January 22, 2001

MEMORANDUM FOR: Jack R. Strosnider, Jr., Director
Division of Engineering
Office of Nuclear Reactor Regulation

FROM: William H. Bateman, Chief ***/ra/***
Materials and Chemical Engineering Branch
Division of Engineering

SUBJECT: AUTHORIZATION FOR PRESENTATION OF TECHNICAL PAPER

Andrea D. Lee has authored a paper entitled, "NRC Perspective on the Interpretation that ASME Section XI Allows Through-Wall Leakage," which will be presented at the 2001 ASME Pressure Vessel and Piping Conference. Andrea will attend the meeting July 22-26, 2001, and will make the presentation. This memorandum is to request your concurrence for presentation of the subject paper which is attached together with a copy of NRC Form 390.

We believe this paper is covered by Paragraph 033a of NRC Chapter 3205, "Technical Speeches, Papers, and Technical Articles," and NRR Office Letter No. 700, Revision 1. This paper does not involve new or unresolved policy issues. We believe that the NRC staff participation in the subject meeting will be extremely useful in promoting the exchange of information among the participants concerning the use of ASME code cases.

Attached is NRC form 426 approving the abstract. The abstract approval is in ADAMS (00377188.FNI). Expenses for the trip are estimated to be approximately $1300.00

Approval: /ra/ 2/21/01
Jack R. Strosnider, Jr.

Attachments: As stated

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Proceedings of PVP Conference:
2001 ASME Pressure Vessel and Piping Conference
July 22 - 26th 2001, Atlanta, Georgia

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NRC PERSPECTIVE ON THROUGH-WALL LEAKAGE IN ASME CODE CLASS COMPONENTS

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ABSTRACT

A new item entitled, "Leakage Disposition Flow Chart" was introduced during the August 1998 meetings of Section XI of the American Society of Mechanical Engineers (ASME) Working Group on Pressure Testing (WGPT). The flow chart accompanied an action to re-write Subparagraph IWA-5250, "Corrective Action." The proposed re-write resulted from the WGPT's desire to investigate and develop better Code requirements for the disposition of leakage detected during a pressure test.

This paper presents a discussion of the Nuclear Regulatory Commission (NRC) perspective on through-wall leakage with regard to structural integrity and consequences of continued operation. The discussion does not include leakage through bolted connections or gaskets. Leakage through packing or gaskets, for example, are common occurrences that are not likely to compromise the structural integrity of a system or component. Emphasis is placed on NRC regulations and guidelines which govern U.S. commercial nuclear power plants. These regulations do not allow through-wall leakage in, for example, the reactor coolant system (RCS). The stated NRC position is compared to the contention occasionally expressed by the industry that the ASME Code allows through-wall leakage. This opinion periodically emerges and is debated during ASME Section XI Code meetings.

INTRODUCTION

ASME Subparagraph IWA-5250 currently addresses evaluation for corrective action of leakage discovered during a pressure test. However, the guidance provided in IWA-5250 is lacking in that through wall leakage and the required corrective actions are not explicitly delineated. One exception where through wall leakage may be acceptable is Code Case N-513, "Temporary Acceptance of Flaws in Class 3 Piping" which permits through-wall flaws in moderate energy Class 3 piping, for a limited time not exceeding the time to the next scheduled outage, if it can be demonstrated that adequate pipe integrity and leakage containment are maintained. The conditions on Code Case N-513 are currently included in 10 CFR 50.55a.

There is uncertainty among licensees regarding leakage disposition, which prompted WGPT to seek a more concise re-write of IWA-5250. The re-write was intended to clarify the confusion surrounding leakage disposition while maintaining the position that through-wall leakage is a relevant condition. A relevant condition is defined in IWA-9000 as a condition observed during visual examination that requires supplemental examination, corrective measure, correction by repair/replacement activities, or analytical evaluation. During the development of the action, discussions on through-wall leakage were not always consistently presented to the higher Code committees. This fact lead to discussions on whether or not the re-write sought to allow through-wall leakage.

DISCUSSION

NRC Regulations and Guidance Concerning Leakage

ASME Code Section XI is incorporated by reference into Section 50.55a of Title 10 of the Code of Federal Regulations (10 CFR 50.55a). Therefore issues regarding leakage disposition are not only Code compliance questions, but have implications concerning whether or not the proposed re-write of IWA-5250 is consistent with NRC regulations. [1] In addition, a plant's Technical Specifications (TS) are part of the NRC license which authorizes the operation of the facility. Therefore, the TSs establish requirements for items such as safety limits and limiting conditions for operation. The plant improved standard TSs do not allow RCS pressure boundary leakage.

Section 6.15 of NRC Inspection Manual Chapter 9900 states that "If leakage is discovered in a Class 1, 2, or 3 component in the conduct of inservice inspections, maintenance activities, or during plant operation, IWA-5250 of ASME Section XI requires corrective action measures be taken based on repair or replacement in accordance with Section XI". [2]

Through-wall leakage may prevent a system or component from performing its intended function which could, in turn, constitute a safety concern. Continued operation could cause flaw growth and compromise structural integrity. One example of the operational impact of through-wall leakage occurred at Oconee Unit 1. During a refueling outage in November 2000, the licensee for Oconee detected small amounts of boron around four of the eight thermocouple nozzles and one control rod drive mechanism nozzle. This reactor coolant pressure boundary leakage caused the plant to remain shut down, and the licensee had to develop a plan for repair of the degraded vessel head penetrations.

Proposed Re-write of IWA-5250

It should be noted that the discussion in this paper is based on the proposed re-write of IWA-5250 as it was presented during the August 2000 ASME Code meetings. The action will likely be revised prior to the July 2001 PVP conference and publication of this paper. The fundamental discussion on through-wall leakage presented in this paper is relevant despite any revisions that may be made to the proposed re-write.

The white paper that accompanied the August 2000 version of the proposed re-write of IWA-5250 states that the objective of the action is to allow all leakage detected during a pressure test to be evaluated by the owner to determine a course of action. This encompasses water, oil, steam or gas leakage. The intent of the action is to clarify that through-wall leakage is a relevant condition.[4] Several discussions in WGPT and higher committees have focused on whether or not the proposed re-write seeks to allow through wall leakage.

The proposed re-write deletes IWB-3522, "Standards for Examination Category B-P, All Pressure Retaining Components", and points the user to IWA-5250 which will have corrective measures and acceptance criteria. For through wall leakage in Class 1 components, the proposed IWA-5250 re-write would send the user to IWB-3142 which has provisions for acceptance by analytical evaluation. This path could allow a user to circumvent repair or replacement of a through wall flaw since the proposed IWA-5250 would not directly require repair or replacement, as is the case in the current IWA-5250.

Summary of Working Group Pressure Testing Discussions

During development of this proposed action, it was noted that older ASME Code Editions stated that through-wall leakage was not allowed, but that later Editions and Addenda removed these words from the Code. Specifically, subarticle IS-524(a)(2) of the 1971 Edition of the Code states, "Leakages from through-wall flaws in the pressure-retaining membrane of a component shall be eliminated either by corrective repairs or component replacement. Such repairs and replacements shall conform with the requirements of IS-400." These words were removed from the Code in the 1974 Edition. Although this point was briefly debated, most members of the WGPT acknowledged that the current re-write of IWA-5250 did not seek to allow through-wall leakage.

The sponsor of the IWA-5250 re-write added the following statement in the white paper in order to address the NRC member's concern regarding through-wall leakage: "The WGPT recognizes Section XI as an international code and that regulators within the United States do not allow through-wall or through-weld leakage." The NRC representative's suggestion to revise the re-write to state that through-wall leakage requires repair or replacement, or to reference the flaw evaluation rules of the Code were not accepted by the WGPT. The majority of the group did not endorse repair or replacement as the only option for through-wall leakage, and did not agree that IWA-5250 should be tied to the flaw evaluation rules of IWB-3600.

The basis for this conclusion is that a "Special Task Group on Leakage" addressed through-wall and mechanical leakage at the ASME Code meetings during 1995 and concluded that structural integrity does not imply leakage tightness. The group also concluded that the purpose of pressure testing is to verify piping, component, and system integrity, and that leakage is acceptable under normal circumstances. The proposed re-write identifies through-wall leakage as a relevant condition that requires corrective action.

Several members of higher Code committees

have concluded that the action could lead to acceptance of through-wall leakage without repair or replacement. The acceptance criteria proposed to be used for dispositioning a through-wall flaw is found in IWB-3142 for Class 1 systems, and IWC-3132 for Class 2 and 3 systems. Although IWB-3142.3 discusses acceptance by corrective measures or repair/replacement activity, other IWB-3142 paragraphs have provisions for acceptance by visual examination, supplemental examination, and analytical evaluation.

NRC Position on Through-Wall Leakage

The removal of wording from the ASME Code which stated that through-wall leakage is not allowed should not be construed as a basis for allowing an affected component to remain in service without repair or replacement. The flaw evaluation rules of the Code must still be met because through-wall leakage is evidence of a flaw and, as discussed earlier, continued operation could cause flaw growth and compromise structural integrity.

Regardless of whether or not the Code allows through-wall leakage, as mentioned above, the plant TSs do not permit any Code Class 1 pressure boundary leakage. Pressure boundary leakage is defined in the TS as "leakage (except steam generator leakage) through a non-isolable fault in an RCS component body, pipe wall, or vessel wall." If RCS pressure boundary leakage exists, the TSs require the plant to be shut down within 36 hours. The operational leakage limiting condition for operation (LCO) must be entered upon discovery of pressure boundary leakage, therefore operability determinations (or leakage disposition) are not appropriate. [2]

As mentioned in the introduction, Code Case N-513, "Temporary Acceptance of Flaws in Class 3 Piping" permits through-wall flaws in moderate energy Class 3 piping, for a limited time not exceeding the time to the next scheduled outage, if it can be demonstrated that adequate pipe integrity and leakage containment are maintained. Code Case N-513 is being extended to include Class 2 moderate energy piping. The key is that the piping must be Class 2 or 3 moderate energy. Continued operation with through-wall leakage in, for example, Class 1 high energy piping could result in safety significant consequences such as personnel injury, damage to systems and components, or catastrophic failure.

The issue discussed in this paper is not a new staff position. For example, in 1998, Browns Ferry was the subject of a task interface agreement (TIA) between NRC Headquarters and the Region 2 offices due to a through wall flaw in the reactor core isolation cooling system steam supply line steam trap piping. The licensee repaired the piping in a reasonable time frame, however, concerns regarding compliance with TS prior to the repair prompted further questions and extensive discussion with the licensee. The staff has granted temporary approval for operation with through wall flaws, but the approval was for very specific and limited time frames. In 1999 Grand Gulf was approved to operate for one cycle with a leak in the standby service water system piping (moderate energy Class 3). NRC Inspection Report No. 50-416/99-04, dated April 23, 1999, contains detailed information regarding this pipe leakage issue. As a result of these events, the NRC determined, in its inspection report mentioned above, that a noncited violation (NCV) occurred. This violation is in the licensee's corrective action program. As a response to the NCV, the licensee submitted a relief request in accordance with the provisions of Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping."

The issues that the IWA-5250 re-write have attempted to address, and the confusion as to what the action would or would not allow have brought the through-wall leakage discussion to the forefront of both ASME Code and NRC discussions. It is important from a regulatory point of view to resolve how through-wall leakage will be addressed by the Code.

CONCLUSION

The staff notes that even well maintained systems may have leakage that can be dispositioned, and evaluated for continued service or corrective action. However, through-wall leakage is a relevant condition that would not meet the flaw evaluation acceptance criteria in IWB-3600. NRC Regulations do not permit any Code Class 1 pressure boundary leakage. The direction that the ASME Code will take on this issue is unclear. It is important that NRC Regulations and ASME Code rules are consistent. The staff concludes that through-wall leakage in Class 1 systems or components requires repair or replacement in order to maintain structural integrity and to ensure that the affected component can perform its intended function.

ACKNOWLEDGMENTS

The authors would like to acknowledge Jim Boughman for his assistance in explaining the intent of the proposed IWA-5250 re-write, and for providing historical information in support of the action.

REFERENCES

1. NRC Inspection Manual, Part 9900:Technical Guidance, May 12, 1986.

2. NRC Inspection Manual, Part 9900, Section 6.15, October 31, 1991.

3. NRC V.C. Summer website: www.nrc.gov/NRC/REACTOR/SUMMER/index.htm

4. ISI 99-32, IWA-5250 Rewrite (August 2000)