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Docket No. 50-331

Iowa Electric Light & Power Company
ATTN: Mr. Duane Arnold, President
Security Building
P. O. Box 351
Cedar Rapids, Iowa 52406

Gentlemen:

The Commission has issued the enclosed Amendment No. 21 to Facility Operating License No. DPR-49 for the Duane Arnold Energy Center (DAEC). The amendment consists of changes to the Technical Specifications in response to your application dated May 14, 1976 and supplement dated June 4, 1976.

This amendment will incorporate exposure-dependent minimum critical power ratio (MCPR) operating limits into the DAEC Technical Specifications.

Copies of the Safety Evaluation and the Federal Register Notice are also enclosed.

Sincerely,

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Enclosures:
1. Amendment No. 21
2. Safety Evaluation
3. Federal Register Notice

cc: See next page

OFFICE ➤	ORB#3	ORB#3	OELD	ORB#3		
SURNAME ➤	CParrish	JShea:acr	Grossman	GLear		
DATE ➤	6/29/76	6/30/76	7/9/76	7/9/76		

Form AEC-318 (Rev. 9-53) AECM 0240 ☆ U. S. GOVERNMENT PRINTING OFFICE: 1974-526-166

cc:

Jack R. Newman, Esquire
Harold F. Reis, Esquire
Lowenstein, Newman, Reis and Axelrad
1025 Connecticut Avenue, N. W.
Washington, D. C. 20036

Cedar Rapids Public Library
426 Third Avenue, S. E.
Cedar Rapids, Iowa 52401

Office for Planning and Programming
523 East 12th Street
Des Moines, Iowa 50319

Mr. Dudley Henderson
Chairman, Linn County
Board of Supervisors
Cedar Rapids, Iowa 52406

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

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

DOCKET NO. 50-331

DUANE ARNOLD ENERGY CENTER

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 21
License No. DPR-49

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Iowa Electric Light and Power Company, Central Iowa Power Cooperative, and Corn Belt Power Cooperative (the licensees) dated May 14, 1976 and supplement dated June 4, 1976, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations; and

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by a change to the Technical Specifications as indicated in the attachment to this license amendment.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Attachment:
Changes to the
Technical Specifications

Date of Issuance: July 9, 1976

ATTACHMENT TO LICENSE AMENDMENT NO. 21

TO THE TECHNICAL SPECIFICATIONS

FACILITY OPERATING LICENSE NO. DPR-49

DOCKET NO. 50-331

Replace pages 1.1-2, 1.1-15, 1.1-17, 3.12-3, 3.12-7 and 3.12-8 with the attached revised pages. Add page 3.12-9a.

SAFETY LIMIT	LIMITING SAFETY SYSTEM SETTING
C. Power Transient To ensure that the Safety Limits established in Specification 1.1.A and 1.1.B are not exceeded, each required scram shall be initiated by its primary source signal. A Safety Limit shall be assumed to be exceeded when scram is accomplished by a means other than the Primary Source Signal.	Where: S = Setting in percent of rated power (1,593 MWt). W = Recirculation loop flow in percent of rated flow. Rated recirculation loop flow is that recirculation loop flow which corresponds to 49×10^6 lb/hr core flow. MTPF = Actual Maximum Total peaking factor. For a peaking factor greater than 2.61 (7 x 7 array) or 2.43 (8 x 8 array), the APRM scram setpoint shall be: $S \leq (0.66\ W + 54) \frac{(\ *\ )}{MTPF}$ NOTE: These settings assume operation within the basic thermal design criteria. These criteria are LHGR $\leq$ 18.5 KW/ft (7 x 7 array) or 13.4 KW/ft (8 x 8 array) and MCPR $\geq$ values as indicated in Table 3.12-2 times K_f, where K_f is defined by Figure 3.12-1. Therefore, at full power, operation is not allowed with total peaking factor greater than * even if the scram setting is reduced. If it is determined that either of these design criteria is being violated during operation, action must be taken immediately to return to operation within these criteria.
D. With irradiated fuel in the reactor vessel, the water level shall not be less than 12 in. above the top of the normal active fuel zone.	2. APRM High Flux Scram When in the REFUEL or STARTUP and HOT STANDBY MODE. The APRM scram shall be set at less than or equal to 15 percent of rated power.

* 2.61 (7 x 7 array) or 2.43 (8 x 8 array)

insertion rate acceptable by Technical Specifications. The effect of scram worth, scram delay time and rod insertion rate, all conservatively applied, are of greatest significance in the early portion of the negative reactivity insertion. The rapid insertion of negative reactivity is assured by the time requirements for 25.6% and 46.4% insertion. By the time the rods are 67.2% inserted, approximately four dollars of negative reactivity have been inserted which strongly turns the transient, and accomplishes the desired effect. The times for 4.7% and 88.1% insertion are given to assure proper completion of the expected performance in the earlier portion of the transient, and to establish the ultimate fully shutdown steady-state condition.

For analyses of the thermal consequences of the transients a MCPR of values as indicated in Table 3.12-2. is conservatively assumed to exist prior to initiation of the transient.

This choice of using conservative values of controlling parameters and initiating transients at the design power level produces more conservative results than would be obtained by using expected values of control parameters and analyzing at higher power levels.

Steady-state operation without forced recirculation will not be permitted, except during special testing. The analysis to support operation at various power and flow relationships has considered operation with either one or two recirculation pumps.

In summary:

i. The abnormal operational transients have been analyzed to a power level of 1658 MWt.

ii. The licensed maximum power level is 1658 MWt.

iii. Analyses of transients employ adequately conservative values of the controlling reactor parameters.

during operation. Reducing this operating margin would increase the frequency of spurious scrams which have an adverse effect on reactor safety because of the resulting thermal stresses. Thus, the APRM scram trip setting was selected because it provides adequate margin for the fuel cladding integrity Safety Limit yet allows operating margin that reduces the possibility of unnecessary scrams.

The scram trip setting must be adjusted to ensure that the LHGR transient peak is not increased for any combination of MTPF and reactor core thermal power. The scram setting is adjusted in accordance with the formula in Specification 2.1.A.1, when the maximum total peaking factor is greater than 2.61 (7 x 7 array) or 2.43 (8 x 8 array).

Analyses of the limiting transients show that no scram adjustment is required to assure MCPR $\geq$ 1.07 when the transient is initiated from MCPR $\geq$ values as indicated in Table 3.12.2.

2. APRM High Flux Scram (Refuel or Startup & Hot Standby Mode).

For operation in these modes the APRM scram setting of 15 percent of rated power and the IRM High Flux Scram provide adequate thermal margin between the setpoint and the safety limit, 25 percent of rated. The margin is adequate to accommodate anticipated maneuvers associated with power plant startup. Effects of increasing pressure at zero or low void content are minor, cold water from sources available during startup is not much colder than that already in the system, temperature coefficients are small, and control rod patterns are constrained to be uniform by operating procedures backed up by the rod

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
C. Minimum Critical Power Ratio (MCPR) During reactor power operations, MCPR shall be ≥ values as indicated in Table 3.12-2 at rated power and flow. If at any time during reactor power operation it is determined by normal surveillance that the limiting value for MCPR is being exceeded, action shall then be initiated within 15 minutes to restore operation to within the prescribed limits. If the operating MCPR is not returned to within the prescribed limits within two hours, the reactor shall be brought to the cold shutdown condition within 36 hours. Surveillance and corresponding action shall continue until the prescribed limits are again being met. For core flows other than rated the MCPR shall be ≥ values as indicated in Table 3.12-2 times K_f, where K_f is as shown in Figure 3.12-1.	C. Minimum Critical Power Ratio (MCPR) MCPR shall be determined daily during reactor power operation at ≥ 25% rated thermal power and following any change in power level or distribution that would cause operation with a limiting control rod pattern as described in the bases for Specification 3.3.2.
D. Reporting Requirements If any of the limiting values identified in Specifications 3.12.A, B or C are exceeded, a Reportable Occurrence report shall be submitted. If the corrective action is taken, as described, a thirty-day written report will meet the requirements of this specification.	

2. MCPR Limits for Core Flows Other than Rated Flow

The purpose of the K_f factor is to define operating limits at other than rated flow conditions. At less than 100% flow the required MCPR is the product of the operating limit MCPR and the K_f factor. Specifically, the K_f factor provides the required thermal margin to protect against a flow increase transient. The most limiting transient initiated from less than rated flow conditions is the recirculation pump speed up caused by a motor-generator speed control failure.

For operation in the automatic flow control mode, the K_f factors assure that the operating limit MCPR of values as indicated in Table 3.12-2 will not be violated should the most limiting transient occur at less than rated flow. In the manual flow control mode, the K_f factors assure that the Safety Limit MCPR will not be violated for the same postulated transient event.

The K_f factor curves shown in Figure 3.12-1 were developed generically and are applicable to all BWR/2, BWR/3 and BWR/4 reactors. The K_f factors were derived using the flow control line corresponding to rated thermal power at rated core flow.

For the manual flow control mode, the K_f factors were calculated such that at the maximum flow state (as limited by the pump scoop tube set point) and the corresponding core power (along the rated flow control line), the limiting bundle's relative power was adjusted until the MCPR was slightly above the Safety Limit. Using this relative bundle power, the MCPR's were calculated at different points along the rated flow control line corresponding to different core flows. The ratio of the MCPR calculated at a given point of core flow, divided by the operating limit MCPR determines the value of K_f.

For operation in the automatic flow control mode, the same procedure was employed except the initial power distribution was established such that the MCPR was equal to the operating limit MCPR at rated power and flow.

The K_f factors shown in Figure 3.12-1 are conservative for Duane Arnold operation because the operating limit MCPR of values as indicated in Table 3.12-2 is greater than the original 1.20 operating limit MCPR used for the generic derivation of K_f.

D. Reporting Requirements

The Limiting Conditions for Operation associated with monitoring the fuel rod operating conditions are required to be met at all times, i.e., there is no allowable time in which the plant can knowingly exceed the limiting values of MAPLHGR, LHGR and MCPR. It is a requirement, as stated in Specifications 3.12.A, B and C that if at any time during reactor power operation, it is determined that the limiting values for MAPLHGR, LHGR or MCPR are exceeded, action is then initiated to restore operation to within the prescribed limits. This action is initiated as soon as normal surveillance indicates that an operating limit has been reached. Each event involving operation beyond a specified limit shall be reported as a Reportable Occurrence. If the specified corrective action described in the LCO's was taken, a thirty-day written report is acceptable.

TABLE 3.12-2

MCPR LIMITS

Fuel Type	Exposure Remaining to End of Cycle		
	> 2000 MWD/T	≤ 2000 MWD/T, > 1000 MWD/T	≤ 1000 MWD/T to E.O.C.
7 x 7	1.26	1.26	1.40
8 x 8	1.30	1.34	1.50

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 21 TO LICENSE NO. DPR-49

IOWA ELECTRIC LIGHT AND POWER COMPANY

CENTRAL IOWA POWER COMPANY

CORN BELT POWER COOPERATIVE

DOCKET NO. 50-331

DUANE ARNOLD ENERGY CENTER

Introduction

By letter dated May 14, 1976, and by a supplemental letter dated June 4, 1976, Iowa Electric Light and Power Company (IELP) requested an amendment to Facility Operating License No. DPR-49 for the Duane Arnold Energy Center (DAEC). The proposed amendment would incorporate exposure - dependent minimum critical power ratio (MCPR) operating limits into the DAEC Technical Specifications.

Background and Discussion

On March 19, 1976 the NRC issued License Amendment No. 19 for DAEC which authorized operation during fuel cycle 2 with a Safety Limit Minimum Critical Power Ratio (MCPR) of 1.07 and MCPR operating limits of 1.50 for 8x8 fuel and 1.40 for 7x7 fuel. These limits were based on a thermal-hydraulic analysis(1) of the DAEC core using the GE BWR Thermal Analysis Basis (GETAB). The analysis was performed using the end of cycle 2 (EOC-2) scram reactivity insertion rate which conservatively bounds the exposure dependent scram reactivity insertion rates for fuel cycle 2.

In order to provide greater operating flexibility throughout fuel cycle 2, IELP has reanalyzed the thermal-hydraulic performance of the DAEC core using the scram reactivity insertion rates for fuel exposures of 2850 Megawatt-days/ton (MWD/T) and 3850 MWD/T. This reanalysis(2) resulted in the calculation of three sets of MCPR operating limits, each of which is applicable during a particular portion of fuel cycle 2; i.e., OMWD/T to 2850 MWD/T exposure, 2850 MWD/T - 3850 MWD/T exposure, and 3850 MWD/T to EOC-2 (approximately 4850 MWD/T exposure according to IELP).

At the present time (June 1976) approximately 400 MWD/T exposure has been utilized in fuel cycle 2. The proposed Technical Specification changes would allow the plant to immediately reduce the MCPR operating limits to 1.30 for 8x8 fuel and 1.26 for 7x7 fuel. At 2850 MWD/T exposure, the MCPR operating limit for 8x8 fuel would be increased to 1.34. At

3850 MWD/T exposure, the previously approved operating limit MCPRs of 1.50 for 8x8 fuel and 1.40 for 7x7 fuel would become effective and remain in effect through the end of cycle 2. The previously approved Safety Limit MCPR of 1.07 would remain in effect throughout fuel cycle 2.

Evaluation

Operating Limit MCPR

For the DAEC core, the safety limit MCPR of 1.07 is the point at which more than 99.9% of the fuel rods would be expected to avoid boiling transition. Boiling transition represents an unstable heat transfer condition on the fuel clad surface and could result in fuel clad temperatures exceeding allowable limits. The most limiting abnormal operational transients have been analyzed to determine which transient results in the largest reduction in critical power ratio (ΔCPR). Addition of the largest ΔCPR to the Safety Limit MCPR results in the minimum operating limit MCPR to assure that the fuel cladding integrity Safety Limit MCPR of 1.07 will not be violated should the most limiting abnormal operational transient occur.

IELP has submitted the results of analyses of those abnormal operational transients which could cause a significant decrease in CPR. The types of transients evaluated were loss of flow, pressure and power increase, coolant temperature decrease, and rod withdrawal error. The most limiting transients in the stated categories are as follows:

Event	ΔCPR 104% Rated Power BOC to 2850 MWD/T		ΔCPR 104% Rated Power 2850 MWD/T to 3850 MWD/T		ΔCPR 104% Rated Power 3850 MWD/T to EOC (4850 MWD/T)	
	7x7	8x8	7x7	8x8	7x7	8x8
Rod Withdrawal Error	0.19	0.15	0.19	0.15	0.19	0.15
Loss of Feedwater Heater	*	*	*	*	0.16	0.19
Turbine Trip w/o Bypass	0.17	0.23	0.19	0.27	0.33	0.43

*less severe than EOC

For 8x8 fuel, the Turbine Trip without bypass transient is the most limiting transient throughout fuel cycle 2. For 7x7 fuel, the Rod Withdrawal Error transient is the most severe abnormal operational transient from the beginning of cycle 2 through 3850 MWD/T exposure, at which time the Turbine Trip without bypass transient becomes most limiting.

The resulting minimum required operating limit MCPRs which assure that the Safety Limit MCPR will not be violated are summarized below:

Cycle Exposure	MCPR Operating Limit	
	7x7 fuel	8x8 fu l
BOC to 2850 MWD/T	1.26	1.30
2850 MWD/T to 3850 MWD/t	1.26	1.34
3850 MWD/T to EOC (4850 MWD/T)	1.40	1.50

The transient analyses for each of the three analyzed portions of fuel cycle 2 were evaluated with scram reactivity insertion rates for 2850 MWD/T exposure, 3850 MWD/T exposure, and EOC-2 exposure (4850 MWD/T) respectively. In each case the scram reactivity insertion rate used in the analyses included a design conservatism factor and conservatively bounded the exposure-dependent scram reactivity insertion rate for the applicable portions of the fuel cycle. The initial parameters used for the worst operational transient analyses were acceptable and included CPRs equal to or greater than the established operating MCPR values for each core exposure. The ECCS performance analysis assumed that reactor operation will be limited to operating MCPR no lower than 1.18. The proposed operating limits are higher than 1.18 thus are acceptable in terms of ECCS performance.

Rod Withdrawal Error Transient

IELP discussed the rod withdrawal error transient in terms of worst case conditions. The analysis shows that the local power range monitor subsystem (LPRM's) will detect high local powers and alarm. However, if the operator ignores the LPRM alarm, the rod block monitor subsystem (RBM) will stop rod withdrawal while the critical power ratio is still greater than the 1.07 MCPR safety limit, and the cladding plastic strain limit of one percent is not exceeded. We conclude that the consequences of this localized transient are acceptable.

Operating MCPR Limits for Less than Rated Power and Flow

For the limiting transient of recirculation pump speed control failure at lower than rated power and flow conditions, the licensee will conform to Technical Specifications limiting conditions for operation, Figure 3.12-1. This requires the licensee to maintain the required operating MCPR greater than the MCPR limit times the K_f factor for core flows less than rated. The K_f factor curves were generically derived to assure that the most limiting transient occurring at less than rated flow will not result in a MCPR below the safety limit of 1.07. We conclude that the submitted safety

analyses of abnormal operational transients for the Duane Arnold Energy Center Nuclear Power Plant are acceptable. The minimum operating limit MCPR established for DAEC that is required to avoid violation of the Safety Limit MCPR, should the most limiting transient occur, is acceptable.

Overpressurization Protection

The licensee's previous submittal (reference 1) on overpressure protection was based upon EOC-2 conditions. It showed that there was adequate margin to meet the ASME code allowable pressure in the event of MSIV closure with flux scram, no relief function of the safety relief valves and one failed safety valve. That analysis is valid throughout fuel cycle 2 since it was performed for the most severe conditions (end of cycle). Hence, as in reference 3, we find the overpressure protection to be acceptable.

Environmental Aspects

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in authorized 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 §51.5(d)(4), that an environmental statement, negative declaration, or environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Summary

Based on the discussion above, we conclude that the proposed changes to the DAEC MCPR operating limits are acceptable.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the change 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 change 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.

References:

1. "General Electric Boiling Water Reactor Reload No. 1 Licensing Submittal for Duane Arnold Energy Center With Bypass Holes Plugged" NEDO 21082 Class 1 January, 1976. Appendix A to NEDO-20360 Revision 1 Supplement 3.

2. "General Electric Boilding Water Reactor Reload No. 1 Licensing Submittal for Duane Arnold Energy Center" NEDO 21082-01 Class I - Supplement 1 June, 1976.

3. Safety Evaluation by the Office of Nuclear Reactor Regulation of Amendment No. 19 to Facility Operating License No. DPR-49, March 19, 1976.

Dated: July 9, 1976

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-331

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

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY OPERATING LICENSE

Notice is hereby given that the U. S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 21 to Facility Operating License No. DPR-49 issued to Iowa Electric Light and Power Company, Central Iowa Power Cooperative, and Corn Belt Power Cooperative, which revised Technical Specifications for operation of the Duane Arnold Energy Center, located in Linn County, Iowa. The amendment is effective as of its date of issuance.

The amendment will incorporate exposure-dependent minimum critical power ratio (MCPR) operating limits into the Duane Arnold Energy Center Technical Specifications.

The application for the amendment complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Prior public notice of this amendment was not required since the amendment does not involve a significant hazards consideration.

The Commission has determined that the issuance of this amendment will not result in any significant environmental impact and that pursuant to 10 CFR §51.5(d)(4) an environmental statement, negative declaration or environmental impact appraisal need not be prepared in connection with issuance of this amendment.

For further details with respect to this action, see (1) the application for amendment dated May 14, 1976, and supplement dated June 4, 1976, (2) Amendment No. 21 to License No. DPR-49, and (3) the Commission's related Safety Evaluation. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street N.W., Washington, D. C. and at the Cedar Rapids Public Library, 426 Third Avenue, S.E., Cedar Rapids, Iowa 52401.

A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland this 9 day of July 1976.

FOR THE NUCLEAR REGULATORY COMMISSION

Jack S. Wetmore, Acting Chief
Operating Reactors Branch #3
Division of Operating Reactors