

# NORTH ANNA 3 FSER

## TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION AND INTERFACES.....</b>	<b>1-1</b>
1.1	Summary of Application.....	1-1
1.2	Regulatory Basis.....	1-4
	1.2.1 Applicable Regulations .....	1-4
	1.2.2 Finality of Referenced NRC Approvals.....	1-5
	1.2.3 Overview of the Design-Centered Review Approach.....	1-7
1.3	Principal Review Matters.....	1-8
1.4	Staff Review of North Anna 3 COL FSAR Chapter 1.....	1-11
	1.4.1 Introduction.....	1-11
	1.4.2 Summary of Application.....	1-11
	1.4.3 Regulatory Basis.....	1-19
	1.4.4 Technical Evaluation.....	1-20
	1.4.5 Post Combined License Activities.....	1-33
	1.4.6 Conclusion.....	1-34
1.5	Additional Regulatory Requirements.....	1-34
	1.5.1 Financial Qualifications.....	1-34
	1.5.1.1 Introduction.....	1-34
	1.5.1.2 Regulatory Evaluation.....	1-34
	1.5.1.3 Financial Qualifications.....	1-35
	1.5.1.4 Operating License.....	1-38
	1.5.1.5 Decommissioning Funding Assurance.....	1-39
	1.5.1.6 Antitrust.....	1-40
	1.5.1.7 Foreign Ownership, Control, or Domination.....	1-40
	1.5.1.8 Nuclear Insurance & Indemnity.....	1-40
	1.5.1.9 Conclusion.....	1-43
	1.5.2 Nuclear Waste Policy Act.....	1-43
	1.5.3 Consultation with Department of Homeland Security and Notifications.....	1-43
	1.5.4 Exemptions Associated SNM Control and Accounting (MC&A) Program.....	1-44
	1.5.5 Receipt, Possession, and Use of Source, Byproduct, and SNM....	1-45
	1.5.5.1 Introduction.....	1-45
	1.5.5.2 Parts 30, 40, and 70 License Requests.....	1-46
	1.5.5.3 Parts 30, 40, 70 License Request Clarifications.....	1-46
	1.5.5.4 Exemptions from Part 70 License Request.....	1-46
	1.5.5.5 Parts 30, 40, and 70 Materials and Use Clarifications.....	1-46
	1.5.5.6 Parts 30, 40, and 70 License Conditions.....	1-48
	1.5.5.7 Operational Programs to Support 10 CFR Parts 30, 40, and 70.....	1-50
	1.5.5.8 Part 70 License Staff Review.....	1-50
	1.5.5.9 Parts 30 and 40 License Staff Review.....	1-65
	1.5.5.10 Part 37 Staff Review.....	1-70
	1.5.5.11 Conclusion.....	1-70
<b>2.0</b>	<b>SITE CHARACTERISTICS.....</b>	<b>2-1</b>
2.0	North Anna 3 Site.....	2-1
	2.0.1 Introduction.....	2-1
	2.0.2 Summary of Application.....	2-1
	2.0.3 Regulatory Basis.....	2-3

2.0.4	Technical Evaluation.....	2-3
2.0.5	Post Combined License Activities.....	2-5
2.0.6	Conclusion.....	2-6
2.1	Geography and Demography.....	2-6
2.1.1	Introduction.....	2-6
2.1.2	Summary of Application.....	2-6
2.1.3	Regulatory Basis.....	2-7
2.1.4	Technical Evaluation.....	2-10
2.1.5	Post Combined License Activities.....	2-12
2.1.6	Conclusion.....	2-12
2.2	Nearby Industrial, Transportation, and Military Facilities.....	2-13
2.2.1	Locations and Routes.....	2-13
2.2.2	Descriptions.....	2-13
2.2.3	Evaluation of Potential Accidents.....	2-16
2.3	Meteorology.....	2-23
2.3.1	Regional Climatology.....	2-24
2.3.2	Local Meteorology.....	2-32
2.3.3	Onsite Meteorological Measurement Programs.....	2-35
2.3.4	Short-Term Diffusion Estimates (Chapter 2, C.I.2.3.4).....	2-37
2.3.5	Long-Term Diffusion Estimates (Chapter 2, C.I.2.3.5).....	2-42
2.4	Hydrology.....	2-48
2.4.1	Hydrologic Description.....	2-48
2.4.2	Floods.....	2-55
2.4.3	Probable Maximum Flood on Streams and Rivers.....	2-79
2.4.4	Potential Dam Failures.....	2-83
2.4.5	Probable Maximum Surge and Seiche Flooding.....	2-87
2.4.6	Probable Maximum Tsunami Hazards.....	2-87
2.4.7	Ice Effects.....	2-88
2.4.8	Cooling Water Canals and Reservoirs.....	2-90
2.4.9	Channel Diversions.....	2-93
2.4.10	Flooding Protection Requirements.....	2-94
2.4.11	Low Water Considerations.....	2-97
2.4.12	Groundwater.....	2-101
2.4.13	Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters.....	2-117
2.4.14	Technical Specification and Emergency Operation Requirements.....	2-126
2.5	Geology, Seismology, and Geotechnical Engineering.....	2-130
2.5.1	Basic Geologic and Seismic Information.....	2-130
2.5.2	Vibratory Ground Motion.....	2-157
2.5.3	Surface Faulting.....	2-184
2.5.4	Stability of Subsurface Materials and Foundations.....	2-190
2.5.5	Stability of Slopes.....	2-238
2.5.6	Embankments and Dams.....	2-251
<b>3.0</b>	<b>DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS.....</b>	<b>3-1</b>
3.1	Conformance with NRC General Design Criteria.....	3-1
3.2	Classification of Structures, Systems and Components.....	3-1

3.2.1	Introduction.....	3-1
3.2.2	Summary of Application.....	3-2
3.2.3	Regulatory Basis.....	3-3
3.2.4	Technical Evaluation.....	3-5
3.2.5	Post Combined License Activities.....	3-11
3.2.6	Conclusion.....	3-11
3.3	Wind and Tornado Loadings.....	3-11
3.3.1	Introduction.....	3-11
3.3.2	Summary of Application.....	3-12
3.3.3	Regulatory Basis.....	3-12
3.3.4	Technical Evaluation.....	3-12
3.3.5	Post Combined License Activities.....	3-13
3.3.6	Conclusion.....	3-13
3.4	Water Level (Flood) Design.....	3-13
3.5	Missile Protection.....	3-14
3.5.1	Introduction.....	3-14
3.5.2	Summary of Application.....	3-14
3.5.3	Regulatory Basis.....	3-15
3.5.4	Technical Evaluation.....	3-15
3.5.5	Post Combined License Activities.....	3-17
3.5.6	Conclusion.....	3-17
3.6	Dynamic Effects Associated with the Postulated Rupture of Piping .....	3-18
3.7	Seismic Design.....	3-18
3.7.1	Seismic Design Parameters.....	3-18
3.7.2	Seismic System Analysis.....	3-40
3.7.3	Seismic Subsystem Analysis.....	3-78
3.7.4	Seismic Instrumentation.....	3-81
3.7.5	Site-Specific Information.....	3-87
3.8	Seismic Category I Structures.....	3-89
3.8.1	Concrete Containment.....	3-89
3.8.2	Steel Components of the Reinforced Concrete Containment.....	3-101
3.8.3	Concrete and Steel Internal Structures of the Concrete Containment.....	3-108
3.8.4	Other Seismic Category I Structures.....	3-113
3.8.5	Foundations.....	3-136
3.9	Mechanical Systems and Components.....	3-150
3.9.1	Introduction.....	3-150
3.9.2	Summary of Application.....	3-150
3.9.3	Regulatory Basis.....	3-154
3.9.4	Technical Evaluation.....	3-155
3.9.5	Post Combined License Activities.....	3-167
3.9.6	Conclusion.....	3-175
3.10	Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.....	3-176
3.10.1	Introduction.....	3-176
3.10.2	Summary of Application.....	3-177
3.10.3	Regulatory Basis.....	3-177

	3.10.4	Technical Evaluation.....	3-178
	3.10.5	Post Combined License Activities.....	3-179
	3.10.6	Conclusion.....	3-180
3.11		Environmental Qualification of Mechanical and Electrical Equipment.....	3-180
	3.11.1	Introduction.....	3-180
	3.11.2	Summary of Application.....	3-181
	3.11.3	Regulatory Basis.....	3-181
	3.11.4	Technical Evaluation.....	3-183
	3.11.5	Post Combined License Activities.....	3-186
	3.11.6	Conclusion.....	3-187
3.12		Piping Design Review.....	3-187
	3.12.1	Introduction.....	3-187
	3.12.2	Summary of Application.....	3-187
	3.12.3	Regulatory Basis.....	3-188
	3.12.4	Technical Evaluation.....	3-188
	3.12.5	Post Combined License Activities.....	3-189
	3.12.6	Conclusion.....	3-189
3.13		Threaded Fasteners – ASME BPV Code Class 1, 2 and 3.....	3-189
	3.13.1	Introduction.....	3-189
	3.13.2	Summary of Application.....	3-189
	3.13.3	Regulatory Basis.....	3-190
	3.13.4	Technical Evaluation.....	3-191
	3.13.5	Post Combined License Activities.....	3-192
	3.13.6	Conclusion.....	3-192
<b>4.0</b>		<b>REACTOR.....</b>	<b>4-1</b>
	4.1	Introduction.....	4-1
	4.2	Summary of Application.....	4-1
	4.3	Regulatory Basis.....	4-1
	4.4	Technical Evaluation.....	4-2
	4.5	Post Combined License Activities.....	4-7
	4.6	Conclusion.....	4-7
<b>5.0</b>		<b>REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS.....</b>	<b>5-1</b>
	5.1	Summary Description.....	5-1
	5.2	Integrity of Reactor Coolant Pressure Boundary.....	5-1
	5.2.1	Compliance with Codes and Code Cases.....	5-1
	5.2.2	Overpressure Protection.....	5-6
	5.2.3	Reactor Coolant Pressure Boundary Materials.....	5-6
	5.2.4	Preservice and In-service Inspection and Testing of Reactor Coolant Pressure Boundary.....	5-6
	5.2.5	Reactor Coolant Pressure Boundary Leakage Detection.....	5-11
	5.3	Reactor Vessel.....	5-14
	5.3.1	Reactor Vessel Materials.....	5-14
	5.3.2	Pressure-Temperature Limits.....	5-18
	5.3.3	Reactor Vessel Integrity.....	5-26
	5.4	Reactor Coolant System Component and Subsystem Design.....	5-27

5.4.1	Introduction.....	5-27
5.4.2	Summary of Application.....	5-27
5.4.3	Regulatory Basis.....	5-28
5.4.4	Technical Evaluation.....	5-28
5.4.5	Post Combined License Activities.....	5-29
5.4.6	Conclusion.....	5-29
<b>6.0</b>	<b>ENGINEERED SAFETY FEATURES.....</b>	<b>6-1</b>
6.1	Design Basis Accident Engineered Safety Feature Materials.....	6-1
6.2	Containment Systems.....	6-1
6.3	Emergency Core Cooling System.....	6-2
6.4	Control Room Habitability Systems.....	6-2
6.4.1	Introduction.....	6-2
6.4.2	Summary of Application.....	6-2
6.4.3	Regulatory Basis.....	6-3
6.4.4	Technical Evaluation.....	6-4
6.4.5	Post Combined License Activities.....	6-7
6.4.6	Conclusion.....	6-7
6.5	Atmospheric Cleanup Systems.....	6-8
6.6	Preservice and IST of Class 2 and 3 Components and Piping.....	6-8
6.6.1	Introduction.....	6-8
6.6.2	Summary of Application.....	6-8
6.6.3	Regulatory Basis.....	6-10
6.6.4	Technical Evaluation.....	6-10
6.6.5	Post Combined Operating License Activities.....	6-13
6.6.6	Conclusion.....	6-14
<b>7.0</b>	<b>INSTRUMENTATION AND CONTROL SYSTEMS.....</b>	<b>7-1</b>
<b>8.0</b>	<b>ELECTRIC POWER.....</b>	<b>8-1</b>
8.1	Introduction.....	8-1
8.1.1	Introduction.....	8-1
8.1.2	Summary of Application.....	8-1
8.1.3	Regulatory Basis.....	8-2
8.1.4	Technical Evaluation.....	8-2
8.1.5	Post Combined License Activities.....	8-9
8.1.6	Conclusion.....	8-9
8.2	Offsite Power System.....	8-9
8.2.1	Introduction.....	8-9
8.2.2	Summary of Application.....	8-10
8.2.3	Regulatory Basis.....	8-12
8.2.4	Technical Evaluation.....	8-12
8.2.5	Post Combined License Activities.....	8-30
8.2.6	Conclusion.....	8-30
8.3	Onsite Power Systems.....	8-30
8.3.1	AC Power System.....	8-30
8.3.2	DC Power Systems.....	8-33

8.4	Station Blackout.....	8-38
<b>9.0</b>	<b>AUXILIARY SYSTEMS.....</b>	<b>9-1</b>
9.1	Fuel Storage and Handling.....	9-1
9.1.1	New Fuel Storage.....	9-1
9.1.2	Spent Fuel Storage.....	9-2
9.1.3	Spent Fuel Cooling and Cleanup System.....	9-2
9.1.4	Light Load Handling System (Related to Refueling).....	9-3
9.1.5	Overhead Heavy Load Handling System.....	9-6
9.2	Water Systems.....	9-11
9.2.1	Plant Service Water System.....	9-11
9.2.2	Reactor Component Cooling Water System.....	9-21
9.2.3	Makeup Water System.....	9-22
9.2.4	Potable and Sanitary Water Systems.....	9-24
9.2.5	Ultimate Heat Sink.....	9-27
9.2.6	Condensate Storage and Transfer System.....	9-30
9.2.7	Chilled Water System.....	9-32
9.2.8	Turbine Component Cooling Water System.....	9-33
9.2.9	Hot Water System.....	9-33
9.2.10	Station Water System.....	9-33
9.3	Process Auxiliaries.....	9-36
9.3.1	Compressed Air Systems.....	9-36
9.3.2	Process Sampling System.....	9-36
9.3.3	Equipment and Floor Drain System.....	9-39
9.3.4	Chemical and Volume Control System.....	9-40
9.3.5	Standby Liquid Control System.....	9-40
9.3.6	Instrument Air System.....	9-43
9.3.7	Service Air System.....	9-43
9.3.8	High Pressure Nitrogen Supply System.....	9-43
9.3.9	Hydrogen Water Chemistry System.....	9-43
9.3.10	Oxygen Injection System.....	9-47
9.3.11	Zinc Injection System.....	9-49
9.3.12	Auxiliary Boiler System.....	9-51
9.4	Heating, Ventilation, and Air Conditioning.....	9-52
9.5	Other Auxiliary Systems.....	9-52
9.5.1	Fire Protection System.....	9-52
9.5.2	Communication Systems.....	9-64
9.5.3	Lighting System.....	9-71
9.5.4	Diesel Generator Fuel Oil Storage and Transfer System.....	9-72
9.5.5	Diesel Generator Jacket Cooling Water System.....	9-75
9.5.6	Diesel Generator Starting Air System.....	9-76
9.5.7	Diesel Generator Lubrication System.....	9-76
9.5.8	Diesel Generator Combustion Air Intake and Exhaust System.....	9-76
<b>10.0</b>	<b>STEAM AND POWER CONVERSION SYSTEM.....</b>	<b>10-1</b>
10.1	Summary Description.....	10-1
10.2	Turbine Generator.....	10-1

10.2.1	Introduction.....	10-1
10.2.2	Summary of Application.....	10-1
10.2.3	Regulatory Basis.....	10-2
10.2.4	Technical Evaluation.....	10-3
10.2.5	Post Combined License Activities.....	10-11
10.2.6	Conclusion.....	10-11
10.3	Turbine Main Steam System.....	10-12
10.4	Other Features of Steam and Power Conversion System.....	10-12
10.4.1	Main Condenser.....	10-13
10.4.2	Main Condenser Evacuation System.....	10-13
10.4.3	Turbine Gland Seal System.....	10-13
10.4.4	Turbine Bypass System.....	10-13
10.4.5	Circulating Water System.....	10-13
10.4.6	Condensate Purification System.....	10-18
10.4.7	Condensate and Feedwater System.....	10-20
<b>11.0</b>	<b>RADIOACTIVE WASTE MANAGEMENT.....</b>	<b>11-1</b>
11.1	Source Terms.....	11-1
11.2	Liquid Waste Management System.....	11-1
11.2.1	Introduction.....	11-1
11.2.2	Summary of Application.....	11-2
11.2.3	Regulatory Basis.....	11-4
11.2.4	Technical Evaluation.....	11-5
11.2.5	Post Combined License Activities.....	11-14
11.2.6	Conclusion.....	11-14
11.3	Gaseous Waste Management System.....	11-15
11.3.1	Introduction.....	11-15
11.3.2	Summary of Application.....	11-15
11.3.3	Regulatory Basis.....	11-16
11.3.4	Technical Evaluation.....	11-16
11.3.5	Post Combined License Activities.....	11-17
11.3.6	Conclusion.....	11-18
11.4	Solid Waste Management System.....	11-18
11.4.1	Introduction.....	11-18
11.4.2	Summary of Application.....	11-19
11.4.3	Regulatory Basis.....	11-21
11.4.4	Technical Evaluation.....	11-21
11.4.5	Post Combined License Activities.....	11-26
11.4.6	Conclusion.....	11-27
11.5	Process Radiation Monitoring System.....	11-27
11.5.1	Introduction.....	11-27
11.5.2	Summary of Application.....	11-28
11.5.3	Regulatory Basis.....	11-29
11.5.4	Technical Evaluation.....	11-30
11.5.5	Post Combined License Activities.....	11-32
11.5.6	Conclusion.....	11-33

<b>12.0</b>	<b>RADIATION PROTECTION</b> .....	<b>12-1</b>
12.1	Exposures are As Low As Is Reasonably Achievable.....	12-1
	12.1.1 Introduction.....	12-1
	12.1.2 Summary of Application.....	12-1
	12.1.3 Regulatory Basis.....	12-2
	12.1.4 Technical Evaluation.....	12-3
	12.1.5 Post Combined License Activities.....	12-7
	12.1.6 Conclusion.....	12-8
12.2	Plant Sources.....	12-8
	12.2.1 Introduction.....	12-8
	12.2.2 Summary of Application.....	12-9
	12.2.3 Regulatory Basis.....	12-12
	12.2.4 Technical Evaluation.....	12-13
	12.2.5 Post Combined License Activities.....	12-29
	12.2.6 Conclusion.....	12-29
12.3	Radiation Protection Design Features.....	12-30
	12.3.1 Introduction.....	12-30
	12.3.2 Summary of Application.....	12-30
	12.3.3 Regulatory Basis.....	12-32
	12.3.4 Technical Evaluation.....	12-32
	12.3.5 Post Combined License Activities.....	12-39
	12.3.6 Conclusion.....	12-39
12.4	Dose Assessment.....	12-40
	12.4.1 Introduction.....	12-40
	12.4.2 Summary of Application.....	12-40
	12.4.3 Regulatory Basis.....	12-40
	12.4.4 Technical Evaluation.....	12-40
	12.4.5 Post Combined License Activities.....	12-45
	12.4.6 Conclusion.....	12-45
12.5	Operational Radiation Protection Program.....	12-46
	12.5.1 Introduction.....	12-46
	12.5.2 Summary of Application.....	12-46
	12.5.3 Regulatory Basis.....	12-47
	12.5.4 Technical Evaluation.....	12-47
	12.5.5 Post Combined License Activities.....	12-51
	12.5.6 Conclusion.....	12-52
<b>13.0</b>	<b>CONDUCT OF OPERATIONS</b> .....	<b>13-1</b>
13.1	Organizational Structure of Applicant.....	13-1
	13.1.1 Introduction.....	13-1
	13.1.2 Summary of Application.....	13-1
	13.1.3 Regulatory Basis.....	13-2
	13.1.4 Technical Evaluation.....	13-2
	13.1.5 Post-Combined License Activities.....	13-7
	13.1.6 Conclusions.....	13-7
13.2	Training.....	13-8
	13.2.1 Introduction.....	13-8



	13.2.2 Summary of Application.....	13-8
	13.2.3 Regulatory Basis.....	13-9
	13.2.4 Technical Evaluation.....	13-9
	13.2.5 Post Combined License Activities.....	13-13
	13.2.6 Conclusion.....	13-13
13.3	Emergency Planning.....	13-13
	13.3.1 Introduction.....	13-13
	13.3.2 Summary of Application.....	13-16
	13.3.3 Regulatory Basis.....	13-20
	13.3.4 Technical Evaluation.....	13-21
	13.3.5 Post-Combined License Activities.....	13-80
	13.3.6 Conclusions.....	13-82
13.4	Operational Program Implementation.....	13-100
	13.4.1 Introduction.....	13-100
	13.4.2 Summary of Application.....	13-100
	13.4.3 Regulatory Basis.....	13-100
	13.4.4 Technical Evaluation.....	13-101
	13.4.5 Post Combined License Activities.....	13-102
	13.4.6 Conclusion.....	13-102
13.5	Plant Procedures.....	13-102
	13.5.1 Administrative Procedures.....	13-102
	13.5.2 Operating and Maintenance Procedures.....	13-114
13.6	Physical Security.....	13-130
	13.6.1 Introduction.....	13-130
	13.6.2 Summary of Application.....	13-130
	13.6.3 Regulatory Basis.....	13-134
	13.6.4 Technical Evaluation.....	13-136
	13.6.5 Post Combined License Activities.....	13-194
	13.6.6 Conclusions.....	13-195
	13.6A Site-Specific Inspection, Test, Analysis, for Physical Security.....	13-196
	13.6A.1 Introduction.....	13-196
	13.6A.2 Summary of Application.....	13-196
	13.6A.3 Regulatory Basis.....	13-197
	13.6A.4 Technical Evaluation.....	13-199
	13.6A.5 Post-Combined License Activities.....	13-206
	13.6A.6 Conclusions.....	13-206
13.7	Fitness for Duty.....	13-214
	13.7.1 Introduction.....	13-214
	13.7.2 Summary of Application.....	13-214
	13.7.3 Regulatory Basis.....	13-215
	13.7.4 Technical Evaluation.....	13-215
	13.7.5 Post Combined License Activities.....	13-220
	13.7.6 Conclusion.....	13-220
13.8	Cyber Security.....	13-220
	13.8.1 Introduction.....	13-220
	13.8.2 Summary of Application.....	13-220

13.8.3	Regulatory Basis.....	13-221
13.8.4	Technical Evaluation.....	13-221
13.8.5	Post Combined License Activities.....	13-228
13.8.6	Conclusion.....	13-228
<b>14.0</b>	<b>INITIAL TEST PROGRAM.....</b>	<b>14-1</b>
14.1	Initial Test Program for Preliminary Safety Analysis Reports.....	14-1
14.2	Initial Plant Test Program for Final Safety Analysis Reports .....	14-2
14.2.1	Introduction.....	14-2
14.2.2	Summary of Application.....	14-2
14.2.3	Regulatory Basis.....	14-4
14.2.4	Technical Evaluation.....	14-4
14.2.5	Post Combined License Activities.....	14-20
14.2.6	Conclusion.....	14-22
14.3	Inspections, Tests, Analyses, and Acceptance Criteria.....	14-23
14.3.1	Introduction.....	14-23
14.3.2	Summary of Application.....	14-23
14.3.3	Regulatory Basis.....	14-24
14.3.4	Technical Evaluation.....	14-24
14.3.5	Post-Combined License Activities.....	14-29
14.3.6	Conclusion.....	14-30
<b>15.0</b>	<b>SAFETY ANALYSES.....</b>	<b>15-1</b>
15.1	Introduction.....	15-1
15.2	Summary of Application.....	15-1
15.3	Regulatory Basis.....	15-2
15.4	Technical Evaluation.....	15-2
15.5	Post-Combined License Activities.....	15-7
15.6	Conclusion.....	15-7
<b>16.0</b>	<b>TECHNICAL SPECIFICATIONS.....</b>	<b>16-1</b>
16.1	Introduction.....	16-1
16.2	Summary of Application.....	16-1
16.3	Regulatory Basis.....	16-7
16.4	Technical Evaluation.....	16-9
16.5	Post Combined License Activities.....	16-18
16.6	Conclusion.....	16-18
<b>17.0</b>	<b>QUALITY ASSURANCE.....</b>	<b>17-1</b>
17.0.1	Introduction.....	17-1
17.0.2	Summary of Application.....	17-1
17.0.3	Regulatory Basis.....	17-1
17.0.4	Technical Evaluation.....	17-1
17.0.5	Post Combined License Activities.....	17-2
17.0.6	Conclusion.....	17-2
17.1	Quality Assurance During Design.....	17-2
17.1.1	Introduction.....	17-2

17.1.2	Summary of Application.....	17-3
17.1.3	Regulatory Basis.....	17-3
17.1.4	Technical Evaluation.....	17-3
17.1.5	Post Combined License Activities.....	17-4
17.1.6	Conclusion.....	17-4
17.2	Quality Assurance During Construction and Operations.....	17-4
17.2.1	Introduction.....	17-4
17.2.2	Summary of Application.....	17-4
17.2.3	Regulatory Basis.....	17-5
17.2.4	Technical Evaluation.....	17-5
17.2.5	Post Combined License Activities.....	17-6
17.2.6	Conclusion.....	17-6
17.3	Quality Assurance Program Description.....	17-6
17.3.1	Introduction.....	17-6
17.3.2	Summary of Application.....	17-6
17.3.3	Regulatory Basis.....	17-6
17.3.4	Technical Evaluation.....	17-7
17.3.5	Post Combined License Activities.....	17-7
17.3.6	Conclusion.....	17-7
17.4	Reliability Assurance Program During Design Phase.....	17-8
17.4.1	Introduction.....	17-8
17.4.2	Summary of Application.....	17-8
17.4.3	Regulatory Basis.....	17-10
17.4.4	Technical Evaluation.....	17-10
17.4.5	Post Combined License Activities.....	17-12
17.4.6	Conclusion.....	17-12
17.5	Quality Assurance Program Description – Design Certification, Early Site Permits, and New License Applicants.....	17-13
17.5.1	Introduction.....	17-13
17.5.2	Summary of Application.....	17-13
17.5.3	Regulatory Basis.....	17-14
17.5.4	Technical Evaluation.....	17-14
17.5.5	Post Combined License Activities.....	17-34
17.5.6	Conclusion.....	17-34
17.6	Maintenance Rule Program.....	17-35
17.6.1	Introduction.....	17-35
17.6.2	Summary of Application.....	17-35
17.6.3	Regulatory Basis.....	17-36
17.6.4	Technical Evaluation.....	17-36
17.6.5	Post Combined License Activities.....	17-38
17.6.6	Conclusion.....	17-38
<b>18.0</b>	<b>HUMAN FACTORS ENGINEERING.....</b>	<b>18-1</b>
18.1	Introduction.....	18-1
18.2	Summary of Application.....	18-1
18.3	Regulatory Basis.....	18-1
18.4	Technical Evaluation.....	18-1

18.5	Post Combined License Activities.....	18-2
18.6	Conclusion.....	18-2
<b>19.0</b>	<b>PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENTS.....</b>	<b>19-1</b>
19.1	Introduction.....	19-1
19.2	PRA Results and Insights.....	19-2
19.2.1	Introduction.....	19-2
19.2.2	Summary of Application.....	19-2
19.2.3	Regulatory Basis.....	19-3
19.2.4	Technical Evaluation.....	19-4
19.2.5	Post-Combined License Activities.....	19-7
19.2.6	Conclusion.....	19-7
19.3	Severe Accident Evaluation.....	19-7
19.4	PRA Maintenance.....	19-7
19.5	Conclusions.....	19-8
19.5.1	Introduction.....	19-8
19.5.2	Summary of Application.....	19-8
19.5.3	Regulatory Basis.....	19-8
19.5.4	Technical Evaluation.....	19-8
19.5.5	Post Combined License Activities.....	19-9
19.5.6	Conclusion.....	19-9
Appendix 19A	Regulatory Treatment of Non-Safety Systems (RTNSS).....	19-10
Appendix 19ACM	Availability Controls Manual.....	19-15
Appendix 19B	Deterministic Analysis for Containment Pressure Capability.....	19-16
Appendix 19C	Probabilistic Analysis for Containment Pressure Fragility.....	19-16
Appendix 19D	Assessment of Malevolent Aircraft Impact.....	19-16
Appendix 19AA	Summary of Plant-Specific PRA Review.....	19-16
19AA.1	Introduction.....	19-16
19 AA.2	Summary of Application.....	19-16
19AA.3	Regulatory Basis.....	19-17
19AA.4	Technical Evaluation.....	19-17
19AA.5	Post-Combined License Activities.....	19-21
19AA.6	Conclusion.....	19-21
 <b>ATTACHMENT 19.A LOSS OF LARGE AREAS OF THE PLANT</b>		
<b>DUE TO EXPLOSIONS OR FIRES.....</b>		<b>19.A-1</b>
19.A.1	Introduction.....	19A-1
19.A.2	Summary of Application.....	19A-1
19.A.3	Regulatory Basis.....	19A-2
19.A.4	Technical Evaluation.....	19A-2
19.A.5	Post Combined License Activities.....	19A-3
19.A.6	Conclusion.....	19A-4
 <b>20.0 REQUIREMENTS RESULTING FROM FUKUSHIMA</b>		
<b>NEAR-TERM TASK FORCE RECOMMENDATIONS.....</b>		<b>20-1</b>
20.1	Mitigation Strategies for Beyond-Design-Basis External Events.....	20-4
20.1.1	Introduction.....	20-5
20.1.2	Summary of Application.....	20-5

	20.1.3 Regulatory Basis.....	20-7
	20.1.4 Technical Evaluation.....	20-8
	20.1.5 Post Combined License Activities.....	20-13
	20.1.6 Conclusion.....	20-14
20.2	Recommendation 7.1, Reliable Spent Fuel Pool Instrumentation.....	20-14
	20.2.1 Introduction.....	20-15
	20.2.2 Summary of Application.....	20-15
	20.2.3 Regulatory Basis.....	20-16
	20.2.4 Technical Evaluation.....	20-17
	20.2.5 Post Combined License Activities.....	20-23
	20.2.6 Conclusion.....	20-24
20.3	Recommendation 9.3, Emergency Preparedness.....	20-24
	20.3.1 Introduction.....	20-24
	20.3.2 Summary of Application.....	20-24
	20.3.3 Regulatory Basis.....	20-24
	20.3.4 Technical Evaluation.....	20-25
	20.3.5 Post Combined License Activities.....	20-26
	20.3.6 Conclusion.....	20-26

## **APPENDICES**

- APPENDIX A. POST COMBINED LICENSE ACTIVITIES -- LICENSE CONDITIONS, INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA, AND FINAL SAFETY ANALYSIS REPORT COMMITMENTS.
- APPENDIX B. CHRONOLOGY OF COMBINED LICENSE APPLICATION FOR NORTH ANNA 3
- APPENDIX C. ELECTRONIC REQUEST FOR ADDITIONAL INFORMATION DATABASE.
- APPENDIX D. REFERENCES
- APPENDIX E. PRINCIPAL CONTRIBUTORS
- APPENDIX F. REPORT BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

## LIST OF TABLES

Table 1-1	Non-Fuel Special Nuclear Material for Use .....	1-48
Table 2.4.2-1	Local intense precipitation depths for durations less than 6 hours and over a 2.59-km <sup>2</sup> (1-mi <sup>2</sup> ) area. (Derived from ESP SSAR Table 2.4-3) .....	2-59
Table 2.4.2-2	Subbasin characteristics used to estimate discharge during the local intense Precipitation. (Derived from COL FSAR Tables 2.4-201, 2.4-202, and 2.4-203 .....	2-61
Table 2.4.12.1	Average and minimum porosity for soil samples with percentage of gravel greater than and less than 10 percent. ....	2-109
Table 2.5.2-1	Mean Magnitude and Distance for LF and HF Response Spectra for three MAFEs (Table 2.5.2-218, Rev 9) .....	2-167
Table 2.5.4-1	Properties of NAPS 3 Site Subsurface Materials (FSAR Table 2.5.4-208).....	2-199
Table 2.5.4-2	Estimated Settlements Structures (FSAR Table 2.5.4-212).....	2-215
Table 12.2.4-1	Site-Specific Gaseous Effluent Doses.....	12-18
Table 12.2.4-2	Estimated Site Gaseous and Liquid Effluent Doses.....	12-21
Table 12.2.4-3	Site-Specific Liquid Effluent Doses.....	12-26
Table 13.3-1	North Anna 3 ITAAC .....	13-84
Table 2.2.1-1	ITAAC for the Site-Specific Physical Security.....	13-208
Table 13.4-201	Operations Programs Required by NRC Regulations and Program Implementation .....	13-217
Table 16.1	Site-Specific Information to Resolve COL Item 16.0-1-A .....	16-3
Table 16.2	Battery Cell Parameters.....	16-13

## LIST OF FIGURES

Figure 2.4.2-1	Site map with locations of drainage basins and primary hydraulic features of the drainage system flooding analysis from local intense precipitation (FSAR Figure 2.4-201) .....	2-64
Figure 2.4.2-2	Site map with locations of the inline control structures that correspond to blocked culverts (North Anna 3 COL FSAR Figure 2.4-203) .....	2-65
Figure 2.4.2-3	Site map with locations of supercritical flow and of hydraulic jumps from the applicant’s HEC RAS model and North Anna 3 COL FSAR Figure 2.4 221 (after North Anna 3 COL FSAR Figure 2.4-203).....	2-66
Figure 2.4.2-4	HEC-RAS schematic of the channel geometry derived from input files provided by the COL applicant.....	2-67
Figure 2.4.12-1	NAPS Unit 3 groundwater head observations on 5/30/2007 as a function of ground surface elevation at the well.....	2-114
Figure 2.4.12-2	Water levels for the USGS Louisa County well and NAPS Unit 3 well OW-842.....	2-116
Figure 2.5.1-1	NAPS site region with seismotectonic source zones and the August 2011 Mineral, Virginia, earthquake (from FSAR Figure 2.5.1-202, Rev. 8) .....	2-133
Figure 2.5.1-2	August 2011 Mineral, VA, earthquake aftershocks map and cross-sections illustrating subsurface rupture plane (from McNamara et al. (2014) from FSAR Figure 2.5.1-209, Rev. 9.....	2-135
Figure 2.5.1-3	Recent geologic map (Burton et al. [2014]) and aftershocks (McNamara et al. 2014) in the 2011 Mineral, VA, earthquake epicentral area within 25 miles of the NAPS site (from FSAR Figure 2.5.1-210C, Rev. 9) .....	2-144
Figure 2.5.1-4	NAPS Geologic Field Reconnaissance after the 2011 Mineral, VA, earthquake showing traverse routes, waypoints and the LiDAR survey boundary.....	2-148
Figure 2.5.1-5	LiDAR-Derived Relief Map of the 2011 Mineral, VA, Earthquake Vicinity (from FSAR Figure 2.5.1-212A, Rev 9).....	2-145



Figure 2.5.1-6	Stream and Ridge Topographic Profiles FSAR Figure 2.5.1-216, Rev 9.0. ....	2-146
Figure 2.5.1-7	South Anna River Profile Showing Geology of Burton et al. (2014) from FSAR Figure 2.5.1-223, Rev. 9 .....	2-150
Figure 2.5.1-8	Stream Profiles with Geology of Burton et al. (2014) from FSAR Figure 2.5.1-217 and -219, Rev. 9 .....	2-151
Figure 2.5.2-1	Map Showing the COL Applicant’s Updated Seismicity Catalog for the CEUS-SSC Region (FSAR Figure 2.5.2-202, Rev. 8).....	2-160
Figure 2.5.2-2	Map Showing the CEUS-SSC Seismotectonic Zones for One of the Four Alternative Models for the MidC Seismotectonic Zone (FSAR Figure 2.5.2-215, Rev. 8).....	2-163
Figure 2.5.2-3	Map Showing the Repeated Large Magnitude Earthquake(RLME) Sources in the CEUS-SSC Model (FSAR Figure 2.5.2-218, Rev. 8) .....	2-164
Figure 2.5.2-4	Deaggregation Results for LF (Upper) and HF (Lower) at the 10 <sup>-4</sup> Mean Annual Frequency of Exceedance Level (Figure 2.5.2-250 and Figure 2.5.2-251, Rev.9) .....	2-168
Figure 2.5.2-5	Input Shear-wave Velocity Profiles for the RB/FB and CB Buildings Used for Site Response Calculations (FSAR Figure 2.5.2-259, Rev. 8).....	2-171
Figure 2.5.2-6	Horizontal and Vertical GMRS for the North Anna 3 Site at Elevation 68.28 m (224 ft) (FSAR Figure 2.5.2-313, Rev. 9).....	2-173
Figure 2.5.2-7	Map of Changes in Seismicity Rates and B-Values for CEUS- SSC Source Zone ECC-AM, Case A (Figure from Applicant Response to RAI 2.5.2-7.).....	2-178
Figure 2.5.2-8	Comparison of the Applicant’s Base Rock Hazard Curves with the Results of the Staff’s Confirmatory Analysis.....	2-179
Figure 2.5.2-9	Comparison of the Applicant’s UHRS at the 10 <sup>-4</sup> and 10 <sup>-5</sup> Annual Frequencies of Exceedance with the Results of Staff’s Confirmatory Analysis .....	2-179

Figure 2.5.2-10	Comparison of the Applicant’s Site Amplification Function with the Results of Staff’s Confirmatory Analysis .....	2-182
Figure 2.5.2-11	Comparison of the Applicant’s GMRS with the Results of Staff’s Confirmatory Analysis at Elevation 68.3 m (224 ft) .....	2-183
Figure 2.5.3-1	LiDAR-derived hillshade map showing locations of key North Anna 3 borings and surface mapped .....	2-189
Figure 2.5.4-1	Typical Subsurface Profile across Unit 3 Power Block Area (FSAR Figure 2.5.4-207).....	2-195
Figure 2.5.4-2	Best Estimate Shear Wave Velocity Profiles for RB/FB and CB (FSAR Figure 2.5.4-242).....	2-206
Figure 2.5.4-3	Best Estimate Shear Wave Velocity Profiles for FWSC (FSAR Figure 2.5.4-243) .....	2-207
Figure 2.5.4-4	Best Estimate Shear Wave Velocity Profiles for Free-Field Slope (FSAR Figure 2.5.4-244 .....	2-208
Figure 2.5.4-5	Best Estimate Shear Wave Velocity Profile for Structural Fill in 5-Foot Intervals (FSAR Figure 2.5.4-246) .....	2-209
Figure 2.5.4-6	Shear Modulus Reduction Design Curves (FSAR Figure 2.5.4-247).....	2-210
Figure 2.5.4-7	Damping Ratio versus Cyclic Shear Strain (FSAR Figure 2.5.4-249).....	2-211
Figure 2.5.4-8	Unit 3 Boring Locations (FSAR Figure 2.5.4-217).....	2-222
Figure 2.5.4-9	Excavation and Backfill Plan for Cross Section A-A’ (FSAR Figure 2.5.4-225).....	2-240
Figure 2.5.5-1	Location of Elevated Slopes (FSAR Figure 2.5.5-201).....	2-240
Figure 2.5.5-2	Probability Density and Distribution Functions of FS. Probabilistic Seismic Loading of $a_h=0.25g$ and $a_v = 0.125g$ with COV = 1.0 .....	2-248

Figure 3.7.4-1

Plot comparing the CSDRS derived OBE (a) and the site-specific OBE (b) with the other requirements used to determine an OBE exceedance.

3-85