

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:)
)
CAROLINA POWER AND LIGHT COMPANY) Docket No. 50-261
)
(H. B. Robinson Steam Electric)
Plant, Unit 2))

AFFIDAVIT OF CYRIL J. CRANE AND GARY J. TOMAN

INTRODUCTION

I, Cyril J. Crane, being first duly sworn, depose and state as follows:

I am a Senior Partner and Manager of Engineering at Main Line Engineering Associates. As such, I conduct or supervise engineering and technical program management services for nuclear utilities and governmental agencies. I am a consultant to several utilities in the area of equipment environmental qualification. Prior to joining Main Line Engineering Associates and Westec Services, I was employed by Franklin Research Center (FRC) as Project Manager for NRC Licensing issues and Manager of Equipment Qualification Analysis and Planning (1980-82). In that capacity, I served as technical group leader for equipment qualification programs for the NRC, completing assignments on (1)

the evaluation of equipment qualification for the Systematic Evaluation Program (SEP) plants, and (2) the evaluation of equipment qualification associated with IE Bulletin 79-01B. As part of a continuing program, I completed Technical Evaluation Reports (TERs) for 30 operating reactors on the evaluation of equipment qualification programs.

I, Gary J. Toman, being first duly sworn, depose and state as follows:

I am a Principal Engineer for ERC International, WESTEC Power Engineering Division. I am responsible for development and evaluation of equipment qualification documentation and supervision of qualification tests, and consult with various utilities in the equipment qualification area. Prior to working for ERC I was employed by Franklin Research Center as the Head of the Nuclear Engineering Section (1982-87). I was in charge of the completion of the evaluation of all harsh environment safety-related electrical equipment for 41 operating nuclear power plants for the NRC. The evaluation entailed preparation of an individual qualification data base for each power plant and evaluation of utility-supplied documentation against the requirements of the DOR Guidelines, IE Bulletin 79-01B and NUREG-0588 in conjunction with plant-specific requirements.

From 1979 through March of 1983, then, Franklin evaluated the environmental qualification of 71 operating nuclear power plants on behalf of the NRC. These technical evaluations were

led by Cyril Crane from 1980 through September 1982, and by Gary Toman from October 1982 through March 1983. Two of the plants were reviewed to the requirements of NUREG-0588, Category II; 69 plants were reviewed to the requirements of the DOR Guidelines. As a result, seventy-one (71) Technical Evaluation Reports were completed on the evaluation of equipment qualification programs. In addition, an Equipment Qualification Implementation Guide was prepared in 1982 by Cyril Crane (and issued by Gary Toman in 1983), and an Equipment Qualification Inspection Module was prepared by Gary Toman in 1984 for use by NRC inspectors subsequent to the Franklin EQ reviews.

At some point in 1986, NRC reviewers started to focus attention on the potential degrading effects of insulation resistance and leakage current on instrument loop accuracy for instruments located in harsh environments requiring environmental qualification. An instrument loop includes all components in the circuit, for example the sensor device; cable, splice or terminal block; penetration; receiver and power supply. Environmental Qualification program test results indicated in some cases that leakage currents and low insulation resistance could possibly compromise the ability of some instrument circuits to perform required safety functions. In certain instances the Staff found escalated enforcement actions appropriate where insulation resistance data was absent since, according to the Staff, licensees "clearly should have known" prior to November 30, 1985,

the EQ deadline, that instrument loop accuracy calculations were required for equipment qualification.

We have been asked to provide our views on whether licensees "clearly should have known" that loop accuracy calculations were a requirement prior to the November 1985 EQ deadline.

SUMMARY AND CONCLUSIONS

The EQ reviews performed for the NRC by Franklin Research Center were done on a component-by-component basis, since it was generally believed within the industry at that time that devices could be individually qualified by device type without significant concern for potential problems resulting from integration of the devices into a qualified configured system. Although the concept of "loop accuracy" was not totally unfamiliar, virtually everyone -- the NRC, we as its consultants, and licensees -- addressed the accuracy issue by examining instrument sensors, the implicit assumption being that potential inaccuracies due to the individual components of the circuit (e.g., splices, penetrations, cable) were insignificant, and would not contribute to overall inaccuracy (provided that each component showed satisfactory performance). Accordingly, lack of instrument loop accuracy or of insulation resistance measurements were not considered to be qualification deficiencies at the time Franklin did its reviews. Instrument loop accuracy calculations that included insulation resistances of cables and other circuit components under accident environment conditions were not

expected as part of the qualification documentation since the principal focus was on the device rather than the loop. Franklin, as the NRC's consultant, accepted from licensees, for qualification purposes, test reports for cables and penetrations that did not contain IR data (or contained very few IR data measurements) in the LOCA accident simulation portion of the test program. Moreover, the NRC seemed to place its approval on the evaluations in the Franklin TERS by attaching SERs to them. Accordingly, at the time Franklin was involved in its EQ review of licensee test reports for the NRC, neither Franklin, the industry, nor, apparently, the NRC, viewed loop accuracy calculations as an essential qualification requirement. Thus, in our view, it cannot be said that licensees "clearly should have known" that loop accuracy calculations were required.

DISCUSSION

From the inception of equipment qualification issues in the late 1960's up until 1986, the industry and regulators approached environmental qualification on a component-by-component basis, as evidenced by the regulatory and industry standards then in effect, as well as by the inspection reports issued through 1985.¹ It was generally believed that devices could be individually qualified by device type (e.g., 1153D transmitters manufactured

¹/ These standards and inspection reports are discussed in detail in the Affidavit of Vincent S. Noonan, Philip A. DiBendetto and Robert G. LaGrange on loop accuracy, which we have reviewed and with which we concur.

by Rosemount) without a great deal of attention given to potential problems resulting from the integration of the devices into a qualified system configuration (i.e., the connecting cable, terminal block, splice, penetration, etc.). (This was true as long as each qualification file for the particular equipment exhibited satisfactory performance during the accident simulation test and there were no indications of failure or significant anomalies.) Since the initial objective of the NRC qualification review program was to provide reasonable assurance of equipment operability and accomplishment of safety functions, this approach appeared reasonable and technically sound. The effects of the integration of components into a system was dealt with by evaluating significant interfaces (e.g., voltage fluctuations from the power supply were considered as was mounting, electrical terminations, and sealing).

The EQ reviews Franklin performed for the NRC were, accordingly, performed on a component-by-component basis. The goal of the Franklin reviews was to determine if there was a reasonable basis for stating that the components would function adequately under a design basis accident condition. If a reasonable basis was present (i.e., the component functioned properly through a steam exposure test that enveloped the plant environmental profile, and radiation and aging were addressed in accordance with the DOR Guidelines or NUREG-0588) the documentation reviewed was declared technically acceptable, and

found to be in accordance with NRC criteria. Generally, the early tests (prior to 1980) focused on verifying that equipment integrity would remain intact and function through the harsh environment test. There were very few attempts in the test reports to show precise margin, the exact degree of degradation or trend performance characteristics (i.e., monitor insulation resistance or leakage current during the LOCA test). The reviews evaluated basic characteristics of the test: (1) the item was exposed to a steam test with a sufficient temperature/pressure peak and duration; (2) radiation was addressed and enveloped the plant condition; (3) aging and qualified life were appropriately addressed; (4) chemical or demineralized water spray was sufficient; (5) similarity between test specimen and installed equipment was sufficient; (6) test sequences were acceptable; (7) test failure and anomalies were adequately addressed; and (8) accuracy of instruments -- as individual components rather than as an instrument loop -- was addressed. With respect to cable and penetrations, the basic requirement was that they carry load current and withstand applied voltage during the steam environment test. The screening guidelines used to evaluate the acceptability of the qualification documents were (1) the DOR Guidelines, (2) NUREG - 0588 Rev. 1, and (3) IE Bulletin 79-01B. The principal objective of these technical reviews was to identify equipment with qualification documentation that did not give reasonable assurance that the equipment was capable of

performing its specified safety function so that licensees could take appropriate corrective action.

Indeed, a review of a number of TERs produced during that period confirms that the issue of accuracy was considered only for instrument sensors. The Equipment Environmental Qualification Summary form and Equipment Environmental Qualification Review forms that were used to document the TER reviews contained a field specifically addressing "instrument accuracy." However, for devices other than instrument sensors, these fields were generally either left blank or contained a "not applicable" ("N/A"). In general, for devices such as instrument cables, electrical penetrations, or splices used in instrumentation circuits, TER deficiencies were not identified when IR information was not provided. Moreover, these reviews did not indicate that the effects of other circuit components must be considered prior to acceptance of the sensor or the interfacing electrical devices.

In addition, as part of the assignment, Franklin issued to the NRC the Implementation Guidance for New and Corrective Equipment Environmental Qualification in January 1983. Its objectives were to identify for licensees the typical deficiencies found during the TER review and discuss methods of resolution and qualification methodology. The discussion of accuracy deficiencies in Section 4.16.3 is limited to either (a) a lack of instrument accuracy data in the test report or (b) a

lack of review of sensor accuracy data by the licensees. The discussion of terminal block and splice qualification deficiencies addresses a number of issues but does not identify any concerns with instrument circuit accuracy. (To our knowledge, this document was not issued to the licensees.)

Lack of instrument loop accuracy calculations, and lack of insulation resistance measurements during LOCA accident simulation on cables and penetrations, then, were not considered to be qualification deficiencies by the industry or its regulators at the time Franklin did its reviews on behalf of the NRC. Cable qualification reports were considered to be acceptable provided that current and voltage were maintained, the cable passed post-LOCA wet high-potential tests, and the reports contained no significant anomalies. With respect to instrument loop accuracy calculations or assessments, these were not generally expected since the principal focus was on the device rather than the loop. Insulation resistance information was desirable, but its absence in the report was not considered a reason to reject the qualification documents based on NRC criteria. If insulation resistance or leakage current data were contained in the test report, however, it was reviewed and evaluated. In short, a cable or penetration tested with appropriate load current and voltage followed by a successful high potential test would have been considered acceptable with or without insulation resistance data, provided there were no

failures or significant anomalies. "Accuracy" was viewed as relating primarily to instrument sensors (i.e., the transmitters).

For the foregoing reasons, the Franklin environmental qualification review program did not include evaluation of interconnected instrument loop components. The program was based on the concept that if the individual components performed well during the test program, the system would function properly. Indeed, information requested of the licensees by the NRC and presented by the licensees to the NRC for review did not contain sufficient information to allow determination of which instruments were connected to which cable and which penetration. Therefore, it was not possible to perform a system-level review for instrument loop accuracy. Significantly, the NRC accepted and validated Franklin's reviews, as evidenced by the fact that they attached SERs to the Franklin TERs.

Additionally, an Inspection Module was prepared by FRC in 1984 for use by NRC inspectors as a basis for performing site inspections related to equipment qualification. The Module provided guidance on the evaluation of the EQ equipment list, resolution of corrective action from the Franklin TERs, evaluation equipment qualification documentation, and performance of plant walk-downs. No explicit requirement was contained in

the Module to evaluate cable or penetration insulation resistances or to evaluate instrument loop accuracies.

Based on the above discussion, and the fact that we were fully aware of NRC criteria and the state-of-the-art for equipment environmental qualification, in our view, instrument loop accuracy calculations were not considered a regulatory requirement during the period in which we performed our review of licensee test reports on behalf of the NRC.

The foregoing paragraphs are true and correct to the best of my knowledge.


Cyril J. Crane
Cyril J. Crane

Subscribed and sworn to before me this 29 day of August, 1988.

Winifred F. McLean
Notary Public

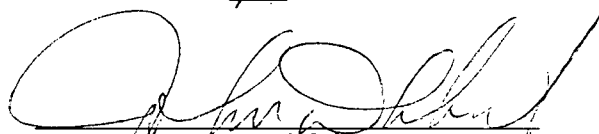
WINIFRED F. McLEAN, Notary Public
Frazer, Chester County, Pa.
My Commission Expires July 23, 1990

The foregoing paragraphs are true and correct to the best of my knowledge.



Gary J. Toman

Subscribed and sworn to before me this 29 day of August, 1988.



Notary Public

JOHN D. LIBERT
Notary Public, Phila., Phila. Co.
My Commission Expires May 7, 1990