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

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MEMORANDUM FOR: Thomas Novak, Assistant Director
for Operating Reactors
Division of Licensing

FROM: William V. Johnston, Assistant Director
Materials & Qualifications Engineering
Division of Engineering

SUBJECT: STAFF EVALUATION OF TMI #1 STEAM GENERATOR CORROSION PROBLEM

We have determined that the subject problem constitutes an unreviewed safety question and recommend that formal staff review be required. Our determination is based on four primary factors, as follows;

1. Uniqueness and extent of the S.G. corrosion damage.

2. Potential for this type of corrosion to affect other primary pressure boundary materials.

3. Uniqueness of the repair method which is proposed by GPUNC.

4. Unpredictability of ECT in detecting and quantifying this type of corrosion.

In all likelihood, the GPUNC program will answer the questions which are necessary to ensure that a significant safety hazard does not exist.

Enclosed is a more detailed discussion of our rationale in support of this recommendation.

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Rationale for Determination of The potential for TMI No. 1 S.G. Corrosion Problems to Constitute an Unreviewed Safety Question

The proposed repair by TMI-1 to resolve their steam generator problems appears to be reasonable. Basically, they are in the process of identifying:

1. The extent of degradation in the S.G.'s,

2. The extent of degradation, if any, in the remainder of the reactor coolant system,

3. The causative agent(s) and their source,

4. Cleanup techniques to remove the causative agent(s) and

5. Optimum S.G. repair techniques.

However, we believe there are a number of issues regarding the program which should be formally reviewed by the staff. Our reasoning in deciding that formal staff review is required is based on three major factors.

A) To the extent that we have not experienced this type of behavior before, the corrosion mechanism is unique, thus the staff has not reviewed the potential consequences of additional operations subsequent to repair of known defects. Particularly, the potential for this type of corrosion to rapidly progress upon restart and adversely affect the S.G. primary pressure boundary.

B) The potential for this type of corrosion to adversely affect other primary pressure boundary materials.

C) The proposed S.G. tube repair technique, although having a similarity to some past repair techniques is in itself unique.

We consider the existance of a type of corrosion which has extensively degraded the steam generators, to also have the potential to degarde other reactor coolant system materials. In addition, the licensee proposes to employ a unique repair technique. We believe that the combination of all these becomes an unreviewed safety question.

As stated at the beginning, the program which GPUNC is conducting appears reasonable. In all liklihood, the GPUNC program will answer the questions which are necessary to ensure that a significant safety hazard does not exist.

Based on our knowledge to date, we have the following comments and/or concerns:

1. Eddy current test requirements in the plant technical specifications and in the ASME code are by themselves inadequate to assure that a meaningful inspection will be performed, given the nature of the

corrosion mechanism which exists at TMI-1. The licensee's inspection program including the scope of the inspection should be evaluated by the staff for its adequacy.

2. Licensee is proposing to employ an alternative repair technique to plugging which is the required tube repair method and specified in the plant Technical Specification.

   Thus, some modification of the plant Tech. Specs. would be necessary.

3. The proposed repair technique involves a leak limiting rather than a leak free seal against primary to secondary leakage. Because the expansion joint seal will function as the primary pressure boundary for as many as 20,000 tubes, leakage characteristics under normal and postulated accident conditions should be established by test. Testing should include expansion into dirty crevices.

4. The staff has some questions pertaining to the proposed repair. For example, will pre-existing cracks on the repair process itself result in a significant relaxation of tube preload? If so, excessive compressive loading may result upon heatup of the plant which could lead to bowing or local buckling which could cause new corrosion initiation sites.

5. The corrosion mechanism is unique, apparently very fast acting, and not well understood. The licensee's recovery program should be closely reviewed by the staff to establish that there is adequate assurance against rapid failures occuring upon plant restart. In addition, some licensing actions may be necessary, such as (a) more restrictive limits on primary to secondary leak. (Note the current 1 gpm limit is the most liberal in the PWR industry) and (b) frequent shutdowns for inspection as part of the restart program.

Considering the above listed concerns, we believe that specific staff review and concurrence is required at least in the following areas:

1. Review of ECT data and scope of the inspections performed to determine that indications outside the tubesheet have been adequately characterized and addressed in the repair program.

2. Review of ECT data and basis for rolling/plugging various tubes. Including an assessment of tube relaxation due to cracking or the repair technique (if tubes have been relaxed from tension due to cracking, excessive compressive loads may exist on restart).

3. Review of the proposed roll technique, including the supporting analytical and test verification program

4. Review of the basis for and materials selected for primary side examination to detect the presence on corrosion on other pressure boundry materials. Also, an evaluation of the examination techniques to determine the presence of corrosion in these materials.

   The staff should be present during examination of some pre-selected primary system materials.

5. Review of test data which supports the method selected for sulfur removal from system surfaces or conversely, the data which demonstrate that removal is not necessary.

6. Review of the current Tech. Spec. limit (1.0 gpm) for primary to secondary leakage to determine the impact of operation with up to that volume of leakage and whether it adequately supports the leak before break objective.

7. Review of the restart program to ensure that sufficient check points are included to determine that excessive primary pressure boundary degradation does not occur during subsequent operations. At least the following general type of program would seem to be prudent.

   a) Perform a series of leak checks utilizing nitrogen, helium etc. prior to pressurization.

   b) Conduct a hydrostatic test

   c) Perform a full temp. and press. hot functional for two to three weeks. Then, shutdown and ECT a selected number of tubes to ensure that excessive degradation is not occurring.

   d) Operate for 30 to 60 days. Then, shutdown and ECT to assess the progression of degradation.

   e) Assuming no excessive degradation in "d" above, operate for 150 to 210 days. Then ECT again.

   f) During refueling, ECT and examine additional primary system materials for evidence of corrosion. If no new or excessive corrosion is found, return to normal reg. guide test frequencies.