UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

FEB 7 1992

MEMORANDUM FOR: A. Bert Davis, Regional Administrator

FROM: H. J. Miller, Director, Division of Reactor Safety

SUBJECT: PERRY NUCLEAR POWER PLANT - FIRE PROTECTION PROGRAM CONCERNS (AITS 92-0013)

We reviewed the memorandum to you dated January 10, 1992, from Frank J. Miraglia, NRR, and plan to take the following actions:

Summary of Issues

1. While performing the plant walkdown inspections, the task force observed a split in a Thermo-Lag fire barrier on a conduit at the 638-foot elevation of the control complex division 1 cable spreading room. This split was the full depth of a joint between preshaped conduit sections. This damage appeared to have been caused by individuals stepping on the conduit. On December 17, 1991, the licensee informed the task force that it had issued a work order to repair the conduit fire barrier. Fire watches have been established in the cable spreading room because of the banding strap spacing deviations reported in LER 91-020 of November 4, 1991. The licensee informed the task force that the split will be repaired when the banding strap spacing is improved.

Action

A fire protection inspection will be conducted early in 1993 which will include the following:

a. Observe a sample of Thermo-Lag barriers on cable trays and conduits including the conduit at the 638-foot elevation previously identified.

b. Review completed Thermo-Lag fire barrier surveillances for cable trays and conduits to determine if there is a significant number of degraded installations.

c. Evaluate corrective action measures if there are a significant number of damaged or degraded installations.

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2. The licensee purchases Thermo-Lag as a commercial grade material. The licensee does not impose 10 CFR Part 21 or 10 CFR Appendix B requirements on Thermal Sciences, Incorporated (TSI, the vendor). The licensee does not conduct source inspections at the vendor's site, but conducts annual quality assurance (QA) audits. Instead of conducting the annual QA audit, the licensee may obtain the results of an annual audit performed by another licensee and assess those results for applicability to its QA program. In this case, if the licensee finds that the third party audit satisfies its requirements, it does not conduct an independent audit of the vendors's program that year.

   Action

   In discussion with Steve West (one of the individuals who identified this concern), he indicated that this was background information and that the information identified in the paragraph below is the actual concern.

3. The task force found that the licensee included the temperature strip charts in the receipt inspection file but did not check the temperature data against inspection acceptance criteria or record the data in the receipt inspection report. The licensee stated that this was a flaw in its receipt inspection procedures and that it would revise the procedures to ensure that the temperature limits are included in the future receipt inspections of the trowel- grade material. The task force found this response acceptable.

   Action

   A fire protection inspection will be conducted early in 1993 which will include the following:

   a. Determine the technical significance of the temperature limitations. If a safety problem exists, determine what the licensee has done or plans to do to correct it.

   b. Verify that temperature limits are included in the revised receipt inspections (Thermo-Lag trowel grade material) procedures.

Postponing our followup actions until 1993 is consistent with our assessment of the significance of these issues.

Should you have any questions regarding this matter, please contact Mr. Jeff Holmes of my staff on Ext. 594.

T. O. Martin for
H. J. Miller, Director
Division of Reactor Safety

cc: J. Zwolinski, NRR
B. Grimes, NRR
L. Plisco, NRR
S. West, NRR

MAR 27 1992

Docket No. 50-458
License No. NPF-47

Gulf States Utilities
ATTN: James C. Deddens
Senior Vice President (RBNG)
P.O. Box 220
St. Francisville, Louisiana 70775

Gentlemen:

SUBJECT INSPECTION REPORT NO. 50-458/92-04

This refers to the inspection conducted by Messrs. A. Singh, and M. E. Murphy of this office and M. T. Widmann of the Office of Nuclear Reactor Regulation and T. Storey of Science Applications International Corporation (SAIC), during the period January 27-31 and March 10, 1992, of activities authorized by NRC Operating License NPF-47 for River Bend Station, and to discussion of our findings with you and the members of your staff at the conclusion of the on-site portion of the inspection on January 31 and by telephone conversation on March 10, 1992.

Areas examined during the inspection are identified in the report. These included the review of application and installation of Thermo-Lag fire barrier, assessment of the fire barrier protection program, compliance with requirements of Appendix R to 10 CFR Part 50, and followup of previously identified items.

Within the scope of the inspection, no violations or deviations were identified.

Two unresolved items are identified in paragraphs 4.2.6 and 5.1.7 of the enclosed inspection report.

We have also examined actions you have taken with regard to previously identified inspection findings. The status of these items is identified in paragraph 2 of the enclosed report.

You are requested to provide a written response to the unresolved items identified in the report within 30 days of the date of this letter as agreed to in our telephone conversation of March 10, 1992. Your response should specifically address the action you have taken or planned regarding each of the issues included in the unresolved items. This should include a schedule for completion of all actions required to assure compliance with 10 CFR Part 50, Appendix R. For the original Thermo-Lag installations, a discussion of the original basis for qualification should be included in your response.

RIV:TPS	C:TPS	D:DRS	D:DRP
ASingh	JEGagliardo	SJCollins	ABBeach
3/27/92	3/27/92	3/27/92	3/27/92

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In accordance with 10 CFR Part 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, we will be pleased to discuss them with you.

Sincerely,
Original Signed By:
Thomas P. Gwynn
for
A. Bill Beach, Director
Division of Reactor Projects

Enclosure:
Appendix - NRC Inspection Report
50-458/92-04 w/Attachment

cc w/enclosure:
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bcc to DMB (IE01)

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APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-458/92-04

Operating License: NPF-47

Docket: 50-458

Licensee: Gulf States Utilities (GSU)
P.O. Box 220
St. Francisville, Louisiana 70775

Facility Name: River Bend Station (RBS)

Inspection At: St. Francisville, Louisiana

Inspection Conducted: January 27-31 and March 10, 1992

Inspectors: A. Singh, Reactor Inspector, Test Programs Section, Division of Reactor Safety (Lead Inspector)

M. E. Murphy, Reactor Inspector, Test Programs Section, Division of Reactor Safety

Accompanying Personnel: M. T. Widmann, Reactor Systems Engineer
Office of Nuclear Reactor Regulation (NRR)

T. A. Storey, Fire Protection Engineer
Science Application International Corporation

Approved: Dwight D. Chamberlain for   3-27-92
J. E. Gagliardo, Section Chief, Test Programs Section, Division of Reactor Safety   Date

Inspection Summary

Inspection Conducted January 27-31 and March 10, 1992 (Report 50-458/92-04)

Areas Inspected: Review of application and installation of Thermo-Lag fire barrier, assessment of the fire barrier protection program, compliance with requirements of Appendix R to 10 CFR Part 50, and licensee action on previously identified inspection findings.

Results: The inspection verified that the licensee had maintained an hourly or continuous fire watch as appropriate when the Thermo-Lag fire barriers were declared inoperable. Two major unresolved items were identified as a result of the inspection. The first unresolved item (paragraph 4.2.6), involves the acceptability of the licensee's basis for the initial determination of the adequacy of Thermo-Lag applications and installation, including the adequacy and timeliness of corrective actions. The second unresolved item (paragraph 5.1.7) involves the adequacy and timeliness of the licensee's past and future corrective actions associated with the identification and correction of Appendix R technical noncompliance issues.

No violations or deviations were identified.

DETAILS

1. PERSONS CONTACTED

GSU

#*D. Andrews, Director, Nuclear Training
*L. Ballard, Supervisor, Contract Services
#*T. Crouse, Manager Administration
#*M. Cumbest, Senior Fire Protection Engineer
*J. Deddens, Senior Vice President
*B. Ellis, Fire Protection Coordinator
*L. England, Director, Nuclear Licensing
*W. Fountain, Senior Quality Assurance (QA) Engineer
*P. Graham, Plant Manager
#*J. Hamilton, Director, Design Engineering
#*T. Hoffman, Supervisor, Civil/Structural Design
*R. Kerar, Fire Protection Engineer
#*D. Lorfing, Supervisor, Nuclear Licensing
#*J. Maher, Nuclear Licensing Engineer
*I. Malik, Operations QA Supervisor
*D. McCarter, Director, Loss Prevention
*J. McQuirter, Licensing Engineer
#*W. Odell, Manager, Oversight
*J. Pruitt, Manager, Business Systems
*F. Richter, QA Engineer
*M. Sankovich, Manager, Engineering
*J. Schippert, Assistant Plant Manager, Operations
*J. Spivey,Jr. Senior QA Engineer/Audit Coordinator
#*K. Suhrke, General Manager, Engineering & Administration
*D. Thomas, Director, Administration Services

CAJUN ELECTRIC COOPERATIVE

*W. Curran, Site Representative

NRC

*E. Ford, Senior Resident Inspector
*J. Gagliardo, Section Chief, Test Program Section
*D. Loveless, Resident Inspector

*Denotes those attending the inspection debrief conducted on January 31, 1992.
#Denotes those participating in the inspection telephone exit on March 10, 1992.

2. BACKGROUND INFORMATION

During the week of January 22-26, 1990, an inspection was conducted at River Bend Station (RBS) to verify the fire protection program compliance, and from that inspection a notice of violation was issued for the lack of a complete fire hazard analysis at RBS. The inspection was documented in NRC Inspection Report 50-458/90-02. NRC subsequently issued Information Notice 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test," which identified problems that could result from the use of or improper installation and application of Thermo-Lag material utilized to satisfy the requirements of Appendix R to 10 CFR Part 50. In October 1991, the NRR staff visited the RBS in order to collect additional information related to the generic use of Thermo-Lag material. During the NRR staff's visit, they identified issues concerning the application, qualification, and configuration of Thermo-Lag used at RBS, these issues are discussed in paragraph 4 of this report. To followup these issues, NRC Region IV conducted an inspection and also evaluated the licensee's corrective action and response to NRC Inspection Report 50-458/90-02, Appendix R compliance issues as discussed in paragraph 5 of this report.

3. LICENSEE ACTION ON PREVIOUSLY IDENTIFIED INSPECTION FINDINGS (92701, 92702)

(OPEN) Violation 458/9002-02: Failure to fully implement the fire protection program approved by the NRC.

The licensee's letters dated May 18 and September 18, 1990, in response to this violation stated that the corrective actions would be completed by January 15, 1991. However, by letter dated March 12, 1991, the licensee requested an extension to complete all corrective actions by the end of January 1992. During the time of this inspection they asked for another extension to complete the actions. The NRC will respond to the latest extension request after review of the licensee's revised corrective action schedule provided in letter dated February 7, 1992. Gulf States Utilities (GSU) had retained a contractor to review the fire hazard analysis. The independent review by the contractor identified 106 discrepancies associated with Appendix R. One hundred discrepancies had been resolved. The remaining 6 were being evaluated by the contractor and are discussed in the paragraph 5 of this report. This violation will remain open until corrective actions have been completed by the licensee and reviewed by the NRC.

(CLOSED) Unresolved Item (458/9128-01): Use of acceptance criteria for barrier qualification tests that were not consistent with the acceptance criteria contained in Generic Letter 86-10.

This item is considered closed. The issues for the unresolved item have been incorporated into Unresolved Item 458/9204-01 as stated in the paragraph 4.2.6 of this report.

(CLOSED) Unresolved Item (458/9128-02): Three installed fire barrier configurations containing unprotected structural steel which did not appear to comply with the requirements of Appendix R to 10 CFR Part 50.

This item is considered closed. The issues for this unresolved item have been incorporated into Unresolved Item 458/9204-01 listed in paragraph 4.2.6 of this report.

(CLOSED) Unresolved Item (458/9128-03): Reportability of Thermo-Lag installation deficiencies.

This item involved a concern that additional or supplemental licensee event reports (LERs) were not submitted for nonconforming fire barrier conditions discovered after submittal of LER 87-005. The licensee had discovered new deficiencies which were not addressed in the LER 87-005 and this resulted in the issuance of LER 89-009 in April 1989. To address further developments involving Thermo-Lag, the licensee submitted an "Informational Report" to the NRC in December 1989. A revision to this report was issued in January 1990. Continued evolution in the problems associated with Thermo-Lag resulted in the issue of LER 90-03 in March 1990. This LER has had three revisions, July 1990, February 1991, and June 1991. The inspectors review indicated that licensee's handling of the reportability on Thermo-Lag issues is no longer a concern. This unresolved item is closed.

4. FIRE PROTECTION/PREVENTION PROGRAM (64704)

4.1 Program Review and Implementation

The purpose of this inspection was to review the application and installation of Thermo-Lag fire barriers, to review the status of the fire protection program's compliance with requirements of Appendix R to 10 CFR Part 50 at RBS, and to address unresolved items. This inspection did not address the Thermo-Lag material, but only its installation and application. The inspectors reviewed the licensee's procedures, which constitute the approved fire protection program, pre-fire strategy training records, and administrative procedures on fire barrier inspections. The procedures and the other documents reviewed are listed in the Attachment. Additionally, condition reports were reviewed which documented maintenance work activities on fire protection systems.

The inspectors toured accessible areas of the plant site to observe general area conditions, work activities in progress, and the visual condition of the fire protection system and equipment. Items inspected included the exterior condition, the installed configurations, and the compliance with the manufacturers recommended installation procedures in the plant for the Thermo-Lag fire barrier material. The inspection also included a walkdown of the fire suppression and detection systems throughout the plant.

Housekeeping conditions were generally satisfactory with the exception of a few noted items of miscellaneous debris found during the walkdown of the plant. The licensee took appropriate corrective actions to clean up the areas.

4.2 Fire Barrier Protection/Thermo-Lag

During this inspection, the inspectors reviewed the application, installation, and removal of Thermo-Lag at RBS and the findings are discussed below.

4.2.1 Thermo-Lag Removal

During this inspection, the inspectors noted that Thermo-Lag had been removed in a number of plant locations around junction boxes, conduit seals, and wall penetrations. The licensee stated that the Thermo-Lag had been removed in order to inspect internal conduit seals and wall penetrations. The inspector found that all of the material had been removed prior to July 1991. Since then, there appeared to have been no effort on the part of the licensee to replace the material. The inspectors were concerned that even though there have been questions raised regarding the performance of the Thermo-Lag material, failure to restore a purposely degraded fire barrier reduces the level of protection from that previously provided. This is of particular concern when the separation of closely spaced redundant trains of cables are involved.

The penetration and conduit seal inspections that required removal of Thermo-Lag fire barrier material had been documented by the licensee as part of their maintenance work package system. The documentation was designed to ensure that when the reinstallation of Thermo-Lag material began, all inspection points would be covered with the fire barrier material. Replacing the Thermo-Lag fire barrier material had been complicated by the lack of an approved reinstallation procedure. The licensee's initial schedule to complete reinstallation of the Thermo-Lag material removed from the seals and penetrations was December 1993. After further discussions with the inspectors, licensee representatives committed to commence immediate actions to reinstall the Thermo-Lag. Although there was no approved procedure, the licensee representatives stated that the Thermo-Lag material would be reinstalled or modified if necessary, at a later date using an approved procedure. The licensee had declared all Thermo-Lag barriers as being inoperable, and had established fire watches for compensatory measures in accordance with the RBS Technical Specifications (TS).

4.2.2 Structural Integrity of Thermo-Lag Installation

During walkdowns of fire suppression equipment and Thermo-Lag fire barrier material, it was noted that several inadvertent actuations of the fire protection systems had caused damage to the material. The structural integrity of Thermo-Lag assemblies was found to be questionable because of apparent defects in the installed configurations throughout the plant. The fire suppression deluge system in both "F" and "G" tunnels had water supplied to pipes and sprinkler heads located between the cable trays and internal to the Thermo-Lag enclosures. Sprinkler heads were also located outside of the enclosures on the cable trays. A water spray system was also installed above the "G" tunnel floor/ceiling assembly. If the fire system was actuated in the "F" or "G" tunnel enclosures or above the "G" tunnel floor/ceiling assembly, the water would soften the Thermo-Lag and the weight of the water would cause failure of the barriers. Although drains were provided at the ends of "F" and "G" tunnel enclosures, the current design configuration did not appear to remove all water internally in the event of an inadvertent actuation of the fire suppression system. The inspectors noted visible damage to a portion of Thermo-Lag fire barrier material in "F" tunnel during the inspection. The licensee was apparently unaware that the condition existed prior to the inspection and was not able to identify the source of water damage. Other incidents of water damaged Thermo-Lag had been recorded and documented by the licensee. For example, Nonconformance Report 85-NR-053600 dated October 29, 1985, recorded damage to Thermo-Lag in the "G" tunnel caused by inadvertent actuation of the fire suppression system. The licensee's documents, stated that "TSI panels appear to be deteriorated due to bulging, cracking and peeling." It was also noted that the inadvertent operation of the fire suppression system had caused the seams of the Thermo-Lag barriers to separate.

4.2.3 Qualification Testing of Installed Configurations

The inspectors identified concerns with fire rating qualification testing of several existing fire barrier enclosures at RBS. A fire barrier assembly is considered qualified when an equivalent configuration has successfully passed a fire test in accordance with ASTM E119, usually performed at an independent testing laboratory. The configurations of concern included a floor/ceiling assembly in the stairwell of "G" tunnel, vault enclosures in "F" and "G" tunnels, and an instrument rack enclosure on the (+)98 foot elevation. All of these configurations were considered rated enclosures by the licensee in order to meet separation requirements in 10 CFR Part 50, Appendix R. In addition, for the assemblies that had passed previous fire tests, none of the tests, had simulated the fire suppression system being activated both internal and external to the fire barrier enclosure as installed in "F" and "G" tunnels. The inspectors questioned licensee representatives on the qualification testing of this assembly as installed. No documentation of tests or any engineering evaluation could be provided by the licensee representatives during the inspection.

The licensee had qualified a Thermo-Lag barrier in the "G" tunnel near the service water system. The barrier was a large horizontal floor/ceiling configuration (approximately 10X12 feet) installed in a stairwell between the 67-foot elevation (Fire Area PH1) and the 80 foot elevation (Fire Area PT1) near the service water system in "G" tunnel. The qualification testing of this fire barrier enclosure was questioned as to its rating by the inspectors. The horizontal barrier configuration separates two divisions of safety-related cable trays. Licensee representatives stated that an accepted and successful test configuration for an 18" cable tray was used to simulate this large floor/ceiling installation, and the 4X6X150-foot cable tray enclosures in "F" and "G" tunnels and the 4X6X6-foot instrument rack enclosure on the (+)98 foot elevation. Licensee representatives provided the inspectors with a preliminary test report, which contained information on a test of a Thermo-Lag enclosure. No details of the dimensions of the test assembly could be found in the preliminary report. The licensee representatives stated that the test assembly measured approximately 24X24X30 inches. Additionally, the licensee representatives were unable to provide an engineering evaluation demonstrating that a small scale design could be effectively extrapolated to the sizes that exist in the plant. By accepting the horizontal floor/ceiling configuration as an "enclosure," the licensee had only considered that a fire was probable from one side. The floor/ceiling assembly had been constructed of Thermo-Lag material bolted to the underside of a unistrut support structure. The unistrut was exposed on the top side. The inspectors have reviewed this configuration and concluded that the fire rating qualification test of an "enclosure" did not accurately reflect the as installed horizontal floor/ceiling configuration. The inspectors considered the horizontal floor/ceiling configuration equivalent to a fire area boundary which could be exposed to a fire on either side. There was no assurance that the exposed structural steel unistruts would not fail and jeopardize the integrity of the floor/ceiling assembly. In addition, the extrapolation of test data by the licensee to accept the assemblies in "F" and "G" tunnels and the instrument rack on (+)98 foot elevation, as qualified configurations were not supported by the test data provided in the licensee's preliminary report. Further, the licensee could not provide any engineering evaluations that would indicate acceptance of fire barrier qualification for the assemblies in the "F" and "G" tunnels and the instrument rack enclosure.

4.2.4 Electrical Cable Ampacity Derating

The inspectors found that the licensee may have used non-conservative derating factors for electrical cable ampacity in cable trays protected by Thermo-Lag material. The derating factors presently used by the licensee are documented in calculation E-218 and were provided by Thermal Science, Incorporated (TSI) to Stone and Webster in an August 9, 1984, letter.

During the October 1991 visit, NRR representatives questioned the licensee about an Underwriters Laboratories (UL) test report that was supposedly circulated by TSI to all users of Thermo-Lag. Licensee representatives stated that they had never received an official letter from TSI declaring their original ampacity derating factors in error. Subsequent to learning of the UL report, the licensee initiated an Engineering Evaluation and Assistance Request (EEAR 91-C-0115) to document the engineering review of the report.

The review by the licensee of the UL report raised questions regarding applicability of the test report to RBS. This evaluation had not been completed at the time of the inspection, but the licensee had compared the UL tested configuration to the installed configuration at RBS and with the TSI tested configuration. The licensee had reviewed about 10 percent of the cable installations and found some potential problems. None of these problems were found by the licensee to affect safe operation of the plant.

4.2.5 Fire Test Acceptance Criteria

The inspectors were concerned about the fire test criteria used by the licensee for fire barrier testing. The criteria used deviates from the NRC criteria stipulated in Generic Letter 86-10, which stipulates that transmission of heat through the barrier, "shall not have been such as to raise the temperature on its unexposed surface more than 250° F above its initial temperature." In February 1988, the licensee in commenting on a test plan submitted by TSI, stated that the acceptance criteria should be 325°F above ambient. Generic Letter 86-10, however, stipulates that the acceptance criteria should be 250°F above ambient, with an average ambient of 75°F being an acceptable norm.

The licensee's position on this issue was given in an internal memorandum from V. R. Hamilton to D. N. Lorfing, dated November 22, 1991, File Code No. G15.4.1, which stated:

> "Electrical cables run inside one and three hour Appendix R fire barriers at River Bend Station have passed the flame test in IEEE 383-1974. Degradation of the insulation used on IEEE 383 rated cable does not begin until jacket temperatures reach 450 degrees F to 650 degrees F. The criteria of 325 degrees F plus ambient assures that cable jacket temperatures do not reach these levels. The maximum ambient temperature for any fire test related to River Bend Station has been less than 90 degrees F, therefore; the criteria of 325 degrees F plus ambient assures that temperatures are sufficiently below the temperatures where jacket degradation begins. From the aspect of elevated temperature, this assures that cables are maintained free of fire damage in accordance with Appendix R, Section III.G requirements.
>
> "Although this variation from Generic Letter 86-10 guidance is not explicitly addressed and accepted by the NRC in the SER, Design Engineering believes it is implicitly accepted. Penetrations are an integral part of the barriers and NRC guidance in BTP CMEB 9.5-1 Section 5.a.3 requires penetrations to be sealed or closed to provide a fire resistance rating at least equal to that required of the barrier itself. Based on this, the criteria for cold side temperature would be the same for fire barriers and penetration seals. USAR Section 9B.4.13 specifically identifies the cold side temperature criteria of 325 degrees F above ambient used for penetrations seals. Also, the NRC specifically reviewed and accepted in SSER-3, Section 9.5.1.4 River Bend Station test reports for internal conduit seals which used ANI/MAERP criteria (325 degrees F plus ambient) for cold side temperature criteria. Based on the above, NRC acceptance of this 325 degrees F plus ambient criteria is implied."

The licensee's position on this matter was not approved by NRC during the inspection and will require further NRC review.

4.2.6 Thermo-Lag Conclusion

The acceptability of the licensee's basis for the initial determination of the adequacy of Thermo-Lag application, installation, and qualification testing at RBS remains an unresolved item pending the licensee's response to the specific items identified above in paragraphs 4.2.1 through 4.2.5 and future inspection as appropriate (Unresolved Item 458/9204-01). The adequacy and timeliness of the licensee's corrective actions will also be assessed along with any potential future enforcement action by NRC.

5. REVIEW OF OTHER LICENSEE IDENTIFIED APPENDIX R ISSUES

During this inspection, the inspectors also reviewed the licensee identified Appendix R issues found as a result of corrective actions in response to NRC Inspection Report 50-458/90-02. These issues were related to the licensee's compliance with 10 CFR Part 50, Appendix R, for technical concerns other than Thermo-Lag applications which are discussed above in paragraph 4 of this report.

5.1 Appendix R Issues

During this inspection, the inspectors discussed with the licensee the status of their response to NRC Inspection Report 90-02. Licensee representatives stated that a contractor was reviewing all Appendix R issues in response to NRC Inspection Report 50-458/90-02. During the review, 106 Appendix R deficiencies were identified by the licensee's contractor. One hundred items had already been resolved. The 6 remaining items had been addressed in condition reports (CR) and/or Licensee Event Reports (LER). These significant Appendix R issues are discussed below.

5.1.1 Electrical Separation for Spent Fuel Pool

Spent fuel pool equipment required for cooling were identified in LER-91-008, Supplement 1, as not being separated electrically from the control room, which in the event of a fire could result in the loss of spent fuel pool cooling. Upon discovery of this condition, immediate actions were taken by the licensee and administrative procedures for handling heat loads at existing conditions were implemented.

5.1.2 Lack of Automatic Control of Dampers in Fuel Building

Normal ventilation for the spent fuel pool cooling pump depends on three dampers within the area of the fuel building. Manual operator action is required to close the dampers in the event of a fire because of the lack of automatic controls on the dampers. The licensee had written a condition report to address this issue, and had taken compensatory measures by placing a continuous fire watch in the area of concern. The licensee had conducted an engineering evaluation of fire damper scenarios, which determined that the licensee would have sufficient time (approximately 4-5 hours) to send an operator into the area to realign the dampers in the event of a fire. Because there was no fire detection in the area, a continuous fire watch was being maintained.

5.1.3 Twenty Foot Separation In Reactor Building

Separation criteria in the reactor building was identified as an Appendix R issue that had not been previously analyzed correctly. The licensee had completed a 20 foot horizontal separation analysis using a sphere instead of 20 foot horizontal separation criteria as stated in 10 CFR Part 50, Appendix R, Section III.G. In accordance with Appendix R requirements, but the licensee was to separate cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. Upon completion of an evaluation by the licensee, it was determined that they did not meet the 20-foot separation criteria with no intervening combustibles. The licensee had written a condition report to address this issue and established an hourly fire watch as a compensatory measure in accordance with TS requirements.

5.1.4 Lack of Fire Hazard Analysis

The review of the Appendix R issues by the licensee's contractor had determined that no fire hazard analysis review could be found for a portion of the "D" tunnel in the electrical cable room. The lack of a documented fire hazard analysis is significant because of the existence of safety equipment cables being routed through the "D" tunnel. At the time of this inspection, a preliminary analysis had been completed by the licensee's contractor, but had not been approved.

5.1.5 Breaker/Fuse Coordination Study

This issue, identified by the licensee, was the absence of a breaker/fuse coordination analysis as part of the associated circuit analyses required by Appendix R. The licensee's contractor was developing the breaker/fuse coordination analysis and a single source document to enhance the control of breaker/fuse coordination for the control of 125VDC/120VAC circuits.

5.1.6 Lack of High Impedance Fault Analysis

This issue, also identified by the licensee, involved the absence of documentation for a multiple high impedance fault analysis, or compensatory procedures for operator actions. The significance of this concern is that an inadvertent trip of safe shutdown equipment could result from the fire induced circuit damage of the associated circuits, therefore, potentially affecting safe shutdown systems. A high impedance fault analysis or compensatory procedures is part of associated circuit analysis required by Appendix R, and is further addressed in the guidance provided in Generic Letter (GL) 86-10. A contractor had been retained by the licensee to develop the required analysis or the appropriate procedures. No completion date for the analysis was provided to the inspectors at the time of the inspection.

5.1.7 Conclusion - Appendix R Issues

The adequacy and timeliness of the licensee's past and future corrective actions associated with the identification and correction of these remaining Appendix R technical noncompliance issues remains an unresolved item pending the licensee's response to the items in paragraphs 5.1.1 through 5.1.6 and future inspection as appropriate (Unresolved Item 458/9204-02).

5.2 Management Oversight of the Fire Protection Area

During the course of the inspection, the inspectors primarily interfaced with plant engineering personnel. It was not evident during this inspection that any individual or organization had overall responsibility for the fire protection program. The many examples of fire protection weaknesses and inadequacies documented in this report demonstrate an apparent lack of management attention to the fire protection program at River Bend Station.

6. EXIT MEETINGS

An interim exit briefing was held on January 31, 1992, with the personnel indicated in paragraph 1 of this report. At this briefing, the scope of the inspection and the findings were summarized. The licensee did not identify as proprietary any of the information provided to or reviewed by the inspectors. A telephone exit interview was held on March 10, 1992, with the persons indicated in paragraph 1. During this meeting, NRC representatives reiterated the findings and the unresolved items associated with those findings. The licensee representatives were advised that a 30-day response would be requested for each of the unresolved items documented in the report and they agreed to respond.

ATTACHMENT

Administrative Procedures

Procedure No.	Title	Date
RBNP-038, Revision 4	River Bend Station Site Fire Protection Program	06/07/90
ADM-0009, Revision 7	Station Fire Protection Program	05/23/90
STP-000-3602, Rev. 8A	Fire Barrier Visual Inspection	07/25/90
STS-250-1, Revision 0	Operator Simulator for Auxiliary Building Fire	07/02/91

Condition Reports

Report No.	Title	Date
86-1492	Appendix R Fire Barriers	10/06/86
91-0028	Fire Hazard Analysis Review	01/18/91
91-0095	Fire Hazard Analysis Review	03/08/91
91-0121	Fire Protection Program - Fire Doors	03/21/91
91-0122	Fire Protection Program - Fire Detectors	03/21/91
91-0123	Fire Protection Program - Sliding Fire Door	03/26/91
91-0124	Fire Protection Program - Deluge Valves	03/21/91
91-0125	Fire Protection Program - Sprinkler System Relief Valve	03/27/91
91-0126	Fire Protection Program - Sprinkler Heads	03/25/91
91-0127	Fire Protection Program - Spray Nozzles	03/27/91
91-0128	Fire Protection Program - Spray Nozzles	03/21/91

91-0129	Fire Protection Program - Spray Nozzles	03/26/91
91-0162	Fire Hazard Analysis Review	04/15/91
92-0028	Fire Hazard Analysis Review	01/14/92
92-0031	Fire Hazard Analysis Review	01/15/92
92-0032	Fire Hazard Analysis Review	01/15/92

Miscellaneous Documents Reviewed

Document No.	Title	Date
RBG-36472	GSU Letter addressing corrective actions in response to NRC Report 90-02	02/07/92
LER-91-008,	Licensee Event Report - Supplement 1 Fire Hazard Analysis Deficiencies/Inadequate Fire Barrier	02/18/92
85-NR-053600	Nonconformance Report - Appendix R Barriers	10/29/85
91-IR-21990	QC Inspection Report - Penetration Seal Database, Individual Seal Record	08/27/91
MWR-13237	Maintenance Work Request - Appendix R Barriers	10/29/85
MR-87-0095	Modification Request - Correct/ Clarify Appendix R Details	02/06/87
TCN-91-0424	Temporary Change Notice - Fire Barrier Visual Inspection Procedure STP-000-3602, Rev. 8A	06/10/91
TCN-91-0913	Temporary Change Notice - Fire Barrier Visual Inspection Procedure STP-000-3602, Rev. 8A	10/24/91
C-263978	Stone & Webster Eng. & Design Coordination Report - Appendix R Details	03/23/85

C-27597, Revision A	Stone & Webster Eng. & Design Coordination Report - Standby Cooling Tower No.1 Chase Barrier	06/07/85
080884-B	TSI Technical Note - Selected Information on Thermo-Lag 330-1	08/09/84
No. 321, Revision A	TSI Technical Note - Engineering Test Plan To Perform One and Three Hour Tests	04/90
Section 14.9	TSI Preliminary Test Results - Tests Performed on GSU's Insitu One and Three Hour Fire Barrier Design For Vault Enclosures	01/91
NUREG 0989	River Bend Station Safety Evaluation Report with Supplements	05/84

Drawings

Drawing No.	Title
12210-EE-34YA-3	Appendix R Raceway Fire Protection Details
12210-EE-34YB-3	Appendix R Raceway Fire Protection Details
12210-EE-34YC-3	Appendix R Raceway Fire Protection
12210-EE-34YD-3	Appendix R Raceway Fire Protection
12210-EE-34YE-3	Appendix R Raceway Fire Protection Details
PCN-N19810-600, Revision 3	Construction Details Racks 1JCB-RAK 1&2 River Bend Station Unit 1

TU ELECTRIC

DESIGN ENGINEERING ORGANIZATION

SCOPE B

ENGINEERING REPORT

EVALUATION OF THERMO-LAG FIRE BARRIER SYSTEMS

ER-ME-067

REVISION 0

– PRELIMINARY –

Confirmation Required
March 30, 1992

Prepared by ______ for FAC

Reviewed by ______

Approved by ______

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TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this engineering report is to define the methodology, design inputs, assumptions, acceptance criteria, and results of the review relative to acceptability of the Thermo-Lag Fire Barriers Systems Design at CPSES.

2.0 SCOPE

The scope of this engineering report includes all Thermo-Lag Fire Barrier Systems installed at CPSES. This includes both raceways and structural fire barriers.

3.0 DESCRIPTION

The TSI Thermo-Lag Fire Barrier Systems are a composite of various materials used to protect essential safe shutdown commodities from the adverse affects of a fire. Thermo-Lag principally is used at CPSES to provide a one hour fire barrier between redundant trains of fire safe shutdown equipment. In this use, the material is installed as a protective envelope around an essential commodity, such as a raceway, junction box, or pull box which contains safe shutdown cables. In these applications, the TSI material is used to preclude fire-induced damage to the cables thereby preserving safe shutdown functions. Thermo-Lag is also used to protect structural steel, to assure its structural integrity, and to prevent the collapse of a fire barrier which would allow the spread of the fire. In very limited applications, Thermo-Lag is also used to coat steel hatch covers in fire barriers to prevent the fire from heating the cover and igniting an object on the opposite side thereby spreading the fire.

COMANCHE PEAK FIRE TESTING IS NOT DEMONSTRATING THAT CABLES ARE FREE FROM FIRE DAMAGE

4.0 DEFINITIONS

Fire Barrier System	an enclosure or wrap which separates/protects the items in the enclosure from the surrounding area in the event of a fire.
Fire Rated	a commodity which has been tested and assigned a fire endurance rating in hours in accordance with ASTM E119.
Thermo-Lag	a trademark for a line of subliming fire resistive compounds manufactured by Thermal Science Inc. (TSI) that are used to protect various commodities such as raceways (cables) and structural steel from the effects of a fire.
ANI	American Nuclear Insurers
TSI	Thermal Science Inc.

5.0 ASSUMPTIONS

Thermo-Lag is installed in accordance with Specification CPSES-M-2032, 2323-MS-38H, 2323-AS-47, and details shown on M1-1701 and M2-1701. The assumption is based on the following:

1. The QC requirements of the specifications
2. The level of installation detail in the specifications
3. The training of craft and QC personnel by TSI representatives using TSI training manuals

6.0 LICENSING BASIS

Appendix A to Branch Technical Position 9.5-1 provides NRC guidance for fire protection at nuclear power facilities. Specific guidance relative to the design of fire barriers and CPSES commitments are provided in the FSAR as described below.

6.1 FSAR 9.5.1.5.2 - Structural Construction Elements

"Where these assemblies are designated as fire barriers (i.e., 1-hour, 2-hour, or 3-hour fire ratings), the construction is in accordance with a U.L. listed design, a uniform building code design, a specific fire test by a nationally recognized laboratory, or as described in Section 9.5.1.6.1."

6.2 FSAR 9.5.1.5.5 - Electrical Cable and Cable Tray Design Characteristics

WHAT DOES THIS MEAN?

"Outside the Containment Buildings, where cable trays containing cabling related to both redundant trains of equipment required to bring the plant to a hot standby condition, and where both trains are located in the same fire area, and are not separated by a negligible combustible horizontal distance of greater than or equal to 20 ft, and are not comprised of 1-hour fire rated cable, one train of cabling will be protected by at least a 1-hour rated fire barrier."

6.3 FSAR 9.5.1.6.1

SRP ?

- APCSB 9.5-1 - Appendix A
- D.1.a 1) A 1-hour fire barrier or 1-hour fire rated cable for one set of required fire safe shutdown cabling.

6.4 Generic Letter 86-10

- 3.2 Fire Barrier Qualification

- 3.2.1 Acceptance Criteria

QUESTION

Recently the Staff has applied a 325°F cold side temperature criterion to its evaluation of the acceptability of 1-hour and 3-hour fire barrier cable tray wraps. This criterion is not in Branch Technical Position (BTP) APCSB 9.5-1, Appendix A as an acceptance criterion for fire barrier cable tray wraps and is not contained in Appendix R. It appears to represent post-Appendix R guidance. What is the origin of this criterion and why is it applicable to electrical cables where insulation degradation does not begin until jacket temperatures reach 450°F to 650°F?

RESPONSE

Fire barriers relied upon to protect shutdown related systems to meet the requirements of III.G.2 need to have a fire rating of either one or three hours. § 50.48 references BTP APCSB 9.5-1, where the fire protection definitions are found. Fire rating is defined:

"Fire Rating - the endurance period of a fire barrier or structure; it defines the period of resistance to a standard fire exposure before the first critical point in behavior is observed (see NFPA 251)."

The acceptance criteria contained in Chapter 7 of NFPA 251, "Standard Methods of Fire Tests of Building Construction and Materials," pertain to nonbearing fire barriers. These criteria stipulate that transmission of heat through the barrier "shall not have been such as to raise the temperature on its unexposed surface more than 250°F above its initial temperature." The ambient air temperature at the beginning of a fire test usually is between 50°F and 90°F. It is generally recognized that 75°F represents an acceptable norm. The resulting 325°F cold side temperature cold side temperature criterion is used for cable tray wraps because they perform the fire barrier function to preserve the cables free of fire damage. It is clear that cable that begins to degrade at 450°F is free of fire damage at 325°F.

During the Appendix A review, licensees began to propose fire barriers to enclose cable trays, conduit, fuel lines, coolant lines, etc. Industry did not have standard rating tests for such components or for electrical, piping, or bus duct penetrations. The NRC issued staff position giving acceptance criteria for electrical penetration tests. These criteria require an analysis of any temperature on the unexposed side of the barrier in excess of 325°F. In the past, manufacturers designed their own qualification tests. Nuclear Insurers and the Institute of Electrical and Electronic Engineers have issued tests for some of these components. These tests usually exposed the component to the ASTM E-119 time temperature curve, but all had different acceptance criteria. Conduit and cable tray enclosure materials accepted by the NRC as 1-hour barrier prior to Appendix R (e.g. some Kaowool and 3M materials) and already installed by the licensee need not be replaced even though they may not have met the 325°F criteria. However, for newly identified conduit and cable trays requiring such wrapping new material which meets the 325°F criterion should be used, or justification should be provided for use of material which does not meet the 325°F criterion. This may be based on an analysis demonstrating that the maximum recorded temperature is sufficiently below the cable insulation ignition temperature.

• 3.2.2 Deviations from Tested Configurations

IMPACT THE QUALIFICATION OF THE ITEM AS TESTED SINCE

QUESTION

Due to obstructions and supports, it is often impossible to achieve exact duplication of the specific tested configuration of the 1-hour fire barriers which are to be placed around either conduits or cable trays. For each specific instance where exact replication of a previously tested configuration is not and cannot be achieved, is an exemption necessary in order to avoid a citation for a violation?

RESPONSE

No. Where exact replication of a tested configuration cannot be achieved, the field installation should meet all of the following criteria:

1. The continuity of the fire barrier material is maintained.

2. The thickness of the barrier is maintained.

TRAY

3. The nature of the support assembly is unchanged from the tested configuration.

4. The application or "end use" of the fire barrier is unchanged from the tested configuration. For example, the use of a cable tay barrier to protect a cable tray which differs in configuration from those that were tested would be acceptable. However, the use of structural steel fire proofing to protect a cable tray assembly may not be acceptable.

5. The configuration has been reviewed by a qualified fire protection engineer and found to provide an equivalent level of protection.

7.0 METHODOLOGY

At CPSES, Thermo-Lag was installed in many different configurations. It is neither practical nor necessary to test each one of these unique configurations to substantiate their fire rating. Testing was performed on a select number of representative configurations which would allow the extrapolation of the results to the balance of the configurations.

The evaluation of the fire/derating tests to support installation details at CPSES was performed by personnel qualified in accordance with GL 86-10. This engineering report documents the evaluation.

The evaluation consisted of a review of 1) fire barrier systems selection and installation and 2) ampacity derating.

The evaluation was performed using the following methodology.

7.1 Fire Barrier Systems Review

The fire barrier system systems review was composed of the following attributes:

7.1.1 Review of the Applicable Standards

A review of the various standards (References 10.1 to 10.3) was done to determine the acceptance criteria for an acceptable fire test.

7.1.2 Fire Endurance Test Review

Each fire endurance test (Reference 10.12.1 to 10.12.9) was reviewed to determine its acceptability and limitation with respect to CPSES installations.

7.1.3 Installation Specification Review

The Specifications (Reference 10.14.1 to 10.14.3) were reviewed to ensure that the CPSES installation criteria met the criteria for installation in the fire tests (e.g., the way the TSI material was installed in the fire test is the way the material is installed at CPSES).

7.1.4 Installation Details Review

The installation details (M1-1701 and M2-1701) were reviewed to ensure that the CPSES installation details met the installed configurations in the TSI Technical Note 20684, Revision V (Reference 10.13.1) and, if required, provided engineering basis.

The TSI Technical Note was also reviewed against the fire tests.

7.1.5 Installation Schedule Review

The Installation Schedules (M1-1700 and M2-1700) were reviewed to determine if the commodities protected (size and configurations) are enveloped by the fire test and, if required, provide engineering basis.

7.1.6 Design Change Document Review

The design change documents were reviewed to ensure that any unique configurations were reviewed against tested configurations and justification provided where required.

7.1.7 Installation Procedures Review

The installation procedures (Reference 10.18.1 to 10.18.3) were reviewed to ensure that the CPSES specification criteria and TSI technical notes were met.

7.2 Ampacity Derating Factors

This is a discussion of how derating factors were derived and utilized at CPSES.

8.0 ANALYSIS

8.1 Review of Standards

8.1.1 Review of ASTM E-119

NRC CRITERIA IS TO ASSURE THAT CABLING IS FREE FROM FIRE DAMAGE "NO DAMAGE NO LOSS OF CIRCUIT INTEGRITY"

ASTM E-119 is intended to demonstrate in terms of fire endurance (time) the ability of a wall or floor assembly to contain a fire or to retain the structural integrity (including beams and columns) or both during the test conditions imposed by this standard. The standard was not specifically developed for testing of cable raceway barriers and as such does not contain provisions which address the integrity of the circuit. This was recognized in later ANI guidelines (Reference 10.3.1 and 10.3.2).

The general provisions of this standard considered applicable to Thermo-Lag testing are:

NOR ASTM E-119 FOR NEW BUILDING WALL TEST CRITERIA

1. Furnace temperature shall be as prescribed by the standard time-temperature curve.

2. The test specimen shall be representative of the actual plant physical configuration.

   "AVERAGE" IS NOT WITHIN THE BOUNDS OF NRC CRITERIA

3. Average temperature on the unexposed surface (excludes structural steel) shall not exceed 250°F above ambient (Note: the NRC has set ambient at 75°F so that the temperature limit is 325°F).

4. The assembly shall have withstood the test without the passage of flame or hot gasses (excluding structural steel).

5. The assembly shall have withstood the prescribed hose stream test without the passage of flame, hot gases or water.

6. For structural steel, the average temperature on the surface of the steel shall not exceed 1000°F or no one temperature reading above 1200°F.

Based on the review of this standard, the key items listed above were used as acceptance criteria when reviewing the test reports.

8.1.2 Review of NFPA 251

NFPA 251 is referenced by the NRC in Generic Letter 86-10 as providing acceptance criteria. NFPA 251 is a version of ASTM E-119 and the acceptance criteria applicable to CPSES is the same.

8.1.3 Review of ANI Acceptance Test

ANI Bulletin No. 5, "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits" (Reference 10.3.2) is intended to demonstrate in terms of fire endurance (time) the ability of electrical circuits to remain functional inside a protective envelope during the fire test conditions.

Circuit integrity test
Low voltage
• Amps not specified
• Does not simulate actual current flow conditions & ampacity heating conditions within protective barrier.

The general provisions of this standard are considered applicable to Thermo-Lag testing and are the same as the ASTM E-119 test procedure with the following addition:

• Test does not demonstrate cables will be able to function under load after fire exposure

All circuits are to be monitored to detect failure; circuit-to-circuit, circuit-to system, and circuit-to-ground.

(Note: "Test II Internal Fire" of ANI Bulletin No. 5 is not applicable to the TSI material).

8.2 Fire Endurance Tests Review

A review has been performed for the nine TSI fire endurance tests listed below, and are discussed in Sections 8.2.1 through 8.2.9.

ITL Report No. 82-11-80	(Reference 10.12.1)
ITL Report No. 82-11-241	(Reference 10.12.2)
ITL Report No. 83-5-472A	(Reference 10.12.3)
ITL Report No. 84-5-387	(Reference 10.12.4)
ITL Report No. 85-2-382	(Reference 10.12.5)
ITL Report No. 85-4-377	(Reference 10.12.6)
ITL Report No. 85-5-314	(Reference 10.12.7)
ITL Report No. 87-5-77	(Reference 10.12.8)
SWRI Project No. 01-6763-302	(Reference 10.12.9)

With the exception of ITL Report No. 84-5-387 and SWRI Project No. 01-6763-302, the fire endurance tests were used to qualify the TSI Thermo-Lag 330 1-hour protective envelope designs and details as described in TSI Technical Note 20684, Rev. V (Reference 10.13.1). Specific comments and deficiencies related to each fire endurance test are discussed in Sections 8.2.1 through 8.2.9; however, some generic comments and deficiencies common to most of the fire endurance tests are discussed below.

In general, the fire endurance tests neither contain sufficient details of the construction methods used for the test article, nor contain sufficient details of the materials used to protect the test article, and do not contain dimensioned drawings. Normally, only the maximum and average thermocouple readings are provided with the test report. The recordings of all thermocouple ratings are not included with the test report. The fire endurance tests for cable protective envelopes reference the TSI Nuclear QA Program Manual and Quality Control Operating Procedures Manual (NQAPM/QCOPM) for methods of installation. The CPSES specifications, details, and procedures employed TSI Technical Note 20684, Rev. V (Reference 10.13.1) for guidance. Based on a comparison of the TSI-NQAPM/QCOPM to the TSI Technical Note (to be performed later), it is expected that the comparison should resolve the noted generic comments.

8.2.1 ITL Report No. 82-11-80

The fire endurance test documented in ITL Report No. 82-11-80 (Reference 10.12.1) was conducted in the laboratory facilities of TSI between September 9, 1982 and September 28, 1982. ITL Report No. 82-11-80 was approved by Industrial Testing Laboratories (ITL) in November 1982.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July, 1979 and were "accepted for insurance purposes" by ANI in November, 1985.

8.2.1.1 Test Articles

The test articles consisted of the following raceways and cables:

- Test Article No. 1

  Test Article No. 1 was a 6" x 6" solid bottom cable tray section loaded with a 100 percent cable fill (40 percent of cross sectional area). The cable fill consisted of 8 power cables, 98 control cables, and 16 instrumentation cables. A 5 in. square tube was attached to the side of the cable tray to simulate a cable tray support.

- Test Article No. 2

  Test Article 2 was a 6" x 6" solid bottom cable tray section filled with a single layer of cables. The cable fill consisted of 2 power cables, 9 control cables, and 4 instrumentation cables.

- Test Article Nos. 3 and 5 (combined)

  Test Article No. 3 was a 12" x 4" ladder cable tray section loaded with a 100 percent cable fill (40 percent of cross sectional area). The cable fill consisted of 12 power cables, 19 control cables and 130 instrumentation cables.

  An air drop identified as Test Article No. 5 was incorporated into the design of Test Article No. 3.

- Test Article No. 4

  Test Article No. 4 was a 12" x 4" ladder-type cable tray section filled with a single layer of cables. The cable fill consisted of 5 power cables, 14 control cables, and 14 instrumentation cables.

- Test Article No. 6

  Test Article No. 6 was a 4 in. diameter conduit loaded with a 100 percent cable fill (40 percent of cross-sectional area). The cable fill consisted of 6 power cables, 8 contr cables, and 3 instrumentation cables. A condulet and pullbox were incorporated into tl 4 in. diameter conduit design.

8.2.1.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-1 subliming coating envelope system products were used in this test:

- Thermo-Lag Stress Skin 330-69

  This material provides strong mechanical base for the Thermo-Lag 330-1 Subliming Coating. It is an open weave, "V" stiffened steel mesh having a 0.017 in. minimum strand diameter, 56 minimum mesh size and a weight per square yard of 1.75 pounds minimum.

- Thermo-Lag 330-1 Subliming Coating

  This material provides the required level of fire resistance. It is a water based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures - exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied.

- Thermo-Lag 330-70 Conformable Ceramic Blanket (Used on Air Drop-Test Article No. 5, only)

  This material is used for insulation enhancement of temperature sensitive components and is designed to provide equal compatibility, efficiency, and greater heat resistance when used in concert with Thermo-Lag 330-1 Subliming Coating. It is a lightweight, flexible ceramic blanket manufactured from long ceramic fibers.

- Thermo-Lag Cure Accelerator

  This is a noncombustible material which when mixed with the THERMO-LAG 330-1 Subliming Coating will accelerate the set-up time without adversely affecting the fire resistive properties of the material. The mixture was applied to the test articles, by means of caulking and troweling, to seal and cover the edges, butt joints, flanges and other surfaces, and to effect the simulated repair patch area, thus, demonstrating the feasibility of accelerated set-up time.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures:

- A layer of Thermo-Lag Stress Skin Type 330-69
- A 0.500 in. minimum (-0.00, +0.125 in.) dry film thickness of THERMO-LAG 330-1 Subliming Coating
- Butt joints, edges, flanges and the simulated repair patched area on Test Article Nos. 3 and 5 Combined were filled in with the Thermo-Lag 330-1/Cure Accelerator Mixture to demonstrate the ability of the material to accelerate the otherwise normally required set up time.
- In addition to the above, the air drop utilized a layer of THERMO-LAG 330-70 Conformable Ceramic Blanket and an additional layer of THERMO-LAG Stress Skin Type 330-69.

- Several alternate application methods were used to install the Thermo-Lag 330-1 Subliming Coating Envelope System to the test articles. These methods included direct spray, brushing, rolling, troweling, caulking, and Thermo-Lag Prefabricated Panels, which were cut to the required size and shape and affixed to each test article by means of fasteners.

- A tapered circular section, approximately 4-in. in diameter, was cut through the fully cured protective envelope of Test Article Nos. 3 and 5 Combined, to effect a "simulated" repair. This patch was then removed and installed in the cut out section by attaching it to the test article with wire fasteners. The open areas around the repair patch were filled in with the THERMO-LAG 330-1/Cure Accelerator mixture using troweling and caulking methods.

Please note that ITL 82-11-80 Section 8.1 identifies this simulated repair patch on Test Article No. 4. However, Section 7.2 and Figures 13A through 13E support that the simulated repair was made on Test Article Nos. 3 and 5 (Combined).

8.2.1.3 ASTM E119 Standard Time Temperature

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.1.4 Cable Surface Temperatures

The maximum and average cable surface temperatures achieved for each test article are listed below.

- Test Article No. 1

  The maximum cable surface temperature achieved for Test Article No. 1 was 232°F with an average temperature at 60 minutes of 127°F.

- Test Article No. 2

  The maximum cable surface temperature achieved for Test Article No. 2 was 288°F with an average temperature at 60 minutes of 210°F.

- Test Article Nos. 3 and 5 (Combined)

  The maximum cable surface temperature achieved for Test Article Nos. 3 and 5 (Combined) was 180°F with an average temperature at 60 minutes of 131°F.

- Test Article No. 4

  The maximum cable surface temperature achieved for Test Article No. 4 was 282°F with an average temperature at 60 minutes of 202°F.

- Test Article No. 6

  The maximum cable surface temperature achieved for Test Article No. 6 was 148°F with an average temperature at 60 minutes of 96°F.

8.2.1.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2 1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July, 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 feet.

8.2.1.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify a loss of continuity of any of the monitored circuits.

8.2.1.7 Deficiencies or Comments

- Appendices I through IV are not included with the test report and thus will be reviewed later.

- See generic comments in Section 8.2.

8.2.2 ITL Report No. 82-11-241

The fire endurance test documented in ITL Report No. 82-11-241 (Reference 10.12.2) was conducted in the laboratory facilities of TSI on October 22, 1982. ITL Report No. 82-11-241 was approved by Industrial Testing Laboratories (ITL) on November 1982.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July, 1979 and were "accepted for insurance purposes" by ANI in November, 1985.

8.2.2.1 Test Articles

The test articles consisted of the following raceway and cables:

- Test Article No. 7G

  Test Article No. 7G was a 4 in. diameter conduit with a cable fill that consisted of 6 power cables, 3 instrumentation cables, and 3 control cables. A condulet and pull box were incorporated into the 4 in. diameter conduit design.

8.2.2.2 TSI Thermo-Lag Protection Envelope Materials and Enclosures

The following Thermo-Lag 330-1 subliming coating envelope system products were used in this test:

- Thermo-Lag 351-2 Primer

  This material provides excellent corrosion inhibiting properties and is used as a tie coat between steel substrates and the Thermo-Lag 330-1 Subliming Coating, or between previously primed steel surfaces and the Thermo-Lag 330-1 Subliming Coating.

- Thermo-Lag 330-1 Subliming Coating

  This material provides the required level of fire resistance. It is a water based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix and blocks heat to protect the substrate material to which it is applied.

- Thermo-Lag 330-70 Conformable Ceramic Blanket

  This material is used for insulation enhancement of temperature sensitive components and is designed to provide equal compatibility, efficiency and greater heat resistance when used in concert with Thermo-Lag 330-1 Subliming Coating. This material was used to seal the test article's entries and exits air tight in order to prevent air from circulating within the test article. As noted above, this material is also rated as non-combustible. It is a light weight, flexible ceramic blanket manufactured from long ceramic fibers.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures:

- A 0.002 in. minimum (-0.000, +0.001 in.) dry film coating thickness of Thermo-Lag 351-2 Primer applied directly to the steel surface of the conduit section by direct spray-on design methods.

- A 0.500 in. minimum (-0.000, +0.125 in.) dry film thickness of the Thermo-Lag 330-1 Subliming Coating applied to the primed surface of the conduit section by direct spray-on design methods.

- The primer and the subliming coating were spray applied to the test article in accordance with procedures set forth in Section 3.2.18 of TSI's Technical Note 80181, Revision II, dated December 1981 (Reference 10.13.3).

8.2.2.3 ASTM E119 Standard Time Temperature

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.2.4 Cable Surface Temperatures

The maximum and average cable surface temperature achieved for each test article is listed below.

- Test Article No. 7G

  The maximum cable surface temperature achieved for Test Article No. 7G was 315°F with an average temperature at 60 minutes of 181°F.

8.2.2.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July, 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 feet.

8.2.2.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground, or open circuits (loss of continuity) on any of the monitored circuits.

8.2.2.7 Deficiencies or Comments

- Appendices I through IV were not included in the test report and thus will be reviewed later.
- See generic comments in Section 8.2.

8.2.3 ITL Report No. 83-5-472A

The fire endurance test documented in ITL Report No. 83-5-472A (Reference 10.12.3) was conducted in the laboratory facilities of TSI on June 1, 1983. ITL Report No. 83-5-472A was approved by Industrial Testing Laboratories (ITL) in July 1983.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July 1979, and were "accepted for insurance purposes" by ANI in November 1985.

8.2.3.1 Test Articles

The test articles consisted on the following raceways and cables:

- Test Article No. 1014A

  Test Article No. 1014A was constructed from a 12" x 4" ladder-type cable tray that was modified by the addition of steel plates. The steel plates were added to Test Article No.

1014A to simulate a solid bottom cable tray (3 sections) as well as a ladder-type cable tray (3 sections).

A total of sixty-one (61) power and control, and instrumentation cable were installed in the test article. Twenty-two (22) of these cables comprised a single layer of cables that ran throughout the entire test assembly. The remaining cables created a 100 percent of capacity loading (40 percent of cross sectional area) in the top half of the test article. These additional cables entered through the top tray opening and then extended 60 in. to the midpoint of the 180 degree curved section before making a 180 degree bend and exiting through the top tray opening.

8.2.3.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-1 subliming coating envelope system products were used in this test:

- Thermo-Lag 330-1 Subliming Coating

  This material provides the required level of fire resistance. It is a water-based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied.

- Thermo-Lag Stress Skin Type 330-69 (Used in Thermo-Lag Prefabricated Panels Only for the Purpose of this Test)

  This material provides a strong mechanical base of the Thermo-Lag 330-1 Subliming Coating. It is an open weave, "V" stiffened steel mesh having a 0.017 in. minimum strand diameter, 56 minimum mesh size and a weight per square yard of 1.75 pounds, minimum.

- Thermo-Lag Cure Accelerator (Optional)

  This is a noncombustible material which when mixed with the Thermo-Lag 330-1 Subliming Coating will accelerate the set up time without adversely affecting the fire resistive properties of the material. The mixture was applied to the test article by means of caulking and troweling to seal and cover the edges, butt joints, flanges and other surfaces, to demonstrate the feasibility of accelerated set up.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures:

- A 1-hour fire rated design of the Thermo-Lag 330-1 Subliming Coating material was applied by direct spraying, rolling and troweling methods to the Class 1E Electrical Cables installed in the test article and to the sides and bottom of the test article. One-hour fire rated Thermo-Lag Fire Barriers were installed for a distance of approximately two (2) feet from the ends of both the upper and lower horizontal legs of the test article. These fire barriers were constructed from a Thermo-Lag Prefabricated Panel, having a dry film thickness of 0.500 in. of the Thermo-Lag 330-1 Subliming Coating.

- The transition from the fire barrier to the Thermo-Lag protected Class 1E Electrical Cables was accomplished by means of a tapered section of Thermo-Lag 330-1 Subliming Coating. The minimum dry film thickness of this tapered section was 5/8 in. ± 1/8 in. at all points covering the opening between the fire barrier and the protected electrical cables.
- The Thermo-Lag 330-1 Subliming Coating was applied in a dry film thickness of 5/8 in. ± 1/8 in. in accordance with procedures set forth in TSI's Technical Note 80181, Revision IV, dated June 1983 (Reference 10.13.4).

8.2.3.3 <u>ASTM E119 Standard Time Temperature</u>

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.3.4 <u>Cable Surface Temperatures</u>

The minimum and average cable surface temperature achieved for each test article is listed below:

- Test Article No. 1014A

  The maximum cable surface temperature achieved overall for Test Article No. 1014A was 199°F with an average temperature at 69 minutes of 144°F.

  For the solid bottom cable tray section, the maximum cable surface temperature achieved was 199°F with an average temperature at 69 minutes of 153°F.

  For the ladder-type cable tray sections, the maximum cable surface temperature achieved was 170°F with an average temperature at 69 minutes of 137°F.

8.2.3.5 <u>Hose Stream Test</u>

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.3.6 <u>Electrical Circuit Monitoring Test</u>

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground, or open circuits (loss of continuity) on any of the monitored circuits.

8.2.3.7 <u>Deficiencies or Comments</u>

See generic comments in Section 8.2.

8.2.4 ITL Report No. 84-5-387

The fire endurance test documented in ITL Report No. 84-5-387 (Reference 10.12.4) was conducted in the laboratory facilities of TSI on May 25, 1984. ITL Report No. 84-5-387, Revision No. 1 was approved by Industrial Testing Laboratories (ITL) in June 1985.

The fire endurance test and hose stream test for the penetration fire stop systems were performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 7 (Reference 10.3.3), dated February 1976. No ANI acceptance form was provided with this fire test.

8.2.4.1 Fire Wall, Penetration Openings and Penetrants

- Fire Wall

  A 4'x 4' fire wall test assembly was used in conducting this test program. It was constructed of a 3-in. thick concrete slab. To impart it with a 1-hour fire resistive capability, a 1 in. thick sheet of "M" board (Babcock/Wilcox) was attached. The "M" board did not cover the penetrations.

- Penetration Openings

  Three penetration openings were provided in the fire wall and were aligned vertically on the centerline of the test assembly.

  The uppermost opening was approximately 4 in. in diameter, with its centerline located approximately 6-3/4 in. or 7 in. from the top of the test assembly.

  The middle opening measured approximately 8 in. high x 12 in. wide with its centerline located approximately 18 in. or 25 in. from the top of the test assembly.

  The bottom opening measured approximately 10 in. high by 10 in. wide with its centerline located approximately 12 in. from the bottom of the test assembly.

- Penetrants

  A group of 4 cables was installed in the uppermost opening.

  A 4 in. conduit was installed in the middle opening. Fifty-one power, control, and instrumentation cables were routed in the 4 in. conduit.

  A 6" x 6" solid bottom cable tray was installed in the bottom opening. One hundred twenty-two power, control, and instrumentation cables were routed in the 6" x 6" cable tray.

8.2.4.2 TSI Thermo-Lag Fire Stop System Materials and Designs

The following Thermo-Lag 330 penetration fire stop system products were used in this test:

Therm 330 One-Hour Fire d Prefabricated Panel

This material is installed as a transition section between the penetration item and the area surrounding the opening in the fire rated wall, floor or ceiling. In addition, a section of this material is cut and contoured to fit and is then inserted as a fire stop between the penetra article and the test as ably opening. The 1-h ur Thermo-Lag Prefabricated Panel consists of an inner layer of Thermo-Lag Stress Skin Type 330-69, applied with a minimum dry film thickness of 0.035 in. of the Thermo-Lag 330-1 Subliming Material.

- Thermo-Lag 3 -1 Subliming Material

This material is used to seal the openings between the penetration item and the pe tration opening. It is a water based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix while blocking heat to protect the substrate material to which it is applied. The Thermo-Lag 330-1 Subliming Material is applied by spraying olling and methods, and is used in the fabrication of Thermo-Lag 330 Pr abricated Panels.

- Thermo-Lag Stress Skin Type 330-69

This material provides the strong mechanical base for the Thermo-Lag 330-1 Subliming Material. It is mprised of an open weave, self stiffened steel mesh. This material is used in the fabrication of Thermo-Lag 330 Prefabricated Panels and as a damming board for the application of the Thermo-Lag 330-1 Subliming Material.

The penetration openings were protected by the following TSI Thermo-Lag 330 penetration fire stop system designs.

A 1-hour fire-rated design of the Thermo- ag 300 Penetration Fire Stop System was used to seal the open areas remaining in the top, middle, and m openings of the test assembly, after the installation of the cables and raceways. The 1-hour fire r design consisted of:

- A sectio -Hour Fire-Rated Thermo-Lag 330 Prefabricated Panel was cut and contoure it and then was inserted as a fire stop between the penetration and the penetration opening. Thermo-Lag 330-1 Subliming Material was used to caulk the openings between the Prefabricated Panel inserts and the penetration openings.
- Thermo-Lag 330 1-Hour Fire-Rated Prefabricated Panel sections were cut and installed as a transition section between the enetration and the area surrounding the penetration opening, extending 18 in. into the anticipated fire zone.

tops installed the 4-in. diameter conduit and the 6" x 6" solid bottom cable tray by filling t ids with approximately 3 in. of the Thermo-Lag 330 1 Sublim Material.

8.2.4.3 ASTM E119 Standard Time Temperature

The Thermo-Lag penetration fire stop systems were exposed to the standard time temperature curve of ASTM E119, 1982 for a minimum of 1 hour.

8.2.4.4 Cold Side Temperatures

The maximum and average cold side temperatures recorded for each penetration fire stop are listed below:

- Upper Penetration Fire Stop

  The maximum cold side temperature recorded for the upper penetration fire stop was 138°F with an average temperature at 60 minutes of 126°F.

- Middle Penetration Fire Stop

  The maximum cold side temperature recorded for the middle penetration fire stop was 182°F with an average temperature at 60 minutes of 168°F.

- Lower Penetration Fire Stop

  The maximum cold side temperature recorded for the lower penetration fire stop was 128°F with an average temperature at 60 minutes of 132°F.

8.2.4.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI/MAERP requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.4.6 Deficiencies or Comments

- This fire test is not applicable to CPSES.
- The penetration fire stop design is not incorporated into the CPSES standard details.
- The fire stop design used at CPSES is to be installed in the upcoming fire tests.
- This fire test was designed for one hour applications, however, the figure depicting the fire stop calls out 3-hour materials and components. This appears to be an error on the drawing and should not impact the results.

8.2.5 ITL Report No. 85-2-382

The fire endurance test documented in ITL Report No. 85-2-382 (Reference 10.12.5) was conducted in the laboratory facilities of TSI on February 21, 1985. ITL Report No. 85-2-382 was approved by Industrial Testing Laboratories (ITL) in February 1985.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July 1979, and were "accepted for insurance purposes" by ANI in November 1985.

8.2.5.1 Test Articles

The test articles consisted of the following raceways and cables.

The test article consisted of a 4-in. diameter conduit loaded with 16 power, control, and instrumentation cables. A condulet and junction box were incorporated into the 4-in. conduit design. An air drop consisting of 5 control and instrumentation cables were routed between the condulet and junction box. The 5 air drop cables were actually part of the original 16 cables installed in the 4-in. conduit. A unistrut was also incorporated into the 4-in. conduit design.

8.2.5.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-660 flexi-blanket and bulk products were used in this test:

- Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier

  This material provides the required level of fire resistance. It is subliming high temperature, heat blocking, flexible, thermal barrier. It is reinforced on both sides with a low density, fiberglass cloth, further implemented by a heat blocking thermal catalyzer.

- Thermo-Lag 330-660 Bulk Grade Material

  This material provides the required level of fire resistance. It is a water-based, subliming, thermally-activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. This material was used in a paste-like consistency suitable for troweling and caulking purposes.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures:

- A 1-hour fire-rated design of the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier was installed in two (2) 0.250 in. nominal layers on the 4-in. diameter electrical conduit section with a junction box and condulet attached, and to the air drop cable group. Each layer was spiral wrap applied to the top one-half of the conduit section and both layers were circular wrap applied to the bottom one-half of the conduit section, the condulet, the junction box, and the unistrut section.

- Circular Wrap

  Each circular wrapped layer was installed with a two (2) in. overlapping edge on the circumference. The first circular wrapped layer was cut to size and installed using 18 ga. minimum stainless steel tie wires, fastened at 12 in. intervals. The second circular wrapped layer was cut a minimum of 4 in. shorter in length than the first layer to provide for an overlap when butt joining additional longitudinal layers. The second layer was installed in the same manner as the first layer but with the edge seam reversed and sealed with Thermo-Lag Fire Resistant Adhesive, and fastened at 12-in. intervals with 0.5" x 0.020" minimum stainless steel banding material.

- Spiral Wrap

  Each spiral wrapped layer was installed with 2-in. overlapping seams sealed with the Thermo-Lag Fire Resistant Adhesive. The second layer was installed in the same manner as the first layer but with the direction of the edge seams reversed. Each layer was secured at 12-in. intervals with 0.5" x 0.020" minimum stainless steel banding material.

- Caulking Seams and Openings

  Thermo-Lag 330-660 Bulk Grade Material was used to caulk the seams and openings in the test assembly.

- Flared Transition Section

  The flared transition sections were created by flaring the Flexi-Blanket material into a cone configuration at the upper and lower junctions of the electrical conduit section with the concrete access door.

- Caulking Seams and Openings

  Thermo-Lag 330-660 Bulk Grade Material was used to caulk the seams and openings in the test assembly.

8.2.5.3 ASTM E119 Standard Time Temperature

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.5.4 Cable Surface Temperatures

The minimum and average cable surface temperature achieved for each test article is listed below:

- Conduit Section

  The maximum cable surface temperature recorded in the conduit section of the test article was 163°F with an average temperature at 60 minutes of 137°F.

- Air Drop Section

  The maximum cable surface temperature recorded in the air drop section of the test article was 200°F with an average temperature at 60 minutes of 195°F.

- Unistrut Section

  The maximum cable surface temperature recorded in the unistrut section of the test article was 231°F with an average temperature at 60 minutes of 218°F.

- Condulet Section

  The maximum cable surface temperature recorded in the condulet section of the conduit was 141°F. Note: Only one thermocouple was used to monitor temperature in the condulet.

- Junction Box Section

  The maximum cable surface temperature recorded in the junction box section of the conduit was 163°F. Note: Only one thermocouple was used to monitor temperature in the junction box.

8.2.5.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.5.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground, or open circuits (loss of continuity) on any of the monitored circuits.

8.2.5.7 Deficiencies or Comments

- Although this fire test is similar to designs used at CPSES, the band spacing (12 inches on center) and flexi-blanket spiral wrap differ from CPSES standard details. CPSES band spacing is more conservative at 6 inches on center maximum and the CPSES flexiblanket designs utilize the circular or blanket wrap.

- In lieu of the band spacing, this fire test did demonstrate that (2) 0.25 in. layers of "blanket-wrapped" flexiblanket could adequately protect a conduit, junction box, and condulet and could maintain 1) circuit integrity, and 2) cable surface temperatures below 325°F.

- See generic comments in Section 8.2.

8.2.6 ITL Report No. 85-5-314

The fire endurance test documented in ITL Report No. 85-5-314 (Reference 10.12.7) was conducted in the laboratory facilities of TSI on May 21, 985. ITL Report No. 85-5-314 was approved by Industrial Testing Laboratories (ITL) in June 1985.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July 1979, and were "accepted for insurance purposes" by ANI in November 1985.

8.2.6.1 Test Articles

The test articles consisted of the following raceways and cables:

- The test article consisted on a 4-in. diameter conduit loaded with 19 power, control, and instrumentation cables. A condulet and junction box were incorporated into the 4-in. conduit design. An air drop consisting of 5 cables were routed between the condulet and junction box. A P1000 unistrut was also incorporated into the 4-in. conduit design.

8.2.6.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-660 flexi-blanket and bulk products and Thermo-Lag 330-1 subliming coating system products were used in this test:

- Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier

  This material provides the required level of fire resistance. It is subliming high temperature, heat blocking, flexible, thermal barrier. It is reinforced on both sides with a low density, fiberglass cloth, further implemented by a heat blocking thermal catalyzer. This material is applied in two (2) 0.250 in. layers to provide 1-hour fire resistance.

- Thermo-Lag 330-660 Bulk Grade Material

  This is a water-based, subliming, thermally-activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. This material is used in a paste-like consistency suitable for troweling and caulking purposes.

- Thermo-Lag 330-1 Subliming Material

  This is a water-based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. This material is used in a paste-like consistency suitable for troweling and caulking purposes.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures:

- A 1-hour fire-rated design of the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier was installed in two (2) 0.250 in. nominal layers on the test assembly. All layers were secured at six (6) in. intervals using 18 ga. minimum stainless steel tie wires or 0.5" x 0.020" minimum stainless steel banding material. The Thermo-Lag 330-660 Bulk Grade Material was used to caulk or trowel all seams, as required.

- Flared Transition Section

  Two (2) 0.250 in. nominal thickness layers of the Thermo-Lag 330-660 Flexi-Blanket Material were used to provide a flared transition section between the bulkhead of the furnace and the conduit test assembly. This transition was accomplished by circumferentially wrapping the conduit for a distance of at least 2 in. and flaring to the furnace bulkhead at least 2 in. All joints were caulked with the Thermo-Lag 330-660 Bulk Grade Material in the minimum required dry film thickness of 0.500 in.

- Thermo-Lag Fire Stop

  A fire stop comprised of Thermo-Lag 330-1 Subliming Trowel Grade Material wa inserted in the entry and exit openings of the test article for a minimum of 5 in. into the conduit. Those sections of the conduit and their protruding cables located on the no-fire side of the test assembly were wrapped with 2 in. of ceramic blanket to minimize any major heat transfer with the ambient laboratory environment.

8.2.6.3 <u>ASTM E119 Standard Time Temperature</u>

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.6.4 <u>Cable Surface Temperatures</u>

The minimum and average cable surface temperature achieved for each test article is listed below:

- Conduit Section

  The maximum cable surface temperature recorded in the conduit section of the test article was 149°F with an average temperature at 60 minutes of 117°F.

- Air Drop Section

  The maximum cable surface temperature recorded in the air drop section of the test article was 270°F with an average temperature at 60 minutes of 167°F.

- Unistrut Section

  The maximum cable surface temperature recorded in the unistrut section of the test article was 341°F at 60 minutes. No average temperature was provided in the test report for the unistrut even though four thermocouples were installed to monitor temperature on the unistrut.

- Condulet Section

  The maximum cable surface temperature recorded in the condulet section of the conduit was 157°F. Note: Only one thermocouple was used to monitor temperature in the condulet.

8.2.6.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.6.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground, or open circuits (loss of continuity) on any of the monitored circuits.

8.2.6.7 Deficiencies or Comments

- The fire stop tested herein is not typical of CPSES as-installed conditions. This fire stop is constructed of Thermo-Lag 330-1 and is not fire tested with exposed combustibles. CPSES will incorporate a fire stop design in the upcoming fire test.

- This test should not be used to justify a junction box design since no cable surface temperatures were recorded inside the junction box. Other test data is available to support CPSES junction box designs (i.e., ITL Report No. 85-2-382, Section 8.2.5).

- The unistrut section tested herein was tested as a fire barrier enclosure and not as a protruding member, and reached a temperature of 341°F of which is greater than the 325°F NRC limit. Since CPSES does not run cables in unistrut this is not problem.

- See generic comments in Section 8.2.

8.2.7 ITL Report No. 85-4-377

The fire endurance test documented in ITL Report No.85-4-377 (Reference 10.12.6) was conducted in the laboratory facilities of TSI on April 15, 1985. ITL Report No. 85-4-377, Revision No. 1 was approved by Industrial Testing Laboratories (ITL) in June 1985.

The fire endurance test, hose stream test, and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July, 1979. No ANI acceptance form was provided with this fire test.

8.2.7.1 Test Articles

The test articles consisted of the following raceways and cables:

- The test article consisted of a 4 in. diameter aluminum conduit that was filled with 10 cables. A condulet was incorporated into the 4 in. conduit design.
- An air drop routed in a 3/4 in. fluid type flex conduit and a P1000 unistrut was also incorporated into the test article.

8.2.7.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-600 Flexi-Blanket and Bulk Grade System products and Thermo-Lag 330-1 Subliming Coating System products were used in this test:

- Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier

  This material provides the required level of fire resistance. It is a subliming, high temperature, heat blocking, flexible, thermal barrier. It is reinforced on both sides with a low density, fiberglass cloth, further implemented by a heat blocking thermal catalyzer. This material was applied to the test article in two layers, each 0.250 in.

- Thermo-Lag 330-660 Bulk Grade Material

  This is a water based, subliming, thermally activated fire resistive coating which volatizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. This material was used in a paste-like consistency suitable for troweling and caulking purposes.

- Thermo-Lag Preshaped Conduit Sections

  This material is comprised of an initial layer of the Thermo-Lag Stress Skin Type 330-69, applied with a minimum dry film thickness of 0.500 in. of the Thermo-Lag 330-1 Subliming Material to provide 1-hour's fire resistive enhancement.

- Thermo-Lag 330-1 Subliming Material

  This is a water based, subliming, thermally activated fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. This material is used in a paste-like consistency suitable for troweling and caulking purposes.

The test articles were protected by the following TSI Thermo-Lag protective envelope enclosures.

A 1-hour fire-rated design of the Thermo-Lag 330 Fire Barrier System Materials was installed on the test assembly as follows:

- Two (2) 0.250 in. minimum wraps of the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier Material was installed on approximately three-quarters of the 4 in. diameter aluminum conduit test section, with the other quarter protected by a 4 in. nominal diameter of the Thermo-Lag Preshaped Conduit Section design. A minimum dry film thickness of 0.500 in. of the Thermo-Lag 330-660 Bulk Grade Material was used to seal the areas where the two designs were joined.

- Two (2) 0.250 in. minimum wraps of the Thermo-Lag 330-660 Flexi- Blanket Thermal Barrier Material was installed on approximately one-half of the 3/4 in. fluid type flex conduit test section, with the other half being protected by a 3/4 in. nominal diameter of the Thermo-Lag Preshaped Conduit Section design. A minimum dry film thickness of 0.500 in. of the Thermo-Lag 330-660 Bulk Grade Material was used to seal the areas where the two designs were joined.

- Two (2) 0.250 in. minimum dry film thickness layers of the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier Material were installed on the condulet and the P1000 unistrut. All edges and seams were filled in with the Thermo-Lag 330-660 Bulk Grade Material.

- Thermo-Lag 330-660 Flexi-Blanket was used to provide the transition between the Preshaped Conduit Sections and those portions of the aluminum conduit and fluid type flex conduit protected with the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier. The transitions were accomplished by circumferentially wrapping the butt joint between the two entities for a distance of at least 2 in. in either direction, using stainless steel bending material (0.5" x 0.020" minimum) and caulking all the joints with the Thermo-Lag 330-660 Bulk Material, in the required dry film thickness.

- Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier Material and the Thermo-Lag Preshaped Conduit Sections were secured to the test article at approximately six(6) in. intervals with either 18 ga. minimum stainless steel tie wires and/or 0.5" x 0.020" minimum stainless steel banding material.

- A fire stop comprised of Thermo-Lag 330-1 Subliming Trowel Grade Material was inserted in the entry and exit openings of the test article, for a minimum distance of 5 in. into the conduit.

8.2.7.3 ASTM E119 Standard Time Temperature

The Thermo-Lag protective envelopes and test articles were exposed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of one hour.

8.2.7.4 Cable Surface Temperatures

The maximum and average cable surface temperature achieved for each test article is listed below:

- Aluminum Conduit Section

  The maximum cable surface temperature recorded for the aluminum conduit section was 115°F with an average temperature at 60 minutes of 103°F.

- Condulet Section

  The maximum cable surface temperature recorded for the condulet section of the conduit was 119°F with an average temperature at 60 minutes of 119°F.

- Fluid Type Flex Conduit

  The maximum cable surface temperature recorded for the fluid type flex conduit was 292°F with an average temperature at 60 minutes of 236°F.

- P1000 Unistrut

  The maximum surface temperature recorded for the P1000 Unistrut was 455°F with an average temperature at 60 minutes of 380°F.

8.2.7.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelopes and test articles were subjected to a 2 1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July, 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.7.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground or open circuits (loss of continuity) on any of the monitored circuits.

8.2.7.7 Deficiencies or Comments

- The unistrut section tested herein was tested as a fire barrier enclosure and not as a protruding member and exceeded the maximum temperature of 325°F (unistrut reached 455°F) as imposed by NRC. Furthermore, it is evident from this test that consideration should be given to fire testing Flexi-Blanket to support its use as an allowable fire barrier material for wrapping protruding items.

  Note: No fire test exists to support using Flexi-Blanket on a protruding item.

8.2.8 ITL Report No. 87-5-77

The fire endurance test documented in ITL Report No. 87-5-77 (Reference 10.12.8) was conducted in the laboratory facilities of TSI on May 7, 985. ITL Report No. 87-5-77 was approved by Industrial Testing Laboratories (ITL) on October 13, 1987.

The fire endurance test, hose stream test and electrical circuit monitoring test was performed to the requirements of American Nuclear Insurers (ANI) Bulletin No. 5 (Reference 10.3.2), dated July 1979. No ANI acceptance forms were provided with this fire test.

8.2.8.1 Test Articles

The test articles consisted of the following raceways and cables:

- The test article consisted on a 12" x 4" ladder-type cable tray that was filled with 42 power and instrumentation cables. A P1000 unistrut was welded to one side of the cable tray. The P1000 unistrut had cross-sectional dimensions of 1-5/8" x 1-5/8", weight per sq ft of circa 3.51 lb and an overall length of 21-3/4 in.

8.2.8.2 TSI Thermo-Lag Protective Envelope Materials and Enclosures

The following Thermo-Lag 330-1 subliming material envelope system products were used in this test:

- Thermo-Lag Stress Skin Type 330-69

  This material provides a strong mechanical base for the Thermo-Lag 330-1 Subliming Material. It is an open weave, self-stiffened steel mesh, having a 0.017 in. minimum strand diameter, 56 minimum mesh size and a weight per sq yd of 1.75 lb, minimum. This material was used in the fabrication of the Thermo-Lag 330 Prefabricated Panels.

- Thermo-Lag 330-1 Subliming Material

  This material provides the required level of fire resistance. It is a water-based, subliming, thermally activated, fire resistive coating which volatilizes at fixed temperatures, exhibits a volume increase through the formation of a multi-cellular matrix, and blocks heat to protect the substrate material to which it is applied. In addition to this ma ... bein ... ed to fa ... ate the Thermo-Lag 330 Prefa ... ated Panels, it is also used in ... owel grade consistency to trowel and caulk areas where required.

- Thermo-Lag 330 Prefabricated Panels

  The Thermo-Lag 330 Prefabricated Panels were comprised on an initial layer of the Thermo-Lag Stress Skin Type 330-69, a minimum dry film thickness of 0.500 in. of the Thermo-Lag 330-1 Subliming Material, and an outer layer of the Thermo-Lag Stress Skin Type 330-69.

The test articles were protected ... the following TSI Thermo-Lag protective envelope enclosures:

- A 1-hour fire-rated design of the Thermo-Lag 330 Fire Barrier System was insta... on the ladder-type cable tr... section of the test assembly using a Prefabricated Panel Ready Access Design to completely enclose that portion of the cable tray located on the fire side of the furnace access door. Prefabricated Panel Sections were also used to enclose the unistrut attachment for a distance of 9 in. from its intersection with the cable tray and to construct the flared transition design used to join the upper and the lower legs of the prot...ed cable tray to the furnace access door at its upper and lower penetration junct...n.

- The Prefabricated Panels were fabricated fr... Thermo-Lag Stress Skin Type 330-69 and Thermo-Lag 330-1 Subliming material.

- The installation of the Prefabricated Panel Ready Access Design was accomplished by cutting the number of pieces required to form the fire barrier from 0.500 in. minimum dry film thickness Thermo-Lag Pr...ricated Panels and then mou...ing the sections o... the cable tray using 0.5" x 0.0... ...nimum ...inless steel ba...ng material. The stainless steel banding material wa... ...ed at the interface of the cable tray and the upper wall opening, and then at 12-in. ma...imum intervals along the cable tray. The installation of the Prefabricated Panel Sections on the unistrut attachment was accomplished in ...e same manner except that the stainless steel banding ma...rial was placed at approximately 2-1/2 i... ...tervals. The joints and edges of the installed Prefabricated Panels we... caulked ... Thermo-Lag 330-1 Sublimi... Trowel Grade Materials.

- The installation of the flared transition designs was ... ...ated by cutting pieces from a 0.500 in. minimum dry film thick... Thermo-Lag Pre...ricated Panel and then forming each piece into a flanged section b... making a 90 degree bend along its centerline. The flanged sections were then attached to the furnace access door using two machine bolts per flanged section.

8.2.8.3 ASTM E119 S...dard Time Temp... ...re

The The... ...Lag protective envelopes and test art...es were ex...sed to the standard time temperature curve of ASTM E119, 1976 (revised to ASTM E119, 1981) for a minimum of 1 hour.

8.2.8.4 Cable Surface Temperatures

The maximum and average cable surface temperature achieved for each test article is listed below:

- Cable Tray Section

  The maximum cable surface temperature recorded for the cable tray section was 165.6°F with an average temperature at 60 minutes of 133.5°F.

- Unistrut/Cable Tray Interface

  The maximum recorded temperature at the unistrut/cable tray interface was 119.9°F.

8.2.8.5 Hose Stream Test

Following the exposure fire, the Thermo-Lag protective envelops and test articles were subjected to a 2-1/2 minute hose stream test utilizing a 2-1/2 in. diameter national standard playpipe equipped with a 1-1/8 in. nozzle. The nozzle pressure was equal to or exceeded the minimum 30 psi as required by the ANI Bulletin No. 5 (July 1979) requirements. The nozzle distance from the test article was maintained at a maximum of 20 ft.

8.2.8.6 Electrical Circuit Monitoring Test

At no time during the fire endurance test or the hose stream test did the electrical circuit monitoring system identify any shorts, shorts to ground, or open circuits (loss of continuity) on any of the monitored circuits.

8.2.8.7 Deficiencies or Comments

9" RULE
1/2 INCH TL 330
2 1/2" MAX
BAND SPACING.

Protruding Item Protection

TSI fire endurance test ITL 87-5-77 provided the basis for the 9 inch rule currently in use at CPSES for protecting protruding items. Protruding items are required to be protected with fire barrier materials to prevent heat from being conducted along the protruding item into a protective envelope. Fire endurance test ITL 87-5-77 is the only test on file at this time that provides a representative protruding item. Although other fire tests included similar items (e.g., unistrut, air drops, conduits) these items were fully enclosed by a protective envelope. The protruding item included as part of ITL 87-5-77 was a P-1000 Unistrut attached to a cable tray. The unistrut was "L" shaped and measured approximately 21-3/4 in. long. This unistrut was protected 9 in. from the cable tray protective envelope by .500 inch minimum dry film thickness Thermo-Lag 330 prefabricated panels that were mounted to the unistrut with 0.5 in. x 0.020 in. stainless steel bands. The stainless steel bands were placed at approximately 2-1/2 in. intervals. In addition all joints, seams and gaps were sealed with Thermo-Lag 330-1 trowel grade subliming coating. This installation was unique in that;

1) The Thermo-Lag 330 Prefabricated Panels were comprised on an initial layer of the Thermo-Lag Stress Skin Type 330-69, a minimum dry film thickness of 0.500 inches of

the Thermo-Lag 330-1 Subliming Material, and an outer layer of the Thermo-Lag Stress Skin Type 330-69.

2) The fire test reduced the previous protruding item distance from 18 in. to 9 in.

Since this protruding item is the only tested configuration on file to support the 9 in. rule, it is our concern that the Unit 1 and Unit 2 specifications and installation details do not resemble the tested configuration.

The CPSES Unit 1 and Unit 2 specifications and installation details for protruding items; 1) do not specify an additional outer layer of Thermo-Lag 330-69 stress skin over the Thermo-Lag 330 prefabricated panel, 2) do allow the use of Thermo-Lag 330-660 Flexiblanket which has not been tested in any configuration other than a full protective envelope (i.e., no exposed steel or combustibles), and 3) do not reflect the 2-1/2 in. stainless steel band spacing interval specified in the tested configuration. Additional testing is recommended to support the CPSES design, however it is believed that the CPSES design is adequate.

8.2.9 SWRI Project No. 01-6763-002

A fire test of irradiated samples of Thermo-Lag 330-1 was conducted by Southwest Research Institute (SWRI) for TSI. The total exposure dose to the samples was 2.12×10^8 rads. A fire test was performed on one irradiated sample and one nonirradiated sample. Cold side temperatures were recorded during the 1-hour fire test and it was determined that there was no difference in the fire resistive properties of the irradiated sample versus the nonirradiated sample.

N-EXPOSED (COLD) SIDE TEMP 422°F

The maximum cold side surface temperature recorded of the irradiated sample at 60 minutes was 345°F.

The maximum cold side surface temperature recorded of the nonirradiated sample at 60 minutes was 422°F.

The purpose of the fire test of irradiated samples of Thermo-Lag 330-1 was to demonstrate that the fire resistive properties of the Thermo-Lag panels would not be degraded after exposure to radiation. The test results did indicate the fire resistive properties actually increased following radiation exposure. Although this fire test did not represent a typical installation detail, the results should be applicable to all installation details that incorporate Thermo-Lag 330-1 into the design that may be subjected to a radiation exposure.

There is a concern, however, that the cold side surface temperatures, recorded for both the irradiated and non-irradiated samples, exceeded the maximum temperature of 325°F. This concern will require further review that will be performed later.

SIZE OF THE SAMPLE TESTED

8.3 Specification Review

8.3.1 Specification CPSES-M-2032, Rev. 1 (Reference 10.14.2), "Procurement and Installation of Fire Barrier and Fireproofing Material"

This specification is applicable to installation in Unit 2 and common areas with respect to Unit 2 work only.

This specification was reviewed against TSI Technical Note 20684, Rev. V (Reference 10.13.1). See Appendix A.1 for a summary of this review.

This review was limited to Thermo-Lag installation on cable raceway. Radiant Energy Shield (RES) installation is outside of the scope of this report. Also, this specification is in the process of being revised for structural steel fireproofing. Therefore the review of this specification for structural steel fireproofing will be performed later.

This specification incorporates the required data to ensure that Thermo-Lag is installed in accordance with TSI requirements. This specification is more restrictive and provides a higher level of detail than TSI's Technical Notes. This specification incorporates requirements which enhance the installation.

Minor discrepancies were found which require additional documentation, but do not impact the design basis (see Appendix A-1 for more detail).

8.3.2 Specification 2323-MS-38A, Rev. 2, including DCA 77269, Rev. 3 (Reference 10.14.1), "Cable Raceway Fire Barrier Materials"

The specification is applicable to installation for Unit 1, and Unit 2 after completion.

The specification was reviewed against TSI Technical Note 20684, Revision V (Reference 10.13.1). See Appendix A.2 for a summary of this review.

This review was limited to Thermo-Lag installation. Radiant Energy Shield (RES) installation is outside of the scope of this report.

This specification incorporates the requirements of the Technical Note. In fact, this specification provides a higher level of detail and additional requirements which will ensure an adequate Thermo-Lag installation.

Minor discrepancies were found which require additional documentation, but do not impact the design basis (see Appendix A-2 for more detail).

8.3.3 Specification 2323-AS-47, Rev. 3 (Reference 10.14.3), "Fireproofing of Structural Steel"

This specification is applicable to installation for Unit 1, and Unit 2 after completion.

The specification was reviewed against Underwriters' Laboratories, Inc. (UL) Fire Resistance Directory, specifically detail X-611.

This review was limited to Thermo-Lag installation. Other fireproofing materials are outside the scope of this report.

This specification incorporates the requirements of the UL directory. In fact, this specification provides additional requirements which will ensure an adequate Thermo-Lag installation.

Section 4.1 allows the use of prefabricated panels to be inserted in the trowel-grade material. This installation appears to be acceptable; however, no documentation exists to support this design. An Engineering Evaluation will be provided (later) as part of this report.

8.4 Installation Details Review

8.4.1 Comparison of CPSES Installation Schedules to the TSI Technical Note

The installation details shown on CPSES Installation Schedules M1-1701 and M2 1701 (References 10.15.2 and 10.15.4) were reviewed against the installation details shown in TSI Technical Note 20684, Revision V (Reference 10.13.1). See Appendices A.1 and A.2 for a summary of this review.

8.4.2 Comparison of Fire Endurance Tests to TSI Details

In general, the test articles as described in the Fire Endurance Tests (see Section 8.2) cannot be directly correlated to a specific fire barrier protective envelope detail as contained and described in TSI Technical Note 20684, Revision V (Reference 10.13.1). Descriptions of the test articles are lacking in specific information regarding test article construction and dimensions, and protective envelope construction, dimensions, and techniques. This section provides a comparison of each test article described in the fire endurance tests to the installation details described in the TSI technical note that are similar in design, only.

This comparison is not intended to indicate or convey in any manner that the tested configurations are exactly replicated in the TSI Technical Note installation details.

8.4.2.1 ITL Report No. 82-11-80

A comparison of the test articles contained in ITL Report No. 82-11-80 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-1.

Table 8.4.2-1

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Cable Tray	Prefab Panel	II-1.1	II-1 to II-5	Ladder type and solid bottom cable tray
	Direct Spray Over Stress Skin	II-2.1	II-6 to II-8	Ladder type and solid bottom cable tray
	Direct Spray Over Stress Skin	II-2.3	II-9 to II.11	Ladder type and solid bottom cable tray
	Direct Spray-On or Trowel-On	II-3.0	N/A	Ladder type and solid bottom cable tray
Conduit, Junction Box and Condulet	Prefab Panel	IV-1.1.7	IV-2, IV-3	Conduit not specifically addressed
	Direct Spray Over Stress Skin	IV-2.1.9	N/A	
	Direct Spray-On or Trowel On	IV-3.1	N/A	
Air Drop	Stress Skin, Conf. Blanket, Direct Spray-On or Trowel-On	III-2.3	III-3	
Support	Prefab Panel	V-1.1	V-1	
	Direct Spray-On or Trowel-On	V-2.1	N/A	

8.4.2.2 ITL Report No. 82-11-241

A comparison of the test articles contained in ITL Report No. 82-11-241 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-2.

Table 8.4.2-2

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Conduit	Direct Spray-On	III-3.1	N/A	
Junction Box	Direct Spray-On	IV-3.1	N/A	
Condulet	Direct Spray-On	IV-3.1	N/A	

8.4.2.3 ITL Report No. 83-5-472A

A comparison of the test articles contained in ITL Report No. 83-5-472A to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-3.

Table 8.4.2-3

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Cable Tray	Prefabricated Panel	II-1.1	II-1 to II-5	Ladder type and solid bottom cable tray
	Direct Spray Over Stress Skin	II-2.1	II-6 to II-8	Ladder type and solid bottom cable tray
	Direct Spray Over Stress Skin	II-2.3	II-9 to II-11	Ladder type and solid bottom cable tray
	Direct Spray-On	II-3.0	N/A	Ladder type and solid bottom cable tray

2.4 ITL Report No. 84-5-387

A comparison of the test articles contained in ITL Report No. 84-5-387 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-4.

Table 8.4.2-4

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Fire Stop	Prefab panel and trowel-on	None	None	Not used at CPSES

8.4.2.5 ITL Report No. 85-2-382

A comparison of the test articles contained in ITL Report No. 85-2-382 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-5.

Table 8.4.2-5

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Conduit	Flexiblanket-Blanket Wrap	III-4.1	III-5	
	Flexiblanket-Spiral Wrap	III-4.3	N/A	
Junction Box	Flexiblanket-Blanket Wrap	IV-4.1	N/A	
Condulet	Flexiblanket-Blanket Wrap	IV-4.1	N/A	
Air Drop	Flexiblanket-Blanket Wrap	III-4.1	III-5	
Unistrut	Flexiblanket-Blanket Wrap	V-3.1	V-1	
	Flexiblanket-Blanket Wrap	III-4.1	III-5	

NOTE: The circular wrap and circumferential wrap identified in the fire test is the same as the blanket wrap identified in the TSI Technical Note.

8.4.2.6 ITL Report No. 85-4-377

A comparison of the test articles contained in ITL Report No. 85-4-377 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-6.

Table 8.4.2-6

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Conduit	Preshaped Conduit Section	III-1.1	III-1	
	Flexiblanket-Blanket Wrap	III-4.1	III-5	
Condulet	Flexiblanket-Blanket Wrap	IV-4.1	N/A	
Flex Conduit/Air Drop	Preshaped Conduit Section	III-1.1	III-1	
	Flexiblanket-Blanket Wrap	III-4.1	III-5	
Unistrut	Flexiblanket-Blanket Wrap	V-3.1	V-1	
	Flexiblanket-Spiral Wrap	V-3.3	N/A	
	Flexiblanket-Blanket Wrap	III-4.1	III-5	
	Flexiblanket-Spiral Wrap	III-4.3	N/A	

NOTE: Test does not indicate circular (blanket) wrap or spiral wrap except circular wrap is specified as transition between flexiblanket and preshaped conduit section. A review of Figure 6 in the test report indicates flexiblanket is blanket wrapped around all test sections except unistrut. Unistrut flexiblanket wrap is indeterminable thus assumed both methods were used.

8.4.2.7 ITL Report No. 85-5-314

A comparison of the test articles contained in ITL Report No. 85-3-314 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-7.

Table 8.4.2-7

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Conduit	Flexiblanket-Blanket Wrap	III-4.1	III-5	
	Flexiblanket-Spiral Wrap	III-4.3	N/A	
Junction Box	Flexiblanket-Blanket Wrap	IV-4.1	N/A	
	Flexiblanket-Spiral Wrap	IV-4.3	N/A	
Condulet	Flexiblanket-Blanket Wrap	IV-4.1	N/A	
	Flexiblanket-Spiral Wrap	IV-4.3	N/A	
Air Drop	Flexiblanket-Blanket Wrap	III-4.1	III-5	
Unistrut	Flexiblanket-Blanket Wrap	V-3.1	V-1	
	Flexiblanket-Blanket Wrap	III-4.1	III-5	[illegible]

NOTE: Unable to determine if flexiblanket wrap is circular (blanket) or spiral.

8.4.2.8 ITL Report No. 87-5-77

A comparison of the test articles contained in ITL Report No. 87-5-77 to the details contained in TSI Technical Note 20684 Rev. V are shown below in Table 8.4.2-8.

Table 8.4.2-8

RACEWAY TYPE/ TEST SECTION	METHOD OF APPLICATION	TSI SECT NO.	TSI FIG. NO.	COMMENTS
Cable Tray	Prefab Panels	II-1.1	II-1 to II-5	TSI Technical Note does not reference outer layer of stress skin
Unistrut	Prefab Panel	V-1.1	V-1	TSI Technical Note does not reference outer layer of stress skin

8.4.2.9 SWRI Project No. 01-6763-002

The test articles contained in SWRI Project No. 01-6763-002 do not resemble any installation detail contained in TSI Technical Note 20684 Rev. V.

8.4.3 Comparison of TSI Details to Fire Endurance Tests

Table 8.4.3-1, below, provides a cross reference comparison between the details contained in the TSI Technical Note and the Fire Endurance Tests.

Table 8.4.3-1

TSI Technical Note Section Nos.	TSI Technical Note Figure Nos.	Fire Endurance Tests
II-1.1	II-1 to II-5	82-11-80 83-5-472A 87-5-77
II-2.1	II-6 to II-8	82-11-80 83-5-472A
II-2.3	II-9 to II-11	82-11-80 83-5-472A
II-3.0	N/A	82-11-80 83-5-472A

TSI Technical Note Section Nos.	TSI Technical Note Figure Nos.	Fire Endurance Tests
III-1.1	III-1	85-4-377
III-2.3	III-3	82-11-80
III-3.1	N/A	82-11-241
III-4.1	III-5	85-2-382 85-4-377 85-5-314
III-4.3	N/A	85-2-382 85-4-377 85-5-314
IV-1.1.7	IV-2 and IV-3	82-11-80
IV-2.1.9	N/A	82-11-80
IV-3.1	N/A	82-11-80 82-11-241
IV-4.1	N/A	85-2-382 85-4-377 85-5-314
IV-4.3	N/A	85-5-314
V-1.1	V-1	82-11-80 87-5-77
V-2.1	N/A	82-11-80
V-3.1	V-1	85-2-382 85-4-377
V-3.3	N/A	85-4-377 85-4-314

8.5 Installation Schedule Review

The installation schedules M1-1700 and M2-1700 were reviewed to determine if the commodities protected (size and configurations) are enveloped by the fire test data.

A summary of the review on M2-1700 is provided in Appendix B. M1-1700 was only compared against M2-1700 for differences. The limited review of M1-1700 demonstrated no significant differences from M2-1700.

There are two major areas where the Fire Test do not adequately support the CPSES installations. These are 1) conduits smaller than 4 in. (CPSES goes down to 3/4 in.) and cable trays larger than 12 in. x 4 in. (CPSES goes to 36 in. x 6 in. with tee sections). See Appendix C for an Engineering Evaluation of these nontested configurations.

This latter concern extends to multiple raceways in a common enclosure. The concern with multiple raceways is that the size of the enclosure extends well beyond tested configurations. This is a structural concern similar to large trays as addressed in Appendix C. It is believed, that based on the installations requirements, that this is not a problem at CPSES; however, documentation is required to justify these configurations on a case-by-case basis. Due to the schedule restraints, this justification will be performed subsequent to augmented testing and will be incorporated into this report.

8.6 Design Change Document Review

8.6.1 Review of Design Changes Posted Against Specification 2323-MS-38H

A review has been performed on the DCAs, DCNs, and NCRs that have been posted against specification 2323-MS-38H. These DCAs, DCNs, and NCRs have been tabulated with a brief description in Appendices D.1, D.2, and D.3.

This review has generated a number of concerns pertaining to design changes specifically related to 1) reductions in the 9 in. rule, 2) wrapping pipe interferences with non-qualified materials and 3) installation of junction box covers with dry joints and turnbuckle type banding designs.

8.6.1.1 Reduction in the 9 In. Rule

Eight DCAs were specifically written to reduce the cable tray support Thermo-Lag protection requirements from 9 in. to 5 in. (or 6 in.) as justified by calculation ME-CA-0000-2062, Rev. 0. These DCAs are listed below:

DCA 91906	DCA 92665
DCA 92541	DCA 92813
DCA 92610	DCA 92977
DCA 92613	DCA 93093

Calculation ME-CA-0000-2062 established the minimum Thermo-Lag requirements for supports and other members that are in thermal contact with cable trays. Calculation ME-CA-0000-2062 provided specific guidelines to be followed in reducing the required Thermo-Lag coverage. These guidelines are contained in the conclusion section of the calculation.

The specific concern lies with the fact that the guidelines of calculation ME-CA-0000-2062 may not have been applied consistently for the eight DCAs. The guidelines for cable tray sizes, cable tray fill, and the location of the nearest cable to the cable tray side rail were not always specified in the DCAs. Only two of the DCAs (DCA 91906 and DCA 92665) invoked the requirements of specification 2323-ES-100 to move cables away from the side rails of the cable tray.

The following recommendations should be considered regarding the reduction in the 9 in. rule:

1) For those DCAs that did not invoke the requirements of specification 2323-ES-100, work orders and other documents should be reviewed to ensure that the installation meets the guidelines as justified in calculation ME-CA-0000-2062 Rev. 0 or should be documented in an Engineering Evaluation, if required, to be provided later.

2) A detailed procedure should be included in the specification providing the necessary guidelines to be implemented and used whenever a reduction in Thermo-Lag coverage is requested.

8.6.1.2 Pipe Interferences

A review of the DCAs posted against specification 2323-MS-38H has also revealed a number of cases where TSI Thermo-Lag 330-70 ceramic blanket was used to wrap pipes that interfered with the proper installation of an essential raceway's protective envelope. These pipes were not in physical contact with the essential raceway however the pipe's location in respect to the raceway was less than the thickness of a Thermo-Lag prefabricated panel. Various installation methods were used in applying the ceramic blanket wrap. Some installations specified a maximum band spacing of 10 in. on center while others specified a maximum band spacing of 6 in. on center. There appears to have been no consistency in the methods employed to install or specify the ceramic blanket wrap. The ceramic blanket wrap is not qualified by fire test for this application nor is it discussed in the manufacturer's installation procedure for this application.

Several of the DCAs reviewed invoked calculation ME-CA-0000-0990 R/O as justification for the ceramic blanket wrap by comparing the ceramic blanket wrap to material used in radiant energy shield installations. The affected DCAs are listed below.

DCA 86194	DCA 89857
DCA 91146	DCA 92791

Furthermore, each essential raceway's protective envelope had to be modified at the point of interface with the interfering pipe.

One particular deviation has been identified on DCA 89857 where a 10 in. condenser vacuum line is located within 1/8 in. of an essential conduit. This 1/8 in. gap was filled by a fillet of Thermo-Lag 330-1 subliming material which per a vendor letter is equivalent to a 12 minute fire rating. The concern with this installation is whether or not pipe movement has been adequately addressed. This installation should be reviewed to determine if potential rework or an engineering evaluation is required.

The following recommendations should be considered when a pipes location interferes with the proper installation of an essential raceway's protective envelope:

1) Specific guidelines should be included in the specifications or detail drawings to address pipe interferences. These guidelines should include a determination of pipe temperatures and pipe movement.

2) Instructions should be provided to ensure a consistent method or approach to wrapping or protecting the interfering item.

8.6.1.3 Dry Joints/Dry Fittings

Detail No. 8-1 as shown on CPSES Drawing M2-1701, Sh. 08, Rev. CP-1 was developed from CPSES Unit No. 1 DCN No. 687 Rev. 10. This referenced DCN was a one time deviation to specification 2323-MS-38H to allow installation of a removable cover for Unit 1 junction box JBIS-942. The removable cover was installed using ASTM 304 stainless steel tiewires that were double stranded through a 1/4 in. X 4 in. ASTM 304 stainless steel turnbuckle. The removable cover was installed using the "dry-fitting" method, in that, the seams that overlapped the Thermo-Lag installed on the junction box body were not sealed, caulked or pre-buttered. This condition was specifically addressed in NRC Information Notices 91-47 and 91-79 and has been responded to by TSI as not being a qualified installation method. The "dry-fitting" method discussed in the NRC information notices greatly differs from the installation method used at CPSES for this DCN. The NRC information notices identify a "dry-fitting" as a installation where prefabricated panels are caulked and sealed after butt jointing. Neither the "dry-fitting" nor the turnbuckle arrangement represent a tested configuration. The engineering basis for the removable cover is predicated on the assumption that the dry joint (3/32 in. maximum width) will seal itself during a fire since Thermo-Lag reacts to fire exposure by sublimation and partial intumescence. The DCN references a TSI letter that is attached to the DCN but is not included in the copy of the DCN provided.

The following recommendations should be considered regarding Detail 8-1:

- Since the original installation was considered a one time deviation, Detail 8-1 should not be included as part of the standard Thermo-Lag details for Unit 2 even though use of the detail requires engineering approval.

- An Engineering Evaluation should be written or rework may be required to justify this non-tested configuration.

8.6.2 Review of Design Changes Posted Against Drawing M1-1701

A review has been performed on the DCAs that have been posted against drawing M1-1701. These DCAs have been tabulated with a brief description in Appendix D.4.

This review has identified a number of concerns specifically related to common enclosures. These common enclosure concerns will be addressed in an engineering evaluation. The engineering evaluation, however, requires input from the upcoming Wide Tray fire test

8.7 Review of Installation and QC Procedures

8.7.1 Review of CQP-CV-107, Rev. 0 (Reference 10.18.2), "Application of Fire Barrier and Fireproofing Materials"

This procedure is applicable to installation in Unit 2 and common areas with respect to Unit 2 work only.

This procedure was reviewed against specification CPSES-M-2032 (Reference 10.14.2) and Installation Details M2-1701 (Reference 10.15.4). This procedure was also reviewed against TSI Technical Note 20684, Rev. V (Reference 10.13.1).

This review was limited to Thermo-Lag installations on cable and raceway only. The reason for this limited review is that Radiant Energy Shield (RES) installation is outside the scope of work and specification. CPSES-M-2032 is being revised for structural steel fireproofing; therefore, the review of this procedure with respect for structural steel fireproofing will be done later.

This procedure incorporates the needed attributes to ensure that Thermo-Lag is installed in accordance with the specification requirements. Some minor recommendations are listed below. These would only be enhancements to the procedure and make no technical changes.

<u>Recommendations</u>

Section 6.4.3.6 - Limit flatten of "V" shaped stiffening ribs to no more than "1" in. to ensure that the ribs are not flatten out to the point that where sagging of the board could occur.

Section 6.4.3.8 - State that the preferred method of mechanical fastening is using the banding materials.

Section 6.4.4 - Add statement that this section (6.4.4) is limited to fill-in work, e.g., filling seams, joints, gaps, and cracks in association with installation of prefabricated panels and does not apply to the installation of trowel grade as an independent installation, e.g., protecting a complete air drop in trowel grade. The reason for this is that stress skin is required for larger installations.

Sections 6.4.2 and 6.6 should have verification that fire stops on protruding items have been installed prior to enclosing the item. This is a paper work item to demonstrate proper installation.

8.7.2 Review of CP-CPM-10.3

Due to document availability, schedule restraints and the fact that this Unit 1 installation procedure is no longer in use, this document was not reviewed and needs to be reviewed to validate Unit 1's installation.

8.7.3 Review of NQA 3.09-1.07, Rev. 3 (Reference 10.18.1), "Inspection of Fire Protection to Cable Raceway and Structural Steel"

This procedure is no longer in effect, but was used to provide guidance on the inspection of Unit 1 installations.

This procedure was reviewed against Specification 2323-MS-38H (Reference 10.14.1) and 2323-AS-47 (Reference 10.14.3).

This procedure basically provided the appropriate forms to document inspection of the TSI installations. The procedure referred back to the appropriate QC attributes in Specifications 2323-MS-38H and 2323-AS-47. Based on the level of detailed signoff required, this procedure provided adequate documentation to ensure that the Thermo-Lag installed in Unit 1 conformed to the specification requirements.

8.8 Ampacity Derating Factors

The NRC in Draft Generic Letter 92-XX (Reference 10.10) raised the concern about ampacity derating factors that the numbers used may not be conservative. This is based on fact that the as-built configurations may not be representative of the tested configurations.

As stated in DBD-EE-052, "Cable Philosophy and Sizing Criteria," cable ampacity derating factors for Thermo-Lag raceways at CPSES Units 1 and 2 are as follows:

1. 31 percent for single trays enclosed with Thermo-Lag applied against ICEA P-534-440 "Cables in Random Filled Trays" (factors taken from UL Report R6802 (Reference 10.11.4)).

2. 20 percent for single conduits enclosed with box design Thermo-Lag, applied agains ICEA P-46-426 "Power Cable Ampacities for Conduits in Air" (factors determined by SWEC calculation 16345/6-EE(B)-004 (Reference 10.16.3)).

3. 7.5 percent for single conduit enclosed with shell design Thermo-Lag (factor based on review of TSI Report No. 111781 for 1-in. conduit (Reference 10.11.1)).

4. Other specific cable ampacity derating factors for free air wrapped cables (factors determined by SWEC calculation 16345-EE(B)-140 (Reference 16.4)).

Variations in configuration in the field that differ from the approved guidelines are documented in the Design Change documents which allow the configurations. The engineering basis for each design change documents the fact that the derating factors are not impacted (example of this is DCA-87040, Rev. 1).

Concerns raised by the subject generic letter regarding the appropriate cable ampacity factor for Thermo-Lag 330-1 fire barrier systems on power cable are as follows:

ISSUE 1

CONCERN: TSI provided test results to licensees that documented ampacity derating factors for enclosed tray ranging from 12.5 percent for 1-hour barriers to 20.55 percent for three-hour barriers. On October 2, 1986, TSI informed its customers and the NRC that, while performing tests at Underwriter's Laboratory (UL) facility, TSI found that the ampacity derating factors for Thermo-Lag were greater than previous tests indicated.

The UL tested ampacity derating factor ranged from 28 percent for 1-hour barriers to 31 percent for 3-hour barriers. However, TSI stated that the test results may not be comparable to previous test results since the test procedure and configurations were different.

Testing conducted at Southwest Research Institute (SWRI) (by TSI competitors), as reported by the NRC, found the ampacity derating at 37 percent for a 1-hour barrier.

The NRC is concerned that licensees may be using nonconservative ampacity derating factors for cable in tray with Thermo-Lag.

DISCUSSION: The ampacity derating factors differ significantly between the ITL Report and the UL Report. The test philosophy and method differ considerably between the two tests. Since the test philosophy used by UL is consistent with the latest draft of a proposed IEEE standard on "Ampacity Derating of Fire Protected Cables," SWEC utilizes the cable derating factor for power tray consistent with the results of the UL report.

UL is a nationally recognized testing agency and has published the ampacity tables for the National Electric Code. The test results from SWRI have not been made available to SWEC. Note: Pat Madden (NRC) per telecon with Keith Petty (SWEC) on 2/24/92 indicated that the document may be proprietary and has not supplied SWEC with a copy.

The thickness of the 1-hour rated Thermo-Lag in the UL test was a minimum 0.5 in. and 0.6 in. maximum. However, the Unit 1 Brown & Root installation procedure indicates that a maximum thickness of 0.75 is permitted. To account for this, SWEC recommended a 31 percent derating factor be used. This 31 percent corresponds to the derating factor for 1.0 in. thick product in the UL test and would be applied against the ICEA cable ampacity standard for single trays enclosed with Thermo-Lag.

ISSUE 2

CONCERN: The ampacity derating factors for enclosed conduit from the TSI report (7.5 percent) differ significantly from the UL Report (0 percent).

The NRC is concerned that licensees may be using nonconservative ampacity derating factors for cable in conduit with Thermo-Lag.

DISCUSSION: The significant differences for derating factors between the TSI report (7.5 percent) and UL report (0 percent) may be due to differences in conduit sizes used in the test. The tests utilized the pre-shaped form of Thermo-Lag on conduit. The Thermo-Lag is factory made in two halves and fits over the conduit. On the 4-in. conduit, the Thermo-Lag fits tightly against the conduit, improving heat transfer. However, for the 1-in. conduit used in the TSI test, a small air gap can be expected between the Thermo-Lag and the conduit, resulting in reduced heat transfer and lower ampacities. Accordingly, SWEC concluded that the TSI results be used for all conduit sizing using the pre-shaped shell shaped Thermo-Lag.

DISCUSSION OF ISSUES PREVIOUSLY RAISED BY TUE/SWEC IN 1986-1987

ISSUE 3

CONCERN: The thermal resistance of Thermo-Lag, as determined in an ambient test environment of 40°C versus a normal plant ambient environment of 50°C, was used in calculating the ampacity of cables. The concern was that this may result in a less conservative ampacity rating.

DISCUSSION: SWEC provided an analysis for using the thermal resistance of Thermo-Lag, applicable for an ambient environment of 40°C, in calculating the ampacity of cables in an ambient environment of 50°C. The analysis showed that use of the 40°C thermal resistance factor results in a more conservative ampacity derating factor, and therefore is acceptable.

ISSUE 4

CONCERN: Thermo-Lag 1-hour installation procedures at CPSES require a thickness of 0.500 in. with a tolerance of 0.250 in. The concern was that this installation may require additional derating factors.

DISCUSSION: SWEC used the results of the UL test for the 1-in. thick product.

ISSUE 5

CONCERN: No cable ampacity testing was submitted for box design Thermo-Lag on conduit. The concern was that cables installed in these configurations may not have proper ampacity ratings applied.

DISCUSSION: Unit 1 installation procedure CP-CPM-10.3 permitted the conduit to be boxed out with Thermo-Lag, which may produce an air gap between the Thermo-Lag and the conduit resulting in an expected higher derating factor. SWEC analyzed this condition in calculation 16345/6-EE(B)-004, and concluded that a 20 percent derating factor be applied against the ICEA P-46-426 cable ampacity standard for single conduit enclosed with Thermo-Lag.

ISSUE 6

CONCERN: No cable ampacity testing was submitted for Thermo-Lag on free air drop cable. The concern was that cables installed in this configuration may not have proper ampacity ratings applied.

DISCUSSION: Calculation 16345-EE(B)-140 calculates the ampacity of free air cables which are wrapped with the flexible version of Thermo-Lag (330-660). Instead of calculating a derating factor, a specific ampacity is developed.

Based on the discussion above and review of the existing documentation (Reference 10.11.1 through 10.11.4) adequate documentation and engineering basis is available to support the numbers used.

9.0 CONCLUSIONS

Based on the review of the documentation, Thermo-Lag Fire Barrier Systems are adequately designed and installed at CPSES. However, documentation is lacking to support the design.

In order to remove these deficiencies additional fire tests are required. These fire tests should consist of a least two tests. One, a large tray 36 in. x 6 in. with a tee-section, the tee section should contain a fire stop (seal) made of TSI Thermo-Lag 330-1 trowel grade, and a unistrut for a protruding item. The other test should be small conduits, based on cable fill, both 1 in. and 3/4 in. conduits should be included in this test, with a conduit support and junction box incorporated into the design.

Various recommendations/enhancements to various documentation are noted throughout the report, see the applicable review of each document.

The following action items remain open at this time and will be closed when the additional information or documentation is received or completed:

1. A comparison is required of the TSI-NQAPM/QCOPM to the TSI Technical Note (see Section 8.2).

2. Appendices I to IV of ITL Report No. 82-11-80 require review (see Section 8.2.1.7).

3. Appendices I to IV of ITL Report No. 82-11-241 require review (see Section 8.2.2.7).

4. Fire stop design requires fire testing (see Section 8.2.4.6).

5. Protruding item 9 in. design incorporating flexiblanket requires fire testing (see Section 8.2.7.7).

6. Protruding item 9 in. design incorporating Thermo-Lag prefabricated panels require fire testing (see Section 8.2.8.7).

7. Engineering Evaluation required to support the use of prefabricated panels inserted in trowel grade for structural steel fireproofing (see Section 8.3.3).

8. Common enclosures for multiple raceways require justification (see Sections 8.5 and 8.6.2).

9. Engineering Evaluation may be required to justify certain installations invoking a reduction in the 9 in. rule (see Section 8.6.1.1).

10. Engineering Evaluation or rework may be required for certain protective envelope installations that included pipe interferences (see Section 8.6.1.2).

11. Engineering Evaluation or rework may be required to justify the dry joint junction box installation (see Section 8.6.1.3).

12. Several enhancements to the installation and QC procedures may be required to ensure that Thermo-Lag is installed in accordance with the installation specification (see Section 8.7.1).

13. CP-CPM-10.3 requires review to validate Unit 1 installations (see Section 8.7.2).

14. Documents are required to justify using chemical solvents for 351-2 Primer (see Appendix A.1, Section VIII and Appendix A.2, Section VIII).

15. Documents are required to justify 350 Top Coat applications following a reduced cure time (see Appendix A.2, Section VIII and Appendix A.2, Section VIII).

16. Small conduits and large trays require additional testing (see Appendix C).

10.0 REFERENCES

10.1 ASTM E-119 (83) "Standard Methods of Fire Tests of Building Construction and Materials, American Society for Testing and Materials"

10.2 NFPA 251 (1985) "Standard Methods of Fire Tests of Building Construction and Materials"

10.3 American Nuclear Insurers (ANI)

10.3.1 ANI Bulletin B.7.2, 11/87, Attachment B, entitled "ANI/MAERP RA Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits," Revision 1

10.3.2 ANI Bulletin No. 5, "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits," dated July 1979.

10.3.3 ANI Bulletin No. 7, "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops

10.4 Appendix A to BTP 9.5-1, NRC Supplemental Guidance Nuclear Plant Fire Protection Functional Responsibilities Administrative Controls and Quality Assurance"

10.5 Federal Register/Volume 45 No. 225/Wednesday, November 19, 1980 Fire Protection Program for Operating Nuclear Power Plants 10 CFR, Part 50, Appendix R

10.6 CPSES Final Safety Analysis Report, Section 9.5.1

10.7 NRC Generic Letter 86-10 "Implementation of Fire Protection Requirements," 4/24/86

10.8 NRC INFORMATION NOTICE 91-79 "Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials," 12/6/91

10.9 NRC INFORMATION NOTICE 91-47 "Failure of Thermo-Lag Fire Barrier Materials to Pass Fire Endurance Test," 8/6/91

10.10 NUMARC Letter "Fire Protection Issue - Thermo-Lag Fire Barriers" included NRC Draft Generic Letter 92-XX: "Thermo-Lag Fire Barriers," March 6, 1992

10.11 Thermal Science, Inc. (TSI) Cable Ampacity Test

10.11.1 TSI Technical Note 111781, dated November 1981, "Engineering Report on Ampacity Test for 600 Volt Power Cables Installed in a Five Foot Length of Two Inch Conduit Protected with Thermo-Lag 330-1 Subliming Coating Envelope System"

10.11.2 Industrial Testing Laboratories, Inc. (ITL) Report No. 82-355-F-1, Revision 1, dated January 1985, "Ampacity Test for 600 Volt Power Cables in an Open Top Cable Tray Protected by the Thermo-Lag 330-1 Subliming Coating Envelope System"

10.1..3 ITL Report No. 83-8-183, da ugust 1983, "Ampacity Deratin : at 70°C, ° °C, a 90°C, for 1000 Volt Power s in a Ladder Cable Tray Assem.., Protected with a One-Hour Fire Rated Design of the Thermo-Lag 330 Fire Barrier System

10.11.4 writer oratories, Inc. (UL) Letter to TSI, dated January 21, 19° for Project 23826, R6802, "Special ervice Investigation of Ampacity Ratings for Power Cables in Ste. onduits and in Open-Ladder Cable trays with Field-Applied Enclosures"

10.12 The al Science, Inc. (TSI) Fire Endurance Tests

10.12.1 Industrial Testing Laboratories, Inc. (ITL) Report No. 82-11-80, dated November 1982, "On Hour F Endurance Tests Conducted on Test Articles Containing "Generic" Cables Protected with Thermo-Lag 330-1 Subliming Coating Envelope System"

10.12.2 ITL Report No. 82-11-241, dated November 1982, "One-Hour Fire Endurance Tests Conducted on the Therm -Lag 330-1 Subliming Coating System Applied by the Direct Spray-On Design to 4-Inch Diameter Standard Electr al Conduit Containing Generic Cables"

10.12.3 ITL Report No. 83-5-472A, dated July 1983 ne-Hour Fire Endurance Test nducted on the Thermo-Lag 330 Subliming Fire Barrier System Applied by Direct Spraying, Rolling, and Troweling Methods to Class 1E Electrical Cables Installed in a Modified Ladder Cable Tray Test Article"

10.12.4 ITL Report No. 84-5-387, Revision 1, ed June 1985, "One-Hour Fire Endurance Test Conducted on Various Configurations of the Ther Lag 330 Penetration Fire Stop System"

1(..5 ITL Report No. 85-2-382, dated February 1985 "One-Hour Fire Endurance Test Conducted on Air Drop Cables and a Unistrut Section Conne d to a 4-Inch Diameter Standard Electrical Conduit Protec ed with the Thermo-Lag 330-660 Flexi-Blanket Thermal Barrier"

10.12.6 ITL Report No. 85-4-377, Revision 1, dated June 1985, "One-Hour Fire Endurance Test Conducted on 4 Inch Diameter Aluminum Conduit Test Assembly with a Condulet, an Air Drop Cable Installed in a 3/4 Inch Fluid Type Flex Conduit and a P1000 Unistrut Protected with the Thermo-Lag 330 Fire Barrier Systems Designs"

10.12.7 ITL Report No. 85-5-314, dated June 1985, "One-Hour Fire Endurance Test Conducted on a 4-Inch Diameter Condu Protected with the Thermo-Lag 330-660 Flexi-Blanket System"

10.12.8 ITL Report No. 87-5-77, Revision 2, dated October 3 1987, "One-Hour Fire Endurance Test Conducted on a Ladder Cable Tray with a P 00 Unistrut Attachment with the Therm g 330 Fire Barrier System"

10.12.9 Southwest earch Institute (SWRI) Project 01-6763-302 Final Report, dated December 2, 1981 "Fire Res ce of Irradiated Ther g 3 "

10.13 Thermal Science, Inc. (TSI) Installation Procedures

10.13.1 TSI Technical Note 20684, Revision V, dated November 1985, "Thermo-Lag Fire Barrier System Installation Procedures Manual Power Generating Plant Applications"

10.13.2 TSI Technical Structural Steel (Later)

10.13.3 TSI Technical Note 80181, Revision II, "Thermo-Lag 330-1 Subliming Coating Envelope System Application Procedures," dated December 1981.

10.13.4 TSI Technical Note 80181, Revision IV, "Thermo-Lag 330-1 Subliming Coating Fire Barrier System Application Procedures," dated June 1983.

10.14 CPSES Specifications

10.14.1 CPSES Unit No. 1 Specification No. 2323-MS-38H, "Cable Raceway Fire Barriers"

10.14.2 CPSES Unit No. 2 Specification No. CPSES-M-2032, "Procurement and Installation of Fire Barrier and Fireproofing Materials"

10.14.3 CPSES Unit 1 and 2 Specification No. 2323-AS-47, "Fireproofing of Structural Steel"

10.15 CPSES Drawings

10.15.1 CPSES Unit 1 Drawing No. M1-1700, "Thermo-Lag and RES Schedule"

10.15.2 CPSES Unit 1 Drawing No. M1-1701, Sheets 1-7, "Thermo-Lag Typical Details"

10.15.3 CPSES Unit 2 Drawing No. M2-1700, "Unit 2 Thermo-Lag Report"

10.15.4 CPSES Unit 2 Drawing No. M2-1701, Sheets 1-15, "Thermo-Lag typical Details"

10.16 CPSES Calculations

10.16.1 CPSES Unit 1 and 2 Calculation No. ME-CA-0000-0965, "Thermo-Lag Primary Protruding Member Installation Requirements"

10.16.2 CPSES Unit 1 and 2 Calculation No. ME-CA-0000-2062, "Heat Transfer Analysis of Cable Tray Supports to Determine Thermo-Lag Requirements"

10.16.3 CPSES Unit 1 and 2 Calculation 16345/G-EE(B)-004 Rev. 0," Cable Ampacity Derating Factors for Conduits Boxed in with Thermo-Lag (TSI Product)"

10.16.4 CPSES Unit 1 and 2 Calculation No. 16345-EE(B)-140 Rev. 1, "Ampacity of Power Cable Wrapped with Thermo-Lag 330-660 Installed as Free Air Drop"

10.16.5 CPSES Unit 1 and 2 Calculation No. 16343/G-EE (B)-142, Rev. 2," Thermo-Lag Tray Interface Analysis"

10.17 CPSES Design Basis Document

10.17.1 DBD-EE-052 "Cable Philosophy and Sizing Criteria," Rev. 3

10.18 <u>CPSES Procedures</u>

10.18.1 NEO Quality Assurance Department Procedure No. NQA 3.09-1.07, "Inspection of Fire Protection to Cable Raceway and Structural Steel" (CPSES Unit 1)

10.18.2 CPSES Construction/Quality Procedure No. CQP-CV-107, "Application of Fire Barrier and Fireproofing Materials" (CPSES Unit 2 and Common)

Appendix A.1

TSI MANUAL REVIEW - Unit 2
Spec. CPES-M-2032 Rev.1

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
Section I			
A. General Description	Describes T-L Material	NA	
B. Fire Barrier Design	Describes 5 basic designs of T-L 330	3.1	
I. T-L Prefab.Panel Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	3.2	
II. T-L Preshaped Conduit Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	3.2	
III. Direct Spray Over Stress Skin Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	3.2	
IV. Direct Spray On Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	3.2	
V. T-L 330-660 Flexi Blanket Thermal Blanket Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	3.2	
C.Material Components	Describes material used in T-L 330 Fire Barrier	3.2; 3.3	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
D.Recommendations-Primary Raceway Supports and All Penetrations Into the T-L 330 Fire Barrier	Requires struct.steel to be protected min 18" from fire barrier	1.2.15; 1.27	Spec.req.is 9" versus TSI 18", Justified by calculation ME-CA-0000-0965.
E.Preapplication Practices	Contractor to be qualified by TSI	3.2	
F.Safety Precautions	Conform to OSHA		
G.Delivery	Defines delivery requirements	4.2	
H.Storage	Defines storage conditions and temp.	4.2	
Section II. T-L Fire Barrier System for Cable Trays	Provides detailed instr.and installation sequence	3.3	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
1.Prefab.Panel Ready Access Design for Cable Trays		3.3	
Fig.II-1	Solid Bottom Tray Miter Cut		
Fig.II-2	Ladder Tray Butted Cut	M2-1701 Sh5 Det.5-2 and Sh11 Det11-3	Wire att.to ladder diff. from spec. req.removal & holes patch Installation aid only does not impact design basis
Fig.II-3	Ladder Tray Scored One Piece	M2-1701 Sh11 Det11-4	
Fig.II-4	Solid Bottom Scored One Piece	M1-1701 Sh5 Det.5-1 and Sh11 Det11-5	
Fig.II-5	Ladder Tray Scored One Piece		
2.Direct Spray Over Stress Skin Design for Cable Trays FigII-6,FigII-7,FigII-8	Stress Skin Prep.Det.with Mech. Fasteners	Not used	
FigII-9,FigII-10,FigII-11	As Above but using s.s. wire or banding	Not used	
Section III T-L 330 Fire Barrier System For Protection of Conduit,Cables Drops and Instr. Tubing	Provides detailed instr.and installation sequence	3.3	
1.Preshaped Cond. Section Design Fig.III-1		3.3	
Fig.III-2	Preshaped Cond. Det Cond.Adjacent to Concr.Wall	M2-1701Sh4 Det4-1 M2-1701Sh4 Det4-3	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
2.Direct Spray Over Stress Skin Design		3.3	
Fig.III-3	Direct Spray Over Stress Skin	Not used	
Fig.III-4	As Above but 3 Hr. Det.	Not used	
3.Direct Spray-On Design		3.3	
4.T-L 330-660 Flexi-Blanket Therm. Barrier		3.3	
Fig.III-5	T-L 330-660 Inst.Det.1-Hr.	M2-1701Sh4 Det4-2	
Fig.III-6	As Above but 3 Hr.	NA	
<u>Section IV</u> T-L 330 Fire Barrier for Protect. of Junction Boxes,Pull Boxes and Condulets	Provides detailed instr.and installation sequence	3.3	
1.Prefabricated Panel Design		M2-1701Sh2	
Fig.IV-1	Prefab.Panel for Surf. Mounted Junct.Boxes	Det2-3	Tie wires shown remaining /penetrating fire barrier
Fig.IV-2	As Above but not surface mounted		
Fig.IV-3	As Above but for condulets	M2-1701Sh6 Det6.1	Acceptable based on TSI details II-1, 2, and 3
2.Direct Spray Over Stress Skin		3.3	
3.Direct Spray or Trowel Appl.		3.3	
4.T-L Flexi Blanket		3.3	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
Section V T-L Fire Barrier System for Structural Supports, Hangers and Fire Dampers	Provides detailed instr. and installation sequence	3.3	
1. Prefabricated Panel Design Fig. V-1 Fig. V-2	 Detail for Struct. Steel Detail for Fire Damper	 M2-1701Sh1 Det1-1,-2,-3, -4 Not used	
2. Direct Spray or Trowel Appl.		3.3	
3. T-L 330-660 Flexi Blanket		3.3	
Section VI T-L 330 Fire Barrier for Interfaces	Provides detailed instr. and installation sequence	3.3	
1. Installation of 1 or 3 Hour Fire Barrier for Interfaces between Cable Tray, Conduit, Instr. Tubing and Penetr. Seal Fig. VI-1 Fig. VI-2 Fig. VI-3	Installation sequence for prefab. or coating over stress skin method T-L F.B. raceway Interfacing w/penetr. seal 1/2"-1hr. As above but 1"-3hr. As Above but 2x1/2"-3hr.	3.3 M2-1701 SH5A Det5-4 NA NA	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
2.Installation of 1 or 3 hr. Self-supporting Interface between Conduit or Instr. Tub. and wall or Ceiling	Installation sequence for prefab. or coating over stress skin or flexi blanket method		
Fig.VI-4	Self-support. sys.of pref.panels 1/2"	Not used	
Fig.VI-5	As above but 1"	Not used	
3.Installation of 1 or 3 hr. Self-supporting Interface between Cable Tray and Conduit	Provides detailed instr.and installation sequence	3.3	
Fig.VI-6	Typical cable tray and cable interface	Not used	
Section VII T-L Fire Barrier Coating Application		3.3	
1.T-L 351-2 Primer Application		3.3	
2.T-L 330-1 Spray Application		3.3	
3.T-L 330 Trowel Application		3.3	
4.T-L 330-660 Trowel Application		3.3	
5.T-L 350 Two Part Spillresistant Top Coat		3.3	
6.Dry Film Thickness Measurement		3.3	
7.Repair Procedures		3.2	
8.Cable Replacement		3.2	
9.Post Application Procedures		3.2	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
Section VIII A. Technical Documentation			
T-L 330-1 Data Sheet		3.2	
T-L 330-69 Stress Skin Data Sheet		-	
T-L 351-2 Primer Data Sheet		3.2.2.5; 3.3.6	Spec.lists 351 and chem. solvents; Manual lists 351-2 and water as a solvent Primer is not part of Fire Barrier System and therefore does not impact design basis. Note: documents will be provided to justify acceptability [LATER]

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
T-L 350 Spill Resistant Top Coat Data Sheet	Specifies 28 days or less than 20 reading on moisture meter for curing of 330-1 before top coat appl.	3.2.7.2; 3.3.7.2	TSI temp. at least 5°F above dew point spec does not list this req.; spec. solution req.10% by volume,TSI max 5% for roller appl. 10% for spray. Cure time for 330-1 in 3.3.7.2 specified as 14 days Or less than 100 on moist meter. In 3.2.7.2 only 24 hrs specified. Top coat not part of Fire Barrier System. Documentation of acceptability will be provided.
T-L 330-70 Ceramic Insulator Data Sheet		-	
T-L Prefab.Panel Data Sheet		-	
T-L Preshaped Cond.Section Data Sheet		-	
T-L 330-660 Flexi Blanket Bulk Material Data Sheet		-	
B.Recommended List of Instr. Tools		-	
C.Recommended List of Spray Equipment		-	
D.Recommended Onsite Quality Control Procedures		-	

Appendix A.2

TSI MANUAL REVIEW - Unit 1
Spec. 2323-MS -38H Rev.2/DCA 77269 R3

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
Section I			
A. General Description	Describes T-L Material	NA	
B. Fire Barrier Design	Describes 5 basic designs of T-L 330	2.2.1	
I. T-L Prefab.Panel Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	2.6.2; 2.7.2	
II. T-L Preshaped Conduit Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	2.6.2; 2.7	
III. Direct Spray Over Stress Skin Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	2.7	
IV. Direct Spray On Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	2.7	
V. T-L 330-660 Flexi Blanket Thermal Blanket Design a.Composition b.Installation details	Defines rating and thickness,and installation requirements	2.7	
C.Material Components	Describes material used in T-L 330 Fire Barrier	App.A Sect.2	

TSI Section No. or Dwg.No.	Subje	Addressed in Specification in Section No.	Comments
D Recommendations-Primary [illegible] way Su ports and All [illegible]trations into the T-L 330 Fire [illegible]rier	Rec[illegible] s str[illegible] eel to b pr[illegible] d min 18[illegible] m fire b[illegible]	1.3.24; 1.3.25; 1.3.26; 1.3.28	Spec.req.is o" versus TSI Just ied b calculatic CA-0000-[illegible]
E.Preapplication Practices	C ntractor to be qualified by TSI	2.7	
F.Safety Precautions	Conform to OSHA		
(Delivery	Defines delivery requirements	App.A Sect4.2	
H.Storage	Defines storage conditions and temp.	1.3.17; 2.2.5 App.A Sect1	
Section II. T-L Fire Barrier System for Cable Trays	Provides detailed instr.and installation sequence	Section 2.2.1; 2.6; 2.7	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
1.Prefab.Panel Ready Access Design for Cable Trays		2.6; 2.7	
Fig.II-1	Solid Bottom Tray Miter Cut		
Fig.II-2	Ladder Tray Butted Cut	M1-1701 Sh5 Det.5-2	Wire att.to ladder diff. from spec. req.removal & holes patch Installation aid only does not impact design basis.
Fig.II-3	Ladder Tray Scored One Piece		
Fig.II-4	Solid Bottom Scored One Piece	M1-1701 Sh5 Det.5-1	
Fig.II-5	Ladder Tray Scored One Piece		
2.Direct Spray Over Stress Skin Design for Cable Trays			
FigII-6,FigII-7,FigII-8	Stress Skin Prep.Det.with Mech. Fasteners	Not used	
FigII-9,FigII-10,FigII-11	As Above but using s.s. wire or banding	Not used	
Section III T-L 330 Fire Barrier System For Protection of Conduit,Cables Drops and Instr. Tubing	Provides detailed instr.and installation sequence	2.6; 2.7	
1.Preshaped Cond.Section Design		2.7	
Fig.III-1	Preshaped Cond.Det.	M1-1701Sh4 Det10	
Fig.III-2	Cond.Adjacent to Concr.Wall	M1-1701Sh4 Det12	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
2.Direct Spray Over Stress Skin Design Fig.III-3 Fig.III-4	Direct Spray Over Stress Skin As Above but 3 Hr. Det.	2.7 Not used Not used	
3.Direct Spray-On Design		2.7	
4.T-L 330-660 Flexi-Blanket Therm. Barrier Fig.III-5 Fig.III-6	T-L 330-660 Inst.Det.1-Hr. As Above but 3 Hr.	2.7 M1-1701Sh4 Det11 NA	
Section IV T-L 330 Fire Barrier for Protect. of Junction Boxes,Pull Boxes and Condulets	Provides detailed instr.and installation sequence	2.7	
1.Prefabricated Panel Design Fig.IV-1 Fig.IV-2 Fig.IV-3	Prefab.Panel for Surf. Mounted Junct.Boxes As Above but not surface mounted As Above but for condulets	M1-1701Sh2 Det2-3 M1-1701Sh6 Det6.1	Tie wires shown remaining/ penetrating fire barrier. Acceptable based on TSI details II-1, 2, and 3.
2.Direct Spray Over Stress Skin		2.7	
3.Direct Spray or Trowel Appl.		2.7	
4.T-L Flexi Blanket		2.7	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
Section V T-L Fire Barrier System for Structural Supports, Hangers and Fire Dampers	Provides detailed instr.and installation sequence	2.7	
1.Prefabricated Panel Design Fig.V-1 Fig.V-2	 Detail for Struct. Steel Detail for Fire Damper	 M1-1701Sh1 Det1-1,1-4.1 Not used	
2.Direct Spray or Trowel Appl.		2.7	
3.T-L 330-660 Flexi Blanket		2.7	
Section VI T-L 330 Fire Barrier for Interfaces	Provides detailed instr.and installation sequence	2.7	
1.Installation of 1 or 3 Hour Fire Barrier for Interfaces between Cable Tray,Conduit,Instr. Tubing and Penetr. Seal Fig.VI-1 Fig.VI-2 Fig.VI-3	Installation sequence for prefab. or coating over stress skin method T-L F.B. raceway Interfacing w/penetr.seal 1/2"-1hr. As above but 1"-3hr. As Above but 2x1/2" = 3hr.	2.7; 2.8 M1-1701 SH5A Det5-4 NA NA	

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
2.Installation of 1 or 3 hr. Self-supporting Interface between Conduit or Instr. Tub. and wall or Ceiling Fig.VI-4 Fig.VI-5	Installation sequence for prefab. or coating over stress skin or flexi blanket method Self-support. sys.of pref.panels 1/2" As above but 1"	 Not used Not used	
3.Installation of 1 or 3 hr. Self-supporting Interface between Cable Tray and Conduit Fig.VI-6	Provides detailed instr.and installation sequence Typical cable tray and cable interface	2.7 Not used	
Section VII T-L Fire Barrier Coating Application		2.7	
1.T-L 351-2 Primer Application		2.7	
2.T-L 330-1 Spray Application		2.7	
3.T-L 330 Trowel Application		2.7	
4.T-L 330-660 Trowel Application		2.7	
5.T-L 350 Two Part Spillresistant Top Coat		2.7	
6.Dry Film Thickness Measurement		2.7	
7.Repair Procedures		2.9	
8.Cable Replacement		2.9	
9.Post Application Procedures		2.10	
Section VIII A. Technical Documentation			

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
T-L 330-1 Data Sheet		App.A Sect5	Wire and banding listed as steel not s.s. Section 3 requires s.s. steel acceptable as-is
T-L 330-69 Stress Skin Data Sheet		-	
T-L 351-2 Primer Data Sheet		2.6.3; App.A Sect4	Spec.lists 351 and chem. solvents; Manual lists 351-2 and water as a solvent Primer is not part of Fire Barrier System and therefore does not impact design basis. Documents to be provided later.
T-L 350 Spill Resistant Top Coat Data Sheet		2.7.14; 2.6.3	TSI temp. at least 5°F above dew point spec does not list this req.; spec. solution req.10% by volume.TSI max 5% for roller appl. 10% for spray Top coat not part of Fire Barrier System and therefore does not impact design basis. Documentation to be provided later.

TSI Section No. or Dwg.No.	Subject	Addressed in Specification in Section No.	Comments
T-L 330-70 Ceramic Insulator Data Sheet		-	
T-L Prefab.Panel Data Sheet		-	
T-L Preshaped Cond.Section Data Sheet		-	
T-L 330-660 Flexi Blanket Bulk Material Data Sheet		App.A Sect6	
B.Recommended List of Instr. Tools		-	
C.Recommended List of Spray Equipment		-	
D.Recommended Onsite Quality Control Procedures		-	

COMMODITY	CONDUIT 3/4 CONTROL FILL 30 %	CONDUIT 3/4 INSTRUMENT FILL 28 %	CONDUIT 1 IN POWER FILL 36%	CONDIUT 1 IN CONTROL FILL 30-40%	CONDUIT 1 IN INSTRUMENT FILL 35 %	CONDUIT 1 1/2 POWER FILL 9 %
M2-1701 DETAIL NO.	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2
TESTED CONFIGURATION	NO	NO	NO	NO	NO	NO
TEST ACCEPTABLE	N/A	N/A	N/A	N/A	N/A	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802
TESTING CATEGORIES	1	1	1	1	1	2

KEY

1=TESTING REQUIRED TO SUPPORT POSITION
2=ENGINEERING EVALUATION BASED ON ITEM 1 ING
3= ENGINEERING EVALUATION BASED ON PRESE... TESTS

COMMODITY	CONDUIT 1 1/2 CONTROL FILL 29-46 %	CONDUIT 1 1/2 INSTRUMENT FILL 26-35 %	CONDUIT 2 IN POWER FILL 9-28%	CONDUIT 2 IN CONTROL FILL 13 - 32 %	CONDUIT 2 IN INSTRUMENT FILL 4-54 %	CONDUIT 3 IN POWER FILL 8 - 35 %
M2-1701 DETAIL NO.	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2
TESTED CONFIGURATION	NO	NO	NO	NO	NO	NO
TEST ACCEPTABLE	N/A	N/A	N/A	N/A	N/A	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802
TESTING CATEGORIES	2	2	2	2	2	

COMMODITY #	CONDUIT 3 IN CONTROL FILL 40 %	CONDUIT 3 IN INSTRUMENT FILL 12 - 54 %	CONDUIT 4 IN POWER FILL 9 - 40 %	CONDUIT 4 IN CONTROL FILL 34 - 38 %	CONDUIT 4 IN INSTRUMENT FILL 22 - 51 %	CONDUIT 5 IN POWER FILL 13 - 26 %
M2-1701 DETAIL NO.	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 1-6,7, 6-1,2
TESTED CONFIGURATION	NO	NO	YES ITL. 84-5-387	YES ITL. 84-5-387	YES ITL. 84-5-387	NO
TEST ACCEPTABLE	N/A	N/A	YES	YES	YES	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	N/A	N/A	N/A	TEST DATA EVALUATED FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802	N/A	N/A	7.5 OR 20 % BY CALCULATION/ TEST UL. R6802
TESTING CATEGORIES	2	2	N/A	N/A	N/A	

COMMODITY	CONDUIT 5 IN CONTROL FILL 33 - 41 %	CONDUIT 5 IN INSTRUMENT FILL 32 - 51 %	TRAY 12 X 4 POWER FILL 45-107 %	TRAY 12 X 4 CONTROL FILL 22 - 30	TRAY 12 X 4 INSTRUMENT FILL 3 - 48 %	TRAY 18 x 4 POWER FILL 42-135%
M2-1701 DETAIL NO.	4-1,2,3,4,5 4-6,7, 6-1,2	4-1,2,3,4,5 4-6,7, 6-1,2	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1
TESTED CONFIGURATION	NO	NO	YES ITL. 87-5-77	YES ITL. 87-5-77	YES ITL. 87-5-77	NO
TEST ACCEPTABLE	N/A	N/A	YES	YES	YES	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	N/A	N/A	N/A	TEST DATA EVALUATED FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	31 % BY CALCULATION/ TESTING ITL.82-335-F-1	N/A	N/A	31 % BY CALCULATION/ TESTING ITL.82-335-F-1
TESTING CATEGORIES	2	2	N/A	N/A	N/A	

COMMODITY	TRAY 18 X 4 CONTROL 1 39 %	TRAY 18 X 4 INSTRUMENT FILL 5 - 65 %	TRAY 18 X 6 POWER FILL 9 %	TRAY 18 X 6 CONTROL FILL 9 %	TRA 24 X 4 POWER FILL 11 - 52 %	X 4 CONTROL FILL 11 - 53 %
M2-1701 DETAIL NO.	5 ,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1
TESTED CONFIGURATION	NO	NO	NO	NO	NO	NO
TEST ACCEPTABLE	N/A	N/A	N/A	N/A	N/A	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR E ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DA EVA FOR SIZE ACCEPTABLE	TEST D FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	31 % BY CALCULATION/ TESTING ITL.82-335-F-1	N/A	31 % BY CA ATION/ TESTING ITL.82-335-F-1	N/A
TESTING CATEGORIES	2	2	2	2	2	

COMMODITY #	TRAY 24 X 4 INSTRUMENT FILL 1 - 43 %	TRAY 24 X 6 CONTROL FILL 15 - 55 %	TRAY 30 X 4 POWER FILL 20 - 120 %	TRAY 30 X 6 CONTORL FILL 21 - 44 %	TRAY 30 X 6 INSTRUMENT FILL 21 %	TRAY 36 X 6 CONTROL FILL 6 %
M2-1701 DETAIL NO.	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1	5-1,2,3,3.1
TESTED CONFIGURATION	NO	NO	NO	NO	NO	NO
TEST ACCEPTABLE	N/A	N/A	N/A	N/A	N/A	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE	TEST DATA EVALUATED FOR SIZE ACCEPTABLE
DERATING FACTOR METHOD	N/A	N/A	31 % BY CALCULATION/ TESTING ITL.82-335-F-1	N/A	N/A	N/A
TESTING CATEGORIES	2	2	2	1	1	

COMMODITY	TRAY 36 X 6 INSTRUMENT FILL .6 %	AIR DROPS VARIOUS	PULL/JUNCTION BOXES VARIOUS	TWO TRAYS IN COMMON ENCLOSURE	TWO CONDUITS IN COMMON ENCLOSURE	ELEC BOXES IN COMMON ENCLOSURE
M2-1701 DETAIL NO.	5-1,2,3,3.1	3-1,1.1,1.2,2,2.1 3-3,4,5	2-2,3	N/A	N/A	N/A
TESTED CONFIGURATION	NO	YES ITL. 84-5-387	PARTIAL ITL. 84-5-387	NO	NO	NO
TEST ACCEPTABLE	N/A	YES	YES	N/A	N/A	N/A
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR SIZE ACCEPTABLE		TEST DATA EVALUATED FOR CONFIGURE. ACCEPTABLE	TEST DATA EVALUATED FOR CONFIGURE. ACCEPTABLE	TEST DATA EVALUATED FOR CONFIGURE. ACCEPTABLE	TEST DATA EVALUATED FOR CONFIGURE. ACCEPTABLE
DERATING FACTOR METHOD	N/A	VARIOUS BY CALCULATION 16345-EE(B)-140	VARIOUS JUSTIFICATION IN DCA ENGINEERING BASI	VARIOUS JUSTIFICATION IN DCA ENGINEERING BASI	VARIOUS JUSTIFICATION IN DCA ENGINEERING BASI	VARIOUS JUSTIFICATION IN DCA ENGINEERING BAS
TESTING CATEGORIES	1	N/A	3	3	3	

COMMODITY	STRUCTURAL STEEL VARIOUS
M2-1701 DETAIL NO.	N/A
TESTED CONFIGURATION	PARTIAL UL. X611
TEST ACCEPTABLE	YES
ACCEPTED ENGINEERING EVALUATION	TEST DATA EVALUATED FOR CONFIGURE. ACCEPTABLE
DERATING FACTOR METHOD	N/A
TESTING CATEGORIES	3

APPENDIX C

Engineering Evaluation
of
Generic Non-Tested Configuration
for
Raceways

There are basically two Non-Tested Generic Configurations at CPSES. They are; 1) small conduits (with diameters ranging in size from 3/4 in to 3 in and 2) large cable trays (with widths ranging from 18 in to 36 in).

A. Small Conduits

There are fundamentally two types of failure modes of fire barriers protecting raceways. One failure mode is that the thermal properties of the fire barrier material are not adequate to limit raceway temperatures and thus cable temperatures below a predetermined maximum value (NRC references 325°F). The other failure mode is lack of fire barrier integrity, that is the fire barrier does not remain intact during the fire scenario (e.g., the joints or seams open up).

For small conduits, the issue is a thermal properties problem. Only 4 in. and larger conduits have been tested with Thermo-Lag fire barrier systems. For conduits (round fire barrier), smaller diameter conduits present the worst case thermally. This is predicated by the fact that the wall thickness of the conduit get thinner as the conduit diameter decreases (reducing the mass) and the weight of material (W) to heated perimeter (D) ratio decreases as the conduit gets smaller (3/4 in.; W/D = .10; and 4 in.; W/D = .54). As the "W/D" ratio decreases for a given thermal resistance, internal temperatures will increase. (Ref 5).

In order to determine the effect of the reduction in conduit size, three fire models (thermal models) were used. One was a heat lump model and the other two were finite element nonsteady state heat transfer models. Though the results between the 3 models varied greatly, the results for various size conduits within each model varied less than 15 percent. Based on a review of the Fire Tests, a small 3/4 in. conduit could reach 350°F. However, the NRC in generic letter 86-10 stated that with adequate justification higher temperatures would be acceptable. Based on the types of cable used at CPSES (IEEE-383 qualified cable, the results of the fire endurance tests, and Refs. 6 and 7), temperatures as high as 400°F would be acceptable. The acceptability is based on the fact that circuit integrity can be maintained and the cables inside the fire barrier will not ignite.

1. Discussion of Fire Models

a) Heat Lump Model

The heat lump model was taken from Ref. 2 and is as follows:

$$\Delta T_s = \frac{k_i}{h}\left[\frac{T_f - T_s}{C_s(W/D) + 1/2\ C_i P_i h}\right]\Delta t$$

Where

ΔT_s	=	temperature rise in the steel (°F)
D	=	heated perimeter (ft) = π d; d = outer I.D. of conduit
W	=	weight of conduit (steel only) per linear foot
C_s	=	steel specific heat (Btu/lb°F) use .12 Btu/lbm-F Ref. 2
C_i	=	specific heat of Thermo-Lag (Btu/lbm °F) use 2.3 discussed later
P_i	=	density of Thermo-Lag (lmb/ft^2) use 78 per Ref. 1
T_f	=	fire temperature (°F)

Where $T_f = C_1$ logic $(0.133t + 1) + T_o$

C_1	=	620 °F per Ref. 1
t	=	time elapsed in sec
T_o	=	original ambient temperature 75°F used per Ref. 8
T_s	=	steel temperature °F
k_i	=	thermal conductivity of Thermo-Lag (Btu/ft-s °F) (discussed later)
h	=	Thickness of Thermo-Lag in ft use .5 in/12 = .04 design min.
Δt	=	time step in (sec)

By running this equation in an iterative process, using small time increments, the temperature of the steel can be determined. The three variables which greatly effect the results of the model and are not constant are; the specific heat (C_i), density (P_i) and thermal conductivity (k_i) of Thermo-Lag. Thermo-Lag is a subliming material which sublimes around 375°F. The physical changes that take place have not had sufficient data collected to provide detailed data on the physical changes. For this analysis, a C_i of 2.3 Btu/lbm°F was used based on Ref. 1. This C_i is an approximation of the heat capacity during sublimation. A density of 78 lbm/ft^3 was used, this is the density at 70°F, and a thermal conductivity of .03 was used. Normally k_i = .1, however .03 was used to account for charring.

This model was run on 5 in., 4 in., 3 in., 2 in., 1 in. and 3/4 in. conduits. As can be seen in Figure C-1, the effect of conduit size, only has a small impact on temperature.

This model was also run on 4 in. and 3/4 in conduits varying the k_i and C_i. The results showed that varying these parameters only slightly, varied the results significantly, but that the difference in temperature due to conduit size remained around 10 percent between the 4 in. and 3/4 in.

b) Finite Element Models

The two finite element models basically use the same approach except one was normalized to a flat plate model while the other used a circular model. The basic format of the equations used are as follows Ref. 4:

$$\Delta T_m = \left[A\left[\frac{k_m}{h_m}(T_1 - T_3)\right]\right] x \left[\frac{\Delta t}{C_M \times P_m \times V_m}\right]$$

Where ΔT_m = change in material temperature
k_m = thermal conductivity of materials
C_m = specific heat of materials
P_m = density of material
A = area of material
h_m = thickness of material
Δt = time increment
T_1 = outside surface temperature
T_3 = inside surface temperature

By making up a series of small elements (using the above equation), a model of the Thermo-Lagged conduits was made. To model the fire conditions, the following was done to the model.

The flame temperature was modeled using the following equation to simulate the ASTM E-119 Time - Temperature curve.

T_f	= $C_1 \log 10 (0.133\ t + 1) + T_o$	Ref. 2
T_f	= fire temperature °K	
C_1	= 620 constant	Ref. 2
t	= time (sec) lapsed time	
T_o	= ambient temperature, 535°K = 75°F ambient	

The thermal heat transfer for convective and radiative heat transfer was modeled by replacing $\frac{k_m}{h_m}$ with

α; where $\alpha = \alpha r + \alpha c$. αr is the radiative component and equals $1.714 \times 10^{-9} \times E_f \times (T_f{}^\wedge 4 - T_1{}^\wedge 4)/(T_f - T_1)$

where T_f = Fire Temperature
T_1 = surface Temperature of materials
E_f = flame emissivity this was varied between .7 and 1 and shown to have insignificant impact on the results.

αc is the convective heat transfer component, which was kept constant at 6.0 Btu/hr-ft²°F. This simulates an air velocity of 1320 fpm which is larger than the air movement in any ASTM E-119 furnace.

C_m for the steel was modeled using the following equation from Ref. 1.

C_s = .100322 + (3.3075 x 10^{-5} x T_s) + (9.383 x 10^{-8} x T_s)
C_s = specific heat of steel
T_s = temperature of steel

k_m for the steel was modeled using the following equation from Ref. 1.

k_s = .05305 - (2.23 x 10^{-5} x T_s) + (1.186 x 10^{-8} x T_s^2)
k_s = thermal conductivity of steel

C_m for the Thermo-Lag was modeled using the following equations based on Ref. 1.

C_t = .3 for T_t < 350°F
C_t = .08 x (T_t - 350) + .3 for T_t = 350°F To 375°F
C_t = 2.3 - .08 x (T_t - 375) for T_t = 375°F to 400°F
C_t = .3 for T_t > 400°F

Where

C_t = specific heat of Thermo-Lag
T_t = temperature of Thermo-Lag

The variation between 350°F and 400°F is to represent the impact of subliming on the model.

k_m for Thermo-Lag was modeled using the following equations based on Ref. 1.

k_t = .1 for T_t < 350°F
k_t = .01 for $T_t \geq$ 350°F

Where

k_t = Thermal conductivity of Thermo-Lag

This increase is used to represent the increase in k_t caused by the expansion of TSI material during subliming and the charring effect.

These models were also run on 5 in, 4 in, 3 in, 2 in, 1 in and 3/4 in conduits. Even though the results differed greatly between the two models and the varying of parameters, the difference in the effect of size remained about the same.

Therefore, the temperature of smaller conduits can be expected to be above that of a 4 in conduit, but will be within acceptable limits. These models were run to judge the sensitivity of the raceway internal temperature to raceway size using existing test data. Based on these results minimal risk exists in proceeding with the Unit 2 installations while final justification will be based upon augmented testing.

B) Large Trays

Unlike the small conduits, the large trays are a barrier integrity (structural) concern, instead of a thermal concern. This integrity concern is based on the unsupported length of TSI material.

At CPSES, in accordance with the installation specifications, for trays 24 in and over, additional steel banding is required. This additional banding provides an increase in support for the Thermo-Lag. In addition, for the tops of trays, the "V" in the Thermo-Lag is installed perpendicular to the tray, this also increases the structural integrity of the fire barrier.

Based on these additional installation requirements at CPSES, the fire barrier around, large trays will remain intact, thereby providing the required level of protection.

These conclusions will be augmented by additional testing as noted in Section 9 .

References

1. CPSES calculation ME-CA-0000-2062 Rev. 0.

2. The SFPE Handbook of Fire Protection Engineering.

3. NBS Report PB - 284-517 "A Numerical Procedure for Calculating Temperature in Hollow Structures Exposed to Fire." by ULF Wickstrom.

4. Heat Transfer by Frank M. White

5. Underwriters Labs "Fire Resistance Directory" ed 1987.

6. U.S. Department Transportation Report No. UMTA-MA.06-0025-79-1, Volume I "Electrical Insulation Fire Characteristics."

7. EPRI Report No. NP-1675 "Assessment of Exposure Fire Hazards to Cable Trays."

8. NRC Generic Letter 86-10 "Implementation of Fire Protection Requirements," 4/24/86.

APPENDIX D.1

DCAs POSTED AGAINST SPECIFICATION 2323-MS-38H

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
18569	0	Fire protection envelope is seismically too rigid. Install flexible fire barrier system. Add specification section 3.8.5. Specification sections 3.6.8, 3.6.9, 3.7.7 and 3.7.5 are not applicable	No impact on Design Basis
78607	0	DFT for site fabricated Thermo-Lag Panels.	DCA Engineering Basis
81340	0	9" Rule. Final 1" of protruding items (instrument lines) are covered by insulation.	DCA Engineering Basis
81377	0	9" Rule. Final 1" of protruding item is a lamphead.	DCA Engineering Basis
85011	0	330-660 flexiblanket thickness violation (3/8" vs. 1/2") due to interference. Wrap is required to limit combustibles only.	DCA Engineering Basis
86194	0	Interference. 4" chill water pipe interferes with cable tray fire barrier enclosure. TSI prefab panel inside tray. Pipe wrapped with TSI 330-70 ceramic blanket.	See Section 8.6.2
86764	0	Interference. 6" chill water pipe interferes with cable tray fire barrier enclosure. TSI prefab panel inside tray. Pipe wrapped with TSI 330-70 ceramic blanket.	See Section 8.6.2
86804	0	9" Rule. Final portion of protruding item is smoke detector	DCA Engineering Basis
86805	0	9" Rule. Final portion of protruding item is smoke detector 004-18.	DCA Engineering Basis
89857	1	Interference. 10" condenser vacuum line interferes with 4" conduit fire barrier enclosure. (< 1/8"). TSI document (not included) states 1/8" fillet TSI 330-1 has a 12 min. fire rating. Pipe wrapped with TSI 330-70 ceramic blanket.	See Section 8.6.2
89860	2	Prefab panel with no stress skin installed between interfaces. Prefab panel banded per 330-660 requirements. Siltemp installed in cable tray at stress skin/cable interface. Detail 14-4. Common enclosure through wall sleeves (TWS).	DCA Engineering Basis

DC[illegible] OSTED AGAINST SPECIFICATI[illegible] 2323-M[illegible]38H

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
[illegible]27	3	[illegible]lternate detail to wrap non-essential cable airdrops to reduce weight of Thermo-Lag cable tray.	DCA Engineering Basis
91146	1	Prefab panel w/o stress skin was used to cover pipe support. TSI 330-70 ceramic blanket was used to provide wrap for 2" SW line. Invokes requirements of calculation ME-CA-0000-0990 R/O to jus[illegible]y TSI 330-70 wrap.	See Section 8.6.2
91906	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Detail 14-1. Invokes requirements of 2323-ES-100 for moving cables.	See Section 8.6.1
92198	0	Kellum grips, shims, and airdrops. Fire stop exceeds 11" protruding item limit in order to install one fire stop only.	DCA Engineering Basis
[illegible]2137	[illegible]	330-1 bulk used as an adhesive on embed pla[illegible] in lieu of mechanical fasteners. Details 12-1 a[illegible] 12-1.1.	DCA Engineering Basis
92580	0	Interference. 4" DD line interferes with two separate cable tray fire barriers (< 1/32" and < 3/4"). At 1/32" interface install 330-660 and install prefab panel w/o stress skin inside tray. At 3/4" interface install prefab pane[illegible] w/o stress skin.	DCA Engineering Basis
92541	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverag[illegible] [illegible] 5". Design utilizes band-through metho[illegible] sim[illegible] to that shown on Detail 2-3. Does not invoke 2323-ES-100 for moving cables.	See Section 8.6.1
92588	2	330-660 band spacing no[illegible] met. First and second layers of 330-660 will overlap instea[illegible] of being offset.	DCA Engi[illegible]ering Basis
[illegible]596	0	Secondary interference. 2" CC line through pipe support is a secon[illegible]ry inter[illegible]rence a[illegible] is not Thermo-Lagged. [illegible]side of pipe support H-CC-1-EC-006-002-3 is not Thermo-Lagged.	DCA Engineering Basis

DCAs POSTED AGAINST SPECIFICATION 2323-MS-38H

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
92610	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Does not invoke 2323-ES-100 for moving cables.	See Section 8.6.1
92613	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Does not invoke 2323-ES-100 for moving cables.	See Section 8.6.1
92644	1	Fire stop. Deletes fire stop requirements for conduits that begin and end in same area (Room 115A).	DCA Engineering Basis
92665	2	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Invokes 2323-ES-100 for moving cables.	See Section 8.6.1
92768	2	Reduction in overlap requirements for 330-660 and 330-1 interface from 3" min. to 1" min.	DCA Engineering Basis
92784	0	Reduction in overlap requirements for 330-660 and 330-1 interface from 3" min. to 1" min.	DCA Engineering Basis
92791	1	Interference. 3" DD line is a secondary interference. Pipe is wrapped with TSI 330-70 ceramic blanket. Invokes calc ME-CA-0000-990 R/O to justify wrap.	See Section 8.6.2
92813	1	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Does not invoke 2323-ES-100 for moving cables. Common enclosure-multiple trays and airdrops enclosed by single fire barrier.	See Section 8.6.1
92831	0	Reduction in overlap requirements for 330-660 and 330-1 interface from 3" min. to 1/2" min.	DCA Engineering Basis
92876	0	330-1 bulk used as adhesive on embed plate in lieu of mechanical fasteners. Detail 12-1 and 12-1.1.	DCA Engineering Basis
92935	0	Fire stop. Reduction in depth requirements for 330-1 fire stop from 4"-5" to 11/16" min.	DCA Engineering Basis
92971	0	Reduction in overlap requirements for 330-660 and 330-1 interface from 3" min. to 1/2" min.	DCA Engineering Basis

DCAs POSTED AGAINST SPECIFICATION 2323-MS-38H

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
92977	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Does not invoke 2323-ES-100 for moving cables.	DCA Engineering Basis
92988	1	Common Enclosure for air drops and conduits. Air drops for C12006987 and C12004695 are covered by prefab conduit w/o stress skin.	DCA Engineering Basis
93005	0	Reduction in overlap requirements for 330-660 and 330-1 interface from 3" min. to 1/2" min.	DCA Engineering Basis
93093	0	5" Rule. Invokes calculation ME-CA-0000-2062 R/O for reducing coverage to 5". Does not invoke 2323-ES-100 for moving cables.	See Section 8.6.1
93169	1	Air drop is wrapped with 330-660 flexiblanket completely through enclosure and continues to a separate enclosure.	DCA Engineering Basis
93240	0	Stress Skin. 3 foot long piece of prefab panel w/o stress skin is installed on bottom of tray T12OAD01.	DCA Engineering Basis

APPENDIX D.2

DCN'S POSTED AGAINST SPECIFICATION 2323-MS-38H

DCN NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
687	0	Dry-joint fitting for Junction Box Cover. Turnbuckle banding design.	See Section 8.6.3

APPENDIX D.3

NCRS POSTED AGAINST SPECIFICATION 2323-MS-38H

NCR NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
88-12990	1	RES Installation. Non Thermo-Lag related.	NCR Engineering Basis
89-03584	1	Temperature. Thermo-Lag 330-1 subliming material exceeded 100°F storage limit. Accept per TSI letter of Apr 5 1989 and retest	NCR Engineering Basis
89-03680	0	Flexiblankets and Prefab Conduit sections damaged by water. TSI Telecon.	NCR Engineering Basis
89-05610	0	Flexiblanket exceed min/max thickness. TSI letter dated Nov, 13, 1989.	NCR Engineering Basis
89-05613	0	COC for density requirements of 330-660.	NCR Engineering Basis
89-08602	0	Digital thermometer failed calibration; coating applications.	NCR Engineering Basis
89-08867	0	DFT dimensions preshaped conduit sections	NCR Engineering Basis
89-11534	2	330-660 Flexi-blanket exceeds max thickness requirement.	NCR Engineering Basis
89-11587	1	DFT and density measurements for 330-660.	NCR Engineering Basis
89-11600	1	DFT and density measurements for 330-660.	NCR Engineering Basis
89-11786	0	No density stated on COC.	NCR Engineering Basis
89-00502	0	Minimum storage temperatures.	NCR Engineering Basis

APPENDIX D.4

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
079272	6	M1-1700-added notes 4A and 4B re: through wall sleeves and protruding items. M1-1701 - added detail 5-4 and 5-5 for Thermo-Lag/Bisco seal interface (CT). Added detail 4-4 for Thermo-Lag/Bisco seal interface (Fl conduit). Qualification of Thermo-Lag penetrating a Bisco blockout justified by TSI Test ITL 82-3-2 and Spec 2323-MS-38F.	DCA engineering basis
081380		DCA not provided for review	N/A
081631	3	Provided detail and notes for protecting a containment penetration.	DCA engineering basis
083340	1	Common enclosure. Conduits and interferences.	DCA engineering basis
083342	3	Common enclosure. Conduits, junction boxes, and TWS. DCA allows band through method similar to Detail 2-3.	DCA engineering basis
083356	0	Common enclosure. Conduits.	DCA engineering basis
083656	0	Revised detail numbers for consistency.	DCA engineering basis
084505	4	Allows the use of Bisco fire stops (and specifies products) in Thermo-Lag installations.	DCA engineering basis
084682	0	Common enclosure. LBDs for essential conduits.	DCA engineering basis
084863	0	Provides wrap detail for conduit and small bore pipe hanger.	DCA engineering basis
084866	0	Common enclosure. Essential conduit and nonessential conduit.	DCA engineering basis
084868	0	Interference. Prefab (w/o stress skin) installed between pipe interference and bottom of essential raceway.	DCA engineering basis

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
084871	1	Interference. 4" Fire Protection Pipe interferes with protective envelope for essential cable tray. Include Pipe in envelope and wrap as protruding item.	DCA engineering basis
085079	1	Interference. HVAC is in hard contact with essential cable tray. Install (2) layers of 330-660 flexiblanket inside of tray at point of contact.	DCA engineering basis
085683	1	Alternate detail provided for conduit/unistrut arrangement. Created Detail 6.3. Anchor tie wire used instead of mechanical fasteners.	DCA engineering basis
086095	0	Interference. Seismic angle interferes with protective envelope for essential junction box. Flat board used and Detail 2-3 band through method was used.	DCA engineering basis
086183	3	Provided details for protruding air drops that penetrate a cable trays primary protective envelope. Reduces require protection from 9"-11" to 4"-5". Detail 3-1, 3-1.1.1, 3-1.1.2, 3-2.1, 3-3, 3-4.	DCA engineering basis
086802	1	9" Rule. Provided detail 7-4 for wrapping fire detector as protruding item.	DCA engineering basis
087040	1	Penetration Seal. Clarified ampacity concerns with BISCO SF60/150 seal material. Added notes to M1-1701 Sh. 2 and 4.	DCA engineering basis
087594	0	Interference. Sway strut and pipe clamp interfere with protective envelope installation for essential cable tray. Sway strut transferred to DCA 87593. Pipe clamp protected by depressed box design.	DCA engineering basis
087918		DCA not provided for review.	N/A
088553	0	9" rule. Protruding item coverage cannot meet 9" criteria when measured from outside the protective envelope. Measure from inside envelope.	DCA engineering basis
088583	0	Interference. Non-essential cable tray interferes with protective envelope for two essential cable trays. Wrap non-essential tray.	DCA engineering basis

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
088584	1	Interference. Cable tray support prevents proper installation of end cap. Tubing restraint block will not allow full ½" coverage of essential cable tray. Utilizes band-through method as shown on Detail 2-3. Reduces end cap thickness requirements.	DCA engineering basis
088660	1	Interference. 2" SS pipe interferes with installation of essential cable tray protective envelope. Use Detail 12 to include 2" pipe in protective envelope. Non-essential tray (protruding item) invokes calculation ME-CA-0000-2062 to wrap 5".	DCA engineering basis
089513	0	Cable tray overfill and cables touch concrete beam. Install protective envelope up to bottom of beam and band-through Thermo-Lag.	DCA engineering basis
089750		DCA not provided for review.	N/A
089751		DCA not provided for review.	N/A
089855	0	Interference. Pipe hangers interfere with proper installation of protective envelope for essential cable tray. Install box design, depressed in cable tray to avoid interference.	DCA engineering basis
089856	3	Common Enclosure. Two trays and two conduits. Interference. Pipes interfere with proper installation of essential cable tray protective envelope. Flexiblanket used inside tray at point of interference.	DCA engineering basis
089858	1	Interference. Insulated pipe interferes with proper installation of essential cable tray protective envelope. Notch prefab panel and install flexiblanket at interface. Install flat board inside of rail.	DCA engineering basis
089860		DCA not provided for review.	N/A
089927		DCA not provided for review.	N/A

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
089993	3	Interference. 2" pipe interferes with proper installation of cable tray protective envelope. Fire damper frame interferes with BISCO seal installation. Cover pipe as protruding item and use M Board to support Thermo-Lag.	DCA engineering basis
090222	0	Common enclosure. Air drops and embedded conduit sleeves.	DCA engineering basis
090227	0	Interference. Conduit and air drops interfere with proper installation of cable tray protective envelope. Install ½ section of preshaped conduit 330-1 at interface.	DCA engineering basis
091026	0	Use of preshaped conduit section larger than conduit size. Detail 4-1.1	DCA engineering basis
091146		DCA not provided for review.	N/A
091235	1	Cable tray not protected between nodes identified on M1-1700 installation schedule due to air drop. Essential cables are protected.	DCA engineering basis
091416	0	Interferences and seal interface. Use common enclosure.	DCA engineering basis
091631	1	Seal interface. Box in tray to concrete only.	DCA engineering basis
091737	1	Common enclosure. Multiple trays and TWS.	DCA engineering basis
091738	0	Common enclosure. Multiple trays, air drops and TWSs.	DCA engineering basis
091822	0	Protruding item. Non-essential cable tray shares common support with essential cable tray. Flexiblanket used to wrap non-essential cables in tray.	DCA engineering basis
091823	0	Seal interface. Install sheet metal and butt Thermo-Lag to concrete.	DCA engineering basis
091985	0	Proximity of essential conduits require detail modification.	DCA engineering basis

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
092007	0	Interference. Instrument tray (angle) prevents proper installation of protective envelope at cable tray support. Wrap instrument tray (angle) for 28".	DCA engineering basis
092134	0	Seal interface. Modify sheet metal installation.	DCA engineering basis
092167	2	Cable tray shims for interferences and overfill.	DCA engineering basis
092168	1	Interference. Instrument tubing support prevents proper installation of essential cable tray protective envelope. Modify support and wrap three sides.	DCA engineering basis
092200	0	Seal interface. Use Thermo-Lag panel flush with concrete.	DCA engineering basis
092204	0	Common enclosure. Multiple cable trays.	DCA engineering basis
092205	1	Modify essential cable tray protective enclosure to include air drop and ground cable.	DCA engineering basis
092206	0	Seal interface. Modify sheet metal sleeve in area of air drop.	DCA engineering basis
092207	1	Common envelope. Multiple trays.	DCA engineering basis
092212	2	Alternate pant-leg design for protecting air drops. Detail 7.5.	DCA engineering basis
092213	0	Alternate thermo-lag design for ground nut on conduit. Detail 7.1.	DCA engineering basis
092214	1	Air drop and Kellum grip coverage. Flexiblanket enters protective envelope.	DCA engineering basis
092260	0	Flex conduit/Rigid conduit interface. Detail 7.2	DCA engineering basis
092294		DCA not provided for review.	N/A
092295		DCA not provided for review.	N/A
092317		DCA not provided for review.	N/A

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
092383	0	Common enclosure and seal interface. Multiple trays.	DCA engineering basis
092451	0	Butting Thermo-Lag to concrete su:face. New Detail.	DCA engineering basis
092462		DCA not provided for review.	N/A
092515	0	Containment penetration. Box as if protruding item.	DCA engineering basis
092535	0	Overfill. Shim cable tray as required.	DCA engineering basis
092536	0	Interference. Grating support steel interferes with essential c: duit protective envelope. Trim grating support.	DCA engineering basis
092537	0	Interference. Fiat Board.	DCA engineering basis
092545	1	Interference. Wrap pipe as protruding item.	DCA engineering basis
092555	0	Common enclosure. Air Drops.	DCA engineering basis
092556		DCA not provided for review.	N/A
092564	1	Common enclosure. Multiple conduits Flexiblanket wrap.	DCA engineering basis
092566	0	Provide thermo-lag box to include air drops.	DCA engineering basis
092583	0	Interference.	DCA engineering basis
092584	0	Interference. Pipe.	DCA engineering basis
092585	2	Overfill.	DCA engineering basis
092586	2	Air drop wrap too stiff to complete installation.	DCA engineering basis
092588		DCA not provided for review.	N/A
092605		DCA not provided for review.	N/A

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
092611		DCA not provided for review.	N/A
092612	0	Identify essential cables and specify detail.	DCA engineering basis
092615		DCA not provided for review.	N/A
092634		DCA not provided for review.	N/A
092642	0	Wall penetrating and structural steel "secondary" steel member.	DCA engineering basis
092665		DCA not provided for review.	N/A
092684	0	Cable tray overfill and concrete butt.	DCA engineering basis
092705	0	Air drops through penetration.	DCA engineering basis
092720	0	Ground cable is thermally conductive path.	DCA engineering basis
092730	0	Common enclosure.	DCA engineering basis
092731	0	Thermo-Lag coverage for two essential conduits.	DCA engineering basis
092732	0	Common enclosure.	DCA engineering basis
092734	0	Cable tray protective enclosure box to allow for conduit.	DCA engineering basis
092741	0	Interferences. Conduit Supports and cable tray bundle at end of tray.	DCA engineering basis
092744	0	Common enclosure. Tray and multiple conduits.	DCA engineering basis
092745	4	Air drops; alternate detail.	DCA engineering basis
092755	2	Ampacity concerns; Additional thickness of 330-660. Air drops.	DCA engineering basis
092768		DCA not provided for review.	N/A
092771	0	Add note for butting Thermo-Lag to M-Board.	DCA engineering basis

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV. NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
092772	:	Common enclosure. Cable Trays and Junction Box.	DCA e ering basis
092813		DCA not provided for review.	N/A
092838	0	Alternate banding detail for cable tray supports with diagonal brace.	DCA engineering basis
092839	0	Modify detail to enclose con it LBDs with zero clearance.	DCA engineering basis
092841	1	Interference. HVAC dust stiffener. Install 2 layers of 330-660 around cable tray at interface.	DCA engineering basis
092860	0	Common enclosure. Air Dr s.	DCA engineering basis
092868	0	9" rule. Measure from cable tray to cable tray instead of from ou e protective envelope.	DCA engineering basis
092869	(	Interference. 4" pipe interferes with proper installation of essential cable tray protective envelope. Use flat board on side tail.	DCA engineering basis
092875		DCA not provided for review.	N/A
092876		CA not provided for review.	N/A
2905	1	Interference. 2" Pipe interferes with proper installation of essential cable tray protective envelope. Remove de rail extensions and u flat board.	DCA engineering basis
0929	0	5" rule. Invokes calculation ME-CA-0000-2062 for reducing coverage from 9".	DCA engine ng basis
092	0	Overfill tray with side extensions. Use siltemp before installing protective envelope.	DCA engin ing basis
09296		DCA not provided for review.	N/A
9297		DCA not provided for review.	N/A
093006	0	rfill. Install siltemp over cables before alling protective velope. Band through side s.	DCA engineering basis
93008		DCA not provided for review.	N/A

DCAs POSTED AGAINST DRAWINGS M1-1701

DCA NO.	REV NO.	DEVIATION	ACCEPTANCE/ RESOLUTION
093010	0	Interference. Steel framework interferes with proper installation of cable tray protective envelope. Use flat board.	DCA engineering basis
093025	0	9" rule. Request to measure direct thermal conductive path from inside protective envelope.	DCA engineering basis
093041	0	Cable tray overfill. Request to install side rails and siltemp to protect cables.	DCA engineering basis
093059	0	Detail to butt 330-660 to M-Board.	DCA engineering basis
093096	0	Common enclosure. Cable trays and air drops. Used flatboard.	DCA engineering basis
093104	1	Protective envelope for containment penetration.	DCA engineering basis
093108		DCA not provided for review.	N/A
093117	0	Common enclosure. Cable tray, TWS, and junction box.	DCA engineering basis
093130	0	Overfill. Extend thermo-lag side panels and install siltemp over cables.	DCA engineering basis
093137	0	Interference. Conduits interfere with proper installation of essential cable tray protective envelope. Modify protective envelope (depressed box) and wrap conduits as protruding items.	DCA engineering basis
093148		DCA not provided for review.	N/A
093169		DCA not provided for review.	N/A
093193	0	9" rule. Request to measure protruding item from inside of protective envelope.	DCA engineering basis
093240		DCA not provided for review.	N/A

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

April 3, 1992

MEMORANDUM FOR: Frank J. Miraglia, Deputy Director, Office Nuclear Reactor Regulation

FROM: A. Bert Davis, Regional Administrator, Region III

SUBJECT: CALLAWAY PLANT - THERMO-LAG CONCERNS

Your memorandum dated February 6, 1992, identified concerns pertaining to missing test results and engineering analyses to support Thermo-Lag installations at the Callaway Plant. From discussion with Loren Plisco of your staff, we understand the problem of missing test results and analyses is widespread. This is based upon additional site visits made since your memorandum on Callaway. You have, therefore, concluded that this issue should be addressed in a generic letter which is being prepared by the special NRR team reviewing Thermo-Lag issues.

Accordingly, no further action on the issue will be taken with respect to specific plants until issuance of the generic letter. Following issuance of the generic letter, we will proceed with whatever inspections are required. Currently, our next routine fire protection inspection at Callaway is planned for February 1994.

We will address the second issue in your memorandum (licensee's inability to locate a specific vendor supplied record) as part of a general inspection of Callaway engineering and technical support activities now scheduled for July 1992.

Please contact Mr. H. J. Miller (FTS 388-5788) of my staff if you have any questions on our response.

Carl J. Paperiello for

A. Bert Davis
Regional Administrator

cc: J. Zwolinski, NRR
B. Grimes, NRR
L. Plisco, NRR
S. West, NRR
SRI, Callaway

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