4.4.5.4 Acceptance Criteria

a. As used in this specification:

1) Imperfection means an exception to the dimensions, finish or contour of a tube or sleeve from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube or sleeve wall thickness, if detectable, may be considered as imperfections;

2) Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube or sleeve;

3) Degraded Tube means a tube or sleeve containing imperfections greater than or equal to 20% of the nominal tube or sleeve wall thickness caused by degradation;

4) % Degradation means the percentage of the tube or sleeve wall thickness affected or removed by degradation;

5) Defect means an imperfection of such severity that it exceeds the repair limit. A tube or sleeve containing a defect is defective;

6) Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving. It also means the imperfection depth at or beyond which a sleeved tube shall be plugged. The repair limit is equal to 40% of the nominal tube or sleeve wall thickness. For Unit 1, this definition does not apply to the region of the tube subject to the alternate tube plugging criteria.

If a tube is sleeved due to degradation in the F* distance, then any defects found in the tube below the sleeve will not necessitate plugging.

The Babcock & Wilcox process described in Topical Report BAW-2045(P)-A, Rev. 1 will be used for sleeving.

7) Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in 4.4.5.3c., above;

8) Tube Inspection means an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg;

STEAM GENERATORS (Continued)

generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. Inservice inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

The B&W process (or method equivalent) to the inspection method described in Topical Report BAW-2045(P)-A, Rev. 1 will be used. Inservice inspection of steam generator sleeves is also required to ensure RCS integrity. Because the sleeves introduce changes in the wall thickness and diameter, they reduce the sensitivity of eddy current testing, therefore, special inspection methods must be used. A method is described in Topical Report BAW-2045(P)-A, Rev. 1 with supporting validation data that demonstrates the inspectability of the sleeve and underlying tube. As required by NRC for licensees authorized to use this repair process, Catawba commits to validate the adequacy of any system that is used for periodic inservice inspections of the sleeves, and will evaluate and, as deemed appropriate by Duke Power Company, implement testing methods as better methods are developed and validated for commercial use.

The plant is expected to be operated in a manner such that the secondary coolant will be maintained within those chemistry limits found to result in negligible corrosion of the steam generator tubes. If the secondary coolant chemistry is not maintained within these limits, localized corrosion may likely result in stress corrosion cracking. The extent of cracking during plant operation would be limited by the limitation of steam generator tube leakage between the Reactor Coolant System and the Secondary Coolant System (reactor-to-secondary leakage = 500 gallons per day per steam generator). Cracks having a reactor-to-secondary leakage less than this limit during operation will have an adequate margin of safety to withstand the loads imposed during normal operation and by postulated accidents. Operating plants have demonstrated that reactor-to-secondary leakage of 500 gallons per day per steam generator can readily be detected by radiation monitors of steam generator blowdown. Leakage in excess of this limit will require plant shutdown and an unscheduled inspection, during which the leaking tubes will be located and repaired.

Wastage-type defects are unlikely with proper chemistry treatment of the secondary coolant. However, even if a defect should develop in service, it will be found during scheduled inservice steam generator tube examinations. Repair will be required for all tubes with imperfections exceeding the repair limit of 40% of the tube nominal wall thickness. For Unit 1, defective tubes which fail under the alternate tube plugging criteria do not have to be repaired. Defective steam generator tubes can be repaired by the installation of sleeves which span the area of degradation, and serve as a replacement pressure boundary for the degraded portion of the tube, allowing the tube to remain in service. Steam generator tube inspections of operating plants have demonstrated the capability to reliably detect wastage type degradation that has penetrated 20% of the original tube wall thickness.

ATTACHMENT II

TECHNICAL SPECIFICATION CHANGE

This proposed amendment to the Technical Specifications (TS) will allow the use of the B&W sleeving process as described in BAW-2045P, Rev 1. This revision to the topical allows sleeving to be used in the tube support plate region, as well as in the tube sheet region which is currently allowed per TS 4.4.5.4.a.6.

DISCUSSION AND TECHNICAL JUSTIFICATION

The ability to repair steam generator tubes by tube support plate sleeving will be important in the future due to the increasing number of secondary side stress corrosion cracking indications located in the tube support regions of the hot leg. At the end of Unit 1 Cycle 4, 15 tubes were detected containing indications of intergranular attack (IGA/SCC) on the tube outer diameter. At the end of Cycle 5, the number of indications had increased to 159. Original analysis predicted that Catawba Unit 1 would be expected to reach 1% of tubes repaired at about 5 effective full power years. In reality, Catawba Unit 1 has reached this level in a little more than 4 effective full power years.

If the steam generator tubes cannot be sleeved, all defects greater than 40% through-wall will be plugged. The rapid rate at which indications are increasing suggests that without the ability to use sleeving in the support plate region in the near future, a large number of tubes may have to be plugged.

The purpose of sleeving is to repair a degraded tube in a manner that maintains the function and integrity of the tube. A degraded tube means a tube or sleeve containing imperfections greater than 20% of the nominal tube or sleeve wall thickness caused by degradation. A sleeve, consisting of an 11" or a 17.5" length of tubing is placed inside the existing steam generator tube to span a tube support plate or tube sheet defect or indication. The risk of a tube leak or rupture is reduced. Sleeving also helps to maintain plant margin for safety analysis. Twenty sleeves can be installed with the same primary flow reduction as with one plugged tube. The use of sleeves rather than plugs leaves a greater heat transfer area available in the steam generator. Forty-eight tube sheet, or sixty-five tube support plate sleeves, causes the same reduction in heat transfer as plugging one tube.

The sleeving process requires cleaning the area to be sleeved, inserting and kinetically welding the sleeve, and stress relieving the welds. Robotic manipulators commonly used in other steam generator work perform the majority of these processes. Cleaning is performed by a flexible hone system. The sleeve is inserted and positioned. For the tube support plate sleeves, both joints are simultaneously kinetically welded. Following welding, a temperature controlled heater is inserted into the sleeve to stress relieve both freespan joints simultaneously for a support plate sleeve. Only the upper joint is stress relieved in the tube sheet sleeve. The details of these processes are presented in Topical Report BAW-2045P, Rev. 1.

Eddy current testing is used to verify positioning and expansions, as well as tube and sleeve integrity. A bobbin coil inspects the tube outside the sleeve area. In the sleeved area, a rotating pancake coil supplements the bobbin coil analysis.

M. S. Tuckman's letter, dated December 19, 1990, submitted a proposed revision to the Catawba Technical Specifications to allow the option of using the B&W Kinetic Sleeving Process for 3/4" OD Tube Repair described in Topical Report BAW-2045(P)-A. This proposed amendment was approved as Amendment 84/78 to the Catawba Technical Specifications on March 4, 1991. At the time this amendment was issued, the staff concluded that there was reasonable assurance that operation in accordance with the proposed amendment would not endanger the health and safety of the public.

This proposed amendment will allow steam generator tube sleeving to be done in accordance with BAW-2045P, Rev. 1. This topical allows the use of sleeving in the tube support plate region using kinetic welds at both the upper and lower joints, which was not included in Rev. 0 of the topical. The topical also provides additional corrosion test data information from the 7/8" tube sleeve qualification program, and information on the redesign of the 3/4" tube sheet sleeve using a kinetic weld at both the upper and lower joints, where in the previous design the lower joint had been rolled.

The tube support plate sleeves are qualified to meet applicable portions of the 1986 ASME Code Sections criteria for steam generator design and operation. Verification included analysis, and determinations of critical fatigue loading conditions. Leak testing, pressure cycling, and axial load fatigue testing verified the mechanical integrity of the support plate sleeves. The installed structural integrity of both the tube sheet and tube support plate kinetically welded joints was proven by subjecting the sleeve/tube weld samples to a series of tests representing design service conditions. The samples were leak tested, fatigue tested, and leak tested again, to qualify the joint by experimental stress analysis. Subsequent examination showed that the structural integrity of the sleeves and kinetic weld were maintained after testing. Thermally treated alloy 690 was selected for the sleeve material due to enhanced corrosion resistance. A battery of corrosion testing showed alloy 690 was superior in nearly all steam generator environments when compared with alloy 600. Details of the sleeve qualification are found in BAW-2045P, Rev. 1.

ATTACHMENT III

NO SIGNIFICANT HAZARDS ANALYSIS

10 CFR 50.92 states that a proposed amendment involves no significant hazards consideration if operation in accordance with the proposed amendment would not:

1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

3) Involve a significant reduction in the margin of safety.

Operation of Catawba in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated. Considering the function of the sleeve, the principal accident associated with this amendment is the steam generator tube rupture accident. The steam generator sleeve has been analyzed and tested to the operating and design conditions of the original tube as documented in Topical Report BAW-2045P, Rev. 1. The Topical Report contains the design verification results from the analysis and confirmatory testing performed on the sleeve. The probability or consequences of this previously evaluated accident does not involve a significant increase since the sleeve meets the original tube design conditions and the structural integrity of the tube is maintained by the sleeving process. The sleeve is less susceptible to the identified stress corrosion failure mechanisms of the original tube because of the B&W specified installation process and the use of improved material (Inconel alloy 690); therefore, the potential for primary to secondary leakage is also reduced by the addition of a steam generator tube sleeve. The continued integrity of the sleeve will be verified by TS inspection requirements, and the sleeve will be plugged in accordance with TSs, if necessary.

Operation of Catawba in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated. The purpose of the sleeve is to repair a defective steam generator tube to maintain the function and integrity of the tube as opposed to plugging and removing the tube from service. The sleeve functions in essentially the same manner as the original tube, and has been analyzed and tested for steam generator design conditions. The sleeve is less susceptible to the identified stress corrosion failure mechanisms of the original tube because of the B&W specified installation process and the use of improved material (Alloy Inconel 690); therefore, the potential for primary to secondary leakage is also reduced by the addition of a steam generator tube sleeve. The continued integrity of the sleeve will be verified by TS inspection requirements and the sleeve will be plugged in accordance with TSs, if necessary. Repairing a steam generator tube to a serviceable condition utilizing the proposed sleeve process does not create the possibility of a new or different type of accident since the sleeving is a passive component with postulated failures that are similar to the original tube.

Operation of Catawba in accordance with the proposed amendment would not involve a significant reduction in a margin of safety. The structural integrity of the tube is maintained by the installation of the sleeve and the sleeve/tube weld. The potential for primary to secondary leakage is reduced by the addition of the steam generator tube sleeve. Kinetic sleeving has proven to be attractive from an ALARA point of view.

The Catawba LOCA analysis in Chapter 15 of the FSAR takes into account the effect of plugged tubes on primary coolant flow. The LOCA analysis assumes a worst case where 10% of the tubes are plugged. The effects of sleeve installation (versus tube plugging) on steam generator performance, heat transfer, flow restriction, and steam generation capacity were analyzed and described in the B&W Topical Report. Twenty sleeves can be installed with the same primary flow reduction as with one plugged tube. Forty-eight tube sheet, or sixty-five tube support plate sleeves, causes the same reduction in heat transfer as plugging one tube.

ENVIRONMENTAL IMPACT ANALYSIS

One of the major design objectives of the B&W steam generator tube sleeving process was to minimize personnel exposure. The results of a personnel exposure study are presented in Section 7.3 of the Topical Report BAW-2045P, Rev. 1. The conclusion is that tube sleeving provides a radiological economic alternative to plugging and removing tubes from service.

The sleeving process does result in radioactive waste which is considered disposable and cannot be reused. The solid volume produced during the installation of 50 sleeves is approximately 0.75 cubic feet. This waste consists of nylon tubing, stress relief heaters, roll expanders, cleaning hones, and water. The cleaning hones (less than one percent of the waste) are expected to have the highest contamination dose rate. This contact will result in an expected hone radiation reading of approximately 1-2 R/hr after the usable life of the hone. The remainder of the waste is considered to be extremely low level waste. The cleaning water will be retrieved and piped to the station radioactive waste water treatment system. Approximately one gallon per each tube will be required. Additional wastes will be produced consisting of protective clothing, tape, plastic bags, and other materials normally used in a radioactive area.

The proposed amendment does not involve a significant hazards consideration, nor significantly increase the types and amounts of effluents or waste that may be released offsite, nor increase individual or cumulative occupational radiation exposures. Therefore, the proposed TS amendment meets the criteria given in 10 CFR 51.22(c)(9) for categorical exclusion from the requirement for an Environmental Impact Statement.