November 6, 1992

POLICY ISSUE
(Information)

SECY-92-378

For: The Commissioners

From: James M. Taylor
Executive Director for Operations

Subject: FIRE ENDURANCE TESTING ACCEPTANCE CRITERIA FOR COMANCHE PEAK STEAM ELECTRIC STATION UNIT 2

Purpose: To inform the Commission of the staff's action relating to fire endurance testing acceptance criteria for Thermo-Lag fire barrier systems for Comanche Peak Steam Electric Station Unit 2.

Discussion: In June 1991, the NRC began a comprehensive review of Thermo-Lag 330-1 fire barriers after receiving reports about installation problems and qualification fire tests that failed. The staff found that Thermo-Lag 330-1 fire barriers may not provide the level of fire resistance required.

The staff has developed an Action Plan to resolve technical issues associated with Thermo-Lag 330-1 fire barriers. An important part of the action plan to resolve fire endurance testing and qualification concerns is to work with industry in a public forum to reach a common understanding on fire endurance testing acceptance criteria for fire barrier systems used to separate safe shutdown functions within the same fire area.

Currently, Thermo-Lag 330-1 fire barrier qualification tests are being conducted by TU Electric for its Comanche Peak Steam Electric Station. Tennessee Valley Authority (TVA) is planning fire tests for its Watts Bar Nuclear plant. The Nuclear Management and Resources Council (NUMARC) is also developing an industry-wide fire test program for Thermo-lag 330-1 fire barriers. The staff has been interacting with TU Electric, TVA, and NUMARC in an effort to establish acceptance criteria to be used for the various tests. TU Electric is in the lead with respect to the need to establish criteria. A series of TU Electric qualification tests started on November 3, 1992.

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NOTE: TO BE MADE PUBLICLY AVAILABLE IN 10 WORKING DAYS FROM THE DATE OF THIS PAPER

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The enclosed letter to TU Electric reflects the staff's comments and final agreement on its proposed acceptance criteria. We have agreed to an approach that can be used to acceptably demonstrate cable functionality in the event there are deviations from the fire barrier acceptance criteria. All such deviations will be submitted for NRC review and approval.

The staff will continue to work with industry, including NUMARC and TVA, on proposed fire barrier acceptance criteria. The staff is also developing generic NRC fire barrier acceptance criteria. Consistent with the Commission guidance on issuing generic staff positions (SECY-92-224), the staff will review its proposed staff position with the Committee to Review Generic Requirements (CRGR) and the Advisory Committee for Reactor Safety (ACRS), and will request public comments.

James M. Taylor
Executive Director
for Operations

Enclosure:
Letter from S. Black to
W. Cahill dated October 29, 1992,
"Thermo-Lag Acceptance Methodology
for Comanche Peak Steam Electric
Station - Unit 2"

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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

October 29, 1992

Docket No. 50-446

Mr. William J. Cahill, Jr.
Group Vice President, Nuclear
TU Electric
400 North Olive Street, L.B. 81
Dallas, Texas 7520

Dear Mr. Cahill:

SUBJECT: THERMO-LAG ACCEPTANCE METHODOLOGY FOR COMANCHE PEAK STEAM ELECTRIC STATION - UNIT 2

The NRC staff has completed a review of TU Electric's submittal dated September 24, 1992, "Confirmatory Testing of Thermo-Lag Fire Barrier System at CPSES." A meeting was held on October 27, 1992 between NRC and TU Electric, where you updated your fire barrier testing acceptance criteria. The enclosure to this letter provides the revised acceptance criteria you proposed at that meeting.

This letter informs you of the results of the staff review of your criteria. Final NRC staff review of your fire barrier acceptance testing will be documented in a future safety evaluation.

Your acceptance criteria, including the use of a fog hose stream test in accordance with NUREG-0800, is acceptable based on the following conditions:

1. The NRC maintains that the temperature measured on the external surface of the raceway should not exceed 325°F. Your criteria, submitted in your September 24, 1992 letter, states that cable temperatures are to be maintained below 325°F[1] as measured by thermocouples installed at six-inch intervals on cables close to the inside of the protective envelope.

   In your previous tests, the raceway, in addition to the cables, was instrumented with thermocouples. These thermocouples provide a better indication of barrier unexposed side thermal performance during the fire test. You have stated that you will be monitoring various raceway locations in these upcoming tests; however, in reviewing your criteria as submitted in your September 24, 1992 letter, we could not determine how you propose to evaluate the barrier's thermal performance using the raceway thermocouples.

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[1] The 325°F temperature condition was established by allowing the internal temperature on the raceway surface to rise 250°F above ambient laboratory air temperature, assumed to be 75°F, during the fire test.

In the October 27, 1992 meeting, we discussed this concern and your staff indicated that the cable tray side rail and the external conduit temperatures would be used to determine the temperature acceptance of the fire barrier system. In addition, your staff agreed, for cable trays, to also use the cable thermocouple temperature readings to supplement the raceway thermocouples in assessing the thermal performance of the fire barrier system.

With respect to determining the temperature acceptance criteria, the NRC staff considers thermocouple averaging acceptable, provided similar series of thermocouples (e.g., cable tray side rail) are averaged together. It was determined that the temperature performance of the cable tray fire barrier would be based on temperature averages (i.e., the thermocouples on each side rail, and the thermocouples on each of the three instrumented cables) and would be independently evaluated against the temperature acceptance criteria. In addition, it was agreed that averaging the thermocouples on the external conduit surface would be used to evaluate the thermal performance of the conduit fire barrier system. It is our understanding that your temperature acceptance criteria would find the test results in deviation if the average temperature of any thermocouple series exceeds the 250°F plus ambient condition or if any single thermocouple exceeds 30 percent above the maximum allowable temperature rise (i.e., 250°F + 75°F = 325°F, above ambient) during the test. If this occurs, under your criteria a visual inspection of the cables for signs of thermal damage is required. Any sign of thermal cable damage would be a deviation to the fire barrier requirements which would require the functionality of the cabling to be demonstrated by testing.

2. Your barrier inspection criteria, submitted in your September 24, 1992 letter, allows burnthrough no greater than one-half square inch. In the October 27, 1992 meeting, your staff revised its position on burnthrough. In this meeting your staff indicated that any burnthrough is now a deviation requiring cable functionality testing. If burnthrough occurs, based upon visual examination and notwithstanding the size of the defect, the NRC views the fire barrier as deviating from the fire barrier requirements and would require that cable functionality be demonstrated.

3. Your visual cable acceptance criteria, submitted in your September 24, 1992 letter, stated that none of the following attributes should be identified: jacket swelling, splitting, or discoloration; shield exposed; or jacket hardening. The NRC staff has determined that the following attributes also indicate thermal degradation: jacket blistering, cracking or melting; conductor insulation exposed, degraded, or discolored; and bare copper conductor exposed. It is our understanding that your criteria for visual cable acceptance will include all of the above attributes.

4. Your acceptance methodology calls for a megger test after the cable has been installed in the raceway, continuity measurements during the test, and a subsequent megger test immediately following the test. At the October 27, 1992 meeting, you provided additional details and clarification regarding your proposed testing to demonstrate cable functionality. Additionally, you stated that you may use loss-of-coolant-accident (LOCA) cable qualification test results in evaluating cable functionality at elevated temperatures.

   At the October 27, 1992 meeting, the NRC staff described the following tests which can be used to demonstrate functional performance of cables where there are signs of thermal damage to cables or where barrier burnthrough or openings occur:

   > The megger tests (pre-fire, during the fire [if performed], and immediately after the fire test conditions) should be done conductor-to-conductor for multiconductor and conductor-to-ground for all cables. The minimum acceptable insulation resistance (IR) value, using the test voltage values for various system voltages is determined by using the following expression:
   >
   > $$IR\ (\text{Mega-ohms}) \geq \frac{[[(1\ \text{Mega-ohm per KV}) + 1] * 1000(\text{ft})]}{\text{Length (ft)}}$$
   >
   > In addition, an AC or DC high potential (Hi-Pot) test for power cables greater th[illegible]00 volts should be performed after the post fire meg[illegible]sts to assess the dielectric strength. This test pr[illegible] assurance that the cable will withstand the applied voltage during and after a fire. The high potential test should be performed for a five minute duration at 60 percent of either 80 volts/mil AC or 240 volts/mil DC (e.g., 125 mil conductor insulation thickness X 240 volts DC X 60% = 18,000 vdc).
   >
   > The table below summarizes the megger and Hi-Pot test voltages which, when applied to power, control and instrumentation cables, would constitute an acceptable cable functionality test.

TYPE	OPERATING VOLTAGES	MEGGER TEST VOLTAGE	HIGH POTENTIAL TEST VOLTAGE
POWER	≥ 1000 volts	2500 VDC	60% x [illegible] V/mil(AC) 60% x 240 V/mil(DC)
	< 1000 volts	1500 VDC	NONE
INSTRUMENT AND CONTROL	≤ 250 vdc	500 VDC	NONE
	≤ 120 vac		

In addition, at time intervals (at least once) during your one-hour fire exposure test, a megger test should be performed for instrumentation cables in order to assure that the cable will maintain sufficient insulation resistance levels necessary for proper operation of instruments. LOCA temperature profiles may be used to evaluate cable functionality instead of megger testing during the fire test. If this approach is taken, you should ensure that the LOCA temperatures bound the fire temperature profile, by including cable operating temperatures. Additionally, in determining the insulation resistance levels required for nuclear instrumentation cables, an assessment of the minimum insulation resistance value (e.g., one mega-ohm) and its potential impact on the functionality of these cables should be evaluated.

The NRC concludes that performance of your proposed testing, with the additional megger and Hi-Pot testing described above, would constitute an acceptable set of tests to demonstrate that any fire barrier test deviations, should they occur, will not affect the capability of the protected cable to perform its safety function. Other tests or combination of tests for cable functionality, different from those described above, would require NRC review and approval.

5. Discussions with your staff indicate that CPSES power and instrument cable meets IEEE-383 and is all thermoset insulation type. Additionally, you have stated that installation procedures prohibit cabling to extend above cable tray side rails. When you submit your next test summary, confirm these facts in writing.

In summary, your criteria, as supplemented with the above conditions, ensures that adequate cable and barrier tests will be performed. Satisfactory results from these tests (raceway/cable temperature <325°F and no barrier burnthrough) constitutes a satisfactory basis for rated fire barrier qualification. Where the temperature criteria is not met and cable inspection criteria results in deviation(s), and/or barrier inspection results in deviation(s), your criteria calls for subsequent cable functionality testing. Also, as discussed at the October 27, 1992 meeting, since no cabling greater than 1000 volts is being subjected to the fire tests, additional testing would be required on this voltage class to demonstrate functionality should test deviations warrant cable functionality verifications. NRC review of your test deviation(s), should they occur, will be included in the staff's safety evaluation of your fire barrier acceptance testing.

The NRC staff plans on observing your upcoming testing. Further, we request that you meet with the NRC following completion of this next set of testing to review test results.

Sincerely,

Original Signed By
Suzanne C. Black, Director
Project Directorate IV-2
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure:
TU Revised Acceptance Criteria

cc w/enclosure:
See next page

*See previous concurrence

OFFICE	PDIV-2/LA	PDIV-2/PM	SPLB	SPLD*	DIR/DSSA*	NRR:AD
NAME	EPeyton	BHolian:nb BEH	PMadden	CMcCracken	ATabbani	W. Russell
DATE	10/28/92	10/28/92	10/28/92	10/29/92	10/29/92	10/29/92

OFFICE	DET/D*	PDIV-2/D	ADR4/5	DRPW:D	ADP
NAME	JRichardson	SBlack	MVirgilio	JRoe	JPartlow
DATE	10/28/92	10/29/92	10/29/92	10/30/92	10/30/92

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Test Sequence

Build Sample
Megger

Fire Test
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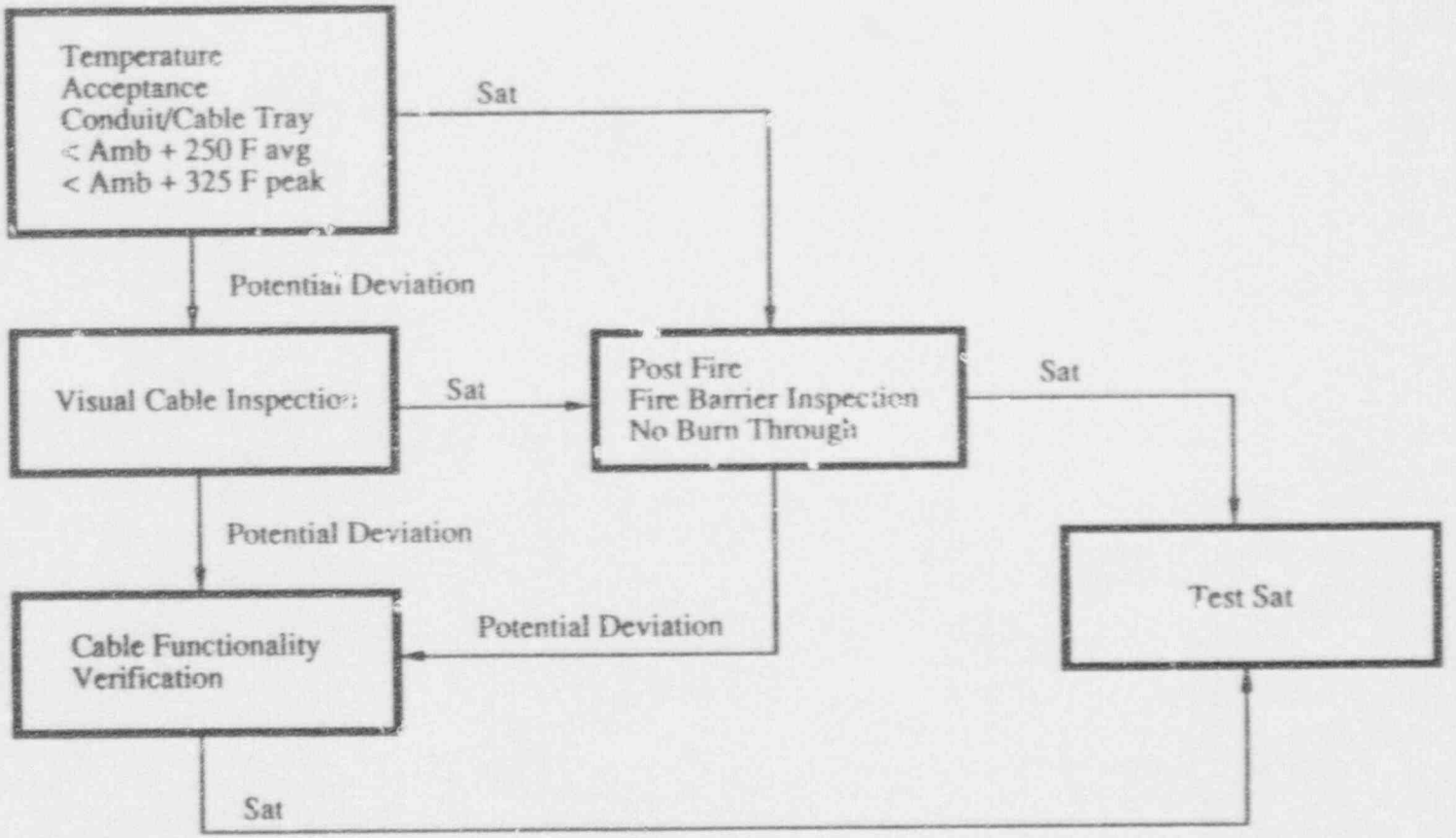
Temperature

Fog Nozzel Test
Hot Megger
Fire Barrier Inspection
Functionality Tests *
Visual Cable Inspection *

* If Required



CABLE FUNCTIONALITY TESTING

TEST SEQUENCE	TU ELECTRIC PROPOSAL	JUSTIFICATION
DURING FIRE TEST	CONTINUITY TEST AT 12VDC	- UL 1724 RECOMMENDS THAT LOW VOLTAGE SHOULD BE USED ON CIRCUIT DURING FIRE TESTING - LABORATORY PERSONNEL SAFETY REQUIREMENTS - LOGISTICS OF MEGGERING ALL CONDUCTORS DURING THE ONE HOUR FIRE TEST RESTRICTS INTERMITTENT TESTING - FUNCTIONALITY OF CABLE AT ELEVATED TEMPERATURE MAY BE CONFIRMED BY LOCA TEST RESULTS PROVIDED CABLE JACKET TEMPERATURES DID NOT EXCEED LOCA QUALIFICATION TEMPERATURES
AFTER HOST STREAM TEST	HOT MEGGER TEST - INSTRUMENTATION CABLE 500VDC - CONTROL/LOW VOLTAGE CABLE AT 1500VDC	- ACCEPTANCE CRITERIA BASED ON MOST LIMITING INSTALLATION (5 M) ACCEPTANCE CRITERIA FOR CONTROL/LOW VOLTAGE CABLE BASED ON DC EQUIVALENT TEST VOLTAGES OF RATED AC VOLTAGE (1500VDC)