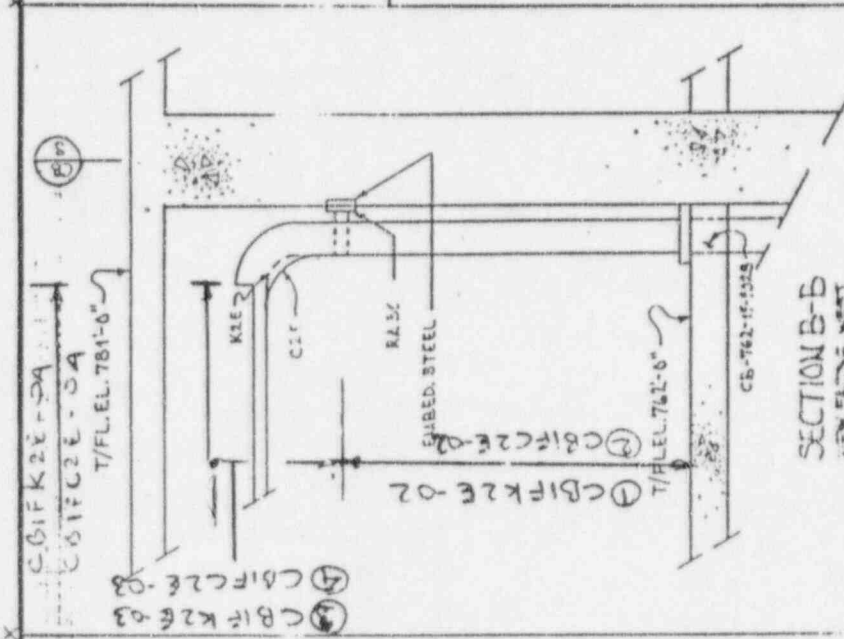
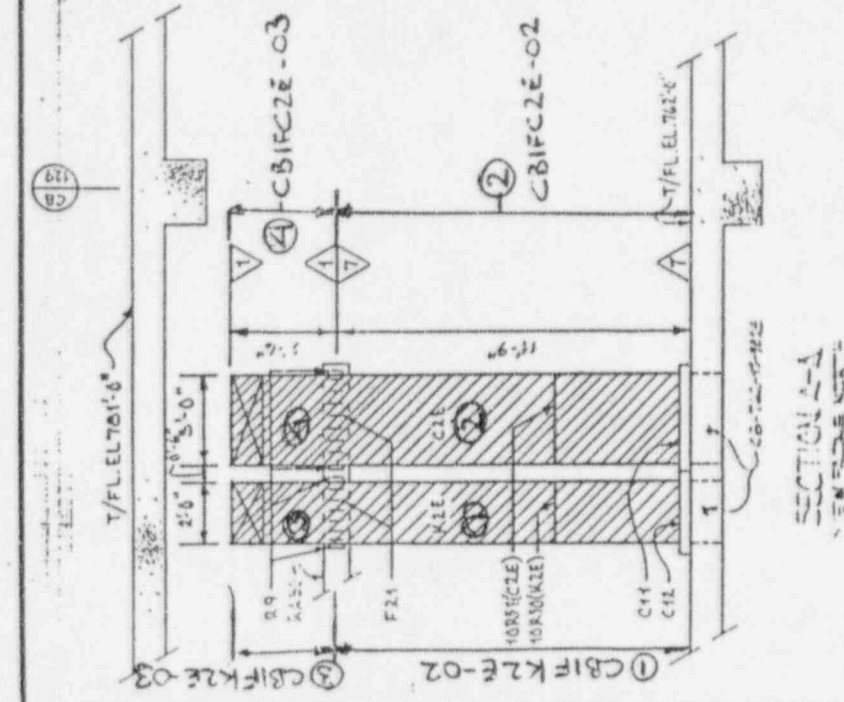
Based on parameter comparison of the various segments in Sections 6.1, 6.2 and 6.3, the installed configuration is bounded by trays A and D tested configurations in NEI Test 2-10 with the exception of the specific commodities and configuration deviations that are analyzed in Section 7.



Justification provided in Section 7 shows that the items described therein exhibit characteristics and attributes that are comparable to tested configurations and are therefore supported by the NEI Test 2-10 , until temperature criteria were exceeded.

In conclusion the installed CPS configurations of Cable Trays P2E ,C2E, and K2E in Fire Zone CB-1f that are protected by Thermo-Lag fire Barrier System, would meet the temperature acceptance and structural integrity criteria in accordance with NEI Tests for 85 minutes of fire duration.





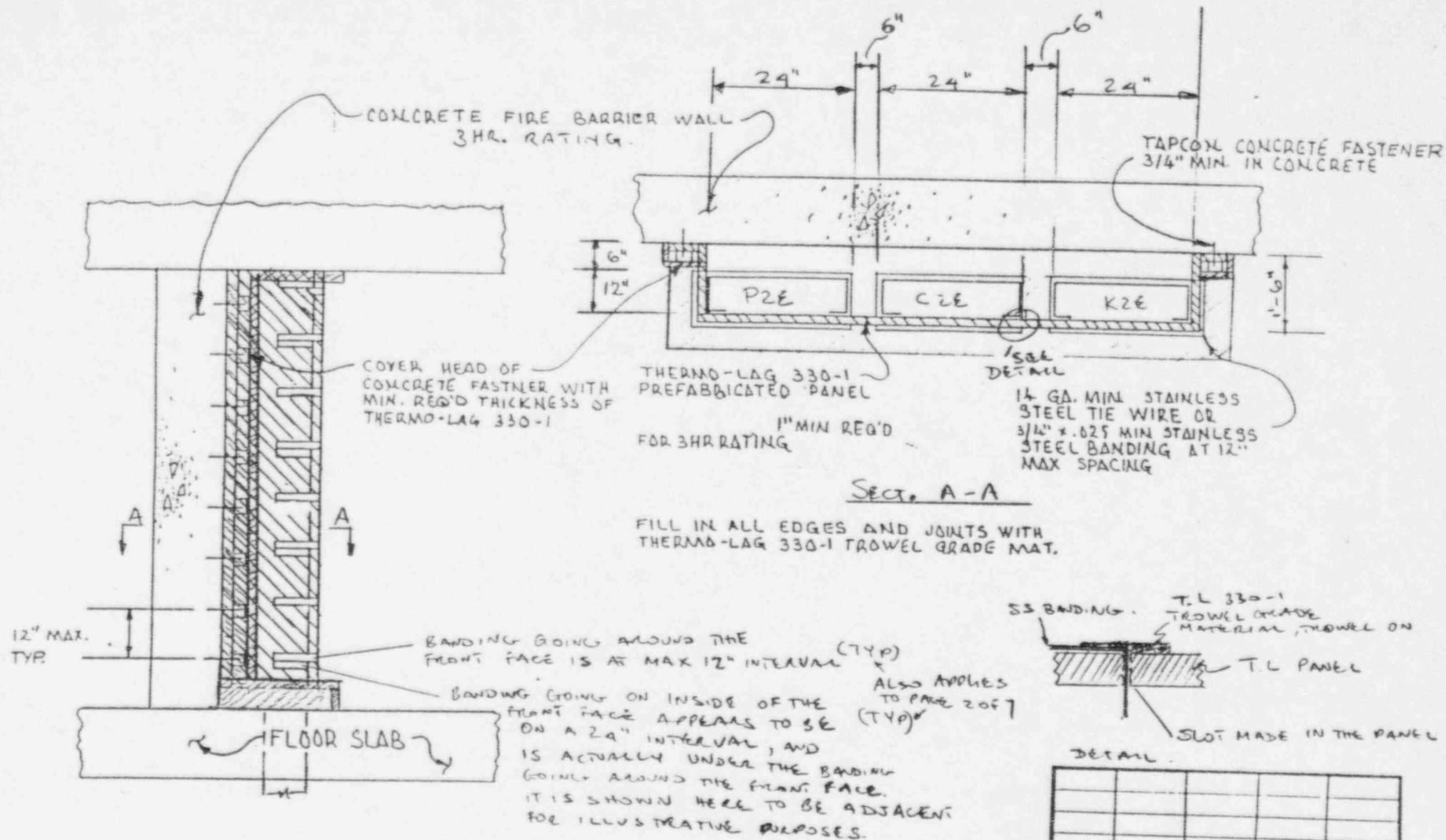


	BUILDING	LEGEND
	SECTION	
	B.C.W.A.	REF. DRAWINGS
	SECTION	

CONTROL BUILDING  
SECTION A-A  
SECTION B-B  
SECTION C-C  
ELEV. 762'-0" - 781'-0"  
FIRE ZONE CB-1F  
FPS, FIRE RATING


BUILDING: CENTRAL	DRAWN BY: J. A.	CHECKED BY: J. A.	DATE: 11-1-80
ELEVATION: 742'-0"	AREA / RM: 1	APPROVED BY: J. A.	DATE: 11-1-80
FLOOR: N/A	REF. DRAWING: A3 (NOTED)	DRAWING NO: C8-0762	DATE: 11-1-80
SCALE: 1/8" = 1'-0"	SHEET: 1	OF	

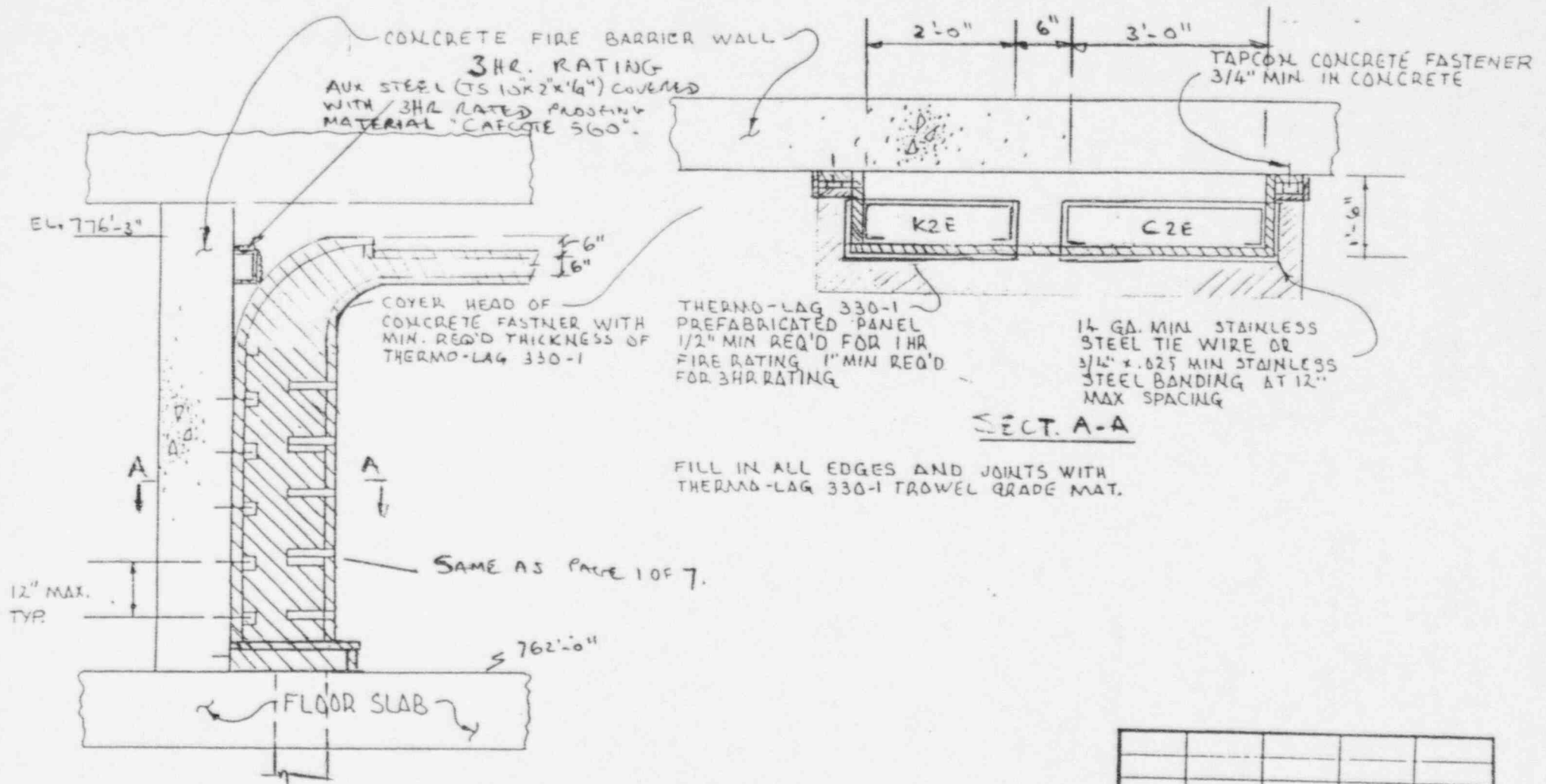





PREFABRICATED PANEL DESIGN  
FOR INSTALLATION OF THE READY  
ACCESS FIRE BARRIER ON VERTICAL  
CABLE TRAY RISERS ADJACENT  
TO FIRE BARRIER WALLS

REV NO	DATE	DRAWN	APPROVED
Brand Inc. Steel Services, Inc. 1110 HAWKINS RD. 2011 HAWKINS RD.			
APPROVED BY <b>D SCHULTZ</b>			

bisco 



PREFABRICATED PANEL DESIGN  
FOR INSTALLATION OF THE READY  
ACCESS FIRE BARRIER ON VERTICAL  
CABLE TRAY RISERS ADJACENT  
TO FIRE BARRIER WALLS

REV NO	DATE	DRAWN	APPROVED
Brand Industrial Services, Inc. 1110 W. 10th St. Fort Worth, Texas 76102			
APPROVED BY <u>D. SCHULTZ</u>			

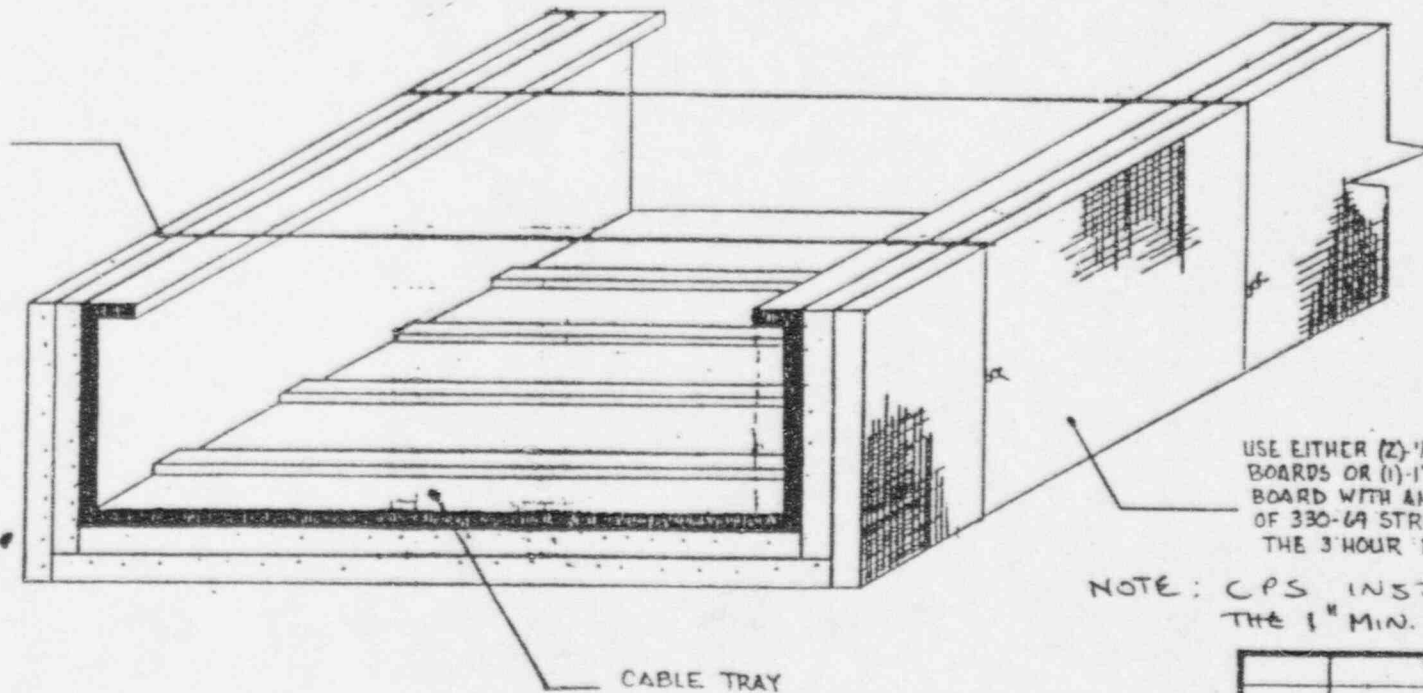
4A



REF: FIRE TEST  
TEST ARTICLE  
LADDER CABLE TRAY

TEST REPORT NO.  
ITL 84-12-181  
ITL 85-1-106

APPROVED 3/4" ST. STEEL  
BANDING OR STAINLESS  
STEEL TIE WIRE MAX.  
12" SPACING.



USE EITHER (2) 1/2" PREFABRICATED  
BOARDS OR (1) 1" PREFABRICATED  
BOARD WITH AN OUTER LAYER  
OF 330-69 STRESS SKIN FOR  
THE 3 HOUR RATING.

NOTE: CPS INSTALLATION USES  
THE 1" MIN. THICKNESS PANELS.

NOTE: EASY ACCESS DESIGN  
PRIOR TO INSTALLATION  
OF TOP SECTION

TYPICAL PREFAB. BOARD  
CABLE TRAY COVERING  
(3 HOUR RATING)

1	10-28-85	JJP	DDG
REV. NO	DATE	DRAWN	APPROVED

Brand Industrial Services, Inc.  
1420 WINDWARD DRIVE  
PORT HURON, MICHIGAN 48130

**biscon b**

**CABLE TRAY EASY ACCESS  
3-HR**

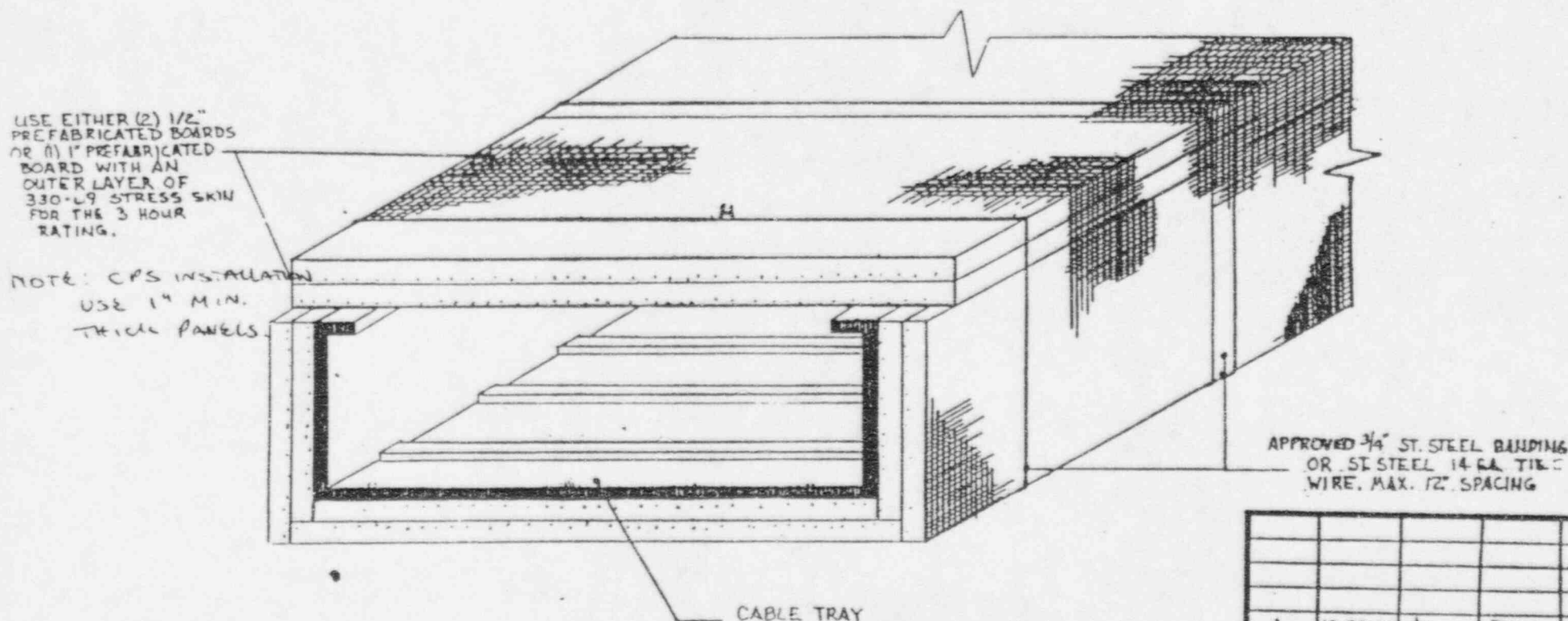
APPROVED BY: **K. LEITE**



REF: FIRE TEST  
TEST ARTICLE  
LADDER CABLE TRAY

TEST REPORT NO.  
ITL 84-12-101  
ITL 85-1-106

TYPICAL PREFAB. BOARD  
CABLE TRAY COVERING  
(3 HOUR RATING)



APPROVED 3/4" ST. STEEL BANDING  
OR ST. STEEL 14 GA. TIE  
WIRE, MAX. 12" SPACING

1	10-28-85	Jop	DPS
REV. NO	DATE	DRAWN	APPROVED

Grand Industrial Services, Inc.  
1400 Remondino Drive  
Port Hope, Ontario, Canada

**bisco**

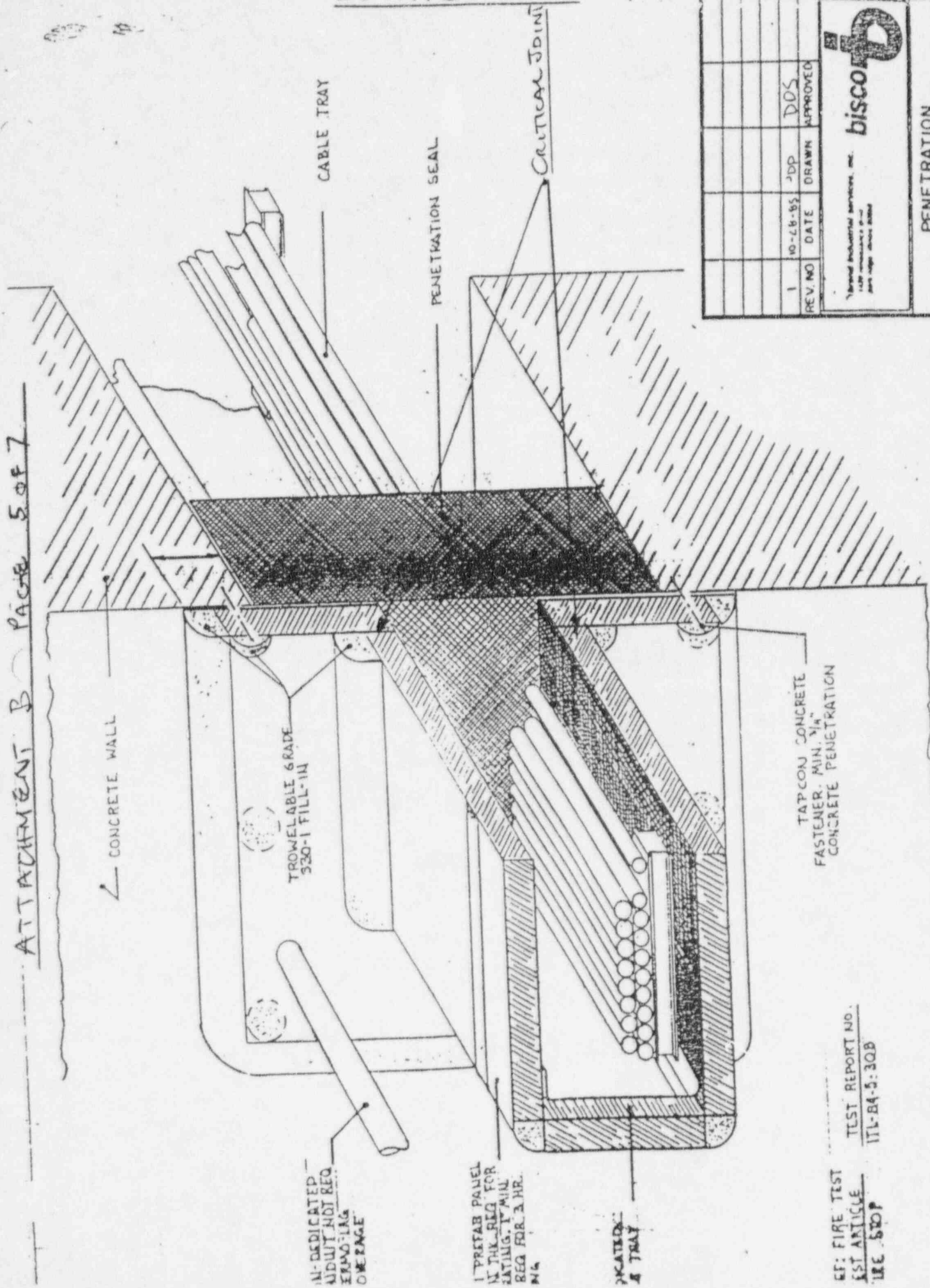
**CABLE TRAY EASY ACCESS  
COMPLETE COVERAGE 3-HR**

APPROVED BY: K. LEITZE

DATE	SCALE	DRAWN	BY	REVISION
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ATTACHMENT B PAGE 5 OF 7

DETAIL 16.



REV. NO.	1	NO. 28-85	JDP	DOS	APPROVED
DATE					

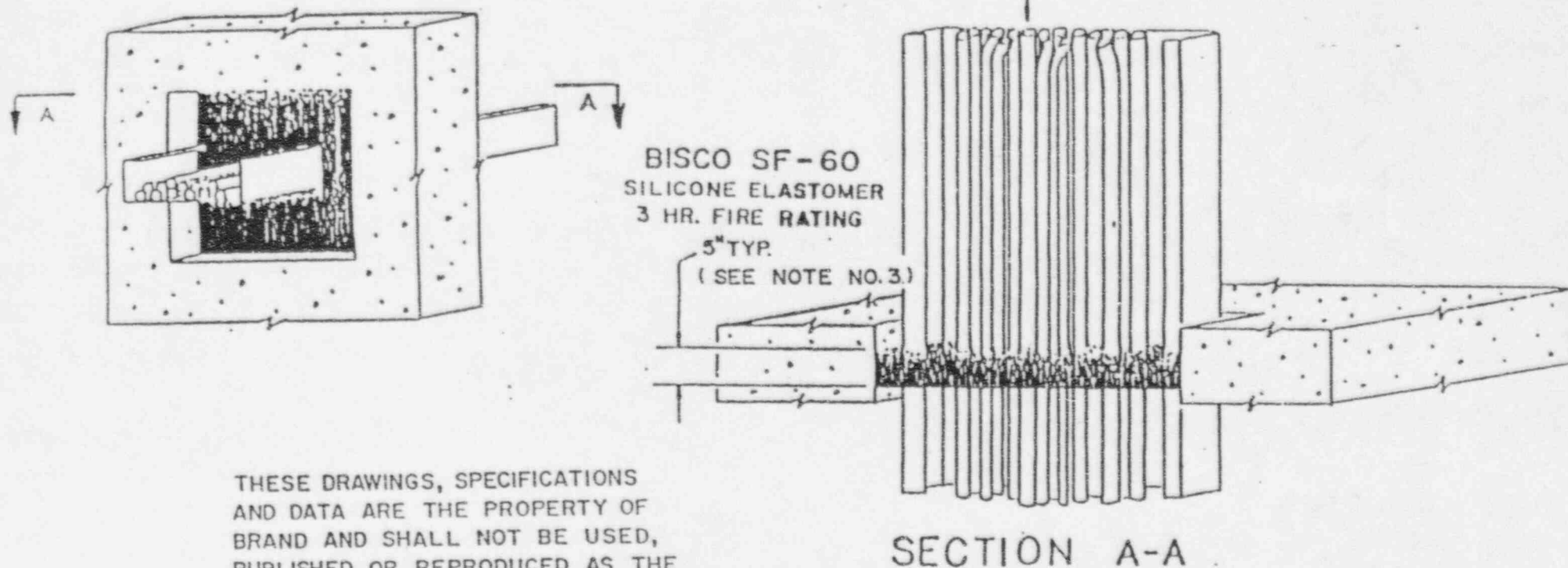
bisco**p**  
 Thermal Industrial Services, Inc.  
 11200 W. 11th Ave. Suite 100  
 Denver, CO 80233

PENETRATION SEAL / TL INTERFACE  
 APPROVED BY: D. SCHULTZ

DATE | SCALE | DRAWN | S.A. | BISCO

GF: FIRE TEST  
 TEST ARTICLE  
 IITL-B4-5-3QB  
 LRE STOP

THERMO-LAG RACEWAY  
 WITH PENETRATION SEAL

TYP. CABLE TRAY  
WITH CABLES

THESE DRAWINGS, SPECIFICATIONS  
AND DATA ARE THE PROPERTY OF  
BRAND AND SHALL NOT BE USED,  
PUBLISHED OR REPRODUCED AS THE  
BASIS FOR MANUFACTURING USE,  
OR SALE TO OTHERS WITHOUT  
PERMISSION.

## NOTES:

1. FOR CONCRETE WALL, MASONRY WALL, OR  
CONCRETE FLOOR PENETRATIONS.
2. THIS DETAIL TO BE USED WHEN POWER  
CABLES ARE PRESENT.
3. MINIMUM DEPTH OF 7-1/2" WHEN KELLUM  
GRIP IS INTERNAL OF SEAL.

# FOR INFORMATION ONLY

SEAL CRITERIA				
RATING	1	2	3	4
SATISFIES		X	X	

FIRE TEST REPORT 748-100

FIRE TEST REPORT 748-103

PRESSURE TEST REPORT 748-106

CLINTON POWER STATION, UNIT-1, BALDWIN ASSOCIATES CONTRACT K-2840, BISCO JOB NO. 3285

## TYPICAL INSTALLATION: CABLE TRAY THRU FIRE BARRIER

DRAWN BY:	RLR	DATE:	8-31-83	REV.	BY:	DATE	DESCRIPTION	APP'D. BY	DATE
APPROVED BY:	RLR	DATE:	9/24/83	1	RLR	4-3-84	CHANGE JOB NUMBER	JLS	4-17-84
				2	RLR	11-6-84	REVISE TESTING & ADD NOTE 3	RLR	11/20/84

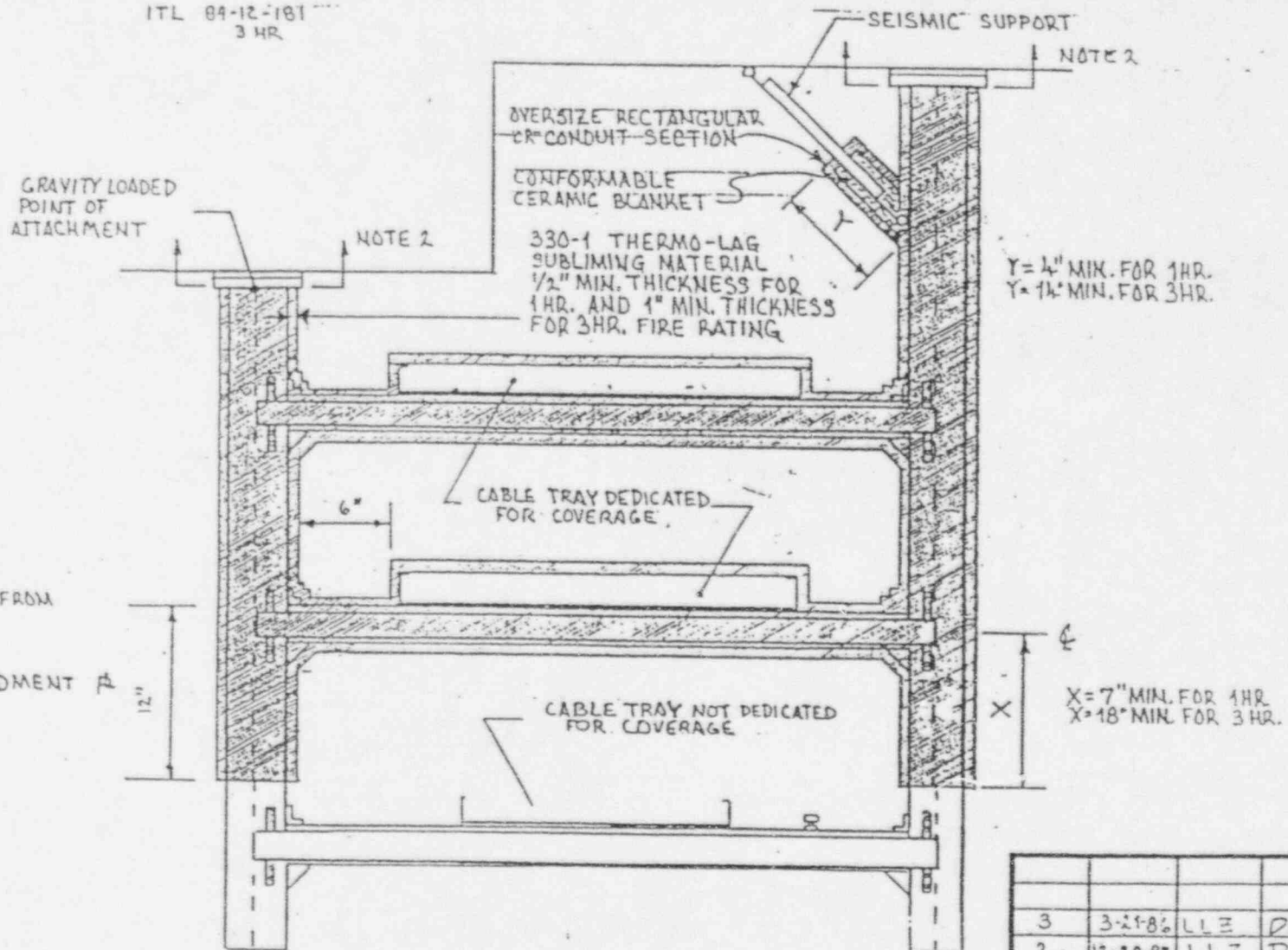
bisco **b**

brand industrial services, inc.  
1420 renaissance drive  
park ridge, illinois, 60068

DETAIL NO. 108

REF: FIRE TEST  
TEST ARTICLE...  
UNISTRUT

TEST REPORT NO. ...  
ITL 89-12-181  
3 HR



DETAIL 20


ES:  
ALL CASES 18" COVERAGE FROM  
SEWAGE ENVELOPE MUST  
MAINTAINED

EXISTING STEEL AN EMBEDMENT A  
BE COVERED BY OTHERS.

TYPICAL DETAIL FOR HANGER  
SUPPORT WITH THERMO-LAG

3	3-21-86	LLZ	DDS
2	12-10-87	LLZ	DDS
1	10-28-85	JDp	DDS
REV. NO	DATE	DRAWN	APPROVED

Brand Industrial Services, Inc.  
11700 Commercial Drive  
P.O. Box 10000 Dallas, TX 75224

bisco 

THERMO-LAG HANGER COVERAGE DETAIL			
APPROVED BY: D. SCHUTZ			
DATE	SCALE	DRAWN	B.A.   BISCO



CB-1f.

Segment No. CB1FP2E-01		Cable Route No. 10R60 same as 10113D	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref.5	
1AP29B	03355	5.9360	
1AP34G	02096	0.2630	
1AP34H	02096	0.2630	
1AP34N	04201	2.8330	
1AP34V	03101	1.7700	
1AP34W	03101	1.7700	
1AP37D	03351	5.1670	
1AP37J	03351	5.1670	
1CM09H	03061	0.6590	
1CM09K	03061	0.6590	
1RD31H	03021	1.1920	
1RP02C	04201	2.8330	
1SX27A	03091	0.3640	
1SX40A	03091	0.3640	
1SX51A	03091	0.3640	
1SX51D	03091	0.3640	
1SX51G	03091	0.3640	
1VC25B	03091	0.3640	
1VC25C	03091	0.3640	
1VC25D	03091	0.3640	
1VC28D	03091	0.3640	
1VC26B	03091	0.3640	
1VC26C	03091	0.3640	
1VC26D	03091	0.3640	
1VC27B	03091	0.3640	
1VC27C	03091	0.3640	
1VC27D	03091	0.3640	
1VC28B	03091	0.3640	
1VC28C	03091	0.3640	
SUB-TOTAL		34.700	

Segment No. CB1FP2E-01		Cable Route No. 10R60 same as 10113D	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref.5	
1VC28F	03091	0.3640	
1VC35B	03091	0.3640	
1VC35C	03091	0.3640	
1VC35D	03091	0.3640	
1VC35P	03091	0.3640	
1VC35S	03091	0.3640	
1VC36B	03091	0.3640	
1VC36C	03091	0.3640	
1VC36D	03091	0.3640	
1VC36P	03091	0.3640	
1VC36Q	03091	0.3640	
1VC50B	03091	0.3640	
1VC50C	03091	0.3640	
1VC51B	03091	0.3640	
1VC51C	03091	0.3640	
1VC51D	03091	0.3640	
1VC51E	03091	0.3640	
1VC56B	03091	0.3640	
1VC56C	03091	0.3640	
1VC56D	03091	0.3640	
1VG38A	03091	0.3640	
1VG40A	03091	0.3640	
1VQ05A	03091	0.3640	
1VQ14A	03091	0.3640	
SUB-TOTAL		8.736	
TOTAL		43.436	



Segment No. CB1FC2E-01		Cable Route No. 10R61	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.	
1AP29q	02126	0.1690	
1AP60B	12126	0.6590	
1AP60C	03096	0.3180	
1HG11H	03126	0.2210	
1HG11K	03126	0.2210	
1IP04A	03126	0.2210	
1IP04B	02096	0.2630	
1LV12A	02096	0.2630	
1LV14B	02096	0.2630	
1LV14C	02096	0.2630	
1RP35B	02096	0.2630	
1SC08G	02126	0.2630	
1SX27B	02126	0.2630	
1SX31B	09126	0.5160	
1SX40B	09126	0.5160	
1SX51B	12126	0.6590	
1SX51C	09126	0.5160	
1SX51E	12126	0.6590	
1SX51F	09126	0.5160	
1SX51H	09126	0.5160	
1SX51J	09126	0.5160	
1SX51M	09126	0.5160	
1SX51Q	09126	0.5160	
1SX51T	09126	0.5160	
1SX52C	09126	0.5160	
1SX52F	09126	0.5160	
1SX52J	09126	0.5160	
1SX54L	09126	0.5160	
1SX54P	12126	0.6590	
1SX66A	02126	0.2630	
1VC02C	12126	0.6590	
1VC04C	12126	0.6590	
1VC06B	12126	0.6590	
1VC08B	12126	0.6590	
1VC12C	12126	0.6590	
1VC14B	15126	0.7990	
1VC25G	09126	0.5160	
1VC25O	04126	0.2650	
1LV14D	02096	0.2630	
1LV14E	02096	0.2630	
SUBTOTAL		17.999	

Segment No. CB1FC2E-01		Cable Route No. 10R 61	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.	
1LV14F	02096	0.2630	
1LV14G	02096	0.2630	
1LV14H	02096	0.2630	
1LV14J	02096	0.2630	
1LV14K	02096	0.2630	
1LV14L	02096	0.2630	
1LV14M	02096	0.2630	
1LV14P	02126	0.2630	
1RA01F	02126	0.1690	
1VC25P	04126	0.2650	
1VC25Q	04126	0.2650	
1VC26E	04126	0.5160	
1VC27G	04126	0.5160	
1VC27O	04126	0.2650	
1VC27P	04126	0.2650	
1VC27Q	04126	0.2650	
1VC27R	02096	0.2630	
1VC28E	09126	0.5160	
1VC35G	15126	0.7990	
1VC35T	04126	0.2650	
1VC35U	04126	0.2650	
1VC35W	04126	0.2650	
1VC36G	15126	0.7990	
1VC36R	15126	0.7990	
1VC36S	04126	0.2650	
1VC40A	02126	0.1690	
1VC40E	07126	0.3830	
1VC40L	07126	0.3830	
1VC45A	15126	0.7990	
1VC45B	15126	0.7990	
1VC45C	15126	0.7990	
1VC45D	15126	0.7990	
1VC45E	15126	0.7990	
1VC45F	09126	0.5160	
1VC45G	15126	0.7990	
1VC45H	15126	0.7990	
1VC46C	15126	0.7990	
1VC46D	15126	0.6590	
1VC46E	15126	0.7990	
1VC46F	15126	0.7990	
SUBTOTAL		18.966	

Segment No. CB1FC2E-01	Cable Route No. 10R61	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.
1VC46G	15126	0.7990
1VC47C	04126	0.2650
1VC50D	12126	0.6590
1VC50K	04126	0.2650
1VC50L	04126	0.2650
1VC50M	02096	0.2630
1VC51F	12126	0.6590
1VC51T	04126	0.2650
1VC51U	04126	0.2650
1VC51V	04126	0.2650
1VC51W	04126	0.2650
1VC56E	12126	0.6590
1VC56N	04126	0.2650
1VC56O	04126	0.2650
1VC56P	04126	0.2650
1VC57S	02126	0.1690
1VC57T	02126	0.1690
1VC66A	24164	0.4590
1VC68A	16163	0.5920
1VC68B	16163	0.5920
1VC70A	24164	0.4590
1VC70D	04163	0.2270
1VD18D	02096	0.2630
1VC70E	24164	0.4590
SUBTOTAL		9.078

Segment No. CB1FC2E-01	Cable Route No. 10R61	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.
1VF07J	09126	0.5160
1VF13G	04126	0.2650
1VF86A	04164	0.1180
1VG32G	02126	0.1690
1VG32M	04126	0.2650
1VG38B	15126	0.7990
1VG38E	04126	0.2650
1VG38F	09126	0.5160
1VG40B	15126	0.7990
1VG95C	04164	0.1180
1VP20L	02096	0.2630
1VQ05B	15126	0.7990
1VQ14B	12126	0.6509
1VR05Q	04126	0.2650
1VR05V	04126	0.2650
1VR18C	12126	0.6590
1VX25C	02126	0.1690
1VX28F	12126	0.6590
1VX28K	12126	0.6590
1VX28N	02126	0.1690
1VX28P	02126	0.1690
SUBTOTAL		8.5569
TOTAL		54.600

Segment No. CB1FC2E-02	Cable Route No. 10R51	
Cable number	Type Code	Weight per linear foot (#/ft)
Same as CB1FC2E-05	Same as CB1FC2E-05	67.867
1SX66A	02126	0.1690
TOTAL		68.036

Segment No. CB1FC2E-03		Cable Route No. 10R50
Cable number	Type Code	Weight per linear foot (#/ft)
Same as CB1FC2E-02	Same as CB1FC2E- 02	68.036
<b>TOTAL</b>		<b>68.036</b>

Segment No. CB1FC2E-04		Cable Route No.10200E
Cable number	Type Code	Weight per linear foot (#/ft)
Same as CB1FC2E-03	Same as CB1FC2E- 03	68.036
<b>TOTAL</b>		<b>68.036</b>

Segment No. CB1FC2E-05	Cable Route No. 10R138 & 10199E	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref.5
1AP21K	02163	0.0920
1AP21L	02126	0.1690
1AP23L	02163	0.0920
1AP23M	02126	0.1690
1AP29Q	02126	0.1690
1AP60B	12126	0.6590
1AP60C	03096	0.3180
1CM07L	02096	0.2630
1CZ02B	02096	0.2630
1DG21A	15126	0.7990
1DG21B	15126	0.7990
1DG21C	15126	0.7990
1DG21F	04096	0.3900
1DG21K	07126	0.3830
1DG21M	07126	0.3830
1DG31C	04096	0.3900
1DG31D	04096	0.3900
1DG31E	03096	0.3180
1DG31F	03096	0.3180
1DG31K	04126	0.2650
1DG31R	02163	0.0920
1DG31S	07126	0.3830
1DG31T	07126	0.3830
1DO02B	09126	0.5160
1DO02C	12126	0.6590
1HG11E	12126	0.6590
1HG11F	12126	0.6590
1HG11L	03126	0.2210
1IP04A	02096	0.2630
1IP04B	02096	0.2630
1LD08J	02126	0.1690
1LV14A	02096	0.2630
1LV14B	02096	0.2630
1LV14C	02096	0.2630
1LV14D	02096	0.2630
1LV14E	02096	0.2630
1LV14F	02096	0.2630
1LV14G	02096	0.2630
1LV14H	02096	0.2630
1LV14J	02096	0.2630
SUBTOTAL		14.062

Segment No. CB1FC2E-05	Cable Route No. 10R138 & 10199E	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.
1LV14K	02096	0.2630
1LV14L	02096	0.2630
1LV14M	02096	0.2630
1LV14P	02096	0.2630
1PS10N	07126	0.3830
1PS10P	07126	0.3830
1PS10S	04126	0.2650
1PS10T	04126	0.2650
1RA01F	02126	0.1690
1RH04J	07126	0.3830
1RH34D	03126	0.2210
1RH57D	07126	0.3830
1RH65A	02126	0.1690
1RI19C	12126	0.6590
1RP35B	02096	0.2630
1SC02G	15126	0.7990
1SC08G	02126	0.1690
1SF07A	07126	0.3830
1SX29B	09126	0.5160
1SX29C	09126	0.5160
1SX31C	09126	0.5160
1SX40C	09126	0.5160
1SX51C	09126	0.5160
1SX51F	09126	0.5160
1SX51J	09126	0.5160
1SX51M	09126	0.5160
1SX51Q	09126	0.5160
1SX51T	09126	0.5160
1SX52C	09126	0.5160
1SX52F	09126	0.5160
1SX52J	09126	0.5160
1SX54C	09126	0.5160
1SX54L	09126	0.5160
1SX54P	12126	0.6590
1VC02C	12126	0.6590
1VC04C	12126	0.6590
1VC06B	12126	0.6590
1VC08B	12126	0.6590
1VC12C	12126	0.6590
1VC14B	15126	0.7990
SUBTOTAL		18.439



Segment No. CB1FC2E-05	Cable Route No. 10R138 & 10199E	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref.5.
1VC40A	02126	0.1690
1VC40E	07126	0.3830
1VC40L	07126	0.3830
1VC45A	15126	0.7990
1VC45B	15126	0.7990
1VC45C	15126	0.7990
1VC45D	15126	0.7990
1VC45E	15126	0.7990
1VC45F	09126	0.5160
1VC45G	15126	0.7990
1VC45H	15126	0.7990
1VC46B	15126	0.7990
1VC46C	15126	0.7990
1VC46D	12126	0.6590
1VC46E	15126	0.7990
1VC46F	15126	0.7990
1VC46G	15126	0.7990
1VC47C	04126	0.2650
1VC66A	24164	0.4590
1VC68A	16163	0.5920
1VC68B	16163	0.5920
1VC70A	24164	0.4590
1VC70D	04163	0.2270
1VC70E	24164	0.4590
1VD02D	07126	0.3830
1VD02E	09126	0.5160
1VD02F	04126	0.2650
1VD05B	12126	0.6590
1VD05C	07126	0.3830
1VD18C	02126	0.1690
1VF07J	09126	0.5160
1VF13G	04126	0.2650
1VF86A	04164	0.1180
1VG02B	15126	0.7990
1VG02C	07126	0.3830
1VG04B	09126	0.5160
SUBTOTAL		19.723

Segment No. CB1FC2E-05	Cable Route No. 10R138 & 10199E	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref.5.
1VG04C	12126	0.6590
1VG06B	15126	0.7990
1VG08C	09126	0.5160
1VG08G	09126	0.5160
1VG12F	12126	0.6590
1VG18C	12126	0.6590
1VG20F	12126	0.6590
1VG26F	12126	0.6590
1VG32G	02126	0.1690
1VG32H	15126	0.7990
1VG32J	12126	0.6590
1VG38C	04126	0.2650
1VG40C	04126	0.2650
1VG91B	08163	0.3640
1VG92B	16163	0.5920
1VG93B	04163	0.2270
1VG93C	04164	0.1180
1VG95C	04164	0.1180
1VG95E	04163	0.2270
1VQ05B	15126	0.7990
1VQ08E	12126	0.6590
1VQ14B	12126	0.6590
1VR05Q	04126	0.2650
1VR05V	04126	0.2650
1VR18C	12126	0.6590
1VX25C	02126	0.1690
1VX28F	12126	0.6590
1VX28K	12126	0.6590
1VX28N	02126	0.1690
1VX28P	02126	0.1690
1VY05D	07126	0.3830
1VY06F	07126	0.3830
1VY07F	07126	0.3830
1VY11A	02126	0.1690
1VY13C	04126	0.2650
SUBTOTAL		15.643
TOTAL		67.867



Segment No. CB1FK2E-01		Cable Route No. 10R62
Cable number	Type Code	Weight per linear foot (#/ft) Ref. 5.
1VC83D	02163	0.0920
1VC83F	02163	0.0920
1VC83G	03164	0.0520
1VC86B	02163	0.0920
1VC86C	03164	0.0520
1VC87B	02163	0.0920
1VC91Q	02163	0.0920
1VC91R	02163	0.0920
1VC93D	02163	0.0920
1VC94B	02163	0.0920
1VC94E	02163	0.0920
1VC95F	02163	0.0920
<b>TOTAL</b>		<b>1.024</b>

Segment No. CB1FK2E-02		Cable Route No. 10R50
Cable number	Type Code	Weight per linear foot (#/ft)
Same as CB1FK2E-04	Same as CB1FK2E- 04	
<b>TOTAL</b>		<b>3.899</b>

Segment No. CB1FK2E-03		Cable Route No. 10R50 & 10200F
Cable number	Type Code	Weight per linear foot (#/ft)
Same as CB1FK2E-02	Same as CB1FK2E- 02	
<b>TOTAL</b>		<b>3.899</b>

Segment No. CB1FK2E-04		Cable Route No. 10199F & 10200F	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.	
1DG80A	04163	0.2270	
1DO78A	02163	0.0920	
1DO78B	02163	0.0920	
1LD26E	02166	0.0880	
1LD26F	02166	0.0880	
1LD26G	02166	0.0880	
1LD28A	02166	0.0880	
1LD28C	02166	0.0880	
1LD28D	02166	0.0880	
1LD44D	02166	0.0880	
1LD44E	02166	0.0880	
1LD44F	02166	0.0880	
1LD45D	02166	0.0880	
1LD45E	02166	0.0880	
1LD45F	02166	0.0880	
1LD61D	02166	0.0880	
1LD61E	02166	0.0880	
1LD61F	02166	0.0880	
1VC83D	02163	0.0920	
1VC83F	02163	0.0920	
1VC83G	03164	0.0520	
1VC86B	02163	0.0920	
SUBTOTAL		2.059	

Segment No. CB1FK2E-04		Cable Route No. 10199F & 10200F	
Cable number (Ref. 2)	Type Code (Ref. 2)	Weight per linear foot(#/ft) Ref. 5.	
1VC86C	03164	0.0520	
1VC87B	02163	0.0920	
1VC91Q	02163	0.0920	
1VC91R	02163	0.0920	
1VC93D	02163	0.0920	
1VC94B	02163	0.0920	
1VC94E	02163	0.0920	
1VC95F	02163	0.0920	
1VG77A	02163	0.0920	
1VG81A	02163	0.0920	
1VG82A	02163	0.0920	
1VG85A	02163	0.0920	
1VG85B	03163	0.1140	
1VG86A	02163	0.0920	
1VG86B	03163	0.1140	
1VG87V	02163	0.0920	
1VG88C	02163	0.0920	
1VC88D	02163	0.0920	
1VG88F	02163	0.0920	
1LD28B	02166	0.0880	
SUBTOTAL		1.84	
TOTAL		3.899	

Segment No. CB1FK2E-05		Cable Route No. 10R137	
Cable number	Type Code	Weight per linear foot (#/ft)	
Same as CB1FK2E-04	Same as CB1FK2E-04		
TOTAL		3.899	

Illinois Power Company  
Nuclear Station Engineering Department  
P. O. Box 678  
Clinton, IL 61727  
(217) 935-8881

ATTACHMENT E.

RECORD OF COORDINATION

Y-104476

Prepared by R.P. Bhat/S.R. Wilson *R.P.B. S.R.W.*

Date 11/21/94

Copies to B.T. Ford

File Code B51-1800-94(11-21)-6

RCCL No. \_\_\_\_\_

Meeting \_\_\_\_\_ Telecon X \_\_\_\_\_ Other \_\_\_\_\_

Date 11/14/94 and 11/21/94 Time 0900 and 1100

Participants R.P. Bhat (NSEI), S.R. Wilson (NAD), and Cal Banning, Vectra. (817) 737-1145

Subject Thermo-Lag Panel Thickness NEI Tested vs. CPS As-Installed.

SUMMARY

The following question arose during the generation of the CPS AS-Installed Thermo-Lag Fire Endurance calculations.

The NEI Test samples are stated to be 1/2" nominal with tolerance of +1/8", -0", and 1" nominal with tolerance of +1/4", -0". The CPS purchase specifications called for 1/2" and 1" minimum panels. Would the NEI tests be applicable to CPS?

Ram called Cal on 11/14/94 and Simon called on 11/21/94. Mr. Banning was called because he was the prime technical coordinator for NEI during the TSI-NEI fire tests conducted at Omega Point Labs. Cal stated that the +1/8", -0" and 1/4", -0" tolerances were provided because QA acceptance criteria for the panels required tolerances.

There was a special effort made during the NEI tests to ensure that the panels were closer to 1/2" and 1". This was done by shaving off excess material in some cases.

The NEI 1/2", +1/8", -0" and 1", +1/4", -0" panels would envelop the CPS panels because CPS panels were at least 1/2" and 1" thick.



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CALC100