October 31, 2000

Mr. William T. Cottle
President and Chief Executive Officer
STP Nuclear Operating Company
South Texas Project Electric
Generating Station
P. O. Box 289
Wadsworth, TX 77483

SUBJECT: SOUTH TEXAS PROJECT, UNIT 2 - REQUEST FOR ADDITIONAL INFORMATION RE: LICENSE AMENDMENT REQUEST ASSOCIATED WITH MODIFYING ALTERNATE REPAIR CRITERIA OF STEAM GENERATOR TUBES AT CERTAIN INTERSECTIONS OF TUBES AND TUBE SUPPORT PLATES (TAC NO. MA8271)

Dear Mr. Cottle:

In a letter dated February 21, 2000, STP Nuclear Operating Company (STPNOC) proposed to change the Technical Specifications for South Texas Project, Unit 2, to modify requirements associated with the alternate repair criteria of steam generator tubes at certain intersections of tubes and tube support plates. The amendment proposed revising the current alternate repair criteria of 1.0 volt to 3.0 volts.

Based on our review of the February 21, 2000, submittal, we have determined that additional information is required in order for us to complete our review of your request. The general nature of the enclosed questions was discussed with your staff during a teleconference held on October 26, 2000.

Please let me know if you have any questions regarding the enclosed request for additional information or if you desire a meeting with the staff to discuss these question.

Sincerely,

***/RA/***

Tae Kim, Senior Project Manager, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-499

Enclosure: Request for Additional Information

cc w/encl: See next page

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**<u>REQUEST FOR ADDITIONAL INFORMATION (RAI)</u>**

**SOUTH TEXAS PROJECT- UNIT 2**

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The principal question addressed here is "What is the movement between steam generator (SG) tubes and the tube support plates (TSPs) following initiation of a main steam line break (MSLB)?" The information we have received does not support a conclusion that your analyses adequately address important phenomena that influence tube/TSP movement. The additional information we identify below will clarify this issue. In some cases, it may be sufficient to show that the effect of the requested information on tube/TSP movement is negligible. In others, further clarification and/or justification will be necessary.

The following comments and questions reference WCAP-15163 (Proprietary, not publicly available. See WCAP-15164 for nonproprietary version.) which was included in your February 21, 2000, submittal unless another reference is specified.

## 1.0 <u>VIBRATION AND RELATED TOPICS</u>

Please provide a summary of the lowest resonance frequency, vibration loading, and response for each SG component. This should include SG tubes between the TSPs, the shell, tube sheet, wrapper, and any other components that could affect relative movement between the tubes and the TSPs. For components where vibration is not addressed, please justify its exclusion. Include a discussion of the vibration aspects addressed in designing an SG and, if these were not addressed in your analysis, show why they are not needed in light of the increased flow rate through the flow exit venturi during an MSLB. Also address potential loadings, including sonic waves, that may occur downstream of the SG flow exit venturi and establish if they propagate upstream of the flow venturi, and address transient/vibration behavior, including sonic waves, in the flow exit venturi and establish whether loads are propagated upstream of the venturi via the fluid or via mechanical interactions. Where component vibration is included, then (1) address the capability of the computer codes referenced in your submittal to accurately predict tube/TSP vibration behavior based on interaction of all relevant components, and (2) address how interactions between mechanical components (TSPs, tubes, tie-rods, TSP spacers, phase separators, shell, wrapper, tube sheet, SG exit venturi, other structure and flow control components) and between components and the fluid volumes are modeled to obtain realistic feedback between the vibrating components and between the components and the fluid to correctly predict the transient loading and TSP/tube relative movement. Include the potential for impact loads between loosely fitting components such as TSPs, tubes, and spacers; and include the effect of such items as sludge accumulation and component wear on hydraulic loading and component vibration.

What is the potential error due to your treatment of "average density" as described in page 6-4?

During vibration conditions with axial cracking, is it possible that the TSP moves a little, thus allowing SG tube expansion, followed by more movement on the next cycle, and so on, with the TSP return movement constrained by the tube expansion?

## 2.0 RELAP-5 AND ITS APPLICATION

Please justify use of RELAP-5 for this application (1) by contrasting/comparing the RELAP-5 fluid dynamic models with the phenomena that occur within the SG during an MSLB and (2) by applicable comparisons to experimental data. If you reference data for scaled facilities or conditions such as non-full flow MSLB rates, then please provide suitable justification for the scaling applicability. Your response should establish why RELAP-5 is applicable and why it is not necessary to use a verified, multi-dimensional, two-phase, transient, fluid dynamics code linked to the response of the mechanical components to support your request.

Please justify the applicability of the referenced test facility to determination of TSP loss coefficients. Also address the adequacy of your Figure 4-4 comparison of a correlation with data when the loss coefficient of interest appears to be outside the range of the data.

How does RELAP-5 provide tube and TSP loadings and vibration in the axial cross-tube flow pattern areas of the preheater and flow distribution baffle (FDB) regions? Please address, for example, the non-uniformity of the loading under cross-flow conditions and how this is addressed in your analysis.

How are horizontal tube loadings addressed and how do such loadings affect relative tube/TSP movement? How are vertical tube loadings addressed in the U-bend regions.

Experience shows that a venturi operating with choked flow may cause significant hydraulic loads and pipe movement. How have you addressed such phenomena for the SG exit venturi? If you believe RELAP-5 will predict this behavior, please provide substantiation.

Please address the adequacy of fluid noding with respect to local void generation and local void/liquid slugs throughout the SG internals. Include propagation/movement through the SG structure, generation of local loads as a result of generation/movement, translation of these loads into mechanical movement, and feedback of this mechanical movement into the fluid behavior. Include a discussion of the applicability of RELAP-5 to analysis of this behavior for normal operation, during upset conditions, and under accident conditions. (Note your sensitivity calculation with radial nodes near the top of the SG may not be sufficient to address the local fluid aspects of this question because (1) RELAP-5 has not been shown to apply and (2) the maximum calculated TSP deflection and maximum cross flow rates do not occur in the region of your sensitivity calculation.)

## 3.0 SG THERMAL RESPONSE

We do not understand from your Section 7.5 discussion how transient temperature behavior of the SG components was considered when calculating SG component movement For example, the SG shell and tube sheet are thick in comparison to tube thickness and the tubes will cool more rapidly in response to SG depressurization. Since the tubes are constrained at the tube sheet and the TSPs are attached to the wrapper, a differential thermal expansion is expected between the TSP and tubes that we did not see addressed during the blowdown. Further, the tube sheet may not be cooled uniformly, which could induce a bowing that would influence relative movement between the tubes and TSPs. Stayrod/tierod response to changing temperature would also be expected to influence response. A further consideration may be needed due to most tubes remaining active whereas some tubes are plugged and will not respond in the same way.

## 4.0 OTHER ANALYSIS-RELATED ITEMS

Please amplify your Section 7.2 discussion of stayrod/tierod response to include potential bowing. This should include consideration of bowing due to (1) differential thermal expansion, as identified above, (2) fluid cross-flow, (3) TSPs moving toward each other due to differential pressure, (4) cyclic fluid flow effects, and (5) any propagation of forces from the vicinity of the exit venturi.

Why does local yielding in the preheater region not have a significant effect on response of the hot leg plates (Section 7.3)?

There are a number of locations where fluid makes a 180-degree turn, such as at the edges of TSPs B - H. What is the horizontal “wall” and SG tube deflection behavior at these locations? What are the local TSP deflections due to the vertical component of flow in these turning locations? Include the effect of local void/water slugs in your response.

You have taken the reference case as a steam line break from a hot standby condition and you assumed an initial water level of 503 inches to bound the expected water level based on measurement uncertainties. (Lower water level is stated to provide greater TSP plate loading and movement.) Would it be reasonable to postulate a loss of feedwater event followed by main steam isolation valve (MSIV) closure which in turn causes the MSLB? Would such a case result in a lower initial water level that in turn would cause TSP loads greater than the ones you addressed? Conversely, there is an obvious concern with overfilling events that lead to MSLBs with water in the steam lines. Would such “water solid” situations cause significant TSP/tube relative movement, perhaps via transmission of vibration and/or spike loadings?

The second paragraph on page 6-1 uses “elastic,” “significant yielding,” and “in tact” as results of the applicability of the “elastic analysis” approach. Please expand your discussion with emphasis on the potential difference between these terms. How is “significant yielding” consistent with an elastic analysis? What is the loading on the tack welds of the stayrods to TSP A and how does this compare to yield?

The top of page 6-3 states “The median rim width is 1.62 inches, and is the value used for this analysis.” How is this consistent with a variable rim width that may deform differently at various locations?

What is the influence of primary side depressurization on SG tube response during the MSLB? (The question is meant to address the change in tube “stiffness” with change in primary-side pressure.)

In Section 8.3, the bounding tube leak rate is based upon the pressure operated relief valve (PORV) setting plus uncertainty. Should there be an allowance for pressure drop through the valve and opening time? Are there conditions where PORV opening may not occur and the reactor coolant system (RCS) pressure is relieved by the pressurizer safety relief valves? If so, why isn't the bound taken as that condition?

## 5.0 PROBABILISTIC ANALYSIS CONSIDERATIONS

The staff has reviewed the basis for the estimated probability of induced tube rupture and finds that further justification is necessary. The analysis appears to assume that the dominant contribution to the probability of rupture is the uncertainty of the burst pressure correlation for a crack that is assumed to be a precisely known length. However, it is the uncertainty of the actual length of the crack that is exposed in the free span that will dominate the burst probability. That will be dominated by the uncertainty in the length of crack potentially exposed by the motion of the TSPs under the design-basis accident conditions. In addition, although not a dominant issue, the potential for a crack to initially extend a short distance outside the confinement of the TSP appears to be more significant to the probability calculation than is the burst pressure correlation uncertainty that was considered in the application. The conditional tube rupture probability analysis should address these factors.