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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AMENDMENT NO. 38 TO FACILITY OPERATING LICENSE NO. DPR-50

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER AND LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

INTRODUCTION

By letter dated February 17, 1978, Metropolitan Edison Company (Met Ed) requested amendment of Operating License DPR-50 for the Three Mile Island Nuclear Station, Unit No. 1 (TMI-1). The requested change would modify the axial power imbalance limits and Axial Power Shaping Rod position limits consistent with extending the duration of the present operating cycle (Cycle 3) from 270±10 effective full power days (EFPD) to 315 EFPD.

Background

By letter dated January 26, 1977, Met Ed requested amendment of the TMI-1 Technical Specifications to provide operating limits consistent with the fuel loading to be used during Cycle 3. The safety analysis supporting this request was contained in the Babcock & Wilcox report "Three Mile Island Unit 1 Cycle 3 Reload Report," BAW-1442, November 1976, which was included in Met Ed's January 26, 1977 submittal. This safety analysis was based on the specified fuel loading and a design cycle length of 270±10 EFPD. We reviewed Met Ed's submittal and additional information provided by Met Ed in their letter of March 31, 1977. Based on this review, we concluded that operation in Cycle 3 with the specified fuel loading and the proposed operating limits was acceptable, and by letter dated April 22, 1977, approved such operation.

Operation in Cycle 3 commenced on May 13, 1977 and with the exception of a 261 hour outage in September 1977 to repair equipment, operation at or near licensed power has been almost continuous. It is presently estimated that the current fuel loading will achieve its design cycle length (280 EFPD) at about midnight on March 7, 1978, or in the early morning of March 8, 1978. This would normally be the point at which TMI-1 would shutdown and begin refueling for operation in Cycle 4.

In late January 1978, however, when it became clear that the protracted duration of the national coal strike could consume Met Ed's coal reserves by mid-March, and thereby require shutdown of their coal-fired units, Met Ed began considering the possibility of extending the life of Cycle 3 beyond the design cycle length of 270±10 EFPD. The object of such an extension would be to provide as much time as possible for coal supplies to be restored to normal and thereby minimize the possibility of a condition where all coal-fired units and a large nuclear unit would be unavailable to the Met Ed system at the same time. In response to an inquiry the NRC staff advised Met Ed that they should submit a safety analysis for our review which addressed the safety issues involved in the Cycle 3 extension, and should submit a request for any changes in the Technical Specifications that would be required to assure safety of operation during the extension. These submittals were made by the Met Ed letters of February 17 and March 1, 1978.

EVALUATION

A comprehensive evaluation of Cycle 3 for its design cycle length of 270±10 EFPD is given in our Safety Evaluation of April 22, 1977. This evaluation addresses only those issues which are pertinent to the extension of Cycle 3 from 280 to 315 EFPD.

Mode of Operation

In order to extend operation in Cycle 3 beyond its design cycle length, additional reactivity will be obtained by operating TMI-1 at successively lower powers. This will provide additional reactivity because of the negative power coefficient of reactivity and reduced equilibrium xenon poisoning. TMI-1 operates in a constant moderator T-average control mode and neither this mode nor the value of T-average will be changed.

Met Ed states that operation and control in the extended cycle will proceed as follows: the boron concentration will approach zero ppm, and all control rods will be fully withdrawn except for the regulating group which will be maintained in a narrow control band near the fully withdrawn position. The reactor power demand setting will remain constant until the regulating group of control rods reach a point near the upper limit of the control band (rod index of about 285). At this point, the reactor power demand setting will be manually reduced by about 5% and the automatic control system will adjust the position of the regulating group to maintain this power level. After completion of the xenon transient associated with the change in power level, it is expected that the regulating group will be automatically inserted to a rod index of about 270. As fuel burnup proceeds at this reduced power level, the regulating group will be gradually withdrawn by the control system. When the regulating group reaches an index of about 285, the power will again be manually reduced. Met Ed estimates that by the time the cycle has accumulated an exposure of 315 EFPD, the reactor will be operating at about 55% of licensed power.

Because this mode of operation does not differ significantly from that normally used by TMI-1 near the end of an operating cycle, except that the reactor will be operating at progressively lower powers, we find this mode of operation for extending Cycle 3 acceptable.

Fuel Mechanical Design

In addressing cladding collapse in our Safety Evaluation (SE) of April 22, 1977, we stated that the most limiting fuel assembly was found to have a collapse time longer than the maximum projected three-cycle core exposure of 24,288 effective full power hours (EFPH). This statement could be made because the conservatively calculated collapse time for the most limiting assembly was >30,000 EFPH. Extending Cycle 3 from 280 EFPD to 315 EFPD will increase the three-cycle core exposure by 35 EFPD or 840 EFPH. The projected three-cycle core exposure will then become 25,128 EFPH which is still well below the calculated collapse time for the most limiting assembly of >30,000 EFPH. Therefore, with respect to cladding collapse, we find that the proposed extension of Cycle 3 is acceptable.

In addressing fuel cladding strain in the SE for Cycle 3, we stated that the 1% cladding strain criterion was predicted not to be exceeded in Cycle 3. This judgment was based on the fuel supplier's design criterion that cladding strain would be less than 1% for a local pellet burnup of 55,000 MWd/mtU along with the projection that the maximum expected three-cycle local pellet burnup would be less than that value.

For the extension of Cycle 3, Met Ed states that the maximum expected three-cycle local pellet burnup will be about 44,200 MWd/mtU which is still below the design burnup of 55,000 MWd/mtU. Accordingly, with respect to cladding strain, we find the extension of Cycle 3 acceptable.

Nuclear Design

No changes in nuclear design are required or proposed for the extension of Cycle 3. However, because of additional burnup, the nuclear power distribution within the core during the extension of the cycle will be slightly different from that previously considered for Cycle 3. These differences have been analyzed by the fuel supplier for TMI-1 and based on this analysis and its effect on Loss of Coolant Accident (LOCA) considerations, Met Ed has proposed changes in the axial power imbalance limits and in the Axial Power Shaping Rod (APSR) position limits. These changes would reduce the allowable positive axial power imbalance at 102% power from + 14.28% to +13.70% and reduce the allowable range of APSR insertion at 102% power by about 13%. The proposed change also increases the allowable range of insertion of the APSR's below about 85% power. Met Ed states, however, that this increase is simply the result of more analyses being performed for reduced power levels so that more data are available than were available for the original analysis of Cycle 3. Based on inspection of the present and proposed APSR curves, we accept Met Ed's explanation of the reason for increased allowable span at power levels below 85%.

Therefore, inasmuch as the most severe consequences of a LOCA occur at full power, because more conservative limits are proposed for that power level, and for the reasons stated above with respect to APSR position limits at reduced power, we conclude that the proposed changes in axial imbalance and APSR limits are acceptable.

Thermal-Hydraulic Analysis

Because fuel rod bowing increases with fuel burnup and is a factor affecting the departure from nucleate boiling ratio (DNBR), we requested that Met Ed provide information on the effect of the extended cycle on the calculated values of DNBR. Met Ed stated that previous DNBR calculations have considered rod bowing equivalent to an exposure of 33,000 MWd/mtU in the peak irradiated fuel bundle and that at the end of the proposed extension of Cycle 3 (315 EFPD), the peak irradiated fuel bundle will have an exposure of 32,800 MWd/mtU. Because this exposure will be less than the value assumed in DNBR calculations, we find that with respect to fuel rod bowing, the extension of Cycle 3 is acceptable.

Accident and Transient Analysis

The effects of extension of Cycle 3 on the LOCA analysis were analyzed by the TMI-1 fuel supplier and resulted in proposed revised limits for axial power imbalance and APSR insertion. As noted above, we find the proposed limits acceptable.

With respect to other postulated events, some are most severe at the beginning of the cycle (BOC) while others are most severe at the end of the cycle (EOC). Since Met Ed's request would extend Cycle 3 and therefore tend to increase the severity of postulated events which are most severe at EOC, we requested Met Ed to supply information relating to this concern. The specific events considered included the Cold Water (Pump Startup) Accident, the Stuck-Out, Stuck-In or Dropped Control Rod Accident, and the Steam Line Break Accident.

For each of the above postulated events, the input parameter affected most by the cycle extension is the moderator temperature coefficient of reactivity. This coefficient becomes more negative over the operating cycle (due to removal of dissolved boron) and therefore provides an increase in the reactivity addition in response to accidents which cause cooling of the moderator. The EOC value of this coefficient originally projected for Cycle 3 was -2.54×10^{-4} $\Delta k/k/^{o}F$. Met Ed estimates that by extending Cycle 3 to 315 EFPD, the value would decrease to about -2.6×10^{-4} $\Delta k/k/^{o}F$.

All of the above postulated events, however, as considered in the Final Safety Analysis Report (FSAR), were analyzed with a value of -3.0×10^{-4} $\Delta k/k/^{o}F$ for the moderator temperature coefficient of reactivity. Therefore, with respect to the value of the moderator coefficient, the consequences of these events are bounded by the FSAR analyses, and the proposed extension of Cycle 3 is acceptable.

Met Ed has also supplied information on the effect of the extension of Cycle 3 on the values of other parameters considered in the analysis of the above events. Based on our review of this information, we find that the change in these parameters either has a negligible effect on or reduces the severity of the consequences of the above events.

Accordingly, we conclude that the proposed extension of Cycle 3 does not increase the probability or consequences of accidents or malfunctions previously considered nor involve a signficant decrease in a safety margin.

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 §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 this amendment.

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: March 7, 1978