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TO:	George Lear
FROM:	Florida Power & Light Co. Miami, FL R. E. Uhrig
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DESCRIPTION

PLANT NAME: Turkey Point Nuclear Pwr Plt
Unit No. 4
RBT 8/3/77

ENCLOSURE

Enclosed additional info requested in NRC ltr of 7/22/77 concerning the recent inspection of facility steam generators.
1p+10p

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ACKNOWLEDGED

FOR ACTION/INFORMATION

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July 27, 1977
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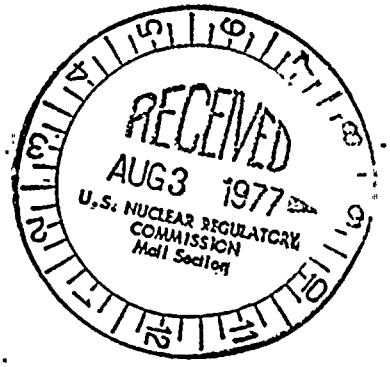

Director of Nuclear Reactor Regulation
Attention: Mr. George Lear, Chief
Operating Reactors Branch No. 3
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Lear:

Re: Turkey Point Unity
Docket Number 50-251
Supplemental Information

Attached herewith is the additional information which was requested in your letter of July 22, 1977 concerning our recent inspection of Turkey Point Unit No. 4 steam generators.

Very truly yours,

J. A. De Mastry
OR
Robert E. Uhrig
Vice President

REU:GDW:sl

cc: Norman Mosely
Robert Lowenstein

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HELPING BUILD FLORIDA

RESPONSES TO REQUEST Regulatory File Cy

FOR ADDITIONAL INFORMATION

TURKEY POINT UNIT 4

The attachment, INVESTIGATION OF ALLEGED MISSING S/G TUBE PLUGS AT TURKEY POINT UNIT 4, supplements responses numbered 1(a), 1(b), 1(c) and 2.

1 (a). What evidence is there that the plugs were not installed? For the 11 tubes in Row 1 where the plugs are "missing", were the tube ends checked with a ball gauge or by other means to evaluate whether tube plugs were installed?

RESPONSE

1 (a). The greatest evidence that the plugs were never installed is the fact that an extensive search of the RC System's credible "hide out" locations was performed without locating any plugs (see attachment for detailed description).

The eleven tube ends were measured using snap gauges and the data were analyzed by the NSSS supplier. The results were inconclusive (i.e., it could not be determined whether or not plugs were originally in the tubes).

1 (b). What piping and components were radiographed to check for the plugs? Discuss estimated sensitivity of this method of inspection for detecting a plug.

RESPONSE

1 (b). The pressurizer spray line was the only auxiliary piping judged as a credible plug "hide out" location, and it was examined using radiography (NOTE: TV camera was used to examine portion of the RC loop piping). All bends and horizontal runs of this 4 inch piping were radiographed. The radiographs showed the line to be void of plugs. For this application, radiography provided excellent sensitivity. The radiographs show conclusively that plugs are not present in the line (radiographs are at the plant site).

1 (c). What areas in the reactor vessel were inspected? Was the lower grid plate inspected? Discuss the method(s) of inspection.

RESPONSE

1 (c). The reactor vessel was examined extensively using an underwater miniature TV camera (see attachment). This examination included removing all fuel from the vessel. The lower grid plate was completely inspected using the TV camera. The removal of the fuel allowed complete access to the lower grid plate.

1 (d). Describe the inspections of the three Unit No. 4 steam generators to determine whether plugs are "missing" from other tubes that were scheduled to be plugged and whether plugs were installed in tubes that were not scheduled to be plugged. Discuss plans for photographic records of tube plugging operations.

RESPONSE

1 (d). After completing the plugging operations, all 3 steam generator tube sheets were photographed. These photographs were cross referenced with the current tube sheet maps containing the required plugging patterns. The results showed that a total of 4 tubes that should have been plugged were missed, and 5 tubes were plugged which were not scheduled to be plugged. These errors apparently resulted from a combination of improper tube identifications and record keeping errors. These errors were corrected by plugging the tubes which had been missed.

Plans for photographic verification of S/G tube plugging have been implemented at Turkey Point. These plans require that a tubesheet photograph be taken after the completion of any plugging operation. The photographs are then compared to plugging maps to ensure that the desired plugging pattern has been implemented.

2. Discuss the potential safety implications if Turkey Point No. 4 is operated with one or more loose steam generator plugs in the system.

RESPONSE

2. Safety implications of operating the Unit with loose steam generator plugs are described in APPENDIX A (PLANT OPERATION WITH LOOSE S/G PLUGS IN THE RCS) included with this submittal.

3. Discuss the loose parts monitor which you plan to install in Turkey Point Unit No. 4, including the predicted sensitivity for detecting the presence and location of a steam generator plug(s) if a plug was in the reactor vessel.

RESPONSE

3. The metal impact monitoring system which has been installed on Turkey Point Unit No. 4 consists of 3 transducers mounted on the bottom of the reactor vessel (installed on the in-core instrumentation guide tubes) with associated electronics to constitute 3 independent sound monitoring channels. The system provides "hard copy" data by recording results for each channel on magnetic tape.

RESPONSE (cont'd.)

3. A steam generator tube plug (or object of similar mass), loose in the reactor vessel, is easily detected by this system. The system's ability to identify the location of an object within the vessel, is expected to be such that the objects' location can be determined within several feet.

4 (a). Provide a summary of the results of the inservice inspection referenced on page 3-2.

RESPONSE

4 (a). The results of the Reg. Guide 1.83 inservice inspection referenced on page 3-2 are summarized below:

A total of 12 tubes were plugged as the result of having indications greater than or equal to 40%, the greatest being 47%. The distribution per generator is as follows:

4 tubes in S/G A, 3 tubes in S/G B, and 5 tubes in S.G C. Of these 12, one was a peripheral tube (R42-C53 S/G C). These indications were all located just above the tubesheet and are indicative of slow wall thinning due to residual phosphate effects.

4 (b). Provide a summary of the tube support plate inspection referred to on page 3-4.

RESPONSE

4 (b). The tube support plate inspection referenced on page 3-4 is summarized below:

This inspection technique utilizes eddy current testing at 3.5KH_Z. The capability of this technique is only to identify abnormal TSP intersections. However, the abnormalities can not be specifically identified as cracks or dents.

The data analysis will not be completed until August 1977; however, the available results show that nearly all intersections show an abnormal signal. These results were expected and are consistent with the extensive denting known to exist in the steam generators.

HISTORY OF SHUTDOWN

During the Cycle III-IV refueling shutdown of Unit 4, which commenced on May 9th, and during a routine entry into steam generator "B" cold leg for eddy current probing of the S/G tubes, one steam generator plug in Row 1 Column 23 was observed to be missing. This plug was logged as being explosively plugged in November of 1976. Efforts to locate the alleged missing plug in the steam generator and associated RCS piping were suspended temporarily to enable the core refueling shuffle to start.

The cavity was flooded (including the steam generators) and the refueling core shuffle took place. After the refueling was completed, steam generator "B" was opened once again to resolve the missing plug issue and mark tubes for preventive plugging. During this entry into "B" steam generator, additional plugs were observed to be missing in the cold leg. The tubes with missing plugs were all located along the tube sheet in Row 1. Specific locations were Columns 1 through 9, which were logged as being explosively plugged in November of 1976. Also, Row 1 - Column 31, recorded as plugged in September 1976, did not contain a plug.

POSSIBLE LOCATIONS OF MISSING PLUGS

In conjunction with the NSSS supplier, and after review of the documentation and assurances of the people associated with the plugging efforts in September and November of 1976, we examined the possible locations of the plugs in the reactor coolant system (RCS).

The consensus of best engineering judgment was that the plugs could have migrated to only two locations in the reactor coolant system. These locations were (1) the lower portion of the reactor vessel (below the shock absorber plate located below the lower internals (2) spray line to the pressurizer. These areas were the focal points of the investigation; however, for additional conservatism, the scope of the search was broadened as described in the following section.

DESCRIPTION OF INVESTIGATION OF RCS

Visual examinations of the reactor vessel, lower internals, "B" loop cold leg, and thermal shield ledge were conducted by personnel qualified in accordance with a W procedure, "Certification of Visual Examination Personnel". These examinations were conducted with remotely operated television viewing systems. The initial phase of the examination consisted of the removal of nine (9) fuel assemblies from the center of the core at locations G-7, G-8, G-9, H-7, H-8, H-9, J-7, J-8, and J-9. A miniature underwater television camera system was utilized to examine the lower internals, the core support plate, and the bottom portion of the reactor vessel. The only foreign material that was observed was fine debris that was later removed by an underwater eductor. At this time, the remaining fuel assemblies were removed from the core and the television camera was manipulated through various flow holes in the lower core plate to permit examination of the entire lower area of the vessel. The camera was positioned to permit viewing of all available areas of the lower internals, lower core support plate, diffuser plate, and casting to determine if any plugs were located in any of these locations. No evidence of any plugs or component damage was detected. The thermal shield ledge

DESCRIPTION OF INVESTIGATION OF RCS (CONT.)

was inspected by removing the flange plugs (for access to the material specimens) and lowering a TV camera. No plugs were detected on the ledge.

This extensive examination of the vessel (with all fuel removed) concluded that the plugs were not in the reactor vessel. The decision was then made to thoroughly examine the cold leg piping.

The cold leg piping of loop "B" was examined by the utilization of an underwater camera mounted on an air-operated skate board. This arrangement permitted examination of the cold leg piping between the S/G and RCP. Once again, no plugs or foreign objects were observed.

The second location that was credible for a plug to "hide-out" was postulated to be the spray line from the steam generator to the pressurizer. All potential "hide-out" locations in the pipe were radiographed, and the results indicated that there were no plugs in the pipe.

RCP HIDE-OUT POSSIBILITIES

The probability that the 6 oz., .775 inch diameter, 6 inch long plug will lodge in the pump is rather remote. The smallest vane-to-vane dimension in the impeller is 4-1/2 inches, meaning that an improbable orientation of the plug is required when passing through the impeller (or diffuser) to permit lodging in the vanes. This occurance is judged to be very unlikely, and considering multiple occurances, is not deemed credible. Impeller seal ring clearances are .025 to .100 inch (assuming some wear) and are, therefore, not large enough for a plug to enter. Since the diffuser exit velocity is 30 fps, it seems most likely that the plug will readily reach the discharge nozzle and be carried down the pipe. Even assuming the plug could fall to the bottom of the casing after exiting from the diffuser, the water velocity of the bottom of the casing around the casing adapter O.D. is estimated to be 15 fps which would be sufficient to pick up the plug and move it into a higher velocity area near the discharge nozzle from where it could enter the pipe.

CONCLUSIONS

The results of the extensive search of the reactor coolant system revealing no loose plugs leads to the conclusion that the plugs were never installed, or remotely, that they may be secured somewhere in the reactor coolant system. These two possibilities will be addressed by implementing the following items:

PLUGS NEVER INSTALLED

(1) Current plugging practices are to be totally reviewed (both W and Florida Power & Light) particular with respect to improving plug accountability and verification that plugs are properly installed in the correct tubes. Procedures will be revised to incorporate the improved methods.

(2) Permanent documentation of the "as plugged conditions" will be required at the conclusion of a plugging operation. A photographic method will be utilized to provide the required documentation.

CONCLUSIONS (CONT.)

PLUGS ARE SECURED IN THE RCS

(1) A metal impact monitoring system will be installed on the reactor vessel. This system will detect the presence of "loose parts" in the vessel. If upon start-up, or during operations, loose parts are detected, then continued operation of the unit will be evaluated. Safety analysis work to address operations with loose plugs in the RC System has concluded that the unit can be safely operated with 4 or less loose plugs.

(2) Start-up surveillance requirements will be in effect so that particular attention is given to reactor vessel "noise" monitoring and reactor coolant pump behavior.

Startup Results and Analysis

Prior to running reactor coolant pumps, a Metal Impact Monitoring System was installed on the bottom outside of the reactor vessel. This system was then set up to monitor and provide a permanent record of any noises caused by loose objects entering the reactor vessel during startup of the reactor coolant pumps. With this monitoring system in effect the pump runs normally made for system venting were performed. The following is a summary of these runs with commentary regarding the noises associated with each run that was heard at the system speaker.

Some limited noise was heard during the individual one minute pump runs and the first eight minute pump runs. During this first eight minute run, the noise went away when the third pump was running. When the second eight minute run was made, the noise was more frequent and very distinct during the starting and running of the first two pumps. When the third pump was started the noise went away. A third eight minute pump run revealed no noise during the entire run.

The results from the first three pump runs has been analyzed by the NSSS vendor and it has been concluded that there is a single object in the bottom of the reactor vessel. The mass of the object has been estimated to be less than a pound leaving the possibility that it may be a steam generator tube plug. The object did not appear to be migrating rapidly within the bottom of the vessel. Based on the estimated size of the object, the velocity patterns in the bottom of the vessel, and the construction of the vessel internals it is judged that the object has now come to rest in a low flow area in the bottom of the vessel.

The NSSS vendor has further analyzed the potential consequences of operation with the loose object in the reactor vessel and concluded that its presence poses no safety concerns.

SUMMARY

During the recent inspections of Turkey Point Unit No. 4 steam generators eleven steam generator tube plugs were discovered to be not installed as indicated by our records. A search of the reactor vessel, reactor coolant system loop piping and other associated piping resulted in none of the plugs being found. The areas of the system which were not searched were judged by ourselves and our NSSS vendor to be highly unlikely locations for a single plug to be found. Therefore, the possibility of eleven plugs being in these areas was judged to be extremely remote. The results of those inspections were reviewed by ourselves and our vendor and we concluded that the eleven plugs were either not originally installed, or remotely that they may be secured somewhere in the reactor coolant system.

For additional assurance, a metal impact monitoring system was installed on the reactor vessel. The system was used during the plant heatup during various pump running combinations. The evaluation of the results indicates that a single metal object entered the reactor vessel during the heatup and is now dormant, most likely in a low flow area in the bottom of the reactor vessel. This additional information has been evaluated by our NSSS vendor and ourselves and we have concluded that returning the plant to full power operation does not pose a safety concern.

The following additional actions are being taken or have been taken:

1) Current plugging practices are being totally reviewed, with an emphasis on accountability and verification.

2) Photographic records have been taken and will be taken following future plugging operations.

3) A metal impact monitoring system has been installed.

4) Start-up surveillance is in effect.

The Plant Nuclear Safety Committee and the Company Nuclear Review Board have reviewed the situation and have concluded that the unit may be safely returned to full power operation with the MIMS installed.

PLANT OPERATION WITH LOOSE S/G PLUGS IN THE RCS

Plant operation with one or more steam generator tube plugs misplaced in the RCS has been investigated. Potential effects on the plant safety or integrity have been evaluated.

Tube plugs which enter the RCS from the outlet (cold leg) side of the steam generator can remain in the steam generator channel head or be pushed along by the reactor coolant flow through the crossover leg piping. No measureable impediment to flow is expected by the presence of one or several tube plugs in the flow path. Flow velocity in the piping is sufficient to carry plugs along to the reactor vessel.

Passage of a plug through a reactor coolant pump during operation was also considered. Westinghouse experience on canned motor pumps in the shop has shown that if material which is relatively large (compared to the size of the impeller/diffuser vanes), breaks from the system and passes through or lodges in the pump, that the most noticeable effects will be higher vibration level (if an object lodges in a vane of the impeller) and vane denting or gouging, usually very localized. Since in this case the plug relative size and weight is small, no significant damage to the impeller or diffuser would be expected in the event a plug were to pass through the pump hydraulics.

A loose plug bounding around the bottom of the casing will have no detrimental effect on the casing interior surfaces. The casing itself is 7-1/2 inches thick (minimum) stainless steel and is unclad so there is no problem of cladding abrasion. Furthermore, there is no delicate instrumentation or fragile hardware within the volute which has any chance of being damaged by a moving plug.

Once in the vessel, the plug will follow the path of the cold water and end up in the lower plenum. The presence of the plug in the lower plenum presents two potential problems. The first aspect considered was the potentiality of loose pieces impacting the lower internals components. Due to the low velocities present, only insignificant effects of such impacts can be expected. The plugs are too large to enter either the core region or the drive line area. The chance that the plug will fracture and small pieces will migrate into the core region is believed to be remote due to the shape of the plug and material used (Inconel).

A second potential problem which may occur is wedging of the tube plugs in close clearance areas during start-up after a cold shutdown. Only one area was identified as a potential problem should wedging occur.

The identified area is the clearance between the vessel and the secondary core support base plate. Should a plug become wedged between the base plate and vessel during start-up from cold shutdown, the constriction against thermal growth would cause forces to exist. The existance of such forces acting with the normal hydraulic forces could cause movement of the vessel internals. A sensitivity study indicates that for the most conservative conditions more than four plugs would need to be wedged between the vessel and the baseplate. The forces generated by any lesser number of wedged plugs will not be large enough to cause movement of the internals.

PLANT OPERATION WITH LOOSE S/G PLUGS IN THE RCS (CONT.)

The potential effects of loose plugs on the fuel performance and integrity were also evaluated. Since it was previously mentioned that no plugs could enter the core through the lower internals, no nuclear, thermal, hydraulic, or mechanical concerns exist. Even if plugs were found on the top surface of the core, no nuclear, thermal, hydraulic, or mechanical damages are expected. When operation commences, any plugs on the top of the core would probably be swept down the hot leg and into a channel head where it would come to rest in a low flow area. The clearances between fuel pins and assemblies are too small to allow movement of a plug into those areas.

As previously demonstrated, only the wedging of a plug between the secondary core support base plate and the vessel is a potential problem of operation with loose plugs in the RCS, and greater than 4 loose plugs are required to pose a safety concern.