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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 57 TO LICENSE NO. DPR-49

IOWA ELECTRIC LIGHT & POWER COMPANY
CENTRAL IOWA POWER COOPERATIVE
CORN BELT POWER COOPERATIVE

DOCKET NO. 50-331

DUANE ARNOLD ENERGY CENTER

1.0 INTRODUCTION

By letter dated January 2, 1980[1] Iowa Electric Light and Power Company (the licensee) requested an amendment to the Technical Specifications for the Duane Arnold Energy Center (DAEC). 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

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.

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 minimim 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.

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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 Specification 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 major 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 Section 3.3.A., we find the proposed change 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.

There is assurance that a sufficient flux level will be present as long as some exposed fuel is present. The proposed Technical Specification (Section 3.9.B.4) requires that two diagonally adjacent fuel assemblies, which have previously accumulated exposure in the reactor, be loaded into their previous core positions next to each of the SRM's to provide a minimum of 3 cps prior to loading any other fuel. Additionally, the licensee has agreed that at least 50% of the fuel assemblies to be loaded into the core will have previously accumulated a minimum exposure of 1000 MWd/T. We therefore find the proposed change to be acceptable from the point of view of minimum flux.

We do not find the proposed Technical Specification 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 failure. The licensee has committed to load two assemblies diagonally adjacent to each SRM location prior to loading any other fuel. This should bring the count rate up to 3 cps and thus continuously verify operability. 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 control blade must be loaded first. Given this, we have examined the Duane Arnold core layout and determined that the worst case configuration for monitoring purposes consists of four loaded cells, centered on blades 23-23, 22-27, 18-27 and 18-23. This array is two control cells (i.e., about two feet) away from the nearest SRM detector. (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 that a maximum of one decade of sensitivity would be lost (i.e., about one fifth of the SRM's 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 15, 1980

References

1. Letter, L. D. Root (Iowa Electric) to H. Denton (NRC), dated January 2, 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.