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OCT 05 1983

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Divison of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Limerick Generating Station, Units 1 and 2
Safety Evaluation Report Open Issue #8
Airborne Particulate Radioactivity Monitoring
System

Reference: Meeting Between PECO & NRC Auxiliary Systems
Branch on September 22, 1983

File: GOVT 1-1 (NRC)

Dear Mr. Schwencer:

The referenced meeting was held to discuss the subject open item. In the discussion, PECO described the Limerick Reactor Coolant Pressure Boundary Leak Detection System (RCPBLDS) in detail. Included in PECO's description were information on the system's method of operation and details on the system's compliance with Regulatory Guide 1.45 and ANSI/ISA Standard S67.03.

At the conclusion of the meeting, it was agreed that the design of the RCPBLDS is acceptable. It was further agreed that PECO would document additional information presented at the meeting on operating experience with leak detection systems and provide FSAR changes associated with clarifications which had been discussed.

With regard to operating experiences, the drywell leak detection systems which comprise the RCBPLDS provided for Limerick were selected based on PECO operating experience with leak detection equipment at PECO's Peach Bottom Atomic Power Station (PBAPS), other industry operating experience and the work of ISA Subcommittee S67.03. Relevant PBAPS operating experience and practice is described in the following letters:

- S. L. Daltroff (PECO) letter to J. F. Stolz (NRC) dated 12/15/82.

- R. W. Starostecki (NRC) letter to S. L. Daltroff (PECO) dated 5/24/83, Combined Inspection Report 50-277/83-09 and 50-278/83-09.

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- J. S. Kemper (PECO) letter to T. E. Murley (NRC) dated 9/15/83.

Our consultants have confirmed that our operating experience at PBAPS is typical of that of all other BWR's.

The equipment and systems provided at LGS for detection of RCPB leakage in the drywell (i.e. the RCPBLDS) meet or exceed the requirements and recommendations of ISA Standard S67.03 - 1982, Standard for Light Water Reactor Coolant Pressure Boundary Leakage Detection.

Attached are draft revisions to FSAR Sections 1.8, 5.2 and 7.7 as well as a draft revised response to FSAR Question 410.23. The attached draft FSAR revisions will be incorporated into the FSAR exactly as they appear on the attachments in the revision scheduled for November 1983.

Sincerely,

John S Kemper

JTR/gra/I-2

Copy to: See Attached Service List

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REGULATORY GUIDE 1.43 Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components
Rev 0, May 1973

This guide applies to welding of cladding to low alloy steels made to coarse grain practice. Limerick vessel plate and nozzle forgings are made to fine grain practice and a low heat input process is used. Other components are not clad. Therefore, the guide is not applicable.

(Category 1)

REGULATORY GUIDE 1.44 Control of the Use of Sensitized Stainless Steel
Rev 0, May 1973

For GE scope of supply, this guide is not used as a design basis for Limerick and in some instances alternate approaches are used which, however, conform to the intent of this guide.

For the Bechtel scope of supply, there is conformance with the guide except for alternate approaches taken for non-sensitization and intergranular corrosion testing.

Details are discussed in Section 5.2.3.3.

REGULATORY GUIDE 1.45 Reactor Coolant Pressure Boundary Leakage Detection Systems
Rev 0, May 1973

The Limerick design complies with the intent of this Regulatory Guide. Three diverse methods of detection have been provided. The design bases, limitations, and operation of these systems are discussed in Sections 5.2.5.2.1.3 through 5.2.5.2.1.5. These provisions meet or exceed the recommendations of ANSI/ISA Standard S67.03.

(Category 1)

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5.2.4.7 System Leakage and Hydrostatic Pressure Tests

The Class 1 leakage and hydrostatic pressure test program meets the requirements of Section XI, Article IWB-5000, "System Leakage and Hydrostatic Pressure Tests." The technical specification requirements for operating limitations for heatup, cooldown, and system hydrostatic pressure testing will be met during such testing.

5.2.5 REACTOR COOLANT PRESSURE BOUNDARY LEAK DETECTION SYSTEM

5.2.5.1 Design Bases

The leak detection system is designed to:

a. Detect the occurrence of and alert operating personnel to abnormal leakage from the reactor coolant pressure boundary (RCPB).

b. Detect leakage from selected portions of systems located outside the primary containment, and not a part of the RCPB.

c. Remain functional following a safe shutdown earthquake (SSE), except as discussed in Sections 5.2.5.2.1.4 and 5.2.5.2.1.5

5.2.5.2 Description

The RCPB leak detection system consists of temperature, pressure, flow, and radiation sensors, and associated instrumentation and alarms. The system detects, annunciates, and, in certain cases, isolates abnormal leakage in the following systems:

a. Main steam lines

b. Reactor water cleanup (RWCU) system

c. Residual heat removal (RHR) system

d. Reactor core isolation cooling (RCIC) system

e. Feedwater system

f. High pressure coolant injection (HPCI) system

g. Reactor recirculation system

h. Core spray (CS) system

A summary of isolation and/or alarms of affected systems and the methods used appears in Table 5.2-7. The table shows that those

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leak detection methods which detect gross leakage and initiate immediate automatic isolation. Those methods which are capable of detecting small leaks initiate an alarm in the control room, at which time the operator can either manually isolate the leaking system or take other appropriate action.

5.2.5.2.1 Detection of Abnormal Leakage Within the Primary Containment

Leaks within the primary containment are detected by continuously monitoring for:

a. Abnormally high pressure and temperature within the primary containment

b. Rapid level increase in drywell equipment and floor drain sumps

c. A decrease in the reactor vessel water level

d. High gaseous radiation level in the primary containment atmosphere

e. High containment air cooler condensate flow.

In addition to these leak detection methods, selected RCPB components within the primary containment are provided with their own leak detection devices. While some of the methods provided for detecting leakage within the primary containment are not redundant in themselves, it is not postulated that any one event could render all means of leak detection inoperable. Each of the leak detection methods are discussed below. The systems and equipment provided at LGS meet or exceed the requirements and recommendations of ANSI/ISA Standard S67.03-1982.

5.2.5.2.1.1 Drywell Temperature Monitoring

Drywell temperature monitoring provides an indirect method of detecting RCPB leakage.

The drywell area unit coolers circulate and cool the drywell atmosphere to maintain the drywell at its design operating temperature. Cooling water is supplied to the unit coolers by the Drywell Chiller Water System (FSAR Section 9.2.10). A temperature rise in the drywell will indicate the presence of reactor coolant or steam leakage and is detected by the drywell temperature monitors located at various elevations and at the inlet and outlet of the air coolers. A discussion of indications and alarms for drywell temperature is given in Section 7.5.

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5.2.5.2.1.2 Drywell Pressure Monitoring

Drywell pressure monitoring provides an indirect method of detecting RCPB leakage.

The drywell normally ranges from slightly below to slightly above atmospheric pressure during reactor operation. The pressure typically fluctuates slightly as a result of barometric pressure changes and/or outleakage. A pressure rise above the normally indicated value indicates leakage within the drywell. Drywell pressure monitoring is shown in Figures 5.1-4 and 9.4-5. A discussion of indications, alarms, and protective functions for drywell pressure is given in Sections 7.2, 7.3, 7.4, and 7.5.

5.2.5.2.1.3 Drywell Sump Level Monitoring

All leakage from RCPB components inside the drywell, with the exception of leakage from the main steam safety/relief valves (Section 5.2.5.2.1.8), flows directly to either the drywell equipment drain sump or the drywell floor drain sump. There are no other reservoirs in the drywell of sufficient capacity to prevent leakage from draining directly to either of these sumps. Both drain sumps are identically-sized, horizontal cylindrical tanks located inside the reactor vessel pedestal below the diaphragm slab and vented to the drywell atmosphere. The liquid radwaste collection system piping and instrumentation diagram is given in Figure 9.3-4. These drain sumps are discussed below:

a. Drywell equipment drain sump - Certain RCPB components within the drywell are, by the nature of their design, normally subject to a limited amount of leakage. These components include pump seals, valve stem packings, and other equipment that cannot practicably be made to be completely leaktight. These leakages are piped directly to the drywell equipment drain sump. All of the various drains are open only to the equipment they serve, thereby receiving leakage only from identified sources. Background leakage to this sump is determined during initial plant operation. Rates of leakage collection in excess of background indicates abnormal RCPB leakage.

b. Drywell floor drain sump - Leakage from RCPB components inside the primary containment which are not normally subject to leakage is collected by the drywell floor drain sump. This leakage, which may originate from any number of sources within the drywell, is transported to the sump via the floor drain network within the drywell. Thus, separation of unidentified leakage from the identifiable leakage routed to the equipment drain sump ensures that a small unidentified leakage that is of concern will not be masked by a larger, acceptable, identified leakage.

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c. Each sump tank has its own level transmitter which is monitored by a dedicated processing unit. Normally closed drain valves are provided, enabling the level in each tank to increase as leakage drains into them. The processing unit calculates an average leak rate for a given measurement period by establishing the amount of increase in level that occurred during the period, and converting that value into volumetric terms (gpm). The processing units provide alarms in the main control room if the average increase in leakage for any given measurement period exceeds 1 gpm. ~~within one hour.~~ The alarm setpoint can be adjusted at the processing unit, which is located in the main control room, as the amount of acceptable identified leakage changes during operation. Indication of the leakage rates is provided in the main control room on panel-mounted indicators and on CRT displays from the ERFDS system.

Level switches, which are independent of the level transmitters, open the sump tank drain valves when the level increases to an upper setpoint value and keeps them open until the level decreases to an lower setpoint value. The level switches then close the drain valves and reset the processing units in order to start a new measurement period. The measurement period must be long enough to ensure that the level transmitter loop can adequately detect the increase in level that would correspond to a 1 gpm increase in leakage and yet short enough to ensure that such a leak rate will be detected within an hour. The measurement period will be less than one hour.

The calibration interval for the level transmitters and processing units is every six months in accordance with the manufacturer's recommendation. The transmitters which are located in the reactor enclosure and the processing units which are located in the main control room, are accessible during normal plant operation for calibration. The transmitters can be isolated from the sump tanks by existing bypass manifolds. Zero and span adjustments can be made using portable test equipment. The processing unit functions can be calibrated by applying known input levels at the unit and observing the response.

The processing units and the level transmitters are qualified to withstand an SSE. The system is energized by Class 1E power. However, the system will be automatically isolated in the event of a LOCA. Figure 9.3-4 shows the piping and instrument diagram for this system.

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In addition to the sump level monitoring system described above, the discharge from each sump is monitored by a flow element. The measured flow rate is integrated and recorded in the control room. A control room alarm is also provided to indicate excessive discharge rates.

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5.2.5.2.1.4 Drywell Air Cooler Condensate Drain Flow Monitoring

The drywell air cooler condensate drain flow monitoring system consists of six flow sensors and their associated flow transmitters that provide inputs to a separate flow monitoring device. The flow sensors are mounted in the drywell air cooler drain lines located in the drywell. There are a total of eight coolers. Two flow sensors measure the flow from two air cooler drain line headers. Four additional flow sensors measure the drain flow from each of the remaining coolers which are piped separately to the drywell floor drain sump tank. The outputs from the six flow transmitters which receive their input from the flow sensors are added to provide a total continuous drain flow rate by the use of two summing units. The continuous drain flow rate is monitored by a flow switch, located in the main control room, which will alarm if the rate exceeds 1 gpm over the preset identified leak rate. The plant operator establishes the acceptable identified drain flow rate and adjusts the setpoint of this flow switch accordingly (i.e., if the identified flow rate is established at 5 gpm, the system will be set to alarm at 6 gpm). The requirement to detect a 1 gpm increase in unidentified leakage within an hour is met by monitoring the continuous flow rate. Indication of the total continuous drain flow rate is provided in the main control room on panel-mounted indicators and CRT displays from the ERFDS system.

The calibration interval for the flow transmitters and processing units is every six months in accordance with the manufacturer's recommendation. The operability of the sensor can be verified remotely at the transmitter. The transmitters and processing units, which are located in the reactor enclosure and the main control room, respectively, are accessible during normal plant operation for calibration. The transmitters and the processing units can be calibrated by supplying known input levels and observing the response. The proper operation of the flow sensors should be checked every six months by performing continuity and resistance tests for the RTDs and the heater elements. The flow sensors must be removed for cleaning, inspection, and calibration during each refueling outage.

The drywell air cooler condensate drain flow monitoring system is qualified to withstand an OBE. The system is energized by Class 1E power. Figure 9.2-27 shows the piping and instrument diagram for this system.

5.2.5.2.1.5 Containment Airborne Radioactivity Monitoring

The primary containment is continuously monitored for airborne gaseous radioactivity. A drywell air sample is extracted via sample line through containment penetration X-117B at El. 292 ft, area 16. Air flow through the monitoring system is assured by

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the suction created by a vacuum pump. The air sample is surveyed by the Geiger-Mueller tubes in the sampling chamber for its radioactivity content. The air sample is returned to the drywell through the same containment penetration. The level of radioactivity is recorded in the main control room in counts per minute. The range is from 10 cpm to 10^6 cpm. The corresponding concentration is 10^{-6} to 10^{-1} μCi/cc. Particulate and iodine monitors are not provided due to the substantial limitations of their usefulness as described below.

The noble gas monitoring equipment is shown in Figure 11.5-1. It is not designed to be operable following an SSE.

Radioactivity level indication and alarms for loss of sample flow, high radiation, and downscale are provided locally and in the main control room. Activity level indication in the control room is provided on a strip-chart recorder to provide trend information.

The operability of the sensor and the electronic circuitry can be verified during operations from the auxiliary equipment room. A check source is supplied with the monitor. Sample connections are also provided to facilitate additional sampling for laboratory analysis.

The radiation monitor is capable of being calibrated during power operation and will be calibrated in accordance with Technical Specifications requirements (Chapter 16).

The reliability, sensitivity, and response times of radiation monitors to detect 1 gpm in one hour of reactor coolant pressure boundary (RCPB) leakage will depend on many complex factors. The major limiting factors are discussed below.

5.2.5.2.1.5.1 Source of Leakage

a. Location of Leakage -- The amount of activity that would become airborne following a 1 gpm leak from the RCPB will vary depending on the leak location and the coolant temperature and pressure. For example, a feedwater pipe leak may have concentration factors of 100 to 1000 lower than a recirculation line leak. A steam line leak may be a factor of 50 to 100 lower in iodine and particulate concentrations than the recirculation line leak, but the noble gas concentrations may be comparable. An RWCU leak upstream of the demineralizers and heat exchangers may be a factor of 10 to 100 higher than downstream, except for noble gases. Differing coolant temperatures and pressures will affect the flashing fraction and partition factor for iodines and particulates. Thus, an airborne concentration cannot be directly correlated to

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a quantity of leakage without knowing the source of the leakage.

b. Coolant Concentrations -- Variations in coolant concentrations during operation can be as much as two orders of magnitude within a time frame of several hours. These effects are mainly due to spiking during power transients or changes in the use of the RWCU system. Examples of these transients for I-131 are given in Reference 5.2-6. An increase in the coolant concentrations could give increased containment concentrations when no increase in unidentified leakage occurs.

c. Other Sources of Leakage -- Because the unidentified leakage is not the sole source of activity in the containment, changes in other sources will result in changes in the containment airborne concentrations. For example, identified leakage is piped to the equipment drain tank in the drywell, but the tank is vented to the drywell atmosphere allowing the release of noble gases and some small quantities of iodines and particulates from the drain tank.

5.2.5.2.1.5.2 Drywell Conditions Affecting Monitor Performance

a. Equilibrium Activity Levels -- During normal operation, the activity release from acceptable quantities of identified and unidentified leakage will build up to significant amounts in the drywell air. Due to these high equilibrium activity levels, the activity increase due to a small increase in leakage may be difficult to detect within a short period of time.

b. Purge and Pressure Release Effects -- Changes in the detected activity levels have occurred during containment venting operations. These changes are of the same order of magnitude as approximately a 1 gpm leak and are sufficient to invalidate the results from iodine and particulate monitors.

c. Plateout, Mixing, Condensation, Fan Coolant Depletion -- Plateout effects on measured iodine and particulate levels will vary with the distance from the coolant release point to the detector. Larger travel distances would result in more plateout. In addition, the pathway of the leakage will influence the plateout effects. For example, a leak from a pipe with insulation will have greater plateout than a leak from an uninsulated pipe. Although the drywell air will be mixed by the fan coolers, it may be possible for a leak to develop in the vicinity of the radiation detector sample lines. In

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addition, condensation in the coolers and sample lines will remove iodines and particulates from the air. Variations in flow, temperature, and number of coolers will affect the plateout fractions. Plateout within the detector sample chamber will also add to the reduction of the iodine and particulate activity levels. The uncertaintities in any estimate of plateout effects could be as much as one or two orders of magnitude.

5.2.5.2.1.5.3 Physical Properties and Capabilities of the Detector

a. Detector Range -- The detector was chosen to ensure that the operating range covered the concentrations expected in the drywell. The operating range of the noble gas monitor is: 10^{-6} to 10^{-1} μCi/cc.

b. Sensitivity -- In the absence of background radiation and equilibrium drywell activity levels, the detector has the following minimum sensitivity: 10^{-6} μCi/cc for Xe-133.

c. Counting Statistics and Monitor Uncertainties -- In theory, this radioactivity monitor is statistically able to detect increases in concentration as small as 2 or 3 times the square root of the count rate, i.e., at 1E+6 cpm an increase of 2E+3, or 0.2% is detectable; at 100 cpm an increase of 20, or 20% is detectable. In addition, at high count rates the monitors have dead-time uncertainties and the potential for saturating the monitor or the electronics. Uncertainties in calibration (plus or minus 5%), sample flow (plus or minus 10%), and other instrument design parameters tend to make the uncertainty in a count rate closer to 20 to 40% of the equilibrium drywell activity.

d. Monitor Setpoints -- Due to the uncertainity and extreme variability of the radioactivity concentrations to be measured in the containment, the use of tight alarm setpoints on the radioactivity monitor would not be practical or useful. The setpoint, which would be required to alarm at 1 gpm, would be well within the bounds of uncertainty of the measurements. The use of such setpoints would result in many unnecessary alarms and the frequent resetting of setpoints. The alarm setpoints for the radiation monitors are set significantly above normal readings to prevent nuisance alarms.

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e. Operator Action -- There is no direct correlation or known relationship between the detector count rate and the leakage rate because the coolant activity levels, source of leakage, and background radiation levels (from leakage alone) are not known and cannot be cost-effectively determined in existing reactors. There are also several other sources of containment airborne activity (e.g., safety relief valve leakage) that further complicate the correlation.

Thus, the procedure for the control room operator is to set an alarm setpoint at 1 gpm in one hour on the sump level monitor (measuring water collected in the sump that may not exactly correspond to water leaking from an unidentified source). When the alarm is actuated, the operator will review all other monitors (e.g., noble gas, containment temperature and pressure, air cooler condensate flow, etc) to determine if the leakage is from the primary coolant pressure boundary and not from an SRV or cooling water system, etc. Appropriate actions will then be taken in accordance with Technical Specifications. The review of other monitors will consist of comparisons of the increases and rates of increase in the values previously recorded. Increases in all parameters except sump level will not be correlated to a RCPB leakage rate. Instead, the increases will be compared to normal operating limits and limitations, and abnormal increases will be investigated.

Because the Technical Specification limit for leakage is allowed to be averaged over 24 hours, quick and accurate responses are not necessary unless the leakage is large and indicative of a pipe break. In this case, the containment pressure and reactor vessel water level monitors will alarm within seconds, and the sump level monitor would alarm within minutes or tens of minutes.

Radiation monitor alarms are not set to levels that are intended to correspond to the RCPB leakage levels because such correlations are not valid. Because the containment airborne activity levels vary by orders of magnitude during operation due to power transients, spiking, steam leaks, and outgasing from sumps, an appropriate alarm setpoint is determined by the operator based on experience with the specific plant. A setpoint level of 10 times the level during full power steady state operation may be useful for alarming large leaks and pipe breaks, but it would not always alarm for 1 gpm in one hour and therefore could not be considered as any more than a qualitative indication of the presence of abnormal leakage.

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Due to the sum total of the uncertainties identified in the previous paragraphs, ~~the~~ iodine and particulate monitors are not relied upon for immediate leak detection purposes. ~~but only as supporting instrumentation.~~ The noble gas monitor is used to give supporting information to that supplied by the sump discharge monitoring, and it would be able to give an early warning of a major leak, especially if equilibrium containment activity levels are low. However, the uncertainties and variations in noble gas leaks and concentrations would preclude the setting of a meaningful alarm setpoint. Grab sampling and laboratory analyses of airborne particulate, noble gas, and iodine may be utilized to characterize leakage detected by other means.

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7.7.1.9.7.8 AEOE-RMS Operational Considerations

7.7.1.9.7.8.1 General

Annunciator outputs and control trip outputs are provided by this monitoring system. Controls are both local and located in the auxiliary equipment room. Gross radioactivity readings can be further diagnosed using grab samples.

7.7.1.9.7.8.2 AEOE-RMS Reactor Operator Information

Inputs to the control room apprise the operator of concentrations of radioactivity in the air ejector effluents, including indications of fuel element deterioration. Control trip capability is provided to prevent release of contamination to the environment. Diagnostic capability is available.

7.7.1.9.8 Primary Containment Leak Detection Radiation Monitor (PCLD-RMS)

7.7.1.9.8.1 System Identification

The objective of the PCLD-RMS is to indicate and record radiation levels of the primary containment atmosphere. The instrument provides alarm capability in response to a rapid increase in this radiation level. Alarm setpoints are

discussed in Section 5.2.5.2.1.5.3.

7.7.1.9.8.2 PCLD-RMS Classification

The PCLD-RMS is a power generation system and is not related to safety.

7.7.1.9.8.3 PCLD-RMS Reference Design

Table 7.1-2 lists reference design information. The PCLD-RMS ~~is designed to alarm in response to small gaseous or steam leaks in the primary containment and~~ does not have a safety function.

7.7.1.9.8.4 PCLD-RMS Power Sources

Power is supplied by a 120 Vac instrument bus. Safety-related power is not required for this application.

7.7.1.9.8.5 PCLD-RMS Equipment Design

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7.7.1.9.8.5.1 PCLD-RMS General

A gas sample is drawn from the primary containment and is passed through the PCLD-RMS to measure the concentration of noble gases. Alarm capability is provided. Outputs are transmitted to a control module in the auxiliary equipment room, and to a recorder in the control room.

7.7.1.9.8.5.2 PCLD-RMS Circuit Description

The monitor channel has an upscale trip that indicates a rate of increase of radioactivity in the primary containment. ~~equivalent to a leakage rate of one gallon per minute above the normally expected identified leakage~~. A downscale trip is also provided to indicate instrument trouble. These trips annunciate, but provide no control action. The trip circuits are set so that loss of power causes an alarm. The five-decade range is selected to cover both normal and maximum radiation levels (short of an accident resulting in shutdown) in the primary containment. If an accident occurs, the PCLD-RMS will be isolated, and its functions will cease.

The PCLD-RMS monitoring rack is adjacent to the primary containment. Outputs of this instrument are transmitted to the auxiliary equipment room and the control room. Remote controls purge the noble gas chamber, reset the alarm set points, and check the calibrations.

7.7.1.9.8.5.3 PCLD-RMS Testability

Test signals are fed into the monitor via the control module in the auxiliary equipment room. Check sources are provided for secondary calibration of each channel.

7.7.1.9.8.6 PCLD-RMS Environmental Considerations

The monitoring rack is designed to ~~meet~~ be suitable for the environmental conditions adjacent to the primary containment. Control modules and recorders are subjected to the environment of the auxiliary equipment room and control room. See Section 3.11 for the environmental conditions of the equipment locations.

~~7.7.1.9.8.7 PCLD-RMS Operational Considerations~~

~~7.7.1.9.8.7.1 General Information~~

~~Annunciator outputs to PCLD-RMS alarm signals are provided in the control room. The two independent branches of the system provide separate criteria for leak detection. Fixed filters continuously accumulate radioactive particulates and iodines that can be analyzed in the counting room for diagnostic purposes. However,~~

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it is not expected that these particulate/iodine samples will be representative.

7.7.1.9.8.7.2 RCLD-RMS Reactor Operator Information

Inputs to the control room provide the reactor operator with early warnings of anomalous changes in primary containment radiation levels. This information can be used as a guide for remedial action.

7.7.1.9.9 Hot Maintenance Shop Radiation Monitor (HMS-RMS)

7.7.1.9.9.1 System Identification

The objective of the HMS-RMS is to indicate and record the quantity of radioactive material that escapes from the hot maintenance shop ventilation exhaust duct. Filters are provided in this duct, and sample air is drawn from a station downstream of the filters. Consequently, the quantity of radioactive material in the sample is normally negligible.

7.7.1.9.9.2 HMS-RMS Classification

This system is a power generation system and is not related to safety.

7.7.1.9.9.3 HMS-RMS Reference Design

Table 7.1-2 lists reference design information.

7.7.1.9.9.4 HMS-RMS Power Sources

The power source of the HMS-RMS is the 120 Vac instrument bus.

7.7.1.9.9.5 HMS-RMS Equipment Design

7.7.1.9.9.5.1 HMS-RMS General

The system consists of two channels: one for monitoring particulate effluents, and the other for monitoring iodine effluents. Radioactive material in the gas sample is accumulated on filters where it is sensed by scintillator-type detectors. Output signals are transmitted to a microprocessor and then to a recorder. Output signals from the control module are available for transmission to a centralized minicomputer for the purpose of insertion into Regulatory Guide 1.21 reports.

7.7.1.9.9.5.2 HMS-RMS Circuit Description

Each channel has an upscale trip that indicates high radiation and a downscale trip that indicates instrument trouble. These trips sound alarms, but cause no control action. The trip

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The AEOE-RMS monitors have characteristics sufficient to provide accurate indication of radioactivity in the air ejector offgas. The system provides the operator with sufficient information to control the activity release rate. Sufficient redundancy is provided to allow maintenance on one channel without losing the system indications.

7.7.2.9.7.2 AEOE-RMS Conformance to Specific Regulatory Requirements

No specific regulatory guides or IEEE standards apply to this system.

7.7.2.9.7.2.1 AEOE-RMS Conformance to 10 CFR, Part 50, Appendix A, General Design Criteria (GDC)

7.7.2.9.7.2.1.1 Conformance to GDC 13, Instrumentation and Controls

The system conforms to GDC 13 in that the instruments used cover the anticipated range of radiation under normal operating conditions with enough margin to include postulated accident conditions.

7.7.2.9.7.2.1.2 Conformance to GDC 60, Control of Release of Radioactive Materials to the Environment

The system conforms to GDC 60 in that it controls the release of radioactive materials to the environment.

7.7.2.9.7.2.1.3 Conformance to GDC 64, Monitoring Radioactivity Releases

The system conforms to GDC 64 in that it monitors radioactive releases resulting from normal operations including anticipated operational occurrences.

7.7.2.9.8 Primary Containment Leak Detection Radiation Monitoring System (PCLD-RMS) -- Instrumentation and Controls

7.7.2.9.8.1 PCLD-RMS Conformance to General Functional Requirements

The PCLD-RMS supplements the leak detection instrumentation for the primary containment. This monitoring system continually samples the containment (drywell) atmosphere for radioactive noble gases. It is designed to respond to increases in the concentration of radioactivity in the containment atmosphere. This system ~~The system is qualified for a seismic Category 1 occurrence, but it~~ is not intended for use during or after a LOCA. In this eventuality, the PCLD-RMS will be automatically isolated from the

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containment. The PCLD-RMS is a power generation system, and is not safety related.

7.7.2.9.8.2 PCLD-RMS Conformance to Specific Regulatory Requirements

7.7.2.9.8.2.1 PCLD-RMS Conformance to Regulatory Guides

7.7.2.9.8.2.1.1 Conformance to Regulatory Guide 1.45 1973 Reactor Coolant Pressure Boundary Leakage Detection Systems

The PCLD-RMS is designed to provide one of the three independent means of detecting RCPB leakage. ~~purpose is to detect a leak of one gallon per minute within one hour. This can readily be achieved while the containment atmosphere is relatively clear of radioactivity. However, when radioactive material gradually accumulates in the containment atmosphere, the percentage change required to detect a leak of one gpm in one hour becomes progressively smaller. Consequently, the probability of maintaining this degree of sensitivity will gradually decline. Therefore, this system must be used in conjunction with other leak detection monitors to satisfy Regulatory Guide~~ The systems provided meet the intent of Reg. Guide 1.45 and meet or exceed the recommendations of ANSI/ISA S67.03.

7.7.2.9.8.2.2 PCLD-RMS 10 CFR50, Appendix A, General Design Criteria (GDC)

7.7.2.9.8.2.2.1 Conformance to GDC 2, Design Bases for Protection Against Natural Phenomena

The PCLD-RMS is not designed to continue its leak detection capability after a safe shutdown earthquake (SSE). The other RCPB leak detection systems are designed to withstand an SSE (sump level) or an OBE (drywell chiller drains).

7.7.2.9.8.2.2.2 Conformance to GDC 13, Instrumentation and Control

The PCLD-RMS is designed to monitor for containment internal leakage over normal operation and anticipated occurrences, but not for accidents that result in containment isolation.

7.7.2.9.8.2.2.3 Conformance to GDC 64, Monitoring Radioactivity Releases

The PCLD-RMS provides a means of monitoring the RCPB during the containment atmosphere for radioactivity released from normal operations and anticipated operational occurrences.

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7.7.2.15.2 RI Conformance to Specific Regulatory Requirements

No specific regulatory requirements apply to refueling interlocks. The refueling interlocks are designed to be normally energized (fail-safe) and single-failure tolerant of equipment failures.

IEEE standards do not apply because the refueling interlocks are not required for any postulated design basis accident or for safe shutdown. The interlocks are required only for the refueling mode of plant operation. The requirements of 10 CFR, Part 50, Appendix B, are met in the manner set forth in Chapter 17.

No specific GDC requirements apply to this system.

7.7.2.16 <u>Leak Detection System (LDS) -- Instrumentation and Controls</u>

7.7.2.16.1 LDS Conformance to General Functional Requirements

Following are the analyses to demonstrate how various general function requirements listed under the leak detection system (Section 7.7.1.16) are satisfied.

7.7.2.16.2 LDS Specific Regulatory Requirements

7.7.2.16.2.1 Conformance to Regulatory Guides

7.7.2.16.2.1.1 LDS Conformance to Regulatory Guide 1.45 (1973), Reactor Coolant Pressure Boundary Leakage Detection Systems

Leakage into the primary reactor containment from identified sources such as valve stem packing, recirculation pump seal, head seal, etc, is separated so that flow rates are monitored separately from unidentified leakages and total flow rates can be established and monitored. ~~Leakage from the main steam line safety/relief valve is an identified leakage because of the location of the sensors that detect this leakage, but the leakage is not completely separated from unidentified sources. Separation of this leakage is not required because any leak from the main steam line safety/relief valves is from a crack or break in the line and necessitates a plant shutdown for repair. Therefore, there is no identified leakage from the safety/relief valve lines during plant operation that necessitates separation from unidentified leakage.~~ as described in Section 5.2.5.2.1.3.

Similarily, the flow rate for unidentified leakage is monitored to detect a pipe break in the primary containment. ~~Radiation monitoring of the containment atmosphere also satisfies Regulatory Guide 1.45 guidelines.~~

Condensation from the drywell air coolers, is monitored to provide a diverse means of detecting RCPB leakage. This monitoring provision is described in Section 5.2.5.2.1.4.

(over)

Noble gas radioactivity monitoring is also provided to supplement the flow measurement methods of RCPB leak detection. This provision is described in Section 5.2.5.2.1.5.

The RCPB leak detection systems and equipment provided at Limerick meet the intent of Reg. Guide 1.45 and meet or exceed the recommendations of ANSI/ISA Standard S67.03.

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7.7.2.16.2.2 LDS Conformance to 10 CFR, Part 50, Appendix A, General Design Criteria (GDC)

7.7.2.16.2.2.1 Conformance to GDC 13, Instrumentation and Controls

The leak detection sensors and associated electronics are designed to monitor reactor coolant leakage over all expected ranges required for the safety of the plant.

7.7.2.16.2.2.2 Conformance to GDC 19, Control Room

Controls and instrumentation are provided in the control room.

7.7.2.16.2.2.3 Conformance to GDC 30, Quality of Reactor Coolant Pressure Boundary

The system provides the means for detecting and locating the source of the reactor coolant leakage. This also applies to the sump drywell, recirculating pump, and safety relief valve leak detection equipment.

7.7.2.16.2.2.4 Conformance to GDC 34, Residual Heat Removal

Leak detection is provided for the RHR shutdown cooling lines penetrating the drywell.

7.7.2.16.2.2.5 Conformance to GDC 54, Piping Systems Penetrating Containment

Leak detection is provided for the RHR shutdown cooling lines penetrating the containment. Sump fill rate monitoring provides leak detection for other pipes penetrating the containment and reactor enclosures.

7.7.2.16.2.3 LDS Conformance to Industry Codes and Standards

7.7.2.16.2.3.1 Conformance to IEEE 344, (1971) Seismic Qualification of Class 1 Electrical Equipment

The RHR and the drywell leak detection systems comply with this standard.

7.7.2.17 <u>Rod Sequence Control System (RSCS) -- Instrumentation and Controls</u>

7.7.2.17.1 RSCS Conformance to General Functional Requirements

The RSCS provides restraints on a rod drop accident assuming that the drop of the highest worth rod that can be developed at any time by one inadvertent error by the operator. The quality level

7.7.2.16.2.3.2 ANSI/ISA Standard 67.03 - ~~7.7-141~~

The RCPB leak detection systems and equipment provided meet or exceed the recommendations of this standard.

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QUESTION 410.23 (Section 5.2.5)

(a) Provide drawings of the leakage detecting systems for both the identified and unidentified collection systems. The drawings should indicate placement of instrumentation.

(b) Verify that each of the leakage detection systems has a readout and alarm in the control room in accordance with Regulatory Guide 1.45, Position C.7.

(c) Verify that the airborne particulate monitoring system remains functional following an SSE.

(d) Verify that the airborne radiation monitoring system is equipped with provisions to permit testing and calibration during operation. Verify that the monitor operates continuously.

(e) Provide a discussion of the provisions to test and calibrate the sump level detection system and the air cooler condensate flow system. As part of the discussion, specify and justify the frequency of testing and calibration.

(f) Verify that the unidentified leakage detection system (drywell floor drainage system) is seismic Category I supported and specify the frequency of the periodic testing to ensure operability.

RESPONSE

(a) Section 5.2.5.2.1 has been changed to provide reference to drawings of the leakage detection systems.

Figure 9.3-4 for drywell sump level monitoring and Figure 9.2-27 for drywell air cooler condensate flow monitoring have been changed.

(b) Each of the three systems provided for leak detection has readouts and alarms in the main control room in accordance with Regulatory Guide 1.45.

(c) Airborne particulate radioactivity monitoring equipment is not provided for the reasons described in Section 5.2.5.2.1.5.1.

The drywell sump level monitoring system is qualified to withstand an SSE. The drywell air cooler condensate flow monitoring system is qualified to withstand an OBE. A non-seismic noble gas monitoring system is provided to supplement the other two systems. Therefore the intent of Regulatory Guide 1.45 has been met and the recommendations of ANSI/ISA Standard 67.03 have been met or exceeded.

(d) Testing and calibration of the airborne radiation monitoring system is discussed in Section 5.2.5.2.1.5.

(e) Testing and calibration of the drywell sump level and air cooler condensate flow monitors is discussed in Sections 5.2.5.2.1.3 and 5.2.5.2.1.4, respectively.

(f) The drywell sump level monitoring system is designed to withstand an SSE as described in Section 5.2.5.2.1.3. Periodic testing is also described in this section.