PALO VERDE
NUCLEAR GENERATING STATION

I&C Program

Classroom Lesson

I&C Program	Date: 7/6/2010 10:55:17 AM
LP Number: NID04C000101	Rev Author: ERICH F. CONNALLY
Title: Vibration and Loose Parts	Technical Review:
Duration : 10 HOURS	
	Teaching Approval:

INITIATING DOCUMENTS

Site Maintenance Training Program Description

REQUIRED TOPICS

None

CONTENT REFERENCES

R344-0001Technical Manual for Rockwell International Vibration and Loose Parts Monitoring System, Volumes 1, 2, and 3

36ST-9SV01 Vibration and Loose Parts Monitoring System Functional Test

OE13865

OE7883

OE20802

SOER 82-12 STEAM GENERATOR TUBE RUPTURES CAUSED BY LOOSE PARTS ON SECONDARY SIDE

LESSON PLAN REVISION DATA

Jul 06, 2010	Erich Connally	Changed lesson plan number to reflect current numbering scheme IAW 15DP-0TR08. Revised to reflect changes to LVPMS system.

Tasks and Topics Covered

The following tasks are covered in Vibration and Loose Parts :

Task or Topic Number*	**Task Statement**

Lesson: Vibration and Loose Parts

SV03	Troubleshoot Vibration and Loose Parts Monitoring System
SV05	Maintain proximity sensor
SV06	Maintain acoustic sensor

Total task or topics: 3

TERMINAL OBJECTIVE:

1 Given the necessary resource materials, the I & C Technician will describe the purpose, operation and maintenance of the Vibration and Loose Parts. Monitoring System (VLPMS) Mastery will be demonstrated by obtaining at least 80% on a written exam.

1.1 State the purposes of the Loose Parts and Vibration Monitoring System (LPVMS).

1.2 Describe the various types of detectors employed by the LPVMS, including its expected output and installation techniques.

1.3 State the general locations of the sensors used by the LPVMS and identify the LPVMS channels for these sensors.

1.4 Given block diagrams of the LPVMS cabinets, describe the functions performed by the various components.

1.5 Given block diagrams of the Vibration and Loose Parts Amplifier Card, describe the operation of this circuit, including the inputs and outputs.

1.6 Given block diagrams of the LPVMS logic card, describe the operation of this circuit, including the inputs and outputs.

1.7 Given block diagrams of the Audio Amplifier Circuit, describe the operation of this circuit, inlcuding the inputs and outputs.

1.8 Given block diagrams of the dB Meter Board, describe the operation of this circuit, including the inputs and outputs.

1.9 Given a block diagram of the Dual Core Internals Amplifier, describe the operation of this circuit, includint the inputs and outputs.

1.10 Given a block diagram of the Test & Alarm Board, describe the operation of this circuit, includint the inputs and outputs.

1.11 Given the appropriate procedures, describe the testing performed on the LPVMS.

1.12 Describe the PVNGS Technical Specification requirements as they relate to the LPVMS.

1.13 Troubleshooting and Maintenance.

1.14 Industry Events.

TO: 1 Given the necessary resource materials, the I & C Technician will describe the purpose, operation and maintenance of the Vibration and Loose Parts. Monitoring System (VLPMS) Mastery will be demonstrated by obtaining at least 80% on a written exam.

EO: 1.1 State the purposes of the Loose Parts and Vibration Monitoring System (LPVMS).

Main Idea	Methods & Activities
PURPOSE	Pg. 6
• The Loose Parts and Vibration Monitoring System (LPVMS) is designed to detect the presence of loose parts or excessive vibration within the Reactor Coolant System (RCS) – Once detected, various pieces of peripheral equipment are available to assist in analysis of loose parts or vibration signals.	
Loose parts can: – Partially block core – Jam CEAs – Increase wear/damage to components – Increase radioactive crud levels	Question: How can Loose parts get into the RCS? Answer: Loose Parts can be from failed or weakened RCS components, or from items inadvertently left in the primary system during construction, refueling or maintenance. The presence of loose parts has several, potentially serious consequences:
Historical examples of loose parts: – Steam Generator internal fragments – Thermowells (that were knocked off by other loose parts) – RCP impeller parts – Tools – Welding rod	

Main Idea	Methods & Activities
SAFETY NOTE: **Operating Experience – Review SOER 82-12**	
Monitors the RCS for excessive vibration of RCS components. – Extreme vibration can cause abnormal wear and failures in the NSSS. – Early detection allows adequate lead time for maintenance planning and correction during scheduled plant outages.	
• Monitor Excore Power Signals for potential Core Barrel movement. – DC outputs for all 6 power range excore drawers (2 control and 4 safety) are monitored for an AC ripple that could be indicative of a swaying movement of the reactor vessel core barrel.	
<u>Major Components:</u>	Pg. 8
The Loose Parts and Vibration Monitoring system can be separated into two different sections, cabinet J-SVN-C01 and cabinet J-SVN-C02.	
Cabinet J-SVN-C01: – Contains the components necessary to monitor for loose parts and vibration in the RCS (except RCPs)	SLIDE
Cabinet J-SVN-C02: – Contains the components to monitor the RCPs for excessive vibration, shaft displacement, and possible cracked shaft.	

Main Idea	Methods & Activities
The remainder of this training course will only cover Cabinet J-SVN-C01	
Sensors:	
– Accelerometer (vibration and loose parts)	
Pre-amps:	
– Accelerometers require a charge Amp type pre-amp	
Spectrum Analyzer/Plotter	
– Used by Vibration Group for analysis of alarm data (one for all three units.	
THERE ARE NO AUTOMATIC CONTROL FUNCTIONS FROM THE LOOSE PARTS AND VIBRATION MONITORING SYSTEM	

EO: 1.2 Describe the various types of detectors employed by the LPVMS, including its expected output and installation techniques.

Main Idea	Methods & Activities
<u>Accelerometers:</u>	Pg. 10, fig. 2
– Detect presence of loose parts and vibration of components	
– Use piezoelectric crystal to convert acceleration energy into an electric signal.	Require no external power.
Noise – An undesirable sound or signal: can be plotted as a waveform.	
Vibration – A periodic motion about a fixed reference point.	
Loose parts impact creates noise that is aperiodic (without a specific period).	
The signal generated by the accelerometers is so miniscule that Charge Amps are required to amplify the signals and drive them to the drawer	Accelerometer output is in the pico-coulomb range, pre-amplifier output is in the milli-volt range
<u>Accelerometer mounting:</u>	Pg.11, fig. 3
Once the accelerometer is torqued, the resonant frequency of the device may shift somewhat.	
– Loose Parts channel filter's medium frequency bandpass. Characteristics are checked by "pinging."	

Main Idea	Methods & Activities
Old Style:	SLIDE
– Hardline cable threaded onto the accelerometer connector and Lockwired.	
– Lockwire MUST BE INSTALLED FROM HARDLINE CABLE CONNECTOR TO ACCELEROMETER CABLE CONNECTOR (NOT THE ACCELEROMETER HEX FLATS) TO PREVENT SIGNAL GROUNDING	
New Style:	
– 3-sided accelerometers have integral hardline cable, and “quick connect/disconnect.	
<u>Output signals from accelerometer</u>	SLIDE
– Can be expressed as – Displacement (mils)	Pg. 12, fig.4
<u>Vibration Detection</u>	
– Extreme vibration in RCS results in low frequency output from piezoelectric detectors that are continuous/repetitive	
<u>Loose Parts detection</u>	SLIDE Pg. 13, fig. 5
– Loose part impacting NSSS component produces a mechanical shock – Figure 5 shows the resulting waveform – Narrow bandpass filters look for this 23 Khz ringdown signal	
<u>Nuclear Channels</u>	Pg. 14

Main Idea	Methods & Activities
– LPVMS monitors PR Excore DC signal for presence of a specific low Frequency AC ripple, If present, it could be an indication of possible Reactor Vessel Core Barrel movement. – Core Barrel rests in Reactor Vessel, suspended at the nozzles. – A pendulum motion (> 25 mils) could cause structural fatigue of reactor components - Core Barrel sway causes the gap thickness of the downcomer coolant flow region to vary. Water is an effective neutron shield, changes in downcomer flow channel thickness will affect the number of neutrons that escape the reactor to be detected by the excore detectors. STUDIES AT OAK RIDGE NATIONAL LABS HAVE FOUND THAT FREQUENCIES OF ABOUT 2 HZ COULD BE DESTRUCTIVE LPVMS CIRCUITRY FILTERS FOR THIS FREQUENCY	

EO: 1.3 State the general locations of the sensors used by the LPVMS and identify the LPVMS channels for these sensors.

Main Idea

SENSOR LOCATIONS:

Channel No.	Channel Type	Sensor Location
1	Vib./ L.P.	Upper Vessel (Head Assy. 345□)
2	Vib./ L.P.	Upper Vessel (Head Assy. 165□)
3	Vib./ L.P.	Lower Vessel (Inst guide tube #58)
4	Vib./ L.P.	Lower Vessel (Inst guide tube #59)
5	Vib./ L.P.	S.G. #1 Hot Leg
6	Vib./ L.P.	Cold Leg between SG #1 and RCP 1A
7	Vib./ L.P.	S.G. #2 Hot Leg
8	Vib./ L.P.	Cold Leg between SG #2 and RCP 2A
11	Nuclear	Safety Range Excore, Train A (Lin.)
12	Nuclear	Safety Range Excore, Train B (Lin.)
13	Nuclear	Safety Range Excore, Train C (Lin.)

Methods & Activities

SLIDE

Pg. 15 & 16, fig 6 & 7

Refer participants to drawings 13-J-11D-0050, 051, 052, 053 and excore (safety channels and control channels) layout. RK window 7C14B is illuminated on receipt of Vibration x 8 = 3g, LP x 8 = 0.5ft/lbs, Core Barrel Sway x 6 = 2 g (though these signals have been removed per DBCN 00001, RCP Vibration x 4 = 2 g; RCP Displacement alarm level differs from pump to pump with setpoint derived from empirical data. Sensors 1&2 have been moved to permanent mountings on the Reactor Vessel Head skirt weld fillet, and Sensors 5,6,7,8 have been moved to permanent locations on the Steam Generator bodies.

Main Idea			Methods & Activities
14	Nuclear	Safety Range Excore, Train D (Lin.)	
15	Nuclear	Control Range Excore, Ch. 1 (Lin.)	
16	Nuclear	Control Range Excore, Ch. 2 (Lin.)	

EO: 1.4 Given block diagrams of the LPVMS cabinets, describe the functions performed by the various components.

Main Idea	Methods & Activities
CABINET J-SVN-C01	SLIDE Pg. 17, fig. 8
– contains equipment for monitoring and analysis of channels 1 - 8 and 11 - 16.	
It consists of three sections:	SLIDE
– Loose Parts Event Analysis Computer (LPEAC)	
– V & LP Monitoring chassis	
– LPEAC Diagnostic Panel.	
<u>Vibration and Loose Parts Monitoring Chassis:</u>	Pg. 18, fig. 19
– Receives input for channels 1-8 and 11-16	
– Contains the components for processing these input signals.	

Main Idea			Methods & Activities
V&LP Amp	1-8	Monitors the AC signal coming from each of the pre-amps, filters for Loose parts & Vib. signals, and outputs amplified signals and alarms.	Pg. 19
Dual Core Amp	11-16	Monitors 0-10VDC Excore signals for low frequency AC Ripple indicating motion in the Vessel internals. Outputs both alarms and amplified signals	
Logic Card	1-16	Receives alarms from the input cards, provides: alarm LED for Loose Parts and Dual core channels, causes 1st out LED to flash, sends alarm signals to the plant annunciator through LPEAC	
Audio Amp	1-16	Single stage audio amplifier that drives the speake	
dB Meter Input	1-16	Conditions selected signal and drives the dB Meter	
Test & Alarm Card	1-16	Generates test signals to test all input cards	

Main Idea			Methods & Activities
POWER SUPPLIES:			
PS-1	1-16	Provides +5vdc, +15vdc, and -15vdc to the chassis	
PS-2	1-8	Provides +24vdc to pre-amps	
Test Switch	1-16	Applies the test signals to the input cards	
Reset Switch	1-16	Resets alarm latches on input cards	
Auto/Man Switch	1-16	Resets alarm latches on input cards	
Thumbwheel Switches		P-1 only selects the Parts input for the dB meter P-2 selects Vibration or Core Internals For a) Speaker b) dB meter c) Aux Monitoring jacks	
dB Meter switch		Selects either Vibration or Loose Parts signals.	

Main Idea	Methods & Activities

<u>Loose Parts Eevent Analysis Computer:</u>

Pg. 20

- Analyzes data when the V & LP Monitoring Chassis generates an alarm for a loose part impact. It analyzes the data against certain criteria and if it exceeds the criteria allows the alarm to be sent to the control room
- added as a method of evaluating Loose Parts alarms generated by the monitoring chassis and preventing spurious alarms from causing the control room annunciators to alarm
- stores data for trending events, allowing the previously installed tape recorder to be removed
- *On-Demand* processing is also possible to allow gathering baseline data during normal conditions

The LPEAC hardware consists of: a central processor, two A/D subsystems (alarm A/D and on-demand A/D), a VGA monitor, a removable cartridge disc, and an internal modem.

<u>Central Processor</u>

- The LPEAC central processor is an Intel 80386 16/32 bit processor operating at a clock rate of 25 MHz. The system contains 8 megabytes of fast access RAM. A math co-processor (Intel 80387-20MHz) is included for computational intensive functions.

Main Idea	Methods & Activities

Alarm A/D

- Two A/D are dedicated to monitoring LPM inputs. They provide 12 bits of resolution, variable length data windows and pre/post event capture.

On-Demand A/D

- Used with the diagnostic panel to provide an independent On-Demand data sampling system

Video Monitor

- The VGA color monitor provides the LPEAC system with dynamic color displays. The monitor provides 640x380 resolution.

Hardcopy Printer

- The LPEAC system uses an HP Laserjet IIP printer to produce hardcopy output. The printer provides four pages per minute of full page graphics. Print resolution is 300x300 dots per inch. Standard copier paper is used.

Disc Storage

- 1.2 MB 5 1/4" floppy disc drive.
- 40 MB Hard drive
- 44 MB Bernoulli Removable Cartridge Disc.

Main Idea	Methods & Activities
LPEAC Diagnostic Panel	SLIDE Pg. 21, fig. 10
– Provides access to all of the LPM channel signals via BNC connectors which can be connected to any recording system which might be brought to the LPM cabinet. This access does not affect normal operation of LPM, but provides easy access to the LPM signals	
– Provides for the input of two additional signals into the "on-demand" signal list. Any -10 to +10vdc plant signal can be connected into LPEAC using the "AUX" inputs and analyzed using the extensive LPEAC "on-demand" function library. The "on-demand" function library is part of the software program used to do live processing of the input data	
– Contains all the cable transitions between the LPM alarm chassis output and LPEAC A/D subsystem inputs.	
– LPEAC LPM alarm relay bypass is located on the diagnostic panel. In “SUPERVISORY” operation this relay prevents an LPM alarm condition from being annunciated until LPEAC has performed an alarm validation. If the alarm is judged to be valid then the relay is opened and the LPM alarm results in an alarm in the control room. If LPEAC evaluates the alarm to be false, no alarm is sent to the control room and LPEAC resets the LPM alarm. The system can also be operated in the “MONITOR” mode, which allows any bistable alarm from the Rockwell cards to be annunciated via RK. Operating the system in “OFF” mode allows no alarms to be passed. These modes are selected via the LPEAC keyboard (see SV01 Functional Test for commands).	
SIGNAL FLOWPATHS:	Pg. 22, fig. 11

Main Idea	Methods & Activities
Channels 1-8	SLIDE
Processes and analyzes the AC signal coming from the pre-amps for the Vessel Head, Lower Vessel, Hot Leg Piping, and Cold Leg Piping. monitors for both Vibration and Loose Parts	
Channels 11-16	SLIDE
Monitors the 0-10VDC Excore Internals Signals for the presence of a low frequency AC Ripple which might indicate motion in the Vessel internals.	

EO: 1.5 Given block diagrams of the Vibration and Loose Parts Amplifier Card, describe the operation of this circuit, including the inputs and outputs.

Main Idea	Methods & Activities
Vibration and Loose Parts Amp	SLIDE Pg. 24, fig. 13
– There are 8 V&LP amps in the V&LP Chassis, used for channels 1-8. The V&LP amp receives the input from field-mounted accelerometers, splitting the signal into two separate paths, a Vibration path and a Loose Parts path.	
• **Vibration Path:**	
– The upper section shows the flow path for developing the vibration signals. After passing through a low pass filter (approximately 600 hz), the low frequency vibration signals are isolated and amplified, yielding a low frequency AC signal called the "audio signal". This audio signal is buffered and can then be lined up to be monitored at: the speaker; the dB Meter, and the Auxiliary Jacks. This audio signal is also sent to LPEAC for analysis and trending. The Peak Detector converts the low frequency AC signal to a DC voltage that represents the Peak value of the AC signal. The DC signal is then compared to the setpoint to generate a logic signal if the input signal exceeds the setpoint. If developed, this logic signal will light the LED on the front of the chassis and go to the logic card.	
• **Loose Parts Path:**	
– The lower section shows the flow path for developing the loose parts signals. The signal enters a band pass filter that allows the signal existing at the resonant frequency (23 Khz) of the	

Main Idea	Methods & Activities
accelerometer to pass, and is then amplified. After the signal is passed through a peak detector (that operates the same as the one in the vibration section), the DC signal output can be lined up to the dB Meter, LPEAC, and the alarm comparator. The alarm comparator generates a logic signal if the setpoint is exceeded, sending this logic signal to the Logic Card.	

EO: 1.6 Given block diagrams of the LPVMS logic card, describe the operation of this circuit, including the inputs and outputs.

Main Idea	Methods & Activities
Eight Channel Logic Card:	SLIDE Pg. 25, fig. 14
There are two logic cards in the V&LP Chassis, (J-16) for channels 1-8 and (J-17) is for channels 11-16.	
– The V&LP Amplifier Cards for channels 1-8 provide logic signals in event of either vibration or loose parts alarms to the Logic Card. If a vibration channel alarms, it passes through the logic card actuating the plant annunciator. If a loose parts channel alarms, it passes through the logic card and actuates the plant annunciator and lights the front panel LED. If the chassis is in AUTO, the first loose parts channel to alarm will flash and subsequent alarms will come in solid. If the chassis is in MANUAL all LEDs come in solid on alarm.	
– For channels 11-16, the logic signals from the Dual Core Internals Amplifier are the inputs. If a core internals channel alarms, the signal passes through the Logic Card and actuates the plant annunciator and lights the front panel LED. If the chassis is in AUTO, the first core internals channel to alarm will flash and subsequent alarms will come in solid. If the chassis is in MANUAL all LEDs come in solid on alarm.	

EO: 1.7 Given block diagrams of the Audio Amplifier Circuit, describe the operation of this circuit, inlcuding the inputs and outputs.

Main Idea	Methods & Activities
Audio Amplifier Card:	SLIDE Pg. 26, fig. 15
– The Audio Amplifier Card takes signals from the Vibration or Nuclear Channels as selected by the thumbwheel switches, amplifies them, and routes these signals to the front panel speaker. Either the Playback or the Monitor controls are used to adjust the volume, (depending on which is selected for control).	
– Since the the human audible range is approximately 20 Hz to 20 Khz, it is unknown why the system is designed to route Nuclear Channels (2-5 Hz) signals to the speaker. This feature is not used.	
– The Loose Parts channel signal (23 Khz) cannot be monitored because of their high frequency (out of the audible range), but the associated vibration channel is monitored.	

EO: 1.8 Given block diagrams of the dB Meter Board, describe the operation of this circuit, including the inputs and outputs.

Main Idea	Methods & Activities
dB Meter Input Card:	SLIDE Pg. 27, fig. 18
– The dB Meter Board receives one of two inputs, depending on the position of the L.P./Vib switch (SW-5). In the Vibration position, the input is an AC voltage proportional to the RCS component peak vibration. In the Loose Parts position, the input is a DC voltage proportional to the peak Loose Parts signal. The dB Meter board conditions these signals for display on the panel dB Meter.	
– The vibration signal enters the card and is sent to the Peak Detector. The output of this stage is a DC voltage proportional to the peak value of the vibration input.	
– The Peak to RMS value converter converts the selected input peak voltage to the equivalent RMS value. Since the dB scale is logarithmic, the Log converter linearizes the logarithmic input and sends it to a summer. The Summer adds in a DC bias, and outputs to the dB Meter, which displays in dB.	

EO: 1.9 Given a block diagram of the Dual Core Internals Amplifier, describe the operation of this circuit, including the inputs and outputs.

Main Idea	Methods & Activities
Dual Core Internals Amplifier Card	SLIDE Pg. 28, fig. 17

As previously discussed, six excore power signals are monitored to detect movement of the Reactor Vessel Core Barrel in relation to the Reactor Vessel. Movement is detected by the monitoring for the presence of a low frequency AC ripple on the Excore Instrumentation Signals (Linear Channels). The 0 to 10 VDC output signals from all four safety trains, and also from the two control range channels are monitored for the presence of this AC component. The Safety signals receive Class/Non-Class signal isolation by means of Foxboro E / E modules in the Foxboro protection racks.

Currently, alarm thresholds are set high enough to render alarm function inoperative (per design change). However, calibration of these cards is important since Vibration Technicians take data from these channels manually for analysis.

The Excore Signals enter the LPVMS cabinet and are routed to the inputs of three Dual Core Internals Amplifiers. The Dual Core Internals Amplifier has two identical circuits (one for each of two different channels), on one circuit board. The operation of one of these circuits is very similar to the operation of the Vibration Section of the V&LP amp, with the following differences:

The constant current power supplies are not utilized in the Dual Core Internal Amps, as there are no Pre-amps. Another difference is the gain of the amplifiers. The Nuclear Channels have an overall gain of 100. However the three biggest differences are shown below:

1. The Input filter on the Dual Core Internals Amplifier is configured with a lower range input filter, sensitive to core

Main Idea	Methods & Activities
internals movement at frequencies of approximately 2 Hz with a signal amplitude higher than setpoint. 2. DC average follower circuits are used to allow the trip point to vary in proportion to the DC average of the incoming signal. This is necessary since for a given amount of core barrel sway there is going to be a fixed percentage of fluctuation on the 0 to 10vdc signal. As the value of the 0 to 10vdc signal increases the amplitude of the AC component also increases. 3. The Test signal activates a separate, low frequency oscillator to test the card circuitry. The alarm functions of the Nuclear channels acts much like the Loose Parts alarm from the V&LP Amps. A separate Logic card in Chassis #1 cause the 1st out LED to flash and subsequent alarms to come in solid. There is also an output to the plant annunciator relays. The analog outputs available from the nuclear channels are: the dB Meter, the Speaker, or the Aux output jacks.	

EO: 1.10 Given a block diagram of the Test & Alarm Board, describe the operation of this circuit, includint the inputs and outputs.

Main Idea	Methods & Activities
Test and Alarm Card	SLIDE Pg. 30, fig. 18
Each chassis has a Test and alarm board for testing the input amplifiers and logic for the Loose Parts, Vibration, & Nuclear Channels.	
When the test pushbutton is depressed on the front of the chassis, the sine wave oscillator is enabled by the test switch logic, outputting a 22.8 KHz sine wave which is routed to both the output summer amp and to the square wave converter. The output of the square wave converter is an amplified square wave which is then divided down in the next stage. The high frequency sine wave and the (larger) low frequency square wave are combined in the summer stage to produce a test output similar to that shown	
The Reset functions to reset the logic on all the amplifiers	

EO: 1.11 Given the appropriate procedures, describe the testing performed on the LPVMS.

Main Idea	Methods & Activities

TESTING THE LPVMS

Certain testing is required on the LPVMS in order to comply with Tech Specs and Regulatory Guide 1.133. Section 3/4.3.3.7 of the PVNGS Technical Specifications requires the following testing to be performed on the LPVMS:

Type of Test	Frequency	Org.
Channel Check	24Hrs	Ops
Channel Functional	31 Days	I&C
Channel Calibration	18 Months	I&C

The Tech Specs also has an action statement concerning the operability of the Loose Parts Channels.

EO: 1.12 Describe the PVNGS Technical Specification requirements as they relate to the LPVMS.

Main Idea	Methods & Activities
TECH SPECS	
Para. 3.3.3.7:	
– The Loose-part detection system shall be OPERABLE with all sensors specified in Table 3.3-11. (All eight Loose Parts Sensors).	
APPLICABILITY:	
– MODES 1 and 2	
ACTION:	
– With one or more loose-part detection system channels inoperable for more than 30 days, prepare and submit a Special Report to the Commission pursuant to Specification 6.9.2 within the next 10 days outlining the cause of the malfunction and the plans for restoring the channel(s) to OPERABLE status.	

EO: 1.13 Troubleshooting and Maintenance.

Main Idea	Methods & Activities
TROUBLESHOOTING AND MAINTENANCE	
The Technical Manual for the LPVMS is R344-0001. This manual, in conjunction with the two I&C procedures for the system, will provide most of the reference material required to troubleshoot and maintain the system.	
Caution should be taken in the area of the sensors as they are located in Radiation Areas, High Radiation Areas, Contaminated Areas, and Hot Particle Control Areas.	
Caution should be taken in the area of the sensors for channels 3 & 4 to ensure that the Fixed Incore detectors are fully inserted into the core and not withdrawn. Confined Space inerting atmopheres are also an issue to consider.	

EO: 1.14 Industry Events.

Main Idea	Methods & Activities

OE13865

During return to power following a reactor trip, loose parts monitor alarms for Steam Generator (S/G) 'D' were received. The alarms were due to loose parts in the primary hot leg (H/L) side of the S/G 'D' inlet plenum (bowl). The loose parts were determined to be a guide-tube support pin nut (split pin nut) and its locking device (lock tab.

OE20801

During startup from a condenser maintenance outage in April 2004, the vibration and loose parts monitoring system (VLPM) alarmed in the lower head region of the reactor vessel. The alarms were expected to decrease and terminate once the reactor coolant system was at, or near, full power. The alarms continued throughout the remainder of Cycle 23. A loose part inspection/retrieval team was put together for the spring 2005 refueling outage. During the refueling outage, the reactor core barrel was removed to inspect the lower head area for the loose part. Based upon vendor analysis of the impact signals, the loose part should weigh approximately 1 pound. On March 24, 2005, with an underwater camera, the loose part was identified sitting at the bottom of the lower vessel head. The item was identified as a fuel alignment pin, which is one of four (4) per fuel assembly. The alignment pin's function is to align the fuel assembly onto the core support plate during fuel loading of the reactor. The apparent cause of the alignment pin coming loose was an inadequate crimp during manufacturing.

Main Idea	Methods & Activities
OE7883 Loose parts were detected on the primary side of a steam generator (SG) channel head. Although urgency was placed on plant shutdown and cool-down for retrieval of the parts, the reactor coolant pump (RCP) in the affected loop was maintained in service to ensure that the parts remained in the SG and were not swept back to the upper internals from reverse flow. Consequently, the SG tube-sheet sustained significant damage. The loose parts were later determined to be a support pin nut and locking device from a control rod guide tube.	

SUMMARY OF MAIN PRINCIPLES

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.,

Objectives Review

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

Questions and Answers

Oral questioning

Ask questions that implement the objectives. Discuss students answers as needed to ensure the objectives are being met.

Problem Areas

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

Concluding Statement

If not done in the previous step, review the motivational points that apply this lesson to students needs. If applicable, end with a statement leading to the next lesson.

You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.