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TU ELECTRIC

November 18, 1994

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
RESPONSE TO ADDITIONAL INFORMATION WITH RESPECT TO
TU ELECTRIC AMPACITY TESTS (TAC NOS. M85536 AND M85999)

REF: 1) NRC letter from Mr. Thomas A. Bergman to TU Electric dated October 20, 1994

2) TU Electric letter logged TXX-94085 from Mr. William J. Cahill Jr., to NRC dated March 25, 1994

3) TU Electric letter logged TXX-94173 from Mr. William J. Cahill Jr., to NRC dated August 8, 1994

Gentlemen:

In the meeting summary for the August 30, 1994, meeting between the NRC staff and TU Electric (reference 1), the NRC noted that TU Electric agreed to provide additional information related to three questions from the staff's request for additional information (RAI) of March 25, 1994 (Reference 2). The requests and TU Electric's responses are provided below.

Request 1:

"Regarding RAI question 2, the licensee is to explicitly state which tests used the Sil-Temp blanket, and verify that the Sil-Temp blanket was not utilized in the baseline ampacity tests."

Response 1: The Sil-Temp blanket was used in the Thermo-Lag clad configuration because it represented the installed conditions. In a cable tray with a cable mass that approaches the top of the tray, a Sil-Temp blanket is sometimes placed in the tray to protect the cables. In the baseline ampacity tests, Sil-Temp blankets were not utilized.

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Request 2:

"For RAI question 7, the licensee is to provide a list of non-standard Thermo-Lag electrical configurations where ampacity is a concern (i.e., power cables) and develop analyses to show that test program results will conservatively bound those configurations. The licensee will discuss their bounding methodology with the staff prior to performing the analyses."

Response 2: TU Electric has identified 124 non-standard Thermo-Lag electrical configurations on CPSES Unit 1 where ampacity is potentially a concern. These configurations are associated with the Thermo-Lag modifications made on raceway with power cables and are classified as follows:

Modifications at raceway transition points	- 41
Modifications to the application of the stress skin	- 26
Upgrade to conduit installations	- 24
Modifications to Flex-blanket installation	- 19
Raceways under common enclosures	- 14

All 124 non-standard configurations were evaluated on a case-by-case basis. The reviews determined that the modifications would not adversely effect the envelopes ability to dissipate heat.

On September 28, 1994, the five categories of modifications were discussed during a telephone conversation with the NRC staff and Sandia personnel and two were identified as of primary concern: upgrades to conduit installations and raceways under common enclosures. The upgrades to conduit installations were necessary to address installation difficulties associated with flexible conduit bends where preformed sections would not fit. The lengths associated with these modifications were short lengths (less than 3 feet). The raceways under common enclosures are primarily multiple trays. There are instances where conduits are under a common enclosure, this occurs at conduit fittings and the common enclosure lengths are less than 3 feet.

TU Electric established two worst case configurations. The first was previously identified to the staff in Attachment 1 of reference 3. This configuration is acceptable based on the following conditions:

1) Only 5% of tray surface area is affected due to interface with the conduit.
2) The cables contained within the tray are derated to 40% (design requires 32%).
3) The 90% of surface of the conduit where Thermo-Lag is applied remains exposed to the ambient environment.
4) The cables contained within the conduit could tolerate a derating of 30% while the required derating is only 11%.

The other worst case involves two cable trays within a common enclosure. This

configuration has been evaluated generically. This evaluation conservatively assumed that the bottom panel of the double tray enclosure is an adiabatic surface, with no heat loss due to convection or radiation. Even with these conservative assumptions, the relatively large surface area of the vertical panels in the double tray enclosure results in an increased ability of the enclosure to dissipate heat as compared to configurations where cable trays are separate enclosures. These matters were discussed with the NRC staff during a telephone conference on September 28, 1994.

Request 3:

"With regard to RAI question 10, TU Electric will provide an estimate of error contribution due to inductive current heating effects on the ampacity derating test results of the 3/4" and 2" conduit configuration."

Response 3: TU Electric conducted a series of ampacity tests on Thermo-Lag enclosed conduit and tray. The testing was done following Draft 11, of IEEE standard P848, IEEE Standard Procedure for the Determination of the Ampacity Derating of Fire Protected Cables. The testing performed by TU Electric identified the need for avoidance of a single phasing condition inside a steel conduit.

The conduit tests used three sizes of conduits as listed below:

3/4 inch conduit with one 3/c 10 AWG copper cable and enclosed in 1/2 inch of Thermo-Lag with a 1/4 inch upgrade.

Baseline ampacity	= 39.6 A
Clad Ampacity	= 35.9 A
Derate factor	= 9.4 %

2 inch conduit with one 3/c 6 AWG copper cable and enclose in 1/2 inch of Thermo-Lag with a 1/4 inch upgrade.

Baseline ampacity	= 64.5 A
Clad Ampacity	= 60.2 A
Derate factor	= 6.6 %

5 inch conduit with four 1/c 750 kcmil copper cables and enclosed in 1/2 inch of Thermo-Lag.

Baseline ampacity	= 571 A
Clad Ampacity	= 510 A
Derate factor	= 10.7 %

5 inch conduit with three 1/c 750 kcmil copper cables and enclose in 1/2 inch of Thermo-Lag.

Baseline ampacity	= 359.6 A
Clad Ampacity	= 266.7 A
Derate factor	= 25.8 %

Single phasing occurs when an odd number of conductors are installed in a steel conduit, and the cable is energized from a single phase source. An unbalanced magnetic field is induced which results in hysteresis losses in the conduit steel. These hysteresis losses generate heat which tend to increase the temperature of the test specimen and thereby reduce ampacity. Hysteresis losses vary with the strength of the magnetic field (magnitude of the current), and the type of steel used in the conduit. During the ampacity testing, single phasing became most noticeable during the final series of tests, the testing of the 5-inch conduit with the 750 kcmil conductors.

The testing setup was amended to use an even number of conductors in the 5-inch conduit, eliminating the single phasing problem.

The test results for the smaller conduits and wire sizes are valid because:

a) the magnitude of the hysteresis losses are not large and
b) the error introduced by the single phasing effect are conservative.

To evaluate the impact of single phasing on the 3/4 and 2 inch conduit tests, the ampacity of the 3/4 and 2 inch conduit were calculated and compared to the measured ampacities with the following results:

a) 3/4 inch conduit with one 3/C 10 AWG copper cable

Measured Baseline = 39.6A
Calculated Baseline = 38.8A

The calculated baseline and the measured baseline ampacity for the 3/4-inch conduit with a 3/C 10 AWG cable are essentially in agreement. Therefore, there are no significant hysteresis losses due to single phasing in the smaller conductor (and lower current condition). The test results for the 3/4-inch conduit were not influenced by the current imbalance.

b) 2 inch conduit with one 3/C 6 AWG copper cable

Measure Baseline = 64.6A
Calculated Baseline = 74A

The ampacity of the raceway is reduced by about 9A due to single phasing which equates to hysteresis losses which are about 20% of the total heat generated during the test including conduit and conductor losses.

This evaluation confirms that the heat generated in the conduit increases with the magnitude of the current imbalance. Reviewing the ampacity correction factor for the 5-inch conduit, with four and three conductors, we noted that

the ampacity correction factor improves when the current imbalance is corrected. Therefore, though some conduit loss occurred during the ampacity testing of the 2-inch conduit, the resulting errors are conservative.

Should you have any questions or need additional information, please contact Obaid Bhatty at extension (817) 897-5839.

Sincerely,

C. L. Terry

OB:tg

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Resident Inspectors