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

Joseph M. Farley Nuclear Plant
Elevated Tube Sheet Laser Welded Sleeve Technical Specification Amendment

Ladies and Gentlemen:

Physical restrictions in the steam generator bowl limit bundle coverage for the full length tube sheet sleeve. In an effort to improve the bundle coverage and provide additional tools for steam generator management, Southern Nuclear intends to utilize a short, elevated tube sheet sleeve. The shorter sleeve, approximately 12 to 20 inches in length, results in the ability to sleeve approximately an additional 30% more of the tube sheet bundle. Sleeving these tubes would not have been possible with a full length tube sheet sleeve due to interference with the steam generator bowl.

Currently, an elevated tube sheet laser welded sleeve is included in the Farley Unit 2 Technical Specifications by reference to WCAP-12672. However, the lower joint of the elevated tube sheet sleeve includes a laser welded joint within the tube sheet. As discussed in Southern Nuclear letter dated April 2, 1992, technical concerns preclude the use of a laser weld within the tube sheet. As a result, Southern Nuclear proposes to replace the laser welded lower joint with a mechanical joint similar to that licensed under WCAP-11178, Revision 1.

As a result, an amendment to the Farley Units 1 and 2 Technical Specifications is proposed to allow the use of the elevated sleeve. Attachment 1 provides the basis for use of the elevated sleeve. Attachment 2 provides a significant hazards assessment for the amendment. Attachment 3 provides the revised technical specification pages. The technical specification pages reflect requested changes for F*, L*, and the voltage based alternate repair criteria. Southern Nuclear requests approval of this amendment by March 1997 in order to support the next scheduled refueling outage.

SNC has determined that the proposed license amendment will not significantly increase the amount of any effluent that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. SNC will implement the proposed license amendment within 30 days of NRC issuance.

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If there are any questions, please advise.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Dave Morey

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Sworn to and subscribed before me this 23rd *day of* August, *1996*

Martha Gayle Dow
Notary Public

My Commission Expires: November 1, 1997

Enclosures:
1. Basis for Use of the Elevated Sleeve
2. Significant Hazards Evaluation
3. Revised Technical Specification Pages

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Enclosure 1

Basis for Use of the Elevated Sleeve

BASIS FOR THE INSTALLATION OF STEAM GENERATOR TUBE
ELEVATED TUBESHEET LASER WELDED SLEEVES
AT FARLEY UNITS 1 AND 2

1. INTRODUCTION

This basis addresses the operation of Farley Units 1 and 2 following the installation of Westinghouse elevated tubesheet laser welded tube sleeves to repair defective steam generator tubes, as described in References 5.1 and 5.2 and further supplemented below. Operating histories throughout the industry have shown a potential for tube wall degradation in the expanded portion of the tube in the tubesheet, in the tube expansion transition, in the tubesheet crevice region, and at the tube support intersections. To maintain tube integrity consistent with the margin of safety used as the bases for the Technical Specifications, an allowable level of tube wall degradation for a sleeved tube (referred to as repair limit) is established. Tubes which have eddy current indications of degradation in excess of the repair limit must be repaired or plugged. The information provided in References 5.1 and 5.2 defines the portion of the tube and the sleeve for which indications of wall degradation must be evaluated.

The laser welded steam generator sleeving process involves the installation of thermally treated Alloy 690 sleeves in steam generator tubes in the tubesheet region at the Farley Units 1 and 2 steam generators. Once installed, the tube is returned to a condition consistent with the design basis; that is, stresses and fatigue usage limits in the tube/sleeve assembly are bounded by the ASME Code requirements, and the tube is leaktight.

Installation of sleeves represents, although small, a reduction in total reactor coolant system flow rate due primarily to the sleeve inside diameter restriction. Information is contained in Reference 5.1 which can be used to estimate the additional flow resistance introduced by the installation of laser welded sleeves. The additional flow restriction introduced by the installation of sleeves can be used to estimate the impact upon minimum measured flow.

Additionally, post weld heat treatment of the free span (upper joint of elevated tubesheet sleeve) laser weld increases the overall corrosion resistance of the joint. Consistent with previous Safety Evaluation Reports issued by the Nuclear Regulatory Commission addressing laser welded sleeving, all free span laser welded joints installed at Farley Units 1 and 2 will receive a post weld heat treatment. Also, leakage testing has shown that laser welded sleeve joints are essentially leaktight during normal operating and faulted plant conditions. Therefore, the installation of laser welded sleeves will not significantly contribute to offsite doses during a postulated steam line break event or any other transient event which involves leakage of reactor coolant to the steam generator secondary side with subsequent release to the environment.

Elevated tubesheet sleeves are secured by first performing a hydraulic expansion of the upper and lower portions of the sleeve. A laser produced weld is implemented in the area of the hydraulic expansion region of the upper joint. This weld is produced in the free span (above the top of the tubesheet) region of the tube and structurally supports the sleeve in addition to forming a leaktight seal. The roll last sequence for the installation of the elevated tubesheet sleeve (as discussed below) involves performing the welding and all heat treatment prior to forming the lower joint. The structural integrity requirements are satisfied by each individual sleeve joint so that structural integrity margin is inherently provided. The acceptance criteria for structural integrity includes inherent safety factors consistent with the ASME Code design criteria.

The hybrid expansion joint (HEJ) performed at the lower joint of the elevated tubesheet sleeves has been previously qualified, and is implemented in the majority of the greater than 47,000 sleeves Westinghouse has installed in the field. The HEJ, being a mechanical seal, has not historically been considered leaktight, although the test data for Alloy 690 HEJ sleeves support the lower joint as being leaktight during operating and accident conditions. As noted above, the development of the lower joint for the elevated tubesheet sleeve is based on the selection of the roll last sleeve installation sequence. In this sequence, the sleeve-to-tube weld is performed before the lower roll expansion. To further reduce the potential for primary-to-secondary leakage during all plant conditions, a two-step rolling process is applied to each lower joint of the elevated tubesheet sleeve.

2. LICENSING BASIS

The NRC, in 10 CFR 50.55a, requires components which are a part of the primary pressure boundary to be built to the requirements of Section III of the ASME Boiler and Pressure Vessel Code. Section 5.2.1.1 of the Standard Review Plan, entitled "Compliance with the Codes and Standards Rule, 10 CFR 50.55a," provides an outline of the standards used for evaluation by the NRC Staff. Any modification, repair, or replacement of these components must also meet the requirements of the ASME Code to assure that the basis on which the unit was originally evaluated is unchanged. The design of the sleeve is predicated by the requirements of Section III, NB-3200, "Analysis", and NB-3300, "Wall Thickness." The ASME Boiler and Pressure Vessel Code provides criteria for evaluation of the stress levels in the tubes for design, normal operating, and postulated accident conditions. The margin of safety is provided, in part, by the inherent safety factors in the criteria and requirements of the ASME Code.

Regulatory Guide 1.121, issued for comment, entitled "Bases for Plugging Degraded PWR Steam Generator Tubes," addresses tubes with both part throughwall and throughwall cracking. The requirements of Regulatory Guide 1.121 are extended to the laser welded sleeve in order to determine the level of degradation which will require removal of the sleeve from service by plugging. By utilizing the requirements for sleeve design according to the ASME Code and Regulatory Guide 1.121 to define acceptance criteria, the design of the sleeve meets the

requirements of General Design Criteria (GDC) 14, "Reactor Coolant Pressure Boundary," GDC 15, "Reactor Coolant System Design," and GDC 31, "Fracture Prevention of Reactor coolant Pressure Boundary."

Regulatory Guide 1.83, Revision 1, "Inservice Inspection of Pressurizer Water Reactor Steam Generator Tubes" and the Farley Units' 1 and 2 Technical Specifications is used as the basis to determine the inservice inspection requirements for the sleeve.

Total plant allowable primary-to-secondary leakage rates, derived from the requirements of 10 CFR 100, are determined on a plant specific basis. Offsite doses during either a main steam line break or tube rupture event are not to exceed a small fraction of 10 CFR 100 limits, per the Bases to the Farley Technical Specifications. Since the free span laser welded joints form a hermetic seal between the sleeve and tube, and the tubesheet sleeve lower joints have been shown to indicate essentially leaktight performance during operating and accident conditions, the installation of elevated tubesheet laser welded sleeves will not significantly contribute to offsite doses during either a postulated steam line break or any other faulted or upset condition which involves primary-to-secondary leakage.

3. EVALUATION

3.1 Sleeve Design and Analysis

The installation of elevated tubesheet laser welded sleeves has been reviewed for impact on safe plant operation, i.e., maintenance of steam generator tube and leaktightness integrity during all plant conditions. The sleeve joint design is qualified through laboratory testing and analysis per References 5.1, 5.2, and 5.3. The function of the sleeve is to restore the integrity of the pressure boundary in the region between the sleeve joints to a level which is consistent with the original tube, i.e., the tube is leaktight and stresses within the tube are bounded by the ASME Code limits. Following elevated tubesheet sleeve installation, the hard roll of the lower joint of the sleeve functions as the primary pressure boundary. The portion of the tube below the lower joint of the elevated tubesheet sleeve will no longer be a part of the primary pressure boundary and, therefore, will not require inservice inspection during subsequent plant outages.

The sleeves described in References 5.1 and 5.2 have been designed according to Section III, Subsection NB-3300, of the 1986 Edition of Section III of the ASME Boiler and Pressure Vessel Code and additional codes and standards as identified in Section 3.0 of WCAP-12672, Revision 1 and WCAP-13115. However, the elevated tubesheet sleeves to be installed at Farley are designed and analyzed according to the 1989 edition of Section III of the ASME Code as well as applicable US NRC regulatory guidelines. The associated materials and processes also meet the rules of the ASME Code. The sleeving codes, i.e., IWB-4300, first approved in the Section XI, Division 1,

1989 addenda, dated March 1990 are also used in this evaluation as guidelines. There are no significant differences between the 1986 and 1989 versions of the ASME Code such that the technical justification for the acceptability of the installation of laser welded sleeves at Farley Units 1 and 2 would be changed.

Fatigue and stress analyses of sleeved tube assemblies were previously completed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Subsection NB-3200. The generic analysis of steam generator tube laser welded sleeving for 7/8" diameter tubes includes a primary stress intensity evaluation, primary plus secondary stress intensity range evaluation, and a fatigue evaluation for mechanical and thermal conditions based on conservatively bounding design transient events. ASME Code minimum material property values for Alloy 690 tubing material were used for the design analysis. Use of ASME Code minimum material property values is conservative, based on the actual sleeve material certification reports.

For all analyzed conditions, the calculated stress levels and fatigue usage factors for both the sleeve and weld are bounded by the ASME code allowable values. The largest ratio of calculated stress to ASME Code allowable is calculated to be less than 1.0, for the Test (hydrotest) condition. Since the hydrotest condition is usually performed once during the plant lifetime, the use of this ratio for comparison purposes is conservative. For all other conditions (normal, upset, and faulted), the largest stress ratio is bounded by the hydrotest condition.

The load cycles used in the fatigue analysis represent 40 year life cycle conditions, and, therefore, are considered conservative for operating plants. Cumulative fatigue usage for Farley Units 1 and 2 sleeves is calculated to be significantly less than 1.0 for the plant specific transient evaluation based on a 40 year evaluation cycle.

Both the primary stress evaluation and the fatigue analysis were performed for cases where the tubes were dented and separated at the top of the tubesheet, and for the case where tubes were undented and intact. For the design condition, the intact tube case results in the highest stresses while the separated tube is the limiting case for fatigue.

3.2 Sleeved Tube Assembly Corrosion Resistance

Corrosion testing has been performed in high temperature-high pressure autoclaves. A high temperature, doped steam environment was utilized to accelerate crack propagation. Results of the accelerated corrosion tests (reference 5.1) indicate that a free span laser welded joint which has not received a post weld heat treatment is less susceptible to primary water stress corrosion cracking (PWSCC) than mechanically roll expanded tube joints at the rolled to unrolled transition. If post weld heat treatment is applied, test results indicate a resistance to corrosion of greater than 10 times that of rolled tube transitions. Several heats of Alloy 600 MA tubing known to be highly

susceptible to PWSCC were used for corrosion testing. The Westinghouse post weld heat treatment process is designed to achieve a minimum tube OD wall temperature at the weld elevation and within the laser welded sleeve heat affected zone. Due to the heat transfer characteristics of the laser welding process, the heat affected zone is narrow compared to other sleeve welding processes. As a consequence, the tube length required to be heated to is also narrow, compared to other processes. Since the weld cooling stresses required to be relieved are concentrated at the tube ID surface, the temperature that this area of the tube will experience during heat treatment is actually higher than the specified temperature, and should provide for greater stress relieving capability in the desired area. Additionally, the length of tube heated during the post weld heat treat has a direct effect upon residual stresses generated in the tube as a result of the process. Data contained in Reference 5.1 suggests adequate post weld heat treatment effects are introduced at temperatures as low as 1250°F at the tube OD adjacent to the weld. In the laser welded sleeving process, the level of tube expansion, laser welding procedure, and post weld heat treatment temperature have been selected specifically to reduce the potential for introducing excessive residual stresses in steam generator tubes.

Laser welded sleeved tubes which have operated for up to 3 plant cycles in the U. S. have recently been inspected using advanced design probes. No degradation of the sleeves or tubes in the weld area was detected. Operating plant experience in Europe has shown good operating experience of laser welded sleeve joints for up to 5 cycles. Recently performed corrosion testing of laser welded sleeve joints for a similar plant indicates that with post weld heat treatment the stress corrosion cracking resistance in the parent tube in the weld region is greatly enhanced. These tests, which simulated stresses due to locked tube conditions at the first support structure, showed exceptional resistance to PWSCC initiation.

3.3 Elevated Tubesheet Sleeve Plugging Limit

The licensed repair limit of 37% allowable depth of penetration of the sleeve tube wall thickness for a full length tubesheet sleeve or tube support plate laser welded sleeves applies to an elevated tubesheet sleeve when a combined eddy current uncertainty and growth allowance of 20% is assumed in the development of the repair limit. However, current state-of-the-art in eddy current inspection capability is such that no probes are qualified to size the depth of penetration of stress corrosion cracking even though it is generally believed that the detection threshold is well below 40% throughwall. Therefore, Southern Nuclear Operating Company will plug on detection any crack-like indications that may occur in the elevated tubesheet sleeve using the sleeve inspection probe of record until an inspection process is qualified to size the depth of the penetration.

3.4 Flow Margin Effects

The installation of a sleeve into a tube results in a small additional flow restriction within the primary system, with an associated increase in pressure drop in the steam generator. The effects of this flow restriction on plant operation are evaluated in the same manner that tube plugging

effects are analyzed. Reference 5.1 identifies the reduction in primary coolant flow caused by the projected sleeving under normal operating conditions and identifies the number of sleeves or combination of sleeves which result in a flow reduction equivalent to one plugged tube. Evaluation of core cooling capability for the minimum reactor coolant system flow rate will bound the effects on all core and system parameters for a combination of plugging and sleeving up to the equivalent resistance associated with the minimum reactor coolant flow rate.

3.5 Joint Structural Requirements

The forces acting on a sleeve during operation are related to the pressure differential between the primary and secondary systems and the cross sectional area of the sleeve/tube assembly. The mechanical strength of laser welded sleeve upper and lower joints have been addressed in a testing program. Prototypic samples of the laser welded joints have been subjected to axial pushout and pullout tests (reference 5.1). The loads required for first slip and one inch of sleeve motion were recorded for each test specimen. Prototypic samples of the two step roll lower joint were subjected to axial pullout tests (reference 5.3). All samples for the upper and lower joints tested had pullout "breakaway" values in excess of a maximum endcap load corresponding to 3 times the normal operating differential pressure, the most limiting Regulatory Guide 1.121 loading. Each joint of the sleeve exceeds the structural integrity requirement; if it is postulated that one of the sleeve joints were to experience a loss of structural integrity, the second sleeve joint would still provide adequate structural integrity.

Test data contained in Reference 5.3 for HEJ standard tubesheet sleeve joints installed in hydraulicly expanded tubes indicates that the structural integrity characteristics of these joints exceeds acceptance criteria. Testing of sleeves installed in hydraulicly expanded tubes represents a good simulation for Farley Units 1 and 2 since the explosive expansion process used at Farley Unit 1 is expected to be similar to hydraulically expanded joints while judged to produce a less substantial fitup between the tube and tubesheet compared to the full depth hardroll expansion in Unit 2. Previous testing in roll expanded tubes indicates that the resultant joint provides for greater levels of axial load bearing capability and leaktightness compared to non-rolled tubes. The effects of tubesheet bow upon the lower joint of the elevated tubesheet sleeve have been evaluated specifically for Farley Units 1 and 2, and the results factored into the design.

For elevated tubesheet sleeves, which are installed in the upper half of the tubesheet, i.e., above the neutral bending axis, tubesheet bow during operation may increase the diameter of the holes drilled into the tubesheet. This diameter must be evaluated to determine whether or not the tubesheet bow results in a decrease in the contact pressures between the sleeve/tube and tube/tubesheet produced by steam pressures and differential thermal expansions among the sleeve, tube, and tubesheet. The results of the analysis indicate that the joint will not be adversely affected by tubesheet bow (reference 5.3). In all cases, the net effect of the tubesheet rotations, thermal expansion, and pressure loading is an increase in the contact pressure between the sleeve and the tube.

3.6 Laboratory Leak Testing

3.6.1 Test Description

Laser welded test specimens have been prepared in a manner that duplicates the field installation process for the elevated tubesheet sleeves. In the two step roll process selected for the elevated tubesheet sleeves to be installed at Farley, the lower elevation pass will be performed first, followed by the upper step. A mechanical test involving measurement of the axial strains during the rolling sequence was performed in conjunction with the concurrent sleeved tube corrosion test. The mechanical test indicated that there was no significant disadvantage, in terms of sleeve and tube axial strain below the laser weld or tube far field strain above the laser weld, to performing the lower step first. Therefore, the lower step is performed first, followed by the upper step.

3.6.2 Leak Test Results For Two-Step Elevated Tubesheet Sleeve Lower Joints

For the sake of simplicity, the axial length of the roll expanded portion of the lower joints of the elevated tubesheet sleeves to be installed at Farley and the full length tubesheet sleeves are the same. The effective axial length of the joints was determined by the axial space available in the vicinity of the tube mouth which is limited by the initial partial roll expansion of Farley Unit 1. This is because a uniform sleeve inner diameter will not generally be obtainable if part of the length is placed in the factory rolled portion and partially in the explosive expansion portion.

The operational leakage criterion used in the development of the sleeves is an average of 1.3 dpm ($1.7X\ 10^{-5}$ gpm) per sleeve, which is an arbitrary allocation of one-third of the 140 gpd operational primary-to-secondary leak rate limit apportioned to 2000 sleeves per generator. The more restrictive primary-to-secondary leakage limit of Unit 1 is used to establish the acceptance criteria.

Non-welded elevated tubesheet sleeve lower joints were essentially leaktight at room temperature. Leak test specimens tested from 1990 to 3110 psi primary-to-secondary pressure differentials resulted in no test samples exceeding 20% of the acceptance criteria. The average primary-to-secondary leakage experienced during the steam line break/feed line break pressure differential of 2650 psi was 0.05 dpm. Total leakage during a postulated steam line break event if 2000 elevated tube sheet sleeves were installed in one steam generator would be limited to approximately 1.3×10^{-3} gpm. Therefore, it can be concluded that primary-to-secondary steam line break leakage through the non-welded sleeve joints will be insignificant or zero for plant normal and postulated faulted event pressure conditions for the two-step hardroll joint configuration (reference 5.3). The dose evaluations for accident conditions which result in secondary steam release to the environment will not be significantly affected due to the installation of laser welded elevated tube sleeves. Tube sleeving will not increase primary coolant release rates during a postulated steam generator tube rupture event, and the installation of tube sleeves will not affect the response of the plant, outside of analyzed flow conditions.

3.7 Rewelding

In the event of an incomplete first cycle, or an uninspectable first cycle weld, a second weld cycle can be performed either over the initial weld or inboard of the original free span weld. In these cases, this additional weld, having the same nominal characteristics as the initial weld, will be performed. If the sleeve/tube has not been perforated by an interrupted weld, an additional weld, having the same nominal characteristics as the original weld, will be made over the initial weld or in the expansion zone near the original weld inboard of this initial weld. If a perforation of the sleeve is suspected in the initial weld area, the repair weld will be made in the expansion zone near the original weld inboard of this initial weld.

3.8 Inspectibility

Rotating probe coil (RPC) inspection results will be used to determine the condition of the parent tube prior to the installation of the elevated tubesheet sleeves to confirm that the tube is undegraded at the lower joint location.

Free span laser welds performed in the field are verified using an ultrasonic (UT) inspection technique. The UT will confirm and quantify the requirement for a minimum width of the weld fusion zone, which has been shown by analysis to satisfy all ASME Boiler and Pressure Vessel Code stress and fatigue usage loading criteria. UT inspection is required prior to the initial return to power following sleeve installation. The free span UT weld fusion zone acceptance criteria implements a minimum acceptable weld width of approximately 50% greater than the analyzed minimum acceptable value. Therefore, field implemented welds with the minimum acceptable weld width as determined by UT will inherently provide large margins to the existing weld stress evaluation, which has been shown to satisfy the ASME Code requirements. Also, field experience has shown that the nominal sized field welds are roughly twice the minimum acceptable weld width as determined by UT. So, even greater margins to the minimum acceptable analyzed value are provided.

The remainder of the sleeve, including the weld, is baseline inspected using an eddy current inspection coil which minimizes the effects of geometry and weld zone changes that are associated with the sleeve geometry. Per Regulatory Guide 1.83, Revision 1, the results of subsequent eddy current inspections will be evaluated against these baseline results. Both the Cecco-5 transmit-receive style of eddy current probe and the +Point probe have been qualified for use in laser welded sleeved tubes. The Cecco-5 probe has been shown to provide for a detection threshold for circumferential and axially oriented degradation of 40 to 50% throughwall (actual degradation depth) in the parent tube. The Cecco-5 probe has been previously utilized at Farley Units 1 and 2 for the inspection of laser welded sleeves.

3.9 Westinghouse Laser Welded Sleeve Operating Experience

Westinghouse laser welded sleeves were first installed in a foreign plant using 7/8" OD tubing in 1988. After one operating cycle, one sleeved tube was removed from the steam generator and metallurgically examined. No degradation of either the parent tube or sleeve wall was observed. The sleeves in these steam generators operated without incident until the steam generators were replaced in 1993. Laser welded tubesheet and tube support plate sleeves were first installed in the U. S. in the Spring of 1992. Since then, greater than 500 laser welded sleeves have been installed at Farley Units 1 and 2. No sleeves or sleeved tubes have been plugged due to either identified leakage or parent tube degradation in the joint area. Many of the sleeves installed in these steam generators involve multiple sleeves installed in a single tube (combination of tube support plate sleeves and tubesheet sleeve). The tubes in these steam generators are also believed to be firmly affixed to the tube support plates. If the installation of laser welded sleeves involved unusual or unanticipated residual stress levels not originally considered, it is reasonable to conclude that, based on industry experience, some indication would have occurred after three operating cycles. Overall, Westinghouse laser welded sleeves and sleeved tubes demonstrate exceptional field performance. Industry experience has shown that other sleeving processes in which residual stress levels were not properly modeled resulted in sleeved tube failures resulting in significant primary-to-secondary leakage in approximately one operating cycle.

Approximately 11,200 laser welded sleeves were installed in a European plant using 3/4" tubing during May to September 1994. All of these sleeves were the elevated tubesheet sleeve type. Elevated tubesheet sleeves were installed based upon the requirement to maximize the number of sleeves that could be installed. The plant returned to power during October/November 1994. No operating events involving these sleeves have occurred. After 8 months of full power operation, these sleeves were inspected using the Cecco-3 transmit receive probe. No crack-like indications were detected in the sleeves or parent tubes.

Approximately 18,500 elevated type tubesheet laser welded sleeves were installed in two U. S. plants in 1995. These steam generators have operated for a limited time following sleeve installation. At the time of the preparation of this document, there is no operational experience to report.

Additionally, approximately 18,000 7/8 inch tube laser welded sleeve joints have been in operation for a number of cycles in Japanese PWRs. The interesting aspect of this installation process is that the free span laser welded sleeve joints are not heat treated. The welds have operated without incident for several plant cycles.

4. CONCLUSION

Based on the above evaluation, the installation of elevated tubesheet laser welded sleeves, as described in WCAP-12672, WCAP-13115, and as supplemented above, into the Farley Units 1 and 2 steam generators will provide a level of leaktightness and individual tube integrity equal to that of a non-degraded tube, and as such will not adversely affect the safe operation of the steam generators or the entire plant

5. REFERENCES

5.1. WCAP-12672, Steam Generator Sleeving Report Laser Welded Sleeves J. M. Farley Units 1 and 2" (Proprietary)

5.2. WCAP-13115, "Steam Generator Sleeving Integration Report J. M. Farley Units 1 and 2"

5.3. NSD-JLH-6202, "Summary of Farley LWS Lower Joint Development - TM & C Qualification Testing; 6/25/96

Enclosure 2

Significant Hazards Evaluation

INSTALLATION OF STEAM GENERATOR TUBE
ELEVATED TUBESHEET LASER WELDED SLEEVES
SIGNIFICANT HAZARDS CONSIDERATION ANALYSIS

INTRODUCTION

As required by 10 CFR 50.91 (a)(1), this analysis is provided to demonstrate that a proposed license amendment for the J. M. Farley Nuclear Plant steam generators involves no significant hazard consideration. In accordance with the three factor test of 10 CFR 50.92(c), implementation of the proposed license amendment (Technical Specification Change) was analyzed using the following standards and found not to: 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 a margin of safety.

DESCRIPTION OF THE AMENDMENT REQUEST

The amendment has been proposed to allow installation of laser welded elevated tubesheet sleeves in Farley Units 1 and 2.

The laser welded steam generator sleeving process involves the installation of thermally treated Alloy 690 sleeves in steam generator tubes in the tubesheet region at the Farley Units 1 and 2 steam generators. Once installed, the tube is returned to a condition consistent with the design basis; that is, stresses and fatigue usage limits in the tube/sleeve assembly are bounded by the ASME Code requirements, and the tube is leaktight.

Elevated tubesheet sleeves are secured by first performing a hydraulic expansion of the upper and lower portions of the sleeve. A laser produced weld is implemented in the area of the hydraulic expansion region of the upper joint. This weld is produced in the free span (above the top of the tubesheet) region of the tube and structurally supports the sleeve in addition to forming a leaktight seal. The roll last sequence for the installation of the elevated tubesheet sleeve involves performing the welding and all heat treatment prior to making the lower joint. The structural integrity requirements are satisfied by each individual sleeve joint so that structural integrity margin is inherently provided. The acceptance criteria for structural integrity includes inherent safety factors consistent with the ASME Code design criteria.

The hybrid expansion joint (HEJ) performed at the lower joint of the elevated tubesheet sleeves has been previously qualified, and is implemented in the majority of the greater than 47,000 sleeves Westinghouse has installed in the field. The HEJ, being a mechanical seal, has not historically been considered leaktight, although the test data for Alloy 690 HEJ sleeves support

the lower joint as being leaktight at operating and accident conditions. As noted above, the development of the lower joint for the elevated tubesheet sleeve is based on the selection of the roll last sleeve installation sequence. In this sequence, the sleeve-to-tube weld is performed before the lower roll expansion. To further reduce the potential for primary-to-secondary leakage during all plant conditions a two-step rolling process is applied to each lower joint of the elevated tubesheet sleeve.

ANALYSIS

Conformance of the proposed amendments to the standards for a determination of no significant hazard as defined in 10 CFR 50.92 (three factor test) is shown in the following:

1. Operation of the Farley Nuclear Plant Units 1 and 2 steam generators in accordance with the proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The installation of elevated tubesheet laser welded sleeves as described below, can be used to repair degraded tubes by returning the condition of the tubes to their original design condition (for tube integrity, stress and fatigue considerations, and leaktightness during all plant conditions). Tube bundle overall structural and leakage integrity will be increased with the installation of the laser welded sleeves. The performance history of Westinghouse sleeves has shown that, to date, no domestic laser welded sleeves have been removed from service due to corrosion degradation of the sleeve or parent tube in the joint area.

   Any hypothetical sleeve failure is bounded by the consequences of a postulated steam generator tube rupture event. The use of elevated tubesheet laser welded sleeves will not increase the amount of primary-to-secondary leakage anticipated during a postulated steam line break and other analyzed accidents. Leak rate tests show only negligible primary-to-secondary leakage through the non-welded elevated tubesheet sleeve lower joints during normal or accident conditions such that any consequences are insignificant with regard to offsite doses. Sleeve installation will result in an increase in resistance to primary coolant flow through the tube. Depending on the assumed steam generator tube rupture location, the primary coolant flow through the ruptured tube is reduced by the influence of sleeves installed below the break location, thereby reducing the consequences to the public due to a steam generator tube rupture event. Steam generator tube sleeving has as a basis that the analyzed steam generator tube plugging level and associated minimum measured flow rate, is not exceeded. Therefore, primary coolant flow area assumptions in the accident analyses are not affected and any consequences of a postulated loss of coolant accident would not be increased.

2. The proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Installation of elevated tubesheet laser welded sleeves will increase the leaktightness of the tube bundle in addition to enhancing overall steam generator tube bundle integrity by isolating localized tube wall degradation. Isolation of the tube degradation is provided by attachment between the tube and sleeve at each end of the sleeve. Following the installation of the sleeves, steam generator tube integrity is restored to its original design bases.

Testing has shown that once installed, there is no mechanism for the sleeves to affect any portion of the steam generator other than the tubes in which they are installed. No other system or component connecting with the steam generator is adversely affected by the operation of the steam generator following installation of laser welded tube sleeves.

Structural analyses of the tube, sleeve and sleeve joints show the stress limits defined in the ASME Code are not exceeded during all plant conditions. The effect of any hypothetical failure of the sleeve would be bounded by existing tube rupture analyses. No increase in leakage is anticipated during a postulated steam line break event. Therefore, operation of the steam generators following installation of elevated tubesheet laser welded sleeves in the tubes of the Farley steam generators will not result in an accident previously not analyzed in the FSAR.

Therefore, SNC concludes that the proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed license amendment does not involve a significant reduction in a margin of safety.

The margin of safety with respect to maintenance of the integrity of the tube bundle is provided, in part, by the safety factors included in the ASME Code, and is not reduced. Nondestructive examination of the sleeve and non-sleeved tube length still can be performed; therefore, the recommendations of Regulatory Guide 1.83, Revision 1 can be implemented. The installation process of the elevated tubesheet laser welded sleeves has been shown to provide an essentially leaktight bond between the sleeve and the tube during all plant conditions, and, as such, would not significantly contribute to the radiological consequences of a postulated steam line break event. Any combination of sleeving and plugging utilized at Farley Units 1 and 2 up to the level that analyzed minimum measured reactor coolant flow rate is maintained per Technical Specification requirements, will be bounded by the accident analyses supporting the analyzed flow level.

Therefore, SNC, concludes that the proposed change does not result in a significant reduction in a loss of margin with respect to plant safety as defined in the Final Safety Analysis Report or the bases of the Farley technical specifications.

CONCLUSION

Based on the preceding analysis, it is concluded that operation of the Farley Nuclear Plant steam generators in accordance with the proposed amendment does not involve a significant hazards consideration as defined in 10 CFR 50.92.