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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO THE EVALUATION OF RESPONSE TO NRC BULLETIN NO. 90-02

GPU NUCLEAR CORPORATION AND JERSEY POWER & LIGHT COMPANY

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

1.0 BACKGROUND

The Oyster Creek Nuclear Generating Station is currently operating in its twelfth (12th) cycle. The current fuel bundles are channeled with 410 first bundle lifetime fuel channel boxes and 150 channel boxes in their second bundle lifetime (i.e. used channels). GPU Nuclear Corporation (GPUN) has targeted the reuse of channel boxes to approximately 25% of the core's total fuel channel population. The exposures of the current reused channel boxes range from approximately 30 to 56 GWD/MTU. Second bundle lifetime channel boxes were installed in cycles 10, 11, and 12. Cycle 12 channel box geometric locations are given in figure 1 of reference 1. Fifty-one (51) reused channel boxes were installed at the beginning of cycle 10, fifty-six (56) in cycle 11, and forty-three (43) in cycle 12. One hundred and nineteen (119) are projected to be reused in cycle 13. All reused channel boxes are scheduled to be discharged at the end of their second bundle lifetime, as required by GPUN's Channel Management Program.

GPUN pointed out in their August 30, 1990 submittal, that GPUN will limit the number of channel box reuse on new bundles in the upcoming cycle 13. New bundles with reused channel boxes will be loaded into core locations that, based on cycle projections, will not be operated near thermal limits. GPUN also pointed out that only those channel boxes with bow less than 150 mils may be loaded into limiting core locations.

2.0 EVALUATION

2.1 Channel Box Management Program

GPUN's objective of developing a Channel Management Program is to have fuel channel boxes meet operating requirements for two fuel bundle lifetimes. The program consists of a historical database regarding location and accumulated exposure, etc., for each channel box; fabrication specifications, physical measurements of the channel boxes, and development of correlations which can predict channel box bow and displacement. GPUN stated that the program has been active since 1977 with the specific intention of keeping track (through physical measurement) of channel box bowing and displacement over the period of two bundle lifetimes.

2.2 GPUN Methodology and Associated Database

GPUN's database represents all the Oyster Creek channel box data obtained since 1977, extending out to approximately 55 GWD/MTU. In order to develop a plant-specific and controlled database for channel box bow and other key channel performance parameters, GPUN established a systematic measuring program. The data from these measurements is used to confirm the satisfactory operation of channel box fabrication to GPUN specification as well as provide a basis for evaluating channel boxes made by alternate suppliers and/or advanced fabrication processes. GPUN made use of this database to generate the predicted bounding channel box bow -vs- exposure curves for use in calculation of the MCPR limits, Reference 3.

The GPUN methodology is very similar to the GE methodology. The GE methodology uses a core average bow to calculate the change in the R-factor due to channel bow. The core average bow is determined by averaging the bow of the four channels in all of the "potentially limiting" cells throughout the core. This approach assumes that the maximum bow will occur in a highly exposed or non-limiting bundle, but its application is limited to first bundle lifetimes where bow is not expected to be excessive. GPUN does not make this assumption in its calculation of bow magnitudes for reused channel boxes. Instead GPUN, in order to account for all of the reused channels, evaluates each control cell that will have a bundle operating at or near the limits with a reused channel box. In essence, the GPUN methodology takes into account the possibility that a reused channel box could be installed on a limiting bundle.

GPUN calculates the R-factors by considering the largest (or the most conservative) contribution from either: a) including the effects of reused channel box bow on the limiting bundle calculations, or b) the average channel box bow of the four channel boxes surrounding the control rod having the limiting bundle.

2.3 Channel Box Bow Analysis Results

In evaluating four-bundle cell locations, GPUN made use of the histories of the channel boxes in each cell in order to determine the cell average bow. Tables 1 and 2 of reference 4 provide core locations and exposure for cycles 12 and 13, as well as the anticipated discharge cycle for each of the channel boxes. Table 2 identifies the predicted maximum channel box bow at End of Cycle (EOC) 12 and 13; the maximum measured channel box bow and corresponding exposure of previously measured cycle 13 reused channels. Predicted EOC 13 average channel box bow is approximately 93 mils for the limiting cell. Table 2 also indicates which cycle 13 reused channels are scheduled for measurement at the EOC 12. This EOC 12 measured data will then be compared to previously predicted EOC 12 data for the purpose of verifying the analytical channel box bow calculational model.

Figure 1 of reference 4 shows the locations of all the 119 reused channel boxes in the core. GPUN analysis of cycle 13 indicated that the bundles closest to the limits during the operation of cycle 13 will not have reused channel boxes with bows greater than 140 mils. Figure 2 of reference 4 is a quarter core map which identifies the locations of the anticipated limiting fuel bundles, reused channel boxes, and the reused channel boxes having a channel bow greater than 140 mils. GPUN pointed out that this quadrant is typical of the remaining quadrants.

2.4 MCPR Limits

Using the GPUN method, the impact of the channel box bow on the thermal limits was investigated for the upcoming cycle 13. A review of the actual fuel operating thermal limits for cycle 13 identified greater than 10% margin to the Technical Specification limits for Oyster Creek. The maximum reduction in available CPR margin due to channel box bow in the limiting cell during cycle 13 is about 3%. Thus, GPUN analysis indicates about 7% available margin to the CPR Technical Specification operating limit at any time during the operating cycle.

The R-factors for cycle 13 fuel designs will be revised to account for the cycle 13 channel box bow in the same manner as cycle 12. This methodology was described in the GPUN May 21, 1990 and July 20 1990 submittals. The method addresses the channel box bowing in each four bundle control cell operating near margins rather than the average channel box bow for the limiting bundles. This addresses the reduction in margin to the MCPR operating limit for locations that have reused channels. These modified R-factors will be installed in the plant process computer at the begining of cycle 13 to account for the channel box bow impact on the thermal limits.

As part of its cycle-specific analysis, GPUN evaluated the impact of the channel box bow on the MCPR safety limit due to increased uncertainties in both the measurement and calculation of critical power by the plant computers. The R-factor uncertainty used in the determination of the MCPR safety limit for Oyster Creek cycle 13 is 1.6%. This uncertainty allows for manufacturing tolerances and calculational model uncertainties, but not explicitly channel box bow. Statistical calculations by GPUN have shown the uncertainty in the core average channel bow to be 46 mils for Oyster Creek cycle 13. Statistically combining the channel box bow and nominal uncertainty yields an overall R-factor uncertainty of 1.8%. The use of 1.8% instead of 1.6% as an R-factor uncertainty increases the overall safety limit by an estimated 0.002 which is not significant.

2.5 LHGR and MAPLHGR

In the July 20, 1990 submittal, GPUN showed that the Oyster Creek channel box bow and associated uncertainty are similar to GE and that the justifications provided by GE are valid for Oyster Creek. In discussions between GE and GPUN, GE supported their argument based on a core average channel box bow of 65 ± 30 mils. At the two (2) sigma level, Oyster Creek channel box bow is 125 mils for

a GE-type fueled core with no channel reuse, and 138 mils for the Oyster Creek cycle 13 core. This 13 mil bow difference represents less than 1.0% increase in local peaking. GPUN pointed out in their December 31, 1990 submittal that those channels that are currently projected to exceed 138 mil bow in cycle 13 will reside on [illegible]les that will not operate near limits (greater than 20% margin to MAPLHGR [illegible]mits and greater than 30% margin to LHGR limits) and represent no safe[illegible] [illegible]oncerns for these limits.

3.0 CONCLUSION

Based on the above evaluation, the NRC staff has concluded that the licensee's cycle 13 reload design with reused channel boxes and the data/methods used to account for the channels box bow impact on the operating limits is acceptable, subject to the following condition:

> Following EOC 12, measured data from EOC 12 reused channels destined to be used in cycle 13, be compared to predicted EOC 12 calculated data for the purpose of verification and possible modification of the analytical channel box bow model. The results of this comparison and any modifications to be made to the model should be submitted to the NRC for review.

If in future cycles channel box reuse is continued, further review and prior approval by the NRC staff will be required.

4.0 REFERENCES

1. Letter from E.E Fitzpatrick, GPUN, to NRC, Response to NRC Bulletin 90-02, "Loss of Thermal Margin Caused by Channel Box Bow," May 21, 1990.

2. Letter from E.E Fitzpatrick, GPUN, to NRC, Response to NRC Bulletin 90-02, "Response to Request for Additional Information", July 20, 1990.

3. Letter from E.E Fitzpatrick, GPUN, to NRC, Response to NRC Bulletin 90-02, "Response to Request for Additional Information," August 30, 1990.

4. Letter from E.E Fitzpatrick, GPUN, to NRC, Response to NRC Bulletin 90-02, "Oyster Creek Fuel Channel Bowing," December 31, 1990.

Principal Contributor: A. Attard

Date: March 11, 1991

The requirements of this letter affect fewer than 10 respondents and therefore, are not subject to Office of Management and Budget review under P.L. 96-511.

Sincerely,

Original signed by

Alexander W. Dromerick, Senior Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

Distribution:
Docket File
NRC & Local PDRs
PD I-4 Plant
SVarga
EGGreenman
SNorris
ADromerick
OGC
EJordan
AAttard
ACRS (10)
CWHehl
BLong

OFC	:PDI-4:LA	:PDI-4:PM	:PDI-4:D	:	:
NAME	:SNorris for	:ADromerick:cn	:JStolz	:	:
DATE	:3/6/91	:3/7/91	:3/8/91	:	:

OFFICIAL RECORD COPY
Document Name: TAC NO 76342