6.1 SAFETY INJECTION SYSTEM

6.1.1 DESIGN BASES

All system components, as described in Subsection 6.1.2.2, were originally designed CPCo Design Class 1. This classification requires that each component be designed to withstand the appropriate seismic loads simultaneously with other applicable loads without loss of function (see Section 5.2). Following the implementation of Permanently Defueled Technical Specifications, these design requirements are no longer applicable.

Components that were located within the containment building and were required to operate in the post-LOCA environment were designed for an ambient condition of 283°F, 55 psig, and 100% relative humidity. Components located within the containment building and required to operate in the post-MSLB environment are designed for an ambient condition of 364°F, 55 psig, and 100% relative humidity. Equipment located in the engineered safeguards rooms in the basement of the auxiliary building is designed for ambient conditions of 135°F and 100% relative humidity. Components whose function has not been proven under such conditions were subjected to testing to demonstrate satisfactory operation. The results of that testing for electrical and instrument and control equipment are provided in Consumers Power Company's report on environmental qualification of electrical equipment (refer to FSAR Chapter 8, Subsection 8.1.3). Following the implementation of Permanently Defueled Technical Specifications, the environmental qualification program is no longer required.

Integrated radiation doses are specified as a design condition for components subject to damage from irradiation and located in a radiation field, inside or outside of the containment. Refer to Section 11.6 for further discussion of radiation zones. Following the implementation of Permanently Defueled Technical Specifications, the environmental qualification program is no longer required

All components of the long-term cooling modifications located inside the containment were Seismic Category I and were designed in compliance with the requirements of ANSI/ASME B31.1-1980 and ANSI N18.2-1973. As the facility is permanently defueled, these design requirements are no longer applicable.

6.1.2 SYSTEM DESCRIPTION AND OPERATION

6.1.2.1 General Description

The components and the flow paths are shown on Figures 6-1 and 6-2.

The elevated safety injection tanks are connected to the Primary Coolant System cold legs through isolation valves which have had the electrical power removed from the valves' electrical system.

The safety injection tanks and the loop injection valves and manifold are located inside containment but outside of the missile shield. The bottoms of the safety injection tanks are approximately 100 feet above the injection nozzles. The inner check valve in each injection line is located close to the primary coolant pipe.

The SIRW tank is located between the reactor building and turbine building above the control room on the auxiliary building roof. The safety injection pumps and all other components of the Safety Injection System are located at the lowest level of the auxiliary building in a tornado-proof area. The safety injection equipment inside the auxiliary building is located in two separate rooms which are protected from external and facility internal flooding. Sufficient space is provided around equipment in these rooms to permit installation of temporary shielding for maintenance.

6.1.2.2 <u>Component Design</u>

1. Safety Injection and Refueling Water (SIRW) Tank

   The SIRW tank is constructed of aluminum and is cathodically protected with insulating flanges. It is field fabricated to the requirements of ASA B96.1. The SIRW tank design parameters are shown in Table 6-1. As the facility is permanently defueled, these design requirements are no longer applicable.

2. Low-Pressure Safety Injection (LPSI) Pumps

   The LPSI pumps are horizontal, single stage, centrifugal design. The pumps are provided with mechanical seals backed up by a bushing with leak offs to collect the leakage past the mechanical seal. The pumps are provided with drain and flushing connections. The pressure containing portions of the pumps are stainless steel with internals selected for compatibility with boric acid. The low-pressure pump data summary is shown in Table 6-2. As the facility is permanently defueled, these design requirements are no longer applicable.

3. High-Pressure Safety Injection (HPSI) Pumps

   The HPSI pumps are seven-stage, horizontal, centrifugal units. Mechanical seals are used. The pumps are provided with drain and flushing connections to permit reducing the radiation levels before maintenance operations. The pressure containing portions of the pump are stainless steel with internals selected for compatibility with boric acid.

A full-scale hydraulic test was performed on each pump assembly. All pump test setups, test procedures and instrumentation were in accordance with the Standards of the Hydraulic Institute, 11th edition, 1965 and the ASME Power Test Code, PTC-8.2-1965. This included verification of satisfactory operation of the stated NPSH. It also included measurement of starting and operating current drawn by the motor when pumping 40°F and 300°F water.

These tests included a transient test at the pump design point under the following conditions:

a. Suction temperature increase from 40°F to 300°F in 10 seconds

b. Suction temperature decrease from 300°F to 40°F in 10 seconds

After the tests were completed, the unit was disassembled and inspected.

The high-pressure pump data summary is shown in Table 6-3. As the facility is permanently defueled, these design requirements are no longer applicable.

4. Shutdown Cooling Heat Exchangers

The shutdown cooling heat exchangers are designed and constructed to the standards of ASME B&PV Code, Section III, Class C, 1965 and TEMA Class R, 4th edition, 1959 requirements. In addition to the requirements of the code, a fatigue analysis was performed which considered all specified transient conditions. The units are of a U-tube design with two tube side passes and a single shell side pass. The tubes are austenitic stainless steel and the shell is carbon steel. The data summary for the shutdown heat exchangers is given in Table 6-4. As the facility is permanently defueled, these design requirements are no longer applicable.

5. Safety Injection Tanks (SIT)

The four safety injection tanks are carbon steel with a stainless steel lining. Design and construction are to the standards of ASME B&PV Code, Section III, Class C, 1965. The SIT design parameters are shown on Table 6-5. As the facility is permanently defueled, these design requirements are no longer applicable.

6. Relief Valves

Thermal relief valves are provided between the safety injection and containment spray pumps and isolation valves and discharge to the engineered safeguard room sump.

Relief valves are provided on the two HPSI trains, on one LPSI header (RV-3165, 3264 and 3162), on the safety injection test and leakage lines (RV-3161). As the facility is permanently defueled, these design requirements are no longer applicable.

7. Piping

The Safety Injection System piping is austenitic stainless steel and conforms to the standards set forth in ASA B31.1-1955 and applicable nuclear code cases. A stress analysis was performed on all piping including flexibility analyses considering thermal stresses and seismic loads. As the facility is permanently defueled, these design requirements are no longer applicable.

The following tests were performed to ensure the quality of fabrication and erection:

a. Piping shop welds were 100% radiographically inspected.

b. Piping was hydrostatically tested in the shop in accordance with the appropriate ASTM specifications.

c. Cast valve bodies were 100% radiographically and dye-penetrant inspected in accordance with Nuclear Code Cases N2 and N10 of ASA B31.1-1955.

d. Valve bodies were hydrostatically tested in the shop in accordance with ASTM specifications.

e. Field welds were 100% radiographically inspected.

f. Field welds were hydrostatically tested in accordance with ASA B31.1-1955.

The following items pertain to suction piping from the sump to the first isolation valve:

a. The piping has a nominal wall thickness of 0.375 inch which results in a maximum allowable pressure for the pipe minimum wall thickness of at least 8 times the maximum expected pressure of 55 psig.

b. The piping has been subjected to flexibility analyses considering thermal stresses and seismic loads. The resultant stresses are 30% of code allowable.

c. All shop piping welds were 100% radiographically inspected.

d. The piping was hydrostatically tested in the shop at 705 psig.

e. The isolation valves are ASA rated 150 pounds based on flange ratings. The valves can withstand 210 psig at 300°F. These valves are actually furnished with weld ends and can thus withstand higher pressures.

f. The valve bodies were 100% radiographically and dye-penetrant inspected.

g. The valve bodies were hydrostatically tested in the shop at 425 psig.

h. The field welds between valves and piping were 100% radiographically inspected.

i. The field welds were hydrostatically tested in accordance with ASA B31.1-1955.

6.1.2.3 Deleted

6.1.3 TESTING

6.1.3.1 Deleted

6.1.3.2 Deleted

6.1.4 DESIGN ANALYSIS

All Safety Injection System components, described in Subsection 6.1.2.2, are designated CPCo Design Class 1. This classification requires that each component be designed to withstand the appropriate seismic loads simultaneously with other applicable loads without loss of function (see Chapter 5). As the facility is permanently defueled, these design requirements are no longer applicable.

6.2 CONTAINMENT SPRAY SYSTEM

6.2.1 DESIGN BASIS

The Containment Spray System is shown on Figures 6-1 and 6-2. All system components were designed to withstand CPCo Design Class 1 loadings as described in Chapter 5. Following the implementation of Permanently Defueled Technical Specifications, these design requirements are no longer applicable.

6.2.2 SYSTEM DESCRIPTION AND OPERATION

6.2.2.1 General Description

The system consists of three half-capacity pumps, two shutdown cooling heat exchangers (shutdown heat exchangers) and all necessary piping, instruments and accessories.

Two of the pumps are on one 2,400 volt bus, while the third is on a second 2,400 volt bus. Both engineered safeguards rooms are located on elevation 570 feet, in the CPCo Design Class 1 portion of the auxiliary building. Each room has a separate pump suction from both the SIRW tank and the containment sump. The Containment Spray System is shown in Figures 6-1 and 6-2.

6.2.2.2 Component Description

Ratings and materials of construction are shown in Table 6-6. All portions of the system in contact with the Primary Coolant System or borated water are fabricated of stainless steel or other corrosion resistant material. As the facility is permanently defueled, these design requirements are no longer applicable.

6.2.2.3 Deleted

6.2.3 SECTION DELETED

6.3 CONTAINMENT AIR COOLERS

6.3.1 DESIGN BASES

All system components are shown in Figure 9-14 and were designed to withstand CPCo Design Class 1 loadings as described in Section 5.2. Following the implementation of Permanently Defueled Technical Specifications, these design requirements are no longer applicable.

6.3.2 SYSTEM DESCRIPTION AND OPERATION

6.3.2.1 General Description

The containment air recirculation and cooling system includes four air handling and cooling units located entirely within the containment building. One non-safety related cooler consists of four coils piped to manifolds connected to the Service Water System.

The remaining three originally safety related coolers also consist of four coil banks each. The headers from each coil bank are connected to the piping of the Service Water System.

The service water supply line for each formerly safety-related cooler has a stop valve. The return line for each formerly safety-related cooler has a discharge valve and a temperature control valve in a bypass line around the discharge valve. The non-safety related cooler (VHX-4) has valves in its service water supply and return lines.

Air filters are located in each cooler ahead of the coil bank. Gravity-operated dampers are installed in each fan discharge.

Each cooler has a sump with a drain, a liquid level switch and an overflow valve. Ratings and materials of construction are shown in Table 6-7. Service water flow is shown in Figure 9-1. As the facility is permanently defueled, these design requirements are no longer applicable.

6.3.2.2 Deleted

6.3.3 DELETED

6.3.4 COMPONENT TESTING

6.3.4.1 Coils

This testing information is historical following the transition to a permanently defueled facility. To prove the design of the cooling coil units, a coil section duplicating the full-size unit characteristics was laboratory tested to determine its thermal performance. The coil section was tested in an independent laboratory facility and all quality-related aspects of the test program were subject to a Quality Assurance program and the applicable requirements of ANSI N45.2-1972, 10CFR50 Appendix B and 10CFR21.

The laboratory test program was initiated to accurately determine the performance parameters of the cooling coil heat transfer configuration in simulated LOCA conditions. The sample coil section was tested in a pressure vessel designed to duplicate LOCA type conditions. A series of tests collected data on the coils air and water temperatures and flow rates, condensate flow rates and temperatures, and system pressures. The test data was tabulated and later used to develop and validate a computer model for the coil unit. The computer model accurately predicts the LOCA performance characteristics for the full-sized installed cooling coil units. (Reference 18)

6.3.4.2 Fans

1. A fan has been tested at design load to prove its ability to operate continuously for 24 hours at the maximum design conditions of 283°F, 55 psig and 100% relative humidity. The motor stator was baked for 9 days at 220°C before the test to degrade the insulation and simulate the effects of normal operation for 10 years. During the test of the motor: field windings, bearings and internal air space temperatures were monitored along with motor current, voltage and power.

2. At the completion of the 24-hour period, the fan continued to run for an additional 48 hours at approximately 100°F. At the completion of this 48-hour run, the motor was cooled down to room temperature and the insulation resistance checked and compared to the original readings. The motor bearings were inspected for damage by the motor manufacturer. Then the test chamber was again pressurized to the design condition of 55 psig and 283°F with the addition of live steam. The fan motor was started and run until the motor operating temperatures reached those determined during the 24-hour test.

6.3.4.3 Testing

Heat transfer capability of the formerly safety related Containment Air Coolers, VHX-1, VHX-2, and VHX-3 could not be verified during performance testing due to small heat loads and instrument inaccuracies. Therefore, periodic cleaning and inspection of the coils is performed in lieu of testing in accordance with GL-89-13. As the facility is permanently defueled, these design requirements are no longer applicable.

6.4 CONTAINMENT SUMP PH CONTROL

6.4.1 DESIGN BASIS

Following the implementation of Permanently Defueled Technical Specifications, these design requirements are no longer applicable. Baskets of sodium tetraborate (NaTB) are installed in the containment.

6.4.2.1 General Description

The sodium tetraborate (NaTB) baskets consist of wire mesh baskets containing between 8,186 and 10,553 lbs of granular NaTB decahydrate (Reference 25) and are placed inside the containment at the 590' elevation. The baskets have solid lids and are raised from the floor.

6.4.2.2 Deleted

6.4.2.3 Materials

As the facility is permanently defueled, these design requirements are no longer applicable.

The material of the equipment and components of the Emergency Core Cooling Systems are listed in Table 6-10. The NaTB baskets are fabricated from all stainless steel materials to be chemically compatible with the NaTB.

Service Water Valves

Body - Carbon Steel ASTM A 216 WCB

Operator Enclosure - Cast Iron

Containment Air Cooler Fan Blades

The fan blades are aluminum.

6.4.2.4 Paint

As the facility is permanently defueled, these design requirements are no longer applicable. Decontaminable coatings of the generic epoxy and phenolic type have been used in the Palisades containment. Both systems have also been subjected to and satisfactorily passed tests of irradiation up to 1×10^{10} rads as reported in ORNL-3589 and ORNL-3916 (see References 4 and 3, respectively).

Certain small surface area equipment has been coated with systems such as red lead primer on structural steel and various manufacturers' standard coatings on equipment.

6.5 CONTAINMENT VENTING CHARCOAL FILTER

6.5.1 GENERAL

The containment atmosphere can be vented through a 1,000 ft^3/min capacity charcoal filter as shown on Figure 6-4 and Figure 9-14.

6.8 REACTOR CAVITY FLOODING SYSTEM

The flooding system consists of a network of floor drain piping as shown in Figure 6-6 arranged to collect normal expected floor drains and transport these drains to the containment sump for subsequent disposal outside the containment. The drain lines serve no safety related function.

6.8.1 SYSTEM OPERATION

Normal floor drains from equipment leakage or washdown during power operation or during shutdown will enter the floor drain piping and flow by gravity onto the containment base slab at elevation 590 feet 0 inch, and then into the containment sump. This drainage will then flow by gravity to receiving equipment outside the containment. The outlet ends of the five 6-inch diameter floor drain downcomers discharging onto the 590-foot 0-inch base slab are capped, with a 1-1/4-inch diameter orifice hold drilled in each cap. These orifices are sized to pass the maximum expected normal floor drains with less than eight feet static head in the downcomers.

6.9 INSERVICE INSPECTION OF ASME CLASSES 1, 2 AND 3 SYSTEMS AND COMPONENTS

SEP-ISI-PLP-003, "Palisades Inservice Inspection Master Program Fifth Interval, ASME Section XI, Division 1," is the basis document and database for the Inservice Inspection Program. Systems and components were selected for coverage by the inspection plan through Section 50.55a of 10 CFR 50 for ASME Class 1 systems and components. Regulatory Guide 1.26 was used to select ASME Classes 2 and 3 systems and components for coverage by the inspection plan. Additional inspection requirements are incorporated in the inspection plan by implementing Technical Specification LCO 3.4.14 and Operating Requirements Manual Specification 4.12. The inspection plan requires that ASME B&PV Code, Section XI unacceptable discontinuities be dispositioned through application of the Quality Program that is identified in Section 15.1. Fulfilling the requirements of this program will initiate additional code requirements identified in Section XI, which will be implemented by Facility procedures as necessary.

Selected portions of the major components and systems to be examined in accordance with Section XI are listed in Table 6-12.

The use of Code Cases and Relief Requests shall be documented in SEP-ISI-PLP-003.

The Inservice Inspection Program shall be updated to the latest approved edition and addenda of Section XI prior to the start of each new inspection interval in accordance with 10 CFR 50.55a(g)(4). Palisades may also optionally update the Inservice Inspection Program as allowed by 10 CFR 50.55a(g)(4)(iv) to use subsequent editions and addenda of Section XI as referenced by 10 CFR 50.55a(b). Updates are subject to approval by the NRC (Reference 7).

6.9.1 STRUCTURAL INTEGRITY EXAMINATION

Pursuant to Paragraph 50.55a(g) of 10 CFR 50, the fifth Inservice Inspection Interval examination requirements are based on the rules set forth in ASME Section XI, 2007 Edition through 2008 Addenda.

Temporary non-code repair of ASME XI Class 1, 2, and 3 components requires specific written relief granted by the NRC. Due to the frequency of small leaks in some Class 3 systems, the NRC issued Generic Letter 90-05 (Reference 14) which provides guidance to be considered by the NRC in evaluating relief requests submitted by licensees for temporary non-code repair of ASME Class 3 piping. Subsequent to GL 90-05, the NRC issued guidance (Reference 15) that permitted use of stop gap measures to limit leakage from a Class 3 system while a relief request for a non-code repair is being prepared. The criteria for using stop gap measures for Class 3 piping are that the structural integrity of the flawed piping must not be affected, the measures must be reversible, and the relief request must be submitted expeditiously.

System leakage tests, system functional tests, system inservice tests and system hydrostatic tests are performed in accordance with the latest edition of ASME Section XI approved for use at the Palisades Facility and with approved relief requests and requests for code case use.

In February of 1994, CPCo detected a leak in a containment sump check valve, CK-ES3166. CPCo requested and received approval from the NRC (NRC letter dated April 6, 1994) to use Code Case N-504-1 for a weld overlay repair as an alternative to the ASME B&PV, Section XI Code requirements. The code case was used for repair of the valve and for the corresponding valve in the alternate train (CK-ES3181). A requirement of the NRC's approval was that CPCo commit to inspect the valves every refueling outage using surface and volumetric techniques demonstrated to be effective.

6.9.2 SECTION DELETED

6.10 CONTROL ROOM HABITABILITY

The control room habitability systems include radiation protection, air purification, and climatically controlled ventilation and air-conditioning systems, lighting and power systems, fire protection systems, storage capacity for food and water and sanitary facilities. Other equipment and systems are described only as necessary to define their connection with control room habitability and, accordingly, reference is made to other FSAR sections as appropriate.

Following the implementation of Permanently Defueled Technical Specifications, the control room habitability information herein is considered historical and does not constitute design requirements unless otherwise noted to still be applicable in the defueled condition.

6.10.1 DELETED

6.10.2 SYSTEM DESIGN

The control room heating, ventilation and air conditioning (CRHVAC) envelope consists of the control room, technical support center (TSC), mechanical equipment room (MER) and former viewing gallery (now consisting of offices, restroom and corridor). These areas are served by the CRHVAC system. A description of the CRHVAC system is provided in Subsection 9.8.2. This subsection also includes schematic diagrams and design data for major components of the CRHVAC system.

As discussed in Section 9.8, the CRHVAC system functions to limit air in-leakage during normal conditions by maintaining a positive air pressure in the control room envelope. In the event of smoke, the system has the capability to purge the smoke. In 1983 the system was modified to extend the control room air intake from the then existing configuration, increasing the intake air duct to allow 100% makeup air, installing redundant charcoal filters, extending the control room habitability zone and replacing air intake and discharge dampers.

Shielding design for the control room is discussed in Subsection 11.6.4.

6.10.3 DELETED