

October 28, 2004

Mr. Christopher M. Crane
President and CEO
AmerGen Energy Company, LLC
200 Exelon Way, KSA 3-E
Kennett Square, PA 19348

SUBJECT: OYSTER CREEK GENERATING STATION - NRC SUPPLEMENTAL
INSPECTION REPORT 05000219/2004007

Dear Mr. Crane:

On September 23, 2004, the U. S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Oyster Creek Generating Station. The enclosed report documents the inspection findings that were discussed on September 23, 2004, with Mr. C. N. Swenson and Mr. M. Massaro and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed activities, and interviewed personnel.

Based on the results of this inspection, the issues associated with the white finding and Notice of Violation are closed.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response, if any, will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

If you have any questions, please contact John F. Rogge of my staff at (610) 337-5146.

Sincerely,

/RA/

John Rogge, Chief
Electrical and Fire Protection Branch
Division of Reactor Safety

Docket No.: 50-219
License Nos.: DPR-16

Mr. Christopher M. Crane

Enclosure: Inspection Report 05000219/2004/007

cc w/encl:

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Site Vice President, Oyster Creek Nuclear Generating Station, AmerGen

Plant Manager, Oyster Creek Generating Station, AmerGen

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Mr. Christopher M. Crane

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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket Nos: 50-219

License Nos: DPR-16

Report Nos: 05000219/2004007

Licensee: AmerGen Energy Company, LLC (AmerGen)

Facility: Oyster Creek Generating Station

Location: Forked River, N.J.

Dates: September 20 - 23, 2004

Inspectors: A. Della Greca, Senior Reactor Inspector

Approved by: John F. Rogge, Chief
Electrical Branch
Division of Reactor Safety

Enclosure

SUMMARY OF FINDINGS

IR 0500219/2004-007; 09/20/2004 - 09/24/2004; Oyster Creek Generating Station, Supplemental Inspection

Cornerstone: Initiating Event, Mitigating Systems, Barrier Integrity

The U.S. Nuclear Regulatory Commission (NRC) performed this supplemental inspection to assess AmerGen Energy's (AmerGen) evaluation of a 4160V cable failure associated with emergency diesel generator No. 1 (EDG-1), on May 20, 2003. This performance issue was previously characterized as having low to moderate risk significance (White) in NRC Inspection Report No. 50-219/03-05. During this supplemental inspection, performed in accordance with Inspection Procedure (IP) 95001, the inspector determined that AmerGen had performed a comprehensive evaluation of the failed cable.

In their response to a Notice of Violation, dated April 14, 2004, the licensee indicated that the primary root cause of the performance issue was their failure to identify a deficiency with respect to the cable type for the EDG-1 power feed. Specifically, the data used for determining the EDG-1 cable type had incorrectly identified the cable as manufactured by Cablec rather than Anaconda. Therefore, they had not scheduled that Anaconda cable for replacement as they had planned, following a similar failure in November 2001. The use of Anaconda cables in a wet environment, the reason for several cable failures at Oyster Creek, was not limited to EDG-1 and the licensee had taken corrective actions to verify, to the extent possible, the manufacturer of medium voltage cables and place the remainder of medium voltage Anaconda cables in a replacement program. In addition, AmerGen was evaluating a new cable testing method to improve their ability to identify degradation status of all medium voltage cable types.

Given the licensee's performance in addressing the cable failure, the issues associated with the Notice of Violation are closed and the white finding associated with the cable failure will only be considered in assessing plant performance for a total of four quarters in accordance with the guidance of IMC 0305, "Operating Reactor Assessment Program." Implementation of AmerGen's corrective actions will be reviewed during a future inspection.

Report Details

01 INSPECTION SCOPE

The U.S. Nuclear Regulatory Commission (NRC) performed this supplemental inspection to assess AmerGen's evaluation of a 4160V cable failure associated with the "1C" emergency bus on May 20, 2003. This performance issue was previously characterized as "White" in NRC letter dated March 15, 2004, "Final Significance Determination for a White Finding and Notice of Violation (NRC Inspection Report 05000219/03-05)," and is related to the initiating event, mitigating systems, and barrier integrity cornerstones in the reactor safety strategic performance area.

The inspection included a review of the corrective action program item associated with the issue and the evaluations performed by the licensee to identify the root and contributing causes. The inspector also reviewed a previous cable failure event and associated facts and analyses to assess whether Amergen's evaluations had considered them in their review of root and contributing causes and their development of corrective actions for the performance deficiencies identified. The inspector conducted interviews of appropriate licensee personnel and performed a walkdown of the emergency diesel generators and 4160V switchgear to evaluate cable routing and moisture intrusion issues.

02 EVALUATION OF INSPECTION REQUIREMENTS

02.01 Problem Identification

- a. Determination of who (i.e., licensee, self-revealing, or NRC) identified the issue and under what conditions:

The failure was self-revealing when the normally energized cables that connect the emergency diesel generator No. 1 (EDG-1) to the "1C" emergency bus developed a ground fault causing the "1C" bus normal supply breaker to trip and lock-out.

- b. Determination of how long the issue existed, and prior opportunities for identification:

The independent analysis of the cable fault determined that the failure was the result of water intrusion into the cable between the insulation and the insulation shield. The water intrusion, over the period of several years, degraded the insulation, and caused the normally energized cable to short to ground. Based on the above, it was not possible to tell how long the cable in question had been degraded and susceptible to failure.

Based on previous experience with the same type of cable (Anaconda Unishield type cable), AmerGen recognized the vulnerability of such cables to moisture intrusion failure. They also recognized that their testing program had been ineffective in predicting such failures. AmerGen had opportunities to evaluate the condition of the failed cable and replace it, if necessary, following similar failures in 1996 and 2001. In 2001, AmerGen developed a cable replacement program. However, the cables associated with the May 20, 2003, event were not in the list of cables to be replaced. As stated in AmerGen's response to the NOV, the data they used for determining the EDG-1 cable type had incorrectly identified the cable as manufactured by Cablec rather than Anaconda.

- c. Determination of the plant-specific risk consequences (as applicable) and compliance concerns associated with the issue:

The NRC performed a significance determination process (SDP) Phase 2 evaluation and determined that the finding was of low to moderate safety significance (White), based primarily on emergency bus "1C" and associated loads unavailability time. Both internal and external events were addressed. The NRC also determined that the increase in large early release frequency (LERF) for the event was greater than $1.0E-7$ and less than $1.0E-6$ per year. Therefore, the NRC concluded that the performance deficiency was of low to moderate safety significance (White) based on both the increase to core damage frequency (CDF) and LERF. The licensee independently concluded that the significance of the cable failure was of low to moderate safety significance.

02.02 Root Cause and Extent of Condition Evaluation

- a. Evaluation of method(s) used to identify root cause(s) and contributing cause(s).

To evaluate the EDG-1 cable failure, the licensee used a combination of laboratory analysis and structured root cause analysis techniques. Based on the results of the laboratory analysis performed by Cable Technology Laboratories, Inc., as stated in AmerGen's response to the NOV, the failure resulted from non-uniform thickness of insulation shield (jacket) and moisture intrusion. In the formalized root cause analysis, the licensee evaluated causal factors and contributing causes. Specifically, for each causal factor and contributing cause, the licensee identified the precursor(s), the cause, the bases for the identified cause, and the action(s) required to correct the error and prevent recurrence.

- b. Level of detail of the root cause evaluation:

As indicated in section 02.02.a., above, the AmerGen analysis used a two-pronged approach. To determine the root cause of the cable failure, the licensee obtained a detailed laboratory analysis of failed and degraded cable sections. To address contributing causes, including human performance, AmerGen reviewed available information regarding each contributing cause and provided appropriate references to confirm the basis for the conclusions. The amount of detail provided, including references and tables, were sufficient for an independent assessment of the conclusions.

- c. Consideration of prior occurrences of the problem and knowledge of prior operating experience:

Prior to the May 20, 2003, Oyster Creek had experienced numerous medium voltage cable failures, including ten in-service failures. Therefore, AmerGen had previous experience with cable failures and was aware of their prevalent failure mode. The inspector's review of the licensee's root cause analysis determined that the licensee had

made charts of all medium voltage cable failures, including all pertinent information, such as year of failure, cable type, manufacturer, load impacted, age of cable, failure mode, and root cause. This information was used by AmerGen to formulate required corrective actions.

- d. Consideration of potential common cause(s) and extent of condition of the problem:

AmerGen's review of failed cables concluded that the moisture that entered the conduits and cable vaults penetrated the cable jacket, aggravated some times by manufacturing defects, and, over time, caused the cable to short to ground. In 2001, AmerGen recognized the failures as potentially common cause and planned to replace all Anaconda cables within the sand-bed of the plant with equivalent Okonite Okoguard type cables which AmerGen considered to be less susceptible to failure due to moisture intrusion. At that time, AmerGen performed an extent of condition review. However, as stated in the NOV response, the data used for determining the EDG-1 cable type had incorrectly identified the cable as manufactured by Cablec rather than Anaconda. Therefore, the EDG-1 cables were not entered in the cable replacement list.

02.03 Corrective Actions

- a. Appropriateness of corrective action(s):

As also stated in their letter to the NRC, dated April 14, 2004, AmerGen took immediate corrective actions to restore the "1C" emergency bus and associated emergency equipment to operable status by replacing the failed as well as the parallel Anaconda cables with equivalent Okonite Okoguard cables. They satisfactorily tested the new cables and confirmed the operability of the bus. To establish the cable failure mode, the licensee sent portions of the failed cable to a laboratory for an in-depth post-mortem analysis. Regarding known non-safety-related Anaconda cables buried in a wet environment, AmerGen planned to replace them with Okonite Okoguard cables, partly during the upcoming refueling outage and the remainder in the fall of 2006.

AmerGen previously recognized that the Oyster Creek cable testing program had not been successful in identifying Anaconda cable degradation and predicting failures. Therefore, they began to evaluate alternate testing methods. Following the 2003 cable failure, they engaged a contractor to test a sample of the underground cables using an on-line testing method developed by Detroit Edison. The new test method operates on the principle that, when voltage is applied to the cable an electrical discharge occurs in the areas where voids have developed between the insulation and the insulation shield. By measuring the spectrum of the discharges along the cable length, a proprietary computer program is capable of identifying the degradation status of the tested cable and predicting its failure probability within a specified period of time. As a result of this test, AmerGen identified one cable that "should be reevaluated within two years" to ensure that no further degradation has occurred in the interim. AmerGen decided to include this cable in the list of cables to be replaced during the upcoming refueling outage and to use appropriate testing and analyses to confirm the validity and usefulness of the new cable testing method. At the time of the inspection, the licensee

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had not completed a full evaluation of the Detroit Edison test results. Therefore, they had not reached any definite conclusions regarding the test method and condition of other cables. For instance, based on the results of the Detroit Edison test, the cables for two emergency service water pumps, while still acceptable, were considered to be more degraded than the cables for the "B" feedwater and condensate pumps scheduled for replacement during the upcoming refueling outage.

Regarding the incorrect cable list, to the extent it was possible, the licensee verified that the information for the other underground cables was correct. The licensee was planning to complete their review during the upcoming refueling outage. To address the human performance element with this issue, the licensee conducted a focused area self-assessment, and actions were in place to improve and monitor engineering performance in the fundamentals of technical rigor. In addition, AmerGen developed a technical human performance practices procedure. The purpose of this procedure is to establish roles and responsibilities and to identify the expected standards and behaviors for the Exelon technical staff in the area of technical human performance. Appropriate training was provided in the area of human performance and expectations.

b. Prioritization of corrective actions:

The licensee's immediate corrective actions were to restore the "1C" emergency bus to service by removing the failed Anaconda cable and replacing it with an Okonite cable. As stated in the NOV response, during the resulting plant shutdown, AmerGen conducted walk downs to physically verify the type of cable associated with many medium voltage components, including the EDG-2 cables. The inspector's review of the corrective action program (CAP) item initiated to address the event determined that the licensee had identified 16 individual corrective actions, including formulation of root cause, determination of extent of condition, and development of corrective actions required to prevent recurrence. The corrective actions were appropriately prioritized.

c. Establishment of a schedule for implementing and completing the corrective actions:

At the time of the inspection, AmerGen already had completed most of the corrective actions identified in CAP O2003-1000. Two remaining actions were pending the initiation of the refueling outage scheduled later in 2004. The actions scheduled for the 2004 outage included: (1) confirming that the manufacturer and type of cables that are unaccessible during plant operation correspond to those specified in their cable matrix; and (2) replacement of Anaconda cables associated with the "B" condensate and feedwater loop.

As a result of the DTE cable test, AmerGen also planned to replace the cables for unit substation No. 1A1 (USS-1A1). The current plan and schedule for future cable replacements were based on risk impact.

- d. Establishment of quantitative or qualitative measures of success for determining the effectiveness of the corrective actions to prevent recurrence

AmerGen established a plan to replace all cables that are vulnerable to moisture intrusion and failure. In the interim, efforts were made to prevent moisture from entering conduits and cable ducts. The replacement schedule was based on risk. In conjunction with these activities, AmerGen was evaluating alternate tests that are capable of determining the condition of the cable and predict failure. The DTE Cable Wise method, recently used to evaluate the condition of approximately 18 cables of various manufacture and type, appeared to be promising, but new. By testing and inspecting the condition of the "USS-1A1" cable, AmerGen expected to confirm the validity of the new method and its ability to predict failure. Future actions will depend on the results of this evaluation.

03. MANAGEMENT MEETINGS

The inspector presented the inspection results to Mr. C. Swenson and Mr. M. Massaro and other members of AmerGen management on September 23, 2004. AmerGen management acknowledged that no proprietary information was involved.

ATTACHMENT

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel

V. Aggarwal	Director, Business Support
D. Barnes	Manager, Design Engineering
H. Behnres	HR Manager
D. Fawcett	Licensing Engineer
M. Filippone	System Manager
S. Hutchins	Manager, System Engineering
D. Jones	Electrical Component Specialist
J. Kandasamy	Regulatory Assurance
M. Massaro	Plant Manager
J. O'Rourke	Assistant Director, Site Engineering
R. Pruthi	Engineering
D. Robillard	Corporate Licensing Engineer
D. Slear	Manager, Reg Assurance
C. Swenson	Senior Vice President
G. Waldrep	NOS Manager, Oyster Creek

Licensee Personnel

J. Herrera	Resident Inspector
J. Rogge	Chief, Electrical Branch
R. Summers	Senior Resident Inspector

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

EA-04-033	NOV	Failure to Take Prompt and Appropriate Corrective Actions for Significant Conditions Adverse to Quality Involving Power Cables
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Discussed

None

LIST OF DOCUMENTS REVIEWED

Miscellaneous Reports and Documents

HU-AA-102, Technical Human Performance Practices, Revision 0g (Draft)
HU-AA-1081, Fundamentals Tool Kit, Revision 0
HU-AA-1212, Technical Task Risk/Rigor Assessment, Pre-job Brief, Independent Third Party Review, and Post-Job Brief, Revision 0
200-SME-3780.06, Dielectric Testing for 2.3KV and 5KV Cables and Equipment, Revision 7
ESP/Continuing Training 03-2, Technical Rigor Verification Review
CTL Report No. 03-085, Failure Analysis and Assessment of the Condition of a 5kV EPR, Unshield Cable from Oyster Creek Nuclear Generation Station.
DTE Energy Technical Brochure, Cable Wise Condition Assessment
DTE Energy Report, Condition Assessment of Circuits at Exelon AmerGen Oyster Creek Nuclear Power Station.
DTE Energy Technical Paper, Condition Assessment of Distribution and Transmission Class Voltage Cable Systems by Nagu N. Srinivas & Dr. Nezar Ahmed.
Focus Area Self Assessment Plan - Engineering Fundamentals
FASA AT #249673, Cable Failure Supplemental Inspection

Corrective Action Program (CAP) Items

O2001-1718, O2003-1000, O2003-1060, O2003-1603, O2003-2193, O2004-0447, O2004-0657, O2004-2494,

Action Requests

A2011634, A2021848, A2021857, A2021867, A2021871, A2021877, A2021878, A2021932, A2021940, A2059477, A2060903, A2062455, A2073455

Work Orders

C2005626, C2006782, M2062455, R0805030, R0805031

LIST OF ACRONYMS

CAP	Corrective Action Program
CDF	Core Damage Frequency
EDG	Emergency Diesel Generator
LERF	Large Early Release Frequency
NRC	Nuclear Regulatory Commission
SDP	Significance Determination Process