UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION



BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | : | |
| | : | |
| GEORGIA POWER COMPANY, et al. | : | Docket Nos. 50-424 OL<br>50-425 OL |
| | : | |
| | : | |
| (Vogtle Electric Generating Plant, Units 1 and 2) | : | |

AFFIDAVIT OF JOEL KITCHENS

COUNTY OF LOS ANGELES )
)
STATE OF CALIFORNIA )

I, Joel Kitchens, being duly sworn according to law, depose and say as follows:

1. My name is Joel Kitchens. I am employed by Bechtel Power Corporation in the position of Assistant to the Chief Electrical Engineer. My business address is Bechtel Power Corporation, 12440 East Imperial Highway, Norwalk, California 90650. Attached to this Affidavit as Exhibit A is a summary of my professional qualifications.

2. The purpose of this affidavit is to support Applicants' Motion for Summary Disposition of Joint Intervenors' Contention 10.3. In that contention the Joint Intervenors challenge the environmental qualification of multiconductor electrical cable used at the Vogtle

Electric Generating Plant ("VEGP"), asserting that the use of single conductor configurations in qualification testing may not adequately test the performance of a multiconductor electrical cable. I have personal knowledge of the matters set forth herein and believe them to be true and correct.

I. Background.

3. The common practice in the nuclear industry has been to use single conductor configurations in tests performed to establish the environmental qualification of multiconductor cables. Performing qualification testing on a single conductor taken from a sample of the particular multiconductor under scrutiny is considered to be a more conservative methodology than testing the multiconductor itself. Multiconductor cables generally have jacketing material or additional insulation or both surrounding the insulated single conductors comprising the multiconductor that should provide additional protection from adverse environmental conditions not available to a single conductor. Regulatory Guide 1.131, entitled "Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants," endorses IEEE Standard 383-1974, "IEEE Standard for Type Test of Class IE Electric Cables, Fields splices, and Connections for Nuclear Power Generating Stations."

Table 1 of this standard specifically provides that single conductor or multiconductor cables may be used for type testing for qualification purposes of multiconductor cables, except for vertical tray flame tests.

II. Studies Performed by Sandia National Laboratories Comparing Test Results for Multiconductor Samples to Results Obtained from Corresponding Single Conductor Samples Under LOCA Conditions.

A. The Study Performed on Conductors Insulated with Ethylene-Propylene Rubber Materials.

4. In October 1983, Sandia National Laboratories ("Sandia") published the results of a study sponsored by the Nuclear Regulatory Commission ("NRC") that investigated (a) whether qualification test results for electrical cable insulated with ethylene-propylene rubber (EPR) materials were sensitive to the order of aging and accident stress application and (b) the importance of simultaneous versus sequential stress exposures. L.D. Bustard, The Effect of LOCA Simulation Procedures on Ethylene-Propylene Rubber's Mechanical and Electrical Properties, SAND83-1258, NUREG/CR-3538, October 1983 ("the first Sandia report"). In that study, Sandia subjected samples of commercially available single, double, and triple conductor cable assemblies insulated with EPR polymer material to simulated loss-of-coolant accident ("LOCA") conditions. Eight cable products were tested. Four of the

products were manufactured by Anaconda Wire and Cable Company, two by Eaton Corporation, and two by Okonite Company. Three of the cable products were single conductors, two were double conductors, and three were triple conductors. For the multiconductor cables, tests were performed on samples of the multiconductor cables themselves and on single conductors obtained by disassembling the multiconductor cables. Test conditions were similar for each type of cable.

5. With one exception, all five of the multiconductor cable products tested had chlorosulfonated polyethylene (CSPE) (also known as Hypalon) outer jackets. The one exception was a three conductor cable manufactured by Anaconda Wire and Cable Company that had EPR insulation on the individual conductors and an outer thermoplastic jacket of chlorinated polyethylene (CPE). Unlike most of the other multiconductor cable products tested, the single conductors comprising this multiconductor cable were not individually jacketed. This multiconductor cable product was referred to in the Sandia study as cable "EPR D."

6. When tested under simulated LOCA conditions in a multiconductor configuration, cable EPR D deteriorated to a much greater degree than the other multiconductor products tested. More significantly for this proceeding, it also deteriorated to a much greater extent than the single

conductor samples obtained by disassembling a sample of multiconductor cable EPR D. None of the other multiconductor cables tested suffered greater damage in a multiconductor configuration than in the corresponding single conductor configuration. While the individual conductors in those multiconductors also had EPR insulation, the outer jacket around those conductors was not made of CPE but CSPE.

7. The author of the first Sandia report, Larry Bustard, postulated that interaction between the chlorinated polyethylene outer jacket and the EPR insulation around each of the single conductors comprising cable EPR D contributed to the degradation of that cable product. He observed that the insulation around the conductors had swelled, causing the outer jacket to split. The splitting of the jacket, he hypothesized, resulted in a sudden release of the constrictive force on the insulation, allowing it to crack or break up. Ultimate tensile elongation measurements performed on tensile specimens suggested to Bustard that by the end of the simulated LOCA conditions the insulation ultimate elongation was similar to the calculated strain resulting from the geometry of the multiconductor configuration, which would likely lead to insulation cracking. As an alternative hypothesis, Bustard proposed that portions of the insulation that

adhered to the outer jacket when it split were pulled away from the conductors.

8. Bustard concluded that these two variations of the jacket-insulation interaction hypothesis were both consistent with the observed results of the testing on EPR D, which were bare copper conductors being visible at the end of the testing. While Bustard suggested for completeness two additional theories that might account for the degradation found with EPR D, first that a jacket-insulation chemical reaction may have caused the degradation and second that the cable geometry may have resulted in stress buildup, he discounted those possible explanations as less acceptable.

9. Based upon the experimental results for EPR D, the first Sandia report concluded in part that "[f]uture EPR cable qualification tests should not employ single conductor test specimens to establish qualification for multiconductors." That conclusion may be questioned on the basis of the results of the first Sandia study itself, since the EPR D cable was the only one of the five multiconductor cable products for which the multiconductor configuration showed significantly greater degradation than the single conductor configuration. More importantly, however, a subsequent Sandia study of cross-linked polyolefin cable, conducted in part for the purpose of

testing this conclusion, showed no significant differences in deterioration between single conductor and multi-conductor configurations. L.D. Bustard, The Effect of LOCA Simulation Procedures on Cross-Linked Polyolefin Cable's Performance, SAND83-2406, NUREG/CR-3588, April 198. ("the second Sandia report").

B. The Study Performed on Conductors Insulated with Cross-Linked Polyolefin Materials.

10. The second Sandia report, also authored by Mr. Bustard, published the results of tests in which three commercially available multiconductor cable assemblies were subjected to simulated LOCA conditions. Similar to the prior study, for two of the cable products tested the tests were performed both on the multiconductor cable products and on single conductors obtained by disassembling samples of the multiconductor cables. All three of the multiconductor cable products had cross-linked polyolefin insulation and thermosetting Hypalon or Neoprene outer jackets.

11. As noted above, one of the chief purposes of the second Sandia study was to test experimentally whether qualification testing of single conductors was more severe, equal to, or less severe than the testing of multiconductor cables. The results obtained demonstrated that the effect of the simulated LOCA conditions upon the cable products tested did not differ depending upon

whether a multiconductor configuration or single conductor configuration was tested. With respect to the two cable products tested in both multiconductor and single conductor configurations, the second Sandia report concluded that the electrical properties retained by those cable products following exposure to LOCA conditions "did not depend on whether single conductor or multiconductor testing was performed."

12. Thus, of the eight multiconductor cable products tested in both Sandia studies, only the multiconductor cable manufactured by Anaconda Wire and Cable Company that had conductors with EPR insulation and a chlorinated polyethylene outer jacket suffered greater degradation in a multiconductor configuration. In fact, two other multiconductor cables manufactured by Anaconda were tested in the first Sandia study and did not suffer greater degradation in a multiconductor configuration. The results of the second Sandia study further support Bustard's hypothesis that the greater degradation experienced by the EPR D cable in a multiconductor configuration resulted from a jacket-insulation interaction, since other cable products not having the same combination of jacket and insulation have not shown similar degradation.

13. My conclusion from these two studies is that only cables having a thermoplastic chlorinated polyethylene jacket are likely to suffer greater degradation when

tested in a multiconductor configuration rather than in a single conductor configuration. To determine whether any such electrical cable has been used at VEGP, Bechtel Power Corporation reviewed all purchase orders for electrical cable and questioned all suppliers of safety related equipment for use at VEGP that could be exposed to a harsh environment. No such electrical cable was procured for use at VEGP or included in any fabricated equipment purchased for VEGP. All electrical cable used at VEGP has either a chlorosulfonated polyethylene (Hypalon) jacket or a polychloropreme (Neoprene) jacket. Multiconductor cables with these jacket materials performed as well in multiconductor configurations as in single conductor configurations in the Sandia studies. Considering this, I am confident that multiconductor cables used at VEGP that were environmentally qualified by testing single conductor cables or elements of a multiconductor cable are fully qualified.

Joel Kitchens

Joel Kitchens

Sworn to and subscribed
before me this 27th day
of June, 1985.

Joanne E. Henry
Notary Public

OFFICIAL SEAL
JOANNE E HENRY
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
My comm. expires NOV 22, 1986

EXHIBIT A

JOEL KITCHENS
Assistant to the Chief Electrical Engineer
Bechtel Power Corporation, Western Power Division

PROFESSIONAL QUALIFICATIONS

EDUCATION

BSEE - University of California, Berkeley - 1948
Business Management Certificate Program, University of California, Berkeley - 1973

EXPERIENCE SUMMARY

37 years design, supervisory and management positions in power engineering fields.

EMPLOYMENT HISTORY

| | |
|---|---|
| 1966 to present: | Bechtel Group - various locations |
| 1956 to 1966: | Anaconda Company - Wire and Cable Division<br>New York and San Francisco |
| 1948 to 1956: | Pacific Gas and Electric Company<br>San Francisco |

PROFESSIONAL AFFILIATIONS:

Fellow, Institute for the Advancement of Engineering
Senior Member, Institute of Electrical and Electronic Engineers
Member, IEEE Insulated Conductors Committee
Member, Project Management Institute
Registered Professional Engineer, Arizona and California

SPECIFIC QUALIFICATIONS IN THE INSULATED CABLE FIELD

Ten years with the Anaconda Company, Wire and Cable Division. These years included the following positions held and duties performed:

- 3 1/2 years as a Cable Engineer doing cable design, specification writing, inspection and manufacturing engineering.
- 2 years as a Regional Engineer doing application engineering and providing technical assistance for sale personnel and clients.
- 2 1/2 years a Chief Cable Engineer with full responsibility for design, specifications and quality for the company's insulated products in the low voltage and medium voltage field.
- 2 years as General Manager of the Cable Accessories Division in charge of design, manufacture and marketing of the accessories product line.

During 19 years with the Bechtel Group of Companies, have been a Cable Specialist with responsibility for insulated cable master specifications for all voltages and applications. Have been a member of the IEEE Power Engineering Society Insulated Conductors Committee and have represented Bechtel on this committee for this full time. Have actively participated on subcommittees and working groups responsible for maintaining and revising, as necessary, cable industry qualification standards such as IEEE Standard 383.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

| | | |
|---|---|---|
| In the Matter of | : | |
| | : | |
| GEORGIA POWER COMPANY, et al. | : | Docket Nos. 50-424 |
| | : | 50-425 |
| (Vogtle Electric Generating Plant, Units 1 and 2) | : | |
| | : | |

CERTIFICATE OF SERVICE

I hereby certify that copies of the Affidavit of Joel Kitchens, dated June 27, 1985, were served upon those persons on the attached Service List by deposit in the United States mail, postage prepaid, or where indicated by an asterisk (*) by hand delivery, this 1st day of July, 1985.

James E. Joiner

James E. Joiner
Attorney for Applicants

Dated: July 1, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| GEORGIA POWER COMPANY, et al. | ) | Docket Nos. 50-424 |
| | ) | 50-425 |
| (Vogtle Electric Generating Plant, Units 1 and 2) | ) | |

SERVICE LIST

Morton B. Margulies, Chairman
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Gustave A. Linenberger
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Oscar H. Paris
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Bernard M. Bordenick, Esquire
Office of Executive Legal Director
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Atomic Safety and Licensing Appeal Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

*Douglas C. Teper
1253 Lenox Circle
Atlanta, Georgia 30306

*Laurie Fowler
Legal Environmental Assistance Foundation
218 Flora Avenue, N. E.
Atlanta, Georgia 30307

*Tim Johnson
Campaign for a Prosperous Georgia
175 Trinity Avenue, S. W.
Atlanta, Georgia 30303

Docketing and Service Section
Office of the Secretary
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Bradley Jones, Esquire
Regional Counsel
U. S. Nuclear Regulatory Commission
Suite 3100
101 Marietta Street
Atlanta, Georgia 30303