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SEP 21 1984

Docket Nos. 50-352
50-353

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Limerick Generating Station, Units 1 & 2
Information for Containment Systems Branch (CSB)
Drywell/Suppression Chamber Vacuum Breaker Valve Position Switches

Reference: 9/20/84 Telecon Between D. R. Helwig (PECo) and F. Eltawila (NRC-CSB)

File: GOVT 1-1 (NRC)

Dear Mr. Schwencer:

Attached are draft changes to FSAR Sections 9.4.5.1.5 and response to RAI 480.7 which are being made as a result of discussions during the referenced telephone conversation.

The information contained on these draft FSAR changes will be incorporated into the FSAR, exactly as it appears on the attachments, in the revision scheduled for October, 1984.

Sincerely,

JW Gallagher
for
JS Kemper

DAA/cmv/09108413

Attachment

Copy to: See Attached Service List

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PDR ADOCK 05000352
A PDR

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Each gas sample line is provided with two solenoid valves in series, for containment isolation. The isolation signals to these valves may be overriden by using keylocked bypass switches.

Containment Hydrogen Recombiner Packages

In the event of a LOCA, hydrogen and oxygen may be generated inside the primary containment. To control the buildup of oxygen and prevent a combustible concentration from occurring, redundant containment hydrogen recombiners are provided, as described in Section 6.2.5. The process gas supply and return lines for the recombiner packages connect to the high-volume purge lines, inboard of the latter's containment isolation valves. The supply and return lines are each provided with a normally-closed, motor-operated butterfly valve for containment isolation. These valves may be operated from the control room during normal plant operation, and they automatically close upon receipt of a containment isolation signal. For operation of the recombiners after a LOCA, the isolation signals to these valves are overridden by using keylocked bypass switches. Redundant isolation valves will be added to the recombiner lines before the end of the first refueling outage. The portions of the recombiner system that would be exposed to the post-LOCA containment atmosphere have been designed to the same pressures and temperatures as the containment. Containment isolation is discussed further in Section 6.2.4.

Post-LOCA Purge

As a backup to the redundant oxygen recombiners, post-LOCA oxygen concentration can be controlled by purging the containment atmosphere. The post-LOCA purge is accomplished by the same method described above for the low-volume purge. Under post-LOCA conditions, however, the gases exhausted from the containment are processed through the RERS and the SGTS (both are described in Section 6.5.1) prior to release to the environment. The isolation signals to the containment isolation valves on the low-volume purge lines may be overridden by using keylocked bypass switches. Containment isolation is discussed further in Section 6.2.4.

Primary Containment Vacuum Relief Valve Assemblies

In order to limit the degree to which suppression chamber pressure can exceed drywell pressure, four primary containment vacuum relief valve assemblies are provided. The assemblies are located in the suppression chamber, each assembly being mounted on the side of a downcomer. Each assembly consists of two 24-inch (nominal diameter) vacuum relief valves mounted in series. When the suppression chamber pressure exceeds the drywell pressure by a specified amount, the vacuum relief valves open automatically, allowing gases from the suppression chamber to enter the downcomer and flow upward into the drywell, thereby equalizing pressure above and below the diaphragm slab.

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A single vacuum relief valve (upstream type) is shown schematically in Figure 9.4-6. The downstream valves are the same, except for a shorter body length. The valve consists of a swinging disk that closes an orifice in the body of the valve. The valve disk is keyed to a body-penetrating shaft that rotates as the disk opens or closes. By way of lever arms also keyed to this shaft, a compression spring holds the valve disk against the seat. When the differential pressure across the disk (in the opening direction) results in a force greater than the force exerted by the spring, the valve begins to open. The opening set pressure of the valve is 0.5 psid. However, because each assembly consists of two valves in series, measurable flow starts when the differential pressure across the valve assembly reaches about 1 psid, and both valves reach fully-open position when the differential pressure is 2.9 psid.

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The flow loss coefficient for the vacuum relief valves was calculated based on actual flow measurements conducted in the manufacturer's shop. The valve was mounted in a test rig, a differential pressure established across the valve, and the resulting flow rate was measured. Using this measurement, the loss coefficient for 24-inch pipe size was calculated to be 2.7 for a single valve and 5.63 for two valves mounted in series.

A valve operator is provided so that the valve can be opened to check the operation of the valve and the disk position indication system. Associated hand switches are located on a test panel in the reactor enclosure so that the valve may be tested remotely. When the switches are actuated, air pressure is applied to the actuating cylinder. This pressure overcomes the closing force applied by the spring and thus opens the valve.

9.4.5.1.3 Safety Evaluation

The safety-related functions of the CAC system include primary containment isolation, suppression chamber to drywell vacuum relief, suppression chamber pressure monitoring, and post-LOCA combustible gas monitoring and control.

All safety-related portions (including supporting structures) of the CAC system are designed to seismic Category I requirements as defined in Section 3.7. That piping which is safety-related is designed, fabricated, inspected, and tested in accordance with the requirements of the ASME B&PV Code, Section III, Class 2, as discussed in Section 3.2. All safety-related portions of the CAC system are located within the reactor enclosure, which is designed to seismic Category I requirements as discussed in Section 3.8.4. Evaluation of the CAC system with respect to the following areas is discussed in the following sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11

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Each line penetrating the primary containment (other than the hydrogen recombiner supply and return lines) is provided with redundant isolation valves powered from different divisions of Class 1E power. Therefore, in the event of failure of one division of Class 1E power, no more than one containment isolation valve in each pair is disabled, and the isolation function is assured. Each supply and return line for the hydrogen recombiners is provided with a single containment isolation valve. The hydrogen recombiner loops are closed systems outside containment, so that failure of an isolation valve in the open position would not constitute a breach of containment integrity. The bypass of an isolation signal to any valve is annunciated in the control room.

The simplicity of design of the primary containment vacuum relief valve assemblies assures their ability to operate, when necessary, to limit the differential pressure across the diaphragm slab. The valves are of the swing check configuration and require no motive power other than the differential pressure across the valve. The use of two valves in series within each assembly prevents a failure of any single valve in the stuck-open position from compromising the pressure suppression capability of the primary containment.

Post-LOCA combustible gas monitoring and control is discussed in detail in Section 6.2.5.

A failure modes and effects analysis for the CAC system and the drywell air cooling system is presented in Table 9.4-11.

9.4.5.1.4 Tests and Inspections

The CAC system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16. Inservice inspection of the safety-related portions of the system is in accordance with the ASME B&PV Code, Section XI, for Section III, Class 2 components.

The primary containment vacuum relief valve assemblies are preoperationally tested by the manufacturer to verify the opening set pressure. The set pressure is determined by applying a slowly increasing pressure to the inlet side of the valve and observing the point at which the inlet pressure suddenly stops increasing. This point indicates the start of leakage across the valve disk, which is the definition of the beginning of valve opening.

9.4.5.1.5 Instrumentation Applications

The CAC system is designed to be operated remotely from the control room. Power-operated valves are provided with hand switches and position indicating lights in the control room. All operations other than containment isolation are performed manually.

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The liquid nitrogen facility is provided with controls and instrumentation necessary to maintain the pressure and temperature of the gaseous nitrogen supplied by the facility within appropriate ranges. The steam inlet piping to the water bath vaporizer is provided with a control valve which modulates to control the rate of steam admission to the steam coil inside the vaporizer. A temperature sensor immersed in the water bath provides a signal to this control valve so that the water bath temperature can be automatically controlled within a preset range. The pressure of the gaseous nitrogen leaving the liquid nitrogen facility is maintained at 50 psig by a pair of pressure control valves located in the nitrogen supply piping downstream of the vaporizer. A dual setpoint temperature switch installed in the nitrogen supply piping near the two pressure control valves is wired into the control circuits of those two valves. The presence of nitrogen in the piping at a temperature outside the range defined by the setpoints of the temperature switch will cause the switch to trip and the pressure control valves to close, thereby terminating the flow of nitrogen gas from the liquid nitrogen facility.

During inerting of the primary containment through the high-volume purge penetrations, the desired flow rate of nitrogen into the high-volume purge piping is set by the operator on a flow controller in the control room. The measured flow rate in the nitrogen supply piping is displayed on the flow controller and is automatically compared to the value set on the flow controller; a signal corresponding to the difference between these two values is used to automatically modulate a flow control valve in the nitrogen supply piping so as to maintain the desired flow rate. When nitrogen is introduced into the primary containment in the low-volume purge mode, the nitrogen flow rate in the low-volume purge piping is recorded in the control room and the operator controls the flow rate by remotely actuating a motor-operated valve in that piping.

Gas pressure in the nitrogen supply lines is indicated in the control room. Temperature in the nitrogen supply lines is indicated locally.

Position indication for each (INBOARD) vacuum relief valve is provided by a set of position switches that operate off the same body-penetrating shaft to which the valve disk is attached. (POSITION INDICATION FOR EACH OUTBOARD VACUUM RELIEF IS PROVIDED BY A SET OF POSITION SWITCHES THAT ARE ACTUATED DIRECTLY BY THE VALVE DISK.) The redundant position switches and their associated indicating lights on a test panel in the reactor enclosure provide visual indication when the valve is "not fully closed" or "not fully open." When the valve is in an intermediate position, both the "not fully closed" and "not fully open" sets of lights are on. (SEE INSERT "A") ~~The plunger-type "not fully closed" switches have a hysteresis, or differential travel, of 0.004 inch. The switch hysteresis is multiplied through the mechanical linkage to the valve disk, so that when the valve is opening under differential pressure, the~~ (DELETE)

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INSERT "A"

"... WHICH LIMITS THE SENSITIVITY OF THE SWITCH. FOR THE OUTBOARD VALVE, THIS IS THE ONLY LIMITATION ON SWITCH SENSITIVITY. HOWEVER, FOR THE INBOARD VALVES, THIS HYSTERESIS IS MULTIPLIED THROUGH THE MECHANICAL LINKAGE TO THE VALVE DISK. THE POSITION INDICATING SWITCHES ARE CALIBRATED TO INDICATE INBOARD VALVE DISK DISPLACEMENT GREATER THAN OR EQUAL TO 0.120", AND OUTBOARD VALVE DISK DISPLACEMENT OF GREATER THAN OR EQUAL TO 0.050". THESE SETPOINTS ASSURE THAT THE STEAM BYPASS LEAKAGE PATH WILL BE MAINTAINED BELOW $\frac{A}{\sqrt{K}} = 0.046\ ft^2$ FOR THE VACUUM RELIEF SYSTEM, EVEN WITH ONE OF THE OUTBOARD VALVES IN THE FULLY OPEN POSITION."

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disk of the downstream valve is 0.06 inch off the seat before the "not fully closed" lights comes on. The upstream valve can be 0.06 inch off the seat in the same situation. When the valve is closing under differential pressure or when the valve is opening or closing by the actuator, the mechanical linkage ensures that the "not fully closed" lights are on unless the disk is on the seat. A valve position other than fully closed is annunciated in the control room.

Atmosphere temperature in the drywell and suppression chamber is monitored by two temperature elements in each volume. The temperatures at all four points are recorded simultaneously in the control room. Drywell temperature is also indicated at the remote shutdown panel.

Pressures in the drywell and suppression chamber are monitored by pressure transmitters mounted outside the containment and are indicated in the control room. Suppression chamber pressure is also recorded in the control room.

9.4.5.2 Drywell Air Cooling System

The drywell air cooling system serves to remove heat from the drywell during normal plant operations and to maintain air circulation in the drywell under accident conditions. This latter function is safety-related.

9.4.5.2.1 Design Bases

a. The drywell air cooling system is designed to limit the temperature inside the drywell, during normal reactor operation, to an average of 135°F, with the maximum not to exceed 150°F.

b. The drywell air cooling system is designed to limit the temperature inside the drywell, in the event of loss of offsite power and reactor scram, to 186°F in general drywell areas and 210°F in the area below the reactor vessel (inside the reactor pedestal).

c. The drywell air cooling system is designed to prevent concrete structures within the primary containment from exceeding their maximum design temperature during normal operation.

d. The drywell air cooling system is designed to maintain the drywell atmosphere in a thoroughly mixed condition following a LOCA to prevent stratification of oxygen that may be generated as a result of the accident.

e. Safety-related portions of the drywell air cooling system are designed to remain functional after an SSE.

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QUESTION 480.7 (Section 6.2.1.1)

Appendix I to SRP Section 6.2.1.1.C provides criteria designed to upgrade the steam bypass capability of the Mark II containment design and to assure that the bypass leakage is not substantially increased over the life of the plant. Provide the following information to demonstrate compliance with Appendix I to SRP Section 6.2.1.1.C:

a. The analysis of the Limerick steam bypass capability for small breaks presented in FSAR Section 6.2.1.1.5 is unacceptable. Provide an analysis that shows the suppression chamber design pressure is not exceeded when a leakage area of $A/\sqrt{K}$ equal to 0.05 ft^2 is assumed and a minimum of 30 minutes is assumed for operator action to terminate the suppression chamber pressure transient following indication in the main control room that a bypass leakage path exists. Specify the plant parameter that will indicate the existence of a bypass leakage path, and commit to providing main control room annunciation of this condition. Also specify the specific operator action that will be taken to terminate the suppression chamber transient. If this analysis shows the suppression chamber design pressure is exceeded prior to the time when operator action can be assumed, then NRC's position is that the wetwell spray must be automatically actuated. If the wetwell sprays must be automatically actuated, the consequences of automatic actuation of the wetwell sprays on ECCS function and long-term pool cooling must be evaluated to show that the minimum ECCS and pool cooling requirements are met.

b. Provide a complete description of the transient analysis requested in part (a) including all analysis assumptions; initial conditions; the pressure history in the drywell and wetwell; wetwell spray capacity, efficiency, coverage, start time and temperature history; and identification and quantification of heat sources. In addition, for the wetwell spray nozzles, provide the spectrum of drop sizes and mean drop size emitted from the nozzles as a function of pressure drop across the nozzles and describe how this data was obtained (e.g., a spray nozzle test program). Also, discuss the consideration given to evaporation due to impingement of spray water on the hot downcomer surfaces.

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c. If the wetwell spray system is to be used to mitigate the consequences of suppression pool steam bypass either manually or automatically, it is our position that the wetwell spray headers must meet Quality Group B standards rather than the Quality Group C standards shown in FSAR Table 3.2-1. Provide information on how you will comply with this position.

d. Per the guidance of SRP 6.2.1.1.C (Appendix I) it is our position that a preoperational high-pressure leakage test and postoperational low-pressure leakage tests should be performed to detect leakage from the drywell to the suppression chamber. The high-pressure test should be performed at approximately the peak drywell to wetwell differential pressure. The low-pressure test should be performed at a differential pressure corresponding to approximately the submergence of the vents during each refueling outage. Acceptance criteria for both tests shall be a measured leakage less than 10% of the capability of the containment to accommodate bypass leakage at the test pressure. Verify that the above testing requirements will be met for Limerick.

e. Verify that a visual inspection will be conducted during each refueling outage to detect possible leakage paths and to check each vacuum relief valve and associated piping to determine that it is clear of foreign matter.

f. Demonstrate that the vacuum relief valve position indicator system has adequate sensitivity to detect a total valve opening, for all valves, that is less than the bypass capability of a small break. The detectable valve opening should be based on the assumption that the valve opening is evenly divided among all the vacuum breakers.

g. Verify that the vacuum breakers will be tested for operability at monthly intervals.

RESPONSE

a. No automation of the wetwell spray system is needed. It has been determined for the SBA that the minimum time available to the operator to terminate suppression chamber pressurization by manually activating the

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wetwell spray system exceeds the SRP 30 minute criterion for operator action.

The operator will be alerted to the existence of significant steam bypass leakage by the attendant drywell pressure increase which the operator will be monitoring as part of the emergency procedures. The operator will initiate the wetwell spray in accordance with plant emergency procedures which will be based on the BWR Owners Group Emergency Procedure Guidelines (EPGs). These EPGs explicitly consider the possibility of suppression pool bypass leakage in determining spray initiation points. The BWROG EPGs have been reviewed and approved by the NRC (Memorandum for D. Eisenhut (NRC) from R. Matson and H. Thompson (NRC) dated December 9, 1982).

Termination of the wetwell (and drywell) pressure increase is assured by the operation of only one of the two wetwell sprays.

b.1 Assumptions

The following assumptions were made in performing the small break bypass leakage computations to demonstrate conformance to the SRP 30 minute criterion.

a. The steam that leaks into the wetwell air space does not mix with the air already there.

b. No portion of the steam that has leaked into the wetwell air space condenses.

c. Only steam leaks into the wetwell; any air moving from the drywell into the wetwell goes through the vents.

d. All of the air initially in the drywell is cleared into the wetwell before the moment when the operator is alerted.

e. The vents do not refill with water during the time span considered in this procedure.

f. The flow of steam through leakage paths is treated as being incompressible.

g. The pressure difference across the leakage path is assumed to be constant and equal to the vent submerged hydrostatic pressure difference.

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h. The drywell pressure at which the operator is alerted is 30 psig.

i. The wetwell air temperature when the operator is alerted to the occurrence of bypass leakage is assumed to be equal to the initial wetwell temperature (95°F). Later, when the drywell pressure is reduced due to operator action, the wetwell air temperature is assumed to be 50°F greater than the initial wetwell temperature, i.e., 145°F.

j. Maximum allowable leakage area $A/\sqrt{k} = 0.05\ ft^2$.

k. The wetwell air space is saturated at the time of spray initiation.

2. <u>Initial Conditions</u>

Drywell Temperature	135°F
Drywell Pressure	15.45 psia
Drywell Relative Humidity	20%
Wetwell Temperature	95°F
Wetwell Relative Humidity	100%
Drywell Volume	248390 ft^3 (HWL)
Wetwell Volume	149425 ft^3 (HWL)
Vent Submergence	12.25 ft (HWL)

3. <u>Time for Operator Action</u>

Using the above assumptions and initial conditions, a small break LOCA in the drywell produces a constant drywell-to-wetwell pressure differential equivalent to the vent submergence static head (5.28 psid). The resulting bypass steam flow through the leakage path of $A/\sqrt{k} = 0.05\ ft^2$ is 3.76 lbm/s. The operator becomes alerted to the existence of bypass leakage when the drywell pressure reaches 30 psig. For the drywell pressure to increase from 30 psig to 55 psig (design pressure), the corresponding wetwell pressure rise is from 24.72 to 49.72 psig. Therefore, based on the amount of bypassed steam needed to produce this pressure rise, the operator has about 31 minutes to complete an action that will terminate the pressure increase.

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4. Wetwell Spray Termination Adequacy

The following table shows the minimum required spray efficiency as a function of spray temperature. Because the wetwell airspace is saturated when the spray is initiated (this conservative assumption maximizes pressurization at a given temperature), no net evaporation from hot downcomer surfaces will occur to counteract the spray depressurization effect. The mass flow rate of one spray system is 500 gpm. With two spray systems in operation, the required efficiency would be halved. The spray efficiency is typically on the order of 0.7 and, therefore, even with a single system is operation, the termination of the wetwell (and drywell) pressure increase is assured.

Spray Temperature	Required Efficiency of 1 Wetwell Spray System
70°F	0.22
90°F	0.24
120°F	0.28

c. Table 3.2-1 has been changed to correct the quality group classification.

d. Section 6.2.6.5.1 and Table 14.2-4 have been changed to provide the requested information.

e. A visual inspection will be conducted at each refueling outage to detect possible drywell-to-suppression bypass leakage paths. A visual inspection of each primary containment vacuum relief valve assembly will be conducted during each refueling outage to verify that it is clear of foreign matter.

f. The vacuum relief valve position indicator system has adequate sensitivity to detect a total valve opening, for all valves, that is less than the bypass capability for a small break. ~~Valve opening is detectable at a disk lift of 0.06 inches or greater above the valve seat. Even assuming that all the vacuum breakers are open by 0.06 inches, the corresponding leakage area, A/√k, is well below 0.05 ft².~~ Therefore, the valve leakage, which is based on the assumption that the valve opening is evenly divided among all the vacuum breakers, is well within the limits of acceptable bypass leakage.

REPLACE WITH INSERT "B"

..., WITH ONE OUTBOARD VALVE IN THE FULLY OPEN POSITION, ...

g. Vacuum breakers will be tested for operability at an interval specified by the technical specifications.

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INSERT "B"

"... OUTBOARD VALVE OPENING IS DETECTABLE AT A DISK LIFT OF 0.050" OR GREATER ABOVE THE VALVE SEAT. INBOARD VALVE OPENING IS DETECTABLE AT A DISK LIFT OF 0.120" OR GREATER ABOVE THE VALVE SEAT. EVEN ASSUMING THAT ONE OUTBOARD VALVE IS IN THE FULLY OPEN POSITION, AND ALL OTHER VALVES ARE OPEN BY THEIR MINIMUM DETECTABLE AMOUNTS, THE CORRESPONDING LEAKAGE AREA, $\frac{A}{\sqrt{k}}$, IS WELL BELOW 0.05 ft^2."