SNUPPS

Standardized Nuclear Unit
Power Plant System

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Nicholas A. Petrick
Executive Director

September 8, 1981

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SUBJ: Loose Parts Monitor

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket Nos. STN 50-482, STN 50-483, and STN 50-486

Dear Mr. Denton:

In discussions with Dr. Gordon Edison, NRC project manager for the SNUPPS applications, it was determined that additional FSAR documentation concerning the SNUPPS Loose Parts Monitoring System was required. The enclosure to this letter provides the requested information and will be incorporated in the next FSAR revision.

Very truly yours,

NAPetrick

Nicholas A. Petrick

RLS/jdk

Enclosure

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startup sources at an elevation approximately 1/4 of the core height. Two compensated ionization chambers for the intermediate range, located in the same instrument wells and detector assemblies as the source range detectors, are positioned at an elevation corresponding to 1/2 of the core height. Four dual section uncompensated ionization chamber assemblies for the power range are installed vertically at the four corners of the core and are located equidistant from the reactor vessel at all points and, to minimize neutron flux pattern distortions, within 1 foot of the reactor vessel. Each power range detector provides two signals corresponding to the neutron flux in the upper and in the lower sections of a core quadrant. The three ranges of detectors are used as inputs to monitor neutron flux from a completely shutdown condition to 120 percent of full power with the capability of recording overpower excursions up to 200 percent of full power.

The output of the power range channels is used for:

a. The rod speed control function

b. Alerting the operator to an excessive power unbalance between the quadrants

c. Protecting the core against the consequences of rod ejection accidents, and

d. Protecting the core against the consequences of adverse power distributions resulting from dropped rods

Details of the neutron detectors and nuclear instrumentation design and the control and trip logic are given in Chapter 7.0. The limits on neutron flux operation and trip setpoints are given in the Technical Specifications.

4.4.6.4 Loose Parts Monitoring System

The loose parts monitoring system (LPMS) monitors the reactor coolant system (RCS) for the presence of metallic loose parts. It consists of 12 active instrumentation channels, each comprising a piezoelectric accelerometer (sensor), signal conditioning, and diagnostic equipment. The system complies with NRC Regulatory Guide 1.133.

Two redundant sensors are fastened mechanically to the RCS at each of the following potential loose parts collection regions:

Reactor pressure vessel - upper head region

Reactor pressure vessel - lower head region

Each steam generator - reactor coolant inlet region

The output signal from each accelerometer is amplified by a preamplifier and amplifier. The amplified signal is processed through a discriminator to eliminate noises and signals not indicative of loose parts, and the processed signal is compared to a preset alarm setpoint. Loose parts detection is accomplished at a frequency of approximately 25 kHz, where background signals from the RCS are low. Spurious alarming to control rod stepping or reactor coolant pump startups is prevented by contacts that sense these events and activate alarm disable circuits.

arrival   and energy amplitudes &

If a measured signal exceeds the preset alarm level, audible and visible alarms at the LPMS console in the control room are activated. The LPMS automatically initiates recording, on a four-channel tape recorder, the signals from the alarmed channel and three other channels in proximity to the alarmed channel. A microprocessor records the times ~~that~~ the first and subsequent impact signals reach various sensors. This enables the location of the loose part to be determined. The LPMS also has provision for audio monitoring of any channel. Audio monitoring, including comparison of the audio signal with a previously recorded "signature" audio signal, if there is an ambiguity, will be performed to confirm the presence of a loose part.

approximate   and size

The on-line sensitivity of the LPMS is such that the system will detect a loose part that weighs from 0.25 to 30 pounds and impacts with a kinetic energy of 0.5 feet pounds on the inside surface of the RCS pressure boundary within 3 feet of a sensor.

The components of the LPMS are designed for the environmental conditions specified in Table 4.4-5. All of the equipment inside the containment is designed to remain functional through an OBE and radiation exposures anticipated during a 40-year operating lifetime. Physical separation of the two instrument channels, associated with the redundant sensors at each RCS location, exists from the sensor to the output of the signal conditioning devices.

The LPMS will be calibrated prior to plant startup by impacting the reactor vessel and steam generators with a calibrated impact device with 0.5 ft-lbs energy 3 feet from each sensor location. The LPMS must produce an alarm under these conditions with a 0.5 ft-lbs alarm setpoint. The preoperational calibration will be performed with the reactor coolant system filled with water at an elevated temperature and will be recorded for analysis and reference audio analysis. Channel audio outputs will also be recorded during hot functional testing to obtain a "signature" record, which can subsequently be used for comparison with real or suspected loose parts signals. Capabilities exist for subsequent periodic on-line channel checks and channel functional tests and for off-line channel calibrations at refueling outages.

LPMS

Operators will be trained in the operation and maintenance of the LPMS prior to initial plant startup. This will consist of a short formal training session onsite by the vendor using the installed LPMS. The vendor also can provide service personnel on short notice to assist the operating staff in operation or maintenance of the equipment and analysis of loose parts signals, as may be required.

LPMS

TABLE 4.4-5

LOOSE PARTS MONITORING SYSTEM

Environmental Conditions

A. Accelerometers

Temperature	40-650 F
Humidity	0-100%
Radiation	10^{18}nvt and 10^{8} rad
Pressure	69 psig
Vibration	OBE
Atmosphere	Air

B. Preamplifiers and Cables (inside containment)

Temperature-electronics	40-150 F
Hardline Cable	40-650 F
Cable inside containment	40-150 F
Humidity	0-100%
Radiation	10^{12}nvt and $6x10^{6}$ rad
Pressure	69 psig
Shock and Vibration	OBE
Atmosphere	Air

C. Signal Conditioning Amplifier, Signal Processor, and Associated Equipment (outside of containment)

Temperature	40-120 F
Radiation	10^{3} rad
Pressure	Atmospheric
Humidity	0-95%
Shock and Vibration	In accordance with good engineering practice
Atmosphere	Air

REGULATORY GUIDE 1.131 REVISION 0 DATED 8/77

Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants

DISCUSSION:

The recommendations of this regulatory guide are met with the exceptions noted in Section 8.1.4.3.

REGULATORY GUIDE 1.132 REVISION 1 DATED 3/79

Site Investigations for Foundations of Nuclear Power Plants

DISCUSSION:

Refer to Appendix 3A of each Site Addendum.

REGULATORY GUIDE 1.133 REVISION ~~0~~ 1 DATED ~~9/77~~ 5/81

Loose-Part Detection Program for the Primary System of Light-Water-Cooled Reactors

DISCUSSION:

The recommendations of this regulatory guide are met. ~~to the extent described in~~ Refer to Section 4.4.6.4.

REGULATORY GUIDE 1.134 REVISION 1 DATED 3/79

Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses

DISCUSSION:

Refer to Appendix 3A of each Site Addendum.

REGULATORY GUIDE 1.135 REVISION 0 DATED 9/77

Normal Water Level and Discharge at Nuclear Power Plants

DISCUSSION:

Refer to Appendix 3A of each Site Addendum.

REGULATORY GUIDE 1.136 REVISION 1 DATED 10/78

Material for Concrete Containments

DISCUSSION:

The recommendations of Section 3.8.1.6 are used in lieu of the recommendations of this regulatory guide, which generally endorses ACI Standard 359-74.