UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of	)	
	)	
LOUISIANA POWER AND LIGHT COMPANY	)	Docket No. 50-382
	)	
(Waterford Steam Electric Station, Unit 3)	)	

AFFIDAVIT OF ROBERT E. SHEWMAKER

Q.1. Please state your name, title and by whom you are employed?

A.1. My name is Robert E. Shewmaker. I am employed as a Senior Civil-Structural Engineer in the Engineering and Generic Communications Branch of the Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission. A statement of my professional qualifications is attached.

Q.2. What is the purpose of this affidavit?

A.2. The purpose of this affidavit is to provide a summary of the inspection efforts, technical assessment, and conclusions reached by the civil/structural allegation review team which I supervised at the Waterford site during April and May, 1984, relative to the concrete cracks and water seepage that have been discovered in the common foundation base mat at Waterford Unit 3.

Q.3. Please describe the nature of your involvement with issues related to the Waterford common foundation base mat?

A.3. I first became involved with these issues when I was assigned to be the civil-structural engineer on the Office of Inspection and Enforcement's Waterford Inquiry Team on June 21, 1983, following the May 1983 discovery of cracks in the base mat. The Inquiry Team focused on three issues: (a) the cracking discovered in both 1977 and 1983, (b) water leakage through the base mat, and (c) potential design questions concerning the size of dewatering pumps and techniques used to provide a "watertight barrier". The Inquiry Team's evaluation, recommendations and conclusions with respect to these matters were provided in a memorandum dated July 14, 1983, and were forwarded to the Atomic Safety and Licensing Appeal Board on September 15, 1983 (Board Notification BN-83-133).

Following the filing of a motion to reopen this proceeding to consider the base mat cracking, the Inquiry Team's report and other information were transmitted to Dr. John Ma, the Staff's reviewer in the Office of Nuclear Reactor Regulation who had then been assigned lead responsibility to evaluate the adequacy of the base mat in conjunction with the Staff's preparation of a response to the motion to reopen. Thereafter, I provided some limited assistance to the NRR Staff in its base mat review efforts, prior to the filing of Staff affidavits on November 28, 1983.

Following the publication of certain allegations concerning the Waterford facility, on April 5, 1984 I was assigned to the special Task Force which had been formed to review those and other Waterford-related allegations, including allegations related to the

foundation base mat. I arrived at the Waterford site on April 9, 1984, as a member of that Task Force, and participated in the on-site allegation review effort until May 25, 1984, when that portion of the Task Force efforts were completed. Since then, I have been involved in preparing written evaluations and summaries of the Task Force findings.

Q.4. Please describe your responsibilities as a member of the Waterford Task Force?

A.4. The Task Force was comprised of some 40 individuals, organized into four teams; one of these teams was assigned responsility for reviewing allegations in the civil/structural and piping/mechanical disciplines, under the direction of a single team leader, Dr. Lawrence Shao. I served as group leader for the civil/structural disciplines, reporting to Dr. Shao.

The civil/structural discipline group, in addition to myself and Dr. Shao, consisted, on the average, of six individuals. I was assigned responsibility to supervise these individuals in their review efforts, to ascertain the facts pertaining to all allegations made concerning civil/structural matters, to evaluate the safety significance of the allegations which were found to be substantiated, and to determine whether those items raised questions with generic implications.

Q.5. Will the Task Force findings be published by the Staff?

A.5. Yes. It is my understanding that the Task Force findings, along with written summaries of the allegations reviewed and their disposition, are scheduled to be published within the next few weeks.

Q.6. Please describe the means by which the civil/structural allegation team performed its review of base mat-related allegations?

A.6. The team took as its starting point the specific allegations, including the allegations which had appeared in various newspaper articles, and transcripts of allegations which had been obtained in interviews with certain allegers; this information was organized and sifted by the team in arriving at a concise statement of the allegations. The team then reviewed the pertinent engineering and quality assurance documents, related to the construction of the base mat, which had been prepared by EBASCO, the Applicant's architect-engineer; these included the applicable engineering specifications, engineering drawings and, in some instances, additional documents. Additionally, the team reviewed the work procedures which had been developed by J.A. Jones Construction Company, as well as the construction quality control inspection procedures of both EBASCO and J.A. Jones Construction Company.

Once the assigned team member arrived at an understanding of the applicable engineering, inspection and quality requirements disclosed by these documents, insofar as they related to the issues raised by a particular allegation, the team member would gather all pertinent facts which could be assembled, and an evaluation was performed as to whether the allegation was valid. Where an allegation was found to be valid, a determination would be made as to whether the issue was significant from a safety standpoint. Finally, where an allegation was found to be valid, a determination would be made as to whether the issue had any generic implications.

In performing these activities, the team members utilized various methods, such as interviews, obtaining sworn statements, field inspections, reviews of records and construction photographs, and meetings with applicable personnel.

Q.7. Please describe the aspects of base mat construction in which allegations were considered by the civil/structural review team?

A.7. The team considered allegations involving various aspects of the materials used, construction, inspection, and testing of the base mat and its components, including personnel qualifications, as follows:

a. The materials used, placement, compaction, and testing of the clam shell filter blanket beneath the base mat;

b. The reinforcing steel, including Cadweld splicing and reinforcing placement;

c. The materials used, splicing techniques, and installation of construction joint waterstops;

d. The concrete materials, concrete mix, and concrete placement, curing and testing;

e. Soil backfill placement against the base mat and walls of the nuclear plant island structure; and

f. Inspector certifications.

Q.8. Please describe the findings of the civil/structural allegation review team, relative to the base mat-related issues which it reviewed?

A.8. The overall findings of the team relative to the base mat-related issues it reviewed, as set forth in response to question 7 above, are as follows.

Clam Shell Filter Blanket

The team's review of records related to construction of the clam shell filter blanket, including the placement of a filter cloth between the natural soil and the clam shell, focused on an extensive nonconformance report relating to this subject. Various difficulties in controlling water, placing filter cloth, placing and compacting the clam shell, as well as mud spurts, were documented in this NCR. At the same time, the team found that a qualified geotechnical engineer from EBASCO's engineering office was on-site during this period and was directly involved in the construction effort and in resolving construction difficulties as they arose. While unexpected occurrences were encountered during placement of the clam shell filter blanket, the team found that this is normally the case where non-homogeneous materials are involved. The team concluded that, on balance, the clam shell filter blanket was adequately placed.

Reinforcing Steel and Cadwelding

The team's review of records of user testing of the reinforcing steel indicated that the supplied material met applicable specifications. Also, the photographs which were reviewed on a random basis indicated that the reinforcing steel was placed in accordance with engineering design drawings.

The allegations related to Cadwelding were consolidated into four subject areas. These were assessed as follows:

(a) Signatures and Initials

The team found that some entries were made on daily Cadweld inspection reports by persons other than the person whose initials or signature appeared on the document, as had been alleged. The team identified no questions, however, as to the actual data recorded on the forms. The Cadweld inspection process involved color coding the completed Cadwelds to indicate whether they were accepted or rejected and, in some cases, whether they had been selected on a random basis for tensile testing. Based on the Applicant's detailed procedures for inspection and color coding, and on the team's records review, the team is satisfied that the Cadwelds were installed properly and that there is no safety significance or generic implication associated with this issue.

(b) Replacement and Reconstruction of Records

The team found that tensile test records were created to replace lost, missing or damaged records; however, these reconstructed records had as their basis the original test lab's log book, which was maintained at the location of the testing machine. No discrepancies were found for the record samples selected for review by the team. Thus, while the allegation was substantiated, it was found to have neither safety significance nor generic implications.

(c) Oversized Cadweld Sleeves

The allegation that oversized Cadweld sleeves had been used was found to be substantiated; however, the team found that this was a permissible practice as long as certain safeguards and restrictions were utilized. The team verified that the manufacturer's recommendations and procedures had been followed, and that the oversized Cadweld sleeves had

been properly installed and successfully tested as part of the production sampling program. Thus, while the allegation was substantiated, it was found to have neither safety significance nor generic implications.

(d) Specifications for Cadweld Sampling, Testing and Inspection

The team examined several allegations that various Cadweld splicing activities did not fully meet the specifications. The team reviewed selected examples of Cadweld test records to compare with the specifications, and found that, in most instances, the sampling, testing and inspection requirements had been met. The team did, however, determine that the records related to all Cadweld splicing should be consolidated and the data put into a format consistent with the specification requirements, and that this should be accomplished before the team can reach a final generic assessment. Notwithstanding the need for this to be accomplished, however, the team is confident that there is no safety significance involved with this matter for the following reasons. First, of the approximately 600 Cadweld splices subjected to testing (out of more than 14,000 Cadweld splices made), only six were noted to be failures. i.e., only six Cadwelds did not sustain the specified stress level; however, even these six still carried significant stresses equal, at least, to the minimum yield stress of the reinforcing steel. In addition, there is reason to believe that when the reassembled data are submitted, the specification requirements will be found to have been met in nearly all cases, since the test data demonstrate that consistently good Cadweld splices were made at the Waterford construction site.

Waterstops

The waterstop materials, splicing techniques and placement of the waterstops were reviewed by the team, even though the waterstops are classified as non-Category I, because of the leakage that had been experienced by the base mat. The team agreed that the waterstops were properly classified as non-safety related, because the base mat water collection system (which would include the collection of rainwater accumulating on the surface of the base mat) appeared to be adequate to dispose of a considerable volume of water. The team noted that very detailed splicing, repair, installation and inspection procedures were available and used during the construction period, and an examination of available photographs added to the team's confidence that good quality work was executed on the waterstops.

Concrete

Considerable effort was devoted to reviewing all phases of the concrete activities involved in construction of the base mat. This included reviewing the records related to the basic ingredient materials and the tests performed to verify conformance to material specifications, as well as records relating to the mixing, transporting, placing, curing, and testing phases of the concrete construction. Particular emphasis was given to searching for possible causes or contributors to base mat cracking or degradation. Many monitored properties and characteristics of concrete were studied during this review, utilizing the allegations that had been made concerning record and document deficiencies. In this regard, the team was assisted by an independent consultant, Mr. Robert E. Philleo,

who is a past president of the American Concrete Institute and former Chief of the Structures Branch, U.S. Army Corps of Engineers.

The team's extensive review led it to conclude that the deficiencies noted in nonconformance reports and other documents were not of the type or magnitude to have been significant factors in causing base mat cracking or leakage. For example, the team's review and evaluation of the complete records packages for 20 of the 28 concrete placements of the base mat resulted in finding only minor record discrepancies, in addition to the deficiencies already identified by the Applicants' quality assurance program. The team's finding that these deficiencies were not significant from a safety standpoint was concurred in by Mr. Philleo based upon his review of the records and observations of the base mat; Mr. Philleo concluded that the construction of the base mat was adequate to insure the safety of the structure, and that the structural integrity of the base mat was not impaired. See "Evaluation of Concrete Construction Adequacy in the Basemat, Waterford Unit No. 3," by Robert E. Philleo, Consulting Engineer, at 7 (Enclosure 1 to Memorandum from L. C. Shao to Dennis Crutchfield, dated May 21, 1984, filed with the Atomic Safety and Licensing Appeal Board on June 15, 1984).

Soil Backfill

Three allegations were made concerning the records of soil backfill placed in the excavation next to the base mat and walls of the nuclear plant island structure in depths of up to 60 feet. The first allegation asserted that during a quality assurance review of soils records, several deficiencies had been found in the records for a particular layer of soil backfill; the team found this allegation to

be substantiated. The second allegation asserted that the soils records review had been halted prior to being completed; the team found that this allegation was correct at one time, but that, subsequently, a 100% review of soil backfill records was completed. However, in reviewing some samples from these records, the team found that substantial errors and discrepancies still existed. For example, the team could not locate the inspection packages for a layer of backfill soil in one of the seven backfill areas; this was a different layer and area than that which was the subject of the allegation discussed above.

The team's findings relative to missing soil backfill documents leaves open a question as to the adequacy of backfill placement and compaction. The Applicant has been requested to take action on the soil backfill question identified by the civil/structural team, in order to verify the capability of the soil and its response to lateral loadings; also, the Staff has indicated that it may be necessary for the Applicant to obtain samples or other field data in order to resolve this concern. Nonetheless, the team does not believe that the fact that soil records are missing will have any impact on plant safety, due to the limited soil volumes involved and the absence of any reason to believe that compaction results were obtained in those areas which were significantly different from the compaction results reflected in other records. This item does not entail any generic implications, since all other soil data appeared to be accurate and indicated that the soils criteria had been met.

The third allegation in this area asserted that the recorded physical locations of where soil test samples had been taken

actually fell outside the backfill area. The civil/structural team believes that this discrepancy represents a documentation problem resulting from a basic error in defining the coordinates of the locations from which the test samples were obtained; the team found no reason to believe that the test samples were, in fact, taken outside the backfill area. This allegation is not believed to have any safety significance or generic implications.

Inspector Certifications

The team pursued several allegations concerning the certification of inspectors and found that, in the area of concrete construction, certain requirements, especially related to the experience of the inspectors, had not been fully met. Also, the team found one instance in which a waiver had been granted from a training course and from an exam, without any explanation provided. These findings led the team to conclude that additional assurance that these waivers were justified and proper should be required of the Applicant. While this situation cannot be associated with any specific item of safety significance, it should have been identified and corrected through the quality assurance program. Nonetheless, these waivers do not appear to have had any impact on the quality of the base mat. For example, in one case where the team identified a concern about an inspector's qualifications, information was obtained which indicated that an engineering representative from EBASCO's home office was directly involved in the decisions being made by the inspector and was, in effect, controlling activities with the assistance of the inspector in question.

Q.9. Did the civil/structural team identify any other open issues apart from those raised by allegation?

A.9. Yes. During the team's on-site walkdowns and inspection effort, the team found an electrical conduit of approximately six inches in diameter that contained what appeared to be ground water above the elevation of the base mat. The Staff is requiring adequate sealing and closure of this potential leaking path by the Applicant. While this situation was judged not to have any real safety significance, since the floor drain system could remove any inflow by pumping, the team considered it appropriate to require the closure and sealing of this pathway in the interest of preventing such inflow from occurring.

Q.10. Have any of the items related to the foundation base mat which were reviewed by the civil/structural allegation review team been identified as having potential safety significance?

A.10. Yes. Items 7, 10, 11, and 19, as set forth in a letter from Darrell G. Eisenhut to LP&L, dated June 13, 1984 (submitted to the Atomic Safety and Licensing Appeal Board on June 15, 1984), relate to the base mat in whole or in part, and have been identified as items that may have potential safety significance; further efforts on the part of the Applicant are required to satisfactorily resolve these matters. However, for the reasons discussed in response to Question 8 above, the civil/structural team believes that, to the extent that these items relate to the base mat, they are likely to be resolved in a satisfactory manner and will not be found to have any safety significance. Accordingly, these items are considered to be confirmatory in nature.

In addition, Item 20 identified in Mr. Eisenhut's letter of June 13, 1984, relates in part to the foundation base mat and has been identified as having potential safety significance. This item was reviewed by the Office of Inspection and Enforcement's Inquiry Team with the assistance of a member of the civil/structural review team. Because of the deterministic types of material tests involved in civil/structural engineering work (i.e., the material either does or does not pass the test) it is likely that results of the tests performed by the GEO construction testing personnel are valid. Also, the examples and records reviewed by the civil/structural allegation review team demonstrated to our satisfaction that the tests were adequately executed and the results properly reported. Based on these facts, to the extent that this item relates to the foundation base mat, it has been determined to have neither safety significance nor generic implications.

Q.11. Has the civil/structural allegation review team identified any reason to believe that the foundation base mat was constructed in a manner such that the base mat design assumptions are no longer valid?

A.11. No. Subject to the satisfactory resolution of the items referred to above concerning Cadwelding, soils records, inspector certifications and closure of the embedded conduit, it is our belief that the manner in which the base mat was constructed has not rendered the design assumptions invalid.

Q.12. Has the civil/structural allegation review team identified any matter relative to the foundation base mat which raises a significant safety or environmental issue?

A.12. No. Notwithstanding the fact that certain items were identified as requiring additional demonstrations on the part of the Applicant, it is believed that these items will be resolved satisfactorily. Pending satisfactory resolution of these outstanding items, it is concluded that the allegations and other issues reviewed by the civil-structural team concerning the foundation base mat do not raise a significant safety or environmental issue.

Robert E. Shewmaker

Subscribed and sworn to before me
this 7th day of August, 1984

Notary Public

My Commission expires: 7/1/86.

Robert E. Shewmaker

Statement of Professional Qualifications

Education:

B.S. degree in Civil Engineering (Structures) at the University of Illinois at Champaign-Urbana, Illinois (September 1958 - June 1962).

M.S. degree in Civil Engineering (Structures) at the University of Illinois at Champaign-Urbana, Illinois (June 1962 - June 1963).

Registration:

Registered Professional Engineer in the Commonwealth of Virginia since 1967.

Registered Professional Engineer in the State of Maryland since 1968.

Experience:

Research Assistant and Fellow, University of Illinois, Department of Civil Engineering, Champaign-Urbana, Illinois (January 1962 - June 1983). Research and testing of small scaled reinforced concrete models for flat slab structures.

Construction Engineer, Lieutenant, US Army Corps of Engineers, 146th Engineer Detachment, 8th Special Forces Group (Airborne), Ft. Gulick, Canal Zone (July 1963 - June 1965). Project engineer for airborne training school facilities, roads, airfields and training facilities and instructor in military engineering at the U.S. Army School of the Americas, Canal Zone.

Structural Engineer at Anderson, Birkeland, Anderson and Mast, Structural Consulting Engineers, Tacoma, Washington, (July 1965 - May 1966). Design and analysis of commercial and industrial facilities, including offices, port and pier facilities, bridges, dormitories, elevated monorail systems etc. in Seismic Zone III, and computer applications. Extensive reinforced and prestressed concrete design.

Senior Structural Engineer at Bechtel Power Corporation, Gaithersburg, Maryland (May 1966 - May 1969). Structural analysis and design of structural steel frames and transmission towers, and concrete structures for circulating water system and chimneys for Turkey Point 1 and 2, and Cape

Cape Kennedy 1 and 2. Lead of structural analysis and design section for prestressed containment structures at Oconee 1, 2 & 3, and Calvert Cliffs 1 and 2. Assistant Lead Civil-Structural Engineer for Calvert Cliffs 1 and 2.

Senior Structural Engineer at USAEC and USNRC, Bethesda, Maryland (May 1969 to present) in the Division of Reactor Licensing, the Division of Reactor Standards, and the Office of Inspection and Enforcement. Performed technical review of nuclear power plant applications for civil-structural aspects, developed structural criteria and standards, provided input as a member of national code committees, and provided technical support for construction problems, inspection activities, and inspection and enforcement programs.

Professional Affiliations:

Fellow, American Concrete Institute (ACI)

Member of ACI 349 - Concrete Nuclear Structures

Member of ACI 359, Joint Committee with the American Society of Mechanical Engineers, Section III, Division 2, Boiler and Pressure Vessel Code for Concrete Reactor Vessels and Containments.

Member, Prestressed Concrete Institute

Member, American Society of Civil Engineers