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April 12, 1993
C311-93-2051

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Dear Sir:

Subject: Three Mile Island Nuclear Station, Unit I (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
Response to Generic Letter 92-08
Thermo-Lag 330-1 Fire Barriers

This letter submits the TMI-1 response to Generic Letter 92-08. Attachment 1 addresses each of the four specific issues requiring written response, pursuant to Section 182(a) of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). References to previous GPUN submittals have been included, where appropriate, to minimize the duplication of material. GPUN letters C311-92-2102 dated 7/28/92 and C311-92-2111 dated 8/18/92 comprise the original and supplemental response to Bulletin 92-01 and C311-92-2102 dated 7/28/92 is the response to Bulletin 92-01, Supplement 1.

TMI-1 is currently maintaining a compensatory action program for inoperable 1 and 3 hour Thermo-Lag 330-1 barriers in accordance with Fire Protection Program requirements implemented by TMI-1 License Condition 2.c.(4).

We continue to support NUMARC efforts to resolve of the Thermo-Lag qualification problem.

Sincerely,

T. G. Broughton
Vice President & Director, TMI-1

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Attachment

cc: Administrator, Region I
TMI-1 Senior Project Manager
TMI Senior Resident Inspector

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Response to Item 1

Thermo-Lag 330-1 barriers were installed at TMI-1 to provide safe shutdown protection to meet Section III.G of 10 CFR 50 Appendix R under the requirements of 10 CFR 50.48. The following list identifies the Thermo-Lag 330-1 materials used and their applications:

a) TMI-1 used 1 hour and 3 hour rated fire barrier envelopes fabricated from Thermo-Lag 330-1 preformed panels and conduit shapes; no spray-on application was used since safety was considered to be an issue with the plant in operation (e.g. water run-off, over-spray, affect on ventilation, dust).

b) Thermo-Lag 330-1 "Flexi-Blanket" wrap was used as part of the fire barriers to protect cable drops from trays and locations where cable left conduit and was no longer protected. Use of the product in these applications was consistent with TSI's standard designs.

c) Thermo-Lag 330-1 material in a 30 minute fire rated design (1/4" thick panels) was used in lieu of simple Radiant Energy Heat Shields within containment. This use was also to meet requirements of 10 CFR 50, Appendix R Sect. III.G.

Class 1E circuit separation (R.G.1.75) at TMI-1 is described in Section 8.2.2.12 of the TMI-1 FSAR. Separation is accomplished either by providing adequate spacial clearance between circuits or installing non-combustible barriers. Material comprising the non-combustible barriers includes; transite board (asbestos: limited use), metal plates, marinite board (two types used, with the older being essentially all asbestos), ceraboard (mineral fiber material qualified by numerous ASTM E-119 tests of fire penetration seal materials) and wrapping material from 3M's product line. Thermo-Lag is not used to provide Class 1E separation.

Response to Item 2a

Existing test documents provided by Thermal Science Inc. were utilized at TMI-1 in the selection of designs installed to protect safe shutdown capability. Thermo-Lag 330-1 was used at TMI-1 because, at the time TMI-1 was actively evaluating barrier materials (1982-1983), it was found to meet 1 and 3 hour protection requirements of 10 CFR 50 Appendix R and had the broadest qualification by testing.

Thermo-Lag was installed following QA requirements for receipt and installation that were much broader and more specific than those recommended by TSI. Tested configurations were followed during installation. Deviations from those configurations, typically size and position, were considered in accordance with the direction provided by GL 86-10 (see response to 2b).

No specific fire endurance tests were performed to qualify configurations for TMI-1. However, in July 1992, in response to concerns raised by Bulletin 92-01, TMI-1 had combustibility tests performed per ASTM-E136 at Southwest Research Institute (SRI). The results showed the material to be combustible. The results were provided to NRR through the site NRC resident. A copy of the SRI August 24, 1992 report is included as Attachment 2.

Response to Item 2b

TMI-1 followed TSI's procedures for the installation of 1 and 3 hour prefabricated panels, conduit preforms and Flexi-Blanket. As part of the task preparation, a training program and detailed quality control receipt inspection guidelines were developed and implemented. The effort was initiated based on our concerns and requirements for:

1) shelf life of trowel grade material;

2) material thickness: too thick affected weight and ampacity derating; too thin affected fire rating (a practical rule used in all TSI designs and applications was that a minimum thickness of 1" of material was mandatory for a 3 hour design and 1/2 inch minimum thickness was required for a 1 hour design);

3) material weight: it was important to control material weight based on design (seismic and dead load for tray and conduit supports) but as a criteria to ensure there were no substantial voids in the material (i.e., weight and thickness both within specified limits;

4) reinforcement ribs and stress skin integrity/continuity;

5) consistency of shape of preformed conduit sections - there were some early problems with material deformity;

6) miscellaneous other checks; e.g. lot numbers.

During installation, several deviations from supposedly qualified and tested configurations were identified. The deviations were evaluated by qualified fire protection engineers using the guidance of NRC GL 86-10 Section 3.2.2, "Deviations for Tested Configurations". Evaluation of the deviations was permitted at TMI-1 since the Appendix R Compliance Program extended into March of 1987 (ie. TMI-1 subject to earlier TMI-2 based shut down orders). The deviations and evaluations are maintained as part of the installation construction package.

As part of the planned design using TSI standard configurations, American Nuclear Insurers (ANI) was relied upon to "accept for insurance purposes", standard configurations. This reliance was based on past experience with ANI and NRR on standard fire barrier penetration seal designs and their installation. As part of this interface with ANI, a basic concept was applied: fire barrier envelope qualification and extrapolations of tested

configurations was different than the extrapolations that would be done for penetration seals. In essence the philosophy was that penetration seals smaller than the te configuration were usually acceptable because less area was challenged. rger seals were more difficult to evaluate. With envelopes (the term for Thermo-Lag barriers at TMI-1), smaller was not necessarily better. This was due to the small mass, potential fire duration and resultant heat transfer leading to failure. Larger configurations, due to their mass and the assumption that the envelope does not open or fail structurally, should be acceptable.

Based on this concept, the initial design required small diameter conduit (≤1") to be built up with several layers of Thermo-Lag 330 "Flexi-Blanket" material, then covered with conduit preform of the 1/2 or 1" thick material for either a 1 or 3 hour rating. Due to the extreme difficulty inherent in this type installation (e.g. labor, multiple QC verifications, weight, available space), the process was re-examined and approved design deviations were issued in accordance with NRC GL 86-10. As a result, a simple reliance on the 1/2" or 1" thick preform, without an initial build-up in diameter, was adequate considering the fire loadings, continuity of the barrier, material being protected, configuration and location.

Generic TSI designs were followed for the application of TSI material on all of the variations on cable tray, "tee" sections, junction boxes, and splice boxes (ie., size and orientation).

Future access to cable trays was assurred by engineered deviations from standard envelope design and installation processes. The deviation consists of covering the tray sides and bottoms with TSI and banding the sub-assembly prior to applying the top. The outside banding was spaced at ≤12". This design is an improvement over the standard since it provides some protection for the banding material. It is typical of some later tested configurations.

The top coat sealer material was not used at TMI-1 since there were no installation locations that warranted its use (i.e., outdoors). It was also eliminated from the design for use within containment since internal concerns on qualifications during a LOCA could not be resolved.

The design employed at TMI-1 also required that the TSI material not simply butt up against silicone foam fire penetration seals. Installation specifications required that the TSI penetrate the foam beyond the other side of the barrier (ie., TSI was extended typically 9 inches beyond the unexposed face of the penetration seal). Installation in this fashion ensured that no interface problem existed on the side of the barrier where protection by TSI material was required.

Another deviation involved the protection of splice points between normal cables and Rockbestos Firezone R Cable. Rockbestos Firezone R Cable was developed, tested, qualified and accepted as 1 hour fire rated cable. Thermo-Lag was used to protect splice points with regular cable if splices were made within the fire area requiring operability of the circuit.

Further exceptions involved application of the "18 inch" rule for the protection of metal items which penetrate the envelope. The distance was relaxed to nine inches in areas protected by sprinklers. The requirement to protect envelope supports with Thermo-Lag was also relaxed (ie., approved exemption) based on sprinklers, detection and fire brigade response time.

Response to Item 2c

Questions concerning the derating values associated with TSI material were raised as early as 1986. Based on the heat transfer considerations made on the small diameter conduit protection, as described above, engineering was concerned about the low values used. Since the material worked as an insulator to keep heat out during a fire, it was expected therefore, that it would retain heat during normal operation.

A field test was performed to resolve this concern. The internal temperatures of Thermo-Lag envelopes protecting power circuits were monitored. The data obtained showed that ampacity derating was not a concern for instrument and control circuits or power circuits which were only intermittently operated. At the same time, as part of the Rockbestos Firezone R Cable development, evaluations performed found no problem with application of TSI material on those circuits providing instrumentation or control as a function of circuit resistance (fire or simply envelope protection could raise conductor temperature changing resistance and thereby changing indication).

The initial circuit review utilized the derating factors reported by TSI for Thermo-Lag envelopes. Upon notification of the UL findings, the cable ampacity was reevaluated using a 28.04% derating factor for safety related cables within the Thermo-Lag envelopes. Several cables do not meet the ampacity desired when the 28% derating is combined with 125% of rated load and the derating factor for cable in tray.

Cable rerouting was considered and in one case utilized to minimize the number of affected cables. To evaluate the long term temperature effect on the cable, temperature was measured in what was considered to be the worst case raceway protected by Thermo-Lag. The test results were evaluated and it was determined that the combined derating factors were conservative for the configuration used at TMI. The temperature inside the envelope with all available components running was 7 °F above the temperature outside the envelope.

Although TSI subsequently reported a derating factor of 33% for a one hour fire barrier, this revised derating factor did not change the conclusion that the internal envelope temperature for the TMI-1 configuration would not cause long term cable degradation.

Response to Items 3 and 4

TSI fire barriers at TMI-1 were considered operable and qualified based upon technical guidance at the time of installation. Based on information provided by the NRC at the NUMARC TSI Thermo-Lag Workshop on August 25, 1992, during the NRC/GPUN teleconference of August 26, 1992 and the content of Supplement 1 to IEB 92-01, TMI-1 concurred with the finding of inoperability of the Thermo-Lag 330-1 fire barriers and initiated compensatory measures (reference C311-92-2125, Response to IEB 91-01 Supplement 1, dated 9/25/92). GPUN agrees that further actions are necessary to address concerns with the fire endurance and qualification of Thermo-Lag 330-1 barriers. GPUN is participating with NUMARC in their effort to resolve this issue such that nuclear plant safety will be ensured in the event of fire. At TMI-1, ampacity derating is not considered a concern with the TSI as presently installed. However, the issue will require reevaluation should any corrective action result in increasing the envelope material thickness.

Regarding a schedule for proposed corrective action, we understand that specific testing schedules will be provided to the NRC by NUMARC.

GPUN at TMI-1 will continue to follow and participate in NUMARC/NRC actions on this issue and the testing results. Once upgrades or other corrective action requirements are identified, both the means and the effort required to satisfy them must be determined. The schedule for the specific TMI-1 actions will be dependent on the results and will be consistent with industry and NRC schedules. In the interim, the compensatory measures will continue as will the close monitoring of their implementation.

8/31/92

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August 24, 1992

GPU Nuclear
Three Mile Island Nuclear Station
P.O. Box 480 - Route 441 South
Middletown, Pennsylvania 17057

Attn: Mr. Richard Barth

Re: SwRI Project No. 01-4510-581 FINAL REPORT
"Behavior of Materials in a Vertical Tube Furnace at 750°C (ASTM E136-82)"

Gentlemen:

This letter constitutes our final report on your Thermo-Lag 330 Prefabricated Panel, identified as Thermal Science, Inc., submitted for evaluation by the referenced test method.

The results apply specifically to the specimens tested, in the manner tested, and not to the entire production of these or similar materials, nor to the performance when used in combination with other materials. All test data are on file and are available for review by authorized persons.

TEST OBJECTIVE AND PROCEDURE

The method covers the performance of elementary building materials when exposed to 750°C (1382°F), to indicate those materials which do not act to aid combustion or add appreciable heat to an ambient fire. It is not intended to apply to laminated or coated materials. It should be used to measure and describe the properties of materials, products or systems in response to heat and flame under controlled laboratory conditions and should not be used for the description or appraisal of the fire hazards of materials, products or systems under actual fire conditions.

The sample is exposed to a temperature of 750 ± 5.5°C (1382 ± 10°F) in the center of an air stream in a furnace tube at an air velocity of 10 ft/minute (3 m/minute) ± 20% until maximum temperatures inside and outside the specimen are reached, or until it is clearly evident that the specimen does not pass the test. The internal and external temperatures of the sample are measured. The weight loss is also determined.

PASS/FAIL CRITERIA

To be reported as passing this test, at least three of the four specimens shall meet the following criteria:

1. No flaming after the first 30 seconds;
2. Average weight loss less than 50 percent;
3. Interior and exterior temperatures shall not increase more than 30°C (54°F) above the furnace temperature at the beginning of the test.

DESCRIPTION AND PREPARATION OF MATERIAL

Date Received:	July 30, 1992
Trade Name*:	Thermo-Lag 330 Prefabricated Panel
Identification*:	Thermal Science, Inc.
Color*:	Antique White
Finish*:	Textured
Construction*:	The Client provided the following construction details:

This product is used in the fabrication/construction of 3-hour fire-rated barrier systems. The 3-hour design consists of: "an inner layer of THERMO-LAG Stress Skin Type 330-69, coated with a minimum dry film thickness of 0.500" of the THERMO-LAG 330-1, Subliming Coating, another 0.500" minimum dry film thickness of THERMO-LAG 330-1 Subliming Coating, and an outer layer of THERMO-LAG Stress Skin Type 330-69. The three hour design can be obtained by the use of 2 one hour Prefabricated Panels, as described above, or the minimum dry film thickness of 1.00" of the THERMO-LAG 330-1 Subliming Coating can be used in lieu of the 2 one hour Prefabricated Panels."

Nominal Density*: 67.2 lb/ft^3 (maximum)

* From Client's material description

TEST RESULTS

Date of Test:	August 10, 1992
Conditioning:	24 hours, 140 ± 5°F (60 ± 3°C)
Nominal Size Tested:	1.5-in. wide x 2.0-in. long x 1.5-in. thick
Nominal Weight Tested:	65 grams
Number of Runs:	3

Furnace temperature at beginning of test (before inserting test specimen): 750 ± 5°C (1382°F ± 10°F)

Temperature at approximate position to be occupied by the center of the specimen: 750 ± 5°C (1382 ± 10°F)

A summary of the test results is shown in Table 1. Plots appear in the Appendix.

TABLE 1.
SUMMARY OF TEST RESULTS

Run No.	Maximum Temperature Reached, °C (°F) Surface	Interior	Maximum Temperature Rise, °C (°F) Surface	Interior	Time to Maximum*, min:s Surface	Interior	Weight Loss, %
1	788 (1450)	98 (208)	38 (68)	-652 (-1174)	3:00	3:00	15.83
2	920 (1688)	50 (122)	170 (306)	-700 (-1260)	1:00	1:00	6.61
3	811 (1492)	273 (523)	61 (110)	-477 (- 859)	15:00	15:00	50.12

* time = 0:00 at the time the specimen was inserted in the furnace.

OBSERVATIONS

In all runs, the specimen ignited approximately 2 seconds after it was inserted in the furnace. Run Nos. 1 and 2 were terminated approximately 2 minutes after ignition occurred. Run No. 3 was continued for 15 minutes to determine the behavior of the material during a longer exposure time. During this run, the specimen continued to flame after it was removed from the furnace.

Based on the aforementioned values, Thermo-Lag 330 Prefabricated Panel can be stated to have failed the criteria for the ASTM E136 test. If you have any questions, please contact us.

Sincerely,

Gladys M. Finley

Gladys M. Finley
Project Leader
Fire Testing Services
GMF/rr

Approved by:

for Alex B. Wenzel
Director
Department of Fire Technlogy

APPENDIX

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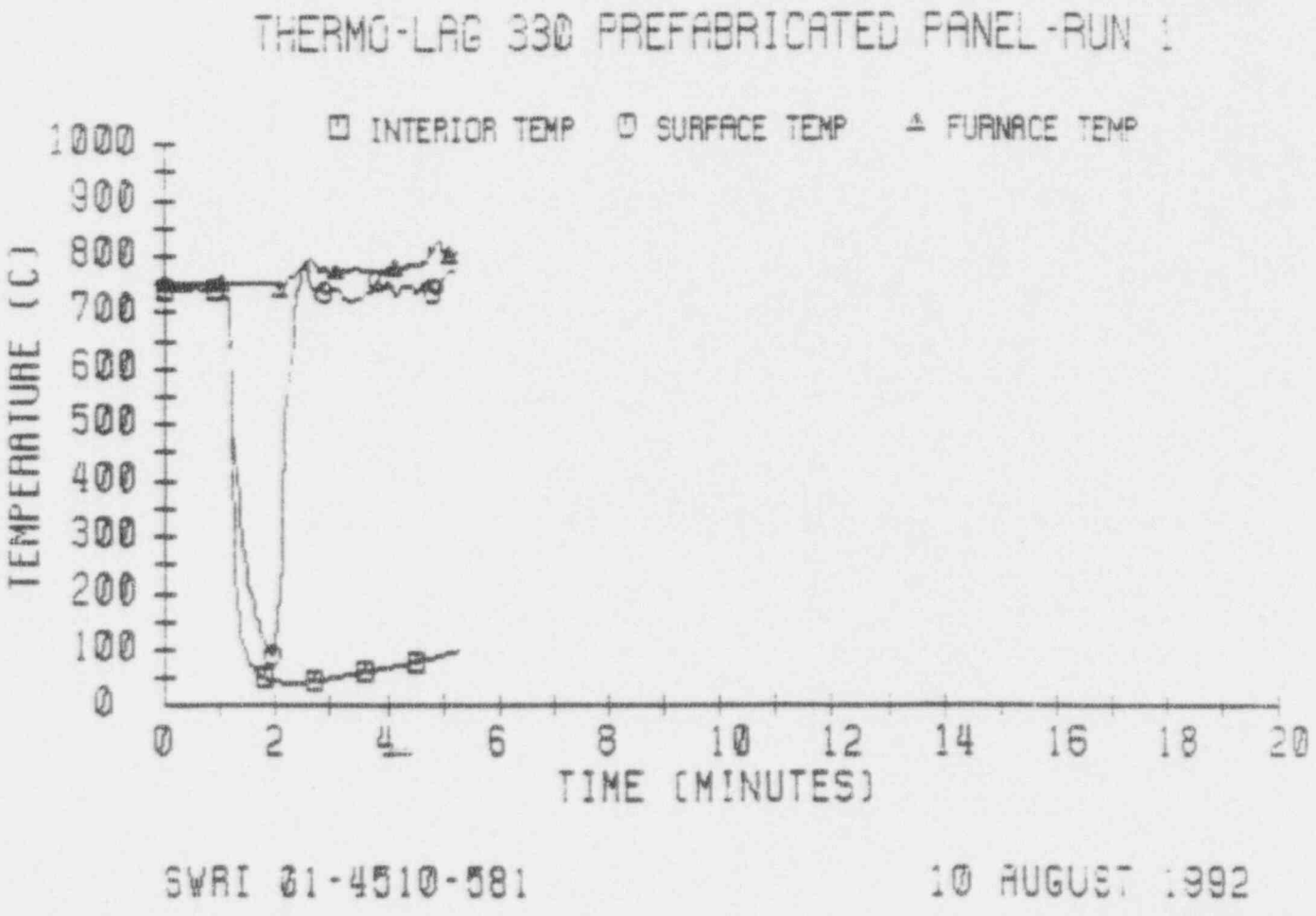
ASTM E136 Test Method



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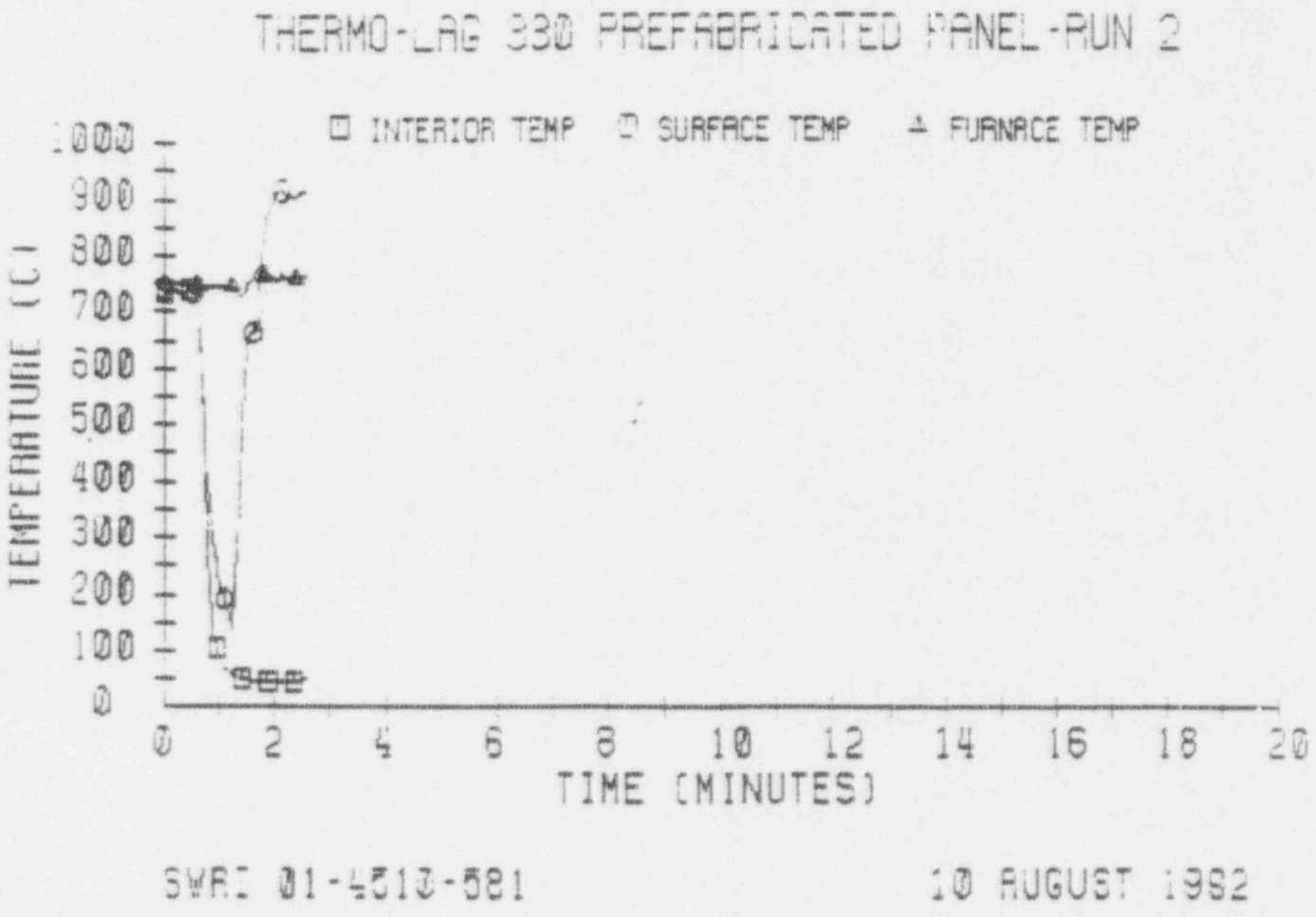
ASTM E136 Test Method



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