INSPECTION PROCEDURE 61705

CALIBRATION OF NUCLEAR INSTRUMENTATION SYSTEMS

PROGRAM APPLICABILITY: 2515 (SUPPLEMENTAL), 2525

61705-01 INSPECTION OBJECTIVES

01.01 For boiling water reactor (BWR) plants, to determine that:

a. the local power range monitor (LPRM) system has been properly calibrated to the local neutron flux.

b. the average power range monitor (APRM) system has been properly calibrated to the core thermal power.

01.02 For pressurized water reactor (PWR) plants, to determine that:

a. the source, intermediate, and power range detector calibrations have been properly performed and at the required frequency.

b. the incore/excore detector calibration has been properly performed and at the required frequency.

61705-02 INSPECTION REQUIREMENTS

02.01 LPRM Calibration. Select a recent LPRM calibration procedure and calibration data to verify the following:

a. Records of the LPRM calibration are retained.

b. The procedure used to calibrate LPRMs is technically adequate and contains:

1. a requirement for the performance of a full-core flux map using the Traversing Incore Probe (TIP) system before LPRM amplifier gain adjustment

2. a requirement for the operator to check for unacceptable Base Crit Codes by running the P-1 computer program after completion of the full core flux map

3. appropriate precautions and prerequisites

c. Input calibration current was properly calculated for each LPRM.

d. Proper LPRM calibration adjustments were made by qualified personnel, using an approved written procedure and the new calibration current.

e. The APRM channel bypassed during its respective LRPM calibration was adjusted to keep APRM signal magnitude constant.

f. The LPRM calibration constant "C" did not change significantly from its previous value.

g. The LPRM calibration frequency meets the plant's technical specification requirements.

h. The instruments and calibration equipment used were traceable to the National Bureau of Standards.

i. Test equipments used and their serial numbers were recorded on the procedure.

j. Licensee's procedures ensure that the setpoint levels for alarms, permissive and prohibitive interlocks are in compliance with the appropriate technical specifications.

k. Calibration results were reviewed, approved, and documented in accordance with the licensee's administrative control procedures.

02.02 APRM Calibration. Review the results of a recent APRM system calibration to verify the following:

a. All precautions and prerequisites were met.

b. Steady-state recirculation flow, power level, and xenon concentration existed during the calibration.

c. Only one APRM channel per reactor protection system (RPS) bus was bypassed at a time.

d. APRM channels were properly adjusted to read the calculated percent rated power.

e. Frequency of calibration meets the plant's technical specification requirements.

f. The instruments and calibration equipment used were traceable to the National Bureau of Standards.

g. Test equipments used and their serial numbers were recorded on the procedures.

h. Licensee's procedures ensure that the setpoint levels for alarms, permissive and prohibitive interlocks are in compliance with the appropriate technical specifications.

i. Calibration results were reviewed, approved, and documented in accordance with the licensee's administrative control procedures.

02.03 Source, Intermediate, and Power Range Detector Calibrations. Review the results of source, intermediate, and power range detector calibrations to verify the following:

a. All precautions and prerequisites were met.

b. Power supply voltages were all within tolerance.

c. Frequency of calibration meets the plant's technical specification requirements.

d. Source range plateau voltage was determined properly and the correct voltage was used for subsequent calibration (source range detectors only).

e. Discriminator voltage was determined properly and the correct voltage was used for subsequent calibration (source range detectors only).

f. Compensating voltage was determined properly for the intermediate range detectors (compensated ion chamber detectors only).

g. High voltage setting was properly set for the intermediate and power range detectors (compensated ion chamber detectors only).

h. 100% current value was correctly calculated for the power range detectors.

i. The instruments and calibration equipment used were traceable to the National Bureau of Standards.

j. Test equipments used and their serial numbers were recorded on the procedure.

k. Licensee's procedures ensure that the setpoint levels for alarms, permissive and prohibitive interlocks are in compliance with the appropriate technical specifications.

l. Calibration results were reviewed, approved, and documented in accordance with the licensee's administrative control procedures.

02.04 Incore/Excore Calibration. Review the results of a recent incore/excore calibration to verify the following:

a. The test procedure includes:

1. adequate prerequisites and initial conditions

2. step-by-step instructions to induce xenon oscillation and to stop the oscillation, if necessary (Westinghouse (W) only)

3. applicable limiting conditions for operation (LCO) and other limitations specified in the plant technical specifications

4. step-by-step recovery procedure, if abnormal xenon transient occurs during the test (W only)

b. Axial flux difference required by the plant technical specifications was not exceeded during the test.

c. Control rod insertion limit was not exceeded during the calibration.

d. For the condition, 0% incore axial flux difference, and at calibration reference power, normalized power range detector current was correctly calculated (W only).

e. Good linearity was exhibited by the graph of excore detector current vs. incore axial flux difference (W only).

f. All points plotted on the graph of "out-of-core offset" vs. "full incore offset" and "backup incore offset" vs. "full incore offset" were in the acceptable region (Babcock and Wilcox (B&W) only).

g. Least square fit of points plotted on the "out-of-core offset" vs. "full incore offset" yielded a line with a slope of greater than or equal to 1.15 (B&W only).

h. The instruments and calibration equipment used were traceable to the National Bureau of Standards.

i. All data collected were reasonable and calculations performed were correct.

j. The value for the internal axial shape index (ASI) was within required tolerance of the calculated ASI (Combustion Engineering (CE) only).

k. Calibration results were reviewed, approved, and documented in accordance with the licensee's administrative control procedures.

l. Incore/excore detector calibration frequency meets the plant's technical specification requirements.

61705-03 INSPECTION GUIDANCE

General Guidance

a. BWR General Guidance. The LPRM system must be calibrated periodically throughout the fuel cycle to compensate for the depletion of the LPRM chamber. The calibration procedure involves the use of the TIPs to measure the axial neutron flux profile for comparison with the LPRM readings and the computer for data storage and calibration. The TIPs must by

intercalibrated because there is more than one TIP used to calibrate the core and because outputs from different TIPs may not necessarily be the same. The intercalibration procedure runs the individual TIPs through a common channel to make their output read the same.

The BWR plant process computer has many programs and subroutines that may be used by the operator for a variety of purposes. One of these programs is called OD-1, "Whole-Core LPRM Calibration." The OD-1 program is called up in the process computer to calibrate the LPRMs. After successfully running the OD-1 program, the operator initiates the P-1 program. The P-1 program (Periodic Core Evaluation) is used to obtain useful core thermal performance data for evaluation by the operator and is normally run after the OD-1 program. In addition, OD-1/P-1 combination is usually run a second time to confirm the validity of the first printout and also to ensure data has been properly stored in the process computer.

LPRMs should be recalibrated whenever there is an abrupt change in the neutron flux. Therefore, the LPRM system is recalibrated (1) during the initial startup, at each particular power level used for test purposes; (2) following a major control rod pattern change; (3) following a change to a significantly different operating mode, such as derating; and (4) after a refueling.

b. PWR General Guidance. The majority of (PWR) plants use similar types of nuclear instrumentation. Source range detectors are proportional detectors, intermediate range detectors are either compensated ion chamber type or fission detectors, and the power range detectors are uncompensated ion chamber detectors. Some plants have combined the source range proportional detectors and the intermediate range fission detectors and call them wide range nuclear instrumentation (WRNI). The basic principles involved in calibration of these nuclear instruments remain the same.

Section 02.03 of this procedure is intended to cover the majority of the nuclear instrumentation currently in use. The inspector should use the applicable steps for his plant. Likewise, Section 02.04 covers the calibration of excore detectors for PWRs using incore detectors as a reference. Because excore detectors are used for reactor protection, plants need to ensure that linearity exists between incore and excore detectors. W, B&W, and CE all perform their incore/excore detector calibration slightly differently. However, all three different methods are intended to verify incore-to-excore detector linearity.

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