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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 28 TO FACILITY OPERATING LICENSE NO. NPF-21

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WPPSS NUCLEAR PROJECT NO. 2

DOCKET NO. 50-397

1.0 INTRODUCTION

By letter dated February 26, 1986, from G. Sorensen, Washington Public Power Supply System, to Director of Nuclear Reactor Regulation (Reference 1), as supplemented by letters dated April 7, 24, 25, 30 and May 22, 1986, Technical Specification changes were proposed for the operation of Nuclear Plant No. 2 (WNP-2) for Cycle 2 (N2C2) with a reload using Exxon manufactured fuel assemblies and Exxon analyses and methodologies. Enclosed in the February 26 letter were requested Technical Specification changes and a number of reports (References 2-5) discussing the reload and analyses done to support and justify the second cycle operation with General Electric (GE) and Exxon fuel and the Technical Specification changes. A subsequent letter (Reference 6) was submitted, providing a supplemental report (Reference 7) describing changes to the fuel loading from that assumed in some of the initial analyses and providing the changes to those analysis results. There were also changes to some of the proposed Technical Specifications in the later letters. On May 22, 1986, the licensee added Figures 3.2.1-4, 3.2.1-5, and 3.2.1-6 to the Technical specifications. These figures replace the licensee's original proposal which would have used existing figures and required operations to adjust those curves by a predetermined multiplier. The staff finds this change to be more practical and find it acceptable. Cycle 2 will be the first use of Exxon fuel and analysis in this reactor. However, similar reloads with Exxon fuel have been done for Dresden 2 and 3, and more recently for Cycles 2 and 3 for Susquehanna 1; and these reloads and the associated Exxon methodologies were extensively reviewed and approved (see for example Reference 8). These methodologies are generally applicable and were used for the most part for N2C2 analyses.

Beyond the use of Exxon-provided reload fuel, there is little that is different about N2C2 from the first cycle, and the proposed Technical Specification changes are primarily related to the use of Exxon fuel and accompanying analyses and methodology, terminology or related operational approaches. In addition to the standard reload changes, the following variations will also be included in N2C2: (a) There will be two Exxon Lead Test (Fuel) Assemblies (LTA) as part of the reload fuel; (b) There will be a new recirculation pump impeller and other parts originally manufactured for the Black Fox reactor to replace defective parts found during Cycle 1 operation; (c) It is proposed that N2C2 be allowed to operate at a condition of up to 106 percent flow and 100 percent power, and analyses and

Technical Specification additions for this operation have been presented; (d) "Normal" Minimum Critical Power Ratio (MCPR) Technical Specification limits, and the transient analyses to determine them, have been based on measured control rod scram insertion times. The reload, its analyses and the above variations will be discussed in the following evaluation.

2.0 EVALUATION

2.1 Reload Description

The N2C2 reload will retain 636 General Electric (GE) fuel assemblies from the first cycle and will add 128 Exxon manufactured XN-1 8X8, 2.72 percent average, 2.89 percent peak radial average U235 enriched fuel assemblies. As noted above, the XN-1 fuel assemblies are similar to those used in the Susquehanna 1 second cycle (S1C2) reload. The loading pattern will be a conventional scatter pattern with low reactivity fuel on the periphery. Two of the 128 assemblies will be the LTA.

This reload of 128 assemblies is discussed in the supplemental report, Reference 7. The original submittal, References 2 and 3, indicated that originally the reload was planned for 196 assemblies, but was later revised to 132, and finally to 128, largely as a result of failure of a recirculation pump in first cycle and consequent revised power load history. Because of these changes, the transient analyses in the original submittal were mostly based on 196 new assemblies, but the results were revised in the supplement. The nuclear design was based on 132 assemblies.

2.2 Fuel Design

The Exxon XN-1 fuel assembly used for N2C2 is essentially the same as that used for the S1C2 reload. There are slight differences in the fuel enrichment and gadolinium placement patterns, but the significant mechanical and thermal-hydraulic design elements are the same and power distributions are similar. The methodologies used for the fuel design and analysis are the same as those developed and approved during the S1C2 reload review and then approved for the Susquehanna 1 Cycle 3 (S1C3) reload. The design and analyses of the XN-1 fuel assembly as used in N2C2 are thus acceptable.

For N2C2 the Technical Specifications will provide for a Linear Heat Generation Rate (LHGR) specification as a function of fuel burnup for the Exxon fuel. A similar specification was accepted for S1C3 as a result of discussions between the NRC staff and Exxon on the need for a LHGR specification. The specification is based on the approved fuel design methodology as discussed in the S1C3 review (Reference 9) and is acceptable.

The mechanical response of Exxon fuel assemblies to design Seismic-LOCA events is essentially the same as for GE assemblies. Similar to the S1C2 and S1C3 reloads, the channel boxes were manufactured for the assemblies to GE design criteria and dimensions, and as in those reviews, the analyses indicating that the design limits are not exceeded are acceptable.

Two of the 128 XN-1 assemblies will be Lead Test Assemblies. The nuclear, thermal-hydraulic and general mechanical design of these LTA will be the same as the standard assemblies. They will differ only in that 8 (non limiting) fuel pins in each of the assemblies will have fuel pellets and clad variations exploring properties such as grain size, fabrication process and clad heat-treat. The safety related fuel assembly parameters are not affected and the introduction of these LTA is acceptable.

2.3 Nuclear Design

The nuclear design for N2C2 has been performed with Exxon methodologies previously reviewed and approved, and which were listed in the review for the S1C2 reload (Reference 8). The nuclear design for N2C2 was done for the core with 132 new assemblies and was described in the original submittal (Reference 2). The new loading will be 128 assemblies. Exxon has examined the small differences between the 132 and 128 new assembly cores and determined that the original analyses are applicable to the 128 assembly core. Our review indicates this to be a reasonable conclusion and it is acceptable.

The fuel loading pattern is a normal type of scattered configuration. The beginning of cycle shutdown margin is 3.1 percent delta k and at minimum conditions is 1.7 percent delta k, well in excess of the required 0.38 percent delta k. The Standby Liquid Control System also fully meets shutdown requirements. These and other N2C2 nuclear design parameters are consistent with the 128 assembly loading and have been obtained with previously approved methods and fall within expected ranges. Thus the nuclear design is acceptable.

WNP-2 will use the Exxon POWERPLEX core monitoring system to monitor reactor parameters. We have not specifically reviewed details of this system (nor have we in the past reviewed details of the GE process computer monitoring system), but we have reviewed the principal methodologies involved in the system and consider them to be appropriate and acceptable. The system has been in use in Susquehanna and has provided suitable monitoring and predictive results.

2.4 Thermal Hydraulic Design

The Exxon thermal-hydraulic methodology and criteria used for the N2C2 design and analysis is the same as that used and approved in the S1C2 and S1C3 reloads. As was the case for the Susquehanna reloads, statistical aspects of the methodology for which the reviews are incomplete were not needed since bounding transient analyses were used. The previous reviews concluded that hydraulic compatibility between GE and Exxon fuel is satisfactory and the calculation of core bypass flow and the Safety Limit MCPR are acceptable. This is also the case for N2C2. The Safety Limit MCPR continues to be 1.06 for two recirculation loop operation (the same value as for the first cycle GE methodology) as it is for Susquehanna, and this is acceptable. The Operating Limit MCPR is discussed later.

WNP-2 already has Technical Specifications from Cycle 1 allowing and controlling one recirculation loop operation, including changes required on limits for Maximum Average Planar Linear Heat Generation Rate (MPLHGR), Average Power Range Monitor (APRM) settings, and Safety Limit MCPR. Since the Exxon fuel is hydraulically compatible with the GE fuel the previous analyses are also applicable to the Exxon XN-1 fuel loading.

Similar to the approval for the Susquehanna one loop operation review (Reference 10), the above first cycle one loop limit changes are also acceptable for this Exxon reload. WNP-2 also had Technical Specifications approved during the first cycle for Thermal-Hydraulic Stability surveillance and the subsequent suppression of possible oscillations. These specifications are also applicable to N2C2 and thus further review of stability is not necessary for this cycle, although Exxon calculations indicate stability is equivalent to or better than first cycle.

WNP-2 has requested to be allowed to operate at 106 percent flow at 100 percent power for the second cycle. The request is based primarily on GE mechanical and system analyses for Cycle 1 operation presented in Reference 11. This has been augmented by Exxon mechanical analyses for the XN-1 fuel as well as parameter and transient analyses at this statepoint to determine limiting conditions of operation in the extended flow region. The GE analyses examined the effects of increased pressure differential (due to increased flow) on reactor internals, fuel channels and fuel bundles and the effect on flow-induced vibration response of internals, in order to show that design limits would not be exceeded. They also examined the effects of increased flow on containment LOCA response, including LOCA related pool conditions. Standard methodologies were used throughout the analyses and the results were satisfactory. The Exxon review indicated that because of the similarity of the Exxon and GE fuel, the analyses are applicable to the reload core. Since all relevant areas have been covered in these analyses and acceptable methodologies have been used, the extended flow region is acceptable. The relevant MCPR limits are discussed later.

2.5 Transient and Accident Analyses

The originally submitted transient analyses (References 2 and 4) were calculated for a 196 XN-1 assembly core. The relevant transients were reanalyzed for a 132 (equivalent to 128) XN-1 assembly core and reported in Reference 7.

The Exxon transient methodology is the same as that used and approved for the Susquehanna reloads (listed and discussed in Reference 8). The only aspects of the methodology review not yet completed involve statistical analyses which were not used for N2C2 since bounding parameters were used in the calculations.

Exxon examined the standard transient events and the submittal presented results for the more limiting events. The most limiting corewide transient, setting some of the Operating Limit MCPR values, is the Load Rejection Without Bypass (LRWB). The other event setting MCPR limits is the Control Rod Withdrawal Error. These events were analyzed at both 100 percent and 106 percent flow conditions, with both "normal" (defined below) and standard Technical Specification required scram times, and with Recirculation Pump

Trip (RPT) operable and inoperable. These various analyses were used to determine the Technical Specification MCPR operating limits. The selected CRWE analysis used a Rod Block setting of 106 percent in determining the Technical Specification limit and, for "normal" scram times and RPT operable, is the limiting event. These analyses were done with approved methodologies and the results are acceptable.

"Normal" scram time is based on actual rod speeds determined by measurements at WNP-2 and is given in the Technical Specifications. In the event that surveillance indicates that these times are exceeded, the Technical Specifications MCPR limits revert to those determined using standard Technical Specification scram times. Scram time surveillance specifications are the usual requirements of the Standard Technical Specifications. "Normal" scram insertion time is determined via the slowest measured average insertion time (to specified notches) for each group of 4 rods arranged in a 2X2 array. Our review has concluded that this is a reasonable use of plant measured scram time (comparable to GE option B) and is acceptable.

Reduced flow operation and the Recirculation Flow Run-Up event was analyzed by Exxon for N2C2 for manual flow control (automatic control not allowed). This analysis was discussed in Reference 8 for S1C2. In the Exxon methodology this provides a Technical Specification limit for MCPR as a function of core flow. The operating limit MCPR is then the maximum of this curve and the full flow MCPR limit. The analysis has been done with previously approved methods and the results are acceptable.

Compliance with overpressurization criteria was demonstrated by analysis of the Main Steam Isolation Valve (MSIV) closure with MSIV position switch failure. Six safety-relief valves were assumed out of service. Maximum pressure was 105 percent of vessel design pressure, well under the 110 percent criterion. The calculation was done with approved methodology and the results are acceptable.

Because of the difficulties with the loop B recirculation pump during the first cycle, WNP-2 has replaced the pump impeller with one of similar design intended for the Black Fox reactor. The new impeller is slightly smaller than the original, the result of being trimmed to meet specified flow requirements. The results are slightly reduced full flow capacity and inertial moment. The transients and accident analyses have been examined for the effects of this replacement (Reference 7). For the transient analyses the conclusion is that either the event is not impacted

by the impeller, e.g., the CRWE, or the event is slightly improved because of lower inertia, leading to faster flow coastdown and thus increased core voiding and smaller delta CPR. Thus the analysis concludes that transients are not adversely affected. This is acceptable. LOCA effects will be discussed next.

The LOCA analysis for N2C2 was performed with essentially the same Exxon methodology previously approved and used for the S1C2 and S1C3 reloads (References 8 and 9). This analysis is used to provide MAPLHGR limits as a function of burnup for the XN-1 fuel for N2C2. The basic analyses were performed with the generically approved methodologies used for Susquehanna analysis. Exxon also performed a (BWR-5) break spectrum analysis (Reference 12) parallel (and using similar methodology) to that for the BWR-4 break spectrum analysis used for the Susquehanna calculations (Reference 8). This analysis determined the limiting break to be a 3.04ft^2 split break in the recirculation suction piping, which is consistent with the previous GE analysis. Analyses were performed at 106 percent flow to include the extended flow region. The analysis was reexamined and partly redone to determine the effects of the Black Fox impeller (Reference 7). The effect on the break spectrum and impeller placement in either the broken or unbroken loop were investigated. The overall analysis indicated that the peak clad temperature change with the new impeller is small, less than 20°F and the originally calculated MAPLHGR values remain valid. These LOCA analyses have covered an acceptable range of conditions, have been performed with approved methodology and the resulting Technical Specification MAPLHGR values for the XN-1 fuel are acceptable (including operation at 106 percent flow).

The rod drop accident was analyzed with Exxon methodology. The resulting maximum fuel enthalpy of 98 cal/gm is well below the limit of 280 cal/gm. The analysis and result are acceptable.

Our review of the transient and accident analyses done for N2C2 indicates that appropriate methodology and input have been used and the results provide a suitable basis for N2C2 Technical Specifications.

2.6 Technical Specification Changes

The following WNP-2 Technical Specifications and Bases changes have been requested to accommodate the change to Exxon fuel and methodology, operation at 106 percent flow and use of "normal" scram times. For the most part these changes are the same as those approved for S1C2 (or S1C3) on changing to Exxon methodology. The only significant differences relate to scram time definitions and the use of "normal" scram time in the WNP-2 specifications.

(1) Definitions are added for:

(a) Average Bundle Exposure; this is necessary to match the parameter used in Exxon methodology for MAPLHGR and is acceptable,

(b) Critical Power Ratio; this changes to the Exxon XN-3 correlation and is acceptable.

(2) 3/4.12: The change to the definition of reactivity anomaly from control rod density to a monitored k_{eff} anomaly, reflects the use of a more direct parameter. POWERPLEX, which maintains a consistent methodology between active determination and prediction, can monitor k_{eff} directly. The change is acceptable.

(3) 3/4.1.3.3 and 3.1.3.4: The scram time average for all rods is removed (in Reference 7) since it is not used in the transient analysis. The definition for the average scram time for 2X2 arrays of rods is changed (conservatively) to include all four rods rather than just the three fastest rods. This specification is used in the analyses. These changes are acceptable.

(4) 3.2.1, and Figures 3.2.1-1 through 3: This is a change to the use of the Exxon definition of Average Bundle Exposure for Exxon fuel and the transfer to metric units for GE fuel burnup. A MAPLHGR curve is added for the XN-1 fuel and the curve for unused low enrichment GE fuel is removed. These are acceptable changes.

(5) 3/4.2.3 plus Table 3.2.3-1 plus Figure 3.2.3-1: This change removes the elements of the GE methodology for determining MCPR limits, including the K_f function, and replaces them with the results of the Exxon methodology and analyses for N2C2. The new MCPR limits are principally single value functions of (1) GE or Exxon fuel, (2) Scram time, (3) RPT operability and (4) Core flow. MCPR is limited, for reduced flow operation, as given in the figure. As previously discussed these values are the results of Exxon's calculations of transients and are primarily controlled by the RWE and LRWB. The values to be used for Table 3.2.3-1 are not those of the original submittal, but those of Reference 7 from analyses using the revised loading parameters. "Normal" scram time is defined in this specification, including the time to standard notches and surveillance is referenced to the existing surveillance specification of 4.1.3.1. These changes are acceptable.

(6) 3.2.4 and Figure 3.2.4-1: A LHGR for the Exxon XN-1 fuel is added to this specification. As was previously discussed, this type of specification and figure giving LHGR as a function of burnup was added to the Susquehanna 1 specification as a result of staff discussions with Exxon. This addition to the WNP-2 specification is also acceptable.

(7) 3.3.4.2: This change reflects the fact that in 3/4.2.3 MCPR limits are available from calculations with RPT not in operation. Thus operation can continue if these MCPR limits are met. This is acceptable.

(8) There are also minor changes to the index and to the Bases related to the above specification changes. These are changes to components of Bases 2.0, 2.1, 3/4.1 and 3/4.2. In each case these add to, subtract from or change the Bases in order to refer to Exxon fuel, terminology, methodology and references or remove unneeded GE methodology. These changes are similar to those approved for S1C2. These are acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation and use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes in surveillance requirements. The staff has determined that this 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 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.

4.0 CONCLUSION

The Commission made a proposed determination that the amendment involves no significant hazards consideration which was published in the Federal Register (51 FR 15416) on April 23, 1986, and consulted with the state of Washington. No public comments were received, and the state of Washington did not have any comments.

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.

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Dated: May 23, 1986

REFERENCES

1. Letter from G. S. Sorensen, Washington Public Power Supply System (WPPSS), to E. Adensam, NRC dated February 26, 1986, "Nuclear Plant No. 2 - Reload License Amendment (Cycle 2)"

2. WPPSS - EANF - 101, February 1986, "WNP-2 Cycle 2 Reload Summary Report" and attachment "Technical Specification Changes"

3. XN-NF-86-01 Rev. 1, dated February 1986, "WNP-2 Cycle 2 Reload Analysis"

4. XN-NF-85-143 Rev. 1, dated February 1986 "WNP-2 Cycle 2 Plant Transient Analysis"

5. XN-NF-85-139, dated December 1985, "WNP-2 LOCA-ECCS analyses, MAPLHGR Results"

6. Letter from G. Sorensen, WPPSS, to E. Adensam, NRC, dated April 24, 1986, "Supplement"

7. WPPSS-EANF-101, Supplement, April 1986, "WNP-2 Cycle 2 Reload Summary Report"

8. Letter from W. Butler, NRC to N. W. Curtis, Pennsylvania Power & Light (PP&L), dated May 22, 1985

9. Letter from E. Adensam, NRC, to H. W. Keiser, PP&L, dated April 11, 1986 "Amendment No. 57 - Susquehanna Steam Electric Station, Unit 1"

10. Letter from E. Adensam, NRC to H. W. Keiser, PP&L, dated April 11, 1986, "Amendment Nos. 56 and 26 to - Susquehanna Steam Electric Station Units 1 and 2"

11. Letter from G. Sorensen, WPPSS, to E. Adensam, NRC, dated April 30, 1986, enclosing the report NEDC-31107, March 1986, "Safety Review of WPPSS Nuclear Project No. 2 at Core Flow Conditions above Rated Flow Throughout Cycle 1 and Final Feedwater Temperature Reduction"

12. XN-NF-85-138 (P), dated December 1985, "LOCA Break Spectrum Analysis for a BWR-5" Transmitted by letter dated April 25, 1986

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