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

SAFETY EVALUATION REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 75 TO OPERATING LICENSE NPF-1

PORTLAND GENERAL ELECTRIC COMPANY

TROJAN NUCLEAR PLANT

DOCKET NUMBER 50-344

1.0 Background

By application dated May 21, 1982 (Ref. 1), Portland General Electric Company (the licensee) proposed to amend Operating License NPF-1 to permit the use of additional fuel assemblies that have been modified with solid stainless steel rods and partial grids. Specifically, it was requested in License Change Application (LCA) 88 that the existing waiver of Technical Specification 5.3.1 contained in License Condition 2.C (11) be replaced. The replacement would permit the substitution of: (a) five solid stainless steel dummy rods for fuel rods in eight fuel assemblies located adjacent to corner-injection baffle joints (i.e., at inside baffle joint locations, where the fuel "sees" the 90° angle corner of a box from inside the box); and, (b) three stainless steel dummy rods for fuel rods in twelve fuel assemblies located adjacent to center-injection (i.e., outside baffle) joint locations.

In addition, partial (2 rod x 8 rod) grids would be used at midspan locations to increase resistance to damaging vibration. The exact wording of the proposed replacement of the existing waiver in License Condition 2.C (11) is, as follows:

a. "The requirement of Technical Specification 5.3.1 that each fuel assembly contain 264 rods is waived for 20 fuel assemblies during Cycle 5 and up to 12 additional fuel assemblies during each fuel cycle after Cycle 5. The modified fuel assemblies may each be reused during later fuel cycles. This requirement is also waived for one cycle subsequent to Cycle 4 for the two fuel assemblies which were previously modified with stainless steel rods and were used in core locations B-12 and M-2 during Fuel Cycle 3. The waiver for these two assemblies was previously approved by the NRC in Amendment 60.

b. "The requirement of Technical Specification 5.3.1 that reload fuel shall be similar in physical design to the initial core loading is waived beginning with the Cycle 5 core for fuel assemblies with partial grids.

c. "The Licensee shall provide a report containing an evaluation of the effects of the stainless steel rods similar to that contained in its February 5, 1981 letter prior to the startup of Cycle 5. The Licensee shall perform a visual examination of the modified fuel assemblies at the end of Cycle 5 to provide assurance that further unanticipated baffle-jetting wear has not occurred. Finally, the Licensee shall also provide a startup physics testing report for Cycle 5."

The reason for the proposed change was that significant fuel assembly damage has occurred in 17 fuel assemblies, ten of which were located adjacent to baffle joints during Cycle 4 operation. The failure mechanism for 10 assemblies has been identified as fuel rod vibration caused by impingment of water-jets through the gaps between the baffle plates adjacent to the fuel assemblies, i.e., "baffle-jetting," see License Event Report (LER) 82-06 (Ref. 2). Of the remaining seven leaker assemblies, one had been previously located adjacent to a baffle joint. The gaps in the corner-injection baffle joints had apparently been opened up during the peening of center-injection baffle joints at the end of Cycle 3. In addition to contributing to the corner-injection problem, the peening did not correct the center-injection problem, as evidenced by damage attributed to the latter mechanism to three fuel assemblies.

2.0 Evaluation

A review was conducted of (a) fuels (materials), (b) physics (neutronics), and (c) thermal/hydraulic (coolant flow) considerations.

2.1 Materials Considerations

A. Likelihood of Further Damage

With regard to the possibility of further damage to the modified peripheral assemblies, the discussion can be separated into two parts: (1) center-injection assemblies, and (2) corner-injection assemblies. The most susceptible fuel rod in the assemblies located at center-injection points has been the third rod in the first row (that rod is most nearly aligned with the center-injection baffle-plate gap.) The recommended interim fix for that problem is to replace the third rod and the two adjacent rods in the first row with dummy (solid) stainless steel rods. That solution had been used for two assemblies following the Cycle 2 center-injection baffle-jetting failures (Refs. 3-5), and no further baffle-jetting failures occurred in those assemblies in Cycles 3 and 4. That result, thus, supports Westinghouse analyses that show that the increased stiffness of the stainless steel dummy rods, compared with normal fuel rods, reduces the amplitude of the vibration induced by baffle-jetting, and replacement of the most susceptible fuel rods with dummy solid rods precludes the possibility of cladding perforations at this location. Replacement of the adjacent rods on either side of the most susceptible rod with solid dummy rods provides further assurance that damaging vibration will not propagate.

With regard to fuel assemblies located at corner-injection points, the water jet passing along the face of the fuel assemblies (as apart from the 90° impingement onto an assembly with center-injection) causes so-called "whirling" of the fuel rods on the outside row (Ref. 6). Although interior (2nd row) fuel rods, as well as outer row rods, were damaged by the corner-injection type of baffle-jetting, it is believed (Ref. 6) that the interior rods were "secondary" failures caused by whirling of the damaged (i.e., broken) rods on the outer row. Thus, by replacing the first five fuel rods on the face of the eight fuel assemblies subject to this type of flow, PGE expects to preclude damage, not only to the five outer rods, but also to the interior rods as well. It is notable that, while only the first five of the outer row rods will be dummy stainless steel rods, some failures occurred at positions seven and eight in the outer row and in positions two, three, and four in the second row. The 2x8 partial grids are intended to ensure that failures will not occur at similar locations during Cycle 5.

While the proposed "fix" consisting of solid stainless steel rods and partial grids appears reasonable, there is, of course, no absolute assurance that additional failures will not occur. PGE has, therefore, proposed to perform visual examination of the modified fuel assemblies at the end of Cycle 5 to verify that further unanticipated baffle-jetting wear has not occurred. We conclude that this is acceptable provided that there are no indications, from fission product activities in the primary coolant, that additional baffle-jetting failures have occurred. Such indications may consist of sudden decreases in the I-131/I-133 ratio and sudden increases in the NP-239, Ce-144, or Cs-137/Ca-134 ratio (Ref.7). Should such positive indications of new baffle-jetting failures exist, additional checks of fuel cladding integrity, including sipping, should be performed at least on those assemblies adjacent to the baffle gaps. Such checks would be required because visual inspections, while highly effective in detecting baffle-jetting failures (which generally occur in the outer rows of the fuel bundles and often evidence large defects that are easily visible on a TV screen), are not 100% effective; for example, one of the baffle-jetted assemblies examined at EOC 4 passed the visual examination, but was found to be a leaker when it was subsequently sipped.

B. Effects on Fuel Assembly Structural Integrity

The partial grids will be used on fuel assemblies adjacent to corner-injection joints to increase the frequencies and decrease the amplitudes of the fundamental modes of vibration for the rods in the 2x8 arrays encompassed by the grids. Since the partial grids and dummy stainless rods are being added to the otherwise unchanged fuel assemblies, they are not expected to affect the capability of the assemblies to withstand normal operating, seismic, or refueling loads. As is also pointed out in LCA 88, axial growth of the stainless steel rods and fuel rods can be accommodated by axial slip through the partial grids. We, therefore, agree with the licensee that the structural integrity of the modified fuel assemblies should be essentially unchanged from the standard fuel assemblies.

C. Materials Evaluation Conclusion

We conclude that there is substantial reason to expect that the proposed substitution of the modified fuel assemblies will solve the baffle-jetting problem at Trojan. Some uncertainties do exist, however, related to: (1) the effectiveness of the partial grids, and (2) the fact that in only some, not all, of the locations where failed rods were discovered will there be dummy solid stainless steel rods. For those reasons, our approval of LCA 88 is applicable only for Cycle 5 operation. Approval for subsequent cycles must await the results of the performance of the modified assemblies during Cycle 5, as evidenced by coolant activities during the Cycle and visual examinations at EOC5 (supplemented by sipping if the coolant activities are indicative of new baffle-jetting failures).

2.2 Physics Considerations

The Cycle 5 core will contain 22 assemblies which contain stainless steel rods -- two previously burned assemblies, each containing three stainless steel rods, twelve new assemblies, each containing three stainless steel rods and eight new assemblies, each containing five stainless steel rods. The 76 new Cycle 5 stainless steel rods are positioned symmetrically in the four quadrants. The two previously burned assemblies with stainless steel rods lie on the core mid-line. Thus, the core is nearly quadrant symmetric and the stainless steel rods produce negligible effect on quadrant tilt.

The Cycle 5 nuclear design calculations were done with the standard reload methodology with the 22 assemblies containing stainless steel rods appropriately modeled. The stainless steel rods produced only small changes in the radial peaking factors. No changes were required to the Technical Specification values for $F_{\Delta H}$ and F_{xy}. The only overall effect of this loading is to lower very slightly the power on the core periphery. The partial grids add additional parasitic neutron absorption, but are located in low flux regions. Thus, the local power distribution changes due to these grids are negligible.

The core power distribution will be compared with predictions at the beginning of Cycle 5 during the startup physics tests and throughout the cycle. These tests and measurements during the cycle will confirm the licensee's analysis.

We agree with the licensee's assessment that the impact of the stainless steel rods and partial grids is minimal and we conclude that these changes are acceptable for Cycle 5. Our acceptance of the additional number of stainless steel rods in Cycle 5 is based on cycle specific information provided to us by the licensee. Future cycles will require additional information for our further review.

2.3 Thermal/Hydraulic Considerations

In Cycle 5 twenty modified 17x17 fuel assemblies containing dummy stainless steel rods to replace fuel rods are to be placed on the outer periphery of the core (see Figure 1). Our evaluation is to find the effect of these modified fuel assemblies on the thermal-hydraulic performance. Eight of the assemblies which are in the corner-injection locations also have a further change in that they have partial "mini" grids to encompass a 2x8 array of rods to provide additional support for the five stainless steel rods and three adjacent fuel rods in Row 1 of the modified fuel assemblies, plus the eight fuel rods in Row 2 behind the stainless rods. For each of these fuel assemblies a total of seven partial grids are to be inserted midspan between the full grid assembly to help reduce the vibration of the rods located in the 2x8 partial grids.

The solid stainless steel rods are the same diameter and approximately the same length (½-inch longer at each end initially, but the same length after thermal expansion - Ref. 6) as the fuel rods they replace and, therefore, are geometrically and hydraulically similar.

For the assemblies with partial 2x8 grids, we expect that the mini grids will add only a small additional effect on flow turbulence, flow stability and critical heat flux (CHF). The power at the outer periphery where these assemblies are located is only approximately 70% of the core average, which has a conservative effect much greater than possible adverse effects from the modifications in the assemblies. Therefore, we conclude that the grid effect is acceptable provided that the eight assemblies with the partial grids remain at their outer periphery locations for the full three cycles.

The operation with the current baffle gaps does not lead to excessive core bypass flow as the corner-injection baffle joint gaps were measured and determined to be smaller than the limits set by Westinghouse for excessive core bypass flow. The center-injection baffle joint gaps are expected to be even smaller since they were peened. In addition, the bypass flow from the baffle joints is relatively small compared to all four paths available for core bypass flow. (Ref. 6)

We find that the modifications to the fuel assemblies are acceptable since the changes are small and the new modified fuel assemblies are in the low power peripheral core locations where their effect on the thermal-hydraulic performance is minimal. This conclusion is based on the modified fuel assemblies being in their outer periphery locations in the core. Further use of modified fuel assemblies will require NRC review and approval.

3.0 Summary

In summary, based on our review of the proposed change, the physics startup test report commitment, and the required fuel surveillance, we find the change acceptable for Cycle 5 operation. The acceptance is limited to the placement of the modified assemblies in core locations identified in LCA 88. If the licensee decides either to relocate these assemblies or to reuse the modified assemblies in future cycles, further application and review will be required. Approval for further use will be dependent upon satisfactory performance during Cycle 5. This modification to the licensee's proposal has been discussed with and agreed to by licensee's staff.

4.0 Environmental Conclusion

We have determined that the proposed license amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR 51.5(d)(4), that an environmental impact statement negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

5.0 Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated, does not create the possibility of an accident of a type different from any evaluated previously, and does not involve a significant reduction in a margin of safety, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

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6.0 References

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2. C. P. Yundt and R. L. Steele (PGE), Letter to R. H. Engelken (NRC), with Licensee Event Report 82-06, May 6, 1982.
3. License Event Report 80-006/OIT-0, April 25, 1980.
4. C. Goodwin, Jr. (PGE), Letter to Robert A. Clark (NRC), Transmitting License Change Application 61, May 12, 1980.
5. R. O. Meyer (NRC), Memorandum for Robert A. Clark, "Trojan License Change and Cycle 3 Reload," June 20, 1980.
6. M. Tokar, H. Balukjian, and C. Trammell (NRC), Telecommunication with G. Zimmerman, et al (PGE), June 11, 1982.
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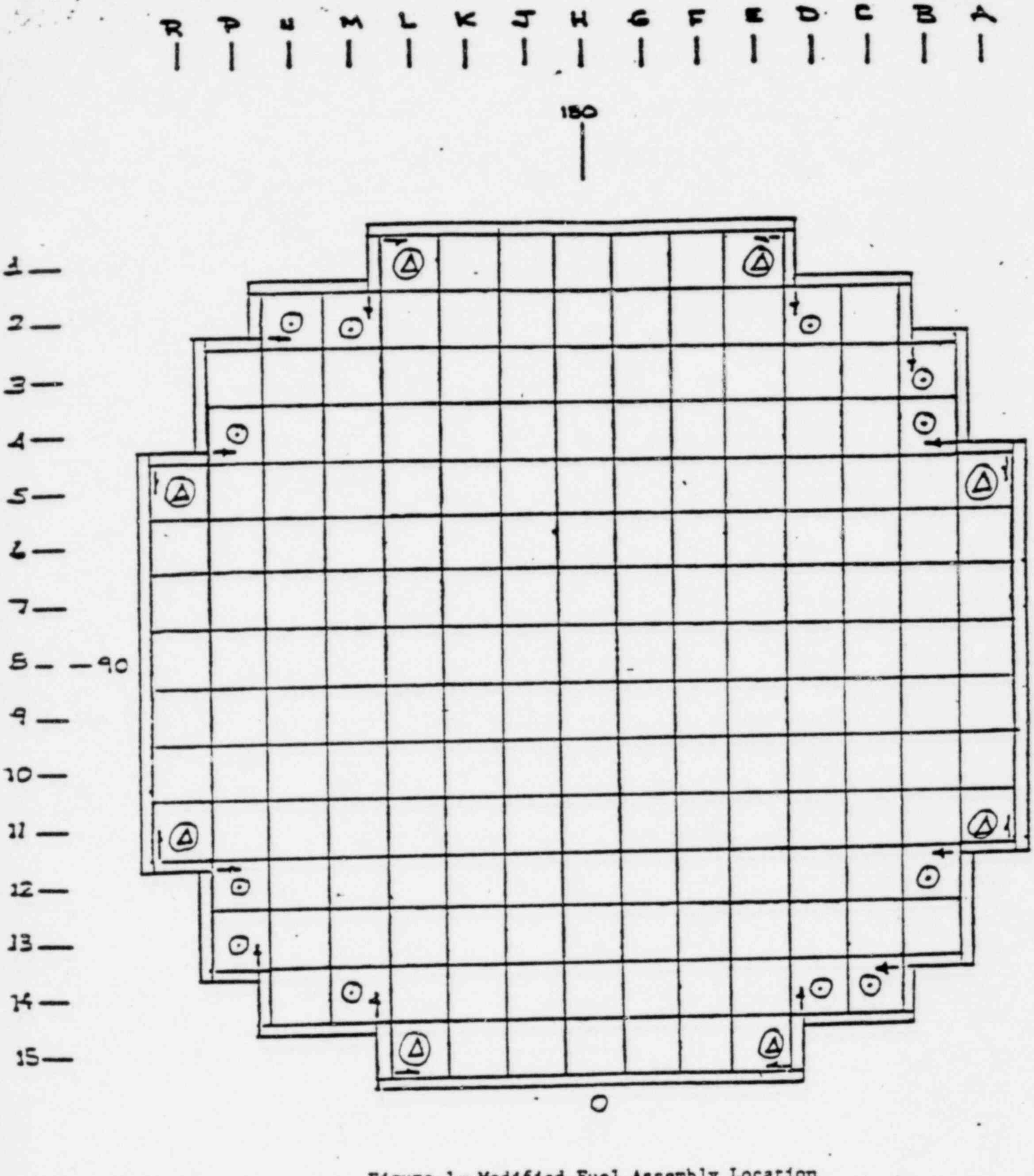

Figure 1 - Modified Fuel Assembly Location

(△) – Corner - Injection assembly (8)

⊙ – Center - Injection assembly (12)