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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 61 TO LICENSE NO. DPR-46

NEBRASKA PUBLIC POWER DISTRICT

DOCKET NO. 50-298

COOPER NUCLEAR STATION

1.0 Introduction

By letter dated January 14, 1980,(1) Nebraska Public Power District (the licensee) has requested an amendment to the Technical Specifications for the Cooper Nuclear Station. The effect of the amendment would be to allow the count rate in the Source Range Monitor (SRM) channels to drop below 3 counts per second (cps) when the entire reactor core is being removed or replaced. The present Technical Specifications require that a count rate of at least 3 cps be maintained whenever one or more fuel assemblies are present in the core.

2.0 Discussion

Cooper Technical Specifications require that all control blades be inserted into the core during fuel loading. This is no problem during normal refueling and control blade drive maintenance since only one core cell (defined as a control blade plus the four adjacent fuel assemblies) is worked on at any given time. However, a removal of the entire core would require all the fuel to be removed before any control blade was removed. This is not possible unless the plant has a full complement of control blade guides. These guides are needed to provide lateral support to control blades in defueled cells.

Cooper Technical Specifications, in addition to the control blade insertion requirement, require that the SRM count rates be above 3 cps whenever more than one control blade is removed.

The safety issues are two-fold if control blades are to be removed with fuel still in the core. First, the intermediate fuel and control blade arrays must be subcritical at all times, even if the highest worth blade is withdrawn. Second, there must be adequate monitoring of neutron flux levels during the core alterations.

During any core alteration, and especially during core loading, it is necessary to monitor flux levels. In this manner, even in the highly unlikely event of multiple operator errors, there is reasonable assurance that any approach to criticality would be detected in time to halt operations.

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The minimum count rate requirement in the Technical Specifications accomplishes three safety functions: (1) it assures the presence of some neutrons in the core, (2) it provides assurance that the analog portion of the SRM channels is operable, and (3) it provides assurance that the SRM detectors are close enough to the array of fuel assemblies to monitor core flux levels.

Unloading and reloading of the entire core leads to some difficulty with this minimum count rate requirement. When only a small number of assemblies are present within the core, the SRM count rate will drop below the minimum due to the small number of neutrons being produced, and due to attenuation of these neutrons in the water and control blades separating the fuel from the SRM detectors. Past practice has been to connect temporary "dunking" chambers to the SRM channels in place of the normal detectors, and to locate these detectors near the fuel.

Besides being operationally inconvenient, dunking chambers suffer from signal variations due to their lack of fixed geometry. Moreover, the use of dunking chambers increases the risk of loose objects being dropped into the vessel.

3.0 Evaluation

3.1 Subcriticality of the Intermediate Arrays

The proposed Technical Specifications would only allow spiral unloading and reloading of the core. In such a program, only cells on the edge of the array are unloaded or reloaded. No imbedded cavities or major peripheral concavities would be permitted. In such a case, the neutron multiplication factor of the intermediate arrays must be less than or equal to that of the fully loaded core. Since the shutdown margin of the fully loaded core is well assured by other specifications, we find the proposed change to be acceptable from the point of view of shutdown margin.

By telephone discussion, the licensee has modified his request to include changing Specification 4.10.A.2 to facilitate maintenance of single control rods. The change in Specification 4.10.A.2 allows maintenance of a single control rod to be performed provided (a) all other rods are fully inserted with their refueling interlocks operable and (b) the required shutdown margin of 0.38 percent has been demonstrated for the current core configuration. This restriction assures that no more than one control rod will be withdrawn during single control rod maintenance and that the core will remain subcritical by a sufficient margin during such maintenance. We find this change, also, to be acceptable from the point of view of shutdown margin.

3.2 Flux Monitoring

3.2.1 Minimum Flux in the Core

A multiplying medium with no neutrons present forms the basis for an accident scenario in which reactivity is gradually but inadvertently added until the medium is highly supercritical. No neutron flux will be evident since there are no neutrons present to be multiplied. The introduction of some neutrons at this point would cause the core to undergo a sudden power burst, rather than a gradual startup, with no warning from the nuclear instrumentation.

This scenario is of great concern when loading fresh fuel, but is of lesser concern for exposed fuel. Exposed fuel continuously produces neutrons by spontaneous fission of certain plutonium isotopes, photofission, and photodisintegration of deuterium in the moderator. This neutron production in exposed fuel is normally great enough to meet the 3 cps minimum for a full core after a refueling outage with the lumped neutron sources removed.

Thus, there is assurance that a minimum flux level will be present as long as some exposed fuel is present. We therefore find the proposed amendment to be acceptable from the point of view of minimum flux provided the words "spiral reload" are interpreted to mean "reload of the core with fuel, at least 50% of which has previously accumulated a minimum exposure of 1000 MWD/T." We have modified the licensee's Technical Specification to include this definition in this amendment, and he has agreed to this change. We do not find the amendment to be applicable to the loading of a new core containing only fresh fuel. Such a loading must use lumped neutron sources and dunking chambers to meet the normal 3 cps minimum count rate.

3.2.2 SRM Operability

The Technical Specifications normally require a functional check of the SRM channels, including a check of neutron response, prior to making any alteration to the core and daily thereafter. This would be sufficient for core unloading and reloading, except that the more extensive fuel handling operations involved imply a greater possibility of SRM mechanical failure. The Cooper Technical Specifications have been modified to increase the functional check frequency from once/day to once/12 hours while using the spiral reload technique to compensate. Testing the neutron response is accomplished by using an external source or by loading two fuel assemblies in different cells containing control blades around each SRM to obtain the required 3 cps. This should being the count rate up to 3 cps and thus continuously verify operability. Therefore, we find this alternative to be acceptable.

3.2.3 Flux Attenuation

The four SRM detectors are located, one per quadrant, roughly half a core radius from the center. Although these are incore detectors and thus very sensitive when the reactor is fully loaded, they lose some of their effectiveness when the reactor is partially defueled and the detectors are located some distance from the array of remaining fuel.

GE's spent fuel pool studies have shown[2] that 16 or more fuel assemblies (i.e., four or more control cells) must be loaded together before criticality is possible. Moreover, in a spiral reloading, the cell centered on the central blade must be loaded first. Given this, we have examined the Cooper core layout and determined that the worst case configuration for monitoring purposes consists of four loaded cells, centered on blades 22-27, 22-31, 26-27 and 26-31. This array is two control cells (i.e., about two feet) away from the nearest SRM detectors. (All other arrays containing 16 or more assemblies are closer to a detector.) We have previously examined the sensitivity loss in such a case on another docket,[3] and found it to be at most one decade of sensitivity (i.e., about one fifth of the SRMs logarithmic scale). As in Reference 3, we find this to be acceptable.

4.0 Summary

We have examined the safety issues and found the proposed amendment to be acceptable provided that the spiral reload consists of 50% previously exposed fuel as discussed herein (Section 3.2.1).

5.0 Environmental Considerations

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact, and pursuant to 10 CFR Section 51. 5(d)(4) that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of the amendment.

6.0 Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: February 29, 1980

References

1. Letter, J. M. Pilant (Nebraska Public Power District) to T. A. Ippolito (NRC), dated January 14, 1980.

2. General Electric Standard Safety Analysis Report, 251-GESSAR, Section 4.3.2.7, pg. 4.3-27.

3. "Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment No. 27 to Facility Operating License No. DPR-63," Docket No. 50-220, enclosed with letter, T. A. Ippolito (NRC) to D. P. Dise (Niagara Mohawk Power Corporation), dated March 2, 1979.