UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

August 14, 1992

Docket Nos. 50-445
and 50-446

LICENSEE: Texas Utilities Electric Company (TU Electric)

FACILITY: Comanche Peak Steam Electric Station, Units 1 and 2 (CPSES)

SUBJECT: SUMMARY OF MEETING ON CPSES THERMO-LAG TESTING PROGRAM

TU Electric performed plant specific fire endurance testing of their protective fire barrier system (Thermo-Lag) from June 17-23, 1992. TU Electric performed the testing in order to resolve questions regarding the fire barrier's effectiveness for existing Unit 1 installations, and to support the licensing of Unit 2.

The tests consisted of a series of 1-hour fire endurance tests on a variety of cable tray and conduit "mock-ups." The mock-ups were designed to duplicate typical in-plant applications of the fire barrier material. The fire barrier was installed using stock material, and actual plant procedures and personnel. NRC representatives witnessed both the preparation of test specimens and the actual testing. NRC Information Notice 92-46 and NRC Bulletin No. 92-01 discuss, in part, the CPSES testing and results.

A meeting was held on July 13, 1992 to review the CPSES test results to date, discuss issues raised by NRC representatives witnessing the testing, and discuss revised test configurations for CPSES. TU Electric concluded from their test results that two generic thermo-lag configurations were in question: (1) applications with small thermal mass (e.g., small conduit), where there did not appear to be an adequate quantity of thermo-lag present for protection; and (2) large spans of thermo-lag where structural integrity is not maintained (e.g., joint separation occurs). The revised test configurations, to be tested the week of August 17, 1992, include upgrades to address these issues.

Three issues, previously raised to TU Electric concerning their testing, were discussed at the meeting. The first two issues involved the cable tray and conduit supports. Questions were raised regarding both the modelling and the protection of the supports with thermo-lag (as compared to actual plant design). TU Electric has performed thermal analysis which they state demonstrates that the supports have negligible effect on conducting heat away from the test configurations. This analysis, along with a thermal response calculation, was provided to the NRC staff at the meeting and is included as an enclosure to this summary.

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The third issue discussed regarded thermo-lag heat of combustion. TU Electric has performed preliminary testing in determining the flash ignition temperature of thermo-lag. TU Electric committed to review their results against their fire hazards analysis to determine the impact to safe shutdown capability.

During the meeting, the NRC staff posed additional questions to TU Electric regarding their testing. Specifically, the qualification of the fire barrier material based on testing performed with structural steel and penetrations protected greater than the 9 inch standard (of in-plant applications) was questioned. Additionally, the issue of hose stream testing following the fire endurance tests was discussed.

The NRC will review these issues in more detail following the mid-August 1992 revised testing. In the interim, TU Electric continues to perform roving fire watches in accordance with their Fire Protection Manual for Unit 1.

Original Signed By

Brian E. Holian, Senior Project Manager
Project Directorate IV-2
Division of Reactor Projects III/IV/V
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Enclosures:
1. Attendance List
2. Meeting Handout
3. Thermal Analyses

cc: See next page

DISTRIBUTION: w/o enclosure 3

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PDIV-2 P/F	ACRS (10)
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NRC Participants	

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DATE	8/4/92	8/4/92	8/11/92	8/13/92	/ /

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ENCLOSURE 1

MEETING ATTENDEES

Names	Organization
B. Holian	NRC
S. Black	NRC
R. M. Latta	NRC
J. E. Gagliardo	NRC
G. Holahan	NRC
P. Madden	NRC
R. Architzel	NRC
M. Widmann	NRC
S. West	NRC
R. Schaaf	NRC
A. Masciantonio	NRC
D. Chamberlain	NRC
R. Dible	TU Electric
F. Collins	TU Electric
O. Bhatty	TU Electric
R. Walker	TU Electric
R. Brady	TU Electric
B. Bradley	NUMARC
L. Zerr	STS

ENCLOSURE 2

MEETING AGENDA

CPSES THERMO-LAG TESTING PROGRAM

JULY 13, 1992

* Testing Program to Date
* Preliminary Lessons Learned
* Specific Issues
* Scheduled Tests
* Anticipated Testing Program Results

CPSES THERMO-LAG TESTING PROGRAM RESULTS TO DATE

* **CONDUIT / J-BOX ASSEMBLY- 6-17-92**

5" CONDUIT-Passed

High Temperature on Conduit- 345 degrees F
High Temperature on Cable- 233 degrees F
Circuit Integrity- Maintained Continuity
Cable Damage- None

1" CONDUIT-Under Review

High Temperature on Conduit- 698 degrees F
High Temperature on Cable- 463 degrees F
Circuit Integrity- Maintained Continuity
Cable Damage- Limited to outside jacket. Insulation on individual conductors was not significantly damaged as confirmed by a successful Megohmmeter test following the hose stream test. In addition, a successful wet and dry Megohmmeter test of the damaged cable was conducted following the test at Comanche Peak Steam Electric Station.

3/4" CONDUIT-Failed
High Temperature on Conduit- 694 degrees F
High Temperature on Cable- 609 degrees F
Circuit Integrity- Maintained Continuity
Cable Damage- Significant degradation to both exterior jacket and individual conductor insulation at one location on the cable was identified. Bare wire was exposed due to degredation of cable.

* **12" Cable Tray - 6-18-92 Passed**
High Temperature on Tray Rail- 381 degrees F
High Temperature on Cable- 291 degrees F
Circuit Integrity- Maintained Continuity
Cable Damage- None

* **30" Cable Tray w/Tee - 6-19-92 Failed**
High Temperature on Tray Rail- 723 degrees F
High Temperature on Cable- 578 degrees F
Circuit Integrity- Failed at 42 minutes
Cable Damage- Significant degradation of cabling was observed in the area of Thermo-Lag failure

* **36" Cable Tray w/Tee-Assembly Upgraded 6-22-92 Passed**
  High Temperature on Tray Rail- 377 degrees F
  High Temperature on Cable- 314 degrees F
  Circuit Integrity- Maintained Continuity
  Cable Damage- None

* **36" Vert. Tray w/Stop- 6-23-92 Passed**
  High Temperature on Tray Rail- 480 degrees F
  High Temperature on Cable- 375 degrees F
  Circuit Integrity- N/A
  Cable Damage- None

PRELIMINARY LESSONS LEARNED

* TESTS HAVE PROVEN THAT THE THERMAL PROTECTIVE PROPERTIES OF THERMO-LAG PROVIDE SUFFICIENT PROTECTION TO RACEWAYS. AS A MATERIAL, THE TEST RESULTS HAVE SHOWN FAVORABLE PERFORMANCE FOR THE SUBLIMATION OF THE THERMO-LAG TO COOL THE PROTECTED ENVELOPE.

* ISSUES APPEAR TO BE STRUCTURAL INTEGRITY FOR LARGE SPANS WHICH CAUSE SEPARATION OF JOINTS (36" HORIZONTAL RUNS AND 30" "T" SECTIONS) AND THICKNESS OF THERMO-LAG FOR APPLICATIONS WITH SMALL THERMAL MASS (3/4" CONDUITS) WHERE THERE SIMPLY DID NOT APPEAR TO BE ENOUGH QUANTITY OF THERMO-LAG TO PROTECT THESE SMALL COMMODITIES.

PRELIMINARY LESSONS LEARNED CONT.....

* PROTECTING SUPPORTS 9" ADEQUATELY PREVENTS HEAT TRANSFER INTO THE PROTECTED ENVELOPE.

* VERTICAL RUNS ON ALL SIZES OF CABLE TRAYS ARE ACCEPTABLE AND REQUIRE NO UPGRADES

* BASED ON RESULTS OF THE 3/4" AND 1" CONDUIT TESTS, 1-1/2" AND LARGER CONDUIT APPLICATIONS DO NOT REQUIRE ANY UPGRADES TO AS-BUILT CONDITIONS.

* HORIZONTAL CABLE TRAY RUNS FOR 30" WITHOUT "T" SECTIONS AND ALL SMALLER HORIZONTAL TRAYS ARE ACCEPTABLE WITHOUT UPGRADES.

CPSES THERMO-LAG

ISSUES

ISSUE 1

* IMPACT OF SUPPORTS ON TEST RESULTS

ISSUE 2

* PROTECTION OF RACEWAY SUPPORTS IN THE PLANT

ISSUE 3

* THERMO-LAG COMBUSTIBILITY

ISSUE RESOLUTION

ISSUE 1

MPACT OF SUPPORTS ON TEST RESULTS

ELECTRIC RESPONSE:

- SUPPORTS WERE NOT CONSIDERED WITHIN THE BOUNDS OF THE RACEWAY FIRE BARRIER QUALIFICATION TESTING. ADDITIONAL ANALYSES DEMONSTRATE THAT SUPPORTS WILL NOT FAIL DUE TO SUPPRESSION SYSTEMS AND LOW COMBUSTIBLE LOADING (THIS IS FURTHER DISCUSSED IN THE NEXT ISSUE).

- THERMAL ANALYSIS HAS BEEN PERFORMED FOR THE CONDUIT ASSEMBLY TESTED WHICH DEMONSTRATES THAT THE SUPPORTS HAVE NEGLIGIBLE EFFECT IN CONDUCTING HEAT AWAY FROM THE TEST ENVELOPE.

- SUBSEQUENT TESTS WILL MINIMIZE THE NUMBER OF SUPPORTS AND CLOSELY MODEL PLANT SUPPORT SPACING. SUPPORTS WILL BE PROTECTED WITH A SINGLE LAYER OF THERMO-LAG. THERMOCOUPLES WILL BE INSTALLED ON THE CONDUIT ASSEMBLY SUPPORT TO MEASURE TEMPERATURE DIFFERENTIAL FROM THE TEST ENVELOPE.

THERMAL ANALYSIS FOR SUPPORTS

ISSUE:

Determine heat loss (change in temperature) of the 24"x18"x8" junction box due to thermal conduction into the support steel.

STEPS:

1. Calculate temperature increase on support steel due to ASTM E-119 exposure for the one hour test duration.

2. Calculate heat flux from the junction box to the support steel anchor due to temperature differential along the support.

3. Calculate temperature change on the junction box due to heat loss for one hour.

ASSUMPTIONS:

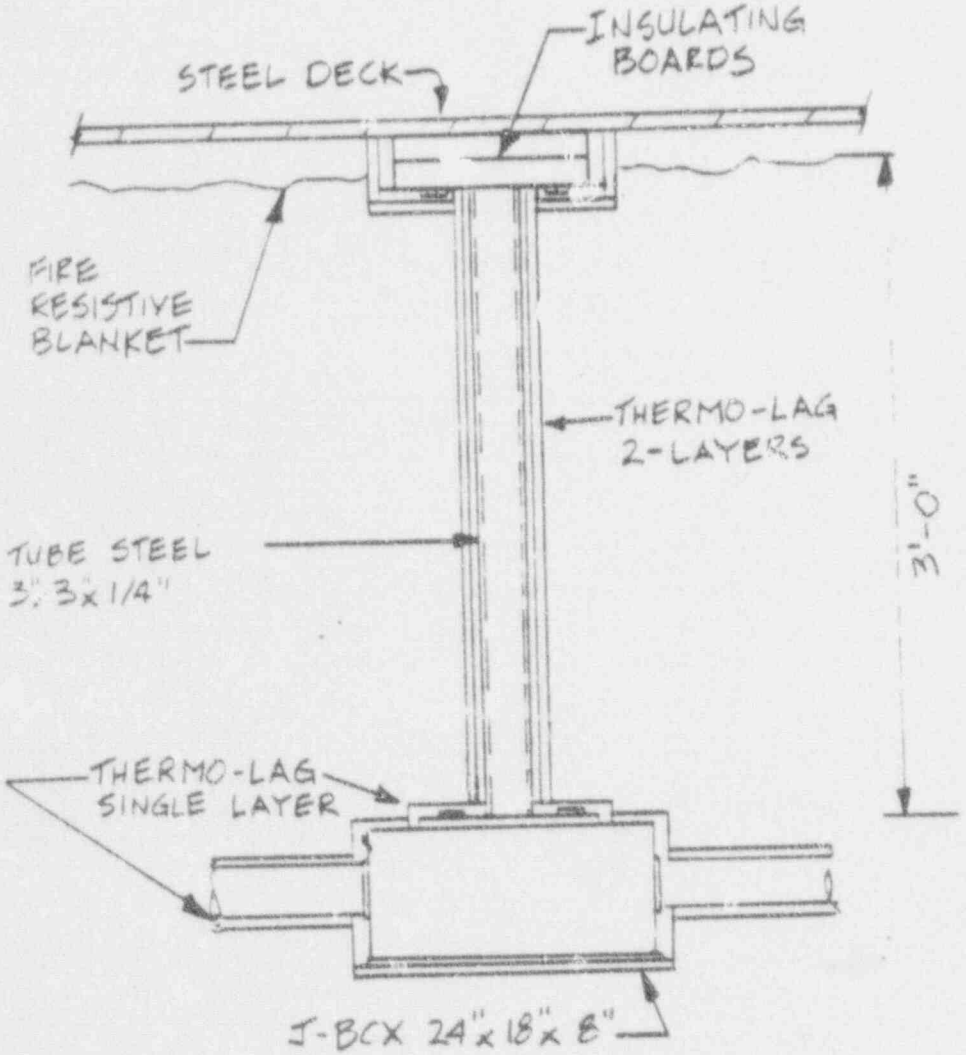
Assume junction box temperature to be 483 degrees F for the entire hour for conservatism and simplification of the model. This is based on the maximum average thermocouple readings during the actual fire test on the junction box.

Assumptions cont....

Assume the support for the junction box is the worst case since the junction box exibited the highest steel temperatures in the area of the supports thus creating the greatest temperature differential.

RESULTS:

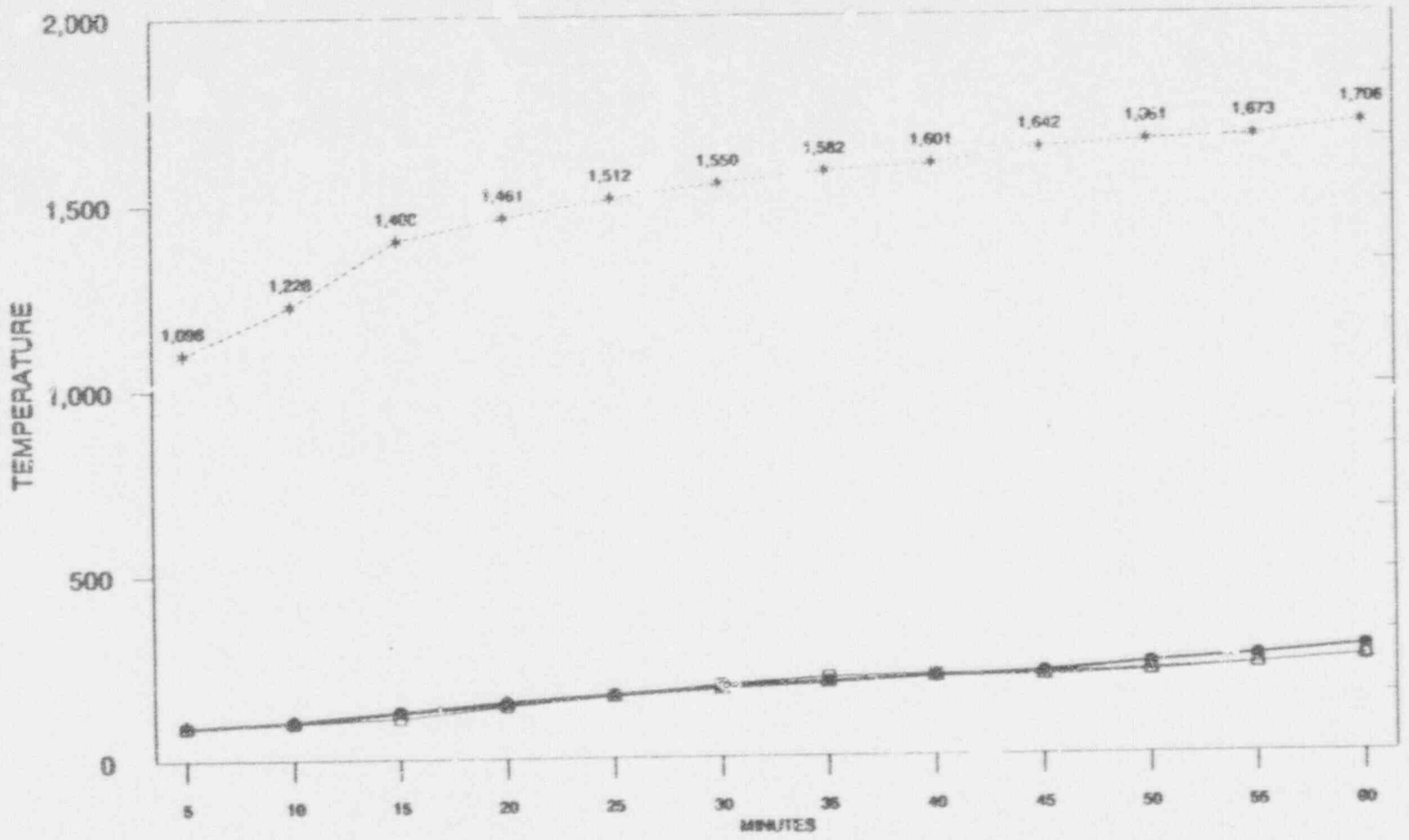
Using these very conservative assumptions there was a 15 degree F maximum reduction in temperature on the junction box steel for the one hour ASTM E-119 exposure due to the transfer of heat through the support.



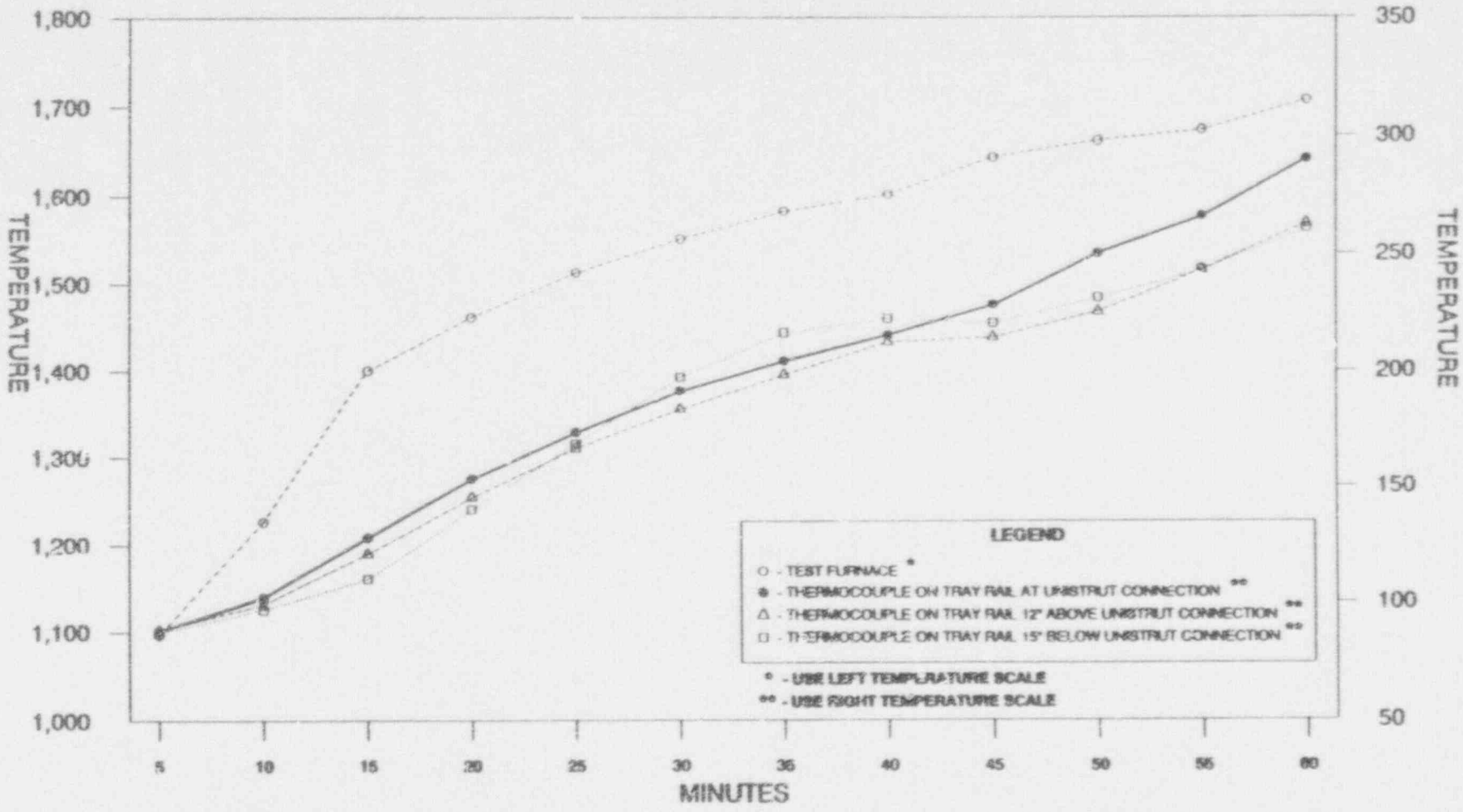
THERMAL ANALYSIS MODEL FOR CONDUIT TEST ASSEMBLY

NTS

COMANCHE PEAK STEAM ELECTRIC STATION
FIRE TEST THERMOCOUPLE READINGS
THERMOLAG TEST 9" RULE



36" UPGRADED CABLE TRAY
FIRE TEST THERMOCOUPLE READINGS
THERMOLAG TEST 9" RULE



ISSUE RESOLUTION

ISSUE:

* PROTECTION OF RACEWAY SUPPORTS IN THE PLANT

TU ELECTRIC RESPONSE:

* GENERIC LETTER 86-10 STATES, "Cable tray supports should be protected, regardless of whether there is a sprinkler system. However, they need not be protected, if ... an analysis is performed which takes into account fire loading and automatic suppression available in the area and demonstrates that the unprotected supports will not fail".

* AN ANALYSIS CONSISTENT WITH THE UNIT 1 APPROACH HAS BEEN COMPLETED FOR UNIT 2. THIS ANALYSIS ALSO DEMONSTRATES THAT UNPROTECTED CABLE TRAY SUPPORTS WILL NOT FAIL UNDER FIRE CONDITIONS.

* REPRESENTATIVE FIRE MODELING TECHNIQUES ALSO DEMONSTRATE THAT SUPPRESSION SYSTEMS PROVIDE ADEQUATE COOLING TO RACEWAY SUPPORTS TO PREVENT FAILURE DURING A FIRE.

* FOR AREAS WITHOUT SUPPRESSION SYSTEMS INSTALLED, LOW COMBUSTIBLE LOADING AND ADMINISTRATIVE CONTROLS ENSURE SUPPORTS WILL NOT FAIL UNDER FIRE CONDITIONS.

UNPROTECTED RACEWAY SUPPORTS

ISSUE:

FOR AREAS WITH SPRINKLER PROTECTION, DEMONSTRATE SPRINKLERS WILL ACTUATE AND SUPPRESS THE FIRE BEFORE THE SUPPORTS REACH THEIR YIELD POINT. FOR AREAS WITHOUT SPRINKLER PROTECTION, DEMONSTRATE LOW COMBUSTIBLE LOADING AND ADMINISTRATIVE CONTROLS ENSURE SUPPORT INTEGRITY WILL NOT BE CHALLENGED BY A DESIGN BASIS FIRE.

STEPS:

1. DETERMINE ACTUATION TIME FOR SPRINKLERS UNDER VARIOUS FIRE SCENARIOS.

2. DETERMINE THE TIME FOR SUPPORT YIELD UNDER THE SAME FIRE SCENARIOS.

3. DETERMINE THE COMBUSTIBLE LOADING REQUIRED TO CAUSE SUPPORT YIELD UNDER THE VARIOUS FIRE CONDITIONS.

UNPROTECTED RACEWAY SUPPORTS (CONT.)

4. DETERMINE THE COOLING EFFECT OF SPRINKLER SYSTEM DISCHARGE.

5. REVIEW [illegible]SE ROOMS WITHOUT SPRINKLER PROTECTION FOR AS-BUILT SUPPORT CONFIGURATIONS, COMBUSTIBLE LOADING AND ADMINISTRATIVE CONTROLS.

ASSUMPTIONS:

1. THE YIELD POINT OF THE SUPPORT IS 1200 DEGREES F , BASED ON THE DEAD WEIGHT STRESS ON THE SUPPORTS BEING 20% OF YIELD.

2. THE SPRINKLER RESPONSE TIME IS BASED ON A RESPONSE TIME INDEX (RTI) OF 285 WHICH WAS DETERMINED BY OVEN TESTING OF SPRINKLERS AT CPSES.

3. THE FIRE WILL BE LOCATED IN THE MIDDLE OF FOUR SPRINKLERS, POSITIONED 10 FT. ON CENTERS. THIS IS CONSERVATIVE BASED ON PLANT CONFIGURATIONS.

UNPROTECTED RACEWAY SUPPORTS (CONT.)

4. THE WATER SPRAY IS ASSUMED TO BE 80% EFFECTIVE. THIS IS CONSERVATIVELY BASED ON TESTING OF VARIOUS SPRINKLER ARRANGEMENTS.

5. DISCHARGE FROM OBSTRUCTION LEVEL SPRINKLERS AND CABLE TRAY SPRAY NOZZLES WAS NEGLECTED FOR CONSERVATISM.

RESULTS:

1. **BASED ON THIS VERY CONSERVATIVE APPRCACH, SPRINKLERS WILL ACTUATE AND SUPPRESS THE FIRE, WELL BEFORE THE SUPPORTS REACH THEIR YIELD POINT.**

C-CURVE FIRE: **SPRINKLER ACTUATION: 5 MINUTES**
SUPPORT YIELD WITHOUT SPRINKLERS: 42 MINUTES

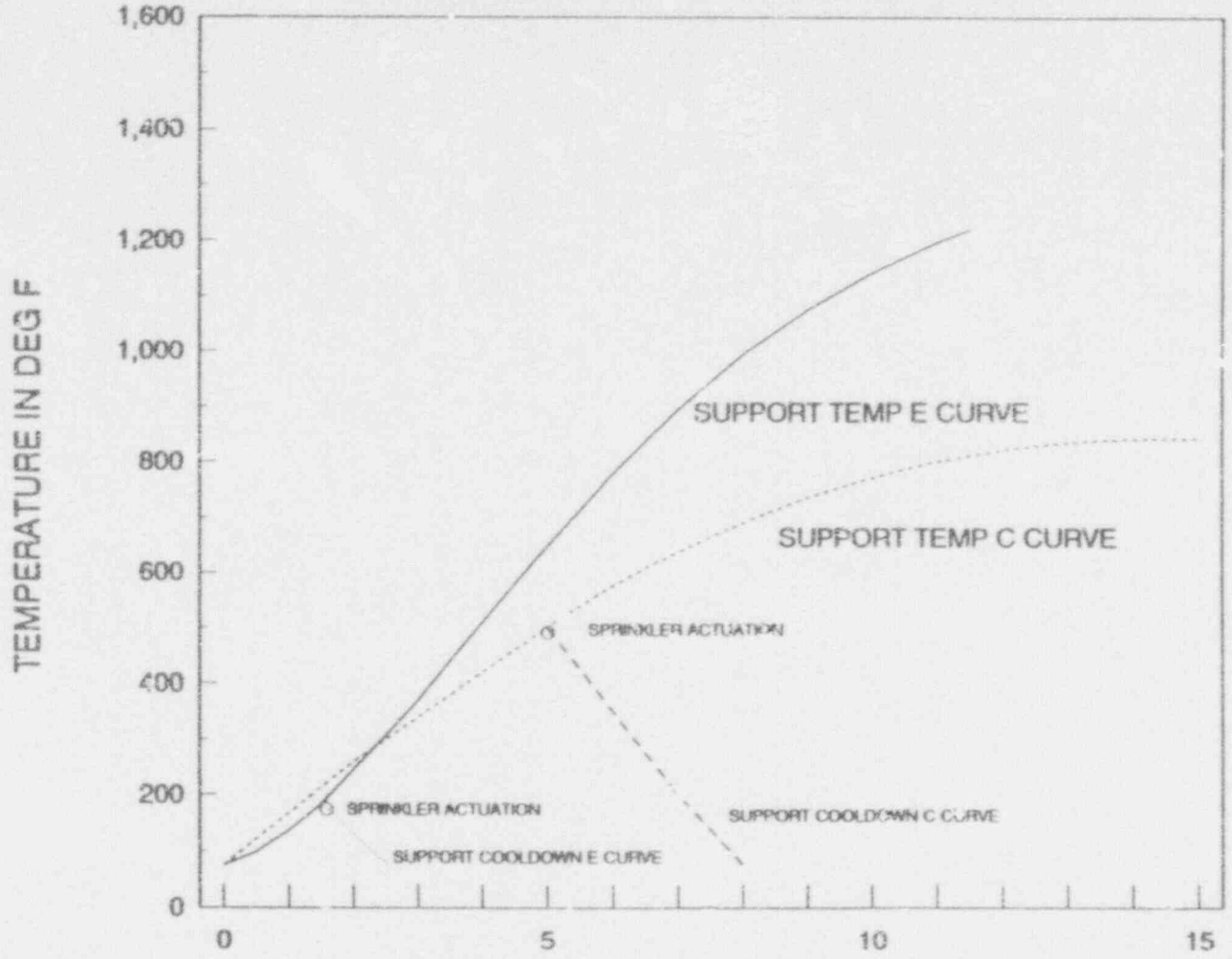
E-CURVE FIRE: **SPRINKLER ACTUATION: 1.5 MINUTES**
SUPPORT YIELD WITHOUT SPRINKLERS: 11 MINUTES

UNPROTECTED RACEWAY SUPPORTS (CONT.)

2. IN ROOMS WITHOUT SPRINKLERS, EXISTING SUPPORT PROTECTION AND ADMINISTRATIVE CONTROLS ENSURE THAT SUPPORTS WILL NOT FAIL DURING A FIRE.

TIME - TEMPERATURE CURVES

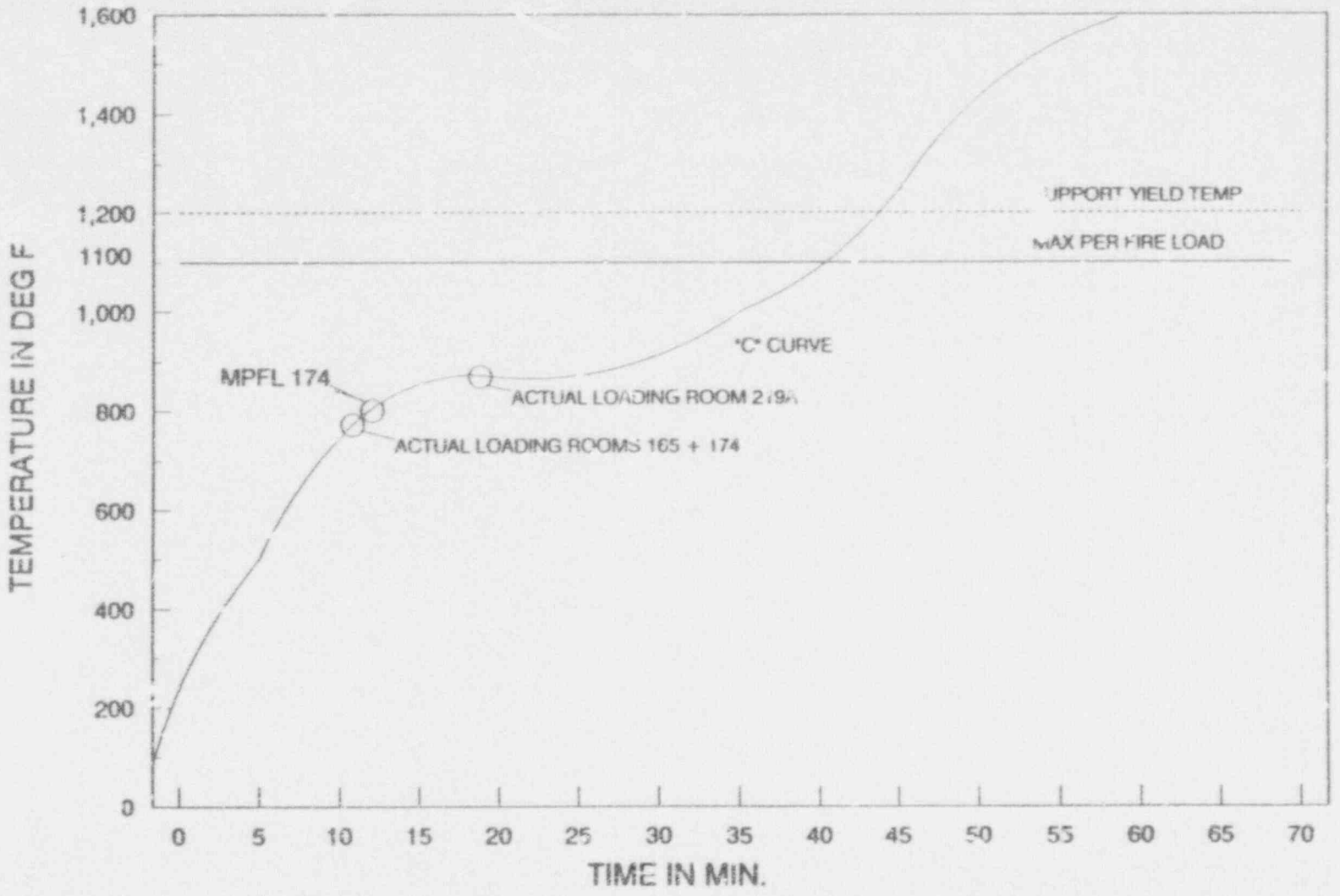
EFFECTS OF SPRINKLER ACTUATION



BASED ON A C6X8.2 CHANNEL
ASSUMED TO BE THERMALLY THIN

TIME - TEMPERATURE CURVES

MAX PERMISSIBLE FIRE LOADING/SUPPORT YIELD POINT
FOR UNSPRINKLERED ROOMS



ISSUE RESOLUTION

ISSUE:

* THERMO-LAG HEAT OF COMBUSTION

TU ELECTRIC RESPONSE:

* CALORIMETER TESTING TO ASTM D-2015 HAS BEEN PERFORMED, TO DETERMINE THE HEAT OF COMBUSTION FOR THERMO-LAG.

* TESTING TO ASTM D-1929 HAS BEEN PERFORMED TO DETERMINE THE FLASH IGNITION TEMPERATURE FOR THERMO-LAG.

* THESE TEST RESULTS WILL BE REVIEWED AGAINST THE FIRE HAZARDS ANALYSIS TO DETERMINE THE IMPACT TO SAFE SHUTDOWN CAPABILITY.

SCHEDULED TESTS

DURING THE WEEK OF AUGUST 17th THREE ADDITIONAL TESTS ARE SCHEDULED AT OMEGA POINT LABORATORIES AS FOLLOWS:

* CONDUIT TEST
  - TEST UPGRADE TECHNIQUES FOR 3/4" CONDUITS (RESULTS WILL ALSO BE APPLICABLE TO 1" CONDUITS)
  - TEST NON-UPGRADED 1-1/2", 2" and 3" CONDUITS

* 24" CABLE TRAY TEST
  - TEST NON-UPGRADED 24" CABLE TRAY ASSEMBLY WITH A "T" SECTION.

* 30" CABLE TRAY TEST
  - TEST NON-UPGRADED 30" CABLE TRAY ASSEMBLY WITHOUT A "T" SECTION.

ANTICIPATED TESTING PROGRAM RESULTS

* PLANT UPGRADES WILL BE REQUIRED FOR 3/4" AND 1" CONDUITS, "T" SECTIONS ON 30"CABLE TRAYS AND ALL HORIZONTAL RUNS (INCLUDING "T" SECTIONS) FOR 36" CABLE TRAYS

* PROPOSED RETROFIT DESIGNS WILL BE QUALIFIED BY TESTS.