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A. Edward Scherer
Manager of
Nuclear Regulatory Affairs

October 30, 1998

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

Gentlemen:

Subject: **Docket Nos. 50-361 and 50-362**
Generic Letter 96-06: "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," Additional Information San Onofre Nuclear Generating Station Units 2 and 3

Reference: Letter from James W. Clifford (NRC) to Harold B. Ray (SCE), dated August 24, 1998, Subject: Request for Additional Information Related to GL 96-06 Response for San Onofre 2 and 3 (TAC Nos. M96862 and M96863)

This letter provides the additional information concerning Generic Letter (GL) 96-06 requested in the referenced August 24, 1998, NRC letter to the Southern California Edison Company (SCE). The additional information is contained in the enclosure to this letter.

SCE is providing the San Onofre Units 2 and 3 responses to the questions asked in the referenced letter without waiting for the completion of an EPRI project to address the issues associated with waterhammer and two phase flow. SCE is providing this information now, because the analysis for San Onofre Units 2 and 3 shows that there is no waterhammer or two phase flow in the cooling water systems associated with either the normal or emergency cooling units. However, SCE is actively participating in the EPRI project to ensure that as information is learned from the EPRI project it can be evaluated for applicability at San Onofre Units 2 and 3.

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P. O. Box 128
San Clemente, CA 92674-0128
949-368-7501
Fax 949-368-7575

If you have any questions or would like additional information, please let me know.

Sincerely,

Enclosure

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 & 3
J. W. Clifford, NRC Project Manager, San Onofre Units 2 and 3

ENCLOSURE

Containment Normal and
Emergency Cooling Units (NCUs & ECUs)

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Question 1. NCUs Only

The effects of waterhammer and two phase flow in the NCUs have not been adequately addressed. While the heat removal function may not be required for accident mitigation, containment integrity must be assured. A severe waterhammer in the normal chilled water system could damage containment isolation valves and rupture system piping such that the containment integrity could be violated. Describe measures that exist or will be taken to assure that waterhammer and two phase flow conditions will not occur in the normal chilled water system.

Response to Question 1. NCUs Only

The Containment Chilled Water System is shown schematically in Figure 1. The response is valid for both Units 2 and 3 because the Containment Chilled Water System supplying the NCUs of the two units are identical and independent. The function of the Chilled Water system is to remove the heat from the Containment Normal Cooling Units (NCUs). There are five 25% capacity NCUs that are serviced by the Containment Chilled Water System. Four NCUs operate continuously during normal operation. The chilled water flow rate through the cooling coil is regulated by a 3-way bypass type temperature control valve. The chilled water from the NCUs flows into a return header, having two containment isolation valves (HV-9971, HV-9921). The return header is connected through an air separator to the suction of the chilled water pump. A compression tank is connected to the air separator. Any air that is released from the chilled water is separated from the system by channeling it to the compression tank. Note, the compression tank and its connection to the system piping are located outside the containment. Two 100% capacity chilled water pumps are provided, but normally only one pump is running and one pump is in standby. The discharge of the pump is connected to a chiller unit which removes the heat from the chilled water. The chilled water from the outlet of the chiller flows through a header, having two containment isolation valves(HV-9920, HV-9900), to the inlet side of the coolers.

Referring to Figure 1, the containment isolation valves, HV-9900 and HV-9971 (located inside the containment), are motor operated 8" butterfly valves that close on the Containment Isolation Actuation Signal (CIAS) OR the Safety Injection Actuation Signal (SIAS). These valves are fail AS IS.

The containment isolation valves HV-9920 and HV-9921 are air operated 8" butterfly valves that close on the Containment Isolation Actuation Signal (CIAS) OR the Safety Injection Actuation Signal (SIAS).

The CIAS is automatically initiated by 2-out-of-4 high containment pressure signals of 3.4 psig OR loss of power to 2-out-of-4 measurement channels. The set points for the SIAS are 2-out-of-4 high containment pressure signals of 3.4 psig, OR low pressurizer pressure of 1740 psia. Thus, CIAS and SIAS would be initiated for a loss of coolant accident (LOCA) and main steam line break (MSLB). The close signal from any of the four isolation valves HV-9900, 9971, 9920, or 9921 will trip the chilled water pumps. The pumps also provide the chiller trip signal for low pump discharge/chiller unit cooler flow.

The plant Emergency Operating Instructions do not permit opening of the containment isolation valves until the containment pressure and temperature are less than 3.4 psig and 143 F, respectively. Hence, in the event of a postulated accident, such as a LOCA or MSLB, the chilled water system inside the containment will be bottled up between the closed isolation valves located at the inlet and outlet headers. The formation of cavities or boiling of the liquid cannot occur because there is no space to expel the liquid (bounded by the closed isolation valves) and replace it with vapor. The chilled water system inside containment is stagnant and precludes any type of waterhammer or two phase conditions. Pressurization of the liquid (due to thermal effects) between the two containment valves has been dealt with separately in Reference 1. The existing measures are, therefore, sufficient to ensure that there will be no waterhammer or two phase flow in the normal chilled water system.

Question 2. ECUs Only.

Discuss specific system operating parameters and other operating restrictions that must be maintained to assure that the waterhammer and two phase flow analysis for the ECUs remain valid (e.g., component cooling water surge tank level, pressure, temperature), and explain why it would not be appropriate to establish Technical Specification requirements to acknowledge the importance of these parameters and operating restrictions. Also, describe and justify reliance on any non-safety related instrumentation and controls in assuring that these conditions are satisfied.

Response to Question 2. ECUs Only.

System Operating Parameters and Restrictions

1) The initial Component Cooling Water (CCW) inlet temperature to the ECUs at the initiation of a LOCA and MSLB was assumed to be 95 F. This is the maximum normal operating temperature and is therefore a conservative assumption.

2) The assumption of a LOCA with loss of offsite power (LOOP) was found to be the bounding case. From the temperature time history for a Design Basis LOCA, which is based on a 9.8175 ft^2 double ended suction slot break, the peak temperature of 280 F was assumed (conservatively for analysis), to be the constant temperature inside the containment.

3) Initial conditions of the surge tank:

Temperature = 100 F (Maximum)
Water level = 15.4 ft (Minimum) to 21.2 ft (Maximum)
Pressure = 46.7 psia (Minimum)

To account for regulator "droop," no credit is taken for any Nitrogen flow into the surge tank until the pressure differential between the regulator set point and the surge tank exceeds 7 psi.

Technical Specification Requirements

Because the parameters above (items 1 and 3) are maximum and minimum normal operating values, an abnormal event would have to occur to cause these values to be exceeded. Therefore, it is not necessary to control these values by a Technical Specification. The CCW inlet temperature would exceed 95 F only in an abnormal condition.

Similarly, an abnormal event would have to occur for the CCW surge tank temperature to exceed 100 F. The CCW non critical loop is automatically isolated from the critical loop, which includes the surge tank, upon reaching the 15.4 ft level (equivalent to the low-low water level of the surge tank). The CCW surge tank is filled manually by procedure. The direct attention of the operator during the filling evolution is adequate to ensure the surge tank is not operated at a level greater than the 21.2 ft maximum.

The backup nitrogen system bottle pressure and third stage regulator setpoint are subject to surveillance requirements in the Technical Specifications. This surveillance helps to ensure that the CCW surge tank pressure is maintained above 46.7 psia (prior to a LOCA or a MSLB). By letter dated September 13, 1995, (Reference 2) the NRC issued Amendment No. 125 to Facility Operating License No. NPF-10 and Amendment No. 114 to Facility Operating License No. NPF-15 for San Onofre Nuclear Generating Station, Unit Nos. 2 and 3. These amendments consist of changes to the Technical Specifications (TS) in response to the Southern California Edison (SCE) application dated May 20, 1994 (Reference 3).

These amendments revised the TS and corresponding Bases to support the addition of the component cooling water surge tank backup nitrogen supply system.

Based on the above discussion, SCE believes that additional TS changes are not required at this time to prevent waterhammer or two phase flow.

Reliance on Any Non-Safety Related Instrumentation and Controls

The analysis is conservative relative to the non-safety related system instrumentaion. CCW critical loop inlet temperature instrumentation is non-safety related. However, this temperature to the ECUs is normally less than 80 F, which is substantially less than the assumed design maximum normal operating temperature of 95 F, which can be exceeded only in an abnormal condition. Therefore, 95 F is a conservative assumption.

The CCW surge tank level annunciator system and alarms are not safety related. This is consistent with the plant licensing basis, which requires instrumentation and controls to be safety related only for safe shutdown, accident mitigation, or accident monitoring. However, the CCW surge tank level indication, which drives the annunciator system and the high and low level alarm, is safety related. The CCW non critical loop is automatically isolated from the critical loop, which includes the surge tank, upon reaching the 15.4 ft level (equivalent to the low-low water level of the surge tank). The CCW surge tank is filled manually by procedure. The direct attention of the operator during the filling evolution is adequate to ensure the surge tank is not operated at a level greater than the 21.2 ft maximum.

Question 3. NCUs and ECUs

Confirm that the waterhammer and two phase flow analyses associated with the NCUs and ECUs considered all scenarios, taking into consideration the complete range of event possibilities, parameters, and system configurations (include those where affected containment penetrations are not isolated, if this is a possibility). Also, confirm the worst case conditions have been identified, and the measures that have been established are adequate to prevent the occurrence of waterhammer and two phase flow in the cooling water system associated with NCUs and ECUs during (and following) these postulated accident scenarios, including those that were determined to be the worst case. Describe the worst case scenario.

Response to Question 3. NCUs and ECUs

Considering all scenarios, and taking into account all the system configurations and parameters, SCE finds that analyses for waterhammer or two phase flow are not required for either the NCUs and the ECUs, because in both (NCUs and ECUs) cases there was no void formation. The existing plant conditions are adequate to prevent voiding or two phase flow conditions. Hence, additional measures were not considered. The explanation for the individual NCU and ECU cases are discussed below.

Response to Question 3. NCUs

The Safety Injection Actuation Signal (SIAS) closes all four containment isolation valves (HV-9920, HV-9921, HV-9900, HV-9971) in the event of a serious breach of the reactor coolant system (LOCA), main steam line (MSLB), or feedwater line. Two of these isolation valves, HV-9920 and HV-9921, which are air operated, fail closed. Hence, they will also close on loss of power. Even for the worst case scenario of a LOCA or a MSLB with a coincident LOOP the containment isolation valves HV-9920 and HV-9921 will close. The closure of these isolation valves will bottle up the NCUs chilled water system, and this will prevent the occurrence of waterhammer or two phase flow. Therefore, there is no need for any analysis.

Response to Question 3. ECUs

Since the geometry of both trains A and B and Units 2 and 3 are similar, especially at the elevations in the ECU area inside containment, only the Unit 2 train A was analyzed and the results are applicable to both trains of both Units. The analysis was performed for both LOCA and MSLB, with and without LOOP. Several runs were performed by varying the surge tank levels. The worst case has been identified as a LOCA with a LOOP, with the initial (time t=0 seconds) surge tank level of 15.4 ft, and tank pressure of 46.7 psia. The sequence of events for the worst case scenario is given below.

LOCA at t=0.0 seconds
LOOP, CCW pumps trip, SIAS/CIAS at t=7.0 seconds
Non-critical loop is isolated from the rest of CCW system at t=28 seconds.
CCW pump starts at t=35.0 seconds.

The results of the analysis indicate that boiling will not occur in the ECU coils for all the cases analyzed, including the worst-case. Since there is no voiding in the system, no waterhammer or two phase flow will occur when the CCW pump is started.

The most significant factors responsible for the San Onofre Nuclear Generating Station ECU's immunity to waterhammer and two-phase flow are the following two design features:

1) the CCW Surge Tank Backup Nitrogen Supply System, which provides surplus pressure at the ECUs, raising the saturation point, and

2) the throttle valves downstream of the ECUs, at a lower elevation, which increase backpressure at the ECUs during a transitory loss of system inventory through a break in the non-critical loop piping.

Question 4. NCUs and ECUs

Confirm that the waterhammer and two phase flow analyses associated with the NCUs and ECUs included a complete failure mode and effects analyses (FMEA) for all components (including electric and pneumatic failures) that could impact performance of the cooling water system, and confirm that the FMEA is documented and available for review or explain why a complete and fully documented FMEA was not performed.

Response to Question 4. NCUs and ECUs

As pointed out above (in the response to Question No. 3), there is no possibility of waterhammer or two phase flow conditions in the systems associated with NCUs or ECUs due to any accident conditions. For the NCUs, there is no single failure that could worsen the calculated results. For the ECUs, CCW FMEAs listed in the Updated Final Safety Analysis Report (UFSAR) Table 9.2-3A were considered. However, the bounding single failure which was considered in the GL 96-06 analysis is failure of a diesel generator to start after a loss of offsite power. Therefore, there is no need for any additional FMEAs to be performed.

Question 5. NCUs and ECUs

Explain and justify all uses of "engineering judgment" associated the waterhammer and two phase flow analysis for the NCUs and ECUs.

Response to Question 5. NCUs and ECUs

Since there is no voiding or two phase flow in both the NCUs and ECUs, there is no need to perform any waterhammer analysis.

Question 6. NCUs and ECUs

Provide a simplified diagram of the affected portions of the cooling water systems associated with the NCUs and ECUs, showing major components, active components, relative elevations, lengths of piping runs, and the location of any flow orifices and flow restrictions.

Response to Question 6. NCUs and ECUs

Figure 2 shows the cooling water system associated with the NCUs, and Figure 3 shows the CCW system associated with the ECUs. The orifices and other major equipment are shown in these figures. Both Figures 2 and 3 are drawn to scale.

Question 7. NCUs and ECUs

Describe in detail any plant modifications or procedure changes that have been made or are planned to be made to resolve the waterhammer and two phase flow issues.

Response to Question 7. NCUs and ECUs

Since our analysis shows that there is no waterhammer or two phase flow in the cooling water system associated with the NCUs, SCE has not made any plant modifications, nor does SCE have any plans for future modifications in this regard.

For the CCW system, which is associated with the ECUs, the following changes have been made:

1) a design change, to delay the start of the ECU fans until after the CCW pumps have restarted, has been implemented, and

2) enhancements to the Emergency Operating Instructions for both Units 2 and 3 were implemented to keep the CCW non-critical loop isolated during periods of time when the non-critical loop is susceptible to waterhammer or two-phase flow conditions.

References:

1) Letter to the Document Control Desk (NRC) from J. L. Rainsberry (SCE) dated July 10, 1998; Subject: "Generic Letter 96-06: Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," Additional Information

2) Letter from M. B. Fields (NRC) to H. B. Ray (SCE) dated September 13, 1995; Subject: Issuance of Amendment for San Onofre Nuclear Generating Station, Unit No. 2 (TAC NO. M90059) and Unit No. 3 (TAC NO. M90060)

3) Letter from R. W. Krieger (SCE) to the Document Control Desk (NRC) dated May 20, 1994; Subject: Docket Nos. 50-361 and 50-362, Amendment Application Nos. 140 and 124, Changes to Technical Specification 3/4.7.3 "Component Cooling Water System" San Onofre Nuclear Generating Station, Units 2 and 3

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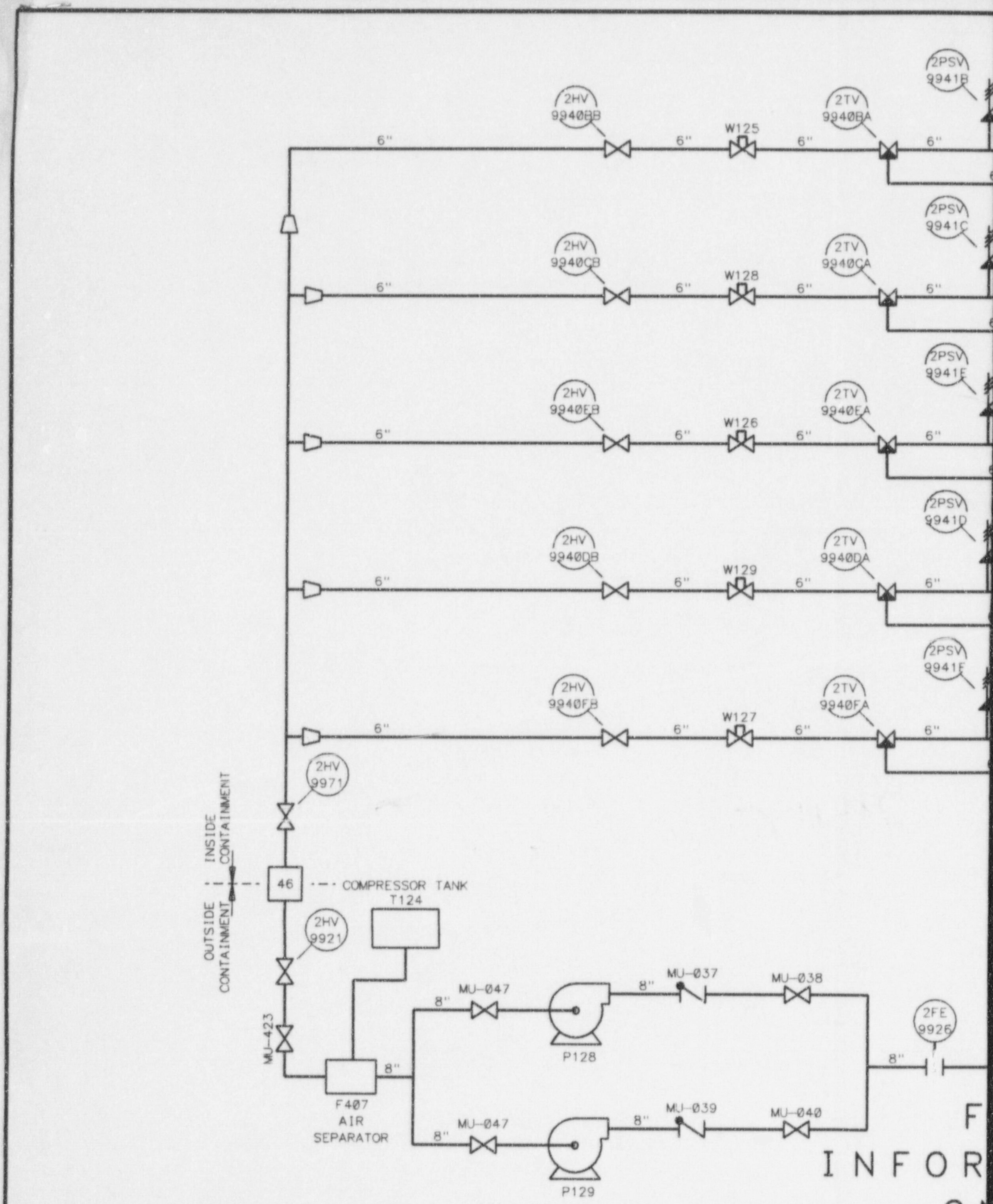
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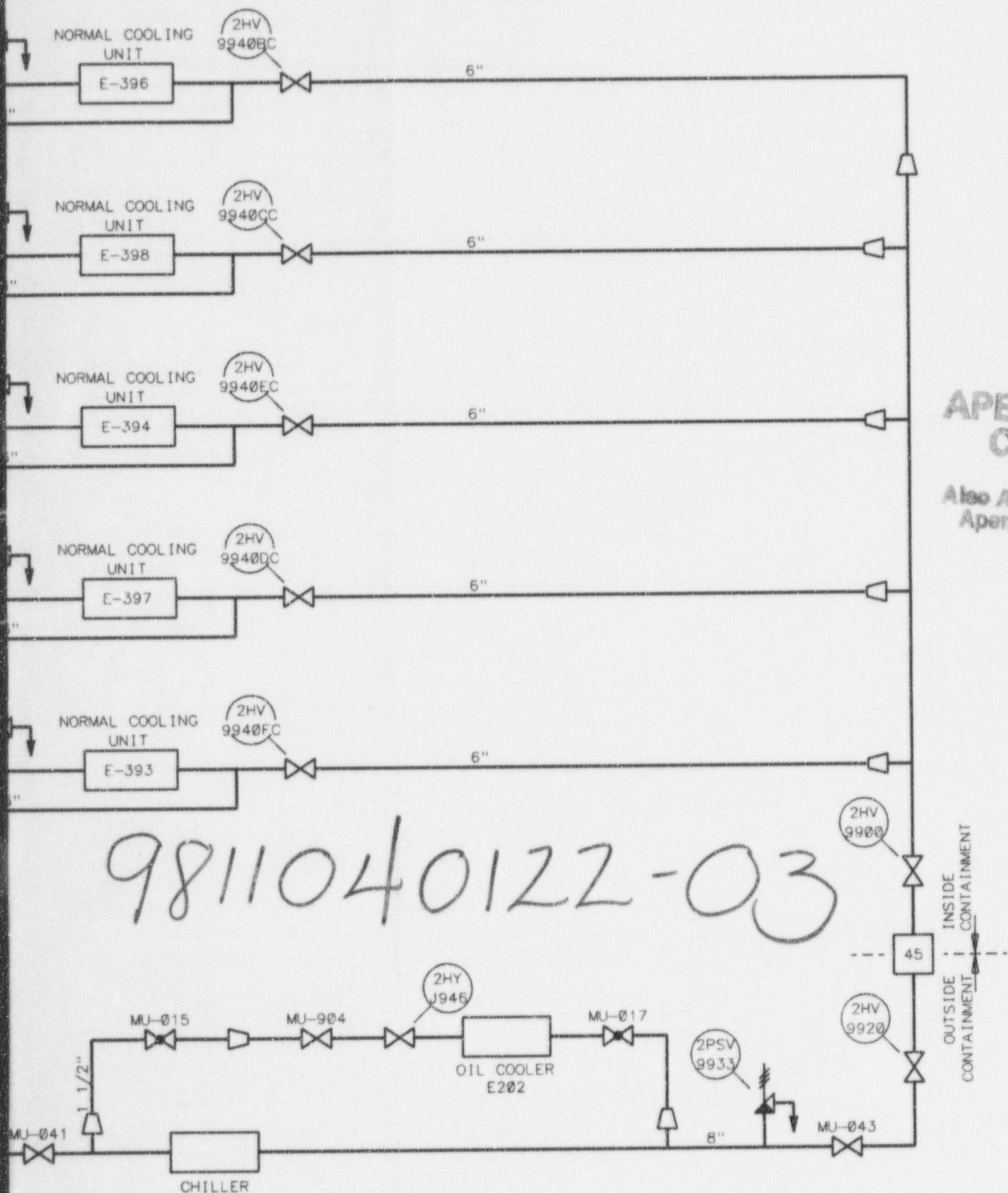

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FIGURE 1
SONGS CONTAINMENT
NORMAL CHILL WATER SYSTEM