Nebraska Public Power District
Always there when you need us

NLS2013027
February 15, 2013

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Reload 27, Cycle 28 Startup Report
Cooper Nuclear Station, NRC Docket No. 50-298, DPR-46

Dear Sir or Madam:

The purpose of this letter is to inform you that the acceptance criteria for the startup tests described in Cooper Nuclear Station Updated Safety Analysis Report, Chapter XIII, Section 5.0, have been met for the recent Cycle 28 startup. The startup test program was completed on January 2, 2013. The attachment provides a summary of the results.

This letter makes no commitments. If you have any questions concerning this report, please contact me at (402) 825-2904.

Sincerely,

David W. Van Der Kamp
Licensing Manager

/lb

Attachment: Startup Report - Reload 27, Cycle 28

cc: Regional Administrator w/attachment
USNRC - Region IV

Senior Project Manager w/attachment
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector w/attachment
USNRC - CNS

NPG Distribution w/o attachment

Records w/attachment

IE26
NRR

COOPER NUCLEAR STATION
P.O. Box 98 / Brownville, NE 68321-0098
***Telephone:** (402) 825-3811 / **Fax:** (402) 825-5211*
www.nppd.com

Startup Report - Reload 27, Cycle 28

Startup Report Introduction

The following information is from the Cooper Nuclear Station (CNS) Updated Safety Analysis Report (USAR) Chapter XIII, Section 5.0 and is included for information.

"A summary report (Startup Report) of plant startup and power escalation testing is submitted following: ...

3. Installation of fuel that has a different design or has been manufactured by a different fuel supplier ...

The Startup Report addresses each of the tests identified in the USAR and includes a description of the measured values of the operating conditions or characteristics obtained during the test program and a comparison of these values with design predictions and specifications. Any corrective actions that were required to obtain satisfactory operation is also described. Any additional specific details required in license conditions based on other commitments is included in this report.

A startup report is submitted within (1) 90 days following completion of the startup test program, (2) 90 days following commencement of commercial power operation or subsequent resumption of power operation, or (3) 9 months after criticality is reached, whichever is earliest. Supplementary reports are submitted every 3 months until all three of these events are complete."

The CNS Cycle 28 reload core contains fuel of a different design than previously used; therefore, this startup report is being submitted under provision 3 of USAR XIII, Section 5.0.

The tests below are from the Startup and Test Program. The purpose, description, and criteria, when cited, are directly from the USAR. The summary of results contains either: a) the results of the test, or b) an explanation of why the test was not necessary for this startup testing, and/or, c) an explanation of differences in the current testing if appropriate.

Test Number 1 - Chemical and Radiochemical

"Purpose

The principal objectives of this test are a) to maintain control of and knowledge about the quality of the reactor coolant chemistry, and b) to determine that the sampling equipment, procedures, and analytic techniques are adequate to supply the data required to demonstrate that the coolant chemistry meets water quality specifications and process requirements.

Secondary objectives of the test program include data to evaluate the performance of the fuel, operation of the demineralizers and filters, condenser integrity, operation of the off-gas system, and calibration of certain process instruments."

Summary of Results

This test was not performed for this startup due to the established procedures in place regarding monitoring of water quality for Technical Specification and other program compliance.

Test Number 2 - Radiation Measurements

"Purpose

To determine the background gamma and neutron radiation levels in the plant environs prior to operation in order to provide base data on activity buildup. Also to monitor radiation at selected power levels to assure the protection of personnel and continuous compliance with the guideline standards of 10CFR20 during plant operation."

Summary of Results

This test was not necessary for this startup due to the established procedures in place regarding monitoring of radiation.

Test Number 3 - Fuel Loading

"Purpose

The purpose of this test is to load fuel safely and efficiently to the full core size."

Summary of Results

This test and its requirements were written for initial core load. For this cycle, the core was loaded by shuffling the fuel with source range monitoring and shutdown margin calculations completed in accordance with established procedures written to comply with the existing Technical Specifications. These tests were therefore not necessary for this fuel loading.

Test Number 4 - Full Core Shutdown Margin

"Purpose

The purpose of this test is to demonstrate that the reactor will be subcritical throughout the first fuel cycle with any single control rod fully withdrawn.

Description

This test will be performed in the fully loaded core at ambient temperature in the Xenon-free condition. Subcriticality will be demonstrated with the strongest rod fully withdrawn and an adjacent rod pulled to a position calculated to be equal to a shutdown margin specified to account for expected reactivity changes during core lifetime. This calculated margin also allows

for geometric and materials asymmetries in the core plus a further allowance for calculational and analytical errors.

Criteria

Level 1

a. *The fully loaded core must be subcritical with the strongest control rod fully withdrawn and a shutdown margin ≥ 0.35% ΔK/K.*

b. *If (a) cannot be satisfied, then the shutdown margin of the fully loaded core is satisfied if the reactor remains subcritical by > 0.25% ΔK/K during the sequential, complete withdrawal and insertion of every control rod within the core."*

Summary of Results

The test was performed prior to startup at 169°F and xenon-free. The test rod sequence was the normal startup rod withdrawal sequence. The strongest rod was not pulled; this was accounted for analytically. The calculated shutdown margin was 1.659% ΔK/K. This meets Criterion a.

Test Number 5 - Control Rod Drives

"Purpose

To demonstrate that the Control Rod Drive (CRD) System operates properly over the full range of primary coolant temperatures and pressures from ambient to operating, and particularly that thermal expansion of core components does not bind or significantly slow control rod movements. Also, to determine the initial operating characteristics of the entire CRD System."

Summary of Results

These tests were not specifically performed for this startup as there was no impact of the fuel design change on the CRD system. The established procedures provide for normal withdrawal and insertion timing and compliance with current Technical Specification scram times.

Test Number 6 - SRM Response and Control Rod Sequence

"Purpose

The purpose of this test is to demonstrate that the operational sources, SRM instrumentation, and rod withdrawal sequences provide adequate information to achieve criticality and increase power in a safe and efficient manner. The effect of typical rod movements on reactor power will be determined."

Summary of Results

This test was not specifically performed for startup as the fuel design change did not affect the design or operational requirements of the Source Range Monitor (SRM) or Intermediate Range Monitor (IRM) systems. Established procedures comply with the Technical Specification requirements on signal-to-noise ratio, minimum count rate, and SRM/IRM overlap.

Test Number 9 - Water Level Measurement

"Purpose

To verify the calibration and agreement of the GEMAC and YARWAY water level instrumentation under various conditions."

Summary of Results

This test was not specifically performed for startup as the fuel design change did not affect the design or operational requirements of the water level instrumentation. Established procedures comply with the Technical Specification requirements on the instrumentation.

Test Number 10 - IRM Performance

"Purpose

To adjust the Intermediate Range Monitor system to obtain an optimum overlap with the SRM and APRM systems."

Summary of Results

This test was not specifically performed for startup as the fuel design change did not affect the design or operational requirements of the SRM, IRM, or Average Power Range Monitor (APRM) systems. Established procedures comply with the Technical Specification requirements on SRM/IRM and IRM/APRM overlap.

Test Number 11 - LPRM Calibration

"Purpose

To calibrate the Local Power Range Monitoring System.

Description

The LPRM channels will be calibrated to make the LPRM readings proportional to average heat flux in the four corner fuel rods surrounding each chamber at the chamber elevation. The calibration factors are obtained from either an off-line or process computer calculation.

Criteria

Level 1

With the reactor in the rod pattern and at the power level at which the calibration is to be performed, the meter reading of each LPRM chamber will be proportional to the neutron flux in the narrow-narrow water gap at the height of the chamber."

Summary of Results

This test was performed at rated power and steady-state xenon conditions per existing plant procedures. The Local Power Range Monitors (LPRMs) were successfully calibrated as required by the plant Technical Specifications.

Test Number 12 - APRM Calibration

"Purpose

To present the method for calibrating the Average Power Range Monitor System.

Description

Each APRM channel reading will be adjusted to be consistent with the core thermal power as determined from the heat balance. During heatup a preliminary calibration will be made by adjusting the APRM amplifier gains so that the APRM readings agree with the results of a constant heatup rate heat balance. The APRMs should be recalibrated in the power range by a heat balance as soon as adequate feedwater indication is available.

Criteria

Level 1

The APRM channels must be calibrated to read equal to or greater than the actual core thermal power.

Technical Specification and Fuel Warranty Limits on APRM scram and Rod Block shall not be exceeded.

In the startup mode, all APRM channels must produce a scram at <15% of rated thermal power.

Recalibration of the APRM System will not be necessary from safety considerations if at least two APRM channels per RPS trip circuit have readings greater than or equal to core power.

Level 2

If the above criteria are satisfied then the APRM channels will be considered to be reading accurately if they agree with the heat balance to within ± 7% of rated power."

Summary of Results

This test was performed using the established calibration procedures. Established procedures comply with the Technical Specification requirements on APRM operation and these were successfully performed.

Test Number 13 - Process Computer

"Purpose

To verify the performance of the process computer under operating conditions.

Description

GE/PAC computer system program verifications and calculational program validations at static and at simulated dynamic input conditions will be preoperationally tested at the computer supplier's site and following delivery to the plant site. Following fuel loading, during plant heatup and the ascension to rated power, the nuclear steam supply system and the balance-of-plant system process variables sensed by the computer as digital or analog signals will become available. Verify that the computer is receiving correct values of sensed process variables and that the results of performance calculations of the nuclear steam supply system and the balance-of-plant are correct. Verify proper operation of all computer functions at rated power operating conditions.

Criteria

Level 2

Program OD-1 and P-1 will be considered operational when 1) the MCHFR calculated by an independent method and the process computer either a) are in the same fuel assembly and do not differ in value by more than 10%, or b) if two different fuel assemblies are chosen by the two methods, the CHFR calculated by the other method in each assembly agrees with the MCHFR in that assembly by not more than 10%, and 2) when the LPRM calibration factors calculated by the independent method and the process computer agree to within 5%.

The remaining programs will be considered operational upon successful completion of static testing and dynamic testing."

Summary of Results

This test was not performed as written due to changes in the plant process computer system since the initial startup test program. The OD-1 and thermal limits programs in the current computer system were successfully used during startup and LPRM calibration using established plant procedures.

Test Number 14 - RCIC System

"Purpose

To verify the operation of the Reactor Core Isolation Cooling (RCIC) system over its expected operating pressure range."

Summary of Results

This test was not performed specifically for this startup as the fuel design changes did not impact the RCIC system.

Test Number 15 - HPCI System

"Purpose

The purpose of this test is to verify the proper operation of the High Pressure Coolant Injection (HPCI) system over its expected operating range."

Summary of Results

This test was not performed specifically for this startup as the fuel design changes did not impact the HPCI system.

Test Number 16 - Selected Process Temperatures

"Purpose

The purposes of this test are a) to establish the minimum reactor recirculation pump speed which will maintain water temperature in the bottom head of the reactor vessel within 145°F of reactor coolant saturation temperature as determined by reactor pressure, and b) to provide assurance that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operations."

Summary of Results

This test was not performed specifically for this startup as there was not an impact on the physical configuration of the reactor recirculation system or its ability to mix the reactor coolant adequately.

Test Number 17 - System Expansion

"Purpose

To verify that the reactor drywell piping system is free and unrestrained in regard to thermal expansion and that suspension components are functioning in the specified manner. The test also provides data for calculation of stress levels in nozzles and weldments."

Summary of Results

This test was not performed as the changes made did not impact the physical configuration of the reactor drywell piping system.

Test Number 18 - Core Power Distribution

"Purpose

To 1) confirm the reproducibility of the TIP system readings, 2) to determine the core power distribution in three dimensions, and 3) to determine core power symmetry.

Description

Core power distribution including power symmetry will be obtained during the power ascension program. Axial power traces will be obtained at each of the TIP locations. Several TIP systems have been provided to obtain these traces; a common location can be traversed by each TIP chamber to permit intercalibration.

A check of the reproducibility of the TIP traces is made at least twice; once near the first time the TIP system is used, and again after the TIP system has been used several times. The check is made with the plant at steady-state conditions by producing several TIP traces in the same location with each TIP machine. Traces from the same TIP machine are evaluated to determine the extent of deviations between them. The results of the complete set of TIP traces may also be evaluated to determine core power symmetry.

Criteria

Level 2

In the TIP reproducibility test, the TIP traces shall be reproducible within ± 3.5% relative error or ± 0.15 inch absolute error at each axial position (whichever is greater) in the non-boiling region."

Summary of Results

The Traversing Incore Probe (TIP) reproducibility section of this test was not performed as the fuel design change did not require a change in TIP detectors or TIP system operation. The core power distribution and core power symmetry were evaluated successfully by the OD-1 and plant computer programs as part of the LPRM calibration.

Test Number 19 - Core Performance

"Purpose

To evaluate the core performance parameters of the core flow rate, core thermal power level, maximum fuel rod surface heat flux, core minimum critical heat flux ratio (MCHFR), maximum average planar heat flux, and core minimum bundle power ratio (MBPR).

Description

Core power level, maximum heat flux, recirculation flow rate, hot channel coolant flow, minimum critical heat flux ratio, fuel assembly power, and steam qualities will be determined at existing power levels. Plant and in-core instrumentation, conventional heat balance techniques and core performance worksheets, and monograms will be used. This will be performed above 10% power and at various pumping conditions and can be done independently of the process computer functions.

Level 1

The maximum fuel rod heat flux during steady-state conditions shall not exceed allowable heat flux. The design allowable heat flux is 135 W/cm^2.

MCHFR shall be maintained at or above the flow dependent limit line which passes through a MCHFR limit of 1.9 for full power and full flow.

Steady-state reactor power shall be limited to values on or below the licensed flow control line (Maximum power of 2,381 MWt with core flow of at least 73.5 x 10^6 lbs/hr.)

The minimum bundle power ratio (MBPR) shall not be maintained greater than or equal to 1.0. The maximum average planar linear heat generation rate (MAPLHGR) shall not exceed the Technical Specification limits."

Summary of Results

The fuel rod heat flux, MCHFR, and MBPR are no longer parameters of interest. The current thermal limit values (Maximum Fraction of Limiting Critical Power Ratio - MFLCPR, Maximum Average Planar [Linear Heat Generation Rate] Ratio [to the limit] - MAPRAT, and Maximum Fraction of Limiting Power Density - MFLPD) have all been maintained less than the limits allowed in Technical Specifications. Steady-state reactor power (licensed 2,419 MWth) with core flow (licensed 77.175 Mlb/hr) is limited to values on or below the licensed flow control line of 118.9%.

Test Number 20 - Steam Production

"Purpose

To demonstrate that the reactor steam production warranty rate is satisfied."

Summary of Results

This test applied only to initial plant operation and was not performed for this startup.

Test Number 21 - Flux Response to Rods

"Purpose

The purpose of this test is to demonstrate the stability of the core power reactivity feedback mechanism with regard to small perturbations in reactivity caused by rod movement.

Description

Rod movement tests will be made at chosen power levels to prove that the transient response of the reactor to a reactivity perturbation is sufficiently stable over the full range of reactor power and flow conditions. The signal from a nearby LPRM string will be measured and evaluated to determine the local core dynamic effects of the rod movement.

Criteria

Level 1

The decay ratio must be less than 1.0 for each process variable that exhibits oscillatory response to control rod movement.

Level 2

The decay ratio is expected to be less than or equal to 0.25 for each process variable that exhibits oscillatory response to control rod movement when the plant is operating above the lower limit setting of the Master Flow Controller."

Summary of Results

This test was not performed as written as the Master Flow Controller is not used. LPRM response to adjacent control rod withdrawal was examined and the LPRMs behaved as expected.

Test Number 22 - Pressure Regulator

"Purpose

The purposes of this test are 1) to determine the optimum settings for the pressure control loop by analysis of the transients induced in the reactor pressure control system by means of the pressure regulators, 2) to demonstrate the takeover capability of the backup pressure regulator upon failure of the controlling pressure regulator and to set spacing between the set points at an appropriate value and 3) to demonstrate smooth pressure control transition between the governor valves and bypass valves when reactor steam generation exceeds steam used by the turbine."

Summary of Results

This test was not performed as no changes were made that would affect the pressure regulator. Regulator settings are controlled by established plant procedures.

Test Number 23 - Feedwater System

"Purpose

The purposes of this test are 1) to adjust the feedwater control system for acceptable reactor water level control, 2) to demonstrate stable reactor response to subcooling changes, 3) to demonstrate the capability of the automatic core flow runback feature to prevent low water level scram following the trip of one feedwater pump and 4) to demonstrate adequate response to feed heater loss."

Summary of Results

This test was not performed as the feedwater control system was not modified by the fuel design change.

Test Number 24 - Bypass Valves

"Purpose

To demonstrate the ability of the pressure regulator to minimize the reactor disturbance during an abrupt change in reactor steam flow and to demonstrate that a bypass valve can be tested for proper functioning at rated power without causing a high flux scram."

Summary of Results

This test was not performed as the turbine bypass system was not modified by these changes.

Test Number 25 - Main Steam Isolation Valves

"Purpose

To a) functionally check the main steam line isolation valves (MSIV) for proper operation at selected power levels, b) to determine reactor transient behavior during and following simultaneous full closure of all MSIV and following closure of one valve, and c) to determine isolation valve closure time."

Summary of Results

This test was not performed as this change did not impact the MSIVs or main steam lines.

Test Number 26 - Relief Valves

"Purpose

To verify the proper operation of the dual purpose relief safety valves, to determine their capacity and response characteristics, and to verify their proper reseating following operation."

Summary of Results

This test was not performed as the relief valves were not modified by these changes.

Test Number 27 - Turbine Stop and Control Valve Trips

"Purpose

To demonstrate the response of the reactor and its control systems to protective trips in the turbine and generator."

Summary of Results

This test was not performed as the turbine stop and control valves were not modified by these changes.

Test Number 28 - Shutdown from Outside the Control Room

"Purpose

The purpose of this test is to demonstrate that the reactor can be brought from a normal initial steady-state power level to the point where cooldown is initiated and under control with reactor vessel pressure and water level controlled from outside the control room."

Summary of Results

This test was not performed as alternate shutdown panels were not modified by these changes.

Test Number 29 - Flow Control

"Purpose

To determine the plant response to changes in recirculation flow and thereby adjust the local control loops. Also to examine the plant overall load following capability in order to establish correct interfacing of the pressure and flow control systems including final settings for the master and local flow controllers."

Summary of Results

This test was not performed as the fuel design change did not require physical modification of the existing recirculation flow control system. In addition, load following is not used at CNS.

Test Number 30 - Recirculation System

"Purpose

The purposes of this test are a) to evaluate the recirculation flow and power level transients following trips of one or both of the recirculation pumps, b) to obtain recirculation system performance data, and c) to verify that no recirculation system cavitation will occur on the operable region of the power-flow map."

Summary of Results

Minimum critical power ratio (MCPR) is analytically determined for both single and dual loop operation. The recirculation system was not physically modified for the fuel design change. The recirculation pump runback to 20% speed was not changed as a result of the fuel design change. The cavitation region of the power/flow map continues to be off-limits for plant operation.

Test Number 31 - Loss of Turbine-Generator and Offsite Power

"Purpose

The purpose of this test is to determine the reactor transient performance during the loss of the main generator and all offsite power, and to demonstrate the correct performance of the station electricity supply system."

Summary of Results

This test was not performed as the generator and electrical systems were not physically modified due to the fuel design change.

Test Number 32 - Recirculation M-G Set Speed Control

"Purpose

The purpose of this test is to determine the individualized characteristics of the recirculation control system (i.e., Drive Motor, Fluid Coupler, Generator, Drive Pump, and Jet Pumps), and to obtain acceptable speed control system performance by the adjustment of linear and nonlinear controller elements."

Summary of Results

This test was not performed as the recirculation system was not physically modified by the fuel design change.

Test Number 33 - Main Turbine Stop Valve Surveillance Test

"Purpose

The purpose of this test is to demonstrate an acceptable procedure for weekly turbine stop valve surveillance tests at a power level as high as possible without producing reactor scram."

Summary of Results

This test was applicable only for initial plant startup and so was not performed.

Test Number 34 - Vibration Measurements

"Purpose

To obtain vibration measurements on various reactor components to demonstrate the mechanical integrity of the system to flow induced vibration and to verify the accuracy of the analytical vibration model. Testing is in response to AEC Safety Guide 20."

Summary of Results

This test was applicable only for initial plant startup and so was not performed.

Test Number 35 - Recirculation System Flow Calibration

"Purpose

The purpose of this test is to perform a complete calibration of the installed recirculation system flow instrumentation.

Description

During the testing program at operating conditions which allow the recirculation pumps to be operated at the speeds required for rated flow at rated power, the jet pump flow instrumentation will be adjusted to provide correct flow indication based on the jet pump flow. After the relationship between drive flow and core flow is established, the flow biased APRM/RBM system will be adjusted to match this relationship.

Criteria

Level 1

Not applicable.

Level 2

Jet pump flow instrumentation shall be adjusted such that the jet pump total flow recorder will provide a correct core flow indication at rated conditions.

The APRM/RBM flow-bias instrumentation shall be adjusted to function properly at rated conditions."

Summary of Results

This test was performed using a procedure to determine actual core flow and adjust instrumentation appropriately. The procedure was successfully performed.

Test Number 70 - Reactor Water Cleanup System

"Purpose

The purpose of this test is to demonstrate specific aspects of the mechanical operability of the Reactor Water Cleanup System. (This test, performed at rated reactor pressure and temperature, is actually the completion of the preoperational testing that could not be done without nuclear heating)."

Summary of Results

This test was not performed as the Reactor Water Cleanup system was not modified for this fuel design change.

Test Number 71 - Residual Heat Removal System

"Purpose

The purpose of this test is to demonstrate the ability of the Residual Heat Removal (RHR) System to remove residual and decay heat from the nuclear system so that refueling and nuclear system servicing can be performed and to condense steam while the reactor is isolated from the main condenser."

Summary of Results

This test of RHR system was not performed as the system was not modified for this fuel design change.

Test Number 72 - Drywell Atmosphere Cooling System

"Purpose

The purpose of this test is to verify the ability of the Drywell Atmosphere Cooling System to maintain design conditions in the drywell during operating conditions and scram conditions."

Summary of Results

This test was not performed as the drywell atmosphere cooling system was not modified for this fuel design change.

Test Number 73 - Cooling Water Systems

"Purpose

To verify that the performance of the Reactor Building Closed Cooling Water (RBCCW), Turbine Building Closed Cooling Water (TBCCW), and Service Water Systems are adequate with the reactor at rated temperature."

Summary of Results

This test was not performed as the cooling systems were not modified for this fuel design change.