TU ELECTRIC

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June 16, 1994

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES) - UNIT 1
DOCKET NO. 50-445
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
TAC NO. M85536

REF:
1) NRC letter dated May 27, 1994, from Mr. Thomas A. Bergman to Mr. William J. Cahill, Jr.
2) NRC Letter dated October 29, 1992, from Ms. Suzanne C. Black to Mr. William J. Cahill, Jr.
3) Safety Evaluation Report, NUREG-0797, Supplement No. 26 dated February 1993
4) Safety Evaluation Report, NUREG-C.97, Supplement No. 27 dated April 1993
5) TU Electric letter logged TXX-93254 from Mr. William J. Cahill, Jr., to NRC dated July 13, 1993
6) TU Electric letter logged TXX-93353 from Mr. William J. Cahill, Jr., to NRC dated October 28, 1993
7) CPSES Final Safety Analyses Report (FSAR) Section 9.5.1

Gentlemen:

This is in response to a request for additional information submitted by Reference 1. We have reviewed your documents and the requested information is provided below. However, in order to clarify the information requested by your staff, we are providing appropriate background information to support our responses.

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BACKGROUND

In a letter of October 29, 1992, the staff stated that TU Electric's proposed acceptance criteria, as supplemented, were acceptable. In summary, the approved fire test acceptance criteria were:

(1) External conduit, cable tray rail, and cable jacket temperatures should not exceed a temperature rise of 250°F (139°K) plus ambient (using thermocouple averaging), and no single thermocouple reading should exceed 30 percent above the specified average temperature rise.

(2) The fire barrier should not burn through or develop any openings through which either the test specimen raceway or cables were visible.

(3) If the temperature rise criteria were not satisfied, the cables should be inspected for visible damage. The following attributes constitute cable damage: jacket swelling, splitting, discoloration, hardening, blistering, cracking, or melting; conductor insulation exposed, degraded, or discolored; shield exposed; or bare copper conductor exposed.

(4) If the fire barrier burned through during the fire exposure, or if a visual cable inspection revealed any of the damage attributes listed above, then the barrier was considered to have deviated from the acceptance criteria. Use of the fire test results to qualify a deviating fire barrier would require that cable functionality be demonstrated. Cable functionality test methodology and criteria were specified in the staff's October 29, 1992 letter. A flow chart describing this process is attached as Attachment 1. The staff concluded that TU Electric's acceptance criteria, as supplemented by the conditions stated in the October 29, 1992 letter, ensured that adequate cable and barrier tests would be performed and that satisfactory results from these tests would constitute an acceptable basis for qualifying the CPSES fire barriers.

In a supplemental response to Generic Letter 92-08 (Reference 5), TU Electric provided the staff with details regarding the methodology to be used in completion of Thermo-Lag certification for CPSES Unit 1, including additional Thermo-Lag Barrier Fire Endurance Testing. In this letter TU Electric specified that the testing will be performed utilizing acceptance criteria established via Reference 2.

Finally, via Reference 6 TU Electric provided the laboratory test reports for the Unit 1 Fire Endurance Tests. A summary of the results for each fire test is provided in Attachment 2 of this letter.

RESPONSES

Question 1:

With regard to the fire tested assemblies that included power, instrument or control cables, provide documentation that concludes that the thermal mass in the plant installed configurations is equal to or greater than the thermal mass in the tested assemblies.

Response 1:

TU Electric's position is that the results obtained from numerous full-scale tests of Thermo-Lag raceway and cable barrier systems provide reasonable assurance that cables enclosed within such barriers installed at CPSES will perform their design function during and following a postulated fire. TU Electric has implemented its testing program such that we have tested Thermo-Lag barrier performance on the full range of raceway commodity sizes installed at CPSES, with representative cable fills, consistent with the methodology for acceptance promulgated by Reference 2. The barrier systems, raceway commodities and associated cabling configurations tested were truly representative of those installed at CPSES. Further, NRC acceptance of the Thermo-Lag fire barrier installations for CPSES Unit 2 was based on the qualification of barriers associated with the full range of installed conduit and cable tray sizes. No commitment was made by TU Electric relative to bounding specific cable fills or mass of enclosed contents by test. TU Electric discussed with the NRC staff in various meetings prior to implementing our testing programs, our test configuration including the cable fill, and the NRC staff was fully cognizant of our use of the representative cable fills rather than bounding cable fills prior to implementation of our testing program. NRC representatives have been present and witnessed all aspects of our testing, including fabrication of test assemblies, and therefore have confirmed that we have implemented testing consistent with Reference 2.

Nevertheless, the acceptance criteria provided in Reference 2 was not contingent upon any "bounding" cable loading but rather was based upon the proposed and implemented cable loading used by TU Electric as discussed with the NRC and as observed by the NRC during test preparations and testing.

Question 2:

With regard to the cables protected with "Flexi-Blanket" such as the 2-inch diameter air drop in Test Scheme 11-2, and the individually protected power cables in Test Scheme 15-2, provide a technical basis for accepting 2 layers of Thermo-Lag "Flexi-Blanket" as a 1-hour rated assembly in consideration of the decision by TU Electric to upgrade the 2 layer "Flexi-Blanket" configurations tested in Scheme 15-2 to a 3 layer configuration. Also, provide a technical basis for concluding that 3 layers of Thermo-Lag "Flexi-

Blanket" will provide a 1-hour fire rated assembly when only a 2 layer assembly has been tested. Test Scheme 15-2 is listed in Appendix E (Plan for Certifying CPSES Unit 1 Thermo-Lag) of Engineering Report ER-ME-067, as being used for CPSES Unit 1, but is not included in Appendix C (Thermo-Lag Installation Review Matrix) for Unit 1. Please clarify the intended application for this scheme.

Response 2:

Test Scheme 15-2 replicated a unique Unit 1 application where, due to high levels of congestion, standard Thermo-Lag panel coverage could not be installed to envelope the cable tray. The cables requiring protection are large (1/c 750kMCil) power cables. For this application, the cables were individually wrapped with two layers of "Flexi-Blanket" with the tray and supports remaining exposed. During the Scheme 15-2 test, temperatures recorded on the cables remained well below acceptance limits. Following the hose stream test, the barrier inspection revealed no openings. While some areas of surface char were observed on the exterior cable jackets, no thermal damage penetrated through to the dielectric insulation, and the IR test results were well within prescribed limits, thereby satisfying the acceptance criteria specified by Reference 2. However, during the test, excessive temperatures were recorded by thermocouples installed on #8 AWG bare copper conductors positioned within each "Flexi-Blanket" barrier, adjacent to the power cables. Although test Scheme 15-2 results determined that the cables remained functional, to provide additional assurance that adequate thermal protection of the power cables would be maintained; TU Electric opted to install a third layer of "Flexi-Blanket" material for the specific Unit 1 application where such cables are routed in exposed trays.

The decision to upgrade cables routed in exposed trays for which test Scheme 15-2 applies with a third layer of Thermo-Lag does not alter the conclusions for test Schemes 11-1 and 11-2 which serve as the basis for generic qualification of Thermo-Lag 330-660 "Flexi-Blanket" barriers installed on cable air drops in Unit 1. Specifically, Scheme 11-2 demonstrated that 1½ inch diameter and larger cable air drop bundles wrapped with two layers of "Flexi-Blanket" meet the acceptance criteria specified by Reference 2. Although the maximum individual temperature threshold was exceeded by 22°F on one cable within a 2 inch diameter bundle, and a minor area of surface char (approximately ¼ sq. inch) was observed on the cable jacket exterior, no thermal damage penetrated through the jacket material. Additionally, following the hose stream test, the barrier inspection revealed no openings, and insulation resistance (IR) test results were well within prescribed limits per Reference 2. Similarly, for cable air drop bundles smaller than 1½ inch diameter, three layers of "Flexi-Blanket" are utilized in Scheme 11-1 which qualified three material layers on a single 7c/#12 AWG control cable air drop.

Finally, Test Scheme 15-2 should have been referenced as the qualifying test in Appendix C of ER-ME-067 for cables wrapped with "Flexi-Blanket" in exposed cable tray. This will be corrected in the next revision of the engineering report.

Question 3:

With regard to the Thermo-Lag "Box Assembly" tested in Scheme 11-4, provide a technical basis for accepting this configuration considering the performance of this assembly during the hose stream test, when barrier material was dislodged exposing the bottom of the cable tray and considering the decision by TU Electric to reinforce the attachments for the CPSES Unit 2 assembly tested in Scheme 12-2 based upon its performance during the hose stream test. This scheme is listed in Appendix E (Plan for Certifying CPSES Unit 1 Thermo-Lag) of Engineering Report ER-ME-067 as being used for CPSES Unit 1, but is not included in Appendix C (Thermo-Lag Installation Review Matrix) for Unit 1. Please clarify the intended application for this scheme.

Response 3:

During the Unit 2 inspection, the NRC staff identified a concern relative to the qualification basis for some unique Thermo-Lag barrier configurations (Reference 3). These configurations consisted of instances where cables requiring protection exit one or more cable tray segments and pass through embedded wall sleeves. The specific barrier designs issued to address these applications entailed extending the Thermo-Lag panel coverage on the cable trays to adjacent wall surfaces, thereby forming "box design" enclosures for the cable air drops. In lieu of addressing these Unit 2 configurations by performance of a specific test, TU Electric opted to upgrade such "box" enclosures by installing a secondary layer of Thermo-Lag panels around portions of these assemblies where the cables air drop from trays to embedded wall sleeves. The acceptability of this configuration was demonstrated by Scheme 10-2. This method for upgrade of "box" enclosures was subsequently accepted by the NRC staff (Reference 4).

For Unit 1, there are approximately 20 equivalent "box design" enclosures. Consistent with TU Electric's intent to evaluate less extensive barrier upgrades for Unit 1, Scheme 11-4 was included in the test program to represent a typical "box design" assembly. The purpose of this test was to evaluate the performance of two specific attributes; a) the adequacy of an enclosure constructed using a single layer of Thermo-Lag panels to protect cables transversing from "stacked" cable tray arrays to a bank of embedded wall sleeves; and b) the integrity of the interface area where the Thermo-Lag panels abut the concrete surfaces around the perimeter of embedded wall sleeves. The results of this test satisfied the criteria for acceptance specified by Reference 2. Although a barrier opening developed during the hose stream test (on the bottom cable tray along the seam between panels installed on the tray underside and those installed on the side rail), satisfactory temperatures were maintained during the test. Additionally, no significant thermal damage was observed during visual inspection of the cables and the IR test results were well within acceptance limits. The recognized basis for the hose stream test is to provide reasonable assurance that following fire exposure, the barrier system is capable of mitigating significant damage to enclosed raceway elements and cabling where subjected to in-plant fire fighting activities or external objects which may fall during a fire. Given the nature and location of the barrier opening which developed during the hose stream test for Scheme 11-4, it is highly unlikely that significant damage to contents contained within such barrier configurations would occur, thereby satisfying the intent of the hose stream test.

Finally, a separate entry should have been made in Appendix C of ER-ME-067 for "box design" configurations and listing Test Scheme 11-4 as the qualifying test. This will be corrected in the next revision of the engineering report.

Question 4:

With regard to Appendix C (page 157) of Engineering Report ER-ME-067, verify that the correct test scheme for the 18-inch by 4-inch power cable tray is Scheme 13-2 not Scheme 31-2, which is listed in the report.

Response 4:

The Engineering Report contains a typographical error. Scheme "31-2" should be "13-2". This will be corrected in the next revision of the engineering report.

Question 5:

Please provide the revised Engineering Report ER-ME-082, "Evaluation of Unit 2 Thermo-Lag Configurations", that reflects the Unit 1 configurations and serves as the basis for "acceptance of minor deviations from specified technical requirements" in accordance with the provisions of NRC Generic Letter 86-10.

Response 5:

See Enclosure 1 to this letter.

Question 6:

Test Scheme 11-1 is listed in Appendix E (Plan for Certifying CPSES Unit 1 Thermo-Lag) of Engineering Report ER-ME-067, as being used for CPSES Unit 1, but is not included in Appendix C (Thermo-Lag Installation Review Matrix) for Unit 1. Please clarify the intended application for this scheme.

Response 6:

Both Schemes 11-1 and 11-2 should have been referenced as qualifying tests for Unit 1 air drops. This will be corrected in the next revision of the engineering report.

Question 7:

With regard to the manufacturing specifications of the Thermo-Lag material installed at Comanche Peak, verify that the material that was qualified for use in CPSES Unit 1, by the fire endurance tests referenced in Appendix E of the Engineering Report ER-ME-067, is representative of the material installed in CPSES Unit 1. This issue was addressed for CPSES Unit 2 in the letter of August 17, 1993, to Mr. William J. Cahill, Jr., from Ms. Suzanne C. Black.

Response 7:

TU Electric has verified that the Thermo-Lag materials used for the CPSES Unit 1 fire tests were representative of materials installed in CPSES Unit 1. Additionally, TU Electric utilized the same inspection and installation methods for the fire test specimens as were used for Unit 1 installations.

Question 8:

With regard to the use of Thermo-Lag fire stops in cable trays at CPSES Unit 1, please provide additional information concerning the specific application of the fire stop configurations and the basis for qualifying the assemblies using IEEE-634. The staff is concerned that IEEE-634 may be inappropriate for the intended application.

Response 8:

Where Thermo-Lag coverage on cable trays terminates away from a fire area boundary such as walls, floors, etc., because the specific cables requiring protection have exited the tray enclosure, internal fire stops are utilized to seal the tray envelope. In these instances, since the Thermo-Lag envelope installed on the cable tray is the fire resistive barrier, penetrations through the barrier, resulting from the continuation of the cable tray containing nonessential cables, are treated as electrical penetrations. Since cables penetrating through the fire stop are not required to remain functional in the event of a fire, the purpose of such fire stops is the same as penetration seals installed in fire-rated walls, floors, etc. Specifically, such stops and seals are installed to prevent fire propagation or significant transmission of heat and hot gases through the barrier. Consistent with the CPSES licensing basis (Reference 7), penetration seals for electrical applications are qualified in accordance with IEEE 634.

For Unit 2, silicone elastomer material was used exclusively to construct internal fire stops within Thermo-Lag envelopes installed on cable trays. The use of silicone elastomer as a qualified penetration seal material is well-founded in the CPSES penetration seals program based on extensive industry testing in accordance with IEEE 634 and other applicable test standards such as ASTM E 814. Additionally, the use of silicone elastomer fire stops to seal Thermo-Lag fire barrier configurations installed on cable trays was qualified for Unit 2 via Test Schemes 11-1, 12-2 and 14-1.

While silicone elastomer was used to construct some fire stops within Thermo-Lag cable tray envelopes, silicone foam material and Thermo-Lag 330-1 ("trowel grade") material were also used for Unit 1. As with silicone elastomer, extensive industry testing has qualified silicone foam as a rated penetration seal material. However, since a valid corresponding test for the use of Thermo-Lag 330-1 as a penetration seal was not available, TU Electric evaluated this specific cable tray fire stop application under Test Scheme 4 for Unit 1 configurations. Consistent with IEEE 634 acceptance criteria, the results of the Scheme 4 test demonstrated that Thermo-Lag 330-1 material performs as an acceptable penetration seal material for internal tray fire stop applications based on the following parameters:

a) The fire stop withstood a standard ASTM E 119 fire exposure for a 1-hour duration without passage of flame or gases hot enough to ignite cables within the protected tray assembly on the unexposed side of the fire stop.

b) Transmission of heat through the fire stop did not raise the temperature on its unexposed surface above the self ignition temperature of the cables in contact with the fire stop material.

c) The fire stop withstood a hose stream test applied as a straight stream without the hose stream causing openings through the fire stop.

Two of the cable tray barrier tests credited in the qualification basis for Unit 1 included fire stops (Schemes 11-2 and 14-1). Although these fire stops were constructed using silicone elastomer material, no appreciable differences in installation attributes or performance characteristics exist between the silicone elastomer fire stops tested and the fire stops installed in Unit 1 using silicone foam or Thermo-Lag 330-1 materials.

Therefore, collectively the results of Test Schemes 11-2 and 14-1, the body of industry testing of silicone-based materials and the effectiveness of Thermo-Lag 330-1 as demonstrated by the Scheme 4 test establish equivalency between these materials when installed as fire stops within Thermo-Lag cable tray barriers.

Finally, Appendix E of ER-ME-067 incorrectly denotes Scheme 4 as a Unit 2 test. As described above, no cable tray fire stops constructed using Thermo-Lag 330-1 were installed for Unit 2. This will be corrected in the next revision of the engineering report.

Question 9:

With regard to the structural steel protected with Thermo-Lag at CPSES Unit 1, please provide additional information concerning the specific application of the structural steel fireproofing described in Appendix D of Engineering Report ER-ME-067, and the basis for the conclusion that the untested configuration is equivalent to the Underwriters Laboratory listed configuration. Include design or installation drawings and identify any differences from the listed configuration.

Response 9:

Appendix D of ER-ME-067 applies to fireproofing of components forming part of a fire-rated plant structural assembly and does not apply to the protection of steel associated with essential cable raceway protection. The installation is based on Underwriter's Laboratories Design X-611. A detailed description of the various applications utilized and the basis for equivalency to the tested configuration is provided in ER-ME-082 (see enclosure to this letter).

Please contact Obaid Bhatty at (817)897-5839 should you require additional information.

Sincerely,

William J. Cahill, Jr.

William J. Cahill, Jr.

By: Roger D. Walker

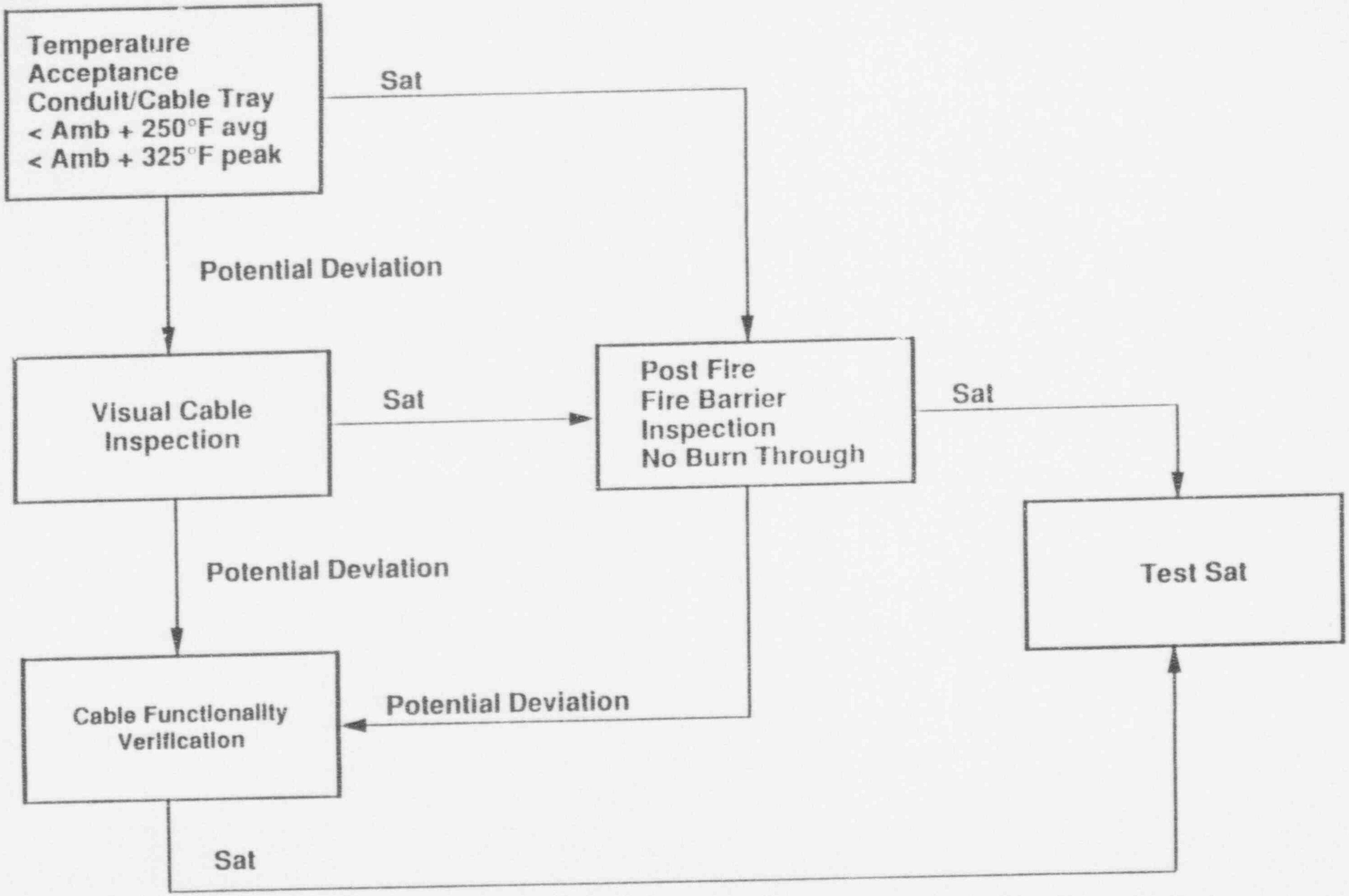
Roger D. Walker
Regulatory Affairs Manager

OB:bm
ATTACHMENTS
ENCLOSURE

cc:	Mr. T. A. Bergman, NRR	w/o enclosure
	Mr. L. J. Callan, Region IV	
	Mr. T. Reis, Region IV	w/o enclosure
	Mr. K. S. West, NRR	
	Resident Inspectors, CPSES	w/o enclosure

ATTACHMENT 1
TO
TXX-94157

ACCEPTANCE CRITERIA
FLOW CHART



Attachment 1 to TXX-94157

ATTACHMENT 2
TO
TXX-94157

FIRE ENDURANCE
TEST RESULTS

UNIT 1 TEST
CONFIGURATION - SCHEME #11-5

SCHEME #11-5 CONSISTED OF THREE 24"X4" LADDER BACK TRAY ASSEMBLIES WITH VARIOUS JOINT REINFORCEMENT METHODS

THE TRAYS WERE PROTECTED WITH 1/2 INCH (NOMINAL) THICK THERMO-LAG BOARD SECTIONS WITH RIBS

(I) ONE TRAY WAS UPGRADED WITH 6 INCH WIDE STRESS SKIN SECTIONS COVERED WITH THERMO-LAG TROWEL GRADE MATERIAL, WRAPPED CIRCUMFERENTIALLY AROUND BOTTOM BUTT JOINTS AND AT 2 FOOT INTERVALS

(II) ONE TRAY WAS UPGRADED WITH STRESS SKIN SECTIONS INSTALLED OVER SIDE PANELS TO OVERLAP TOP AND BOTTOM CORNER (LONGITUDINAL) JOINTS BY 5 INCHES AND COVERED WITH THERMO-LAG TROWEL GRADE MATERIAL

(III) ONE TRAY WAS UPGRADED WITH A BRAIDED CERAMIC BANDING MATERIAL WRAPPED CIRCUMFERENTIALLY AROUND BOTTOM BUTT JOINTS AND AT 2 FOOT INTERVALS

TEST SCOPE:

THE THERMO-LAG ATTRIBUTES TESTED WERE THE VARIOUS CABLE TRAY JOINT UPGRADE TECHNIQUES, UTILIZING STRESS SKIN, TROWEL GRADE THERMO-LAG MATERIAL AND CERAMIC BANDING MATERIAL

SCHEME #11-5

Test Scheme Configuration Description	Maximum Average Raceway Temp.	Maximum Individual Raceway Temp.	Maximum Average Cable Temp.	Maximum Individual Cable Temp.	Barrier Condition	Cable Condition	Conclusions/ Remarks
Three 24"X4" Ladder Back Trays with the following upgrades					NOTE: Initial Temp. = 93°F		
(i) Stress skin wrapped circumferentially around Butt Joints	Right=340°F Left =323°F	549°F	P=284°F C=277°F I=283°F	385°F 340°F 364°F	Barrier Breached	Unsat.	TU Electric will not utilize this upgrade
(ii) Stress skin installed along Longitudinal Joints	Right=270°F Left =293°F	362°F	P=302°F C=239°F I=260°F	336°F 272°F 310°F	Sat.	Sat.[1]	Satisfactory Test. See rationale for jacket swelling in test report.
(iii) Ceramic Banding wrapped circumferentially around Butt Joints	Right=358°F Left =371°F	468°F	P=309°F C=314°F I=339°F	362°F 414°F 401°F	Sat.	Sat.[1]	Satisfactory test based on cable visual inspection and insulation resistance measurements. See rationale for jacket swellingin test report.

P = Power Cable; C = Control Cable; I = Instrument Cable

[1] Some cable jacket swelling was noted on power cables

UNIT 1 TEST
CONFIGURATION - SCHEME #13-2

SCHEME #13-2 CONSISTED OF A 12"X4" LADDER BACK CABLE TRAY WITH 90 DEGREE BENDS AND A 2 INCH DIAMETER CONDUIT WITH TWO 90 DEGREE RADIAL BENDS

(a) THE CABLE TRAY WAS PROTECTED WITH 1/2 INCH (NOMINAL) THICK THERMO-LAG BOARD SECTIONS WITH RIBS. THIS TRAY CONFIGURATION WAS REPRESENTATIVE OF THAT CURRENTLY INSTALLED IN UNIT 1, i.e., NO UPGRADE OF BUTT OR LONGITUDINAL JOINTS

(b) THE 2 INCH DIAMETER CONDUIT WAS PROTECTED WITH 1/2 INCH (NOMINAL) THICK THERMO-LAG SECTIONS. THE RADIAL BENDS WERE UPGRADED WITH FLEXIBLE STAINLESS STEEL MESH AND TROWEL GRADE THERMO-LAG MATERIAL

TEST SCOPE

THE THERMO-LAG ATTRIBUTES TESTED WERE THE 12 INCH CABLE TRAY ENVELOPE WITH NO JOINT UPGRADE AND CONDUIT RADIAL BEND UPGRADE WITH THE STAINLESS STEEL FLEXIBLE MESH

SCHEME #13-2

Test Scheme Configuration Description	Maximum Average Raceway Temp.	Maximum Individual Raceway Temp.	Maximum Average Cable Temp.	Maximum Individual Cable Temp.	Barrier Condition	Cable Condition	Conclusions/ Remarks
12"X4" Cable Tray and a 2 inch Conduit					NOTE: Initial Temp. = 93°F		
i) Cable Tray with no Upgrade	Right=380°F Left =376°F	447°F	P=304°F C=305°F I=328°F	345°F 363°F 396°F	Minor Burn-through at Seam	Sat. Minor jacket discoloration noted	Satisfactory Test based on cable visual inspection and insulation resistance measurements
ii) 2 inch Conduit with only Radial Bends Upgraded	366°F	546°F	P=254°F C=237°F I=247°F	351°F 302°F 308°F	Sat.	Sat. Radial bend area	Satisfactory test for upgrade at radial bends

UNIT 1 TEST
CONFIGURATION - SCHEME #11-2

SCHEME #11-2 CONSISTED OF A 24"X4" LADDER BACK TRAY WITH TWO AIR DROP CONFIGURATIONS

(a) THE CABLE AIR DROP BUNDLES (1-1/2 AND 2 INCH DIAMETER) WERE PROTECTED WITH TWO LAYERS OF THERMO-LAG 330-660 "FLEXI-BLANKET" MATERIAL

(b) THE CABLE TRAY WAS PROTECTED WITH 1/2 INCH (NOMINAL) THICK THERMO-LAG BOARD SECTIONS WITH RIBS. VERTICAL AND BOTTOM BUTT JOINTS AND LONGITUDINAL JOINTS REINFORCED WITH STRESS SKIN AND TROWEL GRADE THERMO-LAG MATERIAL

(c) THE 2 INCH AIR DROP AND A SINGLE CABLE PROTRUDING AIR DROP WERE REINFORCED AT THE CABLE TRAY INTERFACE AREA USING FLEXIBLE STAINLESS STEEL MESH AND TROWEL GRADE THERMO-LAG MATERIAL

Note: #8 bare cooper wire was run through the length of each air drop, in addition to the cables

TEST SCOPE

THE THERMO-LAG ATTRIBUTES BEING TESTED WERE 2 INCH AND 1-1/2 INCH DIAMETER AIR DROPS PROTECTED WITH 2 LAYERS OF "FLEXI-BLANKET", AND THE INTERFACE REGION BETWEEN AIR DROPS AND CABLE TRAY REINFORCED WITH FLEXIBLE MESH AND TROWEL GRADE THERMO-LAG MATERIAL

SCHEME #11-2

Test Scheme Configuration Description	Maximum Average Raceway Temp.	Maximum Individual Raceway Temp.	Maximum Average Cable Temp.	Maximum Individual Cable Temp.	Barrier Condition	Cable Condition	Conclusions/ Remarks
24"X4" Cable Tray with 2 Air Drops from 2 conduit stubs. #8 Bare Copper Wire included in Air Drops					NOTE: Initial Temp. = 93°F		
(i) Cable Tray	Right=249°F Left =250°F	309°F 295°F	P=228°F C=218°F I=218°F	P=273°F C=258°F I=258°F	Sat.	Sat.	Satisfactory Test
(ii) 1 1/2 inch Air Drop	N/A	N/A	P=226°F C=241°F I=241°F	246°F 299°F 327°F	Sat.	Sat.	Satisfactory Test
(iii) 2 inch Air Drop	N/A	N/A	P=254°F C=217°F I=205°F	439°F[2] 251°F 211°F	Sat.	Sat.	Satisfactory Test - One thermocouple exceeded max. temp., but cable undamaged. Insulation resistance measurement satisfactory.
(iv) #8 Bare Copper Wire	N/A	N/A	249°F	344°F	N/A	N/A	Satisfactory Test
(v) 2 inch Conduit Stub Surface	224°F	225°F	N/A	N/A	Sat.	Sat.	Satisfactory Test
(vi) 1 1/2 inch Conduit Stub Surface	241°F	249°F	N/A	N/A	Sat.	Sat.	Satisfactory Test

[2] see remarks

UNIT 1 TEST
CONFIGURATION - SCHEME #11-4

SCHEME #11-4 CONSISTED OF CABLE AIR DROPS FROM EIGHT (8) EMBEDDED WALL SLEEVES INTO TWO, STACKED, 24"X4" LADDER BACK TRAYS

(a) A THERMO-LAG BOX DESIGN ENCLOSURE COVERED THE AIR DROP CABLES INCLUDING BOTH TRAYS, CONTINUING OVER TO THE WALL PENETRATION. THE BOX WAS CONSTRUCTED OF 1/2 INCH (NOMINAL) THICK FLAT AND RIBBED THERMO-LAG BOARD SECTIONS. JOINTS WERE REINFORCED WITH A LAYER OF STRESS SKIN AND TROWEL GRADE THERMO-LAG MATERIAL

(b) THE REMAINDER OF THE 2 CABLE TRAYS NOT INCLUDED AS PART OF THE BOX CONFIGURATION WERE PROTECTED WITH 1/2 INCH (NOMINAL) THICK THERMO-LAG BOARD SECTIONS WITH RIBS. VERTICAL AND BOTTOM BUTT JOINTS AND LONGITUDINAL JOINTS WERE REINFORCED WITH STRESS SKIN AND TROWEL GRADE THERMO-LAG MATERIAL

Note: #8 bare cooper wire was run through the air drop portion inside the box configuration in addition to the cables

TEST SCOPE

THE THERMO-LAG ATTRIBUTE TESTED WAS THE "BOX" DESIGN CONFIGURATION PROTECTED WITH A SINGLE LAYER OF THERMO-LAG PREFABRICATED PANELS AND ITS INTERFACE REGION TO THE CONCRETE STRUCTURE SURROUNDING THE EMBEDDED SLEEVES

SCHEME #11-4

Test Scheme Configuration Description	Maximum Average Raceway Temp.	Maximum Individual Raceway Temp.	Maximum Average Cable Temp.	Maximum Individual Cable Temp.	Barrier Condition	Cable Condition	Conclusions/ Remarks
Cables Air Drops from Embedded Wall Sleeves into two, Stacked, 24"X4" Cable Trays (#8 Bare Copper Wire Included in Air Drops)						NOTE: Initial Temp. = 93°F	
(i) Top Tray	Right=256°F Left =246°F	312°F	P=236°F C=226°F I=225°F	297°F 259°F 263°F	Sat.	Sat.	Satisfactory Test
(ii) Bottom Tray	Right=257°F Left =255°F	335°F	P=242°F C=225°F I=227°F	311°F 288°F 296°F	Sat. See Remark 1	Sat. See Remark 2	Satisfactory Test 1) The Barrier opened up due to hose stream, but no burn through occurred. 2) Some acceptable Jacket Swelling was noted on Power Cables
(iii) Air Drop (Box Configuration)	N/A	N/A	I=231°F	241°F	Sat.	Sat.	Satisfactory Test
(iv) #8 Bare Copper Wire	N/A	N/A	251°F	287°F	N/A	N/A	Satisfactory Test

UNIT 1 TEST
CONFIGURATION SCHEME #15-2

SCHEME #15-2 CONSISTED OF TWO INDIVIDUALLY PROTECTED 1/C 750 MCM CABLES ROUTED IN AN EXPOSED 36"X4" LADDER BACK CABLE TRAY. ADDITIONALLY, A BUNDLE OF THREE UNPROTECTED 3/C #6 AWG (POWER) CABLES WAS PLACED BETWEEN THE TWO 750 MCM CABLES TO REPRESENT PLANT INSTALLATION.

(a) BOTH 750 MCM CABLES WERE WRAPPED WITH TWO LAYERS OF THERMO-LAG 330-660 "FLEXI-BLANKET" MATERIAL

(b) THE 36 INCH CABLE TRAY IN WHICH THE WRAPPED CABLES WERE INSTALLED HAD NO THERMO-LAG PROTECTION FOR THE TRAY OR FOR THE CABLE TRAY SUPPORTS

(c) THE BUNDLE OF CABLES WAS WRAPPED WITH SILTEMP MATERIAL AND PLACED BETWEEN THE TWO PROTECTED 750 MCM CABLES

Note: #8 bare copper wire was run through both protected bundles

TEST SCOPE

THE THERMO-LAG ATTRIBUTES BEING TESTED WERE SINGLE 750 MCM CABLES, EACH WRAPPED WITH TWO LAYERS OF THERMO-LAG "FLEXI-BLANKET" IN EXPOSED CABLE TRAY

SCHEME #15-2

Test Scheme Configuration Description	Maximum Average Raceway Temp.	Maximum Individual Raceway Temp.	Maximum Average Cable Temp.	Maximum Individual Cable Temp.	Barrier Condition	Cable Condition	Conclusions/ Remarks
Single 1/c 750 MCM cables, each wrapped with two Thermo-Lag 330-660 layers and routed in exposed cable tray.					NOTE: Initial Temp. = 93°F		
i) Front Bundle (a) 750 MCM Cable (b) #8 Copper Wire	a) N/A b) N/A	N/A N/A	215°F 465°F	238°F 717°F	Sat.	Sat.	Upgrading from tested configuration
ii) Rear Bundle (a) 750 MCM Cable (b) #8 Copper Wire	a) N/A b) N/A	N/A N/A	275°F 310°F	377°F 586°F	Sat.	Minor Jacket Blistering in some Areas. Insulation undamaged.	Upgrading from tested configuration

ENCLOSURE 1
TO
TXX-94157

ER-ME-082