

January 4, 2000

Mr. William. R. McCollum, Jr., Vice President  
Oconee Site  
Duke Energy Corporation  
P. O. Box 1439  
Seneca, SC 29679

SUBJECT: OPEN ISSUE RELATED TO AGING EFFECTS OF INSULATED CABLES FOR  
THE OCONEE NUCLEAR STATION, UNIT NOS. 1, 2, AND 3 LICENSE  
RENEWAL APPLICATION

Dear Mr. McCollum:

As a result of the license renewal inspections at Oconee the staff identified an issue involving the aging management program for insulated cables and connections in a letter to Duke dated October 5, 1999. The staff designated the issue as safety evaluation report (SER) open item 3.9.3-1 for tracking purposes. The purpose of the following discussion is to detail the issue that remains regarding this open item.

#### Background

Duke provided a proposed response to the staff's letter on November 5, 1999, and the staff and Duke had a phone call on November 10, 1999, to discuss the issue. The phone call and Duke's proposed response are discussed in a summary dated November 18, 1999. In addition, the staff sent Duke a letter dated November 18, 1999, that provided the status of the Oconee SER open and confirmatory items. In the November 18, 1999, open item letter the staff details its concerns with Duke's proposed response.

In response to the staff's comments on the initial proposed aging management program, Duke provided a revised program description on December 8, 1999. Additional discussion with the staff took place on December 9, 1999. The December 8, 1999, proposed response and results of the December 9, 1999, meeting are discussed in a summary dated December 14, 1999. The December 9, 1999, meeting culminated in a revised response to the SER open item. Duke provided the revised response in a letter dated December 17, 1999.

The December 17, 1999, letter provides responses to 4 areas. Based on the December 17, 1999, response the staff considers 3 of the 4 areas resolved. Specifically, the staff considers the issues involving the scope of the cable inspection program, acceptance criteria for visual inspection, and periodic service monitoring of service environments resolved. These are comments 1, 2, and 4 in Duke's response to SER open item 3.9.3-1. However, the staff considers Duke's response to comment 3 open. Comment 3 of SER open item 3.9.3-1 involves electrical measurements of inaccessible medium voltage cables exposed to moisture to detect aging.

Open Issue

In Duke's December 17, 1999, response to comment 3 the applicant states that "Electrical measurements were not included in the aging management program because Duke is not aware of any in-situ, non-destructive, electrical methods currently available to detect aging degradation of inaccessible or direct buried cables." As discussed below, the staff is aware of several situations of in-situ testing and believes that some form of testing should be done on the inaccessible or direct buried non-environmentally qualified medium-voltage cables to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation.

The staff believes that electrical transmission and distribution experience has shown aging degradation associated with inaccessible or direct buried cables.

In addition to the electrical transmission and distribution experience there was a recent failure of a 5-kV cable in underground conduit at Davis-Besse. The headquarters morning report for December 3, 1999, (MR number H-99-0104) provides information regarding this failure. Although a conclusive root cause has not been determined, it appears that the most likely degradation mechanism that caused the failure of the Davis-Besse cable is intrusion of ground water into the cable over a period of time. The December 3, 1999, morning report also provides references to failures of cables in underground conduit at Diablo Canyon and Palisades.

The staff also believes that the electrical transmission and distribution industry, and to a lesser extent, the nuclear industry are using in-situ, non-destructive, electrical methods to detect aging degradation of inaccessible or direct buried cables. Some utilities and industrial entities are using Power Factor (DOBLE) testing along with partial discharge detection as a predictive tool to check the insulation integrity of installed cables. Industry experience has shown that these methods are non-destructive and reliable. They provide information about the degree of cable insulation deterioration. In addition, there are reports available that list other in-situ, non-destructive, electrical methods that can be used to detect aging degradation in cables. One such report is SAND96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations," September 1996, prepared by Sandia National Laboratories for the U.S. Department of Energy. Table 5-2 of this report lists currently available condition monitoring techniques for cables. This table includes in-situ, non-destructive, electrical methods to detect aging degradation of cables. Electric Power Research Institute (EPRI) and Canadian Electricity Association sponsored work performed at cable technology laboratories which demonstrated the ability of very low frequency (VLF) (0.1 HZ ac voltage) testing to detect degraded insulation of cables. Philadelphia Electric Company (PECO) Energy uses the VLF testing extensively to test newly installed cables as well as old cables to assure insulation integrity. The use of VLF testing on PECO Energy systems has corroborated the use of this test method for in-situ testing of cables.

The staff believes that industry experience has demonstrated the existence of aging degradation associated with inaccessible or direct buried cables. Furthermore, the staff believes that there are in-situ, non-destructive, electrical methods that can be used to detect this aging degradation. Based on the above the staff believes that some form of testing should be done on an appropriate sample of inaccessible or direct buried non-environmentally qualified medium-voltage cables exposed to moisture to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation.

Until Duke provides more information regarding the aging management program for inaccessible or direct buried cables the staff considers this item open.

Sincerely,

/RA/

Christopher I. Grimes, Chief  
License Renewal and Standardization Branch  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270  
and 50-287

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The staff believes that industry experience has demonstrated the existence of aging degradation associated with inaccessible or direct buried cables. Furthermore, the staff believes that there are in-situ, non-destructive, electrical methods that can be used to detect this aging degradation. Based on the above the staff believes that some form of testing should be done on an appropriate sample of inaccessible or direct buried non-environmentally qualified medium-voltage cables exposed to moisture to demonstrate that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation.

Until Duke provides more information regarding the aging management program for inaccessible or direct buried cables the staff considers this item open.

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Christopher I. Grimes, Chief  
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Office of Nuclear Reactor Regulation

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and 50-287

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**SUBJECT:** OPEN ISSUE RELATED TO AGING EFFECTS OF INSULATED CABLES FOR THE OCONEE NUCLEAR STATION, UNIT NOS. 1, 2, AND 3 LICENSE RENEWAL APPLICATION

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