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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 73 TO FACILITY OPERATING LICENSE NO. DPR-32

AND AMENDMENT NO. 74 TO FACILITY OPERATING LICENSE NO. DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-280 AND 50-281

INTRODUCTION

By letter dated May 15, 1980, Virginia Electric and Power Company (the licensee) requested amendments to the Surry Power Station, Unit Nos. 1 and 2 licenses which would change the Technical Specification limits for enrichment of new and spent fuel. This letter was supplemented by letters dated September 15 and December 4, 1980, and March 26 and August 18, 1981.

The licensee proposed initially to raise the enrichment limit to 4.1 weight percent U-235 with a burnup limit of 45,000 MWD/MTU but later requested that we approve 4.1 weight percent at 38,000 MWD/MTU.

On February 25, 1981, we issued Amendments 66 and 65 for Surry Units 1 and 2, respectively. The Safety Evaluation with these amendments evaluated the safety aspects of storing 4.1 weight percent of U-235 in the new and spent storage racks. However, the Technical Specification limit was set at 3.7 weight percent U-235 until the safety aspects of operating with 4.1% fuel could be assessed.

We have now evaluated the safety aspects of operating 4.1% fuel to 38,000 MWD/MTU with the exception of the effect of fuel failure rates. Until we can complete our review of fuel failure rates, the use of 4.1% fuel is based on a burnup to 37,000 MWD/MTU. Other parameters are evaluated at 38,000 MWD/MTU.

DISCUSSION AND EVALUATION

Increases in fuel enrichment and burnup beyond the traditional range covered in the Regulatory Guides and Standard Review Plan could affect the radiological consequences of accidents by changes in the fuel failure rate, changes in the total inventory and mix of radioisotopes in the fuel, the fraction of isotopes accumulated in the fuel-clad gap, iodine spiking behavior, and the effect of fuel rod gas pressure on decontamination factors assumed for fuel handling accidents. The parameters are discussed below.

CORE FISSION PRODUCT INVENTORY

Changes in enrichment and burnup would affect the total inventory of fission products in the fuel elements, as well as the relative abundance of various isotopes. Based on many years of experience with radiological consequence calculation, the staff's analyses codified in the Regulatory Guides and Standard Review Plan are based on the assumption that the iodine and noble gas isotopes present the radiologically limiting radionuclides. For enrichment/burnup beyond the traditional limits it is necessary to verify that this assumption is valid.

Calculations confirm that the radioiodines and short lived noble gases remain quite constant, but also show an increased core content of other radiologically important nuclides such as Cs-137 or Sr-90. Two types of accidents must be evaluated in light of the changing mix of nuclides: the loss of coolant accident where the release is calculated for leakage through the containment (LOCA), and the accidents for which the leakage bypasses containment and leaks, for instance, through the steam generator.

In the case of the LOCA, the most important mitigating feature is the containment, which would be equally effective for the retention of all fission products. The Surry and North Anna plants have sub-atmospheric containments which will prevent leakage of fission products except for a short pressure spike above atmospheric in case of a large break LOCA. The staff's Safety Evaluation Report (SER) conservatively assumed that the leakage through the containment would continue for one hour. The conservatism in this value is sufficient to accommodate the increase shown in Cs-137 and Sr-90 in the preliminary calculations. For the LOCA pathway which bypasses the containment, the recirculation leakage, these plants have safety grade filters which will filter the effluent prior to release to the environment. The efficiencies for filtration of Cs or Sr are greater than that assumed for iodine, by enough margin to account, again, for the calculated core inventory increase.

Therefore, the LOCA can be evaluated for this extension of burnup by traditional methods. The licensee provided results (by letters dated August 18, 1981 and March 26, 1981) which showed the noble gas and radioiodine inventories of a core totally fueled with 4.1 weight percent U-235 and burned to the end of the cycle where the batch average discharge burnup would be 38,000 MWD/MTU. The calculation was specific for the North Anna 17 x 17 fuel, but the licensee stated that the minor changes in inventory were representative of both North Anna and Surry. The noble gas inventory was in no case larger than that assumed in the North Anna FSAR and therefore the whole body doses from the LOCA are still bounded by the FSAR calculations. However, due to minor differences in radioiodine yields among the fissile nuclides, the calculation showed between 9% and 3% increases in the core content of specific radioiodine isotopes over the FSAR values. The staff's calculation of the thyroid dose at the exclusion area boundary (EAB) reported in the SER was 113 rem; allowing a 9% increase (the value appropriate to I-131) the calculated dose of 123 rem still indicates that the plant is adequately designed against the LOCA and the dose mitigating features are adequate. The same conclusions apply to Surry; the staff's evaluation of the thyroid dose from the LOCA, 220 rem at the EAB, would still be below the guideline value for the increased inventory.

For other accidents that bypass the containment and release, for instance through the steam generator, the gap content of radionuclides is important and is discussed below.

GAP INVENTORY

In considering those accidents where the content and pressure of the rod are important, the staff evaluated whether the traditional gap fraction of volatile radionuclides (10% except Kr-85 which is 30%) remains adequate. The gap fractions of radioactive volatiles are determined mainly by three parameters: The half life, the linear heat generation rate (LHGR) and the burnup (other factors of less importance since the fuel designs have remained relatively unchanged, are surface to volume ratio of the pellets and the effective density). The state-of-the-art calculational technique for gap release is embodied in the ANS proposed standard 5.4. The licensee provided calculations using this model which showed that the propensity to release more volatiles into the gap due to burnup was more than compensated by the reduction in linear heat generation rate within the high burnup modules. This conclusion is dependent on the proposed fuel management scheme where the high burnup modules are in non-limiting locations, and the burnup limit of 38,000 MWD/MTU. The staff then evaluated whether the gap inventories of modules in limiting locations would exceed the usually assumed 10% value. Since the gap release model is a "best estimate," the peaking factors used to infer a peak linear heat generation rate were plant specific technical specification maxima, thereby preserving a suitably "conservative" resulting inventory. For all the plants, the traditional release fractions (to the gap) for noble gases remains conservative for first and second cycle fuel. For North Anna, the maximum LHGR is 11.4 KW/ft, and the ANS 5.4 model predicts that 10% release is not exceeded for all iodine isotopes. For Surry, the peak LHGR is 13.5 KW/ft. and the limiting rod may be located in either first or second cycle fuel, at the beginning of the cycle, that is, either unburned fuel or fuel at about 13,000 MWD/MTU. For I-131 which represents about half of the dose equivalent I-131, the ANS 5.4 model predicts that slightly over 10% of the inventory would be in the gap. However, for the other iodine isotopes, the best estimate release is 5% or less. This assures that thyroid doses calculated on the basis of 10% of each isotope of iodine are still conservative.

More than 10% of the Cs-137 is in the gap for rods of the Surry peak LHGR from about 10,000 MWD/MTU on. However, for the higher burnup fuel, where the Cs-137 rod content is increased, the LHGR is lower than this maximum. For this species the lower volatility compared to elemental iodine will limit its release.

IODINE SPIKING

The phenomenon of iodine spiking has been considered by the licensee. No changes in the plants' technical specifications are requested for the magnitude of the equilibrium or the "spike" iodine concentration, the surveillance requirements, or the restriction on the total time a plant may operate above the equilibrium concentration. Combined, then, with the lower fraction of radioiodines in the gaps of higher burnup rods, these factors assure that the staff's modeling of the "spiking" in accident calculation remains conservative.

DECONTAMINATION FACTORS

The total pressure of gas in the fuel rods is increased at high burnup. During a fuel handling accident, the higher pressure would cause the bubbles containing the radionuclides to rise more quickly to the pool surface, thereby reducing the time available for diffusion of iodine into the water. The licensee has provided a reanalysis of a decontamination experiment performed by Westinghouse Electric Corporation in 1970 (proprietary). The reanalysis, which was based on a best fit to the data, showed that, at the pressure that would be obtained following high burnup, a decontamination factor of 600 would be appropriate. The staff has independently reviewed the data and has determined that a value that can be supported by more than 90% of the data should be used, especially where extrapolation beyond the range of the experiment is necessary. The staff has concluded that a factor no higher than 300 is justified by the data. The traditional value of a decontamination factor of 100, which provides additional margin for uncertainties in the experiment, is acceptable for bubble rise distances in the pool of about 22 feet.

FUEL FAILURE RATE

We have assessed information currently available from operation with similar fuel at other Westinghouse plants and we conclude that there is reasonable assurance that an increase in batch average burnup to 37,000 MWD/MTU would impose no significant hazards considerations and would not endanger the public health and safety.

We conclude, therefore, that the use of 4.1 weight percent U-235 fuel exposed to a burnup of 37,000 MWD/MTU batch average at discharge does not substantially alter the previously calculated consequences of accidents provided the linear heat generation rate remains at the value implied by the present Technical Specification on peaking factors. The minor increase in the calculated LOCA dose, due to minor differences in yield of iodines among the fissioning species can be accommodated within the 10 CFR Part 100 guidelines.

We have discussed the limit of 37,000 MWD/MTU with the licensee and the licensee agrees with this change.

ENVIRONMENTAL CONSIDERATIONS

We have determined that the amendments do 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 amendments involve 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 these amendments.

CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) because the amendments do not involve a significant increase in the probability or consequences of accidents previously considered and do not involve a significant decrease in a safety margin, the amendments do 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 these amendments will not be inimical to the common defense and security or to the health and safety of the public.

Date: January 19, 1982