marsh

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of CAROLINA POWER AND LIGHT COMPANY AND NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY (Shearon Harris Nuclear Power Plant, Units 1 and 2)	)	Docket Nos. 50-400 OL 50-401 OL

NRC STAFF TESTIMONY OF LEDYARD B. MARSH AND HERBERT F. CONRAD
REGARDING JOINT CONTENTION VII PART (4)

Q1. Mr. Marsh, please state your name, affiliation, and position.

A1. My name is Ledyard B. Marsh. I am Section Leader in the Reactor Systems Branch, Division of Systems Integration, NRC Office of Nuclear Reactor Regulation.

Q2. Have you prepared a copy of your professional qualifications?

A2. Yes. A copy of my professional qualifications is attached to this testimony as Attachment 1.

Q3. Mr. Conrad, please state your name, affiliation, and position.

A3. My name is Herbert F. Conrad. I am presently a Senior Materials Engineer in the Inservice Inspection Section of the Materials Engineering Branch, Division of Engineering in the Office of Nuclear Reactor Regulation.

Q4. Have you prepared a copy of your professional qualifications?

A4. Yes. A copy of my professional qualifications is attached to this testimony as Attachment 2.

8406140075

Q5. What is the purpose of this testimony?

A5 The purpose of this testimony is to address Joint Contention VII, Part (4) which asserts that the Applicant has failed to demonstrate that the steam generators are adequately designed and can be safely operated in light of existing tube failure analyses. Specifically, this testimony addresses the need for the Applicants to address multiple steam generator tube ruptures as a design basis event in their tube failure analysis.

Q6. Have the Applicants analyzed the consequences of a steam generator tube rupture accident?

A6. Yes. The Applicants' analysis is contained in Chapter 15.6.3 of the FSAR, and in the responses to various Staff questions.

Q7. Please describe the analysis and results.

A7 The Applicants' analysis, supplemented by the responses to Staff questions, assumes a double-ended guillotine break of a single steam generator tube combined with an assumed complete loss of off-site power. Also, the analysis assumes no operator action for 30 minutes, the initial primary coolant iodine concentration at the worst allowed by the Technical Specifications, and the initial steam generator tube leakage at the maximum allowed. The analysis evaluated the systems performance, operator actions and off-site consequences. The Applicants' analysis demonstrates that the radiological limits of 10 C.F.R. Part 100 are met. However, Applicants are being required to substantiate selected assumptions of that analysis.

Q8. Have the Applicants postulated a multiple tube rupture as a design basis accident?

A8. No. The Applicants have not postulated multiple double-ended guillotine break tube ruptures, as a design basis accident. The Staff does not require that multiple, double-ended guillotine ruptures be postulated within the design basis for a number of reasons. These are as follows:

(1) The Staff believes that the likelihood of multiple, double-ended guillotine tube ruptures is exceedingly low, although not quantified for the Shearon Harris plant.

(2) The assumption of a single, double-ended guillotine tube break covers a spectrum of smaller, more probable leaks, including the leakage from a few tubes.

(3) The scenarios postulated for design basis accidents were never considered to represent an expected event, but rather are considered to be stylized scenarios designed to bound the consequences of a spectrum of similar, but less severe events.

Thus, while an operating reactor event may show that any one assumption in an accident analysis might be exceeded, it is the integral conservatisms in the analysis that assure that the FSAR analyses will be bounding. The acceptability of this approach has been substantiated by the four domestic steam generator tube rupture accidents in which the overall consequences were all less severe than the FSAR analyses.

However, as part of the Staff's continuing review of the Standard Review Plan and of the Ginna SGTR accident, a thorough review of the SGTR assumptions, analyses and inherent conservatisms is planned.

Q9. What surveillance measures will be implemented at Shearon Harris to minimize the likelihood of a multiple tube rupture accident?

A9. The Shearon Harris plant technical specifications will require periodic inservice inspection of the steam generator tubes and the steam generator secondary side water will be monitored for leakage from the primary side. Eddy current testing of the tubes is routinely required every 12 to 24 months. In the event of a tube leak exceeding the technical specification limit of 500 gallons per day per steam generator, the plant is required to shut down and to perform an unscheduled inspection as well as plug the leaking tube. Eddy current indications in excess of 40% through wall degradation are required to be plugged, except for tubes in the preheater section.

In this manner, the integrity of the steam generator tubes is systematically monitored to uncover any defect or degradation before tube degradation becomes serious. The limits on allowable primary to secondary leakage are designed to assure that a tube leaking at a rate equal to or less than the limit will retain adequate integrity against rupture. Experience has shown that where serious flaws have gone undetected, the usual consequence is a small leak of manageable size. In such cases the plant is shut down in an orderly manner for tube plugging.

Q10. What would be the likely consequences of a multiple tube rupture accident?

A10. In the unlikely event of a multiple tube rupture accident, as either an initiating event or as a consequence of another design basis accident, various calculations performed for another Westinghouse PWR have shown that the existing safety systems automatically respond to bring the plant to a stable condition, allowing the operator sufficient time to assess the accident, and take the appropriate actions. Primary coolant natural circulation, steam generator auxiliary feedwater and the injection of additional coolant from the high pressure safety injection system were sufficient to remove core decay heat and to keep the core covered and cooled. Calculations performed by Westinghouse, in support of the new emergency operating guidelines, have shown similar results.

Although these calculations were not performed for the Shearon Harris plant, the Staff compared the parameters most important in tube rupture accident scenarios (e.g. power, volumes, temperature, and safety injection system characteristics) and concludes that these calculations would bound the Shearon Harris plant.

Even though the Applicant has not postulated multiple tube rupture accidents within the design bases, the new Westinghouse emergency operating procedures, which the Applicant has committed to utilize, will enable the operators to deal with a variety of beyond design basis tube rupture accidents. For example, the emergency procedures

deal with single and multiple tube rupture accidents as initiating events, tube rupture accidents combined with a loss of secondary integrity and tube ruptures combined with a variety of equipment malfunctions. The Shearon Harris operators will be trained to recognize and manage such events.

In summary, the Staff believes the Shearon Harris plant has an inherently large margin to safely accommodate multiple tube ruptures. Moreover, in the unlikely event of a multiple tube rupture accident, the Staff believes that the safety systems and operator actions will ensure the core always remains covered and cooled, and the overall consequences will be acceptable.

Q11. In summary do you believe that the Applicant should be required to consider multiple tube rupture accidents as a design basis accident?

A11. No. The Staff believes the existing design basis SGTR scenario defined in the SRP and analyzed in the Applicants' FSAR is acceptable and will bound a variety of similar less severe scenarios. Past operational experience is consistent with this conclusion. Furthermore, the Staff believes the combination of preventative measures afforded by the steam generator tube design, inspection, plugging and leak rate criteria coupled with the thermal hydraulic calculations demonstrating that the existing plant safety systems can mitigate a variety of multiple steam generator tube rupture accident scenarios, further confirm that the Applicants need not include these multiple failure accidents in the plant's design basis.

Statement of Professional Qualifications
Ledyard B. Marsh

I am employed as a Section Leader in the Reactor Systems Branch, Division of Systems Integration, Office of Nuclear Reactor Regulation. My responsibilities include supervising the safety reviews of the reactor coolant, emergency core cooling, accident and transient analyses as well as other reactor systems which are assigned to me during the review of nuclear power reactor license applications or safety analyses to support proposed operating reactor technical specification changes.

I graduated from the University of Oklahoma in 1970 with a Bachelor of Science in Electrical Engineering. In 1976, I received a Masters of Science degree in Nuclear Engineering from the University of Washington.

From 1970 to 1974, I was an officer in the Navy Nuclear Power Program. I attended a year of formal training in the design and operation of the Navy surface ship nuclear propulsion plant. I was then assigned to nuclear powered heavy destroyer, USS California, where I took part in the propulsion plants construction, testing and operation.

In August, 1976 I accepted employment with the Nuclear Regulatory Commission in the Reactor Safety Branch. I reviewed safety analyses to support licensee propsed ECCS design modifications and technical specification changes. In late 1979 and early 1980 I supervised the review of the three domestic steam generator tube rupture events and was the principal author of NUREG-0651, "Evaluation of Steam Generator Tube

Rupture Events." In my present position as Section Leader in the Reactor Systems Branch, I have been involved in the development of plant specific and generic recommendations as a result of the Ginna SGTR as well as the other domestic SGTRs and have supervised the Division of Systems Integration technical input into the report presenting the resolution of USIs A-3, 4, 5, NUREG-0844. Also, I supervised NRR's review of the need for pressurizer PORVs for the new Combustion Engineering PWRs, and the development of the report presenting the staff's review, "Evaluation of the Need for a Rapid Depressurization Capability for CE Plants", NUREG-1044.

U.S. NUCLEAR REGULATORY COMMISSION
HERBERT F. CONRAD
PROFESSIONAL QUALIFICATIONS

My present position is Senior Materials Engineer, Material Engineering Branch, Office of Nuclear Reactor Regulation. In this capacity I am responsible for technical safety review and evaluation of materials used in the construction of nuclear power plant components. Specifically, the responsibilities include evaluation of materials application, heat treatment, fabrication, inspection and corrosion control. I am a former member of the American Society of Mechanical Engineers Nuclear Code Committee Subgroup on Fabrication and Examination (Section III).

I hold a MS in Metallurgy (1959) and a BS in Mechanical Engineering (1957) from the Massachusetts Institute of Technology. I am registered by the State of California as a Professional Engineer in Mechanical Engineering and in Metallurgical Engineering with more than 24 years of professional experience. I am a member of the American Society for Metals (ASM). I have several publications in metallurgy, the most recent is a contribution to the ASM Metals Handbook, Volume 10, Failure Analysis (ASM, 1975).

I have been with the Nuclear Regulatory Commission since February 1973, two years of which were as a loan employee on detail from the University of California. Prior to my assignment to Washington, I was employed by the Lawrence Livermore Laboratory of the University of California as a Metallurgist.