UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GPU NUCLEAR, INC.

AMPACITY DERATING ISSUES

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

1.0 BACKGROUND

By letter dated June 24, 1997, as supplemented by letter dated July 31, 1997, GPU Nuclear, Inc., submitted a response to the second NRC Request for Additional Information (RAI) related to Generic Letter (GL) 92-08, "Thermo-Lag 330-1 Fire Barriers," for Three Mile Island, Unit 1 (TMI-1) dated May 8, 1997.

The original licensee methodology which was the subject of the RAI utilized the Insulated Power Conductor Engineers Association (IPCEA) Standard P-46-426 rather than ICEA Standard P-54-440 and assumed all cable ampacity limits based upon a cladded cable tray configuration regardless of the actual installation. Given these two critical starting assumptions, the licensee ampacity assessment proceeds as follows:

- The initial baseline ampacity of a given cable is taken from manufacturer recommended ampacity limits for cables installed in open air. These values appear to correspond closely to the IPCEA P-46-426 ampacity tables, again, assuming operation in open air.

- This value of the open air ampacity is then adjusted for the assumed ambient temperature. A value of either 35°C (95°F) or 40°C (104°F) has been assumed for all cables with one exception that involves a winter heating load, and for winter conditions assumption of a lower ambient appears appropriate.

- The corrected open air baseline ampacity is then further adjusted to account for the placement of the cable within a cable tray. This is based on the application of an Ampacity Correction Factor (ACF) value taken from Table VIII of the IPCEA P-42-426 standard. This ACF is based on the total number of conductors in the tray. The result is an estimate of the cable tray installation baseline ampacity.

  The cable tray baseline ampacity is then adjusted for the presence of the fire barrier system. All assessments have assumed a fire barrier Ampacity Derating Factor (ADF) of 32% (ACF of 0.68). The result is an estimate of the derated ampacity limit for a given cable in a given cable tray including the fire barrier impact.

- Finally the derated ampacity limits are compared to actual in plant cable loads for an initial assessment of acceptability. This assessment has included consideration of potential undervoltage conditions of operation.

ENCLOSURE

- For three cables nominally identified as overloaded, the licensee assessment uses an alternate National Electrical Code approach which allows for slightly higher ampacity limits.

The subject staff RAI had identified a number of open issues and concerns requiring clarification by the licensee. The licensee's submittal dated June 24, 1997, contained the response to staff questions regarding its ampacity derating methodology and the licensee's submittal dated July 31, 1997, updated the subject ampacity calculations. The staff evaluation of the ampacity derating methodology for TMI-1 follows.

2.0 EVALUATION

After reviewing the licensee's submittals and SNL Technical Letter Report (see Attachment), the staff agrees with the SNL analyses and conclusions. The ampacity derating analysis questions, the licensee's responses, and the staff's evaluations of the responses follow.

Ampacity Derating Analysis Review

- Question 1

  Sandia National Laboratories (SNL) made the following finding after a review of the licensee's cable ampacity assessment method which is based on the random fill tray correction factors from IPCEA P-46-426:

  > The methodology applied by the licensee was taken from IPCEA P-46-426, which in turn cites IPCEA publication P-33-440 as the basis for the cited ampacity correction factors for random fill trays. ICEA P-54-440 specifically states that the P-33-440 (a.k.a., P-46-426) methodology for random fill trays is superseded by the P-54-440 approach. Hence, SNL finds that the licensee has applied an outdated and inappropriate methodology to the analysis of its cable tray ampacity limits. While licensee approach may actually be conservative for some of the cases examined, SNL also demonstrated that the approach can lead to nonconservative results as well. SNL finds that the P-54-440 methodology is applicable to the licensee cases and should be included in the evaluation.

  Given the above finding the licensee is requested to provide an assessment of the applicable ampacity limits using the ICEA P-54-440 methodology for any cable in a cable tray with three or more cables and for those cables with an available ampacity margin (i.e., after the application of derating factors) of 30% or less including the following seven circuits recommended by SNL: LS6, ME1, ME2, MB11 (winter configuration only), MC12 (winter configuration only), CH61 and LS5.

  Licensee Response

  In its submittal dated June 24, 1997, the licensee stated that the subject calculation will be revised to include an assessment of ampacity limits using ICEA P-54-440 methodology. The licensee's submittal dated July 31, 1997, provided the revised ampacity calculations for staff review.

Staff Response

The information provided by the licensee fully resolves the staff's concerns.

- Question 2

It should be noted that the licensee's response to the staff question regarding an assessment of overloaded cables as detailed in the Request for Information dated July 5, 1996, may require reevaluation given satisfactory resolution for the concerns stated in Item 1 above. In addition, the licensee is requested to conservatively estimate the remaining cable life for any cables which may have operated under overloaded conditions.

Licensee Response

In its submittal dated June 24, 1997, the licensee stated that the preliminary analysis using the P-54-440 methodology indicates that one cable, LS6, is nominally overloaded. An operating life assessment for this cable was performed that indicated a life expectancy extending at least to January 30, 1999; however, it could not guarantee operation until end of plant life (i.e., September 1, 2014.) Through a surveillance procedure (OPS-S94), the licensee will monitor the actual hours energized for the circuit associated with subject cable until the elapsed time indicates that the end of life condition has been reached for cable LS6. The licensee calculation also notes that "Remedial follow-up actions are required to assure cable LS6 life."

This statement implies that the licensee will take corrective actions as necessary prior to the end of life condition for cable LS6.

Staff Response

The information provided by the licensee fully resolves the staff's concerns.

- Question 3

Given that SNL noted apparent depth of fill and conductor discrepancies in the review of the Tray 531/533 case, the licensee is requested to document the applicable calculations in sufficient detail that both the depth of fill and ampacity limit calculations can be verified by SNL. (See Section 2.2.3 of the SNL Letter Report dated April 10, 1998, Attachment 1(a))

Licensee Response

In its submittal dated June 24, 1997, the licensee noted that there was a discrepancy between the cable diameters cited in two different supporting documents. This discrepancy was cited as the basis for the apparent error noted by SNL. Field measurements were made to verify which set of values was correct, and the updated calculations have been performed using these correct diameters.

Staff Response

The information provided by the licensee fully resolves the staff's concerns.

Application of Ampacity Derating Methodology

The staff finds that the licensee has adequately resolved all of the previously identified RAI items. Specifically, the licensee has reanalyzed all of its fire barrier cladded power cables in cable tray applications using the accepted methods of ICEA P-54-440. The fire barrier tray derating factor of 32% determined by tests under the sponsorship of Texas Utilities is based on the ampacity of cables tightly packed in a tray with no air flow up through the tray. The tightly packed tray is considered to the be worst case configuration and bounds the configuration where cables are installed in trays without maintained spacing. The tightly packed tray is the configuration assumed by ICEA P-54-440 and is therefore consistent with the testing which determined the derating factor.

Except for Cable LS6, all cables were found to be operating within acceptable ampacity limits. A monitoring procedure for the nominally overloaded Cable LS6 has been put in place to ensure that remedial actions can be taken before the cable exceeds its life expectancy.

Given the revised methodology and the licensee commitment to monitor for age-related degradation for cable LS6, the staff finds that the licensee has provided adequate information to resolve the ampacity-related points of concern raised in GL 92-08.

3.0 CONCLUSION

From the above evaluation, the staff concludes that although the original licensee thermal model was not acceptable for ampacity derating assessments the revised model identified in its submittal dated June 24, 1997, was appropriate for the analysis of installed electrical raceway ampacity limits. In its submittal dated July 31, 1997, the licensee stated that additional corrective actions will be taken to evaluate and monitor as necessary operating conditions for cable LS6. Therefore, given the licensee's commitment to address age-related cable degradation there are no outstanding safety concerns with respect to ampacity.

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