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Office of Nuclear Reactor Regulation
Attn: John F. Stolz
Operation Reactors Branch No. 4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Sir:

Three Mile Island Nuclear Station, Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
TMI-1 OTSG Post-Repair Test Results

This letter is to inform you of the results of post repair testing of the TMI-1 repaired steam generators performed to date and of our plans to proceed with the remainder of the test program. During the cold test period, three types of examinations have been conducted in each generator: drip testing, bubble testing, and eddy current testing.

Drip testing is performed by filling and pressurizing the secondary system to 150 psig, then observing for water drips from the drained primary tube at the bottom tubesheet. The drip test was conducted twice in each steam generator. The first test identified 10 tubes in "A" and 21 in "B" as leaking. The second identified 6 in "A" and 5 in "B". 2 in "A" and 5 in "B" leaked in both tests. This inconsistency between the two tests is thought to be due in part to condensation in the upper head, in isolated cases to wet felt plugs held in blocked tubes, and to the difficulty and uncertainty in observation. Because drip rates were low, in most cases less than 1 drip/min., identification of the dripping tube was difficult. The drip test is used only as an indicator of a need for further investigation. The determination of the acceptability of a tube was based on the bubble test and ECT results.

Bubble testing is performed by filling the primary system side to just above the upper face of the upper tubesheet, lowering the water level in the OTSG secondary side to approximately the 12th tube support plate and pressurizing the secondary with a nitrogen cover gas to 150 psig. Through wall cracks above the secondary water line are located by bubbles of nitrogen. The bubble test identified 10 tubes in "A" and 13 tubes in "B" as leakers. Of these 23 tubes, 4 tubes in "A" and 11 tubes in "B" had already been identified for

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1/0

further investigation by the drip test. By placing a temporary stopper in each bubbling tube at the lower face of the upper tube sheet (US+0) and at US+14, the axial location of the leak could be further identified. All of the leaks were found to come from below the top of the qualification length of the kinetic expansion joint, with the possible exception of one tube which bubbled slightly, and was not investigated further during stopper testing because the bubbling rate was too low for visual tube identification when the stoppers were placed. No joints were found to leak.

Each of the tubes identified in the drip and bubble test was investigated using eddy current techniques. Using the .540 differential probe, eddy current signals have been found in the unexpanded portion of all but one bubbling tube. This particular tube (OTSG B 80/45) is the tube discussed above which bubbled slightly but was not investigated further during stopper testing. Of the 10 tubes in "A" and 10 in "B" which dripped but did not bubble, only 1 tube in "B" has a pluggable eddy current indication (greater than or equal to 40% through wall). ECT also identified an indication in one dripping tube in "A" of less than 20% through wall at UTS-10.

The 23 tubes have also been examined using the 8 x 1 absolute ECT probe. All signals are on 1 or 2 coils only, corresponding to a range of arc lengths of a minimum sensitivity of .024 inches to approximately .413 inches. The voltage data for most 2 coil defects is not balanced for both coils, suggesting arc lengths closer to the lower end of the range than the higher. Based on this information, GPUN considers that the indications always existed but are now somewhat more visible.

GPUN plans to plug or plug and stabilize the 23 bubbling or dripping tubes with ECT indication greater than or equal to 40% through wall. The tubes with less than 40% ECT indications will be left in service. GPUN has evaluated the 23 pluggable ECT indications (in dripping or bubbling tubes) and determined the following:

1. All leaking defects are between UTS-02 and UTS +07.

2. Four of these defects can be discerned on previous (1982 ECT) inspection records but were missed apparently due to analyst error.

3. Fifteen of these defects have small amplitude signals which in the 1982 examination were masked by UTS noise.

4. Four of the signals are at the entry point of the upper tubesheet, and were previously masked by probe saturation on tube sheet entry signal.

In addition to the ECT described above, GPUN has conducted the post-repair pre-service eddy current examination described in Table A-1 of Topical Report 008, Rev. 2. The pre-service inspection data was obtained as a very sensitive benchmark against which to compare similar ECT inspections proposed to be obtained after 90 Full Power day (Topical Report 008, Rev. 2). Such

comparisons may provide further information confirming arrest of crack growth in an operating generator. The results of these pre-service tests are shown in the following table:

POST REPAIR ECT PRE-SERVICE INSPECTION RESULTS

	Scope from Table A-1 Report 008, Rev. 2	Probe Type	Number of Tubes OTSG A	OTSG B
1.	~180 tubes/OTSG (items 1b, c, e, g) indications ≥40% TW	.540 SD	11	1
2.	All ≤40% TW previously identified to be left in service (item 1a)	.540 SD	1*	No change
3.	~3% of unexpanded tube within UTS below 6" joint (verified ≥40% TW using .540) (items 1f, d)	8 x 1	3**	0
4.	~3% of 6" joint (items 1f, d)	8 x 1	9	21

* On one tube the phase angle for an OD indication at TSP #6 shifted such that the previous 35% through wall indication was evaluated as 60%. The 8x1 data did not change (1 coil, 1/2 volt). The phase shift was apparently due to interference from TSP #6. GPUN evaluated this crack as unchanged, but because of the uncertainty in through wall extent, the tube will be plugged.

** The 11 indications shown in line 1 can also be detected by the 8x1 but are not included in the table twice.

The tube indications in line 1, of the above table (11 in "A" and one in "B") were evaluated in the pre-service inspection as all greater than 40% through wall with predominantly a low voltage amplitude (equal to or less than one volt). The one indication in OTSG "B" is located axially at UTS +2 and the 11 indications in OTSG "A" are located between TSP 13 and UTS +6. These 12 indications were further examined by the 8x1 probe and were all found to be equal to or less than two coils in circumferential extent with 6 of the 12 evaluated as one coil. As you know, during 1982, every unplugged tube in each steam generator was examined using the sensitive high gain differential probe. We have examined the 1982 high gain differential probe baseline inspection result tapes and determined most of the pre-service 1983 indications are within the 1982 tape noise level but can be considered

identifiable given the precise location information from the 1983 pre-service inspection results. Therefore, the post-repair pre-service ECT results are considered consistent with the 1982 record inspection, and the 1982 inspection is valid as the required Technical Specification 100% inspection. No further ECT is planned at this time.

In addition to the 12 tubes of greater than or equal to 40% through wall indications reported on line 1, a total of 6 tubes were called at less than 40% but at equal to or greater than 20% through wall in OTSG "A" (one evaluated at 25% TW, five at 20% TW), and one in "B" (20% TW). All of these less than 40% through wall calls are of such low voltage and such uncertainty in phase angle that we cannot now conclude with any confidence whether they represent intergranular attack or surface anomalies. We have concluded that they are not of a size to warrant plugging.

With regard to the 8x1 inspection results identified on line 3 and line 4 of the above table, these are not unanticipated since the 8x1 probe technique is more sensitive than the standard differential probe in the upper tubesheet region. Prior developmental testing, conducted as part of the expansion joint qualification program and previously reported in Topical Report 008, Rev. 2, Section V.D.1 did identify that tube expansion in the tubesheet (or close to the expansion region) had the potential for making small defects in the tubes more visible by ECT.

It is our intention to plug all tubes identified on line 1 and line 3 of the table having eddy current indications from the pre-service inspection of 40% or greater even though we are not sure at this time of the accuracy of the evaluation. This dispositioning is consistent with the technical specifications and with the plugging criteria in Topical Report 008, Rev. 2 with one exception. The Topical Report states that any indication in the 16th span will be plugged as a precautionary measure. GPUN does not now plan to plug additional tubes with indications in the 16th span called as less than 40% through wall (six of seven tubes identified above) because of the uncertainty associated with interpreting such a small ECT signal. These tubes will be added to the augmented ISI list for reinspection during subsequent ECT, and will add to the data base.

Our overall evaluation of the post repair inspection results, including the pre-service inspection baseline ECT testing, is as follows:

1. With the possible exception of one tube, we have identified no kinetic expansion joints which leak nitrogen from above the 6" qualification length at 150 psi delta P.

2. Existence of small arc length 100% through wall defects found by bubble testing is consistent with GPUNC Topical Report 008, Rev. 2. (Figure IX-1)

3. Existence of small arc length partial through wall defects found by ECT is consistent with GPUNC Topical Report 008, Rev. 2. (Figure IX-1)

4. 8x1 ECT probe results from within the tubesheet region are consistent with prior developmental test results and are as expected.

5. The total evidence available continues to support a conclusion that cracks are not growing and that new cracks are not occurring.

It is our intention to proceed with the few additional plugging repairs identified in this letter and to move into the RCS sulfur cleaning phase followed by the hot testing of the steam generator. We will continue to evaluate the ECT data and subsequent OTSG performance and will consider supplemental laboratory or steam generator testing, if warranted. As you are aware, at the end of OTSG hot testing, we plan to perform a management evaluation of the results of all steam generator testing. The staff will be informed of GPUN's conclusions prior to proceeding to criticality. We consider the current acceptance test results very positive and need now to move on to final verification of the steam generator with the hot full pressure test program.

Very truly yours,

H D Hukill

H. D. Hukill
Director, TMI-1

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