

CALCULATION COVER SHEET

SHEET 1 OF 17

TITLE/DESCRIPTION: FIRE ENDURANCE EVALUATION OF THERMO-LAG FIRE BARRIER IN FIRE AREA D-8.	DEPT/DIV M/NSED	CALCULATION NO. IP-M-0343		
	QUALITY RELATED (Q or N) O	SYSTEM CODE (or NA) XD	TOPIC H98	BLDG/ELEV/AREA (or NA) DG/762

APPROVALS - NAME/SIGNATURE/DATE

PREPARED BY Simon R. Wilson 10/17/95 <small>DATE</small>	CORP PREPARING THIS REV. IP	REVISION 1	VOLUME NA	READY FOR INCORPORATION: <input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> N/A
CHECKED BY Brian T. Ford 10/19/95 <small>DATE</small>	CONFIRMATION REQUIRED <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO PAGE NO(s) _____			MICROFICHE ATTACHED: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
	VOL. INCORP. ASSGNMNT. Not Applicable			
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	COMMENTS: NRC GL 92-08.			MWR NA

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NF-161-1 (12/94)

CALCULATION COVER SHEET

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SW
 12-15-94

TITLE/DESCRIPTION: FIRE ENDURANCE EVALUATION OF THERMO-LAG FIRE BARRIER IN FIRE AREA D-8.	DEPT/DIV M/NSED	CALCULATION NO. IP-M-0343
	QUALITY RELATED (Q or N) Q	SYSTEM CODE (or NA) XD
	TOPIC H98	BLDG/ELEV/AREA (or NA) DG/762

APPROVALS - NAME/SIGNATURE/DATE

PREPARED BY <u>SIMON R. WILSON</u> 12/15/94 <u>Simon R. Wilson</u>	CORP PREPARING THIS REV. IP	REVISION 0	VOLUME NA	READY FOR INCORPORATION: <input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> N/A
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REVIEWED BY <u>BRIAN T. FORD</u> 12/15/94 <u>Brian T. Ford</u>	COMMENTS: NRC GL 92-08.			MOD. PKG., FIELD ALT., CR, TECH SPEC (or N/A) NA
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NF-161-1 (10/92)

REVISION HISTORY

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ATTACHMENTS:	
A) AS-BUILT CONDUIT CONFIGURATION THAT IS PROTECTED BY THERMO-LAG 330-1 FIRE BARRIER (The original installation drawing was marked up for this calc. to show additional dimensional details)	(1 page)
B) APPLICABLE INSTALLATION DETAILS FROM VENDOR MANUAL K-10003-0002 AND BISCO INSTALLATION MANUAL	(4 pages)
C) THERMO-LAG MATRIX (EXCERPT FROM REFERENCE 2)	(1 page)
D) Tabulation of NEI Thermocouple data. (Excerpt of Ref.4 data)	(1 page)
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 5"Ø conduits C92118 and C92120 in CPS Fire Area D-8. The original design intent was to provide a 1-hour rated fire barrier for these conduits.

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 Reference 4. 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. NSED Standard ME-09.00 Rev. 1 dated 7/27/94, "Thermo-Lag 330-1 Fire Endurance Application Guide" , Nuclear Energy Institute.
2. 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. NSLD Calculation CL-FP-SS-1 Rev. 2, Identification of Safe Shutdown Systems, dated 1/21/86.
4. NEI Test 2-1, Fire Endurance Test of Thermo-Lag 330-1 Fire Protective Envelope (6 in., 4 in., 2 in., & 3/4 in. Aluminum Conduit Assemblies), Omega Point Laboratories, dated April 7, 1994.
5. NSED Calculation IP-M-0182 Rev. 2, Heat Content Values for Cable Insulation (SLICE cable trays and free-air).
6. 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., USAR Appendix F Section 3.4.8.
- 8., Vendor Manual K-10003-0002 [BISCO- Fire Barrier (Thermo-lag) Installation], Rev.0, dated 8-14-91.
9. K-2999 Electrical Installation Specification, amendment 15, dated 05-30-86.
10. BISCO - Turn over package for D-8 Fire Area in Diesel Generator Building 762'-0" , dated 03-03-86.
11. ME-08-00 Rev. 0 " Thermo-Lag 330-1 Combustibility Evaluation Methodology Plant Screening Guide" dated 7-25-94.
12. K-2980 Cable Tray and Supports Amendment 6, dated 04-25-86.
13. 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".
14. Texas Utilities Electric Comp. (TUEC) Scheme 9-1, Fire Endurance Test of a Thermo-Lag 330-1 Fire Protective Envelope (¾ in., 3 in., and 5 in. Conduits with Radial Bends), Omega Point Laboratories, dated November 23, 1992.
15. Field Change Request (FCR) No. 45633 " Fire Barrier " dated 3-17-86.

6.0 EVALUATION / ANALYSIS:

Thermo-Lag Barrier System: Conduits C92118 and C92120 and associated thermal shorts (includes supports).

Location: Fire Area D-8, consists of the Division 1 diesel generator ventilation fan room and air intake located along the south wall of the diesel generator building at elevation 762 feet 0 inch.

Purpose of Thermo-Lag: The main power feed cables 1DG31A and 1DG31B for the Division 2 diesel generator are routed in conduits through this area along the south side, and are protected by a 1-hour fire rated Thermo-Lag 330-1 material.

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 were protected with a material that has a 1-hour fire rating.

A walk down of Fire Zone D-8 revealed that the structural integrity of the fire barrier wrappings on conduits C92118 and C92120 appear to be intact.

Installation of the Preshaped Conduit section design (Procedure No. SP-FBI-01 Rev. 3 dated 3-28-86, Ref.8)

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

The edges on one (1) of the one hour fire rated Thermo-Lag preshaped conduit sections are precoated with 1/4 to 1/2 inch bead of Thermo-Lag 330-1 Subliming Trowel Grade Material.

The coated section is mounted on the other one hour fire rated section on the conduit with the edges flush with each other to form a cylindrical section around the conduit. The two sections are fasten together using 14 ga. minimum stainless steel tie wires or 0.5" x 0.020" minimum banding material at a maximum of twelve (12) inch intervals as shown in attachment B.

A 1/4 to 1/2 inch bead of Thermo-Lag 330-1 Subliming Trowel Grade Material is applied to the end of the installed section, and the next section is attached, making sure that the ends are butted and flush.

6.0 EVALUATIONS/ANALYSIS (Continued)

The applicable commodity tested, its fire resistive barrier construction and its tested acceptance basis are as described in **References 4 & 14** and are tabulated below:

Commodity Tested	Fire Resistive Barrier Construction	Test Acceptance Basis
<p>NEI Test 2-1, Ref. 4. 4" Ø standard weight rigid aluminum conduit. Thermo Couples 220-233</p>	<p>0.5 in. nominal pre-shaped Thermo-Lag 330-1 sections, pre-buttered joints.</p>	<p>Satisfactory bare conductor temperatures when test stopped at 50 minutes. No thermocouple exceeded the temperature requirements. However the average temperature was exceeded at 47 Min. (See attachment D). Prior to the Hose Stream test no openings were observed, following the Hose Stream test the Thermo-Lag pieces remained affixed and the stainless steel banding was sagging slightly from the assembly.</p>
<p>TUEC Scheme 9-1, Ref. 14 5" Ø rigid steel conduit. (Horizontal section only, Thermo Couples 122-127)</p>	<p>0.5 in. nominal pre-shaped Thermo-Lag 330-1 sections, pre-buttered joints, with TSI 350 Topcoat applied.</p>	<p>Satisfactory surface conduit temperatures, barrier conditions, cable visual inspection, and cable functionality after 60 minutes. No failure openings or other severe damage was noticed prior to the Hose Stream test, following the Hose Stream test the Thermo-Lag pieces remained firmly affixed and the stainless steel banding was still tightly wrapped around the assembly.</p>

The comparison to the Ref.14 TUEC Test was made mainly due to the application of the TSI 350 Topcoat on the wrapped commodity, however due to the uncertainty related to the actual material thickness, the NEI Test was use in this conclusion.

Segment ID	Segment Description
<p>D8-01</p>	<p>Two 5" Ø steel rigid conduits C92118 & C92120, extending for 38'-2" in a horizontal orientation from wall penetration on the west side of the room to wall penetration on east side of the room, each supported by five supports (CC63D-H & CC64D-H) , wall interface consisting of Thermo-Lag panel pieces bolted to the wall (See Attachment B for installation details).</p>

FIRE BARRIER SYSTEM:	C92118 & C92120			
FIRE ZONE:	D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating)			
SEGMENTS:	D8-01			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Conduit	Conduit	Same.	See other parameters.
COMMODITY SIZE	5 in. diameter	4 in. diameter	Smaller tested size bounds larger size due to lower thermal capacity, lower thermal resistance.	See other parameters.
COMMODITY MATERIAL	Steel (Rigid, zinc coated, hot-dip, galvanized per ANSI Spec. C80.1)	Aluminum	Aluminum tested conduit bounds installed steel conduit due to lower thermal capacity and higher thermal conductivity of aluminum. NEI Test 2-1 Thermo Couples 220-233.	Test was terminated at 50 minutes, none of the thermo couples in the segment of interest (i.e., 220-223) exceeded temperature limits when the test was terminated. However the average temperature was exceeded at 47 Min.
COMMODITY CONTENTS	Conduit = 13.140 #/ft (Ref 9) Cables = 11.248 #/ft (Ref. 1 & 5) <hr/> Total = 24.388 #/ft	Total = 3.40 #/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	Horizontal NEI Test 2-1 (Thermo Couples 220-233).	Same	46 minutes.
BARRIER TYPE	Thermo-Lag 330-1, pre-shaped conduit half round sections 1 Hr. rating for the conduit sections. Support sections were Thermo-Lag 330-1 prefabricated panels, 1Hr. rating. TSI 350 Topcoat applied.	Thermo-Lag 330-1, pre-shaped conduit half round sections 1 Hr. rating for the conduit sections. Support sections were Thermo-Lag 330-1 prefabricated panel sections with V-ribs, 1Hr. rating.	Same, except no V-ribs on panel pieces for CPS hanger installations, however, the presence of V-Ribs on the panel pieces have no impact on the thermal or structural characteristics in this configuration, mainly due to the short unsupported spans. No Topcoat applied to NEI tested configuration.	See pages 12-14 for evaluation of barrier with Topcoat.

FIRE BARRIER SYSTEM: C92118 & C92120 FIRE ZONE: D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating) SEGMENTS: D8-01				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1/2" Max. unknown	1/2" Nominal, (0.5 +0.125-0.0)	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	V-Ribs is not applicable to conduit pre-shaped sections. No V-Ribs on panel pieces for supports	V-Ribs is not applicable to conduit pre-shaped sections. V-Ribs on panel pieces for supports.	Same, except no V-Ribs on panel pieces for supports, the presence of V-Ribs on the panel pieces have no impact on the thermal or structural characteristics in this configuration, mainly due to the short unsupported spans.	46 Minutes
BARRIER STRESS-SKIN LOCATION	Inside face of the panel.	Inside face 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)	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections.	NEI Test 2-1 Thermo Couples 220-233 on 4"O conduit.	46 Minutes
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	1/2"x 020" Stainless Steel banding with 1/2" wing seals #202SS 10" O.C. Max. spacing, 2"max spacing from joints	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.	See other parameters.

FIRE BARRIER SYSTEM: C92118 & C92120 FIRE ZONE: D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating) SEGMENTS: D8-01				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref. 4)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	10" Max.	12" Max.	Shorter distance bounds installed configurations.	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 (Hangers, Non-Dedicated Conduits, Conduit/Wall Interface)	Hanger⇒ wrapped per detail 5 & 6 Attachment B, using Thermo-Lag 330-1 prefabricated panel 0.5" min thickness, wrapped from the point where the hanger supports the conduit all the way to the point the support attaches to the auxiliary steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material coverage extending at a 9" distance from the conduit protective envelope.	Shorter distance from conduit envelope bounds installed configurations. The presents of V-Ribs does not affect the structural or thermal integrity of the wrapped commodity in this configuration.	See other parameters.
	Conduit/Wall Interface⇒ 1 hour rated configuration described in section 7.0, item 1.	Not specifically tested.	See section 7.0, item 1 for acceptance justification.	46 minutes.

FIRE BARRIER SYSTEM:	C92118 & C92120			
FIRE ZONE:	D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating)			
SEGMENTS:	D8-01			
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref.14)	COMPARISON EVALUATION	LIMITING ENDURANCE
COMMODITY TYPE	Conduit.	Conduit.	Same.	See other parameters.
COMMODITY SIZE	5 in. diameter.	5 in. diameter.	Same.	See other parameters.
COMMODITY MATERIAL	Steel. (Rigid, zinc coated, hot-dip, galvanized per ANSI Spec. C80.1).	Steel, rigid.	Same.	See other parameters.
COMMODITY CONTENTS	Conduit = 13.140 #/ft (Ref 9) Cables = 11.248 #/ft <hr/> Total = 24.388 #/ft	Conduit = 13.70 #/ft Cables = 6.71 #/ft <hr/> Total = 20.41 #/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	Horizontal (Thermo Couples 122-127).	Same.	60 minutes.
BARRIER TYPE	Thermo-Lag 330-1, pre-shaped conduit half round sections 1 Hr. rating for the conduit sections. Support sections were Thermo-Lag 330-1 prefabricated panels, 1Hr. rating. TSI 350 Topcoat applied.	Thermo-Lag 330-1, pre-shaped conduit half round sections 1 Hr. rating for the conduit sections. Support sections were Thermo-Lag 330-1 prefabricated panel sections with V-ribs, 1Hr. rating. TSI 350 Topcoat applied.	Same, except no V ribs, the presence of V-Ribs on the panel pieces have no impact on the thermal or structural characteristics in this configuration, mainly due to the short unsupported spans.	See other parameters.

FIRE BARRIER SYSTEM: C92118 & C92120 FIRE ZONE: D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating) SEGMENTS: D8-01				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref.14)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER THICKNESS	Min. 1/2" Max. unknown	5/8" Nominal, (0.625 +/-0.125) per Ref. 10 Appendix C, page C-5. Ref. 15 test report indicates 1/2" nominal.	Installed Thermo-Lag is bounded by tested T.L, since installed thickness is at least same as test. (See conclusion sect. 8.0)	See other parameters.
BARRIER STIFFNESS V-RIB LOCATION & ORIENTATION	V-Ribs is not applicable to conduit pre-shaped sections. No V-Ribs on panel pieces for supports.	V-Ribs is not applicable to conduit pre-shaped sections. V-Ribs on panel pieces for supports.	Same, except no V-Ribs on panel pieces for supports the presence of V-Ribs on the panel pieces have no impact on the thermal or structural characteristics in this configuration, mainly due to the short unsupported spans.	See other parameters.
BARRIER STRESS-SKIN LOCATION	Inside face of the panel.	Inside face 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)	330-1 T.L. Trowel grade used to caulk all joints and seams between panels (Pre-Buttered butt joints) on straight run sections. TUEC Scheme 9-1, 5" in. conduit , Thermo Couples 122-127.	Average temperature increase at 60 minutes was less than 250°F (246°F vs.250°F).	60 minutes
BARRIER FASTENERS TYPE, SPACING AND DISTANCE FROM JOINT.	1/2"x.020" Stainless Steel banding with 1/2" wing seals #202SS 10" O.C. Max spacing, 2"max spacing from joints.	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.	See other parameters.

FIRE BARRIER SYSTEM: C92118 & C92120 FIRE ZONE: D-8 (Diesel Generator Bld'g El. 762'-0", 1 Hr. rating) SEGMENTS: D8-01				
PERFORMANCE PARAMETERS	AS-BUILT CONFIGURATION	TESTED CONFIGURATION(S) UTILIZED FOR EVALUATION (Ref.14)	COMPARISON EVALUATION	LIMITING ENDURANCE
BARRIER UNSUPPORTED SPAN	10" Max.	12" Max.	Shorter distance bounds installed configurations.	See other parameters.
BARRIER JOINT REINFORCEMENT	None specified in installation or inspection details.	Upgrades to the 5"Ø conduit were only to the radial and lateral bends, no upgrades to the horizontal sections.	Same.	See other parameters.
BARRIER STRUCTURAL AND INTERVENING STEEL PROTECTION (Hangers, Non-Dedicated Conduits, Conduit/Wall Interface)	Hanger⇒ wrapped per detail 5 & 6 Attachment B, using Thermo-Lag 330-1 prefabricated panel 0.5" min. thickness, wrapped from the point where the hanger supports the conduit all the way to the point the support attaches to the auxiliary steel. No intervening steel present.	One hour rated Thermo Lag 330-1 V-Ribbed Panel material coverage extending at a 9" distance from the conduit protective envelope.	Shorter distance from conduit envelope bounds installed configurations. The presents of V-Ribs does not affect the structural or thermal integrity of the wrapped commodity in this configuration.	See other parameters.
	Conduit/Wall Interface⇒ 1 hour rated configuration described in section 7.0, item 1.	Not specifically tested.	See section 7.0, item 1 for acceptance justification.	60 minutes.

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 installation of the interface between the conduits and the wall Penetration (Attachment B page 1) is as follows:
 - a) The conduits are covered with Thermo-Lag 330-1 preshaped conduit sections as previously described in section 6.0 and illustrated in Attachment B , is flush to the wall penetration.
 - b) A piece of prefabricated Thermo-Lag panel is cut large enough to allow for the installation of concrete fasteners. Holes for conduits that penetrate the wall 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 $\frac{1}{4}$ " 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 wall using at least two fasteners per section at a maximum interval of 12".
 - d) Sufficient amount of Thermo-Lag is applied to cover the bolt heads of the concrete fasteners with the $\frac{1}{2}$ " min. envelope thickness.
 - e) The installation is than completed by filling in all edges and joints with Thermo-Lag 330-1 Subliming Trowel Grade material.

There are no external forces acting on the vertical Thermo-Lag pieces. From a walkdown of this area, it appears that there are four separate pieces butted together with the seams running vertically to form the cover for the face of the penetration. It appears that each piece mounted by two Tapcon screws. The size of each piece is conservatively estimated as 12" X 12" (1ft²).

The weight of $\frac{1}{2}$ " thick Thermo-Lag panel is approximately 5.25 Lbs/ft² (Ref. 11). It is calculated that the maximum force per screws is approximately 3 lbs. This force produces negligible stresses compared to the tensile and shear stress allowables of the $\frac{1}{4}$ " screws, the punching shear effect of the bolts trying to punch/pry through the Thermo-Lag is minimize due to the 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.

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 wall.

7.0 JUSTIFICATION ANALYSIS (Continued)

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

The construction of the joint interface between the wall mounted Thermo-Lag and wrapped conduits is an overlapping of two pieces and as such it exhibits better thermal protection characteristics than the butting of pieces of Thermo-Lag together methods used in the Reference 4 & 14 NEI & TUEC tested conduits. Hence these joint formations are considered bounded by the joint configuration of the test.

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 or test was terminated, (i.e., 46 or 60 minutes), including the Hose Stream test.

8.0 RESULTS / CONCLUSIONS:

Based on parameter comparison of the segment in Sections 6.0, the installed configuration is bounded by the 4"Ø Aluminum conduit configurations in NEI Test 2-1 or the 5"Ø Steel conduit configuration in TUEC Scheme 9-1 with the exception of the specific commodity and configuration deviation that are analyzed in Section 7.0.

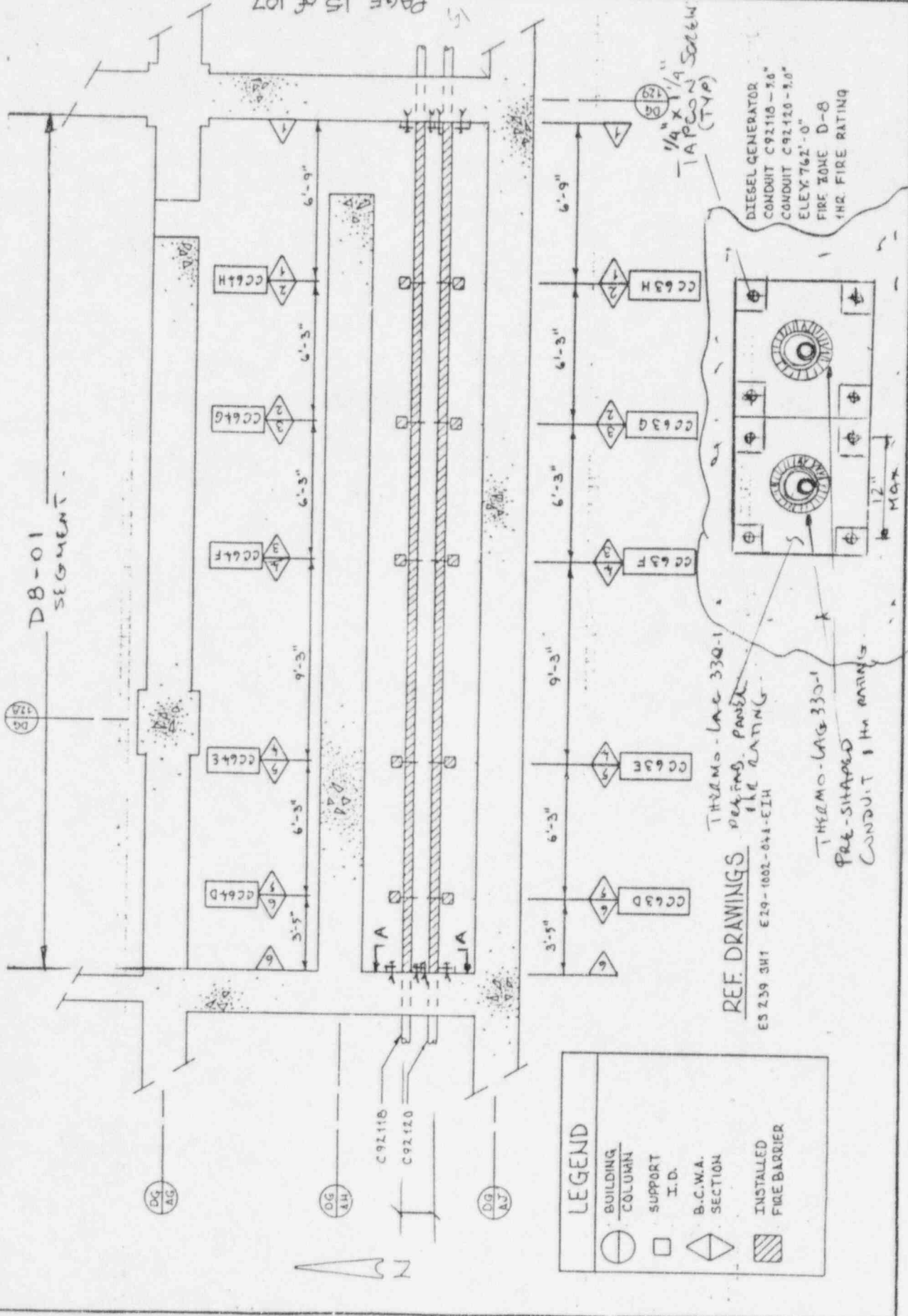
Justification provided in Section 7.0 shows that the items described therein exhibit characteristics and attributes that are comparable to tested configurations and are therefore supported by the NEI Test 2-1 or TUEC Scheme 9-1 Test Reports, until temperature criteria were exceeded or test was terminated, (i.e., 46 or 60 minutes).

The comparison to the Ref.14 TUEC Test was made mainly due to the application of the TSI 350 Topcoat on the wrapped commodity, however due to the uncertainty related to the actual material thickness, the NEI Test was used in this conclusion. However, it appears that the application of Topcoat on the fire barrier material used in the Ref.14 TUEC Test, did not have a significant impact on the test results.

In conclusion the installed CPS configurations of conduits C92118 and C92120 in Fire Area D-8 that are protected by Thermo-Lag fire Barrier System, would conservatively meet the temperature acceptance and structural integrity criteria in accordance with NEI Test for **46 minutes** of fire duration.

ATTACHMENT A PAGE 1 OF 1

DB-01
SEGMENT



Page 15 of 107

LEGEND

	BUILDING COLUMN
	SUPPORT I.D.
	B.C.W.A. SECTION
	INSTALLED FIRE BARRIER

REF. DRAWINGS

ES 239 3H1 E29-1002-043-EIH

THEMO-LAGE 330-1
PRE-FABRICATED
CONDUIT 1 Hr RATING

THEMO-LAGE 330-1
PRE-SITING
CONDUIT 1 Hr RATING

DIESEL GENERATOR
CONDUIT C92110-70
CONDUIT C92120-70
ELEV. 762'-0"
FIRE 30ME D-8
1HR. FIRE RATING

1/4" x 1/4" TAPCON SIZES (TYP)

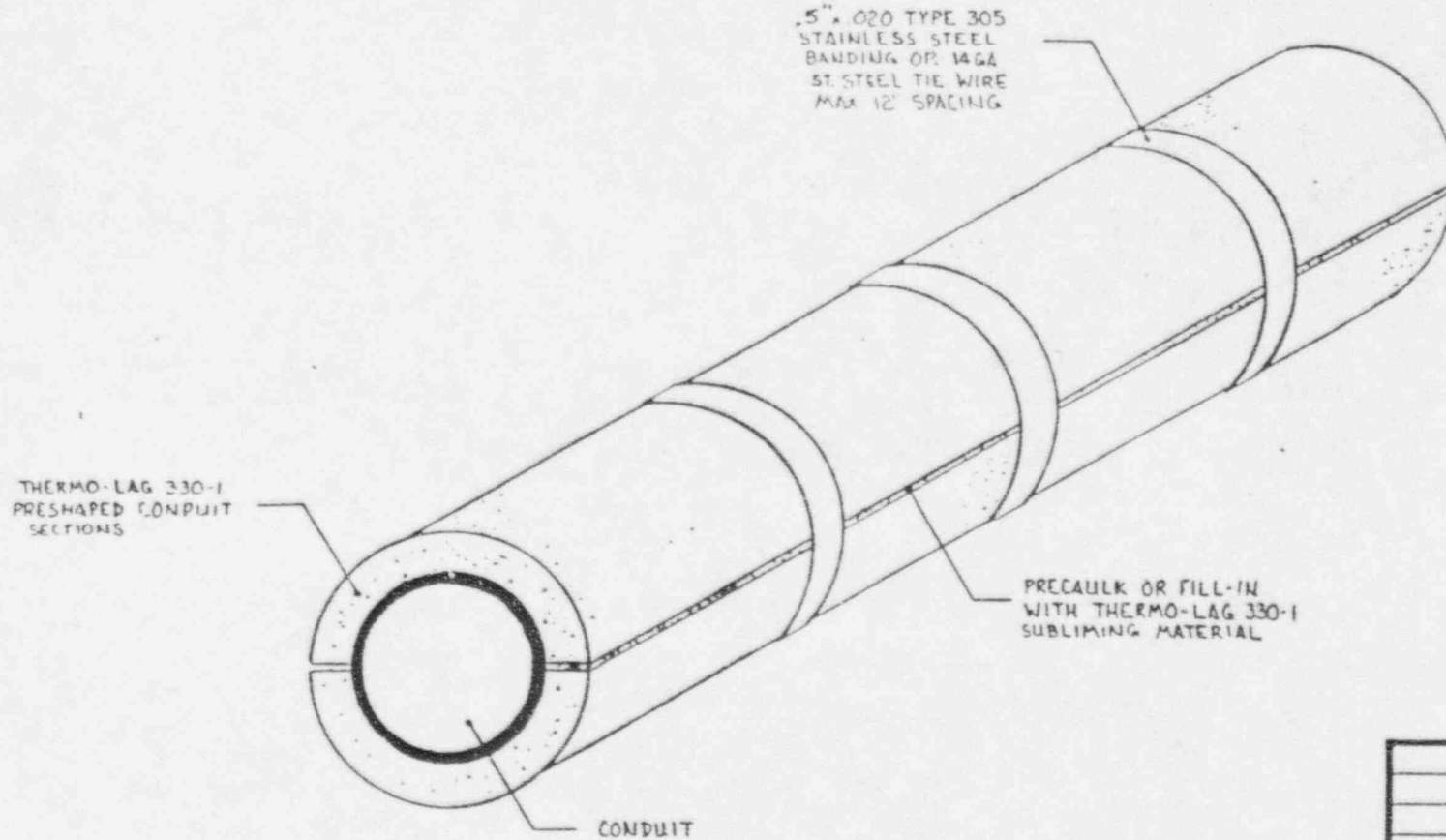
SECTION A-A

CLINTON POWER STATION, UNIT 1, BALDWIN ASSOCIATES CONTRACT K-2840, BISCO JOB NO 3092, 3093, 3094	DESCRIPTION	BY: DATE	F.C. DATE
REV	DESCRIPTION	BY: DATE	F.C. DATE
1	RE DRAWN	LLZ 2-15-06	2-15-06
APPROVED BY	DATE	REV	
CH/LLZ	2-15-06	1	
WALL (AG-AJ) (120-12)	REF. DRAWING AS NOTED		
FLOOR: N/A	DRAWING NO: DG-0762-COMP-01		
SCALE: 1/4" = 1'-0"	SHEET: 1 OF 1		

ATTACHMENT B PAGE 1 OF 4

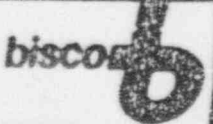
REF: FIRE TEST
TEST ARTICLE
ALUM CONDUIT

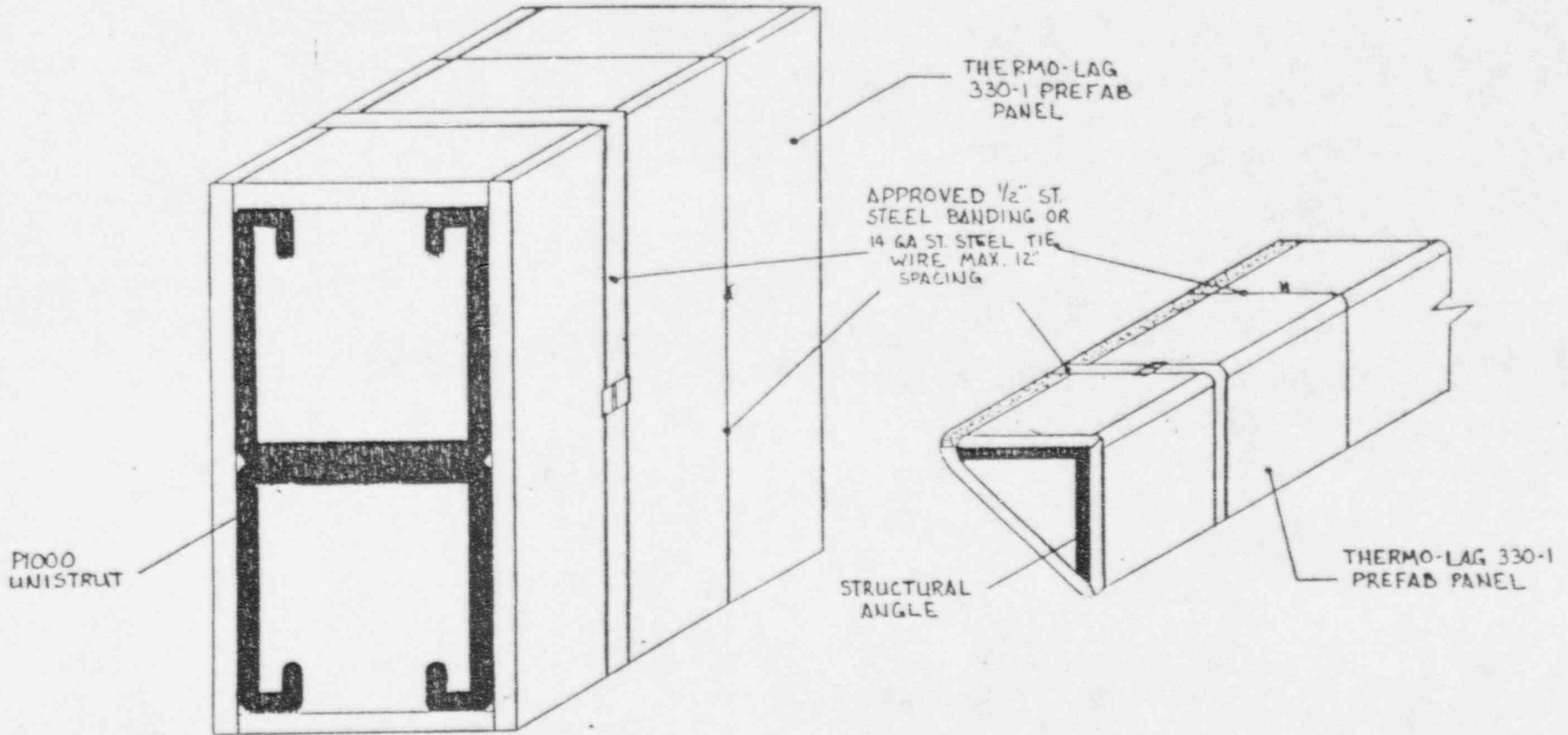
TEST REPORT NO.
85-4-377



DETAIL 10

THERMO-LAG 330-1 PRESHAPED SECTIONS
FOR CONDUIT, CABLE DROPS, OR INSTRUMENT TUBING
(1-HOUR)

1	10-28-85	DDP	DDS
REV. NO	DATE	DRAWN	APPROVED
<small>Grand Industrial Services, Inc. 1420</small>			
PRESHAPED CONDUIT INSTALLATION 1-HR			
APPROVED BY <u>K. LEITZ</u>			
DATE	SCALE	DRAWN	BY




DETAIL 6

PREFAB PANEL DESIGN
FOR STRUCTURAL SUPPORT
(UNISTRUT & ANGLE SUPPORT)

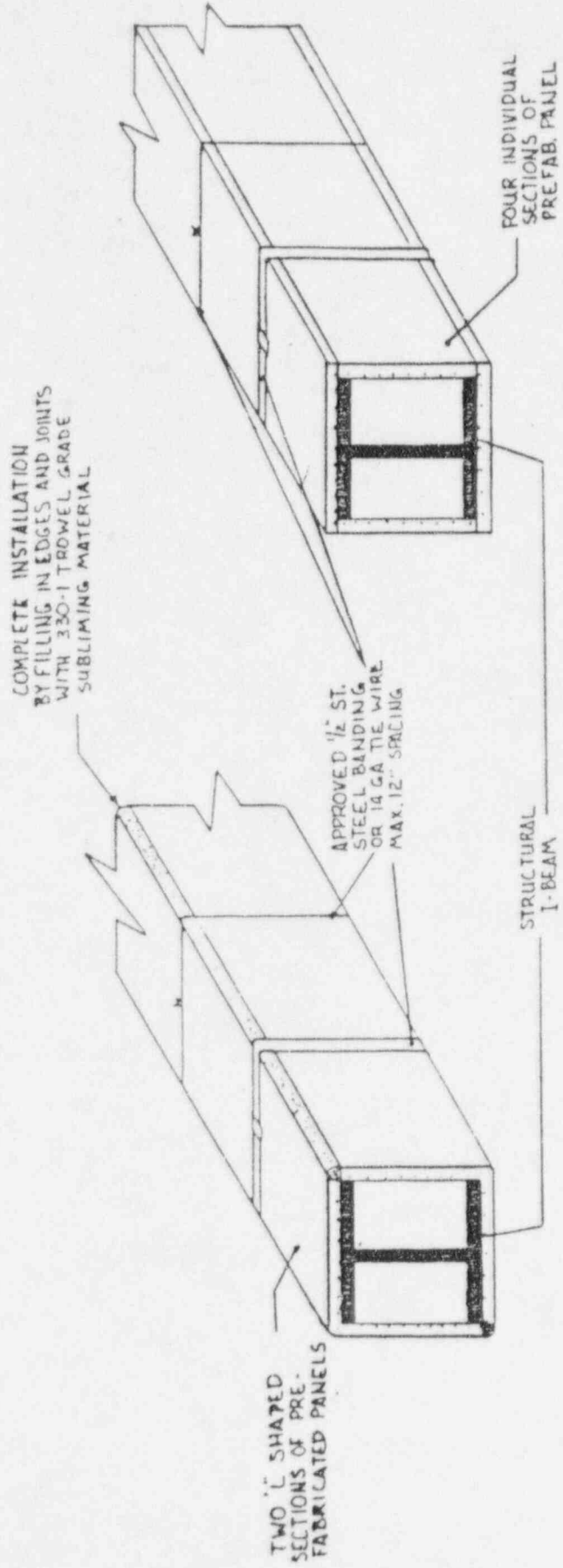
REF: FIRE TEST
TEST ARTICLE
UNISTRUT

TEST REPORT NO.
ITL-84-12-181 3-HR

1	10-28-85	JDP	Dps
REV. NO.	DATE	DRAWN	APPROVED
<small>General Industrial Services, Inc. 1128 Commercial Blvd. Bartlett, Illinois 60015</small>			
PREFAB PANEL DESIGN FOR STRUCTURAL SUPPORT APPROVED BY <i>K. LEITZE</i>			

Page 2 of 4

ATTACHMENT B PAGE 30FA



REV. NO.	DATE	DRAWN	APPROVED
1	10-28-85	JDP	DD5

biscope

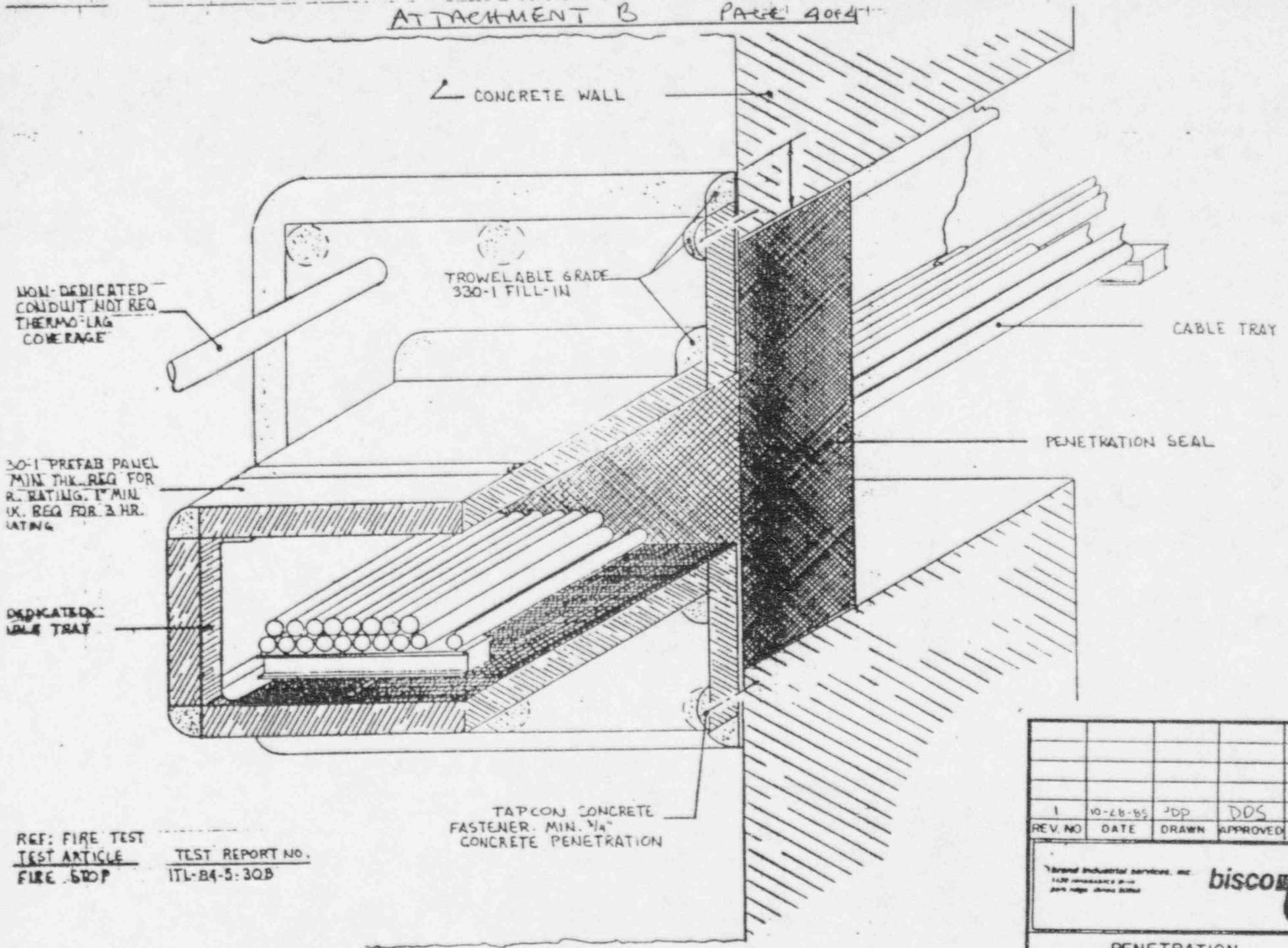
PRECAST PANEL DESIGN
FOR STRUCTURAL I-BEAM

APPROVED BY *K. LEITZ*

PREFAB. PANEL DESIGN
FOR STRUCTURAL SUPPORT
(I-BEAM)

REF: FIRE TEST
TEST ARTICLE
UNISTRUT

TEST REPORT NO.
ITL-84-12-181 3-HR



NON-DEDICATED
CONDUIT NOT REQ
THERMO-LAG
COVERAGE

TROWELABLE GRADE
330-1 FILL-IN

CABLE TRAY

30-1' PREFAB PANEL
MIN THK. REQ FOR
R. RATING. 1" MIN
TK. REQ FOR 3 HR.
RATING

PENETRATION SEAL

DEDICATED
CABLE TRAY


TAPCON CONCRETE
FASTENER. MIN. 3/4"
CONCRETE PENETRATION

REF: FIRE TEST
TEST ARTICLE
FIRE STOP

TEST REPORT NO.
ITL-B4-5:30B

THERMO-LAG RACEWAY
INTERFACING WITH PENETRATION SEAL

DETAIL 16

1	10-28-85	JDP	DDS	
REV NO	DATE	DRAWN	APPROVED	
Brand Industrial Services, Inc. 1120 WINDYBROOK DR PARK RIDGE, ILLINOIS 60068				
PENETRATION SEAL / TL INTERFACE				
APPROVED BY <i>D. SCHULTZ</i>				
DATE	SCALE	DRAWN	B.A	BISCO

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ATTACHMENT C PAGE 10E1

2/4/94

Item Parameters	Thermo-Lag Matrix																																												
	IIA1	IIA2	IIA3	IIA4	IIA5	IIA6	IIA7	IIA8	IIA9	IIA10	IIA11	IIA12	IIA13	IIA14	IIA15	IIA16	IIA17	IIA18	IIA19	IIA20	IIA21	IIA22	IIA23	IIA24	IIA25	IIA26	IIA27	IIA28	IIA29	IIA30	IIA31	IIA32	IIA33	IIA34	IIA35	IIA36	IIA37	IIA38	IIA39	IIA40	IIA41	IIA42	IIA43	IIA44	IIA45
Identification	Thermo-Lag (T-L) Fire Barrier Parameters																																												
Thermo-Lag	Thermo-Lag (T-L) Fire Barrier Parameters																																												
Number of	Thermo-Lag (T-L) Fire Barrier Parameters																																												
conduit Item	Thermo-Lag (T-L) Fire Barrier Parameters																																												
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45	Thermo-Lag (T-L) Fire Barrier Parameters																																												
46	Thermo-Lag (T-L) Fire Barrier Parameters																																												

Attachment 3 page 10 of 10

D-8

250+
AMB
Furnace # 1

222-233
AVG

TC # 220 (°F)	Time (min)	TC # 221 (°F)	TC # 222 (°F)	TC # 223 (°F)	TC # 224 (°F)	TC # 225 (°F)	TC # 226 (°F)	TC # 227 (°F)	TC # 228 (°F)	TC # 229 (°F)	TC # 230 (°F)	TC # 231 (°F)	TC # 232 (°F)	TC # 233 (°F)	Ambient (°F)	Furnace # 1 (°F)
55	0	55	55	55	55	55	56	56	55	56	56	54	54	54	59	309
55	1	54	54	54	54	54	54	55	55	55	54	55	55	55	60	310
55	2	55	55	55	55	55	55	55	55	56	55	55	55	55	59	309
56	3	55	56	56	56	56	57	57	56	57	56	55	55	56	59	
57	4	55	57	58	57	58	58	59	57	59	58	57	56	57	59	
60	5	57	61	62	59	61	62	64	61	62	61	57	56	59	59	
63	6	59	66	68	63	66	68	70	65	66	65	61	58	63	59	
67	7	63	72	74	68	72	75	78	72	72	70	63	61	67	59	
72	8	68	80	83	75	79	83	87	80	79	76	67	64	73	59	
76	9	74	88	92	83	86	93	96	88	87	82	70	66	77	59	
81	10	79	96	100	90	93	101	104	97	94	89	75	71	84	60	310
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297	Max:	301	333	348	327	331	353	354	355	346	337	303	273	334		
380	Max Allowed:	380	380	380	380	380	381	381	380	381	381	379	379	379		

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

ATTACHMENT E.

RECORD OF COORDINATION

Prepared by R.P. Bhat/S.R. Wilson ^{RAB} SW.

Copies to B.T. Ford

Y-104476
Date 11/21/94
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 (NSED), 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.

FILE D21-94(12-14)-L

CALCULATION # IP-M-0343 REV. 0 VI -

TOTAL PAGES 24

CONTENTS OF D21 FILE

FORM NUMBER	TITLE/DESCRIPTION
NF-258	NSED COMMENT CONTROL FORM
NF-214 1 & 2	DESIGN VERIFICATION CHECKLIST
	<i>Markup copy</i>