UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY, ET AL.	)	Docket No. 50-289-OLA
	)	ASLBP 83-491-04-OLA
(Three Mile Island Nuclear Station, Unit No. 1)	)	(Steam Generator Repair)

LICENSEE'S TESTIMONY OF
DOUGLAS E. LEE, F. SCOTT GIACOBBE AND
DAVID G. SLEAR ON ISSUE 3 (CONTENTION 1.a)

To Mr. Lee:

Q1. Please state your name and address, and describe your involvement with the TMI-1 steam generator tube repair.

A1. My name is Douglas E. Lee. I am employed by Babcock & Wilcox, an operating unit of McDermott, Inc., P.O. Box 1260, Lynchburg, Virginia 24505. I managed the Mechanical Engineering Section of the Engineering Department. This section contained the Mechanical Design Unit that was assigned to design, qualify and implement the kinetic expansion joint installed as part of the TMI-1 steam generator tube repair program.

A statement of my professional qualifications is attached.

To Mr. Giacobbe:

Q2. Please state your name and address, and describe your involvement with the TMI-1 steam generator tube repair program.

A2. My name is F. Scott Giacobbe. I am employed by GPU Nuclear Corporation, P.O. Box 1018, Reading, Pennsylvania 19603. As Manager of Materials Engineering/Failure Analysis, I have been involved in the planning and management of the failure analysis activities, corrosion test programs, materials evaluation and tube sampling and removal programs associated with the steam generator tube repair program.

A statement of my professional qualifications is attached.

To Mr. Slear:

Q3. Please state your name and address, and describe your involvement with the TMI-1 steam generator tube repair program.

A3. My name is David G. Slear. I am employed by GPU Nuclear Corporation, 100 Interpace Parkway, Parsippany, New Jersey 07054. I am the Manager of Engineering Projects for TMI-1. As such, I was the overall task manager for the TMI-1 OTSG Tube Repair Program reporting directly to the Vice President of Technical Functions. My responsibilities included all activites associated with the evaluation and repair of the steam generators.

A statement of my professional qualifications is attached.

To All Witnesses:

Q4. What is the purpose of your testimony?

A4. The purpose of this testimony is to address Issue 3 of Contention 1.a as enumerated at page 23 of the Board's Memorandum and Order (Rulings on Motions for Summary Disposition, dated June 1, 1984) in which the Licensing Board stated:

> 3. The reasons for not including hardness tests on repaired tubes in the post repair testing program should be addressed.

Q5. Did the post-repair testing program include testing the repair joints for hardness?

A5. No. Hardness testing of the repair joints would be both unnecessary and impractical. Hardness is a material property which measures a material's resistance to deformation. When tubes are expanded (through "cold working"), the hardness of the material increases due to the deformation. This can result in high residual tensile stress, which can be indicative of increased susceptibility to intergranular stress assisted cracking (IGSAC).

The kinetic expansion process used at TMI-1 resulted in cold working of the expanded portions of the tube, which increased the hardness of the material. The roll expansion process used in the original tube-to-tubesheet joints also produced cold working and thereby increased the material's hardness.

Hardness testing was used during the qualification programs to determine how the kinetic expansion process compares to the non-stress-relieved roll expansions in terms of cold working. These tests showed the kinetically expanded joints to be less hard, and therefore to have less cold working of the inside diameter surface, than non-stress-relieved rolled joints. Less cold working results in lower residual tensile stresses. This suggests that the kinetically expanded joint will be less susceptible to intergranular stress assisted cracking (which is associated with residual tensile stress) than are non-stress-relieved rolled joints. Such rolled joints have operated successfully in many steam generators in nuclear power plants.

Hardness was not considered a parameter indicative of the adequacy of the kinetic expansion joint. The joint was qualified for a range of material tensile strengths bracketing those of the TMI-1 steam generator tubes and a range of possible tubesheet annulus geometries and conditions. Joint adequacy was established by qualification tests and internal tube diameter measurements. Post-repair testing in the steam generator included measurements to verify that the expansion process was in accordance with the qualification program. This provided a much more direct and informative means of assessing the adequacy of the joint than would any measurement of hardness. Moreover, as a practical matter, hardness testing is done with relatively large equipment and cannot be performed on the repaired tubes within the steam generator.

PROFESSIONAL QUALIFICATIONS

DOUGLAS E. LEE

EXPERIENCE

Babcock & Wilcox Company

(Current Assignment) Manager, Engineering Department - Responsible for engineering activities involving system design, performance analysis, component design and structural/stress analysis in support of B&W supplied engineering services and engineered service products. Responsibilities also include engineering efforts to complete nuclear steam supply system backlog contracts in the above areas. Responsible to define and implement research programs to maintain and advance base technology, develop new products and services and to automate engineering functions. Work is managed to be in accordance with customer, regulatory and quality assurance requirements. Managed the efforts of 250 professionals organized into three sections and ten units.

(1982 - 1983) Manager, Mechanical Engineering Section - Reponsible for reactor component and reactor accessory equipment mechanical design, specification, acquisition hardware and related engineering services. Also responsible for component performance such as steam generator tube integrity and for reactor plant materials and chemistry. Defined and implemented research programs to maintain and strengthen materials and chemistry technology. Work is managed to be in accordance with contractural, internal and quality assurance requirements. Managing the efforts of about 90 professionals in four working units.

(1980 - 1982) Manager, Plant Engineering Section - Responsible to provide competitive, quality-engineered nuclear power plant and system level engineering design and analysis including reliability and risk evaluations. Responsibilities included system design requirements and functional design, performance and safety analyses, preparation of appropriate SAR materials, defining and implementing computer code development programs, resolving operational problems and developing operator guidelines to safely manage the plant during anticipated transients. Work was managed to be in accordance with contractual and quality assurance requirements. Managed the efforts of approximately 110 professionals in six working units.

(1980) Manager, Equipment Engineering Section - Responsible to develop, specify, standardize, license and provide competitive, reliable, quality-engineered equipment and equipment related services for plant protection, control, monitoring and display, for reactor coolant system and auxiliary system operation, and for fuel storage activities which comply with contractual obligations, satisfy customer needs, meet plant and system performance requirements and meet applicable quality assurance requirements. Managed the efforts of approximately 50 professionals in three working technical units.

(1978 - 1980) Manager, Fluid Systems Unit - Unit responsible for NSSS auxiliary system design, hardware specification and procurement. Specific systems are makeup, chemical addition, decay heat, emergency safeguard cooling and waste processing. Hardware responsibilities include valves, heat exchangers, tanks, demineralizers and filters. Work was managed in accordance with technical, contractual and quality assurance requirements. Directly managed the efforts of 15-20 professionals.

(1978) Associate Project Manager - Responsible for portions of the NSSS being supplied to the Power Authority of the State of New York for the Greene County Nuclear Power Plant. Plant design and licensing reached the stage of meeting the requirements for a construction permit.

(1977 - 1978) Site Coordinator - Temporarily assigned to TMI-2 to organize and coordinate site efforts to install accelerometers and strain gages in the primary side of a steam generator for the purpose of measuring tube vibration. Work included supervision of craft personnel, planning and coordination with customer, site personnel and B&W design engineering to complete the installation prior to reactor start-up.

(1975 - 1977) Associate Project Manager, NSSS supplied to Power Authority of the State of New York. Responsibilities included ensuring that the accessory equipment portion of the B&W scope of supply is technically acceptable, delivered on time and delivered within the contract budget. Contract in the detailed design phase requiring frequent, detailed interface with the Architect Engineer as well as project direction of engineers in matrix organization assigned to the contract.

(1974 - 1975) Generic Project Manager - Responsibilities included identifying items with potential risk impact (cost increases) to backlog NSSS contracts and driving these problems to a least impact solution, managing selected programs designed

to minimize cost impacts to backlog contracts, and performing assigned Project Management Department projects. Key feature of assignment was to work across NSSS contracts to identify and minimize contract risk.

(1973 - 1974) Auxiliary Systems Engineer - Responsible for the system design and equipment procurement for reactor support fluid systems such as makeup and decay heat. Work included preparing system descriptions, PSAR material, equipment specifications and obtaining quotations for the Toledo Units 2 and 3 (NSS-25 & 26) project as well as providing support for the Toledo Unit 1 (NSS-14) project. Achieved the functional level of Task Engineer in this assignment.

Division of Naval Reactors, USAEC

(1968 - 1973) Engineer in the Refueling Branch - Responsible for supervising prime contractor organizations in the refueling and maintenance of U.S. Navy and AEC nuclear reactors. This work includes technical responsibility for the development of refueling systems, for planning and following refueling work and for design and procurement of specialized refueling equipment. Work with equipment ranged from approving initial equipment design concepts and specifications through use of the equipment by field organizations such as shipyards. Have extensive experience in planning, design, procurement and use of special purpose weld cutting and welding machines.

EDUCATION

University of Virginia, Charlottesville, Virginia

B.S. degree in Engineering, graduated with distinction in June, 1968. Majored in aerospace engineering. Dean's List, elected to Tau Beta Pi Honorary engineering fraternity. Naval Reserve Officer's Training Corps scholarship program. Midshipman Battalion Commander. Awarded the Commanding Officer's Sword as the outstanding midshipman.

Lynchburg College, Lynchburg, Virginia

Master of Business Administration in May, 1980. Subject area was Management Control.

MILITARY SERVICE

Commissioned Ensign, USN in June, 1968 upon graduation from college. Assigned duty with the Division of Naval Reactors, USAEC, Washington, D.C. Earned a certificate from the Bettis

Reactor Engineering School, Pittsburgh, Pennsylvania in June, 1969. Promoted to grade of Lieutenant in June, 1971.

STATEMENT OF QUALIFICATIONS AND EXPERIENCE

F. SCOTT GIACOBBE

I, F. Scott Giacobbe, am employed by General Public Utilities Nuclear Corporation as Manager, Materials Engineering/Failure Analysis. I have been in this position since July of 1982.

My education includes a Bachelor's Degree in Mechanical Engineering from Villanova University in 1970 and a Master's Degree in Materials Engineering from Drexel University in 1975.

My work experience has provided me many years of direct involvement in the materials evaluation and failure analysis of power plant components; early in my career it also provided a very intense involvement in heat exchanger tubing evaluations.

In 1970, I began my employment with Westinghouse Electric Corporation in their Heat Transfer Division as a Materials Engineer. In this position I worked on the materials selection, corrosion evaluations and failure analysis of heat exchanger components such as feedwater heaters, condensors, radioactive waste evaporators and other secondary side heat exchangers. In particular, I was responsible for assuring that tubing utilized in the Westinghouse heat exchangers was properly specified and manufactured. This function provided me with in-depth knowledge of heat exchanger tubing fabrication practices, corrosion resistant properties and failure mechanisms.

In 1977 I left Westinghouse to join General Public Utilities as a Senior Engineer in their metallurgical laboratory. This position afforded me the opportunity to expand my areas of expertise to include materials selection, corrosion evaluation and failure analysis of other components of both nuclear and fossil power plants, and to gain a broader understanding of power plant operation.

In 1978 I was promoted to supervisor of the metallurgical laboratory. This was a first line supervising position which gave me the responsibility for the daily operation of the laboratory and supervision of the technicians and engineers reporting to me. This position also carried with it a large technical responsibility which kept me heavily involved in the day-to-day materials engineering problems.

My career took on a slight change in direction in 1980 when the company reorganized and formed the Nuclear Corporation. At that time I became Materials and Welding Manager in the Nuclear Assurance Division. With this position I essentially had the same functions as before, with the added responsibility for welding at the nuclear power stations. While in this position I was responsible for the technical and metallurgical aspects of the development of the Nuclear Corporation welding program. During this time I was still supervising all failure analysis activities, including the TMI spent fuel pool pipe cracking incident.

In July 1982, another reorganization took place. At this time my section merged with the materials engineering section in the Technical Functions Division and I took over management of that newly formed section. In this position I now had functional responsibility for the materials configuration control of both GPU nuclear power plants as well as welding engineering and failure analysis. In addition, my section still provided failure analysis services to the fossil companies.

I have been involved in the steam generator tube failure issue from the beginning. I participated directly in the initial decision-making regarding the tube sampling and removal operations and was present to perform the initial visual evaluations of the removed tubing. I personally planned and oversaw the failure analysis activities performed by the outside laboratories. I also developed the corrosion testing programs which GPUN implemented to gain insight and understanding into the failure mechanism and responsible corrodants. It was also my responsibility to coordinate the input from all our technical consultants as well as plant experience and formulate the current failure scenario.

During the steam generator repair, my section also provided materials evaluation and consultation on all aspects of the repair including explosive expansion, flushing, peroxide cleaning, and so forth. My section also developed and implemented the long term corrosion testing program and is evaluating the results as the testing progresses.

Lastly, during the course of the steam generator repairs, I was responsible for making all presentations to the NRC on corrosion testing and failure analysis activities.

Over the years I have kept fully abreast with the state-of-the-art in corrosion technology through my attendance and participation in technical seminars and conferences, and through attending training sessions. I am a member of the Edison Electric Institute Materials, Piping, Welding and Corrosion Task Force, a group of industry representatives who meet to share and develop solutions to corrosion problems in the field of materials and welding in the power industry. In addition, I am a member of the American Society for Metals.

Publications

1. F. S. Giacobbe, "Examination, Evaluation and Repair of Stress Corrosion Cracking in a PWR Borated Water Piping System", NACE Corrosion 81.

2. F. S. Giacobbe, J.D. Jones, R. L. Long, D. G. Slear, "Repairs of TMI-1 OTSG Tube Failures" Plant/Operations Progress AICHE, July 1983, Vol. 2, No. 3.

PROFESSIONAL QUALIFICATIONS

DAVID G. SLEAR

WORK EXPERIENCE

Company:	GPU Nuclear Corporation
Title:	TMI-1 Manager Engineering Projects
Responsibilities:	Management of TMI-1 modification, which entails: Management of the $25 million annual budget allocated for plant modification; prioritization of the various phases of plant modification; oversight of the technical adequacy of plant modification and of the components involved in plant modification; consultation regarding problem resolution with respect to matters concerning plant modification; and direct supervision of 16 GPU employees. This position demands constant attention to long term and daily plant modification concerns and an extremely firm grasp of both the technical aspects of TMI-Unit 1 and of the various modes and components of modification available for implementation at TMI-Unit 1.
Dates:	1983 - Present
Company:	GPU Nuclear Corporation
Title:	OTSG Repair Project Manager
Responsibilities:	Management (in conjunction with individual task managers) of all aspects of the OTSG Recovery program at TMI-1 including failure analysis, eddy current testing, corrosion testing, RCS examination, RCS sulfer cleanups, and plant performance analysis. This position involved direct management of the OTSG repair process and personal involvement in the decision making process with respect to the repair program. This position also entailed the definition and implementation of the overall project, and required a broad overview and analysis of the OTSG Recovery program. In his capacity as OTSG Repair Project Manager, Mr. Slear was also called

upon to deliver numerous presentations concerning project details before the NRC, ACRS, TPR, and the GPU Nuclear Corp. management.

Dates: December 1981 - November 1983

Company: GPU Service Corporation

Title: TMI-1 Manager Engineering Projects

Responsibilities: Similar to those listed for Mr. Slear's present position including management of a $20 million budget and of project engineering for modifications.

Dates: 1979 - 1981

Company: GPU Service Corporation

Title: Preliminary Engineering Manager

Responsibilities: This position entailed: the analysis and preliminary design of 400 Megawatt combustion turbines and of a 600 Megawatt coal fired power plant; extensive analysis of the reliability and availability of the components to be installed in the prospective power plant; and the establishment of a baseline criteria document for the designated plants including the technical documentation and presentation of the plant design for management review.

Dates: 1978 - 1979

Company: GPU Service Corporation

Title: Component Engineer

Responsibilities: This position entailed: the review of design specifications and technical details of products going into TMI-2, including the steam generators, pressurizer, main

condensors, cooling towers, reactor vessel, and internals; technical consultation and analysis of problems; and review of the contractor's design work on new components going into a plant.

UNITED STATES NAVY NUCLEAR SUBMARINE FORCE OFFICER

Title: Engineer Officer

Responsibilities: This position entailed: essentially primary responsibility and control of the onboard nuclear power plant; control of all engineering sections, command of 4 divisions; and supervision of approximately 55 crewmen.

Dates: 1972 - 1974

Title: Machinery Division Officer

Responsibilities: As Machinery Division Officer, Mr. Slear was responsible for: all mechanical components of the primary and secondary systems of the power plant including the steam generator, reactor, and drive controls; chemistry control of the primary and secondary systems; and the supervision of 15 crewmen. Mr. Slear also served as an Auxiliary Division Officer in charge of non-nuclear life support systems, and as a Communications Division Officer.

Dates: 1968 - 1972

Mr. Slear also attended the Nuclear Power Submarine School from 1966 - 1968, during which time he obtained one year of nuclear power plant training (6 months classroom, 6 months actual plant training) in addition to the submarine qualification program.

EDUCATION

College: University of Oklahoma

Degree: B.S. Mechanical Engineering

Dates: 1961 - 1966

College: Stevens Institute of Technology

Degree: M.S. Mechanical Engineering

Dates: 1974 - 1978