(b) Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube.

(c) Degraded Tube means a tube containing imperfections $\geq$20% of the nominal wall thickness caused by degradation.

(d) % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

(e) Defect means an imperfection of such severity that it exceeds the plugging limit. A tube containing a defect is defective.

(f) Plugging Limit means the imperfection dept at or beyond which the tube shall be removed from service because it may become unserviceable prior to the next inspection is is equal to 40% of the nominal tube wall thickness.

(g) 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 a steam line break, feedwater line break, Operating Basis Earthquake, or a loss-of-coolant accident as specified in 4.10.c.3 above.

(h) 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.

2. The steam generator shall be determined OPERABLE after completing the corresponding actions (plug all tubes exceeding the plugging limit and all tubes containing through-wall cracks) required by Table 4.10-2.

EXCEPTION

During the cycle 6/7 refueling conducted during the fall of 1982 only, the steam generator shall be determined operable without performing 100% tube inspection required by Table 4.10-2 when first or subsequent sample inspection results are at the C-3 level due to defects in the area of the short radius tube bends provided:

(a) such tube defects are associated with rows 5-8 and

(b) no such defects are found in rows 3, 4, 9, 10, 11, or 12 when these rows are inspected at the 100% level.

E. Reports

1. Following each inservice inspection of steam generator tubes, the number of tubes plugged in each steam generator shall be reported to the Commission within 15 days.

2. The complete results of the steam generator tube inservice inspection shall be included in the Annual Operating Report for the period in which this inspection was completed. This report shall include:

   (a) Number and extent or tubes inspected.

   (b) Location and percent of wall-thickness penetration for each indication of an imperfection.

   (c) Identification of tubes plugged.

3. Results of steam generator tube inspections which fall into Category C-3 and require prompt notification of the Commission shall be reported pursuant to Specification 5.7.A prior to resumption of plant operation. The written followup of this report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

ATTACHMENT A TO PROPOSED CHANGE NO. 96

MODIFICATION OF MAINE YANKEE'S TECHNICAL SPECIFICATIONS

CONCERNING STEAM GENERATOR TUBE SURVEILLANCE

CONTENTS

ECT PATTERN AND TUBE PLUGGING JUSTIFICATION FOR MAINE YANKEE

1 Introduction

The purpose of this document is to justify relaxation of the requirements for expansion of the size of the sample of steam generator tubes that would be required to be eddy current tested by Maine Yankee's current technical specification.

The justification consists of establishing that the tube degradation phenomenon observed in the Maine Yankee #2 steam generator is similar to that observed elsewhere. Therefore, as has been previously determined for another unit, the type of degradation experienced at Maine Yankee is not likely to occur outside the limited area already eddy current tested on a tube by tube basis. In addition, this type of tube degradation is characteristically slow to progress.

2. Description of Problem

During the current October 1982 outage at Maine Yankee, indications of tube degradation were found during ECT of tubes in Steam Generator No. 2. All except one indication were located in the four rows of tubes passing through the crevice region created by the batwing and vertical support strip intersections in the U-bend area of the inner rows of tubes. The indications are at the apex of the U-bend, are OD initiated, and have some length associated with several of them. They range in depth from less than 20% wall to 90% wall at the worst case.

The one anomaly was found just above the second eggcrate on the cold side near the center of the tube bundle. It is considered to be unique and not related to the U-bend indications discussed here.

3. Comparison to St. Lucie I

The tube degradation indications found at Maine Yankee are quite similar to those observed at St. Lucie I during the October 1981 outage.

In both cases, the defects are located in the tube U-bends at the intersection of batwings and vertical support strips. They are OD initiated and have associated length.

The steam generator configurations are similar also. The plants have similar tube support design except that St. Lucie I is slightly larger. This causes the batwing and support strip intersection to fall two rows further from the tubelane than Maine Yankee which corresponds exactly to the defect locations found in each plant. Even though overall differences certainly exist in the hydraulics of a three-loop versus two loop system, very small areas such as the tube support intersections will have characteristics which for practical purposes are identical.

For these reasons, the phenomenan now being seen at Maine Yankee is believed to be identical in nature to that previously observed at St. Lucie I. Therefore, the ECT techniques used to define the localized area of occurence at St. Lucie are also valid for defining this area at Maine Yankee. This type of degradation would not be expected to be observed outside of this area.

4. Defect Bounding

The cycle 6/7 outage ECT inspection pattern at Maine Yankee was developed expressly to seek out St. Lucie type defects. Rows 8 through 12 at St. Lucie correspond to rows 6 through 10 at Maine Yankee (taking into account the shift due to difference in steam generator configuration). When two (2) indications were found at Maine Yankee, further testing was specified requiring that rows 3 thru 12 be completely examined in all three steam generators. When U-bend indications were first discovered at St. Lucie I, examinations were conducted well beyond the actual areas of degradation with the results demonstrating that the condition is localized. Areas which may have been remotely suspect due to similar design considerations were also inspected and shown to be void of the condition. Using this experience as a guide, the expanded Maine Yankee pattern provides adequate coverage to define the affected area.

5. Plugging Criteria

Regulatory Guide 1.121 sets a margin of safety of at least 3 against tube rupture under normal operating conditions. The 40% wall criterion in ASME Section XI, Paragraph IWB-3521.1 takes into account this safety factor and the results of burst pressure testing done on tubes with various types of prepared defects. Any defects found that are less than 40% do not have to be plugged unless they will cause a safety hazard if the tubes remain in operation. Based on observed rate of defect progression and test data recently completed by CE, no safety hazard will exist if a 40% wall plugging criteria is used.

Several data are available which suggest low growth rate in U-bend defects. At St. Lucie, and at Maine Yankee, ECT data from two inspections approximately six months apart record degradation indications in the same tubes. Comparison of the two sets of ECT results shows no growth even for defects as deep as 50% wall. This shows the indications are reasonably stable and will propagate little if any even over a full cycle of operation. Maine Yankee has operated four years longer and shown a lower maximum observed depth of degradation than St. Lucie (90% at Maine Yankee vs. through wall at St. Lucie). This is additional evidence that growth of tube degradation is expected to proceed only at low rates at Maine Yankee.

The reliability of ECT data has been questioned in the past for crack-like indications of the type now being found at Maine Yankee. If anything, the signal obtained characterized the indications shallower than they really were. CE is currently completing a series of tests on tubes prepared with 100% through wall cracks in the U-bend area and the data generally indicates that cracks of this nature leak at slowly increasing volumes. If a plant is in operation and a crack propagates 100% through the tube wall, the small resulting leak can be detected and the plant can shut down without any safety hazard. This means that even if ECT underpredicts the depth of indications and the cracks are large enough to propagate through the tube wall before the next scheduled outage, a controlled shutdown would be the worst possible consequence. This is exactly what happened at St. Lucie I where the phenomenon was first discovered.

6. Conclusions

Based on evidence from ECT data collected at both Maine Yankee and St. Lucie I, a test pattern covering rows 3 through 12 will completely contain the U-bend defects being seen at Maine Yankee.

A plugging criteria of 40% tube wall or greater is prudent from an engineering standpoint. Even if some remaining crack were to propagate completely through the tube wall, recent CE test results, soon to be published, show that a detectable leak will occur at a slowly increasing rate. The steam generators could be operated safely through an additional full cycle with a controlled shutdown as the worst possibility.