August 9, 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	)	Docket No. 50-400 OL
MUNICIPAL POWER AGENCY	)	
	)	
(Shearon Harris Nuclear Power	)	
Plant)	)	

APPLICANTS' TESTIMONY OF
JAMES F. NEVILL, ALEXANDER G. FULLER,
DAVID R. TIMBERLAKE AND KUMAR V. HATE
IN RESPONSE TO EDDLEMAN CONTENTION 41
(PIPE HANGER WELDING)

Q.1 Please state your names.

A.1 James F. Nevill, Alexander G. Fuller, David R. Timberlake and Kumar V. Hate.

Q.2 Mr. Nevill, by whom are you employed, and what is your position?

A.2 (JFN): I am Principal Engineer-Civil, Harris Plant Engineering Section, Harris Nuclear Project Department, Carolina Power & Light Company.

Q.3 Please summarize your professional qualifications and describe your involvement with pipe hangers at the Shearon Harris Nuclear Power Plant.

A.3 (JFN): I received a Bachelor of Science degree in Civil Engineering in 1971 from West Virginia Institute of Technology, and I am a registered Professional Engineer in the State of North Carolina. I have been employed by CP&L in various engineering assignments at the Shearon Harris site since September, 1973. A complete statement of my professional qualifications is appended as Attachment 1 to this testimony. Since March, 1982, I have been responsible for two Civil sub-units of the Harris Plant Engineering Section which perform the following functions with respect to pipe hangers: resolution of identified field problems, design of new pipe supports due to pipe/system changes, and stress analysis evaluations associated with field changes.

Q.4 Mr. Fuller, by whom are you employed and what is your position?

A.4 (AGF): I am Principal Engineer-Mechanical (Hanger Engineering), Harris Plant Construction Section of the Harris Nuclear Project Department, Carolina Power & Light Company.

Q.5 Please summarize your professional qualifications and describe your involvement with pipe hangers at SHNPP.

A.5 (AGF): I received a Bachelor of Science degree in Civil Engineering in 1973 from North Carolina State University, and I am a registered Professional Engineer in the State of North Carolina. With the exception of thirteen months in 1974-75 and eight months in 1976-77, I have been engaged in engineering assignments at the Shearon Harris site since May, 1973. A complete statement of my professional qualifications is appended as Attachment 2 to this testimony. From January, 1981, through September, 1983, I was the lead in the Hanger Engineering group responsible for the technical support of pipe hanger installation. I was also responsible for the revision of procedures for hanger installation and the resolution of nonconformances involving hanger installations. Since October, 1983, when the Hanger Engineering group was reorganized, I have been responsible for technical support of hanger installation.

Q.6 Mr. Timberlake, by whom are you employed and what is your position?

A.6 (DRT): I am Senior Engineer-Metallurgy/Welding in the Harris Plant Construction Section of the Harris Nuclear Project Department, Carolina Power & Light Company.

Q.7 Please summarize your professional qualifications and describe your involvement with pipe hangers at SHNPP.

A.7 (DRT): I received a Bachelor of Science degree in Engineering Operations from North Carolina State University in 1972. From 1972 to 1980, I worked for various firms as a welding engineer, as a pipe welder, and in welding supply. I am a certified welding inspector, a qualified welder, and a member of the American Welding Society. I have been employed by CP&L at the Shearon Harris site since August, 1980. A complete statement of my professional qualifications is appended as Attachment 3 to this testimony. I have been responsible for the review of pipe hanger sketches from the standpoint of welding requirements for field fabrication. I have been responsible for assigning welding procedures, filler metal and mandatory inspection holdpoints on Seismic Weld Data Reports, as well as supplying additional welding instructions as needed. I have also been responsible for resolving field-related welding problems, and have provided training to Quality Control-Welding inspection personnel and craft personnel. Finally, I have been responsible for maintaining and, as needed, revising the field welding procedure for pipe hangers.

Q.8 Mr. Hate, by whom are you employed and what is your position?

A.8 (KVH): I am employed by Carolina Power & Light Company's Corporate Quality Assurance Department at the Shearon Harris Nuclear Power Plant as Principal QA Engineer in the QA/QC Harris Plant Section.

Q.9 Please summarize your professional qualifications and describe your involvement with pipe hangers at SHNPP.

A.9 (KVH): I received a Bachelor of Science degree in Metallurgical Engineering in 1970 from the Indian Institute of Technology in Bombay, a Master of Science degree in Materials Engineering in 1972 from Mississippi State University, and a Master of Science degree in Management in 1984 from North Carolina State University. I am a registered Professional Engineer, and have been employed by CP&L in various QA assignments since July, 1974. A complete statement of my professional qualifications is appended as Attachment 4 to this testimony. The responsibilities of the QA/QC Harris Plant Section with respect to pipe hangers include performance of the following functions to assure that the hanger program is adequate and complies with regulatory requirements: review of construction specifications, procedures and documentation; weld inspections; QA surveillances; and nonconformance identification/resolution.

Q.10 What is the purpose of this testimony?

A.10 (AGF): The purpose of this testimony is to respond to Eddleman Contention 41, which states:

> Applicants' QA/QC program fails to assure that safety-related equipment is properly inspected (e.g. the "OK" tagging of defective pipe hanger welds at SHNPP).

In its Memorandum and Order of September 22, 1982, the Atomic Safety and Licensing Board clarified the scope of this

contention by holding that it does not cover the entire Quality Assurance (QA)/Quality Control (QC) program, but rather is limited to the assertion "that there exist defective hanger welds that have been improperly inspected and approved."

Q.11 How is your testimony organized?

A.11 (AGF): First we provide background information on pipe hangers, including an overview of the processes for design and fabrication, installation and inspections. Second, we describe the relevant deficiencies discovered in 1980 and in 1982, and the resultant reinspection programs and other corrective actions undertaken. Third, we assess the safety significance of these occurrences. Fourth, we describe the enhancements to the hanger program, implemented in December 1983, and demonstrate the effectiveness of that program in ensuring that the quality of the final hanger product is established. Finally, we assess the implications of the hanger program experience for the quality assurance program.

Q.12 Mr. Nevill, what is a pipe hanger?

A.12 (JFN): A pipe hanger is a component or structural assembly designed and installed to support or restrain a section of pipe subjected to a combination of loads, and which protects the pipe from stresses that could impair the pipe's ability to perform its function. For purposes of the QA program and this testimony, safety-related pipe hangers may be equated with the term seismic pipe hangers.

Q.13 Please summarize the design process for the seismic pipe hangers.

A.13 (JFN): The design of seismic pipe supports starts with the piping designer and pipe stress analysts. For SHNPP, the architect/engineer, Ebasco, is the organization responsible for piping design and analysis. The piping group develops pipe lay-outs to satisfy system function requirements and provides design parameters for stress analyses. The piping arrangement is then stress analyzed for operating loads, thermal loads, seismic loads and other appropriate loadings to determine location, function, and magnitude of support loads. This data is utilized by the support designer to develop pipe support designs.

The supports are designed to counteract the combined loads and to prevent the pipe from being overstressed. For SHNPP, Bergen-Paterson was the primary design and fabrication organization for the pipe supports.

Q.14 Are inspections performed at the vendor's facility?

A.14 (KVH): Yes. Welds received both in-process and final inspection by Bergen-Paterson inspectors, and hangers were presented to Ebasco inspectors for final approval prior to shipment. Inspections were conducted visually by trained inspectors using the Bergen-Paterson design drawing to identify size and type of weld and hanger geometry. Prior to the identification in 1982 of deficiencies in vendor-supplied welds, inspection was done on a sampling basis.

Q.15 How are the pipe hangers installed?

A.15 (AGF): Early in the hanger erection effort, CP&L studied the hanger erection problems being reported in the industry and visited several other sites to gain a better understanding of current hanger erection and inspection problems. It was concluded that many of the problems being encountered at other sites during the completion phase could be avoided if inspection started as early as possible. A complete hanger inspection cannot be accomplished, however, until both the pipe and hanger are installed in final location. This sometimes does not occur until late in the overall construction schedule. Site management nevertheless concluded that delaying any hanger inspection until the final phase of construction would deny the project an early indication of problems. It was also concluded that the absence of any early preliminary inspection contributed to the problems being reported at other sites.

Based on these considerations, the initial hanger erection program was set up to include an initial (Phase I) inspection and a final (Phase II) inspection. Phase I inspections were set up to include an intermediate check of location and an inspection of any field welding performed up to the point of inspection. Phase II inspections were to verify the total hanger installation after both pipe and hanger had been adjusted to final location and work was completed. In fact, to a great extent the deficiencies being discussed here were found as a result of the early start on inspection activities during Phase I

inspections. Consequently, the early inspections accomplished the goal of providing site management with early warning of potential hanger problems.

The following groups are involved in the installation of seismic hangers:

- Document Control issues and controls design documents.
- Harris Plant Engineering Section generates and approves design changes required.
- Hanger Engineering (Harris Plant Construction Section) provides technical support to the craft.
- Welding Engineering (Harris Plant Construction Section) provides technical support to the craft and hanger engineering.
- Construction Inspection (CI) inspects hangers for design compliance, including geometry, location, and bill of materials.
- QC performs receipt inspections and inspects hanger welds.

Installation involves the following basic phases: (1) receipt and processing of design documents; (2) receipt and inspection of material; (3) issuance of hanger design documents and material for construction; (4) installation and inspection of the hanger; and, (5) final documentation review.

Q.16 What is involved in the receipt and processing of design documents?

A.16 (AGF): Hanger design drawings are received by Document Control and are issued to Hanger Engineering for inclusion in the hanger work package.

Q.17 Mr. Hate, what presently occurs during the receipt and inspection of material?

A.17 (KVH): The hanger material for a particular design is received and inspected by QC for compliance to the purchase order (i.e., identification, dimensions, damage and shop welds).

Q.18 What presently takes place in connection with the issuance of the hanger work package and material for construction?

A.18 (AGF): First, the hanger design is surveyed in the field to minimize installation conflicts prior to material issue.

Second, an initial review group of Hanger Engineering personnel reviews the hanger drawing and develops a work package consisting of:

(1) A Seismic Weld Data Report (SWDR) for weld joint inspection records.

(2) A traveler for tracking the [illegible] of installation and inspection.

(3) Work directives for detailing special instructions if required.

(4) The hanger design drawing.

(5) Field modifications as required.

(6) A Material Verification Sheet.

Third, the hanger package is then "weldmapped" by numbering the welded joint(s) on the hanger. The field joint numbers are listed on the SWDR for tracking weld acceptance. This procedure was instituted in December 1983, per Work Procedure 139. Prior to implementation of WP-139, field welds were tracked by various methods.

Fourth, the package is reviewed by Welding Engineering to determine the particular welding procedure specification necessary in accordance with project site requirements, mandatory holdpoints for fitup and preheat prior to welding, and to identify unclear, missing, or erroneous welding instructions on the drawing. Any additional instructions are placed on the SWDR.

Fifth, QC Welding then reviews the new SWDR for completeness and accuracy. Documentation for previous welding is also reviewed and, if accepted, is transcribed forward to the new SWDR. Welds not yet accepted on the SWDR will be reinspected along with any additional new welding.

Sixth, the package is routed to the material handling group and the material is sent from the controlled storage warehouse to a lay down area.

Finally, the package is routed to a construction crew foreman who requisitions the material from the lay down area for installation.

Q.19 What presently is involved in the installation and inspection of a hanger?

A.19 (AGF, DRT, KVH): The following steps are involved in the installation and inspection process:

(1) The hanger members are fit-up, tack welded in place, and examined by Hanger Engineering personnel prior to weldout. Field Mods (modifications) are generated by Hanger Engineering personnel to resolve interferences or other installation problems.

(2) QC welding inspections are performed to insure fit-up compliance and preheat verifications as required by the SWDR.

(3) The hanger is welded out by qualified welders.

(4) Final shimming and adjustments are made to the hanger.

(5) Welding Engineering personnel examine hanger welds.

(6) Hanger Engineering personnel examine the hanger for compliance to the design intent. Field Mods may be generated to report the field condition to HPES (Harris Plant Engineering Section).

(7) CI (Construction Inspection) inspects hanger geometry, location, and other parameters for design compliance.

(8) QC Welding inspects hanger field welds and records the weld joint acceptance on the SWDR.

Q.20 What is the final documentation review?

A.20 (AGF): Final documentation review includes verification of the following: documentation has been properly completed and signed-off; pertinent documentation has been included in the hanger package; and modifications have been correctly incorporated into the final drawing.

Q.21 Mr. Haté, please describe in more detail the inspection process applicable to pipe hangers, including Vendor QA and the site inspections performed by the CI and QC organizations.

A.21 (KVH): CP&L has contracted with Ebasco for vendor surveillance pertaining to shop fabrication of hangers supplied by Bergen-Paterson. Ebasco Vendor QA performs surveillances, inspections, and audits of the vendor's facility and work activities. The actions include review of such documents as material test reports, inspection records and non-destructive test reports and coating records, and performance of shop inspections on work accomplished. Inspections now include, but are not limited to, inspection of welds on non-standard parts prior to painting. Nonconformances identified during the shop inspections are documented and resolved. Vendor-caused nonconformances identified by CP&L after receipt of the hanger on site are investigated by Ebasco Vendor QA and reviewed with Bergen-Paterson management to prevent reccurrence.

After completion of final inspection in the vendor's shop, Ebasco issues a Quality Release (QR) indicating the hanger is

acceptable and is ready for shipment to the field. Originally when hangers were received at the site they were accepted based on this QR. The hangers were also checked for identification, documentation, damage, and obvious welding discrepancies prior to release for installation. The quality attributes to be checked during receipt inspection were increased once QC inspections started noting discrepancies with previously accepted shop welds. Statistical sampling of vendor welds was initiated in May 1982. Due to the high reject rate experienced from this statistical sampling, 100 percent receipt inspection of vendor welds was initiated during June 1982. This high reject rate was due in part to the fact that vendor QA and site QC inspectors were using somewhat different weld acceptance criteria. The majority of welds rejected on site were for minor weld defects. Increased vendor QA inspection and standardization of weld acceptance criteria have resolved this problem. The inspection of shop weld quality attributes has been retrofit to include hangers received on site prior to June, 1982.

Inspection of pipe hangers in the field is performed by Construction Inspection (CI) and QC. The CI inspections address hanger attributes other than welding.

Inspection of welding performed on site is done by the QC Welding group. These inspections are performed to assure: compliance with the hanger drawings with respect to weld type, size and length; acceptability of materials; and weld quality.

These inspections are performed by inspectors who are qualified and certified in accordance with procedure CQA-1, and are performed in accordance with procedure CQC-19 (procedure on weld control) and NDEP605 (visual weld inspection procedure), and documented on a SWDR. Acceptance and rejection of the welds are noted on the SWDRs. Rejected welds must be dispositioned (reworked or waivered) and accepted by a QC inspector prior to final acceptance of the hanger. The SWDR is included in the hanger package and becomes a QA record. SWDRs are reviewed by the QC welding specialist for completeness and accuracy. The QC welding specialist periodically trends the weld reject rate to determine if an adverse trend is developing and whether management attention is required. Since the implementation in December 1983 of the enhanced hanger program, no adverse trends have been identified; rather, as discussed later, positive results have been noted.

Q.22 Were there early indications of pipe hanger problems at SHNPP?

A.22 (AGF): Yes. On September 3, 1980, the resident NRC inspector identified several hangers with unclear and incorrect weld symbols on Bergen-Paterson Seismic Class I pipe hanger drawings. Additionally, the NRC inspector identified cases in which the field applied weld was different from the drawing requirements and had not been identified by QC. This discovery was cited as an infraction in an inspection report dated November 3, 1980. Consequently, a site investigation by CP&L

into selected hanger drawings and installed hangers was conducted. The results indicated that several weaknesses existed in the program for installing and inspecting seismic hangers, in that a substantial number of seismic hanger drawings contained erroneous, missing, or unclear welding instructions, and many installed hangers were not welded to meet the design requirements or quality acceptance criteria. Due to the extensive scope of the problems identified, it was deemed necessary to reinspect seismic hangers on which field welding had been performed. A final report on the deficiencies and subsequent reinspection program was submitted to the Staff on May 1, 1981 (and revised on June 11, 1981); and the NRC closed out this item on September 14, 1981.

Q.23 What did the reinspection program consist of which was initiated as a result of discovering these problems?

A.23 (AGF): Approximately 1800 hanger design drawings which had been issued to the field were reviewed for missing, unclear, and erroneous weld symbols. These hanger drawings were issued to QC for reinspection. Of the 1800, approximately 1200 hangers were found to have some completed welds and these were reinspected by the QC inspectors. None of the hangers had yet been completed and finally accepted by QC. (The hangers had been basically assembled and some welding completed, but final adjustments and/or welding work remained to be done.) Discrepant welds were either reworked by craft personnel or accepted by the design organization on the basis of an appropriate engineering analysis.

Q.24 What corrective actions were undertaken with respect to review of hanger drawings?

A.24 (AGF, DRT): Hanger Engineering and Welding Engineering began reviewing pipe hanger design drawings for missing, unclear, and incorrect weld symbols prior to issuance to the field. Welding Engineering personnel performed the primary review for weld symbol problems. Drawings with problems were reported to Ebasco/Bergen-Paterson for correction via pipe hanger problem memos written by Hanger Engineering. Revised design drawings were received and reviewed to ensure that welds were properly dispositioned.

Ebasco discussed the design drawing problems with Bergen-Paterson, which identified the problem to its design personnel. Bergen-Paterson agreed to revise their review procedures to insure that design drawings show proper weld symbols. Drawings being issued from Bergen-Paterson's three design offices were routed through a single office to provide more consistent reivew by Bergen-Paterson engineering personnel.

Q.25 Were any corrective actions undertaken in connection with the welders?

A.25 (DRT): Yes. Weld symbol identification training classes were conducted by welding and hanger engineers. The classes consisted of training on AWS standard weld symbol nomenclature in accordance with AWS A2.4-79 as related to Bergen-Paterson pipe hangers. Craft personnel attending these

training classes included superintendents, general foremen, foremen and welders of pipe and pipe hangers. In addition to instructions on weld symbol identification, emphasis was given to the importance of welding the pipe hanger exactly as the design drawing requires. In those instances where this is not possible, due to physical limitations or drawing errors, craft personnel were directed to return the hanger drawing to Hanger Engineering.

Q.26 Were any other corrective actions initiated?

A.26 (KVH): Yes. QC personnel attended the weld symbol identification classes Mr. Timberlake just discussed, and additional classes given within their organization. These classes emphasized the necessity for inspections to be conducted strictly in accordance with drawing details and also instructed QC personnel to report incorrect design drawings to Hanger Engineering.

Q.27 Was there a subsequent reinspection?

A.27 (AGF): Yes, in 1982. Surveillances performed by Hanger Engineering identified hangers with documentation errors and weld defects. The Receipt Inspection Program, revised to encompass examination of vendor welds, discovered deficient shop welds made by Bergen-Paterson. Finally, it was determined that inspectors and craftsmen were using an improper technique in the measurement of skewed tee welds.

The widespread scope of these deficiencies made it necessary to reinspect seismic pipe hangers welded or partially

welded out prior to June 26, 1982. The reinspection program addressed both shop and field welds, and the results for each hanger were documented on that hanger's individual SWDR and dispositioned on that document.

Q.28 What did the 1982 reinspection reveal?

A.28 (AGF): The reinspection found: (1) missing and undersized shop and field welds; (2) minor shop and field weld defects; and (3) inaccurate and incomplete QC weld documentation.

Q.29 Why did these deficiencies occur in view of the corrective actions initiated after the discovery of deficiencies in 1980?

A.29 (AGF, DRT, KVH): Undersized skewed tee welds were not discovered until the first quarter of 1982, and therefore were not the subject of the efforts in 1980. Further, there had been no training of craft personnel, and improper training of inspectors, on the technique for measuring the fillet weld size on skewed tee joints.

Similarly, vendor-supplied welds were not part of the 1980 reinspection. While isolated cases of minor weld defects had been identified previously and documented on deficiency and disposition reports which were forwarded to Ebasco for strengthening of the vendor QA programs, the isolated nature of the defects indicated that the vendor QA program had been performing satisfactorily.

Neither did the 1980 reinspection address the documentation problems identified in 1982 caused by minimal review of weld records or the absence of a procedure for standardizing the requirements for completing documentation records. Finally, the 1980 reinspection relied on the qualifications of QC inspectors and their acceptance of welds as the final word, without routine checks or surveillances on their work.

Q.30 What corrective actions and/or preventive measures were undertaken as a result of the 1982 reinspection effort?

A.30 (AGF, DRT, KVH): Shop and field welds on installed hangers were reinspected and deficiencies were either reworked by the craft or evaluated and accepted by the design organization, except for the few hangers currently on design hold. Deficiencies were recorded on the SWDR and acceptance eventually recorded on that document by the QC inspection organization. In addition, vendor welds were examined prior to releasing material to the field for installation. Deficiencies noted were also either reworked or accepted by engineering evaluation. This program is still in progress.

In addition, the following measures were implemented:

(1) Weld acceptance criteria were revised to provide consistent inspection criteria to be used by site and vendor QA inspectors.

(2) Ebasco assigned four vendor QA representatives to the Bergen-Paterson facility and began performing both in process and 100 percent final visual weld inspections. These

inspections consist of a visual inspection of shop welds prior to coating of the hangers. After the hangers are coated, they undergo a dimensional and coating inspection. (Prior to the corrective action, Ebasco had one vendor QA representative assigned to the Bergen-Paterson facility who performed random dimensional, coating and welding inspections when the hangers were ready for shipment.)

(3) An inspection/documentation procedure specifically for pipe hanger welding was developed.

(4) Routine audits of each QC inspector's field work were implemented by QC supervisors.

(5) Weld documentation was reviewed to insure it was correct and complete.

(6) Additional training on weld acceptance criteria (including skewed tee welds) was initiated.

Q.31 Mr. Nevill, the witnesses have been describing various deficiencies discovered in connection with the welding of seismic pipe hangers. Are there design considerations which might provide some perspective on the significance of the deficiencies?

A.31 (JFN): Yes. There are various input criteria used in support design that induce conservatism in support functions. I will briefly describe these conservative aspects, which are considered inherent to the design process but are not routinely utilized in engineering evaluations of a defective condition.

(1) Material Properties. Actual mil test reported values of material stresses are typically higher than the specified nominal stress properties used in design.

(2) Design Allowables. Design codes and regulatory agencies dictate allowable stresses and loading combinations. Margin exists between the stress limits used in design when comparing allowable, yield, and ultimate stresses. Design loading aspects are combined in a manner to assure the governing design input provides worst-case analysis.

(3) Minimum Weld Size. The design codes require the application of minimum weld sizes. Compared to actual loading conditions, minimum weld size may be larger than the size required to resist the design stresses.

(4) Response Spectra Curves. The engineering application of response spectra curves provides margin due to the need to address complexities in the time history seismic modeling technique. Curves are broadened, enveloped, and amplified for qualification and design of plant systems and structures, which increase the range of frequencies using peak values as well as increasing accelerations throughout the entire frequency range. This results in analyses using conservatively higher seismic inputs than will actually occur.

(5) Support Stiffness. Structural designs are based on stress levels and deflection criteria. Since the pipe analysis dictates deflection limitations, the support design deflection criteria rather than stress levels typically govern the member

size and support configuration. Weld sizing is developed from the stress levels, and therefore margin is induced.

Where weld problems are accepted by engineering evaluation, various applications of design techniques are available to determine functional acceptance. Examples are: comparison of actual weld stresses to allowables; additional pipe analysis to reduce the loading on a particular hanger; or computer modeling in place of hand calculations.

Q.32 What is the significance, then, of the typical pipe hanger welding deficiencies in light of these design conservatisms?

A.32 (JFN): The types of weld defects reported primarily involved relatively minor instances of undersize, undercut, lack of fusion and porosity. Consideration of conservative aspects of the design criteria indicates the significance of the typical deficiency to be minor and to have no adverse impact on structural integrity.

Q.33 For the 1980 and 1982 reinspections, did you frequently rely on engineering evaluations to disposition pipe hanger welding nonconformances?

A.33 (AGF): No. The majority of the deficiencies identified in these reinspections were not evaluated to determine if they were acceptable as is, but were repaired due to the economics associated with the engineering evaluation.

Q.34 Have further changes been made to the pipe hanger program since 1982?

A.34 (AGF, DRT, KVH): Yes. An enhanced hanger installation/inspection program was put into place in December 1983 in order to provide more positive control of construction, inspection and documentation activities. The enhanced program was initiated by QA and Construction management to achieve these goals. The key elements of the enhanced program are as follows:

(1) A work package group has been created to review hanger work packages prior to issuance to the field. During the review the hanger sketch is weld mapped for inspection documentation and the drawing is checked for constructability. Weld mapping has provided a high level of confidence that welds are inspected and accepted. (This is being retrofitted to previously installed hangers as well as applied to the installation of new hangers.) This review also insures that necessary documentation and instructions for installation and inspection are present in the package prior to issuance to the field. Hangers are also surveyed in the field to insure that the hanger can be installed with minimal interferences with existing structures.

(2) The seismic hanger work procedure has been revised and its requirements simplified. Generic engineering documents are no longer used as solutions to common problems. Instead, field modifications are written for each hanger detailing necessary changes due to these problems. This has greatly reduced the potential for misinterpretation and subsequent misapplication of construction requirements.

(3) A field hanger engineering support unit has been developed whose purpose is to support the craft during hanger installation. These Hanger Engineering personnel remain in the field thoughout the hanger's construction and identify and resolve installation problems. These efforts produce additional confidence that the design organization's intent is being met during construction. Field Hanger Engineering personnel also examine the hanger for design compliance and have Welding Engineering personnel examine hanger welds (both shop and field) prior to submitting the hanger package to CI and QC for final inspection. Hanger Field Mods are generated by Hanger Engineering personnel to resolve problems encountered. These examinations by the Hanger and Welding Engineering personnel will generate higher quality levels in the work being presented for final inspection and thereby render this process more effective.

(4) In addition to CI and QC review, a Hanger Engineering final review group has been formed to review seismic hanger packages prior to final turnover to the permanent QA records vault. Hanger package documentation is verified as being complete and accurate.

Q.35 Is there any evidence that the enhanced program is effective?

A.35 (KVH): Yes. For example, in the second quarter of 1984, approximately 93 percent of the quality attributes presented by the craft to CI for inspection were found to be

acceptable. Also, approximately 93 percent of the work presented by the craft to QC for weld inspection was found to be acceptable. In addition, an independent check of inspector performance for the period February to April, 1984, by QA surveillance revealed a 99.82 percent acceptance rate for CI-inspected attributes and a 99.37 percent acceptance rate for QC Welding inspected attributes.

Q.36 What are the implications of the pipe hanger welding experience, if any, for the effectivenss of the QA/QC programs for construction of SHNPP?

A.36 (KVH): The fact that improvements have been made over a period of time does not undermine my view that our QA/QC programs have been effective in discovering and reporting deficiencies. Weaknesses were looked for and identified early in the hanger program, and the QA/QC programs were strengthened. As with any program of procedures, the human element exists and mistakes will be made. One measure of program effectiveness, however, is the ability to identify weaknesses and correct them; and another is the prompt implementation of corrective actions necessary to preclude recurrence of identified deficiencies. The corrective steps taken in the resolution of these problems represent a systematic and prudent approach to assure a safe and quality product. As demonstrated by the audit results I discussed above, the improvements in the hanger program, vendor surveillance activities, receipt inspection and installation inspections, along with increased

field surveillances have resulted in a program which assures that desired results are and have been achieved.

JAMES F. NEVILL

Principal Engineer - Civil

Date of Birth: January 12, 1947

I. EDUCATION

A. B.S. Degree in Civil Engineering from West Virginia Institute of Technology, 1971

II. EXPERIENCE

A. June 1967 to September 1973

1. Newport News Shipbuilding & Dry Dock Company

a. June 1967 to January 1968 - Junior Engineer - Drafting experience with compartment and access plans. Returned to school.

b. May 1968 to August 1968 - Junior Designer - Drafting experience in structural and welding detail. Returned to school.

c. January 1969 to August 1969 - Junior Designer - Drafting experience associated with structural design. Returned to school.

d. May 1970 to August 1970 - Designer - Aiding engineers in design. Returned to school.

e. January 1972 to September 1973 - Engineer - Supervision of construction for fabrication of two nuclear submarines.

B. September 10, 1973 to Present

1. Carolina Power & Light Company

a. September 10, 1973 - Employed as a Junior Engineer in the Nuclear Construction Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

b. June 8, 1974 - Promoted to Civil Engineer, Nuclear Construction Section, Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

c. September 27, 1975 - Reclassified as Engineer II, Nuclear Construction Section, Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

d. August 14, 1976 - Promoted to Engineer III in the Nuclear Construction Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

e. November 5, 1977 - Promoted to Senior Engineer in the Nuclear Construction Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

f. June 16, 1979 - Promoted to Project Engineer - Civil in the Harris Site Management Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

g. June 28, 1980 - Promoted to Principal Engineer - Civil in the Harris Site Management Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, NC.

h. July 5, 1980 - Transferred to Nuclear Power Plant Engineering Department, Harris Plant Engineering Section, as Principal Engineer-Civil. Located at the Harris Site, New Hill, NC.

III. <u>PROFESSIONAL SOCIETIES</u>

A. Engineer-In-Training with State Board of Registration for Professional Engineers of West Virginia.

B. Professional Engineer Registered in North Carolina, February 9, 1979.

Alexander G. Fuller

Principal Engineer - Mechanical

I. Date of Birth - October 14, 1951

II. Education

A. BS Degree in Civil Engineering from N. C. State University, 1973.

III. Experience

A. Summer, 1970

1. Carolina Builders

a. Salesman.

B. Summers, 1971 and 1972

1. N. C. State Highway Commission

a. Engineering Assistant.

C. May 29, 1973, to Present

1. Carolina Power & Light Company

a. May 29, 1973 - Employed as Junior Engineer in the Construction Section of the Power Plant Engineering & Construction Department. Located at the Harris site, New Hill, N. C.

b. September 1, 1973 - Transferred from Power Plant Engineering & Construction Department to Power Plant Construction Department, Nuclear Construction Section. Located at the Harris site, New Hill, N. C.

c. August 17, 1974 - Transferred from the Nuclear Construction Section to the Fossil Construction Section. Assigned to Cape Fear Plant working out of General Office.

d. January 18, 1975 - Promoted to Civil Engineer in the Fossil Construction Section of the Power Plant Construction Department. Assigned to Cape Fear Plant working out of General Office.

e. September 27, 1975 - Transferred from Fossil Construction Section to Nuclear Construction Section. Located at the Harris site, New Hill, N. C.

f. September 27, 1975 - Reclassified as Engineer II in the Nuclear Construction Section of the Power Plant Construction Department. Located at the Harris site, New Hill, N. C.

g. August 16, 1976 - Transferred from Harris site to Cape Fear Plant as Engineer in the Nuclear Construction Section of the Power Plant Construction Department. Assigned to supervise contractor accomplishment of drainge modifications at the Cape Fear Plant.

h. April 2, 1977 - Transferred from Cape Fear Plant to Harris site as Engineer in the Nuclear Construction Section of the Power Plant Construction Department. Resumed duties as civil engineer in the Resident Engineer subunit.

i. March 25, 1978 - Promoted to Senior Engineer in the Nuclear Construction Section of the Power Plant Construction Department. Located at the Harris site, New Hill, N. C.

j. July 1, 1978 - Transferred to the Miscellaneous Projects Unit in the Nuclear Construction Section of the Power Plant Construction Department. Assigned to supervise contractor accomplishment of the main dam. Located at the Harris site, New Hill

k. November 15, 1980 - Promoted to Project Engineer - Civil in the Miscellaneous Projects Unit, Nuclear Construction Section, Power Plant Construction Department. Located at the Harris site, New Hill, N. C.

l. January 31, 1981 - Transferred to the Mechanical Engineering Subunit in the Harris Site Management Section of the Nuclear Plant Construction Department. Located at the Harris site, New Hill, N. C.

m. June 27, 1981 - Reclassified as Project Engineer-Mechanical in the Harris Site Management Section of the Nuclear Plant Construction Department. Located at the Harris site, New Hill, N. C.

n. October 30, 1982 - Promoted to Principal Engineer-Mechanical in the Harris Site Management Section of the Nuclear Plant Construction Department. Located at the Harris site, New Hill, N. C.

o. September 3, 1983 - Reorganization - Group, Department, and Section renamed to Nuclear Generation Group, Harris Nuclear Project Department, Harris Plant Construction Section. Located at the Harris Plant, New Hill, N. C.

IV. <u>Professional Societies</u>:

A. Professional Engineer Registered in North Carolina - July 7, 1978

David R. Timberlake
Senior Engineer

I. Date of Birth - June 26, 1950

II. Education

A. BS Degree in Engineering Operations for N. C. State University, 1972

III. Experience

A. June, 1972 to September, 1974

1. Newport News Shipbuilding

A. Welding Engineer

B. February, 1975 to November, 1977

1. National Welders, Charlotte, N. C.

a. District Manager - managed retail welding supply distributorship

C. December, 1977 to May, 1978

1. Victor Equipment Company, Denton, Texas

a. Contractor Specialist

D. May, 1978 to March, 1979

1. Brown & Root, Glen Rose, Texas

a. Pipe Welder

E. April, 1979 to February, 1980

1. Brown & Root, Roxboro, N. C.

a. Welding Engineer

F. March 3, 1980, to Present

1. Carolina Power & Light Company

a. March 3, 1980 - Employed as a Construction Specialist in the Brunswick Site Management Section of the Power Plant Construction Department. Located at the Brunswick site, Southport, N. C.

b. August 1, 1980 - Transferred to the Harris Site Management Section of the Power Plant Construction Department. Located at the Harris Site, New Hill, N. C.

c. November 15, 1980 - Reclassified to Engineer in the Harris Site Management Section of the Power Plant Construction Department. Located at the Harris site, New Hill, N. C.

d. January 31, 1981 - Reorganization - Department renamed to Nuclear Plant Construction.

e. March 5, 1983 - Promoted to Senior Engineer in the Harris Site Management Section of the Nuclear Plant Construction Department. Located at the Harris Site, New Hill, N. C.

f. September 3, 1983 - Reorganization - Department renamed to Harris Nuclear Project - Section renamed to Harris Plant Construction.

IV. Professional Societies

A. American Welding Society

V. Certification

A. Certified Welding Inspector (AWS) - Certificate #82055171

Kumar V. Hate'
Principal QA Engineer

I. Date of Birth

January 30, 1947

II. Education and Training

A. BS Degree in Metallurgical Engineering, Indian Institute of Technology, Bombay, India, 1970

B. MS Degree in Materials Engineering, Mississippi State University, State College, Mississippi, 1972

C. MS Degree in Management, NC State University, Raleigh, North Carolina, 1984

D. Completed course in "Quality Assurance", Ohio State University, Columbus, Ohio, 1974

III. Experience

A. AMBAC Industries, Columbus, Mississippi

1. October 1971 - September 1972

a. Engineering Laboratory Technician

2. September 1972 - July 1974

a. Materials Engineer

B. Carolina Power & Light Company

1. July 1974 employed as a QA Engineer in the QA Section of the Power Plant Engineering Department. Located in the General Office, Raleigh, North Carolina.

a. September 1975 reclassified as a QA Engineer II in the QA Section of the Power Plant Engineering Department. Located in the General Office, Raleigh, North Carolina.

b. June 1976 promoted as a QA Engineer III in the QA Section of the Power Plant Engineering Department. Located in the General Office, Raleigh, North Carolina.

c. November 1976 transferred and reclassified as a QA Engineer in the Engineering & Construction QA Section of the Technical Services Department. Located in the General Office, Raleigh, North Carolina.

d. July 1977 promoted as a Senior QA Engineer in the Engineering & Construction QA Section of the Technical Services Department. Located in the General Office, Raleigh, North Carolina.

e. June 1979 promoted as a Project QA Engineer in the Engineering & Construction QA Section of the Technical Services Department. Located in the General Office, Raleigh, North Carolina.

f. March 1981 transferred as a Project QA Engineer in the Engineering & Construction QA/QC Section of the Corporate Quality Assurance Department. Located in the General Office, Raleigh, North Carolina.

g. February 1982 promoted and transferred as a Principal QA/QC Engineer in the Engineering & Construction QA/QC Section of the Corporate Quality Assurance Department. Located at the Harris site, New Hill, North Carolina.

h. February 1983 - SECTION TITLE CHANGE - Principal QA/QC Engineer in the QA Engineering Unit of the QA/QC Harris Plant Section of the Corporate Quality Assurance Department. Located at the Harris site, New Hill, North Carolina.

i. March 1983 reclassified as a Principal QA Engineer in the QA Engineering Unit of the QA/QC Harris Plant Section of the Corporate Quality Assurance Department. Located at the Harris site, New Hill, North Carolina.

IV. Professional Societies

A. Licensed Professional Engineer, Commonwealth of Virginia, April 1973