Consumers Power Company

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Director, Nuclear Reactor Regulation
Att Mr Dennis M Crutchfield, Chief
Operating Reactors Branch No 5
US Nuclear Regulatory Commission
Washington, DC 20555

DOCKET 50-155 - LICENSE DPR-6 -
BIG ROCK POINT PLANT - SEP TOPIC IV-2, REACTIVITY CONTROL SYSTEMS INCLUDING FUNCTIONAL DESIGN AND PROTECTION AGAINST SINGLE FAILURES

Enclosed is the Consumers Power Company evaluation of SEP Topic IV-2 for the Big Rock Point Plant.

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SAFETY EVALUATION REPORT

SEP TOPIC IV-2, REACTIVITY CONTROL SYSTEMS

INCLUDING FUNCTIONAL DESIGN AND

PROTECTION AGAINST SINGLE FAILURES

BIG ROCK POINT PLANT

DOCKET NO. 50-155

I. INTRODUCTION

This evaluation addresses the issue of the conformance of the Big Rock Point reactivity control system design to General Design Criterion 25. The Criterion requires that the reactor protection system be designed to assure that specified acceptable fuel design limits are not exceeded in the event of any single malfunction of the reactivity control systems.

II. REVIEW CRITERION

The review criterion for this topic is based upon Section 7.7, Part II of the NRC Standard Review Plan. In the specific case of the reactivity control systems a single failure shall not cause plant conditions more severe than those for which the reactor protection system is designed.

III. RELATED SAFETY TOPICS

SEP Topic XV-8 Control Rod Misoperation (System Malfunction or Operator Error) overlaps the subject of this topic (IV-2). Except for the fact that Topic IV-2 only addresses control system single failures while Topic XV-8 includes operator errors, the two topics are virtually the same.

SEP Topic XV-13 Spectrum of Rod Drop Accidents (BWR) is related in that a failure of a control rod coupling spud could be a contributing factor in a rod drop accident. Since this accident is covered by Topic XV-13, and a coupling

spud failure by itself cannot cause a rod drop accident, consideration of this failure is excluded from this evaluation.

IV. EVALUATION

Information was provided in Consumers Power Company letter dated May 4, 1981, describing a single failure analysis of the Big Rock Point Nuclear Plant reactivity control system. Based upon this information we conclude that the following may occur as a result of single failures:

1) A control rod could drift out of the core.
2) A control rod could fail to settle resulting in it being mispositioned by one notch.
3) Two control rods could move simultaneously resulting in one rod being mispositioned by one notch.
4) A control rod could be continuously withdrawn or inserted when the operator is expecting a movement of only one notch.
5) All of the control rods could drift into the core.

Of these events, the insertion of control rods and the mispositioning of control rods by one notch are of little consequence. The failures causing a rod to drift out of the core or to be inadvertantly continuously withdrawn could have serious consequences because of the potential for a large reactivity insertion along with a highly peaked power distribution.

Control rod withdrawal accidents fall into two general catagories, those which are initiated from a low power condition and those that occur during power operation. Withdrawals from low power are characterized by rapid power excursions that are turned over by the doppler effect followed by a reactor trip on either short period or high flux. Rod withdrawals at high power result in much slower power increases that are terminated either by operator action or high flux trips.

A continuous rod withdrawal from low power (startup accident) was analyzed in the Big Rock Point Final Hazards Summary Report.[2] That analysis considered a 3.9%Δk rod withdrawn at 0.25 ft/sec from the cold critical condition and concludes that no fuel damage will occur if safety circuit trips function as designed. An analysis was also submitted[3] in 1974 considering a continuous rod withdrawal from the hot critical condition which showed that a 3.0%Δk rod could be withdrawn at speeds up to 0.82 ft/sec before the fuel damage limit of 170 cal/gm is exceeded. In addition to the analysis, results of a rod withdrawal timing test were submitted that indicate that the fastest possible withdrawal rate for the Big Rock Point control rods (cold condition) is 0.35 ft/sec. Current technical specifications limit the worth of control rods to 2.5%Δk/k and rod withdrawal rates averaged over travel length to 0.25 ft/sec.

Consumers Power Co. has also submitted an analysis of a control rod withdrawal accident from full power.[1] In the analysis it was assumed that, because of the highly peaked radial power distribution, the excore detectors would not fully respond to the increase in core power, and a RPS trip would not occur at 125% of full power. Also, even though the operator would receive an alarm indicating the opening of the turbine bypass valve and would almost certainly receive incore detector high flux alarms, no credit was taken for operator action. Withdrawing the highest worth rod to its full out position resulted in a core power level of 140% of rated power. At this condition six assemblies in the core had MCPR's (XN-2 correlation) between 1.197 and 1.290, which is below the accepted limit of 1.32. It was concluded from a review of the CHF data that a few fuel rods in two of the assemblies next to the control rod are likely to fail. Peak centerline fuel temperatures were analyzed to be less that 5000° F during the accident, so no fuel melting was expected to occur. It was reported in the rod drop accident analysis[4] that failure of all the fuel rods in four assemblies result in doses which are well within 10CFR100 exposure guidelines, therefore the radiological impact of the rod

withdrawal accident, in which a small fraction of this amount of failures may occur, would be very small.

CONCLUSION

Single malfunctions in the Big Rock Point reactivity control system can cause a control rod to be inadvertantly continuously withdrawn or to drift out of the core. It has been shown that fuel damage limits are not exceeded during rod withdrawal accidents from low power. However it has not been demonstrated that the reactor protective system assures that specified fuel design limits are not exceeded during a control rod withdrawal from full power accident. In fact CPCo claims no credit for RPS actuation because of the highly peaked radial power distribution in this event. CPCo also concludes that a few fuel rods in the region of the withdrawn control rod could experience departure from nucleate boiling and cladding failure.

Even though it has not been demonstrated that the Big Rock Point reactivity control system meets General Design Criterion 25, the most severe single failures result in radiological releases which are well within guidelines for infrequent accidents. It is therefore concluded that an adequate margin of safety exists for control system malfunctions and no remedial actions are necessary.

REFERENCES

Letter to Director, Nuclear Reactor Regulation from D. P. Hoffman, CPCo, dated May 4, 1981, subject: "BIG ROCK POINT PLANT - SEP Topic IV-2, REACTIVITY CONTROL SYSTEMS DESIGN AND PROTECTION AGAINST SINGLE FAILURES."

2. "FINAL HAZARDS SUMMARY REPORT FOR BIG ROCK POINT PLANT," November 14, 1961.

3. Letter to Directorate of Licensing, USAEC from R. B. Sewell, CPCo, dated November 1, 1974, subject: "REQUEST FOR CHANGE TO THE TECHNICAL SPECIFICATIONS DOCKET 50-155, LICENSE DPR-6."

4. Letter to Director, Nuclear Reactor Regulation from R. A. Vincent, CPCo, dated July 1, 1981, subject: "BIG ROCK POINT PLANT - SEP TOPIC XV-13, SPECTRUM OF ROD DROP ACCIDENTS (BWR) - SYSTEMS AND RADIOLOGICAL PORTIONS."