Boston Edison
Pilgrim Nuclear Power Station
Rocky Hill Road
Plymouth, Massachusetts 02360

L. J. Olivier
Vice President Nuclear Operations
and Station Director

January 28, 1997
BECo Ltr. 2.97-006

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Docket No. 50-293
License No. DPR-35

120 Day Response to Generic Letter 96-06
Assurance of Equipment Operability and Integrity During Design-Basis Accident Conditions

Generic Letter (GL) 96-06 requested addressees to determine:

1) if containment air cooler cooling water systems are susceptible to either waterhammer or two phase flow conditions during postulated accident conditions; and

2) if piping systems that penetrate the containment are susceptible to thermal expansion of fluid so that overpressurization of piping could occur.

Within 120 days of the GL date, a written summary report is required stating actions taken in response to the requested actions noted above, conclusions that were reached relative to susceptibility for waterhammer and two-phase flow in the containment air cooler cooling water system and overpressurization of piping that penetrates containment, the basis for continued operability of affected systems and components as applicable, and corrective actions that were implemented or are planned to be implemented. If systems were found to be susceptible to the conditions that are discussed in the generic letter, identify the systems affected and describe the specific circumstances involved.

Attached is Pilgrim Station's 120 day summary report in response to the above.

L. J. Olivier

A072 1/1

Attachment: GL 96-06 Summary Report
JDK\dmc\radmisc\gl96-06A

Commonwealth of Massachusetts)
County of Plymouth)

Then personally appeared before me, L. J. Olivier, who being duly sworn, did state that he is Vice President Nuclear Operations and Station Director of Boston Edison Company and that he is duly authorized to execute and file the submittal contained herein in the name and on behalf of Boston Edison Company and that the statements in said submittal are true to the best of his knowledge and belief.

My commission expires: September 20, 2002 Peter M Kohler
DATE NOTARY PUBLIC

cc: Mr. Alan B. Wang, Project Manager
Project Directorate I-1
Office Of Nuclear Reactor Regulation
Mail Stop: 14B2
1 White Flint North
11555 Rockville Pike
Rockville, MD 20852

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Senior Resident Inspector
Pilgrim Nuclear Power Station

CONTAINMENT AIR COOLING WATER SYSTEM

The reactor building closed cooling water (RBCCW) system loop B provides the cooling water for the containment air coolers. The containment air coolers at Pilgrim Station do not perform any active safety-related function in response to any postulated design basis accidents. However, the portion of the RBCCW system (loop B non-essential piping) that cools the containment air coolers is required to maintain pressure boundary integrity (a passive safety function) to,

- maintain a closed system configuration (i.e., the piping does not communicate with the reactor coolant pressure boundary or the containment atmosphere) and,
- prevent loss of RBCCW fluid that could jeopardize the ability of the RBCCW safety-related (essential) portion of the system to perform its safety function.

We performed an evaluation of the RBCCW system inside containment subject to heating during design basis loss-of-coolant accidents and concluded the system is not susceptible to waterhammer or two-phase flow that would degrade pressure boundary integrity or RBCCW safety-related heat removal performance. Thus, the system is operable and corrective actions are not required. The details of our evaluation are described below.

During a postulated design basis loss-of-coolant accident (DBA-LOCA) with a concurrent loss of off-site power (LOOP), the component cooling water pumps temporarily lose power until the emergency AC power system is initiated and AC power is restored by the emergency diesel generators (EDGs). LOCA containment heat removal is accomplished via the residual heat removal (RHR) system together with the RBCCW and salt service water (SSW) systems. The RHR pumps are part of the emergency core cooling system (ECCS) and are started early in the EDG loading sequence. The first SSW and RBCCW pumps are restarted after a short, and intentional, time delay. The RBCCW system restarts with the same system lineup in which it shut down, which is assumed to be the normal system lineup. Loop B of RBCCW includes the drywell coolers, which provide drywell temperature control when the plant is operating at normal full power conditions. The drywell coolers are not needed for containment heat removal during emergency conditions and are not included as active components in the design basis accident analyses.

For the DBA-LOCA event, the drywell rapidly achieves saturated steam conditions with the peak temperature and pressure occurring within the first ten seconds. Main steam line break (MSLB) events create superheated steam conditions but at initially lower pressures than the DBA-LOCA. With a concurrent LOOP or degraded AC voltage, the drywell cooler fans and RBCCW cooling water flow will stop. With no forced circulation,

the water within the drywell coolers and associated piping will heat up due to the steam condensation on the tube outside surface and free convection currents formed within the tubing. After the appropriate time delays, the cooling water pumps restart. The drywell cooler fans do not automatically restart without an intentional manual reset being performed.

BECo performed calculations to determine the time required for the water in the lowest pressure drywell cooler to reach saturation and begin boiling. Due to its elevation relative to the RBCCW head tank, the lowest pressure drywell cooler under static conditions has a saturation temperature of 261°F. Using the worst case saturated steam conditions in the drywell and zero fouling assumed for the cooler, a thermal calculation was done using conservative assumptions such that the results represent the bounding lower limit for the cooler heatup time. These bounding results show that the saturation temperature of 261°F is achieved within the cooler tubes approximately 72 seconds after the DBA LOCA/LOOP event. Considering the subsequent heatup of the surrounding subcooled water in the connected piping to the same saturation temperature, it was determined that it will be approximately 94 seconds before a stable vapor bubble can be formed within the cooler.

Following a LOOP, the first RBCCW pump is restarted after 45 seconds. If necessary due to failure of the first pump to start, a second RBCCW pump starts after 75 seconds. If the pumps had been stopped due to a load shed with off-site power available, they would restart at approximately the same time as for the LOOP case. It was concluded that under design basis conditions, with either the first or second RBCCW pump starting per the automatic sequencing following a LOCA/LOOP, there will not be a condensation-induced water hammer transient caused by steam vapor in the drywell coolers. These calculations are considered to be conservative and to bound other events and transients that create a less severe steam environment in the drywell.

The design basis accident analysis does not consider the use of the drywell coolers for post-accident containment heat removal, and the supply and return lines may be isolated along with other non-essential heat loads in the RBCCW system. This isolation of the non-essential heat loads is assumed to be manually initiated after the system has restarted and is assumed to occur at 10 minutes into the event for the DBA-LOCA analysis. Although not a design basis situation, it is possible that operators may at some later time choose to open the isolation valves and restore RBCCW flow to the drywell coolers. At all times after the first ten minutes into a LOCA or MSLB event, the drywell saturation condition drops below 270°F. The isolated drywell coolers may, therefore, be pressurized at a saturated equilibrium condition of approximately 270°F. When the isolation valves are opened with the RBCCW pumps operating, the system pressure will be greater than the isolated portion, and the water that was in the drywell coolers and piping will remain subcooled as it is flushed out. It is, therefore, concluded that condensation-induced water hammer will not occur if the drywell coolers are manually restarted after having been isolated.

Since the drywell coolers are not required for post-accident heat removal, the expected performance or efficiency of the operating units under post-accident conditions was not rigorously analyzed. The drywell coolers are intended for sensible and latent heat removal for dry or moist air (or nitrogen) under normal plant operating conditions. The post-accident steam environment is not the intended service, and the actual heat transfer achieved is not included in any design basis accident analysis. If the plant were in the limiting case for the design basis accident in which only one loop of containment heat removal was operating, that loop would be operated in the most efficient containment cooling mode which maximizes the RBCCW flow to the RHR heat exchanger. The available containment cooling modes are LPCI with heat rejection and suppression pool cooling with or without containment spray.

For potential accident cases where the drywell coolers may continue to be used, the proportion of flow passing through the parallel flow path of the RHR heat exchanger will still be several times greater than through the drywell coolers. The return flow from the RHR heat exchanger (cooling water outlet) will also be substantially subcooled with design temperatures under 142°F. Therefore, the smaller heated water return flow from the drywell coolers will be joining with this subcooled water returning to the RBCCW heat exchanger. It is concluded that there is no potential condition where any significant vapor from the operating drywell coolers would be carried by two-phase flow to any extent that restricts the essential cooling water flow, accumulates in the RBCCW system, or results in a waterhammer.

DRYWELL PENETRATION PIPING

A review of drywell penetration piping was performed to determine the susceptibility of each line to thermal expansion of fluid such that thermal pressurization of the line could occur. The review revealed that the piping at the following six drywell penetrations is subject to thermal pressurization effects:

- RBCCW System Supply to Drywell (Penetration X-23)
- RBCCW System Return from Drywell (Penetration X-24)
- Core Spray Sample Line (Penetration X-28A)
- Residual Heat Removal (RHR) Shutdown Cooling Suction Line (Penetration X-12)
- Drywell Equipment Sump Pump Discharge Line (Penetration X-19)
- Drywell Floor Sump Pump Discharge Line (Penetration X-18)

Each of the lines is discussed in detail in the following sections.

RBCCW System Supply to Drywell (Penetration X-23) and RBCCW System Return from Drywell (Penetration X-24)

RBCCW system loop B supplies cooling water to various non-essential components within the drywell. The cooling water passes through the single isolation valve located outside containment, check valve 30-CK-432, and enters the drywell at penetration X-23. After cooling the various non-essential loads within the drywell, the cooling water exits the drywell at penetration X-24 and passes through a single isolation valve, motor operated valve MO-4002, that is located outside containment. The RBCCW piping passing through penetrations X-23 and X-24 is six inch diameter piping.

Valve 30-CK-432 is normally open due to the RBCCW flow and will automatically close upon a reversal of process fluid flow. Valve MO-4002 is a normally open valve that does not receive any automatic isolation signals. Valve MO-4002 can be manually closed by control room operators via the remote manual control switch located on control room panel C-1. The only scenario where operators would be required to close MO-4002 would be for a breach of the RBCCW piping inside containment. Operators are not directed to close valve MO-4002 for any other reason.

The normal system lineup precludes overpressurization since the lines communicate with the RBCCW surge tank. In the event that operators isolate these lines from the RBCCW surge tank by closing the non-essential loop block valves, MO-4009A and MO-4009B, with valve MO-4002 open, RBCCW relief valve PSV-4033, located on the reactor water cleanup (RWCU) non-regenerative heat exchanger, E-216B, protects the RBCCW piping at drywell penetrations X-23 and X-24 from overpressurization. In light of this protective function and GL96-06 concerns, PSV-4033 will be added to the IST Program and will be tested or replaced with a tested or new relief valve during Refuel Outage 11 (commencing in February 1997).

Core Spray Sample Line (Penetration X-28A)

The core spray system sample line penetrates the primary containment at penetration X-28A. This line is normally isolated between the inboard isolation valve, 1400-64A, and the outboard isolation valve, 14-HO-5. The volume of liquid between valves 1400-64A and 14-HO-5 is trapped and could become pressurized such that the line could fail under postulated accident conditions. The line is uninsulated and is configured as follows,

- 3/4" Schedule 80S stainless steel piping from valve 1400-64A reduces to 3/8" stainless steel tubing (nominal wall thickness of 0.062") inside the containment, and

- the 3/8" tubing connects to 1" Schedule 80 stainless steel piping that penetrates the containment and connects to valve 14-HO-5.

If the piping were to fail inside the primary containment, primary containment integrity is maintained by the piping outboard of the penetration and outboard isolation valve 14-HO-5. Similarly, for piping failure outside primary containment, the piping inboard of

the penetration and inboard isolation valve 1400-64A maintain primary containment integrity.

To preclude failure of the line, the line will be unisolated by opening valves 1400-64A and 1400-63A during Refuel Outage 11. Opening the valves will connect the line to the reactor pressure vessel and prevent the buildup of pressure in the line.

Residual Heat Removal (RHR) Shutdown Cooling (SDC) Line (Penetration X-12)

The RHR SDC line penetrates the primary containment at penetration X-12. This 20" diameter line is insulated and is normally isolated between the inboard isolation valve, MO-1001-50, and the outboard isolation valve, MO-1001-47. This line has approximately 5 feet of exposed piping within the containment to absorb the thermal energy from the containment atmosphere and approximately 40 feet of piping outside the containment to dissipate the pressure energy. Even assuming that the insulation inside containment is removed during the event, the pressure in the line remains below the maximum operating pressure of the line during postulated DBA-LOCA and MSLB events. Thus, no corrective actions are required for this penetration.

Drywell Floor Sump Pumps Discharge Line (Penetration X-18) and Drywell Equipment Sump Pumps Discharge Line (Penetration X-19)

The drywell floor sump pumps discharge line penetrates the primary containment at penetration X-18. This 2" diameter piping is uninsulated and is normally isolated between the pump discharge check valves, 20-CK-213 and 20-CK-223, which close upon the cessation of flow, and the first outboard containment isolation valve, AO-7017A, which is normally closed.

The drywell equipment sump pumps discharge line penetrates the primary containment at penetration X-19. This 2" diameter piping is uninsulated and is normally isolated between the pump discharge check valves, 20-CK-152 and 20-CK-154, which close upon the cessation of flow, and the first outboard containment isolation valve, AO-7011A, which is normally closed.

These lines consist of piping spools, valves, and a pressure switch. There are both flanged joints and socket welded fittings in the system. The system is designed to operate at 50 psig and 210°F. The piping inside the containment does not perform any safety-related function. The piping outside the containment penetration is safety-related in order to maintain primary containment integrity and is designed to meet Seismic Class I criteria.

An initial engineering analysis of the effects of postulated DBA-LOCA and MSLB temperatures on these lines was performed. The analysis concluded that, during heat-up of the trapped volume, leakage will occur at the flanged joints inside the drywell that will preclude pressure build-up to any degree that could threaten failure of other components in the system. Except for the flanged joints and the 150# check and plug valves, all other system components involved are over-specified for the low operating conditions (i.e., Sch 80 piping, 3000 psi socket-welded fittings, and a pressure switch that was proof tested to 1200 psi.). The low strength flange bolts (with red rubber

gaskets) are not likely to be installed with a preload that will maintain leak tightness during significant pressure increases. Additionally, only the piping inside the drywell will be expanding at accident temperatures. The safety-related Seismic Class I piping outside the primary containment will be at a much lower ambient temperature. Thermal moment loading on the flanged joints inside the drywell was shown to exceed the flange design criteria provided in current piping codes. Although this is not an indication of imminent component failure, it is an indication that the flange will be susceptible to leakage.

Thus, any thermally induced pressure increases developed in this piping will be intermittently relieved as leakage through the flanged joints inside containment, and primary containment integrity is maintained by the containment outboard piping and isolation valves.

To ensure that pressure build-up due to fluid thermal expansion is limited, a pressure relieving device will be added to each sump pump discharge line within the containment during Refuel Outage 11.