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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 82 TO FACILITY OPERATING LICENSE NO. DPR-58

INDIANA AND MICHIGAN ELECTIC COMPANY

DONALD C. COOK NUCLEAR PLANT UNIT NO. 1

DOCKET NO. 50-315

1.0 INTRODUCTION

By letter dated August 23, 1984 (Ref. 1) Indiana & Michigan Electric Company (I&MEC) submitted a request for the Technical Specification changes for an extension of the Cook-1 Cycle 8 core. Changes are requested for:

(1) an increase of the total peaking factor (F_Q) for the fuel supplied by Westinghouse (W) from a limit of 1.97 to 2.10, and

(2) an increase of peak pellet burnup in the fuel supplied by Exxon Nuclear Company (ENC) from 42,200 MWD/MTU to 48,000 MWD/MTU.

We have reviewed the documents related to the Technical Specification changes and discuss our evaluation below.

2.0 THERMAL-HYDRAULIC DESIGN EVALUATION

The licensee provided an evaluation (Attachment D of Ref. 1) on the effects of the increased F_Q limit on the postulated loss-of-coolant-accident (LOCA). In the licensee's evaluation only double ended cold leg guillotine (DECLG) breaks were analyzed since they were identified previously as limiting cases that result in the highest peak cladding temperature. The DECLG break analyses were performed with 102% of the design thermal power of 3411 MWt (instead of the licensed power level of 3250 MWt) for conservatism, a total peaking factor (F_Q) of 2.10 and the assumption that offsite power is lost

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at the beginning of the accident. The analysis also assumed no single failure and ECCS at the maximum safety injection flow. This case was previously demonstrated to be the worst case since for a plant with ice condenser in the containment such as Cook-1, the maximum ECCS flow causes a lower containment back pressure, resulting in a slower reflood rate and higher peak cladding temperature). A discharge coefficient of 0.6 was used since the sensitivity study shows that the DECLG break with a discharge coefficient of 0.6 results in the highest peak cladding temperature.

The analyses were performed by using a modified revision of the 1981 Westinghouse ECCS evaluation model (Ref. 2). This evaluation model uses the standard PAD Fuel Thermal Safety Model (Ref. 4) for the calculation of the initial fuel rod conditions, the SATAN-VI code for the thermal-hydraulic transient analysis for the RCS during blowdown, the WREFLOOD code for the analysis of the refill and reflood transient period, the LOTIC code for the calculation of the containment pressure transient, and the LOCTA-IV code for the calculation of the peak cladding temperature. The modified version of the ECCS evaluation model uses the approved BART code (Ref. 3) to calculate the reflood heat transfer coefficeint normally performed by the WREFLOOD code. This code takes no credit for the effects of the grids in increasing reflood heat transfer.

The staff has reviewed the large-break LOCA analysis. We conclude that the results presented are acceptable since we find that approved methods and computer codes are used and the results show that the peak cladding temperature, metal-water reaction and clad oxidation are within the acceptance criteria of 10 CFR 50.46.

However, it should be clarified that this evaluation approves the results of LOCA analysis to support an increase in F_Q for the fuel provided by Westinghouse for Cycle 8 operation only and in no way approves the plant to operate at the higher power of 3411 MWt assumed in the analysis. If Cook-1 is planning to operate at this power level an independent review is necessary.

3.0 EXTENDED BURNUP OF EXXON FUEL

The licensee has extended the ENC fuel mechanical design analyses from a peak pellet burnup of 42,200 MWd/MTU to 48,000 MWd/MTU. The analyses were based on the approved RODEX2 code. The licensee demonstrated in the report NX-NF-84-25, "Mechanical Design Report Supplement for D. C. Cook Unit 1 Extended Brunup Fuel Assemblies" that cladding strain, fatigue, rod pressure, creep collapse, oxide corrosion, hydriding, fuel rod growth, etc. satisfy the respective criteria.

This report is almost identical to ENC's generic high burnup report XN-NF-82-06, which is currently under NRC review. Our review of XN-NF-82-06 has progressed to the point where we find its use for this licensing action to be acceptable. No issues have been identified which would affect the conclusion that the Exxon fuel can be operated safely to the requested peak pellet burnup of 48,000 MWd/MTU.

4.0 ECCS ANALYSIS OF EXXON FUEL

The analyses performed in Reference 5 utilized the WREM-IIA ECCS evaluation model (Ref. 7) with the following EXEM/PWR ECCS Evaluation model (Ref. 8) modifications:

- Fuel rod stored energy and fission gas release calculations were performed with the RODEX2 code (Ref. 9).
- Fuel rod swelling and rupture was calculated with the ENC/NUREG-0630 clad rupture blockage model (Ref. 10).
- The EXEM/PWR revised steam cooling model was used in the TOODEE 2 calculation.

The WREM/IIA ECCS evaluation model has previously been approved as meeting the requirements of Appendix K to 10 CFR 50. As documented in Reference 11, the staff has previously reviewed and approved the RODEX2 code for LOCA applications. The revised clad rupture/blockage model of Reference 10 has been reviewed for compliance with Section I.B of Appendix K. As documented in Reference 12, we found this model to meet those requirements.

The EXEM/PWR revised steam cooling model was developed to satisfy Section I.D.5 of Appendix K to 10 CFR 50. This section of Appendix K requires that a steam cooling model be utilized to predict heat transfer coeffients when flooding rates fall below one inch per second. In addition, the steam cooling model must take into account the effect of flow blockage relative to both local steam flow and heat transfer.

The revised steam cooling model calculates an equivalent steam flow for use in the TOODEE-2 energy solution which assures that superheated steam exits the core. This flow rate includes the effect of blockage based upon the currently approved flow divergence model of the WREM-IIA ECCS evaluation model. Heat transfer coefficeints predicted by the steam cooling model are adjusted to account for the effect of blockage on mass flux and hydraulic diameter, and for the effect of increased turbulence and droplet breakup downstream of the blockage. The net effect of these modifications is a decreased heat transfer downstream of the flow blockage relative to that which would be obtained for an unblocked core.

Since the revised Exxon steam cooling model predicts decreased heat transfer downstream of the blockage, we find that the effect of flow blockage on local steam flow and heat transfer has been treated conservatively. Thus, we find that the revised steam cooling model satisfies the requirements of Section I.D.5 of Appendix K to 10 CFR 50.

4.1 Summary

Based on the foregoing discussion, we find that the ECCS evaluation model, utilized for the analyses in Reference 5, fully complies with Appendix K to 10 CFR 50, and is therefore acceptable for extended exposure from 42,200 to 48,000 MWd/MTU (peak pellet) for D. C. Cook 1.

5.0 TECHNICAL SPECIFICATIONS

The preceding sections have shown the acceptability of (1) the extension of the peak pellet burnup in Exxon fuel from 42,200 MWD/MTU to 48,000 MWD/MTU and (2) the LOCA analysis supporting an increase in the F_Q limit for Westinghouse fuel from 1.97 to 2.10. We reviewed each of the Technical Specification changes, which are the result of the burnup extension and LOCA analyses, and find that they appropriately reflect these analyses, and are therefore acceptable.

Specifically, the changes to Technical Specification pages 3/4 2-5, 3/4 2-6, 3/4 2-9, 3/4 2-18, and Figure 3.2-5 on page 3/4 2-24 only provide the necessary adjustments to the Technical Specifications to accommodate the increase in F_Q to 2.10. The revised Figure 3.2-3 on page 3/4 2-11 appropriately reflects the changes to the K(z) (Normalized $F_Q(z)$ as a Function of Core Height For Westinghouse Fuel) which occurs with the increase in F_Q to 2.10.

The changes to the Technical Specifications on pages 3/4 2-7, 3-4 2-20 and the Figure 3.2-4 on page 3/4 2-23 extend the values for quantities Ep(z), Fp, and F_Q^L (El), respectively, from 42,200 to 48,000 MWD/MTU. The quantity Ep(z) is an uncertainty factor to account for a reduction in the F_Q^L (El) curve due to accumulation of exposure between flux maps. The quantity F_p is a similar factor for use in the APDMS power distribution monitoring mode. The quantity F_Q^L (El) is the exposure dependent F_Q limit for Exxon fuel which is the result of the Exxon LOCA analysis. The slope of the extension of the

F_Q^L (E1) is not as steep as the preceding segment. This is because the LOCA analysis extension for the 48,000 MWD/MTU exposure results in an estimated peak clad temperature of 1778°F, well below the value of 2186°F for 42,000 MWD/MTU. The extended values of Ep(z), Fp and F_Q^L(E1) are conservative and therefore acceptable.

6.0 SUMMARY

We have reviewed the proposed changes to the Cook-1 Technical Specifications including an increase in the total peaking factor (F_Q) for the Westinghouse fuel from a limit of 1.97 to 2.10 and an increase of the burnup for the Exxon fuel from 42,200 to 48,000 MDW/MTU, and find they are acceptable.

The F_Q limit increase for the Westinghouse fuel does not significantly increase the probability or consequences of accidents previously analyzed because the LOCA analyses performed for the F_Q of 2.10 show results below the acceptable limits of 10 CFR 50.46.

We approve the extension of ENC's mechanical design analysis from 42,200 to 48,000 MWD/MTU peak pellet based on the approved RODEX2 results and our finding that the ENC generic report on high burnup is acceptable for this case since the remaining issues in the generic review have been adequately addressed by the licensee for this particular case. We also approve the extension of the ECCS analysis for ENC fuel based on use of an acceptable ECCS evaluation model.

The proposed Technical Specification changes discussed in Section 5.0 correctly reflect the analytical results and are therefore, acceptable.

As stated in Section 2.0, the LOCA analyses are acceptable for the Westinghouse fuel for operation at the 3250 MWt power level. Operation at the higher power of 3411 MWt will require that additional justification be provided.

7.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR Sec 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

8.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) 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: November 29, 1984

Principal Contributors:

D. Wigginton
R. Jones
S. Sun
S. Wu
M. Dunenfeld

REFERENCE

1. Letter from M. P. Alexich (I&MEC) to H. R. Denton (NRC), dated August 23, 1984.

2. Rahe, E. P., "Westinghouse ECCS Evaluation Model, 1981 Version," WCAP-9220-A, Revision 1, 1984.

3. Young, M. Y., et al., "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients," WCAP-9695-A, January 1980.

4. Letter from J. F. Stolz (NRC) to T. M. Anderson (Westinghouse), "Review of WCAP-8720, Improved Analytical Models Used in Westinghouse Fuel Rod Design Computations."

5. "D. C. Cook Unit 1 LOCA-ECCA Analysis for Extended Exposure," XN-NF 83-61, August 1983.

6. "LOCA ECCS Reanalysis for D. C. Cook Unit 1 Using the ENC WREM-IIA PWR ECCS Evaluation Model," XN-NF-81-07, February 1981.

7. "Exxon Nuclear Company WREM-Based Generic PWR ECCS Evaluation Model Update ENC WREM-IIA," XN-NF-78-30(A), May 1979.

8. "Exxon Nuclear Company Evaluation Model EXEM/PWR ECCS Model Updates," XN-NF-82-20(P), Revision 1, August 1982.

9. "RODEX2: Fuel Rod Thermal-Hydraulic Response Evaluation Model," XN-NF-81-58(P) Revision 2, February 1983.

10. "Exxon Nuclear Company ECCS Cladding Swelling and Rupture Model," XN-NF-82-07(A), Revision 1, March 1982.

11. Letter, C. O. Thomas (NRC) to J. C. Chandler (ENC), Subject: "Acceptance for Referencing of Licensing Report XN-NF-81-58(P)," November 16, 1983.

12. Letter, C. O. Thomas (NRC) to G. F. Owsley (ENC), Subject: "Acceptance for Referencing of Topical Report XN-NF-82-07(P), Revision 1," October 14, 1982.

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November 29, 1984

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Mr. John Dolan, Vice President
Indiana and Michigan Electric Company
c/o American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43216

Dear Mr. Dolan:

The Commission has issued the enclosed Amendment No. 82 to Facility Operating License No. DPR-58 for the Donald C. Cook Nuclear Plant, Unit No. 1. The amendment consists of changes to the Technical Specifications in response to your application transmitted by letter dated August 23, 1984.

The amendment revises the Technical Specifications for burnup dependent core physics parameters for Exxon fuel left in Unit 1 and for increases in the heat flux hot channel factor, F_Q, for Westinghouse fuel in Unit 1.

A copy of the related Safety Evaluation is enclosed. A Notice of Issuance will be included in the Commission's next regular monthly *Federal Register* notice.

Sincerely,

/s/DWigginton

David L. Wigginton, Project Manager
Operating Reactors Branch #1
Division of Licensing

Enclosures:
1. Amendment No. 82 to DPR-58
2. Safety Evaluation

cc: w/enclosures
See next page

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