UNITED STATES
NUCLEAR REGULATORY COMMISSION
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ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO SAFETY EVALUATION (50.59 REVIEW)
OF TWO CONTROL RODS MOVING AT ONE TIME

GPU NUCLEAR CORPORATION AND
JERSEY CENTRAL POWER & LIGHT COMPANY

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

BACKGROUND

On December 16, 1989, at 0533 hours, a Control Room Operator (CRO) at the Oyster Creek Nuclear Generating Station was increasing power above 10% (Rod Worth Minimizer (RWM) was not in operation) with control rods. The CRO, intending to select control rod 18-27, inadvertently selected an adjacent rod 14-27. Realizing the error, the CRO selected the proper control rod at the same time that the rod select push button for the wrong control rod was being released. This resulted in both rods being inadvertently selected at the same time. The CRO did not realize that two control rods were selected and attempted to withdraw rod 18-27 by taking the rod control switch to the "Notch Out" position. The CRO immediately recognized that both control rods were moving out and quickly took action to stop rod motion.

The Reactor Manual Control System (RMCS) utilizes relay sequencing to control the operation of solenoid operated valves in the Control Rod Drive Hydraulic System. These valves direct high pressure water to the control rod drive mechanism in order to move the control rod. Various switch contacts, including the rod select push button contacts, and an automatic sequencing timer within the system are utilized in the relay control logic. Circuitry within the reactor manual control system is intended to prevent the selection of more than one control rod at a time. This circuitry can be defeated if contacts within the rod select push button are not properly made or disconnected when a rod select push button is actuated. This can occur when a rod select push button is held at mid position and another rod select push button is depressed such as occurred during this event.

The RWM system continuously monitors control rod positions during startup at less than 10% power. It compares the operator selected rod movements and positions against a predetermined rod pattern, and prevents or identifies rod movements that are not in accordance with this pattern.

The operation of the rod worth minimizer with two control rods selected at the same time was investigated by GPU Nuclear Corporation (GPUN). It was determined that the rod worth minimizer would overlay ("or" logic) the rod identification numbers it receives. This will result in only one rod being identified. Depending on which rod is identified and whether it is in the proper step of the withdrawal sequence, the RWM may or may not initiate a select error and rod block. If the two control rods are located at different axial notch positions, it would appear to the RWM as multiple rod position data. However, if the RWM does not provide a select error and both control rods are at the same axial notch position, then both control rods can be withdrawn. Therefore, the RWM cannot be relied upon to provide adequate protection under all conditions.

Since two control rods can be selected and moved at the same time and since RWM protection cannot be assured even when it is in operation, it is necessary to review the FSAR safety analysis for Oyster Creek allowing for withdrawal of two control rods at one time. The licensee has performed this evaluation in a 10 CFR 50.59 review and the staff has audited this evaluation.

EVALUATION

Malfunction or operator error that results in two control rods moving at the same time was not analyzed in the Oyster Creek FSAR. The analysis of the malfunction for two rods being withdrawn must fall within the existing limiting analysis to confirm that the design basis is maintained. This requires the reevaluation of the following events:

1. Uncontrolled Control Rod Withdrawal from a Subcritical or Low Power Startup Condition.

2. Uncontrolled Control Rod Withdrawal at Power.

3. Control Rod Drop.

Uncontrolled Control Rod Withdrawal from a Subcritical or Low Power Startup Condition.

Section 4.6.2.2.3 of the UFSAR describes the continuous control rod withdrawal from low power. A bounding analysis of a rod withdrawal from cold conditions, assuming a control rod worth of 0.025 delta k at a maximum withdrawal rate (adding 0.0019 delta k per second) and no IRM scram, results in no fuel melting or cladding damage. At higher temperatures or higher power levels, the transient would be less severe.

The licensee analyzed withdrawal of the two most reactive rods and found that the bounding FSAR rod worth of 2.5% delta k was exceeded at a notch withdrawal position 10. In order to restrict the reactivity insertion to less than 2.5% delta k, GPUN has initiated a procedure whereby a second licensed operator will

verify that only a single rod was selected and that following the initial control rod withdrawal from 00 to 02 only one control rod has moved. If credit for this operator action is given the FSAR 2.5% delta k value remains bounding since the analysis of the Cycle 12 core shows that even with two face adjacent control rods moving together from 00 to 08, the reactivity insertion would be less than assumed in the single continuous rod withdrawal analysis. Other possible dual rod withdrawal scenarios for rods already partially withdrawn from the reactor would not result in reactivity insertions greater than the bounding analysis. Beyond 10% power or once the core rod pattern is in a black and white configuration, the available combination of rods is such that the reactivity additions would be far less than used in the analysis. Therefore, the movement of two control rods is bounded by the single uncontrolled rod withdrawal if credit is given for operator action.

In section 15.4.1 of the UFSAR, the uncontrolled control rod withdrawal at startup, it is stated that this transient need not be considered since the rod control system at Oyster Creek is single-failure proof which prevents the uncontrolled withdrawal of a control rod. This statement is in conflict with a number of other sections in the UFSAR. The licensee has concluded that section 15.4.1 is incorrect and should be revised.

Uncontrolled Control Rod Withdrawal at Power

This transient is analyzed at each reload. It provides the maximum delta Critical Power Ratio (CPR) in the category of reactivity and power distribution anomalies. The initiating event for this transient is either an operator error or a rod controller malfunction that allows a continuous rod withdrawal. The delta CPR for this transient in Cycle 12 is 0.38.

It is anticipated that the analysis of two control rods moving would be bounded by the uncontrolled withdrawal analysis for the following reasons. The rod withdrawal error analysis maximizes the worth of a fully inserted control rod that is withdrawn until a rod block is reached. The power increase is predominantly in the bundles surrounding the control rod. If two high worth control rods are withdrawn at the same time the power increase needed to reach the rod block would be achieved earlier in terms of feet withdrawn than in the single control rod case. Further, the power increase would be distributed over more fuel bundles limiting the delta CPR for any one bundle.

To confirm the above, GPUN performed an analysis using approved methods to address the current Cycle 12 operation utilizing control cell core operation. Various combinations of control rods in the control cells were withdrawn together. The most limiting case is two rods withdrawn from the full in position to the full out position. The delta CPR for this case is 0.31. Therefore, this analysis is bounded by the uncontrolled control rod withdrawal error for Cycle 12.

The staff has audited GPUN's analysis of this event and finds that it adequately addresses the issue of dual rod withdrawal at power for Cycle 12.

Control Rod Drop Analysis

The control rod drop analysis is not analyzed at each reload since Oyster Creek uses the banked position withdrawal sequence (BPWS). The BPWS insures that the incremental rod worth of any control rod being withdrawn from the core is much less than 1.0 delta k. An incremental rod worth of 1.0 delta k or less will insure that the peak fuel enthalpy design limit of 280 cal/gm is not exceeded. The withdrawal of two control rods at a time has the potential of setting up rod worths in excess of 1.0 delta k.

The rod worth minimizer serves as a backup to procedural controls for limiting rod worth in the event of a rod drop accident. Since the RWM cannot protect against two control rods being withdrawn at one time, the procedures established by GPUN will provide additional verification that rod worths exceeding 1.0 k will not occur. However, if credit is not given for operator action, the 1.0 delta k limit can be exceeded for a dual rod withdrawal.

STAFF POSITION

The staff has reviewed GPUN's 10 CFR 50.59 evaluation of two control rods moving at one time and has audited their calculations supporting this evaluation. While we have found their analysis to be correct, we don't consider reliance on operator action to meet the FSAR limits for rod withdrawal from low power and control rod drop events to be an adequate long term resolution to this problem. We find that the revised operating procedures provide adequate short term protection to allow continued operation of Oyster Creek for the remainder of the current cycle. However, we require that the control selection circuitry be revised at the next refueling outage (13R) to provide more positive protection against withdrawal of two control rods at one time.

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