December 5, 1994

MEMORANDUM TO: Richard Wessman, Chief
Mechanical Engineering Branch
Division of Engineering

FROM: Robert C. Jones, Branch Chief
Reactor Systems Branch
Division of Systems Safety & Analysis

SUBJECT: DSSA SER INPUT REGARDING THE JAMES A. FITZPATRICK CORE SHROUD REPAIR (TAC # M90965)

On July 25, 1994, the staff issued Generic Letter 94-03 concerning core shroud cracking in boiling water reactors (BWRs). By letter dated August 24, 1994, as supplemented by letter dated October 18, 1994, the New York Power Authority (NYPA) responded to the generic letter, providing documentation and analyses to support continued power operation of the James A. FitzPatrick Nuclear Power Station for the remainder of the current fuel cycle, scheduled to end on November 29, 1994. By letter dated October 21, 1994, NYPA submitted the details of their planned repair which involves installation of 10 stainless steel tie-rod/radial restraint assemblies. On November 15, 1994, the staff met with NYPA to discuss the proposed design and their October 21 and subsequent submittals.

The Reactor Systems Branch (SRXB) has reviewed the licensee's October 21 and subsequent submittals. Our evaluation is provided in the attached Safety Evaluation Report (SER). This SER provides our input to the review being conducted by the Division of Engineering regarding the structural and materials aspects of this proposed repair. The SRXB review concerns the systems aspects of the repair including the affect of the repair on the response of the plant to normal, transient and accident conditions.

Docket No.: 50-333

Attachments:
As noted

Contact: K. Kavanagh, SRXB/DSSA, 504-3743

DISTRIBUTION

Docket File	SRXB R/F	KKavanagh R/F*
JStrosnider	KManoly	FitzPatrick P/F
NConicella	JRajan	

H-7

DOCUMENT NAME: G:\FPREPAIR.SER

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	DSSA:SRXB	E	DSSA:SRXB	E	DSSA:SRXB	E				
NAME	KKavanagh KAK		MRubin		RJones RCJ					
DATE	12/1 /94		12/ /94		12/5/94					

9412120059 XA 95/9/11

JAMES A. FITZPATRICK CORE SHROUD REPAIR
SRXB EVALUATION

Introduction

The intent of the New York Power Authority (NYPA) design and summary reports for James A. FitzPatrick Nuclear Power Plant, dated October 21, 1994, was to demonstrate that fuel geometry and core cooling would be maintained given the unlikely occurrence of a through-wall failure of any horizontal weld during normal operations and design basis events with the core shroud repair installed. Fuel geometry must be maintained to ensure control rod insertion while core cooling is ensured by proper emergency core cooling system (ECCS) performance. The NYPA submittal provided analysis of the principal effects and issues of operating the plant with circumferential shroud welds cracked and tie-rod/radial restraint systems installed. Some of the conditions analyzed by the licensee included tie-rod system induced leakage, shroud weld crack leakage, downcomer flow characteristics, lateral displacement of the shroud, and vertical separation of the shroud. The Reactor Systems Branch has reviewed these portions of the NYPA submittal, compared the results to the original consequence assessment without the shroud repair dated October 18, 1994, and provided an evaluation of the licensee's findings in the following discussion.

Evaluation

The proposed design of the FitzPatrick shroud repair consists of 10 stainless steel tie-rod/radial restraint assemblies which are installed in the shroud/reactor vessel annulus between attachment points near the top of the shroud and the lower shroud support cone. NYPA provided a summary report of the proposed core shroud repair response to normal operation and design accident loads, including seismic loads and postulated pipe ruptures. The licensee stated that the tie rod assemblies provide vertical restraint to the shroud. Radial restraints are also provided to impart lateral stability to the shroud assembly, as well as limit lateral displacement of the shroud in order to ensure control rod insertability. The licensee stated that this design protects against potential through-wall cracking in any and all of the circumferential welds from H1 to H7. Furthermore, the licensee stated that the results of the functional and structural evaluation of the tie rod and shroud provided in the submittal, except for shroud radial deflection, bound the response of the tie rods and shroud resulting from the failure of H8, including the combined failure of H7 and H8.

The installation of the tie-rod assemblies does not require the cutting of any access or attachment holes in any portion of the shroud, shroud separator head, or shroud support plate. Thus, the tie-rod assembly and the techniques by which they are installed does not cause any new leakage paths from the inside of the shroud to the downcomer area. Therefore, the ECCS performance is not affected by the physical installation of the tie-rod system.

The tie-rods are installed with a cold preload which ensures that no vertical separation of any or all cracked horizontal welds will occur during normal operations. Vertical separation, if sufficiently large, could compromise fuel geometry and control rod insertion. For FitzPatrick, a maximum vertical separation of 15 inches is required for the top guide to clear the top of the fuel channels. Without the repair, the licensee estimated that the vertical

separation during normal operation was on the order of 1.0 inch for the H3 through H5 locations assuming 360° through-wall weld failure. The licensee also determined that no vertical separation would occur during normal operations at the H6A location. With the repair, the preload on the tie-rods will not allow vertical separation of failed welds during normal operations. The staff notes that, with or without the repair, the estimated vertical separation during normal operations will not affect the fuel geometry, and therefore, control rod insertion is not precluded. However, a small leakage path could be opened due to additional shroud weld cracking not separation. The licensee conservatively modeled the crack to provide a 0.001 inch leakage path per weld. The leakage through the postulated shroud cracks was determined to be approximately 7.6 gpm for cracks above the core plate, and 29.6 gpm for cracks below the core plate. The licensee estimated that the total leakage from all welds, H1 through H8, having 360° through-wall cracks was approximately 135 gpm. Although shroud crack leakage is unlikely due to the preload on the tie-rod, the licensee concluded that there are no consequences associated with the repair installed based on these small leakages during normal operations. The staff acknowledges that the total leakage is insignificant and will not affect the performance of the ECCS.

The licensee analyzed the available flow area in the downcomer at the top of the core shroud due to the installation of the 10 tie-rod assemblies. The licensee stated that the size of the tie-rod assemblies are small compared to the size of the jet pump assemblies and thus, the tie-rod assemblies are not expected to significantly affect the flow characteristics in the downcomer. However, since the flow annulus is smaller at the top of the shroud with few other existing obstructions such as the core spray lines, the licensee evaluated the flow blockage area of the shroud restraint assembly. The licensee's calculations demonstrated that the installation of the tie-rods will decrease the available downcomer flow area by 9.7 percent at the top of the shroud. This corresponds to a pressure drop of 0.5 inches of H_2O. The licensee stated that this pressure drop is insignificant and will have little impact on the reactor coolant level. The staff agrees with the licensee that the installation of the tie-rod assemblies should not affect the recirculation flow of the reactor.

The licensee evaluated the maximum vertical displacement of the shroud assuming 360° through-wall cracks at any weld above or below the core support plate during a main steam line break (MSLB). This postulated event would result in a large upward load on the shroud which could impact the ability of the control rods to insert and the ability of the core spray system to perform its safety function. As stated above, a maximum vertical separation of 15 inches is required for the top guide to clear the top of the fuel channels. Without the repair, the licensee calculated that the maximum vertical separation would be 11.5 inches during a MSLB, assuming 360° through-wall weld failure of the H3 weld location. With the repair, the maximum vertical separation is limited to 0.522 inches given H2 and H3 failed after installation and H6B was failed. This separation is limited by the tie-rods and should not impact the core spray system. The staff acknowledges that the ECCS performance and control rod insertion should not be impacted by this momentary vertical separation. Therefore, based on this assessment, the staff concluded that postulated separation during a MSLB would not preclude any systems from performing their safety functions.

The licensee also evaluated the maximum lateral displacement of the shroud at

the core support plate and upper guide plate under normal operations and load combinations such as DBE, MSLB, and RLB. Lateral displacement of the shroud could damage core spray lines and could produce an opening in the shroud, inducing shroud bypass leakage and complicating recovery. Lateral seismic restraints have been included in the proposed design which will limit the lateral displacement of the shroud to 0.375 inches for normal and worst case accident scenarios. This lateral displacement is significantly less than the 1.5 inch thickness of the shroud, and accordingly, the separated portions of the shroud would remain overlapped during worst case conditions. Therefore, the staff has concluded that the maximum lateral displacement of the core shroud would not result in significant leakage from the core to the downcomer region following an accident scenario and the ability to reflood the core to 2/3 core height would not be precluded.

Conclusion

The staff has evaluated the licensee's safety evaluation of the consequences of the proposed core shroud repair. The staff has found that the proposed repair should not impact the ability to insert control rods, the performance of the ECCS, particularly the core spray system, and the ability to reflood and cool the core. The staff concluded that the proposed repair does not pose adverse consequences to plant safety, and therefore, plant operation is acceptable with the proposed core shroud repair installed.