ATTACHMENT I

ST. LUCIE UNIT 2

Marked-up Technical Specification Page:

3/4 4-12 (plus insert)

SURVEILLANCE REQUIREMENTS (Continued)

1. All nonplugged tubes that previously had detectable wall penetrations (greater than 20%).

2. Tubes in those areas where experience has indicated potentia problems.

3. A tube inspection (pursuant to Specification 4.4.5.4.a.8) sh be performed on each selected tube. If any selected tube do not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shal be selected and subjected to a tube inspection.

c. The tubes selected as the second and third samples (if required by Table 4.4-2) during each inservice inspection may be subjected to partial tube inspection provided:

1. The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found.

2. The inspections include those portions of the tubes where imperfections were previously found.

SEE INSERT NEXT PAGE ↳ d.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

Note: (1) In all inspections, previously degraded tubes must exhibit significant (greater than 10%) further wall penetrations to be included in the above percentage calculations.

(2) The results of the 4.4.5.2.d examinations will not be included in the above percentage calculations

d. Tubes within the following region may be excluded from the first sample:

ALL non plugged tubes contained within the bounds of line 66 to line 102 will be inspected nominally 10 to 11 rows in from the untubed region adjacent to the tube sheet stay cap. All non plugged tubes in lines 65 and 103 will be inspected from row 21 to row 25.

No credit shall be taken for these tubes, if all tubes within the region are inspected, in meeting the minimum sample size requirements.

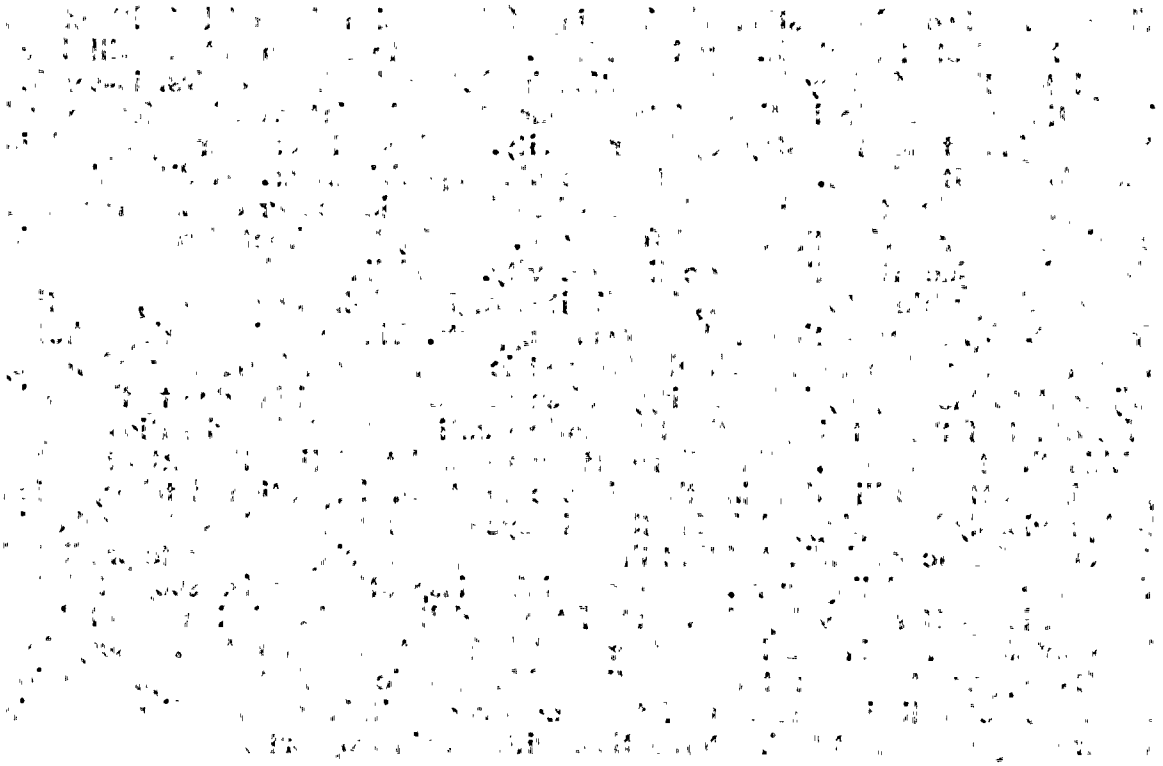
ATTACHMENT 2

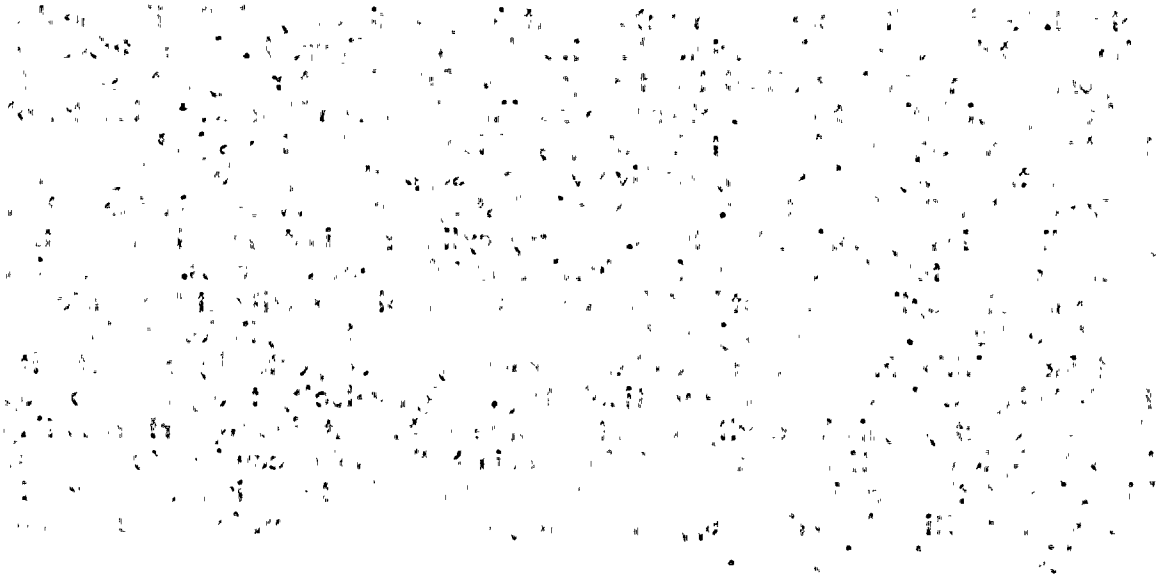
SAFETY EVALUATIONS

There are two Combustion Engineering (CE) designed Model 3410 steam generators installed at St. Lucie Unit 2. The steam generators will have completed three fuel cycles of operation in October1987. The first in-service inspection produced indications of tube wear at batwing intersections for several tubes adjacent to the stay cylinder cavity. These tubes were plugged in accordance with the St. Lucie Unit 2 Technical Specifications. Additional tubes were plugged due to a primary to secondary leak which occurred as a result of continued wear during the second fuel cycle. Again, the affected tubes were in the region adjacent to the stay cylinder cavity. Modeling work performed by CE defined the problem to be wear, in a limited region of the tube bundle, resulting from out-of-plane vibration of the batwing supports. The modeling work predicted that the wear phenomenon should be restricted to a small number of tubes, adjacent to the stay cylinder cavity, and should be self-limiting due to the angle of contact of the batwing on the tube and reduction of batwing vibration deeper within the tube bundle. The CE results were used to define the extent of the plugging pattern utilized during the mid-cycle outage. Inspection of tubes, which had previously been plugged during the mid-cycle outage, as well as other tubes in the area of concern, indicated that the wear was progressing at the rate predicted from the CE modeling work. The remaining inspection results supported the propagation pattern developed as part of the modeling work. Similar results have been obtained from inspection of other Model 3410 steam generators. Thus, field results support the laboratory modeling which predicted that wear progression should affect a limited number of tubes contained within a well defined area in the steam generator at their intersections with batwing supports.

STEAM GENERATOR DESIGN

Both St. Lucie Unit 2 steam generators contain approximately 8400 mill annealed Alloy 600 tubes arrayed in a triangular pitch U bundle (Figure 1). These tubes are supported along their vertical lengths by seven full diameter eggcrate supports and two partial diameter eggcrate supports. The U-bend and horizontal lengths of the tubes are supported by batwing straps, which cross the tubes just below the start of the bend, and as many as five vertical support straps (depending on the horizontal length of the tube). The vertical straps are connected in the out of plane dimension by horizontal straps. A stay cylinder is installed at the central portion of the tubesheet to permit reduction of tubesheet thickness. The region above the stay cylinder cannot be tubed and forms a hollow cavity at the center of the tube bundle. Tubes adjacent to this untubed stay cylinder region and contained within lines 65 to 103 and up to row 59, are supported by contact with the batwings and as few as one vertical strap. High velocity two phase flow up the untubed stay cylinder cavity imparts a force on the batwing supports resulting in out-of-plane motion of the batwing against the tube causing tube wear. Vibration of the batwings ceases when the length of the tubes is long enough to encounter additional vertical supports. Thus, tubes further out in the bundle are not subjected to batwing wear.





MODELING

The St. Lucie Unit 2 steam generators were modeled using two phase flow tests, fatigue tests and vibration tests to predict the extent of tubes affected by the batwing vibration. Results of these tests were used to develop a computer model capable of predicting the extent and rate of wear for affected tubes. The model has received minor updates incorporating results of field inspections. The modeling work predicted that the wear phenomenon should proceed at a reduced rate of attack due to an increased area of contact between the tube and batwing as the wear progresses. Thus, the depth and rate of penetration should be self-limiting. Additionally, the affected tubes were contained within a relatively narrow area adjacent to the stay cylinder cavity (Figure 2). During the second refueling outage inspection of the St. Lucie Unit 2 steam generators, model predictions were checked by inspection of all tubes in the affected area including 29 tubes which had been plugged during previous outages. The 29 tubes were deplugged, inspected and replugged following inspection. The inspection results were in good agreement with the model predictions. Thus, laboratory testing and modeling were confirmed by the field inspections.

PROPOSED INSPECTION PATTERN

The tubes within the projected batwing wear region are as deep as row 56 in from the stay cylinder (Figure 3). Previous inspections resulted in plugging of 200 tubes in the A steam generator and 145 tubes in the B steam generator: conservative plugging limits were used in the affected region ($< 40\%$ throughwall). The proposed inspection pattern will include all unplugged tubes within the projected 40% wear region, as noted on Figure 3, with a minimum of two rows of indication free tubes at the periphery of the inspection pattern. Thus, the affected region of tubes will be geometrically bounded by an inspection pattern with at least two rows of indication-free tubes at the periphery of the pattern. Similar bounding patterns have been used in other steam generators for corrosion and wear indication which were associated with geometric design features. This geometric approach will effectively monitor progression of batwing wear and will provide additional verification of the wear model for future inspections.

The results from the geometrical bounding pattern will be considered to fall into a population of tubes which are atypical of the remainder of the steam generator tubes and will not be included in the St. Lucie Unit 2 Technical Specification S^1 tube population. All other previously identified degraded tubes, tubes in historically suspect areas and a representative statistical sampling of the remainder of the tube bundle will be included in the S^1 tube sample.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

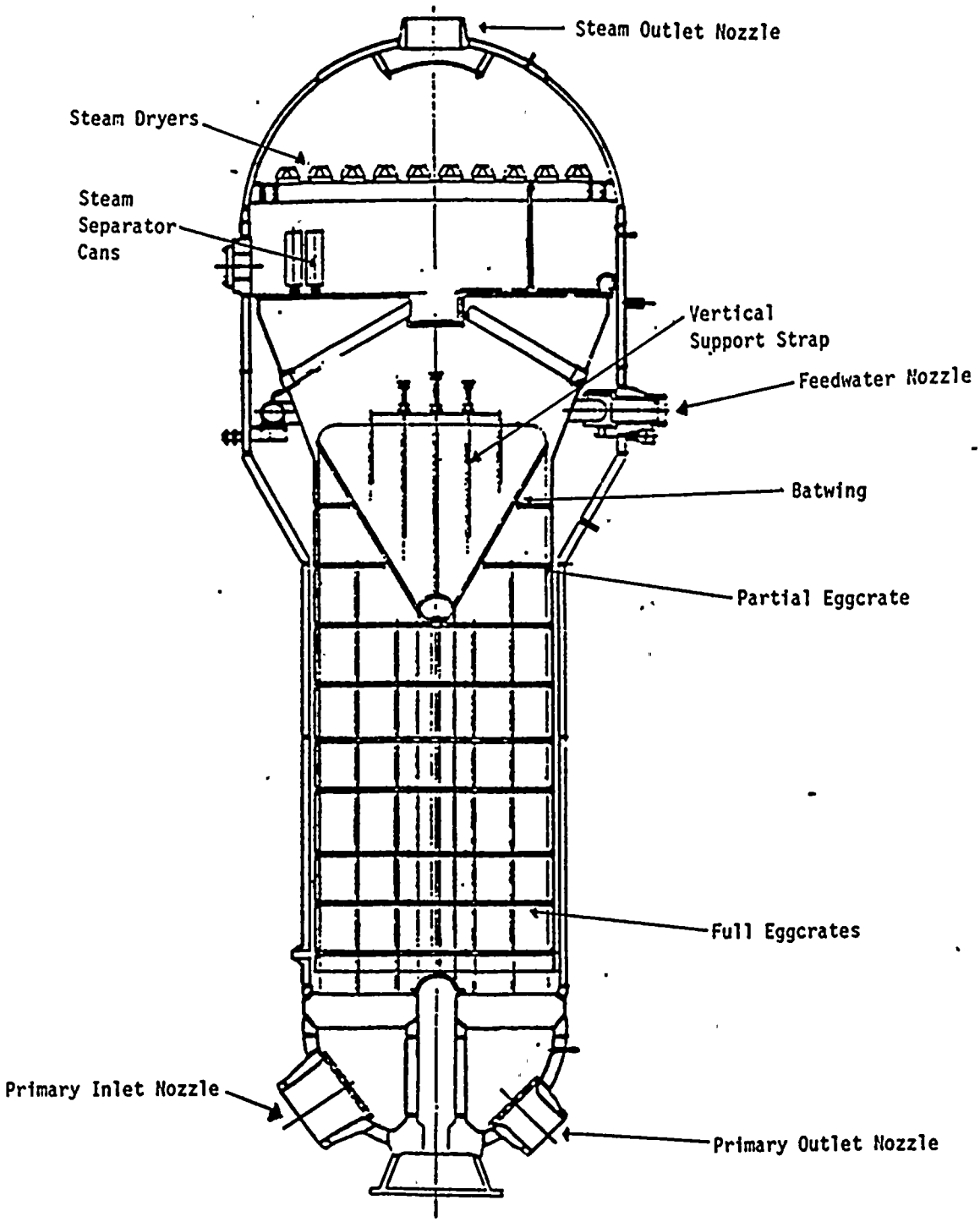


Figure 1. St. Lucie 2 Steam Generator

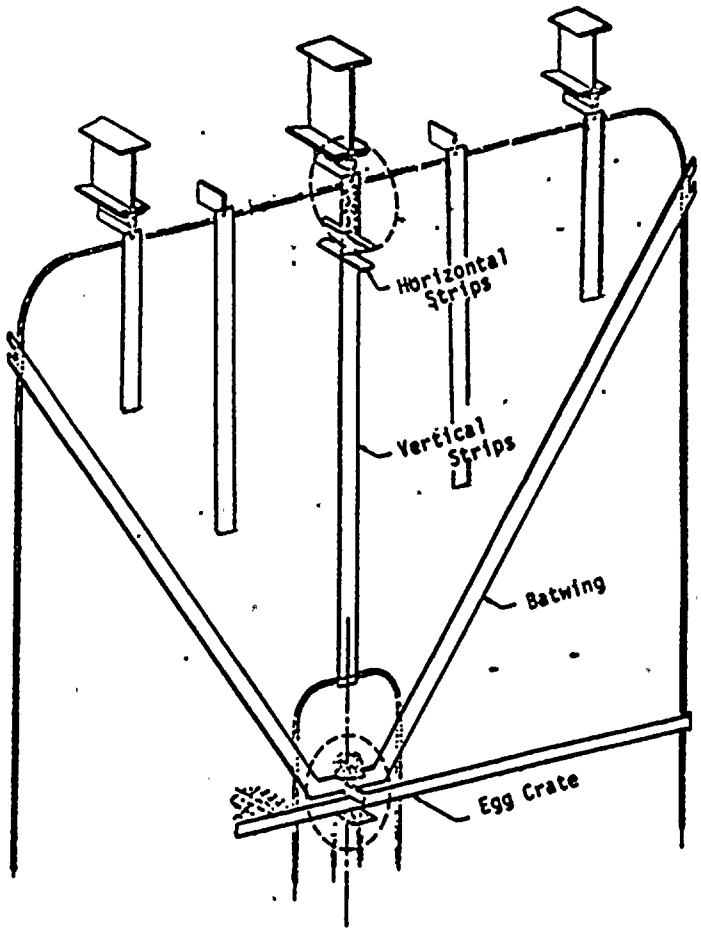


Figure 2. Upper Support Structure

St. Lucie 2 Steam Generator

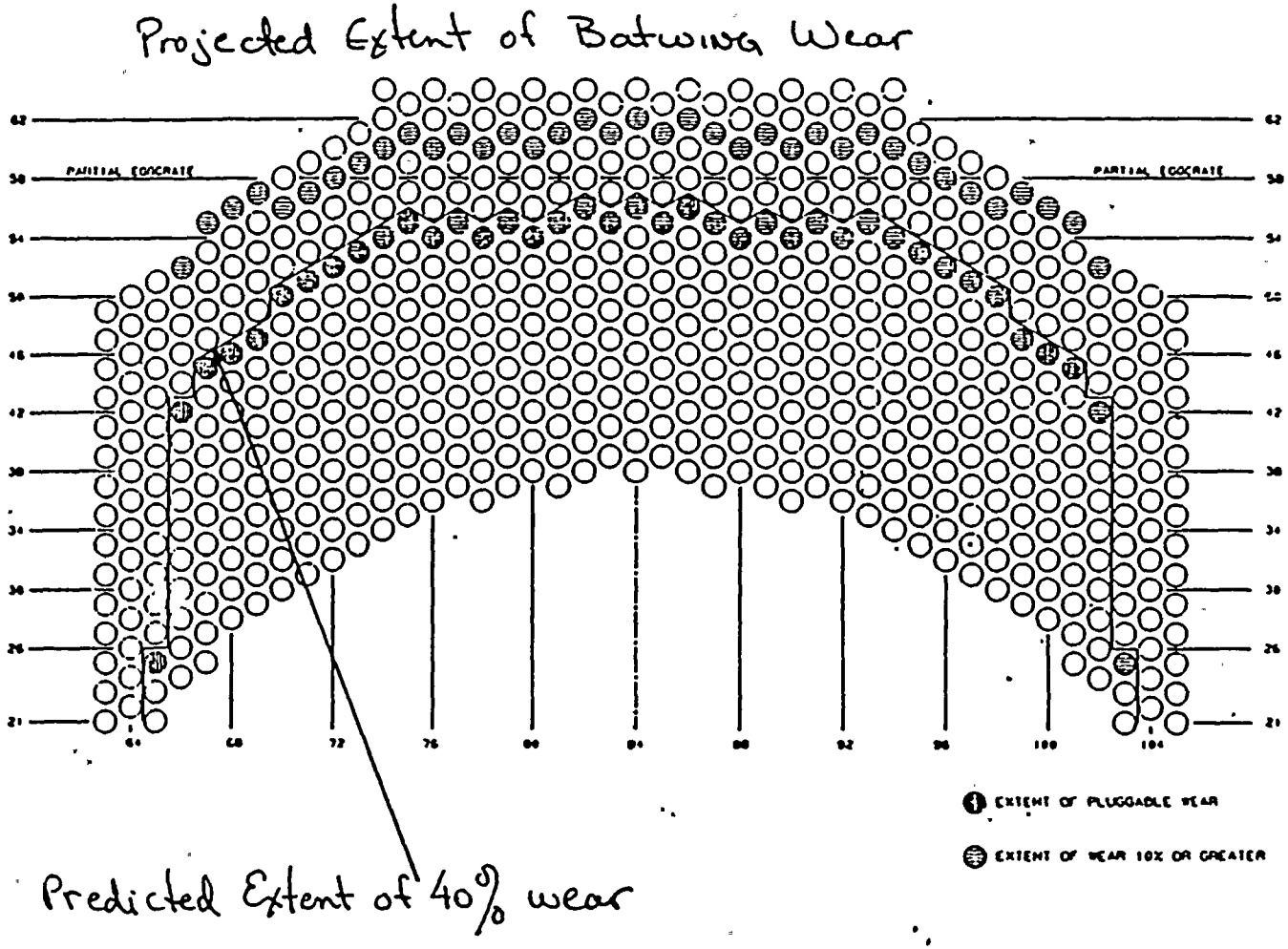


Figure 3. Predicted Extent of Batwing Wear

for 40-Year Life of Steam Generator

ATTACHMENT 3

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

The standards used to arrive at a determination that a request for amendment involves a no significant hazards consideration are included in the Commission's regulations, 10CFR 50.92, which states that no significant hazards considerations are involved if the operation of the facility 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 a margin of safety. Each standard is discussed as follows:

(1) Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed amendment increases the surveillance requirements, for a defined area of tubes in the steam generators. This inspection pattern ensures that the area within the steam generator tube bundle representing the highest likelihood of damage will always be examined. The inspection of the remainder of the tube bundle will continue to be governed by the current technical specification requirements. The probability of not detecting a steam generator tube problem becomes very low.

(2) Use of the modified specification would not create the possibility of a new or different kind of accident from any accident previously evaluated.

This modified specification applies to the inspection of a specific region of tubes in the steam generator while maintaining the intent of the specification. Since no change to the design or operation of the systems or components of the plant are involved, this change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

(3) Use of the modified specification would not involve a significant reduction in a margin of safety.

The margin of safety involved in steam generator tube inspection depends on the accuracy and completeness of the examination. The wear mechanism seen at St. Lucie Unit 2 is well defined and well within the capability of inspection techniques. Using the predictive models based upon experiments and analysis, the area of concern is identified and will continuously be inspected. The current Technical Specifications will be applied elsewhere in the steam generator to ensure future problems (if any) are identified. Therefore, this change will not involve a significant reduction in a margin of safety.

Based on the above, we have determined that the amendment request does not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the probability of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety; and therefore does not involve a significant hazards consideration.