5.1 SUMMARY DESCRIPTION

The reactor coolant system includes those systems and components which contain or transport fluids coming from, or going to the reactor core. These systems form a major portion of the reactor coolant pressure boundary. This chapter provides information regarding the reactor coolant system and pressure-containing appendages out to and including isolation valving. This grouping of components is defined as the reactor coolant pressure boundary (RCPB) as follows:

Reactor coolant pressure boundary (RCPB) includes all pressure containing components such as pressure vessels, piping, pumps, and valves, which are:

(1) Part of the reactor coolant system, or

(2) Connected to the reactor coolant system, up to and including any and all of the following:

   a. The outermost containment isolation valve in piping which penetrates primary reactor containment,

   b. The second of the two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment,

   c. The reactor coolant system safety/relief valves.

This chapter also describes various subsystems connected to the RCPB. Specifically Section 5.4 deals with these subsystems.

The nuclear system pressure relief system protects the reactor coolant pressure boundary from damage due to overpressure. To protect against overpressure, pressure-operated relief valves are provided that can discharge steam from the nuclear system to the suppression pool. The pressure relief system also acts to automatically depressurize the nuclear system in the event of a loss-of-coolant accident in which the high pressure coolant injection (HPCI) system fails to maintain reactor vessel water level. Depressurization of the nuclear system allows the low pressure core cooling systems to supply enough cooling water to adequately cool the fuel. In addition to these two modes to protect against overpressurization, the pressure relief system can also be remotely operated.

Limits on RCPB leakage inside the drywell are established so that appropriate action can be taken before the integrity of the RCPB is impaired (see Subsection 5.2.5).

The reactor vessel and appurtenances are described in the Section 5.3. The major safety consideration for the reactor vessel is the ability of the vessel to function as a radioactive material barrier. Various combinations of loading are considered in the vessel design. The vessel meets the requirements of applicable codes and criteria. The possibility of brittle fracture is considered, and suitable design, material selection, material surveillance activity and operational limits are established that avoid conditions where brittle fracture is possible.

The reactor recirculation system provides coolant flow through the core. Adjustment of the core coolant flow rate changes reactor power output, thus providing a means of adjusting power without moving control rods. The recirculation system is designed to provide a slow coastdown of flow so that fuel thermal limits cannot be exceeded as a result of recirculation system malfunctions. The arrangement of the recirculation system routing is such that a piping failure cannot compromise the integrity of the floodable inner volume of the reactor vessel.

The main steamline flow restrictors of the venturi-type are installed in each main steamline inside the primary containment. The restrictors are designed to limit the loss of coolant resulting from a main steamline break outside the primary containment. The coolant loss is limited so that reactor vessel water level remains above the top of the core during the time required for the main steamline isolation valves to close. This action protects the fuel barrier.

Two isolation valves are installed on each main steamline; one is located inside, and the other is located outside the primary containment. In the event that a main steamline break occurs inside the containment, closure of the isolation valve outside the primary containment acts to seal the primary containment itself. The main steamline isolation valves automatically isolate the reactor coolant pressure boundary in the event a pipe break occurs downstream of the isolation valves. This action limits the loss of coolant and the release of radioactive materials from the nuclear system.

The reactor core isolation cooling (RCIC) system provides makeup water to the core during a reactor shutdown in which feedwater flow is not available. The system is started automatically upon receipt of a low reactor water level signal or manually by the operator. Water is pumped to the core by a turbine-pump set driven by reactor steam.

The residual heat removal (RHR) system includes a number of pumps and heat exchangers that can be used to cool the nuclear system under a variety of situations. During normal shutdown and reactor servicing, the RHR system removes residual and decay heat. One mode of RHR operation allows the removal of heat from the primary containment following a loss of coolant accident. Another operational mode of the RHR system is low pressure coolant injection (LPCI). LPCI operation is an engineered safety feature for use during a postulated loss-of-coolant accident (see Section 6.3). The core spray system (CS) is a redundant, low pressure coolant injection system which sprays water onto the top of the fuel assemblies to cool the core (Section 6.3.2.2.3).

The reactor water cleanup system (Section 5.4.8) recirculates a portion of reactor coolant through filter-demineralizers to remove particulate and dissolved impurities from the reactor coolant. It also removes excess coolant from the reactor system under controlled conditions.

Design and performance characteristics of the Reactor Coolant System and its various components will be found in Table 5.1-1.

5.1.1 Schematic Flow Diagram

Schematic flow diagrams of the reactor coolant system denoting all major components, principal pressures, temperatures, flow rates, and coolant volumes for normal steady-state operating conditions at rated power are presented in Figures 1.2-49, 1.2-49-1, 1.2-49-2, 1.2-49-3 and 5.1-2.

5.1.2 Piping and Instrumentation Diagram

Piping and instrumentation diagrams covering the systems included within the reactor coolant system and connected systems are presented in the following:

(1) the nuclear boiler and vessel instrumentation shown on Dwgs. M-141, Sh. 1, M-141, Sh. 2 and M-142, Sh. 1;

(2) recirculation system shown on Dwg. M-143, Sh. 1;

(3) reactor core isolation cooling system shown on Dwgs. M-149, Sh. 1 and M-150, Sh. 1;

(4) residual heat removal system shown on Dwgs. M-151, Sh. 1 and M-151, Sh. 3;

(5) reactor water cleanup system shown on Dwg. M-144, Sh. 1;

(6) high pressure coolant injection shown on Dwgs. M-155, Sh. 1 and M-156, Sh. 1;

(7) core spray system shown on Dwg. M-152, Sh. 1;

(8) standby liquid control system shown on Dwg. M-148, Sh. 1.

5.1.3 Plan and Elevation Drawings

Plan and elevation drawings showing the principal dimensions of the reactor coolant system in relation to the containment are shown in Figure 5.1-4-1, 5.1-4-2 and 5.1-4-3.

Table 5.1-1
DESIGN AND PERFORMANCE CHARACTERISTICS OF
THE REACTOR COOLANT SYSTEM AND ITS COMPONENTS

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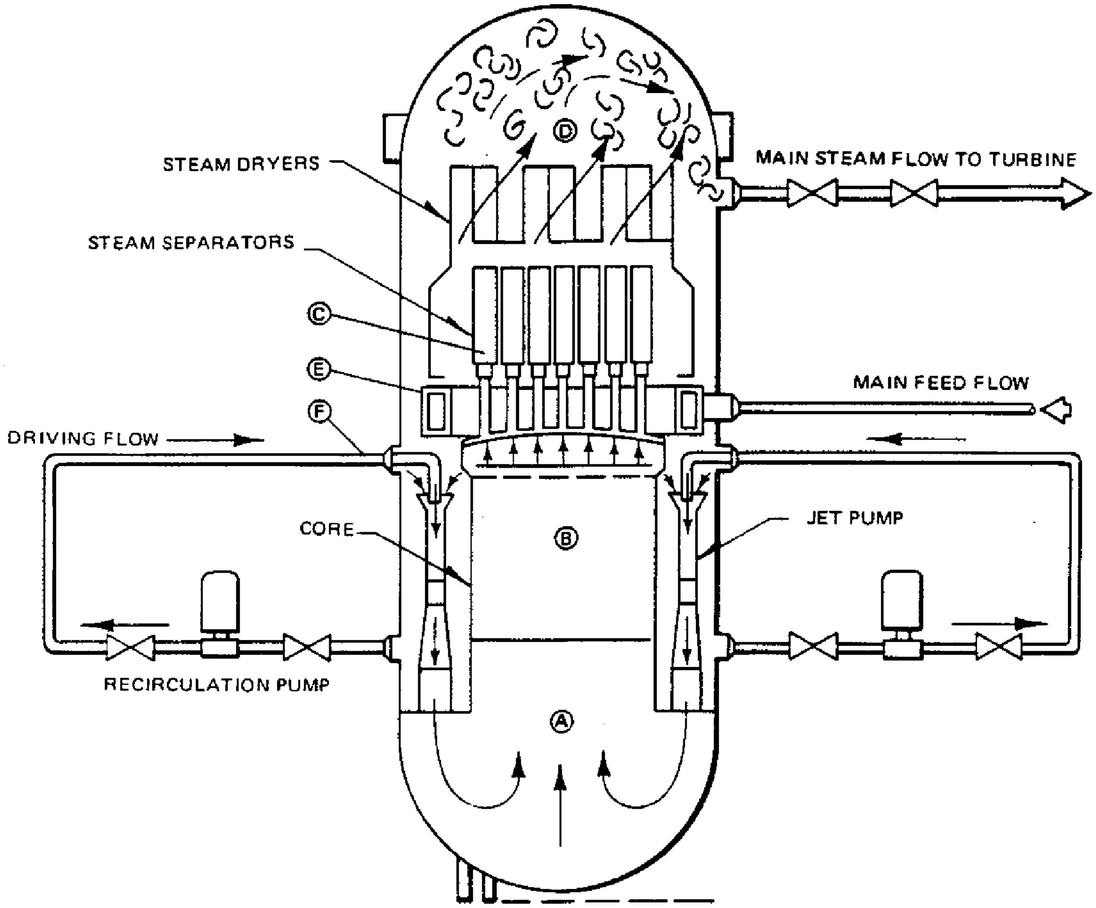
Table Withheld Under 10 CFR 2.390



	VOLUME OF FLUID (ft^3)
A. LOWER PLENUM	3887
B. CORE	2054
C. UPPER PLENUM AND SEPARATORS	1321
D. DOME (ABOVE NORMAL WATER LEVEL)	7934
E. DOWNCOMER REGION	5830
F. RECIRC LOOPS AND JET PUMPS	1398

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COOLANT VOLUMES
OF THE
BOILING WATER REACTOR

FIGURE 5.1-2, Rev. 49

Auto Cad: Figure Fsar 5_1_2.dwg

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-141, Sh. 1

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Figure 5.1-3A-1 replaced by dwg.
M-141, Sh. 1

FIGURE 5.1-3A-1, Rev. 56

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-141, Sh. 2

FSAR REV. 65

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Figure 5.1-3A-2 replaced by dwg. M-141, Sh. 2 FIGURE 5.1-3A-2, Rev. 55

AutoCAD Figure 5_1_3A_2.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
M-142, Sh. 1

FSAR REV. 65

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Figure 5.1-3B replaced by dwg. M-142, Sh. 1 FIGURE 5.1-3B, Rev. 55

AutoCAD Figure 5_1_3B.doc

Security-Related Information
Figure Withheld Under 10 CFR 2.390

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
REACTOR COOLANT SYSTEM PLAN
FIGURE 5.1-4-1

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REACTOR COOLANT SYSTEM ELEVATION DIAGRAM FIGURE 5.1-4-2

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REACTOR COOLANT SYSTEM ELEVATION DIAGRAM
FIGURE 5.1-4-3