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

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WBRD-50-391/82-39
BLRD-50-438/82-34
BLRD-50-439/82-31

U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 2900
Atlanta, Georgia 30303

Dear Mr. O'Reilly:

WATTS BAR AND BELLEFONTE NUCLEAR PLANTS UNITS 1 AND 2 - QUALIFICATION OF RHR/DHR SUMP VALVE ROOM - WBRD-50-390/82-42, WBRD-50-391/82-39, BLRD-50-438/82-34, BLRD-50-439/82-31 - REVISED FINAL REPORT

The subject deficiency was initially reported to NRC-OIE Inspector R. V. Crlenjak on April 22, 1982 in accordance with 10 CFR 50.55(e) as NCRs WBN NEB 8207 for Watts Bar and BLN NEB 8204 for Bellefonte. Interim reports were submitted on June 7, September 8, and November 15, 1982. Our final report was submitted on March 9, 1983. Enclosed is our revised final report.

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
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ENCLOSURE

WATTS BAR AND BELLEFONTE NUCLEAR PLANTS UNITS 1 AND 2
QUALIFICATIONN OF RHR/DHR SUMP VALVE ROOM
NCRs WBN NEB 8207 AND BLN NEB 8204
WBRD-50-390/82-42, WBRD-50-391/82-39
BLRD-50-438/82-34, BLRD-50-439/82-31
10 CFR 50.55(e)
REVISED FINAL REPORT

Description of Deficiency

Electrical penetrations in the Watts Bar residual heat removal (RHR) and Bellefonte decay heat removal (DHR) sump valve rooms do not meet the criteria specified in their respective FSARs. The FSAR states that the sump valve rooms will be designed for the same conditions as containment and would serve as a means to provide leaktight enclosure for the single valve and piping between the containment and the valve. Some electrical penetrations into these rooms will not meet the leaktight criteria.

The cause of this deficiency for the Watts Bar Nuclear Plant (WBN) was the failure to establish and implement required design criteria for the RHR sump valve rooms in accordance with section 6.2.4.2.4 of the FSAR. The FSAR and applicable design criteria for the Bellefonte Nuclear Plant (BLNP) provided the necessary guidance for the design of a leaktight enclosure. However, the criteria relative to the electrical penetrations for the DHR sump valve rooms was interpreted to be consistent with the existing design for WBN.

Safety Implications

WBN

This nonconformance constitutes a deviation from the design specified in the FSARS. However, TVA considers the FSAR commitments in this area to exceed the general design criteria (GDC) of 10 CFR 50, Appendix A. Based on the following, TVA believes the safe operation of the plant will not be impaired by this condition.

At WBN, there are two RHR sump valve rooms per unit. Each room contains the RHR sump valve, containment spray sump valve, and corresponding sump piping for a single piping train. (See Figure 1, attached.)

In the WBN FSAR, TVA makes the following commitments:

1. FSAR Section 6.2.4.1 states:

The isolation function of an engineered safety feature or system required to test an engineered safety feature requires one barrier to remain functional after the occurrence of a single active failure. Normally, this is accomplished by providing two isolation valves in series. If it can be shown that a single active failure can be accommodated with only one valve in the line and that fluid system reliability is enhanced by a single valve over two valves in series, then one valve and a closed system both located outside of the containment are acceptable. The single valve and piping between the containment and the valve shall be enclosed in a protective leaktight housing to prevent leakage to the atmosphere in the event of external leakage.

2. FSAR Section 6.2.4.2.4 states:

The valve compartments are designed for the same conditions as the containment.

Based upon the assumed worst case accident described in 2 above, TVA calculations determined the corresponding conditions inside the room to be as follows:

0-24 Hours after accident:

Air pressure - 15 lb/in$^2$ from inside

Hydraulic pressure - 10 lb/in$^2$ from inside (water to 719'-3" from melted ice, RWST contents, and reactor coolant)

Temperature - 250° F

Radiation dose - 1.0 x $10^8$ rads

24-720 Hours after accident:

Air pressure - Negligible

Hydraulic pressure - 24.0 lb/in$^2$ from inside (water to 750'-0" as required to remove fuel after certain primary system rupture)

Temperature - 190° F

Radiation dose - 1.0 x $10^8$ rads

Section 3.1 of the FSAR also requires that certain types of failures must be withstood by the plant design. The design criteria for a passive failure of a fluid system considers: "a break in the pressure boundary resulting in abnormal leakage not exceeding 50 gal/min for 30 minutes." This room was thus intended to be designed to contain a spill due to a break inboard of the RHR sump and containment spray sump isolation valves.

The electrical penetrations from the auxiliary building into the RHR sump valve rooms employ cylindrical steel sleeves through the ceilings. EYS fittings and Chico filling compound were placed in the sleeve to fill the gap between the steel sleeve and the electrical cables running through the sleeve. This type of penetration is a standard design and is a commonly used low pressure boundary electrical penetration throughout the plant.

It has been shown that the Chico compound breaks down when exposed to large doses of radiation and could lose its ability to act as a leaktight pressure boundary. Thus, an electrical penetration using Chico compound does not meet the FSAR commitments.

Two possible solutions to this deficiency have been investigated by TVA:

1. Seal the room to required leaktightness.

2. Show by evaluation that the existing design is acceptable and meets the intent of the original design.

The first step taken was to check into the cost, time, and feasibility of installing qualified electrical penetrations into the room. As a result of this investigation, it was determined that only primary containment type electrical penetrations would meet the environmental conditions which were assumed to occur in the sump valve rooms. A total of 8 electrical penetrations would be needed per unit with a production lead time of approximately 1 to 1-1/2 years. After considering the long lead time which could possibly impact fuel loading, it was decided to evaluate the feasibility of the second solution.

The initial step in determining if the rooms as they existed with the improper electrical penetrations were acceptable was to examine the design basis for the sump valve rooms.

As with many other WBN features, the design for this room is based on Westinghouse experience with other plant designs. The original design basis for this room at another Westinghouse plant similar to WBN is described in its P/FSAR as follows.

1. To prevent radioactive material from leaking to the atmosphere by containing any sump line or isolation valve leakage. This will act to reduce the offsite dose.

2. To prevent loss of recirculation fluid from the sump during a LOCA. Loss of recirculation fluid in large quantities will reduce the ability to cool the core and containment atmosphere post-LOCA.

From the above design basis, this room is to be leaktight and withstand the LOCA conditions of primary containment. In addition, the pressures seen in the room will be larger than containment LOCA conditions due to the additional pressure of the water head in the containment sump which are directly additive to the containment atmospheric pressure.

As seen above, the primary concerns with regard to the sump valve rooms result from leakage into the room. Three types of failures may be considered which would result in leakage into the RHR sump valve room:

1. A passive RHR sump line failure inboard of the contaiment isolation valves.

2. A passive failure of the RHR sump or containment spray sump isolation valve bodies.

3. A valve packing leak.

Following a review of the concern cited in the NCR, it is TVA's position that catastrophic sump line or sump valve failures which will result in large leakage into this room are not credible. The particular failures and bases for incredibility of those failures are as follows:

<u>Pipe Rupture:</u> A pipe break of the RHR sump line in the valve room need not be considered because this line will only be in use after an accident. Pipe break studies for normal operation do not consider these lines, as they are not in use during normal operation.

The RHR sump line process pipe along with the sump line flued head and guard pipe form the RHR sump line penetrations assembly. The process pipe was determined to be the component of the assembly with the least overdesign. Applying the maximum design (nonpressure) loads to the process pipe simultaneously with the application of a pressure equal to four times the maximum calculated accident pressure ($4 \times 25$ lb/in$^2$g = 100 lb/in$^2$g) results in a process pipe critical fiber stress which is less than the pipe yield stress.

The entire penetration assembly is analyzed to quality group B requirements and experiences very little movement. Additionally, the integrity of the assembly is tested during type A containment isolation testing.

<u>Weld Integrity:</u> The welds to the isolation valves and other welds in the pipe between the containment sump and the valves were tested per the requirements listed on TVA weld and NDT requirements drawing 47B333-74-3-R1. Welds tested to this criteria are qualified as Class B welds, which is the appropriate classification for the containment boundary.

<u>Valve Body Failure:</u> Passive failure of the valve body of each isolation valve is also considered to be not credible. These valves are always closed during normal operation. The RHR sump valves are qualified to 600 lb/in$^2$ gauge (at 4[illegible]0$^{\circ}$F) and the containment spray valves are qualified to 200 lb/in$^2$ gauge (at 250$^{\circ}$F), much higher than the 25 lb/in$^2$ gauge they will experience when the line is in use (after a LOCA). The valves will also experience only moderate temperatures (190$^{\circ}$F maximum) and are tested during Type A containment isolation testing. Welds to the valves have been radiographically tested. As before, these valves are analogous to the RHR torus isolation valve of a BWR for which no passive failures are considered.

Postulated Leakage. The only remaining postulated leakage into the RHR sump valve room therefore would come from minor stem packing leakage from the isolation valves. These valves were purchased to the specification of no stem leakage. Taking advantage of state-of-the-art technology, TVA has replaced the packing in most of its ECCS valves, including these valves, with Grafoil type graphite packing. This packing has been shown to drastically reduce the amount of any stem leakage in a valve. Since the containment spray and the RHR sump valves are designed to 200 and 600 lb/in$^2$, respectively, the Grafoil packing is designed for correspondingly high pressures, the $\Delta p$ is almost negligible, and the valves are rarely opened, there will be virtually no leakage. Again, this case is analogous to the case of the packing of the RHR torus isolation valve of a BWR.

It should be noted that NRC Standard Review Plan (SRP) 6.2.4 does not require this room to be designed to the conditions of primary containment, only that it be enclosed in a controlled leakage housing. The auxiliary building and the auxiliary building gas treatment system which contain the RHR sump valve rooms meet the criterion of a controlled leakage housing. Other nuclear plants similar to Watts Bar have no enclosure such as a room or pressure vessel around their RHR sump valves. In these instances, the valves are located in the auxiliary building along with the other valves and piping in the RHR system which are located outside containment.

For the reasons described previously, the piping, welds, and valves are all qualified to withstand post-LOCA conditions without any passive failures. Thus, leakage into the RHR sump valve room will be virtually nonexistent.

In summary, it is the intent of the WBN FSAR commitments to have a leaktight sump valve room which meets post-LOCA conditions, thus ensuring that there would not be a loss of reactor coolant from the sump and that offsite dose limits would not be exceeded. As was demonstrated by the ultraconservatism of the design for the conditions that would exist, the intent is more than adequately met with the existing design. Therefore, the RHR sump valve room, as it exists, is acceptable and is not necessary from a plant safety standpoint.

BLN

Failure of the containment isolation valve in the DHR sump valve rooms would expose the electrical penetrations to an environment for which they were not qualified. The resulting postulated leak of radioactive water could exceed allowable radiation levels thereby adversely affecting the safe operation of the plant.

Corrective Action

WBN

No steps are necessary to correct the as-constructed RHR sump valve rooms at WBN for the reasons discussed above under the WBN safety implications.

TVA considers the event which led to the sump valve rooms not being constructed in accordance with FSAR commitments to be an isolated occurrence. Therefore, no actions to prevent recurrence are necessary.

The Watts Bar FSAR is being revised to accurately reflect the plant configuration.

BLN

Upon completion of the WBN RHR sump valve room analysis, an initial investigation was performed for the piping in the DHR sump valve room at BLN. It was determined that the DHR sump valve piping has an internal design pressure of about 75 $lb/in^2g$ and would experience a maximum internal pressure of 58 $lb/in^2g$. The 75 $lb/in^2g$ design pressure gives the BLN piping a conservatism in design which is less than that at WBN.

Although it was felt that sufficient conservatism was present in the BLN design, it was decided to proceed with the installation of qualified electrical penetrations into the DHR sump valve rooms. This would provide an extra margin of safety and expedite solution of the problem.