

IFSAR Table of Contents

Chapter 1 — Introduction and General Description of the Plant

Chapter 2 — Site Characteristics

Chapter 3 — Design of Structures, Components, Equipment and Systems

Chapter 4 — Reactor

Chapter 5 — Reactor Coolant System and Connected Systems

Chapter 6 — Engineered Safety Features

Chapter 7 — Instrumentation and Controls

Chapter 8 — Electric Power

Chapter 9 — Auxiliary Systems

Chapter 10 — Steam and Power Conversion

Chapter 11 — Radioactive Waste Management

Chapter 12 — Radiation Protection

Chapter 13 — Conduct of Operation

Chapter 14 — Initial Test Program

Chapter 15 — Accident Analyses

Chapter 16 — Technical Specifications

Chapter 17 — Quality Assurance

Chapter 18 — Human Factors Engineering

Chapter 19 — Probabilistic Risk Assessment

IFSAR Formatting Legend






Color	Description
	Original Westinghouse AP1000 DCD Revision 19 content (part of plant-specific DCD)
	Departures from AP1000 DCD Revision 19 content (part of plant-specific DCD)
	Standard FSAR content
	Site-specific FSAR content
	Linked cross-references (chapters, appendices, sections, subsections, tables, figures, and references)

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 3	DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS	3.1-1
3.1	Conformance with Nuclear Regulatory Commission General Design Criteria.....	3.1-1
3.1.1	Overall Requirements	3.1-1
3.1.2	Protection by Multiple Fission Product Barriers	3.1-4
3.1.3	Protection and Reactivity Control Systems.....	3.1-10
3.1.4	Fluid Systems	3.1-14
3.1.5	Reactor Containment.....	3.1-23
3.1.6	Fuel and Reactivity Control	3.1-26
3.1.7	Combined License Information	3.1-29
3.1.8	References	3.1-29
3.2	Classification of Structures, Components, and Systems	3.2-1
3.2.1	Seismic Classification	3.2-1
3.2.1.1	Definitions	3.2-1
3.2.1.2	Classifications.....	3.2-3
3.2.1.3	Classification of Building Structures	3.2-3
3.2.2	AP1000 Classification System.....	3.2-3
3.2.2.1	Classification Definitions.....	3.2-3
3.2.2.2	Application of Classification	3.2-4
3.2.2.3	Equipment Class A	3.2-5
3.2.2.4	Equipment Class B	3.2-5
3.2.2.5	Equipment Class C	3.2-6
3.2.2.6	Equipment Class D.....	3.2-7
3.2.2.7	Other Equipment Classes.....	3.2-9
3.2.2.8	Instrumentation and Control Line Interface Criteria ..	3.2-11
3.2.2.9	Electrical Classifications	3.2-11
3.2.3	Inspection Requirements.....	3.2-11
3.2.4	Application of AP1000 Safety-Related Equipment and Seismic Classification System	3.2-12
3.2.5	Combined License Information	3.2-16
3.2.6	References	3.2-16
3.3	Wind and Tornado Loadings	3.3-1
3.3.1	Wind Loadings	3.3-1
3.3.1.1	Design Wind Velocity.....	3.3-1
3.3.1.2	Determination of Applied Forces	3.3-1
3.3.2	Tornado Loadings.....	3.3-1
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 Failure of Structures or Components Not Designed for Tornado Loads	3.3-3
3.3.2.4	Tornado Loads on the Passive Containment Cooling System Air Baffle	3.3-3
3.3.3	Combined License Information.....	3.3-4
3.3.4	References	3.3-4
3.4	Water Level (Flood) Design	3.4-1
3.4.1	Flood Protection	3.4-1

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.4.1.1 Flood Protection Measures for Seismic Category I Structures, Systems, and Components	3.4-1
	3.4.1.2 Evaluation of Flooding Events	3.4-4
	3.4.1.3 Permanent Dewatering System	3.4-20
3.4.2	Analytical and Test Procedures	3.4-20
3.4.3	Combined License Information	3.4-20
3.4.4	References	3.4-20
3.5	Missile Protection	3.5-1
3.5.1	Missile Selection and Description	3.5-3
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	3.5-9
3.5.1.4	Missiles Generated by Natural Phenomena	3.5-10
3.5.1.5	Missiles Generated by Events Near the Site	3.5-11
3.5.1.6	Aircraft Hazards	3.5-11
3.5.2	Protection from Externally Generated Missiles	3.5-12
3.5.3	Barrier Design Procedures	3.5-14
3.5.3.1	Ductility Factors for Steel Structures	3.5-16
3.5.4	Combined License Information	3.5-16
3.5.5	References	3.5-17
3.6	Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping	3.6-1
3.6.1	Postulated Piping Failures in Fluid Systems Inside and Outside Containment	3.6-2
3.6.1.1	Design Basis	3.6-3
3.6.1.2	Description	3.6-5
3.6.1.3	Safety Evaluation	3.6-7
3.6.2	Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping	3.6-10
3.6.2.1	Criteria Used to Define High- and Moderate-Energy Break and Crack Locations and Configurations	3.6-10
3.6.2.2	Analytical Methods to Define Jet Thrust Forcing Functions and Response Models	3.6-17
3.6.2.3	Dynamic Analysis Methods to Verify Integrity and Operability	3.6-18
3.6.2.4	Protective Assembly Design Criteria	3.6-22
3.6.2.5	Evaluation of Dynamic Effects of Pipe Ruptures	3.6-22
3.6.2.6	Evaluation of Flooding Effects from Pipe Failures	3.6-25
3.6.2.7	Evaluation of Spray Effects from High- and Moderate-Energy Through-Wall Cracks	3.6-25
3.6.3	Leak-before-Break Evaluation Procedures	3.6-25
3.6.3.1	Application of Mechanistic Pipe Break Criteria	3.6-26
3.6.3.2	Design Criteria for Leak-before-Break	3.6-27
3.6.3.3	Analysis Methods and Criteria	3.6-29
3.6.3.4	Documentation of Leak-before-Break Evaluations ...	3.6-30
3.6.4	Combined License Information	3.6-30
3.6.4.1	Pipe Break Hazard Analysis	3.6-30

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.6.4.2 Leak-before-Break Evaluation of As-Designed Piping.....	3.6-31
	3.6.4.3 Leak-before-Break Evaluation of As-Built Piping.....	3.6-31
	3.6.4.4 Primary System Inspection Program for Leak-before-Break Piping	3.6-31
3.6.5	References	3.6-31
3.7	Seismic Design	3.7-1
3.7.1	Seismic Input.....	3.7-1
	3.7.1.1 Design Response Spectra	3.7-1
	3.7.1.2 Design Time History	3.7-5
	3.7.1.3 Critical Damping Values	3.7-6
	3.7.1.4 Supporting Media for Seismic Category I Structures..	3.7-7
3.7.2	Seismic System Analysis.....	3.7-9
	3.7.2.1 Seismic Analysis Methods	3.7-10
	3.7.2.2 Natural Frequencies and Response Loads	3.7-11
	3.7.2.3 Procedure Used for Modeling	3.7-11
	3.7.2.4 Soil-Structure Interaction	3.7-15
	3.7.2.5 Development of Floor Response Spectra	3.7-15
	3.7.2.6 Three Components of Earthquake Motion.....	3.7-16
	3.7.2.7 Combination of Modal Responses.....	3.7-17
	3.7.2.8 Interaction of Seismic Category II and Nonseismic Structures with Seismic Category I Structures, Systems, or Components	3.7-17
	3.7.2.9 Effects of Parameter Variations on Floor Response Spectra	3.7-22
	3.7.2.10 Use of Constant Vertical Static Factors	3.7-23
	3.7.2.11 Method Used to Account for Torsional Effects	3.7-23
	3.7.2.12 Methods for Seismic Analysis of Dams	3.7-23
	3.7.2.13 Determination of Seismic Category I Structure Overturning Moments	3.7-23
	3.7.2.14 Analysis Procedure for Damping	3.7-24
3.7.3	Seismic Subsystem Analysis.....	3.7-24
	3.7.3.1 Seismic Analysis Methods	3.7-24
	3.7.3.2 Determination of Number of Earthquake Cycles	3.7-24
	3.7.3.3 Procedure Used for Modeling	3.7-25
	3.7.3.4 Basis for Selection of Frequencies	3.7-25
	3.7.3.5 Equivalent Static Load Method of Analysis.....	3.7-26
	3.7.3.6 Three Components of Earthquake Motion.....	3.7-27
	3.7.3.7 Combination of Modal Responses.....	3.7-27
	3.7.3.8 Analytical Procedure for Piping.....	3.7-32
	3.7.3.9 Combination of Support Responses	3.7-36
	3.7.3.10 Vertical Static Factors.....	3.7-38
	3.7.3.11 Torsional Effects of Eccentric Masses.....	3.7-38
	3.7.3.12 Seismic Category I Buried Piping Systems and Tunnels	3.7-39
	3.7.3.13 Interaction of Other Systems with Seismic Category I Systems	3.7-39

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.7.3.14 Seismic Analyses for Reactor Internals	3.7-44
	3.7.3.15 Analysis Procedure for Damping	3.7-44
	3.7.3.16 Analysis of Seismic Category I Tanks	3.7-45
	3.7.3.17 Time History Analysis of Piping Systems	3.7-45
3.7.4	Seismic Instrumentation	3.7-46
	3.7.4.1 Comparison with Regulatory Guide 1.12	3.7-46
	3.7.4.2 Location and Description of Instrumentation	3.7-46
	3.7.4.3 Control Room Operator Notification.....	3.7-48
	3.7.4.4 Comparison of Measured and Predicted Responses.....	3.7-48
	3.7.4.5 Tests and Inspections.....	3.7-48
3.7.5	Combined License Information.....	3.7-48
	3.7.5.1 Seismic Analysis of Dams	3.7-48
	3.7.5.2 Post-Earthquake Procedures.....	3.7-48
	3.7.5.3 Seismic Interaction Review.....	3.7-49
	3.7.5.4 Reconciliation of Seismic Analyses of Nuclear Island Structures.....	3.7-49
	3.7.5.5 Free Field Acceleration Sensor	3.7-49
3.7.6	References	3.7-49
3.8	Design of Category I Structures	3.8-1
	3.8.1 Concrete Containment.....	3.8-1
	3.8.2 Steel Containment	3.8-1
	3.8.2.1 Description of the Containment	3.8-1
	3.8.2.2 Applicable Codes, Standards, and Specifications	3.8-5
	3.8.2.3 Loads and Load Combinations	3.8-5
	3.8.2.4 Design and Analysis Procedures.....	3.8-6
	3.8.2.5 Structural Criteria.....	3.8-14
	3.8.2.6 Materials, Quality Control, and Special Construction Techniques	3.8-15
	3.8.2.7 Testing and In-Service Inspection Requirements	3.8-16
3.8.3	Concrete and Steel Internal Structures of Steel Containment	3.8-16
	3.8.3.1 Description of the Containment Internal Structures	3.8-16
	3.8.3.2 Applicable Codes, Standards, and Specifications	3.8-20
	3.8.3.3 Loads and Load Combinations	3.8-20
	3.8.3.4 Analysis Procedures	3.8-22
	3.8.3.5 Design Procedures and Acceptance Criteria.....	3.8-28
	3.8.3.6 Materials, Quality Control, and Special Construction Techniques	3.8-35
	3.8.3.7 In-Service Testing and Inspection Requirements	3.8-36
	3.8.3.8 Construction Inspection	3.8-36
3.8.4	Other Category I Structures.....	3.8-37
	3.8.4.1 Description of the Structures	3.8-37
	3.8.4.2 Applicable Codes, Standards, and Specifications	3.8-42
	3.8.4.3 Loads and Load Combinations	3.8-42
	3.8.4.4 Design and Analysis Procedures.....	3.8-45
	3.8.4.5 Structural Criteria.....	3.8-49

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3.8.4.6 Materials, Quality Control, and Special Construction Techniques	3.8-53
	3.8.4.7 Testing and In-Service Inspection Requirements	3.8-55
	3.8.4.8 Construction Inspection	3.8-55
3.8.5	Foundations	3.8-56
	3.8.5.1 Description of the Foundations	3.8-56
	3.8.5.2 Applicable Codes, Standards, and Specifications	3.8-57
	3.8.5.3 Loads and Load Combinations	3.8-57
	3.8.5.4 Design and Analysis Procedures	3.8-58
	3.8.5.5 Structural Criteria	3.8-63
	3.8.5.6 Materials, Quality Control, and Special Construction Techniques	3.8-66
	3.8.5.7 In-Service Testing and Inspection Requirements	3.8-66
	3.8.5.8 Construction Inspection	3.8-66
3.8.6	Combined License Information	3.8-67
	3.8.6.1 Containment Vessel Design Adjacent to Large Penetrations	3.8-67
	3.8.6.2 Passive Containment Cooling System Water Storage Tank Examination	3.8-67
	3.8.6.3 As-Built Summary Report	3.8-67
	3.8.6.4 In-Service Inspection of Containment Vessel	3.8-67
	3.8.6.5 Structures Inspection Program	3.8-67
	3.8.6.6 Construction Procedures Program	3.8-67
3.8.7	References	3.8-67
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	3.9-23
	3.9.1.3 Experimental Stress Analysis	3.9-23
	3.9.1.4 Considerations for the Evaluation of the Faulted Conditions	3.9-23
	3.9.1.5 Module Interaction, Coupling, and Other Issues	3.9-24
3.9.2	Dynamic Testing and Analysis	3.9-24
	3.9.2.1 Piping Vibration, Thermal Expansion, and Dynamic Effects	3.9-24
	3.9.2.2 Seismic Qualification Testing of Safety-Related Mechanical Equipment	3.9-26
	3.9.2.3 Dynamic Response Analysis of Reactor Internals under Operational Flow Transients and Steady-State Conditions	3.9-28
	3.9.2.4 Pre-operational Flow-Induced Vibration Testing of Reactor Internals	3.9-31
	3.9.2.5 Dynamic System Analysis of the Reactor Internals Under Faulted Conditions	3.9-33
	3.9.2.6 Correlation of Reactor Internals Vibration Tests with the Analytical Results	3.9-37

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
3.9.3	ASME Code Classes 1, 2, and 3 Components, Component Supports, and Core Support Structures	3.9-37
3.9.3.1	Loading Combinations, Design Transients, and Stress Limits	3.9-38
3.9.3.2	Pump and Valve Operability Assurance	3.9-51
3.9.3.3	Design and Installation Criteria of Class 1, 2, and 3 Pressure Relieving Devices	3.9-53
3.9.3.4	Component and Piping Supports	3.9-55
3.9.3.5	Instrumentation Line Supports	3.9-62
3.9.4	Control Rod Drive System (CRDS).....	3.9-62
3.9.4.1	Descriptive Information of CRDS	3.9-62
3.9.4.2	Applicable CRDS Design Specifications.....	3.9-67
3.9.4.3	Design Loads, Stress Limits, and Allowable Deformations	3.9-70
3.9.4.4	Control Rod Drive Mechanism Performance Assurance Program	3.9-70
3.9.5	Reactor Pressure Vessel Internals	3.9-71
3.9.5.1	Design Arrangements	3.9-71
3.9.5.2	Design Loading Conditions	3.9-73
3.9.5.3	Design Bases	3.9-74
3.9.6	Inservice Testing of Pumps and Valves	3.9-76
3.9.6.1	Inservice Testing of Pumps	3.9-77
3.9.6.2	Inservice Testing of Valves	3.9-77
3.9.6.3	Relief Requests	3.9-87
3.9.7	Integrated Head Package	3.9-88
3.9.7.1	Design Bases	3.9-88
3.9.7.2	Design Description	3.9-89
3.9.7.3	Design Evaluation	3.9-91
3.9.7.4	Inspection and Testing Requirements	3.9-91
3.9.8	Combined License Information	3.9-91
3.9.8.1	Reactor Internals Vibration Assessment and Predicted Response	3.9-91
3.9.8.2	Design Specifications and Reports	3.9-91
3.9.8.3	Snubber Operability Testing	3.9-92
3.9.8.4	Valve Inservice Testing	3.9-92
3.9.8.5	Surge Line Thermal Monitoring	3.9-92
3.9.8.6	Piping Benchmark Program	3.9-92
3.9.8.7	As-Designed Piping Analysis	3.9-92
3.9.9	References	3.9-93
3.10	Seismic and Dynamic Qualification of Seismic Category I Mechanical and Electrical Equipment	3.10-1
3.10.1	Seismic and Dynamic Qualification Criteria	3.10-2
3.10.1.1	Qualification Standards	3.10-2
3.10.1.2	Performance Requirements for Seismic Qualification	3.10-2
3.10.1.3	Performance Criteria	3.10-2

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
3.10.2	Methods and Procedures for Qualifying Electrical Equipment, Instrumentation, and Mechanical Components	3.10-3
3.10.2.1	Seismic Qualification of Instrumentation and Electrical Equipment	3.10-4
3.10.2.2	Seismic and Operability Qualification of Active Mechanical Equipment	3.10-4
3.10.2.3	Valve Operator Qualification	3.10-6
3.10.2.4	Seismic Qualification of Other Seismic Category I Mechanical Equipment	3.10-6
3.10.3	Method and Procedures for Qualifying Supports of Electrical Equipment, Instrumentation, and Mechanical Components	3.10-6
3.10.4	Documentation	3.10-6
3.10.5	Standard Review Plan Evaluation	3.10-7
3.10.6	Combined License Information Item on Experienced-Based Qualification	3.10-7
3.10.7	References	3.10-7
3.11	Environmental Qualification of Mechanical and Electrical Equipment	3.11-1
3.11.1	Equipment Identification and Environmental Conditions	3.11-1
3.11.1.1	Equipment Identification	3.11-1
3.11.1.2	Definition of Environmental Conditions	3.11-1
3.11.1.3	Equipment Operability Times	3.11-2
3.11.1.4	Standard Review Plan Evaluation	3.11-3
3.11.2	Qualification Tests and Analysis	3.11-3
3.11.2.1	Environmental Qualification of Electrical Equipment	3.11-3
3.11.2.2	Environmental Qualification of Mechanical Equipment	3.11-3
3.11.3	Loss of Ventilation	3.11-4
3.11.4	Estimated Radiation and Chemical Environment	3.11-4
3.11.5	Combined License Information Item for Equipment Qualification File	3.11-5
3.11.6	References	3.11-6
APPENDIX 3A	HVAC DUCTS AND DUCT SUPPORTS	3A-1
3A.1	Codes and Standards	3A-1
3A.2	Loads and Load Combinations	3A-1
3A.2.1	Loads	3A-1
3A.2.1.1	Dead Load (D)	3A-1
3A.2.1.2	Construction Live Load (L)	3A-1
3A.2.1.3	Pressure (P)	3A-1
3A.2.1.4	Safe Shutdown Earthquake (Es)	3A-2
3A.2.1.5	Wind Loads (W)	3A-2
3A.2.1.6	Tornado Loads (Wt)	3A-2
3A.2.1.7	External Pressure Differential Loads (PA)	3A-2
3A.2.1.8	Thermal (TO/TA)	3A-2
3A.2.2	Load Combinations	3A-2
3A.3	Analysis and Design	3A-2
3A.3.1	Response Due to Seismic Loads	3A-3

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3A.3.2 Deflection Criteria	3A-3
	3A.3.3 Relative Movement	3A-3
	3A.3.4 Allowable Stresses	3A-3
	3A.3.5 Connections	3A-3
APPENDIX 3B	LEAK-BEFORE-BREAK EVALUATION OF THE AP1000 PIPING	3B-1
3B.1	Leak-before-Break Criteria for AP1000 Piping	3B-1
3B.2	Potential Failure Mechanisms for AP1000 Piping	3B-2
	3B.2.1 Erosion-Corrosion Induced Wall Thinning	3B-2
	3B.2.2 Stress Corrosion Cracking	3B-3
	3B.2.3 Water Hammer	3B-4
	3B.2.4 Fatigue	3B-5
	3B.2.5 Thermal Aging	3B-6
	3B.2.6 Thermal Stratification	3B-6
	3B.2.7 Other Mechanisms	3B-7
3B.3	Leak-before-Break Bounding Analysis	3B-8
	3B.3.1 Procedure for Stainless Steel Piping	3B-8
	3B.3.1.1 Pipe Geometry, Material and Operating Conditions ..	3B-8
	3B.3.1.2 Pipe Physical Properties	3B-9
	3B.3.1.3 Low Normal Stress Case (Case 1)	3B-9
	3B.3.1.4 High Normal Stress Case (Case 2)	3B-9
	3B.3.1.5 Develop the Bounding Analysis Curve	3B-10
	3B.3.2 Procedure for Non-stainless Steel Piping	3B-10
	3B.3.2.1 Pipe Geometry, Material and Operating Conditions	3B-10
	3B.3.2.2 Calculations Steps	3B-10
	3B.3.2.3 Low Normal Stress Case (Case 1)	3B-11
	3B.3.2.4 High Normal Stress Case (Case 2)	3B-11
	3B.3.2.5 Develop the Bounding Analysis Curve	3B-11
	3B.3.3 Evaluation of Piping System Using Bounding Analysis Curves ...	3B-12
	3B.3.3.1 Calculation of Stresses	3B-12
	3B.3.3.2 Normal Loads	3B-13
	3B.3.3.3 Maximum Loads	3B-13
	3B.3.3.4 Bounding Analysis Curve Comparison – LBB Criteria	3B-14
	3B.3.4 Bounding Analysis Results	3B-14
3B.4	Differences in Leak-before-Break Analysis for Stainless Steel and Ferritic Steel Pipe	3B-14
3B.5	Differences in Inspection Criteria for Class 1, 2, and 3 Systems	3B-14
3B.6	Differences in Fabrication Requirements of ASME Class 1, Class 2, and Class 3 Piping	3B-14
3B.7	Sensitivity Study for the Constraint Effect on LBB	3B-15
3B.8	References	3B-15
APPENDIX 3C	REACTOR COOLANT LOOP ANALYSIS METHODS	3C-1
3C.1	Reactor Coolant Loop Model Description	3C-1
	3C.1.1 Steam Generator Model	3C-1
	3C.1.1.1 Steam Generator Mass and Geometrical Model	3C-1
	3C.1.1.2 Steam Generator Supports	3C-1

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
3C.1.2	Reactor Coolant Pump Model	3C-1
	3C.1.2.1 Static Model.....	3C-1
	3C.1.2.2 Seismic Model	3C-1
	3C.1.2.3 Reactor Coolant Pump Supports.....	3C-2
3C.1.3	Reactor Pressure Vessel Model	3C-2
	3C.1.3.1 Mass and Geometrical Model.....	3C-2
	3C.1.3.2 Reactor Pressure Vessel Supports	3C-2
3C.1.4	Containment Interior Building Structure Model.....	3C-2
3C.1.5	Reactor Coolant Loop Piping Model.....	3C-2
3C.2	Design Requirements.....	3C-2
3C.3	Static Analyses.....	3C-3
	3C.3.1 Deadweight Analysis	3C-3
	3C.3.2 Internal Pressure Analysis	3C-3
	3C.3.3 Thermal Expansion Analysis	3C-3
3C.4	Seismic Analyses	3C-3
3C.5	Reactor Coolant Loop Piping Stresses	3C-4
3C.6	Description of Computer Programs	3C-4
APPENDIX 3D	METHODOLOGY FOR QUALIFYING AP1000 SAFETY-RELATED ELECTRICAL AND MECHANICAL EQUIPMENT	3D-1
3D.1	Purpose.....	3D-2
3D.2	Scope	3D-2
3D.3	Introduction	3D-2
3D.4	Qualification Criteria.....	3D-2
	3D.4.1 Qualification Guides	3D-3
	3D.4.1.1 IEEE Standards.....	3D-3
	3D.4.1.2 NRC Regulatory Guides.....	3D-4
	3D.4.2 Definitions	3D-6
	3D.4.3 Mild Versus Harsh Environments	3D-6
	3D.4.4 Test Sequence	3D-7
	3D.4.5 Aging	3D-8
	3D.4.5.1 Design Life	3D-8
	3D.4.5.2 Shelf Life	3D-8
	3D.4.5.3 Qualified Life	3D-8
	3D.4.5.4 Qualified Life Reevaluation	3D-9
	3D.4.6 Operability Time	3D-10
	3D.4.7 Performance Criterion	3D-10
	3D.4.8 Margin.....	3D-11
	3D.4.8.1 Normal and Abnormal Extremes	3D-11
	3D.4.8.2 Aging	3D-11
	3D.4.8.3 Radiation	3D-12
	3D.4.8.4 Seismic Conditions.....	3D-12
	3D.4.8.5 High-Energy Line Break Conditions	3D-13
	3D.4.9 Treatment of Failures	3D-13
	3D.4.10 Traceability	3D-13
	3D.4.10.1 Auditable Link Document	3D-13
	3D.4.10.2 Similarity.....	3D-14
3D.5	Design Specifications.....	3D-14

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
3D.5.1	Normal Operating Conditions	3D-15
	3D.5.1.1 Pressure, Temperature, Humidity	3D-15
	3D.5.1.2 Radiation Dose	3D-15
3D.5.2	Abnormal Operating Conditions	3D-15
	3D.5.2.1 Abnormal Environments Inside Containment	3D-16
	3D.5.2.2 Abnormal Environments Outside Containment	3D-16
3D.5.3	Seismic Events	3D-16
3D.5.4	Containment Test Environment	3D-16
3D.5.5	Design Basis Event Conditions	3D-17
	3D.5.5.1 High-Energy Line Break Accidents Inside Containment	3D-17
	3D.5.5.2 High-Energy Line Break Accidents Outside Containment	3D-20
3D.6	Qualification Methods	3D-20
3D.6.1	Type Test	3D-20
3D.6.2	Analysis	3D-21
	3D.6.2.1 Similarity	3D-21
	3D.6.2.2 Substitution	3D-21
	3D.6.2.3 Analysis of Safety-Related Mechanical Equipment	3D-22
3D.6.3	Operating Experience	3D-24
3D.6.4	On-Going Qualification	3D-24
3D.6.5	Combinations of Methods	3D-24
	3D.6.5.1 Use of Existing Qualification Reports	3D-25
3D.7	Documentation	3D-25
3D.7.1	Equipment Qualification Data Package	3D-26
3D.7.2	Specifications	3D-26
	3D.7.2.1 Equipment Identification	3D-26
	3D.7.2.2 Installation Requirements	3D-26
	3D.7.2.3 Electrical Requirements	3D-27
	3D.7.2.4 Auxiliary Devices	3D-27
	3D.7.2.5 Preventive Maintenance	3D-27
	3D.7.2.6 Performance Requirements	3D-27
	3D.7.2.7 Environmental Conditions	3D-27
3D.7.3	Qualification Program	3D-28
3D.7.4	Qualification by Test	3D-28
	3D.7.4.1 Specimen Description	3D-28
	3D.7.4.2 Number Tested	3D-28
	3D.7.4.3 Mounting	3D-28
	3D.7.4.4 Connections	3D-28
	3D.7.4.5 Test Sequence	3D-29
	3D.7.4.6 Simulated Service Conditions	3D-29
	3D.7.4.7 Measured Variables	3D-29
	3D.7.4.8 Type Test Summary	3D-29
3D.7.5	Qualification by Analysis	3D-30
3D.7.6	Qualification by Experience	3D-30
3D.7.7	Qualification Program Conclusions	3D-30

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3D.7.8 Combined License Information	3D-30
3D.8	References	3D-30
Appendix 3D-Attachment A	— Sample Equipment Qualification Data Package (EQDP).....	3D-56
Appendix 3D-Attachment B	— Aging Evaluation Program	3D-74
B.1	Introduction	3D-74
B.2	Objectives	3D-74
B.3	Basic Approach	3D-74
B.4	Subprogram A	3D-74
	B.4.1 Scope	3D-75
	B.4.2 Aging Mechanisms.....	3D-75
	B.4.3 Time	3D-75
	B.4.4 Operational Stresses	3D-75
	B.4.5 External Stresses.....	3D-76
	B.4.6 Synergism	3D-77
	B.4.7 Design Basis Event Testing	3D-77
	B.4.8 Aging Sequence.....	3D-77
	B.4.9 Performance Criterion.....	3D-77
	B.4.10 Failure Treatment.....	3D-77
B.5	Subprogram B	3D-78
	B.5.1 Scope.....	3D-78
	B.5.2 Performance Criteria	3D-78
	B.5.3 Failure Treatment.....	3D-79
Appendix 3D-Attachment C	— Effects of Gamma Radiation Doses Below 104 Rads on the Mechanical Properties of Materials.....	3D-82
C.1	Introduction	3D-82
C.2	Scope	3D-82
C.3	Discussion.....	3D-83
C.4	Conclusions.....	3D-83
C.5	References.....	3D-84
Appendix 3D-Attachment D	— Accelerated Thermal Aging Parameters.....	3D-88
D.1	Introduction	3D-88
D.2	Arrhenius Model	3D-88
D.3	Activation Energy	3D-89
D.4	Thermal Aging (Normal/Abnormal Operating Conditions).....	3D-90
	D.4.1 Normal Operation Temperature (T ₀)	3D-90
	D.4.1.1 External Ambient Temperature (T _a).....	3D-90
	D.4.1.2 Temperature Rise in Enclosure (T _r).....	3D-90
	D.4.1.3 Self-Heating Effects (T _j)	3D-91
	D.4.2 Accelerated Aging Temperature (T _i).....	3D-91
	D.4.3 Examples of Arrhenius Calculations	3D-91
D.5	Post-Accident Thermal Aging.....	3D-92
	D.5.1 Post-Accident Operating Temperatures.....	3D-92
	D.5.2 Accelerated Thermal Aging Parameters for Post-Accident Conditions	3D-92
D.6	References.....	3D-92
Appendix 3D-Attachment E	— Seismic Qualification Techniques.....	3D-98
E.1	Purpose.....	3D-98

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
E.2	Definitions	3D-98
E.2.1	1/2 Safe Shutdown Earthquake	3D-98
E.2.2	Seismic Category I Equipment.....	3D-98
E.2.3	Seismic Category II Equipment.....	3D-98
E.2.4	Non-seismic Equipment	3D-98
E.2.5	Active Equipment	3D-98
E.2.6	Passive Equipment	3D-98
E.3	Qualification Methods.....	3D-98
E.3.1	Use of Qualification by Testing	3D-99
E.3.2	Use of Qualification by Analysis.....	3D-99
E.4	Requirements.....	3D-99
E.4.1	Damping.....	3D-99
E.4.1.1	Testing.....	3D-99
E.4.1.2	Analysis	3D-100
E.4.2	Interface Requirements.....	3D-100
E.4.3	Mounting Simulation	3D-100
E.4.4	1/2 Safe Shutdown Earthquake	3D-100
E.4.5	Safe Shutdown Earthquake	3D-100
E.4.6	Other Dynamic Loads	3D-100
E.5	Qualification by Test.....	3D-101
E.5.1	Qualification of Hard-Mounted Equipment	3D-101
E.5.2	Qualification of Line-Mounted Equipment	3D-102
E.5.2.1	Seismic Qualification Test Sequence.....	3D-102
E.5.2.2	Line Vibration Aging	3D-103
E.5.2.3	Single Frequency Testing.....	3D-103
E.5.2.4	Seismic Aging.....	3D-103
E.5.2.5	Static Deflection Testing of Active Valves	3D-103
E.5.3	Operational Conditions	3D-104
E.5.4	Resonant Search Testing	3D-104
E.6	Qualification by Analysis	3D-104
E.6.1	Modeling	3D-104
E.6.2	Qualification by Static Analysis	3D-105
E.6.3	Qualification by Dynamic Analysis	3D-105
E.6.3.1	Response Spectrum Analysis	3D-105
E.6.3.2	Static Coefficient Method	3D-106
E.6.3.3	Time History Analysis.....	3D-106
E.7	Qualification by Test Experience.....	3D-106
E.8	Performance Criteria.....	3D-106
E.8.1	Equipment Qualification by Test	3D-106
E.8.2	Equipment Qualification by Analysis.....	3D-106
E.8.2.1	Structural Integrity	3D-106
E.8.2.2	Operability	3D-107
APPENDIX 3E	HIGH-ENERGY PIPING IN THE NUCLEAR ISLAND	3E-1
APPENDIX 3F	CABLE TRAYS AND CABLE TRAY SUPPORTS	3F-1
3F.1	Codes and Standards	3F-1
3F.2	Loads and Load Combinations	3F-1
3F.2.1	Loads	3F-1

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3F.2.1.1 Dead Load (D)	3F-1
	3F.2.1.2 Construction Live Load (L)	3F-1
	3F.2.1.3 Safe Shutdown Earthquake (Es)	3F-1
	3F.2.1.4 Thermal Load	3F-1
	3F.2.2 Load Combinations	3F-2
3F.3	Analysis and Design	3F-2
	3F.3.1 Damping	3F-2
	3F.3.2 Seismic Analysis	3F-2
	3F.3.3 Allowable Stresses	3F-3
	3F.3.4 Connections	3F-3
APPENDIX 3G	NUCLEAR ISLAND SEISMIC ANALYSES.....	3G-1
3G.1	Introduction	3G-1
3G.2	Nuclear Island Finite Element Models.....	3G-1
	3G.2.1 Individual Building and Equipment Models.....	3G-2
	3G.2.1.1 Coupled Auxiliary and Shield Building.....	3G-2
	3G.2.1.2 Containment Internal Structures.....	3G-2
	3G.2.1.3 Containment Vessel	3G-2
	3G.2.1.4 Polar Crane	3G-3
	3G.2.1.5 Major Equipment and Structures Using Stick Models.....	3G-4
	3G.2.2 Nuclear Island Dynamic Models.....	3G-4
	3G.2.2.1 NI10 Model	3G-4
	3G.2.2.2 NI20 Model	3G-5
	3G.2.2.3 Nuclear Island Stick Model.....	3G-5
	3G.2.2.4 NI05 Model	3G-5
	3G.2.2.5 Seismic Stability Model	3G-5
	3G.2.3 Static Models	3G-6
	3G.2.3.1 Quadrant Model of Shield Building Roof	3G-6
	3G.2.3.2 Containment Vessel 3D Finite Element Model.....	3G-6
	3G.2.3.3 Containment Vessel Axisymmetric Model	3G-6
3G.3	2D SASSI Analyses	3G-6
3G.4	Nuclear Island Dynamic Analyses.....	3G-8
	3G.4.1 ANSYS Fixed Base Analysis	3G-8
	3G.4.2 3D SASSI Analyses.....	3G-8
	3G.4.3 Seismic Analysis	3G-9
	3G.4.3.1 Response Spectrum Analysis	3G-9
	3G.4.3.2 Absolute Accelerations	3G-9
	3G.4.3.3 Seismic Response Spectra	3G-9
	3G.4.3.4 Bearing Pressure Demand	3G-10
3G.5	References.....	3G-10
APPENDIX 3H	AUXILIARY AND SHIELD BUILDING CRITICAL SECTIONS.....	3H-1
3H.1	Introduction	3H-1
3H.2	Description of Auxiliary and Shield Buildings	3H-1
	3H.2.1 Description of Auxiliary Building	3H-1
	3H.2.2 Description of Shield Building.....	3H-2
3H.3	Design Criteria	3H-4
	3H.3.1 Governing Codes and Standards	3H-4

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	3H.3.2 Seismic Input	3H-4
	3H.3.3 Loads	3H-5
	3H.3.4 Load Combinations and Acceptance Criteria	3H-8
3H.4	Seismic Analyses	3H-8
	3H.4.1 Live Load for Seismic Design	3H-8
3H.5	Structural Design of Critical Sections	3H-8
	3H.5.1 Shear Walls	3H-10
	3H.5.1.1 Exterior Wall at Column Line 1	3H-11
	3H.5.1.2 Wall at Column Line 7.3	3H-11
	3H.5.1.3 Wall at Column Line L	3H-11
	3H.5.1.4 Wall at Column Line 11	3H-12
	3H.5.2 Composite Structures (Floors and Roof)	3H-12
	3H.5.2.1 Roof at Elevation 180'-0", Area 6 (Critical Section is between Col. Lines N & K-2 and 3 & 4)	3H-13
	3H.5.2.2 Floor at Elevation 135'-3", Area 1 (Between Column Lines M and P)	3H-14
	3H.5.3 Reinforced Concrete Slabs	3H-14
	3H.5.3.1 Operations Work Area (Tagging Room) Ceiling	3H-14
	3H.5.4 Concrete Finned Floors	3H-15
	3H.5.5 Structural Modules	3H-16
	3H.5.5.1 West Wall of Spent Fuel Pool	3H-16
	3H.5.6 Shield Building Roof and Connections	3H-17
	3H.5.6.1 Air Inlets and Tension Ring	3H-17
	3H.5.6.2 Compression Ring and Interior Wall of Passive Containment Cooling Water Storage Tank	3H-18
	3H.5.6.3 Knuckle Region and Exterior Wall of Passive Containment Cooling System Tank	3H-18
	3H.5.7 Shield Building Cylinder (SC)	3H-19
	3H.5.7.1 Shield Building Cylindrical Wall	3H-19
	3H.5.7.2 Reinforced Concrete (RC)/Steel Concrete Composite (SC) Horizontal and Vertical Connections	3H-19
	3H.5.8 References	3H-20
APPENDIX 3I	EVALUATION FOR HIGH FREQUENCY SEISMIC INPUT	3I-1
	3I.1 Introduction	3I-1
	3I.2 High Frequency Seismic Input	3I-1
	3I.3 NI Models Used To Develop High Frequency Response	3I-1
	3I.4 Evaluation Methodology	3I-2
	3I.5 General Selection Screening Criteria	3I-2
	3I.6 Evaluation	3I-3
	3I.6.1 Building Structures	3I-3
	3I.6.2 Primary Coolant Loop	3I-4
	3I.6.3 Piping Systems	3I-5
	3I.6.4 Electrical and Electro-Mechanical Equipment	3I-5
	3I.7 References	3I-8
APPENDIX 3JJ	SOIL STRUCTURE INTERACTION SOIL PROFILES AND INPUT MOTIONS	3JJ-1

TABLE OF CONTENTS (CONTINUED)

<u>Section</u>	<u>Title</u>	<u>Page</u>
3JJ.0	Introduction	3JJ-1
3JJ.1	Development of Amplification Factors at FIRS Horizon	3JJ-1
3JJ.2	Development of FIRS	3JJ-2
3JJ.3	Safe Shutdown Earthquake Motion.....	3JJ-3
3JJ.4	Strain-Compatible Soil Property Profiles	3JJ-4
3JJ.5	Spectral Matching of Acceleration Time Histories.....	3JJ-5
3JJ.6	SSI Acceleration Time Histories.....	3JJ-5
3JJ.7	SSI Input Motions and Properties Sensitivity Assessment.....	3JJ-6
3JJ.7.1	Description of Sensitivity Analysis Input	3JJ-6
3JJ.7.2	Methodology for Sensitivity Assessment	3JJ-7
3JJ.7.3	Site Response Analyses.....	3JJ-9
3JJ.7.4	Sensitivity Conclusions	3JJ-10
3JJ.8	References.....	3JJ-10
APPENDIX 3KK	SITE SPECIFIC SEISMIC EVALUATION REPORT	3KK-1

LIST OF TABLES

<u>Table Number</u>	<u>Title</u>	<u>Page</u>
3.2-1	Comparison of Safety Classification Requirements	3.2-18
3.2-2	Seismic Classification of Building Structures	3.2-19
3.2-3	AP1000 Classification of Mechanical and Fluid Systems, Components, and Equipment	3.2-20
3.2-201	Not Used	3.2-94
3.2-202	Not Used	3.2-94
3.5-201	Comparison Between AP1000 DCD Tornado and Site-Specific Hurricane Missile Parameters	3.5-18
3.6-1	High-Energy and Moderate-Energy Fluid Systems Considered for Protection of Essential Systems	3.6-33
3.6-2	Subcompartments and Postulated Pipe Ruptures	3.6-34
3.6-3	NI Rooms With Pipe Whip Restraints and Corresponding Hazard Sources and Essential Targets	3.6-41
3.7.1-1	Safe Shutdown Earthquake Damping Values	3.7-53
3.7.1-2	Embedment Depth and Related Dimensions of Category I Structures ...	3.7-54
3.7.1-3	AP1000 Design Response Spectra Amplification Factors for Control Points	3.7-55
3.7.1-4	Strain Compatible Soil Properties	3.7-56
3.7.2-1–3.7.2-16	Not Used	3.7-61
3.7.3-1	Seismic Category I Equipment Outside Containment by Room Number	3.7-62
3.7.3-2	Equipment Classified as Sensitive Targets for Seismically Analyzed Piping, HVAC Ducting, Cable Trays	3.7-65
3.7-201	Recommended Horizontal and Vertical FIRS (Elevation –16 foot Horizon at Bottom of Nuclear Island Foundation)	3.7-66
3.7-202	Total Static and Pseudo-Dynamic Loads (ksf)	3.7-68
3.8.2-1	Load Combinations and Service Limits for Containment Vessel	3.8-71
3.8.2-2	Containment Vessel Pressure Capabilities	3.8-72
3.8.2-3	Analysis and Test Results of Fabricated Heads	3.8-73
3.8.2-4	Summary of Containment Vessel Models and Analysis Methods	3.8-74
3.8.2-5	Maximum Absolute Nodal Acceleration (ZPA) Steel Containment Vessel	3.8-75
3.8.3-1	Shear and Flexural Stiffnesses of Structural Module Walls	3.8-76
3.8.3-2	Summary of Containment Internal Structures Models and Analysis Methods	3.8-77
3.8.3-3	Definition of Critical Locations and Thicknesses for Containment Internal Structures	3.8-78
3.8.3-4	Design Summary of West Wall of Refueling Canal Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height	3.8-79
3.8.3-5	Design Summary of South Wall of Steam Generator Compartment Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height	3.8-82
3.8.3-6	Design Summary of North-East Wall of IRWST Design Loads, Load Combinations, and Comparison to Acceptance Criteria Mid-Span at Mid-Height	3.8-85
3.8.3-7	Design Summary of Steel Wall of IRWST	3.8-88

LIST OF TABLES (CONTINUED)

<u>Table Number</u>	<u>Title</u>	<u>Page</u>
3.8.4-1	Load Combinations and Load Factors for Seismic Category I Steel Structures	3.8-89
3.8.4-2	Load Combinations and Load Factors for Seismic Category I Concrete Structures	3.8-90
3.8.4-3	Acceptance Tests for Concrete Aggregates.....	3.8-91
3.8.4-4	Criteria for Water Used in Production of Concrete	3.8-92
3.8.4-5	Types of Water Reducing Agents Used in Production of Concrete.....	3.8-93
3.8.4-6	Materials Used in Structural and Miscellaneous Steel	3.8-94
3.8.5-1	Minimum Required Factor of Safety for Overturning and Sliding of Structures	3.8-96
3.8.5-2	Factors of Safety for Flotation, Overturning and Sliding of Nuclear Island Structures	3.8-97
3.8.5-3	Definition of Critical Locations, Thicknesses and Reinforcement for Nuclear Island Basemat (in ² /ft)	3.8-98
3.9-1	Reactor Coolant System Design Transients	3.9-96
3.9-2	Pump Starting/Stopping Conditions	3.9-98
3.9-3	Loadings for ASME Class 1, 2, 3, CS and Supports	3.9-99
3.9-4	First Plant AP1000 Reactor Internals Vibration Measurement Program Transducer Locations	3.9-101
3.9-5	Minimum Design Loading Combinations For ASME Class 1, 2, 3 And CS Systems And Components	3.9-102
3.9-6	Additional Load Combinations and Stress Limits for ASME Class 1 Piping	3.9-103
3.9-7	Additional Load Combinations and Stress Limits for ASME Class 2, 3 Piping	3.9-104
3.9-8	Minimum Design Loading Combinations for Supports for ASME Class 1, 2, 3 Piping and Components	3.9-105
3.9-9	Stress Criteria for ASME Code Section III Class 1 Components and Supports and Class CS Core Supports.....	3.9-106
3.9-10	Stress Criteria for ASME Code Section III Class 2 and 3 Components and Supports.....	3.9-107
3.9-11	Piping Functional Capability – ASME Class 1, 2, and 3.....	3.9-109
3.9-12	List of ASME Class 1, 2, and 3 Active Valves	3.9-110
3.9-13	Control Rod Drive Mechanism Production Tests	3.9-117
3.9-14	Maximum Deflections Allowed for Reactor Internal Support Structures.....	3.9-118
3.9-15	Computer Programs for Seismic Category 1 Components	3.9-119
3.9-16	Valve Inservice Test Requirements.....	3.9-120
3.9-17	System Level Operability Test Requirements	3.9-148
3.9-18	AP1000 Pressure Isolation Valves	3.9-149
3.9-19	Critical Piping Design Methods and Criteria (Piping Design Criteria)....	3.9-150
3.9-20	Piping Packages Chosen to Demonstrate Piping Design for Piping DAC Closure	3.9-152
3.9-201	Safety Related Snubbers	3.9-154
3.11-1	Environmentally Qualified Electrical and Mechanical Equipment.....	3.11-7
3B-1	AP1000 Leak-Before-Break Bounding Analysis Systems and Parameters.....	3B-16

LIST OF TABLES (CONTINUED)

<u>Table Number</u>	<u>Title</u>	<u>Page</u>
3D.4-1	Typical Mild Environment Parameter Limits	3D-32
3D.4-2	Equipment Post-Accident Operability Times	3D-33
3D.4-3	AP1000 EQ Program Margin Requirements	3D-34
3D.5-1	Normal Operating Environments	3D-35
3D.5-2	60-Year Normal Operating Doses	3D-38
3D.5-3	Abnormal Operating Environments Inside Containment	3D-39
3D.5-4	Abnormal Operating Environments Outside Containment	3D-40
3D.5-5	Accident Environments.....	3D-42
3D.6-1	Mechanical Equipment Components Requiring Environmental Qualification.....	3D-43
3G.1-1	Summary of Models and Analysis Methods	3G-11
3G.1-2	Summary of Dynamic Analyses and Combination Techniques.....	3G-15
3G.2-1	Steel Containment Vessel Lumped-Mass Stick Model (Without Polar Crane) Modal Properties	3G-16
3G.2-2	Comparison of Frequencies for Containment Vessel Seismic Model.....	3G-18
3G.3-1	AP1000 ZPA for 2D SASSI Cases	3G-19
3G.4-1	Key Nodes at Location	3G-20
3G.4-2	Maximum Bearing Pressure from 2D Time History Analyses.....	3G-21
3H.5-1	Nuclear Island: Design Temperatures for Thermal Gradient.....	3H-21
3H.5-2	Exterior Wall at Column Line 1 Forces and Moments in Critical Locations	3H-22
3H.5-3	Exterior Wall on Column Line 1 Details of Wall Reinforcement (in ² /ft).....	3H-23
3H.5-4	Interior Wall at Column Line 7.3 Forces and Moments in Critical Locations	3H-24
3H.5-5	Interior Wall on Column Line 7.3 Details of Wall Reinforcement.....	3H-25
3H.5-6	Interior Wall at Column Line L Forces and Moments in Critical Locations	3H-26
3H.5-7	Interior Wall on Column Line L Details of Wall Reinforcement.....	3H-27
3H.5-8	Design Summary of Spent Fuel Pool Wall Design Loads, Load Combinations, and Comparisons to Acceptance Criteria – Element No. 20477	3H-28
3H.5-9	Shield Building Roof Reinforcement Summary	3H-35
3H.5-10	Design Summary Of Roof At Elevation 180'-0", Area 6.....	3H-40
3H.5-11	Design Summary Of Floor At Elevation 135'-3" Area 1 (Between Column Lines M And P)	3H-41
3H.5-12	Design Summary Of Floor At Elevation 135'-3" (Operations Work Area (Previously Known As 'Tagging Room') Ceiling))	3H-42
3H.5-13	Design Summary Of Floor At Elevation 135'-3" Area 1 (Main Control Room Ceiling)	3H-43
3H.5-14	Design Summary of Enhanced Shield Building Cylindrical Wall Load Combinations, and Comparison to Acceptance Criteria Elevation 180 Feet Near Fuel Handling Building Roof.....	3H-44
3H.5-15	Shield Building Roof Reinforcement Ratio of Code Required Versus Provided	3H-47
3I.6-1	Potential High Frequency Sensitive Equipment List.....	3I-10

LIST OF TABLES (CONTINUED)

<u>Table Number</u>	<u>Title</u>	<u>Page</u>
3I.6-2	List of Potential High Frequency Sensitive AP1000 Safety-Related electrical and Electro-mechanical Equipment	3I-11
3I.6-3	List Of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive	3I-39
3JJ-201	HF and LF Horizontal 10^{-4} Site Spectra, and Raw and Smoothed Envelope UHRS Spectra for the FAR and NI Soil Columns at FIRS Horizon	3JJ-11
3JJ-202	HF and LF Horizontal 10^{-5} Site Spectra, and Raw and Smoothed Envelope UHRS Spectra for the FAR and NI Soil Columns at FIRS Horizon	3JJ-13
3JJ-203	Horizontal 10^{-4} and 10^{-5} Smoothed Site Spectra, Values of AR and DF, and DRS for the FAR Soil Column at FIRS Horizon	3JJ-15
3JJ-204	Horizontal 10^{-4} and 10^{-5} Smoothed Site Spectra, Values of AR and DF, and DRS for the NI Soil Column at FIRS Horizon	3JJ-17
3JJ-205	V/H Ratios, Vertical 10^{-4} and 10^{-5} Smoothed Site Spectra, Values of AR and DF, and DRS for the FAR Soil Column at FIRS Horizon	3JJ-19
3JJ-206	V/H Ratios, Vertical 10^{-4} and 10^{-5} Smoothed Site Spectra, Values of AR and DF, and DRS for the NI Soil Column at FIRS Horizon	3JJ-21
3JJ-207	Recommended Horizontal and Vertical FIRS	3JJ-23
3JJ-208	Absolute Value of the Zero-Lag Cross Correlations Between Components for the Spectrum Compatible Time Histories Developed for the SSI Analysis	3JJ-24
3JJ-209	SSI Motion Adjustment Factors	3JJ-24
3JJ-210	Key Elevations for Calculation of the Ground Motion	3JJ-25
3JJ-211	Site Profiles for the “Initial” Models	3JJ-26
3JJ-212	Site Profiles for the Sensitivity Model	3JJ-26
3JJ-213	G/G_{max} and Damping Model and Units Weights used for the Units in the “Initial” Profile	3JJ-27
3JJ-214	G/G_{max} and Damping Models and Units Weights used for the Units in the Sensitivity Model	3JJ-27
3JJ-215	Summary of Computed FIRS, DRS, and GMRS	3JJ-28

LIST OF FIGURES

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3.3-1	Velocity Pressure Variation with Radius from Center of Tornado	3.3-6
3.4-1	Typical Details of Nuclear Island Waterproofing Below Grade.....	3.4-21
3.4-2	Typical Details of Nuclear Island Waterproofing Below Grade with Step Back	3.4-22
3.4-3	Not Used	3.4-23
3.4-4	Typical Details of Membrane Corner Detail at Basemat and Exterior Wall	3.4-24
3.6-1	Typical U-Bar Restraint	3.6-48
3.6-2	Typical Energy Absorbing Material Restraint	3.6-49
3.6-3	Terminal Ends Definitions	3.6-50
3.7.1-1	Horizontal Design Response Spectra Safe Shutdown Earthquake.....	3.7-69
3.7.1-2	Vertical Design Response Spectra Safe Shutdown Earthquake.....	3.7-70
3.7.1-3	Design Horizontal Time History, "H1" Acceleration, Velocity & Displacement Plots.....	3.7-71
3.7.1-4	Design Horizontal Time History, "H2" Acceleration, Velocity & Displacement Plots.....	3.7-72
3.7.1-5	Design Vertical Time History Acceleration, Velocity & Displacement Plots	3.7-73
3.7.1-6	Acceleration Response Spectra of Design Horizontal Time History, "H1"	3.7-74
3.7.1-7	Acceleration Response Spectra of Design Horizontal Time History, "H2"	3.7-75
3.7.1-8	Acceleration Response Spectra of Design Vertical Time History.....	3.7-76
3.7.1-9	Minimum Power Spectral Density Curve (Normalized to 0.3g)	3.7-77
3.7.1-10	Power Spectral Density of Design Horizontal Time History, "H1"	3.7-78
3.7.1-11	Power Spectral Density of Design Horizontal Time History, "H2"	3.7-79
3.7.1-12	Power Spectral Density of Design Vertical Time History.....	3.7-80
3.7.1-13	Not Used	3.7-81
3.7.1-14	Nuclear Island Structures Dimensions	3.7-82
3.7.1-15	Strain Dependent Properties of Rock Material (Ref. 37)	3.7-83
3.7.1-16	Strain Dependent Properties of Soil Material (Ref. 38)	3.7-84
3.7.1-17	Generic Soil Profiles	3.7-85
3.7.2-1–3.7.2-11	Not Used	3.7-86
3.7.2-12	(Sheet 1 of 12) Nuclear Island Key Structural Dimensions Plan at El. 66'-6"	3.7-87
3.7.2-12	(Sheet 2 of 12) Nuclear Island Key Structural Dimensions Plan at El. 82'-6"	3.7-88
3.7.2-12	(Sheet 3 of 12) Nuclear Island Key Structural Dimensions Plan at El. 100'-0" & 107'-2".....	3.7-89
3.7.2-12	(Sheet 4 of 12) Nuclear Island Key Structural Dimensions Plan at El. 117'-6"	3.7-90
3.7.2-12	(Sheet 5 of 12) Nuclear Island Key Structural Dimensions Plan at El. 135'-3"	3.7-91
3.7.2-12	(Sheet 6 of 12) Nuclear Island Key Structural Dimensions Plan at El. 153'-0" & 160'-6".....	3.7-92
3.7.2-12	(Sheet 7 of 12) Nuclear Island Key Structural Dimensions Plan at El. 160'-6", 180'-0", & 329'-0"	3.7-93

LIST OF FIGURES (CONTINUED)

Figure Number	Title	Page
3.7.2-12	(Sheet 8 of 12) Nuclear Island Key Structural Dimensions Section A - A	3.7-94
3.7.2-12	(Sheet 9 of 12) Nuclear Island Key Structural Dimensions Section B - B	3.7-95
3.7.2-12	(Sheet 10 of 12) Nuclear Island Key Structural Dimensions Sections C - C and H - H	3.7-96
3.7.2-12	(Sheet 11 of 12) Nuclear Island Key Structural Dimensions Section G - G	3.7-97
3.7.2-12	(Sheet 12 of 12) Nuclear Island Key Structural Dimensions Section J - J	3.7-98
3.7.2-13	Not Used	3.7-99
3.7.2-14	Typical Design Floor Response Spectrum	3.7-100
3.7.2-15–3.7.2-18	Not Used	3.7-101
3.7.2-19	(Sheet 1 of 10) Annex Building Key Structural Dimensions Plan at Elevation 100'-0"	3.7-102
3.7.2-19	(Sheet 2 of 10) Annex Building Key Structural Dimensions Plan at Elevation 107'-2" and 117'-6"	3.7-103
3.7.2-19	(Sheet 3 of 10) Annex Building Key Structural Dimensions Plan at Elevation 135'-3"	3.7-104
3.7.2-19	(Sheet 4 of 10) Annex Building Key Structural Dimensions Plan at Elevation 158'-0" and 146'-3"	3.7-105
3.7.2-19	(Sheet 5 of 10) Annex Building Key Structural Dimensions Roof Plan at Elevation 154'-0" and 181'-11 3/4"	3.7-106
3.7.2-19	(Sheet 6 of 10) Annex Building Key Structural Dimensions Section A - A	3.7-107
3.7.2-19	(Sheet 7 of 10) Annex Building Key Structural Dimensions Section B - B	3.7-108
3.7.2-19	(Sheet 8 of 10) Annex Building Key Structural Dimensions Section C - C	3.7-109
3.7.2-19	(Sheet 9 of 10) Annex Building Key Structural Dimensions Sections D - D, E - E, & F - F	3.7-110
3.7.2-19	(Sheet 10 of 10) Annex Building Key Structural Dimensions Sections G - G, H - H, & J - J	3.7-111
3.7.2-20	East-West 2D SASSI Model with Adjacent Buildings	3.7-112
3.7.2-21	2D North-South SASSI Model with Adjacent Buildings	3.7-113
3.7.2-22	3D SASSI Model with Adjacent Buildings	3.7-114
3.7.3-1	Impact Evaluation Zone	3.7-115
3.7.3-2	Impact Evaluation Zone and Seismic Supported Piping	3.7-116
3.7-201	Recommended Horizontal and Vertical FIRS (Elevation –16 foot Horizon at Bottom of Nuclear Island Foundation)	3.7-117
3.7-202	Comparison of Turkey Point Horizontal and Vertical FIRS with AP1000 Horizontal and Vertical CSDRS	3.7-118
3.7-203	PLAXIS 3D Sensitivity Model with 20-foot Diameter Cylindrical Void ...	3.7-119
3.7-204	Relative Shear Stresses (Static and Pseudo-Dynamic Loading, Multiplier of 1 as defined in Table 3.7-202)	3.7-120
3.7-205	Relative Shear Stresses (Static and Pseudo-Dynamic Loading, Multiplier of 2 as defined in Table 3.7-202)	3.7-121

LIST OF FIGURES (CONTINUED)

Figure Number	Title	Page
3.8.2-1	(Sheet 1 of 3) Containment Vessel General Outline	3.8-99
3.8.2-1	(Sheet 2 of 3) Containment Vessel General Outline	3.8-100
3.8.2-1	(Sheet 3 of 3) Containment Vessel General Outline	3.8-101
3.8.2-2	Equipment Hatches	3.8-102
3.8.2-3	Personnel Airlock	3.8-103
3.8.2-4	(Sheet 1 of 7) Containment Penetrations Main Steam	3.8-104
3.8.2-4	(Sheet 2 of 7) Containment Penetrations Startup Feedwater	3.8-105
3.8.2-4	(Sheet 3 of 7) Containment Penetrations Normal RHR Piping	3.8-106
3.8.2-4	(Sheet 4 of 7) Containment Penetrations	3.8-107
3.8.2-4	(Sheet 5 of 7) Containment Penetrations Fuel Transfer Penetration	3.8-108
3.8.2-4	(Sheet 6 of 7) Containment Penetrations Typical Electrical Penetration	3.8-109
3.8.2-4	(Sheet 7 of 7) Containment Penetrations Steam Line and Feedwater Line Insert Plates.....	3.8-110
3.8.2-5	(Sheet 1 of 5) Containment Vessel Response to Internal Pressure of 59 psig Displaced Shape Plot	3.8-111
3.8.2-5	(Sheet 2 of 5) Containment Vessel Response to Internal Pressure of 59 psig Membrane Stresses (ksi).....	3.8-112
3.8.2-5	(Sheet 3 of 5) Containment Vessel Response to Internal Pressure of 59 psig Surface Meridional Stress (ksi).....	3.8-113
3.8.2-5	(Sheet 4 of 5) Containment Vessel Response to Internal Pressure of 59 psig Outside Surface Stresses (ksi)	3.8-114
3.8.2-5	(Sheet 5 of 5) Containment Vessel Response to Internal Pressure of 59 psig Outer Stress Intensity (ksi)	3.8-115
3.8.2-6	(Sheet 1 of 2) Containment Vessel Axisymmetric Model	3.8-116
3.8.2-6	(Sheet 2 of 2) Containment Vessel Axisymmetric Model	3.8-117
3.8.2-7	Finite Element Model for Local Buckling Analyses.....	3.8-118
3.8.2-8	(Sheet 1 of 2) Location of Containment Seal	3.8-119
3.8.2-8	(Sheet 2 of 2) Seal Sections and Details.....	3.8-120
3.8.3-1	(Sheet 1 of 7) Structural Modules in Containment Internal Structures	3.8-121
3.8.3-1	(Sheet 2 of 7) Structural Modules in Containment Internal Structures	3.8-122
3.8.3-1	(Sheet 3 of 7) Structural Modules in Containment Internal Structures	3.8-123
3.8.3-1	(Sheet 4 of 7) Structural Modules in Containment Internal Structures	3.8-124
3.8.3-1	(Sheet 5 of 7) Structural Modules in Containment Internal Structures	3.8-125
3.8.3-1	(Sheet 6 of 7) Structural Modules in Containment Internal Structures	3.8-126
3.8.3-1	(Sheet 7 of 7) Structural Modules in Containment Internal Structures	3.8-127
3.8.3-2	Typical Structural Wall Module	3.8-128
3.8.3-3	Typical Structural Floor Module.....	3.8-129
3.8.3-4	Reactor Vessel Supports.....	3.8-130
3.8.3-5	(Sheet 1 of 5) Steam Generator Supports.....	3.8-131

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3.8.3-5	(Sheet 2 of 5) Steam Generator Supports.....	3.8-132
3.8.3-5	(Sheet 3 of 5) Steam Generator Supports.....	3.8-133
3.8.3-5	(Sheet 4 of 5) Steam Generator Supports.....	3.8-134
3.8.3-5	(Sheet 5 of 5) Steam Generator Supports.....	3.8-135
3.8.3-6	(Sheet 1 of 4) Pressurizer Support Columns.....	3.8-136
3.8.3-6	(Sheet 2 of 4) Pressurizer Lower Lateral Supports	3.8-137
3.8.3-6	(Sheet 3 of 4) Pressurizer Lower Supports	3.8-138
3.8.3-6	(Sheet 4 of 4) Pressurizer Upper Supports	3.8-139
3.8.3-7	IRWST Temperature Transient	3.8-140
3.8.3-8	(Sheet 1 of 3) Structural Modules – Typical Design Details	3.8-141
3.8.3-8	(Sheet 2 of 3) Structural Modules – Typical Design Details	3.8-142
3.8.3-8	(Sheet 3 of 3) Structural Modules – Typical Design Details	3.8-143
3.8.3-9	Test Tank Finite Element Model.....	3.8-144
3.8.3-10	(Sheet 1 of 2) IRWST Fluid Structure Finite Element Model CIS Structural Model	3.8-145
3.8.3-10	(Sheet 2 of 2) IRWST Fluid Structure Finite Element Model IRWST Structural Model	3.8-146
3.8.3-11	IRWST Fluid Structure Finite Element Model Fluid Model	3.8-147
3.8.3-12	IRWST Fluid Structure Finite Element Model Sparger Region Detail ...	3.8-148
3.8.3-13	Effective Sections for Floor Modules.....	3.8-149
3.8.3-14	(Sheet 1 of 5) CA-01 Module.....	3.8-150
3.8.3-14	(Sheet 2 of 5) CA-02 Module.....	3.8-151
3.8.3-14	(Sheet 3 of 5) CA-03 Module.....	3.8-152
3.8.3-14	(Sheet 4 of 5) CA-04 Structural Module	3.8-153
3.8.3-14	(Sheet 5 of 5) CA-05 Module.....	3.8-154
3.8.3-15	(Sheet 1 of 2) Typical Submodule	3.8-155
3.8.3-15	(Sheet 2 of 2) Typical Submodule	3.8-156
3.8.3-16	Typical Liner Modules	3.8-157
3.8.3-17	(Sheet 1 of 2) Structural Modules – Design Details Standard Floor Connection	3.8-158
3.8.3-17	(Sheet 2 of 2) Structural Modules – Design Details Heavily Loaded Floor Connection	3.8-159
3.8.3-18	Location of Structural Wall Modules.....	3.8-160
3.8.4-1	(Sheet 1 of 4) Containment Air Baffle General Arrangement.....	3.8-161
3.8.4-1	(Sheet 2 of 4) Containment Air Baffle Panel Types.....	3.8-162
3.8.4-1	(Sheet 3 of 4) Containment Air Baffle Typical Panel on Cylinder	3.8-163
3.8.4-1	(Sheet 4 of 4) Containment Air Baffle Sliding Plate.....	3.8-164
3.8.4-2	Passive Containment Cooling Tank	3.8-165
3.8.4-3	Not Used	3.8-166
3.8.4-4	(Sheet 1 of 5) Structural Modules in Auxiliary Building	3.8-167
3.8.4-4	(Sheet 2 of 5) Structural Modules in Auxiliary Building	3.8-168
3.8.4-4	(Sheet 3 of 5) Structural Modules in Auxiliary Building	3.8-169
3.8.4-4	(Sheet 4 of 5) Structural Modules in Auxiliary Building	3.8-170
3.8.4-4	(Sheet 5 of 5) Structural Modules in Auxiliary Building	3.8-171
3.8.4-5	Shield Building Structure Key Areas	3.8-172
3.8.5-1	Foundation Plan	3.8-173
3.8.5-2	Isometric View of Finite Element Model	3.8-174

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3.8.5-3	(Sheet 1 of 7) Radial Reinforcement, Top Side of DISH	3.8-175
3.8.5-3	(Sheet 2 of 7) Circumferential Reinforcement, Top Side of DISH	3.8-176
3.8.5-3	(Sheet 3 of 7) Longitudinal Reinforcement Map, Top Side in NS Direction	3.8-177
3.8.5-3	(Sheet 4 of 7) Longitudinal Reinforcement Map, Top Side in EW Direction	3.8-178
3.8.5-3	(Sheet 5 of 7) Longitudinal Reinforcement, Bottom Side of DISH and 6' Basemat (NS)	3.8-179
3.8.5-3	(Sheet 6 of 7) Longitudinal Reinforcement, Bottom Side of DISH and 6' Basemat (EW)	3.8-180
3.8.5-3	(Sheet 7 of 7) Shear Reinforcement Map.....	3.8-181
3.9-1–3.9-3	Not Used	3.9-155
3.9-4	Control Rod Drive Mechanism	3.9-156
3.9-5	Lower Reactor Internals	3.9-157
3.9-6	Upper Core Support Structure.....	3.9-158
3.9-7	Integrated Head Package.....	3.9-159
3.9-8	Reactor Internals Interface Arrangement	3.9-160
3.9-9	Flow Skirt Schematic.....	3.9-161
3B-1	Typical Bounding Analysis Curve (BAC)	3B-18
3B-2	Bounding Analysis Curve for Primary Loop Hot Leg	3B-19
3B-3	Bounding Analysis Curve for Primary Loop Cold Leg	3B-20
3B-4	Bounding Analysis Curve for 38" Main Steam Line.....	3B-21
3B-5	Bounding Analysis Curve for 20" Normal RHR	3B-22
3B-6	(Sheet 1 of 2) Bounding Analysis Curve for 18" Surge Line.....	3B-23
3B-6	(Sheet 2 of 2) Bounding Analysis Curve for 18" Surge Line.....	3B-24
3B-7	Bounding Analysis Curve for 18" PRHR Supply/ADS 4	3B-25
3B-8	Bounding Analysis Curve for 14" PRHR Supply to Cold Trap, PRHR Supply/ADS4	3B-26
3B-9	Bounding Analysis Curve for 14" PRHR Supply after Cold Trap, Return – to Isolation Valve	3B-27
3B-10	Bounding Analysis Curve for 14" ADS Stage 2, 3	3B-28
3B-11	Bounding Analysis Curve for 14" PRHR Return – after Isolation Valve, 14" PRHR Return	3B-29
3B-12	Not Used	3B-30
3B-13	Bounding Analysis Curve for 8" Accumulator to Isolation Valve	3B-31
3B-14	Bounding Analysis Curve for 8" CMT Cold Leg Balance Line and Vent, DVI Cold Trap to RV	3B-32
3B-15	Bounding Analysis Curve for 8" CMT, DVI IWRST (Various Sections)	3B-33
3B-16	Not Used	3B-34
3B-17	Bounding Analysis Curve for Accumulator after Isolation Valve	3B-35
3B-18	Bounding Analysis Curve for RNS Discharge	3B-36
3B-19	Bounding Analysis Curve for ADS Header to RCS Safety Valve	3B-37
3B-20	Bounding Analysis Curve for 12" Normal RHR	3B-38
3B-21	Bounding Analysis Curve for 10" Normal RHR	3B-39
3B-22	Bounding Analysis Curve for 8" ADS Stage 2, 3	3B-40

LIST OF FIGURES (CONTINUED)

Figure Number	Title	Page
3D.5-1	(Sheet 1 of 3) Typical Abnormal Environmental Test Profile: Main Control Room	3D-44
3D.5-1	(Sheet 2 of 3) Typical Abnormal Environmental Test Profile: I&C and DC Equipment Rooms.....	3D-45
3D.5-1	(Sheet 3 of 3) Typical Abnormal Environmental Test Profile: Voltage and Frequency Variations	3D-46
3D.5-2	Gamma Dose and Dose Rate Inside Containment After a LOCA.....	3D-47
3D.5-3	Beta Dose and Dose Rate Inside Containment After a LOCA	3D-48
3D.5-4	Gamma Dose and Dose Rate Inside Containment After a Steam Line Break	3D-49
3D.5-5	Beta Dose and Dose Rate Inside Containment After a Steam Line Break	3D-50
3D.5-6–3D.5-7	Not Used	3D-51
3D.5-8	(Sheet 1 of 2) Typical Combined LOCA/SLB/FLB Inside Containment Temperature.....	3D-52
3D.5-8	(Sheet 2 of 2) Typical Combined LOCA/SLB/FLB Inside Containment Pressure	3D-53
3D.5-9	(Sheet 1 of 2) MSIV Compartment Response to MSLB (Short Term).....	3D-54
3D.5-9	(Sheet 2 of 2) MSIV Compartment Response to MSLB (Long Term).....	3D-55
3E-1	(Sheet 1 of 2) High Energy Piping – Steam Generator System	3E-2
3E-1	(Sheet 2 of 2) High Energy Piping – Steam Generator System	3E-3
3E-2	High Energy Piping – Normal Residual Heat Removal System	3E-4
3E-3	(Sheet 1 of 2) High Energy Piping – Reactor Coolant System.....	3E-5
3E-3	(Sheet 2 of 2) High Energy Piping – Reactor Coolant System.....	3E-6
3E-4	(Sheet 1 of 2) High Energy Piping – Passive Core Cooling System	3E-7
3E-4	(Sheet 2 of 2) High Energy Piping – Passive Core Cooling System	3E-8
3E-5	(Sheet 1 of 2) High Energy Piping – Chemical and Volume Control System.....	3E-9
3E-5	(Sheet 2 of 2) High Energy Piping – Chemical and Volume Control System.....	3E-10
3G.1-1	Nuclear Island Seismic Analysis Models	3G-22
3G.2-1	3D Finite Element Model of Coupled Shield and Auxiliary Building	3G-23
3G.2-2	3D Finite Element Model of Containment Internal Structures	3G-24
3G.2-3	3D Finite Element Model of Containment Outer Basemat (Dish).....	3G-25
3G.2-4	Steel Containment Vessel and Polar Crane Models	3G-26
3G.2-5A	Polar Crane Model Simplified Model	3G-27
3G.2-5B	Polar Crane Model Detailed Model	3G-28
3G.2-6	Reactor Coolant Loop Lumped-Mass Stick Model	3G-29
3G.2-7	Pressurizer Model	3G-30
3G.2-8	Core Makeup Tank Models	3G-31
3G.2-9	AP1000 Nuclear Island Solid-Shell Model (NI10).....	3G-32
3G.2-10	Containment Internal Structure with the SCV, PC, Reactor Coolant Loop, and Pressurizer	3G-33

LIST OF FIGURES (CONTINUED)

Figure Number	Title	Page
3G.2-11	Soil Structure Interaction Model – NI20 Looking East	3G-34
3G.2-12	Coarse Model of Containment Internal Structures	3G-35
3G.2-13	Fine Mesh (NI05) Model of Auxiliary and Shield Building	3G-36
3G.2-14	NI05 Model of Containment Internal Structures	3G-37
3G.2-15	3D NI05 Refined Mesh Model of Outer Containment Basemat (Dish).....	3G-38
3G.2-16	Quadrant Model of Shield Building Roof	3G-39
3G.2-17	Detailed 3D Finite Element Model of Containment Vessel Including Large Penetrations	3G-40
3G.2-18	Axisymmetric Model of Containment Vessel	3G-41
3G.2-19	Schematic of Non-linear 2D East-West Nuclear Island Stick Model Used for Stability Evaluation that Addresses Sliding and Overturning	3G-42
3G.3-1	Generic Soil Profiles	3G-43
3G.3-2	2D SASSI FRS – Node 41 X (ASB El. 99').....	3G-44
3G.3-3	2D SASSI FRS – Node 41 Y (ASB El. 99').....	3G-45
3G.3-4	2D SASSI FRS – Node 120 X (ASB El. 179.6').....	3G-46
3G.3-5	2D SASSI FRS – Node 120 Y (ASB El. 179.6').....	3G-47
3G.3-6	2D SASSI FRS – Node 310 X (ASB El. 333.2').....	3G-48
3G.3-7	2D SASSI FRS – Node 310 Y (ASB El. 333.2').....	3G-49
3G.3-8	2D SASSI FRS – Node 411 X (SCV El. 200.0')	3G-50
3G.3-9	2D SASSI FRS – Node 411 Y (SCV El. 200.0')	3G-51
3G.3-10	2D SASSI FRS – Node 535 X (CIS El. 134.3').....	3G-52
3G.3-11	2D SASSI FRS – Node 535 Y (CIS El. 134.3').....	3G-53
3G.4-1	Auxiliary Shield Building “Rigid” Nodes at El. 135'	3G-54
3G.4-2	Auxiliary Shield Building “Flexible” Nodes at El. 135'	3G-55
3G.4-3	Excavated Soil.....	3G-56
3G.4-4	Additional Elements for Soil Pressure Calculations	3G-57
3G.4-5X	X Direction FRS for Node 130401 (NI10) or 1761 (NI20) CIS at Reactor Vessel Support Elevation of 100'	3G-58
3G.4-5Y	Y Direction FRS for Node 130401 (NI10) or 1761 (NI20) CIS at Reactor Vessel Support Elevation of 100'	3G-59
3G.4-5Z	Z Direction FRS for Node 130401 (NI10) or 1761 (NI20) CIS at Reactor Vessel Support Elevation of 100'	3G-60
3G.4-6X	X Direction FRS for Node 105772 (NI10) or 2199 (NI20) CIS at Operating Deck Elevation 134.25'	3G-61
3G.4-6Y	Y Direction FRS for Node 105772 (NI10) or 2199 (NI20) CIS at Operating Deck Elevation 134.25'	3G-62
3G.4-6Z	Z Direction FRS for Node 105772 (NI10) or 2199 (NI20) CIS at Operating Deck Elevation 134.25'	3G-63
3G.4-7X	X Direction FRS for Node 4724 (NI10) or 2078 (NI20) ASB Control Room Side Elevation 116.50'	3G-64
3G.4-7Y	Y Direction FRS for Node 4724 (NI10) or 2078 (NI20) ASB Control Room Side Elevation 116.50'	3G-65
3G.4-7Z	Z Direction FRS for Node 4724 (NI10) or 2078 (NI20) ASB Control Room Side Elevation 116.50'	3G-66
3G.4-8X	X Direction FRS for Node 5754 (NI10) or 2675 (NI20) ASB Fuel Building Roof Elevation 179.19'.....	3G-67

LIST OF FIGURES (CONTINUED)

Figure Number	Title	Page
3G.4-8Y	Y Direction FRS for Node 5754 (NI10) or 2675 (NI20) ASB Fuel Building Roof Elevation 179.19'.....	3G-68
3G.4-8Z	Z Direction FRS for Node 5754 (NI10) or 2675 (NI20) ASB Fuel Building Roof Elevation 179.19'.....	3G-69
3G.4-9X	X Direction FRS for Node 8573 (NI10) or 3329 (NI20) ASB Shield Building Roof Elevation 327.41'.....	3G-70
3G.4-9Y	Y Direction FRS for Node 8573 (NI10) or 3329 (NI20) ASB Shield Building Roof Elevation 327.41'.....	3G-71
3G.4-9Z	Z Direction FRS for Node 8573 (NI10) or 3329 (NI20) ASB Shield Building Roof Elevation 327.41'.....	3G-72
3G.4-10X	X Direction FRS for Node 130412 (NI10) or 2788 (NI20) SCV Near Polar Crane Elevation 224.00'.....	3G-73
3G.4-10Y	Y Direction FRS for Node 130412 (NI10) or 2788 (NI20) SCV Near Polar Crane Elevation 224.00'.....	3G-74
3G.4-10Z	Z Direction FRS for Node 130412 (NI10) or 2788 (NI20) SCV Near Polar Crane Elevation 224.00'.....	3G-75
3H.2-1	General Layout of Auxiliary Building.....	3H-48
3H.5-1	(Sheet 1 of 3) Nuclear Island Critical Sections Plan at El. 135'-3".....	3H-49
3H.5-1	(Sheet 2 of 3) Nuclear Island Critical Sections Plan at El. 180'-0".....	3H-50
3H.5-1	(Sheet 3 of 3) Nuclear Island Critical Sections Section A-A.....	3H-51
3H.5-2	(Sheet 1 of 3) Wall on Column Line 1.....	3H-52
3H.5-2	(Sheet 2 of 3) Wall on Column Line 7.3.....	3H-53
3H.5-2	(Sheet 3 of 3) Wall on Column Line L.....	3H-54
3H.5-3	Typical Reinforcement in Wall on Column Line 1.....	3H-55
3H.5-4	Typical Reinforcement in Wall 7.3.....	3H-56
3H.5-5	(Sheet 1 of 3) Concrete Reinforcement in Wall 11.....	3H-57
3H.5-5	(Sheet 2 of 3) Concrete Reinforcement Layers in Wall 11 (Looking East).....	3H-58
3H.5-5	(Sheet 3 of 3) Wall 11 at Main Steamline Anchor Section A-A.....	3H-59
3H.5-6	Auxiliary Building Typical Composite Floor.....	3H-60
3H.5-7	Typical Reinforcement and Connection to Shield Building.....	3H-61
3H.5-8	Auxiliary Building Operations Work Area (Tagging Room) Ceiling.....	3H-62
3H.5-9	(Sheet 1 of 3) Auxiliary Building Finned Floor.....	3H-63
3H.5-9	(Sheet 2 of 3) Auxiliary Building Finned Floor.....	3H-64
3H.5-9	(Sheet 3 of 3) Auxiliary Building Finned Floor.....	3H-65
3H.5-10	Spent Fuel Pool Wall Divider Wall Element Locations.....	3H-66
3H.5-11	(Sheet 1 of 6) Design of Shield Building: Roof and Air Inlets.....	3H-67
3H.5-11	(Sheet 2 of 6) Design of Shield Building: Concrete Detail at Tension Ring.....	3H-68
3H.5-11	(Sheet 3 of 6) Design of Shield Building: Roof/Air Inlet Interface.....	3H-69
3H.5-11	(Sheet 4 of 6) Design of Shield Building at Air Inlets.....	3H-70
3H.5-11	(Sheet 5 of 6) Design of Shield Building: Tank/Roof Interface Reinforcement.....	3H-71
3H.5-11	(Sheet 6 of 6) Design of Shield Building: Tank/Compression Ring Roof Interface Reinforcement.....	3H-72
3H.5-12	Typical Reinforcement in Wall L.....	3H-73
3H.5-13	Enhanced Shield Building Wall Panel Layout.....	3H-74

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3H.5-14	Elevation View of Tension Ring and Air Inlets.....	3H-75
3H.5-15	Shield Building Tension Ring	3H-76
3H.5-16	(Sheet 1 of 2) Design of Shield Building: Surface Plates on Cylindrical Section – Developed View 90-270 Degrees	3H-77
3H.5-16	(Sheet 2 of 2) Design of Shield Building: Surface Plates on Cylindrical Section – Developed View 270-90 Degrees	3H-78
3I.1-1	Comparison of Horizontal AP1000 CSDRS and HRHF Envelope Response Spectra	3I-71
3I.1-2	Comparison of Vertical AP1000 CSDRS and HRHF Envelope Response Spectra	3I-72
3JJ-201	Randomized Shear Wave Velocity Profiles, Median Shear Wave Velocity Profile and the Input Median Profile Used for Randomization — NI Site Conditions	3JJ-29
3JJ-202	Randomized Shear Wave Velocity Profiles, Median Shear Wave Velocity Profile and the Input Median Profile Used for Randomization — FAR Site Conditions	3JJ-30
3JJ-203	ARS Amplification Factors at FIRS Horizon — NI Site Conditions.....	3JJ-31
3JJ-204	ARS Amplification Factors at FIRS Horizon — FAR Site Conditions	3JJ-31
3JJ-205	ARS Amplification Factors at Ground Surface — NI Site Conditions	3JJ-32
3JJ-206	ARS Amplification Factors at Ground Surface — FAR Site Conditions	3JJ-32
3JJ-207	Strain Profiles — NI Site Conditions.....	3JJ-33
3JJ-208	Strain Profiles — FAR Site Conditions	3JJ-34
3JJ-209	HF and LF Horizontal 10^{-4} and 10^{-5} Site Spectra — FAR Soil Column	3JJ-35
3JJ-210	HF and LF Horizontal 10^{-4} and 10^{-5} Site Spectra — NI Soil Column	3JJ-35
3JJ-211	Smoothed Horizontal 10^{-4} and 10^{-5} Site Spectra and DRS — FAR Soil Column	3JJ-36
3JJ-212	Smoothed Horizontal 10^{-4} and 10^{-5} Site Spectra and DRS — NI Soil Column	3JJ-36
3JJ-213	Smoothed Vertical 10^{-4} and 10^{-5} Site Spectra and DRS — FAR Soil Column	3JJ-37
3JJ-214	Smoothed Vertical 10^{-4} and 10^{-5} Site Spectra and DRS — NI Soil Column	3JJ-37
3JJ-215	Recommended Horizontal and Vertical FIRS (Elevation –16 foot Horizon at Bottom of Nuclear Island Foundation)	3JJ-38
3JJ-216	Recommended SSI Shear-Wave Velocity Profiles — NI Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown).....	3JJ-39
3JJ-217	Recommended SSI Damping Profiles — NI Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown)	3JJ-40
3JJ-218	Recommended P-Wave Velocity Profiles — NI Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown)	3JJ-41
3JJ-219	Recommended SSI Shear-Wave Velocity Profiles — FAR Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown).....	3JJ-42

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3JJ-220	Recommended SSI Damping Profiles — FAR Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown)	3JJ-43
3JJ-221	Recommended P-Wave Velocity Profiles — FAR Site Conditions (Upper 1000 feet — below 1000 feet depth is not shown)	3JJ-44
3JJ-222a	Final Spectrum-Compatible Acceleration, Velocity, and Displacement Time Histories for Horizontal 1 Case Before Constant Scale Factor of 1.01 is Applied	3JJ-45
3JJ-222b	Comparison of Initial Seed Acceleration Normalized Arias Intensities Plot and Final Spectrum-Compatible Acceleration Normalized Arias Intensities Plot for Horizontal 1 Case Before Constant Scale Factor of 1.01 is Applied	3JJ-46
3JJ-222c	Comparison Between the Final Scaled Spectrum-Compatible Response Spectrum, Horizontal SSE ARS, and Upper and Lower Target Spectrum Bounds for Horizontal 1 Case With the Constant Scale Factor of 1.01 Applied	3JJ-47
3JJ-223a	Final Spectrum-Compatible Acceleration, Velocity, and Displacement Time Histories for Horizontal 2 Case Before Constant Scale Factor of 1.015 is Applied	3JJ-48
3JJ-223b	Comparison of Initial Seed Acceleration Normalized Arias Intensities Plot and Final Spectrum-Compatible Acceleration Normalized Arias Intensities Plot for Horizontal 2 Case Before Constant Scale Factor of 1.015 is Applied	3JJ-49
3JJ-223c	Comparison Between the Final Scaled Spectrum-Compatible Response Spectrum, Horizontal SSE ARS, and Upper and Lower Target Spectrum Bounds for Horizontal 2 Case With the Constant Scale Factor of 1.015 Applied	3JJ-50
3JJ-224a	Final Spectrum-Compatible Acceleration, Velocity, and Displacement Time Histories for Vertical Case Before Constant Scale Factor of 1.015 is Applied	3JJ-51
3JJ-224b	Comparison of Initial Seed Acceleration Normalized Arias Intensities Plot and Final Spectrum-Compatible Acceleration Normalized Arias Intensities Plot for Vertical Case Before Constant Scale Factor of 1.015 is Applied	3JJ-52
3JJ-224c	Comparison Between the Final Scaled Spectrum-Compatible Response Spectrum, Vertical SSE ARS, and Upper and Lower Target Spectrum Bounds for Vertical Case With the Constant Scale Factor of 1.015 Applied	3JJ-53
3JJ-225	5% Damping ARS at Ground Surface — Direction H1 — NI Site Condition	3JJ-54
3JJ-226	5% Damping ARS at Ground Surface — Direction H2 — NI Site Condition	3JJ-55
3JJ-227	5% Damping ARS at Ground Surface — Direction UP— NI Site Condition	3JJ-56
3JJ-228	5% Damping ARS at Ground Surface — Direction H1 — FAR Site Condition	3JJ-57
3JJ-229	5% Damping ARS at Ground Surface — Direction H2 — FAR Site Condition	3JJ-58

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3JJ-230	5% Damping ARS at Ground Surface — Direction UP — FAR Site Condition	3JJ-59
3JJ-231	Not Used	3JJ-60
3JJ-232	SSI Input “Within” Acceleration Time History — Direction H1 — NI Site Condition Time [sec]	3JJ-61
3JJ-233	SSI Input “Within” Acceleration Time History — Direction H2 — NI Site Condition Time [sec]	3JJ-62
3JJ-234	SSI Input “Within” Acceleration Time History — Direction UP — NI Site Condition Time [sec]	3JJ-63
3JJ-235	SSI Input “Within” Acceleration Time History — Direction H1 — FAR Site Condition Time [sec]	3JJ-64
3JJ-236	SSI Input “Within” Acceleration Time History — Direction H2 — FAR Site Condition Time [sec]	3JJ-65
3JJ-237	SSI Input “Within” Acceleration Time History — Direction UP — FAR Site Condition	3JJ-66
3JJ-238	5% Damped ARS for FIRS and RG 1.60 Scaled to a PGA of 0.1 g (Elevation –16 Foot Horizon at Bottom of Nuclear Island Foundation	3JJ-67
3JJ-239	Propagated Motion at Founding Level — NI Soil Column (Elevation –16-Foot Horizon at Bottom of Nuclear Island Foundation)	3JJ-68
3JJ-240	Propagated Motion at Foundation Level — FAR Soil Column (Elevation –16-Foot Horizon at Bottom of Nuclear-Island Foundation)...	3JJ-69
3JJ-241	Comparison of Best-Estimate S-Wave Velocity Profile for the FAR Profile Provided by the Three Sources (Upper 600 feet - below 600 feet is not shown)	3JJ-70
3JJ-242	Comparison of Best-Estimate S-Wave Velocity Profiles for the NI Profile Provided by the Three Sources (Upper 600 feet - below 600 feet is not shown)	3JJ-71
3JJ-243	Comparison of Logarithmic Standard Deviation of the S-Wave Velocity for the FAR Profile Provided by the Two Sources (Upper 600 feet - below 600 feet is not shown).....	3JJ-72
3JJ-244	Comparison of Logarithmic Standard Deviation of the S-Wave Velocity for the NI Profile Provided by the Three Sources (Upper 600 feet - below 600 feet is not shown).....	3JJ-73
3JJ-245	Nonlinear Curves for the Structural Fill	3JJ-74
3JJ-246	Nonlinear Curves for the Miami Limestone	3JJ-75
3JJ-247	Nonlinear Curves for Key Largo and Fort Thompson Formations.....	3JJ-76
3JJ-248	Nonlinear Curves for the Natural Soil (El. >-151 feet)	3JJ-77
3JJ-249	Nonlinear Curves for the Natural Soil (El. <-151 feet)	3JJ-78
3JJ-250	Surface ARS for the “Updated” Site Column with the HF4 Input Motion.....	3JJ-79
3JJ-251	Surface Site Amplification for the “Updated” Site Column with the HF4 Input Motion	3JJ-80
3JJ-252	Surface Site Amplification with the HF4 Input Motion	3JJ-81
3JJ-253	Corrective Ratio for the Surface Site Amplification for the FAR Site Column and the HF4 Input Motion	3JJ-82
3JJ-254	Surface Site Amplification with the LF5 Input Motion	3JJ-83

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3JJ-255	Corrective Ratio for the Surface Site Amplification for the FAR Site Column and the LF5 Input Motion	3JJ-84
3JJ-256	Sensitivity Surface Site Amplification for the FAR Site Column and the LF5 Input Motion	3JJ-85
3JJ-257	Sensitivity Surface ARS for the FAR Site Column and the LF5 Input Motion.....	3JJ-86
3JJ-258	Comparison of the Site Amplification for the NI Foundation Between the Sensitivity and the Initial Analyses (FAR Profile)	3JJ-87
3JJ-259	Comparison of the ARS for the NI Foundation Between the Sensitivity and the Initial Analysis (FAR Profile).....	3JJ-88
3JJ-260	Comparison of the Site Amplification for the NI Foundation Between the Sensitivity and the Initial Analysis (NI Profile)	3JJ-89
3JJ-261	Comparison of the ARS for the NI Foundation Between the Sensitivity and the Initial Analysis (NI Profile)	3JJ-90
3JJ-262	Comparison Between the NI FIRS Computed with the Sensitivity Analysis and the Initial Analysis (NI Profile)	3JJ-91
3JJ-263	Comparison of the Enveloped Site Amplification for the Surface DRS Between the Sensitivity and the Initial Analysis (FAR Profile)	3JJ-92
3JJ-264	Comparison of the Enveloped ARS for the Surface DRS Between the Sensitivity and the Initial Analysis (FAR Profile).....	3JJ-93
3JJ-265	Comparison of the Site Amplification for the Surface DRS Between the Sensitivity and the Initial Analysis (NI Profile)	3JJ-94
3JJ-266	Comparison of the ARS for the Surface DRS Between the Sensitivity and the Initial Analysis (NI profile).....	3JJ-95
3JJ-267	Comparison of the Enveloped Site Amplification for the Turbine Building FIRS Between the Sensitivity and Initial Analyses (FAR Profile)	3JJ-96
3JJ-268	Comparison of the Enveloped ARS for the Turbine Building FIRS Between the Sensitivity and Initial Analyses (FAR Profile)	3JJ-97
3JJ-269	Comparison of the Enveloped Site Amplification for the Turbine Building FIRS Between the Sensitivity and Initial Analyses (NI Profile)	3JJ-98
3JJ-270	Comparison of the Enveloped ARS for the Turbine Building FIRS Between the Sensitivity and the Initial Analysis (NI Profile)	3JJ-99
3JJ-271	Comparison of the Site Amplification for the GMRS Calculation Between the Sensitivity and the Initial Analysis	3JJ-100
3JJ-272	Comparison of the ARS for the GMRS Calculation Between the Sensitivity and the Initial Analysis	3JJ-101
3JJ-273	First Iteration of the Iterative RG 1.60 Process for the FAR Profile with “Updated” Properties.....	3JJ-102
3JJ-274	Tenth Iteration of the Iterative RG 1.60 Process for the FAR Profile with “Updated” Properties	3JJ-103
3JJ-275	Estimated Best-Estimate S-Wave Velocity Profile for the NI Profile for the RG 1.60 Motion	3JJ-104
3JJ-276	Estimated Best-Estimate P-wave Velocity Profile for the NI Profile for the RG 1.60 Motion	3JJ-105

LIST OF FIGURES (CONTINUED)

<u>Figure Number</u>	<u>Title</u>	<u>Page</u>
3JJ-277	Estimated Best-Estimate Damping Profile for the NI Profile for the RG 1.60 Motion	3JJ-106
3JJ-278	Estimated Best-Estimate S-Wave Velocity Profile for the FAR Profile ..	3JJ-107
3JJ-279	Estimated Best-Estimate P-Wave Velocity Profile for the FAR Profile ..	3JJ-108
3JJ-280	Estimated Best-Estimate Damping Profile for the FAR Profile	3JJ-109
3JJ-281	Estimated Best-Estimate S-Wave Velocity Profile for the NI Site Column for the Site-Specific Motion	3JJ-110
3JJ-282	Estimated Best-Estimate P-Wave Velocity Profile for the NI Site Column for the Site-Specific Motion	3JJ-111
3JJ-283	Estimated Best-Estimate Damping Profile for the NI Site Column for the Site-Specific Motion.....	3JJ-112
3JJ-284	Estimated Best-Estimate S-Wave Velocity Profile for the FAR Site Column for the Site-Specific Motion	3JJ-113
3JJ-285	Estimated Best-Estimate P-Wave Velocity Profile for the FAR Site Column for the Site-Specific Motion	3JJ-114
3JJ-286	Estimated Best-Estimate Damping Profile for the FAR Site Column for the Site-Specific Motion	3JJ-115