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Docket Nos. 50-269/270 & 287

Duke Power Company
ATTN: Mr. William O. Parker, Jr.
Vice President
Steam Production
Post Office Box 2178
422 South Church Street
Charlotte, North Carolina 28242

Gentlemen:

By letter dated October 14, 1977, you requested amendments to the Facility Operating Licenses for the Oconee Nuclear Station, Units 2, 2 and 3 which would permit the disposition of a fuel rod that was bent and partially dislodged from a Unit 1 spent fuel assembly while being handled in the Unit 1 and 2 spent fuel pool. It is our understanding from discussions with you, that your basis for requesting an amendment was that the procedure for removing the fuel rod involved a potential accident not described in the FSAR.

We have reviewed and evaluated your proposed procedure for removing the damaged fuel rod from assembly 1D40 as described in your October 14, 1977 letter, and find that the potential accident associated with that procedure (i.e., rupture of the bent fuel rod) falls well within the bounds of the fuel handling accident described in the FSAR and evaluated by the NRC prior to licensing Oconee Unit 1. We conclude, that the removal of the fuel rod is acceptable as proposed and that a license amendment is not required in this case.

Our Safety Evaluation supporting our conclusion is enclosed.

Sincerely,

Original Signed By

A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

OP 3

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING NRC REVIEW OF FUEL ROD REMOVAL FROM ASSEMBLY 1D40

DUKE POWER COMPANY

OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3

DOCKET NOS. 50-269, 50-270 AND 50-287

Introduction

By letter dated October 14, 1977, Duke Power Company (the licensee) requested amendments to Facility Operating Licenses DPR-38, DPR-47 and DPR-55, for the Oconee Nuclear Station, Units 1, 2 and 3 which would allow for the disposition of one fuel rod from Unit 1 fuel assembly 1D40. However, as indicated below, our review indicates that amendments to the licenses are not necessary.

Discussion

During the Unit 1 refueling outage following Cycle 3 operation, fuel assembly 1D40 sustained damage to a fuel rod during handling in the Spent Fuel Pool. The incident resulted in the upper ten inches of a corner rod in an outer row of rods being bent outward from the assembly at about a 45^{0} angle. No radioactive releases were detected.

Because of the rod protrusion, it was impossible to set the assembly fully down on the Spent Fuel Pool floor without interference with the storage rack grillage. Also, any attempt to return the rod end to the spacer grid cell could result in breakage. Thus it was decided that, pending further disposition, the assembly would be temporarily left suspended from the post-irradiation examination (PIE) crane approximately 2-1/2 feet above the bottom of the pool.

With the protrusion of the damaged rod the assembly cannot be fitted into a shipping cask and removed "as is" because of the limited clearances within the cask. Since the prime consideration is that of maintaining the integrity of the cladding and minimizing the chance of radioactive release, attempting to regain the original assembly envelope by bending the rod back is not considered to be a viable alternative. Therefore, the licensee has concluded that the most reasonable option is the removal of the bent fuel rod from the assembly within the Spent Fuel Pool. The damaged rod would then be transferred to a shipping cask pending its ultimate disposition.

Evaluation

Pulling fuel rods from fuel assemblies has been performed in several instances at reactor sites. Although this would be the first time at Oconee, it has been demonstrated at Surry 1, Zion 1, Maine Yankee and St. Lucie, that a fuel or poison rod can be removed safely from a fuel assembly at a reactor site under similar circumstances. In addition, the B&W PIE program has demonstrated that this type of operation can be accomplished in a safe manner.

The procedures developed by the licensee are such that the pulling of the bent fuel rod would be virtually the same as pulling an unbent fuel rod. In addition, the entire operation will be viewed with underwater television cameras. The cameras will also monitor the pulling force continuously registered on a meter so that should any problems develop during the operation they will be detected before a safe force is exceeded.

Although the rod pulling equipment and the procedures have been developed to minimize the risk of damage, a small but finite probability of an accident remains. Potential accidents that could occur during the operation are described below including discussion of precautions the licensee intends to take to prevent them. All of these accidents involve the potential breakage of a single fuel rod which is much less severe than the breakage of 56 fuel rods already analyzed on the FSAR and evaluated by the NRC prior to licensing Unit 1.

Rod Break Due to Bumping - Certain operations will result in objects being brought close to or in contact with the upper part of the fuel rod. There is the possibility that the strain-hardened region of the bend may be somewhat brittle. However, the region has already shown itself to be capable of withstanding significant strain and impact during the bending and subsequent removal from the assembly examination frame. Thus, minor contact with the upper portion of the rod is not considered to be a problem. Nevertheless, to assure little or no chance of adverse contact, all critical operations (such as shield installation, gripper installation, tightening and extraction) will be closely followed through direct observation or TV monitoring. All operations will be performed with caution using lightweight tools and safety lines where applicable.

Rod Break During Pulling - The two areas of potential concern during this operation are: (a) tensile or bending failure of the rod below the clamp on the fuel rod due to the pulling force, and (b) slippage of the clamp upward to the bend area, thus impacting stress at the bend.

It is very unlikely that the rod will fail in tension due to the pulling forces. To date, 38 irradiated rods have been withdrawn at the B&W Lynchburg Research Center (LRC) without incident (relatively low pulling forces were shown to be required). Outer row corner rods irradiated through two reactor cycles have been pulled, and the maximum (breakaway) force required of any of the four rods was 91 lbs. This was for the case of any assembly with double end grids top and bottom (total of 10 grids). Assembly 1D40, on the other hand, is a single end grid design, and only one end grid (the bottom) is still gripping the rod under consideration. Thus, only 7 grids are holding the rod, so the maximum expected pulling force should be no more than 70% of 91 lbs, or about 64 lbs. Even less may be required because the end grids have the stiffest springs and 1D40 now has only one intact, as compared with the four present during the two-cycle tests mentioned above. A force of 65 lbs will produce a cladding axial tensile stress of about 2000 psi. This is very small when compared with a value for the 0.2% yield strength of unirradiated B&W Zircaloy-4 cladding of about 54,000 psi (irradiated yield strength through two cycles is even higher).

Due to the slight angle of pull planned (about 2^{0} from the vertical), a small amount of rod bending will probably occur at the top intermediate spacer grid. However, since the rod has already been shown to take a 45^{0} bend without breaking, no problem is expected during the pulling operation. Tests on irradiated cladding have shown that it retains about 75% of its as-built ductility (based on decrease in total elongation).

The possibility of clamp slippage during the pulling operation is remote. The licensee has stated that no sign of slippage has been seen during the dry runs conducted. Additional clamping checks have shown that with a pulley rope force of approximately 7 lbs, the clamp will hold without slipping to a force of 150 lbs. The pulling force will be limited to 150 lbs. Since the expected force is less than half of this, the margin to prevent slipping is quite high. Furthermore, the tests to date have been on unirradiated (relatively smooth) cladding. The friction coefficient on irradiated, oxidized, crudded cladding is expected to be higher. As an extra safety precaution, any slippage would be detected by monitoring before the clamp reached the bend area. Since the load is continuously monitored by watching the spring scale, significant slippage would be immediately noted as a sharp drop in pulling force, and the pulling operation would be stopped. The clamp area will be followed with the underwater TV camera to determine whether slippage has occurred. Corrective action (such as repositioning or tightening) would then be taken as necessary.

Rod Break During Subsequent Handling - After removal from the assembly, the rod (with clamp still attached) would need to be moved only a few feet to the storage container. Nothing will be between the two locations that the rod could strike. Chances of dropping the rod are negligible since the entire assembly is being doubly held by the pulling cable and the pulley rope until the rod is in the container. Transport of the container to the shipping cask should also present no problems. To ensure that the cask cover will not interfere with the top of the rod, underwater TV will be used to confirm adequate clearance. Once the cover is installed, no adverse effects would arise from a rod break (e.g., during shipping).

Although the probability of fuel rod rupture is very low, the licensee has calculated the consequences of such a rupture. The results show the off-site two-hour doses would be well below 10 CFR 100 guidelines. We have compared the rupture during handling of this one fuel rod with the fuel handling accident in the FSAR. The FSAR case assumes 56 fuel rods (which have cooled and decayed for 72 hours) fail. Based on our review, we conclude that the FSAR evaluation bounds this case and, in fact, the consequences of the rupture of 1 fuel rod would be significantly less.

Based on our evaluation and review of (1) the experience to date in removing fuel rod at reactor sites, (2) the procedures and precautions to be taken by the licensee, (3) the strength of the fuel rod cladding, and (4) the consequences of an unlikely fuel rod cladding break, we conclude that the proposed action to remove the fuel rod from fuel assembly 1D40 is acceptable.

Conclusions

We conclude that there is no significant increase in the probability or consequences of accidents previously considered, and (2) there is reasonable assurance that the health and safety of the public will not be endangered by this action.

Date: JAN 12 1978