August 31, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT COMPANY and NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY	)	Docket No. 50-400 OL
	)	
(Shearon Harris Nuclear Power Plant)	)	

APPLICANTS' TESTIMONY OF RICHARD M. BUCCI, EDWIN J. PAGAN AND EDWARD M. MCLEAN IN RESPONSE TO EDDLEMAN CONTENTION 9E (PHYSICAL ORIENTATION OF EQUIPMENT)

Q.1 Please state your names.

A.1 Richard M. Bucci, Edwin J. Pagan and Edward M. McLean.

Q.2 Mr. Bucci and Mr. Pagan, are your addresses, occupations, employers, educational backgrounds and professional work experiences described elsewhere in the record of this proceeding?

A.2 (RMB, EJP) Yes, the relevant information is provided in "Applicants' Testimony of Richard M. Bucci and Edwin J. Pagan in Response to Eddleman Contention 9D (Instrument Cables)."

Q.3 Mr. McLean, please state your address, present occupation and employer.

A.3 (EMcL) I am employed by Carolina Power & Light Company ("CP&L") as a Project Mechanical Engineer. My business address is the Shearon Harris Nuclear Power Plant, P.O. Box 101, New Hill, North Carolina 27562.

Q.4 State your educational background and professional work experience.

A.4 (EMcL) I graduated from North Carolina State University in 1968 with a Bachelor of Science Degree in Mechanical Engineering. I joined the Navy in March 1969 and served as missile officer aboard the U.S.S. Bainbridge until March 1972. I joined CP&L in April 1972 as a Heating and Cooling Engineer in the Customer Services Department. I transferred to what is now the Harris Plant Construction Section of the Harris Nuclear

Project Department in June 1974. I have been involved in engineering support of construction at the SHNPP, Brunswick Steam Electric Plant, and the H.B. Robinson Nuclear Plant for the last ten years. My major responsibilities at the SHNPP have included developing and supervising the storage and maintenance program for the equipment and materials onsite, designing temporary mechanical facilities, and providing engineering support for the installation of piping, equipment, HVAC duct work, and hangers. My major responsibilities during two assignments at the Brunswick Plant included start-up of HVAC equipment and supervising the mechanical engineering support group. This group was responsible for providing engineering support for piping, hangers, and equipment. I also acted as the CP&L night shift representative responsible for all phases of construction. At the Robinson Plant during an assignment lasting ten months I provided engineering support for the mechanical construction activities. For the past two and one-half years I have been responsible for providing engineering support for the installation of equipment at the SHNPP. I am a registered professional engineer in North Carolina.

Q.5 Please elaborate on your professional experience that is directly relevant to the testimony which you are presenting regarding physical orientation of electrical equipment at SHNPP.

A.5 (EMcL) The group that I have supervised for the past two and one-half years is responsible for providing engineering

support for the installation of both mechanical and electrical equipment. We develop work packages that provide design information to field supervision personnel and provide process control sheets associated with work packages to ensure that quality control inspections are made.

Q.6 What is the purpose of this testimony?

A.6 (RMB, EJP, EMcL) The purpose of this testimony is to respond to Eddleman Contention 9E, which states:

> There is not sufficient assurance that the physical orientation of equipment in testing is the same as the physical orientation of equipment installed.

Q.7 How is your testimony organized?

A.7 (RMB, EJP, EMcL) First, we discuss circumstances in which physical orientation of safety-related electrical equipment is a potential concern. Second, we describe the process by which physical orientation of such equipment at SHNPP is controlled, from qualification testing of the equipment, to installation design, to physical installation of the equipment in the plant.

Q.8 What is meant by "physical orientation of equipment"?

A.8 (RMB, EJP) Physical orientation of equipment refers to the mounting location with respect to a set of rectangular coordinates, its angular position, its location with respect to other items in the plant and installation interfaces.

Q.9 When is physical orientation of safety-related electrical equipment a concern with respect to environmental qualification of the equipment?

A.9 (RMB, EJP) Physical orientation of e ctrical equipment in the SHNPP generally does not affect environmental qualification. For most electrical equipment, environmental conditions are identical regardless of the orientation. Physical orientation is more likely to be related either to seismic qualification or to operability of the equipment.

There are circumstances in which physical orientation of electrical equipment could affect environmental qualification. For example, if an electro-hydraulic valve operator were installed upside down, hydraulic fluid could potentially leak onto the cable terminations -- possibly causing corrosion of the electrical connections. Another example could be improper orientation of a battery charger, which could result in inadequate ventilation -- raising the temperature of the components above the expected normal operating temperature and potentially shortening the qualified life of the equipment.

Q.10 What information is received from vendors concerning physical orientation of electrical equipment?

A.10 (RMB, EJP) The environmental qualification test reports, provided by vendors of electrical equipment which is qualified by testing, describe and/or provide sketches or photographs of the test set-up, including physical orientation of the test equipment. A typical photograph of a test set-up for a level transmitter is shown on Attachment A hereto. (Attachment A shows test set-up in a thermal aging chamber indicating the vertical orientation of the level transmitter.)

Orientation is addressed in a variety of ways. The vendor may test the equipment in the most limiting orientation, i.e., the orientation determined by engineering analysis that results in the most severe environmental conditions. In that case, the equipment would be environmentally qualified for any physical orientation. The vendor may instead test in a single orientation which is not the most limiting condition, and either qualify the equipment by analysis for other orientations or simply specify the test orientation as the only permissible orientation. Or, finally, the vendor may test the equipment in several orientations.

Vendors also are required to provide technical manuals containing installation and maintenance instructions. Finally, the vendor provides mounting drawings which include specific instructions for orientation.

Q.11 Who receives this information?

A.11 (RMB, EJP) Vendor supplied information is sent by the vendor to the responsible design organization.

Q.12 What does Ebasco, as a design organization, do with the vendor supplied information?

A.12 (RMB, EJP) With regard to physical orientation for a particular piece of equipment, Ebasco reviews the test orientation or orientations against the design drawings which Ebasco has prepared for installation of the equipment at the SHNPP. Orientation during testing must either be identical to the installation shown on the design drawings, or the equipment must

be able to be qualified by analysis for a different orientation. In addition, Ebasco reviews the vendor mounting drawings and technical manuals to make sure that they are consistent with the qualification test set-up. If there are any discrepancies, inconsistencies or ambiguities concerning physical orientation of the equipment, Ebasco requests further information from the vendor as necessary.

Q.13 With regard to physical orientation, please describe Ebasco's procedures for preparation, control and review of installation design drawings and for documentation of corrective actions concerning physical orientation.

A.13 (RMB, EJP) Physical installation drawings are prepared based on vendor supplied information and the specific physical conditions at the equipment location. During their preparation, the drawings are reviewed by affected engineering disciplines (e.g., civil, mechanical and electrical engineering) to ensure adequate consideration of applicable aspects of the plant design. In addition, in some cases the installation drawings are sent to the equipment vendor for his review and concurrence prior to issuance to the field.

As a part of the SHNPP environmental qualification program, vendor qualification reports are also specifically reviewed to ensure that physical orientation during testing was consistent with the installation drawings. Any concerns resulting from this review are documented in the qualification review package as outstanding items which require resolution

prior to considering the equipment environmentally qualified. Should resolution of a concern require a change to the installation drawing, a design change notice ("DCN") must be issued. The DCN is subject to the same review as the original drawing for the area affected by the DCN. In addition, the DCN is tied to the drawing by the design change procedure so that all affected personnel are made aware of the change. After final approval, the DCN is issued to the field personnel for implementation. It is subsequently incorporated on the installation record drawing.

For example, Attachment B -- which is an instrument installation drawing for the safety-related level transmitter depicted in Attachment A -- indicates the original approval and revision status. This example also indicates the DCN's that have been incorporated on the drawing via the above-described procedures. (The required physical orientation of the level transmitter is clearly indicated in Attachment B, consistent with the orientation during the qualification test set-up as shown in Attachment A.)

Q.14 How does CP&L assure that safety-related electrical equipment is installed according to the installation drawings?

A.14 (EMcL) CP&L assures that safety-related electrical equipment is installed according to the installation drawings through detailed procedures for control of design documents, preparation of installation work packages based on design documentation, installation performed in accordance with work

packages and work procedures, and quality inspection to verify proper installation.

Q.15 How does CP&L control installation drawings and other design documentation at the SHNPP?

A.15 (EMcL) Installation design drawings and documents are transmitted by Ebasco to CP&L's Document Control Center ("DCC"). The construction engineer, following written engineering procedures, then obtains the drawing from the DCC. The DCC will automatically issue subsequent revisions, DCN's, and field change requests ("FCR"), to holders of controlled drawings.

Q.16 What does the construction engineer do with this information?

A.16 (EMcL) In preparing for the installation of equipment at the SHNPP, the construction engineer prepares a work package that generally includes Ebasco installation design drawings, vendor drawings, vendor manuals, process control sheets, and design changes in the form of FCR's and DCN's.

Q.17 What is done with the work package?

A.17 (EMcL) The work package is given to the field superintendent responsible for installing each piece of equipment. The field superintendent ensures the equipment is installed according to the design documents and notifies the quality inspector when he reaches inspection points for quality related activities. These inspection points are indicated on the process control sheets.

The quality inspector prepares inspection documents corresponding to the process control sheets developed by the construction engineers. The inspectors refer to the work packages when they make their inspections. Physical orientation is one of the required inspections.

Q.18 What happens if the construction personnel are unable to install the equipment in accordance with the work package?

A.18 (EMcL) If a change in installation orientation is required which exceeds the design tolerances contained in the work package -- e.g., if the orientation of a motor control center needs to be changed in order for it to fit into its allotted space -- the construction engineer writes a FCR. The FCR must be reviewed and approved by the responsible design engineer. The design engineer evaluates the FCR based on the design drawing and available vendor information. If necessary, the design engineer obtains additional information from the vendor or Ebasco.

If the design engineer approves the FCR, it is submitted to the DCC, is forwarded to the construction engineer, and becomes part of the work package. Construction personnel then install the equipment based on the FCR.

A design change in the form of a DCN might also come from Ebasco. This would occur if the equipment were installed prior to Ebasco having received the vendor qualification test report and Ebasco, on reviewing the report, identifies a

limiting condition with respect to installation orientation which is inconsistent with the original design drawing. In this situation, the same procedures would be followed as those controlling a FCR initiated by construction personnel.

Q.19 What corrective actions are taken if the FCR is denied?

A.19 (EMcL) A FCR is seldom denied. The cases in which a FCR is denied usually relate to FCR's submitted by the construction engineer for economic reasons and disapproved by the design engineer. In such cases, the construction engineer can still complete the work in accordance with the original design documents. If the installation cannot be completed as designed and the design engineer does not agree with the resolution proposed by the construction engineer, he should provide an alternate resolution. If the design engineer denies a FCR and the installation cannot be completed as designed, work stops. The quality program will not allow work to be completed and accepted until the installation agrees with design documents.

Q.20 Please describe how CP&L's quality inspection/verification program for SHNPP helps to assure proper installation orientation of safety-related electrical equipment.

A.20 (EMcL) Inspection points are specified on the process control sheets in the work package. These inspection points are for such items as location, elevation, orientation, and anchor tightening. Certain installations require that the

construction engineer prepare process control sheets without predesignated inspection points. The construction engineer refers to design documents to prepare the appropriate inspection points. The inspection points are written in the form of a command with spaces for craft and inspector signatures for acceptability of completion of each command. These process control sheets are reviewed by the quality inspector and the resident engineer responsible for equipment installation. An inspection point is designated for those activities that affect the quality of the installation. There is an inspection point for almost every activity performed on the equipment. Until the inspection points for a piece of equipment are accepted, the installation is not acceptable and the procedural requirements are not satisfied.

Q.21 Who conducts these inspections?

A.21 (EMcL) Construction inspections are generally conducted by quality inspectors, who, depending on the equipment, may be either Construction Inspectors or Quality Control Inspectors. The inspector reviews the installation of the equipment according to the design information in the work package. The quality inspector records the inspections on inspection reports. If there is a discrepancy a nonconformance report is written and a "hold tag" is placed on the equipment, which may limit the work that can be performed. Each nonconformance report requires a specific disposition, i.e. rework, repair, scrap, or accept as-is, which requires design engineering approval.

Q.22 What additional assurance is there that electrical equipment is correctly installed with respect to physical orientation?

A.22 (EMcL) Through industry-wide programs, problems experienced by one utility are reported to other utilities and reviewed and evaluated by these other utilities. Problem experienced by equipment suppliers are also reported to the utilities that purchased their product. Engineering, Licensing and Corporate Nuclear Safety personnel are involved in problem evaluation.

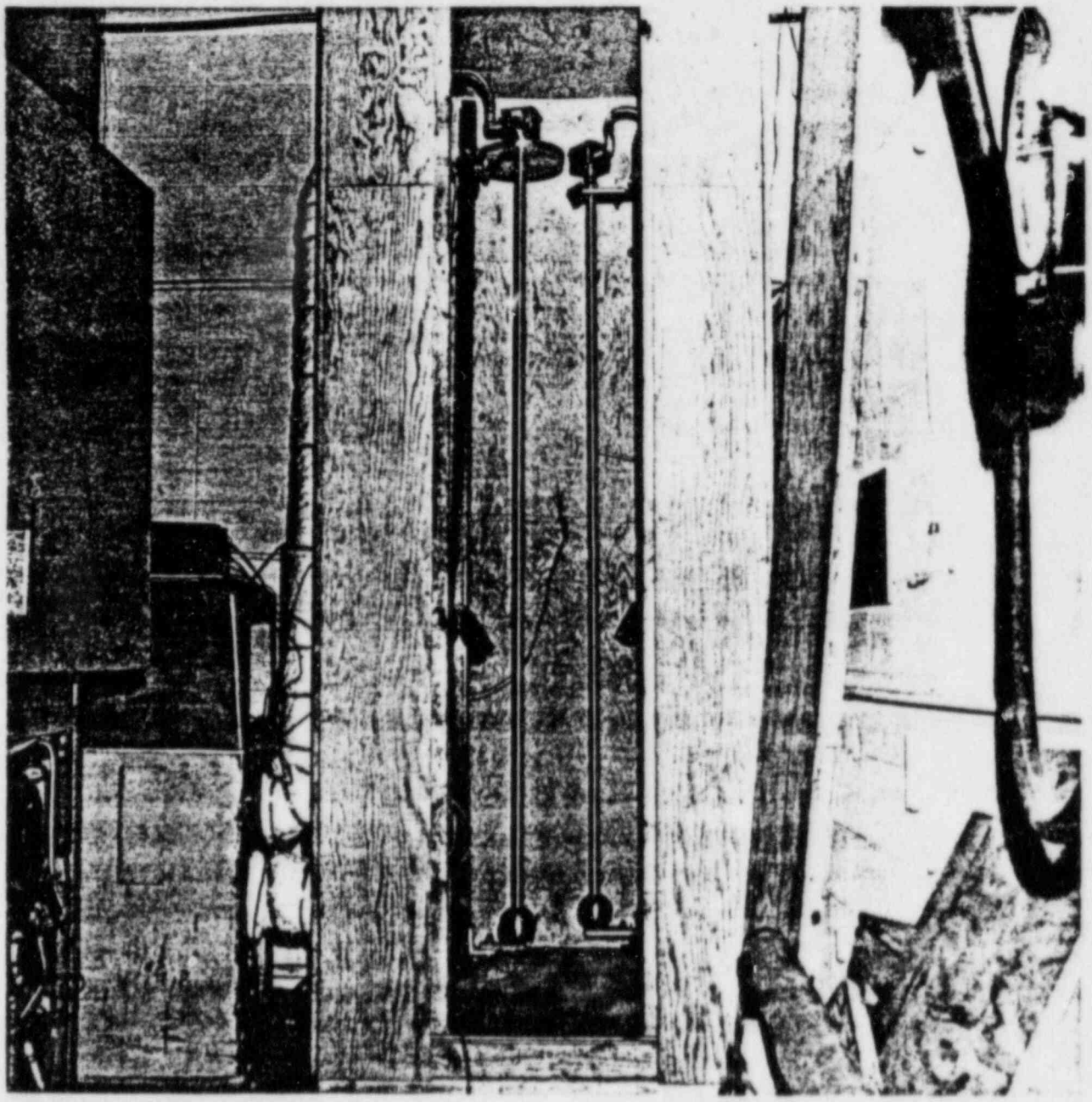
The construction personnel both in engineering support and field installation have accumulated years of experience in their work. Reporting potential problems is encouraged by management.

Finally, the start-up organization checks the equipment in its various modes prior to operation. These programs and the experience of SHNPP construction personnel provide additional assurance of the quality of installation of electrical equipment.

Q.23 In conclusion, do you believe that there is sufficient assurance that safety-related electrical equipment is installed so that physical orientation of the equipment does not prevent the equipment from being environmentally qualified?

A.23 (RMB, EJP, EMcL) Yes. Procedures established by CP&L and Ebasco require that installation design drawings reflect physical orientation limitations determined from review

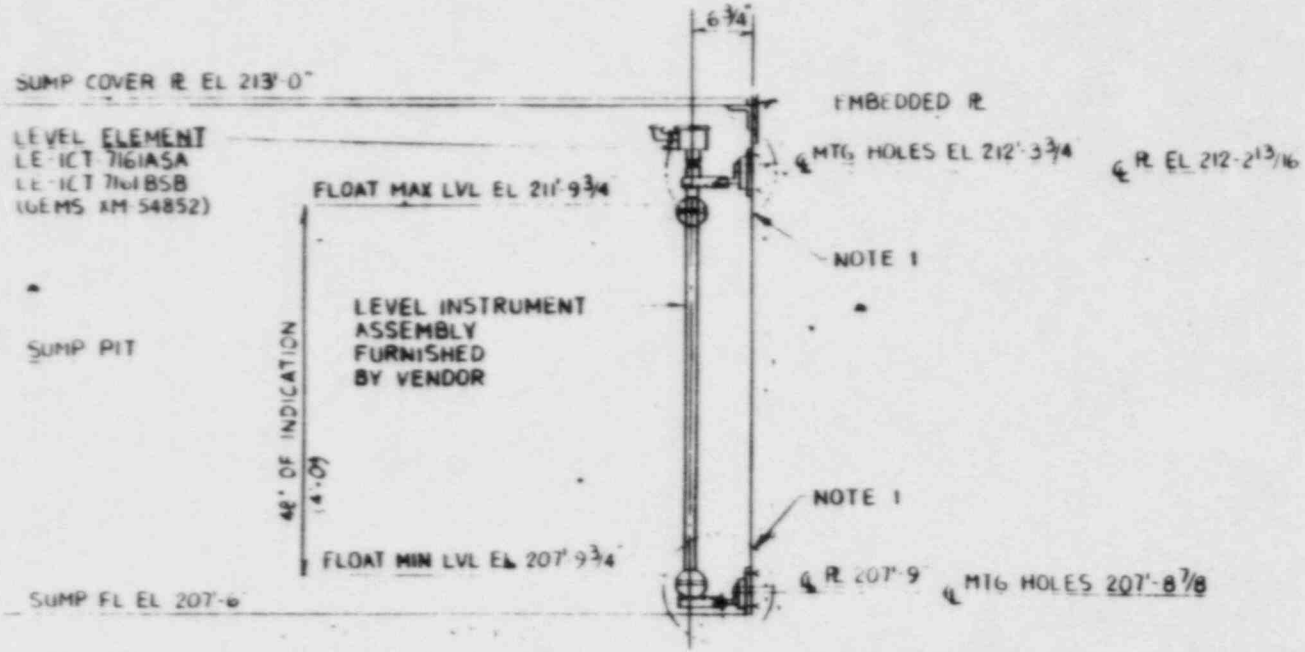
of environmental qualification test reports. Procedures for preparation of work packages and quality inspections ensure that installation of electrical equipment is in accordance with design drawings.



PHOTOGRAPH IV-3

TRANSMITTERS INSTALLED IN THERMAL AGING CHAMBER
WITH HEATING UNIT ATTACHED

Attachment B



CONTAINMENT BLDG SUMP LEVEL INSTRUMENT INSTALLATION
NARROW RANGE

I/DCN-	REV
	1
FCR'S/DCN'S INCORPORATED ON THIS DWG	

APPROVED FOR CONSTRUCTION
(CE-14331)

NUCLEAR SAFETY RELATED

NOTES
1. FOR SUPPORT DETAILS OF GEMS MOUNTING BRACKET SEE DWG CAR 2166 B-431 SH X 38

REV	DATE	BY	APPR
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7			
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9			

REV	DATE	BY	APPROVED
4			
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EBASCO SERVICES INCORPORATED
DIV T&C DR SZ
CH R BELISLE
APPROVED

CAROLINA POWER & LIGHT CO.
SHEARON HARRIS NUCLEAR PP
UNIT NO 1
INSTRUMENT INSTALLATION DETAILS

CAR 2166
B-431
SHEET 1 of 3