UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CATAWBA CONTAINMENT INTEGRITY POSITIONS

(REGION II TIA 96-015)

1.0 INTRODUCTION

By memorandum, J. Johnson to H. Berkow, dated September 17, 1996, Region II requested technical assistance (TIA 96-15) to evaluate a Catawba site document entitled "Catawba Nuclear Station Containment Integrity Review." TIA 96-15 requested NRR to determine whether the licensee's positions are consistent with various regulations and codes.

The staff learned that the "Catawba Nuclear Station Containment Integrity Review" was a one-time self-assessment performed as a result of identification of several containment-related issues in late 1995. The document was meant to be advisory in nature and was not used as a site procedure; some of its recommendations have been adopted by the licensee.

2.0 DISCUSSION AND EVALUATION

The staff's review findings of the licensee's 10 positions in the site document "Catawba Nuclear Station Containment Integrity Review" are set forth below.

2.1 Position I: Overpressure Protection

This position states that "Catawba Nuclear Engineering Calculation CNC-1223.02-00-0016, 'Evaluation of Containment Isolation Overpressure Protection Features in Response to PIR 0-C90-0273,' addresses this issue." TIA 96-15 did not identify specific portions of that calculation which may not meet NRC regulatory requirements. In the absence of specific concerns, NRR cannot justify the resources needed to review the calculation. NRR will, however, review the adequacy of specific aspects of containment penetration overpressure protection features at Catawba during its review of the licensee's response to Generic Letter (GL) 96-06. Any concerns associated with overpressure protection for containment penetrations will be addressed under the GL 96-06 effort.

2.2 Position II: Retest Requirements Following Removal and Reinstallation of an Instrument Line Test Tee Cap or Plug

The licensee's position is that for those instrument line installations that have a double barrier as an option for the test connection, the double barrier test connection should be used. However, with few exceptions, most instrument lines penetrating primary containment do not have a valve installed between the test tee and cap. For these cases it is imperative to have procedure controls for both removal and replacement of the cap. The procedure should require double verification before returning the instrument loop to service. Evidence supporting the acceptability of this practice is given by the Integrated Leak Rate Test (ILRT) results at DPC's seven nuclear units. No periodic ILRT has ever failed to meet its as-found acceptance criterion of less than 75% of the allowable leakage, due to a loose or missing instrument line test tee cap.

The licensee also indicated that the accepted industry practice is that no local leak rate test is required on the pressure boundary provided that the following conditions are met: (1) the removal and replacement of the test cap is controlled by a procedure, and (2) the procedure requires that double verification of proper cap placement be performed before returning the instrument loop to service.

The applicable codes and standards are generally silent on this issue. ANSI/ANS 56.8-1987 and 1994 state that local leak rate testing of test connection vents and drains located between primary containment boundaries is not required providing that the test connection vent or drain is 1 inch or less in size, is administratively secured closed and consists of double barriers (e.g., two valves in series, one valve with a nipple and cap, one valve and a blind flange). While the test connections are part of the containment system barrier, due to their infrequent use, leak rate testing is not required if the above conditions are met.

Based on the probability of very low leakage expected from threaded test tee caps or plugs, the staff has accepted in the past that no local leak rate test of the instrument line is required if the removal and the replacement of the test tee cap or plug is controlled by a procedure which requires double verification before returning the instrument loop to service. Therefore, the staff finds the licensee's position as stated above acceptable.

2.3 Position III: Retest Requirement Following Replacement/Repair of Instrument Loop Fittings, Components and Tubing

This position states that:

> It is recommended that a local leak rate test of the instrument loop should be performed following any activity that breaks the pressure boundary other than removal and replacement of an instrument test cap or plug. Examples of the activities that require a retest of the instrument loop pressure boundary include:

1. breaking the impulse line at a test tee (other than the cap)
2. removal or replacement of tube fittings
3. replacement of tubing
4. replacement or removal of any component within the instrument loop, etc.

With any modification, including the replacement of components associated with the pressure boundary and the breaking of tubing fittings, the potential to introduce an unknown leakage path increases. Therefore, local leak rate testing of the affected pressure boundary is required. The extent and scope of the modification or repair needs to be evaluated, and the extent of the leak rate test determined accordingly. If the scope of the work cannot be determined, the pressure boundary for the instrument loop should originate from the inside containment and extend out to the point of termination for the loop (the transmitter or the return tubing back into containment).

The retest requirements following the removal and reinstallation of an instrument line test tee cap or plug had been addressed above and found acceptable. The licensee's position that the local leak rate test be performed following any activity that breaks the pressure boundary (other than removal and replacement of an instrument test tee cap or plug) meets the requirements of Appendix J local leak rate testing; it is, thus, acceptable.

2.4 Position IV: Instrument Line Containment Vessel Penetrations and Isolation Devices

The licensee's position is as follows:

A. For an instrument line, which is attached to an ASME III system, one automatic isolation valve or control room operated isolation valve located outside containment is acceptable. The line from the tap through the isolation valve should be Duke Class B and routed and protected to prevent damage from missiles, pipe whip, jet impingement, etc. An approved excess flow check valve is suitable for use as the automatic isolation valve where adequate differential pressure is available to close the valve when required.

B. For an instrument line, which is directly connected to the containment atmosphere, one automatic or control room operated isolation valve located outside containment is acceptable. ASME III solenoid valve or motor operated valves must be used on lines connected to the containment atmosphere as insufficient D/P [differential pressure] will exist to close the excess flow check valves in these applications.

C. Instrument lines that are not part of the protective system must consider the Discussion section (B) of Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment." Instrument lines which attach to non-code systems must as a minimum have an automatic isolation valve located outside the containment vessel. The isolation valve must be located as close to the penetration as possible. The instrument line between the penetration and the isolation valve must be routed and/or protected to prevent damage from missiles, pipe whip, jet impingement, etc. The line from the containment to isolation valve should be Duke Class B. The isolation valve should fail closed on loss of power. An excess flow check valve is not acceptable for this case.

D. Filled capillary systems do not require any isolation valves.

E. A locked close isolation valve may be used inside and outside containment for lines which are used for test purposes.

In all cases, the isolation valve must be able to perform the intended function in normal and accident environments.

Regarding Part A above for instrument lines that are part of the protective system, the licensee should state that the design requirements of Regulatory Guide 1.11, Position C.1.b, was met during the licensing review. Parts B thru E meet the containment isolation requirements of Regulatory Guide 1.11 and, therefore, are acceptable.

2.5 <u>Position V: Spare Penetrations</u>

The licensee indicated that since the construction phase, spare instrument line tubing penetrations were required to be installed with caps on both ends of the tubing (containment and annulus sides) in order to maintain containment integrity. Tack welding was required to prevent accidental removal of the tubing caps. Later, during the design phase of an NSM [undefined licensee internal acronym], Catawba reviewed the sealing method of tack welding both ends of capped spare instrument line penetrations and concerns were raised as to the effect of heat from welding on the tubing sealing capability. As a result of the review, it was decided to only require welding (sealed) caps on the containment side of the instrument line penetration. The annulus side of the instrument line penetration would not require tack welding.

The staff finds the licensee's position of sealed welding of caps (no tack welding) on the containment side of spare instrument line penetrations acceptable to meet the containment integrity requirements, as there will be no leakage through the caps if the caps are seal welded.

2.6 Position VI: Testing Valves in Reverse Accident Direction

The licensee's position states:

> 10CFR50, Appendix J requires Type C testing to be performed by local pressurization. In addition, the pressure shall be applied in the same direction as that when the valve would be required to perform its safety function, unless it can be determined that the results from tests for a pressure applied in a different direction will provide equivalent or more conservative results.
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> CNS [Catawba Nuclear Station] position is to fully comply with 10CFR50 Appendix J testing requirements of performing Type C tests in the accident (containment side) direction whenever possible. However, when it is necessary to deviate from testing in the accident direction (reverse direction test), an engineering evaluation will be performed to ensure that the test results are equivalent to or more conservative than the accident direction results.

The staff agrees that testing valves in the reverse accident direction meets the requirements of Appendix J for Type C leak test, because the results from a test for a pressure applied in the reverse direction will provide equivalent or more conservative results. The licensee's position is, therefore, acceptable.

2.7 Position VII: Containment Valve Injection Water System

The licensee's position states that:

> The Containment Valve Injection Water (NW) System is designed to prevent leakage of the containment atmosphere past certain gate valves used for containment isolation. Following a LOCA [loss-of-coolant accident], seal water is injected at a pressure higher than peak containment accident pressure (Pa) between the seating surfaces of the flex wedges valves.
>
> The system is designed to meet all regulatory and testing requirements set forth in 10CFR50, Appendix J (paragraph III-C) and ASME Code Section IX. Pressure is maintained at 110% of peak accident pressure at the most hydraulically remote containment isolation valve and the injection supply/pressure is assured for at least 30 days following the postulated accident.
>
> Containment isolation valves which receive NW are not required to be Type 'C' tested. These valves are tested for injection water leakage. If injection water is assured at a pressure of at least 1.1 Pa for 30 days following a postulated accident, then the containment isolation valves served by NW are considered leak tight and exempt from normal Type C testing. The acceptance criteria for allowable seal water leakage (per train) is such that the cavity pressure at the hydraulically most remote valve on each train does not drop below 1.1 Pa.

The staff finds the licensee's position on containment valves, which are sealed with water as stated above, meet the Appendix J paragraphs III-C.2.b and C.3.b acceptance criteria. The position is, therefore, acceptable.

2.8 Position VIII: Test Vents and Drains Relative to Technical Specification 3.6.1:

The licensee's position states:

> Technical Specification 4.6.1.1.a - 31 day surveillance requirement with respect to test vents and drains (TVDs) located between the credited containment isolation valves.

The licensee stated that the 31-day surveillance requirement applies only to inoperable automatic containment isolation valves that are sealed closed, usually by deactivating the valve; manual containment isolation valves; and penetrations sealed closed with blind flanges. The surveillance does not apply to manual TVDs located between the credited containment isolation valves.

The licensee's position is that the periodic surveillance of manual test vents and drain valves located outside containment be changed to a cold shutdown frequency based on the following administrative controls and licensing basis:

Administrative Controls

The licensee indicated that TVDs are subject to a battery of administrative control: Site Directives, Maintenance Management Procedures, Operational Management Procedures. The TVDs are in place for the specific purpose of testing the main containment isolation valves (CIVs) and these activities usually take place during outage periods (Mode 5 or 6). Regardless of when the leakage testing of the CIV is performed, the operation procedure for Type 'C' Leak Rate Tests will ensure that the penetration is restored to normal - including the assurance that all test connection vents and drain valves are closed and that the pipe caps are installed. Typically, when exiting an outage, systems undergo system alignment to restore that system to service. Any system that is tagged out during the outage first undergoes the block tagout restoration process which fills and vents the system, and then the specific system valve checklist (from system alignment procedure) is performed. Both of these steps ensure the proper positioning of the TVDs. Additionally, the procedure for visual inspection of radioactive systems outside containment is run on a weekly basis. The purpose of the procedure is to inspect those systems carrying radioactive fluids outside containment for leakage and to initiate necessary action to stop or to reduce the leakage.

Licensing Basis

The licensee indicated that Regulatory Guide 1.141 identifies the method acceptable to the NRC staff for complying with General Design Criteria (GDC) 54, 55, 56, and 57 of Appendix A to 10 CFR Part 50. With few exceptions, the regulatory guide endorses ANSI N271-1976. ANSI N271-1976 clearly differentiates between test connection vents and drains in both the definition section and in the body of the standard. ANSI N271 requires leakage rate testing of containment valves in accordance with 10 CFR Part 50 Appendix J. Appendix J provides the same definition for a containment isolation valve as that given in ANSI N271. Although test connection vents and drains are never specifically referred to in Appendix J, it is clear from the definition for Type C testing that the containment isolation valves referred to are those in-line process valves that are required to meet the GDC 55 or 56 criteria of Appendix A. Standard Review Plan (SRP) Sections 6.2.4 and 6.2.6 also distinguish between containment isolation valves and test connections vents and drains, and therefore do not consider test vent and drain connections to be containment isolation valves.

The licensee stated that in view of administrative controls established at Catawba, together with the licensing basis in the documents cited above, it is evident that the application of the monthly surveillance to test connection vents and drains is clearly marginal to safety. The applicable regulatory documents and approved standards draw clear distinction between TVD connections and CIVs. This argument, coupled with the administrative controls imposed on these components, led the licensee to conclude that TVDs are not required to be included in the TS 4.6.1.1.a surveillance.

The staff believes that the TVDs are containment isolation valves. The fact that ANSI N271-1976 has a definition for the TVDs does not mean the TVDs cannot also be CIVs. ANSI/ANS 56.8 recognizes that the test connections are part of the containment system barrier; however, the system also recognizes that the TVDs are infrequently used, that they consist of double barriers, and that the barriers are administratively controlled. ANSI/ANS 56.8 therefore recognizes that TVDs are CIVs. SRP Section 6.2.6 does not draw a conclusion that TVDs are not CIVs. The staff's position is that the TVDs should meet the 31-day Surveillance Requirement 4.6.1.1.a for CIVs. In a conference call with the licensee on June 10, 1997, the staff was informed that currently all TVDs are still on the 31-day surveillance schedule. Hence compliance with TS 4.6.1.1.a is not a concern. The staff did advise Catawba personnel to consider submitting an amendment request to modify TS 4.6.1.1.a should the licensee intend to survey TVDs on a less stringent schedule than every 31 days.

2.9 Position IX: Structural Integrity Testing

The title of this position may be misleading but the licensee seems to understand it correctly as referring to the one-time preoperational test in which the containment was pressurized to 1.15 times its design pressure (17.0 psig). The licensee's position states that "outside of the preoperational test, there is no requirement to perform a structural integrity test," and specifies that "structural integrity testing should be used as an alternative or complementary test or test method to ensure that a system component, instrumentation, and/or piping is capable of maintaining the integrity of the pressure boundary for a system which is part of or interfaces with the containment pressure boundary."

The staff has no basis to dispute the licensee's position.

2.10 Position X: Penetration M261 and M393 Evaluation With Respect to 10 CFR Part 50, Appendix A, GDC 57

The licensee indicated that Containment Penetrations M261 and M363 are Main Steam (SM) line penetrations. Outside of the containment, before the respective main steam isolation valve (MSIV), one branch (SA) from each of these two main steam lines supply steam to the Auxiliary Feedwater Pump Turbine (CAPT). These two SA lines are joined together before reaching the CAPT, such that only one line actually enters the CAPT. Valves SA-1 and SA-4 are manual gate valves located on the SA pipes in the Interior Doghouse immediately downstream of the SM piping. These valves are currently listed in Catawba Technical Specification (TS) Section 3.6.3, Table 3.6-2, as containment isolation valves and are locked open and capable of local manual operation only. These valves are required to be open to supply steam to the CAPT for Engineered Safety Features (ESF) operation of the CAPT. The CAPT can perform its function with one of these valves closed providing that steam is available from the opposite SM piping.

Valves SA-3 and SA-6 are stop check valves located in the Auxiliary Building downstream of SA-1 and SA-4 before the SA piping joins together to supply the CAPT. The licensee stated that piping and supports for SA-3 and SA-6 meet ASME Class II (Duke Class B) standards, and are therefore, of acceptable construction to extend the penetration beyond the identified Containment Isolation Valves (SA-1 and SA-4). Following a design study, Valves SA-1 and SA-4 have been replaced in the UFSAR table by valves SA-3 and SA-6 as containment isolation valves. The design study concluded that these valves and associated piping are of acceptable design and construction for use as containment isolation valves due to accessibility concerns with SA-1 and SA-4 for certain scenarios requiring the isolation of one steam supply to the CAPT.

The two accident scenarios that require the isolation of one steam supply to the CAPT due to current dose assessment limitations and CA System operation requirements are steam generator tube rupture (SGTR) and main steam line break. For the main steam line break, environmental conditions in the doghouse may prevent operator access to valves SA-1 and SA-4. The licensee indicated that operator action is taken as directed within current Emergency Operating Procedures (EPs) and/or Abnormal Operating Procedures (APs) to manually close SA-3 and/or SA-6 as applicable in these scenarios due to more assured accessibility. However, SA-1 and SA-4 are the closest isolation valves to containment and if accessible, can also be closed in a shorter time frame than SA-3 and SA-6. Unless the steam line break is located in the

Interior Doghouse, closing SA-1 and SA-4 would be preferable over SA-3 and SA-6. In each of these accident scenarios, the time required for an operator to close the applicable valve has been estimated and factored into the accident analyses and resultant dose calculations.

GDC 57 Compliance for SA Piping of Penetrations M261 and M363

Appendix A of 10 CFR Part 50, GDC 57, regarding reactor containment closed system isolation valves, states that "each line that penetrates primary reactor containment and is neither part of the reactor coolant pressure boundary nor connected directly to the containment atmosphere shall have at least one containment isolation valve which shall be either automatic, or locked closed, or capable of remote manual operation." It further states that this valve shall be outside containment and located as close to containment as practical, and that a simple check valve may not be used as the automatic isolation valve.

The GDC 55 and 56 requirements given by 10 CFR Part 50, Appendix A provide explicit containment isolation valve arrangements, "unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis." A penetration can satisfy the requirements of GDC 55 and 56 on "other defined basis" through use of one valve instead of two if system reliability is enhanced by the single valve and a single barrier is still maintained after accommodating a single valve failure, or if a position of greater safety is accomplished by enabling an ESF system to function. The licensee stated that although the GDC 57 requirement for closed system isolation does not specifically provide an "other defined basis" alternative, the requirement does not preclude the use of this option. The use of manual locked open valves minimizes the opportunity for SA-1 and SA-4 to be mispositioned in the closed position and the reliability of an ESF system, in this case the CA System, is enhanced. From a probability risk assessment (PRA) perspective, the CAPT is one of the most risk-significant safety system components.

The licensee indicated that other less desirable alternative for compliance with GDC 57 for Penetrations M261 and M363 is to provide remote manual operation capability to SA-1 and SA-4 but the issue of greater safety and cost justification must be considered. With the current design, SA-1 and SA-4 are locked open, and therefore the inadvertent closure of one or both of these valves, and the resulting inoperability of the CAPT is minimized. The remote manual operation would have to reside in the control room (to limit access) and an alarm for a "not open" condition would be required. It is estimated that such a modification would cost at minimum of $1 million for the station. Given that the current method of isolating these lines by local manual operation is sufficient to ensure offsite doses are below allowable limits, the expense required to reduce the time to close these valves is not cost-justifiable.

The licensee's position is that Penetrations M261 and M363 meet the intent of GDC 57 on "other defined basis:" leave TS Table 3.6-2 as is, with SA-1 and SA-4 listed as the containment isolation valves for Penetrations M261 and M363; change the FSAR to identify SA-1 and SA-4 instead of SA-3 and SA-6 as containment isolation valves for these penetrations; revise the applicable Operation EPs and APs to use SA-1 and SA-4 for first response with the option for using SA-3 and SA-6 if access to the Doghouse is restricted due to environmental concerns. This recognizes the design acceptability of closing SA-3 and SA-6, if SA-1 and SA-4 are not acceptable due to a steam piping break in the Doghouse. These procedure changes will not increase the time required to isolate the affected penetration, thereby assuring that no current accident analysis assumption is changed in a nonconservative manner.

The staff's position is that, based on the limited information in the document, Penetrations M261 and M393 do not meet the requirements of GDC 57 for containment isolation. Unlike GDC 55 and 56, GDC 57 requirement for closed system isolation does not allow for an "other defined basis." Region II should follow up through inspection and review of current documentation. If noncompliance is indeed established, the licensee may, among a number of alternatives, provide remote manual containment isolation capability for these penetrations, or request an exemption from GDC 57. The staff learned that such an exemption request is being processed by the licensee.

The NRR staff agrees with the licensee's position that UFSAR Table 6-77 be revised to identify SA-1 and SA-4 instead of SA-3 and SA-6 as containment isolation valves; the revision would conform the UFSAR to the Technical Specifications in this regard. The staff was informed that the licensee has already planned to submit this change as part of the UFSAR update in 1997.

3.0 CONCLUSION

As discussed in detail above, the NRR staff reviewed and commented on the licensee's 10 positions on containment integrity review. Recognizing that the subject document was meant to be advisory and one-time in nature, any regulatory actions Region II plans to undertake should be based on the licensee's subsequent actions and current information.

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