ARIZONA NUCLEAR POWER PROJECT

PALO VERDE II

LOOSE PART MONITORING SYSTEM

LOOSE PART DETECTION PROGRAM REPORT

LIST OF ABBREVIATIONS

P/N	Part Number
NVT	Integrated neutron flux (neutron/cm^2)
RAD	Radiation Exposed Unit
pc	Pico - coulomb
pf	Pico - Farad
g	Gravitational acceleration unit
v/g	Volt per g
LED	Light emitting diode

I. SYSTEM DESCRIPTION

A. LOOSE PART MONITORING SYSTEM (LPMS)

The LPMS consists of eight channels. Each channel is made up of the following:

a). A piezoelectric crystal sensor (accelerometer).
b). A preamplifier (charge converter).
c). A signal processing unit.

These sensors are positioned in the following location:

a). Two sensors are mounted on the reactor vessel upper head.
b). Two are clamped on the in-core instrumentation guide tube (penetrating the reactor vessel lower position).
c). Two are on steam generator (S/G) inlets
d). Two sensors are on steam generator outlets (leg 1A for SG1 and Leg 2A for SG2).

B. SENSOR SPECIFICATION AND MOUNTING DETAILS

The sensor (P/N 76M1) and cabling (P/N 3075M6) are manufactured by Rockwell International. They are high temperature, radiation resistant and hermetically sealed.

76M1 ACCELEROMETER WITH 3075 M6 CABLE

Temperature: (°F)	-65 to 700
Radiation: neutron (nvt)	10
Radiation: Gamma (rad)	10
Vibrations (g)	500
Pressure (psig)	70
Sensitivity (ft. lb.)	0.05

The sensor mounting installation was performed in accordance with vendor procedure ER-001-530-001 (Reference procedure attached).

C. PREAMPLIFIER (Charge Converter)

The Remote Charge Converter (P/N 52M9), manufactured by Rockwell International, is used to change the charge developed by the accelerometer into a voltage signal that is proportional to vibrations/impacts. The system sensitivity (accelerometer and preamplifier) is 100 mV/g. The preamplifiers are located outside of biological shield, inside the containment building (see attached drawing for location).

REMOTE CHARGE CONVERTER 52M9

Sensitivity:	10mv/pc
Frequency Response:	±3db .45 to 50kHz
Accuracy:	±1% of full scale with source capabilities of 1000 pf or less
Operating Range:	-67°F to 180°F

D. FUNCTIONAL DESCRIPTION OF LPMS

The LPMS performs two primary functions: 1) detects the presence of loose parts in the Reactor Coolant System (RCS) and alert the operator of any abnormal condition, and 2) provides sufficient diagnostic information to locate the loose parts.

The piezoelectric sensors detect loose parts by measuring the acoustic signals which are generated when the loose parts impact the RCS components or structures. The sensors produce a charge signal that is proportional to the impact forces. This signal is sent to a charge converter which converts the charge signal to a proportional voltage signal. The voltage signal is then sent to a signal processing unit for amplification, signal conditioning and detection. The signal is bandpass filtered to the resonance frequency of the accelerometer (28kHz) before it is sent to the detector and comparator section of the processing unit.

Upon receipt of an alarm, a logic signal is sent from the alarm module to the logic card. The logic card performs two functions. It illuminates the proper alarm (LED) on the front panel. If the alarm is the first alarm, the indicator will flash. All the alarms are latched-on type, thus will remain on when the system returns to normal, and will not clear until the alarm is reset. The other function of the logic card is to send a signal to the analog card, and the analog card will send a signal to start the recorder. The recorder operation is enabled when the front panel Auto-Manual switch is in the auto position and the tape recorder is set for standby recording. The tape recorder will start within seven seconds upon receipt of the signal. Four selected channels will be recorded onto a cassette tape at frequencies from 0.0HZ to 5KHZ. These signals are recorded for approximately ten minutes.

II. OPERATING PROCEDURES

A. SYSTEM CALIBRATION PROCEDURES AND RESULTS

1. Initial and subsequent calibrations: Initially, the system was calibrated by the vendor ultilizing an actual input from an impact instrument with an equivalent force of 0.5 ft. lb. Palo Verde ultilizes the same method of calibration, repeating the impact 10 times for each sensor. An output value is obtained. To ensure system sensitivity, the alarm setpoint utilizes 70% of average output. In doing so the system sensitivity is enhanced, thus assuring a conservative approach.

2. Functional check: The LPMS functional check is performed by the surveillance program at a frequency of 31 days in Mode 1 and Mode 2. The functional test includes verifying that the alarm indicators (LED), tape recorder auto-start at the LPM cabinet, the main control board indicator, and plant computer events log operate correctly.

3. Channel check: The channel check and audio sound check for each loose parts channel (eight (8) channels) is performed by a surveillance procedure, at 24 hour intervals.

B. PLANT OPERATOR INSTRUCTION FOR USE OF LPMS

1. The procedure to be used following indication of a loose part, "Operating the Loose Part and Vibration Monitoring System", is an Administrative Control Procedure to direct the operator in the event of a LPMS alarm condition. The operator is to verify that the alarm is valid by trying to clear the alarm. If the alarm will not clear, he or she will notify the Shift Technical Advisor (STA) of the condition. The STA will follow the instruction in "Loose Parts and Vibration Monitoring System STA Analyses" procedure to analyse the alarm by comparing audio levels between channels and signal traces of alarm channels. The spectrum from the alarming channel is compared to quarterly spectrum data to verify the presence of loose parts. The STA will also notify the System Engineer and, Vibration and Loose Parts Engineering Group for further advice.

2. Method to diagnose loose parts: Presently, there are three methods being ultilized: 1) relative time at arrival, 2) relative amplitude at arrival, and 3) the audio level detection. The relative time and amplitude analysis is conducted by Vibration and Loose Parts Engineering Group. The most common method of verifying and locating loose parts, within a general region, is by audio level comparisions between channels using the systems audio speaker.

III. EXPERIENCE WITH LPMS

A. FALSE ALARMS

The system experienced a high false alarm rate during no-core and off design condition operation. The false alarm rate during normal operation is higher than Unit One. The Unit is experiencing several false alarms per hour. The major source of the false alarms is the operation of various support systems operations. An example of this is control rod motion which activates the upper reactor vessel alarms. The system has also alarmed due to major feedwater flow changes to the Steam Generator. When the Steam Bypass Control System has a sudden large flow rate this is also detected by the system's sensors. One contributing cause to the false alarm rate is the difficult alarm setting procedure. If the person doing the "impacting" is not very careful in holding the punch, a low reading will be obtain. This results in the setpoint being set to low, and thus being overly sensitive to the high background noise and high amplitude standing waves which produced by the Reactor Coolant Pumps.

B. LOOSE PARTS

There have been no loose parts.

C. SYSTEM AVAILBILITY

The system has been available for loose parts determination at all times. There have been two problem areas.

1. The high false alarm rate due to the high background levels. Further investigation is being conducted for the affected sensors.

2. The tape recorder has had tape transport malfuctions which have been reworked.

IV. EVALUATION FOR CONFORMANCE TO R.G.1.133

A. LOOSE PART DETECTION PROGRAM

The Palo Verde Loose Parts Detection Program is in accordance with the guide lines established in Regulatory Guide 1.122, with the exception of the 92 day background noise level measurement during normal plant operation (section e.3.2.8). This exception has previously been approved by NRC. Technical Specification 4.3.3.8 for Palo Verde takes exception to the 92 day background noise level measurements. However, the maintenance program does obtain background data on a time permitted basis. As currently configured the system meets R.G. 1.133; However, there are several modifications which have been or will be recommended to reduce the false alarm rate and improve analysis capabilities.