

CHAPTER 4
REACTOR COOLANT AND ASSOCIATED SYSTEMS

TABLE OF CONTENTS

	<u>PAGE</u>	
4.0	<u>REACTOR COOLANT AND ASSOCIATED SYSTEMS</u>	4.1-1
4.1	<u>REACTOR COOLANT SYSTEM</u>	4.1-1
4.1.1	DESIGN BASIS	4.1-1
	4.1.1.1 <u>Effect of Steam Generator Replacement on Structural Design Basis</u>	4.1-2
4.1.2	SYSTEM DESCRIPTION	4.1-2
4.1.3	COMPONENT DESCRIPTION	4.1-3
	4.1.3.1 <u>Reactor Vessel</u>	4.1-3
	4.1.3.2 <u>Steam Generator</u>	4.1-5
	4.1.3.3 <u>Reactor Coolant Pumps</u>	4.1-10
	4.1.3.4 <u>Reactor Coolant Piping</u>	4.1-16
	4.1.3.5 <u>Pressurizer</u>	4.1-17
	4.1.3.6 <u>Reactor Coolant Vent System</u>	4.1-21
4.1.4	DESIGN EVALUATION	4.1-22
	4.1.4.1 <u>Codes</u>	4.1-22
	4.1.4.2 <u>Materials Compatibility</u>	4.1-22
	4.1.4.3 <u>Welding Procedures</u>	4.1-23
	4.1.4.4 <u>Seismic Design</u>	4.1-26
	4.1.4.5 <u>Prevention Of Brittle Fracture</u>	4.1-26
	4.1.4.6 <u>Reactor Vessel Thermal Shock</u>	4.1-31
4.1.5	TESTS AND INSPECTIONS	4.1-31
	4.1.5.1 <u>General</u>	4.1-31
	4.1.5.2 <u>Surveillance Program</u>	4.1-31
	4.1.5.3 <u>Non-destructive Tests</u>	4.1-34
	4.1.5.4 <u>Additional Tests</u>	4.1-35
	4.1.5.5 <u>In-Service Inspection</u>	4.1-36
	4.1.5.6 <u>Pre-operational Vibration Test Program</u>	4.1-38
	4.1.5.7 <u>Boric Acid Corrosion Monitoring Program</u>	4.1-38
4.1.6	REFERENCES	4.1-38
4.2	<u>OVERPRESSURE PROTECTION SYSTEM</u>	4.2-1
4.2.1	HIGH TEMPERATURE OVERPRESSURE	4.2-1
	4.2.1.1 <u>Design Basis</u>	4.2-1
	4.2.1.2 <u>System Description</u>	4.2-1
4.2.2	LOW TEMPERATURE OVERPRESSURE PROTECTION	4.2-3
4.2.3	REFERENCE	4.2-6
4.3	<u>LEAK DETECTION SYSTEM</u>	4.3-1
4.3.1	DESIGN BASIS	4.3-1
4.3.2	SYSTEM DESCRIPTION	4.3-1
4.3.3	DESIGN ANALYSIS	4.3-2

CHAPTER 4
REACTOR COOLANT AND ASSOCIATED SYSTEMS

TABLE OF CONTENTS

	<u>PAGE</u>
4.3.4 IDENTIFIED VERSUS UNIDENTIFIED LEAKAGE	4.3-2
4.3.5 OTHER CONSIDERATIONS	4.3-3
4.4 <u>LOOSE PARTS DETECTION SYSTEM</u>	4.4-1
4.4.1 DESIGN BASIS	4.4-1
4.4.2 SYSTEM DESCRIPTION	4.4-1
4.4.3 DESIGN ANALYSIS	4.4-1
4.5 <u>COASTDOWN OPERATION AT END OF CYCLE</u>	4.5-1
APPENDIX 4A CALVERT CLIFFS REACTOR COOLANT PUMP FLOW MEASUREMENT	4A.1-1

CHAPTER 4
REACTOR COOLANT AND ASSOCIATED SYSTEMS

LIST OF TABLES

<u>TITLE</u>		<u>PAGE</u>
4-1	PRINCIPAL DESIGN PARAMETERS OF REACTOR COOLANT SYSTEM	4.1-42
4-2	REACTOR VESSEL PARAMETERS	4.1-43
4-3	STEAM GENERATOR PARAMETERS	4.1-44
4-5	REACTOR COOLANT PUMP PARAMETERS	4.1-45
4-6	REACTOR COOLANT PIPING PARAMETERS	4.1-46
4-7	PRESSURIZER PARAMETERS	4.1-47
4-8	TABLE OF LOADING COMBINATIONS AND PRIMARY STRESS LIMITS	4.1-48
4-9	REACTOR COOLANT SYSTEM CODE REQUIREMENTS	4.1-50
4-9A	REACTOR COOLANT VENT VALVES	4.1-51
4-10	MATERIALS EXPOSED TO COOLANT	4.1-52
4-11	REFERENCES FOR IRRADIATED MATERIAL TEST DATA USED AS BASIS FOR CE DESIGN CURVE OF FIGURE 4-12	4.1-53
4-11A	CALVERT CLIFFS UNIT 1 REACTOR VESSEL BELTLINE MATERIAL PROPERTIES	4.1-56
4-11B	CALVERT CLIFFS UNIT 2 REACTOR VESSEL BELTLINE MATERIAL PROPERTIES	4.1-57
4-12	SUMMARY OF SPECIMENS PROVIDED FOR EACH EXPOSURE LOCATION	4.1-58
4-13A	UNIT 1 REACTOR VESSEL SURVEILLANCE CAPSULE REMOVAL SCHEDULE	4.1-59
4-13B	UNIT 2 REACTOR VESSEL SURVEILLANCE CAPSULE REMOVAL SCHEDULE	4.1-60
4-13C	Deleted	
4-14	RCS QUALITY ASSURANCE PROGRAM	4.1-61
4-15	RCS INSPECTION CE REQUIREMENTS	4.1-63
4-16	ACTUATOR-OPERATED THROTTLING VALVE PARAMETERS	4.2-7
4-17	ACTUATOR-OPERATED STOP VALVE PARAMETERS	4.2-8
4-18	PRESSURIZER POWER-OPERATED RELIEF VALVE PARAMETERS	4.2-9
4-19	PRESSURIZER SAFETY VALVE PARAMETERS	4.2-10
4-20	Deleted	
4-21	QUENCH TANK PARAMETERS	4.2-11

CHAPTER 4
REACTOR COOLANT AND ASSOCIATED SYSTEMS

LIST OF FIGURES

FIGURE

4-1	REACTOR COOLANT SYSTEM - UNIT 1
4-2	REACTOR VESSEL
4-3A	STEAM GENERATOR PROFILE VIEW
4-3B	STEAM GENERATOR PRIMARY HEAD DESIGN
4-4	REACTOR COOLANT PUMP
4-6	REACTOR COOLANT PUMP - SEAL AREA
4-6A	REACTOR COOLANT PUMP - SEAL AREA
4-7	REACTOR COOLANT PUMP PERFORMANCE
4-8	PRESSURIZER
4-9	TEMPERATURE CONTROL PROGRAM
4-10	PRESSURIZER LEVEL SET POINT PROGRAM
4-11	PRESSURIZER LEVEL CONTROL PROGRAM
4-12	C-E DESIGN CURVE OF NDTT INCREASE (550°F IRRADIATION)
4-13	LOCATION OF SURVEILLANCE CAPSULE ASSEMBLIES
4-14	TYPICAL SURVEILLANCE CAPSULE ASSEMBLY
4-15	TYPICAL CHARPY IMPACT COMPARTMENT ASSEMBLY
4-16	TYPICAL TENSILE - MONITOR COMPARTMENT ASSEMBLY
4-17	REACTOR COOLANT SYSTEM - UNIT 2
4-18	CALVERT CLIFFS COASTDOWN OPERATING REGION

CHAPTER 4
REACTOR COOLANT AND ASSOCIATED SYSTEMS

LIST OF ACRONYMS

ART	Adjusted Reference Temperature
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B&PV	Boiler and Pressure Vessel
BGE	Baltimore Gas and Electric Company
BWC	Babcock & Wilcox, Canada
CE	Combustion Engineering, Inc.
CEA	Control Element Assembly
CEDM	Control Element Drive Mechanism
CCNPP	Calvert Cliffs Nuclear Power Plant
CVCS	Chemical and Volume Control System
ECCS	Emergency Core Cooling System
GMA	Gas Metal Arc
GTA	Gas Tungsten Arc
HAZ	Heat Affected Zone
HPSI	High Pressure Safety Injection
HSST	Heavy Section Steel Technology
LOCA	Loss-of-Coolant Accident
LTOP	Low Temperature Overpressure Protection
MPT	Minimum Pressurization Temperature
NDTT	Nil Ductility Transition Temperature
NFPA	National Fire Protection Association
NSSS	Nuclear Steam Supply System
OBE	Operating Basis Earthquake
OSG	Original Steam Generator
P-T	Pressure-Temperature
PORV	Power-Operated Relief Valve
PTS	Pressurized Thermal Shock
PWSCC	Primary Water Stress Corrosion Cracking
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RG	Regulatory Guide
RSG	Replacement Steam Generator
RVCH	Reactor Vessel Closure Head
SA	Submerged Arc
SCC	Stress Corrosion Cracking
SG	Steam Generator
SMA	Shielded Metal Arc
SRP	Standard Review Plan
SSE	Safe Shutdown Earthquake