

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)

GEORGIA POWER CO.)
et al.)

(Vogtle Electric Generating Plant,)
Units 1 and 2))

Docket Nos. 50-424
50-425
(OL)

AFFIDAVIT OF JAI RAJ RAJAN IN SUPPORT
OF NRC STAFF RESPONSE TO APPLICANTS'
MOTION FOR SUMMARY DISPOSITION OF CONTENTION 11

I, Jai Raj Rajan, being duly sworn, state the following:

1. I am a Senior Mechanical Engineer in the Mechanical Engineering Branch of the Division of Engineering, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. A summary of my professional qualifications and experience is attached.
2. The purpose of this affidavit is to respond to one of the issues raised in Joint Intervenors' Contention 11. Contention 11 states:

Applicants have not demonstrated their basis for confidence that no unacceptable radiation releases will occur as the result of steam generator tube failures occasioned by vibration-induced fatigue cracking and by bubble collapse within the Vogtle steam generators.

My Affidavit addresses the issue of vibration-induced fatigue cracking.

3. The vibration of a flexible member such as a steam generator tube results in a cyclic deflection or bowing of the tube between its supports. This motion induces stresses in the tube walls which alternate between a peak compressive stress and a peak tensile stress during the cycle. High stresses could cause the tube walls to experience degradation or fatigue and eventually to fail by cracking after a finite number of cycles. This mechanism of failure is referred to as vibration-induced fatigue cracking.

4. While excessive vibration can result in fatigue cracking, if the vibration amplitudes (and consequently the stress amplitudes) are kept within certain limits, the tube walls will tolerate an infinite number of cycles without cracking. This limit is referred to as the endurance limit of the tube material. The steam generator tubes and their supports are the only components within the steam generators which are subjected to vibratory loads of any significance.

5. The Westinghouse Model F steam generators installed at the Vogtle facility are described in detail in Paragraphs 4 through 7 of Mr. Hirst's Affidavit attached to the Applicants' Motion for Summary Disposition. I have reviewed the material therein and can state that it is an accurate description of the Model F steam generators.

6. Vibration-induced fatigue cracking is not expected to be a problem with the Westinghouse U-tube type steam generators (the Model F is a

U-tube type generator) for the following reasons:

7. Operational experience with the Westinghouse U-tube type steam generators to date has not revealed any vibration-induced fatigue cracking. This experience, which includes Model F steam generators, is documented in NUREG-0886 ("Steam Generator Tube Experience", February, 1982) and NUREG-0606 ("Unresolved Safety Issues Summary", August 17, 1984).
8. The NRC Staff has reviewed the analytical results and model test data generated by Westinghouse to evaluate the secondary flow in the Model F generators. This review indicates that the vibratory motion of the tubes in the various regions of the steam generator is likely to be well under the endurance limit. The Westinghouse evaluation considered parallel and cross flow excitation and the three vibration mechanisms: vortex shedding, fluid-elastic excitation, and turbulence. The results indicate that vibration-induced fatigue cracking should not be a concern with Model F steam generators.
9. The first operating plant with Model F steam generators was instrumented to monitor vibration of the tubes during actual operation. The vibration data generated under these plant operating conditions revealed no excessive vibration and were consistent with the analytical and model test results.

10. Based on my evaluation of the analytical and model test results, as well as the operational data generated for the Model F generator, it is my conclusion that vibration-induced fatigue cracking is highly unlikely to occur in Westinghouse Model F steam generators.

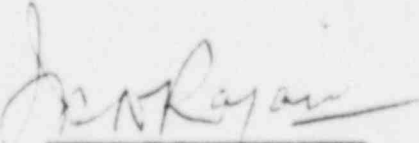
11. Even though vibration-induced fatigue cracking is not expected to occur, it is worth pointing out that the plant technical specifications provide an additional level of protection. The technical specifications for Vogtle provide permissible limits on leakage from the primary system to the secondary system. Any time the leakage rate exceeds this limit, the plant is required to shut down and take appropriate remedial action. These permissible leak limits are of such a small magnitude that in the unlikely event a fatigue-induced crack does propagate through the tube wall and cause a leak, the leak would be detected, the plant shut down, and remedial action initiated before any appreciable amounts of radiation could be released that might adversely affect the public health and safety.

12. Fretting wear of the tubes, which can result from vibratory impacts or rubbing between the steam generator tubes and another metal part such as a support plate, is not a matter of concern for the Model F steam generator. The phenomenon of fretting is distinct from the vibration-induced fatigue cracking discussed earlier. Fretting wear was observed in the preheat region of the Westinghouse Model D steam generators. The problem was evaluated, and it was determined

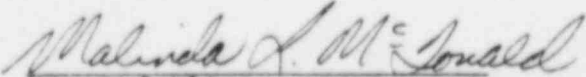
that the fretting was caused by the high level of flow turbulence in the preheat region of the Model D generator. The Model F generator has no preheat region and was designed to preclude the possibility of fretting by reducing the level of flow turbulence. The Staff has reviewed the Model F design and agrees that fretting should not be a concern for Model F generators.

13. I have reviewed the Statement of Material Facts attached to the Applicants' Motion. I agree with the material contained in Statements 1 through 7. I have not addressed the material contained in the other Statements dealing with bubble collapse water hammer.

The above statements are true to the best of my knowledge and belief.


Jai Raj Rajan

Subscribed and sworn to before
me this 30th day of July, 1985


Notary Public

My commission expires: 7/1/86