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,
DON K. CRONEBERGER AND DAVID G. SLEAR
ON ISSUE 5 (CONTENTION 1.b)

To Mr. Lee:

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

A2. 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 responsible 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. Croneberger:

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

A2. My name is Don K. Croneberger. I am employed by GPU Nuclear Corporation, 100 Interpace Parkway, Parsippany, New Jersey 07054. As the Director of Engineering and Design, I provided technical management oversignt of the failure analysis and repair activities, with special emphasis on evaluation of the steam generator's mechanical design and the impact of any indwelling defects on the response of the components. My department also provided engineering support in the areas of Materials/ Engineering/Failure Analysis, Chemical Engineering, Mechanical Engineering and Engineering Mechanics

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 activities 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 the issue related to Contention 1.b as enumerated at page 32 of the Board's Memorandum and Order (Rulings on Motions for Summary Disposition, dated June 1, 1984), in which the Licensing Board stated:

> . . .[T]he central issue is whether the repair process has increased the probability of [simultaneous tube ruptures involving both TMI-1 steam generators].

Q5. Has the repair process increased the probability of simultaneous tube ruptures involving both steam generators?

A5. No. The repair process has not increased the likelihood of tube rupture, and therefore has not increased the probability of simultaneous tube ruptures involving both steam generators.

In developing the repair joint to be used in the TMI-1 once-through steam generator (OTSG) repair program, the primary objective was to establish a system that would not increase the likelihood of tube rupture. This objective was met by establishing that the repair joint is not more susceptible to tube rupture than the original joint would have been, and that the repair process has not adversely affected the tube in a manner that would increase the likelihood of tube rupture.

The design basis transients specified for the original design tube-to-tube sheet joint were specified as applicable to the repaired steam generator tube-to-tubesheet joint. These

transients in temperature and pressure produce a postulated main steam line break load of 3140 pounds tension. This is the maximum design basis loading of the tube-to-tubesheet joint. All other normal operating or postulated accident loadings are enveloped by this loading.

The repaired joint was carefully designed and qualified to carry loads resulting from normal and faulted conditions. The work performed in the steam generators during the repair process was conducted in such a manner that the design and qualification work was applicable to the actual kinetic expansion repair. That is, the minimum six-inch length of defect free expansion exists for all tubes returned to service. Moreover, additional margin exists in the steam generators since most tubes have more than this minimum defect free expansion qualification length.

If, nevertheless, one were to postulate "failure" of the kinetic expansion joint, the "failure" would be by slippage under applied axial load, rather than by tube rupture. This allows the repair joint to remain leak resistant even if loads are applied which "fail" the joint. Furthermore, slippage is limited because slipping relieves the applied load. This indicates that "failure" of the expanded portion of the tube-to-tubesheet joint would not result in a tube rupture.

Thus, the likelihood of tube rupture due to the failure of the tube-to-tubesheet joint is no greater than for the original joint.

The kinetic expansion repair produces a new transition zone between the expanded and non-expanded portions of the tube. A similar transition zone existed previously at the original roll expansion. However, the transition for the kinetic expansion was carefully developed to be more gradual than that of the original shop roll expansion. The residual stresses in the kinetic expansion transition may be slightly higher than those in roll expansions which have experienced the fabrication stress relief heat treatment. Nonetheless, residual stresses and the amount of cold working in the kinetic expansion are both less than in non-stress-relieved roll expansion transitions for which there is a considerable body of satisfactory operating experience in nuclear power plants.

The residual stresses within the transition zone are not a concern from a static or fatigue stress standpoint, but could affect the susceptibility of the material to intergranular stress-assisted cracking (IGSAC). The resistance of the kinetic expansion transition zone to IGSAC is demonstrated by operating experience of OTSGs containing non-stress-relieved roll expansions, and by Licensee's accelerated and long-term corrosion testing.

To date, there have been no failures, by cracking in the transition zone, of tubes with non-stress-relieved roll expansions in B&W OTSGs in service. Short-term (accelerated) corrosion testing, which was performed as part of the TMI-1 qualification program, showed no evidence of cracking in either

kinetic or non-stress-relieved roll expansion transitions during the simulated life of the repair when exposed to a caustic (10% NaOH at constant potential) environment.

Thus, the likelihood of tube rupture of the new transition due to either loading or IGSAC is no greater than that for tubes currently operating in other OTSGs.

The potential effects of the kinetic expansion process on the balance of the tube were also carefully evaluated. The only effect warranting further analysis was the change in tube preload. The kinetic expansion repair process produces less than a 30-pound decrease in tube preload for normal steam generator tubes. A small percentage of the tubes in the steam generators may have lost all preload due to the IGSAC completely severing the tube in or near the original roll expansion at the top of the tube. This allowed the tube to slip down slightly and relieve the existing preload in the tube. In some cases, vibrations from nearby kinetic expansions may have contributed to the slipping process. The increase in the compressive load due to loss of any or all of the tube preload when added to the maximum compressive load (which occurs during a normal heat-up transient of 100°F/hr) is less than the compressive load required to cause contact between adjacent tubes. Accordingly, there is no increased potential for tube ruptures due to increased wear. Furthermore, the loss of the tube preload does not increase the likelihood of fatigue failure because preload, being a constant load, is not a factor in the

fatigue load range and does not reduce natural frequency to a level which would be of concern. Total loss of tube preload reduces the tube natural frequency by approximately 15% which is less than the variation in natural frequency within some individual steam generators. Another plant with similar steam generators operates with tube natural frequencies 15% lower than those expected for TMI-1.

Thus, the kinetic expansion repair process does nothing to the balance of the tube to increase the likelihood of tube ruptures.

Therefore, for the reasons indicated above, the repair process has not increased the likelihood of tube ruptures, and hence of simultaneous tube ruptures.

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.

PROFESSIONAL QUALIFICATIONS

Don K. Croneberger
Director - Engineering & Design
GPU Nuclear Corporation

GPU Experience:

Technical responsibility for the Mechanical, Electrical, Civil/Structural, Chemical, Radwaste and Materials Engineering support for all nuclear generating stations for the GPU Systems.

1978 to 1980 was Manager - Design and later Manager - Engineering & Design with GPU Service Corporation. Directed design engineering activities for all nuclear and fossil power generating facilities and modifications assigned to GPUSC.

Other Experience:

Prior work experience included a number of positions at Gilbert/Commonwealth during the period 1963 to 1978. The last position was Manager Structural Engineering. It included technical responsibility for structural engineering mechanics for all nuclear and fossil generating facilities. Some of the other positions included Project Manager for balance of plant studies for a liquid metal fast breeder reactor demonstration plant. Other positions as Project Structural Engineer included responsibility for technical supervision of structural engineering and engineering mechanics for a number of domestic nuclear power plants. Earlier experience with the U.S. Navy included engineering and construction of radio telescope and ancillary experience.

Industry affiliations have included the EPRI Steam Generator Owners Group, ASME Section 3 Division 2 (former Chairman) and other industry nuclear standards activities including Nuclear Structures and Plant Design Against Missiles.

Education and training includes a B.S. degree in Civil Engineering from Pennsylvania State University, 1959. Other technical training includes courses at U.C.L.A., M.I.T. and the University of Michigan.

I have been involved in the Steam Generator tube failure issue from the beginning. I provided technical management oversight of failure analysis and repair activities. Special emphasis was placed on understanding the mechanical design of the Steam Generators and applying that understanding to the repair program and the understanding of the impact of the repair on the response of the components.

My department provided engineering support in the areas of Materials Engineering/Failure Analysis, Chemical Engineering and Chemistry, Mechanical Engineering and Engineering Mechanics.

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

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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)

CERTIFICATE OF SERVICE

I hereby certify that copies of

(1) Licensee's Testimony of Richard F. Wilson, David G. Slear and Don K. Croneberger on Issue 1.a (Contention 1.a);

(2) Licensee's Testimony of Richard F. Wilson, David G. Slear and F. Scott Giacobbe on Issue 1.b (Contention 1.a);

(3) Licensee's Testimony of Richard F. Wilson, David G. Slear and T. Gary Broughton on Issue 1.c (Contention 1.a);

(4) Licensee's Testimony of Don K. Croneberger and F. Scott Giacobbe on Issue 1.d (Contention 1.a);

(5) Licensee's Testimony of Douglas E. Lee, Don K. Croneberger and David G. Slear on Issue 2 (Contention 1.a);

(6) Licensee's Testimony of Douglas E. Lee, F. Scott Giacobbe and David G. Slear on Issue 3 (Contention 1.a);

(7) Licensee's Testimony of Dr. David H. Pai on Issue 4 (Contention 1.a); and

(8) Licensee's Testimony of Douglas E. Lee, Don K. Croneberger and David G. Slear on Issue 5 (Contention 1.b)

were served upon those persons on the attached Service List, by

deposit in the United States mail, postage prepaid this 29th day of June, 1984.

Bruce W. Churchill

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	)	ASLBP 83-491-04-OLA
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	)	

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