TENNESSEE VALLEY AUTHORITY

5N 157B Lookout Place

July 27, 1990

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - CONDITION ADVERSE TO QUALITY REPORT (CAQR) SQP900305 - OPERABILITY DETERMINATION

References: 1. TVA letter to NRC dated July 17, 1990, "Sequoyah Nuclear Plant (SQN) Units 1 and 2 - Condition Adverse to Quality (CAQR) SQP900305 Revision 0 - Operability Determination"

2. TVA letter to NRC dated March 28, 1990, "Sequoyah Nuclear Plant (SQN) - Reevaluacion of Cable testing Program - Watts Bar Nuclear Plant (WBN) Pullby Damage"

TVA and NRC met on July 23, 1990, in Rockville, Maryland, to discuss the problems recently identified by TVA with the ranking calculation used to select conduits to be tested for pullby damage. TVA identified that there were errors in the implementation of the ranking criteria that affected the final ranking of the conduits. In conjunction with this activity, TVA provided an operability determination of SQN by reference 1. This determination and the information provided by reference 2 were also discussed during the meeting.

At the conclusion of the meeting TVA agreed to supplement the operability determination provided by reference 1 with the additional information presented at the meeting. The revised operability determination is included as enclosure 1 to this letter. This revision includes additional supporting evidence for our conclusion that the probability of cable damage from installation practices is low and that the probability is high that any significant cable damage from poor installation practices would have been detected. In addition, the potential consequences of undetected cable damage were evaluated. In summary, there is a high degree of confidence that the SQN safety-related cables will perform their intended function.

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In the meeting TVA discussed the corrective action plan and tentative schedule for resolution of the cable test program discrepancies identified. As noted in the meeting, TVA will provide a complete program plan description and schedule by August 17, 1990. The program plan includes a two part evaluation of the SQN safety-related conduits that may have experienced significant forces during pullby operation. Phase I involves the conduits that are accessible during power operation; Phase II involves inaccessible conduits.

The operability determination will remain in effect until the completion of the Phase I activities. Successful resolution of Phase I will provide further compelling evidence on the adequacy of SQN cable and render Phase II a confirmatory effort. TVA intends to keep NRC fully informed of the Phase I activities and will submit a Phase I report within 30 days of completion of the Phase I efforts. Further details on reporting will be included in the program plan submittal.

The commitment made in this letter is included as enclosure 2.

Please direct questions concerning this issue to Marcia A. Cooper at (615) 843-6422.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Mark J. Burzynski for

E. G. Wallace, Manager
Nuclear Licensing and
Regulatory Affairs

Enclosures
cc: See page 3

cc (Enclosures):

Ms. S. C. Black, Deputy Director
Project Directorate II-4
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. J. N. Donohew
Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

NRC Resident Inspector
Sequoyah Nuclear Plant
2600 Igou Ferry Road
Soddy Daisy, Tennessee 37379

Mr. B. A. Wilson, Project Chief
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE 1

SEQUOYAH NUCLEAR PLANT (SQN)
CONDITION ADVERSE TO QUALITY REPORT (CAQR) SQP900305 R1
OPERABILITY DETERMINATION

Discussion

Deficiencies were identified with the application of the criteria used in ranking conduits that were tested to address pullby concerns during restart at SQN. These problems were documented in CAQR SQP900305 RO. Continued operation of SQN in light of the deficiencies is justified by the following.

1. Probability of Occurrence at SQN

Watts Bar Nuclear Plant (WBN) had specific employee concerns related to cable installation. SQN did not have any substantiated cable installation employee concerns. The WBN concerns were investigated at SQN because at the time there were the questions whether the configurations and the cable pulling methods for both plants were similar. Subsequently, SQN conducted extensive reviews of the cable raceway systems and the attributes that contribute to the possibility that cable damage during installation could occur. These prerestart reviews, involving cable pull data retrieval and conduit walkdowns, were undertaken as a part of the SQN cable test program (CTP) and included the issues of pullbys, jamming, and silicone-rubber cables supported in vertical conduits by conduit bodies at the top of the run. In addition, as a postrestart commitment, other 10 CFR 50.49 cables in vertical conduits were evaluated for compliance with the National Electrical Code requirements and provided support as required. No programmatic problems related to cable installation practices have been identified at SQN during the extensive cable work associated with all the restart efforts and recent refueling outages.

As a prelude to the SQN efforts to address the WBN concerns, NRC consultants visited SQN, conducted interviews, and walked down areas of the plant. While they concluded that there were deficiencies in the instructions for cable pulling activities from 1973 to 1979, they did not find that the conduit configurations differed significantly from other nuclear plants of SQN's vintage. Recent comparisons of conduit configurations have shown that SQN's installations more closely resemble those at Browns Ferry Nuclear Plant (BFN). The short runs with many pull points translate into "easy pulls." This conduit information is also supported by the comparison of the current SQN-calculated sidewall bearing pressure (SWBP) values to the BFN values for their conduits selected for testing. The SQN conduits evaluated represent some of the most severe SQN configurations, as identified by either criteria 5 of the SQN CTP or the BFN screening criteria method. As such, TVA has a high confidence that the SWBP values for the conduits and cables successfully tested at BFN fully bound the current SWBP values for SQN.

These reviews and evaluations lead to the conclusion that SQN conduit configurations are not the same as WBN and SQN does not exhibit the same programmatic problems that have been discovered and documented at WBN. The problems identified at WBN are in the areas of conduit configuration (long runs with excessive bends between pull points) and cable pulling practices (nylon parachute cords). The conduit configurations depart from the requirements of the TVA General Construction Specifications and industry good practices. The SQN CTP Conduit Selection Criterion 5 focuses on the conduits that exceed the TVA General Construction Specifications definition of an easy pull for lengths of conduits and number of bends between pull points. A review of field sketches for over 350 safety-related conduits that contain at least seven cables and have at least two pullbys reveal that only a small number (14) of that population exceed TVA's definition of an easy-pull. In addition, seven of those conduits were direct current (dc) high-voltage tested. Since the major factors in SWBP calculations are the lengths of conduit and the degrees of bends between pull points, TVA concludes that SQN has a smaller probability of having conduits with excessive SWBP than WBN. Also, no evidence exists that nylon parachute cords were utilized at SQN.

While SQN has not fully resolved the issue of conduit overfill, a review of 181 conduits evaluated at SQN using the BFN screening methodology revealed only one conduit that was overfilled (40 percent allowable, 42 percent calculated). In contrast the WBN pullby corrective action plan included direct consideration for overfill in the screening process because of problems identified there with overfill. The industry has only recently recognized the significance of conduit fill as a risk factor when performing pullbys. Lower fills increase the potential for obtaining a clear path during the pullby operation. The raceway fill at SQN ensures that fewer pullbys occurred, and that those that did would be small and with less potential for pullby damage.

Because of these facts, TVA concludes that there was not then, nor is there now, any evidence that SQN has any safety-related cables installed that were damaged by the cable pulling practices.

2. Probability of Damage Discovery at SQN

Even though there was no evidence of damaged cables at SQN, a population of conduits and cables was identified to conduct high-voltage tests for the purpose of detecting damage caused by pullbys, jamming, and silicone rubber insulated vertical cables supported by conduit bodies near the top of the conduit run. Over 900 conductors were successfully tested at voltages ranging from 4.8 kilovolt (kV) to 10.8 kV dc. The three wet-tested pullby conduits remain in the population with a higher potential for pullby damage. It is also important to note that the test anomaly with the American Insulated Wire Company (AIW) silicone-rubber cable (which was not discernable to the naked eye) was detected with a dry high-potential test. This fact also highlights the importance of material susceptibilities. The SQN CTP represents the most comprehensive in-situ test program ever undertaken in the industry.

SQN's CTP selection criteria was biased toward material damage susceptibility. However, even though discrepancies have been discovered in the unissued calculation to document the application of the selection criteria, TVA has confirmed that seven of the original 15 tested pullby conduits remain in the worst-case or higher-risk category. The remaining eight conduits could, therefore, be considered to be randomly selected. The successful testing of these conduits still provides a high degree of confidence that if a programmatic problem with the installation practices at SQN existed it would likely have been found. In addition, the AIW silicone rubber cables inside containment were replaced at SQN and the PN-type cable was not used at SQN in 10 CFR 50.49 applications.

Fifty-five SQN conduits were also evaluated for SWBP. Fifteen were the tested conduits from the material susceptible population and 40 were the highest ranked by the BFN screening criteria from the remainder of the population with seven or more cables. Overall, these conduits represent some of the "worst-case" from a configuration (and force) perspective. The SWBPs were bounded by the BFN wet-tested conduits. Therefore, it is reasonable to conclude that the forces developed in these conduits are not great enough to cause cable damage. It is also reasonable to conclude that these tests bound all SQN conduits because of the similarity between the SQN and BFN conduit configurations, the comparable sample of SWBP calculations performed for SQN, and the other favorable conduit attributes previously described. Based on the similarities in the conduit configurations between the two plants, it is expected that the SQN calculated SWBP values for the future conduit calculations will remain bounded by the BFN results.

In January 1989, SQN implemented a Cable Monitoring Program to document and trend problems. These problems include age-related failures that would surface if the cable was installed improperly. To date, no cables have been identified as incapable of performing their safety-related function by this program. Additionally, many maintenance and modification activities and Quality Control inspections have been performed since the initial concern and no installation damage to cables or operational failures of cables attributed to installation practices have been identified.

TVA's overall confidence in the integrity of SQN cables has increased. The large number of review and test activities have not found cable installation problems. The overall favorable information about the SQN conduit configurations, and results of both the SQN and BFN CTPs are the basis for this increased confidence.

3. Consequences of Undiscovered Cable Damage

In the unlikely event that a SQN safety-related cable was damaged during installation, the consequences of that damage can be evaluated by the two types of failure mechanisms that might occur.

The first type is the random failure. For the purposes of this discussion, and based on the operating experience at SQN, this type of failure is limited to age-related damage due to improperly installed cables. This failure is mitigated by the fact that the redundant circuit for the failed cable is expected to perform the safety-related function that might be lost by the cable failure. The effects of a random failure are inconsequential because of the redundancy, diversity, and defense in depth afforded by the standard design requirements. For example, the effects of a faulted cable inside containment during a loss of coolant accident on containment integrity are mitigated by the diverse and redundant penetration overcurrent protection design (fuse and breaker combination). The effects on emergency safeguards actuation are mitigated by the redundant and diverse design of the reactor protection system (e.g 2/3 and 2/4 logic combinations in conjunction with diverse parameters sensing containment pressure and pressurizer pressure).

The second type of failure is the common mode failure. This type of cable failure is primarily related to environmental conditions (water, steam, and humidity) created by an accident. For the purposes of this discussion, the environmental conditions will be separated into those inside containment and those outside containment.

For the cables inside containment, there are several factors that support the adequacy of the installed safety-related cables. Because the containment equipment is typically a termination point for conduits and cables (as opposed to a distribution point), there are relatively fewer pullbys in the conduit systems there. The straight line space limitations inside containment result in shorter conduit runs and more cable pull points than in more spacious areas. In particular. of the top ranked conduits from the SQN SWBP screening activities, 2 conduits were inside containment, 10 were in the secondary containment (annulus) area, and 30 were in the control and auxiliary buildings.

Redundant safety-related equipment is physically separated and compartmented by concrete walls and barriers inside containment to provide protection against events that create dynamic environmental effects. The conduits and cables that supply this equipment derive some benefits from this line of protection. As a result, the common mode failure from undetected cable damage is unlikely.

Other Category I areas outside containment include the auxiliary building (AB) and the control building (CB). The harsh areas of the AB are primarily transition areas for safety-related cables (and the vast majority of them are in cable trays). However, the harsh environments are less severe and not as prolonged as those inside containment. The primary safety function required for events that produce these environments is the ability to achieve and maintain safe shutdown conditions. This function is also the focus of Appendix R evaluations. As such, separation, compartmentalization, and fire wrap all provide a measure of protection from environmental effects. Conduits are also sealed to prevent water intrusion from flooding and flood propagation between rooms and floors. The sealing also provides a measure of protection against water or moisture intrusion. As a result, the common mode failure from undetected cable damage is unlikely.

In the power, control, and signal cable distribution areas of the AB, as well as the CB, where a large number of pullbys occur, the environment is considered mild and is therefore not impacted by adverse effects of an accident that would create a potential common mode failure mechanism from undetected cable damage.

Conclusion

The probability of cable damage during installation is low. Substantia evidence from a variety of sources establishes that the SQN conduits are typical of its vintage of nuclear plant and that there are no programmatic cable installation problems.

The probability that significant cable damage would have been identified is high. The SQN CTP results provide a high degree of confidence that cable damage in material susceptible cable would have been detected. The BFN CTP results in conjunction with the SWBP calculations performed for SQN give a high degree of assurance that the forces developed during pullbys were not large enough to cause cable damage. The nature of the SQN conduit configurations also support this conclusion.

The potential consequences due to the random failure from undetected cable damage is inconsequential because of the redundance, diversity, and defense in depth afforded by standard design requirements. Common mode failures from undetected cable damage are highly unlikely. The most severe environments (inside containment) that might trigger the common mode failures are in locations where pullbys (and hence damage from pullbys) were least likely to occur. On the other hand, pullbys were most likely to occur in areas that are strictly mild environments and unlikely to initiate common mode failures. In addition, the separation and protection features incorporated for other programs (e.g., fire protection, moderate energy line break flooding, and high energy like break protection) provide additional protection from environmental effects. These features further lessen the likelihood of common mode failure.

As a result, there is a high degree of confidence that the SQN safety-related cables will perform their intended functions.

ENCLOSURE 2

TVA will provide a complete program plan description and schedule by August 17, 1990.