



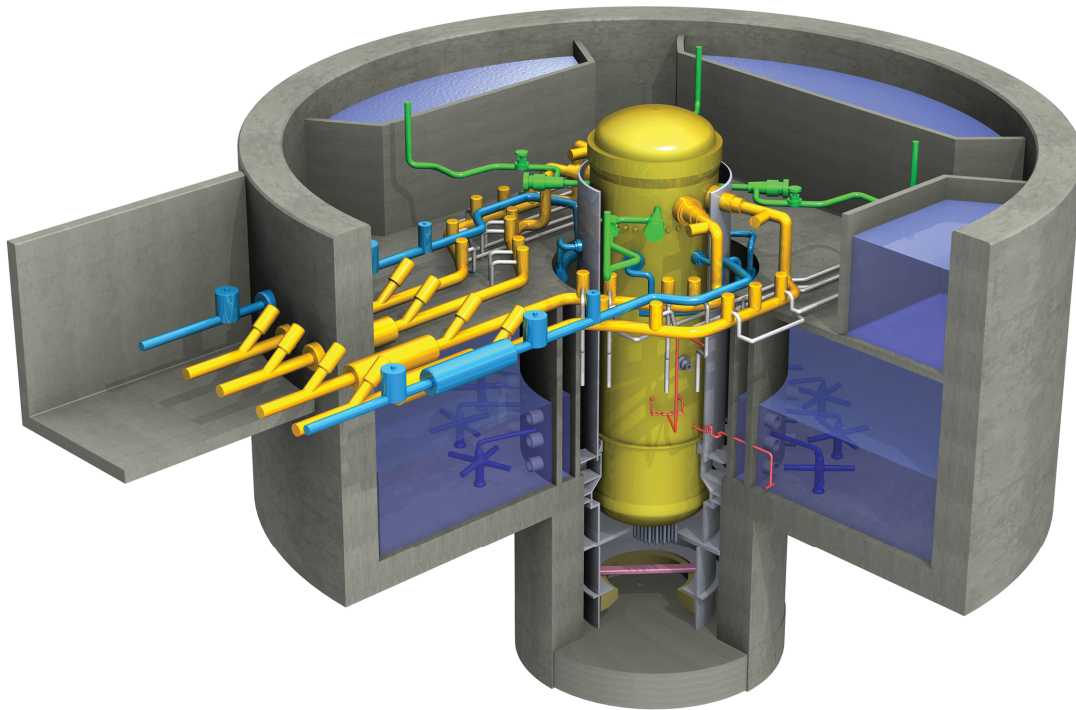
HITACHI

GE Hitachi Nuclear Energy

26A6642AB

Revision 10

April 2014



ESBWR Design Control Document

Tier 2

Table Of Contents

Copyright, 2005, 2014, GE-Hitachi Nuclear Energy Americas LLC

All Rights Reserved

NOTICE

The design, engineering, and other information contained in this document is furnished by GE-Hitachi Nuclear Energy Americas LLC (GEH) for the purpose of supporting the GEH application to the United States Nuclear Regulatory Commission (NRC) for certification of the ESBWR nuclear plant design pursuant to Title 10 Code of Federal Regulations (10 CFR) Part 52.

No use of or right to copy any of the information contained in this document, other than by the NRC and its contractors in support of GEH application, is authorized except by contract with GEH. The information provided in this document is part of and dependent upon a larger set of knowledge, technology, and intellectual property rights pertaining to standardized, nuclear powered, electric generating facilities that utilize the design certification, as designed and certified to U.S. Codes, Standards, and Regulations by GEH, and referred to as the ESBWR nuclear power plant design. Without access and a GEH grant of rights to that larger set of knowledge, technology, and intellectual property rights, this document is not practically or rightfully usable by others, except by the NRC or through contractual agreements with Combined License Applicants and Licensees or customers and participating utilities.

Contents

VOLUME 26A6642AD

1. Introduction and General Description of Plant.....	1.1-1
1.1 Introduction	1.1-1
1.1.1 Format and Content.....	1.1-1
1.1.2 General Description	1.1-1
1.1.2.1 ESBWR Standard Plant Scope.....	1.1-1
1.1.2.1.1 Seismic Category I Standard Plant Structures	1.1-1
1.1.2.1.2 Seismic Category II and NS Standard Plant Structures	1.1-1
1.1.2.2 Type of License Request.....	1.1-2
1.1.2.3 Number of Plant Units	1.1-2
1.1.2.4 Description of Location	1.1-2
1.1.2.5 Type of Nuclear Steam Supply	1.1-2
1.1.2.6 Type of Containment	1.1-2
1.1.2.7 Rated Core Thermal Power.....	1.1-2
1.1.3 COL Information	1.1-3
1.1.4 References	1.1-3
1.2 General Plant Description.....	1.2-1
1.2.1 Principal Design Criteria	1.2-1
1.2.1.1 General Power Generation (Nonsafety) Design Criteria	1.2-1
1.2.1.2 General Safety Design Criteria	1.2-2
1.2.1.3 Nuclear System Criteria.....	1.2-4
1.2.1.4 Electrical Power Systems Criteria	1.2-5
1.2.1.5 Auxiliary Systems Criteria.....	1.2-5
1.2.1.6 Shielding and Access Control Criteria.....	1.2-6
1.2.1.7 Power Conversion Systems Criteria	1.2-6
1.2.1.8 Nuclear System Process Control Criteria	1.2-6
1.2.1.9 Electrical Power System Process Control Criteria.....	1.2-6
1.2.2 Plant Description.....	1.2-7
1.2.2.1 Nuclear Steam Supply.....	1.2-7
1.2.2.1.1 Reactor Pressure Vessel and Internals	1.2-7
1.2.2.1.2 Nuclear Boiler System	1.2-10
1.2.2.1.3 RPV Natural Circulation Process.....	1.2-15
1.2.2.2 Controls and Instrumentation.....	1.2-16
1.2.2.2.1 Rod Control and Information System	1.2-16
1.2.2.2.2 Control Rod Drive System.....	1.2-18
1.2.2.2.3 Feedwater Control System.....	1.2-20
1.2.2.2.4 Standby Liquid Control System.....	1.2-22
1.2.2.2.5 Neutron Monitoring System	1.2-22
1.2.2.2.6 Remote Shutdown System	1.2-23
1.2.2.2.7 Reactor Protection System.....	1.2-24
1.2.2.2.8 Plant Automation System	1.2-25
1.2.2.2.9 Steam Bypass and Pressure Control System.....	1.2-26
1.2.2.2.10 Distributed Control and Information System.....	1.2-26
1.2.2.2.11 Leak Detection and Isolation System	1.2-27

1.2.2.2.12 Safety System Logic and Control System	1.2-28
1.2.2.2.13 Diverse Instrumentation and Controls	1.2-29
1.2.2.3 Radiation Monitoring Systems	1.2-31
1.2.2.3.1 Process Radiation Monitoring System.....	1.2-31
1.2.2.3.2 Area Radiation Monitoring System	1.2-34
1.2.2.4 Core Cooling Systems Used For Abnormal Events.....	1.2-34
1.2.2.4.1 Isolation Condenser System.....	1.2-34
1.2.2.4.2 Emergency Core Cooling System — Gravity-Driven Cooling System...	1.2-36
1.2.2.5 Reactor Servicing Equipment	1.2-38
1.2.2.5.1 Fuel Service Equipment.....	1.2-38
1.2.2.5.2 Miscellaneous Service Equipment.....	1.2-38
1.2.2.5.3 Reactor Pressure Vessel Servicing Equipment.....	1.2-39
1.2.2.5.4 RPV Internals Servicing Equipment.....	1.2-39
1.2.2.5.5 Refueling Equipment	1.2-39
1.2.2.5.6 Fuel Storage Facility	1.2-40
1.2.2.5.7 Under-Vessel Servicing Equipment.....	1.2-40
1.2.2.5.8 FMCRD Maintenance Area	1.2-41
1.2.2.5.9 Fuel Cask Cleaning.....	1.2-41
1.2.2.5.10 Fuel Transfer System	1.2-42
1.2.2.5.11 [Deleted]	1.2-43
1.2.2.6 Reactor Auxiliary Systems	1.2-43
1.2.2.6.1 Reactor Water Cleanup/Shutdown Cooling System.....	1.2-43
1.2.2.6.2 Fuel and Auxiliary Pools Cooling System.....	1.2-44
1.2.2.7 Control Panels.....	1.2-46
1.2.2.7.1 Main Control Room Panels.....	1.2-46
1.2.2.7.2 Radwaste Control Room Panels.....	1.2-46
1.2.2.7.3 Local Control Panels and Racks	1.2-46
1.2.2.8 Nuclear Fuel.....	1.2-46
1.2.2.8.1 Fuel Rods and Bundles	1.2-46
1.2.2.8.2 Fuel Channel	1.2-47
1.2.2.9 Control Rods	1.2-47
1.2.2.10 Radioactive Waste Management System.....	1.2-48
1.2.2.10.1 Liquid Waste Management System	1.2-48
1.2.2.10.2 Solid Waste Management System	1.2-48
1.2.2.10.3 Gaseous Waste Management System	1.2-49
1.2.2.11 Power Cycle	1.2-50
1.2.2.11.1 Turbine Main Steam System.....	1.2-50
1.2.2.11.2 Condensate and Feedwater System.....	1.2-51
1.2.2.11.3 Condensate Purification System	1.2-52
1.2.2.11.4 Main Turbine	1.2-52
1.2.2.11.5 Turbine Gland Seal System	1.2-52
1.2.2.11.6 Turbine Bypass System.....	1.2-53
1.2.2.11.7 Main Condenser	1.2-54
1.2.2.11.8 Circulating Water System	1.2-55
1.2.2.12 Station Auxiliaries	1.2-55
1.2.2.12.1 Makeup Water System.....	1.2-55

1.2.2.12.2 Condensate Storage and Transfer System.....	1.2-56
1.2.2.12.3 Reactor Component Cooling Water System.....	1.2-56
1.2.2.12.4 Turbine Component Cooling Water System.....	1.2-56
1.2.2.12.5 Chilled Water System	1.2-57
1.2.2.12.6 Oxygen Injection System.....	1.2-57
1.2.2.12.7 Plant Service Water System.....	1.2-57
1.2.2.12.8 Service Air System	1.2-58
1.2.2.12.9 Instrument Air System	1.2-58
1.2.2.12.10 High Pressure Nitrogen Supply System.....	1.2-58
1.2.2.12.11 Auxiliary Boiler System	1.2-59
1.2.2.12.12 [Deleted]	1.2-59
1.2.2.12.13 Hydrogen Water Chemistry System	1.2-59
1.2.2.12.14 Process Sampling System	1.2-59
1.2.2.12.15 Zinc Injection System	1.2-60
1.2.2.12.16 Freeze Protection	1.2-60
1.2.2.13 Station Electrical System	1.2-60
1.2.2.13.1 Electrical Power Distribution System.....	1.2-60
1.2.2.13.2 Electrical Penetrations	1.2-60
1.2.2.13.3 Direct Current Power Supply	1.2-61
1.2.2.13.4 Standby On-Site AC Power Supply	1.2-61
1.2.2.13.5 Uninterruptible AC Power Supply.....	1.2-62
1.2.2.13.6 [Deleted]	1.2-62
1.2.2.13.7 Communications System	1.2-62
1.2.2.13.8 Lighting Power Supply	1.2-62
1.2.2.14 Power Transmission.....	1.2-63
1.2.2.15 Containment and Environmental Control Systems.....	1.2-63
1.2.2.15.1 Containment System	1.2-63
1.2.2.15.2 Containment Vessel	1.2-65
1.2.2.15.3 Containment Internal Structures	1.2-65
1.2.2.15.4 Passive Containment Cooling System	1.2-66
1.2.2.15.5 Containment Inerting System	1.2-67
1.2.2.15.6 Drywell Cooling System.....	1.2-68
1.2.2.15.7 Containment Monitoring System.....	1.2-69
1.2.2.16 Structures and Servicing Systems.....	1.2-71
1.2.2.16.1 Cranes, Hoists, and Elevators	1.2-71
1.2.2.16.2 Heating Ventilating and Air Conditioning.....	1.2-71
1.2.2.16.3 Fire Protection System.....	1.2-72
1.2.2.16.4 Equipment and Floor Drainage System	1.2-72
1.2.2.16.5 Reactor Building	1.2-73
1.2.2.16.6 Control Building	1.2-73
1.2.2.16.7 Fuel Building	1.2-73
1.2.2.16.8 Turbine Building.....	1.2-73
1.2.2.16.9 Radwaste Building.....	1.2-73
1.2.2.16.10 Other Building Structures	1.2-74
1.2.2.17 Intake Structure and Servicing Equipment	1.2-74
1.2.2.17.1 Intake and Discharge Structures	1.2-74

1.2.2.18 Yard Structures and Equipment	1.2-74
1.2.2.18.1 Oil Storage and Transfer System	1.2-74
1.2.2.18.2 Site Security	1.2-74
1.2.3 COL Information	1.2-75
1.2.4 References	1.2-75
1.3 Comparison Tables	1.3-1
1.3.1 COL Information	1.3-1
1.4 Identification of Agents and Contractors	1.4-1
1.4.1 Technical Qualifications of Applicant	1.4-1
1.4.2 Use of Contractors	1.4-1
1.5 Requirements for Further Technical Information	1.5-1
1.5.1 Evolutionary Design	1.5-1
1.5.2 Analysis and Design Tools	1.5-1
1.5.2.1 TRACG	1.5-2
1.5.2.2 Scope of Application of TRACG to ESBWR	1.5-3
1.5.3 Testing	1.5-4
1.5.3.1 Major ESBWR Unique Test Programs	1.5-6
1.5.4 References	1.5-8
1.6 Material Incorporated by Reference and General Reference Material	1.6-1
1.7 Drawings and Other Detailed Information	1.7-1
1.7.1 Electrical, Instrumentation and Control Drawings	1.7-1
1.7.2 Piping and Instrumentation Diagrams	1.7-1
1.7.3 Other Detailed Information	1.7-1
1.7.4 COL Information	1.7-2
1.8 Interfaces With Standard Design	1.8-1
1.8.1 Identification of Nuclear Steam Supply System Safety-Related Interfaces	1.8-1
1.8.2 Identification of Balance of Plant Interfaces	1.8-1
1.8.2.1 Circulating Water System	1.8-1
1.8.2.2 Plant Service Water System	1.8-1
1.8.2.3 Off-site Electrical Power	1.8-1
1.8.2.4 Makeup Water System	1.8-1
1.8.2.5 Potable and Sanitary Water	1.8-2
1.8.2.6 Communications Systems	1.8-2
1.8.2.7 Station Water System	1.8-2
1.8.2.8 Independent Spent Fuel Storage Installation	1.8-2
1.9 Conformance with Standard Review Plan and Applicability of Codes and Standards	1.9-1
1.9.1 Conformance with Standard Review Plan	1.9-1
1.9.2 Applicability to Regulatory Criteria	1.9-1
1.9.3 Applicability of Experience Information	1.9-1
1.9.4 COL Information	1.9-1
1.9.5 References	1.9-1
1.10 Summary of COL Items	1.10-1
1.11 Technical Resolutions of Task Action Plan Items, New Generic Issues, New Generic Safety Issues and Chernobyl Issues	1.11-1
1.11.1 Approach	1.11-1

1.11.2 COL Information.....	1.11-1
1.11.3 References	1.11-1

VOLUME 26A6642AF

Appendix 1A Response to TMI Related Matters	1A-1
1A.1 References	1A-1
Appendix 1B Plant Shielding to Provide Access to Areas and Protect Safety Equipment for Post-Accident Operation [II.B.2]	1B-1
1B.1 Introduction	1B-1
1B.2 Summary of Shielding Design Review	1B-1
1B.3 Containment Description and Post-Accident Operations	1B-2
1B.3.1 Description of Containment	1B-2
1B.3.2 Post-Accident Access of Areas and Systems	1B-3
1B.3.3 Post-Accident Operation	1B-3
1B.4 Design Review Bases	1B-4
1B.4.1 Radioactive Source Term and Dose Rates	1B-4
1B.4.2 Accidents Used as the Basis for the Specified Radioactivity Release	1B-4
1B.4.3 Availability of Offsite Power	1B-4
1B.4.4 Radiation Qualification Conditions	1B-5
1B.5 Results of the Review	1B-5
1B.5.1 Systems Required Post-Accident	1B-5
1B.5.1.1 Necessary Post-Accident Functions and Systems	1B-5
1B.5.1.2 Emergency Core Cooling and Residual Heat Removal Systems	1B-6
1B.5.1.3 Flammability Control	1B-7
1B.5.1.4 Fission Product Removal and Control System	1B-7
1B.5.1.5 Instrumentation and Control, Power and Habitability Systems	1B-7
1B.6 References	1B-8
Appendix 1C Industry Operating Experience	1C-1
1C.1 Evaluation	1C-1
1C.2 COL Information	1C-1
Appendix 1D Summary of Tier 2* Information	1D-1
1D.1 Plant-Specific Changes to Certain Designated Material in Tier 2	1D-1
1D.2 Expiration of Tier 2* Information	1D-1

VOLUME 26A6642AH

2. Site Characteristics	2.0-1
2.0 Introduction	2.0-1
2.0.1 COL Information	2.0-2
2.0.2 References	2.0-2
APPENDIX 2A ARCON96 Source/Receptor Inputs.....	2A-1
2A.1 Scope	2A-1
2A.2 Methodology.....	2A-1
2A.3 COL Information	2A-3
2A.4 References	2A-3
APPENDIX 2B Ventilation Stack Pathway Information for Long-Term X/Q Values.....	2B-1
2B.1 Discussion	2B-1
2B.2 COL Information	2B-1
2B.3 References.....	2B-1

VOLUME 26A6642AJ

3.DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT, AND SYSTEMS	3.1-1
3.1 CONFORMANCE WITH NRC GENERAL DESIGN CRITERIA	3.1-1
3.1.1 Group I — Overall Requirements	3.1-1
3.1.1.1 Criterion 1 — Quality Standards and Records	3.1-1
3.1.1.2 Criterion 2 — Design Bases for Protection Against Natural Phenomena	3.1-2
3.1.1.3 Criterion 3 — Fire Protection	3.1-4
3.1.1.4 Criterion 4 — Environmental and Dynamic Effects Design Bases	3.1-5
3.1.1.5 Criterion 5 — Sharing of Structures, Systems, and Components	3.1-7
3.1.2 Group II — Protection by Multiple Fission Product Barriers	3.1-8
3.1.2.1 Criterion 10 — Reactor Design	3.1-8
3.1.2.2 Criterion 11 — Reactor Inherent Protection	3.1-8
3.1.2.3 Criterion 12 — Suppression of Reactor Power Oscillations	3.1-9
3.1.2.4 Criterion 13 — Instrumentation and Control	3.1-10
3.1.2.5 Criterion 14 — Reactor Coolant Pressure Boundary	3.1-12
3.1.2.6 Criterion 15 — Reactor Coolant System Design	3.1-13
3.1.2.7 Criterion 16 — Containment Design	3.1-14
3.1.2.8 Criterion 17 — Electric Power Systems	3.1-15
3.1.2.9 Criterion 18 — Inspection and Testing of Electric Power Systems	3.1-17
3.1.2.10 Criterion 19 — Control Room	3.1-18
3.1.3 Group III — Protection and Reactivity Control Systems	3.1-20
3.1.3.1 Criterion 20 — Protection System Functions	3.1-20
3.1.3.2 Criterion 21 — Protection System Reliability and Testability	3.1-20
3.1.3.3 Criterion 22 — Protection System Independence	3.1-21
3.1.3.4 Criterion 23 — Protection System Failure Modes	3.1-22
3.1.3.5 Criterion 24 — Separation of Protection and Control Systems	3.1-23
3.1.3.6 Criterion 25 — Protection System Requirements for Reactivity Control Malfunctions	3.1-24
3.1.3.7 Criterion 26 — Reactivity Control System Redundancy and Capability	3.1-24
3.1.3.8 Criterion 27 — Combined Reactivity Control Systems Capability	3.1-26
3.1.3.9 Criterion 28 — Reactivity Limits	3.1-27
3.1.3.10 Criterion 29 — Protection Against Anticipated Operational Occurrences	3.1-28
3.1.4 Group IV — Fluid Systems	3.1-29
3.1.4.1 Criterion 30 — Quality of Reactor Coolant Pressure Boundary	3.1-29
3.1.4.2 Criterion 31 — Fracture Prevention of Reactor Coolant Pressure Boundary	3.1-30
3.1.4.3 Criterion 32 — Inspection of Reactor Coolant Pressure Boundary	3.1-31
3.1.4.4 Criterion 33 — Reactor Coolant Makeup	3.1-31
3.1.4.5 Criterion 34 — Residual Heat Removal	3.1-32
3.1.4.6 Criterion 35 — Emergency Core Cooling	3.1-33
3.1.4.7 Criterion 36 — Inspection of Emergency Core Cooling System	3.1-34
3.1.4.8 Criterion 37 — Testing of Emergency Core Cooling System	3.1-35
3.1.4.9 Criterion 38 — Containment Heat Removal	3.1-36
3.1.4.10 Criterion 39 — Inspection of Containment Heat Removal System	3.1-37
3.1.4.11 Criterion 40 — Testing of Containment Heat Removal System	3.1-38
3.1.4.12 Criterion 41 — Containment Atmosphere Cleanup	3.1-38

3.1.4.13 Criterion 42 — Inspection of Containment Atmosphere Cleanup Systems	3.1-39
3.1.4.14 Criterion 43 — Testing of Containment Atmosphere Cleanup Systems	3.1-40
3.1.4.15 Criterion 44 — Cooling Water	3.1-41
3.1.4.16 Criterion 45 — Inspection of Cooling Water System	3.1-41
3.1.4.17 Criterion 46 — Testing of Cooling Water System	3.1-42
3.1.5 Group V — Reactor Containment	3.1-43
3.1.5.1 Criterion 50 — Containment Design Basis	3.1-43
3.1.5.2 Criterion 51 — Fracture Prevention of Containment Pressure Boundary	3.1-43
3.1.5.3 Criterion 52 — Capability for Containment Leakage Rate Testing	3.1-44
3.1.5.4 Criterion 53 — Provisions for Containment Testing and Inspection	3.1-45
3.1.5.5 Criterion 54 — Piping Systems Penetrating Containment	3.1-45
3.1.5.6 Criterion 55 — Reactor Coolant Pressure Boundary Penetrating Containment	3.1-46
3.1.5.7 Criterion 56 — Primary Containment Isolation	3.1-47
3.1.5.8 Criterion 57 — Closed System Isolation Valves	3.1-48
3.1.6 Group VI — Fuel and Radioactivity Control	3.1-48
3.1.6.1 Criterion 60 — Control of Releases of Radioactive Materials to the Environment	3.1-48
3.1.6.2 Criterion 61 — Fuel Storage and Handling and Radioactivity Control	3.1-49
3.1.6.3 Criterion 62 — Prevention of Criticality in Fuel Storage and Handling	3.1-50
3.1.6.4 Criterion 63 — Monitoring Fuel and Waste Storage	3.1-51
3.1.6.5 Criterion 64 — Monitoring Radioactivity Releases	3.1-51
3.1.7 COL Information	3.1-52
3.2 CLASSIFICATION OF STRUCTURES, SYSTEMS AND COMPONENTS	3.2-1
3.2.1 Seismic Classification	3.2-1
3.2.2 System Quality Group Classification	3.2-2
3.2.2.1 Quality Group A	3.2-2
3.2.2.2 Quality Group B	3.2-2
3.2.2.3 Quality Group C	3.2-3
3.2.2.4 Quality Group D	3.2-4
3.2.3 Safety Classification	3.2-4
3.2.3.1 Safety Class 1	3.2-5
3.2.3.2 Safety Class 2	3.2-5
3.2.3.3 Safety Class 3	3.2-6
3.2.3.4 NonSafety-Related	3.2-7
3.2.4 COL Information	3.2-7
3.2.5 References	3.2-8
3.3 WIND AND TORNADO LOADINGS	3.3-1
3.3.1 Wind Loadings	3.3-1
3.3.1.1 Design Wind Velocity and Recurrence Interval	3.3-1
3.3.1.2 Determination of Applied Forces	3.3-1
3.3.1.3 Effect of Failures of Structures or Components Not Designed for Wind Loads	3.3-1
3.3.2 Tornado Loadings	3.3-2
3.3.2.1 Applicable Design Parameters	3.3-2
3.3.2.2 Determination of Forces on Structures	3.3-2

3.3.2.3 Effect of Failures of Structures or Components Not Designed for Tornado Loads.....	3.3-2
3.3.3 References.....	3.3-3
3.4 WATER LEVEL (FLOOD) DESIGN.....	3.4-1
3.4.1 Flood Protection.....	3.4-1
3.4.1.1 Flood Protection Summary	3.4-2
3.4.1.2 Flood Protection From External Sources	3.4-2
3.4.1.3 Internal Flooding Evaluation Criteria	3.4-3
3.4.1.4 Evaluation of Internal Flooding	3.4-4
3.4.2 Analysis Procedures	3.4-7
3.4.3 COL Information	3.4-8
3.4.4 References	3.4-8
3.5 MISSILE PROTECTION.....	3.5-1
3.5.1 Missile Selection and Description	3.5-1
3.5.1.1 Internally Generated Missiles (Outside Containment)	3.5-3
3.5.1.2 Internally Generated Missiles (Inside Containment)	3.5-7
3.5.1.3 Turbine Missiles.....	3.5-8
3.5.1.4 Missiles Generated by Natural Phenomena	3.5-8
3.5.1.5 Site Proximity Missiles (Except Aircraft).....	3.5-9
3.5.1.6 Aircraft Hazards.....	3.5-9
3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles	3.5-9
3.5.3 Barrier Design Procedures.....	3.5-9
3.5.3.1 Local Damage Prediction.....	3.5-9
3.5.3.2 Overall Damage Prediction.....	3.5-10
3.5.3.3 Impact of Failure of Nonsafety-Related Structures, Systems and Components	3.5-10
3.5.4 COL Information.....	3.5-10
3.5.5 References	3.5-10
3.6 PROTECTION AGAINST DYNAMIC EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING.....	3.6-1
3.6.1 Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Inside and Outside of Containment.....	3.6-1
3.6.1.1 Design Bases	3.6-2
3.6.1.2 Description	3.6-4
3.6.1.3 Design Evaluation	3.6-4
3.6.2 Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping	3.6-7
3.6.2.1 Criteria Used to Define Break and Crack Location and Configuration.....	3.6-8
3.6.2.2 Analytic Methods to Define Blowdown Forcing Functions and Response Models	3.6-16
3.6.2.3 Dynamic Analysis Methods to Verify Integrity and Operability.....	3.6-18
3.6.2.4 Guard Pipe Assembly Design	3.6-24
3.6.2.5 [Pipe Break Analysis Results and Protection Methods.....	3.6-24
3.6.2.6 Analytic Methods to Define Blastwave Interaction to SSCs	3.6-25
3.6.3 (Deleted).....	3.6-26

3.6.3.1 (Deleted)	3.6-26
3.6.3.2 (Deleted)	3.6-26
3.6.4 As-built Inspection of High-Energy Pipe Break Mitigation Features	3.6-26
3.6.5 COL Information	3.6-26
3.6.6 References	3.6-26
3.7 SEISMIC DESIGN	3.7-1
3.7.1 Seismic Design Parameters	3.7-2
3.7.1.1 Design Ground Motion	3.7-2
3.7.1.2 Percentage of Critical Damping Values	3.7-6
3.7.1.3 Supporting Media for Category I Structures	3.7-6
3.7.2 Seismic System Analysis	3.7-6
3.7.2.1 Seismic Analysis Methods	3.7-6
3.7.2.2 Natural Frequencies and Responses	3.7-10
3.7.2.3 Procedures Used for Analytical Modeling	3.7-11
3.7.2.4 Soil-Structure Interaction	3.7-12
3.7.2.5 Development of Floor Response Spectra	3.7-12
3.7.2.6 Three Components of Earthquake Motion	3.7-13
3.7.2.7 Combination of Modal Responses	3.7-14
3.7.2.8 Interaction of Non-Category I Structures with Seismic Category I Structures	3.7-16
3.7.2.9 Effects of Parameter Variations on Floor Response Spectra	3.7-19
3.7.2.10 Use of Equivalent Vertical Static Factors	3.7-19
3.7.2.11 Methods Used to Account for Torsional Effects	3.7-20
3.7.2.12 Comparison of Responses	3.7-20
3.7.2.13 Analysis Procedure for Damping	3.7-20
3.7.2.14 Determination of Seismic Category I Structure Overturning Moments	3.7-22
3.7.3 Seismic Subsystem Analysis	3.7-23
3.7.3.1 Seismic Analysis Methods	3.7-23
3.7.3.2 Determination of Number of Earthquake Cycles	3.7-23
3.7.3.3 Procedures Used for Analytical Modeling	3.7-24
3.7.3.4 Basis for Selection of Frequencies	3.7-25
3.7.3.5 Analysis Procedure for Damping	3.7-26
3.7.3.6 Three Components of Earthquake Motion	3.7-26
3.7.3.7 Combination of Modal Responses	3.7-26
3.7.3.8 Interaction of Other Systems with Seismic Category I Systems	3.7-26
3.7.3.9 Multiple-Supported Equipment and Components with Distinct Inputs	3.7-26
3.7.3.10 Use of Equivalent Vertical Static Factors	3.7-27
3.7.3.11 Torsional Effects of Eccentric Masses	3.7-28
3.7.3.12 Effect of Differential Building Movements	3.7-28
3.7.3.13 Seismic Category I Buried Piping, Conduits and Tunnels	3.7-28
3.7.3.14 Methods for Seismic Analysis of Seismic Category I Concrete Dams	3.7-30
3.7.3.15 Methods for Seismic Analysis of Above-Ground Tanks	3.7-30
3.7.3.16 Design of Small Branch and Small Bore Piping	3.7-31
3.7.3.17 Interaction of Other Piping with Seismic Category I Piping	3.7-32
3.7.4 Seismic Instrumentation	3.7-33
3.7.4.1 Comparison with Regulatory Guide 1.12	3.7-34

3.7.4.2 Location and Description of Instrumentation	3.7-34
3.7.4.3 Control Room Operator Notification	3.7-35
3.7.4.4 Comparison of Measured and Predicted Responses	3.7-35
3.7.4.5 In-Service Surveillance	3.7-36
3.7.5 Site-Specific Information	3.7-36
3.7.6 References	3.7-36
3.8 SEISMIC CATEGORY I STRUCTURES	3.8-1
3.8.1 Concrete Containment	3.8-1
3.8.1.1 Description of the Containment	3.8-1
3.8.1.2 Applicable Codes, Standards, and Specifications	3.8-3
3.8.1.3 Loads and Load Combinations	3.8-4
3.8.1.4 Design and Analysis Procedures	3.8-6
3.8.1.5 Structural Acceptance Criteria	3.8-10
3.8.1.6 Material, Quality Control and Special Construction Techniques	3.8-11
3.8.1.7 Testing and In-service Inspection Requirements	3.8-13
3.8.2 Steel Components of the Reinforced Concrete Containment	3.8-17
3.8.2.1 Description of the Steel Containment Components	3.8-17
3.8.2.2 Applicable Codes, Standards, Specifications and Regulatory Guides	3.8-19
3.8.2.3 Loads and Load Combinations	3.8-20
3.8.2.4 Design and Analysis Procedures	3.8-20
3.8.2.5 Structural Acceptance Criteria	3.8-22
3.8.2.6 Materials, Quality Control, and Special Construction Techniques	3.8-22
3.8.2.7 Testing and In-service Inspection Requirements	3.8-23
3.8.3 Concrete and Steel Internal Structures of the Concrete Containment	3.8-24
3.8.3.1 Description of the Internal Structures	3.8-24
3.8.3.2 Applicable Codes, Standards, and Specifications	3.8-26
3.8.3.3 Loads and Load Combinations	3.8-26
3.8.3.4 Design and Analysis Procedures	3.8-27
3.8.3.5 Structural Acceptance Criteria	3.8-28
3.8.3.6 Materials, Quality Control, and Special Construction Techniques	3.8-29
3.8.3.7 Testing and In-service Inspection Requirements	3.8-31
3.8.3.8 Welding Methods and Acceptance Criteria for Structural and Building Steel	3.8-32
3.8.4 Other Seismic Category I Structures	3.8-32
3.8.4.1 Description of the Structures	3.8-33
3.8.4.2 Applicable Codes, Standards, and Specifications	3.8-36
3.8.4.3 Loads and Load Combinations	3.8-38
3.8.4.4 Design and Analysis Procedures	3.8-41
3.8.4.5 Structural Acceptance Criteria	3.8-42
3.8.4.6 Material, Quality Control and Special Construction Techniques	3.8-43
3.8.4.7 Testing and In-Service Inspection Requirements	3.8-44
3.8.5 Foundations	3.8-44
3.8.5.1 Description of the Foundations	3.8-44
3.8.5.2 Applicable Codes, Standards and Specifications	3.8-45
3.8.5.3 Loads and Load Combinations	3.8-45
3.8.5.4 Design and Analysis Procedures	3.8-45

3.8.5.5 Structural Acceptance Criteria.....	3.8-47
3.8.5.6 Materials, Quality Control, and Special Construction Techniques.....	3.8-48
3.8.5.7 Testing and In-Service Inspection Requirements	3.8-48
3.8.6 Special Topics.....	3.8-48
3.8.6.1 Foundation Waterproofing.....	3.8-48
3.8.6.2 Site-Specific Physical Properties and Foundation Settlement	3.8-49
3.8.6.3 Structural Integrity Pressure Result	3.8-49
3.8.6.4 Identification of Seismic Category I Structures.....	3.8-49
3.8.6.5 Foundation Mud Mat	3.8-49
3.8.7 References	3.8-50

VOLUME 26A6642AK

3.9 Mechanical Systems and Components	3.9-1
3.9.1 Special Topics for Mechanical Components	3.9-1
3.9.1.1 Design Transients.....	3.9-1
3.9.1.2 Computer Programs Used in Analyses	3.9-2
3.9.1.3 Experimental Stress Analysis.....	3.9-2
3.9.1.4 Considerations for the Evaluation of Faulted Condition.....	3.9-2
3.9.2 Dynamic Testing and Analysis of Systems, Components and Equipment	3.9-5
3.9.2.1 Piping Vibration, Thermal Expansion and Dynamic Effects.....	3.9-5
3.9.2.1.1 Vibration and Dynamic Effects Testing	3.9-6
3.9.2.1.2 Thermal Expansion Testing	3.9-8
3.9.2.2 Seismic Qualification of Safety-Related Mechanical Equipment (Including Other RBV Induced Loads).....	3.9-10
3.9.2.2.1 Tests and Analysis Criteria and Methods	3.9-10
3.9.2.2.2 Qualification of Safety-Related Mechanical Equipment	3.9-12
3.9.2.3 Dynamic Response of Reactor Internals Under Operational Flow Transients and Steady-State Conditions	3.9-15
3.9.2.4 Initial Startup Flow Induced Vibration Testing of Reactor Internals.....	3.9-18
3.9.2.5 Dynamic System Analysis of Reactor Internals Under Faulted Conditions	3.9-19
3.9.2.6 Correlations of Reactor Internals Vibration Tests with the Analytical Results	3.9-20
3.9.3 ASME B&PV Code Class 1, 2 and 3 Components, Component Supports and Core Support Structures.....	3.9-21
3.9.3.1 Loading Combinations, Design Transients and Stress Limits	3.9-21
3.9.3.1.1 Plant Conditions.....	3.9-22
3.9.3.1.2 Inspections/Testing Following the Reactor Coolant System Exceeding Service Level B Pressure Limit.....	3.9-24
3.9.3.2 Reactor Pressure Vessel Assembly	3.9-25
3.9.3.3 Main Steam System Piping	3.9-25
3.9.3.4 Other Components.....	3.9-26
3.9.3.5 Valve Operability Assurance.....	3.9-27
3.9.3.5.1 Major Active Valves.....	3.9-28
3.9.3.5.2 Other Active Valves.....	3.9-30
3.9.3.6 Design and Installation of Pressure Relief Devices	3.9-32
3.9.3.7 Component Supports	3.9-34
3.9.3.7.1 Piping Supports.....	3.9-34
3.9.3.7.2 Reactor Pressure Vessel Sliding Supports	3.9-41
3.9.3.7.3 Reactor Pressure Vessel Stabilizer.....	3.9-42
3.9.3.7.4 Floor-Mounted Major Equipment.....	3.9-42
3.9.3.8 Other ASME B&PV Code Component Supports.....	3.9-42
3.9.3.9 Threaded Fasteners – ASME B&PV Code Class 1, 2 and 3	3.9-42
3.9.3.9.1 Material Selection	3.9-42
3.9.3.9.2 Special Materials Fabrication Processes and Special Controls.....	3.9-43
3.9.3.9.3 Preservice and Inservice Inspection Requirements.....	3.9-43
3.9.4 Control Rod Drive System	3.9-44
3.9.4.1 Descriptive Information on Control Rod Drive System	3.9-44

3.9.4.2	Applicable Control Rod Drive System Design Specification	3.9-44
3.9.4.3	Design Loads and Stress Limits	3.9-45
3.9.4.4	Control Rod Drive Performance Assurance Program	3.9-45
3.9.5	Reactor Pressure Vessel Internals	3.9-45
3.9.5.1	Core Support Structures.....	3.9-47
3.9.5.2	Internal Structures.....	3.9-48
3.9.5.3	Loading Conditions	3.9-50
3.9.5.4	Design Bases.....	3.9-52
3.9.6	Inservice Testing of Pumps and Valves	3.9-53
3.9.6.1	InService Testing Valves.....	3.9-54
3.9.6.1.1	Valve Exemptions.....	3.9-55
3.9.6.1.2	Valve Categories.....	3.9-55
3.9.6.1.3	Valve Functions	3.9-56
3.9.6.1.4	Valve Testing.....	3.9-56
3.9.6.1.5	Specific Valve Test Requirements.....	3.9-58
3.9.6.2	Inservice Testing of Pumps.....	3.9-59
3.9.6.3	Preservice Testing of Valves	3.9-59
3.9.6.4	Deferred Testing Justifications	3.9-59
3.9.6.5	Valve Replacement, Repair and Maintenance	3.9-60
3.9.6.6	10 CFR 50.55a Relief Requests and Code Cases	3.9-60
3.9.6.7	Inservice Testing Program Implementation.....	3.9-60
3.9.6.8	Non-Code Testing of Power-Operated Valves	3.9-60
3.9.7	Risk-Informed Inservice Testing.....	3.9-61
3.9.8	Risk-Informed Inservice Inspection of Piping	3.9-61
3.9.9	COL Information	3.9-61
3.9.10	References	3.9-62
3.10	Seismic and Dynamic Qualification of Mechanical and Electrical Equipment	3.10-1
3.10.1	Seismic and Dynamic Qualification Criteria.....	3.10-3
3.10.1.1	Selection of Qualification Method	3.10-3
3.10.1.2	Input Motion.....	3.10-3
3.10.1.3	Dynamic Qualification Program.....	3.10-3
3.10.1.4	Dynamic Qualification Report.....	3.10-3
3.10.2	Methods and Procedures for Qualifying Mechanical and Electrical Equipment ...	3.10-4
3.10.2.1	Qualification by Testing	3.10-4
3.10.2.2	Qualification by Analysis	3.10-7
3.10.2.3	Qualification by Combined Testing and Analysis.....	3.10-7
3.10.2.4	(Deleted)	3.10-9
3.10.3	Analysis or Testing of Electrical Equipment Supports	3.10-9
3.10.3.1	Nuclear Steam Supply System Electrical Equipment Supports (Other than Motors and Valve-Mounted Equipment).....	3.10-9
3.10.3.2	Other Electrical Equipment Supports	3.10-10
3.10.3.3	Documentation of Testing or Analysis of Electrical Supports.....	3.10-11
3.10.4	COL Information	3.10-12
3.10.5	References	3.10-12

3.11 Environmental Qualification of Mechanical and Electrical Equipment.....	3.11-1
3.11.1 Description Requirements	3.11-1
3.11.1.1 Applicable Regulations and Standards	3.11-2
3.11.1.2 General Requirements	3.11-4
3.11.1.3 Definitions	3.11-5
3.11.2 Equipment Identification	3.11-6
3.11.3 Environmental Conditions.....	3.11-6
3.11.3.1 General Requirements	3.11-6
3.11.3.2 Environmental Requirements	3.11-11
3.11.4 Qualification Program, Methods and Documentation.....	3.11-11
3.11.4.1 Harsh Environment Qualification	3.11-11
3.11.4.2 Mild Environment Qualification	3.11-13
3.11.4.3 Computer-based Instrumentation and Control Systems.....	3.11-13
3.11.4.4 Environmental Qualification Documentation	3.11-15
3.11.5 Loss of Heating, Ventilating and Air Conditioning	3.11-15
3.11.6 Estimated Chemical and Radiation Environment.....	3.11-15
3.11.7 COL Information	3.11-15
3.11.8 References	3.11-16

VOLUME 26A6642AL

3A. SEISMIC SOIL-STRUCTURE INTERACTION ANALYSIS	3A-1
3A.1 Introduction	3A-1
3A.2 ESBWR Standard Plant Site Plan.....	3A-3
3A.3 Site Conditions	3A-5
3A.3.1 Generic Site Conditions.....	3A-5
3A.3.2 North Anna ESP Site Conditions	3A-5
3A.4 Input Motion and Damping Values	3A-9
3A.4.1 Input Motion.....	3A-9
3A.4.2 Damping Values	3A-9
3A.5 <i>Soil-Structure Interaction Analysis Method</i>	3A-10
3A.5.1 <i>DAC3N Analysis Method</i>	3A-10
3A.5.2 <i>SASSI2000 Analysis Method</i>	3A-10
3A.6 <i>Soil-Structure Interaction Analysis Cases</i>	3A-17
3A.7 [<i>Analysis Models</i>].....	3A-20
3A.7.1 <i>Method of Dynamic Structural Model Development</i>	3A-20
3A.7.2 <i>Lumped Mass-Beam Stick Model for SSI Analysis</i>	3A-21
3A.7.3 <i>SSI Model for SASSI2000 Analysis</i>	3A-22
3A.8 Analysis Results	3A-56
3A.8.1 Effect of Soil Stiffness.....	3A-57
3A.8.2 Effect of Single Envelope Ground Motion.....	3A-57
3A.8.3 Effect of Updated Design of Reactor Shield Wall and Vent Wall	3A-58
3A.8.4 Effect of Infill Concrete Stiffness of Vent Wall and Diaphragm Floor	3A-58
3A.8.5 Effect of Loss-of-Coolant-Accident (LOCA) Flooding	3A-59
3A.8.6 Effect of Layered Sites	3A-59
3A.8.7 Effect of Embedment.....	3A-59
3A.8.8 Effect of Lateral Soil Pressures	3A-60
3A.8.9 Effect of Concrete Cracking.....	3A-61
3A.8.10 Effect of Wall Out-of-plane Vibration	3A-61
3A.8.11 Effect of Structure-Structure Interaction	3A-61
3A.9 [<i>Site Envelope Seismic Responses</i>]	3A-212
3A.9.1 <i>Enveloping Maximum Structural Loads</i>	3A-212
3A.9.2 <i>Enveloping Floor Response Spectra</i>	3A-212
3A.9.3 <i>Basemat Interface Loads with Foundation Medium for Foundation Stability</i> <i>Evaluation</i>	3A-213
3B. [CONTAINMENT HYDRODYNAMIC LOAD DEFINITIONS].....	3B-1
3B.1 <i>Safety Relief Valve Loads</i>	3B-1
3B.1.1 <i>Oscillating Pressure Load Into the Suppression Pool from Safety Relief Valves</i>	3B-1
3B.1.2 <i>Pressure Time History</i>	3B-1
3B.2 <i>Accident Pressure Loads</i>	3B-1
3B.3 <i>Combined License (COL) Information</i>	3B-2
3B.4 <i>References</i>	3B-2

3C. COMPUTER PROGRAMS USED IN THE DESIGN AND ANALYSIS OF SEISMIC CATEGORY I STRUCTURES.....	3C-1
3C.1 Introduction.....	3C-1
3C.2 Static and Dynamic Structural Analysis Program (NASTRAN).....	3C-1
3C.2.1 Description.....	3C-1
3C.2.2 Validation	3C-1
3C.2.3 Extent of Application.....	3C-1
3C.3 ABAQUS and ANACAP-U.....	3C-1
3C.3.1 Description.....	3C-1
3C.3.2 Validation	3C-2
3C.3.3 Extent of Application.....	3C-2
3C.4 Concrete Element Cracking Analysis Program (SSDP-2D).....	3C-2
3C.4.1 Description.....	3C-2
3C.4.2 Validation	3C-2
3C.4.3 Extent of Application.....	3C-2
3C.5 Heat Transfer Analysis Program (TEMCOM2)	3C-3
3C.5.1 Description.....	3C-3
3C.5.2 Validation	3C-3
3C.5.3 Extent of Application.....	3C-3
3C.6 Static and Dynamic Structural Analysis Systems: ANSYS.....	3C-3
3C.6.1 Description.....	3C-3
3C.6.2 Validation	3C-3
3C.6.3 Extent of Application.....	3C-3
3C.7 Soil-Structure Interaction.....	3C-3
3C.7.1 Dynamic Soil-Structure Interaction Analysis Program—DAC3N.....	3C-3
3C.7.1.1 Description	3C-3
3C.7.1.2 Validation	3C-4
3C.7.1.3 Extent of Application	3C-4
3C.7.2 Dynamic Soil-Structure Interaction Analysis Program – SASSI2000	3C-4
3C.7.2.1 Description	3C-4
3C.7.2.2 Validation	3C-4
3C.7.2.3 Extent of Application	3C-4
3C.7.3 Free-Field Site Response Analysis – SHAKE.....	3C-4
3C.7.3.1 Description	3C-4
3C.7.3.2 Validation	3C-5
3C.7.3.3 Extent of Application	3C-5
3D. COMPUTER PROGRAMS USED IN THE DESIGN OF COMPONENTS, EQUIPMENT, AND STRUCTURES	3D-1
3D.1 Introduction	3D-1
3D.2 Fine Motion Control Rod Drive (FMCRD).....	3D-1
3D.2.1 ABAQUS.....	3D-1
3D.2.1.1 Description	3D-1
3D.2.1.2 Validation.....	3D-1
3D.2.1.3 Extent of Application	3D-1
3D.2.2 ANSYS	3D-1

3D.2.2.1 Description	3D-1
3D.2.2.2 Validation	3D-1
3D.2.2.3 Extent of Application	3D-2
3D.3 Reactor Pressure Vessel and Internals	3D-2
3D.3.1 ANSYS	3D-2
3D.3.1.1 Description	3D-2
3D.3.1.2 Validation	3D-2
3D.3.1.3 Extent of Application	3D-2
3D.3.2 Dynamic Stress Analysis of Axisymmetric Structures Under Arbitrary Loading - ASHSD2	3D-2
3D.3.2.1 Description	3D-2
3D.3.2.2 Validation	3D-3
3D.3.2.3 Extent of Application	3D-3
3D.3.3 EVAST	3D-3
3D.3.3.1 Description	3D-3
3D.3.3.2 Validation	3D-3
3D.3.3.3 Extent of Application	3D-3
3D.3.4 TACF	3D-3
3D.3.4.1 Description	3D-3
3D.3.4.2 Validation	3D-3
3D.3.4.3 Extent of Application	3D-4
3D.3.5 ABAQUS	3D-4
3D.3.5.1 Description	3D-4
3D.3.5.2 Validation	3D-4
3D.3.5.3 Extent of Application	3D-4
3D.3.6 FEMFL	3D-4
3D.3.6.1 Description	3D-4
3D.3.6.2 Validation	3D-4
3D.3.6.3 Extent of Application	3D-4
3D.3.7 SEISM	3D-4
3D.3.7.1 Description	3D-4
3D.3.7.2 Validation	3D-5
3D.3.7.3 Extent of Application	3D-5
3D.3.8 PVElite	3D-5
3D.3.8.1 Description	3D-5
3D.3.8.2 Validation	3D-5
3D.3.8.3 Extent of Application	3D-5
3D.3.9 ANSYS Workbench	3D-5
3D.3.9.1 Description	3D-5
3D.3.9.2 Validation	3D-5
3D.3.9.3 Extent of Application	3D-5
3D.3.10 Structural Analysis Program - SAP4G	3D-5
3D.3.10.1 Description	3D-5
3D.3.10.2 Validation	3D-6
3D.3.10.3 Extent of Application	3D-6
3D.4 Piping	3D-6

3D.4.1 Piping Analysis Program – PISYS	3D-6
3D.4.1.1 Description	3D-6
3D.4.1.2 Validation	3D-7
3D.4.1.3 Extent of Application	3D-7
3D.4.2 Component Analysis - ANSI7	3D-7
3D.4.2.1 Description	3D-7
3D.4.2.2 Validation	3D-7
3D.4.2.3 Extent of Application	3D-7
3D.4.3 (Deleted)	3D-7
3D.4.4 Dynamic Forcing Functions	3D-7
3D.4.4.1 Relief Valve Discharge Pipe Forces Computer Program – RVFOR	3D-7
3D.4.4.2 Turbine Stop Valve Closure – TSFOR	3D-8
3D.4.4.3 (Deleted)	3D-8
3D.4.4.4 (Deleted)	3D-8
3D.4.5 (Deleted)	3D-8
3D.4.6 Response Spectra Generation	3D-8
3D.4.6.1 ERSIN Computer Program	3D-8
3D.4.6.2 RINEX Computer Program	3D-9
3D.4.6.3 (Deleted)	3D-9
3D.4.6.4 (Deleted)	3D-9
3D.4.7 Pipe Dynamic Analysis (PDA) Program	3D-9
3D.4.7.1 Description	3D-9
3D.4.7.2 Validation	3D-9
3D.4.7.3 Extent of Application	3D-9
3D.4.8 Thermal Transient Program – LION	3D-10
3D.4.8.1 Description	3D-10
3D.4.8.2 Validation	3D-10
3D.4.8.3 Extent of Application	3D-10
3D.4.9 Engineering Analysis System - ANSYS	3D-10
3D.4.9.1 Description	3D-10
3D.4.9.2 Validation	3D-10
3D.4.9.3 Extent of Application	3D-10
3D.4.10 Piping Analysis Program – EZPYP	3D-10
3D.4.10.1 Description	3D-10
3D.4.10.2 Validation	3D-10
3D.4.10.3 Extent of Application	3D-10
3D.4.11 Pipe Support Structural Analysis and Design Verification Computer Program – E/PD STRUDL	3D-11
3D.4.11.1 Description	3D-11
3D.4.11.2 Validation	3D-11
3D.4.11.3 The Extent of Application	3D-11
3D.4.12 ANSYS CFX COMPUTER PROGRAM	3D-11
3D.4.12.1 Description	3D-11
3D.4.12.2 Validation	3D-11
3D.4.12.3 Extent of Application	3D-12
3D.4.13 RELAP5/MOD3.3	3D-12

3D.4.13.1 Description	3D-12
3D.4.13.2 Validation	3D-13
3D.4.13.3 Extent of Application	3D-13
3D.5 Pumps and Motors	3D-13
3D.5.1 Structural Analysis Program - SAP4G	3D-13
3D.5.1.1 Description	3D-13
3D.5.1.2 Validation	3D-13
3D.5.1.3 Extent of Application	3D-13
3D.5.2 (Deleted)	3D-13
3D.6 COL Information	3D-13
3D.7 References	3D-14
3E. (Deleted)	3E-1
3F. RESPONSE OF STRUCTURES TO CONTAINMENT LOADS	3F-1
3F.1 [Scope]	3F-1
3F.2 Dynamic Response	3F-1
3F.2.1 Classification of Analytical Procedure	3F-1
3F.2.2 Analysis Models	3F-1
3F.2.3 Load Application	3F-2
3F.2.4 Analysis Method	3F-4
3F.3 Containment Loads Analysis Results	3F-4

VOLUME 26A6642AN

3G. DESIGN DETAILS AND EVALUATION RESULTS OF SEISMIC CATEGORY I STRUCTURES.....	3G-1
3G.1 <i>Reactor Building</i>	3G-1
3G.1.1 <i>Objective and Scope</i>	3G-1
3G.1.2 <i>Conclusions</i>	3G-1
3G.1.3 <i>Structural Description</i>	3G-2
3G.1.3.1 Description of the Reactor Building.....	3G-2
3G.1.3.1.1 <i>Reactor Building Structure</i>	3G-2
3G.1.3.1.2 <i>Containment and Containment Structure</i>	3G-2
3G.1.3.1.3 <i>Reactor Building Structure/Containment Structure Connections</i>	3G-3
3G.1.3.1.4 <i>Containment Internal Structures</i>	3G-3
3G.1.4 <i>Analytical Models</i>	3G-3
3G.1.4.1 Structural Models	3G-3
3G.1.4.2 Foundation Models.....	3G-5
3G.1.5 <i>Structural Analysis and Design</i>	3G-5
3G.1.5.1 Site Design Parameters	3G-5
3G.1.5.2 Design Loads, Load Combinations, and Material Properties.....	3G-5
3G.1.5.2.1 <i>Design Loads</i>	3G-5
3G.1.5.2.1.1 <i>Dead Load (D) and Live Load (L and L_o)</i>	3G-5
3G.1.5.2.1.2 <i>Snow and Rain Load</i>	3G-5
3G.1.5.2.1.3 <i>Lateral Soil Pressure at Rest</i>	3G-6
3G.1.5.2.1.4 <i>Wind Load (W)</i>	3G-6
3G.1.5.2.1.5 <i>Tornado Load (W_T)</i>	3G-6
3G.1.5.2.1.6 <i>Thermal Loads</i>	3G-6
3G.1.5.2.1.7 <i>Pressure Loads</i>	3G-7
3G.1.5.2.1.8 <i>Condensation Oscillation and Chugging Loads</i>	3G-7
3G.1.5.2.1.9 <i>Safety Relief Valve Loads</i>	3G-7
3G.1.5.2.1.10 <i>Steam Tunnel Subcompartment Pressure</i>	3G-7
3G.1.5.2.1.11 <i>Subcompartment Pressure in Other Compartments</i>	3G-7
3G.1.5.2.1.12 <i>Annulus Pressurization Loads</i>	3G-7
3G.1.5.2.1.13 <i>Design Seismic Loads</i>	3G-7
3G.1.5.2.2 <i>Load Combinations and Acceptance Criteria</i>	3G-8
3G.1.5.2.2.1 <i>Reinforced Concrete Containment Vessel</i>	3G-8
3G.1.5.2.2.2 <i>Steel Containment Components</i>	3G-8
3G.1.5.2.2.3 <i>Containment Internal Structures</i>	3G-8
3G.1.5.2.2.4 <i>Reactor Building Concrete Structures Including Pool Girders</i>	3G-8
3G.1.5.2.3 <i>Material Properties</i>	3G-9
3G.1.5.2.3.1 <i>Concrete</i>	3G-9
3G.1.5.2.3.2 <i>Reinforcing Steel</i>	3G-9
3G.1.5.2.3.3 <i>Structural Steel</i>	3G-10
3G.1.5.3 <i>Stability Requirements</i>	3G-10
3G.1.5.4 <i>Structural Design Evaluation</i>	3G-10
3G.1.5.4.1 <i>Containment Structure</i>	3G-10

3G.1.5.4.1.1 Containment Wall Including RPV Pedestal	3G-11
3G.1.5.4.1.2 Containment Top Slab and Suppression Pool Slab	3G-11
3G.1.5.4.1.3 Containment Foundation Mat	3G-12
3G.1.5.4.1.4 Drywell Head	3G-12
3G.1.5.4.1.5 PCCS Condenser	3G-13
3G.1.5.4.2 Containment Internal Structures	3G-13
3G.1.5.4.2.1 Diaphragm Floor	3G-14
3G.1.5.4.2.2 Vent Wall Structure	3G-15
3G.1.5.4.2.3 Reactor Shield Wall	3G-15
3G.1.5.4.2.4 RPV Support Bracket	3G-15
3G.1.5.4.2.5 Gravity-Driven Cooling System Pool	3G-15
3G.1.5.4.3 Reactor Building	3G-16
3G.1.5.4.3.1 RB Shear Walls	3G-16
3G.1.5.4.3.2 RB Foundation Mat Outside Containment	3G-16
3G.1.5.4.3.3 RB Floor Slabs	3G-16
3G.1.5.4.3.4 Pool Girders	3G-16
3G.1.5.4.3.5 Main Steam Tunnel Floors and Walls	3G-17
3G.1.5.5 Foundation Stability	3G-17
3G.1.5.5.1 Effect of Basemat Uplift	3G-18
3G.1.5.5.2 Effect of Horizontal Variation of Soil Spring	3G-18
3G.1.5.5.3 Effect of Construction Sequence	3G-18
3G.1.5.5.4 Foundation Settlement	3G-19
3G.1.5.6 Tornado Missile Evaluation	3G-19
3G.1.6 References	3G-19
3G.2 Control Building	3G-198
3G.2.1 Objective and Scope	3G-198
3G.2.2 Conclusions	3G-198
3G.2.3 Structural Description	3G-198
3G.2.4 Analytical Models	3G-198
3G.2.4.1 Structural Model	3G-198
3G.2.4.2 Foundation Models	3G-199
3G.2.5 Structural Analysis and Design	3G-199
3G.2.5.1 Site Design Parameters	3G-199
3G.2.5.2 Design Loads, Load Combinations, and Material Properties	3G-199
3G.2.5.2.1 Design Loads	3G-199
3G.2.5.2.1.1 Dead Load (D) and Live Load (L and L_o)	3G-199
3G.2.5.2.1.2 Snow and Rain Load	3G-199
3G.2.5.2.1.3 Lateral Soil Pressure at Rest	3G-200
3G.2.5.2.1.4 Wind Load (W)	3G-200
3G.2.5.2.1.5 Tornado Load (W_t)	3G-200
3G.2.5.2.1.6 Thermal Load (T_o and T_a)	3G-200
3G.2.5.2.1.7 Design Seismic Loads	3G-200
3G.2.5.2.2 Load Combinations and Acceptance Criteria	3G-200
3G.2.5.2.3 Material Properties	3G-201
3G.2.5.3 Stability Requirements	3G-201

3G.2.5.4 Structural Design Evaluation	3G-201
3G.2.5.4.1 <i>Shear Walls</i>	3G-201
3G.2.5.4.2 <i>Floor Slabs</i>	3G-201
3G.2.5.4.3 <i>Foundation Mat</i>	3G-201
3G.2.5.5 Foundation Stability	3G-202
3G.2.5.5.1 <i>Foundation Settlement</i>	3G-202
3G.2.5.6 Tornado Missile Evaluation	3G-202
3G.3 <i>Fuel Building</i>	3G-254
3G.3.1 <i>Objective and Scope</i>	3G-254
3G.3.2 <i>Conclusions</i>	3G-254
3G.3.3 <i>Structural Description</i>	3G-254
3G.3.4 <i>Analytical Models</i>	3G-254
3G.3.5 <i>Structural Analysis and Design</i>	3G-255
3G.3.5.1 Site Design Parameters	3G-255
3G.3.5.2 Design Loads, Load Combinations, and Material Properties	3G-255
3G.3.5.2.1 <i>Design Loads</i>	3G-255
3G.3.5.2.1.1 <i>Dead Load (D) and Live Load (L and L_o)</i>	3G-255
3G.3.5.2.1.2 <i>Snow and Rain Load</i>	3G-255
3G.3.5.2.1.3 <i>Lateral Soil Pressure at Rest</i>	3G-255
3G.3.5.2.1.4 <i>Wind Load (W)</i>	3G-255
3G.3.5.2.1.5 <i>Tornado Load (W_t)</i>	3G-255
3G.3.5.2.1.6 <i>Thermal Load</i>	3G-255
3G.3.5.2.1.7 <i>Design Seismic Loads</i>	3G-256
3G.3.5.2.2 <i>Load Combinations and Acceptance Criteria</i>	3G-256
3G.3.5.2.3 <i>Material Properties</i>	3G-256
3G.3.5.3 <i>Stability Requirements</i>	3G-256
3G.3.5.4 <i>Structural Design Evaluation</i>	3G-256
3G.3.5.4.1 <i>Shear Walls and Spent Fuel Pool Walls</i>	3G-257
3G.3.5.4.2 <i>Floor Slabs</i>	3G-257
3G.3.5.4.3 <i>Foundation Mat</i>	3G-257
3G.3.5.5 <i>Foundation Stability</i>	3G-257
3G.3.5.6 <i>Tornado Missile Evaluation</i>	3G-257
3G.4 <i>FireWater Service Complex</i>	3G-282
3G.4.1 <i>Objective and Scope</i>	3G-282
3G.4.2 <i>Conclusion</i>	3G-282
3G.4.3 <i>Structural Description</i>	3G-282
3G.4.4 <i>Analytical Models</i>	3G-282
3G.4.4.1 <i>Structural Model</i>	3G-282
3G.4.4.2 <i>Foundation Models</i>	3G-283
3G.4.5 <i>Structural Analysis and Design</i>	3G-283
3G.4.5.1 <i>Site Design Parameters</i>	3G-283
3G.4.5.2 <i>Design Loads, Load Combinations, and Material Properties</i>	3G-283
3G.4.5.2.1 <i>Design Loads</i>	3G-283
3G.4.5.2.1.1 <i>Dead Load (D) and Live Load (L and L_o)</i>	3G-283

3G.4.5.2.1.2 <i>Snow and Rain Load</i>	3G-283
3G.4.5.2.1.3 <i>Lateral Soil Pressure</i>	3G-283
3G.4.5.2.1.4 <i>Wind Load (W)</i>	3G-283
3G.4.5.2.1.5 <i>Tornado Load (W_d)</i>	3G-284
3G.4.5.2.1.6 <i>Thermal Load (T_o)</i>	3G-284
3G.4.5.2.1.7 <i>Design Seismic Loads</i>	3G-284
3G.4.5.2.2 <i>Load Combinations and Acceptance Criteria</i>	3G-284
3G.4.5.2.3 <i>Material Properties</i>	3G-284
3G.4.5.3 <i>Stability Requirements</i>	3G-284
3G.4.5.4 <i>Structural Design Evaluation</i>	3G-284
3G.4.5.4.1 <i>Shear Walls</i>	3G-285
3G.4.5.4.2 <i>Roof Floor Slabs</i>	3G-285
3G.4.5.4.3 <i>Foundation Mat</i>	3G-285
3G.4.5.4.4 <i>Shear Key</i>	3G-285
3G.4.5.5 <i>Foundation Stability</i>	3G-286
3G.4.5.5.1 <i>Foundation Settlement</i>	3G-286
3G.4.5.6 <i>Tornado Missile Evaluation</i>	3G-286
3G.5 <i>STRUCTURAL EVALUATION FOR TRACG CALCULATED</i> <i>LOCA TEMPERATURES</i>	3G-322
3G.5.1 <i>Drywell</i>	3G-322
3G.5.2 <i>Wetwell Airspace</i>	3G-323
3G.5.3 <i>RB Upper Pools</i>	3G-324
3G.5.4 <i>Conclusions</i>	3G-326
3G.6 <i>CRITICAL DIMENSIONS AND TOLERANCES</i>	3G-378
3H. <i>EQUIPMENT QUALIFICATION DESIGN ENVIRONMENTAL CONDITIONS</i>	3H-1
3H.1 <i>Introduction</i>	3H-1
3H.2 <i>Plant Zones</i>	3H-1
3H.2.1 <i>Containment Vessel</i>	3H-1
3H.2.2 <i>Outside Containment Vessel</i>	3H-1
3H.3 <i>Environmental Conditions</i>	3H-2
3H.3.1 <i>Plant Normal Operating Conditions</i>	3H-2
3H.3.2 <i>Accident Conditions</i>	3H-2
3H.3.2.1 <i>Transient Room Temperature Analysis</i>	3H-2
3H.3.2.1.1 <i>Maximum Temperature Analysis Conditions</i>	3H-5
3H.3.2.1.2 <i>Minimum Temperature Analysis Conditions</i>	3H-5
3H.3.2.1.3 <i>High Humidity Analysis Conditions</i>	3H-6
3H.3.3 <i>Water Quality</i>	3H-6
3H.3.4 <i>Locations of Safety-Related Equipment</i>	3H-7
3H.3.5 <i>Mild Environment Conditions</i>	3H-7
3H.3.6 <i>Combined License (COL) Information</i>	3H-7
3H.4 <i>References</i>	3H-7
3I. <i>DESIGNATED NEDE-24326-1-P MATERIAL WHICH MAY NOT CHANGE</i> <i>WITHOUT PRIOR NRC APPROVAL</i>	3I-1
3I.1 <i>General Requirements for Dynamic Testing</i>	3I-1

3I.2 Product and Assembly Testing.....	3I-2
3I.3 Multiple-Frequency Tests	3I-2
3I.4 Single- and Multi-axis Tests	3I-3
3I.5 Single Frequency Tests	3I-3
3I.6 Damping.....	3I-3
3I.7 Qualification Determination.....	3I-4
3I.8 Dynamic Qualification by Analysis.....	3I-4
3I.9 Required Response Spectra.....	3I-4
3I.10 Time History Analysis	3I-5
3I.11 References	3I-5
3J. EVALUATION OF POSTULATED RUPTURES IN HIGH ENERGY PIPES	3J-1
3J.1 Background and Scope	3J-1
3J.2 Identification of Rupture Locations and Rupture Geometry	3J-1
3J.2.1 Ruptures in Containment Penetration Area	3J-1
3J.2.2 Ruptures in Areas other than Containment Penetration.....	3J-2
3J.2.3 Determination of the Type of Pipe Break	3J-2
3J.3 Design and Selection of Pipe Whip Restraints	3J-2
3J.3.1 Preliminary Selection of Pipe Whip Restraint	3J-2
3J.3.2 Preparation of Simplified Computer Model of Piping-Pipe Whip Restraint System	3J-2
3J.3.3 Piping Dynamic Analysis	3J-2
3J.3.4 Selection of Pipe Whip Restraint for Pipe Whip Restraint Analysis.....	3J-3
3J.4 Pipe Rupture Evaluation	3J-3
3J.4.1 General Approach	3J-3
3J.4.2 Procedure For Dynamic Time-History Analysis With Simplified Model	3J-4
3J.4.2.1 Modeling of Piping System	3J-4
3J.4.2.2 Dynamic Analysis of Simplified Piping Model.....	3J-4
3J.4.3 Procedure For Dynamic Time-History Analysis Using Detailed Piping Model	3J-5
3J.4.3.1 Modeling of Piping System	3J-5
3J.4.3.2 Dynamic Analysis using Detail Piping Model.....	3J-5
3J.5 Jet Impingement on Safety-related Piping.....	3J-5
3K. RESOLUTION OF INTERSYSTEM LOSS-OF-COOLANT-ACCIDENT	3K-1
3K.1 Introduction	3K-1
3K.2 Regulatory Positions.....	3K-1
3K.3 Boundary Limits of Ultimate Rupture Strength	3K-2
3K.4 Evaluation Procedure.....	3K-2
3K.5 Systems Evaluated.....	3K-2
3K.6 Piping Design Pressure for Ultimate Rupture Strength Compliance	3K-3
3K.7 Applicability of Ultimate Rupture Strength FOR Non-piping Components.....	3K-3
3K.8 Results	3K-3
3K.9 Valve Misalignment Due To Operator Error.....	3K-3
3K.10 Summary.....	3K-3
3K.11 References	3K-4
ULTIMATE RUPTURE STRENGTH SYSTEM BOUNDARY EVALUATION	3K-5
3KA.1 Control Rod Drive System.....	3K-5
3KA.1.1 System URS Boundary Description	3K-5
3KA.1.2 Downstream Interfaces	3K-5

3KA.1.3 Low-Pressure Piping Systems and Components Designed to URS Pressure.....	3K-6
3KA.2 Standby Liquid Control System.....	3K-7
3KA.2.1 System URS Boundary Description	3K-7
3KA.2.2 Downstream interfaces	3K-7
3KA.2.3 Low Pressure Piping Systems and Components Designed to URS Pressure	3K-7
3KA.3 Reactor Water Cleanup/Shutdown Cooling System.....	3K-8
3KA.3.1 System URS Boundary Description	3K-8
3KA.3.2 Downstream Interfaces	3K-8
3KA.3.3 Low-Pressure Piping Systems and Components Designed to URS Pressure.....	3K-8
3KA.4 Fuel And Auxiliary Pools Cooling System	3K-9
3KA.4.1 System URS Boundary Description	3K-9
3KA.4.2 Downstream Interfaces	3K-9
3KA.4.3 Low-Pressure Piping Systems and Components Designed to URS Pressure.....	3K-10
3KA.5 Nuclear Boiler System.....	3K-11
3KA.5.1 System URS Boundary Description	3K-11
3KA.5.2 Downstream Interfaces	3K-11
3KA.5.3 Low-Pressure Piping Systems and Components Designed to URS Pressure.....	3K-11
3KA.6 Condensate And Feedwater System	3K-12
3KA.6.1 System URS Boundary Description	3K-12
3KA.6.2 Downstream Interfaces	3K-12
3KA.6.3 Low-Pressure Piping Systems and Components Designed to URS Pressure.....	3K-12
3L. REACTOR INTERNALS FLOW INDUCED VIBRATION PROGRAM.....	3L-1
3L.1 Introduction.....	3L-1
3L.2 Reactor Internal Components FIV Evaluation.....	3L-1
3L.2.1 Evaluation Process – Part 1	3L-1
3L.2.2 Evaluation Process – Part 2.....	3L-3
3L.2.3 Design and Materials Evaluation	3L-4
3L.3 Chimney Assembly and Standby Liquid Control Internal Piping Evaluation	3L-5
3L.3.1 Design and Materials	3L-5
3L.3.2 Prior Operating Experience.....	3L-5
3L.3.3 Testing and Two-phase Flow Analysis.....	3L-5
3L.3.4 SLC Internal Piping Evaluation	3L-6
3L.4 Steam Dryer Evaluation Program	3L-7
3L.4.1 Steam Dryer Design and Performance.....	3L-7
3L.4.2 Materials and Fabrication.....	3L-7
3L.4.3 Load Combinations	3L-8
3L.4.4 Fluid Loads on the Steam Dryer	3L-8
3L.4.5 Structural Evaluation.....	3L-9
3L.4.6 Instrumentation and Startup Testing	3L-9
3L.5 Startup Test Program	3L-14
3L.5.1 Component Selections.....	3L-14
3L.5.2 Sensor Locations	3L-14

3L.5.3 Test Conditions	3L-14
3L.5.4 Data Reduction Methods.....	3L-15
3L.5.4.1 Time History Analysis	3L-15
3L.5.4.2 Frequency Analysis	3L-16
3L.5.5 Data Evaluation Methods	3L-17
3L.5.5.1 Finite Element Models	3L-17
3L.5.5.1.1 Chimney Head and Steam Separators	3L-17
3L.5.5.1.2 Shroud and Chimney	3L-17
3L.5.5.1.3 Steam Dryer	3L-18
3L.5.5.1.4 Standby Liquid Control Lines	3L-19
3L.5.5.2 Stress Evaluation	3L-19
3L.5.5.2.1 Methods I and II	3L-22
3L.5.5.2.2 Method III	3L-24
3L.5.5.3 (Deleted)	3L-25
3L.6 References	3L-25

VOLUME 26A6642AP

4.1 Summary Description	4.1-1
4.1.1 Reactor Pressure Vessel	4.1-1
4.1.2 Reactor Internal Components	4.1-1
4.1.2.1 Reactor Core	4.1-1
4.1.3 Reactivity Control Systems	4.1-3
4.1.3.1 Operation	4.1-3
4.1.3.2 Description of Control Rods	4.1-3
4.1.3.3 Supplementary Reactivity Control	4.1-3
4.1.4 Analysis Techniques	4.1-3
4.1.4.1 Reactor Internal Components	4.1-3
4.1.4.2 Fuel Design Analysis	4.1-5
4.1.4.3 Reactor Systems Dynamics	4.1-5
4.1.4.4 Nuclear Analysis	4.1-5
4.1.4.5 Neutron Fluence Calculations	4.1-5
4.1.4.6 Thermal-Hydraulic Calculations	4.1-5
4.1.5 COL Information	4.1-5
4.1.6 References	4.1-5
4.2 Fuel System Design	4.2-1
4.2.1 Design Bases	4.2-1
4.2.1.1 Fuel Assembly	4.2-1
4.2.1.2 Control Rods	4.2-4
4.2.2 Description and Design Drawings	4.2-4
4.2.2.1 Fuel Assembly	4.2-4
4.2.2.2 Control Rods	4.2-6
4.2.3 Fuel Assembly Design Evaluations	4.2-6
4.2.3.1 Evaluation Methods	4.2-6
4.2.3.2 Cladding Strain	4.2-7
4.2.3.3 Fuel Rod Internal Pressure	4.2-7
4.2.3.4 Fuel Pellet Temperature	4.2-7
4.2.3.5 Cladding Fatigue Analysis	4.2-8
4.2.3.6 Cladding Creep Collapse	4.2-8
4.2.3.7 Fuel Rod Stress Analysis	4.2-8
4.2.3.8 Thermal and Mechanical Overpowers	4.2-8
4.2.3.9 Fretting Wear	4.2-8
4.2.3.10 Water Rods	4.2-8
4.2.3.11 Tie Plates	4.2-9
4.2.3.12 Spacers	4.2-9
4.2.3.13 Channel	4.2-9
4.2.3.14 Conclusions	4.2-9
4.2.4 Control Rod Design Evaluations	4.2-10
4.2.4.1 Scram	4.2-10
4.2.4.2 Seismic	4.2-10

4.2.4.3	Stuck Rod	4.2-10
4.2.4.4	Absorber Burn-Up Related Loads	4.2-11
4.2.4.5	Load Combinations and Fatigue	4.2-11
4.2.4.6	Handling Loads	4.2-11
4.2.4.7	Hydraulics	4.2-11
4.2.4.8	Materials	4.2-11
4.2.4.9	Nuclear Performance	4.2-11
4.2.4.10	Mechanical Compatibility	4.2-11
4.2.5	Testing, Inspection, and Surveillance Plans	4.2-12
4.2.6	COL Information	4.2-12
4.2.7	References	4.2-12
4.3	Nuclear Design	4.3-1
4.3.1	Design Basis	4.3-1
4.3.1.1	Negative Reactivity Feedback Bases	4.3-1
4.3.1.2	Control Requirements (Shutdown Margins)	4.3-1
4.3.1.3	Control Requirements (Overpower Bases)	4.3-1
4.3.1.4	Control Requirements (Standby Liquid Control System)	4.3-2
4.3.1.5	Stability Bases	4.3-2
4.3.2	Nuclear Design Analytical Methods	4.3-2
4.3.2.1	Steady-State Nuclear Methods	4.3-2
4.3.2.2	Reactivity Coefficient Methods	4.3-4
4.3.2.3	Stability Methods	4.3-5
4.3.3	Nuclear Design Evaluation	4.3-5
4.3.3.1	Nuclear Design Description	4.3-5
4.3.3.2	Negative Reactivity Feedback Evaluation	4.3-6
4.3.3.3	Control Requirements Evaluation	4.3-8
4.3.3.4	Criticality of Reactor During Refueling Evaluation	4.3-9
4.3.3.5	Power Distribution Evaluation	4.3-9
4.3.3.6	Stability Evaluation	4.3-10
4.3.4	(Deleted)	4.3-11
4.3.5	COL Information	4.3-11
4.3.6	References	4.3-11
4.4	Thermal and Hydraulic Design	4.4-1
4.4.1	Reactor Core Thermal and Hydraulic Design Basis	4.4-1
4.4.1.1	Critical Power Bases	4.4-1
4.4.1.2	Void Fraction Distribution Bases	4.4-2
4.4.1.3	Core Pressure Drop and Hydraulic Loads Bases	4.4-2
4.4.1.4	Core Coolant Flow Distribution Bases	4.4-2
4.4.1.5	Fuel Heat Transfer Bases	4.4-2
4.4.1.6	Maximum Linear Heat Generation Rate Bases	4.4-2
4.4.1.7	Summary of Design Bases	4.4-3
4.4.2	Reactor Core Thermal and Hydraulic Methods	4.4-3
4.4.2.1	Critical Power Methods	4.4-3
4.4.2.2	Void Fraction Distribution Methods	4.4-4

4.4.2.3	Core Pressure Drop and Hydraulic Loads Methods.....	4.4-4
4.4.2.4	Core Coolant Flow Distribution Methods.....	4.4-8
4.4.2.5	Fuel Heat Transfer Methods.....	4.4-8
4.4.2.6	Maximum Linear Heat Generation Rate Methods.....	4.4-8
4.4.3	Reactor Core Thermal and Hydraulic Evaluations.....	4.4-8
4.4.3.1	Critical Power Evaluations.....	4.4-9
4.4.3.2	Void Fraction Distribution Evaluations.....	4.4-9
4.4.3.3	Core Pressure Drop and Hydraulic Loads Evaluations.....	4.4-10
4.4.3.4	Core Coolant Flow Distribution Evaluations.....	4.4-10
4.4.3.5	Fuel Heat Transfer Evaluations.....	4.4-10
4.4.3.6	Maximum Linear Heat Generation Rate Evaluations.....	4.4-10
4.4.4	Description of the Thermal–Hydraulic Design of the Reactor Coolant System	4.4-10
4.4.4.1	Plant Configuration Data	4.4-10
4.4.4.2	Operating Restrictions on Pumps	4.4-11
4.4.4.3	Power/Flow Operating Map.....	4.4-11
4.4.4.4	Temperature-Power Operating Map	4.4-11
4.4.4.5	Load Following Characteristics.....	4.4-11
4.4.4.6	Thermal-Hydraulic Characteristics Summary Tables.....	4.4-11
4.4.4.7	Inadequate Core Cooling Monitoring System	4.4-11
4.4.5	Loose-Parts Monitoring System.....	4.4-11
4.4.6	Testing and Verification.....	4.4-12
4.4.7	COL Information.....	4.4-12
4.4.8	References	4.4-12
4.5	Reactor Materials.....	4.5-1
4.5.1	Control Rod Drive System Structural Materials	4.5-1
4.5.1.1	Material Specifications.....	4.5-1
4.5.1.2	Austenitic Stainless Steel Components.....	4.5-1
4.5.1.3	Other Materials.....	4.5-2
4.5.1.4	Cleaning and Cleanliness Control.....	4.5-2
4.5.2	Reactor Internal Materials	4.5-3
4.5.2.1	Material Specifications	4.5-3
4.5.2.2	Controls on Welding.....	4.5-3
4.5.2.3	Non-Destructive Examination	4.5-4
4.5.2.4	Fabrication and Processing of Austenitic Stainless Steel—Regulatory Guide Conformance	4.5-5
4.5.2.5	Other Materials	4.5-5
4.5.3	COL Information.....	4.5-6
4.5.4	References	4.5-6
4.6	Functional Design of Reactivity Control System.....	4.6-1
4.6.1	Information for Control Rod Drive System.....	4.6-1
4.6.1.1	Design Bases.....	4.6-1
4.6.1.2	Description.....	4.6-2
4.6.2	Evaluations of the CRD System	4.6-20
4.6.2.1	Safety Evaluation.....	4.6-20

4.6.3 Testing and Verification of the CRDs	4.6-25
4.6.3.1 Factory Quality Control Tests.....	4.6-25
4.6.3.2 Functional Tests	4.6-25
4.6.3.3 Operational Tests	4.6-26
4.6.3.4 Acceptance Tests	4.6-26
4.6.3.5 Surveillance Tests	4.6-26
4.6.4 Information for Combined Performance of Reactivity Control Systems	4.6-28
4.6.4.1 Vulnerability to Common Mode Failures.....	4.6-28
4.6.4.2 Accidents Taking Credit for Multiple Reactivity Systems.....	4.6-28
4.6.5 Evaluation of Combined Performance	4.6-28
4.6.6 COL Information	4.6-28
4.6.7 References	4.6-28
4A. Typical Control Rod Patterns and Associated Power Distribution for ESBWR.....	4A-1
4A.1 Introduction	4A-1
4A.2 Results of Core Simulation Studies	4A-1
4A.3 COL Information	4A-1
4A.4 References	4A-1
4B. Fuel Licensing Acceptance Criteria.....	4B-1
4B.1 General Criteria.....	4B-1
4B.2 Thermal-Mechanical	4B-1
4B.3 Nuclear.....	4B-4
4B.4 (Deleted)	4B-5
4B.5 (Deleted)	4B-5
4B.6 Critical Power	4B-5
4B.7 (Deleted)	4B-6
4B.8 (Deleted)	4B-6
4B.9 (Deleted)	4B-6
4B.10 (Deleted)	4B-6
4B.11 COL Information	4B-6
4B.12 References.....	4B-6
4C. Control Rod Licensing Acceptance Criteria.....	4C-1
4C.1 General Criteria.....	4C-1
4C.2 Basis for Acceptance Criteria	4C-1
4C.3 COL Information	4C-2
4C.4 References.....	4C-2
4D. Stability Evaluation	4D-1
4D.1 Stability Performance During Power Operation.....	4D-1
4D.1.1 Stability Criteria	4D-1
4D.1.2 Analysis Methods	4D-2
4D.1.3 Steady State Stability Performance	4D-3
4D.1.3.1 Baseline Analysis.....	4D-3

4D.1.4 Statistical Analysis of ESBWR Stability	4D-4
4D.1.4.1 Channel Decay Ratio Statistical Analysis.....	4D-4
4D.1.4.2 Core Wide Decay Ratio Statistical Analysis.....	4D-4
4D.1.4.3 Regional Decay Ratio Statistical Analysis.....	4D-4
4D.1.4.4 Comparison with Design Limits	4D-5
4D.1.5 Stability Performance During AOOs.....	4D-5
4D.1.6 Stability Performance for Feedwater Temperature Operating Domain.....	4D-6
4D.1.7 Stability Performance During Anticipated Transients Without Scram	4D-6
4D.2 Stability Performance During Plant Startup	4D-7
4D.2.1 Phenomena Governing Oscillations during Startup	4D-7
4D.2.2 TRACG Analysis of Typical Startup Trajectories	4D-10
4D.2.2.1 ESBWR Plant Startup	4D-10
4D.2.2.2 TRACG Calculations for Simulated Startup Scenarios	4D-10
4D.2.2.3 TRACG Calculation of ESBWR Startup with Neutronic Feedback.....	4D-12
4D.3 Defense-In-Depth Stability Solution	4D-13
4D.3.1 Design Approach	4D-14
4D.3.2 Solution Description.....	4D-14
4D.3.2.1 System Input and LPRM Assignment.....	4D-14
4D.3.2.2 Defense-In-Depth Algorithms.....	4D-15
4D.3.2.3 System Operability.....	4D-17
4D.3.3 Backup Stability Protection	4D-17
4D.3.3.1 Backup Stability Protection Boundary Generation.....	4D-17
4D.3.3.2 Operator Action.....	4D-18
4D.3.3.3 BSP Reload Application	4D-18
4D.4 COL Information	4D-18
4D.5 References	4D-18

VOLUME 26A6642AR

5. Reactor Coolant System and Connected Systems	5.1-1
5.1 Summary Description	5.1-1
5.1.1 Schematic Flow Diagrams	5.1-3
5.1.2 Piping and Instrumentation Schematics	5.1-3
5.1.3 Elevation Schematics	5.1-3
5.1.4 COL Information	5.1-3
5.1.5 References	5.1-3
5.2 Integrity of Reactor Coolant Pressure Boundary	5.2-1
5.2.1 Compliance with Codes and Code Cases	5.2-1
5.2.1.1 Compliance with 10 CFR 50.55a	5.2-1
5.2.1.2 Applicable Code Cases	5.2-1
5.2.2 Overpressure Protection	5.2-2
5.2.2.1 Design Basis	5.2-4
5.2.2.2 System Description	5.2-5
5.2.2.3 Safety Evaluation	5.2-8
5.2.2.4 Testing and Inspection Requirements	5.2-8
5.2.2.5 Instrumentation Requirements	5.2-9
5.2.3 Reactor Coolant Pressure Boundary Materials	5.2-9
5.2.3.1 Material Specifications	5.2-10
5.2.3.2 Compatibility with Reactor Coolant	5.2-10
5.2.3.3 Fabrication and Processing of Ferritic Materials	5.2-16
5.2.3.4 Fabrication and Processing of Austenitic Stainless Steels	5.2-18
5.2.4 Preservice and In-service Inspection and Testing of Reactor Coolant Pressure Boundary	5.2-20
5.2.4.1 Class 1 System Boundary	5.2-21
5.2.4.2 Accessibility	5.2-22
5.2.4.3 Examination Categories and Methods	5.2-24
5.2.4.4 Inspection Intervals	5.2-26
5.2.4.5 Evaluation of Examination Results	5.2-27
5.2.4.6 System Leakage and Hydrostatic Pressure Tests	5.2-27
5.2.4.7 Code Exemptions	5.2-27
5.2.4.8 Code Cases	5.2-28
5.2.4.9 Preservice Examination	5.2-28
5.2.4.10 Relief Requests	5.2-28
5.2.4.11 COL Information for Preservice and In-service Inspection and Testing of Reactor Coolant Pressure Boundary	5.2-28
5.2.5 Reactor Coolant Pressure Boundary Leakage Detection	5.2-29
5.2.5.1 Leakage Detection Methods	5.2-31
5.2.5.2 Leak Detection Instrumentation and Monitoring	5.2-32
5.2.5.3 Display and Indications in the Main Control Room	5.2-37
5.2.5.4 Limits for Reactor Coolant Leakage Rates Within the Drywell	5.2-37
5.2.5.5 Criteria to Evaluate the Adequacy and Margin of Leak Detection System	5.2-37

5.2.5.6 Separation of Identified and Unidentified Leakages in the Containment	5.2-38
5.2.5.7 Testing, Calibration and Inspection Requirements	5.2-38
5.2.5.8 Regulatory Guide 1.45 Compliance	5.2-38
5.2.5.9 COL Information for Leak Detection Monitoring	5.2-39
5.2.6 COL Information	5.2-39
5.2.7 References	5.2-40
5.3 Reactor Vessel	5.3-1
5.3.1 Reactor Vessel Materials	5.3-1
5.3.1.1 Materials Specifications	5.3-1
5.3.1.2 Special Procedures Used for Manufacturing and Fabrication	5.3-1
5.3.1.3 Special Methods for Nondestructive Examination	5.3-2
5.3.1.4 Special Controls for Ferritic and Austenitic Stainless Steels	5.3-3
5.3.1.5 Fracture Toughness	5.3-4
5.3.1.6 Material Surveillance	5.3-5
5.3.1.7 Reactor Vessel Fasteners	5.3-7
5.3.1.8 COL Information for Reactor Vessel Material Surveillance Program	5.3-8
5.3.2 Pressure/Temperature Limits	5.3-8
5.3.2.1 Limit Curves	5.3-9
5.3.2.2 Operating Procedures	5.3-11
5.3.3 Reactor Vessel Integrity	5.3-11
5.3.3.1 Design Bases	5.3-13
5.3.3.2 Description	5.3-14
5.3.3.3 Materials of Construction	5.3-17
5.3.3.4 Inspection Requirements	5.3-17
5.3.3.5 Shipment and Installation	5.3-18
5.3.3.6 Operating Conditions	5.3-18
5.3.3.7 In-service Surveillance	5.3-18
5.3.4 COL Information	5.3-19
5.3.5 References	5.3-19
5.4 Component and Subsystem Design	5.4-1
5.4.1 Reactor Recirculation System	5.4-1
5.4.1.1 Pump Flywheel Integrity (PWR)	5.4-1
5.4.2 Steam Generators (PWR)	5.4-1
5.4.2.1 Steam Generator Materials	5.4-1
5.4.2.2 Steam Generator Tube In-service Inspection	5.4-1
5.4.3 Reactor Coolant Piping	5.4-1
5.4.4 Main Steamline Flow Restrictors	5.4-1
5.4.4.1 Safety Design Bases	5.4-1
5.4.4.2 Description	5.4-1
5.4.4.3 Safety Evaluation	5.4-2
5.4.4.4 Inspection and Testing	5.4-2
5.4.4.5 Instrumentation Requirements	5.4-2
5.4.5 Nuclear Boiler System Isolation	5.4-3
5.4.5.1 Design Bases	5.4-3

5.4.5.2 Main Steamlines Isolation	5.4-4
5.4.5.3 Feedwater Lines Isolation.....	5.4-6
5.4.5.4 Safety Evaluation.....	5.4-8
5.4.5.5 Testing and Inspection Requirements.....	5.4-9
5.4.5.6 Instrumentation Requirements.....	5.4-10
5.4.6 Isolation Condenser System	5.4-10
5.4.6.1 Design Bases.....	5.4-11
5.4.6.2 System Description.....	5.4-12
5.4.6.3 Safety Evaluation.....	5.4-18
5.4.6.4 Testing and Inspection Requirements.....	5.4-19
5.4.6.5 Instrumentation Requirements.....	5.4-20
5.4.7 Residual Heat Removal System	5.4-21
5.4.8 Reactor Water Cleanup/Shutdown Cooling System.....	5.4-22
5.4.8.1 Reactor Water Cleanup Function	5.4-22
5.4.8.2 Shutdown Cooling Function.....	5.4-30
5.4.9 Main Steamlines, Steam Stub Lines, and Feedwater Piping.....	5.4-35
5.4.9.1 Design Bases.....	5.4-35
5.4.9.2 Description.....	5.4-35
5.4.9.3 Safety Evaluation.....	5.4-37
5.4.9.4 Testing and Inspection Requirements.....	5.4-37
5.4.9.5 Instrumentation Requirements.....	5.4-37
5.4.10 Pressurizer	5.4-37
5.4.11 Pressurizer Relief Discharge System.....	5.4-37
5.4.12 Reactor Coolant System High Point Vents	5.4-37
5.4.12.1 Operation of RPV Head Vent System.....	5.4-39
5.4.12.2 Safety Evaluation	5.4-39
5.4.12.3 Inspection and Testing Requirements	5.4-40
5.4.13 Safety and Relief Valves and Depressurization Valves	5.4-40
5.4.13.1 Design Bases	5.4-40
5.4.13.2 Description	5.4-40
5.4.13.3 Safety Evaluation	5.4-42
5.4.13.4 Testing and Inspection Requirements	5.4-42
5.4.13.5 Instrumentation Requirements	5.4-43
5.4.14 Component Supports	5.4-43
5.4.14.1 Safety Design Bases	5.4-43
5.4.14.2 Description	5.4-44
5.4.14.3 Safety Evaluation	5.4-44
5.4.14.4 Testing and Inspection Requirements	5.4-44
5.4.14.5 Instrumentation Requirements.....	5.4-44
5.4.15 COL Information	5.4-44
5.4.16 References	5.4-44

VOLUME 26A6642AT

6.0 General	6.0-1
6.1 Design Basis Accident Engineered Safety Feature Materials	6.1-1
6.1.1 Metallic Materials	6.1-1
6.1.1.1 Materials Selection and Fabrication	6.1-2
6.1.1.2 Compatibility of Construction Materials with Core Cooling Water and Containment Sprays	6.1-2
6.1.1.3 Controls for Austenitic Stainless Steel	6.1-2
6.1.1.4 Composition, Compatibility and Stability of Containment and Core Coolants....	6.1-3
6.1.2 Organic Materials	6.1-3
6.1.2.1 Protective Coatings	6.1-3
6.1.2.2 Other Organic Materials	6.1-4
6.1.2.3 Evaluation	6.1-4
6.1.3 Combined License (COL) Information	6.1-4
6.1.4 References	6.1-4
6.2 Containment Systems	6.2-1
6.2.1 Containment Functional Design	6.2-1
6.2.1.1 Pressure Suppression Containment	6.2-1
6.2.1.2 Containment Subcompartments	6.2-22
6.2.1.3 Mass and Energy Release Analyses for Postulated Loss-of-Coolant- Accidents	6.2-24
6.2.1.4 Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures Inside Containment (PWR)	6.2-25
6.2.1.5 Maximum Containment Pressure Analysis for Performance Capability Studies on Emergency Core Cooling System (PWR)	6.2-26
6.2.1.6 Testing and Inspection	6.2-26
6.2.1.7 Instrumentation Requirements	6.2-26
6.2.2 Passive Containment Cooling System	6.2-27
6.2.2.1 Design Basis	6.2-28
6.2.2.2 System Description	6.2-29
6.2.2.3 Design Evaluation	6.2-32
6.2.2.4 Testing and Inspection Requirements	6.2-33
6.2.2.5 Instrumentation Requirements	6.2-33
6.2.3 Reactor Building Functional Design	6.2-33
6.2.3.1 Design Bases	6.2-35
6.2.3.2 Design Description	6.2-35
6.2.3.3 Design Evaluation	6.2-37
6.2.3.4 Tests and Inspections	6.2-38
6.2.3.5 Instrumentation Requirements	6.2-38
6.2.4 Containment Isolation Function	6.2-39
6.2.4.1 Design Bases	6.2-40
6.2.4.2 System Design	6.2-41
6.2.4.3 Design Evaluation	6.2-45
6.2.4.4 Test and Inspections	6.2-53

6.2.5 Combustible Gas Control in Containment	6.2-53
6.2.5.1 Design Bases.....	6.2-54
6.2.5.2 Containment Inerting System	6.2-56
6.2.5.3 Containment Atmosphere Monitoring.....	6.2-59
6.2.5.4 Containment Overpressure Protection.....	6.2-61
6.2.5.5 Post-Accident Radiolytic Oxygen Generation	6.2-62
6.2.6 Containment Leakage Testing.....	6.2-64
6.2.6.1 Containment Integrated Leakage Rate Test (Type A)	6.2-64
6.2.6.2 Containment Penetration Leakage Rate Test (Type B)	6.2-68
6.2.6.3 Containment Isolation Valve Leakage Rate Test (Type C)	6.2-69
6.2.6.4 Scheduling and Reporting of Periodic Tests.....	6.2-70
6.2.6.5 (Deleted)	6.2-71
6.2.7 Fracture Prevention of Containment Pressure Boundary	6.2-71
6.2.8 COL Information	6.2-71
6.2.9 References	6.2-71
6.3 Emergency Core Cooling Systems.....	6.3-1
6.3.1 Design Bases and Summary Description	6.3-2
6.3.1.1 Design Bases.....	6.3-2
6.3.1.2 Summary Descriptions of ECCS	6.3-4
6.3.2 System Design	6.3-4
6.3.2.1 Equipment and Component Descriptions.....	6.3-5
6.3.2.2 Applicable Codes and Classifications.....	6.3-5
6.3.2.3 Materials Specifications and Compatibility	6.3-5
6.3.2.4 System Reliability	6.3-5
6.3.2.5 Protection Provisions	6.3-5
6.3.2.6 Manual Actions	6.3-6
6.3.2.7 Gravity-Driven Cooling System	6.3-6
6.3.2.8 Automatic Depressurization System	6.3-16
6.3.2.9 Isolation Condenser System.....	6.3-17
6.3.2.10 Standby Liquid Control System	6.3-18
6.3.3 ECCS Performance Evaluation	6.3-18
6.3.3.1 ECCS Bases for Technical Specifications.....	6.3-19
6.3.3.2 Acceptance Criteria for ECCS Performance	6.3-19
6.3.3.3 Single-Failure Considerations	6.3-20
6.3.3.4 System Performance During the Accident.....	6.3-20
6.3.3.5 Use of Dual Function Components for ECCS.....	6.3-20
6.3.3.6 Limits on ECCS Parameters.....	6.3-21
6.3.3.7 ECCS Performance Analysis for LOCA	6.3-21
6.3.3.8 ECCS-LOCA Performance Analysis Conclusions.....	6.3-23
6.3.4 ECCS Performance Tests	6.3-23
6.3.4.1 Reliability Tests and Inspections.....	6.3-23
6.3.5 Instrumentation Requirements.....	6.3-24
6.3.6 COL Information	6.3-24
6.3.7 References	6.3-24

6.4 Control Room Habitability Systems.....	6.4-1
6.4.1 Design Bases	6.4-3
6.4.1.1 Safety Design Basis.....	6.4-3
6.4.1.2 Power Generation Design Bases	6.4-4
6.4.2 System Design	6.4-4
6.4.3 Control Room Habitability Area	6.4-5
6.4.4 System Operation Procedures.....	6.4-9
6.4.5 Design Evaluations	6.4-12
6.4.6 Life Support.....	6.4-14
6.4.7 Testing and Inspection.....	6.4-14
6.4.8 Instrumentation Requirements.....	6.4-16
6.4.9 COL Information	6.4-17
6.4.10 References	6.4-17
6.5 Atmosphere Cleanup Systems.....	6.5-1
6.5.1 Containment Spray Systems.....	6.5-1
6.5.2 Fission Product Control Systems and Structures.....	6.5-1
6.5.2.1 General.....	6.5-1
6.5.2.2 Containment.....	6.5-1
6.5.2.3 Reactor Building	6.5-2
6.5.2.4 Radwaste Building.....	6.5-3
6.5.2.5 Turbine Building.....	6.5-3
6.5.3 Ice Condenser as a Fission Product Control System	6.5-3
6.5.4 Suppression Pool as a Fission Product Cleanup System	6.5-3
6.5.5 COL Information	6.5-3
6.5.6 References	6.5-3
6.6 Preservice and Inservice Inspection and Testing of Class 2 and 3 Components and Piping.....	6.6-1
6.6.1 Class 2 and 3 System Boundaries.....	6.6-1
6.6.1.1 Class 2 System Boundary Description	6.6-2
6.6.1.2 Class 3 System Boundary Description	6.6-2
6.6.2 Accessibility	6.6-3
6.6.3 Examination Categories and Methods.....	6.6-4
6.6.3.1 Examination Categories.....	6.6-4
6.6.3.2 Examination Methods.....	6.6-4
6.6.4 Inspection Intervals	6.6-6
6.6.5 Evaluation of Examination Results	6.6-6
6.6.6 System Pressure Tests	6.6-7
6.6.6.1 System Leakage Test.....	6.6-7
6.6.6.2 Hydrostatic Pressure Tests.....	6.6-7
6.6.7 Augmented Inservice Inspections.....	6.6-7
6.6.8 Code Exemptions.....	6.6-8

6.6.9 Code Cases	6.6-8
6.6.10 Plant Specific PSI/ISI Program Information	6.6-8
6.6.10.1 Relief Requests	6.6-8
6.6.10.2 Code Edition	6.6-8
6.6.11 COL Information	6.6-8
6.6.12 References	6.6-9
6A. TRACG Application for Containment Analysis	6A-1
6B. Evaluation of the TRACG Nodalization for the ESBWR Licensing Analysis.....	6B-1
6C. Evaluation of the Impact of Containment Back Pressure on the ECCS Performance.....	6C-1
6D. Containment Passive Heat Sink Details	6D-1
6E. TRACG LOCA Containment Response Analysis	6E-1
6F. Break Spectra of Break Sizes and Break Elevations.....	6F-1
6G. TRACG LOCA SER Confirmation Items	6G-1
6H. Additional TRACG Outputs and Parametric Cases	6H-1
6I. Results of the Containment Design Basis Calculations with Suppression Pool Bypass Leakage assumption of 1 cm ² (1.08 E-03 ft ²).....	6I-1

VOLUME 26A6642AW

7. Instrumentation and Control Systems	7.1-1
7.1 Introduction	7.1-1
7.1.1 Distributed Control and Information System	7.1-1
7.1.2 Q-DCIS General Description Summary	7.1-2
7.1.2.1 Q-DCIS Safety-Related Design Bases Summary	7.1-5
7.1.2.2 Q-DCIS Power Generation (Nonsafety-Related) Design Bases Summary ..	7.1-26
7.1.2.3 Q-DCIS Safety Evaluation Summary	7.1-27
7.1.2.4 Q-DCIS Regulatory Requirements Conformance Summary	7.1-27
7.1.2.5 Q-DCIS Testing and Inspection Requirements Summary	7.1-28
7.1.2.6 Q-DCIS Operator Interface Requirements Summary	7.1-28
7.1.2.7 Q-DCIS Boundary Summary	7.1-28
7.1.2.8 Q-DCIS Major Systems Description Summary	7.1-28
7.1.3 Q-DCIS Specifics	7.1-33
7.1.3.1 Q-DCIS Design Bases	7.1-34
7.1.3.2 Q-DCIS Description	7.1-35
7.1.3.3 Q-DCIS Safety Evaluation	7.1-39
7.1.3.4 Q-DCIS Testing and Inspection Requirements	7.1-45
7.1.3.5 Q-DCIS Instrumentation and Control Requirements	7.1-47
7.1.3.6 Q-DCIS Boundaries	7.1-48
7.1.4 N-DCIS General Description Summary	7.1-48
7.1.4.1 N-DCIS Safety-Related Design Bases Summary	7.1-49
7.1.4.2 N-DCIS Nonsafety-Related Design Bases Summary	7.1-49
7.1.4.3 N-DCIS Safety Evaluation Summary	7.1-50
7.1.4.4 N-DCIS Regulatory Requirements Conformance Summary	7.1-50
7.1.4.5 N-DCIS Testing and Inspection Requirements Summary	7.1-51
7.1.4.6 N-DCIS Operator Interface Requirements Summary	7.1-51
7.1.4.7 N-DCIS System Boundaries	7.1-52
7.1.4.8 N-DCIS Major Systems Description Summary	7.1-52
7.1.5 N-DCIS Specifics	7.1-55
7.1.5.1 N-DCIS Design Bases	7.1-55
7.1.5.2 N-DCIS Description	7.1-58
7.1.5.3 N-DCIS Safety Evaluation	7.1-74
7.1.5.4 N-DCIS Testing and Inspection Requirements	7.1-79
7.1.5.5 N-DCIS Instrumentation and Control Requirements	7.1-81
7.1.5.6 N-DCIS Major System Interfaces	7.1-81
7.1.6 General DCIS Conformance to Regulatory Requirements, Guidelines and Industry Codes and Standards	7.1-84
7.1.6.1 Code of Federal Regulations	7.1-84
7.1.6.2 General Design Criteria	7.1-86
7.1.6.3 Staff Requirements Memoranda	7.1-87
7.1.6.4 Regulatory Guides	7.1-87
7.1.6.5 Branch Technical Positions	7.1-92
7.1.6.6 Industry Standards	7.1-94
7.1.7 COL Information	7.1-110

7.1.8 References	7.1-110
7.2 Reactor Trip System	7.2-1
7.2.1 Reactor Protection System	7.2-1
7.2.1.1 System Bases	7.2-1
7.2.1.2 System Description	7.2-3
7.2.1.3 Safety Evaluation	7.2-16
7.2.1.4 Testing and Inspection Requirements	7.2-24
7.2.1.5 Instrumentation and Control Requirements	7.2-25
7.2.2 Neutron Monitoring System	7.2-31
7.2.2.1 System Design Bases	7.2-31
7.2.2.2 System Description	7.2-35
7.2.2.3 Safety Evaluation	7.2-43
7.2.2.4 Testing and Inspection Requirements	7.2-49
7.2.2.5 Instrumentation and Control Requirements	7.2-50
7.2.3 Suppression Pool Temperature Monitoring	7.2-53
7.2.3.1 System Design Bases	7.2-54
7.2.3.2 System Description	7.2-54
7.2.3.3 Safety Evaluation	7.2-55
7.2.3.4 Testing and Inspection Requirements	7.2-60
7.2.3.5 Instrumentation and Controls Requirements	7.2-60
7.2.4 COL Information	7.2-60
7.2.5 References	7.2-60
7.3 Engineered Safety Features Systems	7.3-1
7.3.1 Emergency Core Cooling System	7.3-1
7.3.1.1 Automatic Depressurization System	7.3-1
7.3.1.2 Gravity-Driven Cooling System	7.3-12
7.3.2 Passive Containment Cooling System	7.3-25
7.3.3 Leak Detection and Isolation System	7.3-25
7.3.3.1 System Design Bases	7.3-25
7.3.3.2 System Description	7.3-26
7.3.3.3 Safety Evaluation	7.3-28
7.3.3.4 Testing and Inspection Requirements	7.3-35
7.3.3.5 Instrumentation and Controls Requirements	7.3-36
7.3.4 Control Room Habitability System	7.3-36
7.3.4.1 System Design Bases	7.3-36
7.3.4.2 System Description	7.3-37
7.3.4.3 Safety Evaluation	7.3-39
7.3.4.4 Testing and Inspection Requirements	7.3-44
7.3.4.5 Instrumentation and Control Requirements	7.3-45
7.3.5 Safety System Logic and Control/Engineered Safety Features	7.3-45
7.3.5.1 System Design Bases	7.3-45
7.3.5.2 System Description	7.3-46
7.3.5.3 Safety Evaluation	7.3-49
7.3.5.4 Testing and Inspection Requirements	7.3-58
7.3.5.5 Instrumentation and Controls Requirements	7.3-58

7.3.6 Containment System Wetwell-to-Drywell Vacuum Breaker Isolation	
Function.....	7.3-59
7.3.6.1 System Design Bases.....	7.3-59
7.3.6.2 System Description.....	7.3-59
7.3.6.3 Safety Evaluation.....	7.3-61
7.3.6.4 Testing and Inspection Requirements.....	7.3-66
7.3.6.5 Instrumentation and Control Requirements.....	7.3-67
7.3.7 ICS DPV Isolation Function.....	7.3-67
7.3.7.1 System Design Bases.....	7.3-67
7.3.7.2 System Description.....	7.3-68
7.3.7.3 Safety Evaluation.....	7.3-69
7.3.7.4 Testing and Inspection Requirements.....	7.3-75
7.3.7.5 Instrumentation and Control Requirements.....	7.3-75
7.3.8 COL Information.....	7.3-75
7.3.9 References.....	7.3-75
7.4 Safety-Related Safe Shutdown and Nonsafety-Related Cold Shutdown Systems.....	7.4-1
7.4.1 Standby Liquid Control System.....	7.4-1
7.4.1.1 System Design Bases.....	7.4-1
7.4.1.2 System Description.....	7.4-2
7.4.1.3 Safety Evaluation.....	7.4-3
7.4.1.4 Testing and Inspection Requirements.....	7.4-9
7.4.1.5 Instrumentation and Control Requirements.....	7.4-10
7.4.2 Remote Shutdown System.....	7.4-10
7.4.2.1 System Design Bases.....	7.4-10
7.4.2.2 System Description.....	7.4-10
7.4.2.3 Safety Evaluation.....	7.4-13
7.4.2.4 Testing and Inspection Requirements.....	7.4-17
7.4.2.5 Instrumentation and Control Requirements.....	7.4-18
7.4.3 Reactor Water Cleanup/Shutdown Cooling System.....	7.4-18
7.4.3.1 System Design Bases.....	7.4-18
7.4.3.2 System Description.....	7.4-18
7.4.3.3 Safety Evaluation.....	7.4-20
7.4.3.4 Testing and Inspection Requirements.....	7.4-23
7.4.3.5 Instrumentation and Control Requirements.....	7.4-23
7.4.4 Isolation Condenser System.....	7.4-24
7.4.4.1 System Design Bases.....	7.4-24
7.4.4.2 System Description.....	7.4-24
7.4.4.3 Safety Evaluation.....	7.4-24
7.4.4.4 Testing and Inspection Requirements.....	7.4-31
7.4.4.5 Instrumentation and Control Requirements.....	7.4-31
7.4.5 High Pressure Control Rod Drive (HP CRD) Isolation Bypass Function.....	7.4-32
7.4.5.1 System Design Bases.....	7.4-32
7.4.5.2 System Description.....	7.4-32
7.4.5.3 Safety Evaluation.....	7.4-33
7.4.5.4 Testing and Inspection Requirements.....	7.4-39
7.4.5.5 Instrumentation and Control Requirements.....	7.4-40

7.4.6 COL Information	7.4-40
7.4.7 References	7.4-40
7.5 Safety-Related and Nonsafety-Related Information Systems	7.5-1
7.5.1 Post-Accident Monitoring Instrumentation	7.5-1
7.5.1.1 System Design Bases	7.5-1
7.5.1.2 System Descriptions	7.5-1
7.5.1.3 Safety Evaluation	7.5-2
7.5.1.4 Testing and Inspection Requirements	7.5-10
7.5.1.5 Instrumentation and Controls Requirements	7.5-10
7.5.2 Containment Monitoring System	7.5-10
7.5.2.1 System Design Bases	7.5-11
7.5.2.2 System Description	7.5-12
7.5.2.3 Safety Evaluation	7.5-13
7.5.2.4 Testing and Inspection Requirements	7.5-19
7.5.2.5 Instrumentation and Control Requirements	7.5-19
7.5.3 Process Radiation Monitoring System	7.5-19
7.5.3.1 Design Bases	7.5-20
7.5.3.2 System Description	7.5-20
7.5.3.3 Safety Evaluation	7.5-20
7.5.3.4 Testing and Inspection Requirements	7.5-26
7.5.3.5 Instrumentation and Control Requirements	7.5-26
7.5.4 Area Radiation Monitoring System	7.5-26
7.5.4.1 Design Bases	7.5-26
7.5.4.2 System Description	7.5-26
7.5.4.3 Safety Evaluation	7.5-26
7.5.4.4 Testing and Inspection Requirements	7.5-29
7.5.4.5 Instrumentation and Control Requirements	7.5-29
7.5.5 Pool Monitoring Instrumentation	7.5-30
7.5.5.1 System Design Bases	7.5-31
7.5.5.2 System Description	7.5-32
7.5.5.3 Safety Evaluation	7.5-32
7.5.5.4 Testing and Inspection Requirements	7.5-35
7.5.5.5 Instrumentation and Control Requirements	7.5-35
7.5.6 (Deleted)	7.5-35
7.5.7 COL Information	7.5-35
7.5.8 References	7.5-36
7.6 Interlock Logic	7.6-1
7.6.1 High Pressure/Low Pressure Interlock Logic	7.6-1
7.6.1.1 System Design Bases	7.6-1
7.6.1.2 System Description	7.6-2
7.6.1.3 Safety Evaluation	7.6-4
7.6.1.4 Testing and Inspection Requirements	7.6-8
7.6.1.5 Instrumentation and Control Requirements	7.6-8
7.6.2 (Deleted)	7.6-8
7.6.2.1 (Deleted)	7.6-8
7.6.3 COL Information	7.6-8

7.6.4 References	7.6-8
7.7 Control Systems.....	7.7-1
7.7.1 Nuclear Boiler System	7.7-1
7.7.1.1 System Design Bases	7.7-1
7.7.1.2 System Description	7.7-2
7.7.1.3 Safety Evaluation	7.7-4
7.7.1.4 Testing and Inspection Requirements	7.7-6
7.7.1.5 Instrumentation and Control Requirements	7.7-6
7.7.2 Rod Control and Information System	7.7-7
7.7.2.1 System Design Bases	7.7-7
7.7.2.2 System Description	7.7-8
7.7.2.3 Safety Evaluation.....	7.7-22
7.7.2.4 Testing and Inspection Requirements.....	7.7-25
7.7.2.5 Instrumentation and Control Requirements.....	7.7-25
7.7.3 Feedwater Control System.....	7.7-26
7.7.3.1 System Design Bases	7.7-26
7.7.3.2 System Description	7.7-27
7.7.3.3 Safety Evaluation	7.7-29
7.7.3.4 Testing and Inspection Requirements	7.7-33
7.7.3.5 Instrumentation and Control Requirements	7.7-33
7.7.4 Plant Automation System.....	7.7-35
7.7.4.1 System Design Bases.....	7.7-35
7.7.4.2 System Description.....	7.7-35
7.7.4.3 Safety Evaluation.....	7.7-36
7.7.4.4 Testing and Inspection Requirements.....	7.7-39
7.7.4.5 Instrumentation and Control Requirements.....	7.7-39
7.7.5 Steam Bypass and Pressure Control System.....	7.7-39
7.7.5.1 System Design Bases.....	7.7-39
7.7.5.2 System Description.....	7.7-40
7.7.5.3 Safety Evaluation.....	7.7-42
7.7.5.4 Testing and Inspection Requirements.....	7.7-45
7.7.5.5 Instrumentation and Control Requirements.....	7.7-45
7.7.5.6 Major Instrument Interfaces with SB&PC System.....	7.7-45
7.7.6 Neutron Monitoring System - Nonsafety-Related Subsystems	7.7-47
7.7.6.1 System Design Bases	7.7-47
7.7.6.2 System Description	7.7-48
7.7.6.3 Safety Evaluation	7.7-50
7.7.6.4 Testing and Inspection Requirements	7.7-52
7.7.6.5 Instrumentation and Control Requirements	7.7-53
7.7.7 Containment Inerting System	7.7-53
7.7.7.1 System Design Bases.....	7.7-53
7.7.7.2 System Description.....	7.7-53
7.7.7.3 Safety Evaluation	7.7-54
7.7.7.4 Testing and Inspection Requirements	7.7-56
7.7.7.5 Instrumentation and Control Requirements	7.7-56
7.7.8 COL Information	7.7-58

7.7.9 References	7.7-58
7.8 Diverse Instrumentation and Control Systems	7.8-1
7.8.1 System Description	7.8-1
7.8.1.1 Anticipated Transients Without Scram Mitigation Functions	7.8-5
7.8.1.2 DPS Diverse Instrumentation and Control	7.8-9
7.8.1.3 Diverse Manual Controls and Displays	7.8-13
7.8.2 Common Mode Failure Defenses Within Safety-Related System Design	7.8-14
7.8.2.1 Design Techniques for Optimizing Safety-Related Hardware and Software	7.8-14
7.8.2.2 Defense Against Common Mode Failure	7.8-15
7.8.3 Safety Evaluation	7.8-16
7.8.3.1 Code of Federal Regulations	7.8-17
7.8.3.2 General Design Criteria	7.8-19
7.8.3.3 Staff Requirements Memoranda	7.8-19
7.8.3.4 Regulatory Guides	7.8-20
7.8.3.5 Branch Technical Position	7.8-22
7.8.4 Testing and Inspection Requirements	7.8-23
7.8.5 Instrumentation and Control Requirements	7.8-23
7.8.6 COL Information	7.8-24
7.8.7 References	7.8-24
7.9 (Deleted)	7.9-1
7A. (Deleted)	7A-1
7B. Software Development	7B-1
7B.1 Software Development	7B-1
7B.2 Treatment of Systems Designated as RTNSS	7B-8
7B.3 References	7B-8

VOLUME 26A6642AX

8. Electric Power	8.1-1
8.1 Introduction	8.1-1
8.1.1 General	8.1-1
8.1.2 Utility Power Grid and Offsite Power System Descriptions	8.1-1
8.1.2.1 Utility Power Grid Description	8.1-1
8.1.2.2 Offsite Power System Description	8.1-1
8.1.3 Onsite Electric Power System	8.1-2
8.1.3.1 Onsite AC Power System	8.1-2
8.1.3.2 Onsite DC Power System	8.1-3
8.1.4 Safety-Related Loads	8.1-3
8.1.5 Design Basis	8.1-3
8.1.5.1 Offsite Power	8.1-3
8.1.5.2 Onsite Power	8.1-4
8.1.6 Compliance to Regulatory Requirements and Guidelines	8.1-9
8.1.7 COL Information	8.1-9
8.1.8 References	8.1-9
8.2 Offsite Power Systems	8.2-1
8.2.1 Description	8.2-1
8.2.1.1 Transmission System	8.2-1
8.2.1.2 Offsite Power System	8.2-1
8.2.2 Analysis	8.2-2
8.2.2.1 Reliability and Stability Analysis	8.2-2
8.2.2.2 Regulatory Analysis	8.2-2
8.2.3 Design Bases Requirements	8.2-3
8.2.4 COL Information	8.2-4
8.2.5 References	8.2-5
8.3 Onsite Power Systems	8.3-1
8.3.1 AC Power Systems	8.3-1
8.3.1.1 Description	8.3-1
8.3.1.2 Analysis	8.3-14
8.3.1.3 Physical Identification of Safety-Related Equipment	8.3-15
8.3.1.4 Independence of Redundant Systems	8.3-17
8.3.2 DC Power Systems	8.3-23
8.3.2.1 Description	8.3-23
8.3.2.2 Analysis	8.3-27
8.3.3 Fire Protection of Cable Systems	8.3-28
8.3.3.1 Resistance of Cables to Combustion	8.3-29
8.3.3.2 Cables and Raceways	8.3-29
8.3.3.3 Localization of Fires	8.3-30
8.3.4 COL Information	8.3-30
8.3.5 References	8.3-30
Appendix 8A Miscellaneous Electrical Systems	8A-1
8A.1 Station Grounding and Surge Protection	8A-1
8A.1.1 Description	8A-1

8A.1.2 Analysis	8A-2
8A.2 Cathodic Protection	8A-3
8A.2.1 Description	8A-3
8A.2.2 Analysis	8A-3
8A.2.3 COL Information.....	8A-3
8A.3 Electric Heat Tracing.....	8A-3
8A.3.1 Description	8A-3
8A.3.2 Analysis.....	8A-3
8A.4 References	8A-3

VOLUME 26A6642AY

9.1 Fuel Storage and Handling	9.1-1
9.1.1 New Fuel Storage	9.1-1
9.1.1.1 Design Bases	9.1-1
9.1.1.2 Storage Design.....	9.1-2
9.1.1.3 Mechanical and Structural Design.....	9.1-2
9.1.1.4 Material Considerations.....	9.1-2
9.1.1.5 Dynamic and Impact Analysis.....	9.1-2
9.1.1.6 Facilities Description (New Fuel Storage)	9.1-3
9.1.1.7 Safety Evaluation.....	9.1-3
9.1.2 Spent Fuel Storage.....	9.1-4
9.1.2.1 Design Bases.....	9.1-4
9.1.2.2 Nuclear Design	9.1-5
9.1.2.3 Storage Design.....	9.1-5
9.1.2.4 Mechanical and Structural Design.....	9.1-5
9.1.2.5 Thermal-Hydraulic Design	9.1-7
9.1.2.6 Material Considerations	9.1-7
9.1.2.7 Facilities Description (Spent Fuel Storage)	9.1-7
9.1.2.8 Safety Evaluation	9.1-8
9.1.3 Fuel and Auxiliary Pools Cooling System	9.1-9
9.1.3.1 Design Bases.....	9.1-9
9.1.3.2 System Description	9.1-9
9.1.3.3 Safety Evaluation	9.1-17
9.1.3.4 Testing and Inspection Requirements.....	9.1-18
9.1.3.5 Instrumentation and Control	9.1-18
9.1.4 Light Load Handling System (Related to Refueling).....	9.1-20
9.1.4.1 Design Bases.....	9.1-20
9.1.4.2 System Description.....	9.1-21
9.1.4.3 Spent Fuel Cask	9.1-21
9.1.4.4 Overhead Bridge Cranes.....	9.1-21
9.1.4.5 Refueling Equipment	9.1-22
9.1.4.6 Fuel Servicing Equipment	9.1-23
9.1.4.7 Servicing Aids	9.1-24
9.1.4.8 Reactor Vessel Servicing Equipment	9.1-25
9.1.4.9 In-Vessel Servicing Equipment	9.1-27
9.1.4.10 Storage Equipment.....	9.1-27
9.1.4.11 Under-Vessel Servicing Equipment	9.1-28
9.1.4.12 Fuel Transfer System.....	9.1-28
9.1.4.13 Refueling Operations	9.1-30
9.1.4.14 Arrival of Fuel at Reactor Site.....	9.1-30
9.1.4.15 Reactor Preparation for Refueling	9.1-30
9.1.4.16 Refueling.....	9.1-32
9.1.4.17 Vessel Closure	9.1-32
9.1.4.18 Safety Evaluation of Fuel Handling System.....	9.1-33
9.1.4.19 Inspection and Testing Requirements.....	9.1-33

9.1.4.20 Instrumentation Requirements	9.1-34
9.1.4.21 Refueling Cavity Integrity	9.1-34
9.1.5 Overhead Heavy Load Handling (OHLH) Systems	9.1-34
9.1.5.1 Design Bases	9.1-34
9.1.5.2 General	9.1-34
9.1.5.3 Applicable Design Criteria for All OHLH Equipment	9.1-35
9.1.5.4 System Description	9.1-36
9.1.5.5 Fuel Building and Reactor Building Cranes	9.1-36
9.1.5.6 Other Overhead Load Handling System	9.1-37
9.1.5.7 Equipment Operating Procedures Maintenance and Service	9.1-39
9.1.5.8 Operational Responsibilities	9.1-39
9.1.5.9 Safety Evaluations	9.1-39
9.1.5.10 Inspection and Testing	9.1-40
9.1.5.11 Instrumentation Requirements	9.1-40
9.1.6 COL Information	9.1-40
9.1.7 References	9.1-41
9.2 Water Systems	9.2-1
9.2.1 Plant Service Water System	9.2-1
9.2.1.1 Design Bases	9.2-1
9.2.1.2 System Description	9.2-2
9.2.1.3 Safety Evaluation	9.2-4
9.2.1.4 Testing and Inspection Requirements	9.2-4
9.2.1.5 Instrumentation Requirements	9.2-4
9.2.1.6 COL Information	9.2-5
9.2.1.7 References	9.2-5
9.2.2 Reactor Component Cooling Water System	9.2-5
9.2.2.1 Design Bases	9.2-5
9.2.2.2 System Description	9.2-6
9.2.2.3 Safety Evaluation	9.2-8
9.2.2.4 Testing and Inspection Requirements	9.2-8
9.2.2.5 Instrumentation Requirements	9.2-8
9.2.2.6 COL Information	9.2-9
9.2.2.7 References	9.2-9
9.2.3 Makeup Water System	9.2-9
9.2.3.1 Design Bases	9.2-9
9.2.3.2 System Description	9.2-9
9.2.3.3 Safety Evaluation	9.2-11
9.2.3.4 Testing and Inspection Requirements	9.2-11
9.2.3.5 Instrumentation Requirements	9.2-11
9.2.3.6 COL Information	9.2-11
9.2.3.7 References	9.2-11
9.2.4 Potable and Sanitary Water Systems	9.2-11
9.2.5 Ultimate Heat Sink	9.2-12
9.2.5.1 COL Information	9.2-13
9.2.5.2 References	9.2-13

9.2.6 Condensate Storage and Transfer System	9.2-14
9.2.6.1 Design Bases	9.2-14
9.2.6.2 System Description	9.2-14
9.2.6.3 Safety Evaluation	9.2-15
9.2.6.4 Testing and Inspection Requirements	9.2-15
9.2.6.5 Instrumentation Requirements	9.2-16
9.2.6.6 COL Information.....	9.2-16
9.2.6.7 References	9.2-16
9.2.7 Chilled Water System.....	9.2-16
9.2.7.1 Design Bases	9.2-16
9.2.7.2 System Description	9.2-18
9.2.7.3 Safety Evaluation	9.2-20
9.2.7.4 Testing and Inspection Requirements	9.2-20
9.2.7.5 Instrumentation Requirements	9.2-20
9.2.7.6 COL Information.....	9.2-21
9.2.7.7 References	9.2-21
9.2.8 Turbine Component Cooling Water System	9.2-21
9.2.8.1 Design Bases.....	9.2-21
9.2.8.2 System Description.....	9.2-22
9.2.8.3 Safety Evaluation.....	9.2-23
9.2.8.4 Tests and Inspections.....	9.2-23
9.2.8.5 Instrumentation Requirements.....	9.2-23
9.2.8.6 COL Information	9.2-23
9.2.8.7 References	9.2-23
9.2.9 Hot Water System.....	9.2-23
9.2.10 Station Water System	9.2-24
9.2.10.1 Design Basis	9.2-24
9.2.10.2 System Description.....	9.2-24
9.2.10.3 Safety Evaluation.....	9.2-25
9.2.10.4 Testing and Inspection Requirements.....	9.2-25
9.2.10.5 Instrumentation Requirements.....	9.2-25
9.2.10.6 COL Information	9.2-25
9.2.10.7 References	9.2-25
9.3 Process Auxiliaries	9.3-1
9.3.1 Compressed Air Systems.....	9.3-1
9.3.2 Process Sampling System.....	9.3-1
9.3.2.1 Design Bases.....	9.3-1
9.3.2.2 System Description.....	9.3-2
9.3.2.3 Safety Evaluation.....	9.3-5
9.3.2.4 Tests and Inspections.....	9.3-5
9.3.2.5 Instrumentation Requirements.....	9.3-5
9.3.2.6 COL Information	9.3-6
9.3.2.7 References	9.3-6
9.3.3 Equipment and Floor Drain System	9.3-6
9.3.3.1 Design Bases	9.3-7

9.3.3.2 System Description	9.3-7
9.3.3.3 Safety Evaluation	9.3-9
9.3.3.4 Testing and Inspection Requirements	9.3-9
9.3.3.5 Instrumentation Requirements	9.3-10
9.3.3.6 COL Information.....	9.3-10
9.3.3.7 References	9.3-10
9.3.4 Chemical and Volume Control System	9.3-10
9.3.5 Standby Liquid Control System	9.3-10
9.3.5.1 Design Bases	9.3-10
9.3.5.2 System Description.....	9.3-11
9.3.5.3 Safety Evaluation.....	9.3-13
9.3.5.4 Testing and Inspection Requirements	9.3-16
9.3.5.5 Instrumentation Requirements.....	9.3-16
9.3.5.6 COL Information.....	9.3-17
9.3.5.7 References	9.3-17
9.3.6 Instrument Air System.....	9.3-17
9.3.6.1 Design Bases	9.3-17
9.3.6.2 System Description.....	9.3-18
9.3.6.3 Safety Evaluation.....	9.3-18
9.3.6.4 Inspection and Testing Requirements	9.3-18
9.3.6.5 Instrumentation Application.....	9.3-19
9.3.6.6 COL Information.....	9.3-19
9.3.6.7 References	9.3-19
9.3.7 Service Air System	9.3-19
9.3.7.1 Design Bases	9.3-19
9.3.7.2 System Description.....	9.3-20
9.3.7.3 Safety Evaluation.....	9.3-21
9.3.7.4 Inspection and Testing Requirements	9.3-21
9.3.7.5 Instrumentation Application.....	9.3-21
9.3.7.6 COL Information.....	9.3-21
9.3.7.7 References	9.3-21
9.3.8 High Pressure Nitrogen Supply System	9.3-22
9.3.8.1 Design Bases	9.3-22
9.3.8.2 System Description.....	9.3-22
9.3.8.3 Safety Evaluation.....	9.3-24
9.3.8.4 Inspection and Testing Requirements	9.3-24
9.3.8.5 Instrumentation Requirements.....	9.3-24
9.3.8.6 COL Information.....	9.3-24
9.3.8.7 References	9.3-24
9.3.9 Hydrogen Water Chemistry System.....	9.3-24
9.3.9.1 Design Bases	9.3-24
9.3.9.2 System Description	9.3-24
9.3.9.3 Safety Evaluation	9.3-25
9.3.9.4 Inspection and Testing Requirements	9.3-25
9.3.9.5 Instrumentation and Controls.....	9.3-25

9.3.9.6 COL Information.....	9.3-25
9.3.9.7 References	9.3-25
9.3.10 Oxygen Injection System	9.3-26
9.3.10.1 Design Bases	9.3-26
9.3.10.2 System Description	9.3-26
9.3.10.3 Safety Evaluation	9.3-26
9.3.10.4 Testing and Inspection Requirements	9.3-27
9.3.10.5 Instrumentation	9.3-27
9.3.10.6 COL Information.....	9.3-27
9.3.10.7 References	9.3-27
9.3.11 Zinc Injection System.....	9.3-27
9.3.11.1 Design Bases	9.3-27
9.3.11.2 System Description.....	9.3-27
9.3.11.3 Safety Evaluation	9.3-28
9.3.11.4 Test and Inspections	9.3-28
9.3.11.5 Instrumentation and Controls	9.3-28
9.3.11.6 COL Information.....	9.3-28
9.3.11.7 References	9.3-28
9.3.12 Auxiliary Boiler System.....	9.3-28
9.3.12.1 Design Basis	9.3-28
9.3.12.2 System Description.....	9.3-28
9.3.12.3 Safety Evaluation	9.3-30
9.3.12.4 Testing and Inspection Requirements	9.3-30
9.3.12.5 Instrumentation.....	9.3-30
9.3.12.6 COL Information.....	9.3-30
9.3.12.7 References	9.3-30
9.4 Heating, Ventilation, and Air Conditioning	9.4-1
9.4.1 Control Building HVAC System.....	9.4-1
9.4.1.1 Design Bases	9.4-3
9.4.1.2 System Description	9.4-6
9.4.1.3 Safety Evaluation	9.4-11
9.4.1.4 Testing and Inspection Requirements	9.4-12
9.4.1.5 Instrumentation Requirements	9.4-12
9.4.1.6 COL Information.....	9.4-13
9.4.1.7 References	9.4-13
9.4.2 Fuel Building HVAC System (FBVS)	9.4-13
9.4.2.1 Design Bases	9.4-14
9.4.2.2 System Description.....	9.4-15
9.4.2.3 Safety Evaluation.....	9.4-16
9.4.2.4 Testing and Inspection Requirements	9.4-17
9.4.2.5 Instrumentation Requirements.....	9.4-17
9.4.2.6 COL Information.....	9.4-18
9.4.2.7 References	9.4-18
9.4.3 Radwaste Building Heating, Ventilation and Air Conditioning System.....	9.4-18
9.4.3.1 Design Bases	9.4-18

9.4.3.2 System Description	9.4-20
9.4.3.3 Safety Evaluation	9.4-21
9.4.3.4 Testing and Inspection Requirements	9.4-21
9.4.3.5 Instrumentation Requirements	9.4-21
9.4.3.6 COL Information	9.4-22
9.4.3.7 References	9.4-22
9.4.4 Turbine Building HVAC System	9.4-22
9.4.4.1 Design Bases	9.4-23
9.4.4.2 System Description	9.4-24
9.4.4.3 Safety Evaluation	9.4-27
9.4.4.4 Tests and Inspections	9.4-27
9.4.4.5 Instrumentation Requirements	9.4-27
9.4.4.6 COL Information	9.4-28
9.4.4.7 References	9.4-28
9.4.5 Engineered Safety Feature Ventilation System	9.4-28
9.4.6 Reactor Building HVAC System	9.4-28
9.4.6.1 Design Bases	9.4-29
9.4.6.2 System Description	9.4-31
9.4.6.3 Safety Evaluation	9.4-34
9.4.6.4 Testing and Inspection Requirements	9.4-34
9.4.6.5 Instrumentation Requirements	9.4-34
9.4.6.6 COL Information	9.4-36
9.4.6.7 References	9.4-36
9.4.7 Electrical Building HVAC System	9.4-36
9.4.7.1 Design Bases	9.4-36
9.4.7.2 System Description	9.4-38
9.4.7.3 Safety Evaluation	9.4-40
9.4.7.4 Testing and Inspection Requirements	9.4-40
9.4.7.5 Instrumentation Requirements	9.4-41
9.4.7.6 COL Information	9.4-41
9.4.7.7 References	9.4-41
9.4.8 Drywell Cooling System	9.4-41
9.4.8.1 Design Basis	9.4-42
9.4.8.2 System Description	9.4-42
9.4.8.3 Safety Evaluation	9.4-44
9.4.8.4 Testing and Inspection Requirements	9.4-44
9.4.8.5 Instrumentation Requirements	9.4-44
9.4.8.6 COL Information	9.4-44
9.4.8.7 References	9.4-44
9.4.9 Containment Inerting System	9.4-44
9.4.10 HVAC Component Information	9.4-44
9.4.10.1 Filtration	9.4-44
9.4.10.2 Supply and Exhaust Fans	9.4-45
9.4.10.3 Heating Coils/Elements	9.4-46
9.4.10.4 Cooling Coils	9.4-46

9.4.10.5 Dampers	9.4-46
9.4.10.6 Ductwork and Accessories	9.4-46
9.4.10.7 COL Information	9.4-47
9.4.10.8 References	9.4-47
9.5 Other Auxiliary Systems	9.5-1
9.5.1 Fire Protection System	9.5-1
9.5.1.1 Design Bases	9.5-1
9.5.1.2 System Description	9.5-3
9.5.1.3 Facility Features for Fire Protection	9.5-3
9.5.1.4 Fire Protection Water Supply System	9.5-4
9.5.1.5 Firewater Supply Piping, Yard Piping, and Yard Hydrants	9.5-6
9.5.1.6 Manual Suppression Means	9.5-7
9.5.1.7 Fixed Automatic Water Extinguishing Systems	9.5-8
9.5.1.8 Foam System	9.5-9
9.5.1.9 Smoke Detection and Fire Alarm System	9.5-9
9.5.1.10 Fire Barriers	9.5-10
9.5.1.11 Building Ventilation	9.5-12
9.5.1.12 Safety Evaluation	9.5-14
9.5.1.13 Inspection and Testing Requirements	9.5-22
9.5.1.14 Instrumentation Requirements	9.5-22
9.5.1.15 Fire Protection Program	9.5-23
9.5.1.16 COL Information	9.5-32
9.5.1.17 References	9.5-33
9.5.2 Communications System	9.5-33
9.5.2.1 Design Bases	9.5-34
9.5.2.2 System Description	9.5-34
9.5.2.3 Safety Evaluation	9.5-38
9.5.2.4 Inspection and Testing Requirements	9.5-38
9.5.2.5 COL Information	9.5-39
9.5.2.6 References	9.5-39
9.5.3 Lighting System	9.5-40
9.5.3.1 Safety Design Bases	9.5-40
9.5.3.2 Power Generation Design Bases	9.5-40
9.5.3.3 System Description	9.5-41
9.5.3.4 Safety Evaluation	9.5-44
9.5.3.5 Tests and Inspections	9.5-44
9.5.3.6 COL Information	9.5-45
9.5.3.7 References	9.5-45
9.5.4 Diesel Generator Fuel Oil Storage and Transfer System	9.5-45
9.5.4.1 Design Bases	9.5-45
9.5.4.2 System Description	9.5-47
9.5.4.3 Safety Evaluation	9.5-49
9.5.4.4 Tests and Inspections	9.5-50
9.5.4.5 Instrumentation Requirements	9.5-50
9.5.4.6 COL Information	9.5-51
9.5.4.7 References	9.5-51

9.5.5 Diesel Generator Jacket Cooling Water System	9.5-51
9.5.5.1 Design Bases.....	9.5-51
9.5.5.2 System Description.....	9.5-51
9.5.5.3 Safety Evaluation.....	9.5-53
9.5.5.4 Tests and Inspection	9.5-53
9.5.5.5 Instrumentation Requirements.....	9.5-53
9.5.5.6 COL Information	9.5-53
9.5.5.7 References.....	9.5-53
9.5.6 Diesel Generator Starting Air System	9.5-53
9.5.6.1 Design Bases	9.5-53
9.5.6.2 System Description.....	9.5-54
9.5.6.3 Safety Evaluation	9.5-55
9.5.6.4 Tests and Inspection	9.5-55
9.5.6.5 Instrumentation Requirements	9.5-55
9.5.6.6 COL Information.....	9.5-55
9.5.6.7 References	9.5-55
9.5.7 Diesel Generator Lubrication System	9.5-56
9.5.7.1 Design Bases.....	9.5-56
9.5.7.2 System Description.....	9.5-56
9.5.7.3 Safety Evaluation.....	9.5-57
9.5.7.4 Tests and Inspection.....	9.5-57
9.5.7.5 Instrumentation Requirements.....	9.5-57
9.5.7.6 COL Information	9.5-57
9.5.7.7 References.....	9.5-58
9.5.8 Diesel Generator Combustion Air Intake and Exhaust System.....	9.5-58
9.5.8.1 Design Bases.....	9.5-58
9.5.8.2 System Description.....	9.5-58
9.5.8.3 Safety Evaluation.....	9.5-59
9.5.8.4 Inspection and Testing Requirements.....	9.5-59
9.5.8.5 Instrumentation Requirements.....	9.5-60
9.5.8.6 COL Information	9.5-60
9.5.8.7 References.....	9.5-60

VOLUME 26A6642BB

9A. Fire Hazards Analysis.....	9A.1-1
9A.1 Introduction	9A.1-1
9A.2 Analysis Criteria	9A.2-1
9A.2.1 Codes and Standards.....	9A.2-1
9A.2.2 Fire Area Separation and Fire Equipment Drawings	9A.2-1
9A.2.3 Terminology	9A.2-1
9A.2.4 Acceptance Criteria	9A.2-3
9A.2.5 Systems Required to Achieve Safe Shutdown in the Event of Fire	9A.2-7
9A.2.6 Redundant Nonsafety-Related Systems and Equipment	9A.2-7
9A.3 Analysis Approach	9A.3-1
9A.3.1 Review Data.....	9A.3-1
9A.3.2 Steam Tunnel Barrier Exception.....	9A.3-2
9A.3.3 Exceptions to Separation Criteria	9A.3-2
9A.3.4 Exceptions to Penetration Requirements	9A.3-2
9A.3.5 Wall Deviations	9A.3-3
9A.3.6 Door Deviations.....	9A.3-3
9A.3.7 Basemats	9A.3-3
9A.3.8 Smoke Removal.....	9A.3-4
9A.4 Fire Hazard and Safe Shutdown Analysis Summary.....	9A.4-1
9A.4.1 Reactor Building	9A.4-1
9A.4.2 Fuel Building	9A.4-3
9A.4.3 Control Building	9A.4-4
9A.4.4 Turbine Building.....	9A.4-6
9A.4.5 Radwaste Building.....	9A.4-7
9A.4.6 Electrical Building.....	9A.4-8
9A.4.7 Yard	9A.4-10
9A.4.8 Service Building	9A.4-12
9A.4.9 Service Water/Water Treatment Building	9A.4-13
9A.4.10 Ancillary Diesel Building.....	9A.4-13
9A.4.11 Fire Pump Enclosure.....	9A.4-15
9A.5 Fire Protection Analyses by Room or Fire Zone.....	9A.5-1
9A.5.1 Reactor Building.....	9A.5-1
9A.5.2 Fuel Building.....	9A.5-2
9A.5.3 Control Building.....	9A.5-2
9A.5.4 Turbine Building	9A.5-2
9A.5.5 Radwaste Building.....	9A.5-2
9A.5.6 Electrical Building.....	9A.5-2
9A.5.7 Yard	9A.5-2
9A.5.8 Service Building	9A.5-2
9A.5.9 Service Water/Water Treatment Building	9A.5-3
9A.5.10 Ancillary Diesel Building.....	9A.5-3
9A.5.11 Fire Pump Enclosure	9A.5-3
9A.6 Special Cases	9A.6-1

9A.6.1 Piping Penetrations, Reactor Building	9A.6-1
9A.6.2 Fire Door Deviations	9A.6-1
9A.6.3 Pipe Break Analyses	9A.6-1
9A.6.4 Fire Separation for Divisional Electrical Systems.....	9A.6-1
9A.6.5 Comparison to BTP SBLP 9.5-1 and Regulatory Guide 1.189	9A.6-8
9A.6.6 Comparison to International Building Code.....	9A.6-14
9A.7 COL Information	9A.7-1

VOLUME 26A6642BD

9B.1 Introduction.....	9B-1
9B.2 Fire Containment System	9B-1
9B.3 Fire Types	9B-1
9B.4 Fire Barriers	9B-2
9B.5 Allowable Combustible Loading	9B-2
9B.5.1 Permanent Loading	9B-2
9B.5.2 Transient Combustibles	9B-5
9B.5.3 Cable Trays	9B-6
9B.6 References.....	9B-9

VOLUME 26A6642BF

10. Steam and Power Conversion System.....	10.1-1
10.1 Summary Description.....	10.1-1
10.1.1 Protective Features.....	10.1-2
10.1.2 COL Information.....	10.1-3
10.1.3 References.....	10.1-3
10.2 Turbine Generator	10.2-1
10.2.1 Design Bases	10.2-1
10.2.2 Description	10.2-3
10.2.3 Turbine Integrity.....	10.2-13
10.2.4 Evaluation.....	10.2-19
10.2.5 COL Information.....	10.2-20
10.2.6 References	10.2-20
10.3 Turbine Main Steam System	10.3-1
10.3.1 Design Bases	10.3-1
10.3.2 Description	10.3-3
10.3.3 Evaluation.....	10.3-4
10.3.4 Inspection and Testing Requirements	10.3-4
10.3.5 Water Chemistry (PWR)	10.3-4
10.3.6 Steam and Feedwater System Materials.....	10.3-5
10.3.7 COL Information.....	10.3-6
10.3.8 References	10.3-6
10.4 Other Features of Steam and Power Conversion System.....	10.4-1
10.4.1 Main Condenser	10.4-1
10.4.2 Main Condenser Evacuation System	10.4-5
10.4.3 Turbine Gland Seal System.....	10.4-8
10.4.4 Turbine Bypass System.....	10.4-10
10.4.5 Circulating Water System	10.4-13
10.4.6 Condensate Purification System	10.4-16
10.4.7 Condensate and Feedwater System.....	10.4-20
10.4.8 Steam Generator Blowdown System (PWR)	10.4-27
10.4.9 Auxiliary Feedwater System (PWR).....	10.4-27
10.4.10 COL Information.....	10.4-27
10.4.11 References.....	10.4-27

VOLUME 26A6642BH

11. Radioactive Waste Management	11.1-1
11.1 Source Terms	11.1-1
11.1.1 Fission Products	11.1-1
11.1.2 Activation Products	11.1-3
11.1.3 Radionuclide Concentration Adjustment	11.1-4
11.1.4 Fuel Fission Product Inventory	11.1-5
11.1.5 Process Leakage Sources	11.1-5
11.1.6 COL Information	11.1-6
11.1.7 References	11.1-6
11.2 Liquid Waste Management System	11.2-1
11.2.1 Design Bases	11.2-1
11.2.2 System Description	11.2-2
11.2.2.1 Summary Description	11.2-2
11.2.2.2 System Operation	11.2-3
11.2.2.3 Detailed System Component Description	11.2-5
11.2.3 Safety Evaluation - Radioactive Releases	11.2-7
11.2.3.1 Safety Evaluation	11.2-7
11.2.3.2 Radioactive Releases	11.2-7
11.2.3.3 Dilution Factors	11.2-8
11.2.4 Testing and Inspection Requirements	11.2-8
11.2.5 Instrumentation Requirements	11.2-9
11.2.6 COL Information	11.2-9
11.2.7 References	11.2-9
11.3 Gaseous Waste Management System	11.3-1
11.3.1 Design Bases	11.3-1
11.3.2 Offgas System Description	11.3-2
11.3.2.1 Process Functions	11.3-2
11.3.2.2 Process Equipment	11.3-3
11.3.2.3 Process Facility	11.3-3
11.3.2.4 Releases	11.3-3
11.3.2.5 Process Design	11.3-4
11.3.2.6 Component Design	11.3-8
11.3.2.7 Seismic Design	11.3-11
11.3.3 Ventilation System	11.3-11
11.3.4 Radioactive Releases	11.3-12
11.3.5 Testing and Inspection Requirements	11.3-12
11.3.6 Instrumentation Requirements	11.3-12
11.3.7 Radioactive Offgas System Leak or Failure	11.3-13
11.3.7.1 Basis and Assumptions	11.3-13
11.3.7.2 Results	11.3-14
11.3.8 COL Information	11.3-14
11.3.9 References	11.3-14
11.4 Solid Waste Management System	11.4-1
11.4.1 SWMS Design Bases	11.4-1

11.4.2 System Description.....	11.4-3
11.4.2.1 Summary Description.....	11.4-3
11.4.2.2 System Operation.....	11.4-3
11.4.2.3 Detailed System Component Description.....	11.4-6
11.4.3 Safety Evaluation.....	11.4-7
11.4.4 Testing and Inspection Requirements.....	11.4-7
11.4.5 Instrumentation Requirements.....	11.4-8
11.4.6 COL Information.....	11.4-8
11.4.7 References.....	11.4-9
11.5 Process Radiation Monitoring System.....	11.5-1
11.5.1 Design Bases.....	11.5-1
11.5.1.1 Design Objectives.....	11.5-1
11.5.2 System Design Bases and Criteria.....	11.5-2
11.5.2.1 Radiation Monitors Required for Safety.....	11.5-3
11.5.2.2 Radiation Monitors Required for Plant Operation.....	11.5-4
11.5.3 Subsystem Description.....	11.5-4
11.5.3.1 Radiation Monitors Required for Safety.....	11.5-4
11.5.3.2 Radiation Monitors Required for Plant Operation.....	11.5-9
11.5.4 Regulatory Evaluation.....	11.5-18
11.5.4.1 Basis for Monitor Location Selection.....	11.5-19
11.5.4.2 Expected Radiation Levels.....	11.5-19
11.5.4.3 Instrumentation.....	11.5-19
11.5.4.4 Setpoints.....	11.5-19
11.5.4.5 Offsite Dose Calculation Manual.....	11.5-19
11.5.4.6 Process and Effluent Monitoring Program.....	11.5-20
11.5.4.7 Sensitivity or Subsystem Lower Limit of Detection.....	11.5-20
11.5.4.8 Site Specific Offsite Dose Calculation.....	11.5-20
11.5.4.9 Instrument Sensitivities.....	11.5-20
11.5.5 Process Monitoring and Sampling.....	11.5-20
11.5.5.1 Implementation of General Design Criterion 19.....	11.5-20
11.5.5.2 Implementation of General Design Criterion 60.....	11.5-20
11.5.5.3 Implementation of General Design Criterion 63.....	11.5-21
11.5.5.4 Implementation of General Design Criterion 64.....	11.5-21
11.5.5.5 Basis for Monitor Location Selection.....	11.5-22
11.5.5.6 Expected Radiation Levels.....	11.5-22
11.5.5.7 Instrumentation.....	11.5-22
11.5.5.8 Setpoints.....	11.5-22
11.5.5.9 Process and Post-Accident Sampling Programs – Regulatory Compliance.....	11.5-22
11.5.6 Calibration and Maintenance.....	11.5-23
11.5.6.1 Inspection and Tests.....	11.5-23
11.5.6.2 Calibration.....	11.5-24
11.5.6.3 Maintenance.....	11.5-24
11.5.6.4 IE Bulletin 80-10 (Reference 11.5-28) Evaluation.....	11.5-24
11.5.6.5 Implementation of 10 CFR 20.1406 (Reference 11.5-23).....	11.5-25
11.5.7 COL Information.....	11.5-26

11.5.8 References	11.5-27
-------------------------	---------

VOLUME 26A6642BJ

12. Radiation Protection	12.1-1
12.1 Ensuring That Occupational Radiation Exposures Are ALARA	12.1-1
12.1.1 Policy Considerations	12.1-1
12.1.1.1 Design and Construction Policies	12.1-1
12.1.1.2 Operational Policies	12.1-1
12.1.1.3 Compliance with 10 CFR 20 and Regulatory Guides 8.8, 8.10 and 1.8	12.1-1
12.1.1.3.1 Compliance with Regulatory Guide 8.8	12.1-1
12.1.1.3.2 Compliance with Regulatory Guide 8.10	12.1-1
12.1.1.3.3 Compliance with Regulatory Guide 1.8	12.1-1
12.1.2 Design Considerations	12.1-2
12.1.2.1 General Design Consideration for ALARA Exposures	12.1-2
12.1.2.2 Equipment Design Considerations for ALARA Exposures	12.1-2
12.1.2.2.1 General Design Criteria	12.1-2
12.1.2.2.2 Equipment Design Considerations to Limit Time Spent in Radiation Areas	12.1-3
12.1.2.2.3 Equipment Design Considerations to Limit Component Radiation Levels	12.1-3
12.1.2.3 Facility Layout General Design Considerations for Maintaining Radiation Exposures ALARA	12.1-3
12.1.2.3.1 Minimizing Personnel Time Spent in Radiation Areas	12.1-3
12.1.2.3.2 Minimizing Radiation Levels in Plant Access Areas and Vicinity of Equipment	12.1-4
12.1.3 Operational Considerations	12.1-5
12.1.4 COL Information	12.1-5
12.1.5 References	12.1-5
12.2 Plant Sources	12.2-1
12.2.1 Contained Sources	12.2-1
12.2.1.1 Primary Containment Source Terms	12.2-1
12.2.1.1.1 Reactor Vessel Core Sources	12.2-1
12.2.1.1.2 Other Radioactive Sources	12.2-2
12.2.1.2 Reactor Building and Fuel Building Source Terms	12.2-3
12.2.1.2.1 Other Sources	12.2-3
12.2.1.3 Turbine Building Source Terms	12.2-4
12.2.1.4 Radwaste Building Source Terms	12.2-5
12.2.1.5 Other Contained Sources	12.2-6
12.2.2 Airborne and Liquid Sources for Environmental Consideration	12.2-6
12.2.2.1 Airborne Releases Offsite	12.2-6
12.2.2.2 Airborne Dose Evaluation Offsite	12.2-7
12.2.2.3 Liquid Releases Offsite	12.2-7
12.2.2.4 Liquid Doses Offsite	12.2-7
12.2.3 Airborne Sources Onsite	12.2-8
12.2.3.1 Calculation of Airborne Radionuclides	12.2-8
12.2.3.2 Reactor Building	12.2-8
12.2.3.2.1 Airborne Sources During Normal Operation	12.2-8

12.2.3.2.2 Airborne Sources During Refueling	12.2-9
12.2.3.3 Fuel Building	12.2-9
12.2.3.4 Turbine Building	12.2-10
12.2.3.5 Radwaste Building	12.2-10
12.2.4 COL Information	12.2-11
12.2.5 References	12.2-11
12.3 Radiation Protection	12.3-1
12.3.1 Facility Design Features	12.3-1
12.3.1.1 Equipment Design for Maintaining Exposure ALARA	12.3-1
12.3.1.1.1 Pumps	12.3-2
12.3.1.1.2 Instrumentation	12.3-2
12.3.1.1.3 Heat Exchangers	12.3-2
12.3.1.1.4 Valves	12.3-3
12.3.1.1.5 Piping	12.3-3
12.3.1.1.6 Lighting	12.3-3
12.3.1.1.7 Floor Drains	12.3-3
12.3.1.1.8 Ventilation	12.3-4
12.3.1.2 Plant Design for Maintaining Exposure ALARA	12.3-4
12.3.1.2.1 Penetrations	12.3-4
12.3.1.2.2 Sample Stations	12.3-5
12.3.1.2.3 HVAC Systems	12.3-5
12.3.1.2.4 Piping	12.3-5
12.3.1.2.5 Equipment Layout	12.3-6
12.3.1.2.6 Contamination Control	12.3-6
12.3.1.3 Radiation Zoning	12.3-7
12.3.1.4 Implementation of ALARA	12.3-9
12.3.1.4.1 Reactor Water Cleanup / Shutdown Cooling System	12.3-9
12.3.1.4.2 Fuel and Auxiliary Pools Cooling System	12.3-9
12.3.1.4.3 Main Steam System	12.3-10
12.3.1.4.4 Inclined Fuel Transfer System	12.3-10
12.3.1.4.5 Radwaste Building	12.3-11
12.3.1.5 Minimization of Contamination and Radioactive Waste Generation	12.3-12
12.3.1.5.1 Design Considerations	12.3-13
12.3.1.5.2 Operational/Programmatic Considerations	12.3-15
12.3.2 Shielding	12.3-16
12.3.2.1 General Design Guides	12.3-16
12.3.2.2 Design Description	12.3-16
12.3.2.2.1 General Design Guides	12.3-16
12.3.2.2.2 Method of Shielding Design	12.3-17
12.3.2.2.3 Plant Shielding Description	12.3-19
12.3.3 Ventilation	12.3-21
12.3.3.1 Design Objectives	12.3-21
12.3.3.2 Design Description	12.3-21
12.3.3.2.1 Control Room Ventilation	12.3-21
12.3.3.2.2 Containment	12.3-22
12.3.3.2.3 Reactor Building	12.3-22

12.3.3.2.4 Radwaste Building	12.3-22
12.3.3.2.5 Fuel Building	12.3-23
12.3.3.3 Accident Conditions.....	12.3-23
12.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation	12.3-24
12.3.4.1 ARM System Description	12.3-25
12.3.4.2 ARM Detector Location and Sensitivity.....	12.3-26
12.3.4.3 Pertinent Design Parameters and Requirements	12.3-26
12.3.5 Post-Accident Access Requirements.....	12.3-27
12.3.6 Post-Accident Radiation Zone Maps and Mission Doses	12.3-27
12.3.7 COL Information.....	12.3-28
12.3.8 References	12.3-29
12.4 Dose Assessment	12.4-1
12.4.1 Reactor Operations and Surveillance.....	12.4-2
12.4.2 Routine Maintenance	12.4-3
12.4.3 Waste Processing	12.4-4
12.4.4 Refueling Operations	12.4-5
12.4.5 Inservice Inspection	12.4-7
12.4.6 Special Maintenance	12.4-8
12.4.7 Overall Plant Doses.....	12.4-12
12.4.8 COL Information	12.4-12
12.4.9 References.....	12.4-12
12.5 Operational Radiation Protection Program	12.5-1
12.5.1 Objectives.....	12.5-1
12.5.2 Equipment, Instrumentation, and Facilities	12.5-1
12.5.3 Operational Considerations	12.5-1
12.5.4 COL Information.....	12.5-2
12.5.5 References	12.5-2
12.6 Deleted.....	12A-1
12A.1 Evaluation Parameters	12A-1
12A.2 Example Calculation.....	12A-3
12A.3 COL Information	12A-3
12A.4 References	12A-3
12B.1 Reactor Building Releases	12B-1
12B.2 Turbine Building Releases.....	12B-1
12B.3 Radwaste Building Releases.....	12B-2
12B.4 Mechanical Vacuum Pump Releases	12B-2
12B.5 Turbine Seal Releases.....	12B-2
12B.6 Offgas System Releases.....	12B-2
12B.7 Drywell Releases	12B-3

VOLUME 26A6642BL

13.1 Organizational Structure Of Applicant.....	13.1-1
13.1.1 COL Information.....	13.1-1
13.1.2 References	13.1-1
13.2 Training	13.2-1
13.2.1 Reactor Operator Training.....	13.2-1
13.2.2 Training for Non-Licensed Plant Staff.....	13.2-1
13.2.3 Incorporation of Operating Experience	13.2-1
13.2.4 Training Requirements for Preoperational and Low-Power Testing	13.2-1
13.2.5 COL Information	13.2-1
13.2.6 References	13.2-2
13.3 Emergency Planning.....	13.3-1
13.3.1 Preliminary Planning	13.3-2
13.3.2 Emergency Plan.....	13.3-2
13.3.3 COL Information	13.3-2
13.3.4 References	13.3-2
13.4 Operational Program Implementation	13.4-1
13.4.1 COL Information	13.4-1
13.4.2 References	13.4-1
13.5 Plant Procedures	13.5-1
13.5.1 Administrative Procedures	13.5-1
13.5.2 Operating and Maintenance Procedures	13.5-1
13.5.3 COL Information	13.5-3
13.5.4 References	13.5-4
13.6 Physical Security	13.6-1
13.6.1 Preliminary Planning.....	13.6-1
13.6.1.1 Site Physical Security.....	13.6-1
13.6.2 Security Plan.....	13.6-5
13.6.3 COL Information	13.6-5
13.6.4 References	13.6-7

VOLUME 26A6642BN

14. Initial Test Program.....	14.1-1
14.1 Initial Test Program For Preliminary Safety Analysis Reports.....	14.1-1
14.2 Initial Plant Test Program For Final Safety Analysis Reports	14.2-1
14.2.1 Summary of Test Program and Objectives.....	14.2-1
14.2.1.1 Construction Test Objectives	14.2-1
14.2.1.2 Preoperational Test Objectives.....	14.2-1
14.2.1.3 Startup Test Objectives	14.2-2
14.2.1.4 Organization and Staffing	14.2-2
14.2.2 Startup Administrative Manual/Test Procedures/Program/Results/Reports	14.2-4
14.2.2.1 Startup Administrative Manual	14.2-4
14.2.2.2 Test Procedures	14.2-5
14.2.2.3 Conduct of Test Program	14.2-5
14.2.2.4 Review, Evaluation, and Approval of Test Results	14.2-6
14.2.2.5 Test Records.....	14.2-6
14.2.3 Test Program Conformance with Regulatory Guides.....	14.2-6
14.2.4 Utilization of Reactor Operating and Testing Experience in the Development of Test Program.....	14.2-7
14.2.5 Use of Plant Operating and Emergency Procedures	14.2-7
14.2.6 Initial Fuel Loading and Initial Criticality	14.2-7
14.2.7 Test Program Schedule and Sequence	14.2-8
14.2.8 Individual Test Descriptions	14.2-9
14.2.8.1 Preoperational Test Procedures.....	14.2-9
14.2.8.1.1 Nuclear Boiler System Preoperational Test	14.2-10
14.2.8.1.2 Feedwater Control System Preoperational Test	14.2-11
14.2.8.1.3 Standby Liquid Control System Preoperational Test.....	14.2-12
14.2.8.1.4 Control Rod Drive System Preoperational Test.....	14.2-13
14.2.8.1.5 Rod Control and Information System Preoperational Test	14.2-14
14.2.8.1.6 Safety System Logic and Control Engineered Safety Feature Preoperational Test	14.2-15
14.2.8.1.7 DCIS System Preoperational Test.....	14.2-16
14.2.8.1.8 Leak Detection and Isolation System Preoperational Test.....	14.2-17
14.2.8.1.9 Reactor Protection System Preoperational Test	14.2-17
14.2.8.1.10 Neutron Monitoring System Preoperational Test.....	14.2-18
14.2.8.1.11 Plant Automation System Preoperational Test.....	14.2-19
14.2.8.1.12 Remote Shutdown System Preoperational Test	14.2-20
14.2.8.1.13 Reactor Water Cleanup/Shutdown Cooling System Preoperational Test.....	14.2-21
14.2.8.1.14 Fuel and Auxiliary Pools Cooling System Preoperational Test	14.2-22
14.2.8.1.15 Process Sampling System Preoperational Test	14.2-23
14.2.8.1.16 Process Radiation Monitoring System Preoperational Test.....	14.2-23
14.2.8.1.17 Area Radiation Monitoring System Preoperational Test	14.2-24
14.2.8.1.18 Containment Monitoring System Preoperational Test	14.2-24
14.2.8.1.19 Instrument Air and Service Air Systems Preoperational Tests	14.2-26
14.2.8.1.20 High Pressure Nitrogen Supply System Preoperational Test.....	14.2-27

14.2.8.1.21 Reactor Component Cooling Water System Preoperational Test..	14.2-27
14.2.8.1.22 Makeup Water System Preoperational Test.....	14.2-28
14.2.8.1.23 (Deleted)	14.2-29
14.2.8.1.24 Chilled Water System Preoperational Test	14.2-29
14.2.8.1.25 Heating, Ventilation, and Air Conditioning Systems Preoperational Test.....	14.2-30
14.2.8.1.26 Containment Inerting System Preoperational Test	14.2-32
14.2.8.1.27 Containment Isolation Valve Leakage Rate Tests	14.2-32
14.2.8.1.28 Containment Penetration Leakage Rate Tests	14.2-33
14.2.8.1.29 Containment Airlock Leakage Rate Tests	14.2-33
14.2.8.1.30 Containment Integrated Leakage Rate Test	14.2-33
14.2.8.1.31 Containment Structural Integrity Test	14.2-34
14.2.8.1.32 Overall Suppression Pool Bypass Leakage Test.....	14.2-35
14.2.8.1.33 Containment Isolation Valve Functional and Closure Timing Tests	14.2-35
14.2.8.1.34 Wetwell-to-Drywell Vacuum Breaker System Preoperational Test.....	14.2-36
14.2.8.1.35 DC Power Supply System Preoperational Test	14.2-36
14.2.8.1.36 AC Power Distribution System Preoperational Test	14.2-37
14.2.8.1.37 Standby Diesel Generator & AC Power System Preoperational Test.....	14.2-38
14.2.8.1.38 Plant Communications System Preoperational Test	14.2-39
14.2.8.1.39 Fire Protection System Preoperational Test.....	14.2-40
14.2.8.1.40 Radioactive Liquid Drainage and Transfer Systems Preoperational Tests	14.2-41
14.2.8.1.41 Fuel-Handling and Reactor Servicing Equipment Preoperational Test	14.2-42
14.2.8.1.42 Expansion, Vibration and Dynamic Effects Preoperational Test ..	14.2-43
14.2.8.1.43 Deleted	14.2-44
14.2.8.1.44 Condensate and Feedwater Systems Preoperational Test.....	14.2-44
14.2.8.1.45 Condensate Purification System Preoperational Test	14.2-45
14.2.8.1.46 Reactor Water Chemistry Control Systems Preoperational Test...	14.2-46
14.2.8.1.47 Condenser Air Removal System Preoperational Test.....	14.2-47
14.2.8.1.48 Offgas System Preoperational Test.....	14.2-47
14.2.8.1.49 Condensate Storage and Transfer System Preoperational Test	14.2-48
14.2.8.1.50 Circulating Water System Preoperational Test.....	14.2-49
14.2.8.1.51 Plant Service Water System Preoperational Test.....	14.2-50
14.2.8.1.52 Turbine Component Cooling Water System Preoperational Test..	14.2-51
14.2.8.1.53 Main Turbine Control System Preoperational Test	14.2-52
14.2.8.1.54 Main Turbine Bypass System Preoperational Test.....	14.2-53
14.2.8.1.55 Steam Bypass and Pressure Control (SB&PC) System Preoperational Test	14.2-53
14.2.8.1.56 Heater Drain and Vent System Preoperational Test	14.2-54
14.2.8.1.57 Extraction Steam System Preoperational Test.....	14.2-54
14.2.8.1.58 Moisture Separator Reheater System Preoperational Test.....	14.2-55
14.2.8.1.59 Main Turbine and Auxiliaries Preoperational Test.....	14.2-56

14.2.8.1.60 Main Generator and Auxiliary Systems Preoperational Test	14.2-57
14.2.8.1.61 Seismic Monitoring System Preoperational Test.....	14.2-57
14.2.8.1.62 Liquid and Solid Radwaste Systems Preoperational Tests	14.2-58
14.2.8.1.63 Isolation Condenser System Preoperational Test	14.2-59
14.2.8.1.64 Passive Containment Cooling System Preoperational Test	14.2-59
14.2.8.1.65 Gravity-Driven Cooling System Preoperational Test	14.2-60
14.2.8.1.66 Deleted	14.2-61
14.2.8.1.67 Ancillary Diesel Generator & AC Power System Preoperational Test.....	14.2-61
14.2.8.2 General Discussion of Startup Tests	14.2-62
14.2.8.2.1 Chemical and Radiochemical Measurements Test	14.2-63
14.2.8.2.2 Radiation Measurements Test	14.2-64
14.2.8.2.3 Fuel Loading Test.....	14.2-65
14.2.8.2.4 Full Core Shutdown Margin Demonstration Test	14.2-66
14.2.8.2.5 Control Rod Drive System Performance Test	14.2-66
14.2.8.2.6 Neutron Monitoring System Performance Test.....	14.2-68
14.2.8.2.7 Core Performance Test	14.2-69
14.2.8.2.8 Nuclear Boiler Process Monitoring Test	14.2-70
14.2.8.2.9 System Expansion Test.....	14.2-71
14.2.8.2.10 System Vibration Test	14.2-73
14.2.8.2.11 Reactor Internals Vibration Test (Initial Startup Flow-Induced Vibration Testing)	14.2-74
14.2.8.2.12 Feedwater Control Test	14.2-75
14.2.8.2.13 Pressure Control Test.....	14.2-76
14.2.8.2.14 Plant Automation and Control Test	14.2-77
14.2.8.2.15 Feedwater System Performance Test	14.2-78
14.2.8.2.16 Main Steam System Performance Test.....	14.2-78
14.2.8.2.17 Reactor Water Cleanup/Shutdown Cooling System Performance Test.....	14.2-79
14.2.8.2.18 Plant Service Water System Performance Test	14.2-79
14.2.8.2.19 Heating, Ventilation and Air Conditioning System Performance Test.....	14.2-80
14.2.8.2.20 Turbine Valve Performance Test.....	14.2-80
14.2.8.2.21 Nuclear Boiler System Isolation Test.....	14.2-81
14.2.8.2.22 Safety Relief Valve Performance Test	14.2-82
14.2.8.2.23 Loss of Feedwater Heating Test	14.2-82
14.2.8.2.24 Feedwater Pump Trip Test	14.2-83
14.2.8.2.25 Shutdown From Outside the Main Control Room Test.....	14.2-84
14.2.8.2.26 Loss of Turbine Generator and Offsite Power Test.....	14.2-85
14.2.8.2.27 Turbine Trip and Generator Load Rejection Test.....	14.2-85
14.2.8.2.28 Reactor Full Isolation Test	14.2-86
14.2.8.2.29 Offgas System Test.....	14.2-87
14.2.8.2.30 Deleted	14.2-88
14.2.8.2.31 Concrete Penetration Temperature Surveys Test	14.2-88
14.2.8.2.32 Liquid Radwaste System Performance Test.....	14.2-88
14.2.8.2.33 Steam and Power Conversion System Performance Test.....	14.2-89

14.2.8.2.34 Isolation Condenser Performance Test.....	14.2-89
14.2.8.2.35 [<i>ESBWR First of a Kind Tests</i>	14.2-90
14.2.9 Site-Specific Preoperational and Start up Tests	14.2-95
14.2.9.1 Site-Specific Preoperational Tests.....	14.2-96
14.2.9.2 Site Specific Startup Tests.....	14.2-96
14.2.10 COL Information	14.2-96
14.2.11 References.....	14.2-96
14.3 INSPECTIONS, TESTS, ANALYSES AND ACCEPTANCE CRITERIA.....	14.3-1
14.3.1 Tier 1, Section 1 - Introduction	14.3-2
14.3.2 Tier 1, Section 2 - Design Descriptions and ITAACs	14.3-2
14.3.2.1 Design Descriptions.....	14.3-3
14.3.2.2 Inspections, Tests, Analyses and Acceptance Criteria (ITAAC)	14.3-7
14.3.3 Tier 1, Section 3 - Non-System Based Material	14.3-9
14.3.3.1 Design of Piping Systems and Components.....	14.3-10
14.3.3.2 (Deleted)	14.3-11
14.3.3.3 Human Factors Engineering	14.3-11
14.3.3.4 Radiation Protection	14.3-12
14.3.3.5 Initial Test Program	14.3-12
14.3.3.6 Design Reliability Assurance Program	14.3-13
14.3.3.7 Post-Accident Monitoring Instrumentation.....	14.3-13
14.3.3.8 Environmental Qualification of Mechanical and Electrical Equipment..	14.3-13
14.3.4 Tier 1, Section 4 - Interface Material	14.3-13
14.3.5 Tier 1, Section 5 - Site Parameters.....	14.3-14
14.3.6 Tier 1 Generation Summary	14.3-15
14.3.7 Evaluation Process For Updating Design Descriptions and ITAAC	14.3-15
14.3.7.1 Generic Guidance	14.3-16
14.3.7.2 NRC Guidance	14.3-16
14.3.7.3 Criteria and Application Process	14.3-17
14.3.8 Overall ITAAC Content For Combined License Applications.....	14.3-19
14.3.9 Site-Specific ITAAC.....	14.3-20
14.3.10 COL Information	14.3-20
14.3.11 References.....	14.3-20
14.3A Design Acceptance Criteria ITAAC Closure Process	14.3A-1
14.3A.1 Design Acceptance Criteria ITAAC Closure Options.....	14.3A-2
14.3A.2 Design Acceptance Criteria ITAAC for Piping Design	14.3A-2
14.3A.3 Digital Instrumentation and Control Design Acceptance Criteria ITAAC Closure	14.3A-3
14.3A.4 Human Factors Engineering Design Acceptance Criteria ITAAC Closure	14.3A-5
14.3A.5 COL Information	14.3A-6
14.3A.6 References	14.3A-6

VOLUME 26A6642BP

15.0 Analytical Approach.....	15.0-1
15.0.1 Classification and Selection of Events	15.0-2
15.0.1.1 Approach For Determining Event Classifications	15.0-3
15.0.1.2 Results of Event Classification Determinations	15.0-4
15.0.2 Abnormal Events To Be Evaluated	15.0-5
15.0.3 Determination of Safety Analysis Acceptance Criteria.....	15.0-6
15.0.3.1 Anticipated Operational Occurrences.....	15.0-6
15.0.3.2 Infrequent Events.....	15.0-8
15.0.3.3 Accidents	15.0-8
15.0.3.4 Special Events.....	15.0-9
15.0.4 Event Analysis Format	15.0-11
15.0.4.1 Identification of Causes	15.0-12
15.0.4.2 Sequence of Events and Systems Operations	15.0-12
15.0.4.3 Evaluation of Results	15.0-12
15.0.4.4 Barrier Performance.....	15.0-12
15.0.4.5 Radiological Consequences	15.0-12
15.0.5 Single Failure Criterion	15.0-12
15.0.5.1 Single Failures as Event Initiators	15.0-13
15.0.5.2 Application of Single Failure Criterion to Event Analysis	15.0-14
15.0.6 Combined License (COL) Information	15.0-14
15.0.7 References	15.0-14
15.1 Nuclear Safety Operational Analysis	15.1-1
15.1.1 Analytical Approach.....	15.1-1
15.1.1.1 NSOA Objective	15.1-1
15.1.1.2 NSOA Relationship to Safety Analysis	15.1-1
15.1.2 Method of Analysis	15.1-1
15.1.2.1 Operational Criteria.....	15.1-1
15.1.2.2 Analysis Assumptions and Initial Conditions	15.1-2
15.1.2.3 Event Analysis Rules	15.1-2
15.1.3 NSOA Results	15.1-3
15.1.3.1 Event Evaluations and Diagrams	15.1-3
15.1.3.2 Summary Matrices	15.1-3
15.1.4 Event Evaluations	15.1-3
15.1.5 COL Information	15.1-3
15.1.6 References	15.1-3
15.2 Analysis of Anticipated Operational Occurrences	15.2-1
15.2.0 Assumptions	15.2-1
15.2.1 Decrease In Core Coolant Temperature	15.2-1
15.2.1.1 Loss Of Feedwater Heating	15.2-1
15.2.2 Increase In Reactor Pressure	15.2-3
15.2.2.1 Closure of One Turbine Control Valve	15.2-3

15.2.2.2 Generator Load Rejection With Turbine Bypass.....	15.2-5
15.2.2.3 Generator Load Rejection With a Single Failure in the Turbine Bypass System	15.2-6
15.2.2.4 Turbine Trip With Turbine Bypass.....	15.2-8
15.2.2.5 Turbine Trip With a Single Failure in the Turbine Bypass System	15.2-9
15.2.2.6 Closure of One Main Steamline Isolation Valve	15.2-10
15.2.2.7 Closure of All Main Steamline Isolation Valves	15.2-11
15.2.2.8 Loss of Condenser Vacuum.....	15.2-13
15.2.2.9 Loss of Shutdown Cooling Function of RWCU/SDC	15.2-14
15.2.3 Reactivity and Power Distribution Anomalies	15.2-15
15.2.3.1 Control Rod Withdrawal Error During Startup.....	15.2-15
15.2.3.2 Control Rod Withdrawal Error During Power Operation.....	15.2-16
15.2.4 Increase in Reactor Coolant Inventory	15.2-17
15.2.4.1 Inadvertent Isolation Condenser Initiation	15.2-17
15.2.4.2 Runout of One Feedwater Pump	15.2-18
15.2.5 Decrease in Reactor Coolant Inventory.....	15.2-20
15.2.5.1 Opening of One Turbine Control or Bypass Valve	15.2-20
15.2.5.2 Loss of Non-Emergency AC Power to Station Auxiliaries	15.2-21
15.2.5.3 Loss of All Feedwater Flow	15.2-22
15.2.6 AOO Analysis Summary	15.2-23
15.2.7 COL Information	15.2-24
15.2.8 References	15.2-24
15.3 Analysis Of Infrequent Events	15.3-1
15.3.1 Loss of Feedwater Heating – Infrequent Event.....	15.3-1
15.3.1.1 Identification of Causes	15.3-1
15.3.1.2 Sequence of Events and Systems Operation	15.3-2
15.3.1.3 Core and System Performance	15.3-2
15.3.1.4 Barrier Performance	15.3-3
15.3.1.5 Radiological Consequences.....	15.3-3
15.3.2 Feedwater Controller Failure – Maximum Flow Demand	15.3-4
15.3.2.1 Identification of Causes.....	15.3-4
15.3.2.2 Sequence of Events and Systems Operation	15.3-4
15.3.2.3 Core and System Performance	15.3-4
15.3.2.4 Barrier Performance	15.3-5
15.3.2.5 Radiological Consequences.....	15.3-5
15.3.3 Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.3-5
15.3.3.1 Identification of Causes.....	15.3-5
15.3.3.2 Sequence of Events and Systems Operation	15.3-5
15.3.3.3 Core and System Performance	15.3-6
15.3.3.4 Barrier Performance	15.3-6
15.3.3.5 Radiological Consequences.....	15.3-6
15.3.4 Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves	15.3-6
15.3.4.1 Identification of Causes	15.3-6
15.3.4.2 Sequence of Events and Systems Operation.....	15.3-7

15.3.4.3 Core and System Performance	15.3-7
15.3.4.4 Barrier Performance	15.3-7
15.3.4.5 Radiological Consequences	15.3-8
15.3.5 Generator Load Rejection With Total Turbine Bypass Failure.....	15.3-8
15.3.5.1 Identification of Causes	15.3-8
15.3.5.2 Sequence of Events and System Operation	15.3-8
15.3.5.3 Core and System Performance.....	15.3-8
15.3.5.4 Barrier Performance.....	15.3-9
15.3.5.5 Radiological Consequences	15.3-9
15.3.6 Turbine Trip With Total Turbine Bypass Failure.....	15.3-9
15.3.6.1 Identification of Causes.....	15.3-9
15.3.6.2 Sequence of Events and System Operation.....	15.3-10
15.3.6.3 Core and System Performance	15.3-10
15.3.6.4 Barrier Performance	15.3-10
15.3.6.5 Radiological Consequences.....	15.3-11
15.3.7 Control Rod Withdrawal Error During Refueling.....	15.3-11
15.3.7.1 Identification of Causes.....	15.3-11
15.3.7.2 Sequence of Events and Systems Operation	15.3-11
15.3.7.3 Core and System Performance	15.3-12
15.3.7.4 Barrier Performance	15.3-12
15.3.7.5 Radiological Consequences	15.3-12
15.3.8 Control Rod Withdrawal Error During Startup With Failure of Control Rod Block	15.3-12
15.3.8.1 Identification of Causes.....	15.3-12
15.3.8.2 Sequence of Events and Systems Operation	15.3-13
15.3.8.3 Core and System Performance	15.3-13
15.3.8.4 Barrier Performance	15.3-15
15.3.9 Control Rod Withdrawal Error During Power Operation with ATLM Failure....	15.3-15
15.3.9.1 Identification of Causes	15.3-15
15.3.9.2 Sequence of Events and System Operation	15.3-16
15.3.9.3 Core and System Performance.....	15.3-16
15.3.9.4 Barrier Performance.....	15.3-16
15.3.9.5 Radiological Consequences	15.3-16
15.3.10 Fuel Assembly Loading Error, Mislocated Bundle.....	15.3-16
15.3.10.1 Identification of Causes	15.3-16
15.3.10.2 Sequence of Events and Systems Operation.....	15.3-16
15.3.10.3 Core and System Performance.....	15.3-17
15.3.10.4 Barrier Performance.....	15.3-17
15.3.10.5 Radiological Consequences	15.3-17
15.3.11 Fuel Assembly Loading Error, Misoriented Bundle	15.3-18
15.3.11.1 Identification of Causes	15.3-18
15.3.11.2 Core and Barrier Performance	15.3-18
15.3.11.3 Radiological Consequences	15.3-18
15.3.12 Inadvertent SDC Function Operation.....	15.3-19
15.3.12.1 Identification of Causes.....	15.3-19

15.3.12.2 Sequence of Events and Systems Operation	15.3-19
15.3.12.3 Core and System Performance	15.3-19
15.3.12.4 Barrier Performance	15.3-20
15.3.12.5 Radiological Consequences	15.3-20
15.3.13 Inadvertent Opening of a Safety Relief Valve	15.3-20
15.3.13.1 Identification of Causes	15.3-20
15.3.13.2 Sequence of Events and Systems Operation	15.3-20
15.3.13.3 Core and System Performance	15.3-20
15.3.13.4 Barrier Performance	15.3-21
15.3.13.5 Radiological Consequences	15.3-21
15.3.14 Inadvertent Opening of a Depressurization Valve	15.3-21
15.3.14.1 Identification of Causes	15.3-21
15.3.14.2 Systems Operation and Sequence of Events	15.3-21
15.3.14.3 Core and System Performance	15.3-22
15.3.14.4 Barrier Performance	15.3-22
15.3.14.5 Radiological Consequences	15.3-22
15.3.15 Stuck Open Safety Relief Valve	15.3-22
15.3.15.1 Identification of Causes	15.3-22
15.3.15.2 Sequence of Events and Systems Operation	15.3-23
15.3.15.3 Core and System Performance	15.3-23
15.3.15.4 Barrier Performance	15.3-23
15.3.15.5 Radiological Consequences	15.3-23
15.3.16 Liquid-Containing Tank Failure	15.3-24
15.3.16.1 Identification of Causes	15.3-24
15.3.16.2 Sequence of Events and Systems Operations	15.3-24
15.3.16.3 Results	15.3-25
15.3.17 COL Information	15.3-25
15.3.18 References	15.3-25
15.4 Analysis of Accidents	15.4-1
15.4.1 Fuel Handling Accident	15.4-1
15.4.1.1 Identification of Causes	15.4-1
15.4.1.2 Sequence of Events and Systems Operation	15.4-1
15.4.1.3 Core and System Performance	15.4-1
15.4.1.4 Barrier Performance	15.4-3
15.4.1.5 Radiological Consequences	15.4-3
15.4.1.6 Results	15.4-4
15.4.1.7 Assumptions Requiring Confirmation	15.4-4
15.4.2 Loss-of-Coolant Accident Containment Analysis	15.4-4
15.4.3 Loss-of-Coolant Accident ECCS Performance Analysis	15.4-4
15.4.4 Loss-of-Coolant Accident Inside Containment Radiological Analysis	15.4-4
15.4.4.1 Identification of Causes	15.4-5
15.4.4.2 Sequence of Events and Systems Operation	15.4-5
15.4.4.3 Core and System Performance	15.4-6
15.4.4.4 Barrier Performance	15.4-6

15.4.4.5 Radiological Consequences	15.4-6
15.4.4.6 Results	15.4-15
15.4.4.7 Assumptions Requiring Confirmation	15.4-15
15.4.5 Main Steamline Break Accident Outside Containment.....	15.4-15
15.4.5.1 Identification of Causes	15.4-15
15.4.5.2 Sequence of Events and Systems Operation	15.4-16
15.4.5.3 Core and System Performance	15.4-16
15.4.5.4 Barrier Performance	15.4-17
15.4.5.5 Radiological Consequences	15.4-17
15.4.5.6 Results	15.4-18
15.4.5.7 Assumptions Requiring Confirmation	15.4-18
15.4.6 Control Rod Drop Accident.....	15.4-18
15.4.6.1 Features of the ESBWR Fine Motion Control Rod Drives	15.4-18
15.4.6.2 Identification of Causes	15.4-19
15.4.6.3 Sequence of Events and System Operation	15.4-19
15.4.6.4 Core and System Performance	15.4-19
15.4.6.5 Barrier Performance	15.4-20
15.4.6.6 Radiological Consequences.....	15.4-20
15.4.7 Feedwater Line Break Outside Containment	15.4-20
15.4.7.1 Identification of Causes	15.4-20
15.4.7.2 Sequence of Events and System Operation	15.4-20
15.4.7.3 Core and System Performance	15.4-21
15.4.7.4 Barrier Performance	15.4-21
15.4.7.5 Radiological Consequences	15.4-21
15.4.7.6 Results	15.4-22
15.4.7.7 Assumptions Requiring Confirmation	15.4-22
15.4.8 Failure of Small Line Carrying Primary Coolant Outside Containment	15.4-22
15.4.8.1 Identification of Causes	15.4-23
15.4.8.2 Sequence of Events and Systems Operations	15.4-23
15.4.8.3 Core and System Performance	15.4-23
15.4.8.4 Barrier Performance	15.4-24
15.4.8.5 Radiological Consequences	15.4-24
15.4.8.6 Results	15.4-24
15.4.9 RWCU/SDC System Line Failure Outside Containment.....	15.4-25
15.4.9.1 Identification of Causes	15.4-25
15.4.9.2 Sequence of Events and Systems Operation	15.4-25
15.4.9.3 Core and System Performance	15.4-25
15.4.9.4 Barrier Performance	15.4-26
15.4.9.5 Radiological Consequences	15.4-26
15.4.9.6 Results	15.4-27
15.4.9.7 Assumptions Requiring Confirmation	15.4-27
15.4.10 Spent Fuel Cask Drop Accident	15.4-27
15.4.10.1 Identification of Causes	15.4-27
15.4.10.2 Radiological Analysis.....	15.4-27
15.4.11 COL Information	15.4-27

15.4.12 References	15.4-28
15.5 Special Event Evaluations	15.5-1
15.5.1 Overpressure Protection	15.5-1
15.5.1.1 Method of Analysis	15.5-1
15.5.1.2 System Design	15.5-1
15.5.1.3 Evaluation of Results	15.5-3
15.5.1.4 System Reliability	15.5-3
15.5.2 Shutdown Without Control Rods (Standby Liquid Control System Capability) ...	15.5-4
15.5.3 Shutdown from Outside Main Control Room	15.5-4
15.5.4 Anticipated Transients Without Scram	15.5-4
15.5.4.1 Requirements	15.5-4
15.5.4.2 Plant Capabilities	15.5-4
15.5.4.3 Performance Evaluation	15.5-5
15.5.4.4 Conclusion	15.5-12
15.5.5 Station Blackout	15.5-12
15.5.5.1 Acceptance Criteria	15.5-12
15.5.5.2 Analysis Assumptions	15.5-13
15.5.5.3 Analysis Results	15.5-14
15.5.6 Safe Shutdown Fire	15.5-14
15.5.6.1 Acceptance Criteria	15.5-14
15.5.6.2 Analysis Assumptions	15.5-15
15.5.6.3 Analysis Results	15.5-16
15.5.7 Waste Gas System Leak or Failure	15.5-16
15.5.8 COL Information	15.5-17
15.5.9 References	15.5-17
15A. Event Frequency Determination	15A-1
15A.1 Scope	15A-1
15A.2 Methodology	15A-1
15A.3 Results	15A-1
15A.3.1 Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves	15A-1
15A.3.1.1 Introduction	15A-1
15A.3.1.2 Analysis	15A-2
15A.3.1.3 Result	15A-2
15A.3.2 Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves	15A-2
15A.3.2.1 Introduction	15A-2
15A.3.2.2 Analysis	15A-2
15A.3.2.3 Result	15A-3
15A.3.3 Turbine Trip with Total Bypass Failure	15A-3
15A.3.3.1 Introduction	15A-3
15A.3.3.2 Analysis	15A-3
15A.3.3.3 Result	15A-4
15A.3.4 Generator Load Rejection with Total Turbine Bypass Failure	15A-4

15A.3.4.1 Introduction.....	15A-4
15A.3.4.2 Analysis.....	15A-5
15A.3.4.3 Result	15A-6
15A.3.5 Feedwater Controller Failure.....	15A-6
15A.3.5.1 Feedwater Controller Failure – Maximum Flow Demand.....	15A-6
15A.3.5.2 Feedwater Controller Failure – Minimum Temperature Demand	15A-7
15A.3.6 Loss of Feedwater Heating with Failure of SCRR and SRI.....	15A-8
15A.3.6.1 Introduction.....	15A-8
15A.3.6.2 Analysis.....	15A-8
15A.3.6.3 Result	15A-12
15A.3.7 Inadvertent Shutdown Cooling Function Operation.....	15A-12
15A.3.7.1 Introduction.....	15A-12
15A.3.7.2 Analysis.....	15A-12
15A.3.7.3 Result	15A-14
15A.3.8 Inadvertent Opening of a Safety Relief Valve.....	15A-14
15A.3.8.1 Introduction.....	15A-14
15A.3.8.2 Analysis.....	15A-14
15A.3.8.3 Result	15A-16
15A.3.9 Inadvertent Opening of a Depressurization Valve	15A-16
15A.3.9.1 Introduction.....	15A-16
15A.3.9.2 Analysis.....	15A-17
15A.3.9.3 Results.....	15A-20
15A.3.10 Stuck Open Safety Relief Valve.....	15A-20
15A.3.10.1 Introduction.....	15A-20
15A.3.10.2 Analysis.....	15A-21
15A.3.10.3 Result	15A-22
15A.3.11 Control Rod Withdrawal Error During Refueling.....	15A-22
15A.3.11.1 Introduction.....	15A-22
15A.3.11.2 Analysis.....	15A-22
15A.3.11.3 Results.....	15A-24
15A.3.12 Control Rod Withdrawal Error During Startup With Failure of Control Rod Block.....	15A-24
15A.3.12.1 Introduction.....	15A-24
15A.3.12.2 Analysis.....	15A-25
15A.3.12.3 Results.....	15A-26
15A.3.13 Control Rod Withdrawal Error During Power Operation	15A-26
15A.3.13.1 Introduction.....	15A-26
15A.3.13.2 Analysis.....	15A-27
15A.3.13.3 Results.....	15A-28
15A.3.14 Fuel Assembly Loading Error, Mislocated Bundle	15A-28
15A.3.14.1 Introduction.....	15A-28
15A.3.14.2 Analysis.....	15A-28
15A.3.14.3 Results.....	15A-29
15A.3.15 Fuel Assembly Loading Error, Misoriented Bundle	15A-29
15A.3.15.1 Introduction.....	15A-29
15A.3.15.2 Analysis.....	15A-29

15A.3.15.3 Results	15A-30
15A.3.16 Liquid-Containing Tank Failure	15A-30
15A.3.16.1 Introduction	15A-30
15A.3.16.2 Analysis	15A-30
15A.3.16.3 Results	15A-30
15A.4 Summary	15A-30
15A.4.1 COL Information	15A-30
15A.5 References	15A-30
15B. LOCA Inventory	15B-1
15B.1 COL Information	15B-1
15B.2 References	15B-1
15C. Pool pH Methodology	15C-1
15C.1 Source Term Discussion	15C-1
15C.2 NUREG/CR-5950 Assumptions and Methodology	15C-1
15C.2.1 Carbon Dioxide	15C-1
15C.2.2 Cesium Hydroxide	15C-1
15C.2.3 Hydriodic Acid	15C-2
15C.2.4 Hydrochloric Acid	15C-2
15C.2.5 Nitric Acid	15C-3
15C.2.6 Sodium Pentaborate	15C-3
15C.3 Pool pH Determination	15C-3
15C.4 pH Evaluation Results	15C-6
15C.5 COL Information	15C-6
15C.6 References	15C-6
15D. Effect Of Feedwater Temperature Variation	15D-1
15D.1 Introduction	15D-1
15D.2 AOO Analyses	15D-2
15D.3 Infrequent Events Analyses	15D-2
15D.4 Special Events Analyses	15D-2
15D.5 Other Analyses	15D-3
15D.6 Analyses for Reloads	15D-3
15D.7 References	15D-3

VOLUME 26A6642BR

1.0	USE AND APPLICATION	
1.1	Definitions.....	6.0, 08/31/09
1.2	Logical Connectors.....	2.0, 12/22/06
1.3	Completion Times.....	2.0, 12/22/06
1.4	Frequency.....	2.0, 12/22/06
2.0	SAFETY LIMITS (SLs)	5.0, 05/31/08
2.1	SLs	5.0, 05/31/08
2.2	SL Violations.....	5.0, 05/31/08
3.0	LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY.....	2.0, 12/22/06
3.0	SURVEILLANCE REQUIREMENT (SR) APPLICABILITY.....	2.0, 12/22/06
3.1	REACTIVITY CONTROL SYSTEMS	
3.1.1	SHUTDOWN MARGIN (SDM)	5.0, 05/31/08
3.1.2	Reactivity Anomalies.....	2.0, 12/22/06
3.1.3	Control Rod OPERABILITY	6.0, 08/31/09
3.1.4	Control Rod Scram Times	6.0, 08/31/09
3.1.5	Control Rod Scram Accumulators	6.0, 08/31/09
3.1.6	Rod Pattern Control	6.0, 08/31/09
3.1.7	Standby Liquid Control (SLC) System.....	6.0, 08/31/09
3.2	POWER DISTRIBUTION LIMITS	
3.2.1	LINEAR HEAT GENERATION RATE (LHGR).....	3.0, 02/22/07
3.2.2	MINIMUM CRITICAL POWER RATIO (MCPR)	3.0, 02/22/07
3.3	INSTRUMENTATION	
3.3.1.1	Reactor Protection System (RPS) Instrumentation.....	6.0, 08/31/09
3.3.1.2	Reactor Protection System (RPS) Actuation	6.0, 08/31/09
3.3.1.3	Reactor Protection System (RPS) Manual Actuation	6.0, 08/31/09
3.3.1.4	Neutron Monitoring System (NMS) Instrumentation.....	6.0, 08/31/09
3.3.1.5	Neutron Monitoring System (NMS) Automatic Actuation.....	6.0, 08/31/09
3.3.1.6	Startup Range Neutron Monitor (SRNM) Instrumentation	6.0, 08/31/09
3.3.2.1	Control Rod Block Instrumentation.....	6.0, 08/31/09
3.3.3.1	Remote Shutdown System.....	5.0, 05/31/08
3.3.3.2	Post-Accident Monitoring (PAM) Instrumentation	7.0, 03/10/10
3.3.4.1	Reactor Coolant System (RCS) Leakage Detection Instrumentation.....	6.0, 08/31/09
3.3.5.1	Emergency Core Cooling System (ECCS) Instrumentation	6.0, 08/31/09
3.3.5.2	Emergency Core Cooling System (ECCS) Actuation.....	6.0, 08/31/09
3.3.5.3	Isolation Condenser System (ICS) Instrumentation.....	8.0, 10/01/10
3.3.5.4	Isolation Condenser System (ICS) Actuation	8.0, 10/01/10
3.3.6.1	Main Steam Isolation Valve (MSIV) Instrumentation.....	6.0, 08/31/09
3.3.6.2	Main Steam Isolation Valve (MSIV) Actuation	6.0, 08/31/09
3.3.6.3	Isolation Instrumentation	8.0, 10/01/10
3.3.6.4	Isolation Actuation.....	6.0, 08/31/09

3.3	INSTRUMENTATION (continued)	
3.3.7.1	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS) Instrumentation.....	6.0, 08/31/09
3.3.7.2	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS) Actuation	6.0, 08/31/09
3.3.8.1	Diverse Protection System (DPS).....	8.0, 10/01/10
3.4	REACTOR COOLANT SYSTEM (RCS)	
3.4.1	Safety Relief Valves (SRVs)	6.0, 08/31/09
3.4.2	RCS Operational LEAKAGE	2.0, 12/22/06
3.4.3	RCS Specific Activity.....	6.0, 08/31/09
3.4.4	RCS Pressure and Temperature (P/T) Limits	6.0, 08/31/09
3.4.5	Reactor Steam Dome Pressure	5.0, 05/31/08
3.5	EMERGENCY CORE COOLING SYSTEMS (ECCS)	
3.5.1	Automatic Depressurization System (ADS) - Operating	6.0, 08/31/09
3.5.2	Gravity-Driven Cooling System (GDCCS) - Operating.....	8.0, 10/01/10
3.5.3	Gravity-Driven Cooling System (GDCCS) - Shutdown	8.0, 10/01/10
3.5.4	Isolation Condenser System (ICS) - Operating	6.0, 08/31/09
3.5.5	Isolation Condenser System (ICS) - Shutdown	8.0, 10/01/10
3.6	CONTAINMENT SYSTEMS	
3.6.1.1	Containment.....	6.0, 08/31/09
3.6.1.2	Containment Air Lock	5.0, 05/31/08
3.6.1.3	Containment Isolation Valves (CIVs).....	6.0, 08/31/09
3.6.1.4	Drywell Pressure.....	6.0, 08/31/09
3.6.1.5	Drywell Air Temperature.....	5.0, 05/31/08
3.6.1.6	Wetwell-to-Drywell Vacuum Breakers	5.0, 05/31/08
3.6.1.7	Passive Containment Cooling System (PCCS).....	8.0, 10/01/10
3.6.1.8	Containment Oxygen Concentration.....	5.0, 05/31/08
3.6.2.1	Suppression Pool Average Temperature.....	5.0, 05/31/08
3.6.2.2	Suppression Pool Water Level.....	6.0, 08/31/09
3.6.3.1	Reactor Building (Contaminated Area Ventilation Subsystem (CONAVS) Area)	7.0, 03/10/10
3.7	PLANT SYSTEMS	
3.7.1	Isolation Condenser/Passive Containment Cooling System (IC/PCCS) Pools.....	8.0, 10/01/10
3.7.2	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS).....	6.0, 08/31/09
3.7.3	Main Condenser Offgas	5.0, 05/31/08
3.7.4	Main Turbine Bypass System	3.0, 02/22/07
3.7.5	Fuel Pool Water Level and Temperature	8.0, 10/01/10
3.7.6	Selected Control Rod Run-In (SCRRI) and Select Rod Insert (SRI) Functions	6.0, 08/31/09

3.8	ELECTRICAL POWER SYSTEMS	
3.8.1	DC Sources - Operating	6.0, 08/31/09
3.8.2	DC Sources - Shutdown	6.0, 08/31/09
3.8.3	Battery Parameters	7.0, 03/10/10
3.8.4	Inverters - Operating	6.0, 08/31/09
3.8.5	Inverters - Shutdown	6.0, 08/31/09
3.8.6	Distribution Systems - Operating	6.0, 08/31/09
3.8.7	Distribution Systems - Shutdown	6.0, 08/31/09
3.9	REFUELING OPERATIONS	
3.9.1	Refueling Equipment Interlocks	4.0, 09/28/07
3.9.2	Refuel Position One-Rod/Rod-Pair-Out Interlock	1.0, 02/28/06
3.9.3	Control Rod Position	1.0, 02/28/06
3.9.4	Control Rod Position Indication	1.0, 02/28/06
3.9.5	Control Rod OPERABILITY - Refueling	6.0, 08/31/09
3.9.6	Reactor Pressure Vessel (RPV) Water Level	6.0, 08/31/09
3.9.7	Decay Time	1.0, 02/28/06
3.10	SPECIAL OPERATIONS	
3.10.1	Inservice Leak and Hydrostatic Testing Operation	5.0, 05/31/08
3.10.2	Reactor Mode Switch Interlock Testing	1.0, 02/28/06
3.10.3	Control Rod Withdrawal - Hot / Stable Shutdown	6.0, 08/31/09
3.10.4	Control Rod Withdrawal - Cold Shutdown	6.0, 08/31/09
3.10.5	Control Rod Drive (CRD) Removal - Refueling	5.0, 05/31/08
3.10.6	Multiple Control Rod Withdrawal - Refueling	1.0, 02/28/06
3.10.7	Control Rod Testing - Operating	6.0, 08/31/09
3.10.8	SHUTDOWN MARGIN (SDM) Test - Refueling	6.0, 08/31/09
3.10.9	Oxygen Concentration - Startup Test Program	5.0, 05/31/08
3.10.10	Oscillation Power Range Monitor (OPRM) - Initial Cycle	5.0, 05/31/08
4.0	DESIGN FEATURES	7.0, 03/10/10
4.1	Site Location	7.0, 03/10/10
4.2	Reactor Core	7.0, 03/10/10
4.3	Fuel Storage	7.0, 03/10/10
5.0	ADMINISTRATIVE CONTROLS	
5.1	Responsibility	3.0, 02/22/07
5.2	Organization	7.0, 03/10/10
5.3	Unit Staff Qualifications	7.0, 03/10/10
5.4	Procedures	5.0, 05/31/08
5.5	Programs and Manuals	7.0, 03/10/10
5.6	Reporting Requirements	8.0, 10/01/10
5.7	High Radiation Area	6.0, 08/31/09

VOLUME 26A6642BT

B 2.0	SAFETY LIMITS (SLs)	
B 2.1.1	Reactor Core SLs	8.0, 10/01/10
B 2.1.2	Reactor Coolant System (RCS) Pressure SL	5.0, 05/31/08
B 3.0	LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY	8.0, 10/01/10
B 3.0	SURVEILLANCE REQUIREMENT (SR) APPLICABILITY	6.0, 08/31/09
B 3.1	REACTIVITY CONTROL SYSTEMS	
B 3.1.1	SHUTDOWN MARGIN (SDM)	8.0, 10/01/10
B 3.1.2	Reactivity Anomalies	2.0, 12/22/06
B 3.1.3	Control Rod OPERABILITY	8.0, 10/01/10
B 3.1.4	Control Rod Scram Times	6.0, 08/31/09
B 3.1.5	Control Rod Scram Accumulators	6.0, 08/31/09
B 3.1.6	Rod Pattern Control	6.0, 08/31/09
B 3.1.7	Standby Liquid Control (SLC) System	6.0, 08/31/09
B 3.2	POWER DISTRIBUTION LIMITS	
B 3.2.1	LINEAR HEAT GENERATION RATE (LHGR)	6.0, 08/31/09
B 3.2.2	MINIMUM CRITICAL POWER RATIO (MCPR)	8.0, 10/01/10
B 3.3	INSTRUMENTATION	
B 3.3.1.1	Reactor Protection System (RPS) Instrumentation	6.0, 08/31/09
B 3.3.1.2	Reactor Protection System (RPS) Actuation	6.0, 08/31/09
B 3.3.1.3	Reactor Protection System (RPS) Manual Actuation	6.0, 08/31/09
B 3.3.1.4	Neutron Monitoring System (NMS) Instrumentation	6.0, 08/31/09
B 3.3.1.5	Neutron Monitoring System (NMS) Automatic Actuation	6.0, 08/31/09
B 3.3.1.6	Startup Range Neutron Monitor (SRNM) Instrumentation	6.0, 08/31/09
B 3.3.2.1	Control Rod Block Instrumentation	6.0, 08/31/09
B 3.3.3.1	Remote Shutdown System	6.0, 08/31/09
B 3.3.3.2	Post-Accident Monitoring (PAM) Instrumentation	7.0, 03/10/10
B 3.3.4.1	Reactor Coolant System (RCS) Leakage Detection Instrumentation	6.0, 08/31/09
B 3.3.5.1	Emergency Core Cooling System (ECCS) Instrumentation	7.0, 03/10/10
B 3.3.5.2	Emergency Core Cooling System (ECCS) Actuation	7.0, 03/10/10
B 3.3.5.3	Isolation Condenser System (ICS) Instrumentation	8.0, 10/01/10
B 3.3.5.4	Isolation Condenser System (ICS) Actuation	8.0, 10/01/10
B 3.3.6.1	Main Steam Isolation Valve (MSIV) Instrumentation	7.0, 03/10/10
B 3.3.6.2	Main Steam Isolation Valve (MSIV) Actuation	8.0, 10/01/10
B 3.3.6.3	Isolation Instrumentation	8.0, 10/01/10
B 3.3.6.4	Isolation Actuation	8.0, 10/01/10
B 3.3.7.1	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS) Instrumentation	6.0, 08/31/09
B 3.3.7.2	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS) Actuation	8.0, 10/01/10
B 3.3.8.1	Diverse Protection System (DPS)	8.0, 10/01/10

B 3.4	REACTOR COOLANT SYSTEM (RCS)	
B 3.4.1	Safety Relief Valves (SRVs)	6.0, 08/31/09
B 3.4.2	RCS Operational LEAKAGE	5.0, 05/31/08
B 3.4.3	RCS Specific Activity.....	5.0, 05/31/08
B 3.4.4	RCS Pressure and Temperature (P/T) Limits	7.0, 03/10/10
B 3.4.5	Reactor Steam Dome Pressure	5.0, 05/31/08
B 3.5	EMERGENCY CORE COOLING SYSTEMS (ECCS)	
B 3.5.1	Automatic Depressurization System (ADS) - Operating	6.0, 08/31/09
B 3.5.2	Gravity-Driven Cooling System (GDCS) - Operating.....	8.0, 10/01/10
B 3.5.3	Gravity-Driven Cooling System (GDCS) - Shutdown	8.0, 10/01/10
B 3.5.4	Isolation Condenser System (ICS) - Operating	8.0, 10/01/10
B 3.5.5	Isolation Condenser System (ICS) - Shutdown	8.0, 10/01/10
B 3.6	CONTAINMENT SYSTEMS	
B 3.6.1.1	Containment.....	6.0, 08/31/09
B 3.6.1.2	Containment Air Lock	6.0, 08/31/09
B 3.6.1.3	Containment Isolation Valves (CIVs).....	8.0, 10/01/10
B 3.6.1.4	Drywell Pressure	6.0, 08/31/09
B 3.6.1.5	Drywell Air Temperature.....	5.0, 05/31/08
B 3.6.1.6	Wetwell-to-Drywell Vacuum Breakers	6.0, 08/31/09
B 3.6.1.7	Passive Containment Cooling System (PCCS).....	8.0, 10/01/10
B 3.6.1.8	Containment Oxygen Concentration.....	5.0, 05/31/08
B 3.6.2.1	Suppression Pool Average Temperature.....	5.0, 05/31/08
B 3.6.2.2	Suppression Pool Water Level.....	6.0, 08/31/09
B 3.6.3.1	Reactor Building (Contaminated Area Ventilation Subsystem (CONAVS) Area)	7.0, 03/10/10
B 3.7	PLANT SYSTEMS	
B 3.7.1	Isolation Condenser/Passive Containment Cooling System (IC/PCCS) Pools.....	8.0, 10/01/10
B 3.7.2	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS).....	6.0, 08/31/09
B 3.7.3	Main Condenser Offgas	7.0, 03/10/10
B 3.7.4	Main Turbine Bypass System	6.0, 08/31/09
B 3.7.5	Fuel Pool Water Level and Temperature	8.0, 10/01/10
B 3.7.6	Selected Control Rod Run-In (SCRRI) and Select Rod Insert (SRI) Functions	5.0, 05/31/08
B 3.8	ELECTRICAL POWER	
B 3.8.1	DC Sources - Operating	6.0, 08/31/09
B 3.8.2	DC Sources - Shutdown.....	6.0, 08/31/09
B 3.8.3	Battery Parameters	7.0, 03/10/10
B 3.8.4	Inverters - Operating.....	6.0, 08/31/09
B 3.8.5	Inverters - Shutdown.....	6.0, 08/31/09
B 3.8.6	Distribution Systems - Operating.....	6.0, 08/31/09
B 3.8.7	Distribution Systems - Shutdown	6.0, 08/31/09

B 3.9	REFUELING OPERATIONS	
B 3.9.1	Refueling Equipment Interlocks	5.0, 05/31/08
B 3.9.2	Refuel Position One-Rod/Rod-Pair-Out Interlock	7.0, 03/10/10
B 3.9.3	Control Rod Position	1.0, 02/28/06
B 3.9.4	Control Rod Position Indication	5.0, 05/31/08
B 3.9.5	Control Rod OPERABILITY - Refueling	6.0, 08/31/09
B 3.9.6	Reactor Pressure Vessel (RPV) Water Level.....	6.0, 08/31/09
B 3.9.7	Decay Time.....	5.0, 05/31/08
B 3.10	SPECIAL OPERATIONS	
B 3.10.1	Inservice Leak and Hydrostatic Testing Operation.....	6.0, 08/31/09
B 3.10.2	Reactor Mode Switch Interlock Testing	6.0, 08/31/09
B 3.10.3	Control Rod Withdrawal - Hot / Stable Shutdown	5.0, 05/31/08
B 3.10.4	Control Rod Withdrawal - Cold Shutdown	6.0, 08/31/09
B 3.10.5	Control Rod Drive (CRD) Removal Refueling.....	5.0, 05/31/08
B 3.10.6	Multiple Control Rod Withdrawal - Refueling.....	1.0, 02/28/06
B 3.10.7	Control Rod Testing - Operating	6.0, 08/31/09
B 3.10.8	SHUTDOWN MARGIN (SDM) Test - Refueling	6.0, 08/31/09
B 3.10.9	Oxygen Concentration - Startup Test Program.....	5.0, 05/31/08
B 3.10.10	Oscillation Power Range Monitor (OPRM) - Initial Cycle	6.0, 08/31/09

VOLUME 26A6642BW

17. Quality Assurance	17.0-1
17.0 Introduction	17.0-1
17.0.1 COL Information	17.0-2
17.0.2 References	17.0-2
17.1 Quality Assurance During Design	17.1-1
17.1.1 Organization	17.1-1
17.1.2 Quality Assurance Program	17.1-1
17.1.3 Design Control and Verification	17.1-1
17.1.4 Procurement Document Control	17.1-1
17.1.5 Instructions, Procedures, and Drawings	17.1-1
17.1.6 Document Control	17.1-1
17.1.7 Control of Purchased Material, Equipment, and Services	17.1-2
17.1.8 Identification and Control of Materials, Parts, and Components	17.1-2
17.1.9 Control of Special Processes	17.1-2
17.1.10 Inspection	17.1-2
17.1.11 Test Control	17.1-2
17.1.12 Control of Measuring and Test Equipment	17.1-2
17.1.13 Handling, Storage and Shipping	17.1-2
17.1.14 Inspection, Test, and Operating Status	17.1-2
17.1.15 Nonconforming Materials, Parts, or Components	17.1-2
17.1.16 Corrective Action	17.1-3
17.1.17 Quality Assurance Records	17.1-3
17.1.18 Audits	17.1-3
17.1.19 Training and Qualification Criteria – Quality Assurance	17.1-3
17.1.20 Training and Qualification – Inspection and Test	17.1-3
17.1.21 QA Program Commitments	17.1-3
17.1.22 Nonsafety-Related SSC Quality Controls	17.1-3
17.1.23 Independent Review	17.1-3
17.1.24 COL Information	17.1-3
17.1.25 References	17.1-4
17.2 Quality Assurance During Construction and Operations	17.2-1
17.2.1 COL Information	17.2-1
17.2.2 References	17.2-1
17.3 Quality Assurance Program Description	17.3-1
17.3.1 COL Information	17.3-1
17.3.2 References	17.3-1
17.4 Reliability Assurance Program During Design Phase	17.4-1
17.4.1 Introduction	17.4-1
17.4.2 Scope	17.4-2
17.4.3 Purpose	17.4-3
17.4.4 Objective	17.4-3
17.4.5 GEH Organization for D-RAP	17.4-3
17.4.6 SSC Identification/Prioritization	17.4-4

17.4.7 Design Considerations	17.4-5
17.4.8 Defining Failure Modes	17.4-5
17.4.9 Operational Reliability Assurance Activities.....	17.4-6
17.4.10 Owner/Operator's Reliability Assurance Program	17.4-6
17.4.11 D-RAP Implementation – Example Case.....	17.4-7
17.4.11.1 System Description.....	17.4-7
17.4.11.2 Identifying Risk Information	17.4-8
17.4.11.3 Failure Mode Identification	17.4-8
17.4.11.4 Identification of Maintenance Requirements.....	17.4-9
17.4.12 Glossary of Terms	17.4-9
17.4.13 COL Information	17.4-10
17.4.14 References	17.4-10

VOLUME 26A6642BX

18. Human Factors Engineering	18.1-1
18.1 Overview	18.1-1
18.1.1 Design Goals and Design Bases.....	18.1-4
18.1.2 Planning, Development, and Design	18.1-5
18.1.2.1 Standard Design Features	18.1-6
18.1.2.2 Inventory of Controls and Instrumentation.....	18.1-6
18.1.2.3 Detailed Design Implementation Process	18.1-6
18.1.3 Control Room Standard Design Features.....	18.1-6
18.1.4 Remote Shutdown System	18.1-6
18.1.5 Systems Integration	18.1-7
18.1.5.1 Safety-Related Systems	18.1-7
18.1.5.2 Nonsafety-Related Systems	18.1-7
18.1.6 Detailed Design of the Operator Interface System.....	18.1-8
18.1.7 COL Information.....	18.1-8
18.1.8 References	18.1-8
18.2 MMIS and HFE Program Management	18.2-1
18.2.1 HFE Program and MMIS and HFE Implementation Plan.....	18.2-1
18.2.2 MMIS and HFE Implementation Plan	18.2-1
18.2.3 Human Factors Engineering Design Team Composition	18.2-4
18.2.4 COL Information	18.2-6
18.2.5 References.....	18.2-7
18.3 Operating Experience Review	18.3-1
18.3.1 Objectives and Scope of Operating Experience Review	18.3-1
18.3.2 Operating Experience Review Methodology.....	18.3-1
18.3.2.1 Predecessor Plants and Systems.....	18.3-2
18.3.2.2 Risk-Important Human Actions.....	18.3-2
18.3.2.3 Human Factors Engineering Technology	18.3-2
18.3.2.4 Recognized Industry Issues.....	18.3-2
18.3.2.5 Issues Identified by Plant Personnel	18.3-3
18.3.2.6 Issue Analysis, Tracking, and Review	18.3-3
18.3.3 Results of Operating Experience Review	18.3-3
18.3.4 COL Information	18.3-3
18.3.5 References.....	18.3-4
18.4 Functional Requirements Analysis and Allocation of Functions	18.4-1
18.4.1 Functional Requirements Analysis Implementation Plan.....	18.4-1
18.4.1.1 Scope of Functional Requirements Analysis	18.4-1
18.4.1.2 Methods of Functional Requirements Analysis.....	18.4-1
18.4.1.3 Results of Functional Requirements Analysis	18.4-2
18.4.2 Allocation of Functions Implementation Plan.....	18.4-2
18.4.2.1 Scope of Allocation of Functions	18.4-2
18.4.2.2 Methods of Allocation of Functions	18.4-2
18.4.2.3 Results of Allocation of Functions	18.4-3
18.4.3 COL Information.....	18.4-3
18.4.4 References	18.4-3

18.5 Task Analysis	18.5-1
18.5.1 MCR and RSS Minimum Inventory HSI Determination	18.5-1
18.5.1.1 Assumptions.....	18.5-1
18.5.1.2 Process	18.5-2
18.5.2 Task Analysis Implementation Plan - Detailed Design	18.5-4
18.5.2.1 Scope of Task Analysis.....	18.5-4
18.5.2.2 Methods of Task Analysis	18.5-5
18.5.2.3 Results of Task Analysis.....	18.5-5
18.5.3 COL Information.....	18.5-5
18.5.4 References	18.5-5
18.6 Staffing and Qualifications.....	18.6-1
18.6.1 Background.....	18.6-1
18.6.2 Objectives and Scope of Staffing and Qualifications Analyses.....	18.6-1
18.6.3 ESBWR Baseline Staffing Assumptions	18.6-1
18.6.4 Staffing and Qualifications Plan	18.6-1
18.6.4.1 Operating Experience Review	18.6-1
18.6.4.2 Functional Requirements Analysis and Function Allocation	18.6-2
18.6.4.3 Task Analysis.....	18.6-2
18.6.4.4 Human Reliability Analysis.....	18.6-2
18.6.4.5 Human-System Interface Design	18.6-3
18.6.4.6 Procedure Development.....	18.6-3
18.6.4.7 Training Program Development	18.6-3
18.6.5 Methodology of Staffing and Qualifications Analyses	18.6-3
18.6.6 Results of Staffing and Qualifications Analyses	18.6-3
18.6.7 COL Information.....	18.6-3
18.6.8 References	18.6-4
18.7 Human Reliability Analysis	18.7-1
18.7.1 Objectives and Scope of Human Reliability Analysis	18.7-1
18.7.2 Methodology of Human Reliability Analysis.....	18.7-1
18.7.3 Results of Human Reliability Analysis	18.7-2
18.7.4 COL Information.....	18.7-2
18.7.5 References	18.7-2
18.8 Human-System Interface Design.....	18.8-1
18.8.1 Human-System Interface Design Implementation Plan	18.8-1
18.8.2 Results of Human-System Interface Design.....	18.8-2
18.8.3 COL Information	18.8-2
18.8.4 References	18.8-2
18.9 Procedure Development	18.9-1
18.9.1 Objectives and Scope of Procedure Development.....	18.9-1
18.9.2 Methodology of Procedure Development.....	18.9-2
18.9.3 Results of Procedure Development.....	18.9-2
18.9.4 COL Information	18.9-3
18.9.5 References.....	18.9-3
18.10 Training Program Development.....	18.10-1
18.10.1 Purpose	18.10-1

18.10.2 Scope of Training Program Development.....	18.10-1
18.10.3 Methodology of Training Program Development.....	18.10-1
18.10.4 Elements for Training Program Development	18.10-2
18.10.4.1 General Approach	18.10-2
18.10.4.2 Organization of Training.....	18.10-3
18.10.4.3 Learning Objectives	18.10-3
18.10.4.4 Content of Training Program	18.10-4
18.10.4.5 Evaluation and Modification of Training	18.10-5
18.10.4.6 Periodic Retraining	18.10-5
18.10.5 Results of Training Program Development.....	18.10-5
18.10.6 COL Information	18.10-5
18.10.7 References	18.10-5
18.11 Human Factors Verification and Validation.....	18.11-1
18.11.1 Human Factors Verification and Validation Implementation	18.11-1
18.11.2 Results of Human Factors Verification and Validation.....	18.11-2
18.11.3 COL Information	18.11-2
18.11.4 References	18.11-2
18.12 Design Implementation	18.12-1
18.12.1 Objectives and Scope of Design Implementation.....	18.12-1
18.12.2 Methodology of Design Implementation.....	18.12-1
18.12.2.1 Human-System Interface Verification (As-Built).....	18.12-1
18.12.2.2 Procedures and Training Confirmation (As-Built)	18.12-2
18.12.2.3 Final HFE Design Verification Not Performed in the Simulated HFE V&V Activity	18.12-2
18.12.2.4 Resolution of Remaining HEDs and Open Issues and Transfer of HFEITS.....	18.12-2
18.12.3 Results of Design Implementation.....	18.12-2
18.12.4 COL Information.....	18.12-2
18.12.5 References	18.12-2
18.13 Human Performance Monitoring.....	18.13-1
18.13.1 Purpose	18.13-1
18.13.2 Human Performance Monitoring Strategy Development.....	18.13-1
18.13.3 Elements of Human Performance Monitoring Process	18.13-2
18.13.4 Results of Human Performance Monitoring	18.13-3
18.13.5 COL Information	18.13-3
18.13.6 References	18.13-3

VOLUME 26A6642BY

19.1 INTRODUCTION	19.1-1
19.1.1 Regulatory Requirements for PRA and Severe Accidents	19.1-1
19.1.2 Objectives	19.1-2
19.1.3 Report Structure	19.1-3
19.1.4 COL Information	19.1-4
19.1.5 References	19.1-4
19.2 PRA RESULTS AND INSIGHTS	19.2-1
19.2.1 Introduction	19.2-1
19.2.2 Uses of PRA	19.2-2
19.2.2.1 Design Phase	19.2-2
19.2.2.2 COL Application Phase	19.2-4
19.2.2.3 Construction Phase	19.2-4
19.2.2.4 Operational Phase	19.2-4
19.2.3 Evaluation of Full Power Operations	19.2-5
19.2.3.1 Risk from Internal Events	19.2-5
19.2.3.2 Risk from External Events Evaluation of External Event Fire	19.2-12
19.2.4 Evaluation of Other Modes of Operation – Shutdown	19.2-16
19.2.4.1 Significant Core Damage Sequences During Shutdown Mode	19.2-16
19.2.4.2 Significant Large Release Sequences of Shutdown Mode	19.2-18
19.2.4.3 Significant Offsite Consequences of Shutdown Mode	19.2-18
19.2.4.4 Summary of Important Results and Insights of Shutdown Mode	19.2-18
19.2.5 Summary of Overall Plant Risk Results and Insights	19.2-18
19.2.6 COL Information	19.2-19
19.2.7 References	19.2-19
19.3 SEVERE ACCIDENT EVALUATIONS	19.3-1
19.3.1 Severe Accident Preventive Features	19.3-1
19.3.1.1 Anticipated Transients Without Scram (ATWS)	19.3-1
19.3.1.2 Mid-Loop Operation	19.3-1
19.3.1.3 Station Blackout	19.3-1
19.3.1.4 Fire Protection	19.3-2
19.3.1.5 Intersystem Loss-of-Coolant Accident	19.3-2
19.3.1.6 Fire Water Addition System	19.3-2
19.3.1.7 Vessel Depressurization	19.3-2
19.3.1.8 Isolation Condenser System	19.3-2
19.3.2 Severe Accident Mitigative Features	19.3-3
19.3.2.1 Hydrogen Generation and Control	19.3-3
19.3.2.2 Core Debris Coolability	19.3-6
19.3.2.3 High-Pressure Core Melt Ejection	19.3-6
19.3.2.4 Containment Performance	19.3-7
19.3.2.5 GDCS Deluge Subsystem	19.3-8
19.3.2.6 Basemat Internal Melt Arrest and Coolability Device (BiMAC)	19.3-9
19.3.2.7 Containment Isolation	19.3-10
19.3.3 Containment Vent Penetration	19.3-10
19.3.4 Equipment Survivability Analysis	19.3-10
19.3.4.1 Functional Requirements During Severe Accident	19.3-11
19.3.4.2 Equipment Required for Severe Accident Mitigation	19.3-12
19.3.4.3 Severe Accident Environment	19.3-13

19.3.4.4 Equipment Capability	19.3-14
19.3.4.5 Summary	19.3-15
19.3.5 Improvements in Reliability of Core and Containment Heat Removal Systems	19.3-15
19.3.5.1 Core Heat Removal System Reliability Improvements	19.3-15
19.3.5.2 Containment Heat Removal System Reliability Improvements	19.3-15
19.3.6 COL Information	19.3-16
19.3.7 References	19.3-16
19.4 PRA MAINTENANCE	19.4-1
19.4.1 PRA Design Controls	19.4-1
19.4.2 PRA Maintenance and Update Program	19.4-1
19.4.3 Description of Significant Plant, Operational, and Modeling Changes	19.4-3
19.4.3.1 Design Phase Changes	19.4-3
19.4.3.2 COL Application Phase Changes	19.4-3
19.4.3.3 Construction Phase Changes	19.4-3
19.4.3.4 Operational Update Phase Changes	19.4-3
19.4.4 COL Information	19.4-3
19.4.5 References	19.4-3
19.5 CONCLUSIONS	19.5-1
19.5.1 COL Information	19.5-1
19.5.2 References	19.5-1
19A.1 Introduction	19A-1
19A.2 Criterion A: Beyond Design Basis Events Assessment	19A-2
19A.2.1 ATWS Assessment	19A-2
19A.2.2 Station Blackout Assessment	19A-3
19A.3 Criterion B: Long-Term Safety Assessment	19A-3
19A.3.1 Actions Required Beyond 72 Hours	19A-3
19A.3.1.1 Core Cooling	19A-4
19A.3.1.2 Containment Integrity	19A-5
19A.3.1.3 Control Room Habitability	19A-6
19A.3.1.4 Post-Accident Monitoring	19A-6
19A.3.2 Seismic Assessment	19A-7
19A.3.3 Summary of RTNSS Findings for Criterion B	19A-7
19A.4 Criterion C: PRA Mitigating Systems Assessment	19A-7
19A.4.1 Focused PRA Sensitivity Study	19A-8
19A.4.2 Assessment of Uncertainties	19A-9
19A.4.3 PRA Initiating Events Assessment	19A-10
19A.4.3.1 At-Power Generic Transients	19A-10
19A.4.3.2 At-Power Inadvertent Opening of a Relief Valve	19A-10
19A.4.3.3 At-Power Transient with Loss of Feedwater	19A-10
19A.4.3.4 At-Power Loss of Preferred Power	19A-11
19A.4.3.5 At-Power LOCA	19A-11
19A.4.3.6 Shutdown Loss of Preferred Power	19A-11
19A.4.3.7 Loss of Shutdown Cooling	19A-12
19A.4.3.8 Shutdown LOCA	19A-12
19A.4.4 Summary of RTNSS Candidates from Criterion C	19A-13
19A.5 Criterion D: Containment Performance Assessment	19A-13
19A.6 Criterion E: Assessment Of Significant Adverse Interactions	19A-14
19A.6.1 Systematic Approach	19A-14
19A.6.1.1 Gravity Driven Cooling System	19A-14

19A.6.1.2 Automatic Depressurization System (ADS).....	19A-16
19A.6.1.3 Isolation Condenser System (ICS)	19A-16
19A.6.1.4 Standby Liquid Control System (SLC)	19A-18
19A.6.1.5 Passive Containment Cooling System (PCCS)	19A-19
19A.6.2 Further Assessment of Potential Adverse System Interactions.....	19A-19
19A.6.2.1 Assessment of Potential Adverse Functional Interactions	19A-19
19A.6.2.2 Assessment of Potential Adverse Spatial Interactions	19A-20
19A.6.2.3 Assessment of Potential Adverse Operator Interface	19A-20
19A.6.2.4 Conclusion	19A-21
19A.7 Selection Of Important NonSafety-Related Systems	19A-21
19A.8 Proposed Regulatory Oversight.....	19A-21
19A.8.1 Regulatory Oversight – Availability Treatment	19A-21
19A.8.2 Reliability Assurance.....	19A-22
19A.8.3 Augmented Design Standards	19A-22
19A.8.4 Regulatory Treatment.....	19A-24
19A.8.4.1 Nonsafety-Related ATWS Actuation Logic.....	19A-24
19A.8.4.2 FPS Pool Cooling Makeup	19A-24
19A.8.4.3 Diverse Protection System	19A-24
19A.8.4.4 Post-Accident Monitoring	19A-25
19A.8.4.5 Basemat Internal Melt Arrest and Coolability System and GDCS Deluge Lines	19A-25
19A.8.4.6 Nonsafety-Related Distributed Control and Information System	19A-25
19A.8.4.7 Fuel and Auxiliary Pools Cooling System	19A-26
19A.8.4.8 AC Power System.....	19A-26
19A.8.4.9 Component Cooling – HVAC, Cooling Water, Chilled Water, and Plant Service Water	19A-26
19A.8.4.10 Long-Term Containment Integrity	19A-27
19A.8.4.11 Reactor Building HVAC Purge Exhaust Filters	19A-27
19A.8.4.12 Lower Drywell Hatches.....	19A-28
19A.8.4.13 Standby Liquid Control System Actuation/Feedwater Runback Logic	19A-28
19A.8.4.14 Control Room Habitability – Long-Term Cooling.....	19A-28
19A.8.5 COL Information	19A-28
19A.8.6 References	19A-28
19 ACM Availability Controls Manual	19 ACM-I
19B DETERMINISTIC ANALYSIS FOR CONTAINMENT PRESSURE CAPABILITY..	19B-1
19B.1 Introduction.....	19B-1
19B.2 RCCV and Liners.....	19B-2
19B.2.1 Analysis Methods	19B-2
19B.2.2 Model Description	19B-2
19B.2.3 Analysis Results.....	19B-3
19B.2.4 Summary.....	19B-4
19B.3 Drywell Head.....	19B-6
19B.3.1 Buckling Analysis.....	19B-6
19B.4 Hatches and Airlocks	19B-9
19B.5 Penetrations.....	19B-10
19B.6 PCCS Heat Exchangers	19B-11

19B.7 Summary	19B-12
19B.8 References	19B-13
19C PROBABILISTIC ANALYSIS FOR CONTAINMENT PRESSURE FRAGILITY	19C-1
19C.1 Introduction.....	19C-1
19C.1.1 Analysis Methods	19C-2
19C.1.2 Thermal Conditions	19C-3
19C.1.3 Material Properties.....	19C-3
19C.1.4 Failure Criteria.....	19C-4
19C.1.5 Modeling Uncertainty	19C-5
19C.2 RCCV and Liners.....	19C-7
19C.2.1 Model Description	19C-7
19C.2.2 Median Capacity Analysis.....	19C-7
19C.2.3 Evaluation for Uncertainty.....	19C-8
19C.2.4 Variation with Temperature.....	19C-8
19C.2.5 Summary	19C-8
19C.3 Drywell Head.....	19C-10
19C.3.1 Model Description	19C-10
19C.3.2 Median Capacity Analysis.....	19C-10
19C.3.3 Evaluation for Uncertainty.....	19C-10
19C.3.4 Variation with Temperature.....	19C-11
19C.3.5 Summary	19C-11
19C.4 Equipment Hatches	19C-12
19C.4.1 Model Description	19C-12
19C.4.2 Median Capacity Analysis.....	19C-12
19C.4.3 Evaluation for Uncertainty.....	19C-13
19C.4.4 Variation with Temperature.....	19C-13
19C.4.5 Summary	19C-14
19C.5 Pressure Fragility Summary.....	19C-15
19C.6 References.....	19C-16
19D ASSESSMENT OF MALEVOLENT AIRCRAFT IMPACT	19D-1
19D.1 Introduction and Background	19D-1
19D.2 Scope of the Assessment	19D-1
19D.3 Assessment methodology	19D-2
19D.4 Results of Assessment	19D-2
19D.4.2 Site Arrangement and Plant Structural Design.....	19D-2
19D.4.3 Fire Barriers and Fire Protection Features.....	19D-3
19D.4.4 Core Cooling Features	19D-4
19D.4.5 Spent Fuel Pool Cooling.....	19D-4
19D.4.6 Spent Fuel Pool Integrity.....	19D-4
19D.5 Conclusions of Assessment	19D-4
19D.6 References	19D-5

List of Tables

VOLUME 26A6642AD

Table 1.3-1 Comparison of Reactor System Design Characteristics	1.3-2
Table 1.3-2 Comparison of Emergency Core Cooling Systems and Safety-Related Containment Cooling Systems	1.3-9
Table 1.3-3 Comparison of Containment Design Characteristics	1.3-11
Table 1.3-4 Comparison of Structural Design Characteristics	1.3-13
Table 1.4-1 Commercial Nuclear Reactors Completed and Under Construction By GE/GEH	1.4-1
Table 1.5-1 Evolution of the GE/GEH BWR	1.5-10
Table 1.5-2 ESBWR Features and Related Experience	1.5-11
Table 1.6-1 GE / GEH Reports Incorporated By Reference	1.6-2
Table 1.6-2 Non-GE / GEH Reports Incorporated By Reference	1.6-12
Table 1.6-3 Referenced Reports (not Incorporated By Reference)	1.6-13
Table 1.7-1 Piping Designations and Specifications for DCD Drawings	1.7-3
Table 1.7-2 Summary of Electrical/I&C System Configuration Drawings	1.7-7
Table 1.7-3 Summary of Mechanical System Configuration Drawings	1.7-9
Table 1.8-1 Matrix of NSSS Interfaces	1.8-3
Table 1.8-2 Matrix of BOP Interfaces	1.8-5
Table 1.9-1 Summary of Differences from SRP Section 1	1.9-3
Table 1.9-2 Summary of Differences from SRP Section 2	1.9-4
Table 1.9-3 Summary of Differences from SRP Section 3	1.9-5
Table 1.9-4 Summary of Differences from SRP Section 4	1.9-7
Table 1.9-5 Summary of Differences from SRP Section 5	1.9-8
Table 1.9-6 Summary of Differences from SRP Section 6	1.9-10
Table 1.9-7 Summary of Differences from SRP Section 7	1.9-13
Table 1.9-8 Summary of Differences from SRP Section 8	1.9-15
Table 1.9-9 Summary of Differences from SRP Section 9	1.9-19
Table 1.9-10 Summary of Differences from SRP Section 10	1.9-27
Table 1.9-11 Summary of Differences from SRP Section 11	1.9-32
Table 1.9-12 Summary of Differences from SRP Section 12	1.9-33
Table 1.9-13 Summary of Differences from SRP Section 13	1.9-34
Table 1.9-14 Summary of Differences from SRP Section 14	1.9-35
Table 1.9-15 Summary of Differences from SRP Section 15	1.9-36
Table 1.9-16 Summary of Differences from SRP Section 16	1.9-39
Table 1.9-17 Summary of Differences from SRP Section 17	1.9-40
Table 1.9-18 Summary of Differences from SRP Section 18	1.9-41
Table 1.9-19 Summary of Differences from SRP Section 19	1.9-42
Table 1.9-20 NRC Standard Review Plans and Branch Technical Positions Applicability to ESBWR	1.9-43
Table 1.9-21 NRC Regulatory Guides Applicability to ESBWR	1.9-69
Table 1.9-21a EPRI Intent and Optimization Topics	1.9-95
Table 1.9-21b ESBWR Compliance with Quality Related Regulatory Guides	1.9-98
Table 1.9-22 Industrial Codes and Standards Applicable to ESBWR	1.9-100
Table 1.9-23 NUREGs Referenced in ESBWR DCD	1.9-131
Table 1.10-1 Summary of COL Items	1.10-2

Table 1.11-1 Resolutions To NUREG-0933 Table II Task Action Plan Items, New Generic Issues, Human Factors Issues and Chernobyl Issues.....	1.11-2
--	--------

VOLUME 26A6642AF

Table 1A-1 TMI Action Plan Items.....	1A-2
Table 1B-1 Radiation Source Comparison.....	1B-9
Table 1B-2 Post-Accident Emergency Core Cooling Systems and Auxiliaries.....	1B-10
Table 1B-3 Post-Accident Containment Systems and Auxiliaries.....	1B-11
Table 1B-4 Post-Accident Fission Product Removal and Control Systems and Auxiliaries	1B-12
Table 1B-5 Post-Accident Instrumentation and Controls, Power and Habitability Systems and Auxiliaries.....	1B-13
Table 1C-1 Operating Experience Review Results Summary – Generic Letters.....	1C-2
Table 1C-2 Operating Experience Review Results Summary – IE Bulletins	1C-14
Table 1D-1 Summary of Tier 2* Information	1D-3

VOLUME 26A6642AH

Table 2.0-1 Envelope of ESBWR Standard Plant Site Parameters	2.0-4
Table 2.0-2 Limits Imposed on Acceptance Criteria in Section II of SRP by ESBWR Design	2.0-13
Table 2A-1 ARCON96 Assumed Inputs Used for the Determination of On-Site X/Q Values	2A-4
Table 2A-2 Onsite Receptor/Source Locations	2A-5
Table 2A-3 ARCON96 Design Inputs Used for the Determination of On-Site X/Q Values	2A-6
Table 2A-4 ARCON96 Direction Design Inputs Used for the Determination of On-Site X/Q Values	2A-9
Table 2B-1 Ventilation Stack Parameters	2B-2

VOLUME 26A6642AJ

Table 3.2-1 Classification Summary.....	3.2-9
Table 3.2-2 Minimum Safety Class Requirements.....	3.2-53
Table 3.2-3 Quality Group Designations – Codes and Industry Standards.....	3.2-54
Table 3.4-1 Structures, Penetrations and Access Openings Designed for Flood Protection....	3.4-9
Table 3.5-1 Requirement for the Probability of Missile Generation for ESBWR Standard Plant	3.5-12
Table 3.6-1 Safety-Related Systems, Components, and Equipment for Postulated Pipe Failures Inside Containment	3.6-27
Table 3.6-2 Safety-Related Systems, Components, and Equipment for Postulated Pipe Failures Outside Containment.....	3.6-28
Table 3.6-3 High and Moderate Energy Piping Inside Containment.....	3.6-29
Table 3.6-4 High and Moderate Energy Piping Outside Containment.....	3.6-30
Table 3.6-5 Terminal Pipe End Breaks at RPV Nozzles – High Energy Piping Systems.....	3.6-31
Table 3.6-6 Terminal Pipe End Breaks Outside Containment – High Energy Piping Systems	3.6-33
Table 3.6-7 Terminal End Breaks at Containment Penetrations (Inside and Outside the Drywell)	3.6-35
Table 3.7-1 Damping Values for SSE Dynamic Analysis.....	3.7-38
[Table 3.7-2 5%-Damped Target Spectra of Single Envelope Design Ground Motion at Foundation Level	3.7-39
[Table 3.7-3 Summary of Methods of Seismic Analysis for Primary Building Structures.....	3.7-40
[Table 3.8-1 Key Dimensions of Concrete Containment	3.8-51
[Table 3.8-2 Load Combinations, Load Factors and Acceptance Criteria for the Reinforced Concrete Containment ^{(1),(2),(3),(7)}	3.8-52
[Table 3.8-3 Major Allowable Stresses in Concrete and Reinforcing Steel	3.8-53
[Table 3.8-4 Load Combination, Load Factors and Acceptance Criteria for Steel Containment Components of the RCCV ^{(1), (2), (3)}	3.8-54
[Table 3.8-5 Welding Activities and Weld Examination Requirements for Containment Vessel	3.8-56
Table 3.8-6 Codes, Standards, Specifications, and Regulations Used in the Design and Construction of Seismic Category I Internal Structures of the Containment... 3.8-57	
[Table 3.8-7 Load Combination, Load Factors and Acceptance Criteria for Steel Structures Inside the Containment ^{(1),(2)}	3.8-59
[Table 3.8-8 Key Dimensions of RB, CB, FB, RW and FWSC	3.8-60
Table 3.8-9 Codes, Standards, Specifications, and Regulatory Guides Used in the Design and Construction of Seismic Category I Structures	3.8-61
[Table 3.8-10 Temperatures During Operating Conditions (RB)	3.8-63
[Table 3.8-11 Temperatures During Operating Conditions (CB)	3.8-64
[Table 3.8-12 Temperatures During Operating Conditions (FB)	3.8-65
[Table 3.8-13 Key Dimensions of Foundations	3.8-66
[Table 3.8-14 Load Combinations and Factor of Safety for Foundation Design.....	3.8-67
[Table 3.8-15 Load Combinations, Load Factors and Acceptance Criteria for the Safety-Related Reinforced Concrete Structures ^{(1),(2),(3)}	3.8-68

[Table 3.8-16 Load Combinations, Load Factors and Acceptance Criteria for the Safety-Related Steel Structures ^{(1),(2),(3)}	3.8-69
Table 3.8-17 PCCS Passages Through RCCV Top Slab	3.8-70
[Table 3.8-18 Temperatures During Operating Conditions (FWSC)	3.8-71

VOLUME 26A6642AK

Table 3.9-1 Plant Events	3.9-63
[Table 3.9-2 <i>Load Combinations and Acceptance Criteria for Safety-Related, ASME B&PV Code Class 1, 2 and 3 Components, Component Supports, and Class CS Structures</i>	3.9-65
Table 3.9-3 Pressure Differentials Across Reactor Vessel Internals	3.9-69
Table 3.9-4 Deformation Limit for Safety Class Reactor Internal Structures Only	3.9-70
Table 3.9-5 Primary Stress Limit for Safety Class Reactor Internal Structures Only	3.9-71
Table 3.9-6 Buckling Stability Limit for Safety Class Reactor Internal Structures Only	3.9-73
Table 3.9-7 Fatigue Limit for Safety Class Reactor Internal Structures Only	3.9-74
Table 3.9-8 Inservice Testing	3.9-75
[Table 3.9-9 <i>Load Combinations and Acceptance Criteria for Class 1 Piping Systems</i>	3.9-113
[Table 3.9-10 <i>Snubber Loads</i>	3.9-114
[Table 3.9-11 <i>Strut Loads</i>	3.9-115
[Table 3.9-12 <i>Linear Type (Anchor and Guide) Main Steam Piping Support</i>	3.9-116
Table 3.11-1 Electrical and Mechanical Equipment for Environmental Qualification	3.11-17

VOLUME 26A6642AL

[Table 3A.2-1 Standard ESBWR Building Dimensions	3A-4
[Table 3A.3-1 Generic Site Properties for SSI Analysis	3A-6
Table 3A.3-2 North Anna Site-specific Properties for SSI Analysis	3A-7
Table 3A.3-3 Layered Site Cases	3A-8
[Table 3A.5-1 Soil Spring and Damping Coefficient for RB/FB complex	3A-12
Table 3A.5-2 Soil Spring and Damping Coefficient for CB.....	3A-13
Table 3A.5-3 Soil Spring and Damping Coefficient for FWSC	3A-14
[Table 3A.6-1 Seismic SSI Analysis Cases	3A-18
Table 3A.7-1 Eigenvalue Analysis Results for RB/FB model at Soft Site.....	3A-23
Table 3A.7-2 Eigenvalue Analysis Results for RB/FB model at Medium Site.....	3A-24
Table 3A.7-3 Eigenvalue Analysis Results for RB/FB model at Hard Site	3A-25
Table 3A.7-4 Eigenvalue Analysis Results for RB/FB model in Fixed-base Case	3A-26
Table 3A.7-5 Eigenvalue Analysis Results for RB/FB model at Best-estimate North Anna Site.....	3A-27
Table 3A.7-6 Eigenvalue Analysis Results for RB/FB model at Upper-bound North Anna Site.....	3A-28
Table 3A.7-7 Eigenvalue Analysis Results for RB/FB model at Lower-bound North Anna Site.....	3A-29
Table 3A.7-8 Eigenvalue Analysis Results for CB Model at Soft Site	3A-30
Table 3A.7-9 Eigenvalue Analysis Results for CB Model at Medium Site	3A-31
Table 3A.7-10 Eigenvalue Analysis Results for CB Model at Hard Site.....	3A-32
Table 3A.7-11 Eigenvalue Analysis Results for CB Model in Fixed-base Case.....	3A-33
Table 3A.7-12 Eigenvalue Analysis Results for CB Model at Best-estimate North Anna Site.....	3A-34
Table 3A.7-13 Eigenvalue Analysis Results for CB Model at Upper-bound North Anna Site.....	3A-35
Table 3A.7-14 Eigenvalue Analysis Results for CB Model at Lower-bound North Anna Site.....	3A-36
Table 3A.7-15 Eigenvalue Analysis Results for FWSC Model at Soft Site.....	3A-37
Table 3A.7-16 Eigenvalue Analysis Results for FWSC Model at Medium Site.....	3A-38
Table 3A.7-17 Eigenvalue Analysis Results for FWSC Model at Hard Site	3A-39
Table 3A.7-18 Eigenvalue Analysis Results for FWSC Model in Fixed-base Case	3A-40
Table 3A.8.1-1 Maximum Forces - X Direction (RU-1 and RU-2/CU-1 and CU-2).....	3A-63
Table 3A.8.1-2 Maximum Forces - Y Direction (RU-1 and RU-2/CU-1 and CU-2).....	3A-64
Table 3A.8.1-3 Maximum Forces – X Direction (FU-1).....	3A-65
Table 3A.8.1-4 Maximum Forces – Y Direction (FU-1).....	3A-66
Table 3A.8.2-1 Maximum Forces - X Direction (RU-3/ CU-3)	3A-67
Table 3A.8.2-2 Maximum Forces - Y Direction (RU-3/ CU-3).....	3A-68
Table 3A.8.3-1 Maximum Forces - X Direction (RU-4).....	3A-69
Table 3A.8.3-2 Maximum Forces - Y Direction (RU-4).....	3A-70
Table 3A.8.4-1 Maximum Forces - X Direction (RU-5).....	3A-71
Table 3A.8.4-2 Maximum Forces - Y Direction (RU-5).....	3A-72
Table 3A.8.4-3 Maximum Forces – X Direction (RU-5a).....	3A-73
Table 3A.8.4-4 Maximum Forces – Y Direction (RU-5a).....	3A-74

Table 3A.8.5-1 Maximum Forces - X Direction (RU-6)	3A-75
Table 3A.8.5-2 Maximum Forces - Y Direction (RU-6)	3A-76
Table 3A.8.7-1 Comparisons of RB/FB Basemat Reaction Shear Force	3A-77
Table 3A.8.8-1 Lateral Soil Pressure – RB/FB.....	3A-78
Table 3A.8.8-2 Lateral Soil Pressure - CB	3A-79
Table 3A.8.10-1 Maximum Horizontal Acceleration RB/FB Wall Out-of-plane Oscillators (RU-7).....	3A-80
Table 3A.8.10-2 Maximum Horizontal Acceleration RB/FB Cracked Wall Out-of-plane Oscillators (RL-6)	3A-81
[Table 3A.9-1a Enveloping Seismic Loads: RB/FB Stick	3A-214
Table 3A.9-1b Enveloping Seismic Loads: RCCV Stick	3A-215
Table 3A.9-1c Enveloping Seismic Loads: VW/Pedestal Stick.....	3A-216
Table 3A.9-1d Enveloping Seismic Loads: RSW Stick.....	3A-217
Table 3A.9-1e Enveloping Seismic Loads: RPV Stick	3A-218
Table 3A.9-1f Enveloping Seismic Loads: CB Stick	3A-218
Table 3A.9-1g Enveloping Seismic Loads: FWS Stick.....	3A-219
Table 3A.9-1h Enveloping Seismic Loads: FPE Stick	3A-220
Table 3A.9-2a Enveloping Seismic Loads for LOCA Flooding: RB/FB Stick.....	3A-221
Table 3A.9-2b Enveloping Seismic Loads for LOCA Flooding: RCCV Stick.....	3A-222
Table 3A.9-2c Enveloping Seismic Loads for LOCA Flooding: VW/Pedestal Stick	3A-223
Table 3A.9-2d Enveloping Seismic Loads for LOCA Flooding: RSW Stick	3A-224
Table 3A.9-2e Enveloping Seismic Loads for LOCA Flooding: RPV Stick.....	3A-225
Table 3A.9-3a Enveloping Maximum Vertical Acceleration: RB/FB	3A-226
Table 3A.9-3b Enveloping Maximum Vertical Acceleration: RCCV.....	3A-226
Table 3A.9-3c Enveloping Maximum Vertical Acceleration: VW/Pedestal	3A-227
Table 3A.9-3d Enveloping Maximum Vertical Acceleration: RSW	3A-227
Table 3A.9-3e Enveloping Maximum Vertical Acceleration: RB/FB Flexible Slab Oscillators	3A-228
Table 3A.9-3f Enveloping Maximum Horizontal Acceleration: RB/FB Wall Out-of-plane Oscillators	3A-230
Table 3A.9-3g Enveloping Maximum Vertical Acceleration: CB.....	3A-231
Table 3A.9-3h Enveloping Maximum Vertical Acceleration: FWS	3A-232
Table 3A.9-3i Enveloping Maximum Vertical Acceleration: FPE	3A-232
Table 3A.9-4a Enveloping Maximum Vertical Acceleration for LOCA Flooding: RB/FB ..	3A-233
Table 3A.9-4b Enveloping Maximum Vertical Acceleration for LOCA Flooding: RCCV ..	3A-233
Table 3A.9-4c Enveloping Maximum Vertical Acceleration for LOCA Flooding: VW/Pedestal	3A-234
Table 3A.9-4d Enveloping Maximum Vertical Acceleration for LOCA Flooding: RSW	3A-234
Table 3A.9-4e Enveloping Maximum Vertical Acceleration for LOCA Flooding: RB/FB Flexible Slab Oscillators.....	3A-235
Table 3D.1-1 Computer Program User Details.....	3D-15
Table 3F-1 Maximum Accelerations for Annulus Pressurization Loadings (g)	3F-5
Table 3F-2 Maximum Accelerations for Hydrodynamic Loads (g).....	3F-5
Table 3F-3 Maximum Displacements for Annulus Pressurization Loadings (mm).....	3F-6
Table 3F-4 Maximum Displacements for Hydrodynamic Loads (mm)	3F-6

VOLUME 26A6642AN

<i>Table 3G.1-1 Soil Spring Constants for the RB Analysis Model</i>	3G-20
<i>Table 3G.1-2 Site Design Parameters</i>	3G-21
<i>Table 3G.1-3 Equipment and Hydrostatic Loads inside RCCV</i>	3G-23
<i>Table 3G.1-4 Equipment and Hydrostatic Loads in RB Pools</i>	3G-24
<i>Table 3G.1-5 Miscellaneous Structures, Piping, and Commodity Loads on RB Floor</i>	3G-26
<i>Table 3G.1-6 Equivalent Linear Temperature Distributions at Various Sections</i>	3G-27
<i>Table 3G.1-7 Pressure Loads Inside RCCV</i>	3G-28
<i>Table 3G.1-8 Pressure Loads Inside IC/PCCS Pools</i>	3G-28
<i>Table 3G.1-9 Maximum Vertical Acceleration</i>	3G-29
<i>Table 3G.1-10 Selected Load Combinations for the RCCV</i>	3G-30
<i>Table 3G.1-11 Selected Load Combinations for the RB</i>	3G-30
<i>Table 3G.1-12 Material Constants for Design Calculations</i>	3G-31
<i>Table 3G.1-13 Results of NASTRAN Analysis, Dead Load</i>	3G-32
<i>Table 3G.1-14 Results of NASTRAN Analysis, Drywell Unit Pressure (1 MPa)</i>	3G-34
<i>Table 3G.1-15 Results of NASTRAN Analysis, Wetwell Unit Pressure (1 MPa)</i>	3G-36
<i>Table 3G.1-16 Results of NASTRAN Analysis, Thermal Load (Normal Operation: Winter)</i>	3G-38
<i>Table 3G.1-17 Results of NASTRAN Analysis, Thermal Load (LOCA After 6 minutes: Winter)</i>	3G-40
<i>Table 3G.1-18 Results of NASTRAN Analysis, Thermal Load (LOCA After 72 hours: Winter)</i>	3G-42
<i>Table 3G.1-19 Results of NASTRAN Analysis, Seismic Load (Horizontal: North to South Direction)</i>	3G-44
<i>Table 3G.1-20 Results of NASTRAN Analysis, Seismic Load (Horizontal: East to West Direction)</i>	3G-46
<i>Table 3G.1-21 Results of NASTRAN Analysis, Seismic Load (Vertical: Upward Direction)</i>	3G-48
<i>Table 3G.1-22 Combined Forces and Moments: RCCV, Selected Load Combination CV-1</i>	3G-50
<i>Table 3G.1-23 Combined Forces and Moments: RCCV, Selected Load Combination CV-7a</i>	3G-52
<i>Table 3G.1-25 Combined Forces and Moments: RCCV, Selected Load Combination CV-11a</i>	3G-58
<i>Table 3G.1-26 Combined Forces and Moments: RCCV, Selected Load Combination CV-11b</i>	3G-63
<i>Table 3G.1-27 Sectional Thicknesses and Rebar Ratios of RCCV Used in the Evaluation</i>	3G-68
<i>Table 3G.1-28 Rebar and Concrete Stresses of RCCV: Selected Load Combination CV-1</i>	3G-71
<i>Table 3G.1-29 Rebar and Concrete Stresses of RCCV: Selected Load Combination CV-7a</i>	3G-72
<i>Table 3G.1-30 Rebar and Concrete Stresses of RCCV: Selected Load Combination CV-7b</i>	3G-73
<i>Table 3G.1-31 Rebar and Concrete Stresses of RCCV: Selected Load Combination CV-11a</i>	3G-74

<i>Table 3G.1-32 Rebar and Concrete Stresses of RCCV: Selected Load Combination CV-11b</i>	<i>3G-75</i>
<i>Table 3G.1-33 Transverse Shear of RCCV</i>	<i>3G-76</i>
<i>Table 3G.1-34 Tangential Shear of RCCV</i>	<i>3G-77</i>
<i>Table 3G.1-35 Containment Liner Plate Strains (Max)</i>	<i>3G-79</i>
<i>Table 3G.1-36 Drywell Head Elements Stress Summary</i>	<i>3G-81</i>
<i>Table 3G.1-37 Diaphragm Floor (D/F) Slab Elements Stress Summary</i>	<i>3G-82</i>
<i>Table 3G.1-38 Diaphragm Floor (D/F) Slab Anchorage Structural Capacity</i>	<i>3G-83</i>
<i>Table 3G.1-39 Vent Wall Structural Elements Stress Summary</i>	<i>3G-84</i>
<i>Table 3G.1-40 Reactor Shield Wall (RSW) Structural Element Stress Summary</i>	<i>3G-85</i>
<i>Table 3G.1-41 RPV Support Bracket Structural Elements Stress Summary</i>	<i>3G-86</i>
<i>Table 3G.1-42 Vent Wall and RPV Support Bracket Anchorage Structural Capacity</i>	<i>3G-86</i>
<i>Table 3G.1-43 GDCS Pool Structural Elements Stress Summary</i>	<i>3G-87</i>
<i>Table 3G.1-44 GDCS Pool Anchorage Structural Capacity</i>	<i>3G-88</i>
<i>Table 3G.1-46 Combined Forces and Moments: RB, Selected Load Combination RB-8a ...</i>	<i>3G-91</i>
<i>Table 3G.1-47 Combined Forces and Moments: RB, Selected Load Combination RB-8b ...</i>	<i>3G-94</i>
<i>Table 3G.1-48 Combined Forces and Moments: RB, Selected Load Combination RB-9a ...</i>	<i>3G-97</i>
<i>Table 3G.1-49 Combined Forces and Moments: RB, Selected Load Combination RB-9b ...</i>	<i>3G-102</i>
<i>Table 3G.1-50 Sectional Thicknesses and Rebar Ratios of RB Used in the Evaluation</i>	<i>3G-107</i>
<i>Table 3G.1-51 Rebar and Concrete Stresses of RB: Selected Load Combination RB-4</i>	<i>3G-110</i>
<i>Table 3G.1-52 Rebar and Concrete Stresses of RB: Selected Load Combination RB-8a ...</i>	<i>3G-111</i>
<i>Table 3G.1-53 Rebar and Concrete Stresses of RB: Selected Load Combination RB-8b ...</i>	<i>3G-112</i>
<i>Table 3G.1-54 Rebar and Concrete Stresses of RB: Selected Load Combination RB-9a ...</i>	<i>3G-113</i>
<i>Table 3G.1-54 Rebar and Concrete Stresses of RB: Selected Load Combination RB-9a ...</i>	<i>3G-113</i>
<i>Table 3G.1-55 Rebar and Concrete Stresses of RB: Selected Load Combination RB-9b ...</i>	<i>3G-114</i>
<i>Table 3G.1-56 Transverse Shear of RB</i>	<i>3G-115</i>
<i>Table 3G.1-57 Factors of Safety for Foundation Stability</i>	<i>3G-116</i>
<i>Table 3G.1-57a Stresses of RB External Walls against Wall Capacity Passive Pressure: Selected Load Combination RB-9a</i>	<i>3G-117</i>
<i>Table 3G.1-57b Stresses of RB External Walls against Wall Capacity Passive Pressure: Selected Load Combination RB-9b</i>	<i>3G-118</i>
<i>Table 3G.1-57c Transverse Shear of RB External Walls</i>	<i>3G-119</i>
<i>Table 3G.1-57d Stresses of FB External Walls against Wall Capacity Passive Pressure: Selected Load Combination FB-9</i>	<i>3G-120</i>
<i>Table 3G.1-57e Transverse Shear of FB External Walls</i>	<i>3G-121</i>
<i>Table 3G.1-58 Maximum Dynamic Soil Bearing Pressure Involving SSE + Static</i>	<i>3G-122</i>
<i>Table 3G.1-59 Stress Calculation Results for Basemat Uplift Analysis</i>	<i>3G-123</i>
<i>Table 3G.1-60 (Deleted)</i>	<i>3G-124</i>
<i>Table 3G.2-1 Soil Spring Constants for the CB Analysis Model</i>	<i>3G-203</i>
<i>Table 3G.2-2 Equipment Load of CB</i>	<i>3G-203</i>
<i>Table 3G.2-3 Miscellaneous Structures, Piping, and Commodity Load of CB</i>	<i>3G-204</i>
<i>Table 3G.2-4 Equivalent Linear Temperature Distributions at Various Sections</i>	<i>3G-205</i>
<i>Table 3G.2-5 Maximum Vertical Acceleration</i>	<i>3G-206</i>
<i>Table 3G.2-6 Selected Load Combinations for the CB</i>	<i>3G-207</i>
<i>Table 3G.2-7 Results of NASTRAN Analysis: Dead Load</i>	<i>3G-208</i>
<i>Table 3G.2-8 Results of NASTRAN Analysis: Thermal Load (LOCA: Winter)</i>	<i>3G-209</i>

<i>Table 3G.2-9 Results of NASTRAN Analysis: Seismic Load (Horizontal: North to South Direction)</i>	3G-210
<i>Table 3G.2-10 Results of NASTRAN Analysis: Seismic Load (Horizontal: East to West Direction)</i>	3G-211
<i>Table 3G.2-11 Results of NASTRAN Analysis: Seismic Load (Vertical: Upward Direction)</i>	3G-212
<i>Table 3G.2-12 Combined Forces and Moments: Selected Load Combination CB-3</i>	3G-213
<i>Table 3G.2-13 Combined Forces and Moments: Selected Load Combination CB-4</i>	3G-215
<i>Table 3G.2-14 Combined Forces and Moments: Selected Load Combination CB-7</i>	3G-217
<i>Table 3G.2-15 Combined Forces and Moments: Selected Load Combination CB-9</i>	3G-219
<i>Table 3G.2-16 Sectional Thicknesses and Rebar Ratios Used in the Evaluation</i>	3G-222
<i>Table 3G.2-17 Rebar and Concrete Stresses (Basemat and Slabs): Selected Load Combination CB-3</i>	3G-224
<i>Table 3G.2-19 Rebar and Concrete Stresses (Basemat and Slabs): Selected Load Combination CB-4</i>	3G-226
<i>Table 3G.2-20 Rebar and Concrete Stresses (Walls): Selected Load Combination CB-4</i> ..	3G-227
<i>Table 3G.2-21 Rebar and Concrete Stresses (Basemat and Slabs): Selected Load Combination CB-7</i>	3G-228
<i>Table 3G.2-22 Rebar and Concrete Stresses (Walls): Selected Load Combination CB-7</i> ..	3G-229
<i>Table 3G.2-23 Rebar and Concrete Stresses (Basemat and Slabs): Selected Load Combination CB-9</i>	3G-230
<i>Table 3G.2-24 Rebar and Concrete Stresses (Walls): Selected Load Combination CB-9</i> ..	3G-231
<i>Table 3G.2-25 Calculation Results for Transverse Shear</i>	3G-232
<i>Table 3G.2-26 Factors of Safety for Foundation Stability</i>	3G-233
<i>Table 3G.2-26a Stresses of CB External Wall against Wall Capacity Passive Pressure: Selected Load Combination CB-9</i>	3G-234
<i>Table 3G.2-26b Transverse Shear of CB External Walls</i>	3G-235
<i>Table 3G.2-27 Maximum Dynamic Soil Bearing Pressure Involving SSE + Static</i>	3G-236
<i>Table 3G.3-1 Miscellaneous Structures and Commodities in Spent Fuel Pool</i>	3G-258
<i>Table 3G.3-2 Miscellaneous Structures, Piping, and Commodity Load on FB Floor</i>	3G-259
<i>Table 3G.3-3 Equivalent Linear Temperature Distributions at Various Sections</i>	3G-259
<i>Table 3G.3-4 Selected Load Combinations for the FB</i>	3G-260
<i>Table 3G.3-5 Results of NASTRAN Analysis: Dead Load</i>	3G-261
<i>Table 3G.3-6 Results of NASTRAN Analysis: Thermal Load (Winter)</i>	3G-262
<i>Table 3G.3-7 Results of NASTRAN Analysis: Seismic Load (Horizontal: North to South Direction)</i>	3G-263
<i>Table 3G.3-8 Results of NASTRAN Analysis: Seismic Load (Horizontal: East to West Direction)</i>	3G-264
<i>Table 3G.3-9 Results of NASTRAN Analysis: Seismic Load (Vertical: Upward Direction)</i>	3G-265
<i>Table 3G.3-10 Combined Forces and Moments: Selected Load Combination FB-4</i>	3G-266
<i>Table 3G.3-11 Combined Forces and Moments: Selected Load Combination FB-8</i>	3G-267
<i>Table 3G.3-12 Combined Forces and Moments: Selected Load Combination FB-9</i>	3G-269
<i>Table 3G.3-13 Sectional Thicknesses and Rebar Ratios Used in the Evaluation</i>	3G-271
<i>Table 3G.3-14 Rebar and Concrete Stresses: Selected Load Combination FB-4</i>	3G-273
<i>Table 3G.3-17 Transverse Shear of FB</i>	3G-276
<i>Table 3G.4-1 Soil Spring Constants for FWSC Analysis Model</i>	3G-287

<i>Table 3G.4-2 Equipment Load of FWSC</i>	3G-287
<i>Table 3G.4-3 Miscellaneous Structures, Piping, and Commodity Load of FWSC</i>	3G-287
<i>Table 3G.4-4 Equivalent Linear Temperature Distributions at Various Sections</i>	3G-288
<i>Table 3G.4-5 Maximum Vertical Acceleration</i>	3G-289
<i>Table 3G.4-6 Selected Load Combinations for FWSC</i>	3G-290
<i>Table 3G.4-7 Results of NASTRAN Analysis: Dead Load</i>	3G-291
<i>Table 3G.4-8 Results of NASTRAN Analysis: Thermal Load (Winter)</i>	3G-292
<i>Table 3G.4-9 Results of NASTRAN Analysis: Seismic Load (Horizontal: North to South Direction)</i>	3G-293
<i>Table 3G.4-9 Results of NASTRAN Analysis: Seismic Load (Horizontal: North to South Direction)</i>	3G-293
<i>Table 3G.4-10 Results of NASTRAN Analysis: Seismic Load (Horizontal: West to East Direction)</i>	3G-294
<i>Table 3G.4-11 Results of NASTRAN Analysis: Seismic Load (Vertical: Upward Direction)</i>	3G-295
<i>Table 3G.4-12 Combined Forces and Moments: Selected Load Combination FWSC-3</i>	3G-296
<i>Table 3G.4-13 Combined Forces and Moments: Selected Load Combination FWSC-4</i>	3G-297
<i>Table 3G.4-14 Combined Forces and Moments: Selected Load Combination FWSC-6</i>	3G-298
<i>Table 3G.4-15 Combined Forces and Moments: Selected Load Combination FWSC -7 ...</i>	3G-300
<i>Table 3G.4-16 Sectional Thicknesses and Rebar Ratios Used in the Evaluation</i>	3G-302
<i>Table 3G.4-17 Rebar and Concrete Stresses: Selected Load Combination FWSC-3</i>	3G-304
<i>Table 3G.4-18 Rebar and Concrete Stresses: Selected Load Combination FWSC-4</i>	3G-305
<i>Table 3G.4-19 Rebar and Concrete Stresses: Selected Load Combination FWSC-6</i>	3G-306
<i>Table 3G.4-20 Rebar and Concrete Stresses: Selected Load Combination FWSC-7</i>	3G-307
<i>Table 3G.4-21 Calculation Results for Transverse Shear</i>	3G-308
<i>Table 3G.4-22 Factors of Safety for Foundation Stability</i>	3G-309
<i>Table 3G.4-23 Maximum Dynamic Soil Bearing Pressure Involving SSE + Static</i>	3G-309
<i>Table 3G.5-1 RB Upper Pools - Equivalent Linear Temperature Distributions at Various Sections</i>	3G-327
<i>Table 3G.5-2 RB Upper Pools - Load Combination Cases</i>	3G-329
<i>Table 3G.5-3 RB Upper Pools - Results of NASTRAN Analysis, Dead Load.....</i>	3G-329
<i>Table 3G.5-4 RB Upper Pools - Results of NASTRAN Analysis, Drywell Unit Pressure (1 MPa)</i>	3G-330
<i>Table 3G.5-5 RB Upper Pools - Results of NASTRAN Analysis, Wetwell Unit Pressure (1 MPa)</i>	3G-331
<i>Table 3G.5-6 RB Upper Pools - Results of NASTRAN Analysis, Thermal Load (Case 1) ..</i>	3G-332
<i>Table 3G.5-7 RB Upper Pools - Results of NASTRAN Analysis, Thermal Load (Case 2) ..</i>	3G-333
<i>Table 3G.5-8 RB Upper Pools - Results of NASTRAN Analysis, Thermal Load (Case 3) ..</i>	3G-334
<i>Table 3G.5-9 RB Upper Pools - Results of NASTRAN Analysis, Thermal Load (Case 4) ..</i>	3G-335
<i>Table 3G.5-10 RB Upper Pools - Results of NASTRAN Analysis, Seismic Load (Horizontal: North to South Direction)</i>	3G-336
<i>Table 3G.5-11 RB Upper Pools - Results of NASTRAN Analysis, Seismic Load (Horizontal: East to West Direction)</i>	3G-337
<i>Table 3G.5-12 RB Upper Pools - Results of NASTRAN Analysis, Seismic Load (Vertical: Upward Direction)</i>	3G-338

<i>Table 3G.5-13 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 6001</i>	3G-339
<i>Table 3G.5-14 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 6002</i>	3G-341
<i>Table 3G.5-15 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 6003</i>	3G-343
<i>Table 3G.5-16 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 6004</i>	3G-345
<i>Table 3G.5-17 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 7001</i>	3G-347
<i>Table 3G.5-18 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 7002</i>	3G-349
<i>Table 3G.5-19 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 7003</i>	3G-351
<i>Table 3G.5-20 RB Upper Pools - Combined Forces and Moments, Selected Load Combination 7004</i>	3G-353
<i>Table 3G.5-21 RB Upper Pools – Sectional Thicknesses and Rebar Ratios Used in the Evaluation</i>	3G-355
<i>Table 3G.5-21 RB Upper Pools – Sectional Thicknesses and Rebar Ratios Used in the Evaluation (Continued)</i>	3G-356
<i>Table 3G.5-22 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 6001</i>	3G-357
<i>Table 3G.5-23 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 6002</i>	3G-358
<i>Table 3G.5-24 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 6003</i>	3G-359
<i>Table 3G.5-25 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 6004</i>	3G-360
<i>Table 3G.5-26 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 7001</i>	3G-361
<i>Table 3G.5-27 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 7002</i>	3G-362
<i>Table 3G.5-28 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 7003</i>	3G-363
<i>Table 3G.5-29 RB Upper Pools - Rebar and Concrete Stresses: Selected Load Combination 7004</i>	3G-364
<i>Table 3G.5-30 RB Upper Pools - Transverse Shear; RCCV</i>	3G-365
<i>Table 3G.5-31 RB Upper Pools - Transverse Shear; RB</i>	3G-365
<i>Table 3G.6-1 Critical Dimensions of Reactor Building – Part 1</i>	3G-379
<i>Table 3G.6-1 Critical Dimensions of Reactor Building – Part 2</i>	3G-388
<i>Table 3G.6-2 Critical Dimensions of Control Building – Part 1</i>	3G-389
<i>Table 3G.6-2 Critical Dimensions of Control Building – Part 2</i>	3G-391
<i>Table 3G.6-3 Critical Dimensions of Fuel Building – Part 1</i>	3G-392
<i>Table 3G.6-3 Critical Dimensions of Fuel Building – Part 2</i>	3G-395
<i>Table 3H-1 Cross Reference of Plant Environmental Data and Location</i>	3H-8

<i>Table 3H-2 Thermodynamic Environment Conditions Inside Containment Vessel for Normal Operating Conditions</i>	<i>3H-9</i>
<i>Table 3H-3 Thermodynamic Environment Conditions Inside Reactor Building for Normal Operating Conditions</i>	<i>3H-10</i>
<i>Table 3H-4 Thermodynamic Environment Conditions Inside Control Building for Normal Operating Conditions</i>	<i>3H-12</i>
<i>Table 3H-5 Radiation Environment Conditions Inside Containment Vessel for Normal Operating Conditions</i>	<i>3H-13</i>
<i>Table 3H-6 Typical Radiation Environment Qualification Conditions Inside Reactor Building</i>	<i>3H-14</i>
<i>Table 3H-7 Typical Radiation Environment Qualification Conditions Inside Control Building</i>	<i>3H-16</i>
<i>Table 3H-8 Thermodynamic Environment Conditions Inside Containment Vessel for Accident Conditions</i>	<i>3H-17</i>
<i>Table 3H-9 Thermodynamic Environment Conditions Inside Reactor Building for Accident Conditions</i>	<i>3H-18</i>
<i>Table 3H-10 Thermodynamic Environment Conditions Inside Control Building for Accident Conditions</i>	<i>3H-20</i>
<i>Table 3H-11 Radiation Environment Conditions Inside Containment Vessel for Accident Conditions</i>	<i>3H-21</i>
<i>Table 3H-12 Room Heat Loads</i>	<i>3H-22</i>
<i>Table 3H-13 Typical Mild Environment Parameter Limits</i>	<i>3H-24</i>
<i>Table 3H-14 Input Parameters, Initial Conditions and Assumptions used in Reactor Building and Control Building Temperature Analyses</i>	<i>3H-25</i>
<i>Table 3H-15 Analytical Room Environment Temperatures</i>	<i>3H-27</i>
<i>Table 3L-1 Comparison of Typical Major Steam Dryer Configuration Parameters</i>	<i>3L-27</i>
<i>Table 3L-2 Specific Steam Dryer Load Definition Legend</i>	<i>3L-28</i>
<i>Table 3L-3 Typical Vibration Sensors</i>	<i>3L-28</i>
<i>Table 3L-4 Sensor Locations and Types</i>	<i>3L-29</i>
<i>Table 3L-5 Applicable Data Reduction Method for Comparison to Criteria⁽²⁾⁽³⁾</i>	<i>3L-30</i>
<i>Table 3L-6 Parameters Used in Spectrum Generation</i>	<i>3L-31</i>
<i>Table 3L-7 Data Evaluation Methods to be Used for Each Component</i>	<i>3L-31</i>

VOLUME 26A6642AP

Table 4.3-1 (Deleted).....	4.3-13
Table 4.4-1a Typical Thermal–Hydraulic Design Characteristics of the Reactor Core (SI Units).....	4.4-14
Table 4.4-1b Typical Thermal–Hydraulic Design Characteristics of the Reactor Core (English Units).....	4.4-15
Table 4.4-2a Void Distribution for Analyzed Core - TRACG Average Channel.....	4.4-16
Table 4.4-2b Void Distribution for Analyzed Core - TRACG Hot Channel	4.4-17
Table 4.4-3a Flow Quality Distribution for Analyzed Core - TRACG Average Channel....	4.4-18
Table 4.4-3b Flow Quality Distribution for Analyzed Core – TRACG Hot Channel	4.4-19
Table 4.4-4a Axial Power Distribution Used to Generate Void and Quality for Analyzed Core-TRACG Average Channel.....	4.4-20
Table 4.4-4b Axial Power Distribution Used to Generate Void and Quality for Analyzed Core - TRACG Hot Channel	4.4-21
Table 4.4-5 Axial Distribution for Typical Core – Core Simulator Hot Channel.....	4.4-22
Table 4.4-6 ESBWR Reactor Coolant System Geometric Data (SI Units).....	4.4-23
Table 4.5-1 Reactor Internals Material Specifications	4.5-7
Table 4.6-1 Hydraulic Requirements	4.6-29
Table 4.6-2 CRD System Scram Performance	4.6-30
Table 4A-1 (Deleted).....	4A-2
Table 4B-1 Fuel Rod Thermal-Mechanical Design Criteria	4B-7
Table 4D-1 Initial Conditions for Channel and Core Stability Analysis.....	4D-21
Table 4D-2 Baseline Stability Analysis Results.....	4D-22
Table 4D-3 Statistical Stability Analysis Results.....	4D-23
Table 4D-4 Limiting AOO Event Results	4D-24
Table 4D-5 Defense-In-Depth Algorithm Setpoints	4D-25

VOLUME 26A6642AR

Table 5.2-1	Reactor Coolant Pressure Boundary Components (Applicable Code Cases)	5.2-41
Table 5.2-2	Safety Relief Valve and Depressurization Valve Settings and/or Capacities	5.2-44
Table 5.2-3	(Deleted)	5.2-45
Table 5.2-4	Reactor Coolant Pressure Boundary Materials.....	5.2-46
Table 5.2-5	Expected ESBWR Water Chemistry	5.2-55
Table 5.2-6	LD&IS Control and Isolation Functions vs. Monitored Variables.....	5.2-56
Table 5.2-7	Leakage Sources vs. Monitored Variables	5.2-59
Table 5.3-1	Reactor Vessel Controls	5.3-20
Table 5.3-2	Predicted Irradiation Effects on Beltline Materials	5.3-22
Table 5.3-3	Reactor Pressure Vessel Dimensions	5.3-23
Table 5.3-4	RPV Fluence Analysis Results	5.3-24
Table 5.4-1	Component and Subsystem Design Controls	5.4-45
Table 5.4-2	(Deleted)	5.4-50
Table 5.4-3	Reactor Water Cleanup/Shutdown Cooling System Data	5.4-51
Table 5.4-4	DPV Design and Performance Parameters.....	5.4-53

VOLUME 26A6642AT

Table 6.1-1	Containment System Including PCCS, and ECCS Component Materials	6.1-5
Table 6.2-1	Containment Design Parameters.....	6.2-73
Table 6.2-2	Containment Conditions During Normal Operation.....	6.2-74
Table 6.2-3	Containment Major Configuration Data	6.2-75
Table 6.2-4	Major Design Parameters of Vent System.....	6.2-76
Table 6.2-5	Summary of Containment-LOCA Performance Analyses.....	6.2-77
Table 6.2-5a	Bounding Estimate of the ESBWR Containment Pressure ¹	6.2-78
Table 6.2-6	Plant Initial Conditions Considered in the Containment DBA Cases.....	6.2-81
Table 6.2-6a	Summary of ESBWR TRACG Nodalization Changes	6.2-82
Table 6.2-7	Operational Sequence of ECCS For A Feedwater Line Break with Failure of One DPV (Nominal Case).....	6.2-84
Table 6.2-7a	Operational Sequence of ECCS for a Main Steam Line Break with Failure of One DPV (Nominal Case).....	6.2-86
Table 6.2-7b	Operational Sequence of ECCS for a GDCS Line Break with Failure of One DPV (Nominal Case)	6.2-88
Table 6.2-7c	Operational Sequence of ECCS for a Bottom Drain Line Break with Failure of One DPV (Nominal Case).....	6.2-90
Table 6.2-7d	Operational Sequence of ECCS for a Feedwater Line Break with Failure of One DPV (Bounding Case).....	6.2-92
Table 6.2-7e	Operational Sequence of ECCS for a Main Steam Line Break with Failure of One DPV (Bounding Case).....	6.2-94
Table 6.2-7f	Operational Sequence of ECCS for a Feedwater Line Break with Failure of One SRV (Bounding Case)	6.2-96
Table 6.2-7g	Operational Sequence of ECCS for a Main Steam Line Break with Failure of One SRV (Bounding Case)	6.2-98
Table 6.2-7h	Operational Sequence of ECCS for a Main Steam Line Break with Failure of One SRV (Bounding Case, with Offsite Power).....	6.2-100
Table 6.2-8	Model Parameters for Containment Bounding Calculation.....	6.2-102
Table 6.2-9	ESBWR Design Features for Severe Accident Control.....	6.2-103
Table 6.2-10	Passive Containment Cooling Design Parameters.....	6.2-104
Table 6.2-11	RWCU/SDC Break Locations	6.2-105
Table 6.2-12	Subcompartment Vent Path Designation	6.2-106
Table 6.2-12a	Subcompartment Nodal Description	6.2-115
Table 6.2-12b	(Deleted).....	6.2-117
Table 6.2-12c	Heat Sink Descriptions.....	6.2-118
Table 6.2-12d	RPV Sensible Heat Data	6.2-130
Table 6.2-13	Reactor Coolant Pressure Boundary Influent Lines Penetrating Drywell	6.2-131
Table 6.2-14	Reactor Coolant Pressure Boundary Effluent Lines Penetrating Drywell.....	6.2-132
Table 6.2-15	Legend For Tables 6.2-16 through 6.2-45	6.2-133
Table 6.2-16	Containment Isolation Valve Information for the Nuclear Boiler System Main Steam Line A.....	6.2-134
Table 6.2-17	Containment Isolation Valve Information for the Nuclear Boiler System Main Steam Line B.....	6.2-135
Table 6.2-18	Containment Isolation Valve Information for the Nuclear Boiler System Main Steam Line C.....	6.2-136
Table 6.2-19	Containment Isolation Valve Information for the Nuclear Boiler System Main Steam Line D.....	6.2-137

Table 6.2-20	Containment Isolation Valve Information for the Nuclear Boiler System Main Steam Line Drains.....	6.2-138
Table 6.2-21	Containment Isolation Valve Information for the Nuclear Boiler System Feedwater Line A	6.2-139
Table 6.2-22	Containment Isolation Valve Information for the Nuclear Boiler System Feedwater Line B.....	6.2-141
Table 6.2-23	Containment Isolation Valve Information for the Isolation Condenser System Loop A	6.2-143
Table 6.2-24	Containment Isolation Valve Information for the Isolation Condenser System Loop A	6.2-145
Table 6.2-25	Containment Isolation Valve Information for the Isolation Condenser System Loop B	6.2-147
Table 6.2-26	Containment Isolation Valve Information for the Isolation Condenser System Loop B	6.2-149
Table 6.2-27	Containment Isolation Valve Information for the Isolation Condenser System Loop C	6.2-151
Table 6.2-28	Containment Isolation Valve Information for the Isolation Condenser System Loop C	6.2-152
Table 6.2-29	Containment Isolation Valve Information for the Isolation Condenser System Loop D	6.2-154
Table 6.2-30	Containment Isolation Valve Information for the Isolation Condenser System Loop D	6.2-155
Table 6.2-31	Containment Isolation Valve Information for the Reactor Water Cleanup/Shutdown Cooling System.....	6.2-157
Table 6.2-31a	Containment Isolation Valve Information for the Reactor Water Cleanup/Shutdown Cooling System.....	6.2-159
Table 6.2-32a	Containment Isolation Valve Information for the Standby Liquid Control System	6.2-160
Table 6.2-32b	Containment Isolation Valve Information for the Standby Liquid Control System	6.2-161
Table 6.2-33a	Containment Isolation Valve Information for the Fuel and Auxiliary Pools Cooling System.....	6.2-162
Table 6.2-33b	Containment Isolation Valve Information for the Fuel and Auxiliary Pools Cooling System.....	6.2-163
Table 6.2-34	Containment Isolation Valve Information for the Fuel and Auxiliary Pools Cooling System.....	6.2-164
Table 6.2-35	Containment Isolation Valve Information for the Fuel and Auxiliary Pools Cooling System.....	6.2-165
Table 6.2-36	Containment Isolation Valve Information for the Containment Inerting System	6.2-166
Table 6.2-37	Containment Isolation Valve Information for the Containment Inerting System	6.2-168
Table 6.2-38	Containment Isolation Valve Information for the Containment Inerting System	6.2-169
Table 6.2-39	Containment Isolation Valve Information for the Chilled Water System Train A.....	6.2-170
Table 6.2-39a	Containment Isolation Valve Information for the Chilled Water System Train B.....	6.2-171

Table 6.2-40 Containment Isolation Valve Information for the High Pressure Nitrogen Supply System	6.2-172
Table 6.2-41 Containment Isolation Valve Information for the Makeup Water System	6.2-173
Table 6.2-42 Containment Isolation Valve Information for the Process Radiation Monitoring System	6.2-174
Table 6.2-43 Containment Isolation Valve Information for the Equipment and Floor Drain System	6.2-175
Table 6.2-44 Containment Isolation Valve Information for the Service Air System.....	6.2-176
Table 6.2-45 Containment Isolation Valve Information for the Containment Monitoring System	6.2-177
Table 6.2-46 (Deleted).....	6.2-178
Table 6.2-47 Containment Penetrations Subject To Type A, B, and C Testing.....	6.2-179
Table 6.2-48 RWCU/SDC NRHX Parameters Assumed in Post-LOCA Containment Cooling and Recovery Analysis	6.2-192
Table 6.2-49 PCCS Vent Fan Minimum Performance Requirements ^{1, 2}	6.2-193
Table 6.3-1 Significant Input Variables to the ECCS-LOCA Performance Analysis.....	6.3-25
Table 6.3-2 GDCS Design Basis Parameters	6.3-28
Table 6.3-3 Inservice Testing and Maintenance.....	6.3-29
Table 6.3-4 (Deleted).....	6.3-30
Table 6.3-5 Summary of ECCS-LOCA Performance Analyses	6.3-31
Table 6.3-5a Summary of ECCS Line Break Sizes and Elevations	6.3-32
Table 6.3-6 Single Failure Evaluation.....	6.3-33
Table 6.3-7 Operational Sequence of ECCS for a Feedwater Line Break with Failure of One GDCS Injection Valve (Nominal Calculation)	6.3-34
Table 6.3-8 Operational Sequence of ECCS for an Inside Steam Line Break with Failure of One GDCS Injection Valve (Nominal Calculation).....	6.3-35
Table 6.3-9 Operational Sequence of ECCS for a GDCS Injection Line Break with Failure of One GDCS Injection Valve (Nominal Calculation)	6.3-36
Table 6.3-10 Operational Sequence of ECCS for a Bottom Drain Line Break.....	6.3-37
with Failure of One GDCS Injection Valve (Nominal Calculation)	6.3-37
Table 6.3-10a Operational Sequence of ECCS for a IC Drain Line Break with Failure of One GDCS Valve (Bounding Case)	6.3-39
Table 6.3-11 Plant Variables with Nominal and Bounding Calculation Values.....	6.3-41
Table 6.4-1 Design Parameters for CRHAVS.....	6.4-18
Table 6.4-2 Typical Onsite Chemicals and Typical Locations	6.4-19
Table 6A-1 Evaluation of TRACG Application Procedure	6A-3
Table 6B-1 Summary of Peak DW Pressure for Error Correction Cases.....	6B-9
Table 6B-2 Summary of Differences from Reference 6B.1-2	6B-10
Table 6D-1 Listing of Passive Heat Sinks.....	6D-2
Table 6D-2 Modeling of Passive Heat Sinks	6D-2
Table 6D-3 Thermophysical Properties of Passive Heat Sink Materials	6D-2
Table 6D-4 Total Heat Transfer Area by Containment Level.....	6D-2
Table 6F1-1 Summary of Peak DW Pressures for the MSL Break Area Study.....	6F-3
Table 6F1-2 Summary of Peak DW Pressures for the FWL Break Area Study	6F-3
Table 6F2-1 Summary of Peak DW Pressures for the MSL Break Elevation Study	6F-3
Table 6G-1 Phenomena Identification and Ranking Table (PIRT).....	6G-5
Table 6G-2 Major Design Changes from Pre-Application Review Design to DCD Design, Parameter	6G-6

Table 6G-3 Major Design Changes from Pre-Application Review Design to DCD Design, Modeling.....	6G-10
Table 6H-1 Summary of Parametric Cases on the Main Steam Line Break	6H-4
Table 6I-1 Summary of Containment-LOCA Performance Analyses	6I-2
Table 6I-2 Operational Sequence of ECCS for a MSLB with Failure of One DPV (Bounding Case)	6I-3
Table 6I-3 Operational Sequence of ECCS for a MSLB with Failure of One SRV (Bounding Case)	6I-5

VOLUME 26A6642AW

Table 7.1-1 I&C Regulatory Requirements Applicability Matrix.....	7.1-112
Table 7.1-2 I&C Systems - IEEE Std. 603 Criteria Compliance Cross-Reference.....	7.1-122
Table 7.2-1 Sensors Used in Functional Performance of RPS	7.2-62
Table 7.2-2 SRNM Trips and Rod Blocks	7.2-63
Table 7.2-3 SRNM Trip Signals.....	7.2-65
Table 7.2-4 APRM Trip Function Summary.....	7.2-66
Table 7.2-5 Outputs from SPTMs to Other Systems.....	7.2-67
Table 7.2-6 OPRM Trip Function Summary.....	7.2-68
Table 7.3-1 Automatic Depressurization System Parameters	7.3-76
Table 7.3-2 Safety Relief Valve Initiation Parameters.....	7.3-76
Table 7.3-3 Automatic Depressurization Valve Parameters	7.3-77
Table 7.3-4 Gravity Driven Cooling System Parameters.....	7.3-78
Table 7.3-5 LD&IS Interfacing Sensor Parameters	7.3-79
Table 7.5-2 (Deleted).....	7.5-37
Table 7.5-3 (Deleted).....	7.5-37
Table 7.5-4 CMS Testing and Inspection Requirements.....	7.5-37
Table 7.5-5 Instrument Ranges for Hydrogen/Oxygen Analyzers.....	7.5-37
Table 7.7-1 Major Plant Automation System Interfaces	7.7-59
Table 7.8-1 Diverse Instrumentation and Control Systems.....	7.8-25
Functions, Initiators, and Interfacing Systems for ATWS Mitigation or Chapter 15 Design Basis Events1	7.8-25
Table 7.8-2 Diverse Instrumentation and Control Systems Controls, Interlocks and Bypasses for ATWS Mitigation or Chapter 15 Design Basis Events1	7.8-27
Table 7.8-3 Diverse Instrumentation and Control Systems Functions, Initiators, and Interfacing Systems to Address BTP HICB-191	7.8-28
Table 7.8-4 Diverse Instrumentation and Control Systems Controls, Interlocks and Bypasses to Address BTP HICB-191	7.8-30
Table 7B-1 Q-DCIS Platforms	7B-9
Table 7B-2 N-DCIS Network Segments†	7B-9
Table 7B-3 (Deleted).....	7B-9
Table 7B-4 (Deleted).....	7B-9
Table 7B-5 (Deleted).....	7B-10
Table 7B-6 (Deleted).....	7B-10
Table 7B-7 (Deleted).....	7B-10
Table 7B-8 (Deleted).....	7B-10

VOLUME 26A6642AX

Table 8.1-1 Onsite Power System SRP Criteria Applicability Matrix 8.1-10

Table 8.3-1 Diesel-Generator Alarms 8.3-33

Table 8.3-2 Battery Cycle Times..... 8.3-34

Table 8.3-3 250VDC Safety-Related Battery Nominal Load Requirements 8.3-35

Table 8.3-4 Safety-Related DC and UPS Nominal Component Data 8.3-36

VOLUME 26A6642AY

Table 9.1-1 Pools Served by FAPCS and IC/PCCS.....	9.1-42
Table 9.1-2 FAPCS Operating Modes	9.1-43
Table 9.1-3 FAPCS Safety Classification, Quality Group and Seismic Category	9.1-44
Table 9.1-4 (Deleted).....	9.1-46
Table 9.1-5 Reference Codes and Standards.....	9.1-47
Table 9.1-6 Heavy Load Equipment Used to Handle Light Loads and Related Refueling Handling Tasks	9.1-48
Table 9.1-7 Summary of Heavy Load Operations.....	9.1-49
Table 9.1-8 Design Parameters for FAPCS System Components.....	9.1-52
Table 9.2-1 PSWS Heat Loads.....	9.2-26
Table 9.2-2 PSWS Component Design Characteristics	9.2-27
Table 9.2-3 RCCWS Nominal Heat Loads	9.2-28
Table 9.2-4 RCCWS Component Design Characteristics.....	9.2-31
Table 9.2-5 RCCWS Configuration by Mode.....	9.2-32
Table 9.2-6 Makeup Water System Supplied Equipment	9.2-33
Table 9.2-7 Makeup Water System Demineralized Water Storage Tank Nominal Water Quality Requirements	9.2-34
Table 9.2-8 Makeup Water System Demineralizer Effluent Nominal Water Quality Requirements	9.2-35
Table 9.2-9 Major Makeup Water System Components	9.2-36
Table 9.2-10 Capacity Requirements for the Condensate Storage Tank.....	9.2-36
Table 9.2-11 Chilled Water System Component Design Characteristics.....	9.2-37
Table 9.2-12 Turbine Component Cooling Water System Heat Loads.....	9.2-38
Table 9.3-1 Process Sampling System Measurements	9.3-31
Table 9.3-2 Major Equipment for EFDS	9.3-33
Table 9.3-3 Safety-Related Portions of the SLC System	9.3-39
Table 9.3-4 Safety-Related Interfaces for the SLC System	9.3-40
Table 9.3-5 SLC ATWS Mitigation Function Parameters	9.3-41
Table 9.3-6 Instrument Air System Requirements	9.3-42
Table 9.3-7 Service Air System Requirements	9.3-43
Table 9.3-8 High Pressure Nitrogen Supply System Requirements.....	9.3-44
Table 9.4-1 Design Parameters for the CBVS.....	9.4-48
Table 9.4-2 Major Equipment for CBVS	9.4-49
Table 9.4-3 Design Parameters for FBVS.....	9.4-52
Table 9.4-4 Major Equipment for FBGAVS.....	9.4-53
Table 9.4-5 Major Equipment for FBFPVS	9.4-55
Table 9.4-6 RWVS Design Conditions	9.4-56
Table 9.4-7 Major Equipment for the RWVS	9.4-57
Table 9.4-8 Design Parameters for RBVS	9.4-58
Table 9.4-9 Major Equipment for CLAVS.....	9.4-60
Table 9.4-10 Major Equipment for REPAVS	9.4-61
Table 9.4-11 Major Equipment for CONAVS	9.4-62
Table 9.4-12 Drywell Cooling System Design Parameters.....	9.4-64
Table 9.4-13 Drywell Cooling System Fan Cooling Units	9.4-65
Table 9.4-14 Drywell Cooling System Heat Loads.....	9.4-66
Table 9.4-15 Design Parameters for TBVS.....	9.4-67
Table 9.4-16 Design Parameters for EBVS.....	9.4-70

Table 9.4-17 Industrial Codes and Standards Applicable to ESBWR HVAC	9.4-74
Table 9.5-1 Lists of Applicable Codes for Fire Protection	9.5-61
Table 9.5-2 FPS Component Design Characteristics	9.5-64
Table 9.5-3 Typical Luminance Ranges for Normal Lighting.....	9.5-65

VOLUME 26A6642BB

Table 9A.2-1 Fire Protection Codes and Standards.....	9A.2-9
Table 9A.2-2 Systems Required to Achieve Safe Shutdown in the Event of Fire	9A.2-13
Table 9A.5-1 Reactor Building.....	9A.5-4
Table 9A.5-2 Fuel Building	9A.5-55
Table 9A.5-3 Control Building	9A.5-62
Table 9A.5-4 Turbine Building.....	9A.5-77
Table 9A.5-5 Radwaste Building.....	9A.5-97
Table 9A.5-6 Electrical Building.....	9A.5-107
Table 9A.5-7 Yard	9A.5-134
Table 9A.6-1 Turbine and Electrical Building Safety-Related Monitoring Devices.....	9A.6-19

VOLUME 26A6642BD

Table 9B-1 Estimated Fire Severity for Offices and Light Commercial Occupancies.....	9B-10
Table 9B-2 Fire Severity Expected by Occupancy*	9B-11
Table 9B-3 Cable Type and Configuration for UL Tests*	9B-12
Table 9B-4 Summary of Burning Rate Calculations	9B-13

VOLUME 26A6642BF

Table 10.1-1 Summary of Important Design Features and Performance Characteristics of the Steam and Power Conversion System	10.1-4
Table 10.3-1 Turbine Main Steam System Design Data	10.3-7
Table 10.3-2 ASME Section III Class 2 Steam and Feedwater System Piping Materials	10.3-8
Table 10.4-1 Main Condenser Data	10.4-28
Table 10.4-2 Main Condenser Evacuation System	10.4-29
Table 10.4-3 Circulating Water System	10.4-30
Table 10.4-4 Condensate Purification System	10.4-31
Table 10.4-5 Condensate and Feedwater System Data	10.4-32
Table 10.4-6 Condensate and Feedwater System Component Failure Analysis	10.4-33

VOLUME 26A6642BH

Table 11.1-1 Source Term Design Basis Parameters.....	11.1-7
Table 11.1-2a Design Basis Noble Radiogas Source Terms in Steam	11.1-8
Table 11.1-2b Normal Operational Noble Radiogas Source Terms in Steam	11.1-9
Table 11.1-3 Calculational Parameters For Source Term Adjustment	11.1-10
Table 11.1-4a Design Basis Iodine Radioisotopes in Reactor Water and Steam	11.1-11
Table 11.1-4b Normal Operational Iodine Radioisotopes in Reactor Water and Steam	11.1-12
Table 11.1-5a Design Basis Non-Volatile Fission Products In Reactor Water	11.1-13
Table 11.1-5b Normal Operational Non-Volatile Fission Products In Reactor Water	11.1-14
Table 11.1-6 Design Basis*** N16 Concentrations in Reactor Water and Steam	11.1-15
Table 11.1-7a Design Basis Non-Coolant Activation Products in Reactor Water	11.1-16
Table 11.1-7b Normal Operational Non-Coolant Activation Products in Reactor Water ..	11.1-17
Table 11.2-1 Equipment Codes (from Table 1, RG 1.143)	11.2-11
Table 11.2-2a LWMS Component Capacity (Tanks)*	11.2-12
Table 11.2-2b LWMS Component Capacity (Pumps).....	11.2-13
Table 11.2-2c LWMS Component Capacity	11.2-14
Table 11.2-3 Decontamination Factors***	11.2-15
Table 11.2-4 Probable Inputs to LWMS from Operational Occurrences	11.2-16
Table 11.3-1 Offgas System Design Parameters ⁽¹⁾	11.3-16
Table 11.3-2 Offgas System Major Equipment Items	11.3-18
Table 11.3-3 Equipment Malfunction Analysis.....	11.3-20
Table 11.3-4 Offgas System Failure Accident Parameters.....	11.3-23
Table 11.3-5 Isotopic Source Rates for Design Basis*.....	11.3-24
Table 11.3-6 Releases to the Environment*	11.3-25
Table 11.3-7 Offgas System Failure Meteorology and Dose Results.....	11.3-26
Table 11.4-1 SWMS Component Capacities	11.4-11
Table 11.4-2 Annual Shipped Waste Volumes*	11.4-12
Table 11.5-1 Process and Effluent Radiation Monitoring Systems	11.5-29
Table 11.5-2 Process Radiation Monitoring System (Gaseous and Airborne Monitors)	11.5-33
Table 11.5-3 Key to Radiation Monitors Shown on Figure 11.5-1	11.5-39
Table 11.5-4 Process Radiation Monitoring System (Liquid Monitors)	11.5-40
Table 11.5-5 Provisions for Sampling Liquid Streams.....	11.5-41
Table 11.5-6 Provisions for Sampling Gaseous Streams.....	11.5-44
Table 11.5-7 Radiological Analysis Summary of Liquid Effluent Samples	11.5-46
Table 11.5-8 Radiological Analysis Summary of Gaseous Effluent Samples.....	11.5-47
Table 11.5-9 Process Radiation Monitoring System Estimated Dynamic Ranges	11.5-48

VOLUME 26A6642BJ

Table 12.2-1 Basic Reactor Data	12.2-13
Table 12.2-2 Neutron Fluxes at Core Boundary and RPV	12.2-22
Table 12.2-3 Gamma Ray Source Energy Spectra	12.2-24
Table 12.2-4 Neutron and Gamma Ray Fluxes Outside the Vessel Wall.....	12.2-27
Table 12.2-5 Radioactive Sources in the Control Rod Drive System.....	12.2-28
Table 12.2-6a RWCU/SDC Regenerative Heat Exchanger Tube Side Activity	12.2-29
Table 12.2-6b RWCU/SDC Non-Regenerative Heat Exchanger Tube Side Activity	12.2-30
Table 12.2-6c RWCU/SDC Regenerative Heat Exchanger Shell Side	12.2-31
Table 12.2-7 RWCU Demineralizer Activity	12.2-32
Table 12.2-8 FAPCS Filter Activity	12.2-33
Table 12.2-8a FAPCS Demineralizer Activity	12.2-34
Table 12.2-8b FAPCS Heat Exchanger Tube Side Activity	12.2-35
Table 12.2-9 FAPCS Backwash Receiving Tank Activity	12.2-36
Table 12.2-10a Offgas System Steam Jet Air Ejector Inventory	12.2-37
Table 12.2-10b Offgas System Isotopic Inventory for Preheater through Charcoal Tanks.	12.2-40
Table 12.2-11 Turbine Condenser Inventory	12.2-44
Table 12.2-12 Isotopic Inventory in the Ion Exchanger Filters	12.2-45
Table 12.2-13a Liquid Waste Management System Equipment Drain Collection Tank Activity	12.2-46
Table 12.2-13b Liquid Waste Management System Equipment Drain Sample Tank Activity	12.2-47
Table 12.2-13c Liquid Waste Management System Floor Drain Collection Tank Activity	12.2-48
Table 12.2-13d Liquid Waste Management System Floor Drain Sample Tank Activity....	12.2-49
Table 12.2-13e Liquid Waste Management System Chemical Collection Tank Activity...	12.2-50
Table 12.2-13f Liquid Waste Management System Detergent Collection Tank Activity...	12.2-51
Table 12.2-13g Liquid Waste Management System Detergent Sample Tank Activity.....	12.2-52
Table 12.2-14a Solid Waste Management System High Activity Resin Holdup Tank Activity	12.2-53
Table 12.2-14b Solid Waste Management System Low Activity Resin Holdup Tank Activity	12.2-54
Table 12.2-14c Solid Waste Management System Phase Separator Tank Activity	12.2-55
Table 12.2-14d Solid Waste Management System Condensate Resin Holdup Tank Activity	12.2-56
Table 12.2-14e Solid Waste Management System Concentrate Waste Tank Activity.....	12.2-57
Table 12.2-15 Airborne Sources Calculation.....	12.2-58
Table 12.2-16 Annual Airborne Releases for Offsite Dose Evaluations (MBq)**	12.2-59
Table 12.2-17 Comparison of Airborne Concentrations with 10 CFR 20 Concentrations..	12.2-62
Table 12.2-18a Airborne Offsite Dose Calculation Bases.....	12.2-65
Table 12.2-18b ESBWR Annual Average Doses from Airborne Releases	12.2-66
Table 12.2-19a Average Annual Liquid Release Calculation Parameters*	12.2-67
Table 12.2-19b Average Annual Liquid Releases	12.2-69
Table 12.2-20a Liquid Pathway Offsite Dose Calculation Bases**	12.2-71
Table 12.2-20b Liquid Pathway Dose Results in mSv/year	12.2-72
Table 12.2-21 N-16 Skyshine Annual Dose	12.2-74

Table 12.2-22 Radiation Sources Parameters	12.2-75
Table 12.2-23a Parameters and Assumptions Used for Calculating Inside the Building Airborne Radioactivity Concentrations.....	12.2-77
Table 12.2-23b Reactor Building Outside Containment Airborne Radioactivity Concentrations During Normal Operation	12.2-78
Table 12.2-23c Spent Fuel Pool and Equipment Areas Airborne Radioactivity Concentrations	12.2-80
Table 12.2-23d Turbine Building Airborne Radioactivity Concentrations	12.2-82
Table 12.2-23e Radwaste Building Airborne Radioactivity Concentrations.....	12.2-85
Table 12.3-1 Computer Programs Used in Shielding Design Calculations.....	12.3-31
Table 12.3-2 Area Radiation Monitors for Reactor Building.....	12.3-33
Table 12.3-3 Area Radiation Monitors for Fuel Building	12.3-34
Table 12.3-4 Area Radiation Monitors for Radwaste Building.....	12.3-35
Table 12.3-5 Area Radiation Monitors for Turbine Building.....	12.3-36
Table 12.3-6 Area Radiation Monitors for Control Building	12.3-38
Table 12.3-7 Area Radiation Channel Monitoring Range	12.3-39
Table 12.3-8 Shielding Geometry (Nominal).....	12.3-40
Table 12.3-9 Activity Accumulated in the HVAC Filters in Accident Conditions	12.3-46
Table 12.3-10a Dose Rates in the Control Building EFU and Adjacent Rooms in Accident Conditions.....	12.3-48
Table 12.3-10b Dose Rates in the Reactor Building HVAC Filter and Adjacent Rooms in Accident Conditions.....	12.3-49
Table 12.3-11 Beyond 72 Hour And Long Term Post Accident Recovery Actions Access Requirements	12.3-50
Table 12.3-12 Radiation Dose Rates At The Post-Accident Access Rooms	12.3-51
Table 12.3-13 Radiation Dose Rates At The Access Ways To Post-Accident Access Areas	12.3-52
Table 12.3-14 Reactor Building Post Accident Access Area	12.3-54
Table 12.3-15 Control Building Post Accident Access Area	12.3-59
Table 12.3-16 Electrical And Service Building Post Accident Access Area	12.3-60
Table 12.3-17 Outside Area - Post-Accident Radiation Mission Dose At 72 H	12.3-62
Table 12.3-18 Regulatory Guide 4.21 Design Objective and Applicable DCD Subsection Information.....	12.3-63
Table 12.3-19 Figure(s) Additional Notes(s)/Information.....	12.3-125
Table 12.4-1 Projected ESBWR Total Occupational Radiation Exposure Estimates Based on 24-Month Refueling Cycle	12.4-13
Table 12.4-2 Occupational Dose Estimates During Operation and Surveillances	12.4-14
Table 12.4-3 Occupational Dose Estimates During Routine Maintenance	12.4-15
Table 12.4-4 Occupational Dose Estimates During Waste Processing	12.4-16
Table 12.4-5 Occupational Dose Estimates During Refueling Operations	12.4-17
Table 12.4-6 Occupational Dose Estimates During Inservice Inspection	12.4-18
Table 12.4-7 Occupational Dose Estimates During Special Maintenance	12.4-19

VOLUME 26A6642BL

-NONE-

VOLUME 26A6642BN

Table 14.2-1 Power Ascension Test Matrix	14.2-98
Table 14.3-1 Types of Systems and Summary of Their Graded Treatment	14.3-21
Table 14.3-1a ITAAC Screening Summary.....	14.3-22
Table 14.3-1b Design Basis Accident Analysis Critical Parameters.....	14.3-27
Table 14.3-1c PRA and Severe Accident Insights.....	14.3-33
Table 14.3-2 Test, Inspection or Analysis Approach & Application Process	14.3-41

VOLUME 26A6642BP

Table 15.0-1 Chapter 15 Abnormal Event Classification Determination Matrix	15.0-16
Table 15.0-2 ESBWR Abnormal Event Classifications	15.0-17
Table 15.0-3 Safety Analysis Acceptance Criteria for AOOs	15.0-20
Table 15.0-4 Safety Analysis Acceptance Criteria for AOOs in Combination With an Additional Single Active Component Failure or Single Operator Error.....	15.0-21
Table 15.0-5 Safety Analysis Acceptance Criteria for Infrequent Events.....	15.0-22
Table 15.0-6 Safety Analysis Acceptance Criteria for Accidents	15.0-23
Table 15.0-7 ESBWR Event Classifications and Radiological Acceptance Criteria	15.0-24
Table 15.0-8 ESBWR Safety Analysis Codes	15.0-26
Table 15.1-1 Operational Criteria	15.1-4
Table 15.1-2 ESBWR Operating Modes	15.1-5
Table 15.1-3 ESBWR Events Associated With Operating Modes	15.1-6
Table 15.1-4 Event Analysis Rules.....	15.1-8
Table 15.1-5 NSOA System Event Matrix	15.1-11
Table 15.1-6 NSOA Automatic Instrument Trip/Event Matrix.....	15.1-18
Table 15.1-7 ESBWR NSOA Events.....	15.1-26
Table 15.2-1 Input Parameters, Initial Conditions and Assumptions Used in AOO and Infrequent Event Analyses	15.2-25
Table 15.2-2 CRD Scram Times for Vessel Bottom Pressures Below 7.481 MPa gauge (1085 psig)	15.2-30
Table 15.2-3 CRD Scram Times for Bottom Vessel Pressures Between 7.481 MPa gauge (1085 psig) and 8.618 MPa gauge (1250 psig)	15.2-30
Table 15.2-4a Results Summary of Anticipated Operational Occurrence Events ⁽¹⁾	15.2-31
Table 15.2-4b Results Summary of Anticipated Operational Occurrence Events.....	15.2-33
Table 15.2-5 Sequence of Events for Loss of Feedwater Heating.....	15.2-34
Table 15.2-6 Sequence of Events for Fast Closure of One Turbine Control Valve	15.2-35
Table 15.2-7 Sequence of Events for Slow Closure of One Turbine Control Valve.....	15.2-35
Table 15.2-8 Sequence of Events for Generator Load Rejection with Turbine Bypass	15.2-36
Table 15.2-9 Sequence of Events for Generator Load Rejection with a Single Failure in the Turbine Bypass System.....	15.2-37
Table 15.2-10 Sequence of Events for Turbine Trip with Turbine Bypass	15.2-38
Table 15.2-11 Sequence of Events for Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-39
Table 15.2-12 Sequence of Events for Closure of one MSIV	15.2-40
Table 15.2-13 Sequence of Events for Closure of all MSIV	15.2-40
Table 15.2-14 Typical Rates of Decay for Loss of Condenser Vacuum	15.2-41
Table 15.2-15 Sequence of Events for Loss of Condenser Vacuum	15.2-42
Table 15.2-16 Trip Signals Associated With Loss of Condenser Vacuum	15.2-43
Table 15.2-17 Sequence of Events for Inadvertent Isolation Condenser Initiation	15.2-43
Table 15.2-18 Single Failure Modes for Digital Controls	15.2-44
Table 15.2-19 Sequence of Events for Runout of One Feedwater Pump	15.2-45
Table 15.2-20 Sequence of Events for Opening of One Turbine Control or Bypass Valve	15.2-45
Table 15.2-21 Sequence of Events for Loss of Non-Emergency AC Power to Station Auxiliaries.....	15.2-46

Table 15.2-22	Sequence of Events for Loss of All Feedwater Flow	15.2-47
Table 15.2-23	Instrument Response Time Limits for RPS, ECCS, MSIV, ICS, CRHAVS, Isolation, and SCRRI/SRI Functions	15.2-48
Table 15.3-1a	Results Summary of Infrequent Events ^{(1) (2)}	15.3-27
Table 15.3-1b	Results Summary of Other Infrequent Events	15.3-28
Table 15.3-1b	Results Summary of Other Infrequent Events	15.3-28
Table 15.3-2	Sequence of Events for Loss of Feedwater Heating With Failure of SCRRI and SRI	15.3-29
Table 15.3-3	Sequence of Events for Feedwater Controller Failure – Maximum Flow Demand	15.3-30
Table 15.3-4	Sequence of Events for Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves	15.3-31
Table 15.3-5	Sequence of Events for Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves	15.3-32
Table 15.3-6a	Sequence of Events for Generator Load Rejection With Total Turbine Bypass Failure	15.3-33
Table 15.3-6b	(Deleted)	15.3-33
Table 15.3-6c	(Deleted)	15.3-33
Table 15.3-7	Sequence of Events for Turbine Trip With Total Turbine Bypass Failure	15.3-34
Table 15.3-8	Sequence of Events for Continuous Control Rod Withdrawal Error During Reactor Startup With Failure of Control Rod Block	15.3-35
Table 15.3-9	Sequence of Events for the Mislocated Bundle	15.3-36
Table 15.3-10	Sequence of Events for the Misoriented Bundle	15.3-37
Table 15.3-11	Sequence of Events for Inadvertent SRV Opening	15.3-38
Table 15.3-12	Sequence of Events for Stuck Open Safety Relief Valve	15.3-39
Table 15.3-13	1000 Fuel Rod Failure Parameters	15.3-40
Table 15.3-14	1000 Fuel Rod Failure Fission Product Activity Released to Coolant	15.3-42
Table 15.3-15	1000 Fuel Rod Failure Fission Product Activity Cumulative Release to Environment	15.3-43
Table 15.3-16	1000 Fuel Rod Failure Dose Results	15.3-44
Table 15.3-17	Radwaste System Failure Accident Parameters	15.3-45
Table 15.3-18	Radwaste System Failure Accident Isotopic Airborne Release to Environment	15.3-47
Table 15.3-19	Radwaste System Failure Accident Dose Results	15.3-48
Table 15.4-1	Fuel Handling Accident Sequence of Events	15.4-30
Table 15.4-2	Fuel Handling Accident Parameters	15.4-31
Table 15.4-3	Fuel Handling Accident Activity Released from Fuel	15.4-34
Table 15.4-3a	Fuel Handling Accident Isotopic Release to Environment	15.4-35
Table 15.4-4	Fuel Handling Accident Analysis Results	15.4-36
Table 15.4-5	Loss-of-Coolant Accident Dose Consequence Analysis Parameters	15.4-37
Table 15.4-5a	LOCA Atmospheric Dispersion Factors (s/m ³)	15.4-41
Table 15.4-6	LOCA Compartment Inventories (Ci)	15.4-42
Table 15.4-6a	LOCA Compartment Inventories (MBq)	15.4-48
Table 15.4-7	LOCA Integrated Environmental Release (MBq)	15.4-54
Table 15.4-7a	LOCA Integrated Environmental Release (Ci)	15.4-56
Table 15.4-8	LOCA Control Room Activity (MBq)	15.4-58

Table 15.4-8a LOCA Control Room Activity (Ci).....	15.4-60
Table 15.4-9 LOCA Inside Containment Analysis Total Effective Dose Equivalent (TEDE) Results	15.4-62
Table 15.4-10 Sequence of Events for Main Steamline Break Accident (MSLBA) Outside Containment.....	15.4-63
Table 15.4-11 MSLBA Parameters.....	15.4-64
Table 15.4-12 MSLBA Environment Releases	15.4-66
Table 15.4-13 MSLBA Analysis Results.....	15.4-68
Table 15.4-14 Feedwater Line Break Accident Parameters	15.4-69
Table 15.4-15 Feedwater Line Break Accident Isotopic Release to Environment.....	15.4-71
Table 15.4-16 Feedwater Line Break Analysis Results.....	15.4-73
Table 15.4-17 Small Line Carrying Coolant Outside Containment Break Accident Parameters	15.4-74
Table 15.4-18a Small Line Carrying Coolant Outside Containment Break Accident Integral Release to the Environment for the Pre-Accident Spike Case	15.4-76
Table 15.4-18b Small Line Carrying Coolant Outside Containment Break Accident Integral Release to the Environment for the Equilibrium Case	15.4-77
Table 15.4-19 Small Line Carrying Coolant Outside Containment Break Accident Results.....	15.4-79
Table 15.4-20 RWCU/SDC System Line Failure Outside Containment Sequence of Events	15.4-80
Table 15.4-21 RWCU/SDC Line Break Accident Parameters	15.4-81
Table 15.4-22 RWCU/SDC Line Break Accident Isotopic Release to Environment.....	15.4-83
Table 15.4-23 RWCU/SDC Line Break Accident Results	15.4-84
Table 15.5-1 ATWS Performance Requirements	15.5-18
Table 15.5-1a Systems That May Initiate or Trip During Overpressure Event.....	15.5-19
Table 15.5-1b Sequence of Events for Closure of all MSIVs with Flux Trip	15.5-20
Table 15.5-2 ATWS Initial Operating Conditions.....	15.5-21
Table 15.5-3 ATWS Equipment Performance Characteristics	15.5-22
Table 15.5-4a ATWS MSIV Closure Summary - ARI Case	15.5-23
Table 15.5-4b ATWS MSIV Closure Summary - FMCRD Case.....	15.5-23
Table 15.5-4c ATWS MSIV Closure Summary – SLC System Bounding Case	15.5-24
Table 15.5-4d (Deleted).....	15.5-24
Table 15.5-4e ATWS MSIV Closure Sequence of Events	15.5-25
Table 15.5-5a ATWS Loss of Condenser Vacuum Summary – SLC System Bounding Case	15.5-26
Table 15.5-5b ATWS Loss of Condenser Vacuum Sequence of Events Bounding Case ...	15.5-26
Table 15.5-5c (Deleted)	15.5-27
Table 15.5-5d (Deleted).....	15.5-27
Table 15.5-6a ATWS Loss of Feedwater Heating Summary - SLC System Case	15.5-28
Table 15.5-6b ATWS Loss of Feedwater Heating Sequence of Events	15.5-28
Table 15.5-7a ATWS Loss of Non-Emergency AC Power to Station Auxiliaries Summary - SLC System Case	15.5-29
Table 15.5-7b ATWS Loss of Non-Emergency AC Power to Station Auxiliaries Sequence of Events	15.5-29
Table 15.5-8a ATWS Loss of Feedwater Flow Summary - SLC System Case	15.5-30

Table 15.5-8b	ATWS Loss of Feedwater Flow Sequence of Events	15.5-30
Table 15.5-9a	ATWS Load Rejection with a Single Failure in the Turbine Bypass System Summary - SLC System Case	15.5-31
Table 15.5-9b	ATWS Load Rejection with a Single Failure in the Turbine Bypass System Sequence of Events	15.5-31
Table 15.5-10a	Sequence of Events for Station Blackout	15.5-32
Table 15.5-10b	Theoretical Vessel Conditions at 72 hours after SBO	15.5-33
Table 15A-1	Instrumentation & Control (I&C) Failures Leading to Inadvertent Opening of DPVs	15A-32
Table 15A-1	I&C Failures Leading to Inadvertent Opening of DPVs (continued)	15A-35
Table 15A-2	Failure Data	15A-36
Table 15A-3	Summary of Event Frequency Estimates	15A-37
Table 15B-1	ESBWR Core Concentrations	15B-2

VOLUME 26A6642BR

-NONE-

ESBWR

Design Control Document/Tier 2

VOLUME 26A6642BT

-NONE-

VOLUME 26A6642BW

Table 17.0-1 Compliance With Quality Assurance Program Commitments.....	17.0-3
Table 17.4-1 D-RAP Example Case - ICS Importance Analysis	17.4-11
Table 17.4-2 D-RAP Example Case - ICS Failure Modes and Reliability Strategy	17.4-11

VOLUME 26A6642BX

Table 18.1-1a Minimum Inventory of MCR Alarms, Displays, and Controls	18.1-9
Table 18.1-1b Minimum Inventory of RSS Alarms, Displays, and Controls.....	18.1-11
Table 18.6-1 ESBWR Staffing Assumptions	18.6-5
Table 18.10-1 Example Knowledge and Skill Dimensions for Learning Objectives Identification	18.10-6

VOLUME 26A6642BY

Table 19.1-1 Systems and Functions Modeled	19.1-5
Table 19.2-1 Comparison of ESBWR Features With Existing BWRs	19.2-20
Table 19.2-2 ESBWR Design Features That Reduce Risk	19.2-25
Table 19.2-3 Risk Insights and Assumptions	19.2-26
Table 19.2-4 ESBWR Systems and Structures in Seismic Margins Analysis with Plant Level HCLPF not less than $1.67 \cdot SSE^{(1)}$	19.2-35
Table 19A-1 Initiating Events Assessment for RTNSS (Deleted)	19A-29
Table 19A-2 RTNSS Functions	19A-30
Table 19A-3 Structures Housing RTNSS Functions	19A-33
Table 19A-4 Capability of RTNSS Related Structures	19A-34
Table 19B-1 Summary of ASME Factored Load Limits Used for Containment Integrity	19B-14
Table 19B-2 Summary of Steel Elastic Properties for Level C Analysis	B19-15
Table 19B-3 Summary of Steel Plastic Properties for Level C Analysis	19B-16
Table 19B-4 Summary of Concrete Properties for Level C Analysis	19B-17
Table 19B-5 Summary of Thermal Material Properties	19B-18
Table 19B-6 Summary of Maximum Stresses in Rebar and Concrete at 0.620 MPaG (90 psig) Pressure	19B-19
Table 19B-7 Summary of Maximum Stresses in Rebar and Concrete at 0.992 MPaG (144 psig) Pressure	19B-21
Table 19B-8 Summary of Torispherical Shell Parameters for Benchmark Analysis	19B-23
Table 19B-9 Level C Pressure Capability of Drywell Head at 260° C (500°F)	19B-24
Table 19B-10 Level C Pressure Capability of Hatches and Airlocks at 260°C (500°F)	19B-25
Table 19B-11 Summary of Level C/Factored Load Category Pressure Capacity at 260°C (500°F)	19B-26
Table 19C-1 Summary of Thermal Material Properties	19C-18
Table 19C-2 Summary of Elastic Mechanical Properties for Steels	19C-19
Table 19C-3 Summary of Plastic Mechanical Properties for Steels	19C-20
Table 19C-4 Summary of Concrete Material Properties	19C-21
Table 19C-5 Summary of Material Limits and Failure Criteria	19C-22
Table 19C-6 Summary of Variance for Modeling Uncertainty	19C-23
Table 19C-7 Summary of Uncertainty Evaluations for RCCV Pressure Capacity	19C-24
Table 19C-8 Summary of Pressure Fragility for RCCV and Liner	19C-25
Table 19C-9 Summary of Uncertainty Evaluations for Drywell Head Pressure Capacity	19C-26
Table 19C-10 Summary of Pressure Fragility for Drywell Head	19C-27
Table 19C-11 Summary of Uncertainty Evaluations for Equipment Hatch Pressure Capacity	19C-28
Table 19C-12 Summary of Pressure Fragility for Equipment Hatch	19C-29
Table 19C-13 Summary of ESBWR Fragility for over-Pressurization	19C-30
Table 19D-1 Fire Barrier Key Design Features	19D-6

List of Illustrations

VOLUME 26A6642AD

Figure 1.1-1. ESBWR Standard Plant General Site Plan	1.14
Figure 1.1-2. Safety System Configuration (not to scale)	1.15
Figure 1.1-3a. Reactor System Heat Balance at 100% Power (SI Units).....	1.16
Figure 1.1-3b. Reactor System Heat Balance at 100% Power (English Units).....	1.17
Figure 1.2-1. Nuclear Island Plan at Elevation –11500.....	1.2-76
Figure 1.2-2. Nuclear Island Plan at Elevation –6400.....	1.2-77
Figure 1.2-3. Nuclear Island Plan at Elevation –1000.....	1.2-78
Figure 1.2-4. Nuclear Island Plan at Elevation 4650.....	1.2-79
Figure 1.2-5. Nuclear Island Plan at Elevation 9060.....	1.2-80
Figure 1.2-6. Nuclear Island Plan at Elevation 13570.....	1.2-81
Figure 1.2-7. Nuclear Island Plan at Elevation 17500.....	1.2-82
Figure 1.2-8. Nuclear Island Plan at Elevation 27000.....	1.2-83
Figure 1.2-9. Nuclear Island Plan at Elevation 34000.....	1.2-84
Figure 1.2-10. Nuclear Island Elevation Section A-A	1.2-85
Figure 1.2-11. Nuclear Island Elevation Section B-B.....	1.2-86
Figure 1.2-12. Turbine Building Plan at Elevation –1400	1.2-87
Figure 1.2-13. Turbine Building Plan at Elevation 4650	1.2-88
Figure 1.2-14. Turbine Building Plan at Elevation 12000	1.2-89
Figure 1.2-15. Turbine Building Plan at Elevation 20000	1.2-90
Figure 1.2-16. Turbine Building Plan at Elevation 28000	1.2-91
Figure 1.2-17. Turbine Building Plan at Elevation 35000	1.2-92
Figure 1.2-18. Turbine Building Plan at Elevation Various.....	1.2-93
Figure 1.2-19. Turbine Building Elevation Section A-A	1.2-94
Figure 1.2-20. Turbine Building Elevation Section B-B.....	1.2-95
Figure 1.2-21. Radwaste Building Plan at Elevation -9350	1.2-96
Figure 1.2-22. Radwaste Building Plan at Elevation -2350	1.2-97
Figure 1.2-23. Radwaste Building Plan at Elevation 4650	1.2-98
Figure 1.2-24. Radwaste Building Plan at Elevation 10650	1.2-99
Figure 1.2-25. Radwaste Building Elevation Section A-A	1.2-100
Figure 1.2-26. Electrical Building Plan at Elevation 4650.....	1.2-101
Figure 1.2-27. Electrical Building Plan at Elevation 9800.....	1.2-102
Figure 1.2-28. (Deleted)	1.2-103
Figure 1.2-29. Electrical Building Plan at Elevation 18000.....	1.2-104
Figure 1.2-30. (Deleted)	1.2-105
Figure 1.2-31. Electrical Building Plan at Elevation 27000.....	1.2-106
Figure 1.2-32. Electrical Building Plan at Elevation Various	1.2-107
Figure 1.2-33. Electrical Building Elevation Section A-A.....	1.2-108
Figure 1.5-1. Evolution of the GE/GEH BWR	1.5-13
Figure 1.5-2. Evolution of the BWR Reactor Design	1.5-14
Figure 1.5-3. Comparison of BWR Containments	1.5-15
Figure 1.7-1. P&ID Symbols for Valves and Valve Actuators	1.7-11
Figure 1.7-2. P&ID Symbols for Instruments	1.7-12
Figure 1.7-3. Miscellaneous P&ID Symbols.....	1.7-13

Figure 1.7-4. P&ID Symbols for Piping, Instrument and Electrical Lines and Line	
Continuations.....	1.7-14

VOLUME 26A6642AF

-NONE-

VOLUME 26A6642AH

Figure 2.0-1. ESBWR Horizontal SSE Design Ground Spectra at Foundation Level.....	2.0-20
Figure 2.0-2. ESBWR Vertical SSE Design Ground Response Spectra at Foundation Level	2.0-21
Figure 2A-1. Potential Radiological Sources and Receptors for the ESBWR Control Room	2A-11

VOLUME 26A6642AJ

Figure 3.2-1. Quality Group and Seismic Category Classification Applicable to Power Conversion System	3.2-55
Figure 3.2-2. Quality Group and Seismic Category Classification Applicable to Feedwater System	3.2-56
Figure 3.5-1. Missile Velocity and Displacement Characteristics Resulting from Saturated Steam and Water Blowdowns (7.2 MPa (1044 psia) Stagnation Pressure)	3.5-13
Figure 3.5-2. ESBWR Standard Plant Low-Trajectory Turbine Missile Strike Zone	3.5-14
Figure 3.6-1. Jet Characteristics	3.6-37
Figure 3.6-2. Typical Pipe Whip Restraint Configuration	3.6-38
Figure 3.6-3. Typical Terminal End Break at Containment Penetration	3.6-39
Figure 3.7-1. Horizontal SSE Design Spectra, Generic Site	3.7-42
Figure 3.7-2. Vertical SSE Design Spectra, Generic Site	3.7-43
Figure 3.7-3. Horizontal, H1 Component Time History, Generic Site	3.7-44
Figure 3.7-4. Horizontal, H2 Component Time History, Generic Site	3.7-45
Figure 3.7-5. Vertical, Component Time History, Generic Site	3.7-46
Figure 3.7-6. 2% Damped Response Spectra, H1 Component, Generic Site	3.7-47
Figure 3.7-7. 3% Damped Response Spectra, H1 Component, Generic Site	3.7-48
Figure 3.7-8. 4% Damped Response Spectra, H1 Component, Generic Site	3.7-49
Figure 3.7-9. 5% Damped Response Spectra, H1 Component, Generic Site	3.7-50
Figure 3.7-10. 7% Damped Response Spectra, H1 Component, Generic Site	3.7-51
Figure 3.7-11. 2% Damped Response Spectra, H2 Component, Generic Site	3.7-52
Figure 3.7-12. 3% Damped Response Spectra, H2 Component, Generic Site	3.7-53
Figure 3.7-13. 4% Damped Response Spectra, H2 Component, Generic Site	3.7-54
Figure 3.7-14. 5% Damped Response Spectra, H2 Component, Generic Site	3.7-55
Figure 3.7-15. 7% Damped Response Spectra, H2 Component, Generic Site	3.7-56
Figure 3.7-16. 2% Damped Response Spectra, Vertical Component, Generic Site	3.7-57
Figure 3.7-17. 3% Damped Response Spectra, Vertical Component, Generic Site	3.7-58
Figure 3.7-18. 4% Damped Response Spectra, Vertical Component, Generic Site	3.7-59
Figure 3.7-19. 5% Damped Response Spectra, Vertical Component, Generic Site	3.7-60
Figure 3.7-20. 7% Damped Response Spectra, Vertical Component, Generic Site	3.7-61
Figure 3.7-21. Power Spectral Density Function, H1 Component, Generic Site	3.7-62
Figure 3.7-22. Power Spectral Density Function, H2 Component, Generic Site	3.7-63
Figure 3.7-23. Power Spectral Density Function, Vertical Component, Generic Site	3.7-64
Figure 3.7-24. North Anna ESP Horizontal H1 Target Spectrum at ESBWR CB Base	3.7-65
Figure 3.7-25. North Anna ESP Horizontal H1 Time Histories at ESBWR CB Base	3.7-66
Figure 3.7-26. North Anna ESP Horizontal H2 Target Spectrum at ESBWR CB Base	3.7-67
Figure 3.7-27. North Anna ESP Horizontal H2 Time Histories at ESBWR CB Base	3.7-68
Figure 3.7-28. North Anna ESP Vertical Target Spectrum at ESBWR CB Base	3.7-69
Figure 3.7-29. North Anna ESP Vertical Time Histories at ESBWR CB Base	3.7-70
Figure 3.7-30. North Anna ESP Horizontal H1 Target Spectrum at ESBWR RB/FB Base	3.7-71
Figure 3.7-31. North Anna ESP Horizontal H1 Time Histories at ESBWR RB/FB Base	3.7-72
Figure 3.7-32. North Anna ESP Horizontal H2 Target Spectrum at ESBWR RB/FB Base	3.7-73
Figure 3.7-33. North Anna ESP Horizontal H2 Time Histories at ESBWR RB/FB Base	3.7-74
Figure 3.7-34. North Anna ESP Vertical Target Spectrum at ESBWR RB/FB Base	3.7-75

Figure 3.7-35. North Anna ESP Vertical Time Histories at ESBWR RB/FB Base	3.7-76
Figure 3.7-36. Not used.	3.7-77
Figure 3.7-37. Alternative Damping Values for Response Spectra Analysis of ASME B&PV Code, Section III, Division 1 Class 1, 2, and 3, and ASME B31.1 Piping Systems	3.7-78
Figure 3.7-38. Single Envelope Spectrum Match – H1 Component	3.7-79
Figure 3.7-39. Single Envelope Spectrum Match – H2 Component	3.7-80
Figure 3.7-40. Single Envelope Spectrum Match – Vertical Component	3.7-81
Figure 3.7-41. Single Envelope Time Histories – H1 Component	3.7-82
Figure 3.7-42. Single Envelope Time Histories – H2 Component	3.7-83
Figure 3.7-43. Single Envelope Time Histories – Vertical Component	3.7-84
Figure 3.8-1. Configuration of Concrete Containment.....	3.8-72
Figure 3.8-2. Schematic of Reinforcements in RCCV Wall Around Equipment Hatch/Personnel Airlock Opening	3.8-73
Figure 3.8-3. Typical Internal Containment Plate Support with Embedment Integral with Containment Liner	3.8-74
Figure 3.8-4. Typical External Containment Plate Support with Embedment	3.8-75
Figure 3.8-5. Quencher Anchorage.....	3.8-76
Figure 3.8-6. RCCV Wall High-Energy Penetration	3.8-77
Figure 3.8-7. RCCV Top Slab Penetration and PCCS Passages	3.8-78
Figure 3.8-8. RCCV Low-Energy Penetration	3.8-79
Figure 3.8-9. RCCV Multiple Penetration	3.8-79
Figure 3.8-10. RCCV Electrical Penetration	3.8-80
Figure 3.8-11. RCCV Spare Penetration.....	3.8-80
Figure 3.8-12. (Deleted).....	3.8-81

VOLUME 26A6642AK

Figure 3.9-1. Stress-Strain Curve for Blowout Restraints	3.9-117
Figure 3.9-2. Minimum Floodable Volume	3.9-118
Figure 3.9-3. Recirculation Flow Path	3.9-119
Figure 3.9-4. Fuel Support Pieces	3.9-120
Figure 3.9-5. Pressure Nodes for Depressurization Analysis	3.9-121
Figure 3.9-6. Flow Chart for Determining Test Data Frequency and Amplitude	3.9-122
Figure 3.9-7. ESBWR Reactor Assembly Showing Reactor Internal Components	3.9-123
Figure 3.9-8. Typical Shroud, Chimney, and Top Guide Assembly	3.9-124
Figure 3.9-9. Typical Core Plate to Shroud Connection	3.9-125
Figure 3.9-10. Typical In-core Guide Tube Lateral Support Connection to Support Ring	3.9-126
Figure 3.9-11. Typical Inter-Connection Between In-core Guide Tube Lateral Supports	3.9-127
Figure 3.9-12. Typical Connection Between In-Core Guide Tube and Core Plate	3.9-128

VOLUME 26A6642AL

<i>Figure 3A.5-1. Method for Frequency-Independent Soil Properties]*</i>	3A-15
<i>[Figure 3A.7-1. RB/FB Stick Model</i>	3A-41
<i>Figure 3A.7-2. RCCV Stick Model</i>	3A-42
<i>Figure 3A.7-3. Pedestal Stick Model</i>	3A-43
<i>Figure 3A.7-4. RB/FB Complex Seismic Model</i>	3A-44
<i>Figure 3A.7-5. Control Building Stick Model</i>	3A-45
<i>Figure 3A.7-6. Control Building Seismic Model</i>	3A-46
<i>Figure 3A.7-7. FWSC Seismic Model</i>	3A-47
<i>Figure 3A.7-8. SASSI2000 Plate Elements for RB/FB Basemat</i>	3A-48
<i>Figure 3A.7-9. SASSI2000 Plate Elements for RB/FB Exterior Walls</i>	3A-49
<i>Figure 3A.7-10. Overview of RB/FB SASSI2000 Model</i>	3A-50
<i>Figure 3A.7-11. SASSI2000 Plate Elements for CB Basemat</i>	3A-51
<i>Figure 3A.7-12. SASSI2000 Plate Elements for CB Exterior Walls</i>	3A-52
<i>Figure 3A.7-13. Overview of CB SASSI2000 Model</i>	3A-53
<i>Figure 3A.7-14. SASSI2000 Plate Elements for FWSC Basemat</i>	3A-54
<i>Figure 3A.7-15. Overview of FWSC SASSI2000 Model]*</i>	3A-55
<i>Figure 3A.8.1-1a. FRS (Effect of Soil Stiffness) – RB/FB Refueling Floor X</i>	3A-82
<i>Figure 3A.8.1-1b. FRS (Effect of Soil Stiffness) – RCCV Top Slab X</i>	3A-82
<i>Figure 3A.8.1-1c. FRS (Effect of Soil Stiffness) – Vent Wall Top X</i>	3A-83
<i>Figure 3A.8.1-1d. FRS (Effect of Soil Stiffness) – RSW Top X</i>	3A-83
<i>Figure 3A.8.1-1e. FRS (Effect of Soil Stiffness) – RPV Top X</i>	3A-84
<i>Figure 3A.8.1-1f. FRS (Effect of Soil Stiffness) – RB/FB Basemat X</i>	3A-84
<i>Figure 3A.8.1-1g. FRS (Effect of Soil Stiffness) – CB Top X</i>	3A-85
<i>Figure 3A.8.1-1h. FRS (Effect of Soil Stiffness) – CB Basemat X</i>	3A-85
<i>Figure 3A.8.1-2a. FRS (Effect of Soil Stiffness) – RB/FB Refueling Floor Y</i>	3A-86
<i>Figure 3A.8.1-2b. FRS (Effect of Soil Stiffness) – RCCV Top Slab Y</i>	3A-86
<i>Figure 3A.8.1-2c. FRS (Effect of Soil Stiffness) – Vent Wall Top Y</i>	3A-87
<i>Figure 3A.8.1-2d. FRS (Effect of Soil Stiffness) – RSW Top Y</i>	3A-87
<i>Figure 3A.8.1-2e. FRS (Effect of Soil Stiffness) – RPV Top Y</i>	3A-88
<i>Figure 3A.8.1-2f. FRS (Effect of Soil Stiffness) – RB/FB Basemat Y</i>	3A-88
<i>Figure 3A.8.1-2g. FRS (Effect of Soil Stiffness) – CB Top Y</i>	3A-89
<i>Figure 3A.8.1-2h. FRS (Effect of Soil Stiffness) – CB Basemat Y</i>	3A-89
<i>Figure 3A.8.1-3a. FRS (Effect of Soil Stiffness) – RB/FB Refueling Floor Z</i>	3A-90
<i>Figure 3A.8.1-3b. FRS (Effect of Soil Stiffness) – RCCV Top Slab Z</i>	3A-90
<i>Figure 3A.8.1-3c. FRS (Effect of Soil Stiffness) – Vent Wall Top Z</i>	3A-91
<i>Figure 3A.8.1-3d. FRS (Effect of Soil Stiffness) – RSW Top Z</i>	3A-91
<i>Figure 3A.8.1-3e. FRS (Effect of Soil Stiffness) – RPV Top Z</i>	3A-92
<i>Figure 3A.8.1-3f. FRS (Effect of Soil Stiffness) – RB/FB Basemat Z</i>	3A-92
<i>Figure 3A.8.1-3g. FRS (Effect of Soil Stiffness) – CB Top Z</i>	3A-93
<i>Figure 3A.8.1-3h. FRS (Effect of Soil Stiffness) – CB Basemat Z</i>	3A-93
<i>Figure 3A.8.1-4a. FRS (Effect of Soil Stiffness) – FWS Wall Top X</i>	3A-94
<i>Figure 3A.8.1-4b. FRS (Effect of Soil Stiffness) – FWS Basemat X</i>	3A-94
<i>Figure 3A.8.1-4c. FRS (Effect of Soil Stiffness) – FPE Top X</i>	3A-95
<i>Figure 3A.8.1-4d. FRS (Effect of Soil Stiffness) – FPE Basemat X</i>	3A-95

Figure 3A.8.1-5a. FRS (Effect of Soil Stiffness) – FWS Wall Top Y	3A-96
Figure 3A.8.1-5b. FRS (Effect of Soil Stiffness) – FWS Basemat Y	3A-96
Figure 3A.8.1-5c. FRS (Effect of Soil Stiffness) – FPE Top Y	3A-97
Figure 3A.8.1-5d. FRS (Effect of Soil Stiffness) – FPE Basemat Y	3A-97
Figure 3A.8.1-6a. FRS (Effect of Soil Stiffness) – FWS Wall Top Z	3A-98
Figure 3A.8.1-6b. FRS (Effect of Soil Stiffness) – FWS Basemat Z	3A-98
Figure 3A.8.1-6c. FRS (Effect of Soil Stiffness) – FPE Top Z	3A-99
Figure 3A.8.1-6d. FRS (Effect of Soil Stiffness) – FPE Basemat Z	3A-99
Figure 3A.8.2-1a. FRS (Effect of Single Envelope Ground Motion) – RB/FB Refueling Floor X	3A-100
Figure 3A.8.2-1b. FRS (Effect of Single Envelope Ground Motion) – RCCV Top Slab X	3A-100
Figure 3A.8.2-1c. FRS (Effect of Single Envelope Ground Motion) – Vent Wall Top X ..	3A-101
Figure 3A.8.2-1d. FRS (Effect of Single Envelope Ground Motion) – RSW Top X	3A-101
Figure 3A.8.2-1e. FRS (Effect of Single Envelope Ground Motion) – RPV Top X	3A-102
Figure 3A.8.2-1f. FRS (Effect of Single Envelope Ground Motion) – RB/FB Basemat X ..	3A-102
Figure 3A.8.2-1g. FRS (Effect of Single Envelope Ground Motion) – CB Top X	3A-103
Figure 3A.8.2-1h. FRS (Effect of Single Envelope Ground Motion) – CB Basemat X	3A-103
Figure 3A.8.2-2a. FRS (Effect of Single Envelope Ground Motion) – RB/FB Refueling Floor Y	3A-104
Figure 3A.8.2-2b. FRS (Effect of Single Envelope Ground Motion) – RCCV Top Slab Y	3A-104
Figure 3A.8.2-2c. FRS (Effect of Single Envelope Ground Motion) – Vent Wall Top Y ..	3A-105
Figure 3A.8.2-2d. FRS (Effect of Single Envelope Ground Motion) – RSW Top Y	3A-105
Figure 3A.8.2-2e. FRS (Effect of Single Envelope Ground Motion) – RPV Top Y	3A-106
Figure 3A.8.2-2f. FRS (Effect of Single Envelope Ground Motion) – RB/FB Basemat Y ..	3A-106
Figure 3A.8.2-2g. FRS (Effect of Single Envelope Ground Motion) – CB Top Y	3A-107
Figure 3A.8.2-2h. FRS (Effect of Single Envelope Ground Motion) – CB Basemat Y	3A-107
Figure 3A.8.2-3a. FRS (Effect of Single Envelope Ground Motion) – RB/FB Refueling Floor Z	3A-108
Figure 3A.8.2-3b. FRS (Effect of Single Envelope Ground Motion) – RCCV Top Slab Z ..	3A-108
Figure 3A.8.2-3c. FRS (Effect of Single Envelope Ground Motion) – Vent Wall Top Z ..	3A-109
Figure 3A.8.2-3d. FRS (Effect of Single Envelope Ground Motion) – RSW Top Z	3A-109
Figure 3A.8.2-3e. FRS (Effect of Single Envelope Ground Motion) – RPV Top Z	3A-110
Figure 3A.8.2-3f. FRS (Effect of Single Envelope Ground Motion) – RB/FB Basemat Z ..	3A-110
Figure 3A.8.2-3g. FRS (Effect of Single Envelope Ground Motion) – CB Top Z	3A-111
Figure 3A.8.2-3h. FRS (Effect of Single Envelope Ground Motion) – CB Basemat Z	3A-111
Figure 3A.8.3-1a. FRS (Effect of Updated Design of RSW and VW) – RB/FB Refueling Floor X	3A-112
Figure 3A.8.3-1b. FRS (Effect of Updated Design of RSW and VW) – RCCV Top Slab X	3A-112
Figure 3A.8.3-1c. FRS (Effect of Updated Design of RSW and VW) – Vent Wall Top X	3A-113
Figure 3A.8.3-1d. FRS (Effect of Updated Design of RSW and VW) – RSW Top X	3A-113
Figure 3A.8.3-1e. FRS (Effect of Updated Design of RSW and VW) – RPV Top X	3A-114

Figure 3A.8.3-1f. FRS (Effect of Updated Design of RSW and VW) – RB/FB Basemat X	3A-114
Figure 3A.8.3-2a. FRS (Effect of Updated Design of RSW and VW) – RB/FB Refueling Floor Y	3A-115
Figure 3A.8.3-2b. FRS (Effect of Updated Design of RSW and VW) – RCCV Top Slab Y	3A-115
Figure 3A.8.3-2c. FRS (Effect of Updated Design of RSW and VW) – Vent Wall Top Y	3A-116
Figure 3A.8.3-2d. FRS (Effect of Updated Design of RSW and VW) – RSW Top Y	3A-116
Figure 3A.8.3-2e. FRS (Effect of Updated Design of RSW and VW) – RPV Top Y	3A-117
Figure 3A.8.3-2f. FRS (Effect of Updated Design of RSW and VW) – RB/FB Basemat Y	3A-117
Figure 3A.8.3-3a. FRS (Effect of Updated Design of RSW and VW) – RB/FB Refueling Floor Z	3A-118
Figure 3A.8.3-3b. FRS (Effect of Updated Design of RSW and VW) – RCCV Top Slab Z	3A-118
Figure 3A.8.3-3c. FRS (Effect of Updated Design of RSW and VW) – Vent Wall Top Z	3A-119
Figure 3A.8.3-3d. FRS (Effect of Updated Design of RSW and VW) – RSW Top Z	3A-119
Figure 3A.8.3-3e. FRS (Effect of Updated Design of RSW and VW) – RPV Top Z	3A-120
Figure 3A.8.3-3f. FRS (Effect of Updated Design of RSW and VW) – RB/FB Basemat Z	3A-120
Figure 3A.8.4-1a. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor X	3A-121
Figure 3A.8.4-1b. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab X	3A-121
Figure 3A.8.4-1c. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top X	3A-122
Figure 3A.8.4-1d. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RSW Top X	3A-122
Figure 3A.8.4-1e. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RPV Top X	3A-123
Figure 3A.8.4-1f. FRS (Effect of Infill 50% Concrete Stiffness of VW and D/F) – RB/FB Basemat X	3A-123
Figure 3A.8.4-2a. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor Y	3A-124
Figure 3A.8.4-2b. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab Y	3A-124
Figure 3A.8.4-2c. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top Y	3A-125
Figure 3A.8.4-2d. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RSW Top Y	3A-125
Figure 3A.8.4-2e. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RPV Top Y	3A-126
Figure 3A.8.4-2f. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RB/FB Basemat Y	3A-126

Figure 3A.8.4-3a. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor Z	3A-127
Figure 3A.8.4-3b. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab Z	3A-127
Figure 3A.8.4-3c. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top Z	3A-128
Figure 3A.8.4-3d. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RSW Top Z	3A-128
Figure 3A.8.4-3e. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RPV Top Z	3A-129
Figure 3A.8.4-3f. FRS (Effect of 50% Infill Concrete Stiffness of VW and D/F) – RB/FB Basemat Z	3A-129
Figure 3A.8.4-4a. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor X	3A-130
Figure 3A.8.4-4b. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab X	3A-130
Figure 3A.8.4-4c. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top X	3A-131
Figure 3A.8.4-4d. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RSW Top X	3A-131
Figure 3A.8.4-4e. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RPV Top X	3A-132
Figure 3A.8.4-4f. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Basemat X	3A-132
Figure 3A.8.4-5a. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor Y	3A-133
Figure 3A.8.4-5b. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab Y	3A-133
Figure 3A.8.4-5c. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top Y	3A-134
Figure 3A.8.4-5d. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RSW Top Y	3A-134
Figure 3A.8.4-5e. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RPV Top Y	3A-135
Figure 3A.8.4-5f. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Basemat Y	3A-135
Figure 3A.8.4-6a. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Refueling Floor Z	3A-136
Figure 3A.8.4-6b. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RCCV Top Slab Z	3A-136
Figure 3A.8.4-6c. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – Vent Wall Top Z	3A-137
Figure 3A.8.4-6d. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RSW Top Z	3A-137
Figure 3A.8.4-6e. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RPV Top Z	3A-138

Figure 3A.8.4-6f. FRS (Effect of 100% Infill Concrete Stiffness of VW and D/F) – RB/FB Basemat Z	3A-138
Figure 3A.8.5-1a. FRS (Effect of LOCA Flooding) – RB/FB Refueling Floor X	3A-139
Figure 3A.8.5-1b. FRS (Effect of LOCA Flooding) – RCCV Top Slab X	3A-139
Figure 3A.8.5-1c. FRS (Effect of LOCA Flooding) – Vent Wall Top X	3A-140
Figure 3A.8.5-1d. FRS (Effect of LOCA Flooding) – RSW Top X	3A-140
Figure 3A.8.5-1e. FRS (Effect of LOCA Flooding) – RPV Top X	3A-141
Figure 3A.8.5-1f. FRS (Effect of LOCA Flooding) – RB/FB Basemat X	3A-141
Figure 3A.8.5-2a. FRS (Effect of LOCA Flooding) – RB/FB Refueling Floor Y	3A-142
Figure 3A.8.5-2b. FRS (Effect of LOCA Flooding) – RCCV Top Slab Y	3A-142
Figure 3A.8.5-2c. FRS (Effect of LOCA Flooding) – Vent Wall Top Y	3A-143
Figure 3A.8.5-2d. FRS (Effect of LOCA Flooding) – RSW Top Y	3A-143
Figure 3A.8.5-2e. FRS (Effect of LOCA Flooding) – RPV Top Y	3A-144
Figure 3A.8.5-2f. FRS (Effect of LOCA Flooding) – RB/FB Basemat Y	3A-144
Figure 3A.8.5-3a. FRS (Effect of LOCA Flooding) – RB/FB Refueling Floor Z	3A-145
Figure 3A.8.5-3b. FRS (Effect of LOCA Flooding) – RCCV Top Slab Z	3A-145
Figure 3A.8.5-3c. FRS (Effect of LOCA Flooding) – Vent Wall Top Z	3A-146
Figure 3A.8.5-3d. FRS (Effect of LOCA Flooding) – RSW Top Z	3A-146
Figure 3A.8.5-3e. FRS (Effect of LOCA Flooding) – RPV Top Z	3A-147
Figure 3A.8.5-3f. FRS (Effect of LOCA Flooding) – RB/FB Basemat Z	3A-147
Figure 3A.8.6-1a. FRS (Effect of Layered Sites) – RB/FB Refueling Floor X	3A-148
Figure 3A.8.6-1b. FRS (Effect of Layered Sites) – RCCV Top Slab X	3A-148
Figure 3A.8.6-1c. FRS (Effect of Layered Sites) – Vent Wall Top X	3A-149
Figure 3A.8.6-1d. FRS (Effect of Layered Sites) – RSW Top X	3A-149
Figure 3A.8.6-1e. FRS (Effect of Layered Sites) – RPV Top X	3A-150
Figure 3A.8.6-1f. FRS (Effect of Layered Sites) – RB/FB Basemat X	3A-150
Figure 3A.8.6-1g. FRS (Effect of Layered Sites) – CB Top X	3A-151
Figure 3A.8.6-1h. FRS (Effect of Layered Sites) – CB Basemat X	3A-151
Figure 3A.8.6-1i. FRS (Effect of Layered Sites) – FWS Wall Top X	3A-152
Figure 3A.8.6-1j. FRS (Effect of Layered Sites) – FWS Basemat X	3A-152
Figure 3A.8.6-1k. FRS (Effect of Layered Sites) – FPE Top X	3A-153
Figure 3A.8.6-1l. FRS (Effect of Layered Sites) – FPE Basemat X	3A-153
Figure 3A.8.6-2a. FRS (Effect of Layered Sites) – RB/FB Refueling Floor Y	3A-154
Figure 3A.8.6-2b. FRS (Effect of Layered Sites) – RCCV Top Slab Y	3A-154
Figure 3A.8.6-2c. FRS (Effect of Layered Sites) – Vent Wall Top Y	3A-155
Figure 3A.8.6-2d. FRS (Effect of Layered Sites) – RSW Top Y	3A-155
Figure 3A.8.6-2e. FRS (Effect of Layered Sites) – RPV Top Y	3A-156
Figure 3A.8.6-2f. FRS (Effect of Layered Sites) – RB/FB Basemat Y	3A-156
Figure 3A.8.6-2g. FRS (Effect of Layered Sites) – CB Top Y	3A-157
Figure 3A.8.6-2h. FRS (Effect of Layered Sites) – CB Basemat Y	3A-157
Figure 3A.8.6-2i. FRS (Effect of Layered Sites) – FWS Wall Top Y	3A-158
Figure 3A.8.6-2j. FRS (Effect of Layered Sites) – FWS Basemat Y	3A-158
Figure 3A.8.6-2k. FRS (Effect of Layered Sites) – FPE Top Y	3A-159
Figure 3A.8.6-2l. FRS (Effect of Layered Sites) – FPE Basemat Y	3A-159
Figure 3A.8.6-3a. FRS (Effect of Layered Sites) – RB/FB Refueling Floor Z	3A-160
Figure 3A.8.6-3b. FRS (Effect of Layered Sites) – RCCV Top Slab Z	3A-160

Figure 3A.8.6-3c. FRS (Effect of Layered Sites) – Vent Wall Top Z.....	3A-161
Figure 3A.8.6-3d. FRS (Effect of Layered Sites) – RSW Top Z.....	3A-161
Figure 3A.8.6-3e. FRS (Effect of Layered Sites) – RPV Top Z.....	3A-162
Figure 3A.8.6-3f. FRS (Effect of Layered Sites) – RB/FB Basemat Z.....	3A-162
Figure 3A.8.6-3g. FRS (Effect of Layered Sites) – CB Top Z.....	3A-163
Figure 3A.8.6-3h. FRS (Effect of Layered Sites) – CB Basemat Z.....	3A-163
Figure 3A.8.6-3i. FRS (Effect of Layered Sites) – FWS Wall Top Z.....	3A-164
Figure 3A.8.6-3j. FRS (Effect of Layered Sites) – FWS Basemat Z.....	3A-164
Figure 3A.8.6-3k. FRS (Effect of Layered Sites) – FPE Top Z.....	3A-165
Figure 3A.8.6-3l. FRS (Effect of Layered Sites) – FPE Basemat Z.....	3A-165
Figure 3A.8.7-1a. FRS (Effect of Embedment) – RB/FB Refueling Floor X.....	3A-166
Figure 3A.8.7-1b. FRS (Effect of Embedment) – RCCV Top Slab X.....	3A-166
Figure 3A.8.7-1c. FRS (Effect of Embedment) – Vent Wall Top X.....	3A-167
Figure 3A.8.7-1d. FRS (Effect of Embedment) – RSW Top X.....	3A-167
Figure 3A.8.7-1e. FRS (Effect of Embedment) – RPV Top X.....	3A-168
Figure 3A.8.7-1f. FRS (Effect of Embedment) – RB/FB Basemat X.....	3A-168
Figure 3A.8.7-1g. FRS (Effect of Embedment) – CB Top X.....	3A-169
Figure 3A.8.7-1h. FRS (Effect of Embedment) – CB Basemat X.....	3A-169
Figure 3A.8.7-1i. FRS (Effect of Embedment) – FWS Wall Top X.....	3A-170
Figure 3A.8.7-1j. FRS (Effect of Embedment) – FWS Basemat X.....	3A-170
Figure 3A.8.7-1k. FRS (Effect of Embedment) – FPE Top X.....	3A-171
Figure 3A.8.7-1l. FRS (Effect of Embedment) – FPE Basemat X.....	3A-171
Figure 3A.8.7-2a. FRS (Effect of Embedment) – RB/FB Refueling Floor Y.....	3A-172
Figure 3A.8.7-2b. FRS (Effect of Embedment) – RCCV Top Slab Y.....	3A-172
Figure 3A.8.7-2c. FRS (Effect of Embedment) – Vent Wall Top Y.....	3A-173
Figure 3A.8.7-2d. FRS (Effect of Embedment) – RSW Top Y.....	3A-173
Figure 3A.8.7-2e. FRS (Effect of Embedment) – RPV Top Y.....	3A-174
Figure 3A.8.7-2f. FRS (Effect of Embedment) – RB/FB Basemat Y.....	3A-174
Figure 3A.8.7-2g. FRS (Effect of Embedment) – CB Top Y.....	3A-175
Figure 3A.8.7-2h. FRS (Effect of Embedment) – CB Basemat Y.....	3A-175
Figure 3A.8.7-2i. FRS (Effect of Embedment) – FWS Wall Top Y.....	3A-176
Figure 3A.8.7-2j. FRS (Effect of Embedment) – FWS Basemat Y.....	3A-176
Figure 3A.8.7-2k. FRS (Effect of Embedment) – FPE Top Y.....	3A-177
Figure 3A.8.7-2l. FRS (Effect of Embedment) – FPE Basemat Y.....	3A-177
Figure 3A.8.7-3a. FRS (Effect of Embedment) – RB/FB Refueling Floor Z.....	3A-178
Figure 3A.8.7-3b. FRS (Effect of Embedment) – RCCV Top Slab Z.....	3A-178
Figure 3A.8.7-3c. FRS (Effect of Embedment) – Vent Wall Top Z.....	3A-179
Figure 3A.8.7-3d. FRS (Effect of Embedment) – RSW Top Z.....	3A-179
Figure 3A.8.7-3e. FRS (Effect of Embedment) – RPV Top Z.....	3A-180
Figure 3A.8.7-3f. FRS (Effect of Embedment) – RB/FB Basemat Z.....	3A-180
Figure 3A.8.7-3g. FRS (Effect of Embedment) – CB Top Z.....	3A-181
Figure 3A.8.7-3h. FRS (Effect of Embedment) – CB Basemat Z.....	3A-181
Figure 3A.8.7-3i. FRS (Effect of Embedment) – FWS Wall Top Z.....	3A-182
Figure 3A.8.7-3j. FRS (Effect of Embedment) – FWS Basemat Z.....	3A-182
Figure 3A.8.7-3k. FRS (Effect of Embedment) – FPE Top Z.....	3A-183
Figure 3A.8.7-3l. FRS (Effect of Embedment) – FPE Basemat Z.....	3A-183

Figure 3A.8.8-1. Lateral Soil Pressure – RB/FB R1 and F3 Wall.....	3A-184
Figure 3A.8.8-2. Lateral Soil Pressure – RB/FB RA and RG Wall.....	3A-185
Figure 3A.8.8-3. Lateral Soil Pressure - CB C1 and C5 Wall	3A-186
Figure 3A.8.8-4. Lateral Soil Pressure - CB CA and CD Wall	3A-187
Figure 3A.8.9-1a. FRS (Effect of Concrete Cracking) – RB/FB Refueling Floor X	3A-188
Figure 3A.8.9-1b. FRS (Effect of Concrete Cracking) – RCCV Top Slab X.....	3A-188
Figure 3A.8.9-1c. FRS (Effect of Concrete Cracking) – Vent Wall Top X	3A-189
Figure 3A.8.9-1d. FRS (Effect of Concrete Cracking) – RSW Top X.....	3A-189
Figure 3A.8.9-1e. FRS (Effect of Concrete Cracking) – RPV Top X.....	3A-190
Figure 3A.8.9-1f. FRS (Effect of Concrete Cracking) – RB/FB Basemat X.....	3A-190
Figure 3A.8.9-1g. FRS (Effect of Concrete Cracking) – CB Top X	3A-191
Figure 3A.8.9-1h. FRS (Effect of Concrete Cracking) – CB Basemat X.....	3A-191
Figure 3A.8.9-1i. FRS (Effect of Concrete Cracking) – FWS Wall Top X	3A-192
Figure 3A.8.9-1j. FRS (Effect of Concrete Cracking) – FWS Basemat X.....	3A-192
Figure 3A.8.9-1k. FRS (Effect of Concrete Cracking) – FPE Top X.....	3A-193
Figure 3A.8.9-1l. FRS (Effect of Concrete Cracking) – FPE Basemat X	3A-193
Figure 3A.8.9-2a. FRS (Effect of Concrete Cracking) – RB/FB Refueling Floor Y	3A-194
Figure 3A.8.9-2b. FRS (Effect of Concrete Cracking) – RCCV Top Slab Y.....	3A-194
Figure 3A.8.9-2c. FRS (Effect of Concrete Cracking) – Vent Wall Top Y	3A-195
Figure 3A.8.9-2d. FRS (Effect of Concrete Cracking) – RSW Top Y.....	3A-195
Figure 3A.8.9-2e. FRS (Effect of Concrete Cracking) – RPV Top Y	3A-196
Figure 3A.8.9-2f. FRS (Effect of Concrete Cracking) – RB/FB Basemat Y.....	3A-196
Figure 3A.8.9-2g. FRS (Effect of Concrete Cracking) – CB Top Y	3A-197
Figure 3A.8.9-2h. FRS (Effect of Concrete Cracking) – CB Basemat Y	3A-197
Figure 3A.8.9-2i. FRS (Effect of Concrete Cracking) – FWS Wall Top Y	3A-198
Figure 3A.8.9-2j. FRS (Effect of Concrete Cracking) – FWS Basemat Y	3A-198
Figure 3A.8.9-2k. FRS (Effect of Concrete Cracking) – FPE Top Y.....	3A-199
Figure 3A.8.9-2l. FRS (Effect of Concrete Cracking) – FPE Basemat Y	3A-199
Figure 3A.8.11-1. FRS (Effect of Structure-Structure Interaction) – CB Top X	3A-200
Figure 3A.8.11-2. FRS (Effect of Structure-Structure Interaction) – CB Basemat X.....	3A-200
Figure 3A.8.11-3. FRS (Effect of Structure-Structure Interaction) – CB Top Y	3A-201
Figure 3A.8.11-4. FRS (Effect of Structure-Structure Interaction) – CB Basemat Y	3A-201
Figure 3A.8.11-5. FRS (Effect of Structure-Structure Interaction) – CB Top Z.....	3A-202
Figure 3A.8.11-6. FRS (Effect of Structure-Structure Interaction) – CB Basemat Z	3A-202
Figure 3A.8.11-7. FRS (Effect of Structure-Structure Interaction) – CB Top X	3A-203
Figure 3A.8.11-8. FRS (Effect of Structure-Structure Interaction) – CB Basemat X.....	3A-203
Figure 3A.8.11-9. FRS (Effect of Structure-Structure Interaction) – CB Top Y	3A-204
Figure 3A.8.11-10. FRS (Effect of Structure-Structure Interaction) – CB Basemat Y	3A-204
Figure 3A.8.11-11. FRS (Effect of Structure-Structure Interaction) – CB Top Z.....	3A-205
Figure 3A.8.11-12. FRS (Effect of Structure-Structure Interaction) – CB Basemat Z	3A-205
Figure 3A.8.11-13. FRS (Effect of Structure-Structure Interaction) – FWS Wall Top X... 3A-206	
Figure 3A.8.11-14. FRS (Effect of Structure-Structure Interaction) – FWS Basemat X 3A-206	
Figure 3A.8.11-15. FRS (Effect of Structure-Structure Interaction) – FPE Top X..... 3A-207	
Figure 3A.8.11-16. FRS (Effect of Structure-Structure Interaction) – FPE Basemat X 3A-207	
Figure 3A.8.11-17. FRS (Effect of Structure-Structure Interaction) – FWS Wall Top Y... 3A-208	
Figure 3A.8.11-18. FRS (Effect of Structure-Structure Interaction) – FWS Basemat Y 3A-208	

Figure 3A.8.11-19. FRS (Effect of Structure-Structure Interaction) – FPE Top Y	3A-209
Figure 3A.8.11-20. FRS (Effect of Structure-Structure Interaction) – FPE Basemat Y	3A-209
Figure 3A.8.11-21. FRS (Effect of Structure-Structure Interaction) – FWS Wall Top Z ...	3A-210
Figure 3A.8.11-22. FRS (Effect of Structure-Structure Interaction) – FWS Basemat Z.....	3A-210
Figure 3A.8.11-23. FRS (Effect of Structure-Structure Interaction) – FPE Top Z	3A-211
Figure 3A.8.11-24. FRS (Effect of Structure-Structure Interaction) – FPE Basemat Z.....	3A-211
Figure 3A.9-1a. Enveloping Floor Response Spectra – RB/FB Refueling Floor X	3A-237
Figure 3A.9-1b. Enveloping Floor Response Spectra – RCCV Top Slab X	3A-237
Figure 3A.9-1c. Enveloping Floor Response Spectra – Vent Wall Top X.....	3A-238
Figure 3A.9-1d. Enveloping Floor Response Spectra – RSW Top X.....	3A-238
Figure 3A.9-1e. Enveloping Floor Response Spectra – RPV Top X	3A-239
Figure 3A.9-1f. Enveloping Floor Response Spectra – RB/FB Basemat X.....	3A-239
Figure 3A.9-1g. Enveloping Floor Response Spectra – CB Top X	3A-240
Figure 3A.9-1h. Enveloping Floor Response Spectra – CB Basemat X.....	3A-240
Figure 3A.9-1i. Enveloping Floor Response Spectra – FWS Wall Top X.....	3A-241
Figure 3A.9-1j. Enveloping Floor Response Spectra – FWS Basemat X	3A-241
Figure 3A.9-1k. Enveloping Floor Response Spectra – FPE Top X	3A-242
Figure 3A.9-1l. Enveloping Floor Response Spectra – FPE Basemat X.....	3A-242
Figure 3A.9-2a. Enveloping Floor Response Spectra – RB/FB Refueling Floor Y.....	3A-243
Figure 3A.9-2b. Enveloping Floor Response Spectra – RCCV Top Slab Y	3A-243
Figure 3A.9-2c. Enveloping Floor Response Spectra – Vent Wall Top Y.....	3A-244
Figure 3A.9-2d. Enveloping Floor Response Spectra – RSW Top Y	3A-244
Figure 3A.9-2e. Enveloping Floor Response Spectra – RPV Top Y.....	3A-245
Figure 3A.9-2f. Enveloping Floor Response Spectra – RB/FB Basemat Y	3A-245
Figure 3A.9-2g. Enveloping Floor Response Spectra – CB Top Y.....	3A-246
Figure 3A.9-2h. Enveloping Floor Response Spectra – CB Basemat Y	3A-246
Figure 3A.9-2i. Enveloping Floor Response Spectra – FWS Wall Top Y	3A-247
Figure 3A.9-2j. Enveloping Floor Response Spectra – FWS Basemat Y	3A-247
Figure 3A.9-2k. Enveloping Floor Response Spectra – FPE Top Y.....	3A-248
Figure 3A.9-2l. Enveloping Floor Response Spectra – FPE Basemat Y.....	3A-248
Figure 3A.9-3a. Enveloping Floor Response Spectra – RB/FB Refueling Floor Z.....	3A-249
Figure 3A.9-3b. Enveloping Floor Response Spectra – RCCV Top Slab Z	3A-249
Figure 3A.9-3c. Enveloping Floor Response Spectra – Vent Wall Top Z	3A-250
Figure 3A.9-3d. Enveloping Floor Response Spectra – RSW Top Z	3A-250
Figure 3A.9-3e. Enveloping Floor Response Spectra – RPV Top Z.....	3A-251
Figure 3A.9-3f. Enveloping Floor Response Spectra – RB/FB Basemat Z	3A-251
Figure 3A.9-3g. Enveloping Floor Response Spectra – CB Top Z.....	3A-252
Figure 3A.9-3h. Enveloping Floor Response Spectra – CB Basemat Z	3A-252
Figure 3A.9-3i. Enveloping Floor Response Spectra – FWS Wall Top Z	3A-253
Figure 3A.9-3j. Enveloping Floor Response Spectra – FWS Basemat Z	3A-253
Figure 3A.9-3k. Enveloping Floor Response Spectra – FPE Top Z.....	3A-254
Figure 3A.9-3l. Enveloping Floor Response Spectra – FPE Basemat Z]*	3A-254
Figure 3F-1. Beam Model for Annulus Pressurization Load	3F-7
Figure 3F-2. RB/FB 3D Shell Model.....	3F-8
Figure 3F-3. RB/FB 3D Shell Model (0°-180° Direction)	3F-9
Figure 3F-4. RB/FB 3D Shell Model (90°-270° Direction)	3F-10

Figure 3F-5. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 701, Vertical	3F-11
Figure 3F-6. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 706, Vertical	3F-12
Figure 3F-7. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 208, Vertical	3F-13
Figure 3F-8. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 701, Horizontal	3F-14
Figure 3F-9. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 706, Horizontal	3F-15
Figure 3F-10. Floor Response Spectra—Annulus Pressurization Envelope, Node Family: 208, Horizontal	3F-16
Figure 3F-11. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1104, Z-direction (Vertical)	3F-17
Figure 3F-12. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1254, Z-direction (Vertical)	3F-18
Figure 3F-13. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1119, Z-direction (Vertical)	3F-19
Figure 3F-14. Floor Response Spectra—SRV Discharge Envelope, Node Family: 18P1, Z-direction (Vertical)	3F-20
Figure 3F-15. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1104, X-direction (0°-180°)	3F-21
Figure 3F-16. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1254, X-direction (0°-180°)	3F-22
Figure 3F-17. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1119, X-direction (0°-180°)	3F-23
Figure 3F-18. Floor Response Spectra—SRV Discharge Envelope, Node Family: 18P1, X-direction (0°-180°)	3F-24
Figure 3F-19. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1104, Y-direction (90°-270°)	3F-25
Figure 3F-20. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1254, Y-direction (90°-270°)	3F-26
Figure 3F-21. Floor Response Spectra—SRV Discharge Envelope, Node Family: 1119, Y-direction (90°-270°)	3F-27
Figure 3F-22. Floor Response Spectra—SRV Discharge Envelope, Node Family: 18P1, Y-direction (90°-270°)	3F-28
Figure 3F-23. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1104, Z-direction (Vertical)	3F-29
Figure 3F-24. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1254, Z-direction (Vertical)	3F-30
Figure 3F-25. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1119, Z-direction (Vertical)	3F-31
Figure 3F-26. Floor Response Spectra—Chugging & CO Envelope, Node Family: 18P1, Z-direction (Vertical)	3F-32
Figure 3F-27. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1104, X-direction (0°-180°)	3F-33

<i>Figure 3F-28. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1254, X-direction (0°-180°)</i>	3F-34
<i>Figure 3F-29. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1119, X-direction (0°-180°)</i>	3F-35
<i>Figure 3F-30. Floor Response Spectra—Chugging & CO Envelope, Node Family: 18P1, X-direction (0°-180°)</i>	3F-36
<i>Figure 3F-31. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1104, Y-direction (90°-270°)</i>	3F-37
<i>Figure 3F-32. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1254, Y-direction (90°-270°)</i>	3F-38
<i>Figure 3F-33. Floor Response Spectra—Chugging & CO Envelope, Node Family: 1119, Y-direction (90°-270°)</i>	3F-39
<i>Figure 3F-34. Floor Response Spectra—Chugging & CO Envelope, Node Family: 18P1, Y-direction (90°-270°)]*</i>	3F-40

VOLUME 26A6642AN

Figure 3G.1-1. RB and FB Concrete Outline Plan at EL -11500	3G-125
Figure 3G.1-2. RB and FB Concrete Outline Plan at EL 4650.....	3G-126
Figure 3G.1-3. RB and FB Concrete Outline Plan at EL 17500.....	3G-127
Figure 3G.1-4. RB and FB Concrete Outline Plan at EL 27000.....	3G-128
Figure 3G.1-5. RB Concrete Outline Plan at EL 34000	3G-129
Figure 3G.1-6. RB and FB Concrete Outline N-S Section.....	3G-130
Figure 3G.1-7. RB and FB Concrete Outline E-W Section.....	3G-131
Figure 3G.1-8. Finite Element Model of RB/FB (Isometric View).....	3G-132
Figure 3G.1-9. Finite Element Model of RB/FB (Foundation Mat).....	3G-133
Figure 3G.1-10. Finite Element Model of RB/FB (RCCV Wall).....	3G-134
Figure 3G.1-11. Finite Element Model of RB/FB (RPV Pedestal)	3G-135
Figure 3G.1-12. Finite Element Model of RB/FB (Top Slab).....	3G-136
Figure 3G.1-13. Finite Element Model of RB/FB (Suppression Pool Slab)	3G-137
Figure 3G.1-14. Finite Element Model of RB/FB (External Wall: North Side).....	3G-138
Figure 3G.1-15. Finite Element Model of RB/FB (External Wall: East Side).....	3G-139
Figure 3G.1-16. Finite Element Model of RB/FB (Internal Wall on R7/F1 Column Line)	3G-140
Figure 3G.1-17. Finite Element Model of RB/FB (RCCV Internals).....	3G-141
Figure 3G.1-18. Finite Element Model of RB/FB (RCCV Liner).....	3G-142
Figure 3G.1-19. Soil Pressure at Rest.....	3G-143
Figure 3G.1-20. Sections Where Thermal Loads Are Defined	3G-144
Figure 3G.1-21. Condensation Oscillation (CO) Pressure Loads.....	3G-145
Figure 3G.1-22. Chugging (CHUG) Pressure Loads.....	3G-146
Figure 3G.1-23. SRV Pressure Loads.....	3G-147
Figure 3G.1-24. Design Seismic Shears and Moments for RB and FB Walls	3G-148
Figure 3G.1-25. Design Seismic Shears and Moments for RCCV.....	3G-149
Figure 3G.1-26. Design Seismic Shears and Moments for RPV Pedestal and Vent Wall ..	3G-150
Figure 3G.1-27. Seismic Lateral Soil Pressure.....	3G-151
Figure 3G.1-28. Sections Considered for Analysis	3G-152
Figure 3G.1-29. Force and Moment in Shell Element.....	3G-153
Figure 3G.1-30. Section Deformation for Dead Load	3G-154
Figure 3G.1-31. Section Deformation for Drywell Unit Pressure (1 MPa).....	3G-155
Figure 3G.1-32. Section Deformation for Wetwell Unit Pressure (1 MPa)	3G-156
Figure 3G.1-33. Section Deformation for Thermal Load (Normal Operation: Winter)	3G-157
Figure 3G.1-34. Section Deformation for Thermal Load (LOCA After 6 min.: Winter)....	3G-158
Figure 3G.1-35. Section Deformation for Thermal Load (LOCA After 72 hr.: Winter)	3G-159
Figure 3G.1-36. Section Deformation for Seismic Load (Horizontal: North to South)	3G-160
Figure 3G.1-37. Section Deformation for Seismic Load (Horizontal: East to West).....	3G-161
Figure 3G.1-38. Section Deformation for Seismic Load (Vertical: Upward)	3G-162
Figure 3G.1-39. Flow Chart for Structural Analysis and Design	3G-163
Figure 3G.1-40. Reinforcing Steel of Foundation Mat: Plan.....	3G-164
Figure 3G.1-41. Reinforcing Steel of Foundation Mat: Section A-A.....	3G-165
Figure 3G.1-42. Reinforcing Steel of RCCV Wall.....	3G-166
Figure 3G.1-43. Reinforcing Steel of Suppression Pool Slab	3G-167

Figure 3G.1-44. Reinforcing Steel of Top Slab	3G-168
Figure 3G.1-45. Reinforcing Steel of RPV Pedestal	3G-169
Figure 3G.1-46. Reinforcing Steel of IC/PCCS Pool Girder	3G-170
Figure 3G.1-47. List of RB Wall and Slab Reinforcement	3G-171
Figure 3G.1-48. Liner Anchor	3G-172
Figure 3G.1-49. Liner Plate Plans	3G-173
Figure 3G.1-50. Liner Plate Development Elevation	3G-174
Figure 3G.1-51. Drywell Head	3G-175
Figure 3G.1-52. Equipment Hatch	3G-176
Figure 3G.1-53. Wetwell Hatch	3G-177
Figure 3G.1-54. Personnel Airlock	3G-178
Figure 3G.1-55. Diaphragm Floor	3G-179
Figure 3G.1-56. Diaphragm Floor Slab Anchor	3G-180
Figure 3G.1-57. RPV Support Bracket & Vent Wall	3G-181
Figure 3G.1-58. Reactor Shield Wall	3G-182
Figure 3G.1-59. GDCS Pool	3G-183
Figure 3G.1-60. Comparison of Basemat Deformation without Tension Springs (NS Direction SSE)	3G-184
Figure 3G.1-61. Comparison of Basemat Deformation without Tension Springs (EW Direction SSE)	3G-185
Figure 3G.1-62. Comparison of Basemat Sectional Moments (S to N SSE)	3G-186
Figure 3G.1-63. Comparison of Basemat Sectional Moments (W to E SSE)	3G-187
Figure 3G.1-64. Comparison of Basemat Sectional Moments (E to W SSE)	3G-188
Figure 3G.1-65. Deleted	3G-189
Figure 3G.1-66. Detail Local Finite Element Model of RCCV Wall Around Upper Drywell Personnel Airlock Opening	3G-190
Figure 3G.1-67. Additional Reinforcements in RCCV Wall Around Upper Drywell Personnel Airlock Opening (Inside Face)	3G-191
Figure 3G.1-68. Additional Reinforcements in RCCV Wall Around Upper Drywell Personnel Airlock Opening (Outside Face)	3G-192
Figure 3G.1-69. Reinforcements in RCCV Wall Around Upper Drywell Personal Airlock Opening (Section)	3G-193
Figure 3G.1-70. Reinforcements in RCCV Wall Around Upper Drywell Personnel Airlock Opening (Plan)	3G-194
Figure 3G.1-71a. (Deleted)	3G-195
Figure 3G.1-71b. (Deleted)	3G-196
Figure 3G.1-72. (Deleted)	3G-197
Figure 3G.2-1. CB Concrete Outline Plan at EL -7400 and Foundation Reinforcement	3G-237
Figure 3G.2-2. CB Concrete Outline Plan at EL -2000/4650 and Section Details	3G-238
Figure 3G.2-3. CB Concrete Outline Plan at EL 9060/13800, Section and Section Detail	3G-239
Figure 3G.2-4. Finite Element Model of CB (Isometric View)	3G-240
Figure 3G.2-5. Finite Element Model of CB (Foundation Mat)	3G-241
Figure 3G.2-6. Finite Element Model of CB (External Wall: South Side)	3G-242
Figure 3G.2-8. Finite Element Model of CB (Floor Slab: EL -2000)	3G-244
Figure 3G.2-9. Finite Element Model of CB (Floor Slab: EL 4650)	3G-245

Figure 3G.2-10. Finite Element Model of CB (Floor Slab: EL 9060).....	3G-246
Figure 3G.2-11. Finite Element Model of CB (Roof: EL 13800)	3G-247
Figure 3G.2-12. Soil Pressure at Rest.....	3G-248
Figure 3G.2-13. Sections Where Thermal Loads Are Defined	3G-249
Figure 3G.2-14. Design Seismic Shears and Moments for CB	3G-250
Figure 3G.2-15. Seismic Lateral Soil Pressure.....	3G-251
Figure 3G.2-16. Force and Moment in Shell Element.....	3G-252
Figure 3G.2-17. Deleted	3G-253
Figure 3G.3-1. Sections Where Thermal Loads Are Defined	3G-277
Figure 3G.3-2. Section Considered for Analysis	3G-278
Figure 3G.3-3. Force and Moment in Shell Element.....	3G-279
Figure 3G.3-4. Reinforcing Steel of Spent Fuel Pool.....	3G-280
Figure 3G.3-5. List of FB Wall and Slab Reinforcement.....	3G-281
Figure 3G.4-1. FWSC Concrete Outline and Typical Rebar Arrangement.....	3G-310
Figure 3G.4-2. Finite Element Model of FWSC (Isometric View)	3G-311
Figure 3G.4-3a. Finite Element Model of FWSC (Foundation Mat)	3G-312
Figure 3G.4-3b. Finite Element Model of FWSC (Center Shear Key and South Shear Key of Basemat).....	3G-313
Figure 3G.4-4. Finite Element Model of FWSC (South FWS Wall).....	3G-314
Figure 3G.4-5. Finite Element Model of FWSC (FPE Wall: East and South)	3G-315
Figure 3G.4-6. Finite Element Model of FWSC (FPE Roof Slab, South FWS Roof Slab)	3G-316
Figure 3G.4-7. Sections Where Thermal Loads Are Defined	3G-317
Figure 3G.4-8. Design Seismic Shears and Moments for FWSC (FWS).....	3G-318
Figure 3G.4-9. Design Seismic Shears and Moments for FWSC (FPE)	3G-319
Figure 3G.4-10. Force and Moment in Shell Element.....	3G-320
Figure 3G.4-11. (Deleted).....	3G-321
Figure 3G.5-2. DW Design Temperature Curve (ENV) vs. TRACG Medium-Term Bounding Temperature Curve.....	3G-366
Figure 3G.5-3. DW Design Temperature Curve (ENV) vs. TRACG Long-Term Bounding Temperature Curve.....	3G-367
Figure 3G.5-4. DW Integrated Design Temperature Curve vs. TRACG Short-Term Bounding Temperature Curve.....	3G-367
Figure 3G.5-5. DW Integrated Design Temperature Curve vs. TRACG Medium-Term Bounding Temperature Curve.....	3G-368
Figure 3G.5-6. DW Integrated Design Temperature Curve vs. TRACG Long-Term Bounding Temperature Curve.....	3G-368
Figure 3G.5-7. WW Design Temperature Curve (ENV) vs. TRACG Short-Term Bounding Temperature Curve.....	3G-369
Figure 3G.5-8. WW Design Temperature Curve (ENV) vs. TRACG Medium-Term Bounding Temperature Curve.....	3G-369
Figure 3G.5-9. WW Design Temperature Curve (ENV) vs. TRACG Long-Term Bounding Temperature Curve.....	3G-370
Figure 3G.5-10. WW Integrated Design Temperature Curve vs. TRACG Short-Term Bounding Temperature Curve.....	3G-370

Figure 3G.5-11. WW Integrated Design Temperature Curve vs. TRACG Medium-Term Bounding Temperature Curve.....	3G-371
Figure 3G.5-12. WW Integrated Design Temperature Curve vs. TRACG Long-Term Bounding Temperature Curve.....	3G-371
Figure 3G.5-13. Temperature Distributions in RB Upper Pools	3G-372
Figure 3G.5-14. RB Upper Pools - Slab Sections for Heat Transfer Calculation	3G-373
Figure 3G.5-15. RB Upper Pools - Wall Sections for Heat Transfer Calculation.....	3G-374
Figure 3G.5-16. Finite Element Model Around RB Upper Pools	3G-374
Figure 3G.5-17. RB Upper Pools - Elements Selected for Evaluation (Top Slab).....	3G-375
Figure 3G.5-18. RB Upper Pools - Elements Selected for Evaluation (Floor Slab at EL27000)	3G-376
Figure 3G.5-19. RB Upper Pools - Elements Selected for Evaluation (Pool Girder)	3G-377
Figure 3G.5-20. RB Upper Pools - Elements Selected for Evaluation (IC/PCCS Pool Wall in NS Direction)	3G-377
Figure 3G.6-1. RB Concrete Outline Plan at EL -11500	3G-396
Figure 3G.6-2. RB Concrete Outline Plan at EL -6400	3G-397
Figure 3G.6-3. RB Concrete Outline Plan at EL -1000	3G-398
Figure 3G.6-4. RB Concrete Outline Plan at EL 4650	3G-399
Figure 3G.6-5. RB Concrete Outline Plan at EL 9060	3G-400
Figure 3G.6-6. RB Concrete Outline Plan at EL 13570	3G-401
Figure 3G.6-7. RB Concrete Outline Plan at EL 17500	3G-402
Figure 3G.6-8. RB Concrete Outline Plan at EL 27000	3G-403
Figure 3G.6-9. RB Concrete Outline Plan at EL 34000	3G-404
Figure 3G.6-10. RB Concrete Outline N-S Section.....	3G-405
Figure 3G.6-11. RB Concrete Outline E-W Section	3G-406
Figure 3G.6-12. CB Concrete Outline Plan at EL -7400	3G-407
Figure 3G.6-13. CB Concrete Outline Plan at EL -2000	3G-408
Figure 3G.6-14. CB Concrete Outline Plan at EL 4650	3G-409
Figure 3G.6-15. CB Concrete Outline Plan at EL 9060	3G-410
Figure 3G.6-16. CB Concrete Outline E-W Section	3G-411
Figure 3G.6-17. FB Concrete Outline Plan at EL -11500.....	3G-412
Figure 3G.6-18. FB Concrete Outline Plan at EL -6400.....	3G-413
Figure 3G.6-19. FB Concrete Outline Plan at EL -1000.....	3G-414
Figure 3G.6-20. FB Concrete Outline Plan at EL 4650.....	3G-415
Figure 3G.6-21. FB Concrete Outline Plan at EL 22500.....	3G-416
Figure 3G.6-22. FB Concrete Outline N-S Section	3G-417
Figure 3H-1. Control Room Habitability Area.....	3H-30
Figure 3H-2. Control Room Habitability Area Transient Analysis Heat up Profile – 0% Exceedance Maximum Temperature Case.....	3H-31
Figure 3H-3. Control Room Habitability Area Transient Analysis Relative Humidity Profile– 0% Exceedance Maximum Temperature Case.....	3H-31
Figure 3J-1. Simplified Piping Models.....	3J-7
Figure 3J-2. Representation of Pipe With Both Ends Supported With a Longitudinal Break	3J-8
Figure 3L-1. Typical Chimney Assembly	3L-32
Figure 3L-2. Typical Steam Dryer Assembly.....	3L-33

VOLUME 26A6642AP

Figure 4.1-1 Fuel Bundle, Neutron Sources, Neutron Detectors and Control Rod Arrangement	4.1-6
Figure 4.2-1. Axial Power Distributions (Full Length Fuel Rod)	4.2-14
Figure 4.2-2. Fuel Assembly	4.2-15
Figure 4.2-3. Typical Control Rod Assembly	4.2-16
Figure 4.2-4. Typical ESBWR Control Rod Configuration	4.2-17
Figure 4.3-1. (Deleted)	4.3-14
Figure 4.3-2. (Deleted)	4.3-14
Figure 4.3-3. (Deleted)	4.3-14
Figure 4.3-4. (Deleted)	4.3-14
Figure 4.3-5. (Deleted)	4.3-14
Figure 4.4-1. Typical ESBWR Core Power – Feedwater Temperature Operating Domain/Map	4.4-24
Figure 4.6-1. Fine Motion Control Rod Drive Schematic	4.6-31
Figure 4.6-2. Fine Motion Control Rod Drive Unit (Cutaway)	4.6-32
Figure 4.6-3. Continuous Full-in Indicating Device	4.6-33
Figure 4.6-4. Control Rod Separation Detection	4.6-34
Figure 4.6-5. Control Rod to Control Rod Drive Coupling	4.6-35
Figure 4.6-6. FMCRD Electro-Mechanical Brake	4.6-36
Figure 4.6-7. Internal CRD Blowout Support Schematic	4.6-37
Figure 4.6-8. Control Rod Drive System Simplified Process and Instrumentation Diagram	4.6-38
Figure 4.6-9. Control Rod Drive System Process Flow Diagram	4.6-39
Figure 4.6-10. FMCRD Anti-Rotation Devices	4.6-41
Figure 4A-1a. (Deleted)	4A-3
Figure 4A-1b. (Deleted)	4A-3
Figure 4A-1c. (Deleted)	4A-3
Figure 4A-1d. (Deleted)	4A-3
Figure 4A-1e. (Deleted)	4A-3
Figure 4A-2a. (Deleted)	4A-3
Figure 4A-2b. (Deleted)	4A-3
Figure 4A-2c. (Deleted)	4A-3
Figure 4A-2d. (Deleted)	4A-3
Figure 4A-2e. (Deleted)	4A-3
Figure 4A-3a. (Deleted)	4A-3
Figure 4A-3b. (Deleted)	4A-3
Figure 4A-3c. (Deleted)	4A-3
Figure 4A-3d. (Deleted)	4A-3
Figure 4A-3e. (Deleted)	4A-3
Figure 4A-4a. (Deleted)	4A-3
Figure 4A-4b. (Deleted)	4A-3
Figure 4A-4c. (Deleted)	4A-3
Figure 4A-4d. (Deleted)	4A-3
Figure 4A-4e. (Deleted)	4A-3
Figure 4A-5a. (Deleted)	4A-3
Figure 4A-5b. (Deleted)	4A-3
Figure 4A-5c. (Deleted)	4A-3

Figure 4A-5d. (Deleted)	4A-3
Figure 4A-5e. (Deleted).....	4A-3
Figure 4A-6a. (Deleted).....	4A-3
Figure 4A-6b. (Deleted)	4A-3
Figure 4A-6c. (Deleted).....	4A-3
Figure 4A-6d. (Deleted)	4A-3
Figure 4A-6e. (Deleted).....	4A-3
Figure 4A-7a. (Deleted).....	4A-3
Figure 4A-7b. (Deleted)	4A-4
Figure 4A-7c. (Deleted).....	4A-4
Figure 4A-7d. (Deleted)	4A-4
Figure 4A-7e. (Deleted).....	4A-4
Figure 4A-8a. (Deleted).....	4A-4
Figure 4A-8b. (Deleted)	4A-4
Figure 4A-8c. (Deleted).....	4A-4
Figure 4A-8d. (Deleted)	4A-4
Figure 4A-8e. (Deleted).....	4A-4
Figure 4A-9a. (Deleted).....	4A-4
Figure 4A-9b. (Deleted)	4A-4
Figure 4A-9c. (Deleted).....	4A-4
Figure 4A-9d. (Deleted)	4A-4
Figure 4A-9e. (Deleted).....	4A-4
Figure 4A-10a. (Deleted).....	4A-4
Figure 4A-10b. (Deleted)	4A-4
Figure 4A-10c. (Deleted).....	4A-4
Figure 4A-10d. (Deleted)	4A-4
Figure 4A-10e. (Deleted).....	4A-4
Figure 4A-11a. (Deleted).....	4A-4
Figure 4A-11b. (Deleted)	4A-4
Figure 4A-11c. (Deleted).....	4A-4
Figure 4A-11d. (Deleted)	4A-4
Figure 4A-11e. (Deleted).....	4A-4
Figure 4A-12a. (Deleted).....	4A-4
Figure 4A-12b. (Deleted)	4A-4
Figure 4A-12c. (Deleted).....	4A-4
Figure 4A-12d. (Deleted)	4A-4
Figure 4A-12e. (Deleted).....	4A-4
Figure 4A-13a. (Deleted).....	4A-4
Figure 4A-13b. (Deleted)	4A-4
Figure 4A-13c. (Deleted).....	4A-4
Figure 4A-13d. (Deleted)	4A-4
Figure 4A-13e. (Deleted).....	4A-5
Figure 4A-14a. (Deleted).....	4A-5
Figure 4A-14b. (Deleted)	4A-5
Figure 4A-14c. (Deleted).....	4A-5
Figure 4A-14d. (Deleted)	4A-5
Figure 4A-14e. (Deleted).....	4A-5
Figure 4A-15a. (Deleted).....	4A-5
Figure 4A-15b. (Deleted)	4A-5

Figure 4A-15c. (Deleted).....	4A-5
Figure 4A-15d. (Deleted)	4A-5
Figure 4A-15e. (Deleted).....	4A-5
Figure 4A-16a. (Deleted).....	4A-5
Figure 4A-16b. (Deleted)	4A-5
Figure 4A-16c. (Deleted).....	4A-5
Figure 4A-16d. (Deleted)	4A-5
Figure 4A-16e. (Deleted).....	4A-5
Figure 4A-17a. (Deleted).....	4A-5
Figure 4A-17b. (Deleted)	4A-5
Figure 4A-17c. (Deleted).....	4A-5
Figure 4A-17d. (Deleted)	4A-5
Figure 4A-17e. (Deleted).....	4A-5
Figure 4A-18a. (Deleted).....	4A-5
Figure 4A-18b. (Deleted)	4A-5
Figure 4A-18c. (Deleted).....	4A-5
Figure 4A-18d. (Deleted)	4A-5
Figure 4A-18e. (Deleted).....	4A-5
Figure 4A-19. (Deleted)	4A-5
Figure 4D-1. Qualitative Two-Dimensional Stability Map for ESBWR	4D-26
Figure 4D-2. Three-Dimensional Stability Map for ESBWR	4D-27
Figure 4D-3. Core Average Axial Power Shape at Different Exposures	4D-28
Figure 4D-4. (Deleted)	4D-29
Figure 4D-5. Stability in Expanded Operating Map	4D-30
Figure 4D-6. Generalized Stability Map showing Type 1 and Type 2 Instability	4D-30
Figure 4D-7. Indications of Periodic Behavior During Dodewaard Startup	4D-31
Figure 4D-8. Thermal – Hydraulic Conditions during Startup	4D-31
Figure 4D-9. Enthalpy Profiles for Different Heatup Rates.....	4D-32
Figure 4D-10. ESBWR Startup Trajectory	4D-32
Figure 4D-11. TRACG Startup Simulation: Reactor Power Trajectories	4D-33
Figure 4D-12. TRACG Startup Simulation: Pressure Response.....	4D-33
Figure 4D-13. TRACG Startup Simulation – Core Inlet Subcooling	4D-34
Figure 4D-14. TRACG Startup Simulation – Core Inlet Flow	4D-34
Figure 4D-15. Separator Void Fraction (50 MWt heatup).....	4D-35
Figure 4D-16. Separator Void Fraction (85 MWt heatup).....	4D-35
Figure 4D-17. Separator Void Fraction (125 MWt heatup).....	4D-36
Figure 4D-18. Hot Bundle Void Fraction (50 MWt heatup).....	4D-36
Figure 4D-19. Hot Bundle Void Fraction (85 MWt heatup).....	4D-37
Figure 4D-20. Hot Bundle Void Fraction (125 MWt heatup).....	4D-37
Figure 4D-21. Hot Bundle Exit Flow	4D-38
Figure 4D-22. Peripheral Bundle Exit Flow.....	4D-38
Figure 4D-23. Hot Bundle CPR	4D-39
Figure 4D-24. Peripheral Bundle CPR.....	4D-39
Figure 4D-25. ESBWR Control Rod Groups for Startup Simulation	4D-40
Figure 4D-26. Withdrawal Fraction for all Control Rods	4D-41
Figure 4D-27. Reactor Power.....	4D-41
Figure 4D-28. Steam Dome Pressure	4D-42
Figure 4D-29. Core Inlet Subcooling.....	4D-42
Figure 4D-30. Core Inlet Flow	4D-43

Figure 4D-31. Hot Bundle Void Fraction.....	4D-43
Figure 4D-32. ESBWR Backup Stability Protection Boundary.....	4D-44

VOLUME 26A6642AR

Figure 5.1-1. Coolant Volumes.....	5.1-4
Figure 5.1-2. Nuclear Boiler System Schematic.....	5.1-5
Figure 5.1-3. Isolation Condenser System Schematic	5.1-6
Figure 5.1-4. Reactor Water Cleanup/Shutdown Cooling System Schematic.....	5.1-7
Figure 5.2-1. Safety Relief Valve Schematic Elevation	5.2-63
Figure 5.2-2. Safety Relief Valves, Safety Valves, and Depressurization Valves on Steamlines Diagram	5.2-64
Figure 5.2-3. Safety Relief Valve Discharge Line Quencher Arrangement.....	5.2-65
Figure 5.3-1. Minimum Temperatures Required Versus Reactor Pressure for Hydrotest-Core Not Critical (Representative Curve for the ESBWR)	5.3-25
Figure 5.3-2. Minimum Temperatures Required Versus Reactor Pressure for Normal Startup and Shutdown (Representative Curve for the ESBWR).....	5.3-26
Figure 5.3-3. Reactor Pressure Vessel System Key Features	5.3-27
Figure 5.4-1. Main Steamline Nozzle and Flow Restrictor	5.4-54
Figure 5.4-2. (Deleted).....	5.4-55
Figure 5.4-3. Layout of Main Steam and Feedwater Lines	5.4-56
Figure 5.4-4a. Schematic of the Isolation Condenser	5.4-57
Figure 5.4-4b. Isolation Condenser System Simplified Process Diagram.....	5.4-58
Figure 5.4-4c. ICS Simplified Process Diagram – Operating Mode Parameters.....	5.4-59
Figure 5.4-5. NBS Depressurization Valve	5.4-60

VOLUME 26A6642AT

Figure 6.2-1. Containment System.....	6.2-194
Figure 6.2-2. IC/PCCS Pools Configuration.....	6.2-195
Figure 6.2-3. GDCCS Pools Configuration.....	6.2-196
Figure 6.2-4. (Deleted).....	6.2-197
Figure 6.2-5. Horizontal Vent System Configuration.....	6.2-198
Figure 6.2-6. TRACG Nodalization of the ESBWR RPV.....	6.2-199
Figure 6.2-7. TRACG Nodalization of the ESBWR Containment.....	6.2-200
Figure 6.2-8. TRACG Nodalization of the ESBWR Main Steam Lines and DPVs.....	6.2-201
Figure 6.2-8a. TRACG Nodalization of the ESBWR Isolation Condenser System.....	6.2-202
Figure 6.2-8b. TRACG Nodalization of the ESBWR Feedwater Line System.....	6.2-203
Figure 6.2-8c. ESBWR End-of-Cycle Core Average Decay Heat.....	6.2-204
Figure 6.2-9a1. Feedwater Line Break (Nominal Case) – Containment Pressures (72 hrs).....	6.2-205
Figure 6.2-9a2. Feedwater Line Break (Nominal Case) – Containment Pressures (500 s).....	6.2-206
Figure 6.2-9a3. Feedwater Line Break (Nominal Case) – Containment Pressures (2000 s).....	6.2-207
Figure 6.2-9b1. Feedwater Line Break (Nominal Case) – Containment Temperatures (72 hrs).....	6.2-208
Figure 6.2-9b2. Feedwater Line Break (Nominal Case) – Containment Temperatures (500 s).....	6.2-209
Figure 6.2-9b3. Feedwater Line Break (Nominal Case) – Containment Temperatures (2000 s).....	6.2-210
Figure 6.2-9c1. Feedwater Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (72 hrs).....	6.2-211
Figure 6.2-9c2. Feedwater Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (500 s).....	6.2-212
Figure 6.2-9c3. Feedwater Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (2000 s).....	6.2-213
Figure 6.2-9d1. Feedwater Line Break (Nominal Case) - Drywell and GDCCS Airspace Pressures (72 hrs).....	6.2-214
Figure 6.2-9d2. Feedwater Line Break (Nominal Case) - Drywell and GDCCS Airspace Pressures (500 s).....	6.2-215
Figure 6.2-9d3. Feedwater Line Break (Nominal Case) - Drywell and GDCCS Airspace Pressures (2000 s).....	6.2-216
Figure 6.2-9e1. Vessel Wall Heat Slab Temperature (FWL) (72 hrs).....	6.2-217
Figure 6.2-9e2. Vessel Wall Heat Slab Temperature (FWL) (2000 s).....	6.2-218
Figure 6.2-10a1. Main Steam Line Break (Nominal Case) – Containment Pressures (72 hrs).....	6.2-219
Figure 6.2-10a2. Main Steam Line Break (Nominal Case) – Containment Pressures (500 s).....	6.2-220
Figure 6.2-10a3. Main Steam Line Break (Nominal Case) - Containment Pressures (2000 s).....	6.2-221
Figure 6.2-10b1. Main Steam Line Break (Nominal Case) – Containment Temperatures (72 hrs).....	6.2-222
Figure 6.2-10b2. Main Steam Line Break (Nominal Case) – Containment Temperatures (500 s).....	6.2-223

Figure 6.2-10b3. Main Steam Line Break (Nominal Case) – Containment Temperatures (2000 s)	6.2-224
Figure 6.2-10c1. Main Steam Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (72 hrs)	6.2-225
Figure 6.2-10c2. Main Steam Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (500 s)	6.2-226
Figure 6.2-10c3. Main Steam Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (2000 s)	6.2-227
Figure 6.2-10d1. Main Steam Line Break (Nominal Case) - Drywell and GDCS Noncondensable Gas Pressures (72 hrs).....	6.2-228
Figure 6.2-10d2. Main Steam Line Break (Nominal Case) - Drywell and GDCS Noncondensables Gas Pressures (500 s)	6.2-229
Figure 6.2-10d3. Main Steam Line Break (Nominal Case) - Drywell and GDCS Noncondensable Gas Pressures (2000 s)	6.2-230
Figure 6.2-10e1. Vessel Wall Heat Slab Temperature (MSL) (72 hrs).....	6.2-231
Figure 6.2-10e2. Vessel Wall Heat Slab Temperature (MSL) (2000 s).....	6.2-232
Figure 6.2-11a1. GDCS Line Break (Nominal Case) – Containment Pressures (72 hrs)	6.2-233
Figure 6.2-11a2. GDCS Line Break (Nominal Case) – Containment Pressures (500 s).....	6.2-234
Figure 6.2-11a3. GDCS Line Break (Nominal Case) – Containment Pressures (2000 s)...	6.2-235
Figure 6.2-11b1. GDCS Line Break (Nominal Case) – Containment Temperatures (72 hrs).....	6.2-236
Figure 6.2-11b2. GDCS Line Break (Nominal Case) – Containment Temperatures (500 s)	6.2-237
Figure 6.2-11b3. GDCS Line Break (Nominal Case) – Containment Temperatures (2000 s)	6.2-238
Figure 6.2-11c1. GDCS Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (72 hrs).....	6.2-239
Figure 6.2-11c2. GDCS Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (500 s)	6.2-240
Figure 6.2-11c3. GDCS Line Break (Nominal Case) – PCCS Heat Removal versus Decay Heat (2000 s)	6.2-241
Figure 6.2-11d1. GDCS Line Break (Nominal Case) – Drywell and GDCS Noncondensable Gas Pressures (72 hrs).....	6.2-242
Figure 6.2-11d2. GDCS Line Break (Nominal Case) – Drywell and GDCS Noncondensable Gas Pressures (500 s)	6.2-243
Figure 6.2-11d3. GDCS Line Break (Nominal Case) – Drywell and GDCS Noncondensable Gas Pressures (2000 s)	6.2-244
Figure 6.2-12a1. Bottom Drain Line Break (Nominal case) - Containment Pressures (72 hrs).....	6.2-245
Figure 6.2-12a2. Bottom Drain Line Break (Nominal Case) - Containment Pressures (500s).....	6.2-246
Figure 6.2-12a3. Bottom Drain Line Break (Nominal Case) - Containment Pressures (2000 s).....	6.2-247
Figure 6.2-12b1. Bottom Drain Line Break (Nominal Case) - Containment Temperatures (72 hrs).....	6.2-248
Figure 6.2-12b2. Bottom Drain Line Break (Nominal Case) - Containment Temperatures (500 s)	6.2-249

Figure 6.2-12b3. Bottom Drain Line Break (Nominal Case) - Containment Temperatures (2000 s)	6.2-250
Figure 6.2-12c1. Bottom Drain Line Break (Nominal Case) - PCCS Heat Removal versus Decay Heat (72 hrs)	6.2-251
Figure 6.2-12c2. Bottom Drain Line Break (Nominal Case) - PCCS Heat Removal versus Decay Heat (500 s)	6.2-252
Figure 6.2-12c3. Bottom Drain Line Break (Nominal Case) - PCCS Heat Removal versus Decay Heat (2000 s)	6.2-253
Figure 6.2-12d1. Bottom Drain Line Break (Nominal Case) - Drywell and GDCS Noncondensable Pressures (72 hrs)	6.2-254
Figure 6.2-12d2. Bottom Drain Line Break (Nominal Case) - Drywell and GDCS Noncondensable Pressures (500 s)	6.2-255
Figure 6.2-12d3. Bottom Drain Line Break (Nominal Case) - Drywell and GDCS Noncondensable Pressures (2000 s)	6.2-256
Figure 6.2-13a1. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (72 hrs)	6.2-257
Figure 6.2-13a2. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (500 s)	6.2-258
Figure 6.2-13a3. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (2000 s)	6.2-259
Figure 6.2-13b1. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (72 hrs)	6.2-260
Figure 6.2-13b2. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (500 s)	6.2-261
Figure 6.2-13b3. Feedwater Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (2000 s)	6.2-262
Figure 6.2-13c1. Feedwater Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs)	6.2-263
Figure 6.2-13c2. Feedwater Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s)	6.2-264
Figure 6.2-13c3. Feedwater Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s)	6.2-265
Figure 6.2-13d1. Feedwater Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Pressures (72 hrs)	6.2-266
Figure 6.2-13d2. Feedwater Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Pressures (500 s)	6.2-267
Figure 6.2-13d3. Feedwater Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Pressures (2000 s)	6.2-268
Figure 6.2-13d4. Feedwater Line Break, 1 DPV Failure (Bounding) Drywell Annulus and Suppression Pool Levels (72 hrs)	6.2-269
Figure 6.2-13d5. Feedwater Line Break, 1 DPV Failure (Bounding) GDCS Pool Levels (72 hrs)	6.2-269
Figure 6.2-13d6. Feedwater Line Break, 1 DPV Failure (Bounding) GDCS Pool Temperature (72 hrs)	6.2-270
Figure 6.2-13e1. Feed Water Line Break, 1 SRV Failure (Bounding Case) - Containment Pressures (72 hrs)	6.2-271
Figure 6.2-13e2. Feed Water Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (500 s)	6.2-272

Figure 6.2-13e3. Feed Water Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (2000 s).....	6.2-273
Figure 6.2-13f1. Feed Water Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (72 hrs).....	6.2-274
Figure 6.2-13f2. Feed Water Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (500 s).....	6.2-275
Figure 6.2-13f3. Feed Water Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (2000 s).....	6.2-276
Figure 6.2-13g1. Feed Water Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs).....	6.2-277
Figure 6.2-13g2. Feed Water Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s).....	6.2-278
Figure 6.2-13g3. Feed Water Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s).....	6.2-279
Figure 6.2-13h1. Feed Water Line Break, 1 SRV Failure (Bounding Case) – DW and GDCS Noncondensable Gas Pressures (72 hrs).....	6.2-280
Figure 6.2-13h2. Feed Water Line Break, 1 SRV Failure (Bounding Case) – DW and GDCS Noncondensable Gas Pressures (500 s).....	6.2-281
Figure 6.2-13h3. Feed Water Line Break, 1 SRV Failure (Bounding Case) – DW and GDCS Noncondensable Gas Pressures (2000 s).....	6.2-282
Figure 6.2-13h4. Feedwater Line Break, 1 SRV Failure (Bounding) DW Annulus and Suppression Pool Levels (72 hrs).....	6.2-283
Figure 6.2-13h5. Feedwater Line Break, 1 SRV Failure (Bounding) GDCS Pool Levels (72 hrs).....	6.2-283
Figure 6.2-13h6. Feedwater Line Break, 1 SRV Failure (Bounding) GDCS Pool Temperature (72 hrs).....	6.2-284
Figure 6.2-14a1. Main Steam Line Break, 1 DPV Failure (Bounding Case) - Containment Pressures (72 hrs).....	6.2-285
Figure 6.2-14a2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (500 s).....	6.2-286
Figure 6.2-14a3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (2000 s).....	6.2-287
Figure 6.2-14b1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (72 hrs).....	6.2-288
Figure 6.2-14b2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (500 s).....	6.2-289
Figure 6.2-14b3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (2000 s).....	6.2-290
Figure 6.2-14c1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs).....	6.2-291
Figure 6.2-14c2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s).....	6.2-292
Figure 6.2-14c3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s).....	6.2-293
Figure 6.2-14d1. Main Steam Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Gas Pressures (72 hrs).....	6.2-294
Figure 6.2-14d2. Main Steam Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Gas Pressures (500 s).....	6.2-295

Figure 6.2-14d3. Main Steam Line Break, 1 DPV Failure (Bounding Case) - Drywell and GDCS Noncondensable Gas Pressures (2000 s).....	6.2-296
Figure 6.2-14d4. Main Steam Line Break, 1 DPV Failure (Bounding) – Drywell Annulus and Suppression Pool Levels (72 hrs).....	6.2-297
Figure 6.2-14d5. Main Steam Line Break, 1 DPV Failure (Bounding) – GDCS Pool Levels (72 hrs).....	6.2-297
Figure 6.2-14d6. Main Steam Line Break, 1 DPV Failure (Bounding) – GDCS Pool Temperature (72 hrs).....	6.2-298
Figure 6.2-14e1. Drywell, Wetwell and RPV Pressures (720 hr).....	6.2-299
Figure 6.2-14e2. Drywell, Wetwell and RPV Pressures (72 – 144 hr).....	6.2-299
Figure 6.2-14e3. Drywell, Wetwell and Suppression Pool Temperatures (720 hr).....	6.2-300
Figure 6.2-14e4. Drywell, Wetwell and Suppression Pool Temperatures (72 – 144 hr)....	6.2-300
Figure 6.2-14e5. Total Power and Total PCCS Power (720 hr).....	6.2-301
Figure 6.2-14e6. Total Power and Total PCCS Power (72 – 144 hr).....	6.2-301
Figure 6.2-14e7. DW and GDCS Noncondensable Pressures (720 – 144 hr).....	6.2-302
Figure 6.2-14e8. DW and GDCS Noncondensable Pressures (72 – 144 hr).....	6.2-302
Figure 6.2-14e9. GDCS Pool Water Level (720 hr).....	6.2-303
Figure 6.2-14e9a. GDCS Pool Water Level (72 – 144 hr).....	6.2-303
Figure 6.2-14e10. PCCS Pool Water Level (720 hr).....	6.2-304
Figure 6.2-14e10a. PCCS Pool Water Level (72 – 144 hr).....	6.2-304
Figure 6.2-14e11. Containment Pressure Response – Post-LOCA Containment Cooling and Recovery.....	6.2-305
Figure 6.2-14e12. Containment Temperature Response – Post-LOCA Containment Cooling and Recovery.....	6.2-305
Figure 6.2-14f1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (72 hrs).....	6.2-306
Figure 6.2-14f2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (500 s).....	6.2-307
Figure 6.2-14f3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (2000 s).....	6.2-308
Figure 6.2-14g1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (72 hrs).....	6.2-309
Figure 6.2-14g2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (500 s).....	6.2-310
Figure 6.2-14g3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (2000 s).....	6.2-311
Figure 6.2-14h1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs).....	6.2-312
Figure 6.2-14h2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s).....	6.2-313
Figure 6.2-14h3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s).....	6.2-314
Figure 6.2-14i1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (72 hrs).....	6.2-315
Figure 6.2-14i2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (500 s).....	6.2-316
Figure 6.2-14i3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (2000 s).....	6.2-317

Figure 6.2-14i4. Main Steam Line Break, 1 SRV Failure (Bounding) Drywell Annulus and Suppression Pool Levels (72 hrs)	6.2-318
Figure 6.2-14i5. Main Steam Line Break, 1 SRV Failure (Bounding) GDCS Pool Levels (72 hrs).....	6.2-318
Figure 6.2-14i6. Main Steam Line Break, 1 SRV Failure (Bounding) GDCS Pool Temperature (72 hrs)	6.2-319
Figure 6.2-14j1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Pressures (72 hrs)	6.2-320
Figure 6.2-14j2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Pressures (500 s).....	6.2-320
Figure 6.2-14j3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Pressures (2000 s).....	6.2-321
Figure 6.2-14k1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Temperatures (72 hrs)	6.2-322
Figure 6.2-14k2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Temperatures (500 s).....	6.2-322
Figure 6.2-14k3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Containment Temperatures (2000 s).....	6.2-323
Figure 6.2-14l1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – PCCS Heat Removal versus Decay Heat (72 hrs)	6.2-324
Figure 6.2-14l2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – PCCS Heat Removal versus Decay Heat (500 s).....	6.2-324
Figure 6.2-14l3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – PCCS Heat Removal versus Decay Heat (2000 s).....	6.2-325
Figure 6.2-14m1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Drywell and GDCS Noncondensable Gas Pressure (72 hrs)	6.2-326
Figure 6.2-14m2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Drywell and GDCS Noncondensable Gas Pressures (500 s).....	6.2-326
Figure 6.2-14m3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) – Drywell and GDCS Noncondensable Gas Pressures (2000 s).....	6.2-327
Figure 6.2-14m4. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) Drywell Annulus and Suppression Pool Levels (72 hrs)	6.2-327
Figure 6.2-14m5. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) GDCS Pool Levels (72 hrs)	6.2-328
Figure 6.2-14m6. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) GDCS Pool Temperature (72 hrs).....	6.2-328
Figure 6.2-14n1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Noncondensable Gas Mass (72 hrs)	6.2-329
Figure 6.2-14n2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Noncondensable Gas Mass (500 s).....	6.2-330
Figure 6.2-14n3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Noncondensable Gas Mass (2000 s).....	6.2-330
Figure 6.2-14o1. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Pool Void Fraction (72 hrs).....	6.2-331
Figure 6.2-14o2. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Pool Void Fraction (500 s)	6.2-331
Figure 6.2-14o3. Main Steam Line Break, 1 SRV Failure (Bounding Case, with Offsite Power) –Drywell and GDCS Pool Void Fraction (2000 s)	6.2-332
Figure 6.2-15. Summary of Severe Accident Design Features	6.2-333

Figure 6.2-16. PCCS Schematic Diagram.....	6.2-334
Figure 6.2-17. Reactor Building Envelope.....	6.2-335
Figure 6.2-18. RWCU System Compartment Pressurization Analysis.....	6.2-336
Figure 6.2-18a. RWCU Pipe Break Mass Flow Rate.....	6.2-338
Figure 6.2-18b. RWCU Pipe Break Enthalpy	6.2-338
Figure 6.2-18c. RWCU Pipe Break Energy Release.....	6.2-339
Figure 6.2-19. Pressure Histories due to Break Case 1 in Cell 1 (Sub-Model 1).....	6.2-340
Figure 6.2-20. Pressure Histories due to Break Case 1 in Cell 6 (Sub-Model 1).....	6.2-340
Figure 6.2-21. Pressure Histories due to Break Case 2 in Cell 2 (Sub-Model 1).....	6.2-341
Figure 6.2-22. Pressure Histories due to Break Case 2 in Cell 7 (Sub-Model 1).....	6.2-341
Figure 6.2-23. Pressure Histories due to Break Case 3 in Cell 1 (Sub-Model 1).....	6.2-342
Figure 6.2-24. Pressure Histories due to Break Case 3 in Cell 6 (Sub-Model 1).....	6.2-342
Figure 6.2-25. Pressure Histories due to Break Case 4 in Cell 8 (Sub-Model 1).....	6.2-343
Figure 6.2-26. Pressure Histories due to Break Case 4 in Cell 9 (Sub-Model 1).....	6.2-343
Figure 6.2-27. Pressure Histories due to Break Case 5 in Cell 11 (Sub-Model 2).....	6.2-344
Figure 6.2-28. Wetwell-to-Drywell Vacuum Breaker.....	6.2-345
Figure 6.2-29. CIS Simplified System Diagram	6.2-346
Figure 6.2-30. Drywell Fission Product Radiation Monitoring Subsystem	6.2-347
Figure 6.2-31. Containment Isolation Valves for Makeup Water System	6.2-348
Figure 6.2-32. Containment Isolation Valves for Equipment and Floor Drain System.....	6.2-349
Figure 6.2-33. Containment Isolation Valves for Service Air System.....	6.2-350
Figure 6.2-34. Containment Isolation Valves for Chilled Water System.....	6.2-351
Figure 6.2-35. Refueling Cavity Bellows Assembly.....	6.2-352
Figure 6.3-1. GDCS Configuration	6.3-42
Figure 6.3-1a. GDCS Typical Process Flows.....	6.3-43
Figure 6.3-2. (Deleted)	6.3-44
Figure 6.3-3. (Deleted)	6.3-45
Figure 6.3-4. (Deleted)	6.3-45
Figure 6.3-5. (Deleted)	6.3-45
Figure 6.3-6. Minimum Transient Chimney Water Level vs. Break Area.....	6.3-46
Figure 6.3-7a. MCPR, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-47
Figure 6.3-7b. MCPR, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-48
Figure 6.3-8a. Chimney Water Level, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-49
Figure 6.3-8b. Chimney Water Level, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-50
Figure 6.3-9a. Downcomer Water Level, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-51
Figure 6.3-9b. Downcomer Water Level, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-52
Figure 6.3-10a. System Pressures, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-53
Figure 6.3-10b. System Pressures, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-54
Figure 6.3-11a. Steam Line and Break Flows, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-55

Figure 6.3-11b. Steam Line and Break Flows, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-56
Figure 6.3-12a. ADS Flows, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-57
Figure 6.3-12b. ADS Flows, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-58
Figure 6.3-13a. Flows Into Vessel, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-59
Figure 6.3-13b. Flows Into Vessel, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-60
Figure 6.3-14a. PCT, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-61
Figure 6.3-14b. PCT, Feedwater Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-62
Figure 6.3-15a. MCPR, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-63
Figure 6.3-15b. MCPR, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-64
Figure 6.3-16a. Chimney Water Level, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-65
Figure 6.3-16b. Chimney Water Level, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-66
Figure 6.3-17a. Downcomer (DC) Water Level, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-67
Figure 6.3-17b. Downcomer (DC) Water Level, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-68
Figure 6.3-18a. System Pressures, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-69
Figure 6.3-18b. System Pressures, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-70
Figure 6.3-19a. Steam Line and Break Flow with Void Fraction, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-71
Figure 6.3-19b. Steam Line and Break Flow with Void Fraction, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-72
Figure 6.3-20a. ADS Flow, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-73
Figure 6.3-20b. ADS Flows, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-74
Figure 6.3-21a. Flows Into Vessel, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-75
Figure 6.3-21b. Flows Into Vessel, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-76
Figure 6.3-22a. PCT, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-77
Figure 6.3-22b. PCT, Inside Steam Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-78
Figure 6.3-23a. MCPR, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-79

Figure 6.3-23b. MCPR, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-80
Figure 6.3-24a. Chimney Water Level, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-81
Figure 6.3-24b. Chimney Water Level, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-82
Figure 6.3-25a. Downcomer (DC) Water Level, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-83
Figure 6.3-25b. Downcomer (DC) Water Level, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-84
Figure 6.3-26a. System Pressures, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-85
Figure 6.3-26b. System Pressures, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-86
Figure 6.3-27a. Steam Line and Break Flow with Void Fraction, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-87
Figure 6.3-27b. Steam Line and Break Flow with Void Fraction, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-88
Figure 6.3-28a. ADS Flow Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-89
Figure 6.3-28b. ADS Flows, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-90
Figure 6.3-29a. Flows Into Vessel, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-91
Figure 6.3-29b. Flows Into Vessel, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-92
Figure 6.3-30a. PCT, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-93
Figure 6.3-30b. PCT, Bottom Drain Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-94
Figure 6.3-31a. MCPR, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s).....	6.3-95
Figure 6.3-31b. MCPR, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s).....	6.3-96
Figure 6.3-32a. Chimney Water Level, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-97
Figure 6.3-32b. Chimney Water Level, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-98
Figure 6.3-33a. Downcomer Water Level, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-99
Figure 6.3-33b. Downcomer Water Level, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-100
Figure 6.3-34a. System Pressures, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-101
Figure 6.3-34b. System Pressures, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-102
Figure 6.3-35a. Steam Line and Break Flow with Void Fraction, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-103

Figure 6.3-35b. Steam Line and Break Flow with Void Fraction, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-104
Figure 6.3-36a. ADS Flow GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-105
Figure 6.3-36b. ADS Flows, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-106
Figure 6.3-37a. Flows Into Vessel, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-107
Figure 6.3-37b. Flows Into Vessel, GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-108
Figure 6.3-38a. Peak Cladding Temperature (PCT), GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (2000 s)	6.3-109
Figure 6.3-38b. Peak Cladding Temperature (PCT), GDCS Injection Line Break (Nominal Case), 1 GDCS Valve Failure (100 s)	6.3-110
Figure 6.3-38A-a. MCPR, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-111
Figure 6.3-38A-b. MCPR, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-111
Figure 6.3-38B-a. Chimney Water Level, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-112
Figure 6.3-38B-b. Chimney Water Level, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-112
Figure 6.3-38C-a. Downcomer Water Level, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-113
Figure 6.3-38C-b. Downcomer Water Level, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-113
Figure 6.3-38D-a. System Pressures, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-114
Figure 6.3-38D-b. System Pressures, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-114
Figure 6.3-38E-a. Break Flows and Void Fractions, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-115
Figure 6.3-38E-b. Break Flows and Void Fractions, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-115
Figure 6.3-38F-a. ADS Flow, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-116
Figure 6.3-38F-b. ADS Flow, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-116
Figure 6.3-38G-a. Flows Into Vessel, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-117
Figure 6.3-38G-b. Flows Into Vessel, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-117
Figure 6.3-38H-a. Peak Cladding Temperature (PCT), IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-118
Figure 6.3-38H-b. Peak Cladding Temperature (PCT), IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (100 s)	6.3-118
Figure 6.3-38I. Vacuum Breaker Flows, IC Drain Line Break (Bounding Case), 1 GDCS Valve Failure (2000 s)	6.3-119

Figure 6.3-38J. Passive Containment Cooling Flows, IC Drain Line Break (Bounding Case), 1 GDSCS Valve Failure (2000 s)	6.3-119
Figure 6.3-38K. Passive Containment Cooling Power, IC Drain Line Break (Bounding Case), 1 GDSCS Valve Failure (2000 s)	6.3-120
Figure 6.3-38L. Chimney Water Level, IC Drain Line Break (Bounding Case), 1 GDSCS Valve Failure (2000 s)	6.3-120
Figure 6.3-38M. Downcomer Water Level, IC Drain Line Break (Bounding Case), 1 GDSCS Valve Failure (2000 s)	6.3-121
Figure 6.3-39. Normalized Shutdown Power	6.3-121
Figure 6.4-1. CRHAVS Schematic Diagram	6.4-20
Figure 6.4-2. Control Room Habitability Area Airflows Emergency Operation - FOR ILLUSTRATIVE PURPOSES ONLY	6.4-21
Figure 6A-1. TRACG Nodalization showing Containment Heat Slabs.....	6A-9
Figure 6A-2. RPV Nodalization showing Vessel Wall Heat Slab	6A-10
Figure 6B-1. TRACG Nodalization for ESBWR ECCS/LOCA Analysis	6B-11
Figure 6B-2. TRACG Nodalization for ESBWR Containment Analysis	6B-12
Figure 6B-3. TRACG Combined Nodalization.....	6B-13
Figure 6B-4. TRACG Combined Nodalization.....	6B-14
Figure 6B-5. MSLB-CB5 – GDSCS and Downcomer Water Levels	6B-15
Figure 6B-6. MSLB-NL2_V40 – GDSCS and Downcomer Water Levels.....	6B-15
Figure 6B-7. MSLB-CB5 vs. MSLB-NL2_V40 – Total Passive Containment Cooling Condensation Powers	6B-16
Figure 6B-8. MSLB-CB5 vs. MSLB-NL2_V40 – Suppression Pool Surface Temperatures	6B-16
Figure 6B-9. MSLB-CB5 – Drywell Partial Noncondensable Gas Pressures.....	6B-17
Figure 6B-10. MSLB-NL2_V40 – Drywell Partial Noncondensable Gas Pressures.....	6B-17
Figure 6B-11. MSLB-CB5 vs MSLB-NL2_V40 – Drywell Pressures.....	6B-18
Figure 6B-12. MSLB-CB6 – Drywell Partial Noncondensable Gas Pressures	6B-18
Figure 6B-13. MSLB-CB6 – RPV, Drywell and Wetwell Pressures.....	6B-19
Figure 6B-14. Drywell Pressure Comparison – MSLB-CB6, MSLB-CB5 and MSLB-NL2_V40	6B-19
Figure 6B-15. MSLB-CB6 – Suppression Pool Temperatures	6B-20
Figure 6B-16. MSLB-CB5 – Suppression Pool Temperatures	6B-20
Figure 6B-17. MSLB-CB6 – Passive Containment Cooling Condensation Power	6B-21
Figure 6B-18. MSLB-CB5 – PCC Condensation Power	6B-21
Figure 6B-19. E0 (Base Case) – Drywell Pressure Response	6B-22
Figure 6B-20. E0 (Base Case) – Top Main Vent Flow	6B-22
Figure 6B-21. E0 (Base Case) – DPV and SRV Flows.....	6B-23
Figure 6B-22. E0a (Time Step) – Drywell Pressure Response	6B-23
Figure 6B-23. E0a (Time Step) – Top Main Vent Flow	6B-24
Figure 6B-24. E0a (Time Step) – DPV and SRV Flows.....	6B-24
Figure 6C-1. Effect of Wetwell Pressure on the GDSCS Initiation Timing	6C-3
Figure 6C-2. Effect of Wetwell Pressure on the Minimum Chimney Collapsed Level.....	6C-3
Figure 6E-1. (Deleted).....	6E-8
Figure 6E-2. (Deleted).....	6E-8
Figure 6E-3. (Deleted).....	6E-8
Figure 6E-4. (Deleted).....	6E-8
Figure 6F1-1. MSLB - Effect of Break Areas on Transient DW Pressures	6F-4
Figure 6F1-2a. Feedwater Line Break - Parametric Study on the Break Areas (0-72 hrs)	6F-4

Figure 6F1-2b. Feedwater Line Break - Parametric Study on the Break Areas (0-2000 sec)..	6F-5
Figure 6F2-1. Main Steam Line Break - Parametric Study on the Break Elevation	6F-5
Figure 6G-1. Phases of the LOCA Transient	6G-11
Figure 6G-2. Inventory Distributions for Main Steam Line Break	6G-12
Figure 6G-3. RPV and Drywell Water Levels for MSLB (12 hours)	6G-13
Figure 6G-4. RPV and Drywell Water Levels for FWLB (12 hours)	6G-13
Figure 6G-5. Inventory Distributions for Bottom Drain Line Break	6G-14
Figure 6G-6. RPV and Drywell Water Levels for BDL Break (12 hours).....	6G-15
Figure 6G-7. RPV and Drywell Water Levels for GDCS Line Break (12 hours).....	6G-15
Figure 6H-1. Air Mass Profiles in the GDCS Airspace	6H-5
Figure 6H-2. Air Mass Profile in the Drywell Head Airspace	6H-5
Figure 6H-3. Air Mass Profiles in the Wetwell Airspace	6H-6
Figure 6H-4. Comparison of DW Pressures.....	6H-6
Figure 6H-5. Comparison of DW Pressures.....	6H-7
Figure 6H-6. Comparison of DW Pressures.....	6H-7
Figure 6H-7. Comparison of DW Pressures.....	6H-8
Figure 6H-8. Comparison of DW Pressures.....	6H-8
Figure 6H-9. Comparison of DW Pressures.....	6H-9
Figure 6H-10. Comparison of DW Pressures.....	6H-9
Figure 6H-11. Comparison of DW Pressures.....	6H-10
Figure 6I-1a1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (72 hrs).....	6I-7
Figure 6I-1a2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (500 s).....	6I-8
Figure 6I-1a3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Pressures (2000 s).....	6I-9
Figure 6I-1b1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (72 hrs).....	6I-10
Figure 6I-1b2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (500 s).....	6I-11
Figure 6I-1b3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Containment Temperatures (2000 s).....	6I-12
Figure 6I-1c1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs)	6I-13
Figure 6I-1c2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s).....	6I-14
Figure 6I-1c3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s).....	6I-15
Figure 6I-1d1. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (72 hrs).....	6I-16
Figure 6I-1d2. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (500 s)	6I-17
Figure 6I-1d3. Main Steam Line Break, 1 DPV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (2000 s)	6I-18
Figure 6I-2a1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (72 hrs).....	6I-19
Figure 6I-2a2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (500 s).....	6I-20

Figure 6I-2a3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Pressures (2000 s)	6I-21
Figure 6I-2b1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (72 hrs)	6I-22
Figure 6I-2b2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (500 s)	6I-23
Figure 6I-2b3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Containment Temperatures (2000 s)	6I-24
Figure 6I-2c1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (72 hrs)	6I-25
Figure 6I-2c2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (500 s)	6I-26
Figure 6I-2c3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – PCCS Heat Removal versus Decay Heat (2000 s)	6I-27
Figure 6I-2d1. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (72 hrs)	6I-28
Figure 6I-2d2. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (500 s)	6I-29
Figure 6I-2d3. Main Steam Line Break, 1 SRV Failure (Bounding Case) – Drywell and GDCS Noncondensable Gas Pressures (2000 s)	6I-30

VOLUME 26A6642AW

Figure 7.1-1. ESBWR DCIS Simplified Network and Functional Diagram.....	7.1-127
Figure 7.1-2. Deleted.....	7.1-128
Figure 7.1-3. ESBWR Distributed Power-Sensor/Logic Diversity Diagram.....	7.1-129
Figure 7.1-4. ESBWR Hardware/Software (Architecture) Diversity Diagram.....	7.1-130
Figure 7.2-1. RPS Simplified Functional Block Diagram.....	7.2-69
Figure 7.2-2. RPS Interfaces and Boundaries Diagram	7.2-70
Figure 7.2-3. Neutron Flux Monitoring Ranges.....	7.2-71
Figure 7.2-4. Basic Configuration of a Typical SRNM Subsystem.....	7.2-72
Figure 7.2-5. Basic Configuration of a Typical PRNM Subsystem.....	7.2-73
Figure 7.2-6. SRNM Detector Locations	7.2-74
Figure 7.2-7. LPRM Locations in the Core.....	7.2-75
Figure 7.2-8. Axial Distribution of LPRM Detectors.....	7.2-76
Figure 7.2-9. LPRM Assignments to APRM Channels	7.2-77
Figure 7.2-10. LPRM Assignment to OPRM Channels.....	7.2-78
Figure 7.2-11a. Reactor Trip and Isolation Function (RTIF) Simplified Functional Block Diagram	7.2-79
Figure 7.2-11b. Reactor Trip and Isolation Function (RTIF) Simplified Functional Block Diagram – Output Logic Unit Detail.....	7.2-80
Figure 7.2-12. Neutron Monitoring System (NMS) Simplified Functional Block Diagram.....	7.2-81
Figure 7.3-1a. SRV Initiation Logics	7.3-81
Figure 7.3-1b. GDCS and DPV Initiation Logics	7.3-82
Figure 7.3-1c. DPS Initiation Logic	7.3-83
Figure 7.3-2. GDCS Equalizing Valve Initiation Logics	7.3-84
Figure 7.3-3. LD&IS System Design Configuration.....	7.3-85
Figure 7.3-4. SSLC/ESF Simplified Functional Block Diagram	7.3-86
Figure 7.3-5. SSLC/ESF System Interface Diagram.....	7.3-87
Figure 7.3-6. SSLC/ESF Division 1 Layout.....	7.3-88
Figure 7.3-7. SSLC/ESF Simplified Functional Block Diagram	7.3-89
Figure 7.3-8. SSLC/ESF Inter-divisional Communication Detail.....	7.3-90
Figure 7.3-9. SSLC/ESF Safety-Related VDU Communication Detail.....	7.3-91
Figure 7.3-10. SSLC/ESF Nonsafety-Related Communication Detail	7.3-92
Figure 7.4-1. Remote Shutdown System Panel Schematic	7.4-41
Figure 7.4-2a. RWCU/SDC System Train A Differential Mass Flow Logic - Division 1 ...	7.4-42
Figure 7.4-2b. RWCU/SDC System Train A Differential Mass Flow Logic - Division 2 ...	7.4-43
Figure 7.4-2c. RWCU/SDC System Train A Differential Mass Flow Logic - Division 3 ...	7.4-44
Figure 7.4-2d. RWCU/SDC System Train A Differential Mass Flow Logic - Division 4 ...	7.4-45
Figure 7.4-2e. RWCU/SDC Line Break Outside Containment Train A Isolation Logic.....	7.4-46
Figure 7.4-3. Isolation Condenser System Initiation and Actuation	7.4-47
Figure 7.5-1. Containment Monitoring System Design	7.5-38
Figure 7.5-2. (Deleted)	7.5-39
Figure 7.5-3. Area Radiation Monitoring System Simplified Functional Block Diagram ...	7.5-40
Figure 7.7-1. Water Level Range Definition.....	7.7-60
Figure 7.7-2. RC&IS Simplified Functional Block Diagram.....	7.7-61
Figure 7.7-3. Feedwater Control System Simplified Functional Block Diagram	7.7-62
Figure 7.7-4. Plant Automation System Simplified Functional Diagram	7.7-63
Figure 7.7-5. SB&PC System Simplified Functional Block Diagram	7.7-64
Figure 7.7-6. SB&PC System FTDC Simplified Functional Block Diagram.....	7.7-65

Figure 7.7-7. HP Feedwater Heater Temperature Simplified Control Block Diagram.....	7.7-66
Figure 7.8-1. DPS Simplified Functional Block Diagram	7.8-31
Figure 7.8-2. Alternate Rod Insertion & FMCRD Run-in Logic	7.8-32
Figure 7.8-3. ATWS Mitigation Logic (SLC System Initiation, Feedwater Runback)	7.8-33
Figure 7.8-4. Diverse ESF Triple Redundant Logic.....	7.8-34

VOLUME 26A6642AX

Figure 8.1-1. Electrical Power Distribution System.....	8.1-12
Figure 8.1-2. Direct Current Power Supply (Nonsafety-Related).....	8.1-15
Figure 8.1-3. Direct Current Power Supply (Safety-Related)	8.1-17
Figure 8.1-4. Uninterruptible AC Power Supply (Safety-Related)	8.1-18
Figure 8.1-5. Uninterruptible AC Power Supply (Nonsafety-Related).....	8.1-19
Figure 8.1-6. (Deleted)	8.1-21
Figure 8.3-1. Safety-Related 480 Volt Power Centers	8.3-37
Figure 8.3-2. Nonsafety-Related 480 Volt Power Centers.....	8.3-38
Figure 8.3-3. Ancillary Power Functional Figure	8.3-41

VOLUME 26A6642AY

Figure 9.1-1. FAPCS Schematic Diagram	9.1-54
Figure 9.1-2. Inclined Fuel Transfer System.....	9.1-55
Figure 9.1-3. Refueling Sequence	9.1-56
Figure 9.2-1. Plant Service Water System Simplified Diagram.....	9.2-40
Figure 9.2-2a. Reactor Component Cooling Water System	9.2-41
Figure 9.2-2b. Reactor Component Cooling Water System.....	9.2-42
Figure 9.2-3. Chilled Water System Simplified Diagram	9.2-43
Figure 9.2-4. Turbine Component Cooling Water System Configuration	9.2-44
Figure 9.3-1. Standby Liquid Control System Simplified Diagram.....	9.3-45
Figure 9.3-1a. Standby Liquid Control System Simplified Process Flow Diagram	9.3-46
Figure 9.3-2. (Deleted)	9.3-47
Figure 9.3-3. Service Air and Instrument Air System Simplified Diagram.....	9.3-48
Figure 9.3-4. HPNSS Simplified Diagram.....	9.3-49
Figure 9.3-5. Hydrogen Water Chemistry System Simplified Diagram	9.3-50
Figure 9.4-1. CRHAVS Simplified System Diagram	9.4-78
Figure 9.4-2. CRHAVS Air Flow Diagram	9.4-79
Figure 9.4-3. CBGAVS Set A Simplified System Flow Diagram	9.4-80
Figure 9.4-4. CBGAVS Set B Simplified System Flow Diagram	9.4-81
Figure 9.4-5. FBGAVS Simplified System Diagram.....	9.4-82
Figure 9.4-6. FBFPVS Simplified System Diagram	9.4-83
Figure 9.4-7a. RWCRVS Simplified Subsystem Diagram	9.4-84
Figure 9.4-7b. RWGAVS Simplified Subsystem Diagram.....	9.4-85
Figure 9.4-8. TBVS Simplified System Diagram	9.4-86
Figure 9.4-9. CLAVS Simplified System Diagram (Typical Train A/B)	9.4-87
Figure 9.4-10. CONAVS Simplified System Diagram (Typical Train A/B).....	9.4-88
Figure 9.4-11. REPAVS Simplified System Diagram	9.4-89
Figure 9.4-12. EBVS Simplified System	9.4-90
Figure 9.4-13. DCS Simplified System Diagram.....	9.4-91
Figure 9.5-1. Fire Protection System Simplified Diagram.....	9.5-66
Figure 9.5-2. (Deleted)	9.5-67
Figure 9.5-3. (Deleted)	9.5-68
Figure 9.5-4. (Deleted)	9.5-69
Figure 9.5-5. (Deleted)	9.5-70
Figure 9.5-6. (Deleted)	9.5-71
Figure 9.5-7. (Deleted)	9.5-72
Figure 9.5-8. (Deleted)	9.5-73
Figure 9.5-9. Standby Diesel Generator Fuel Oil Storage and Transfer System & Air Intake and Exhaust System Diagram.....	9.5-74
Figure 9.5-9a. Ancillary Diesel Generator Fuel Oil Storage and Transfer System Diagram	9.5-75
Figure 9.5-10. Standby Diesel Generator Jacket Cooling Water System Diagram.....	9.5-76
Figure 9.5-11. Standby Diesel Generator Starting Air System Diagram	9.5-77
Figure 9.5-12. Standby Diesel Generator Lubrication System Diagram.....	9.5-78

VOLUME 26A6642BB

Figure 9A.2-1. Nuclear Island Fire Protection Zones ESBWR DCD EL -11500.....	9A.2-16
Figure 9A.2-2. Nuclear Island Fire Protection Zones ESBWR DCD EL -6400.....	9A.2-17
Figure 9A.2-3. Nuclear Island Fire Protection Zones ESBWR DCD EL -1000	9A.2-18
Figure 9A.2-4. Nuclear Island Fire Protection Zones ESBWR DCD EL 4650.....	9A.2-19
Figure 9A.2-5. Nuclear Island Fire Protection Zones ESBWR DCD EL 9060.....	9A.2-20
Figure 9A.2-6. Nuclear Island Fire Protection Zones ESBWR DCD EL 13570.....	9A.2-21
Figure 9A.2-7. Nuclear Island Fire Protection Zones ESBWR DCD EL 17500.....	9A.2-22
Figure 9A.2-8. Nuclear Island Fire Protection Zones ESBWR DCD EL 27000.....	9A.2-23
Figure 9A.2-9. Nuclear Island Fire Protection Zones ESBWR DCD EL 34000.....	9A.2-24
Figure 9A.2-10. Nuclear Island Fire Protection Zones ESBWR DCD SEC A-A	9A.2-25
Figure 9A.2-11. Nuclear Island Fire Protection Zones ESBWR DCD Section "B-B"	9A.2-26
Figure 9A.2-12. Turbine Island Fire Protection Zones ESBWR DCD EL. -1400.....	9A.2-27
Figure 9A.2-13. Turbine Building Fire Protection Zones ESBWR DCD EL 4650	9A.2-28
Figure 9A.2-14. Turbine Island Fire Protection Zones ESBWR DCD EL. 12000.....	9A.2-29
Figure 9A.2-15. Turbine Island Fire Protection Zones ESBWR DCD EL. 20000.....	9A.2-30
Figure 9A.2-16. Turbine Island Fire Protection Zones ESBWR DCD EL. 28000.....	9A.2-31
Figure 9A.2-16a. Turbine Building Fire Protection Zones ESBWR DCD EL 35000.....	9A.2-32
Figure 9A.2-17. Turbine Island Fire Protection Zones ESBWR DCD EL. Various	9A.2-33
Figure 9A.2-18. Turbine Building Fire Protection Zones ESBWR DCD Section A-A	9A.2-34
Figure 9A.2-19. Turbine Building Fire Protection Zones ESBWR DCD Section B-B.....	9A.2-35
Figure 9A.2-20. Radwaste Building Fire Protection Zones ESBWR DCD EL -9350	9A.2-36
Figure 9A.2-21. Radwaste Building Fire Protection Zones ESBWR DCD EL -2350.....	9A.2-37
Figure 9A.2-22. Radwaste Building Fire Protection Zones ESBWR DCD EL 4650.....	9A.2-38
Figure 9A.2-23. Radwaste Building Fire Protection Zones ESBWR DCD EL 10650.....	9A.2-39
Figure 9A.2-24. Radwaste Building Fire Protection Zones ESBWR DCD Section A-A ..	9A.2-40
Figure 9A.2-25. Electrical Building Fire Protection Zones ESBWR DCD EL 4650.....	9A.2-41
Figure 9A.2-26. Electrical Building Fire Protection Zones ESBWR DCD EL 9800.....	9A.2-42
Figure 9A.2-27. DELETED.....	9A.2-43
Figure 9A.2-28. Electrical Building Fire Protection Zones ESBWR DCD EL 18000.....	9A.2-44
Figure 9A.2-29. DELETED.....	9A.2-45
Figure 9A.2-30. Electrical Building Fire Protection Zones ESBWR DCD EL 27000.....	9A.2-46
Figure 9A.2-31. Electrical Building Fire Protection Zones ESBWR DCD EL (Various) .	9A.2-47
Figure 9A.2-32. Electrical Building Fire Protection Zones ESBWR DCD Section A-A...	9A.2-48
Figure 9A.2-33. Site Fire Protection Zones ESBWR DCD Plot Plan	9A.2-49

VOLUME 26A6642BD

Figure 9B-1. Time-Temperature Curve and Fire Endurance Curves 9B-14

VOLUME 26A6642BF

Figure 10.1-1. Power Cycle Schematic	10.1-7
Figure 10.1-2a. Rated Heat Balance (SI Units)	10.1-8
Figure 10.1-2b. Rated Heat Balance (English Units)	10.1-9
Figure 10.1-3a. Valves Wide Open-Heat Balance (SI Units)	10.1-10
Figure 10.1-3b. Valves Wide Open Heat Balance (English Units)	10.1-11
Figure 10.2-1. Turbine Stop Valve Closure Characteristic	10.2-21
Figure 10.2-2. Turbine Control Valve Fast Closure Characteristic	10.2-22
Figure 10.2-3. Acceptable Range for Control Valve Normal Closure Motion	10.2-23
Figure 10.2-4. Hydrogen Gas Control System	10.2-24
Figure 10.3-1. Turbine Main Steam System	10.3-9
Figure 10.3-2. Main Turbine System	10.3-10
Figure 10.4-1. Circulating Water System	10.4-35
Figure 10.4-2. Main Condenser Evacuation System	10.4-36
Figure 10.4-3. Turbine Gland Seal System	10.4-37
Figure 10.4-4. (Deleted)	10.4-38
Figure 10.4-5. Condensate Purification System	10.4-39
Figure 10.4-6a. Low Pressure Extraction Steam System	10.4-40
Figure 10.4-6b. Low Pressure Drain and Vent System	10.4-41
Figure 10.4-7a. High Pressure Extraction Steam System	10.4-42
Figure 10.4-7b. High Pressure Drain and Vent System	10.4-43

VOLUME 26A6642BH

Figure 11.2-1. Liquid Waste Management System Processing Diagram	11.2-17
Figure 11.2-1a. Equipment Drain	11.2-18
Figure 11.2-1b. Floor Drain	11.2-19
Figure 11.2-2. Liquid Waste Management System Processing Stream Information Directory	11.2-20
Figure 11.2-3. Detergent Drain	11.2-21
Figure 11.2-4. Chemical Drain	11.2-22
Figure 11.3-1. Offgas System	11.3-27
Figure 11.4-1. Solid Waste Management System Process Diagram	11.4-13
Figure 11.4-2. SWMS Collection Subsystem	11.4-14
Figure 11.4-3. SWMS Processing Subsystem	11.4-15
Figure 11.4-4. Dry Active Waste Processing	11.4-16
Figure 11.5-1. Location of Radiation Monitors	11.5-56
Figure 11.5-2. PRMS Channel Block Diagram	11.5-57

VOLUME 26A6642BJ

Figure 12.2-1. Radiation Source Model.....	12.2-87
Figure 12.3-1. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation -11500 mm.....	12.3-123
Figure 12.3-2. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation -6400 mm.....	12.3-124
Figure 12.3-3. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation -1000 mm.....	12.3-125
Figure 12.3-4. Nuclear Island Radiation Zones for Full Power and Shutdown Operation – Elevation 4650 mm	12.3-126
Figure 12.3-5. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation 9060 mm.....	12.3-127
Figure 12.3-6. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation 13570 mm.....	12.3-128
Figure 12.3-7. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation 17500 mm.....	12.3-129
Figure 12.3-8. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation 27000 mm.....	12.3-130
Figure 12.3-9. Nuclear Island Radiation Zones for Full Power and Shutdown Operation - Elevation 34000 mm.....	12.3-131
Figure 12.3-10. Nuclear Island Radiation Zones for Full Power and Shutdown Operation Section A-A.....	12.3-132
Figure 12.3-11. Nuclear Island Radiation Zones for Full Power and Shutdown Operation Section B-B.....	12.3-133
Figure 12.3-12. Turbine Building Radiation Zones - Elevation -1400 mm.....	12.3-134
Figure 12.3-13. Turbine Building Radiation Zones - Elevation 4650 mm.....	12.3-135
Figure 12.3-14. Turbine Building Radiation Zones - Elevation 12000 mm.....	12.3-136
Figure 12.3-15. Turbine Building Radiation Zones - Elevation 20000 mm.....	12.3-137
Figure 12.3-16. Turbine Building Radiation Zones - Elevation 28000 mm.....	12.3-138
Figure 12.3-17. Turbine Building Radiation Zones - Elevation 35000 mm.....	12.3-139
Figure 12.3-18. Turbine Building Radiation Zones at Roof Elevation Various.....	12.3-140
Figure 12.3-19. Radwaste Building Radiation Zones - Elevation -9350 mm.....	12.3-141
Figure 12.3-20. Radwaste Building Radiation Zones - Elevation -2350 mm.....	12.3-142
Figure 12.3-21. Radwaste Building Radiation Zones - Elevation 4650 mm.....	12.3-143
Figure 12.3-22. Radwaste Building Radiation Zones - Elevation 10650 mm.....	12.3-144
Figure 12.3-22a. Radiation Zones in the Access Tunnel to the Electrical Building – Elevation -2000 mm.....	12.3-145
Figure 12.3-22b. Radiation Zones in the Access Tunnel to the Electrical Building and Radwaste Building – Elevation 1300 mm.....	12.3-146
Figure 12.3-23. Nuclear Island Area Radiation Monitors - Elevation -11500 mm	12.3-147
Figure 12.3-24. Nuclear Island Area Radiation Monitors - Elevation -6400 mm	12.3-148
Figure 12.3-25. Nuclear Island Area Radiation Monitors - Elevation -1000 mm	12.3-149
Figure 12.3-26. Nuclear Island Area Radiation Monitors - Elevation 4650 mm	12.3-150
Figure 12.3-27. Nuclear Island Area Radiation Monitors - Elevation 9060 mm	12.3-151
Figure 12.3-28. Nuclear Island Area Radiation Monitors - Elevation 13570 mm	12.3-152

Figure 12.3-29. Nuclear Island Area Radiation Monitors - Elevation 17500 mm	12.3-153
Figure 12.3-30. Nuclear Island Area Radiation Monitors - Elevation 27000 mm	12.3-154
Figure 12.3-31. Nuclear Island Area Radiation Monitors - Elevation 34000 mm	12.3-155
Figure 12.3-32. Turbine Building Area Radiation Monitors - Elevation -1400 mm	12.3-156
Figure 12.3-33. Turbine Building Area Radiation Monitors - Elevation 4650 mm	12.3-157
Figure 12.3-34. Turbine Building Area Radiation Monitors - Elevation 12000 mm	12.3-158
Figure 12.3-35. Turbine Building Area Radiation Monitors - Elevation 20000 mm	12.3-159
Figure 12.3-36. Turbine Building Area Radiation Monitors - Elevation 28000 mm	12.3-160
Figure 12.3-37. Turbine Building Area Radiation Monitors - Elevation 35000 mm	12.3-161
Figure 12.3-38. Turbine Building Area Radiation Monitors at Various Elevations.....	12.3-162
Figure 12.3-39. Radwaste Building Area Radiation Monitors - Elevation -9350 mm	12.3-163
Figure 12.3-40. Radwaste Building Area Radiation Monitors - Elevation -2350 mm	12.3-164
Figure 12.3-41. Radwaste Building Area Radiation Monitors - Elevation 4650 mm	12.3-165
Figure 12.3-42. Radwaste Building Area Radiation Monitors - Elevation 10650 mm	12.3-166
Figure 12.3-43. Nuclear Island Post Accident Radiation Zones - Elevation -11500 mm	12.3-167
Figure 12.3-44. Nuclear Island Post Accident Radiation Zones - Elevation -6400 mm	12.3-168
Figure 12.3-45. Nuclear Island Post Accident Radiation Zones - Elevation -1000 mm	12.3-169
Figure 12.3-46. Nuclear Island Post Accident Radiation Zones - Elevation 4650 mm	12.3-170
Figure 12.3-47. Nuclear Island Post Accident Radiation Zones - Elevation 9060 mm	12.3-171
Figure 12.3-48. Nuclear Island Post Accident Radiation Zones - Elevation 13570 mm	12.3-172
Figure 12.3-49. Nuclear Island Post Accident Radiation Zones - Elevation 17500 mm	12.3-173
Figure 12.3-50. Nuclear Island Post Accident Radiation Zones - Elevation 27000 mm	12.3-174
Figure 12.3-51. Nuclear Island Post Accident Radiation Zones - Elevation 34000 mm	12.3-175
Figure 12.3-51a. Post Accident Radiation Zones Electrical Building - Elevation 4650 mm	12.3-176
Figure 12.3-51b. Post Accident Radiation Zones Electrical Building - Elevation 9800 mm	12.3-177
Figure 12.3-51c. Post Accident Radiation Zones Electrical Building - Elevation 18000 mm	12.3-178
Figure 12.3-51d. Post Accident Radiation Zones Electrical Building - Elevation 27000 mm	12.3-179
Figure 12.3-51e. Post Accident Radiation Zones, Service Building Floor - Elevation 1300mm	12.3-180
Figure 12.3-51f. Post Accident Radiation Zones, Service Building Floor - Elevation 4650 mm	12.3-181
Figure 12.3-52. Reactor Building and Fuel Building Personnel Egress Routes - Elevation -11500 mm	12.3-182
Figure 12.3-53. Reactor, Fuel, & Control Buildings Personnel Access and Egress Routes - Elevation -6400 mm	12.3-183
Figure 12.3-54. Reactor, Fuel, & Control Buildings Personnel Access and Egress Routes - Elevation -1000 mm	12.3-184
Figure 12.3-55. Reactor, Fuel, & Control Buildings Personnel Access and Egress Routes - Elevation 4650 mm	12.3-185
Figure 12.3-56. Reactor, Fuel, & Control Buildings Personnel Access and Egress Routes - Elevation 9060 mm	12.3-186

Figure 12.3-57. Reactor Building & Fuel Buildings Personnel Access and Egress Routes - Elevation 13570 mm.....	12.3-187
Figure 12.3-58. Reactor Building & Fuel Building Personnel Access and Egress Routes - Elevation 17500 mm.....	12.3-188
Figure 12.3-59. Reactor Building & Fuel Building Personnel Access and Egress Routes - Elevation 27000 mm.....	12.3-189
Figure 12.3-60. Reactor Building Personnel Access and Egress Routes - Elevation 34000 mm	12.3-190
Figure 12.3-61. Radwaste Building Personnel Access and Egress Routes - Elevation 9350 mm	12.3-191
Figure 12.3-62. Radwaste Building Personnel Access and Egress Routes - Elevation 2350 mm	12.3-192
Figure 12.3-63. Radwaste Building Personnel Access and Egress Routes - Elevation 4650 mm	12.3-193
Figure 12.3-64. Radwaste Building Personnel Access and Egress Routes - Elevation 10650 mm	12.3-194
Figure 12.3-65. Turbine Building Personnel Access and Egress Routes - Elevation 1400 mm	12.3-195
Figure 12.3-66. Turbine Building Personnel Access and Egress Routes - Elevation 4650 mm	12.3-196
Figure 12.3-67. Turbine Building Personnel Access and Egress Routes - Elevation 12000 mm	12.3-197
Figure 12.3-68. Turbine Building Personnel Access and Egress Routes - Elevation 20000 mm	12.3-198
Figure 12.3-69. Turbine Building Personnel Access and Egress Routes - Elevation 28000 mm	12.3-199
Figure 12.3-70. Turbine Building Personnel Access and Egress Routes - Elevation 35000 mm	12.3-200
Figure 12.3-70a. Turbine Building Personnel Access and Egress Routes at Various Elevations.....	12.3-201
Figure 12.3-71. Reactor Building Rooms Adjacent to the RWCU/SDC and FAPCS Demineralizers - Elevation -11500 mm	12.3-202
Figure 12.3-72. Reactor Building RWCU/SDC and FAPCS Demineralizer Rooms and Adjacent Rooms - Elevation -6400 mm	12.3-203
Figure 12.3-73. Reactor Building Rooms Adjacent to the RWCU/SDC and FAPCS Demineralizers - Elevation -1000 mm	12.3-204
Figure 12.3-74. Areas Requiring Post-Accident Access - Elevation -11500 mm	12.3-205
Figure 12.3-75. Areas Requiring Post-Accident Access - Elevation -6400 mm	12.3-206
Figure 12.3-76. Areas Requiring Post-Accident Access - Elevation from -2000 to -1000 mm	12.3-207
Figure 12.3-77. Areas Requiring Post-Accident Access - Elevation 1300 mm.....	12.3-208
Figure 12.3-78. Areas Requiring Post-Accident Access - Elevation 4650 mm.....	12.3-209
Figure 12.3-79. Areas Requiring Post-Accident Access - Elevation 9060 mm.....	12.3-210
Figure 12.3-80. Areas Requiring Post-Accident Access - Elevation 9800 mm.....	12.3-211
Figure 12.3-81. Areas Requiring Post-Accident Access - Elevation 13570 mm.....	12.3-212
Figure 12.3-82. Areas Requiring Post-Accident Access - Elevation 17500 mm.....	12.3-213

Figure 12.3-83. Areas Requiring Post-Accident Access - Elevation 18000 mm.....	12.3-214
Figure 12.3-84. Areas Requiring Post-Accident Access - Elevation 27000 mm.....	12.3-215
Figure 12.3-85. Areas Requiring Post-Accident Access (Electrical Building) Elevation 27000 mm	12.3-216
Figure 12.3-86. Areas Requiring Post-Accident Access - Elevation 34000 mm.....	12.3-217
Figure 12.5-1. Functional Layout of Health Physics Facilities at Service Building Elevation 1300 mm	12.5-3
Figure 12.5-2. Functional Layout of Health Physics Facilities at Service Building Elevation 4650 mm	12.5-4

ESBWR

Design Control Document/Tier 2

VOLUME 26A6642BL

-NONE-

VOLUME 26A6642BN

-NONE-

VOLUME 26A6642BP

Figure 15.1-1. Event Diagram Format	15.1-29
Figure 15.1-2. Event Diagram – Loss of Feedwater Heating	15.1-30
Figure 15.1-3. Event Diagram – Closure of One Turbine Control Valve.....	15.1-31
Figure 15.1-4. Event Diagram – Generator Load Rejection with Turbine Bypass.....	15.1-32
Figure 15.1-5. Event Diagram – Generator Load Rejection with a Single Failure in the Turbine Bypass System.....	15.1-33
Figure 15.1-6. Event Diagram – Turbine Trip with Turbine Bypass.....	15.1-34
Figure 15.1-7. Event Diagram – Turbine Trip with a Single Failure in the Turbine Bypass System.....	15.1-35
Figure 15.1-8. Event Diagram – Closure of One Main Steamline Isolation Valve	15.1-36
Figure 15.1-9. Event Diagram – Closure of All Main Steamline Isolation Valves	15.1-37
Figure 15.1-10. Event Diagram – Loss of Condenser Vacuum.....	15.1-38
Figure 15.1-11. Event Diagram – Loss of Shutdown Cooling Function of RWCU/SDC System	15.1-39
Figure 15.1-12. Event Diagram – Inadvertent Isolation Condenser Initiation	15.1-40
Figure 15.1-13. Event Diagram – Runout of One Feedwater Pump.....	15.1-41
Figure 15.1-14. Event Diagram – Opening of One Turbine Control or Bypass Valve	15.1-42
Figure 15.1-15. Event Diagram – Loss of Non-Emergency AC Power to Station Auxiliaries	15.1-43
Figure 15.1-16. Event Diagram – Loss of All Feedwater Flow.....	15.1-44
Figure 15.1-17a. Event Diagram – Loss of Feedwater Heating With Failure of SCRRI and SRI	15.1-45
Figure 15.1-17b. Event Diagram – Feedwater Controller Failure - Minimum Temperature Demand	15.1-46
Figure 15.1-18. Event Diagram – Feedwater Controller Failure – Maximum Flow Demand	15.1-47
Figure 15.1-19. Event Diagram – Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.1-48
Figure 15.1-20. Event Diagram – Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.1-49
Figure 15.1-21. Event Diagram – Generator Load Rejection with Total Bypass Failure (at High Power)	15.1-50
Figure 15.1-22. Event Diagram – Turbine Trip with Total Bypass Failure (at High Power).....	15.1-51
Figure 15.1-23. Event Diagram – Control Rod Withdrawal Error During Refueling	15.1-52
Figure 15.1-24a. Event Diagram – Control Rod Withdrawal Error During Startup.....	15.1-53
Figure 15.1-24b. Event Diagram – Control Rod Withdrawal Error During Startup With Failure of Control Rod Block	15.1-54
Figure 15.1-25a. Event Diagram – Control Rod Withdrawal Error During Power Operation with ATLM Failure.....	15.1-55
Figure 15.1-25b. Event Diagram – Control Rod Withdrawal Error During Power Operation	15.1-56
Figure 15.1-26. Event Diagram – Fuel Assembly Loading Error – Mislocated Bundle	15.1-57
Figure 15.1-27. Event Diagram – Fuel Assembly Loading Error – Misoriented Bundle....	15.1-58

Figure 15.1-28. Event Diagram – Inadvertent SDC Function Operation	15.1-59
Figure 15.1-29. Event Diagram – Inadvertent Opening of a Safety Relief Valve	15.1-60
Figure 15.1-30. Event Diagram – Inadvertent Opening of a Depressurization Valve	15.1-61
Figure 15.1-31. Event Diagram – Stuck Open Safety Relief Valve	15.1-62
Figure 15.1-32. Event Diagram – Liquid-Containing Tank Failure	15.1-63
Figure 15.1-33. Event Diagram – Fuel Handling Accident	15.1-64
Figure 15.1-34a. Event Diagram – Loss-of-Coolant-Accident Inside Containment	15.1-65
Figure 15.1-34b. Event Diagram – Loss-of-Coolant-Accident Inside Containment	15.1-66
Figure 15.1-35a. Event Diagram – Main Steamline Break Outside Containment	15.1-67
Figure 15.1-35b. Event Diagram – Main Steamline Break Outside Containment	15.1-68
Figure 15.1-36. Event Diagram – Control Rod Drop Accident	15.1-69
Figure 15.1-37a. Event Diagram – Feedwater Line Break Outside Containment	15.1-70
Figure 15.1-37b. Event Diagram – Feedwater Line Break Outside Containment	15.1-71
Figure 15.1-38a. Event Diagram – Failure of Small Line Carrying Primary Coolant Outside Containment	15.1-72
Figure 15.1-38b. Event Diagram – Failure of Small Line Carrying Primary Coolant Outside Containment	15.1-73
Figure 15.1-39a. Event Diagram – RWCU/SDC System Line Failure Outside Containment	15.1-74
Figure 15.1-39b. Event Diagram – RWCU/SDC System Line Failure Outside Containment	15.1-75
Figure 15.1-40. Event Diagram – Spent Fuel Cask Drop Accident	15.1-76
Figure 15.1-41. Event Diagram – MSIV Closure With Flux Scram (Overpressure Protection)	15.1-77
Figure 15.1-42. Event Diagram – Shutdown Without Control Rods (i.e., SLC System Capability)	15.1-78
Figure 15.1-43. Event Diagram – Shutdown from Outside Main Control Room	15.1-79
Figure 15.1-44a. Event Diagram – Anticipated Transients Without Scram	15.1-80
Figure 15.1-44b. Event Diagram – Anticipated Transients Without Scram	15.1-81
Figure 15.1-45a. Event Diagram – Station Blackout	15.1-82
Figure 15.1-46. Event Diagram – Safe Shutdown Fire	15.1-84
Figure 15.1-47. Event Diagram – Waste Gas System Leak or Failure	15.1-85
Figure 15.2-1a. Loss of Feedwater Heating	15.2-56
Figure 15.2-1b. Loss of Feedwater Heating	15.2-56
Figure 15.2-1c. Loss of Feedwater Heating	15.2-57
Figure 15.2-1d. Loss of Feedwater Heating	15.2-57
Figure 15.2-1e. Loss of Feedwater Heating	15.2-58
Figure 15.2-1f. Loss of Feedwater Heating	15.2-58
Figure 15.2-1g. Loss of Feedwater Heating	15.2-59
Figure 15.2-2a. Fast Closure of One Turbine Control Valve	15.2-60
Figure 15.2-2b. Fast Closure of One Turbine Control Valve	15.2-60
Figure 15.2-2c. Fast Closure of One Turbine Control Valve	15.2-61
Figure 15.2-2d. Fast Closure of One Turbine Control Valve	15.2-61
Figure 15.2-2e. Fast Closure of One Turbine Control Valve	15.2-62
Figure 15.2-2f. Fast Closure of One Turbine Control Valve	15.2-62
Figure 15.2-2g. Fast Closure of One Turbine Control Valve	15.2-63

Figure 15.2-2h. Fast Closure of One Turbine Control Valve (Figure 15.2-2a from 0 to 5s)	15.2-64
Figure 15.2-3a. Slow Closure of One Turbine Control Valve	15.2-65
Figure 15.2-3b. Slow Closure of One Turbine Control Valve	15.2-65
Figure 15.2-3c. Slow Closure of One Turbine Control Valve	15.2-66
Figure 15.2-3d. Slow Closure of One Turbine Control Valve	15.2-66
Figure 15.2-3e. Slow Closure of One Turbine Control Valve	15.2-67
Figure 15.2-3f. Slow Closure of One Turbine Control Valve	15.2-67
Figure 15.2-3g. Slow Closure of One Turbine Control Valve	15.2-68
Figure 15.2-4a. Generator Load Rejection with Turbine Bypass	15.2-69
Figure 15.2-4b. Generator Load Rejection with Turbine Bypass	15.2-69
Figure 15.2-4c. Generator Load Rejection with Turbine Bypass	15.2-70
Figure 15.2-4d. Generator Load Rejection with Turbine Bypass	15.2-70
Figure 15.2-4e. Generator Load Rejection with Turbine Bypass	15.2-71
Figure 15.2-4f. Generator Load Rejection with Turbine Bypass	15.2-71
Figure 15.2-4g. Generator Load Rejection with Turbine Bypass	15.2-72
Figure 15.2-4h. Generator Load Rejection with Turbine Bypass (Figure 15.2-4a from 0 to 5 s)	15.2-72
Figure 15.2-5a. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-73
Figure 15.2-5b. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-73
Figure 15.2-5c. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-74
Figure 15.2-5d. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-74
Figure 15.2-5e. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-75
Figure 15.2-5f. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-75
Figure 15.2-5g. Generator Load Rejection with a Single Failure in the Turbine Bypass System	15.2-76
Figure 15.2-5h. Generator Load Rejection with a Single Failure in the Turbine Bypass System (Figure 15.2-5a from 0 to 5 sec)	15.2-76
Figure 15.2-6a. Turbine Trip with Turbine Bypass	15.2-77
Figure 15.2-6b. Turbine Trip with Turbine Bypass	15.2-77
Figure 15.2-6c. Turbine Trip with Turbine Bypass	15.2-78
Figure 15.2-6d. Turbine Trip with Turbine Bypass	15.2-78
Figure 15.2-6e. Turbine Trip with Turbine Bypass	15.2-79
Figure 15.2-6f. Turbine Trip with Turbine Bypass	15.2-79
Figure 15.2-6g. Turbine Trip with Turbine Bypass	15.2-80
Figure 15.2-7a. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-82
Figure 15.2-7b. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-82
Figure 15.2-7c. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-83
Figure 15.2-7d. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-83
Figure 15.2-7e. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-84

Figure 15.2-7f. Turbine Trip with a Single Failure in the Turbine Bypass System	15.2-84
Figure 15.2-7g. Turbine Trip with a Single Failure in the Turbine Bypass System.....	15.2-85
Figure 15.2-7h. Turbine Trip with a Single Failure in the Turbine Bypass System.....	15.2-85
(Figure 15.2-7a from 0 to 5 sec)	15.2-85
Figure 15.2-8a. Closure of One MSIV.....	15.2-86
Figure 15.2-8b. Closure of One MSIV	15.2-86
Figure 15.2-8c. Closure of One MSIV.....	15.2-87
Figure 15.2-8d. Closure of One MSIV	15.2-87
Figure 15.2-8e. Closure of One MSIV.....	15.2-88
Figure 15.2-8f. Closure of One MSIV	15.2-88
Figure 15.2-8g. Closure of One MSIV	15.2-89
Figure 15.2-9a. Closure of All MSIVs.....	15.2-90
Figure 15.2-9b. Closure of All MSIVs	15.2-90
Figure 15.2-9c. Closure of All MSIVs.....	15.2-91
Figure 15.2-9d. Closure of All MSIVs	15.2-91
Figure 15.2-9e. Closure of All MSIVs.....	15.2-92
Figure 15.2-9f. Closure of All MSIVs.....	15.2-92
Figure 15.2-9g. Closure of All MSIVs	15.2-93
Figure 15.2-10a. Loss of Condenser Vacuum	15.2-94
Figure 15.2-10b. Loss of Condenser Vacuum	15.2-94
Figure 15.2-10c. Loss of Condenser Vacuum	15.2-95
Figure 15.2-10d. Loss of Condenser Vacuum	15.2-95
Figure 15.2-10e. Loss of Condenser Vacuum	15.2-96
Figure 15.2-10f. Loss of Condenser Vacuum.....	15.2-96
Figure 15.2-10g. Loss of Condenser Vacuum	15.2-97
Figure 15.2-11a. Inadvertent Isolation Condenser Initiation	15.2-98
Figure 15.2-11b. Inadvertent Isolation Condenser Initiation.....	15.2-99
Figure 15.2-11c. Inadvertent Isolation Condenser Initiation	15.2-100
Figure 15.2-11d. Inadvertent Isolation Condenser Initiation.....	15.2-101
Figure 15.2-11e. Inadvertent Isolation Condenser Initiation	15.2-102
Figure 15.2-11f. Inadvertent Isolation Condenser Initiation	15.2-103
Figure 15.2-11g. Inadvertent Isolation Condenser Initiation.....	15.2-104
Figure 15.2-12. Simplified Block Diagram of Fault-Tolerant Digital Controller System.	15.2-105
Figure 15.2-13a. Runout of One Feedwater Pump	15.2-106
Figure 15.2-13b. Runout of One Feedwater Pump.....	15.2-106
Figure 15.2-13c. Runout of One Feedwater Pump	15.2-107
Figure 15.2-13d. Runout of One Feedwater Pump.....	15.2-107
Figure 15.2-13e. Runout of One Feedwater Pump	15.2-108
Figure 15.2-13f. Runout of One Feedwater Pump.....	15.2-108
Figure 15.2-13g. Runout of One Feedwater Pump.....	15.2-109
Figure 15.2-14a. Opening of One Turbine Control or Bypass Valve.....	15.2-110
Figure 15.2-14b. Opening of One Turbine Control or Bypass Valve.....	15.2-110
Figure 15.2-14c. Opening of One Turbine Control or Bypass Valve.....	15.2-111
Figure 15.2-14d. Opening of One Turbine Control or Bypass Valve.....	15.2-111
Figure 15.2-14e. Opening of One Turbine Control or Bypass Valve.....	15.2-112
Figure 15.2-14f. Opening of One Turbine Control or Bypass Valve	15.2-112

Figure 15.2-14g. Opening of One Turbine Control or Bypass Valve.....	15.2-113
Figure 15.2-15a. Loss of Non-Emergency AC Power to Station Auxiliaries.....	15.2-114
Figure 15.2-15b. Loss of Non-Emergency AC Power to Station Auxiliaries	15.2-114
Figure 15.2-15c. Loss of Non-Emergency AC Power to Station Auxiliaries.....	15.2-115
Figure 15.2-15d. Loss of Non-Emergency AC Power to Station Auxiliaries	15.2-115
Figure 15.2-15e. Loss of Non-Emergency AC Power to Station Auxiliaries.....	15.2-116
Figure 15.2-15f. Loss of Non-Emergency AC Power to Station Auxiliaries	15.2-116
Figure 15.2-15g. Loss of Non-Emergency AC Power to Station Auxiliaries	15.2-117
Figure 15.2-15h. Loss of Non-Emergency AC Power to Station Auxiliaries (Figure 15.2-15a from 50 to 70 s)	15.2-117
Figure 15.2-16a. Loss of All Feedwater Flow	15.2-118
Figure 15.2-16b. Loss of All Feedwater Flow	15.2-118
Figure 15.2-16c. Loss of All Feedwater Flow	15.2-119
Figure 15.2-16d. Loss of All Feedwater Flow	15.2-119
Figure 15.2-16e. Loss of All Feedwater Flow	15.2-120
Figure 15.2-16f. Loss of All Feedwater Flow.....	15.2-120
Figure 15.2-16g. Loss of All Feedwater Flow	15.2-121
Figure 15.2-16h. Loss of All Feedwater Flow (Figure 15.2-16a from 50 to 70 s)	15.2-121
Figure 15.2-17. ESBWR Core Power-FW Temperature Operating Domain with Representative Rod/FW Temperature Block and Scram Lines.....	15.2-122
Figure 15.3-1a. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-49
Figure 15.3-1b. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-49
Figure 15.3-1c. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-50
Figure 15.3-1d. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-50
Figure 15.3-1e. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-51
Figure 15.3-1f. Loss of Feedwater Heating with SCRRI/SRI Failure.....	15.3-51
Figure 15.3-1g. Loss of Feedwater Heating with SCRRI/SRI Failure	15.3-52
Figure 15.3-2a. Feedwater Controller Failure – Maximum Flow Demand	15.3-53
Figure 15.3-2b. Feedwater Controller Failure – Maximum Flow Demand	15.3-53
Figure 15.3-2c. Feedwater Controller Failure – Maximum Flow Demand	15.3-54
Figure 15.3-2d. Feedwater Controller Failure – Maximum Flow Demand	15.3-54
Figure 15.3-2e. Feedwater Controller Failure – Maximum Flow Demand	15.3-55
Figure 15.3-2f. Feedwater Controller Failure – Maximum Flow Demand.....	15.3-55
Figure 15.3-2g. Feedwater Controller Failure – Maximum Flow Demand.....	15.3-56
Figure 15.3-3a. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.3-57
Figure 15.3-3b. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.3-57
Figure 15.3-3c. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.3-58
Figure 15.3-3d. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves.....	15.3-58
Figure 15.3-3e. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves	15.3-59
Figure 15.3-3f. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves	15.3-59

Figure 15.3-3g. Pressure Regulator Failure – Opening of All Turbine Control and Bypass Valves	15.3-60
Figure 15.3-4a. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-61
Figure 15.3-4b. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-61
Figure 15.3-4c. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-62
Figure 15.3-4d. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-62
Figure 15.3-4e. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-63
Figure 15.3-4f. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-63
Figure 15.3-4g. Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves.....	15.3-64
Figure 15.3-5a. Generator Load Rejection With Total Turbine Bypass Failure	15.3-65
Figure 15.3-5b. Generator Load Rejection With Total Turbine Bypass Failure	15.3-65
Figure 15.3-5c. Generator Load Rejection With Total Turbine Bypass Failure	15.3-66
Figure 15.3-5d. Generator Load Rejection With Total Turbine Bypass Failure	15.3-66
Figure 15.3-5e. Generator Load Rejection With Total Turbine Bypass Failure	15.3-67
Figure 15.3-5f. Generator Load Rejection With Total Turbine Bypass Failure.....	15.3-67
Figure 15.3-5g. Generator Load Rejection With Total Turbine Bypass Failure	15.3-68
Figure 15.3-5h. Generator Load Rejection With Total Turbine Bypass Failure (Figure 15.3-5a from 0 to 5 s)	15.3-68
Figure 15.3-6a. Turbine Trip With Total Turbine Bypass Failure	15.3-69
Figure 15.3-6b. Turbine Trip With Total Turbine Bypass Failure	15.3-69
Figure 15.3-6c. Turbine Trip With Total Turbine Bypass Failure	15.3-70
Figure 15.3-6d. Turbine Trip With Total Turbine Bypass Failure	15.3-70
Figure 15.3-6e. Turbine Trip With Total Turbine Bypass Failure	15.3-71
Figure 15.3-6f. Turbine Trip With Total Turbine Bypass Failure.....	15.3-71
Figure 15.3-6g. Turbine Trip With Total Turbine Bypass Failure	15.3-72
Figure 15.3-6h. Turbine Trip with Total Bypass Failure (Figure 15.3-6a from 0 to 5 s)	15.3-72
Figure 15.3-7. (Deleted).....	15.3-73
Figure 15.3-7a. Causes of Control Rod Withdrawal Error During Startup With Failure of Control Rod Block	15.3-74
Figure 15.3-8a. Inadvertent SRV Opening	15.3-75
Figure 15.3-8b. Inadvertent SRV Opening.....	15.3-75
Figure 15.3-8c. Inadvertent SRV Opening	15.3-76
Figure 15.3-8d. Inadvertent SRV Opening.....	15.3-76
Figure 15.3-8e. Inadvertent SRV Opening	15.3-77
Figure 15.3-8f. Inadvertent SRV Opening.....	15.3-77
Figure 15.3-8g. Inadvertent SRV Opening.....	15.3-78
Figure 15.3-9a. Stuck Open Safety Relief Valve.....	15.3-79
Figure 15.3-9b. Stuck Open Safety Relief Valve	15.3-79
Figure 15.3-9c. Stuck Open Safety Relief Valve.....	15.3-80

Figure 15.3-9d. Stuck Open Safety Relief Valve	15.3-80
Figure 15.3-9e. Stuck Open Safety Relief Valve.....	15.3-81
Figure 15.3-9f. Stuck Open Safety Relief Valve	15.3-81
Figure 15.3-9g. Stuck Open Safety Relief Valve	15.3-82
Figure 15.4-1. LOCA Radiological Paths.....	15.4-85
Figure 15.4-2. Airborne CsI for Removal Coefficient Determination.....	15.4-86
Figure 15.4-3. Removal Coefficient Determination for Low Pressure Bottom Line Break (Accident Scenario-1)	15.4-87
Figure 15.4-4. Control Room Doses for Fuel Handling Accident vs. Control Room Unfiltered Inleakage	15.4-87
Figure 15.5-1a. ATWS MSIV Closure with ARI	15.5-34
Figure 15.5-1b. ATWS MSIV Closure with ARI	15.5-35
Figure 15.5-1c. ATWS MSIV Closure with ARI	15.5-36
Figure 15.5-1d. ATWS MSIV Closure with ARI	15.5-37
Figure 15.5-2a. ATWS MSIV Closure with FMCRD Run-in	15.5-38
Figure 15.5-2b. ATWS MSIV Closure with FMCRD Run-in.....	15.5-39
Figure 15.5-2c. ATWS MSIV Closure with FMCRD Run-in	15.5-40
Figure 15.5-2d. ATWS MSIV Closure with FMCRD Run-in.....	15.5-41
Figure 15.5-3a. ATWS MSIV Closure - SLC System Bounding Case	15.5-42
Figure 15.5-3b. ATWS MSIV Closure - SLC System Bounding Case	15.5-43
Figure 15.5-3c. ATWS MSIV Closure - SLC System Bounding Case	15.5-44
Figure 15.5-3d. ATWS MSIV Closure - SLC System Bounding Case	15.5-45
Figure 15.5-3e. (Deleted).....	15.5-46
Figure 15.5-3f. (Deleted)	15.5-46
Figure 15.5-3g. (Deleted).....	15.5-46
Figure 15.5-4a. ATWS Loss of Condenser Vacuum SLC System Bounding Case	15.5-47
Figure 15.5-4b. ATWS Loss of Condenser Vacuum SLC System Bounding Case	15.5-48
Figure 15.5-4c. ATWS Loss of Condenser Vacuum SLC System Bounding Case	15.5-49
Figure 15.5-4d. ATWS Loss of Condenser Vacuum SLC System Bounding Case	15.5-50
Figure 15.5-4e. (Deleted).....	15.5-51
Figure 15.5-4f. (Deleted)	15.5-51
Figure 15.5-4g. (Deleted).....	15.5-51
Figure 15.5-4h. (Deleted).....	15.5-51
Figure 15.5-5a. ATWS Loss of Feedwater Heating with Boron Injection	15.5-52
Figure 15.5-5b. ATWS Loss of Feedwater Heating with Boron Injection	15.5-53
Figure 15.5-5c. ATWS Loss of Feedwater Heating with Boron Injection	15.5-54
Figure 15.5-5d. ATWS Loss of Feedwater Heating with Boron Injection.....	15.5-55
Figure 15.5-6a. ATWS Loss of Normal AC Power to Station Auxiliaries with Boron Injection	15.5-56
Figure 15.5-6b. ATWS Loss of Normal AC Power to Station Auxiliaries with Boron Injection	15.5-57
Figure 15.5-6c. ATWS Loss of Normal AC Power to Station Auxiliaries with Boron Injection	15.5-58
Figure 15.5-6d. ATWS Loss of Normal AC Power to Station Auxiliaries with Boron Injection	15.5-59
Figure 15.5-7a. ATWS Loss of Feedwater Flow with Boron Injection.....	15.5-60

Figure 15.5-7b. ATWS Loss of Feedwater Flow with Boron Injection	15.5-61
Figure 15.5-7c. ATWS Loss of Feedwater Flow with Boron Injection.....	15.5-62
Figure 15.5-7d. ATWS Loss of Feedwater Flow with Boron Injection	15.5-63
Figure 15.5-8a. ATWS Load Rejection with a Single Failure in the Turbine Bypass System with Boron Injection	15.5-64
Figure 15.5-8b. ATWS Load Rejection with a Single Failure in the Turbine Bypass System with Boron Injection.....	15.5-65
Figure 15.5-8c. ATWS Load Rejection with a Single Failure in the Turbine Bypass System with Boron Injection	15.5-66
Figure 15.5-8d. ATWS Load Rejection with a Single Failure in the Turbine Bypass System with Boron Injection.....	15.5-67
Figure 15.5-9. Core Stability During Turbine Trip with Full Bypass ATWS Event.....	15.5-68
Figure 15.5-10a. Station Blackout	15.5-69
Figure 15.5-10b. Station Blackout.....	15.5-69
Figure 15.5-10c. Station Blackout	15.5-70
Figure 15.5-10d. Station Blackout.....	15.5-70
Figure 15.5-10e. Station Blackout	15.5-71
Figure 15.5-10f. Station Blackout (Figure 15.5-10a from 0 to 5 s).....	15.5-71
Figure 15.5-11a. MSIV Closure With Flux Scram.....	15.5-72
Figure 15.5-11b. MSIV Closure With Flux Scram.....	15.5-72
Figure 15.5-11c. MSIV Closure With Flux Scram.....	15.5-73
Figure 15.5-11d. MSIV Closure With Flux Scram.....	15.5-73
Figure 15.5-11e. MSIV Closure With Flux Scram.....	15.5-74
Figure 15.5-11f. MSIV Closure With Flux Scram	15.5-74
Figure 15.5-11g. MSIV Closure With Flux Scram (Figure 15.5-11a from 0 to 5 s)	15.5-75
Figure 15A-1a. DPV Initiation Logic	15A-38
Figure 15A-1b. DPV Initiation Logic by DPS.....	15A-39
Figure 15A-2a. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 1 of 19).....	15A-40
Figure 15A-2b. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 2 of 19).....	15A-41
Figure 15A-2c. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 3 of 19)	15A-42
Figure 15A-2d. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 4 of 19).....	15A-43
Figure 15A-2e. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 5 of 19).....	15A-44
Figure 15A-2f. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 6 of 19)	15A-45
Figure 15A-2g. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 7 of 19).....	15A-46
Figure 15A-2h. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 8 of 19).....	15A-47
Figure 15A-2i. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 9 of 19)	15A-48

Figure 15A-2j. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 10 of 19).....	15A-49
Figure 15A-2k. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 11 of 19).....	15A-50
Figure 15A-2l. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 12 of 19).....	15A-51
Figure 15A-2m. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 13 of 19).....	15A-52
Figure 15A-2n. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 14 of 19).....	15A-53
Figure 15A-2o. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 15 of 19).....	15A-54
Figure 15A-2p. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 16 of 19).....	15A-55
Figure 15A-2q. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 17 of 19).....	15A-56
Figure 15A-2r. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 18 of 19).....	15A-57
Figure 15A-2s. Fault Tree – Inadvertent Opening of a Depressurization Valve (page 19 of 19).....	15A-58
Figure 15A-3a. Fault Tree – Inadvertent Shutdown Cooling Function Operation (page 1 of 3).....	15A-59
Figure 15A-3b. Fault Tree – Inadvertent Shutdown Cooling Function Operation (page 2 of 3).....	15A-60
Figure 15A-3c. Fault Tree – Inadvertent Shutdown Cooling Function Operation (page 3 of 3).....	15A-61
Figure 15A-4a. Fault Tree - Inadequate Reactivity Insertion Given a Loss of FW Heating (page 1 of 2)	15A-62
Figure 15A-4b. Fault Tree for Inadequate Reactivity Insertion Given a Loss of FW Heating (page 2 of 2)	15A-63
Figure 15B-1. (Deleted).....	15B-3
Figure 15C-1. Pool pH Calculation Results for a Low Pressure Bottom Line Break (Accident Scenario 1)	15C-8
Figure 15C-2. Pool pH Calculation Results for a High Pressure Bottom Line Break (Accident Scenario 2)	15C-9
Figure 15C-3. Pool pH Calculation Results for a Loss of Feedwater/Loss of AC Power (Accident Scenario 3)	15C-10

ESBWR

Design Control Document/Tier 2

VOLUME 26A6642BR

-NONE-

VOLUME 26A6642BT

-NONE-

VOLUME 26A6642BW

-NONE-

VOLUME 26A6642BX

Figure 18.1-1. HFE Implementation Process..... 18.1-12

VOLUME 26A6642BY

Figure 19.3. BiMAC Pipes and Protective Ceramic Layer	19.3-17
Figure 19B. Finite Element Model Showing Steady State Thermal Condition	19B-27
Figure 19B-2 Concrete Compressive Stress, Level C Analysis, 0.992 MPaG (144 psig) Pressure	19B-28
Figure 19B-3. Concrete Cracking Strain, Level C Analysis, 0.992 MPaG (144 psig) Pressure	19B-29
Figure 19B-4. Liner Maximum Principal Strain, Level C Analysis, 0.992 MPaG (144 psig) Pressure	19B-30
Figure 19B-5. Maximum Principal Strains in Liner Near Discontinuities, Level C Analysis	19B-31
Figure 19B-6. Liner Membrane Strain at Representative Locations, Level C Analysis	19B-32
Figure 19B-7. Finite Element Model for Drywell Head Capacity Study	19B-33
Figure 19B-8. Displacement at Crown in Buckling Test Analysis	19B-34
Figure 19B-9. Post Buckled Shape of Test Analysis Model	19B-35
Figure 19B-10. Finite element Model for Buckling Analysis of ESBWR Drywell Head ...	19B-36
Figure 19B-11. Performance of ESBWR Drywell Head Under Internal Pressure at 260°C (500°F)	19B-37
Figure 19B-12. Plastic Strains, Nominal Geometry, 260°C (500°F)	19B-38
Figure 19B-13. Mod-Thickness Plastic Strain at Crown Under Increasing Pressure at 260°C (500°F)	19B-39
Figure 19C-1. Calculation of Variance due to Modeling Uncertainty	19C-31
Figure 19C-2. Finite Element Model Showing the 260°C (500°F) Steady State Thermal Condition	19C-32
Figure 19C-3. Structural Response of RCCV at 1.24 MPaG (180 psig) Pressure	19C-33
Figure 19C-4. Critical Location for Liner Tearing in RCCV	19C-34
Figure 19C-5. Pressure Fragility for RCCV Wall Capacity with Temperature	19C-35
Figure 19C-6. Pressure Fragility for RCCV Liner Tearing with Temperature	19C-35
Figure 19C-7. Local Finite Element Model for Drywell Head	19C-36
Figure 19C-8. Thermal Contours and Deformation for 260°C (500°F) Thermal Condition ..	19C-37
Figure 19C-9. Equivalent Plastic Strains in Steel Components at 2.17 MPaG (315 psig) ...	19C-38
Figure 19C-10. Bolt Stresses in Drywell Head for 260°C (500°F) Thermal Condition	19C-39
Figure 19C-11. Pressure Fragility with Temperature for Leakage at Drywell Head	19C-40
Figure 19C-12. Local Model of Drywell Equipment Hatch	19C-41
Figure 19C-13. Plastic Strains in EQ Hatch Steel Components, 260°C (500°F) Conditions	19C-42
Figure 19C-14. Plastic Strains in Liner for Local Effects Slice Model	19C-43
Figure 19C-15. Pressure Fragility with Temperature for Leakage at Equipment Hatch	19C-44
Figure 19C-16. Pressure Fragility at 260°C (500°F) Steady State Thermal Conditions	19C-44

List of Acronyms

10 CFR	Title 10, Code of Federal Regulations
A/D	Analog-to-Digital
ABA	Amplitude Based Algorithm
ABS	Auxiliary Boiler System
ABWR	Advanced Boiling Water Reactor
AC	Alternating Current
ACLCO	Availability Control Limiting Condition for Operation
ACM	Availability Controls Manual
ACSR	Availability Control Surveillance Requirement
ADB	Ancillary Diesel Building
ADG	Ancillary Diesel Generator
ADS	Automatic Depressurization System
AEO	Auxiliary Equipment Operator
AFC	Automatic Frequency Control
AFIP	Automatic Fixed In-Core Probe
AFT	As-Found Tolerance
AFU	Air Filtration Unit
AHS	Auxiliary Heat Sink
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
ALI	Annual Limits on Intake
ALT	As-Left Tolerance
ALWR	Advanced Light Water Reactor
AMS	Alarm Management System
AO	Air Operated
AOF	Allocation of Function(s)
AOO	Anticipated Operational Occurrence
AOP	Abnormal Operating Procedure(s)
APD	Annulus Pressurization Load(s) (Anchor Displacement Load[s])
APF	Automated Program Function(s)

APR	Automatic Power Regulator
APRM	Average Power Range Monitor
ARI	Alternate Rod Insertion
ARM	Area Radiation Monitoring
ARMS	Area Radiation Monitoring System
ARP	Annunciator Response Procedure(s)
ARS	Amplified Response Spectra
ASD	Adjustable Speed Drive
ASDC	Alternate Shutdown Cooling
ASI	Adverse Systems Interaction(s)
AST	Alternate Source Term
ATLM	Automated Thermal Limit Monitor
ATM	Analog Trip Module(s)
ATWS	Anticipated Transient Without Scram
AV	Allowable Value
B&PV	Boiler and Pressure Vessel
BAF	Bottom of Active Fuel
BDL	Bottom Drain Line
BiMAC	Basemat Internal Melt Arrest Coolability
BISI	Bypass and Inoperable Status Indication
BOC	Beginning of Cycle
BOP	Balance of Plant
BOPCWS	Balance of Plant Chilled Water Subsystem
BPU	Bypass Unit
BPVC	Boiler and Pressure Vessel Code
BRR	Baseline Review Record
BSP	Backup Stability Protection
BTP	Branch Technical Position
BWR	Boiling Water Reactor
BWROG	Boiling Water Reactor Owners' Group
BWRVIP	Boiling Water Reactor Vessel Internals Program
C&FS	Condensate and Feedwater System

CAS	Central Alarm Station
CB	Control Building
CBGAVS	Control Building General Area HVAC Subsystem
CBVS	Control Building HVAC System
CCF	Common Cause Failure
CCFP	Conditional Containment Failure Probability
CCI	Core-Concrete Interaction
CCTV	Closed Circuit Television
CDF	Core Damage Frequency
CFR	Code of Federal Regulation(s)
CIM	Communication Interface Module
CIRC	Circulating Water System
CIS	Containment Inerting System
CIV	Containment Isolation Valve
CLAVS	Clean Area HVAC Subsystem
CMF	Common Mode Failure
CMS	Containment Monitoring System
CO	Condensation Oscillation
COL	Combined License
COLA	Combined License Application
COLR	Core Operating Limits Report
CONAVS	Contaminated Area HVAC Subsystem
CPR	Critical Power Ratio
CPS	Condensate Purification System
CPU	Central Processing Unit
CQC	Complete Quadratic Combination
CRC	Cyclic Redundancy Checking
CRD	Control Rod Drive
CRDA	Control Rod Drop Accident
CRDH	Control Rod Drive Housing
CRDM	Control Rod Drive Mechanism
CRGT	Control Rod Guide Tube

CRHA	Control Room Habitability Area
CRHAVS	Control Room Habitability Area HVAC Subsystem
CRHS	Control Room Habitability System
CRT	Cathode Ray Tube
CS&TS	Condensate Storage and Transfer System
CSAU	Code Scaling, Applicability, and Uncertainty
CSDRS	Certified Seismic Design Response Spectra
CST	Condensate Storage Tank
CVCS	Chemical and Volume Control System
CWS	Chilled Water System
D/A	Digital-to-Analog
D/F	Diaphragm Floor
D/SP	Dryer /Separator Pool
D3	Defense-in-Depth and Diversity
DAC	Derived Air Concentration(s)
DAW	Dry Active Waste
DBA	Design Basis Accident
DBE	Design Basis Event
DBT	Design Basis Threat
DC	Direct Current
DCD	Design Control Document
DCFF	Design Characteristic, Feature or Function
DCH	Direct Containment Heating
DCIS	Distributed Control and Information System
DCPSS	Direct Current Power Supply System
DCS	Drywell Cooling System
DEG	Double-Ended Guillotine
DF	Decontamination Factor
DG	Diesel Generator
DGVS	Diesel Generators HVAC Subsystem
DLF	Dynamic Load Factor
DM	Dissimilar Metal

DOF	Degree of Freedom
DPS	Diverse Protection System
DPV	Depressurization Valve
DQD	Dynamic Qualification Documentation
DQR	Dynamic Qualification Report
D-RAP	Design Reliability Assurance Program
DRC	Doppler Reactivity Coefficient
DRS	Design Report Summary
DSS	Detect and Suppress Solution
DSS-CD	Detect and Suppress Solution - Confirmation Density
DTM	Digital Trip Module
DW	Drywell
EAB	Exclusion Area Boundary
EAL	Emergency Action Level
EB	Electrical Building
EBVS	Electrical Building HVAC System
ECCS	Emergency Core Cooling System
ECP	Engineering Computer Program
EER	Electric and Electronic Room(s)
EERVS	Electric and Electronic Room(s) HVAC Subsystem
EFDS	Equipment and Floor Drain System
EFU	Emergency Filter Unit
EHC	Electrohydraulic Control (Pressure Regulator)
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
ENS	Emergency Notification System
EOC	End of Cycle
EOF	Emergency Operations Facility
EOL	End of Life
EOP	Emergency Operating Procedure
EPDS	Electric Power Distribution System

EPG	Emergency Procedure Guideline
EQ	Environmental Qualification
EQD	Environmental Qualification Document
EQEDC	Equipment Qualification Environmental Design Criteria
EQT	Torsional Seismic Load(s)
EQZ	Vertical Seismic Load(s)
ERDS	Emergency Response Data System
ERFBS	Electrical Raceway Fire Barrier System(s)
ERI	Emergency Rod Insertion
ERICP	Emergency Rod Insertion Control Panel
ERIP	Emergency Rod Insertion Panel
ESF	Engineered Safety Feature
ESFAS	Engineered Safety Features Actuation System
ESP	Early Site Permit
ESW	Emergency (or Essential) Service Water
ETD	Emergency Trip Device
ETS	Emergency Trip System
ETSB	Effluent Treatment Systems Branch
EVE	Ex-Vessel Steam Explosion
EX	Explosively Actuated
FAC	Flow-Accelerated Corrosion
FAPCS	Fuel and Auxiliary Pools Cooling System
FAT	Factory Acceptance Test
FATT	Fracture Appearance Transition Temperature
FB	Fuel Building
FBFPVS	Fuel Building Fuel Pool Area HVAC Subsystem
FBGAVS	Fuel Building General Area HVAC Subsystem
FBVS	Fuel Building HVAC System
FC	Fail Closed
FCISL	Fuel Cladding Integrity Safety Limit
FCM	File Control Module
FCS	Flammability Control System

FCU	Fan Cooling Unit
FD	Failure to Detect an IC Failure
FDA	Final Design Approval
FEA	Finite Element Analysis
FFT	Fast Fourier Transform
FFWTR	Final Feedwater Temperature Reduction
FHA	Fire Hazards Analysis
FHM	Fuel Handling Machine
FIV	Flow-Induced Vibration
FM	Factory Mutual
FMCRD	Fine Motion Control Rod Drive
FME	Foreign Materials Exclusion
FMEA	Failure Modes and Effects Analysis
FOAK	First Of A Kind
FPE	Fire Pump Enclosure
FPM	Fuel Preparation Machine
FPS	Fire Protection System
FRA	Functional Requirements Analysis
FRS	Floor Response Spectra
FSAR	Final Safety Analysis Report
FSGT	Fuel Support and Guide Tube
FSP	Fuel Storage Pool
FTDC	Fault-Tolerant Digital Controller
FTS	Fuel Transfer System
FUHA	Fuel Handling Accident
FW	Feedwater
FWCS	Feedwater Control System
FWL	Feedwater Line
FWLB	Feedwater Line Break
FWS	Firewater Storage Tank
FWSC	Firewater Service Complex
G/F	Ground Floor

GALL	Generic Aging Lessons Learned
GCS	Generator Cooling System
GDC	General Design Criteria (or Criterion)
GDCS	Gravity-Driven Cooling System
GE	General Electric Company
GEEN	GE Energy Nuclear
GEH	GE Hitachi Nuclear Energy
GEN	Generator System
GENE	GE Nuclear Energy
GES	Generator Excitation System
GF	Geometry Factor
GLSOS	Generator Lube and Seal Oil System
GM	Geiger-Mueller Counter
GMAW	Gas Metal Arc Welding
GNF	Global Nuclear Fuel
GPP	General Plant Procedure(s)
GPS	Global Positioning System
GRA	Growth Rate Algorithm
GSI	Generic Safety Issue
GTAW	Gas Tungsten Arc Welding
GTG	General Training Guideline(s)
GTS	Generic Technical Specification(s)
GWSR	Ganged Withdrawal Sequence Restriction(s)
HA	Human Action
HAZ	Heat-Affected Zone
HCLPF	High Confidence Low Probability of Failure
HCTL	Heat Capacity Temperature Limit
HCU	Hydraulic Control Unit
HCW	High Conductivity Waste
HDVS	Heater Drain and Vent System
HED	Human Engineering Discrepancy
HELB	High Energy Line Break

HELSA	High Energy Line Separation Analysis
HEP	Human Error Probability
HEPA	High Efficiency Particulate Air
HF V&V	Human Factors Verification and Validation
HFE	Human Factors Engineering
HFEITS	Human Factors Engineering Issue Tracking System
HGCS	Hydrogen Gas Control System
HIC	High Integrity Container
HID	High Intensity Discharge
HMR	Hydrometeorology Report
HP CRD	High Pressure Control Rod Drive
HP/LP	High Pressure/Low Pressure
HPCF	High Pressure Core Flooder
HPCI	High Pressure Coolant Injection
HPM	Human Performance Monitoring
HPME	High Pressure Core Melt Ejection
HPNSS	High Pressure Nitrogen Supply System
HRA	Human Reliability Analysis
HRO	High Regulatory Oversight
HSI	Human-System Interface
HSS	High Safety Significant
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HVL	Horizontal Vent Chugging
HWC	Hydrogen Water Chemistry System
HWL	High Water Level
HX	Heat Exchanger
I&C	Instrumentation and Control
I/O	Input/Output
IAS	Instrument Air System
IASCC	Irradiation Assisted Stress Corrosion Cracking
IBC	International Building Code

IBL	Intermediate Break LOCA
IC	Isolation Condenser
IC/PCCS	Isolation Condenser/Passive Containment Cooling System
ICD	Interface Control Diagram
ICGT	In-Core Guide Tube(s)
ICM	In-Core Monitor
ICMGT	In-Core Monitor Guide Tube(s)
ICMH	In-Core Monitor Housing
ICP	Independent Control Platform
ICPR	Initial Critical Power Ratio
ICS	Isolation Condenser System
IFC	International Fire Code
IFTS	Inclined Fuel Transfer System
IGA	Intergranular Attack
IGSCC	Intergranular Stress Corrosion Cracking
ILRT	Integrated Leak Rate Test
IMCC	Induction Motor Controller Cabinet
IOP	Integrated Operating Procedure
IORV	Inadvertent Opening of a Relief Valve
IOT	Infrequent Operational Transient
IPEEE	Individual Plant Examination of External Event(s)
IR	Intermediate Resonance
IRV	Inside Reactor Vessel
ISI	Inservice Inspection
ISLOCA	Intersystem Loss-of-Coolant-Accident
ISLT	Inservice Leak Test
ISM	Independent Support Motion
IST	Inservice Testing
ITA	Inspections, Tests or Analyses
ITAAC	Inspections, Tests, Analyses and Acceptance Criteria
ITP	Initial Test Program
ITS	Issue Tracking System

JI	Jet Impingement
L1	Low water level ADS/GDCS initiation setpoint
L2	Low water level IC initiation setpoint
L3	Low water level scram setpoint
L8	High water level scram setpoint
LBB	Leak Before Break
LBL	Large Break LOCA
LCD	Load Capacity Datasheet
LCO	Limiting Condition for Operation
LCS	Local Control Station
LCW	Low Conductivity Waste
LD&IS	Leak Detection and Isolation System
LDA	Lay Down Area
LDV	Load Driver and Voter
LDW	Lower Drywell
LFCV	Low Flow Control Valve
LHGR	Linear Heat Generation Rate
LLD	Lower Limit of Detection
LLRT	Local Leak Rate Test
LMFBR	Liquid Metal Fast Breeder Reactor
LO	Lube Oil
LOCA	Loss-of-Coolant-Accident
LOFW	Loss of Feedwater
LOFWH	Loss of Feedwater Heating
LOOP	Loss of Offsite Power
LOPP	Loss of Preferred Power
LPCI	Low Pressure Coolant Injection
LPCRD	Locking Piston Control Rod Drive
LPCS	Low Pressure Core Spray
LPFL	Low Pressure Flooder
LPMS	Loose Parts Monitoring System
LPRM	Local Power Range Monitor

LPSP	Low Power Setpoint
LPZ	Low Population Zone
LRF	Large Release Frequency
LRO	Low Regulatory Oversight
LSB	Last Stage Blade
LSPS	Lighting and Service Power System
LSSS	Limiting Safety System Settings
LTR	Licensing Topical Report
LTSP	Limiting Trip Setpoint
LVDT	Linear Variable Differential Transformer
LWMS	Liquid Waste Management System
LWR	Light Water Reactor
MAC	Media Access Control
MBB	Motor Built-In Brake
MCC	Motor Control Center
MCES	Main Condenser Evacuation System
MCPR	Minimum Critical Power Ratio
MCR	Main Control Room
MCRBP	Main Control Room Back Panel
MCRP	Main Control Room Panel
MDRFP	Motor Driven Reactor Feed Pump
MELB	Moderate Energy Line Break
MERV	Minimum Efficiency Reporting Value
MFAP	Main Fire Alarm Panel
MLHGR	Maximum Linear Heat Generation Rate
MMI	Man-Machine Interface
MMIS	Man-Machine Interface System
MOC	Middle of Cycle
MOD	Motor Operated Disconnect
MODCOF	Moderator Temperature Coefficient
MOP	Mechanical Overpower
MPL	Master Parts List

MRBM	Multi-Channel Rod Block Monitor
MS	Main Steam
MSF	Mode Shape Factor
MSIV	Main Steam Isolation Valve
MSL	Main Steamline
MSLB	Main Steamline Break
MSLBA	Main Steamline Break Accident
MSR	Moisture Separator Reheater
MST	Main Steam Tunnel
MSV	Mean Square Voltage
MTBF	Mean Time Between Failure
MTBS	Main Turbine Bypass System
MTS	Maintenance Transfer Switch
MTTF	Mean Time to Failure
MTTR	Mean Time To Repair
MUX	Mutliplexer
MVDS	Medium Voltage Distribution System
MVP	Mechanical Vacuum Pump
MWR	Metal Water Reaction
MWS	Makeup Water System
NBR	Nuclear Boiler Rated
NBS	Nuclear Boiler System
N-CIM	Non-safety Communication Interface Module (Non Safety -to-Non Safety Only)
N-DCIS	Nonsafety-Related Distributed Control and Information System
NDE	Nondestructive Examination
ND-OSUTL	Normal Distribution One-Sided Upper Tolerance Limit
NDT	Nil Ductility Temperature
NDTT	Nil-Ductility Transition Temperature
NFI	New Fuel Inspection
NFS	New Fuel Storage
NG	Noble Gas
NI	Nuclear Island

NICWS	Nuclear Island Chilled Water Subsystem
NLF	Non-LOCA Fault
NMS	Neutron Monitoring System
NPHS	Normal Power Heat Sink
NPRD	Nonelectronic Parts Reliability Data
NPSH	Net Positive Suction Head
NQA	Nuclear Quality Assurance
NR	Narrow Range
NRC	Nuclear Regulatory Commission
NRHX	Non-Regenerative Heat Exchanger
NSOA	Nuclear Safety Operational Analysis
NSSS	Nuclear Steam Supply System
NTSP	Nominal Trip Setpoint
NUMAC	Nuclear Measurement Analysis and Control
NWL	Normal Water Level
O&M	Operation and Maintenance
OBCV	Overboard Control Valve
OBE	Operating Basis Earthquake
ODCM	Offsite Dose Calculation Manual
OER	Operating Experience Review
OGS	Offgas System
OHLH	Overhead Heavy Load Handling
OIS	Oxygen Injection System
OL	Other Location
OLMCPR	Operating Limit Minimum Critical Power Ratio
OLMLHGR	Operating Limit Maximum Linear Heat Generation Rate
OLP	On-Line Procedure(s)
OLU	Output Logic Unit
OM	Operations and Maintenance
OOS	Out-Of-Service
OPDRV	Operation with Potential to Drain the Reactor Vessel
OPRM	Oscillation Power Range Monitor

OSC	Operational Support Center
OSI	Open Systems Interconnect
OSUTL	One-Sided Upper Tolerance Limit
OV	Open Vessel
P&ID	Piping and Instrumentation Diagram
PA	Protected Area
P/T	Pressure and Temperature
PA/PL	Plant Page/Party-Line
PABX	Private Automatic Branch Exchange (Telephone)
PAM	Post-Accident Monitoring
PAR	Passive Autocatalytic Recombiner
PARS	Passive Autocatalytic Recombiner System
PAS	Plant Automation System
PASS	Post-Accident Sampling Station(s)
PB	Pressure Boundary
PBA	Period Based Algorithm
PBDA	Period Based Detection Algorithm
PBX	Private Branch Exchange
PCCS	Passive Containment Cooling System
PCD	Plant Configuration Database
PCF	Plant Computer Function(s)
PCI	Pellet Clad Interaction
PCP	Process Control Program
PCS	Power Conversion System
PCT	Peak Cladding Temperature
PCTMS	Plant Cooling Tower Makeup System
PCV	Primary Containment Vessel
PDA	Pipe Dynamic Analysis
PFD	Process Flow Diagram
PG	Power Generation
PGA	Peak Ground Acceleration
PGCS	Power Generation and Control Subsystem

PHE	Peak Hot Excess
PIP	Plant Investment Protection
PIRT	Phenomena Identification and Ranking Table
PLC	Programmable Logic Controller(s)
PMC	Performance Monitoring and Control
PMCS	Performance Monitoring and Control Subsystem
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMS	Pool Monitoring Subsystem(s)
PMWP	Probable Maximum Winter Precipitation
p-p	Peak-to-Peak
PPQS	Product Performance Qualification Specification
PPS	Preferred Power Supply
PRA	Probabilistic Risk Assessment
PRM	Process Radiation Monitor
PRMS	Process Radiation Monitoring System
PRNM	Power Range Neutron Monitoring
PROM	Programmable Read-Only Memory
PS	Pool Swell
PSD	Power Spectra Density
PSI	Preservice Inspection
PSS	Process Sampling System
PSV	Pseudovelocity Response Spectrum
PSWS	Plant Service Water System
PTLR	Pressure and Temperature Limit Report
PTS	Pressurized Thermal Shock
PWR	Pressurized Water Reactor
PWSS	Pretreated Water Supply System
PWSW	Potable Water and Sanitary Waste System
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QC	Quality Control

Q-CIM	Safety-related Communication Interface Module (Safety -to- Safety OR Safety -to- Non Safety)
Q-DCIS	Safety-Related Distributed Control and Information System
R/W	Reactor Well
RACS	Rod Action Control Subsystem
RAM	Reliability, Availability and Maintainability
RAP	Reliability Assurance Program
RAPI	Rod Action and Position Information
RAT	Reserve Auxiliary Transformer
RAW	Risk Achievement Worth
RB	Reactor Building
RBC	Rod Brake Controller
RBCC	Rod Brake Controller Cabinet
RBS	Rod Block Setpoint
RBV	Reactor Building Vibration
RBVS	Reactor Building HVAC System
RC&IS	Rod Control and Information System
RCCV	Reinforced Concrete Containment Vessel
RCCWS	Reactor Component Cooling Water System
RCIC	Reactor Core Isolation Cooling
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
RDA	Rod Drop Accident
RDC	Resolver-to-Digital Converter
REPAVS	Refueling and Pool Area HVAC Subsystem
RETS	Radiological Effluent Technical Specification(s)
RFI	Radio Frequency Interference
RFP	Reactor Feed Pump
RH	Relative Humidity
RHR	Residual Heat Removal
RHX	Regenerative Heat Exchanger
RIP	Reactor Internal Pump
RIPD	Reactor Internal Pressure Difference(s)

RLP	Reference Loading Pattern
RMS	Root Mean Square
RMU	Remote Multiplexer Unit
ROAAM	Risk-Oriented Accident Analysis Methodology
ROM	Read-Only Memory
RPS	Reactor Protection System
RPSM	Reactor Protection System Monitoring
RPT	Recirculation Pump Trip
RPV	Reactor Pressure Vessel
RPVSB	RPV Support Bracket
RRPS	Reference Rod Pull Sequence
RRS	Required Response Spectra
RSM	Rod Server Module
RSPC	Rod Server Processing Channel
RSR	Results Summary Report(s)
RSS	Remote Shutdown System
RSSM	Reed Switch Sensor Module
RSW	Reactor Shield Wall
RT	Radiographic Examination
RTIF	Reactor Trip and Isolation Function(s)
RTNSS	Regulatory Treatment of Non-Safety Systems
RTP	Rated Thermal Power
RTS	Reactor Trip System
RVC	Reactor Vessel Cavity
RW	Radwaste Building
RWCR	Radwaste Building Control Room
RWCRVS	Radwaste Building Control Room HVAC Subsystem
RWCU	Reactor Water Cleanup
RWE	Rod Withdrawal Error
RWGA	Radwaste Building General Area
RWGAVS	Radwaste Building General Area HVAC Subsystem
RWM	Rod Worth Minimizer

RWP	Radwaste Processing System
RWVS	Radwaste Building HVAC System
S&A	Sampling and Analysis
S&Q	Staffing and Qualification(s)
S/DRSRO	Single/Dual Rod Sequence Restriction Override
SACF	Single Active Component Failure
SAG	Severe Accident Guideline(s)
SAR	Safety Analysis Report
SAS	Service Air System
SAT	Site Acceptance Test
SAW	Submerged Arc Welding
SB	Service Building
SB&PC	Steam Bypass and Pressure Control
SBL	Small Break LOCA
SBO	Station Blackout
SBWR	Simplified Boiling Water Reactor
SCBA	Self-Contained Breathing Apparatus
SCC	Stress Corrosion Cracking
SCEW	System Component Evaluation Work
SCF	Stress Concentration Factor
SCG	Startup Coordinating Group
SCMP	Software Configuration Management Plan
SCP	Setpoint Control Program
SCRRI	Selected Control Rod Run-in
SCU	Signal Conditioning Unit
SCWS	Stator Cooling Water System
SD	Scintillation Detector
SDC	Shutdown Cooling
SDG	Standby Diesel Generator
SDM	Shutdown Margin
SDP	Software Development Plan
SDPM	Software Development Plan Module

SDS	System Design Specification
SER	Safety Evaluation Report
SF/WT	Service Water/Water Treatment Building
SFDP	Safety Function Determination Program
SFGA	System Functional Gap Analysis
SFmin	Minimum Safety Factor
SFP	Spent Fuel Pool
SI	Système International d'Unités (International System of Units)
SIL	Service Information Letter
SIP	Separation Indicator Probe
SIT	Structural Integrity Test
SIU	Signal Interface Unit
SJAE	Steam Jet Air Ejector
SL	Safety Limit
SLC	Standby Liquid Control
SLMCPR	Safety Limit Minimum Critical Power Ratio
SMAW	Shielded Metal Arc Welding
SMP	Software Management Plan
SMPM	Software Management Program Manual
SOP	System Operating Procedure(s)
SORV	Stuck Open Relief Valve
SOT	System Operational Transient
SP	Setpoint
SPBS	Sodium Pentaborate Solution
SPC	Suppression Pool Cooling
SPDS	Safety Parameter Display System
SPTM	Suppression Pool Temperature Monitoring
SQAP	Software Quality Assurance Plan
SQAPM	Software Quality Assurance Program Manual
SQAR	Supplier Quality Assurance Requirement(s)
SR	Surveillance Requirement
SRI	Select Rod Insert

SRM	Staff Requirements Memoranda
SRNM	Startup Range Neutron Monitor
SRO	Senior Reactor Operator
SRP	Standard Review Plan
SRSS	Square Root of the Sum of the Squares
SRV	Safety Relief Valve
SSAR	Standard Safety Analysis Report
SSC	Structure, System, or Component
SSE	Safe Shutdown Earthquake
SSI	Soil-Structure Interaction
SSLC	Safety System Logic and Control
SSLC/ESF	Safety System Logic/and Control/Engineered Safety Features
SSP	Software Safety Plan
SSPV	Scram Solenoid Pilot Valve
ST	Steam Tunnel
STI	Startup Test Instruction(s)
STPT	Simulated Thermal Power Trip
STRAP	Scram Time Recording and Analysis Panel
STS	Standard Technical Specification(s)
SV	Safety Valve
SVVP	Software Verification and Validation Plan
SWC	Surge Withstand Capability
SWMS	Solid Waste Management System
SWS	Station Water System
TA	Task Analysis
TAF	Top of Active Fuel
TAPD	Test and Analysis Program Description
TASS	Turbine Auxiliary Steam System
TB	Turbine Building
TBAS	Turbine Building Air Supply
TBCE	Turbine Building Compartment Exhaust
TBD	To Be Determined

TBDRE	Turbine Building Decontamination Room Exhaust
TBE	Turbine Building Exhaust
TBLOE	Turbine Building Lube Oil Area Exhaust
TBS	Turbine Bypass System
TBV	Turbine Bypass Valve
TBVS	Turbine Building HVAC System
TCCWS	Turbine Component Cooling Water System
TCV	Turbine Control Valve
TE	Thermal Expansion
TEDE	Total Effective Dose Equivalent
TG	Turbine Generator
TGCS	Turbine Generator Control System
TGSS	Turbine Gland Seal System
THA	Time-History Accelerograph
TID	Time-Integrated Dose
TIP	Traversing In-Core Probe
TLOS	Turbine Lube Oil System
TLU	Trip Logic Unit
TMI	Three Mile Island
TMR	Triple-Modular Redundant
TMSS	Turbine Main Steam System
TOC	Total Organic Carbon
TOP	Thermal Overpower
TPM&D	Thermal Performance Monitor and Diagnostic
TRA	Transient Recording and Analysis
TRS	Test Response Spectra
TS	Technical Specification(s)
TSC	Technical Support Center
TSCVS	Technical Support Center HVAC Subsystem
TSI	Turbine Supervisory Instrument
TSM	Technical Specification Monitoring
TSV	Turbine Stop Valve

UAT	Unit Auxiliary Transformer
UDW	Upper Drywell
UHS	Ultimate Heat Sink
UPS	Uninterruptible Power Supply
URD	Utilities Requirements Document
URS	Ultimate Rupture Strength
USE	Upper Shelf Energy
USI	Unresolved Safety Issue
USM	Uniform Support Motion
UT	Ultrasonic
V&V	Verification and Validation
Vac / VAC	Volts Alternating Current
VB	Vacuum Breaker
VBIF	Vacuum Breaker Isolation Function
VBS	Vehicle Barrier System
Vdc / VDC	Volts Direct Current
VDU	Video Display Unit
VFTP	Ventilation Filter Testing Program
VLU	Voter Logic Unit
VRLA	Valve Regulated Lead Acid
VW	Vent Wall
WDP	Wide Display Panel
WR	Wide Range
WS	Water Storage
WW	Wetwell
X/Q	Meteorological Dispersion Coefficient
XLPE-FR	Cross-Linked Polyethylene, Flame Retardant
ZNIS	Zinc Injection System
ZPA	Zero Period Acceleration

List of Abbreviations

AASHTO	American Association of Highway and Transportation Officials
ABMA	Anti-Friction Bearing Manufacturers Association
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AEC	Atomic Energy Commission
AGMA	American Gear Manufacturer's Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANI	American Nuclear Insurers
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
ASA	Acoustical Society of America
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASQ	American Society for Quality
ASTM	American Society for Testing and Materials (ASTM International)
AWS	American Welding Society
AWWA	American Water Works Association
BNL	Brookhaven National Laboratory
CEA	Consumer Electronics Association
CMAA	Crane Manufacturers Association of America
CTI	Cooling Technology Institute
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
ECA	Electronic Components Assemblies Materials Association

EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FAA	Federal Aviation Administration
FCI	Fluid Controls Institute Inc.
HEI	Heat Exchange Institute
HICB	Instrumentation and Controls Branch
ICC	International Code Council
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
INPO	Institute of Nuclear Power Operations
MIT	Massachusetts Institute of Technology
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
NFPA	National Fire Protection Association
NIRMA	Nuclear Information and Records Management Association, Inc.
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NSSFC	National Severe Storms Forecast Center
NUMARC	Nuclear Utilities Management and Resources Council
NWS	National Weather Service
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
RG	Regulatory Guide
SECY	Secretary of the Commission, Office of the (NRC)
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSPC	The Society for Protective Coverings
TEMA	Tubular Exchanger Manufacturers' Association
TIA	Telecommunications Industry Association
UL	Underwriter's Laboratories, Inc.