TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

July 29, 1982

SQRD-50-328/81-30

U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

SEQUOYAH NUCLEAR PLANT UNIT 2 - FOAM SEALS IN MECHANICAL PIPE SLEEVES - SQRD-50-328/81-30 - REVISED FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on April 16, 1981 in accordance with 10 CFR 50.55(e) as NCR CEB 8108. Interim reports were submitted on April 23, June 30, September 18 and November 18, 1981 and February 17, 1982. A final report was submitted on April 22, 1982. Enclosed is our revised final report as discussed with Don Quick on June 2, 1982.

If you have any questions, please get in touch with R. H. Shell at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

D S Kammer

for L. M. Mills, Manager
Nuclear Licensing

Enclosure
cc: Mr. Richard C. DeYoung, Director (Enclosure)
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

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ENCLOSURE

SEQUOYAH NUCLEAR PLANT UNIT 2
FOAM SEALS IN MECHANICAL PIPE SLEEVES
NCR CEB 8108
SQRD-50-328/81-30
10 CFR 50.55(e)
REVISED FINAL REPORT

Description of Deficiency

Some wall penetration piping sleeves shown on TVA drawing series 47W470 and 47W471 have rigorously analyzed safety-related piping routed through them. Silicone sealants are provided between the pipe and sleeve at certain locations as shown on TVA drawing series 47W472. These seals had not been considered by the piping analyst for most cases and thereby could result in increases in pipe stresses and support loads for some situations. The maximum pipe movements at the sleeves could cause failure of the sealant to perform its intended design function as a pressure and/or fire protection seal.

There were two causes for this nonconformance:

1. The drawings indicating the sleeve sealing arrangement were not squadchecked to the piping analysts--a lack of identification and control of interfaces.

2. There was no design criteria or other documentation to address the consideration of the foam sleeve seals--inadequate procedures to control the analyst's activities.

Safety Implication

TVA has analyzed this deficiency and determined that there are no loading combinations of design conditions which would render the affected systems unqualified. However, the fire protection and water and pressure sealing criteria of the plant could be compromised due to the separation of the foam seals from the sleeves where large movements are involved which could adversely affect the safe operation of the plant.

Corrective Action

To determine the effect of the silicone foam seal material, a previous test program which tested a single sleeve/pipe combination was reviewed. Spring constants based on this previous test program gave what was considered to be overly conservative estimates of loading, and, additionally, the program did not test a range of pipe/sleeve sizes.

Thus, a second test program was developed to supplement the original series of tests. The second test program tested an assortment of sleeve and pipe size combinations with the pipe centered in the sleeve in some of the test specimens and offset in other specimens. Offsets evaluated correspond to those reported under NRC-OIE bulletin 79-14. The test procedure and data recorded will be documented in Civil Engineering Branch report 82-2.

Based on the test data, modeling techniques to represent the effect of the sleeve seal on the pipe in our rigorous analysis have been developed. The modeling techniques account for the foam's resistance to lateral and axial translation and axial rotation. The effect of the foam is greatest where there are large pipe movements. The foam will tend to dampen out dynamic motions and thus is beneficial; however, where large thermal growth or anchor movement growth occurs, the foam would increase the support loads and piping stresses. Two areas were identified for investigation. The first area was the piping attached to the steel containment vessel and penetrating the shield building wall. This piping is subject to large anchor point movements caused by the steel containment vessel responding to design basis accident conditions. The second area of investigation was where a long run of straight pipe makes a 90° turn and runs through a wall and is subjected to high temperatures. In this case the thermal growth drives the pipe laterally against the foam in the sleeve.

To investigate the piping penetrating the shield building wall, six problems were identified where the sleeve inside diameter to pipe outside diameter ratio is at a minimum relative to pipe movements. This results in the highest compression of the foam in the sleeves and creates the most significant effect on the piping system. Spring rates based on the initial test program caused some difficulty with support loads in two of the problems. These two problems were redone with the revised spring rates based on the second test program. Based on the revised spring rates, the changes in piping stresses and support loads were insignificant requiring no redesign of the supports or reconfiguration of the piping.

To investigate the sleeves subjected to piping movement due to large thermal growth, an extensive review of Sequoyah Nuclear Plant analysis problems produced only four potential problem locations. The additional loading caused by the thermal growth was determined and was found to have an insignificant effect on piping stresses and support loads.

The conclusion of the study on the effects of the foam sleeve seals on the piping stresses was that no signifcant impact would be expected. However, in current and future piping analysis, the effect of the foam on the piping stresses and supports will be determined and accounted for to assure the accuracy of the analysis. The conclusions of the foam seal study and the modeling techniques to be used in accounting for the foam's effect on the piping stresses and support loads will be documented in CEB report 82-9.

During the second test program the silicone foam on some of the samples separated from some of the sleeve piping. However, field investigations at Sequoyah which involved a field survey of approximately 50 penetrations (where large pipe movements have been experienced) revealed no penetrations with a loss of seal. Therefore, no corrective action is deemed necessary.

To prevent future reoccurrence of these problems, two procedural documents will be developed to guide the sleeve designers and piping analysts. A design standard will be developed by March 31, 1983, to give guidance to the sleeve designers. The design standard will set forth required design considerations and procedures including a requirement that design documents specifying sleeve sizes and sleeve sealing be squadchecked to the groups affected by the design of the sleeve and sleeve seal. This will include the persons responsible for reviewing the fire protection capability and the air sealing capacity and, where rigorous analysis of the piping is performed, the piping analyst. Guidance to the piping analysts will be provided by a checklist that will be required to be filled out for each analysis problem. This checklist, committed to as part of the resolution to NCR WBNCEB8112, will be appended to the Sequoyah design criteria SQN-DC-V-13.3 and will include a requirement that the checker of the rigorous piping analysis problem review the sleeve sealing arrangement and assure that it has been properly modeled into the analysis. This checklist will be provided by June 30, 1983.