



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 44 TO FACILITY LICENSE NO. DPR-23

CAROLINA POWER AND LIGHT COMPANY

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NO. 50-261

Introduction

By letter dated November 4, 1976, as supplemented June 30, 1977, July 29, 1977, June 9, 1978, August 9, 1978 and April 9, 1979, Carolina Power and Light Company (the licensee) requested changes to the Technical Specifications appended to Facility Operating License No. DPR-23 for H. B. Robinson Unit No. 2. The proposed changes would establish inservice surveillance requirements for steam generator tubes.

Discussion

On September 14, 1976, we requested that the licensee submit proposed Technical Specification changes that would establish requirements for a program of steam generator tube inspection. To provide guidance in developing an inspection program at that time, the licensee was to refer to Regulatory Guide 1.83, "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes", dated June 1974 (R.G. 1.83). The licensee submitted a program for H. B. Robinson Unit No. 2 on September 24, 1974. However, we made a decision to delay requiring Technical Specification incorporation of the program at that time because of a need to revise R.G. 1.83 to reflect developments in the state of the art of steam generator tube inspection techniques and to more directly take into account the inspection experience that was being gained at operating plants. In making that decision we took into account the industry wide practice which already included voluntary inspection of steam generator tubes that in many respects was comparable to inspections that R.G. 1.83 specified. Revision 1 to R.G. 1.83 was issued after receiving comments from the industry. By letter dated November 4, 1976, the licensee proposed Technical Specifications which reflect the provisions of R.G. 1.83, Revision 1. The Technical Specifications proposed for H. B. Robinson Unit 2 tube inspections are, therefore, in agreement with those provisions.

7912180

076

Certain revisions of the proposed Technical Specifications were necessary to meet our requirements. These changes have been discussed with the licensee and, as agreed, have been incorporated into this amendment.

I. Evaluation - Steam Generator Inspection Program

Surveillance Requirements for Steam Generator Tubes

Structures, systems, and components important to safety of a nuclear power plant are designed, fabricated, constructed, and tested so as to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. To continuously maintain such assurance, General Design Criterion 32 requires that components which are part of the reactor coolant pressure boundary (RCPB) be designed to permit periodic inspection and testing of important areas and features to assess their structural and leaktight integrity. The steam generator tubing is part of the RCPB and is an important part of a major barrier against fission product release to the environment. It also acts as a barrier against steam release to the containment in the event of a Loss of Coolant Accident (LOCA). For this reason, a program of periodic inservice inspection is being established to assure the continued integrity of the steam generator tubes over the service life of the plant.

Generally, the major elements of the steam generator tube inservice inspection program consist of specified: (a) sample selection, (b) examination methods, (c) inspection intervals, (d) acceptance criteria, and (e) reporting requirements. Each of these major elements of the program is separately evaluated below.

1. Sample Selection

The proposed sampling is generally patterned after R.G. 1.83, Rev.1, "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes". However there are some deviations from R.G. 1.83 that we require to improve the program and/or reduce the potential radiation exposure of personnel who perform the inspections. The licensee's program includes these additional requirements. Deviations from R.G. 1.83 supplementary sampling requirements are evaluated below:

- a. Regulatory Position C.5.a, "Supplementary Sampling Requirements" recommends that if the eddy current inspection results during an inservice inspection indicate any tubes with previously undetected imperfections of 20% or greater depth, additional steam generators, if any, should be inspected. In other words, because of a single tube in one steam generator with previously undetected imperfection of 20% or greater depth but still well below the plugging limit, all steam generators in the plant should be inspected. Although

the detection of any defect warrants further inspection to determine the extent of degradation in the steam generators, we believe that this inspection should be expanded initially to determine the extent of any further degradation in the one steam generator under inspection. If the expanded inspection indicates more extensive defect conditions, then expansion to the other steam generator is required. This approach will provide careful stepwise expansion of inspection based on the results of successive steps, while tending to minimize the exposure of inspection personnel resulting from initial positioning of inspection equipment in a steam generator. This inspection approach, as specified in the licensee's proposed Technical Specifications, is appropriate for this facility in which system characteristics are such that both steam generators are expected to perform in a similar manner.

- b. Revision 1 of R.G. 1.83 requires additional inspections if the initial inspection results indicate that more than 10% of the inspected tubes have detectable wall penetration of greater than 20% or that one or more tubes inspected have an indication in excess of the plugging limit. The additional inspections require a complete tube inspection of an additional 3% and, if required, a third inspection of 6% of the tubes. The requirements set forth in the proposed Technical Specifications are acceptable because they require a second inspection doubling the number of tubes inspected in the first sample if 5% of the tubes show degradation of 20% wall thickness or more. Again, if more than 5% in the second sample of the tubes show a detectable penetration greater than 20% or 1% are defective tubes, a third sample is required again doubling the number of tubes inspected in the second sample. In the first sample, sampling is to concentrate on areas of the tube array where prior inspections or experience have indicated potential problems, and full length traverse of each inspected tube is required. For a second or third sample, if required, the inspection may concentrate on areas of the tube array and portions of the tube in which the first sample or the second sample indicated potential problems.

Based on the considerations discussed above, we have concluded that the sample selection scheme proposed by the licensee is acceptable.

2. Examination Method

The proposed examination methods include nondestructive examination by eddy current testing. The specified methods are capable of locating and identifying stress corrosion cracks and tube wall thinning from chemical wastage, mechanical damage or other causes. Based on our review of these methods and experience gained using these methods by the industry, we have concluded that the examination methods are acceptable.

3. Inspection Intervals

The proposed inspection intervals are compatible with those recommended in R.G. 1.83, Revision 1, and thus, are acceptable.

4. Acceptance Criteria

The licensee has submitted tabulated eddy current inspection results showing the mean defect growth (percent of tube wall thickness) between consecutive inspections as a function of the date of the later inspection. The earliest inspection considered was performed in May, 1974, since that was when the onset of thinning was observed. In order to minimize the errors associated with small eddy current indications, the licensee subsequently provided the same type of data considering only those tubes indicating $\geq 30\%$ wall thinning. Additionally, mean and standard deviations were calculated for the three inspections of each steam generator, for all three generators combined, and for all three inspections combined. For all three inspections combined, a mean growth of 0.78% of tube wall per year with a standard deviation of $\pm 8.17\%$ was calculated. Including tubes with indications between 20% and 30%, the plant average was calculated to be 1.17% per year. The licensee assumes a tube thinning rate of 2% per year in order to envelope this calculated value.

Minimum acceptable tube wall thickness calculations have been performed for the licensee by Westinghouse. A summary of the calculations shows that under normal operating conditions, assuming a factor of safety of 3 for the full range of normal operating pressure differentials, a minimum wall thickness of 0.023 inch is required. For postulated accident conditions, a minimum tube wall thickness of 0.017 inch and 0.021 inch is required under MSLB + SSE and LOCA + SSE conditions, respectively. Criteria utilized in preparing these calculations is taken from Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes".

Regulatory Guide 1.121 states, as a tube plugging criteria, that any tube indicating a defect depth greater than the maximum allowable defect minus an operating allowance should be plugged or repaired. Further, the guide specifies that the operating allowance should include a margin for error in eddy current testing and an additional percentage of wall thickness to ensure that the maximum allowable defect depth is not exceeded during operation prior to the next inspection. The licensee, in determining the plugging limit, has used an operating allowance of 2% per year. In determining the required minimum tube

wall thickness, the licensee takes exception to applying a factor of safety of 3 during the full range of normal operating pressure differentials. The licensee states that the requirement, which essentially duplicates the ASME Code Section III requirements for the design of new tubes, cannot realistically be applied to partially degraded tubes. CP&L stated that the requirement is restrictive since it does not recognize the reinforcing effect of limited axial length thinning demonstrated in laboratory tests. CP&L further stated that postulated accident conditions, rather than normal operating conditions, should govern the plugging criteria. The licensee proposes an alternate factor of safety of 2 which would require a 0.016 inch wall thickness.

Based on the above reasoning, the licensee examines the required wall thicknesses for the postulated accident conditions. The licensee states that since a situation in which the tube is uniformly thinned along the axis of the tube for a length exceeding two diameters has not been observed, the calculated required wall thickness of 0.021 inch needed during a postulated LOCA + SSE should not be the limiting case.

The minimum acceptable tube wall thickness finally arrived at and used by the licensee in determining the plugging limit is 0.020 inch. A tube with 0.020 inch of remaining wall ensures that the general primary membrane stress intensity, under normal operating pressure differentials, remains below the materials yield strength at 600°F. This structural requirement of 0.020 inch, or 40% of the tube wall thickness, is added to the mean thinning rate of 2% per year resulting in a minimum acceptable tube wall thickness of 42%. This results in a plugging limit of 58%. However, the licensee states that an additional allowance of 8% is added to provide extra conservatism and, hence, a plugging limit of 50% was recommended.

We have reviewed the results of the licensee's steam generator tube inspections, minimum acceptable tube wall thickness calculations and criteria, and plugging limit determination. Results of the four most recent eddy current inspections indicate that 2% per year is a reasonable tube thinning rate.

The licensee's position is that a factor of safety of 3 against tube burst during normal operation is unnecessary. Although we do not agree with that position, we feel that the licensee's calculation showing a minimum tube wall of 0.023 inch required to maintain a factor of safety of three is indeed conservative. Based on preliminary results of independent tests on steam generator tube burst being performed for the NRC, the required safety factor can be maintained at a wall thickness less than the 0.021 inch required for the LOCA + SSE condition.

As discussed above, the licensee believes the calculated required wall thickness of 0.021 inch for the SSE + LOCA loading condition is not realistic, and has used 0.020 inch for calculating a proposed 50% plugging limit.

Since we do not concur with the licensee's position that 0.021 inch minimum tube thickness is unrealistic, we require that this minimum thickness be maintained. Further, to account for statistical scatter in inspection data and uncertainties in the eddy current testing technique, an additional 9% shall be included in the plugging limit calculation. Adding this 9% to the required minimum tube wall thickness of 42% (0.021 inch) gives plugging limit based on a minimum wall thickness of 51% plus 2% per year degradation or thinning allowance rate between inspections. This results in a plugging limit of 47% for an inspection interval of 12 months, 45% for 24 months, etc. Based on the discussion and evaluation above, we conclude that these tube plugging limits are reasonably conservative and therefore, are acceptable for the H. B. Robinson Unit 2 steam generators. We have discussed these plugging limits with the licensee and the licensee agrees with the staff's position.

5. Reporting of Inspection Results

Regulatory Position C.7.d of R.G. 1.83 states that a licensee should report to the Commission, for resolution and approval, proposed remedial action if the inspection results exceed the limits specified in the Guide. It also states that additional sampling and more frequent inspection may be required. The proposed Technical Specifications clearly specify additional inspections the licensee must perform for those inspection results that fall in Technical Specification Categories C-1 and C-2. Immediate reporting of these results would not be required. Immediate reporting would be required only if the inspection results fall into the most severe Category, C-3, as described in Table 3.8 of the Technical Specifications.

We conclude that the above described reporting requirements, as proposed by the licensee and modified by us, are reasonable and will facilitate reporting of pertinent information without unnecessarily increasing plant downtime, and thus constitute an acceptable alternative method for meeting NRC reporting requirements.

II. Summary - Steam Generator Inspection Program

In summary, we have concluded that the proposed steam generator tube inservice inspection program will provide added assurance of the continued integrity of the steam generator tubes, and thus is acceptable.

Environmental Consideration

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR Section 51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: November 17, 1979