

March 27, 1998

Mr. Nathan L. Haskell
Director, Licensing
Palisades Plant
27780 Blue Star Memorial Highway
Covert, MI 49043

SUBJECT: PALISADES PLANT - REQUEST FOR ADDITIONAL INFORMATION
REGARDING CONSUMERS ENERGY COMPANY'S CABLE AMPACITY
ADJUSTMENT METHODOLOGY (TAC NO. M98067)

Dear Mr. Haskell:

The staff requires additional information in order to complete our review of Consumers Energy Company's cable ampacity adjustment methodology. This methodology was the subject of a previous staff request for additional information (RAI) dated May 27, 1997. Your response to the staff's RAI was submitted by letter dated July 10, 1997. Please provide a response to the enclosed questions within 90 days of the date of this letter. If you have any questions regarding this request, please contact me at 415-1312.

Sincerely,

ORIGINAL SIGNED BY

Robert G. Schaaf, Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure: RAI

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Consumers Energy Company

Palisades Plant

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July 1997

Distribution for Letter to Consumers Energy Co., Palisades Plant, dated: March 27, 1998

Docket File (50-255)

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING CABLE AMPACITY ISSUES

PALISADES PLANT

DOCKET NO. 50-255

1.0 BACKGROUND

The licensee analyzed and documented a sample of overfilled cable tray sections that could potentially exceed the IPCEA/ICEA method and made adjustments based on field conditions using the Harshe-Black method. The Harshe-Black ampacity methodology as described in the Institute of Electrical and Electronic Engineers (IEEE) paper entitled "Ampacity of Cables in Single Open-Top Cable Trays," by B. L. Harshe and W. Z. Black is a mathematical thermal model that can predict the operating temperatures for cables when there is load diversity (i.e., cable trays do not have all cables loaded simultaneously to their maximum allowable levels) in a single, horizontal open-top cable tray.

By letter dated July 10, 1997, Consumers Energy submitted a response to the NRC Request for Additional Information dated May 27, 1997, for Palisades Plant (Palisades). The staff, in conjunction with its contractor, Sandia National Laboratories (SNL), has completed the preliminary review of the licensee's submittal. The staff requests that the following questions be addressed by the licensee.

2.0 QUESTIONS

2.1 Potential Nonconservatisms Associated with Harshe-Black Model

- (a) If one is analyzing a relatively wide tray with a very small number of power cables, the localized heating effects of the power cables may be inappropriately "diluted." Consider, for example, a case involving a single powered cable in a larger mass of cables. Using the as-published Harshe-Black approach, the single cable would be modeled as a very thin layer stretching across the full width of the tray. This would be a very unrealistic model for this situation and overemphasizes the importance of tray width. In such a case those portions of the tray remote from the powered cable (more than a few cable diameters away) will have little real effect on the behavior of the cable of interest. The as-published Harshe-Black model would overcredit the heat dissipating effects of the surrounding cables and could very easily result in overly optimistic ampacity estimates.
- (b) There is a potential that the Harshe-Black model might overestimate cable ampacity limits under certain conditions. In particular, if several powered cables happen to be clustered in close proximity to each other, then the localized heating effects may be more pronounced than will be estimated by Harshe-Black. We found the original arguments regarding this aspect of the model put forth by Harshe-Black to be unconvincing.

The licensee is requested to reconsider its unqualified endorsement of the Harshe-Black ampacity methodology or alternatively to provide additional technical justification in light of the specific findings and the thermal modeling concerns noted above.

Enclosure

2.2 Modified Palisades Ampacity Methodology

We found that the Palisades modified Harshe-Black method does have a nominal ability to provide realistic and reasonable estimates of cable ampacity limits or cable operating temperatures under a range of diverse load conditions. However, validation studies performed by SNL also identified certain conditions under which unreasonable results might be obtained through the subject method. These undesirable results relate to cases where there are a number of very large cables grouped together. Given these concerns, the staff finds that the application of the modified Palisades ampacity determination methodology should be subject to the following constraints:

- (a) The Palisades modified diversity method should not be applied to any tray that includes two or more cables that (1) are powered to at least 80% of the nominal ICEA cable tray ampacity limit, and (2) whose diameter exceeds the tray fill depth when calculated using the ICEA definitions of depth of fill. For this case, as noted by Stolpe, a potential for a severe localized hot spot exists that would make it unwise to credit diversity in the ampacity assessment.
- (b) A lower bound should be established on the thickness of the combined hot and warm zones in the diversity thermal model. This will (1) prevent excessive "thinning" of the more heavily loaded cables, (2) more accurately reflect the presence of larger diameter cables in the hot group, and (3) ensure a conservative treatment of potential clustering effects. The combined thickness of the hot and warm zones should equal or exceed 80% of the diameter of the largest cable in these two groups. If the condition is not met by the nominal model formulation, then the width of the analyzed section may be adjusted (reduced) so as to increase the hot/warm zone thickness until the restriction is met provided that the overall heat load for each cable group is maintained at its correct value.

The licensee is requested to consider these two restrictions for the Palisades modified Harshe-Black methodology in terms of their acceptability and to verify whether the existing analyses performed for the applicable raceways requiring adjustment according to Palisades FSAR Section 8.5.2 are bounded for the two application restrictions. Alternatively, the licensee is requested to provide comprehensive validation data sufficient to address the technical shortcomings of the modified Harshe-Black methodology as cited by the SNL findings.

2.3 Licensee Example Calculation

Although SNL observed that there are no specific errors in the implementation of the Palisades modified ampacity example calculation, the following points require additional clarification:

- (a) It is unclear what the basis is for the assessment of the assumed plant ampacity loads. Please explain the basis upon which the cable load ampacity values were obtained, and confirm that this practice has bounded the most conservative possible configuration for each tray analyzed, including consideration of all possible modes of plant operation.
- (b) The example case provided by the licensee assumes an emissivity of the top surface of the cable mass of 0.95. This value is not consistent with either typical practice, nor the

measured Palisades emissivity values cited in the Harshe-Black paper. The licensee is requested to explain the basis and justification for the assumed emissivity value.

- (c) The licensee model cites the emissivity of the lower surface of the cable tray as 0.65. Regarding this assumption please explain and justify the chosen value of 0.65 for the bottom surface of the cable mass. Are any of the cable trays under analysis solid-bottom type trays? If yes, (1) are the cables installed in direct and continuous contact with this bottom surface, or are they laid on internal rungs within the tray; and (2) is the bottom surface ventilated? If the cables are not in intimate contact with the bottom plate, and the bottom plate is not ventilated, then how has the model been adjusted to account for the additional air gap between the bottom of the cables and the tray bottom? Note that the Harshe-Black thermal model does not inherently allow for any such gap, but rather, inherently assumes either direct cable-to-bottom plate contact or installation in an open ladder-type tray.