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SUBJECT: "Washington Nuclear Plant 2 Cycle 7 Startup Rept."

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December 20, 1991
G02-91-233

Docket No. 50-397

J. B. Martin, Regional Administrator
U.S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596

Dear Mr. Martin:

Subject: NUCLEAR PLANT NO. 2, OPERATING LICENSE NPF-21
WNP-2 CYCLE 7 STARTUP REPORT

This report is submitted in compliance with Technical Specifications requirement in Section 6.9.1.1 that "a report of plant startup and power escalation testing shall be submitted following installation of fuel that has a different design or has been manufactured by a different fuel supplier." Requests were approved for Amendment to the WNP-2 Technical Specifications and the Reload License Application for the 120 assembly reload batch for core cycle 7. The fuel was supplied by Advanced Nuclear Fuels Company (ANF) (name later changed from Advanced Nuclear Fuels to Siemens Nuclear Power). The WNP-2 sixth refuel outage began on April 12, 1991. Major projects completed were refueling, inspection and repair of the three low pressure turbines, and inspection of the turbine moisture separator/reheaters. The outage ended June 11, 1991. The unit remained in administrative shutdown between June 12 and September 25, 1991. The unit restarted on September 26, 1991 and 100% power was reached on October 11, 1991.

In addition to routine outage surveillances, the refueling process required that several tests be performed before, during and after the outage. These included the POWERPLEX Installation Acceptance Test, Shutdown Margin Determination, Reactivity Anomaly Evaluation, Control Rod Functional Testing, Core Power Symmetry Analysis, and Response of LPRMs and TIPs to Control Rod Motion.

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Refueling

WNP-2 is a BWR-5 utilizing 764 fuel assemblies. Cycle 7 energy requirements required a batch size of 8 ANF 8x8 fuel assemblies and 112 ANF 9x9-9X fuel assemblies. The refueling was accomplished by shuffling fuel using "shuffling strings". A shuffle string is defined as the fuel movement that starts with a discharged assembly move to the spent fuel pool, followed by several intermediate assembly movements and concluded with a fresh assembly insertion in the core. During the insertion of a assembly, the SRM count rate was observed, with the insertion to be stopped, if the average SRM count rate exceeded two times the initial value recorded prior to commencing refueling, or if any SRM count rate increased to four times its initial value recorded prior to commencing refueling. The core shuffle and refueling was completed in 15 days. The SRM count rate criteria was not exceeded during fuel shuffling. This included time spent shuffling nine pairs of control blades.

Once core alterations had been completed, a full core verification was performed. This process was used to visually verify fuel assembly identification number, location, and orientation. This examination was recorded on video tape to be saved as part of plant records until core configuration is changed. The video tape of the full core verification was independently reviewed prior to plant startup. The refueling bridge mast was used to confirm proper assembly seating. If any assembly was 0.75 inches higher than a typical new assembly, the assembly was to be evaluated to determine the cause of the deviation. This measurement process helps to assure the assemblies are properly seated in the fuel support pieces. There were no abnormally high assemblies in the core.

POWERPLEX Installation Acceptance Test

A new version of the on-line core monitoring system, POWERPLEX II CMSS, was installed at the plant to support core surveillance during cycle 7. The new version incorporates ANF's advanced MICROBURN and ANF-B methodology. The installation of the new POWERPLEX system and the successful performance of the Installation Acceptance Test Procedure (IATP) were completed prior to the beginning of cycle 7.

The following is a summary of the results obtained from the new POWERPLEX system compared to the expected results provided by the ANF fuel management calculations:

Parameter	Criteria	Case 1	Case 2	Case 3
a. Critical Eigenvalues	0.3 mk	-0.15mk	0.00mk	0.00mk
b. Assembly Power Differences	1%	-0.02%	0.04%	-0.23%
c. Power Peaking Differences	1%	0.21%	0.16%	-0.26%
d. Core Thermal Limits Differences				
MAPRAT	1%	0.21%	0.16%	NA
MFLHGR	1%	0.21%	0.15%	NA
MFLCPR	1%	0.14%	0.09%	NA

Case

1 - Full power, equilibrium xenon, zero cycle exposure, target rod pattern
2 - Full power, equilibrium xenon, 1000 MWD/MTU cycle exposure, target rod pattern
3 - Cold critical calculation, xenon free, zero cycle exposure

The system was also tested verifying that all the plant data required by the POWERPLEX system is properly collected, transmitted and processed. Actual reactor data was used to test the various functions and interfaces of the POWERPLEX system. Some minor software problems were uncovered and resolved during the testing. Other minor software problems, that do not affect the accuracy of the results, were identified to be corrected in future code revisions.

As part of the installation, the POWERPLEX cycle 7 input deck provided by ANF was reviewed for accuracy. The review included all cycle loading information, fuel design data, and Technical Specification limits as specified in the cycle 7 Core Operating Limits Report. The POWERPLEX system as installed successfully met all the requirements established by the Supply System and ANF for core monitoring.

Shutdown Margin Demonstration

An in-sequence shutdown margin demonstration (SDM) was performed during the first startup following the outage. Technical Specifications require that this SDM be equal to or greater than 0.38% ΔK/K, if the highest worth rod is analytically determined. The reactor went critical at step 18 of group 2 (rod 18-31 at notch 04) with a moderator temperature of 128.5 °F and a 132 seconds period. The SDM was demonstrated to be 2.35% ΔK/K. The examination of the calculations in the Cycle 7 Startup and Operations Report showed that an additional SDM at some greater exposure would not be required.

Reactivity Anomaly Evaluation

WNP-2 Technical Specifications require that the reactivity difference between the monitored and predicted core K_{eff} is verified not to exceed 1% ΔK/K during the first startup following core alterations. This testing was performed during the Shutdown Margin Demonstration, comparing cold reactivity calculations with measurements. The predicted K_{eff} was 1.005 and the monitored K_{eff} was 1.005 showing excellent agreement with cold predictions. A second reactivity anomaly evaluation was performed at approximately 360 MWD/MT of exposure and full power equilibrium Xenon. The predicted K_{eff} was 1.0044 and the monitored K_{eff} was 1.0044, demonstrating excellent agreement with hot predictions.

Control Rod Drive Functional Testing

After core verification, the timing of the normal insertion and withdrawal of each control rod was verified to be within 40 to 60 seconds range. Friction testing of all control rods was also performed prior to installing the separator/dryer. This was done after fuel movements and core verification were completed in order to fine tune the CRD system and to discover any physical interference problems in the core.

In addition to this, scram time measurements were performed on all control rods prior to exceeding 40% power. Approximately half of the control rods were measured during a full core scram and the rest were measured by performing individual rod scrams. The Technical Specification requirements that must be met and the results of the testing are as follows:

a. Maximum scram time to notch position 6:

Required	Slowest Measured(to notch 5; rod 34-11)
7 seconds	2.686 seconds

b. Maximum average scram time for 4 rods in a two-by-two array to the four notch positions:

Notch	Required (Sec.)	Measured (Sec.)
45	0.430	0.342
39	0.868	0.642
25	1.939	1.380
05	3.497	2.508

c. In order to operate under the normal scram time Minimum Critical Power Ratio (MCPR), the slowest average scram time of 4 rods in a two-by-two array must be less than the following:

Notch	Required (Sec.)	Measured (Sec.)
45	0.404	0.342
39	0.660	0.642
25	1.504	1.380
05	2.624	2.508

If the average scram time of any 4 rods in a two-by-two array exceeds the times indicated under c. above, the plant must operate with a MCPR penalty. The measured scram times met the criteria permitting the normal MCPR limits to be applied.

Core Power Symmetry Analysis

After the outage, a core power symmetry analysis was performed to determine the degree of power asymmetry measured with the Traversing In-core Probes (TIP) based on comparisons of symmetric TIP string traces. A statistical analysis of data obtained from TIP readings with reactor power stable at rated power, near equilibrium showed that the TIP system met the criterion for symmetry as established by ANF. The criterion involved a Chi-squared (χ^2) test at a 1% significance level, requiring a χ^2 value less than 36.19. Analysis of the data resulted in a value of 1.806 which is well within the criterion.

LPRM and TIP Response to Control Rod Motion

Individual LPRM response during control rod motion was verified during control rod testing to ensure that all LPRMs are properly connected. The TIP machines were verified to be correctly plumbed by observing their response to control rod motion at each of the available core locations. This verified that the TIPs were properly connected. All operable LPRMs and all TIPs were found properly connected.

Very truly yours,

Alan Hosler for

G. C. Sorensen, Manager
Regulatory Programs

DKA/bk
Attachment

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
PL Eng - NRC
DL Williams - BPA/399
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