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REGION I

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2 North Ninth Street
Allentown, Pennsylvania
Facility: Susquehanna Steam Electric Station
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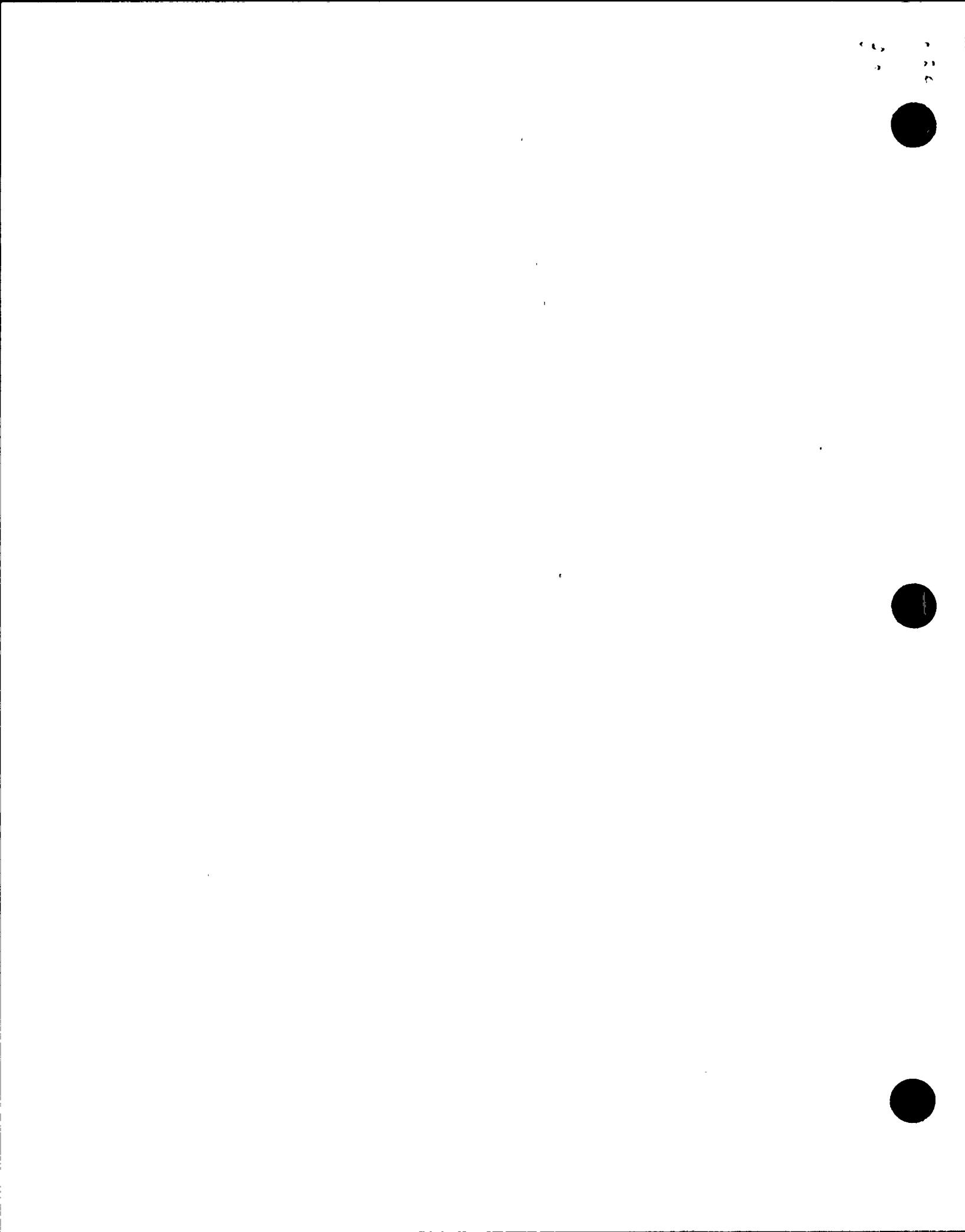
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12/3/92
Date

Inspection Summary: A special announced fire protection safety inspection was performed at the Susquehanna Steam Electric Station from August 24 - September 4, 1992, and at the Pennsylvania Power and Light (PP&L) headquarters in Allentown, Pennsylvania, on September 22, 1992. Inspection efforts continued in the NRC's Region I offices in King of Prussia, Pennsylvania until October 9, 1992. Additionally, a meeting was held with a former NRC employee, a fire protection reviewer, at the NRC offices in Rockville, Maryland, on October 7, 1992.

Areas Inspected: As a result of information identified by an NRC Office of the Inspector General (OIG) investigation and later documented in a OIG report issued on



August 12, 1992, and information from NRC Information Notice 92-46, questions had been raised concerning the qualification and adequacy of the Thermo-Lag fire barriers installed at Susquehanna Steam Electric Station Unit 1 to support licensing of the plant.

The information obtained from the OIG and the NRC's Office of Nuclear Reactor Regulation identified that PP&L submitted a deviation to the NRC in February 1982, requesting an exemption for three Unit 1 areas, to use a cable wrap fire barrier in areas without automatic fire suppression. At the time of the deviation request, nearly all of the required Thermo-Lag barriers were installed in Unit 1. In August 1982, PP&L conducted a fire test of a test specimen that simulated an as-installed cable tray configuration. The tested cable tray configuration did not meet the temperature rise criterion of the ASTM E-119 fire test. The NRC requested that PP&L install a layer of fiberglass on the one hour spray-on Thermo-Lag fire barriers on cable trays to conform to the manufacturer's recommended installation procedures and a previously tested and approved Thermo-Lag installation configuration. The NRC granted PP&L the deviation, in Supplemental Safety Evaluation Report Number 4 (SSER#4), for the three areas within the plant with the stipulation that PP&L comply with the manufacturer's installation procedures. For the remaining areas of the plant where Thermo-Lag was installed on cable trays without the fiberglass armoring and not in accordance with the manufacturer's recommended installation procedures, the licensee continued to rely on the test results from the August 1982 testing and PP&L did not seek an exemption for this condition. Therefore, based on information obtained from interviewing PP&L personnel, the OIG investigators were concerned that Susquehanna Unit 1 has been operating since 1982 with an unqualified Thermo-Lag fire barrier configuration that may not perform adequately.

Consequently, a detailed inspection was conducted and focused on the use of one hour spray-on Thermo-Lag 330-1 that was installed in the 1981 - 1982 time frame as a cable raceway wrap fire barrier at Unit 1 of the Susquehanna Steam Electric Station (SSES) to support plant licensing. This inspection was conducted to determine on what basis the licensee used their August 1982 test results to support the use of the Thermo-Lag cable wrap fire barrier system configuration without fiberglass armoring as a one hour rated fire barrier material when its use had not been found acceptable by SSER#4 for the three Unit 1 fire zones specifically addressed in the February 1982 exemption request. It was noted that SSER#4 did not clearly state that it should be applied to all areas of the plant. The inspection included a review of the qualification documentation used by the licensee to support the installation of the Thermo-Lag 330-1 throughout Unit 1 and a subsequent reevaluation performed by the licensee in response to NRC generic communications to justify continued use of this material in Units 1 and 2. The quality of these installed Thermo-Lag cable raceway fire barriers was inspected. During this inspection, other cable raceway fire barrier materials installed to support the licensing of Unit 1 were identified and the quality of these other fire barrier installations was also reviewed. These inspections included reviews of documents, interviews of responsible personnel and field inspections of installed raceway fire barrier materials.

Results: The inspectors concluded that the licensee was in specific compliance with Supplemental Safety Evaluation Number 4 (SSER#4) as it pertained to the use of one hour spray-on Thermo-Lag used as a fire barrier coating on raceways in Fire Zones 1-2D, 0-28B, and 0-28H (Section 2.0)¹.

Based on a sampling inspection, the inspectors concluded that all of the one hour spray-on Thermo-Lag installed on conduits in Unit 1 was in compliance with SSER#4 (Section 3.1.1). The one hour spray-on Thermo-Lag installed on cable trays in Unit 1 areas outside of Fire Zones 1-2D, 0-28B, and 0-28H was not installed in accordance with the methods approved for these three areas by the NRC in SSER#4. It appears that the licensee believed that SSER#4 applied only to those areas specifically addressed in their February 1982 exemption request. The inspectors concluded that there was reasonable evidence indicating that the licensee had a reasonable basis to believe that the rejection of the cable tray portion of the test results related only to the licensee's exemption request for the three areas, Fire Zones 1-2D, 0-28B, and 0-28H. This conclusion was based on the following information that was identified during the inspection.

Before interviewing the former NRC fire protection reviewer, the inspectors concluded that the NRC Staff reviewer considered the 250 degree cold side rise temperature criterion a requirement necessary to meet the fire barrier rating test acceptance criteria of ASTM standard E-119 and the guidance in Branch Technical Position 9.5-1. Then, the inspector verified this conclusion in an interview with the former NRC employee. The inspectors concluded that the licensee has reasonably demonstrated that, in 1982, they were unaware of, and were not attempting to meet, the 250 degree temperature rise criterion. It also appears that the licensee met the acceptance criteria specified in their qualification test submitted to the NRC for approval. No docketed information was found that indicated that the licensee's test procedures or acceptance criteria were rejected by the NRC. This issue concerning the licensee's interpretation of SSER#4 remains unresolved (Section 3.1.2).

In 1985, the licensee reevaluated the qualification of their raceway barriers when NRC Generic Letter (GL) 85-01 clearly identified cold side temperature as one specific acceptance criterion for cable raceway fire barrier wrap materials. As a result of this reevaluation, PP&L relied on a "generic" Thermal Science, Inc./Industrial Testing Laboratories (TSI/I.T.L.) test as a qualification basis for the one hour spray-on Thermo-Lag installed on the cable trays in their facility. This type of generic test has recently been called into question by NRC Information Notice (IN) 92-46 (Section 3.2). In 1986, the licensee was notified by Bechtel that the cable ampacity derating values previously used in the design of raceways wrapped with Thermo-Lag were too low. At the time of the inspection, the inspectors noted that the results of the evaluation of the less conservative ampacity derating values had not been incorporated into the plants design basis documents. The inspectors concluded that the licensee could have fully evaluated and dispositioned this concern in a

¹ Fire Zone Locations and Fire Barrier Materials are tabulated in Attachment 6

more timely manner. PP&L has since initiated actions to update their design basis documents, and this item remains unresolved pending further review of the licensee actions (Section 3.3).

The quality of cable raceway fire barrier installations was assessed by the inspectors through walkdown inspections of protected safe shutdown raceways (Section 4.1). The use of preformed Thermo-Lag 330-1 was not reviewed in detail since this material has been called into question by recent NRC generic communications (Section 4.2).

The NRC approved the use of Kaowool fire barrier wrap material in specific plant areas by accepting a contractor's recommendation to approve Deviation Request Number 17 based on grandfathering guidance from GL 85-01. This approval for the use of Kaowool is currently unresolved and will be tracked by an Inspection Follow-up Item (Section 4.3.1). The inspectors also found that, contrary to the fire protection program requirements, Kaowool was installed in a fire zone that did not have automatic fire suppression. Kaowool had not been approved for use without automatic fire protection. This violation is discussed in Section 4.3.2. Gypsum board enclosures were found installed as a raceway fire barrier in Fire Zone 0-28B. During the inspection, the licensee was unable to provide the inspectors with documentation that specifically supports a one hour rating for the installed gypsum board enclosure configuration. This item remains unresolved pending the licensee providing this qualification documentation or a fire protection engineer's evaluation justifying deviations from a tested and qualified configuration (Section 4.3.3). During walkdown inspections, the inspectors identified examples where these gypsum board enclosures and Kaowool, installed as a cable raceway fire barrier wrap, were not installed in accordance with design specifications. This is a violation of the fire protection program commitment for field personnel to verify that fire protection installations were installed in conformance with design specifications (Section 4.3.4).

The inspectors reviewed the licensee's program for conducting Technical Specification surveillance inspections of the cable raceway fire barriers and concluded that the licensee has not performed surveillance inspections of Kaowool barriers since their installation. This is a violation of Technical Specification requirement 4.7.7.1.a (Section 4.4). Walkdown inspections identified that in addition to spray-on Thermo-Lag, Kaowool and preformed Thermo-Lag cable raceway wrap materials were used by the licensee as fire barriers. Based upon a sampling inspection, including a walkdown of the ADS system, the inspectors concluded that those raceways required to be wrapped by the licensee's Appendix R safe shutdown analysis were wrapped. However, the adequacy of this safe shutdown analysis was not reviewed (Section 4.5).

The inspectors reviewed a sample of the facilities Fire Protection Features Drawings and conducted a walkdown of the plant. The inspectors also compared the Fire Protection Features Drawings to another one of the licensee's drawings that documented the plant's wrapped raceways. The inspectors noted conflicts between pairs of drawings and between drawings and as-installed plant configurations. The inspectors found that adequate quality

assurance had not been applied to these fire protection design basis documents. This is a violation (Section 5.1). Quality Assurance audits and surveillances of the fire protection program were reviewed and it appeared that licensee management has not fully used their assessment processes to the extent possible to identify deficiencies similar to those identified during this inspection (Section 5.2). Based on a review of previous inspection reports, licensee submittals, and NRC Safety Evaluation Reports, the inspectors concluded that the licensee's safe shutdown methodology has never been fully reviewed and inspected. This item is currently unresolved pending further NRC review (Section 5.3).

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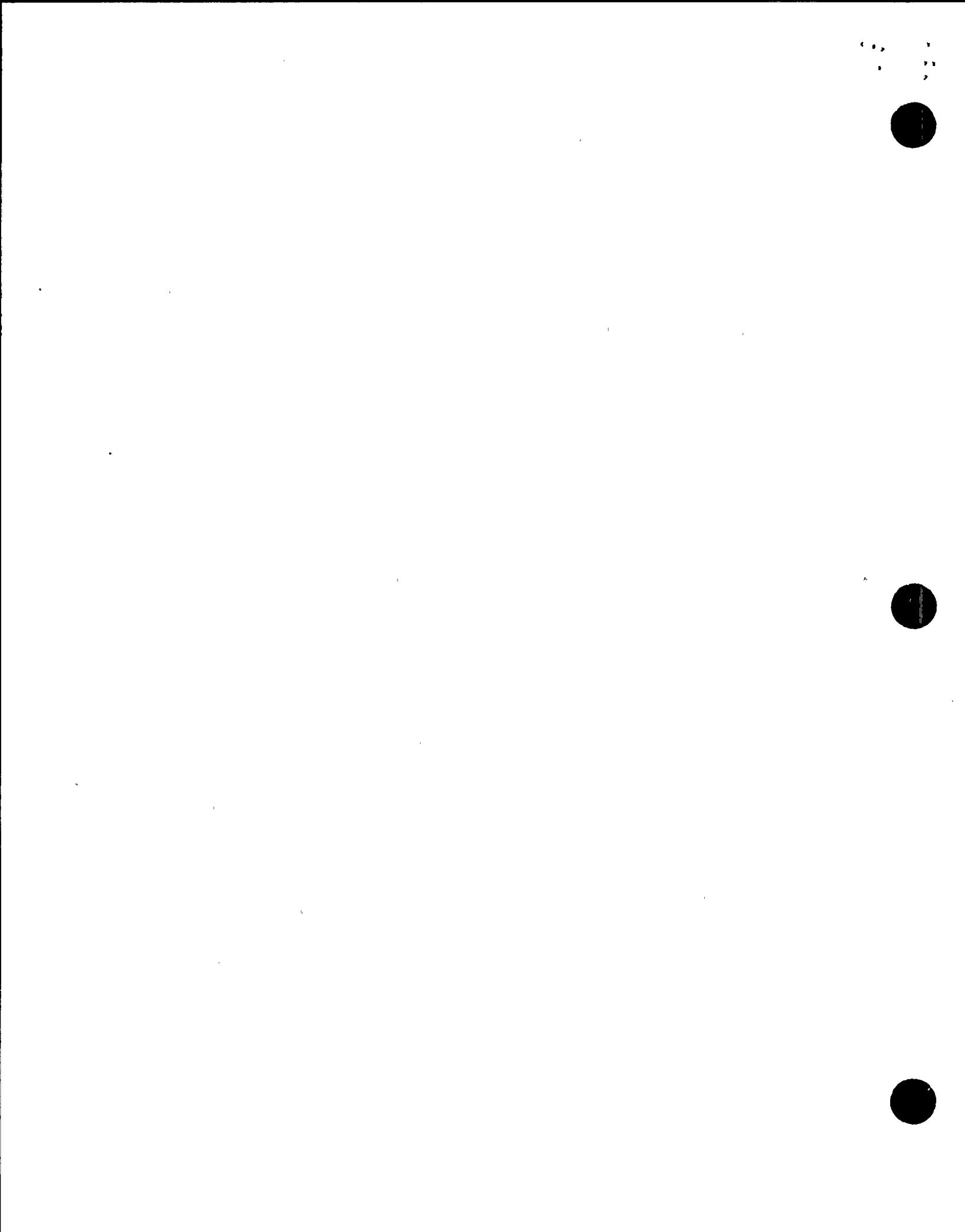


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INSPECTION FINDINGS

1.0 INSPECTION SCOPE

As a result of information obtained from an NRC Office of the Inspector General (OIG) investigation, documented in an OIG report issued on August 12, 1992, and further information in NRC Information Notice 92-46, questions had been raised as to whether Susquehanna Steam Electric Station (SSES) Unit 1 had been operating since licensing in 1982 with unqualified Thermo-Lag fire barrier configurations that might not perform adequately during a fire. This concern was based on information that OIG investigators obtained from interviewing PP&L personnel.

It was identified to the inspectors that PP&L submitted a deviation to the NRC in February 1982, requesting an exemption for three Unit 1 areas, to use a cable wrap fire barrier in areas without automatic fire suppression. At the time of the deviation request, nearly all of the Thermo-Lag barriers were installed in Unit 1. In August 1982, PP&L conducted a fire test of the as-installed Thermo-Lag Fire Barrier configurations. The test specimen replicating the as-installed cable tray configuration did not meet the temperature rise criterion of the ASTM E-119 fire test. Cable trays exceeded the acceptance criterion of a temperature rise of 250° F above ambient in approximately 45 minutes, and therefore, the licensee's proposed method of protecting cable trays was found unacceptable as a 1-hour rated fire barrier for the three areas addressed in the February 1982 exemption request. The NRC requested that PP&L supplement the installed cable tray wrap by installing a layer of fiberglass on the one hour Thermo-Lag cable tray fire barriers to meet manufacturer's recommended installation procedures and a previously tested and approved Thermo-Lag installation configuration. The NRC granted the deviation, in Supplemental Safety Evaluation Report Number 4, for the three areas within the plant with the stipulation that PP&L comply with the manufacturer's installation procedures.

In the remaining areas of the plant Thermo-Lag was installed on cable trays without the fiberglass armoring and this installation configuration was not in accordance with the manufacturer's recommended installation procedures. For these installations, the licensee continued to rely on the August 1982 test results. No exemption was sought for this condition.

Therefore, the inspectors' primary focus was to review the one hour spray-on Thermo-Lag fire barrier system that is used to protect cable raceways in Unit 1. The one hour spray-on Thermo-Lag material was installed during the Unit 1 licensing time frame of 1981 through 1982. The use of Thermo-Lag in Fire Zones 1-2D (Remote Shutdown Panel Room), 0-28H (Cold Instrument Shop), and 0-28B (Battery Equipment Room) was approved by the NRC in NUREG 0776, Supplement 4, the facilities Supplemental Safety Evaluation Number 4 (SSER#4). The licensee's use of Thermo-Lag in these three fire zones and compliance with SSER#4 is discussed in Section 2 of this report. The use and qualification of Thermo-Lag in Unit 1 areas outside of the three Fire Zones, 1-2D, 0-28B, and 0-28H, and in Unit 1 plant

areas common to Unit 2 and the ampacity derating factors for Thermo-Lag are discussed in Section 3.

The quality of Thermo-Lag barrier installations in Unit 1 and common plant areas installed to protect Unit 1 safe shutdown raceways is discussed in Section 4. These quality assessments were based, in part, on visual inspections during plant walkdowns. These walkdowns identified the use of other fire barrier systems, such as Kaowool fire barrier wrap material and Gypsum board enclosures. The quality of these other fire barrier systems installed to protect Unit 1 safe shutdown raceways, the use of Kaowool in a fire zone without automatic suppression, and periodic Technical Specification surveillance and inspection of these barriers are also discussed in Section 4. Additional issues, such as the quality of the licensee's drawings, the review status of the licensee's safe shutdown methodology, and Quality Assurance Audits and Surveillance are discussed in Section 5. It is noted that the licensee's safe shutdown methodology was not reviewed during this inspection since Revision 4 of the licensee's Fire Protection Review Report (FPRR) is currently under NRC staff review. Additionally, the use and qualification of preformed Thermo-Lag was also not reviewed since this material has been called into question by recent NRC generic communications including Bulletin 92-01.

Attachment 6 provides a table of fire zones inspected, a description of the fire zone location, and the cable raceway fire barrier materials used in these fire zones.

2.0 THERMO-LAG FIRE BARRIER CONFORMANCE WITH NRC SUPPLEMENTAL SAFETY EVALUATION NUMBER 4 (SSER#4)

Scope

The inspectors focused their initial inspection efforts on reviewing those areas where the NRC staff had reviewed and approved the use of Thermo-Lag for SSES. This was done by reviewing the fire protection approval chronology (Attachment 4) and discussing it with the licensee. Then the inspectors conducted a review of licensing documents to determine what fire barrier system installation configurations and installation methods were submitted and approved by the NRC Staff, and what, if any, stipulations were placed on the NRC approval. These licensing documents and other documents reviewed by the inspectors are listed chronologically in Attachments 5. Attachment 5 also provides pertinent excerpts from each of these documents. It was noted that SSER#4 approved the licensee's request for an exemption to document a change in their position regarding Branch Technical Position CMEB 9.5-1, Position C.5.b.2(c), and authorized the licensee to use one hour Thermo-Lag cable wrap barriers in three Fire Zones, 1-2D, 0-28B, and 0-28H, which are not protected by automatic fire suppression. The inspectors noted that the justification provided for this exemption request was PP&L's belief that when the combustible loading and reasonable transient combustibles are considered, fire detection, manual fire suppression, and one-hour rated cable enclosures without automatic suppression provide adequate protection for essential safe shutdown cables. Therefore, this portion of the inspection was conducted to determine whether or not the fire barrier systems installed in Fire Zones 1-2D, 0-28B, and 0-28H were installed in accordance with the methods approved in SSER#4. The applicable portions of SSER #4 are included in this report as Attachment 7.

This initial inspection was conducted by gathering facts concerning the Thermo-Lag material installed on cable trays and conduits in Fire Zones 1-2D, 0-28B, and 0-28H, during the 1981 - 1982 time frame. The licensee's installation procedures, specifications, and drawings were reviewed to ascertain whether they were in agreement with the licensing submittals and NRC approvals. Plant records were reviewed to determine whether the fire barrier systems had been installed in accordance with the appropriate installation documents. Visual inspections of the one hour spray-on Thermo-Lag fire barriers in these three fire zones were conducted to determine, to the extent possible by visual inspection, whether the one hour spray-on Thermo-Lag was installed in accordance with the licensee's specifications, drawings, and plant records. Cognizant personnel were interviewed regarding the inspection findings, records, and documentation inspected. The information obtained during these reviews was evaluated to determine if the fire barrier wrap materials installed on the conduits and cable trays in these three fire zones to support the licensing of the plant met the intent of SSER#4. SSER#4 was issued in November 1982.

2.1 Protection of Conduits

Findings

First, the inspectors reviewed SSER#4 as it pertained to the protection of conduits. SSER#4 stated, in part, that the licensee had conducted an ASTM E-119 test of a proposed cable wrap (fire barrier) in its as-installed configuration and documented the results in a report dated August 1982. The SSER further stated that the tests show that conduits protected by the proposed method possess a full 1-hour rating.

From a review of this test report² and the attached PP&L test specification, F1001, the inspectors found that the installation specifications for the test specimens replicating the as-installed one hour spray-on Thermo-Lag conduit configurations for the plant were contained in three Bechtel documents: Specification 8856-E-61; Field Change Request E6347; and Special Detailed Instructions for Installation of Thermo-Lag 330-1. These documents describe the installation of Thermo-Lag Stress Skin Type 330-69, Thermo-Lag 351 Primer, and Thermo-Lag 330-1 Subliming Compound. The inspectors noted that the Special Detailed Instructions, identified above, contained quality control checks for the installation of these Thermo-Lag materials.

The quality control checks included visual, dimensional and temperature checks. The inspectors reviewed quality control records provided by the licensee for the installation of Thermo-Lag in Fire Zones 1-2D, 0-28H, and 0-28B during the 1981 -1982 time period. The quality control checks appeared to have been done as a surveillance on an area-wide or room basis. The surveillance check sheets were included in Field Inspection Reports that identified specific conduits, wireways, and junction boxes and terminal boxes (boxes) that were to be

² Attachments 2, 4, and 5 provide lists of documents reviewed during this inspection.

protected in the areas identified. The list of conduits and boxes on the various inspection report cover sheets matched the list of conduits and boxes to be protected as identified in Appendix A of Revision 2 to the Fire Protection Review Report (FPRR).

The installation of spray-on Thermo-Lag 330-1 on the conduits and boxes identified in Appendix A to the FPRR for Fire Zones 1-2D, 0-28B, and 0-28H was visually inspected and only minor discrepancies were noted. The visual inspection did not detect any fiberglass armoring installed on the protected conduits and boxes. The inspectors noted that the licensee's procedures require fiberglass armoring only be installed on those cable trays protected by one hour spray-on Thermo-Lag material in areas without automatic suppression. The inspectors' visual inspection is discussed further in Section 4.

Conclusion

Based upon the facts gathered, the inspectors concluded that the licensee was in strict compliance with SSER#4 as it pertained to the use of one hour spray-on Thermo-Lag as a cable raceway fire barrier wrap for conduits in Fire Zones 1-2D, 0-28B, and 0-28H. The spray-on Thermo-Lag barrier system, installed on conduits in Fire Zones 1-2D, 0-28B, and 0-28H before reaching five percent power, appeared to be installed in accordance with the licensee's testing that was documented in a Southwest Research Institute (SwRI) report dated August 1982 and was approved by SSER#4.

2.2 Protection Of Cable Trays

Findings

After reviewing SSER#4 as it pertained to the protection of conduits, the inspectors reviewed SSER#4 as it pertained to the protection of cable trays with Thermo-Lag. SSER#4 stated, in part, that the licensee had conducted an ASTM E-119 test of a proposed cable wrap in its as-installed configuration and documented the results in a report dated August 1982. The SSER further stated, in part, that the tests show that cable trays protected by the proposed method did not meet the acceptance criteria for temperature and was, therefore, not acceptable as a 1-hour-rated fire barrier. The SSER also stated that the licensee had committed to provide a cable wrap, previously approved, and to install it in the manner originally tested. The details of the test and installation procedure are documented in a report [Southwest Research Institute (SwRI) Report done for Texas Utilities' Comanche Peak Plant] dated October 1981.

The inspectors noted that the installation specifications for the Thermo-Lag configurations installed on cable trays at SSES were contained in three Bechtel documents, Specification 8856-E-61, Field Change Request E6347, and Special Detailed Instructions for Installation of Thermo-Lag 330-1. These documents were compared to the installation procedure, TSI Technical Note 80181, contained in the October 1981 SwRI test report for Comanche Peak. The inspectors observed a significant difference between the Comanche Peak and Susquehanna installation methods in that the installations at Susquehanna did not have

Fiberglass Armoring embedded under the topcoat of the Thermo-Lag 330-1 Subliming Compound.

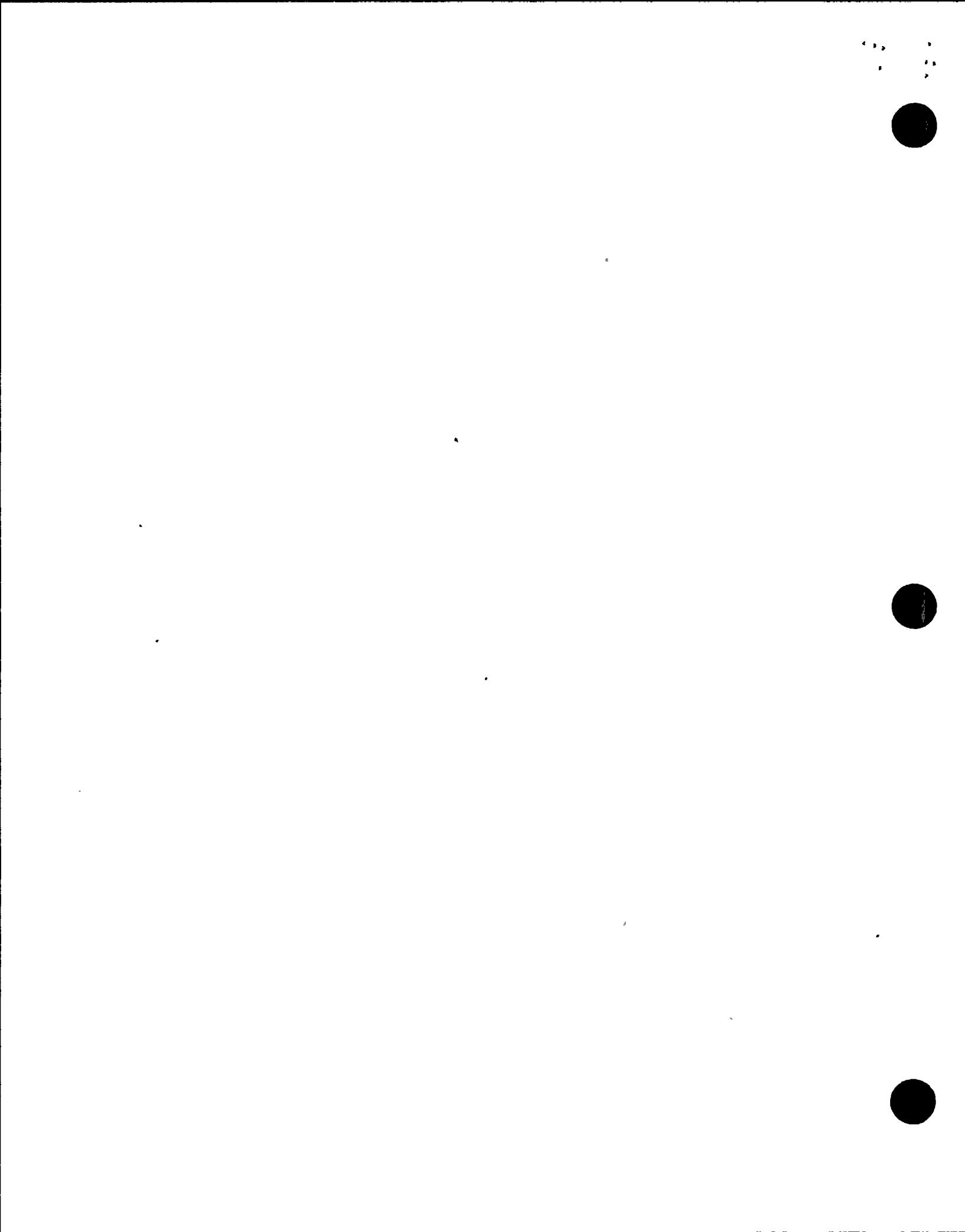
The inspectors found two PP&L letters that were written to the NRC addressing the subject matters being reviewed: (1) PLA-1268, dated August 31, 1982, stated, in part, that PP&L would modify the installation of the fire resistive wrap material on cable trays located in Fire Zone 1-2D, Remote Shutdown Panel, by adding fiberglass armoring embedded in the Thermo-Lag in accordance with TSI Technical note 80181; and (2) PLA-1333, dated October 25, 1982, notified the NRC that the addition of the fiberglass armoring modification committed to in PLA-1268 had been completed.

A list of safe shutdown raceways protected with fire barrier wrap material was contained in Appendix A to Revisions 1 and 2 of the FPRR. The list in this appendix was reviewed. Of the three fire zones in question, Fire Zones 1-2D, 0-28B, and 0-28H, only Fire Zone 1-2D contained a raceway that was assigned a cable tray designation. Subsequent field inspection found that this "cable tray" was one raceway labeled with multiple cable tray section designations. The inspectors reviewed the quality control Field Inspection Reports that were described above in paragraph 2.1. These inspection records indicate that the protective coating installed on the cable trays in Fire Zone 1-2D were originally installed in accordance with the three Bechtel installation specifications that did not specify the fiberglass armoring. Then the inspectors found that a Design Control Package, DCP 82-474, was issued to add Fiberglass Armoring to the cable tray located in Fire Zone 1-2D. A review of the work plan and quality control inspection records associated with DCP 82-474 revealed that Fiberglass Armoring was added to the one protected cable tray located in Fire Zone 1-2D. These records also indicated that 18 inches of fiberglass was added to the connected conduit members.

A visual inspection of Fire Zones 0-28B, and 0-28H was conducted, and no protected cable trays were identified. An inspection of Fire Zone 1-2D identified spray-on Thermo-Lag 330-1 with Fiberglass Armoring, on the raceway sections identified with the cable tray designations, identified in Appendix A to the FPRR. From the visual inspection, the inspectors noted that the "cable tray" run appeared to be a long box and did not appear to be a typical cable tray. Cognizant licensee personnel described the run as a "wireway" or a conduit box with a hinged lid. By close visual inspection, the inspectors identified Fiberglass Armoring embedded in the Thermo-Lag material on the "cable tray." Only minor discrepancies were noted. Further description of the visual inspection performed and the discrepancies identified are contained in Section 4 and Attachment 3, respectively.

Conclusion

Based upon the facts gathered, the inspectors concluded that the licensee was in strict compliance with SSER#4 as it pertained to the use of one hour spray-on Thermo-Lag as a cable wrap fire barrier for cable trays in Fire Zones 1-2D, 0-28B, and 0-28H. Of the three Fire Zones, 1-2D, 0-28B, and 0-28H, only Fire Zone 1-2D contained a raceway run that was



identified with cable tray section designations. The Thermo-Lag system on this one "cable tray" run in Fire Zone 1-2D was initially installed in accordance with the licensee's installation method that was documented in the SwRI test report dated August 1982. Subsequently, the Thermo-Lag installation on this one cable tray run was modified by embedding Fiberglass Armoring in the Thermo-Lag below the top coat. Therefore, the inspectors concluded that this cable tray installation appeared to be equivalent to the Thermo-Lag configuration that was documented in the SwRI test report for Comanche Peak dated October 27, 1981, and was approved for use at SSES in NRC SSER#4.

3.0 QUALIFICATION OF ONE HOUR THERMO-LAG BARRIERS

3.1 Initial Qualification of One Hour Spray-On Thermo-Lag Barriers

Scope

Based on the review of licensing documents discussed above in Section 2.0, the inspectors had concluded that SSER#4 was the only document that provided specific NRC approval for cable raceway fire barrier wrap materials used at SSES. Section 2.0 documented the inspectors' conclusion that one hour spray-on Thermo-Lag installed in three Fire Zones, 1-2D, 0-28B, and 0-28H, were installed in accordance with the methods approved in SSER#4. Therefore, the thrust of the next portion of the inspection was to gather facts and determine whether the fire barrier wrap systems installed in the remaining plant areas, i.e., areas outside Fire Zones 1-2D, 0-28B, and 0-28H, were installed in accordance with the methods approved in SSER#4 or an alternative method.

Documents and records reviewed by the inspectors are listed in Attachments 2, 4, and 5. Attachment 5 provides a chronological listing of documents reviewed and also provides pertinent comments about each of these documents. The licensee's installation procedures, specifications, and drawings were reviewed to ascertain whether they were in agreement with the licensing submittals and NRC approvals. Plant records were reviewed to determine whether the fire barrier systems had been installed in accordance with the appropriate installation documents. Visual inspections of spray-on Thermo-Lag fire barriers in Fire Zones 0-27C, 1-5A, 1-4A, and 1-3A were conducted to determine, to the extent possible by visual inspection, whether the Thermo-Lag was installed in accordance with the licensee's specifications, drawings, and plant records. Cognizant personnel were interviewed during the inspection. Since the qualification and adequacy of the Thermo-Lag installed in Unit 1 at SSES had been questioned, the information collected during this portion of the inspection was evaluated to determine on what basis the licensee considered that Thermo-Lag configurations other than those approved in SSER#4 were qualified as having a one hour fire resistive rating.

3.1.1 Protection Of Conduits In Remaining Unit 1 Areas

Findings

The inspectors discussed the use of the Thermo-Lag fire resistive barrier system on conduits in Fire Zones other than 1-2D, 0-28B, and 0-28H with cognizant licensee personnel. The licensee informed the inspectors that the Thermo-Lag installed on conduits in Unit 1, prior to exceeding five percent power, was installed in accordance with the application method that was tested for the licensee by SwRI, documented in a SwRI test report dated August 1982, and approved by the NRC Staff in SSER#4.

As previously noted, licensee personnel informed the inspectors that the one hour spray-on Thermo-Lag installed on conduits in Unit 1 prior to exceeding five percent power was installed in accordance with the method that was approved by the Staff in SSER#4. The inspectors verified this information by reviewing a sample of plant records and performing a visual inspection of cable wrap installed on conduits in Fire Zones 0-27C, 1-5A, 1-4A, and 1-3A. From a review of the quality control records previously described in Section 2.1, the inspectors noted that the spray-on Thermo-Lag 330-1 installed in these areas prior to exceeding five percent power was documented to have been installed in accordance with Bechtel Specification 8856-E-61. The visual examination was conducted on the readily accessible portions of those conduits listed, in Appendix A of Revision 2 to the FPRR, as requiring protection by cable wrap fire barrier material. These conduits appeared to have been wrapped in a manner similar to those inspected in Fire Zones 1-2D, 0-28B, and 0-28H. Additional information on the visual inspections and the quality of these installations is provided in Section 4.0.

Conclusions

Based on the facts and information gathered, the inspectors concluded that the one hour spray-on Thermo-Lag fire barrier wrap installed on conduits in the remaining plant areas, i.e., areas outside Fire Zones 1-2D, 0-28B, and 0-28H, appeared to be installed in accordance with the methods approved in SSER#4. Additionally, based on the information above and the information in Section 2.1, the inspectors concluded that all of the one hour spray-on Thermo-Lag installed on conduits in Unit 1 appeared to be installed in compliance with the methods approved in SSER#4.

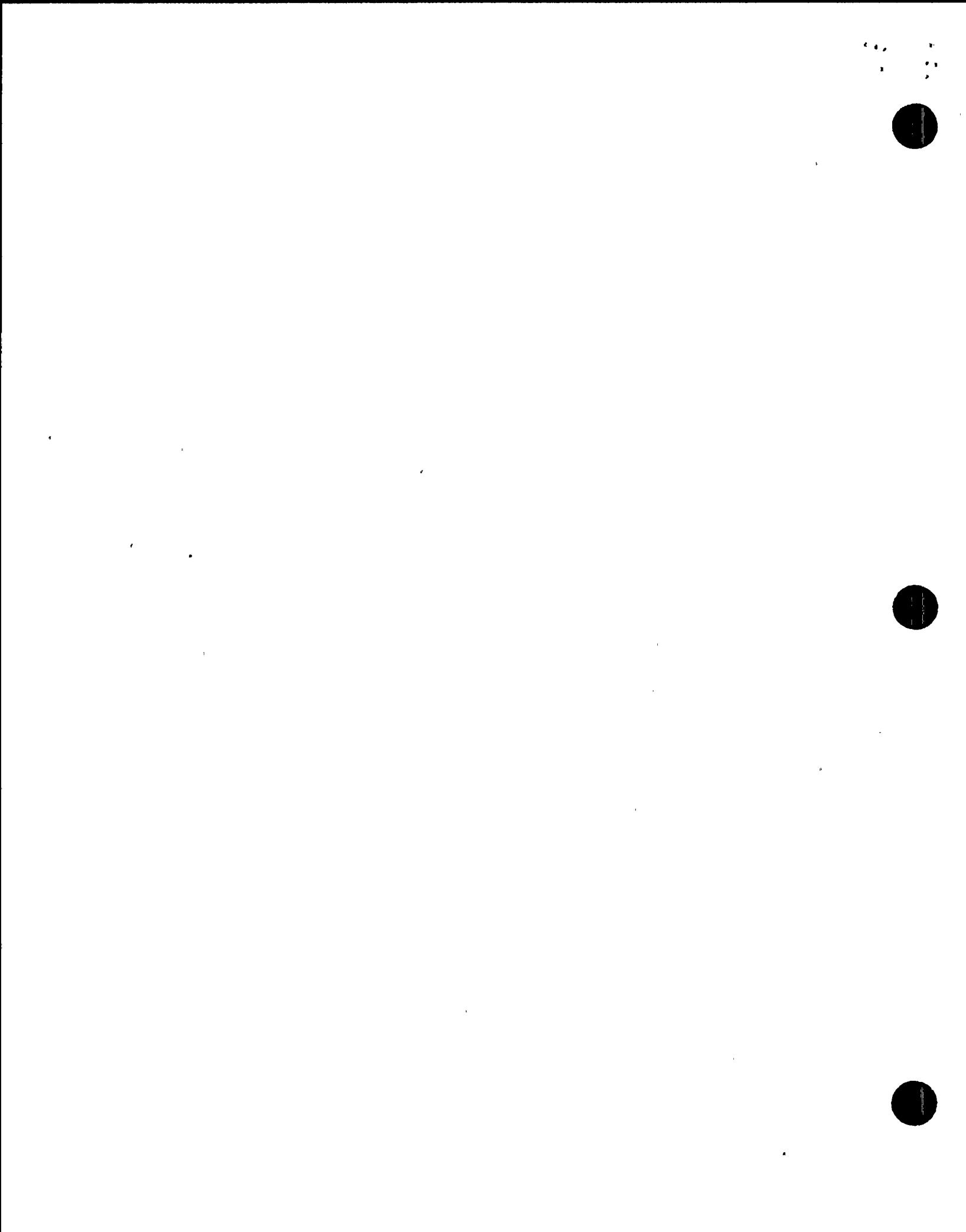
3.1.2 Protection Of Cable Trays In Remaining Unit 1 Areas

Findings

After concluding that all the one hour spray-on Thermo-Lag installed on conduits throughout Unit 1 appeared to be installed in accordance with SSER#4, the inspectors continued their review to determine if the same held true for Thermo-Lag fire barrier wrap installed on cable trays. The inspectors discussed, with cognizant licensee personnel, the use of the Thermo-Lag fire resistive barrier system on Unit 1 cable trays in remaining plant areas, i.e., other than Fire Zones 1-2D, 0-28B, and 0-28H. The licensee informed the inspectors that the one hour spray-on Thermo-Lag installed on all the cable trays in Unit 1 prior to exceeding five percent power, except the one wireway in Fire Zone 1-2D, was installed in accordance with the method that was tested for the licensee, documented in a SwRI test report dated August 1982, and found acceptable by the Staff in SSER#4. The inspectors were also informed that the licensee had taken no action to modify the Thermo-Lag in these areas by adding a layer of Fiberglass Armoring below the topcoat of Thermo-Lag as had been done in Fire Zone 1-2D to meet the requirements of SSER#4.

The inspectors confirmed this information by reviewing a sample of plant records and performing a visual examination of wrap material on cable trays in Fire Zones 0-27C, 1-5A, 1-4A, and 1-3A. Based on the records provided by the licensee and the inspectors' visual examinations, it appeared that the Thermo-Lag wrap installed in these areas prior to exceeding five percent power was installed in accordance with Bechtel Specification 8856-E-61. No evidence was found that would indicate that the barriers had been modified to add the Fiberglass Armoring. Therefore, the inspectors questioned whether the licensee correctly interpreted SSER#4 when they chose to wrap cable trays with a Thermo-Lag fire barrier wrap system installation method that SSER#4 had found unacceptable for use on cable trays. The licensee's response this question is discussed below.

As reported above, the inspectors questioned whether the licensee correctly interpreted SSER#4 when they chose to use a cable wrap fire barrier system, on cable trays, which had been found unacceptable for use on cable trays by SSER#4. Therefore, the inspectors conducted a review to determine on what basis the licensee used their August 1982 test results to support the use of this Thermo-Lag system configuration and installation method as a one hour fire rated material when its use had been found unacceptable by SSER#4. The review was also conducted to ascertain whether this particular Thermo-Lag configuration for cable trays was in compliance with the regulations in force at the time of Unit 1 licensing. This review was conducted to: (1) Identify all pertinent historical background facts from reviewing licensing documents and plant records; (2) Determine the NRC staff fire protection reviewer's perspective based on facts obtained from the background information and an interview of this former NRC employee; and (3) Determine the licensee's perspective from the facts obtained from the background information and discussions with cognizant licensee personnel.



To begin the review of this issue, the inspectors reviewed SSER#4 and the two SwRI test reports cited in SSER#4, one dated October 27, 1981, and the other dated August 1982. First, the inspectors noted that an NRC internal memo, dated September 15, 1982, which forwarded the Fire Protection Safety Evaluation, for inclusion in SSER#4, stated that the 250 degree temperature rise criterion was one of the acceptance criteria of ASTM standard E-119.

The inspectors observed that the significant difference between the two test reports referenced in SSER#4 was that the October 27, 1981, test report for Comanche Peak indicated that the temperature on the unexposed side (cold side) of the Thermo-Lag barrier installed on the cable trays tested did not exceed a 250 degree cold side temperature rise. In contrast, the data from the August 1982 report for Susquehanna showed that temperatures for cable trays exceeded the 250 degree cold side temperature rise and a nominal temperature value of 325 degrees. The inspectors noted neither test report stated that a 250 degree cold side temperature rise was an acceptance criterion for successfully passing the fire test. Therefore, the inspectors focused their review on this cold side temperature criterion and whether the licensee should have applied this criterion as a requirement for all of the cable wrap barriers tested and in use as one hour rated fire barriers.

Next, a review of docketed information was performed to ascertain what criteria the reviewer was using as a standard for approving cable wrap fire barriers. Attachment 5 contains a chronological list of the docketed information reviewed and comments on the documents. The following is some of the information obtained from reviewing the documents listed in Attachment 5. A review of the NRC Safety Evaluation Report (SER), NUREG-0776, dated April 1981, indicates that the SSES Fire Protection Program was being reviewed against Appendix A to Branch Technical Position (BTP) ASB 9.5-1 (dated August 1976). Subsequently, PP&L letter PLA 1013, dated February 9, 1982, stated, in part, that PP&L was requesting an exemption and documenting their change in position regarding Branch Technical Position CMEB 9.5-1, Position C.5.b.2(c). This indicated to the inspectors that although the licensee was required to meet the guidance in Appendix A to BTP ASB 9.5-1, the licensee was considering the latest NRC guidance, BTP CMEB 9.5-1, when developing their fire protection licensing submittals.

SSER#3, issued in July 1982, in response to the licensee's exemption request, indicated that the definitions of fire barriers and fire resistance rating from Section B.4 of BTP CMEB 9.5-1 were used by the reviewer to evaluate the PP&L exemption request dated February 9, 1982. SSER#3 states that fire resistance rating is defined as, "the time that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of, "Standard Methods of Fire Test of Building Construction and Materials" (NFPA 251)," and it goes on to say that ASTM E-119 is an acceptable test method in addition to NFPA 251. SSER#3 also stated that the Staff was concerned about the number of thermocouples used for measuring temperatures on the (test) specimen. This indicated two things to the inspectors: (1) The NRC fire protection reviewer was considering the latest guidance when reviewing the licensee's submittals; and (2) In a response to the licensee's

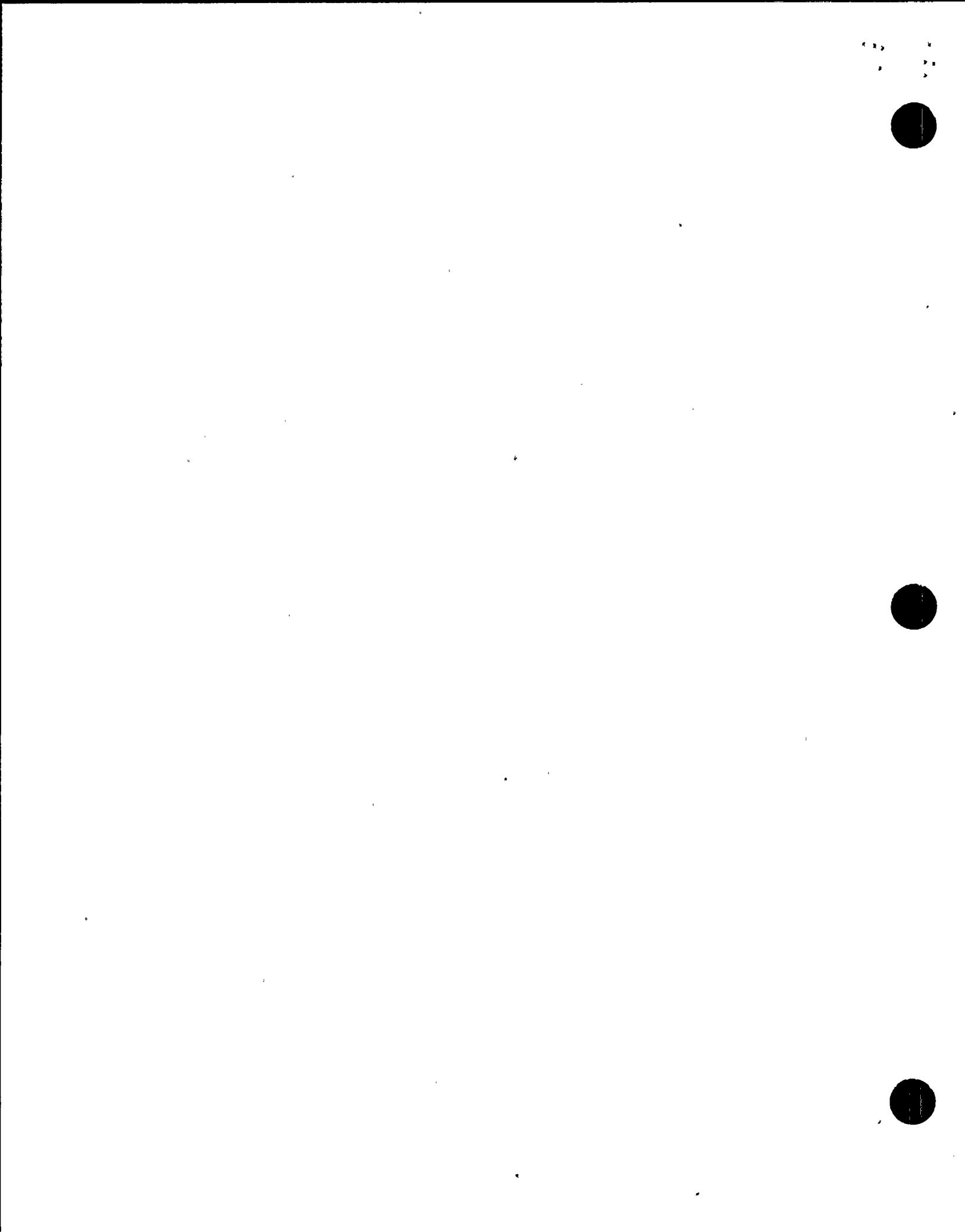
submittal requesting an exemption from the NRC guidance document, BTP CMEB 9.5-1, the NRC reviewer identified that he was concerned about being able to measure temperature on the test specimen.

The inspectors then reviewed the NRC fire protection guidance available in July 1982. From a review of BTP CMEB 9.5-1, Revision 2, July 1981, the inspectors found that, in addition to the information in Section B.4 (referenced in the paragraph above), Section C.5.a contains further information concerning fire barriers. CMEB 9.5-1, Section C.5.a states, in part, that openings through fire barriers for pipe, conduit, and cable trays that separate fire areas should be sealed or closed to provide a fire resistance rating at least equal to that required of the barrier itself. Section C.5 goes on to state that penetration qualification tests should use the time-temperature exposure curve specified by ASTM E-119 and the acceptance criteria should require that there is no passage of flame or ignition of cables on the unexposed side during the rating period, the temperatures on the unexposed side are analyzed and demonstrate that the maximum temperature does not exceed 325 degrees F, and the barrier remains intact during the hose stream test. This indicated to the inspectors that cable raceway fire barriers and their associated penetration seals were required to have the same fire resistive rating. The unexposed temperature requirement clearly delineated for the unexposed side of the penetration seal was a maximum of 325 degrees.

As noted previously, the inspectors reviewed an NRC internal memo, dated September 15, 1982, which forwarded the fire protection Safety Evaluation for inclusion in SSER#4 that stated that the 250 degree cold side temperature rise criterion was one of the acceptance criteria of ASTM standard E-119. From a review of SSER#4, issued November 1982, the inspectors noted that the method of protecting cable trays with Thermo-Lag as proposed by PP&L in the test report dated August 1982 was found unacceptable for a one hour rated fire barrier for cable trays because the acceptance criterion of a temperature rise of 250 degrees above ambient was exceeded in approximately 45 minutes.

Based on a review of the documents listed in Attachment 5 and the information above, the inspectors concluded that at the time of licensing of Susquehanna Unit 1, the NRC staff reviewer considered the 250 degree cold side temperature rise criterion a requirement for cable wrap fire barriers to meet the fire resistive rating testing requirements of ASTM E-119 and BTP 9.5-1.

Although the responsible fire protection reviewer is no longer an NRC employee, the inspector was able to confirm this conclusion in an interview with the former NRC fire protection reviewer on October 7, 1992. The former reviewer stated that there was no specific test procedure for cable wrap material [in ASTM E-119], but that most of the test procedures in the ASTM test standard required the use of the 250 degree cold side temperature rise; therefore, it was a consensus among the NRC reviewers in 1982 to apply this acceptance criterion as a requirement during licensing reviews.



The reviewer also stated that the exemption request for these three areas was the only open item left in the fire protection licensing review, so he was only concerned about the Thermo-Lag materials used in Fire Zones 1-2D, 0-28B, and 0-28H. He also stated that, a less than one hour barrier would have been accepted if sprinkler systems were installed.

The former reviewer also stated that he did not visit the site as part of his review, and he did not remember knowing, in 1982, that Thermo-Lag was used in any other areas of the plant. He also could not recall if other cable raceway fire barrier wrap materials were installed in the plant. He did recall that he knew that Kaowool was not a one hour barrier; but that, in some cases, Kaowool has been approved for use in lieu of a one hour barrier. Additionally, he could not recall if there were any inspection activities that questioned the use of Thermo-Lag at SSES during the time frame that he was reviewing its use in these three fire zones.

Finally, after the inspectors concluded that the NRC reviewer was using temperature as an acceptance criteria for cable wrap fire barriers, but before talking to the former NRC reviewer, the inspectors discussed their conclusion with the licensee. As reported previously, the inspectors questioned why the 250 degree cold side temperature rise criterion, and the SSER#4 requirement to add Fiberglass Armoring was not applied to the one hour spray-on Thermo-Lag wrap installed on cable trays in Unit 1 areas outside of Fire Zones 1-2D, 0-28B, and 0-28H.

The licensee personnel stated to the inspectors that, at the time of Unit 1 licensing, PP&L did not believe or understand that the 250 degree rise/325 degree cold side temperature criterion was an industry known requirement for all cable wrap fire barriers. They further stated that they believed that the 250 degree rise criterion and the addition of Fiberglass Armoring were additional requirements unique to these three Fire Zones, 1-2D, 0-28B, and 0-28H. They believed that these unique requirements had to be met to obtain approval of the exemption request. The licensee stated that they believed that these additional requirements were needed to compensate for the lack of automatic suppression in Fire Zones 1-2D, 0-28B, and 0-28H; and that this was the only remaining issue needing exemption type resolution. They also noted that the general use of Thermo-Lag in the plant, including application and qualification data, had been previously questioned in an inspection report (Nos. 50-387/81-2 & 50-388/81-10). This issue was closed in a subsequent inspection report (Nos. 50-387/82-19 & 50-388/82-08). The licensee representatives also advised the inspectors that they were using the Kaowool blanket wrap system, which they believed to be NRC approved, as a fire barrier for raceways in the plant. The licensee stated that Kaowool also exceeded the 325 degree temperature requirement; therefore, the licensee believed that temperature was not an acceptance criterion in 1982. The use of Kaowool is discussed further in Section 4.0 of this report.

The inspectors reviewed documents that were provided by licensee personnel to support their assertions. These documents and other documents reviewed by the inspectors during this inspection are listed in Attachments 2, 4, and 5. The following information, from documents listed in Attachment 5, supports the licensee's assertions identified in the above paragraph.

The inspectors reviewed the guidance for testing fire barriers. The definition of fire resistance rating provided by Section B.4 of the BTP states that materials have withstood the fire exposure as established by NFPA 251 (ASTM E-119). The review of ASTM E-119 found that the standard contains acceptance criteria for testing walls, floors, ceilings, steel beams, etc., but no specific test acceptance criteria were provided for cable tray wrap or penetration seals. The BTP did provide additional specific acceptance criteria for penetration seals in Section C.5.a.; however, no additional guidance was provided for cable wrap fire barrier materials in the 1981-1982 time frame. Additionally, Generic Letter (GL), 85-01, issued in 1985 acknowledged that there was confusion on the cold side temperature rise requirement. This GL stated the NRC's position that the nonbearing wall or partition test procedure in ASTM E-119, including the 250 degree rise acceptance criterion, were the appropriate test method and acceptance criteria for cable wrap barriers.

Inspection report (Nos. 50-387/81-2 & 50-388/81-10) dated January 13, 1982, was reviewed. Licensee personnel identified that this report left the use of Thermo-Lag materials, installed to protect raceways, unresolved pending a review of documentation associated with the installation, inspection, and qualification of the TSI material. The licensee provided information to address the Unresolved Item (URI 387/81-20-02) by a letter dated May 13, 1982. The licensee also provided this May 13, 1982, letter in response to the NRR fire protection reviewer's request for further information.

The reviewer had requested this additional information for the review of the February 1982 exemption request for Fire Zones 1-2D, 0-28B, and 0-28H. The NRR reviewer found the Thermo-Lag technical information submitted with the May 13, 1982, letter unacceptable in SSER#3. As a result, when the Facility Operating License was issued on July 17 1982, License Condition 2.C(7) required testing of the TSI materials in accordance with ASTM to E-119 or the installation of an automatic fire extinguishing system.

While an NRR reviewer found the information provided by PP&L in the May 13, 1982, letter unacceptable, an NRC inspection report (Nos. 50-387/82-19 & 50-388/82-08) dated August 13, 1982, accepted this information. The inspection report closed the unresolved item (URI 387/81-20-02). As previously reported, this unresolved item concerned the general installation and qualification of the Thermo-Lag used in the plant and was opened by a January 1982 inspection report (Nos. 50-387/81-2 & 50-388/81-10). This inspection report closed this item by stating that information provided by the May 13, 1982, letter adequately addressed the qualification testing and installation of the Thermo-Lag barrier material.

In response to License Condition 2.C(7), PP&L committed, by letter dated July 17, 1982, to perform a test of the TSI material using a Comanche Peak test procedure modified to test the Thermo-Lag configurations installed in accordance with PP&L's (Bechtel) installation procedures. The inspectors noted that this test procedure was the same test procedure used to obtain the test results accepted by the NRC for Comanche Peak, recorded in a report dated October 27, 1981, and referenced in SSER#4. This Comanche Peak test procedure did not contain the 250 degree temperature rise acceptance criterion. By letter dated July 23, 1982,

PP&L forwarded the test specification that they proposed to use for their testing at SwRI and stated that the test objective was to provide documented evidence that the envelope will satisfactorily withstand an ASTM E-119 (80) fire exposure and provide a one hour effective barrier in accordance with ANI/MAERP acceptance rating by maintaining circuit integrity and continuity. The inspectors noted that the ANI/MAERP acceptance rating did not specify any cold side temperature-related acceptance criterion. No docketed information rejecting these test procedures or acceptance criteria was found.

Then, by letter dated August 25, 1982, PP&L forwarded the Southwest Research Institute (SwRI) test report dated August 1982. This letter states that the test was conducted in accordance with test specification, with exceptions as noted in the test report. As previously described in Section 2.0, NRC SSER#4, dated November 1982, documented the NRC staff review of this test report. Licensee personnel stated that this was the first time that they were aware that the cold side temperature rise criterion was being applied as one of the acceptance criteria for the cable wrap fire barrier testing. The licensee further stated that they believed that the 250 degree rise criterion and the addition of Fiberglass Armoring were required by SSER#4 were additional requirements unique to the three Fire Zones, 1-2D, 0-28B, and 0-28H, addressed in the SER.

Summary/Conclusions

Based on the facts and information gathered, the inspectors found that the Thermo-Lag fire barrier wrap systems on cable trays were installed in accordance with PP&L's (Bechtel) own procedures and the methods that they had successfully tested to the acceptance criteria specified in their own test procedures. These test procedures and acceptance criteria were submitted to the NRC staff for review. No docketed information rejecting these test procedures or acceptance criteria was found. However, the installation method used by the licensee for installing 1 hour spray-on Thermo-Lag on cable trays outside Fire Zone 1-2D was found not acceptable in SSER#4. Therefore, the inspectors brought into question whether or not SSER#4 applied to Unit 1 areas outside of the zones that were specifically addressed in SSER#4, i.e., Fire Zones 1-2D, 0-28B, and 0-28H. The inspectors primarily focused their review on this temperature criterion and whether the licensee should have applied this criterion as a requirement for all of the cable wrap barriers it tested and was using as one hour rated fire barriers. The inspectors concluded the following based upon the information gathered and analyzed.

Based on a review of the information above and in Attachment 5, the inspectors concluded that the NRC Staff reviewer considered the 250 degree rise (325 degree nominal) cold side temperature criterion a requirement necessary for cable wrap fire barriers to meet the acceptance criterion of the fire resistive rating testing requirements of ASTM standard E-119 and BTP 9.5-1.

Based on the representations made to the inspectors by the licensee during this inspection, the information above and the information in Attachment 5, the inspectors concluded that the

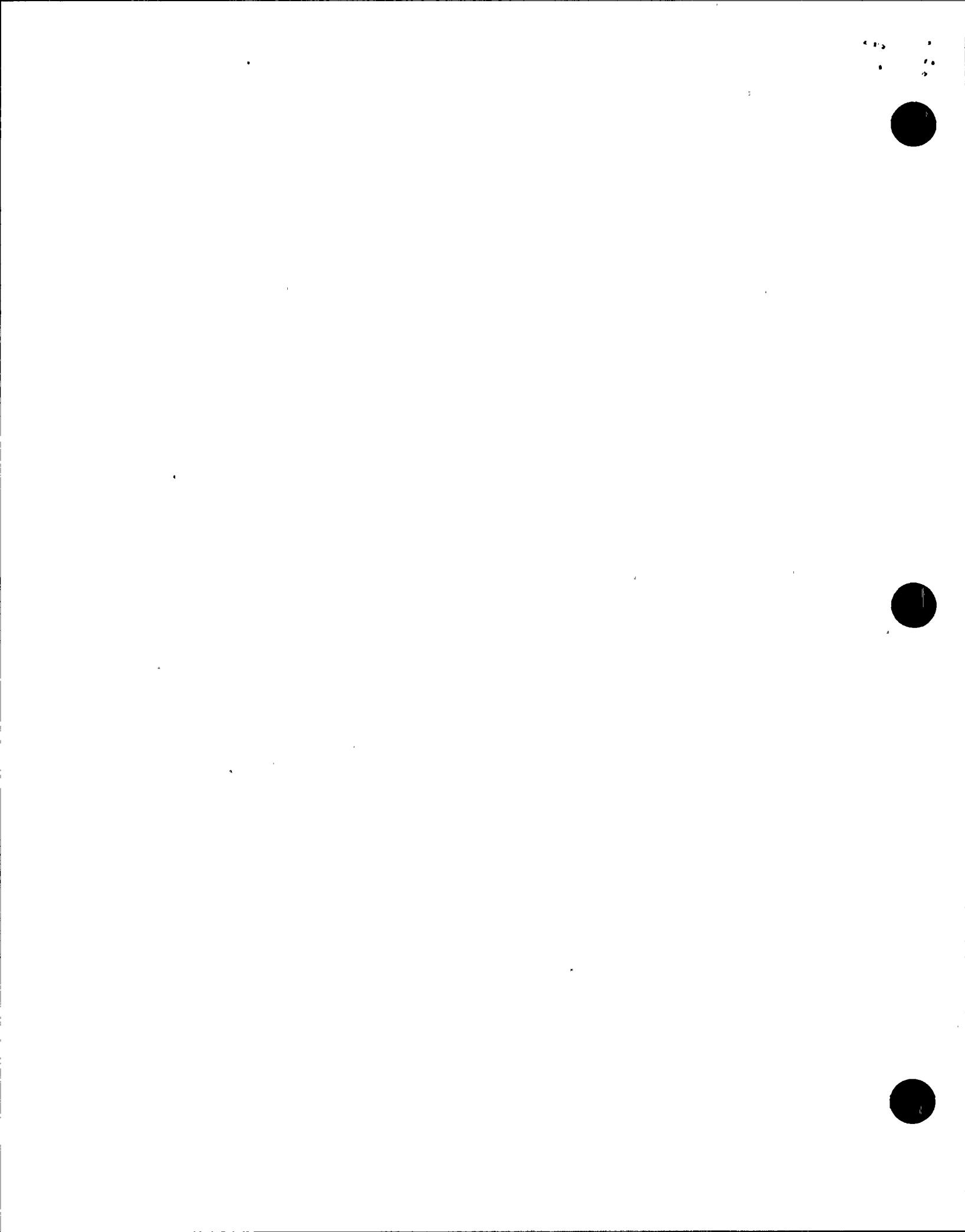
licensee has reasonably demonstrated that they were not fully aware of and were not attempting to meet the 250 degree temperature rise criterion. It also appears that the licensee met the acceptance criteria specified in their qualification test submitted to the NRC for approval. No docketed information was found that indicated that the licensee's test procedures or acceptance criteria were rejected by the NRC. Only the results of the testing were found unacceptable in SSER#4 in conjunction with the specific exemption request for three fire zones. The inspectors concluded that there was some evidence indicating that the licensee had a reasonable basis to believe that the rejection of the cable tray portion of the test results related only to the licensee's exemption request for the three areas. Additionally, it appeared that the licensee believed that the 250 degree rise criterion and the addition of a Fiberglass Armoring was a trade off for not having automatic suppression in the three fire zones and that meeting these "additional" requirements were prerequisite to obtaining the requested exemption.

The inspectors stated at the exit meeting that the issue concerning the licensee's interpretation of SSER#4 was unresolved (URI 387 & 388/92-23-01). A meeting will be held to give licensee management an opportunity to provide additional information concerning this issue. This additional information and the findings above will be reviewed to determine if the licensee was in compliance with the regulations when they did not apply the information in SSER#4, concerning Thermo-Lag, to Thermo-Lag installed on cable trays in other areas of the plant.

3.2 Licensee Review of Initial Qualification of One Hour Thermo-Lag Barriers in Response to NRC Generic Communications

Scope

Since the licensee asserted that they were unaware of the requirement to use cold side temperature as an acceptance criteria at Unit 1 licensing in 1982, the inspectors reviewed the licensee's actions taken in response to Generic Letter 85-01. These actions were reviewed to determine the adequacy of the licensee's response, given that the GL 85-01 provided explicit guidance concerning the NRC's requirements for acceptance criteria for cable wrap fire barriers. This guidance was above the acceptance criteria use by the licensee to qualify many of their installed barriers. The inspectors limited this review to actions taken by the licensee in regard to one hour spray-on Thermo-Lag installed on cable trays in Unit 1.



Findings

The licensee provided the inspectors with a copy of design calculation DK-C-DJK-015 dated November 11, 1985. Section III of this calculation evaluated the one hour rating of TSI material used on cable trays. The calculation stated in part that I.T.L. had performed a test of Thermo-Lag materials that passed the 250 degree cold side temperature rise criterion, identified in GL 85-01, and this test was the basis for the use of Thermo-Lag at several nuclear plants. Calculation DK-C-DJK-015 documented a review that determined it was acceptable to use the I.T.L. test as a qualification test to support the 1-hour Thermo-Lag installed on cable trays. Calculation DK-C-DJK-015 stated that it was conducted in accordance with Section 3.2.2 of GL 85-01. The inspectors noted that the I.T.L. report documented a test of a Thermo-Lag configuration similar to that installed at Susquehanna Steam Electric Station (SSES) in that both configurations consisted of Thermo-Lag Stress Skin covered with Thermo-Lag 330-1 with no Fiberglass Armoring installed. However, the inspectors did not perform an in-depth review of the PP&L engineering calculation or the I.T.L. test since these types of "generic" tests have been recently called into question by NRC IN 92-46.

The inspectors also noted that the engineering design calculation evaluated the use of Kaowool against the information in GL 85-01 and the calculation concluded that an exemption request (Deviation Request Number 17) should be submitted to the NRC. The use of Kaowool is discussed further in Section 4.0.

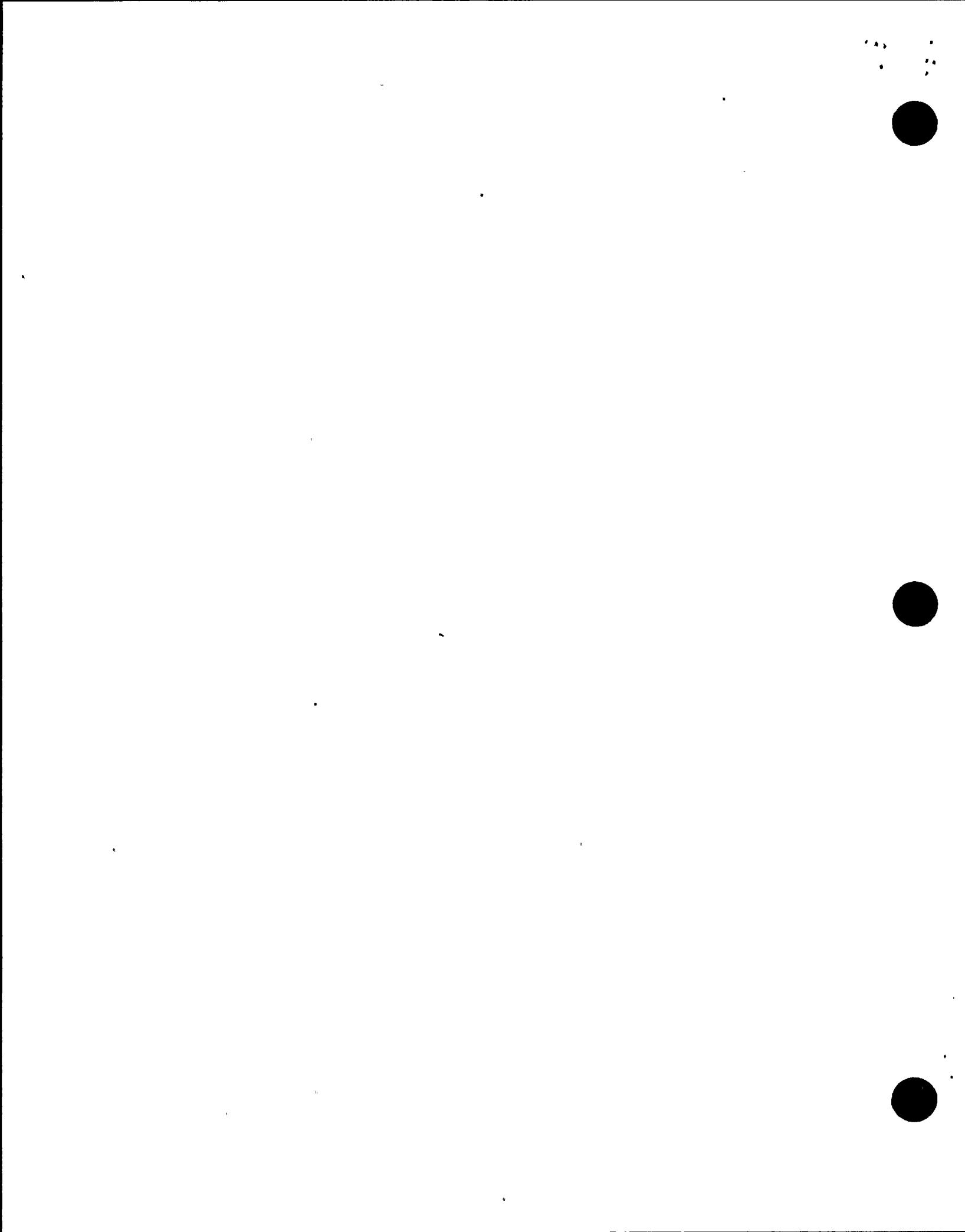
Conclusion

The inspectors concluded that the licensee did reevaluate their qualification of raceway wrap barrier materials when an NRC generic communication, GL 85-01, provided detailed information concerning the NRC's requirements for acceptance criteria for fire barrier testing. The inspectors also conclude that, based on these reevaluations, the licensee relied on generic test results to substantiate its qualification and fire rating of one hour spray-on Thermo-Lag installed as a fire barrier wrap on cable trays. The adequacy of these tests has recently been questioned in NRC Information Notice (IN) 92-46.

3.3 Ampacity Derating of Thermo-Lag

Scope

Since the OIG report and IN 92-46 raised questions concerning ampacity derating factors, a review was conducted to determine what ampacity derating values were used by the licensee when cable raceways were wrapped with fire barrier materials. The inspectors also reviewed actions taken by the licensee in response to industry information provided by the plants' construction architect/engineer (A-E), Bechtel, subsequent to plant licensing, concerning ampacity derating values for the TSI Thermo-Lag material. These inspection efforts included reviews of plant and engineering documentation and records and discussions with



cognizant licensee personnel at PP&L's Allentown offices on September 22, 1992, and in a phone conversation on September 25, 1992.

Findings

The inspectors noted that a Bechtel calculation, number E2006.05, was used to support the cable ampacity values for the initial design of the wrapped raceways. Since the focus of this part of the inspection was the use of subsequent ampacity derating values, the adequacy of this calculation was not reviewed during this inspection. Licensee personnel stated that this calculation was a design basis supporting document for their installed cable raceways wrapped with fire barrier materials. Calculation E2006.05 included a table of derating factors by raceway type and wrap material. Information from this table is included below:

Wrap Material	For Type of Raceway	Derating Factor
Thermo-Lag (1-hr.)	Tray	12.5%
Thermo-Lag (3-hr.)	Tray	17.0%
Thermo-Lag (1-hr.)	Conduit	7.7%
Thermo-Lag (3-hr.)	Conduit	10.5%
2 Layers Kaowool	Conduit	49.0%

The Thermo-Lag derating factors used in the Bechtel calculation were obtained from the TSI and Industrial Testing Lab (I.T.L.), Inc., tests that were attached to the calculation. The calculation obtained the Kaowool derating factors from SwRI tests that were also attached to the calculation. These test reports are listed in detail in Attachment 2.

From discussions with licensee personnel, the inspectors noted that a 1986 Bechtel letter notified the licensee that the cable derating values previously used for cables in trays wrapped with Thermo-Lag were too low. This letter was sent based on advice from Bechtel Problem Investigative Report #SF-86-01EE that was attached to the letter. The inspectors noted that the letter did not appear to address wrapped conduits. Bechtel letter, XLP-1457, dated October 28, 1986, stated, in part, that recent tests for derating caused by the use of Thermo-Lag 330 indicated a derating of 28% when a one-hour protective system was used and 31% when a three-hour system was used. These values are considerably higher than the 12.5% and 17% provided by TSI and used in original SSES wrapped raceway derating calculations.

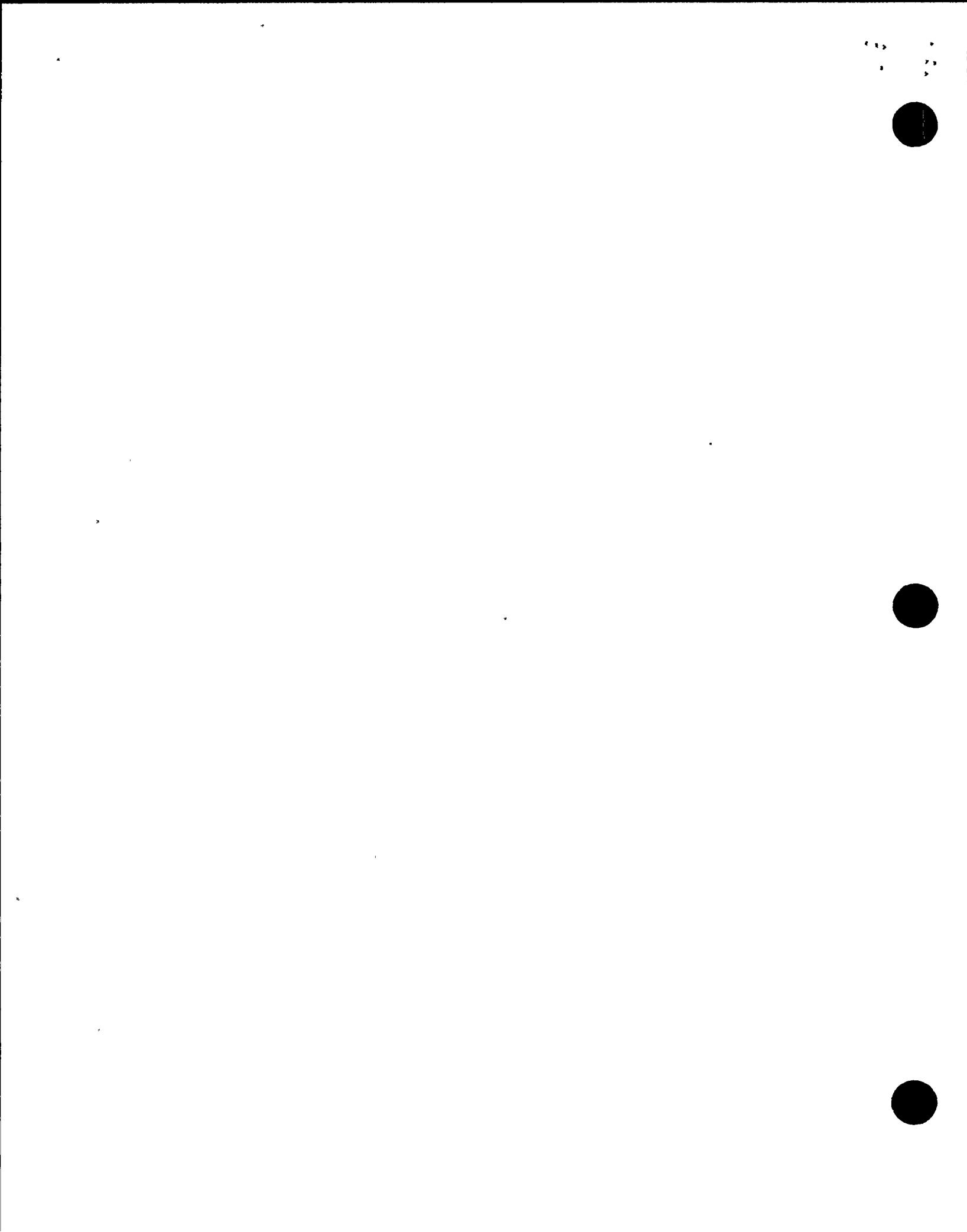
The letter went on to state, in part, that this was not believed to be a serious problem for SSES; however, PP&L will want to review the cable calculations to be sure. Report #SF-86-01EE indicated that Underwriters Laboratory (UL) was preparing a test report to document this information.

In February 1987, Engineering Work Request (EWR) M70214 was initiated requesting engineering action to determine if the higher derating factors reported in the Bechtel letter were applicable to SSES. Discussions with licensee personnel indicated that EWR M70214 was sent to the licensee's architect-engineer, at the time, United Engineers and Constructors (UE&C), for an initial scoping review.

On October 13, 1988, UE&C provided PP&L with a preliminary response to EWR #M70214. The UE&C response indicated that they had obtained copies of pertinent I.T.L. and Underwriters Laboratories Inc. (UL) test reports and had completed a preliminary review. UE&C concluded, in part, that the installed percent tray fill configuration at SSES appears to be different from the configurations described in the test reports. The UE&C response also stated that tests conducted by both I.T.L. and UL used different tray fills, different tray configurations, different voltage levels of cables, etc. The inspectors were concerned about UE&C's conclusion that none of the tested wrap configurations matched the configurations installed at SSES. This concern is addressed further in the conclusions paragraph of this section. The UE&C response went on to say that at that time (1988) there did not appear to be any industry accepted method for determining the ampacity of cables in trays covered with fire wrap materials. An IEEE paper, 88 WM 242-0, attached to the UE&C response presented one possible method to model and calculate derating factors for wrapped cable trays.

The UE&C response noted that it was difficult to establish at this point the exact derating factors that should be applied to SSES. However, the response also stated that derating factors are based upon the baseline ampacity of cables that is generally much higher than the ICEA ampacity; therefore, application of derating factors derived from derating tests (as Bechtel originally did for SSES) to ICEA ampacity is conservative. As a result of their review, UE&C stated in part the following recommendations:

- A. Use the higher derating factors (28.04 % for 1 hour fire barriers and 31.5% for 3 hour barriers). This appears to be the safer approach. However, using higher derating factors may make many existing cables unsuitable/inadequate for their present applications.
- B. Perform further document research and analytical evaluation to establish a heat transfer model to determine cable ampacities for SSES configurations.
- C. Perform representative tests to establish the cable ampacity derating factors for SSES.



The inspectors reviewed the UL test report dated January 21, 1987. It was noted that representatives of both Bechtel and TSI were present for the test. The UL test report provides test results for conduit and cable tray that were unprotected and protected by one and three hour Thermo-Lag. The test results were used to generate the ampacity derating factors reported in the Bechtel letter dated October 28, 1986. This Bechtel letter did not include new derating factors for Thermo-Lag protected conduits. The UL test results indicate that the ampacity for conduits, protected by 1/2 inch (one hour) preformed Thermo-Lag material, would improve. The inspectors noted that this information is a discrepancy in the accuracy of the test results that was not explained in the test report. The adequacy of the I.T.L. and UL tests was not reviewed during this inspection since these types of tests have been generically called into question by NRC IN 92-46.

Next, the inspectors discussed, with licensee personnel, the process used to disposition EWR M70214 and the UE&C recommendations. Licensee personnel stated that the EWR package, including the UE&C recommendations, were reviewed after receiving the A-E's response. As a result of that review, the EWR was assigned a unique responsible individual code, "zzz," to indicate that the disposition of the EWR was open but "inactive," i.e., there were other higher priority EWRs that required resolution prior to addressing EWR #M70214. The licensee personnel noted that there was a backlog of other EWRs, assigned to the electrical group, which were also assigned this "zzz" responsible individual code. The licensee personnel stated that this categorization was based on the results of a collegial review by the supervisor of the electrical group and his sub-group leaders. At the time of the September 22, 1992, meeting, licensee personnel stated that there was no documented record of this review; however, the licensee personnel recollects the following reasons for concluding that the EWR was appropriately classified:

- 1) The UL test configurations were different from those installed at SSES so the applicability of the UL test results was questionable [As previously described, the inspectors noted that the UE&C response stated that the configurations used to develop the lower ampacity factors are also different than those relied upon for the Bechtel calculations to supporting the installed configurations at SSES];
- 2) Use of the National Electric Code (NEC) design guidance adds a conservative margin to the design [The licensee stated that the minimum margin was 20%];
- 3) When they considered the possibility of what the effects of being wrong were, the licensee personnel stated that they concluded that ampacity was an aging and insulation embrittlement issue and not a failure mechanism.

Subsequent information provided by the licensee identified that the results of the collegiate review and the assignment of the "zzz" designator were typically sent to the EWR originator. A sample form letter was provided as an example; but, by the close of this inspection, no form letter had been provided for EWR M70214.

Further discussions with licensee personnel on September 22, revealed that, around the 1990 to 1991 time period, all the EWRs assigned the "zzz" code were reviewed and dispositioned. Possible dispositions included: (1) Closing the EWR; (2) Assigning the EWR to a responsible individual and assigning the EWR a priority code; or (3) Transferring the EWR to another (considered more appropriate) tracking system such as the Engineering Discrepancy Report (EDR) system. Licensee personnel stated that the EDR system was used to track engineering discrepancies and potential safety issues, but EWRs were more of a "wishlist" system.

On February 18, 1992, EDR No. G20006 was initiated to investigate the derating of cables in trays wrapped with Thermo-Lag. EDR G20006 stated in part that the IEEE paper [88 WM 242-0] appeared to confirm the UL [January 21, 1987, test report] test factors. The EDR contains a chronology that included receipt of Bechtel letter XLP-1457, initiation of EWR M70214, and receipt of UE&C's recommendations. This chronology also stated that on September 26, 1988, engineers used the "old" derating factors based on TSI testing in a PP&L engineering calculation, E-AAA-095, supporting Design Change Package (DCP) 88-3020B. This chronology also documented the issue of NRC IN 91-47 on August 6, 1991, and a notation that on January 29, 1992, "NRC investigators indicating that there are problems with TSI ampacity derating factors that were derived from TSI testing." Discussions with licensee personnel revealed that these last two factors contributed to the initiation of EDR No. G20006.

An initial screening of the issues identified in EDR G20006 was performed. This screening determined that the issues were not safety significant or reportable. This screening recommended performing the following evaluations: (1) Determine if test comparisons are valid; (2) If old test is invalid, determine impact of ampacity on Appendix R; and (3) If there is impact on Appendix R, redo analysis as appropriate. As part of this evaluation, Engineering Study, Analysis, and Evaluation, SEA-EE-432, was performed. The stated purpose of this evaluation was to determine the maximum allowable derating factors for power cables in raceway wrapped with Thermo-Lag material. Only power cables in wrapped cable trays and conduits were evaluated. The maximum allowable derating factors obtained were compared to the UL derating factors of 28.04% and 31.15% to assure that the power cable operating temperatures do not exceed their qualified life.

The inspectors reviewed SEA-EE-432 and found the methodology and approach reasonable. The technical content of the evaluation was also reviewed and found generally adequate with the exception that the licensee based inputs to the document on drawings that lacked quality and contained errors (additional information is provided in Section 5.1). SEA-EE-432 concluded that the maximum allowable derating for power cables in raceways with Thermo-

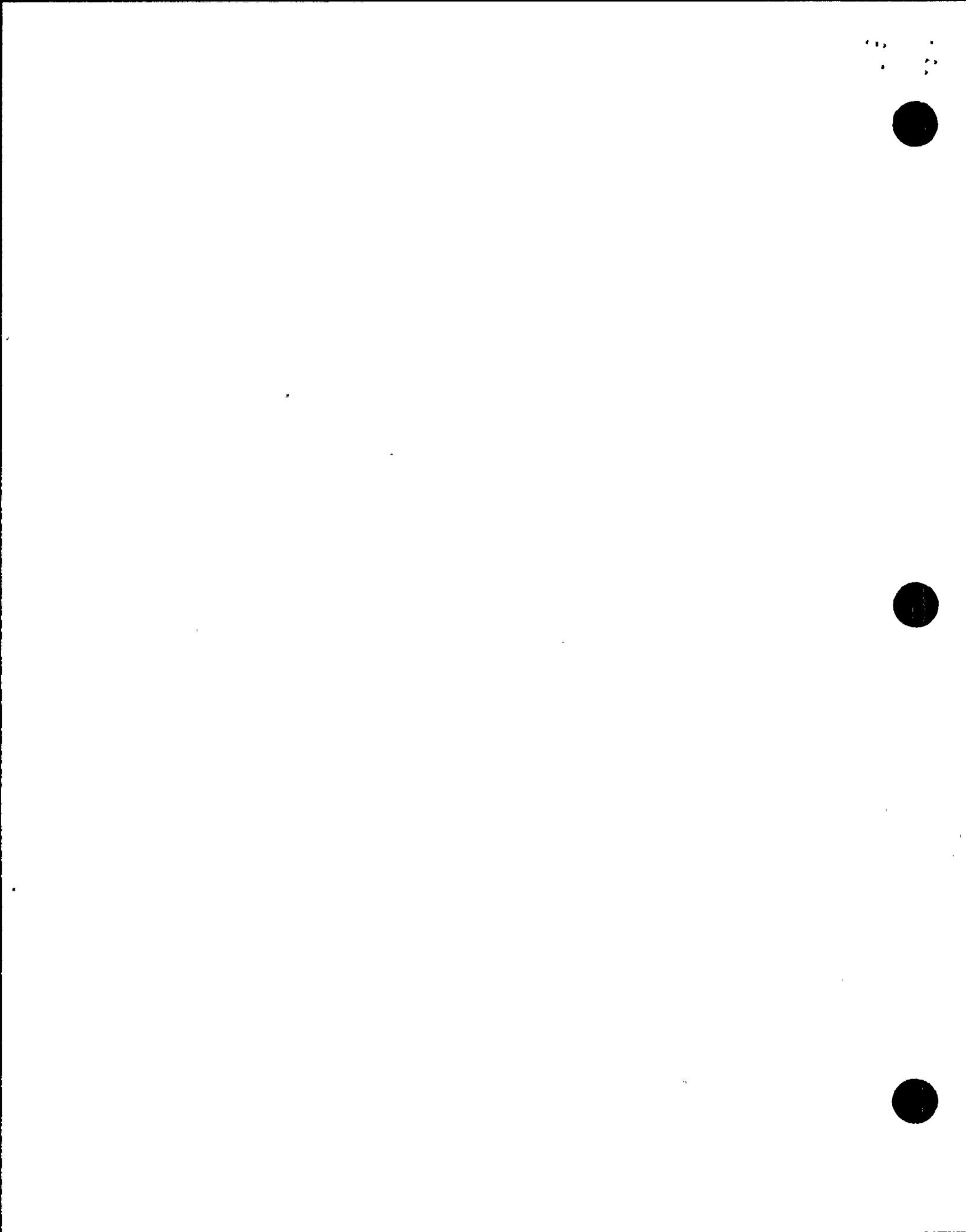
Lag wrap exceeded the UL derating factors of 28.04% for 1-hour barriers or 31.15% for 3-hour barriers and are, therefore, more conservative than the UL derating factors. The SEA also concluded that the cables are not operated beyond their qualified temperatures. In summary, the SEA concluded that there is no adverse impact to the Appendix R safe Shutdown Analysis. The inspectors noted that NRC IN 92-46 has identified ampacity derating factors for one hour Thermo-Lag as high as 37.4%. This value is higher than some of the maximum allowable derating factors calculated by the licensee. However, IN 92-46 has also questioned the validity of testing to determine ampacity derating factors.

On August 18, 1992, EDR G20006 was closed based on the following: (1) SEA-EE-432 having been completed; and (2) The SEA concluding that there was no adverse impact on the cables. However, the inspectors were concerned that, based on the documentation reviewed, and discussions with licensee personnel, on September 22, 1992, the licensee did not appear to have updated their design basis documents, such as drawings and calculations, with the "new" higher UL ampacity derating values so that these more conservative values would be used for future engineering design work.

The inspectors held a telephone conference with licensee personnel on September 25, 1992. Licensee personnel stated that as a result of discussions with the inspectors on September 22, 1992, the licensee identified that there were long term compliance issues that had not been addressed by SEA-EE-432 or the closed EDR G20006. Therefore, the following actions have been initiated to address these long term compliance issues: (1) Bechtel Calculation E2006.05 will be revised to add the January 21, 1987, UL test report, including the more conservative ampacity derating values, as an Appendix; (2) PP&L General Design Standard 16 will be revised to require that the most conservative ampacity derating values known to date are used in future design calculations; (3) Action will be taken to ensure that SEA-EE-432 includes all wrapped raceways including any wrapped or specified to be wrapped during the time frame from the initiation of the SEA to the completion of actions (1) and (2) above, and any identified as a result of correcting drawing errors (Section 5.1); and (4) Since NRC IN 92-46 identified that an NRC special review team has found that Thermo-Lag ampacity derating factors are indeterminate, IN 92-46 and newly identified industry information on ampacity derating will be tracked and resolved by PP&L's Industry Event Review Program.

Conclusion

Based on the information identified above, the inspectors concluded that the licensee's response to the concerns identified in Bechtel letter XLP-1457 could have been fully evaluated and dispositioned in a more timely manner. The inspectors noted three additional concerns: (1) NRC IN 92-46 concluded that the ampacity derating factors for Thermo-Lag were indeterminate; (2) UE&C's response to their investigation of EWR M70214 concluded that the none of the configurations in the test reports reviewed by UE&C were the same as the configurations installed at SSES. Therefore, the inspectors concluded that the applicability of any of these tests to SSES is suspect; and (3) The licensee had not completed



actions to update their design basis documents, such as drawings and calculations, with new higher UL ampacity derating values so that these values will be used for future engineering design work or used drawings with adequate quality upon which to base their analyses. Therefore, these issues remain unresolved (URI 387 & 388/92-23-02) pending resolution of the industry concerns, identified in NRC Information Notice (IN) 92-46, related to ampacity derating factors and PP&L's evaluation of the resolution as it applies to their installed configurations and their design basis documents.

4.0 WALKDOWN INSPECTIONS OF INSTALLED ONE HOUR BARRIERS AND INSPECTION OF THE QUALITY OF THE INSTALLATIONS

Scope

This portion of the inspection was initially conducted to assess visually the quality of the one hour spray-on Thermo-Lag fire barrier wrap installations through a walkdown of selected fire areas (Section 4.1). However, during the course of the walkdowns, other fire barrier materials such as preformed Thermo-Lag (Section 4.2), and Kaowool enclosed in Zetex and gypsum board enclosures (Section 4.3) were identified; the quality of these installations was also assessed. The licensee's procedures for completing Technical Specification required fire barrier visual inspections were also reviewed (Section 4.4). To broaden the sample being taken of the licensee's fire barrier wrap installations, the inspectors selected a system, the Automatic Depressurization System (ADS), to walkdown and inspect the installed raceway fire barrier wrap (Section 4.5). Inspection observations were compared to the licensee's installation drawings and specifications, including some qualification tests conducted to support use of the particular fire barrier wrap materials used. Cognizant personnel were interviewed during the inspection, and records and documentation were inspected.

4.1 Quality of General Installation

Findings

As discussed previously in Section 2.0, the walkdown inspection initially focused heavily on three Fire Zones (0-28B, 1-2D, and 0-28H) to verify that the licensee's fire barrier cable wrap installations were in conformance with SSER#4. To verify the installation configurations of the one hour spray-on Thermo-Lag installed on safe shutdown raceways outside of the fire zones specifically addressed in SSER#4, the inspectors extended the walkdown inspection to cable wrap installed in Fire Zones 0-27C, 1-5A, 1-4A, and 1-3A as previously described in Section 3.0.

A visual inspection was performed on safe shutdown raceways identified as requiring cable wrap by Appendix A of Revision 2 to the FPRR. Typically, the licensee had installed one hour rated cable raceway wrap fire barriers in areas with automatic fire detection and suppression systems and three hour rated cable wrap fire barriers elsewhere unless a specific

deviation request had been approved. The majority of the cable wrap fire barriers observed were rated by the licensee for one hour protection.

Barrier designs were observed to be configured to suit various raceway (conduit and cable tray) arrangements. Thermo-Lag manufactured by TSI was identified to be the principal fire barrier wrap material used to protect the safe shutdown cable raceways and electrical equipment installations during the walkdown inspections. Large electrical breaker cabinets and boxes also were observed to be protected by fire barrier wrap materials. The Thermo-Lag installed on these breaker cabinets and electrical boxes was of the preformed type that is currently under question in NRC Bulletin 92-01. Preformed Thermo-Lag is discussed further below in Section 4.2. Structural steel raceway supports and intersecting raceways contacting wrapped raceways were also observed to be wrapped out to 9 inches from the wrapped raceway for one hour fire wrap barriers and 18 inches for three hour wrap barriers.

Within the fire zones listed above and adjacent zones, the inspectors observed that other fire barrier materials had been used in addition to Thermo-Lag. Other barrier wrap materials observed included Kaowool enclosed in aluminized Zetex and gypsum board. The use of Kaowool and gypsum board is discussed further in Section 4.3.

Overall, the barrier wrap installation was observed to be continuous over the areas specified to be wrapped and met the licensee's installation specification with the few exceptions discussed in the paragraphs below. The inspectors found that within the selected sample of raceway barriers inspected, all raceways specified by the licensee's Appendix R safe shutdown analysis to be wrapped with a fire barrier wrap material were wrapped. Based on visual examination of accessible portions of wrapped raceways, the overall installation was found to be neat and to exhibit quality workmanship, except in several specific locations discussed in the paragraphs below. All of the inspections were performed without destructively testing or analyzing any of the installed barrier wrap materials.

Conclusion

Overall, the inspection found that the licensee's raceway barriers were wrapped in accordance with the licensee's installation specification No. F1000, except as noted otherwise and discussed in the paragraphs below. On an overall basis, the quality of the fire barrier wrap installation workmanship was observed to be neat and installed in a quality manner.

4.2 Use of Preformed Thermo-Lag and Thermo-Lag used in Unique Applications

Findings

As reported above, during plant walkdowns the inspectors observed that preformed Thermo-Lag was installed in some areas of SSES Unit 1. Licensee personnel informed the inspectors that, in addition to using spray-on Thermo-Lag at SSES, preformed Thermo-Lag 330-1 had originally been used in some areas of Unit 2 to support plant licensing. Preformed Thermo-

Lag was later used in both Units 1 and 2 where additional Thermo-Lag was required to be installed as a result of the licensee's reanalyses of their commitment to Appendix R to 10 CFR Part 50. During their walkdown inspections, the inspectors observed that the 3 hour preformed Thermo-Lag had an outer stress skin, and the one hour preformed Thermo-Lag generally did not. Walkdown inspections also identified that some very large electrical breaker cabinets and boxes were protected by barrier wrap materials. The Thermo-Lag installed on these large breaker cabinets and electrical boxes observed was of the preformed type. However, since preformed Thermo-Lag 330-1 has recently been called into question by NRC Bulletin 92-01, the inspectors did not review the licensee's basis for qualification of this material as it will be the subject of future NRC action.

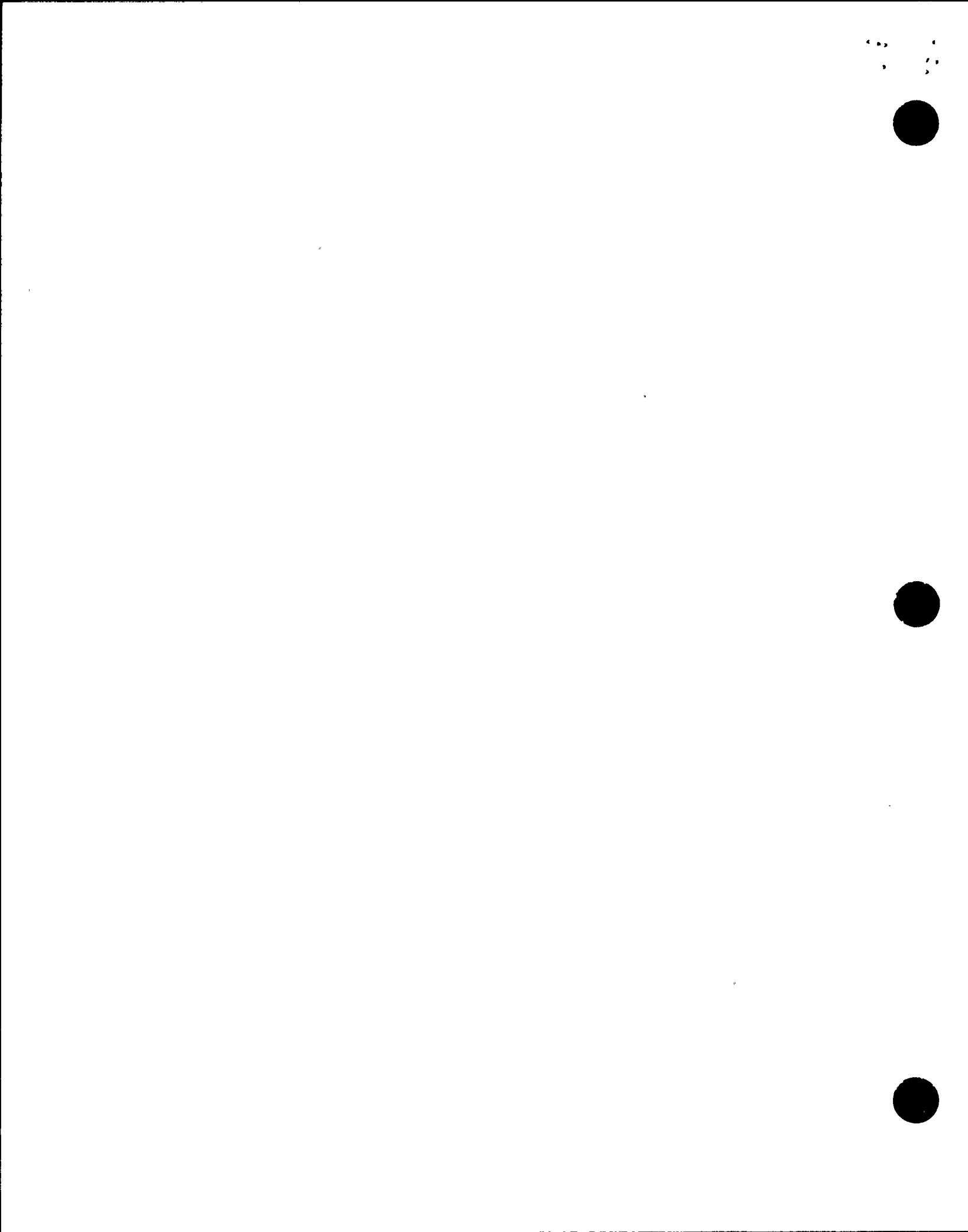
4.3 Kaowool Wrap and Gypsum Board Enclosures

4.3.1 Kaowool Wrap

Findings

As previously reported, during the review of the use of Thermo-Lag and during plant walkdowns, the inspectors found that Kaowool enclosed in Zetex was installed at SSES. The Zetex seams were sealed with Polyken 237 aluminized tape. Joints at junctions, e.g. a barrier wall, were noted to be filled and sealed or caulked with several different materials including Thermo-Lag and silicone type caulking materials. Trowelable type Thermo-Lag was the predominant joint sealing material observed to be used. The licensee's Specification No. F1001, Revision 0, Technical Specification For Fire Qualification Test Of A Protective Envelope System, and the licensee's Specification No. F1000, Revision 4, Technical Specification For The Design And Installation of Electrical Raceway Fire Barriers listed the acceptable materials for use in raceway wrap barriers. For example, Intrumastic 285 manufactured by Carboline Fire Proofing Products Division or an approved equal was listed as acceptable for use in the barrier wrap installation.

Discussions with the licensee revealed that the licensee's contractor, Bechtel, used Kaowool during the early period of initial installation of fire barrier wrap materials on safe shutdown raceways. The contractor apparently based the acceptability for using Kaowool on an Underwriters Laboratories (UL), Inc., report dated September 6, 1978. The report entitled, "Cable Raceway Protection Systems Fire Test Investigation" was performed by Babcock & Wilcox (B&W) in Augusta, Georgia, and numbered File R8758, Project 78N5345. The Kaowool system includes wrapping the raceway with a specified thickness of Kaowool, banding the Kaowool to the raceway with steel bands spaced at a specified distance apart, and independently covering the banded Kaowool with an aluminized fibrous E-glass outer wrap material called Zetex to provide mechanical and moisture protection for the Kaowool. The inspector noted that the Zetex outer wrap material appeared not to have been included in the UL qualification test. The B&W literature indicated that the Zetex had been subsequently added. It further stated that the Zetex can handle temperatures up to 1000 degrees F. This is lower than the maximum ASTM E-119 fire exposure test temperature of approximately 1700



degrees. During walkdown inspections, the licensee's Kaowool installations inspected were visually observed to have an outer wrap of Zetex, with exceptions as noted in Section 4.3.4 below.

As a result of ampacity derating concerns and space limitations, the licensee switched from Kaowool to Thermo-Lag. Except for the early prelicensing installations of Kaowool, the licensee stated that no additional installations of Kaowool were made. The Kaowool that was installed had been installed in accordance with Bechtel procedure FP-E-12 and Bechtel Specification No. 8856-E-61. The licensee later incorporated the Bechtel specification into their own PP&L Specification F1000, "Electrical Raceway Design and Installation of Exposure Fire Barriers and Fire Stops." The licensee stated that there were no quality control documents documenting the installation of Kaowool cable wrap fire barriers.

As previously reported in Section 3.1.2, licensee representatives advised the inspectors that the Kaowool blanket wrap system they were using exceeded the 250 degree temperature rise criterion but stated that the use of this material was approved by the NRC. The inspectors reviewed the following information to followup on this issue.

Generic Letter (GL) 85-01 was issued on January 9, 1985, and paragraph 3.2.1 stated that "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 criterion. However, new material should meet the 325 degrees F criterion. Justification of temperatures that exceed 325 degrees F is required." Based on a review of GL 85-01 for applicability to cable raceway fire barriers at SSES, the licensee submitted Deviation Request No. 17 which requested approval to use the Kaowool fire barrier wrap system along with automatic suppression in those specific fire areas where the installation currently existed. The justification in the deviation request cited GL 85-01 and stated that the existing Kaowool installations at SSES were previously approved by the NRC. However, from discussions with licensee personnel and reviews of Revisions 1 and 2 of the FPRR and the Susquehanna Safety Evaluation Report, NUREG-0776, including Supplements 1, 2, 3, and 4, the inspectors found no evidence that the NRC had specifically approved the use of Kaowool at SSES. By letter dated August 9, 1989, the NRC approved the licensee's Deviation Request (DR) No. 17, based on a contractor's review of the information provided by the licensee. A copy of DR 17, from Revision 3 of the SSES FP RR, and applicable portions of the Associated NRC Safety Evaluation Report are included in Attachment 8.

The use of Kaowool appeared to be approved based on "grandfathering" and the guidance in GL 85-01. Therefore, in a Request For Technical Assistance Memo dated October 14, 1992, the Region I staff requested NRR to review the "grandfathering" of Kaowool and further requested NRR to reevaluate whether valid and reasonable rationale or justification exists to support the continued use of Kaowool material at Susquehanna and other facilities where the product may be applied. The use of Kaowool at SSES and the approval of DR 17 remains an open issue and will be tracked as an Inspection Follow-up Item (IFI 387 & 388/92-23-03).

The NRC approval of DR 17 also incorporated a statement requiring that every area where Kaowool was used is also to be provided with an automatic suppression system. The inspectors identified one fire zone where Kaowool was installed without suppression. This concern is addressed in the next section, Section 4.3.2.

Conclusion

Kaowool was only installed in the prelicensing fire barrier installation period and was identified, during the walkdown inspection and record review, to be only a small percentage of the licensee's total fire barrier wrap installation. The rationale for approving the use of Kaowool at SSES has been questioned. The quality of the Kaowool installations are discussed further in the sections below.

4.3.2 Kaowool Installed in a Fire Zone Without Automatic Suppression

Findings

During a walkdown inspection in the Cold Instrument Shop, Fire Zone 0-28H, the inspectors observed that there was no automatic fire suppression system provided. It was verified that no cable trays were present. The fire barrier wrap for conduits in Fire Zone 0-28H consisted of both Thermo-Lag and Kaowool. The inspectors then compared the as-built installation to the licensee's drawings and found that the licensee's drawings did not accurately reflect the as-built installation. The licensee's drawings (for example, drawing E-294) contained errors in that they did not show that Kaowool was installed in the Cold Instrument Shop (Fire Area CS-15, Fire Zone 0-28H) on conduits C1P107, A1P105, and A1P075. Therefore, the licensee's design basis documentation did not alert them to the fact that Kaowool was installed in an area without automatic suppression. As detailed below, this is a violation of the Facility Operating License and Appendix R. Concerns about the quality of the licensee drawings are discussed in Section 5.1

The licensee submitted a letter to the NRC, dated February 9, 1982, requesting an exemption from BTP CMEB 9.5-1, Position C.5.b.2(c). Position C.5.b.2(c) required that redundant safe shutdown equipment/cables be separated by a fire barrier having a 3-hour rating when automatic suppression is not provided. This request was for Fire Zones 0-28H, 0-28B, and 1-2D. The licensee's request stated that: (1) The minority division raceways are located above a non-rated false ceiling and are run in conduit; (2) The combustible loading for the fire zone is low; and (3) Manual suppression and ionization detectors are provided for the fire zone. The justification stated that the one hour cable enclosures without automatic suppression provide adequate protection for safe shutdown cables. The letter indicated that two materials to be considered for use were TSI Thermo-Lag and materials manufactured by Quelcor.

SSER No. 4 issued in November 1982, approved the licensee's exemption requested by this February 9, 1982, letter. However, the NRC staffs' approval was based on Thermo-Lag

being installed, and it did not address the installation of Kaowool in any of these three fire zones. The inspectors noted that, several years later, to document this exemption in their Appendix R reanalysis submittal, the licensee summarized the exemption request and the NRC approval as Deviation Request (DR) No. 8, "One Hour Fire Barrier Wrap With Limited Suppression." The licensee then incorporated this Deviation Request, DR 8, into Revision 3 of the SSES FPRR.

During the review period of the exemption request described in the previous paragraph, SSES Unit 1 Operating License NPF-14 was issued on July 17, 1982. The license contained a condition 2.C.(7) "Battery Room Area (Section 9.5.4, SER, SSER#1, SSER#3)" that stated:

"Prior to exceeding five percent of full power and subject to NRC review and approval, PP&L shall either conduct at an approved testing laboratory an ASTM E-119 test of the as-installed one-hour cable wrap configuration or install an automatic fire extinguishing system."

Licensee condition 2.C(7) encompassed the Cold Instrument Shop, Fire Zone 0-28H. The licensee did conduct a test on Thermo-Lag. As reported above, Thermo-Lag was approved for use in this area under the conditions specified in SSER#4.

The Kaowool fire barrier wrap used in Fire Zone 0-28H was questioned for its capability to provide a full one hour rated fire barrier, especially without automatic suppression. The licensee has relied on a test that others had previously conducted for Kaowool. The qualification test report relied upon (UL File R8758, Project 78NK5345, dated September 6, 1978) was not submitted by the licensee to the NRC for review for applicability to SSES. Licensee personnel stated that they believed that this test had been approved by the NRC; however, by the end of the inspection period, the licensee had not provided any docketed information that would confirm that this specific UL test report had been reviewed and accepted by the NRC.

The inspectors performed an initial review of this UL test report and noted that it does not meet the GL 85-01 and GL 86-10 guidance for an acceptable fire barrier rating test in accordance with NFPA 251 or ASTM E-119. Two discrepancies noted in test 3 of the UL report were that: (1) The furnace temperatures were lower and, therefore, less conservative than the time temperature curve in ASTM E-119; and (2) The temperature inside the Kaowool barrier at 60 minutes was 400 degrees F, higher than the 325 degrees provided as guidance in GLs 85-01 and 86-10.

Further, by a letter dated June 30, 1988, the licensee submitted Revision 3 to the FPRR that included an Appendix R Deviation Request (DR) No. 17, titled, "Kaowool System as an Acceptable 1- Hour Fire Barrier Wrap." DR 17 stated, in part, that the deviation requested was to use the Kaowool fire barrier wrap system along with automatic suppression in areas of the plant where the installation of this material currently existed. DR 17 also identified a specific list of fire zones where Kaowool was installed in the plant. The inspectors noted that

Fire Zone 0-28H was not on this list. Under the heading "Existing Arrangement," DR 17 states: "All fire zones in which Kaowool has been installed have automatic fire suppression. Fire detection is also provided in these fire zones." Based upon the inspection findings, this statement was not true for the Fire Zone 0-28H located in the Cold Instrument Shop since there was no automatic suppression installed.

DR 17 stated, in part, in the section titled, "Reason for Deviation Request," that 10 CFR 50, Appendix R, Section III.G.2.c allows the use of 1-hour fire barrier wrap; however, GL 85-01, Section 3.2.1 indicates that the Kaowool System, which had been accepted by the NRC, may not have met the 325 degrees F temperature limit and this system is installed at SSES. Additionally, in the DR 17 section titled, "Justification," the licensee stated:

"Kaowool was installed as a barrier wrap at Susquehanna SES prior to fuel load on Unit 1 (July 1982). In NRC Generic Letter 85-01, the staff has stated that conduit and cable tray enclosure materials accepted by the NRC as a 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 degrees F criterion. The existing Kaowool installations at Susquehanna SES were previously approved by the NRC. Each installation is protected by an automatic fire suppression system. While another barrier design may be preferable and has been utilized at Susquehanna SES, Kaowool provides a sufficient level of protection for raceways when fire suppression is provided so as to not warrant its replacement in areas of the plant where it is currently installed."

The inspectors noted that DR 17 was approved by NRC letter dated August 9, 1989. This approval was granted based on paragraph 2.15 of the attached Technical Evaluation Report (TER) that stated, in part, that the deviation could be granted based on the information provided including the information that: (1) Every area where Kaowool was used is also provided with an automatic suppression system; and (2) The Kaowool installed in Unit 1 at SSES was previously approved by the NRC. However, as reported above; during this inspection period, the inspectors found no docketed information that accepted the use of the specific Kaowool configuration installed at SSES for use at SSES or any other NRC licensed facility, and there was no automatic fire suppression provided for the Kaowool in Fire Zone 0-28H.

In summary, from a review of available documents associated with the licensing submittals for DR 8 and DR 17, the inspectors did not find where the licensee had made known to the NRC staff any differences regarding the type of one hour wrap used in Fire Zone 0-28H. In response to the exemption request identified as DR 8, the NRC in SSER No. 4 approved the use of one hour spray-on Thermo-Lag fire barrier wrap in this fire zone. Based upon the licensee drawings and documentation found during the inspection, the licensee, when communicating with the staff for DRs 8 and 17, appeared not to have realized that Kaowool was also installed in Fire Zone 0-28H. As previously noted, the drawings reviewed by the inspectors did not reflect that Kaowool was installed in this area. By installing Kaowool in

Fire Zone 0-28H on conduits A1P105, C1P107, and A1P071, the licensee failed to meet the requirements of License Condition 2.C(7) and did not meet the requirements of License Condition 2.C(6) by failing to meet the requirements of DR 8 (SSER#4) and DR 17 of the FPRR. This is a violation of the Facility Operating License (EEI 50-387/92-23-04).

The inspectors also confirmed that the licensee already had compensatory fire watches established in the area. These compensatory fire watches were established prior to this inspection when the licensee declared their Thermo-Lag raceway cable wrap barriers inoperable and took the required Technical Specification actions in accordance with the guidance provided in NRC Bulletin 92-01, dated June 24, 1992. During this inspection, the licensee extended their actions to all of their raceway cable wrap barrier materials, including Kaowool, in response to NRC Bulletin 92-01, Supplement 1, dated August 26, 1992. This supplement was more comprehensive than the original bulletin that only addressed concerns with Thermo-Lag on small conduits and large cable trays. The licensee committed to maintain these fire watches until the problem was resolved.

The inspectors noted that the licensee initiated NCR 92-201 to track this problem to resolution. At the exit meeting, the inspectors verified that the licensee did not know if this condition, Kaowool, installed in an area without automatic suppression, existed in other areas of the plant. The licensee committed to investigate this problem to determine whether or not this problem exists in any other areas.

Conclusion

The licensee's use of the Kaowool fire barrier wrap system in Fire Zone 0-28H without automatic fire suppression was identified as a violation. The licensee appeared to have failed to distinguish the fact that Kaowool was installed in Fire Zone 0-28H. This finding indicates that the licensee has not previously evaluated the Fire Zone 0-28H adequately. The inaccuracies and poor quality in the documented description/drawings of the installation including failure to perform adequate inspections of the installation further contributed to these matters going undetected.

4.3.3 Gypsum Enclosures

Findings

During an inspection of the one hour spray-on Thermo-Lag cable wrap fire barriers in Fire Zone 0-28B-II, the inspectors noted that portions of the conduits and two circuit breaker boxes, 1D624 and 1D644, which were required to have protective barriers installed, were protected by gypsum board enclosures in lieu of the Thermo-Lag fire barrier system. The inspectors noted similar enclosures in the area outside the Unit 2 battery rooms, Fire Zone 0-28A.

The inspectors requested installation drawings and qualification test data that supported the 1-hour fire resistance rating required for these enclosures. During this inspection period, licensee personnel provided the inspectors with information on several designs that used gypsum board walls and were listed in the Underwriters Laboratory Fire Resistance Directory. However, the inspectors noted that none of these designs exactly matched the design used to install the gypsum board enclosures in Fire Zone 0-28B-II. At the time of the initial exit meeting on September 4, 1992, licensee personnel were continuing to locate data that would support the one hour fire resistance rating of the installed gypsum board enclosures.

Therefore, this item remains unresolved pending the licensee providing: (1) Documentation specifically supporting a one hour rating of the enclosures as installed with the noted discrepancies; or (2) A fire protection engineer's evaluation, as described in Section 3.2.2 of GL 86-10, fully justifying deviations from a tested configuration (URI 387 & 388/92-23-05). Inspector identified discrepancies are described further in Section 4.3.4 and Attachment 3. Licensee personnel stated that these gypsum board enclosures are being considered operable fire barriers pending further investigation.

Conclusion

At the time of the September 4, 1992, exit meeting, licensee personnel had not been able to locate data that would support the one hour fire resistance rating of the installed gypsum board enclosures. Therefore, this item remains unresolved pending the licensee providing documentation to support a one hour rating of the gypsum board enclosures as installed.

4.3.4 Inadequacies Identified in the Installation of Kaowool and Gypsum Barriers

Findings

While performing detailed visual inspections and walkthroughs of the cable raceway fire barrier wraps and gypsum board enclosures, the inspectors identified deficiencies in the licensee's Kaowool and Gypsum installations. These deficiencies appeared to have resulted from a failure to provide adequate inspections to assure that the cable wrap fire barrier were installed in a quality manner and in conformance with design drawings and specifications during plant construction. Details of these installation deficiencies and the quality assurance requirements for inspecting these installations are described below.

The Facility Operating License, NPF-14, was amended on March 27, 1990, by Amendment 95 to revise License Condition 2.C.(6), which states, in part:

"Pennsylvania Power & Light Company shall implement and maintain in effect all provisions of the approved fire protection program as described in the Fire Protection Review Report for the facility and as approved in the Safety Evaluation dated August 9, 1989..."

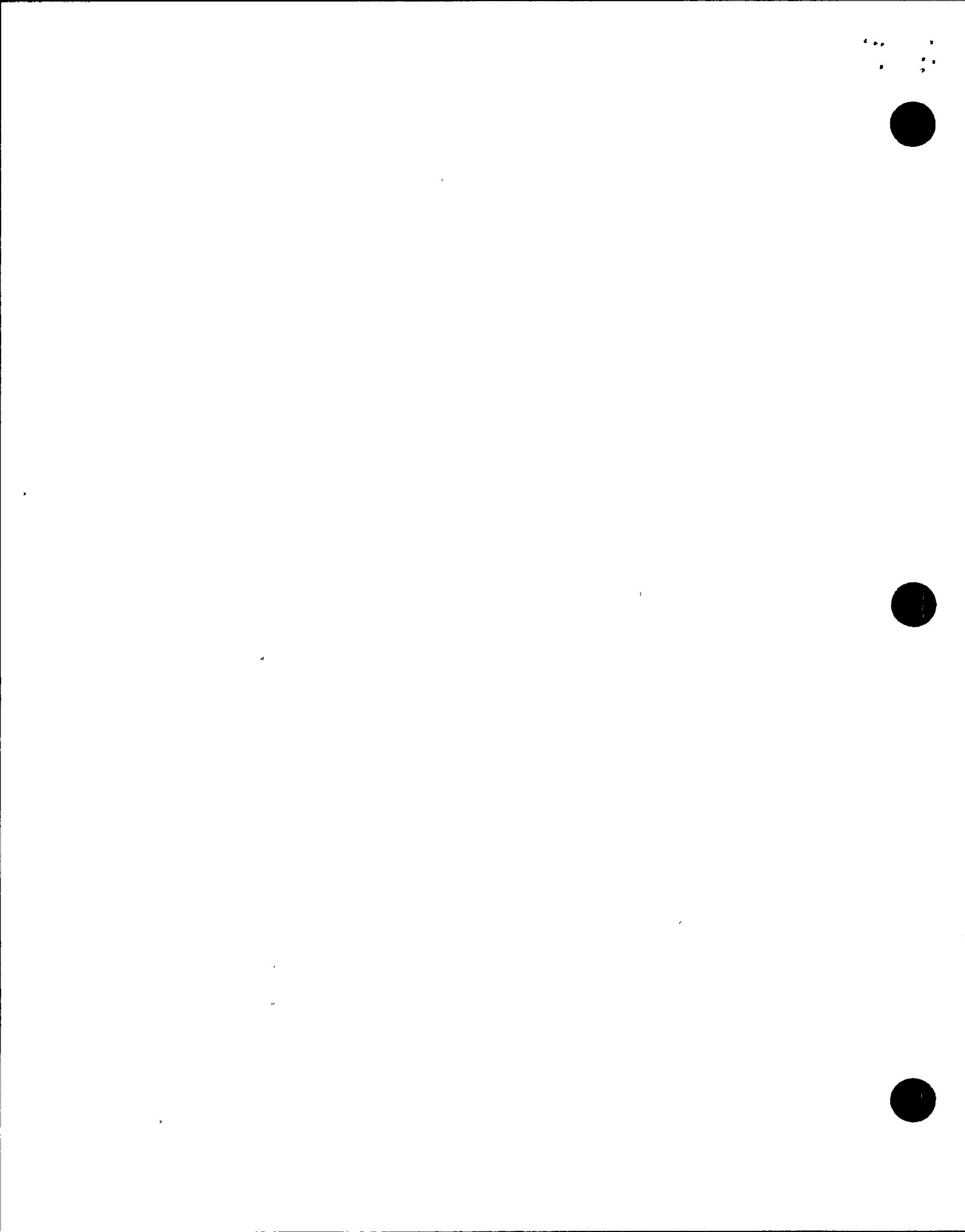


Table 5.0-1, part C.4, "Inspection", of the Fire Protection Review Report under the heading of "Susquehanna SES Compliance" states, in part, that field personnel witnessed the fire protection installation and verified conformance with design drawings.

Contrary to the above, as of September 4, 1992, the following were examples where Fire Protection Program required inspections failed to identify that the installed cable wrap fire barriers did not meet the design requirements:

During inspection in the Cold Instrument Shop, which is located in Fire Zone 0-28H on the 771'-0" elevation of the Control Structure, a fire barrier wrapped conduit, C1P107, located above the ceiling paneling was observed to be wrapped alternately with Kaowool and Thermo-Lag. Starting at the fire rated barrier wall at the rear of the Cold Instrument Shop (near building Column Line N) the conduit wrap material was Kaowool from the wall out to about 30 inches, then Thermo-Lag for 60 inches, then Kaowool for 30 inches after which it became Thermo-Lag for the remainder of its run in the Cold Instrument Shop. The inspector observed one location where a small triangular shaped area of approximately 20 square inches, was missing the Zetex material for the barrier wrap. The area with the missing Zetex appeared to the inspector to have existed since the original installation, i.e., the Zetex did not appear ripped, torn, or damaged. Bechtel Specification 8856-E-61, Revision 1, states in paragraph 6.4.6 that "Zetex shall have a minimum 3 inch overlap." (This Bechtel Specification was used during plant construction and was later incorporated into the licensee's specifications F-1000 and F-1001). The inspectors could physically touch the Kaowool in the triangular barrier wrap area having the missing Zetex. The inspectors concluded that this barrier wrap location missing the Zetex did not comply with the licensee's installation specification. The missing Zetex covering over the Kaowool is one example of a violation of the licensee's installation specification (Bechtel Specification 8856-E-61) and the FPRR requirement to inspect the installation (EEI 50-387/92-23-06). The licensee's surveillance inspections had failed to identify or effect repairs to this out of specification condition. This finding indicates a less than adequate inspection and surveillance of the Kaowool installation. The inadequacy of the licensee's Kaowool barrier wrap inspections is discussed further in the next Section, 4.4.

The licensee initiated a Nonconformance Report (NCR) No. 92-200 to track this problem to resolution. The inspectors confirmed that the licensee had already established compensatory fire watches in the area as described in section 4.3.2.

From the floor level of Reactor Building Elevation 719'-1" in Fire Zone 1-4A-N, the inspectors visually observed a conduit, D1P008, in the overhead that appeared to be missing any type sealing or caulking at the juncture where the conduit entered the 3-hour rated fire barrier wall to the switchgear room. The conduit was approximately 18' above the floor elevation and inaccessible. The inspectors obtained access to the conduit on September 1, 1992, and by touch and close visual examination determined that the barrier wrap (Kaowool) had not been sealed and caulked to the fire barrier wall. Failure to seal the conduit barrier wrap to the barrier wall is in violation of Bechtel Specification 8856-E-61,

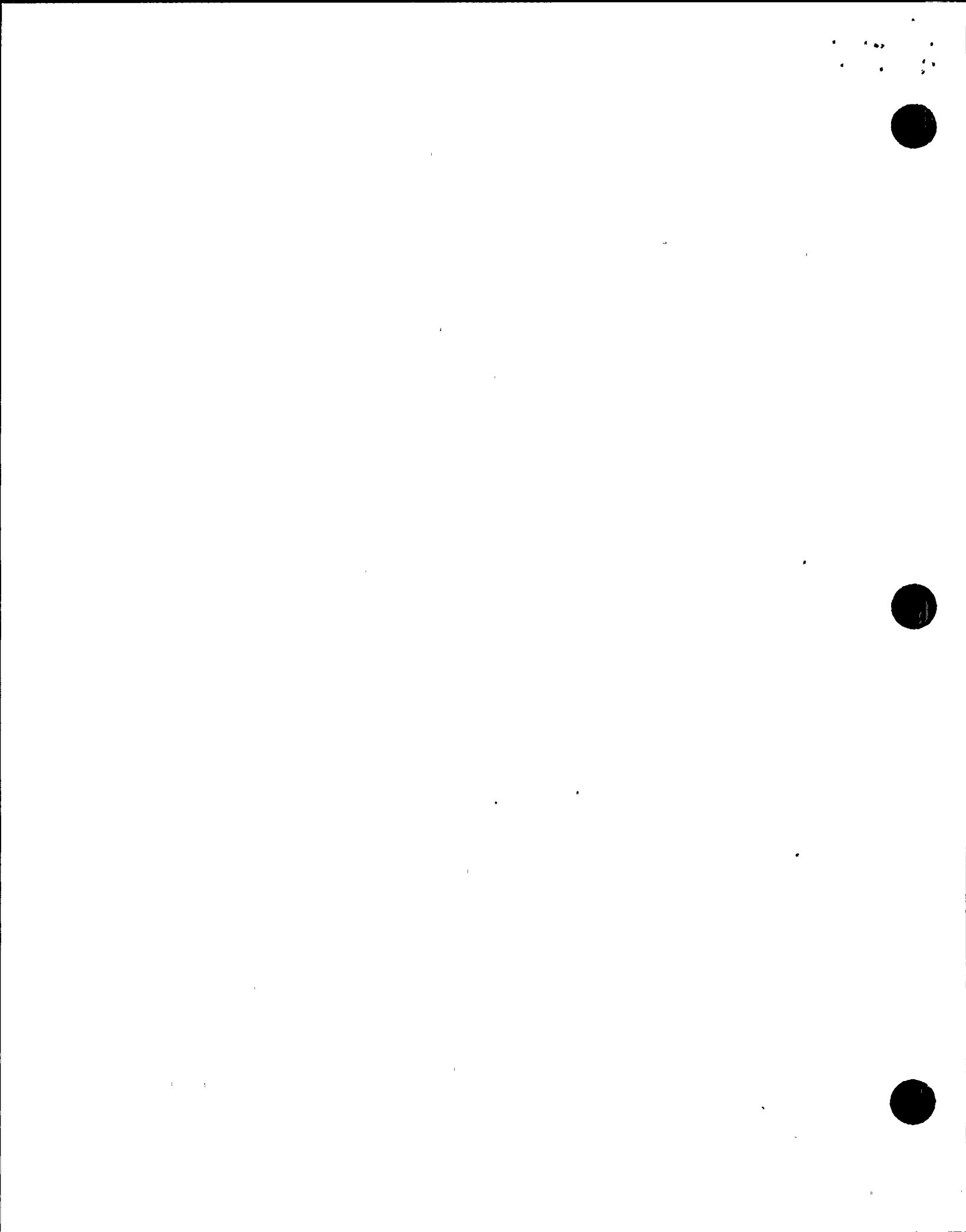
paragraph 6.4.11. This is a second example of a violation of the licensee's installation specification and the FPRR to inspect fire protection installations to verify that they are installed in accordance with the design specifications (EEI 50-387/92-23-06). This is also an example where the licensee's surveillance and inspection programs have not functioned adequately to maintain a fire protection barrier. Section 4.4 below provides additional information regarding inadequacies in the licensee's barrier wrap inspections. This Kaowool insulation appeared to have been installed prior to license issuance and gone undetected and uncorrected by the licensee's inspection and maintenance processes. Another case where the barrier wrap material was inadequately sealed to the barrier wall was observed in the Cold Instrument Shop and is further discussed along with other fire barrier walkdown discrepancies identified as examples of this violation in Attachment 3.

The inspectors also noted that the licensee initiated a Nonconformance Report (NCR), No. 92-200, to track this problem to resolution. The inspectors also confirmed that the licensee had already established compensatory fire watches in the area, as noted in 4.3.2.

During an inspection of the one hour spray-on Thermo-Lag cable wrap fire barriers in Fire Zone 0-28B-II, the inspectors noted that portions of the conduit and two circuit breaker boxes, 1D624 and 1D644, which were required to have protective barriers installed, were protected by gypsum board enclosures in lieu of the Thermo-Lag fire barrier system. The inspectors noted similar enclosures in the area outside the Unit 2 battery rooms, Fire Zone 0-28A. The inspectors requested installation drawings for these enclosures. The installed enclosures were inspected against drawing E-105025. The inspectors found that the enclosures' walls were not installed in compliance with the installation drawing. The drawing requires the header above the door to be constructed of a 1/2" outer gypsum board layer, a 1 1/2" air gap, and an inner 1" gypsum board layer. The inspectors found that the inner layer of gypsum was mounted flush with the outer layer with no air gap present. It was noted that this 1 1/2 inch air gap may be an important factor in the rate of heat transfer through the gypsum board fire barrier. This installation method was also used for the enclosure walls. This is a third example of a violation for the licensee's failure to inspect fire protection installations and verify that the installations were in conformance with design specifications (EEI 387/92-23-06). The qualification of the gypsum board enclosure was previously addressed in Section 4.3.3. Additional installation deficiencies and examples of this violation, such as missing portions and open seams in the inner gypsum board layer, are detailed in Attachment 3. Licensee personnel stated that these enclosures would be considered operable pending completion of further research and investigation.

Conclusion

While performing detailed visual inspections and walkdowns of the cable raceway fire barrier wraps and gypsum board enclosures the inspectors identified deficiencies in the licensee's Kaowool and Gypsum installations. These deficiencies indicated to the inspectors that the licensee's inspections at the time of installation of the fire barriers were inadequate to assure that the barriers were installed in conformance with design drawings and specifications. The



inspectors were concerned that the licensees fire protection program is relying on fire protection features whose quality of installation has been called into question. Three examples are cited as a violation to support the inspectors conclusions regarding failure to apply quality when installing fire barriers in accordance with the design drawings and specifications

4.4 Fire Barrier Inspection Surveillance Test

Scope

As a result of the raceway fire barrier discrepancies noted above and in Attachment 3, the inspectors reviewed the surveillance inspections performed on these fire rated assemblies to meet the requirements of Technical Specification 4.7.7.1.a. The inspectors reviewed the Unit 1 surveillance procedure, SM-013-013, "18 Month Inspection of the Common Buildings Fire Barriers" and the common plant area surveillance procedure, SM-113-013, "18 Month Inspection of Unit 1 Fire Barriers" for technical content. The last test records for these two procedures were reviewed to verify that the procedure had been adequately completed, reviewed, and approved. Cognizant personnel were interviewed regarding the inspection findings and the records and documentation inspected.

Findings

The Technical Specifications were reviewed. Technical Specification 3.7.7 states:

"All fire rated assemblies, including walls, floor/ceilings, cable tray enclosures and other fire barriers separating safety related fire areas or separating portions of redundant systems important to safe shutdown within a fire area, and all sealing devices in fire rated assembly penetrations, including fire doors, fire windows, fire dampers, cable and piping penetrations, seals and ventilation seals shall be OPERABLE."

Technical Specification 4.7.7.1. states:

"Each of the above required fire rated assemblies and sealing devices shall be verified OPERABLE at least once per 18 months by performing a visual inspection of:

- a. The exposed surfaces of each fire rated assembly."

Then, the inspectors reviewed surveillance procedures SM-113-013 and SM-013-013 for technical content and to verify that the procedures verified the requirements of Technical Specification 4.7.7.1.a. The inspectors observed that the level of detail contained in these procedures could be improved. A few examples of where improvements could be made were in the areas of: (1) Describing the types of materials to be inspected; (2) The level of inspection required; (3) Locations of materials to be inspected; (4) The inspection

acceptance criteria; and (5) The level of detail required to document the inspection activities performed. Two specific concerns identified were as follows: (1) The procedure appeared to be directed only towards inspecting Thermo-Lag cable raceway fire barriers and did not appear to address the requirement to inspect Kaowool fire barriers; and (2) The inspection methodology relies heavily on the use of binoculars because many of the wrapped raceways are normally inaccessible since they are located in the Reactor Building overhead and would require scaffolding or ladders to gain access.

After attempting to perform an inspection of some wrapped raceways using binoculars, the inspectors concluded that all surfaces of the fire barriers located in the Reactor Building overhead could not be thoroughly inspected. Therefore, the inspectors questioned the adequacy of the inspections performed with binoculars. Discussion with cognizant licensee personnel revealed that the contents of these procedures were being evaluated and that a sampling procedure similar to that used for penetration seals may be used to inspect difficult to access fire barrier materials.

Specification C-1073, "Technical Specification for Inspection of Fire Wrapped Raceways for Compliance with Technical Specifications" was reviewed since it was referenced by the surveillance procedures. This specification, C-1073, also appeared to be directed to Thermo-Lag and appeared not to address Kaowool.

The inspectors reviewed the records for the last performance of each of these surveillance inspections required by Unit 1 Technical Specification 4.7.7.1.a. The records for SM-113-013 were reviewed and the "action taken" portion of the Surveillance Authorization (SA) A20348 was found to be not detailed enough to determine what barrier materials were inspected. Conversely, in the records for SM-013-013, the detail recorded by the craftsmen in the "action taken" portion of the SA A13962 was excellent; the date, raceways or barriers inspected, fire areas, and fire barrier materials were all recorded. However, these records did not identify that any Kaowool/Zetex fire barrier cable raceway wrap had been inspected. The records also did not identify that the gypsum board enclosures, 1D624, 1D644, 2D624, and 2D644 in Fire Zones 0-28B and 0-28H, had been inspected.

Therefore, the inspectors discussed the inspection and procedure records with two craftsmen who had participated in the performance of SA No. A13962. From these discussions the inspectors found that the craftsmen did not inspect the Kaowool/Zetex barriers because they did not believe that the inspection of this material was required by the surveillance procedure, SM-013-013. The craftsmen did not indicate that they had ever inspected the Kaowool fire barriers when performing this surveillance inspection. During this inspection period, the inspectors saw no records which would indicate that the Kaowool barriers have been periodically inspected to meet this surveillance requirement since initial installation. Failure to inspect the Kaowool/Zetex fire rated assemblies is a violation of Technical Specification 4.7.7.1.a (EEI 387 & 388/92-23-07). The inspectors did not verify whether the craftsmen had inspected the gypsum board enclosures.

Specific deficiencies identified on Kaowool barriers during walkdown inspections are described in Attachment 3. These deficiencies indicated to the inspectors that the licensee's own inspections were inadequate and were not providing the needed attention to detail to assure that the barrier wrap is adequately maintained.

The inspectors noted that during this inspection period and prior to identifying this finding, the licensee declared all of their raceway cable wrap barrier materials, including Kaowool, inoperable and established compensatory fire watches for these barriers in response to NRC Bulletin 92-01, Supplement 1, which was issued on August 26, 1992. This supplement was more comprehensive than the original bulletin that only addressed concerns with Thermo-Lag on small conduits and large cable trays. The licensee also initiated a Significant Operating Occurrence Report (SOOR), No. 1-92-305, to track this problem to resolution.

Conclusion

The inspectors found that as a result of the failure to inspect their Kaowool/Zetex fire-rated assemblies the licensee was not in compliance with Technical Specification 4.7.7.1.a. The inspectors were concerned that the Kaowool/Zetex fire barriers had not been inspected since their installation and that the licensee management was unaware of this problem. The inspectors were also concerned with the apparent lack of licensee management oversight of the surveillance of Kaowool fire barriers.

4.5 ADS System Inspection

Findings

To broaden the sample being taken of the licensee's fire barrier wrap installation, the inspectors selected a system, the Automatic Depressurization System (ADS), to walkdown and inspect the installed cable raceway fire barrier wrap. The walkdown was made to determine if the raceways that were wrapped were required to be wrapped by the licensee's current Appendix R analysis, Revision 4 of the FPRR. It was not the intent of this inspection to sample the quality of the individual raceway barrier wrap installations or the licensee's Appendix R shutdown methodology.

The inspectors selected ADS valves from the licensee's Appendix R safe shutdown logic as follows: one ADS valve from Division 1, logic Pathway 1, and two from Division 2 that included logic Pathways 2 and 3. The inspectors reviewed the licensee's drawings, specifications and raceway routing computer printouts for the subject ADS valves. The walkdown was initiated at the ADS power supply breaker cabinets located on the 771' elevation in the Control Structure.

The inspectors walked the raceways down to the Upper Relay Room on the 754' elevation for Division 1, and continued to the Division 1 containment penetration box located on 719' elevation of the Reactor Building. The reactor was operating and containment was inerted;

these conditions precluded entering containment to follow the ADS raceways to the valves. The ADS Division 1 raceways were found to be routed through 6 different fire zones.

The ADS raceways for Division 2, Pathways 2 and 3 were walked down from the breaker on the 771' elevation of the Control Structure down to the Lower Relay Room on the 698' elevation of the Control Structure, and continuing up to the Division 2 containment penetration boxes on the 719' elevation of the Reactor Building. The Division 2 raceways were found routed through 11 fire zones.

The inspectors found that all raceways that were required to have a fire wrap barrier, by the licensee's Appendix R analysis, had the fire barrier wrap installed. The inspectors observed that each ADS valve had manual controls such that each valve could be operated from its respective Divisional Relay Rooms.

Conclusion

Based upon the sample taken, the inspectors concluded that the ADS raceways fire barriers were wrapped to conform to the licensee's Appendix R safe shutdown methodology. This selected sample of the licensee's raceway fire barrier wrap verified that the license raceways that were required to have fire barrier wrap were wrapped in accordance with the licensee's safe shutdown methodology. Based upon the sample taken, the inspectors had no further questions concerning whether or not raceways that were required to have fire barrier wrap were wrapped. Questions concerning the design documentation and the safe shutdown methodology are discussed below in Section 5.0.

5.0 DRAWING QUALITY, SAFE SHUTDOWN METHODOLOGY AND QUALITY AUDITS

Scope

This section focuses on other issues that were identified and encountered during the course of the inspection. These issues included the quality of drawings documenting the cable raceway fire barrier wrap installations (Section 5.1), the licensee's quality audits and self assessments in those areas inspected during this period (Section 5.2), and the safe shutdown methodology used to determine to safe shutdown raceways that require protection by fire barrier cable wrap (Section 5.3). The inspectors interviewed people regarding these matters, and inspected records and documentation.

5.1 Drawing Quality

Scope

As described in the sections above, the inspectors compared the as-built fire barrier wrap installations to two types of the licensee's drawings during the walkdown inspections of

selected portions of the licensee's raceway fire barrier wrap installations. The first drawing, E-294, Revision 10, List Of Raceways Wrapped With Fire Barrier Material, Unit 1, and Common, provided: (1) A listing of protected raceways; (2) The fire zones in which each raceway was located; (3) The pertinent Fire Protection Features Drawing number; (4) The barrier material installed, e.g., Thermo-Lag or Kaowool; (5) The barrier thickness; and (6) Pertinent comments about the raceway. The inspectors used the licensee's second type of drawing, the C-series of Fire Protection Features Drawings, to follow the actual wrapped raceway routing through the plant for those safe shutdown raceways listed as requiring protective wrapping by Appendix A of Revision 2 of the FPRR, dated December 1982. Comparisons were made between what the inspectors actually found installed and what was shown on the C-series and E-294 drawings.

Findings

During inspection in Fire Zone 0-28H, the inspectors performed an inspection of conduit C1P107 that was located above the false ceiling in the Cold Instrument Shop. The majority of the barrier material on conduit C1P107 was Thermo-Lag; however, the inspectors found two sections approximately 30 inches long each where the barrier wrap material was Kaowool not Thermo-Lag. Drawing E-294 listed the barrier wrap material for conduit C1P107 as one half inch (1-hour) Thermo-Lag in Fire Zone 0-28H. Therefore the E-294 drawing did not accurately reflect the as-built fire barrier wrap installation for the conduit C1P107 in Fire Zone 0-28H.

The inspectors observed a second conduit, A1P071, in the ceiling over the Cold Instrument Shop (Fire Zone 0-28H) that was protected over its entire length in the Instrument Shop with Kaowool fire barrier wrap. A review of Drawing E-294 found the fire barrier wrap material to be specified as one half inch Thermo-Lag. This is a second example where the E-294 drawing did not accurately reflect the as-built installation.

A walkdown of conduits E1P353 and C1P077 in Fire Zone 0-28B-I identified an error on the Fire Protection Features Drawing C-1754, Revision 1, for elevation 771'-0." This drawing showed these two conduits ending within the fire zone at a partial wall, not the barrier wall, which was approximately nine feet away. The drawing was in error in that the conduits were not shown correctly to end at the three hour rated fire barrier wall. The actual installation was observed to be installed correctly. The error was in the drawing.

Drawing C-1721, Sheet No. 2, Revision 1 shows the fire barrier wrap for conduits E1K586 and E1K758 ending within a fire zone boundary wall between Fire Zones 1-2B and 1-2D. The conduits actually enter a junction box in Fire Zone 1-2D on the other side of the fire zone boundary wall. Drawing E-294 did not show that the conduits entered Fire Zone 1-2D. Additionally, conduit E1K586 was incorrectly shown on drawing C-1721, Sheet 2, in that it was not shown entering Fire Zone 1-2D. Additional examples are listed in Attachment 3.

The C- Series of Fire Protection Features Drawings reviewed, including the two typical examples discussed above, C-1754 and C-1721, were clearly labeled in the title block as "NON-QUALITY RELATED." Drawing E-294 had no designation in the title block indicating the quality level of the drawing.

The Facility Operating License, NPF-14, was amended on March 27, 1990, by Amendment 95 to revise License Condition 2.C.(6). This License Condition states in part:

"Pennsylvania Power & Light Company shall implement and maintain in effect all provisions of the approved fire protection program as described in the Fire Protection Review Report for the facility and as approved in the Safety Evaluation dated August 9, 1989..."

Paragraph 1.4 of the Fire Protection Review Report states, in part, that the fire protection program is implemented through approved specifications, drawings and procedures which are generated and controlled under the PP&L Operational QA Program.

Technical Specification 6.8.1 states, in part, that written procedures shall be established, implemented and maintained for the Fire Protection Program. One of the procedures that implements the Fire Protection Program is Procedure NDI-QA-15.3.1. Procedure NDI-QA-15.3.1, Revision 3, Fire Protection Program, states, in part: "This NDI outlines the unique responsibilities and interfaces required to implement the Fire Protection Program." Procedure NDI-QA-15.3.1, Revision 3, Fire Protection Program, Attachment 1, Revision 2, Fire Protection Features And Activities Requiring Quality, specifies that "Quality requirements shall be applied to the fire protection features in the following areas:

- a. Unit 1 Reactor Building; . . .
- d. Control Structure; . . .
- j. Fire barrier wrapping identified as being wrapped to meet Appendix R (10 CFR 50) in Drawings E 294 and E 295;
- k. Fire-rated walls, fire-rated floors,...fire-rated penetration seals within and enclosing the above areas (as specified on engineering drawings). . ."

Contrary to the above, the following are several examples of the licensee's failure to adequately apply his Quality Assurance Program to two series of design drawings for required fire protection features in the Unit 1 Reactor Building and Control Structure and is a violation for the failing to implement Fire Protection Program procedures as required by Technical Specification 6.8.1 (EEI 50-387/92-23-08):

- Drawing E-294 did not show Kaowool as fire barrier wrap material on conduits A1P105, C1P107, and A1P071 in Fire Zone 0-28H located in the Control Structure.

The C-Series of Fire Protection Features Drawings reviewed, including the two typical examples discussed above, C-1754 and C-1721, were clearly labeled in the title block as "NON-QUALITY RELATED." Drawing E-294 had no designation in the title block indicating the quality level of the drawing.

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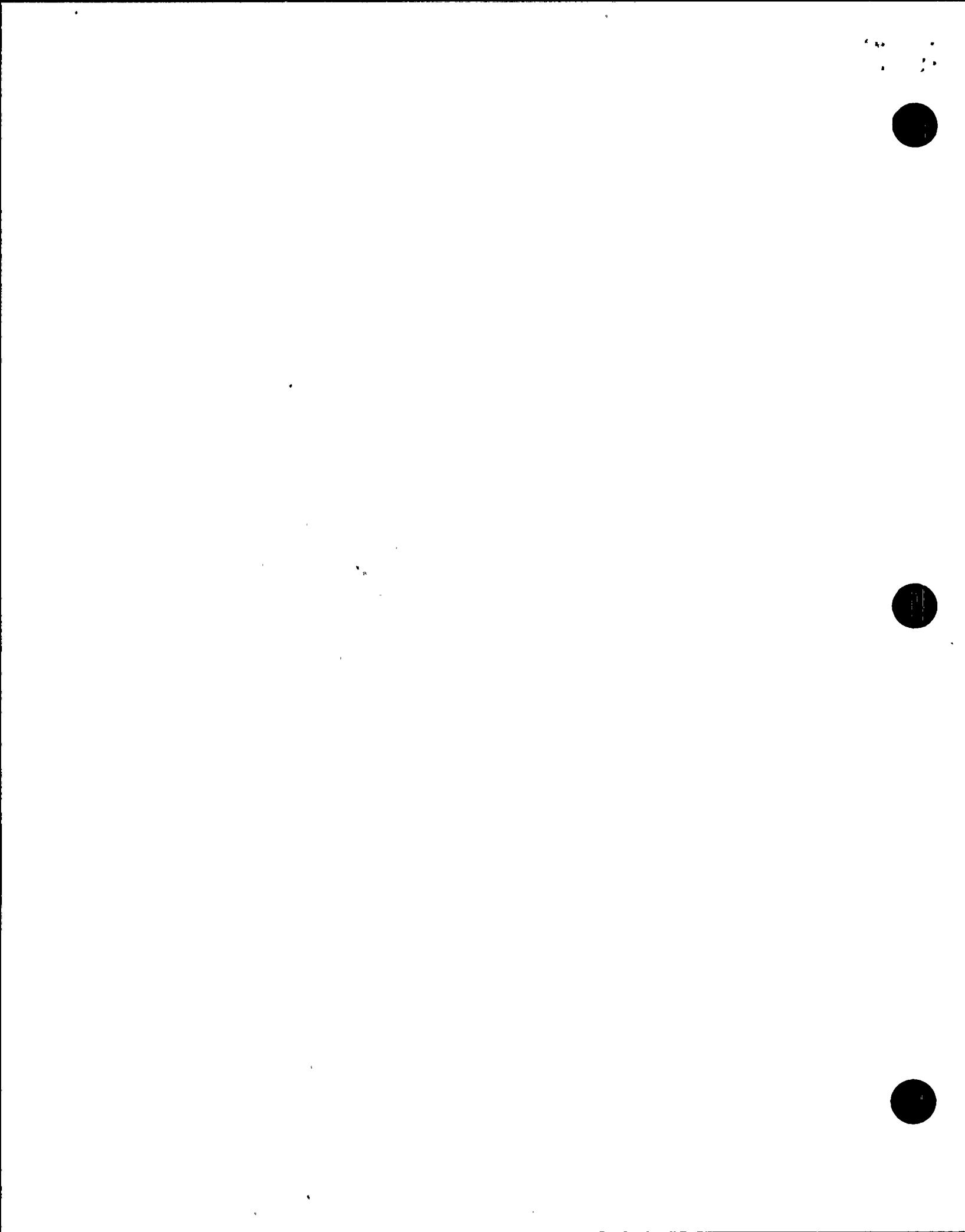
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- d. Control Structure; . . .
- j. Fire barrier wrapping identified as being wrapped to meet Appendix R (10 CFR 50) in Drawings E 294 and E 295;
- k. Fire-rated walls, fire-rated floors,...fire-rated penetration seals within and enclosing the above areas (as specified on engineering drawings). . ."

Contrary to the above, the following are several examples of the licensee's failure to adequately apply his Quality Assurance Program to two series of design drawings for required fire protection features in the Unit 1 Reactor Building and Control Structure and is a violation for the failing to implement Fire Protection Program procedures as required by Technical Specification 6.8.1 (EEI 50-387/92-23-08):

- Drawing E-294 did not show Kaowool as fire barrier wrap material on conduits A1P105, C1P107, and A1P071 in Fire Zone 0-28H located in the Control Structure.



- Drawing C-1754 failed to show correctly the conduit run for conduits E1P353 and C1P077 in Fire Zone 0-28B-I located in the Control Structure.
 - Drawing C-1721, Sheet No. 2, Revision 1, and E-294 omitted showing that conduits E1K586 and E1K758 were wrapped with Thermo-Lag where they entered Fire Zone 1-2D located in the Control Structure.
 - The C-Series drawings were incorrectly labelled in the title block to be, "NON-QUALITY RELATED," typical examples were drawings C-1754, Revision 1, and C-1721, Sheet 2, Revision 1. However, Nuclear Plant Engineering Procedure DC050.0, Revision 3, Paragraph 5.3.2 requires, in part, that drawings controlled and possessed by PP&L shall include information in the title block indicating whether the drawing is or is not Quality Related and the level of Quality involved - i.e., safety related, fire protection, etc.
- Additional examples of this violation for failure to provide adequate quality for fire protection design drawings are identified in Attachment 3 along with the fire barrier walkdown discrepancies.

During the course of the inspection, the inspectors noted cases where the license relied upon these drawings during decision making processes. One example of this was a November 13, 1985, NPE-Civil engineering calculation DK-C-DJK-014 concerned with Appendix R Exemptions. The calculation stated incorrectly that no Kaowool was used in Fire Area CS-15 (Fire Zone 0-28H) based on a reference to drawing E-294. This error was previously discussed in Section 4.3.2. A second example was an engineering evaluation SEA-EE-432, dated August 14, 1992, titled Evaluation Of Unit 1&2 Derating Of Power Cables In Raceways Wrapped With Thermal-Lag (sic) Material. This evaluation relied upon drawing E-294 to identify the barrier material used for the protected raceway derating calculations. An example, Conduit A1P075 was incorrectly listed as Thermo-Lag; however, the inspectors visually observed that the entire conduit was wrapped with Kaowool within the Cold Instrument shop. SEA-EE-432, "Derating Of Power Cables in Raceways Wrapped with Thermo-Lag Material" incorrectly listed conduit A1P071 in its Attachment 1 as being wrapped with Thermo-Lag. The inaccurate and poor quality drawings appeared to have resulted in some incorrect inputs into the licensee's decision making processes.

The inspectors noted that during the inspection period that the licensee initiated an Engineering Discrepancy Report (EDR), No. 620053 to track and resolve the programmatic quality issues associated with discrepancies between drawings and between drawings and the as-built installations.

and during the audit in discussions with personnel involved with fire protection activities. Perspectives on this and other issues presented in the observations/recommendations are offered by the audit team in the interest of program and procedural clarity, improved implementation, and precluding findings in future audits."

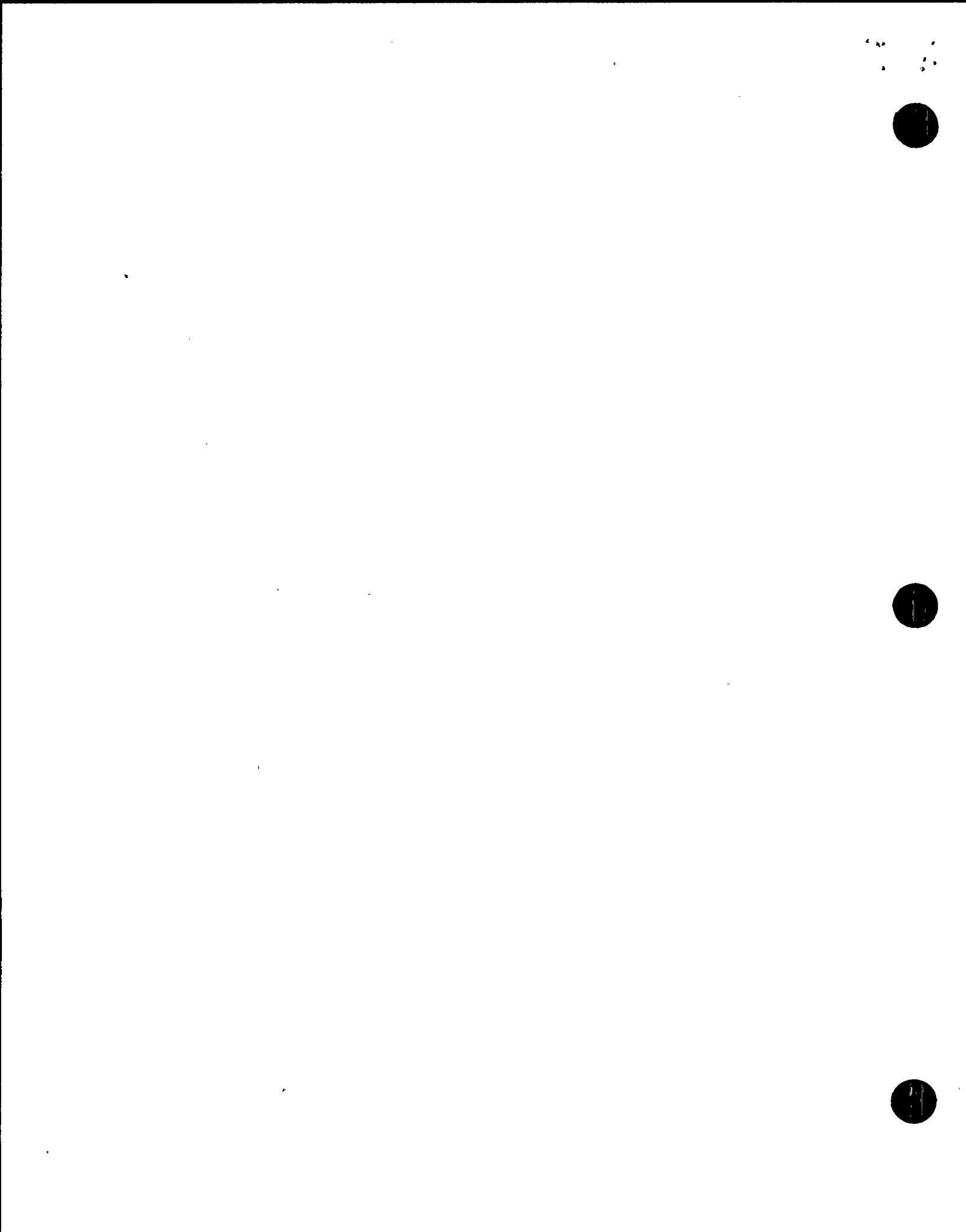
Based on the findings from this inspection, the audit summary indicated to the inspectors that the audits were making substantive findings; however, management's involvement in the fire protection area did not assure the adequacy of quality and corrective actions. Examples of findings by this NRC inspection include: (1) Fire Protection Features Drawings inappropriately marked in the title block "NON-QUALITY- RELATED" (Section 5.1); (2) A number of drawing errors (Section 5.1); and (3) Failures of Technical Specification required surveillance inspections to address Kaowool installed as a fire barrier wrap (Section 4.4), including using the Kaowool fire barrier wrap system on conduits in an area, Fire Zone 0-28H, without an automatic suppression system (Section 4.3.2).

QA surveillances are also conducted for many of the attributes relating to the fire protection program. Surveillance reports relating to the fire protection and Appendix R area were compiled by the QA group for a ten year period starting in 1982. The inspectors sampled several of the reports to assess the surveillance activity relative to this inspection. The inspectors noted that a number of the surveillance covered fire drills, fire brigade training and fire watches. Surveillance No. 87-140 was conducted to assess upgrade work that was being performed by a contractor on conduit penetration seals at a three hour rated penetration. This surveillance involved 55 man hours and determined that the completed work was accomplished in accordance with the Plant Modification Request. The inspectors did note that apparently as a result of the surveillance the work planning was improved. This indicated that the QA surveillance was effective for this job.

No QA surveillance was noted to have been conducted to determine if all fire wrap barriers were being inspected; however, Surveillance No. 86-132 was conducted to assess whether fire doors were being inspected. This surveillance involved nine man hours and it did identify a number of discrepancies that were provided to the Fire Protection Engineer for resolution. The Fire Protection Engineer responded to the surveillance report that the doors to be inspected were based upon a drawing A213427 and Specification C-1070. The quality of these documents was not assessed by the inspectors during this inspection; however, the inspectors concluded that the surveillance reports were making information available to management upon which to assess the quality of the Appendix R and fire protection program areas.

Conclusion

The licensee's QA audits and surveillance did not appear to have covered some Appendix R facets focused upon by this inspection; however, they have provided a number of indicators to management regarding deficiencies in the Appendix R and fire protection areas. It



appeared that management has lacked consistency in promulgating and supporting quality in the Appendix R area commensurate with commitments. Overall, the licensee's assessment processes appear not to have been used by management to the fullest extent practical and possible to identify similar deficiency findings identified by this inspection.

5.3 Shutdown Methodology

Scope

During this inspection, the inspectors performed field walkdowns of installed cable raceway barriers. On a sampling basis, these inspections verified that the cable raceway barriers were installed where required by the licensee's safe shutdown methodology; however, the adequacy of the licensee's safe shutdown methodology was not reviewed during this inspection. The inspectors did review the documents in Attachments 4 and 5 to determine the current review status of the licensee's safe shutdown methodology.

Findings

A special team inspection conducted in 1985 opened Unresolved Item (URI 387 & 388/85-06-01) that stated that the licensee's Fire Hazard Analysis was inadequate to show compliance with Appendix R. In response to this URI, the licensee performed a reanalysis of their safe shutdown methodology and submitted it to the NRC on June 30, 1988, in Revision 3 of the Fire Protection Review Report (FPRR). Region I Inspection Report No. 50-387/88-21 stated, in part, that Revision 3 of the FPRR had been reviewed by the team, but, since an Safety Evaluation Report (SER) has not been issued on the new methodology, the final acceptance of the analysis will be based on the acceptability of this document by NRR. The inspectors noted that the SER issued as a result of the Staff's review of Revision 3 to the FPRR, stated, in part, that although our contractor evaluated your requests for deviation from certain provisions of 10 CFR Part 50 Appendix R, your safe shutdown methodology was not evaluated in this review. The inspectors also noted that Revision 4 to the FPRR is currently under NRC review. Therefore, by a Request For Technical Assistance Memo dated October 14, 1992, the Region I staff specifically requested NNR to evaluate the safe shutdown methodology in Revision 4 of the FPRR.

Conclusion

Based on the information above, the inspectors concluded that the licensee's safe shutdown methodology has never been fully reviewed and inspected by the NRC. Therefore, an Inspection Follow-up Item (IFI 387 & 388/92-23-09) has been opened for tracking purposes to ensure that the licensee's safe shutdown methodology is fully reviewed.

6.0 EXIT MEETING

The inspectors met with licensee personnel (denoted in Attachment 1) at the conclusion of the initial inspection, on September 4, 1992, at Susquehanna Steam Electric Station. The inspector summarized the inspection scope and inspection findings at that time. During the exit interview, the inspectors discussed their initial findings that included four apparent violations being considered for escalated enforcement [Escalated Enforcement Item (EEIs)], two unresolved items (URI), and one inspection follow-up item (IFI).

The first violation concerns the inspectors finding that contrary to License Conditions 2.C(6) and (7) and the fire protection program, Kaowool fire barrier material had been installed in an area that was not protected by automatic suppression and where Kaowool had not been approved for use (Section 4.3.2). The inspectors noted that this condition may have resulted from the inaccurate drawings relied upon by the licensee and the failure to perform adequate periodic inspections on all of their fire barriers. Licensee management committed to conduct an investigation to determine if Kaowool was installed in any other areas that are not protected by automatic fire suppression. The second violation concerns the failure to adequately implement the fire protection program quality assurance requirement for field personnel to verify that fire protection installations were installed in accordance with design specifications (Section 4.3.4). The inspectors expressed concern that the fire protection program is relying on protection features whose quality has been called into question. The third violation concerns the failure to perform Technical Specification required surveillance on Kaowool fire barrier cable raceway wrap systems since their installation over ten years ago (Section 4.4). Since it appeared that the licensee was unaware that they had not been performing required inspections of the Kaowool barriers, the inspectors noted a concern about the adequacy of management oversight. The fourth violation concerns the failure to follow procedures to adequately apply quality measures to fire protection program design drawings (Section 5.1). The inspectors expressed concern that the lack of quality applied to the drawings could impact design decisions that relied on the inaccurate design basis documents.

The first unresolved item concerned the use of a Thermo-Lag configuration, on Unit 1 cable trays, which had been found unacceptable for use on cable trays in Fire Zones 1-2D, 0-28B and 0-28H in Unit 1 (Section 3.1.2). The inspectors stated their conclusions and noted that a meeting will be held to give licensee management an opportunity to provide additional information concerning this issue. This additional information and the findings above will be reviewed to determine if the licensee was in compliance with the regulations when they did not apply the information in SSER#4, concerning Thermo-Lag installed in three specific fire zones, to Thermo-Lag installed on cable trays in other areas of the plant. The discussion on the second unresolved item concerned the unavailability of appropriate qualification data or engineering justification to support the installation of gypsum board enclosures used to provide one hour fire barrier (Section 4.3.3).

The inspectors also stated that an Inspection Follow-up Item would be opened to ensure that the licensee's safe shutdown methodology if fully reviewed during the NRC staff's ongoing review of Revision 4 of the Susquehanna Steam Electric Station Fire Protection Review Report (Section 5.3).

The inspectors noted that compensatory fire watches were in place for all cable raceway fire barrier wrap materials used in both Unit 1 and Unit 2. Some of these fire watches were in place prior to the start of the inspection due to NRC Bulletin 92-01. During this inspection, compensatory fire watches were extended to all cable raceway fire barrier wraps after the receipt of Supplement 1 to Bulletin 92-01.

On November 30, 1992, a second exit interview was conducted with those licensee staff members identified in Attachment 1. In this meeting, the inspectors reiterated the findings discussed at the first exit meeting and identified a new Unresolved Item and a new Inspection Follow-up Item. The Unresolved Item identified the inspectors concerns that Thermo-Lag ampacity derating factors are indeterminate and that at the time the inspectors left the licensee engineering offices on September 22, 1992, the licensee had not updated their engineering instructions and design basis documents to ensure the most conservative currently identified Thermo-Lag ampacity derating factors are used in engineering and design decisions (Section 3.3). The Inspection Follow-up Item identified the inspectors concern that use of Kaowool at Susquehanna had been approved based on "grandfathering" and that NRR had been requested to reevaluate whether valid and reasonable rationale or justification exists to support the continued use of Kaowool material at Susquehanna and other facilities where the product may be applied (Section 4.3.1). During this meeting, the week of January 4, 1993, was scheduled for the conduct of an enforcement conference to discuss the apparent violations. This enforcement conference will be held in the Region I offices in King of Prussia, Pennsylvania.

Attachments

1. Individuals Contacted
2. Documents Reviewed
3. Specific Discrepancies Identified During the Inspections
4. Susquehanna Fire Protection Approval Chronology
5. Chronology of Documents Reviewed Related to Susquehanna Thermo Lag Installations
6. Fire Zone Locations and Fire Barrier Materials
7. Applicable Pages of SSER #4
8. Deviation Request (DR) 17 and Applicable Portions of the Associated NRC Safety Evaluation Report

ATTACHMENT 1

INDIVIDUALS CONTACTEDPennsylvania Power and Light

Name	Position
@#*P. Brady	Senior Project Engineer - Engineering Tech.
#K. Backenstoe	Senior Project Engineer - DMG
*J. Casteel	Site Mod. Group
C. Coddington	Senior Program Engineer - Licensing
*S. Davis	Site Fire Protection Engineer
J. Eichlin	Mod. Installation Group
R. Evina	Engineering Assistant
*W. Forsythe	E & SE Construction
*M. Golden	Supervisor, Nuclear System Engineer (Prog. & Testing)
*G. Jones	Manager - Nuclear Engineering
*I. Kaplan	Manager - Energy Info/SSES
@#*J. Kenny	Licensing Group Supervisor
*D. Kohn	Fire Protection Engineer - NE
*G. Kuczynski	Manager, Nuclear Systems Engineering
*R. Kuhl	Quality Control
S. Laskos	Plant Schedule Supervisor
R. Matthews	Quality Assurance Engineer
*D. McGann	Senior Project Engineer - Compliance
G. Miller	Supervisor - Engineering Technology
*J. O'Sullivan	Supervisor - SMG
*R. Peal	Compliance
*R. Prego	Supervisor, Site Quality Verification
#J. Rothe	Senior Project Engineer
*A. Sabol	Manager - Nuclear Quality Assurance
*B. Saccone	Supervisor, BOP Systems
@*G. Stanley	Superintendent of Plant
*R. Wehry	Compliance Engineer
#*W. Williams	Project Licensing Specialist
D. Zaprazny	Project Engineer, Design Modification Group

United States Nuclear Regulatory Commission

Name	Position
*S. Barber	Senior Resident Inspector
D. Mannai	Resident Inspector
+G. Kenna	Investigator
@B. McDermott	Reactor Engineer
@J. White	Section Chief, RPS 2A
@N. Blumberg	Section Chief, PPS
@L. Bettenhausen	Branch Chief, OB

Former United States Nuclear Regulatory Commission Employees

Name	Former Position
+R. Eberly	Fire Protection Reviewer

The inspectors also held discussions with managers, supervisors, and other licensee employees during the course of this inspection, including operations, technical and administrative personnel.

*Attended the initial exit meeting on September 4, 1992.

#Attended the meeting on September 22, 1992, at PP&L's Allentown offices

+Attended the meeting on October 7, 1992, at NRC Offices in Rockville, MD

@Participated in the final exit meeting conducted via telephone on November 30, 1992.

ATTACHMENT 2**DOCUMENTS REVIEWED****Procedures**

- AP 170.0 Revision 4, Classification of Design Activities, dated March 10, 1987
- DC050.0 Revision 2, Drawing Process Requirements, dated October 31, 1985
- FP-E-12 Revision 2, Procedure for Installation of Electrical Raceway Fire Barriers Insulation for the Susquehanna Steam Electric Station Units 1 and 2 for the Pennsylvania Power and Light Company, dated 02/14/83
- NDI-QA-8.2.3 Revision 0, Quality Assurance Requirements For The Fire Protection Program & Related Systems, dated July 19, 1982
- NDI-QA-15.3.1 Revision 3, Fire Protection Program, dated August 15, 1989
- OPS 14 Revision 5, Control of Inspection and Testing, dated May 22, 1992
- OPS 3 Revision 3, Control and Issuance of Documents, dated April 2, 1992
- SM-013-013 Revision 2, 18 Month Inspection of the Common Buildings Fire Barriers, dated January 10, 1992
- SM-113-013 Revision 2, 18 Month Inspection of Unit 1 Fire Barriers, dated January 10, 1992

Drawings

- A-107 Revision 21, Control Structure Upper Cable Sprdg Rm - El 744'-0", Battery Room - El 771'-0",
- C-1721 SSES Unit 1 Reactor Building Fire Zone Plan of Protected Raceways, Elevation 670'-0" (Fire Protection Features Drawing)
Sheet 2, Revision 1, conduits
Sheet 6, Revision 0, tray sections

- C-1722 SSES Unit 1 Reactor Building Fire Zone Plan of Protected Raceways,
Elevation 683'-0" (Fire Protection Features Drawing)
Sheet 3, Revision 4, conduits
Sheet 2, Revision 5, conduits
Sheet 6, Revision 2, tray sections
Sheet 7, Revision 3, tray sections
Sheet 10, Revision 1, partial plan
- C-1723 SSES Unit 1 Reactor Building Fire Zone Plan of Protected Raceways,
Elevation 719'-1" (Fire Protection Features Drawing)
Sheet 3, Revision 5, conduits
Sheet 4, Revision 2, conduits
Sheet 5, Revision 4, conduits
Sheet 7, Revision 2, tray sections
Sheet 8, Revision 0, tray sections
Sheet 9, Revision 4, tray sections
- C-1724 SSES Unit 1 Reactor Building Fire Zone Plan of Protected Raceways,
Elevation 749'-1" (Fire Protection Features Drawing)
Sheet 3, Revision 3, conduits
Sheet 4, Revision 2, conduits
Sheet 5, Revision 2, conduits
- C-1753 SSES Units 1 & 2 Control Structure Fire Zone Plan of Protected Raceways,
Elevation 754'-0" (Fire Protection Features Drawing)
Sheet 2, Revision 2, conduits
Sheet 4, Revision 1, tray sections
- C-1754 SSES Units 1 & 2 Control Structure Fire Zone Plan of Protected Raceways
(Fire Protection Features Drawing) Sheet 2, Revision 2, conduits
- E-105025 Revision 21, (8856-A-107) Control Structure, Upper Cable Spreading Room -
Elevation 754'-0", Battery Room - Elevation 771'-0"
- E-294 (A-177313) List of Raceway Wrapped with Fire Barrier Material Unit 1 and
Common

Specifications

- C-1073 Revision 1, Technical Specification for Inspection of Fire Wrapped Raceways
for Compliance with Technical Specifications, dated January 14, 1988, with
Change Notice 1 dated August 2, 1990

- F1000 Technical Specification for the Design and Installation of Electrical Raceway Fire Barriers
- F1001 Revision 0, Technical Specification for Fire Qualification Test of a Protective Envelope System, dated July 16, 1982
- F1001, Appendix A Texas Utilities Services, Inc., Test Procedure to Qualify a Protective Envelope System for CPSES, Rev. 0 dated 9/9/81
- F1001, Appendix B Bechtel Specification 8856-E-61, Revision 1
- F1001, Appendix C Bechtel Field Change Request E6347
- F1001, Appendix D Bechtel Special Detailed Instructions for Installation of Thermo-Lag 330-1

QA Audits

- 88-047 Fire Protection Program- Report dated August 5, 1988
- 91-041 Fire Protection Program- Report dated August 1, 1991

QA Surveillance

- 82-032 Fire Brigade Training Drill
- 82-059 Diesel and Motor Driven Fire Pumps Weekly Operability
- 83-154 Annual Fire Protection System Flush and Hydrant Flow Check
- 84-018 18 Month CO-2 System Functional Test
- 85-155 Fire Protection Piping Installation
- 86-132 Six Month Inspection of Fire Doors
- 87-140 Upgrade Penetrations

Test Reports

- 01-7163 Southwest Research Institute Project Number 01-7163, Qualification Fire Test of a Protective Envelope System, Report 1, dated August 1982
- 01-7163, Appendix A ANI/MAERP Test Specification
- 01-7163, Appendix B SwRI Surveillance Report
- 01-7163, Appendix C Temperature Data
- 01-7163, Appendix D Circuit Integrity Data
- 01-7163, Appendix E PP&L Test Specification (F1001)

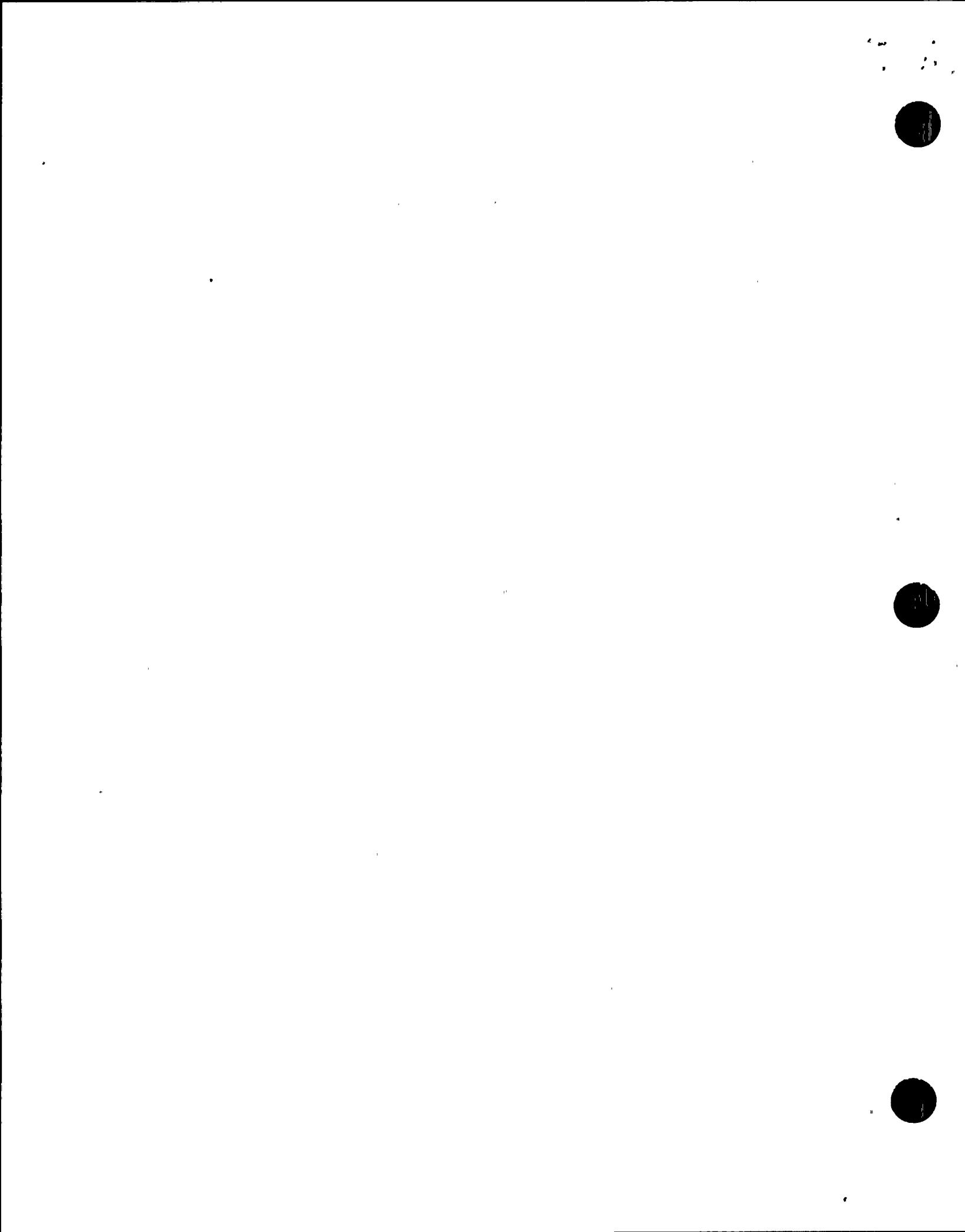
- 86NK23826 Underwriters Laboratories Incorporated Project 86NK23826, File R6802, test report for Special Services Investigation of Ampacity Ratings For Power Cables in Steel Conduits and In Open-Ladder Cable Trays with Field Applied Enclosures dated January 21, 1987
- 82-355-F-1 I.T.L. Test Report, Ampacity Test For 600 Volt Power Cables in an Open Top Cable Tray Protected by the Thermo-Lag 330-1 Subliming Coating Envelope System, conducted for TSI in July 1982 and revised in January 1985
- 84-3-275A I.T.L. Test Report, Ampacity Derating Test For 1000 Volt Power Cables Installed in a Ladder Cable Tray Test Assembly Protected with a Three Hour Rated Design of the Thermo-Lag 330-1 Fire Barrier System, conducted for TSI in March 1984

Calculations

- E2006.05 Revision 3, Bechtel Electrical Calculation, Cable Ampacity for Wrapped Raceway, dated August 26, 1983
- DK-C-DJK-014 Revision 0, PP&L Engineering Calculation, SSES, Appendix R Exemptions, dated November 15, 1985
- DK-C-DJK-015 Revision 0, PP&L Engineering Calculation, Appendix R, III.G, 1-hour Fire Wrap Acceptability, dated November 11, 1985

Miscellaneous

- 82-4212 PP&L Quality Control Inspection Report dated 10/6/82
- 430-5 Bechtel Field Inspection Report dated 6/11/82
- 444-5 Bechtel Field Inspection Report dated 7/1/82
- 455-3 Bechtel Field Inspection Report dated 8/19/82
- 468-3 Bechtel Field Inspection Report dated 11/2/82
- EDR G20006 Engineering Discrepancy Report dated February 18, 1992
- EDR G20053 Engineering Discrepancy Report dated September 2, 1992
- EDR G20052 Engineering Discrepancy Report dated September 2, 1992



- EWR M70214 Engineering Work Request, Derating of Cables in Wrapped Trays, request date February 17, 1987
- NCR 92-200 Nonconformance report dated August 25, 1992
- NCR 92-201 Nonconformance report dated August 28, 1992
- SEA-EE-432 Revision 0, Engineering Studies, Analyses, and Evaluation, Evaluation of Unit 1 and Unit 2 Derating of Power Cables in Raceways Wrapped with Thermal-Lag Material, dated August 19, 1992
- SOOR 1-92-305 SSE Significant Operating Occurrence Report
- WA S24520 Work Authorization dated August 26, 1992
- SA-A20348 Surveillance Authorization, Activity Number Z1716-01, 18 month Inspection of Fire Barriers, dated April 5, 1992
- SA-A13962 Surveillance Authorization, Activity Number Z1715-01, 18 month Inspection of Fire Barriers, dated January 30, 1992
- DCP 82-474 Design Change Package for Susquehanna SES Unit 1 Fire Barrier Modification, Modify Fire Exposure Barrier on Cable Trays E1KG41, 43, 44 in Fire Zone 1-2D, Remote Shutdown Panel Room
- PMR 82-474 Plant Modification Record to "Add fiberglass armoring to cable trays E1KG41, 43, 44 Fire Zone 1-2D (Remote Shutdown Panel Room)
- PP&L Management Issue Summary, Thermo-Lag 330-1, Rev. 8/92

ATTACHMENT 3

SPECIFIC DISCREPANCIES IDENTIFIED DURING THE INSPECTION³Thermo-Lag

1. Two cracks, approximately 4 inches long, were found in the Thermo-Lag on a support member for conduit C1P107 in Fire Zone 0-28H
2. A 3/4 inch diameter hole was found in the Thermo-Lag protecting cable tray section F1KQ17 in Fire Zone 1-4A
3. Exposed fiberglass ends, i.e., not properly embedded in the Thermo-Lag, were found on JB0469
4. In a location above the stairs in Fire Zone 1-5A-SII, the Thermo-Lag on conduit D1P025 had been notched and appeared to be below the thickness required by the installation specification (Additional example of the installation deficiencies cited, EEI 387/92-23-08, in Section 4.3.4)

Kaowool

1. Kaowool fire barrier wrap on conduit A1P071 in Fire Zone 0-28H was not sealed to the Battery Room wall penetration. This was not in accordance with the installation spec. (Additional example of the installation deficiencies cited, EEI 387/92-23-08, in Section 4.3.4, that should have been identified by surveillance inspections, EEI 387 & 388/92-23-07, Section 4.4)
2. A "V" shaped tear, approximately 1-2 inches in length on each leg, was found in the Zetex covering the Kaowool barrier on conduit D1K010 in Fire Zone 1-5A (Additional example of a deficiency that should have been identified by surveillance inspections, EEI 387 & 388/92-23-07, Section 4.4)
3. The licensee identified that the Zetex covering over the Kaowool on conduits A1P071 and C1P107 in Fire Zone 0-28H was butted together at joints in lieu of being overlapped as required by the installation specs. Because the Zetex covering was not removed and there are no QC records for Kaowool installations, the overlap of the Kaowool blankets and the spacing of the banding could not be determined. Additional discrepancies

³ Note: Report Section 4.0 discussed the walkdown inspections which identified these discrepancies. These walkdown discrepancies are examples of the types of discrepancies found during walkdown inspections of a small sample of the wrapped raceways in Unit 1.

identified by the licensee are documented on NCRs 92-200 and 92-201 (Additional example of the installation deficiencies cited, EEI 387/92-23-08, in Section 4.3.4, that should have been identified by surveillance inspections, EEI 387 &388/92-23-07, Section 4.4)

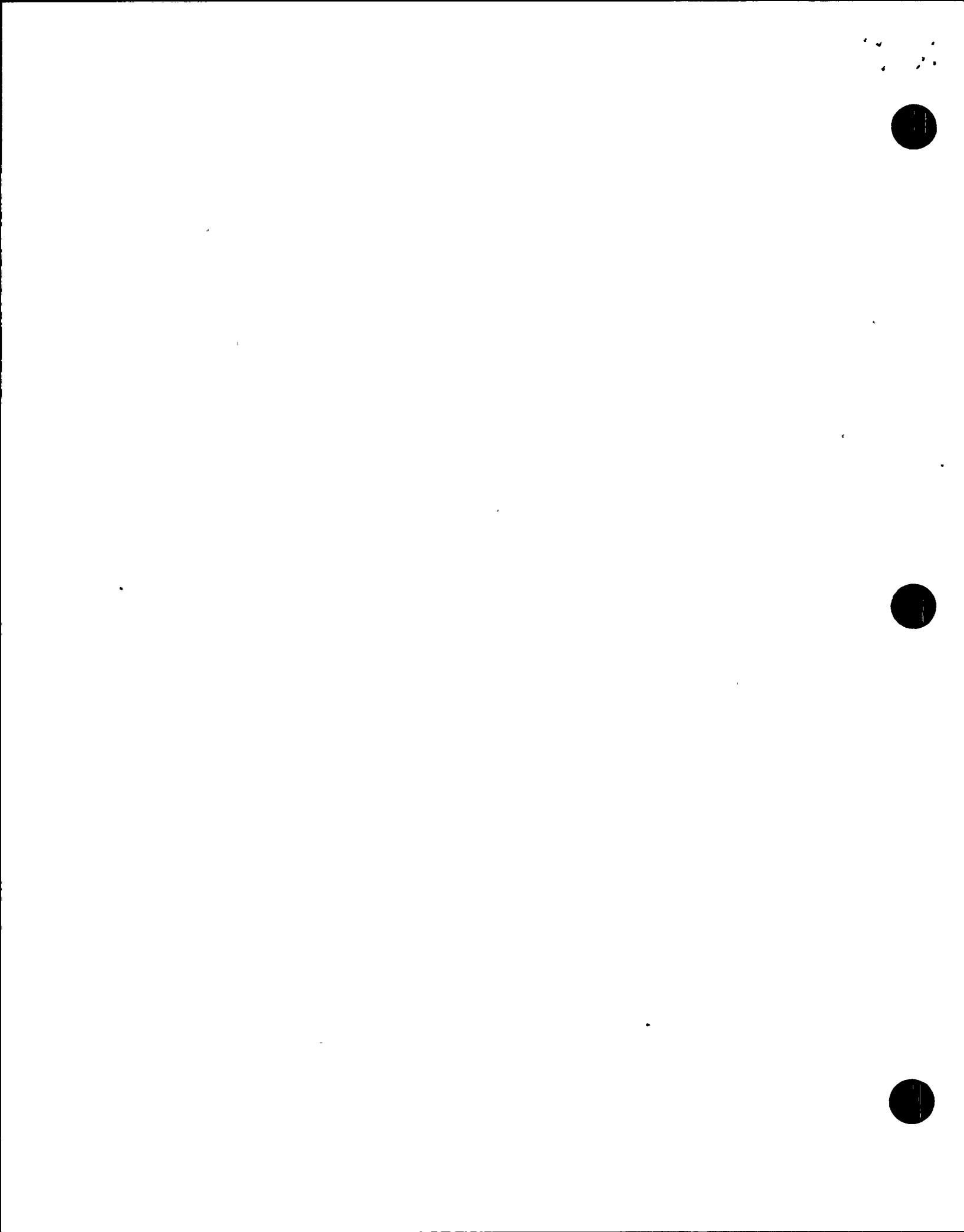
4. In Fire Zone 1-5A-S the Zetex covering on the Kaowool barrier for conduit D1P025 was secured in place with a white tape in lieu of the aluminized tape used in the remainder of the plant (Additional example a deficiency that should have been identified by surveillance inspections, EEI 387 &388/92-23-07, Section 4.4)
5. In Fire Zone 1-4A-W, the licensee identified another taping concern in that conduit F1P096 is protected by the Kaowool and Zetex fire barrier wrap system. The Polyken tape appears to be missing from a section of the Zetex covering and part of the Zetex is missing exposing Kaowool (Additional example a deficiency that should have been identified by surveillance inspections, EEI 387 &388/92-23-07, Section 4.4)

Gypsum Board

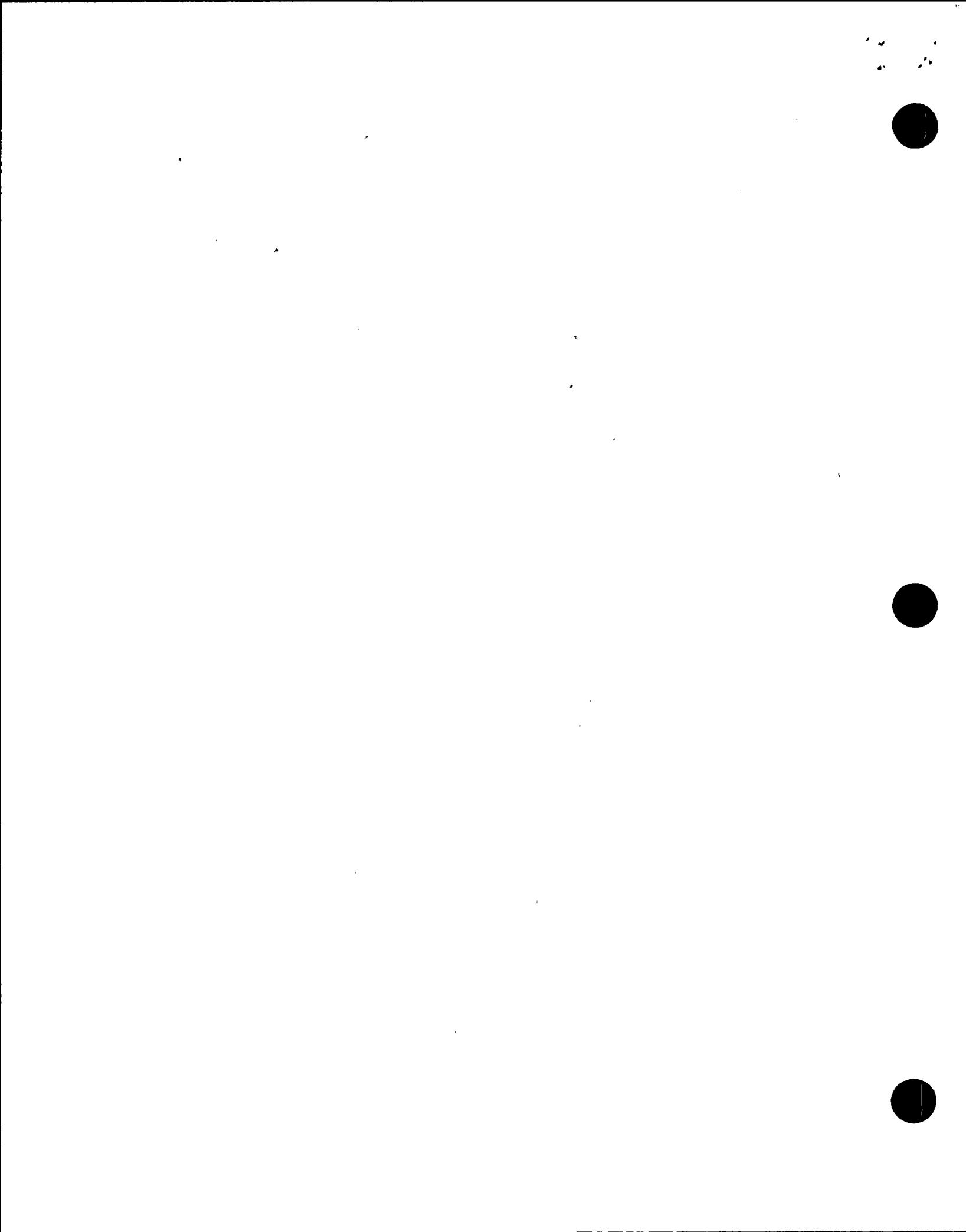
1. While inspecting the Gypsum board enclosures for panels 1D644, 1D624, 2D644 and 2D624 in Fire Zones 0-28B, and 0-28A, the inspectors noted that the inner layer board of the two required Gypsum boards had holes and missing pieces. Additionally there were gaps at the joints between the pieces of Gypsum installed as the inner layer and these joints were not sealed. (Additional example of the installation deficiencies cited, EEI 387/92-23-08, in Section 4.3.4, that should have been identified by surveillance inspections, EEI 387 &388/92-23-07, Section 4.4)

Drawings

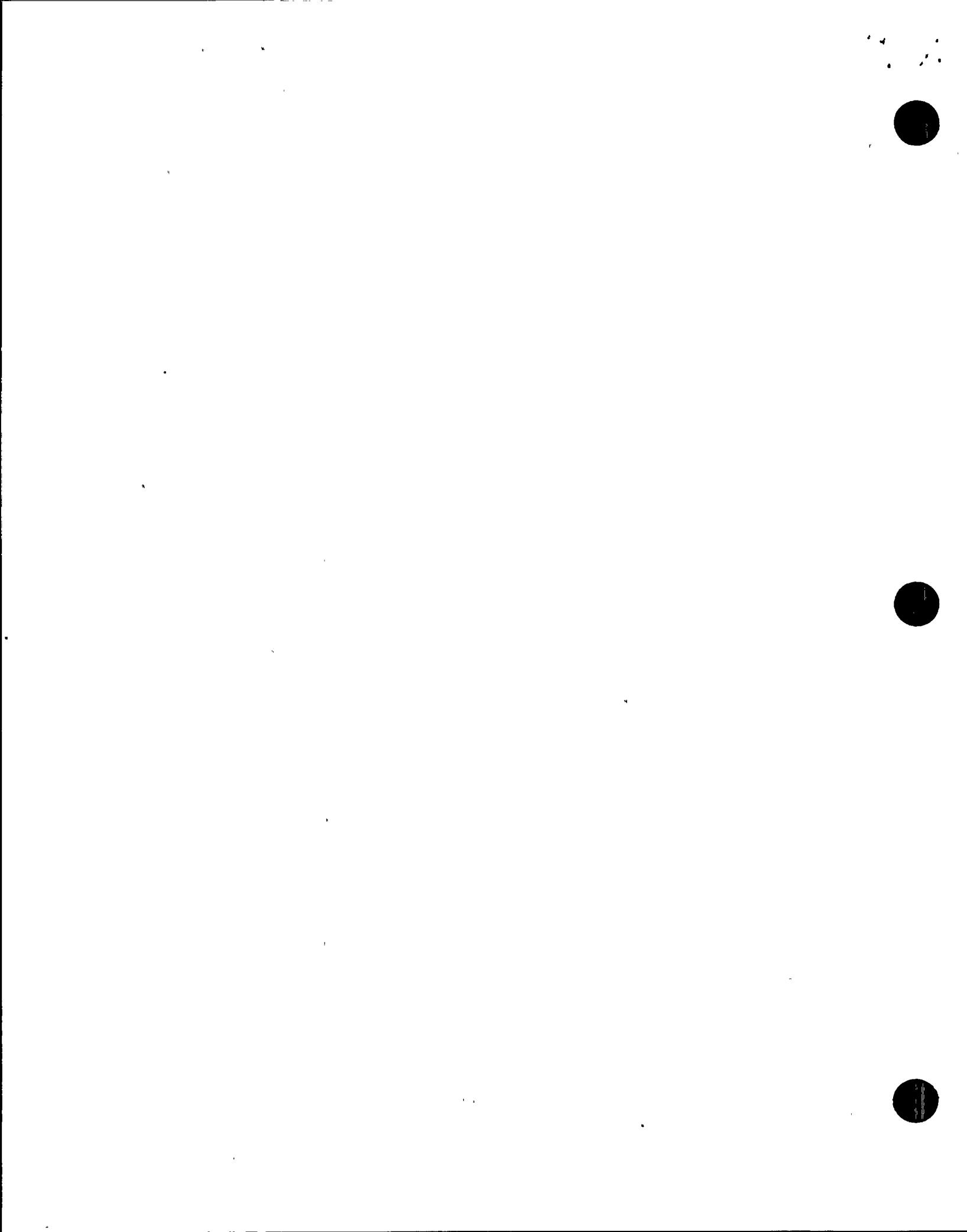
1. E1K586 and E1K662 are not listed on drawing E-294 as being in Fire Zone 1-2D (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
2. Drawing (DWG.) C-1723 lists conduits E1K833, and F1P467 as protected by 1-hour and 3-hour Thermo-Lag respectively; however, the barriers on these conduits in this area included the Kaowool/Zetex system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
3. F1KR09 in Fire Zone 0-27C is wrapped with Kaowool not Thermo-Lag as reflected on drawing E-294 (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
4. F1P579 is not wrapped with Thermo-Lag as shown on drawing E-294, but is really in a Gypsum enclosure (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)



5. A1P071, A1P105, and C1P107 have both Kaowool and Thermo-Lag installed; however, drawing C-1754, sheet 2, revision 2 reflects only Thermo-Lag installed (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
6. Drawing E-294 remarks that conduits E1P353 and C1P077 are only partially wrapped in Fire Zone 0-28B-I; however, this is incorrect (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
7. Drawing C-1723 lists conduits F1P030, F1P467, and E1K617 as protected by 3-hour Thermo-Lag; however, the barriers appeared to be 1-hour Thermo-Lag. These types of generic drawing deficiencies are documented by the licensee on EDR G20053 (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
8. Drawing C-1754 shows the Thermo-Lag barrier on conduits E1P353, and C1P077 as terminating at a half wall in inside Fire Zone 0-28B-II; however, the barriers on these conduits are continuous in this area and terminate at the 3-hour fire rated wall that is the boundary for this zone (Additional example of the drawing deficiencies cited, EEI 387/92-23-08)
9. Drawing C-1724 lists conduit D1P025 as protected by 1-hour Thermo-Lag; however, the barriers on this conduit run in this area included both Thermo-Lag and the Kaowool system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
10. Drawing C-1724 lists conduit F1P030 as protected by 3-hour Thermo-Lag; however, the barriers on this conduit run in this area appeared to be 1 hour Thermo-Lag (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
11. Drawing C-1724 lists conduit D1P008 as protected by the Kaowool system; however, the barriers on this conduit run in this area included both Thermo-Lag and the Kaowool system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
12. Drawing C-1724 lists conduits B1K009 and D1K010 as protected by 1 and 3-hour Thermo-Lag; however, the barriers on these conduit runs in this area included both Thermo-Lag and the Kaowool system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08 in Section 5.1)
13. Drawing C-1723 lists tray sections E1KJ17, 18, 19, 20, and 21 as protected by 1-hour Thermo-Lag; however, the barriers were the Kaowool/Zetex system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08)



14. Drawing C-1753 lists tray section F1KR09 as protected by 1-hour Thermo-Lag; however, the barrier was the Kaowool/Zetex system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08)
15. Drawing C-1754 lists conduits A1P071, A1P105, and C1P107 as protected by 1-hour Thermo-Lag; however, the barriers on these conduits in this area included the Kaowool/Zetex system (Additional example of the drawing deficiencies cited, EEI 387/92-23-08)



ATTACHMENT 4

SUSQUEHANNA FIRE PROTECTION APPROVAL CHRONOLOGY⁴

<u>Date</u>	<u>Description</u>
Feb 1977	BTP APCSB 9.5-1 (Appendix A) Issued by NRC
Jan 1978	SSES Fire Protection Review Report (FPRR) Issued
May 1980	NRC Proposed Rule 10 CFR 50.48 and Appendix R Published for Comment
Oct/Nov 1980	NRC Site Walkdown on Fire Protection
Nov 1980	NRC Issued 10 CFR 50.48 and Appendix R
Jan 1981	NRC Issued 40 and 281 Series Questions (Fire Protection) to SSES
Feb 1981	PP&L Responded to NRC Questions
Mar 1981	Revision 1 to SSES FPRR Issued
Mar 1981	PP&L/NRC Meeting; PP&L Committed to III.G, J&O (Documented in PLA-683)
Apr 1981	NRC Issued NUREG-0776 (SSES SER)
Jun 1981	NRC Issued Supplement #1 to SSES SER
Sep 1981	NRC Issued Supplement #2 to SSES SER
<u>Date</u>	<u>Description</u>

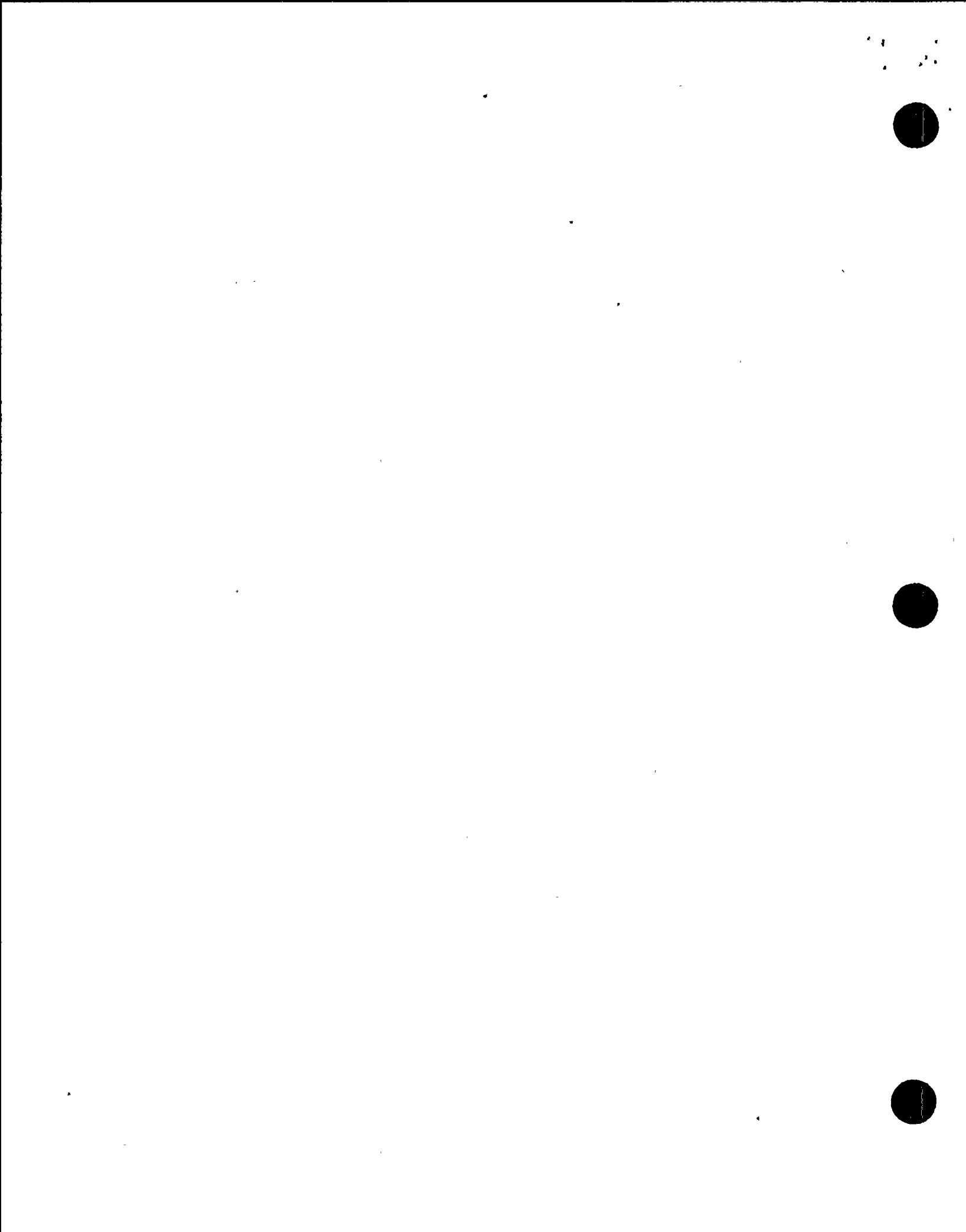
⁴ The contents of this attachment were excerpted from an NRC letter dated November 27, 1985, which detailed an enforcement conference for Inspection Nos. 50-387/85-06 and 50-388/85-06. This letter and the special fire protection team inspection report are identified in Attachment 5 to this report. Section 2.0 of this current report discusses how the inspectors used this chronology during this inspection. Specific documents reviewed by the inspectors during this current inspection are listed in chronological order in Attachment 5.

Dec 1981	PP&L Completed Remote Shutdown Modification
Feb 1982	PP&L Requested Variance for Use of 1-Hour Wrap
Jul 1982	NRC Issued Supplement #3 to SSES SER
Jul 1982	Unit 1 Operating License Issued
Aug 1982	PP&L Committed to Modify 1-Hour Wrap
Oct 1982	PP&L Completed Wrap Modification
Nov 1982	NRC Issued Supplement #4 to SSES SER
Dec 1982	Revision 2 to SSES FPRR Issued
Jan 1983	PP&L Requested License Amendment to Incorporate Rev. 2 to FPRR
Mar 1983	NRC Issued Supplement #5 to SSES SER
Sep 1983	Amendment 16 to Unit 1 License Issued to Incorporate Rev. 2 to the SSES FPRR
Oct 1983	NRC Issued Generic Letter 83-33
Dec 1983	PP&L Requested Exemption from Appendix R Separation Criteria
Mar 1984	NRC Issued Supplement #6 to SSES SER
Mar 1984	Unit 2 Operating License Issued

ATTACHMENT 5

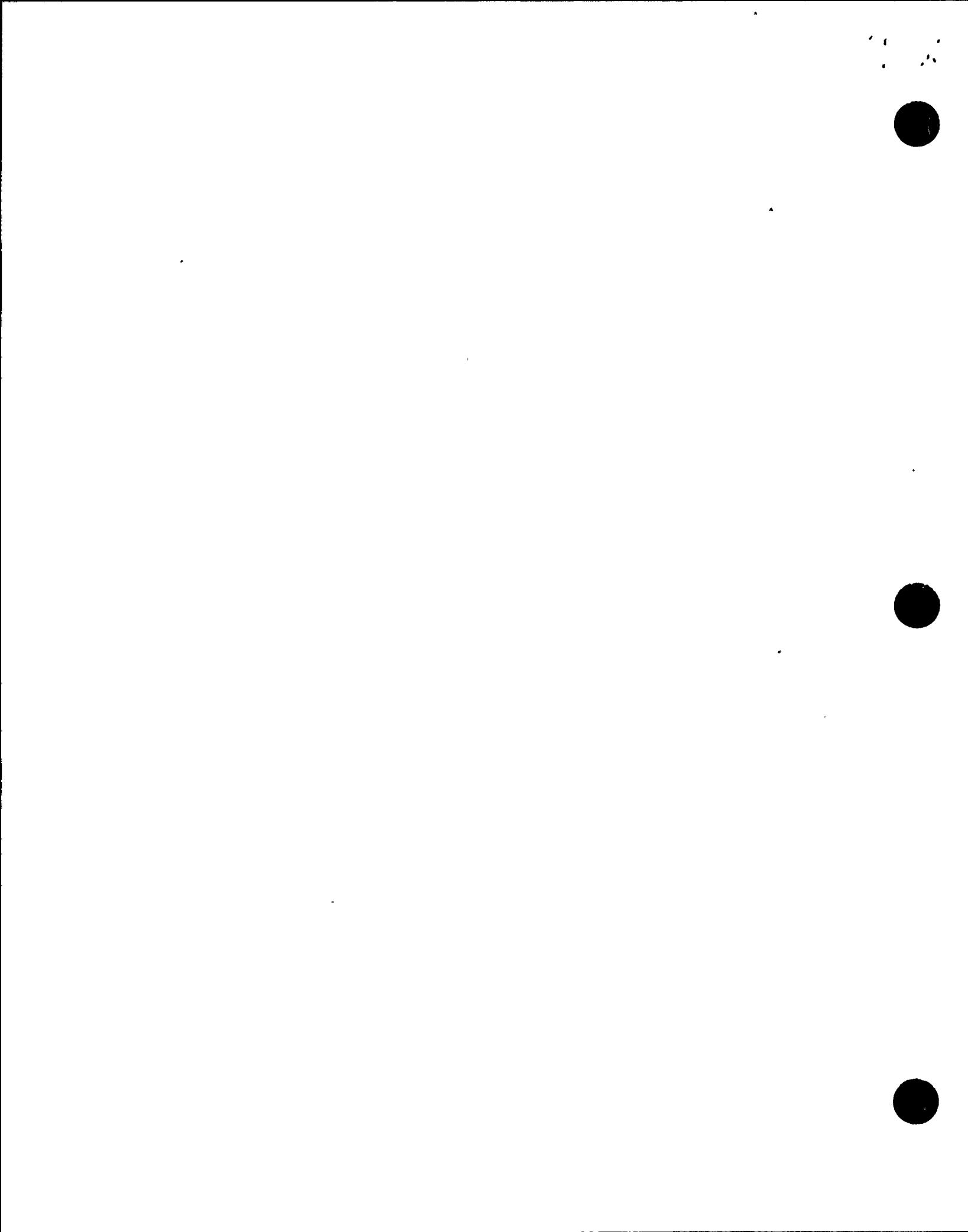
CHRONOLOGY OF DOCUMENTS REVIEWED
RELATED TO SUSQUEHANNA THERMO-LAG INSTALLATIONS

- May 01, 1976 BTP APCS 9.5-1 Section I defined fire rating and fire barrier, Fire Rating - refers to the endurance period of a fire barrier or structure and defines the period of resistance to a standard fire exposure elapsing before the first critical point in behavior is observed. (Refer to NFPA 251) and Fire Barrier - those components of construction (walls, floors and roofs) that are rated by approving laboratories in hours for resistance to fire to prevent the spread of fire.
- Sep 06, 1978 Underwriters Laboratories Inc., File R8758, Project 78NK5345, "Report on Cable Raceway Protection Systems Fire Test Investigation." This document is a test report on the Kaowool Blanket Wrap System. Cold side temperature exceeded 325 degrees before one hour of fire exposure. [The licensee provided this test to support their qualification of the Kaowool used in their plant].
- Mar 26, 1981 PP&L Letter PLA 683 from N. Curtis to B. Youngblood (NRC) stated in part, that as discussed during a meeting with the NRC on March 25, 1981, PP&L would comply with the requirements of Sections G, J, and O of Appendix R to 10 CFR Part 50; a two-hour rated false ceiling would be installed in the Battery Room Area (Equipment Room, Fire Area 0-28B) prior to fuel load to protect raceways from an external fire; the Division II D.C. distribution panels located in the corridor near the cold instrument shop are enclosed within one hour rated barriers.
- Mar 26, 1981 NRC internal memo from V. Noonan to Tedesco stated, in part, we are concerned that a single exposure fire could damage redundant cables and equipment in the battery room area. There is a heavy congestion of cables and equipment handling 125 volt dc power in the battery room area. We will require that the applicant meet requirements set forth in Section III.G of Appendix R to 10 CFR Part 50. The memo enclosed the fire protection section of the Safety Evaluation Report for Susquehanna and stated that the Fire Protection Program was reviewed in accordance with Appendix A to Branch Technical Position ASB 9.5-1.

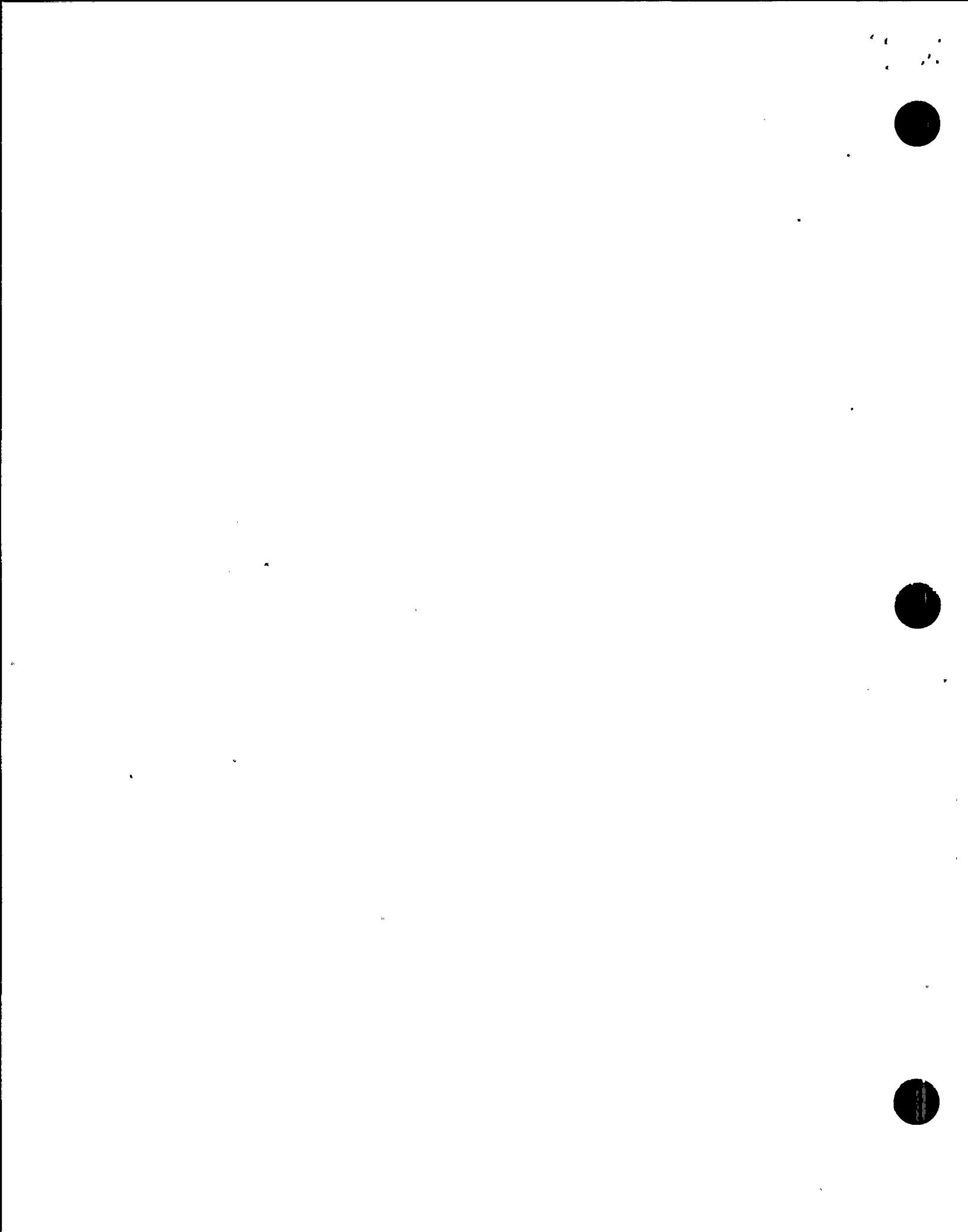


- Apr 1981 NUREG 0776, the Safety Evaluation Report for Susquehanna was issued and Section 9.5.4.5, Battery Room Area, restated (from the March 26 memo) the NRC's concerns about a single exposure fire, and the requirement for the licensee to meet Section III.G.2 of Appendix R
- Apr 15, 1981 NRC internal memo from V. Benaroya to R. Tedesco that forwarded a supplemental fire protection safety evaluation report that stated, in part, that, to resolve the concerns associated with a single exposure fire in the battery room area, the applicant committed to install a two-hour rated fire rated ceiling barrier and a two hour rated fire enclosure for major equipment. The two-hour rated barrier was found adequate, based on our onsite review of the area in terms of its fire loading and fire protection features. Based on the proposed modifications, it was concluded that the area conformed to Appendix A to BTP 9.5-1 and is, therefore, acceptable.
- Jun 1981 NUREG-0776, Supplement 1 was issued and for the Battery Room Area it restated the information contained in the April 15, 1981, supplemental safety evaluation
- Jun 19, 1981 PP&L letter from N. Curtis to A. Schwencer that stated, in part, that PP&L was planning to test fire retardant wrapping material manufactured by Quelcor, Inc., to determine if the material would satisfy NRC requirements for use as a fire barrier wrap for electrical raceways. The testing would be done by Southwest Research Institute (SwRI) for fire, radiation degradation, and ampacity derating. The letter also invited the NRC to witness the testing.
- Jul 09, 1981 NRC internal memo from W. Johnson to R. Tedesco that stated, in part, that the applicant had confirmed by letter their verbal commitment to meet the technical requirements of Appendix R to 10 CFR 50, and this memo also enclosed supplemental safety evaluation number 2 that addressed this issue
- Aug 25, 1981 NRC internal memo from W. Johnson to J. Sniezek requesting the performance of a follow-up inspection of the fire protection program, including an inspection of the Battery Room Area to verify that the applicant has met Section III.G.2 of Appendix R to 10 CFR 50 by installing one hour fire rated barriers on redundant divisions and providing an automatic sprinkler system in the area.

- Sep 1981 NUREG 0776, Supplement 2 was issued and noted that the applicants's submittals on the alternate shutdown systems to meet Sections III.G and III.L of Appendix R are under review.
- Oct 26, 1981 PP&L letter PLA-948 from N. Curtis to A. Schwencer (NRC) stated, in part, that PP&L was proposing to use a one hour wrap in Fire Zone 0-28B and enclosed two test reports for wrap material for NRC concurrence on the acceptability of the testing and use of the wrap materials. The test reports were: (1) SwRI test (17-5941-101), dated September 1981, of Quelcor material. The test was a modification of the "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits" as specified by PP&L and it use the ASTM E-119 time-temperature curve for fire exposure; and (2) TSI Technical Note 90181, dated August 1981, which provided information concerning the Thermo-Lag 330-1 Subliming Coating envelope system
- Oct 27, 1981 SwRI test report, "Fire Qualification Test of a Protective Envelope System," Project No. 03-6491 [Comanche Peak (TU) Test]
- Dec 01, 1981 NRC Letter from R. Tedesco to R. Gary (TU) that stated, in part, that the October 27, 1981, fire test report documented that TSI material successfully protected the cables for a time period of one hour. We have evaluated the fire test report and conclude that it demonstrates that the TSI material/system exhibits equivalent or better characteristics of other approved materials and, therefore, can provide an acceptable fire barrier for cable trays and cables. Based on our evaluation, we conclude that the use of the TSI material/system will meet the requirements of Appendix R to 10 CFR Part 50 and is, therefore, acceptable.
- Jan 08, 1982 TSI Letter from R. Feldman to D. Kohn (PP&L) forwarding an NRC letter (from Tedesco (NRC)) to Gray (TU) dtd 12/1/81) that accepted the use of Thermo-Lag material at Comanche Peak based on a fire test documented in a report titled, "Fire Qualification Test of a Protective Envelope System," dated October 27, 1981
- Jan 13, 1982 Region I Inspection Reports 50-387/81-2- and 50-388/81-10 were issued (for an inspection that was conducted November 16 - 20, 1981) and included Unresolved Items 81-20-02 and 81-10-02 that stated in part that the applicant planned to use TSI Thermo-Lag material to protect raceways and it was unresolved pending a review of the documentation associated with the application, inspection, and qualification data of the Thermo-Lag material by the NRC



- Feb 09, 1982 PP&L Letter PLA 1013 from N. Curtis to A. Schwencer (NRC), regarding a request for variance for fire protection in Fire Zones 0-28B, 1-2D, and 0-28H. The letter stated, in part, that PP&L was documenting their change in position regarding Branch Technical position CMEB 9.5-1, position C.5.b.2(c) for these three Fire Zones. The letter noted that TSI THERMO-LAG had been approved for use at Comanche Peak and that PP&L had forwarded test reports for Quelcor material, via PLA-948, for approval for use as a wrapping material.
- Mar 23, 1982 NRC Letter from R. Perch that documents a meeting held on March 11, 1982, with PP&L to discuss the use of TSI wrap (Thermo-Lag) as a 1-hour barrier in Fire Zones 1-2D (Remote Shutdown Panel), 0-28B (Equipment Room), and 0-28H (Cold Instrument Repair Shop), the staff requested a copy of the installation procedure used by the applicant to apply the TSI wrap at SSES and noted that the issue would remain open pending review of the requested material
- Apr 16, 1982 NRC internal memo from W. Johnson to R. Tedesco forwarding a supplemental safety evaluation regarding fire areas 1-2D, 0-28B, and 0-28H. The memo stated, in part, that the proposed change from a two-hour rated ceiling to a one-hour rated cable wrap meets our guidelines, and is, therefore, acceptable. However, we understand that the one-hour barrier material has not been properly installed. We will require the applicant either to provide test data verifying that the fire barrier as installed provides one hour of fire resistance or to install an automatic fire extinguishing system.
- May 13, 1982 PP&L Letter PLA-1094 from N. Curtis to A. Schwencer (NRC) forwarded the following documents to respond to the staffs requests for documentation: (1) TSI Technical Note 8232-1, Fire Test Report June 1981; (2) TSI Technical Note 8275-1, Fire Test Report June 1981; (3) Bechtel Field Specification 8856-E-61, Revision 1; (4) Bechtel Field Change Request #-6347; (5) Bechtel Quality Control Special Detailed Instructions
- Jun 09, 1982 PP&L Letter PLA-1120 from N. Curtis to A. Schwencer (NRC) the letter stated, in part, that it was forwarding a letter from TSI that responded to questions raised by the NRC based on the staffs review of the documentation provided in the May 13, 1982, letter PLA-1094
- Jun 28, 1982 NRC internal memo from W. Johnson to R. Tedesco forwarding a supplemental safety evaluation regarding fire protection of redundant cable trains remaining open and including Fire Zones 1-2D, 0-28B, and



0-28H. The memo summarized the history of the battery room area exemption request and stated, in part, that the (barrier wrap material qualification) tests were not performed in accordance with adequate quality assurance procedures and, therefore, cannot find them acceptable. Therefore, we stand by our position that the applicant should either conduct an ASTM E-119 test at an approved testing laboratory, or to install an automatic fire extinguishing system. We will permit the applicant until 5% power to resolve this item.

The enclosed safety evaluation stated, in part, Section B.4 of BTP CMEB 9.5-1 defines fire barriers as "those components of construction... [(walls, floors, and their supports), including beams, joists, columns, penetration seals or closures, fire doors, and fire dampers] that are rated by approving laboratories in hours of resistance to fire and are used to prevent the spread of fire." Section B.4 of BTP CMEB 9.5-1 also defines the term fire resistance rating as "The time that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of "Standard Methods of Fire Test of Building Construction and Materials" (NFPA 251). [Note differences from May 1976 BTP, APCSB]. It went on to note that ASTM E-119 is an acceptable test method in addition to NFPA 251; however, the simulated ASTM E-119 test performed differs from the actual test method in several areas such as the accuracy of the furnace temperature control and the type and number of thermocouples used for measuring temperature on the specimen. Additionally, , it was not clear that the wrap tested was in the configuration installed in the applicant's plant.

Jul 1982

Branch Technical Position CMEB 9.5-1, Rev. 2, was issued and Section B.4 provided definitions of fire barriers and fire resistance rating.

[Note differences from May 1976 BTP, APCSB] Section C.5.a states, in part, that openings through fire barriers for pipe, conduit, and cable trays that separate fire areas should be sealed or closed to provide a fire resistance rating at least equal to that required of the barrier itself. The penetration qualification tests should use the time-temperature exposure curve specified by ASTM E-119 and the acceptance criteria should require that there is no passage of flame or ignition of cables on the unexposed side during the rating period, the temperatures on the

unexposed side are analyzed and demonstrate that the maximum temperature does not exceed 325 degrees F, and the barrier remains intact during the hose stream test. Section C.5.b [the section from which PLA-1013 requested a variance] identifies guidance on the use one hour barriers and automatic suppression.

- Jul 1982 NUREG 0776, supplement 3 was issued and contained the information in the supplemental safety evaluation dated June 28, 1982
- Jul 01, 1982 Revision 0 of PP&L Specification F1000, "Technical Specification for Electrical Raceway Design and Installation of Exposure Fire Barriers and Fire Stops," was issued as a PP&L replacement for Bechtel Specification 8856-E-61
- Jul 06, 1982 PP&L Letter PLA-1166 from N. Curtis to A. Schwencer (NRC), regarding PP&L's commitment to perform a fire test of the 1 hour TSI material using the Comanche Peak test procedure with the material installed [on the test specimen] in accordance with the procedures forwarded by the May 13, 1982, letter PLA-1094.
- Jul 17, 1982 Operating License NPF-14 was issued and contained a license condition 2.C(7) titled Battery Room Area that noted the SSER#3 requirement to conduct at an approved testing laboratory an ASTM E-119 test of the as-installed one-hour cable wrap configuration or install an automatic fire extinguishing system prior to exceeding five percent.
- Jul 23, 1982 PP&L Letter PLA-1212 from N. Curtis to A. Schwencer (NRC), regarding PP&L's commitment to perform a fire test of the 1 hour TSI material to satisfy license condition 2.C(7). The letter stated, in part, that the objective of the testing was to provide documented evidence that the envelope will satisfactorily withstand an ASTM E-119 (80) fire exposure and provide a one hour effective barrier in accordance with ANI/MAERP acceptance rating by maintaining circuit integrity and continuity. A copy of the test specification was enclosed and was patterned after a test specification successfully used for qualifying material for Comanche Peak.
- Aug 05, 1982 PP&L Letter PLE-2164 from D. Kohn to R. Feldman (TSI) in response to TSI's offer of assistance in performing qualification testing. The letter states, in part, that PP&L was aware of the risk of performing testing before 30 days had elapsed from the time of installing the material. The letter also stated, in part, that TSI's assistance and the use of preformed panels provided by TSI was being rejected because that would differ from the installations at Susquehanna and may not be



acceptable to the NRC. The letter also noted that PP&L and Bechtel used the same personnel and procedure that were used in the field to ensure that the two installations were identical as possible.

Aug 13, 1982

Region I Inspection Report 50-387/82-19 and 50-388/82-08 document an inspection conducted June 16 - July 27, 1982. The report closed Unresolved Item 387/81-20-02 by stating, in part, that the documents reviewed [see May 13, 1982, PP&L Letter PLA-1094 for the list of documents] adequately address the qualification testing and installation of thermo-lag fire barrier material

Aug 24, 1982

Southwest Research Institute Letter from J. Beitel to D. Kohn (PP&L) that forwarded a copy of Project No. 01-7163, Report No. 2

Aug 25, 1982

PP&L Letter PLA-1268 from N. Curtis to A. Schwencer (NRC), forwarded a copy of the SwRI test report for testing done on August 10, 1982, in response to license condition 2.C(7). The letter states in part that PP&L had completed an ASTM E-119 test of the as-installed one hour cable wrap configurations. The letter further stated that testing was conducted in accordance with their test specification [that was previously submitted to the NRC] with the exceptions noted in the test report. Additionally, it was noted that circuit integrity was maintained throughout the fire endurance portion of the test, and the configurations that failed to maintain circuit-to-circuit integrity during the hose stream test were not the configurations protected by wrap material at Susquehanna

Aug 31, 1982

PP&L Letter PLA-1268 from N. Curtis to A. Schwencer (NRC) states, in part, that PP&L agreed to modify the installation of the fire resistive wrap material on cable trays located in Fire Zone 1-2D, Remote Shutdown Panel, by adding fiberglass armoring embedded in the TSI Thermo-Lag 330-1 in accordance with TSI Technical Note 80181, Revision I, date 8/81. The letter further stated that it was PP&L's understanding that this installation was acceptable to the NRC and would satisfy the license condition.

Sep 15, 1982

NRC Internal memo from W. Johnson to T. Novak regarding supplemental fire protection evaluation report. The memo provided a brief summary of the events leading up to the completion of the review and stated, in part, that an evaluation of the test data provided by letter dated August 25, 1982. It further stated, based on our evaluation, we find it [the wrap material] acceptable for verifying the fire resistance of cables in conduit only. The transmission of heat through the cable wrap permitted a temperature rise on the tested cables in trays in excess of

the permissible acceptance criteria of ASTM standard E-119. Of the three areas protected, only Fire Zone 1-2D contains cable trays and the licensee has committed to install supplemental cable wrap on the trays in zone 1-2D. The supplemental cable wrap will be installed in a manner that we previously had approved. With this commitment we find the proposed method of protecting the cables meets our guidelines and is therefore acceptable. [information from the enclosed SER is provided below].

- Sep 16, 1982 Revision 1 to PP&L Specification F1000 was issued and paragraph 4.6.8 states in part that when TSI material is applied to cables tray in areas that do not have automatic fire protection, Fiberglass Armoring shall be embedded in the Thermo-Lag and covered by a top coat.
- Oct 25, 1982 PP&L Letter PLA-1333 from N. Curtis to A. Schwencer (NRC), this letter updated PP&L's commitment to modify the installation of the fire resistive wrap material on cable trays located in Fire Zone 1-2D, Remote Shutdown Panel as described in PLA-1268 dated August 25, 1982. This letter states in part that the actions in Letter PLA-1268 were completed.
- Nov 1982 NUREG-0776 Supplement 4; under the heading of Fire Protection for Specific Areas, Battery Room Area, SSER#4 summarized the history of the exemption request for three fire zones beginning with the letter containing the request dated February 9, 1982. The SSER states, in part, that the licensee conducted an ASTM E-119 test on the proposed cable wrap in its as-installed configuration. The tests show that conduits protected by the proposed method posses a full 1-hour rating. Cable trays, however, exceeded the acceptance criteria of a temperature rise of 250 degrees F above ambient in approximately 45 minutes. The proposed method of protecting cable trays is therefore not acceptable as a 1-hour-rated fire barrier. The licensee has proposed to supplement the cable wrap on all trays in Fire Zone 1-2D, and zones 0-28H and 0-28B do not contain any protected cable trays. The SSER continued, in part, The licensee has committed to provide the cable wrap, previously approved, and to install it in the manner originally tested. The details of the test and installation procedure are contained in a report dated October 27, 1981 [Comanche Peak Test]. The staff finds this an acceptable method of providing a 1-hour-rated fire barrier for cable trays. With this commitment, the staff finds that the fire protection for Fire Zones 1-2D, 0-28B, and 0-28H meets its guidelines and is, therefore, acceptable. With resolution of this item, the basis of its evaluation, the staff concludes that the Fire Protection Program for the Susquehanna Steam Electric Station meets the guidelines contained in

Appendix A to Branch Technical position ASB 9.5-1, the technical requirements of Appendix R to 10 CFR, and the requirements of GDC 3 and is, therefore, acceptable.

- Nov 1982 TSI test (I.T.L. Report No. 82-11-80), "One-hour Fire Endurance Tests Conducted on Test Articles containing "Generic" Cables Protected With Thermo-Lag 330-1 Subliming Coating Envelope System"
- Jul 1983 ASTM E-119-83 "Standard Methods of Fire Tests of Building Construction and Materials" was published. This standard provides information on how to expose a test specimen to a "standard" fire exposure including furnace information, a time-temperature curve and results reporting information. The standard also provides specific information for conducting tests on bearing walls, nonbearing walls, floors, ceilings, structural members, etc. No specific test procedure or acceptance criteria were specified for cable wrap or penetration seals. (additional information is contained in Generic Letter 85-01 summary)
- Feb 13, 1984 Information Notice 84-09 "Lessons Learned From NRC Inspections of Fire Protection Safe Shutdown Systems (10 CFR 50, Appendix R)" issued
- Jan 09, 1985 Generic Letter 85-01 was issued. Enclosure 6 contained Appendix R Questions and Answers. Section 3.2 of this enclosure stated in part the following information:
- Question: Recently the Staff has applied a 325 degrees F cold side temperature criterion to its evaluation of the acceptability of one-hour and three-hour fire barrier cable tray wraps. This criterion is not in BTP AP-CSB 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?
- Response: AP-CSB 9.5-1 identifies a fire rating as the endurance period of a fire barrier or structure; it defines the period of resistance to a standard fire exposure before the first critical points in behavior is observed (see NFPA 251).
- The acceptance criteria contained in Chapter 7 of NFPA 251 pertains to nonbearing fire barriers. These criteria stipulate that transmission of heat shall not raise the temperature on the unexposed surface more than 250 degrees above the initial temperature and 75 degrees represents an acceptable norm for ambient temperature. The resulting 325 degree

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.

During the Appendix A review, licensees began to propose fire barriers to enclose cable trays and conduit but industry did not give standard rating tests for such components. The NRC issued a staff position giving acceptance criteria for electrical penetration tests. In the past, manufacturers designed their own qualification tests. 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 barriers 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 degree criteria.

Nov 11, 1985

PP&L Engineering Calculation DK-C-DJK-015, "1 hour fire wrap acceptability" that states, in part, that its purpose is to determine the acceptability of 1 hour fire barrier wraps used at Susquehanna and that license condition C(7) is met using 10 CFR 50.48, Appendix R Section III.G, GL 85-01, GL 88-33, and IN 84-09 as a design basis. Section III of the calculation states in part that TSI had performed a generic non proprietary test (I.T.L. No. 82-11-80) where the 250 degree temperature rise criteria specified in GL 85-01 was not exceeded. This test forms the basis for use of TSI at several nuclear plants since only this and a few proprietary tests exist. This calculation concluded that the differences between the Thermo-Lag installed at SSES and the I.T.L. test were acceptable; therefore, SSES was in compliance with Appendix R, Section III.G.2.c.

Nov 15, 1985

PP&L Engineering Calculation DK-C-DJK-014, "Appendix R Exemptions" that states, in part, that its purpose is to determine where exemptions to 10 CFR 50.48 Appendix R, Section G existed and provide justification using 10 CFR 50.48, GL 85-01, GL 88-33, IN 84-09, and SECY-83-269 as a design basis

Nov 21, 1985

NRC letter from S. Ebneter to B. Kenyon (PP&L) regarding an enforcement conference for Inspection Nos. 50-387/85-06 and 50-388/85-06. [Excerpts from an enclosure to this letter are included as Attachment 4 to this current report]

- Apr 29, 1985 Region I Inspection Report Nos. 50-387 & 388/85-06 opened an unresolved item (50-387 & 388/85-06-01) that stated, in part, the licensee's Fire Hazard Analysis was Inadequate to show compliance with Appendix R and that the item was referred to NRR for resolution with the licensee.
- Apr 24, 1986 Generic Letter 86-10 was issued and the contents of the Appendix R questions and answers were similar to those contained in GL 85-01
- Oct 28, 1986 Bechtel Power Corp. letter XLP-1457 from J. Weyandt to J. Kenny (PP&L) concerning the Derating of Cables in Wrapped Trays
- Jan 21, 1987 Underwriters Laboratories (UL) Incorporated letter to R. Feldman (TSI) forwarding the results of UL Project 86NK23826, File R6802, test report for Special Services Investigation of Ampacity Ratings For Power Cables in Steel Conduits and in Open-Ladder Cable Trays with Field Applied Enclosures
- Jun 30, 1988 PP&L letter PLA-3047 from H. Keiser to W. Butler (NRC) placed Revision 3 to the Susquehanna Fire Protection Review Report on the docket
- Jan 26, 1989 Region I Inspection Report No. 50-387/88-21 closed unresolved item Nos. 50-387 & 388/85-06-01. The report stated, in part, that the team had reviewed Revision 3 of the FPRR and did not find any unacceptable conditions; however, the team stated to the licensee that the analysis and shutdown methodology contained in this document have not been reviewed by the NRC office of NRR. Since an SER has not been issued on the new methodology, the final acceptance of the analysis will be based on the acceptability of this document by NRR.
- Aug 09, 1989 NRC letter from M. Thadani to H. Keiser (PP&L) issued the SER for Revision 3 to the SSES FPRR. This letter stated, in part, that, although our contractor evaluated your requests for deviation from certain provisions of 10 CFR Part 50 Appendix R, your safe shutdown methodology was not evaluated in this review. One of the deviation requests reviewed and approved was Deviation Request 17, "Kaowool System As An Acceptable 1-Hour Fire Barrier Wrap"
- Dec 29, 1989 PP&L letter PLA-3317 from H. Keiser to W. Butler (NRC) forwarded the proposed Revision 4 to the SSES FPRR to the NRC staff for review.

- Aug 06, 1991 Information Notice 91-47, "Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test" issued
- Dec 06, 1991 Information Notice 91-79, "Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials" issued
- Feb 03, 1992 NRC Memo from K. Walker (OIG) to F. Miraglia, regarding Referral of Potential Health and Safety Issue to NRR
- Jun 05, 1992 NRC Memo from A. Thadani (NRR) to T. Martin (RI), regarding Request for Inspection of 10 CFR 50 Appendix R, Thermo-Lag Fire Barriers at Susquehanna Steam Electric Station Unit 1
- Jun 06, 1992 Information Notice 92-46, "Thermo-Lag Fire Barrier Material Special Review Team Final Report Findings, Current Fire Endurance Tests, and Ampacity Calculation Errors" issued
- Jun 24, 1992 Bulletin 92-01, "Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free From Fire Damage" issued
- Jul 27, 1992 Information Notice 92-55, "Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material" issued
- Aug 12, 1992 OIG Report, "Inspection of the NRC Staff's Acceptance and Review of Thermo-Lag 330-1 Fire Barrier Material" issued to the Commission
- Aug 26, 1992 Bulletin 92-01, Supplement 1, "Failure of Thermo-Lag 330 Fire Barrier System to Perform Its Specified Fire Endurance Function" issued
- Oct 14, 1992 NRC Internal memo from C. W. Hehl to S. Varga regarding a request for technical assistance on fire protection issues at Susquehanna. This TIA requested NRR to evaluate the use of Kaowool as a fire barrier material at SSES and to evaluate the SSES safe shutdown methodology submitted in Revision 4 to the SSES FPRR.

ATTACHMENT 6

FIRE ZONE LOCATIONS AND FIRE BARRIER MATERIALS

FIRE ZONE	LOCATION DESCRIPTION	FIRE BARRIER MATERIALS
0-28A	Unit 1, Battery Equipment Rooms, Control Structure	TL, G
0-28B	Unit 2, Battery Equipment Rooms, Control Structure	TL, G
0-28H	Cold Instrument Shop, Control Structure	TL, KW
0-27C	Upper Cable Spreading Area and Relay Room, Control Structure	TL, KW
1-2B	Unit 1 Reactor Building Elev. 670'-0"	TL
1-2D	Remote Shutdown Panel Room, Unit 1 Reactor Bldg.	TL
1-3A	Unit 1 Reactor Building Elev. 683'-0"	TL
1-4A	Unit 1 Reactor Building Elev. 719'-1"	TL, KW
1-5A	Unit 1 Reactor Building Elev. 719'-1"	TL, KW

FIRE BARRIER MATERIAL KEY:

TL: Thermo-Lag

KW: Kaowool

G: Gypsum Board Enclosures

ATTACHMENT 7
APPLICABLE PAGES OF SSER #4

NUREG-0776
Supplement No. 4

Safety Evaluation Report
related to the operation of
Susquehanna Steam Electric Station,
Units 1 and 2

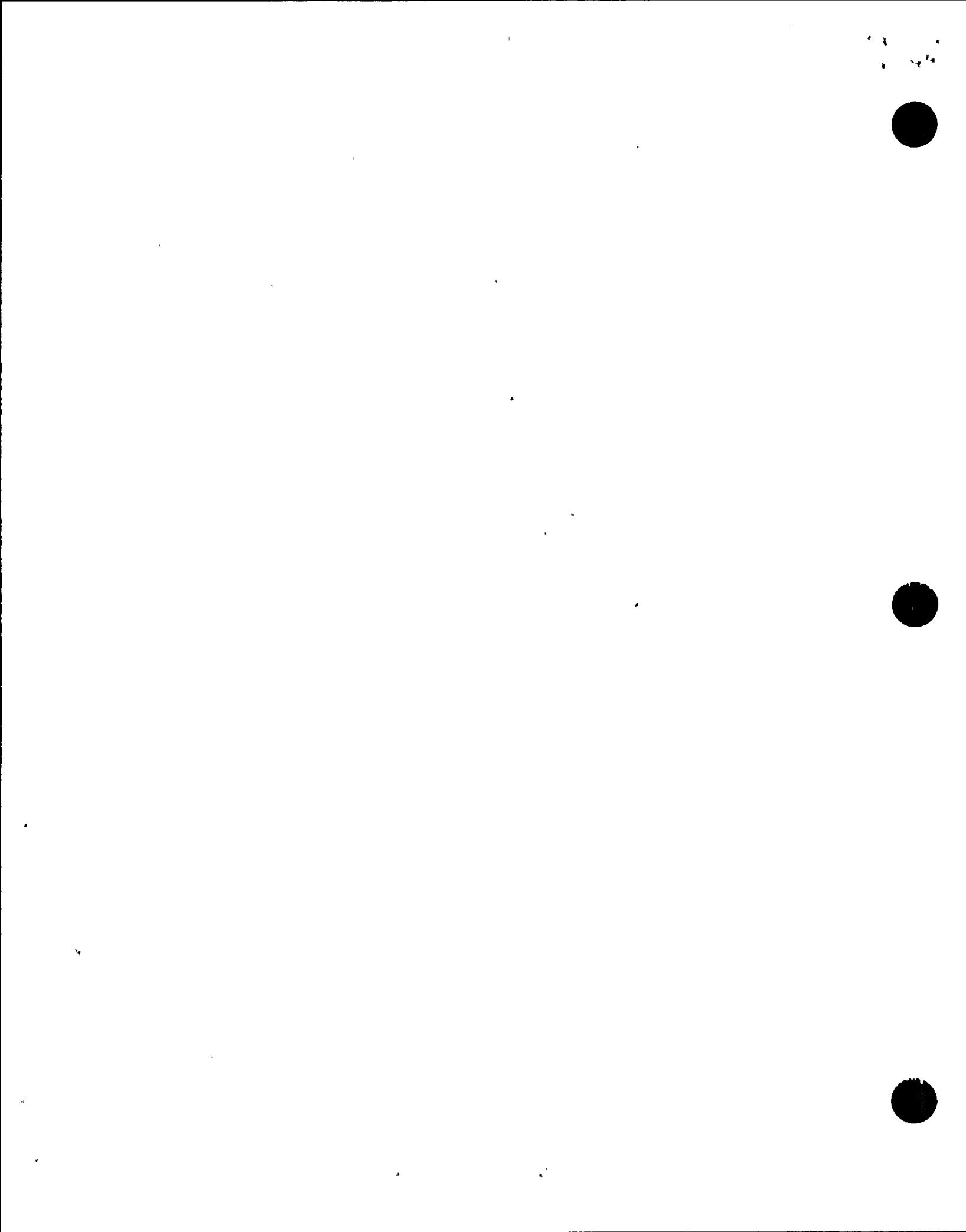
Docket Nos. 50-387 and 50-388

Pennsylvania Power & Light Company
Allegheny Electric Cooperative, Inc.

**U.S. Nuclear Regulatory
Commission**
Office of Nuclear Reactor Regulation

November 1982





cool the core following the postulated LOCA. GE has performed analyses to show that acceptable core cooling is maintained under these conditions if the single LPCI pump operates for at least 10 min. Refer to Section 6.3 of this supplement for an evaluation of the acceptability of the emergency core cooling system (ECCS) analyses under these conditions.

To meet the conditions of the assumptions used in the analyses performed by GE, the licensee had to show that the LPCI pump could operate for 10 min without cooling water to the pump room coolers, lube oil coolers, and seal coolers without loss of function. By letter dated November 8, 1982, the licensee provided data from the manufacturers backed up by actual testing to show that the pump would operate for the required 10 min without exceeding any design limits on the bearings or seals. Refer also to Section 6.3 of this supplement for an evaluation of the test results and operation of the pumps under these conditions.

For the specific LOCA identified above, the ESW loops are actually not capable of providing 100% of the heat loads for both units as originally reported in the FSAR and the SER. However, the licensee has shown by the ECCS analyses, LPCI tests, and manufacturers' data that cooling from the inoperable ESW loop is not necessary to meet the results of the ECCS analyses. For all other accident scenarios that the staff is aware of, one ESW loop is capable of removing 100% of the heat load following an accident in one unit and an orderly shutdown and cooldown of the remaining unit.

Based on its review of the modifications proposed to transfer the diesel cooling water from ESW loop A to loop B plus the acceptability of the ECCS analyses and LPCI pump data as evaluated in Section 6.3 of this supplement, the staff concludes that the ESW system meets the single-failure criterion of GDC 44, "Cooling Water," and is, therefore, acceptable.

9.5 Fire Protection Systems

9.5.4 Fire Protection for Specific Areas

9.5.4.5 Battery Room Area

By letter dated February 9, 1982, the licensee proposed a change to the design that the staff had previously approved for the protection of redundant trains of equipment in the battery room area (Fire Zones 0-28B and 0-28H). The proposed change involved the use of a 1-hour-fire-rated cable wrap instead of a 2-hour-fire-rated ceiling for the battery rooms and remote shutdown panel area (Fire Zone 1-2D). In the SER, the staff found the proposed change acceptable, however, it noted that the licensee had not installed the 1-hour-fire-rated cable wrap in accordance with the manufacturer's recommended application procedure. The staff requested that the licensee either provide test data demonstrating that the fire-resistance rating of the cable wrap, as installed, is 1 hour or install an automatic extinguishing system.

By letter dated May 12, 1982, the licensee provided additional test data to demonstrate the fire-resistance rating of the cable wrap. The staff reviewed

this information and concluded—that the wrap was not acceptable as a barrier. It reported its conclusion in Supplement 3. By letter dated August 25, 1982, the licensee provided additional information. The licensee has conducted an ASTM E-119 test on the proposed cable wrap in its as-installed configuration. The test results are documented in a report entitled, "Qualification Fire Test of a Protective Envelop System," dated August 1982. The tests show that conduits protected by the proposed method possess a full 1-hour rating. Cable trays and air drops, however, exceeded the acceptance criteria of a temperature rise of 250° F above ambient in approximately 45 minutes. The proposed method of protecting cable trays and air drops is, therefore, not acceptable as a 1-hour-rated fire barrier. By letter dated August 31, 1982, the licensee has proposed to supplement the cable wrap on all cable trays in Fire Zone 1-2D (remote shutdown panel area) before 5% power is exceeded. Fire Zones 0-28H and 0-28D do not contain any protected cable trays.

The licensee has committed to provide the cable wrap, previously approved, and to install it in the manner originally tested. The details of this test and installation procedure are documented in a report entitled, "Fire Qualification Test of a Protective Envelop System," dated October 27, 1981. The staff finds this an acceptable method of providing a 1-hour-rated fire barrier for cable trays. With this commitment, the staff finds that the fire protection for Fire Zones 1-2D, 0-28B, and 0-28H meet its guidelines and is, therefore, acceptable.

With the resolution of this item, the basis of its evaluation, the staff concludes that the Fire Protection Program for the Susquehanna Steam Electric Station meets the guidelines contained in Appendix A to Branch Technical Position ASB 9.5-1, the technical requirements of Appendix R to 10 CFR 50, and the requirements of GDC 3, and is, therefore, acceptable.

ATTACHMENT 8

DEVIATION REQUEST 17 AND APPLICABLE PORTIONS OF THE ASSOCIATED NRC
SSES-FPRR

SAFETY EVALUATION REPORT
APPENDIX R DEVIATION REQUEST NO. 17

KAOWOOL SYSTEM AS AN ACCEPTABLE 1-HOUR FIRE BARRIER WRAP

DEVIATION REQUEST:

A Kaowool fire barrier wrap system along with an automatic suppression system is acceptable for use as a 1-hour fire barrier in plant areas where the installation currently exist.

FIRE AREAS/ZONES AFFECTED:

Kaowool has been installed in the following plant areas:

<u>Fire Area</u>	<u>Fire Zones with Kaowool</u>
R-1A	1-3B-S 1-3B-W 1-4A-S 1-4A-W 1-5A-S
R-1B	1-3A 1-3B-N 1-3B-W 1-4A-W 1-4A-N
CS-10	0-27C
CS-30	0-25E

REASON FOR DEVIATION REQUEST:

The requirements of 10CFR50, Section III.G.2.C, allows the use of a 1-hour fire barrier wrap. NRC guidance letter 85-01, Section 3.2.1 indicates that the "Kaowool System", which had been accepted by the NRC, failed to meet the 325°F temperature limit. This system has been at Susquehanna SES.

EXISTING ARRANGEMENT

All fire zones in which Kaowool has been installed have automatic fire suppression. Fire detection is also provided in these fire zones.

SSES-FPRR

JUSTIFICATION:

Kaowool was installed as a barrier wrap at Susquehanna SES prior to fuel load on Unit 1 (July, 1982). In NRC Generic Letter 85-01, the staff has stated that conduit and cable tray enclosure materials accepted by the NRC as a 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." The existing Kaowool installations at Susquehanna SES were previously approved by the NRC. Each installation is protected by an automatic fire suppression system. While another barrier design may be preferable and has been utilized at Susquehanna SES, Kaowool provides a sufficient level of protection for raceways when fire suppression is provided so as to not warrant its replacement in areas of the plant where it is currently installed.