

Bellefonte Nuclear Plant Units 3 & 4

COL Application

Part 2

Final Safety Analysis Report

Revision 2

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
----------------	--------------	-------------

**CHAPTER 1
INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT**

1.1	INTRODUCTION	1.1-1
1.2	GENERAL PLANT DESCRIPTION	1.2-1
1.3	COMPARISONS WITH SIMILAR FACILITY DESIGNS	1.3-1
1.4	IDENTIFICATION OF AGENTS AND CONTRACTORS	1.4-1
1.5	REQUIREMENTS FOR FURTHER TECHNICAL INFORMATION	1.5-1
1.6	MATERIAL REFERENCED	1.6-1
1.7	DRAWINGS AND OTHER DETAILED INFORMATION	1.7-1
1.8	INTERFACES FOR STANDARD DESIGN	1.8-1
1.9	COMPLIANCE WITH REGULATORY CRITERIA	1.9-1
1.10	NUCLEAR POWER PLANTS TO BE OPERATED ON MULTI-UNIT SITES	1.10-1
APP. 1A	CONFORMANCE WITH REGULATORY GUIDES	1A-1
APP. 1B	SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES	1B-1
APP. 1AA	CONFORMANCE WITH REGULATORY GUIDES	1AA-1

**CHAPTER 2
SITE CHARACTERISTICS**

2.0	SITE CHARACTERISTICS	2.0-1
2.1	GEOGRAPHY AND DEMOGRAPHY	2.1-1
2.2	NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES	2.2-1
2.3	METEOROLOGY	2.3-1
2.4	HYDROLOGIC ENGINEERING	2.4-1
2.5	GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL INFORMATION	2.5-1
APP. 2AA	EARTHQUAKE CATALOG	2AA-1
APP. 2BB	GEOTECHNICAL BORING LOGS	2BB-1
APP. 2CC	TEST PIT LOGS	2CC-1
APP. 2DD	ATMOSPHERIC DISPERSION AND DEPOSITION FACTORS BASED ON TWO YEARS OF ON SITE METEOROLOGICAL DATA	2DD-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 3		
DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS		
3.1	CONFORMANCE WITH NUCLEAR REGULATORY COMMISSION GENERAL DESIGN CRITERIA.....	3.1-1
3.2	CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS	3.2-1
3.3	WIND AND TORNADO LOADINGS.....	3.3-1
3.4	WATER LEVEL (FLOOD) DESIGN.....	3.4-1
3.5	MISSILE PROTECTION.....	3.5-1
3.6	PROTECTION AGAINST THE DYNAMIC EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING.....	3.6-1
3.7	SEISMIC DESIGN	3.7-1
3.8	DESIGN OF CATEGORY I STRUCTURES.....	3.8-1
3.9	MECHANICAL SYSTEMS AND COMPONENTS	3.9-1
3.10	SEISMIC AND DYNAMIC QUALIFICATION OF SEISMIC CATEGORY I MECHANICAL AND ELECTRICAL EQUIPMENT.....	3.10-1
3.11	ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT	3.11-1
APP. 3A	HVAC DUCTS AND DUCT SUPPORTS	3A-1
APP. 3B	LEAK-BEFORE-BREAK EVALUATION OF THE AP1000 PIPING	3B-1
APP. 3C	REACTOR COOLANT LOOP ANALYSIS METHODS	3C-1
APP. 3D	METHODOLOGY FOR QUALIFYING AP1000 SAFETY- RELATED ELECTRICAL AND MECHANICAL EQUIPMENT	3D-1
APP. 3E	HIGH-ENERGY PIPING IN THE NUCLEAR ISLAND	3E-1
APP. 3F	CABLE TRAYS AND CABLE TRAY SUPPORTS	3F-1
APP. 3G	NUCLEAR ISLAND SEISMIC ANALYSES	3G-1
APP. 3H	AUXILIARY AND SHIELD BUILDING CRITICAL SECTIONS	3H-1
APP. 3I	EVALUATION FOR HIGH FREQUENCY SEISMIC INPUT	3I-1
CHAPTER 4		
REACTOR		
4.1	SUMMARY DESCRIPTION.....	4.1-1
4.2	FUEL SYSTEM DESIGN.....	4.2-1
4.3	NUCLEAR DESIGN.....	4.3-1
4.4	THERMAL AND HYDRAULIC DESIGN	4.4-1
4.5	REACTOR MATERIALS.....	4.5-1
4.6	FUNCTIONAL DESIGN OF REACTIVITY CONTROL SYSTEMS.....	4.6-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 5		
REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS		
5.1	SUMMARY DESCRIPTION.....	5.1-1
5.2	INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY	5.2-1
5.3	REACTOR VESSEL	5.3-1
5.4	COMPONENT AND SUBSYSTEM DESIGN.....	5.4-1
CHAPTER 6		
ENGINEERED SAFETY FEATURES		
6.0	ENGINEERED SAFETY FEATURES.....	6.0-1
6.1	ENGINEERED SAFETY FEATURES MATERIALS	6.1-1
6.2	CONTAINMENT SYSTEMS	6.2-1
6.3	PASSIVE CORE COOLING SYSTEM	6.3-1
6.4	HABITABILITY SYSTEMS	6.4-1
6.5	FISSION PRODUCT REMOVAL AND CONTROL SYSTEMS	6.5-1
6.6	INSERVICE INSPECTION OF CLASS 2, 3, AND MC COMPONENTS.....	6.6-1
APP. 6A	FISSION PRODUCT DISTRIBUTION IN THE AP1000 POST- DESIGN BASIS ACCIDENT CONTAINMENT ATMOSPHERE	6A-1
CHAPTER 7		
INSTRUMENTATION AND CONTROLS		
7.1	INTRODUCTION	7.1-1
7.2	REACTOR TRIP	7.2-1
7.3	ENGINEERED SAFETY FEATURES.....	7.3-1
7.4	SYSTEMS REQUIRED FOR SAFE SHUTDOWN	7.4-1
7.5	SAFETY-RELATED DISPLAY INFORMATION	7.5-1
7.6	INTERLOCK SYSTEMS IMPORTANT TO SAFETY.....	7.6-1
7.7	CONTROL AND INSTRUMENTATION SYSTEMS.....	7.7-1
CHAPTER 8		
ELECTRIC POWER		
8.1	INTRODUCTION	8.1-1
8.2	OFFSITE POWER SYSTEM	8.2-1
8.3	ONSITE POWER SYSTEMS	8.3-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 9 AUXILIARY SYSTEMS		
9.1	FUEL STORAGE AND HANDLING.....	9.1-1
9.2	WATER SYSTEMS	9.2-1
9.3	PROCESS AUXILIARIES.....	9.3-1
9.4	AIR-CONDITIONING, HEATING, COOLING, AND VENTILATION SYSTEM.....	9.4-1
9.5	OTHER AUXILIARY SYSTEMS.....	9.5-1
APP. 9A	FIRE PROTECTION ANALYSIS	9A-1
CHAPTER 10 STEAM AND POWER CONVERSION		
10.1	SUMMARY DESCRIPTION.....	10.1-1
10.2	TURBINE-GENERATOR.....	10.2-1
10.3	MAIN STEAM SUPPLY SYSTEM	10.3-1
10.4	OTHER FEATURES OF STEAM AND POWER CONVERSION SYSTEM.....	10.4-1
CHAPTER 11 RADIOACTIVE WASTE MANAGEMENT		
11.1	SOURCE TERMS.....	11.1-1
11.2	LIQUID WASTE MANAGEMENT SYSTEMS.....	11.2-1
11.3	GASEOUS WASTE MANAGEMENT SYSTEM	11.3-1
11.4	SOLID WASTE MANAGEMENT	11.4-1
11.5	RADIATION MONITORING.....	11.5-1
CHAPTER 12 RADIATION PROTECTION		
12.1	ASSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS-LOW-AS-REASONABLY ACHIEVABLE (ALARA).....	12.1-1
12.2	RADIATION SOURCES	12.2-1
12.3	RADIATION PROTECTION DESIGN FEATURES	12.3-1
12.4	DOSE ASSESSMENT.....	12.4-1
12.5	HEALTH PHYSICS FACILITIES DESIGN.....	12.5-1
APP. 12AA	RADIATION PROTECTION PROGRAM DESCRIPTION ...	12AA-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
CHAPTER 13 CONDUCT OF OPERATIONS		
13.1	ORGANIZATIONAL STRUCTURE OF APPLICANT	13.1-1
13.2	TRAINING	13.2-1
13.3	EMERGENCY PLANNING	13.3-1
13.4	OPERATIONAL PROGRAMS	13.4-1
13.5	PLANT PROCEDURES.....	13.5-1
13.6	SECURITY	13.6-1
13.7	FITNESS FOR DUTY	13.7-1
APP. 13AA	CONSTRUCTION-RELATED ORGANIZATION.....	13AA-1
CHAPTER 14 INITIAL TEST PROGRAM		
14.1	SPECIFIC INFORMATION TO BE INCLUDED IN PRELIMINARY/ FINAL SAFETY ANALYSIS REPORTS	14.1-1
14.2	SPECIFIC INFORMATION TO BE INCLUDED IN STANDARD SAFETY ANALYSIS REPORTS.....	14.2-1
14.3	CERTIFIED DESIGN MATERIAL.....	14.3-1
14.4	COMBINED LICENSE APPLICANT RESPONSIBILITIES.....	14.4-1
CHAPTER 15 ACCIDENT ANALYSES		
15.0	ACCIDENT ANALYSES	15.0-1
15.1	INCREASE IN HEAT REMOVAL FROM THE PRIMARY SYSTEM.....	15.1-1
15.2	DECREASE IN HEAT REMOVAL BY THE SECONDARY SYSTEM.....	15.2-1
15.3	DECREASE IN REACTOR COOLANT SYSTEM FLOW RATE	15.3-1
15.4	REACTIVITY AND POWER DISTRIBUTION ANOMALIES.....	15.4-1
15.5	INCREASE IN REACTOR COOLANT INVENTORY.....	15.5-1
15.6	DECREASE IN REACTOR COOLANT INVENTORY	15.6-1
15.7	RADIOACTIVE RELEASE FROM A SUBSYSTEM OR COMPONENT	15.7-1
15.8	ANTICIPATED TRANSIENTS WITHOUT SCRAM	15.8-1
APP. 15A	EVALUATION MODELS AND PARAMETERS FOR ANALYSIS OF RADIOLOGICAL CONSEQUENCES OF ACCIDENTS	15A-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
APP. 15B	REMOVAL OF AIRBORNE ACTIVITY FROM THE CONTAINMENT ATMOSPHERE FOLLOWING A LOCA	15B-1

**CHAPTER 16
TECHNICAL SPECIFICATIONS**

16.1	TECHNICAL SPECIFICATIONS	16.1-1
16.2	DESIGN RELIABILITY ASSURANCE PROGRAM	16.2-1
16.3	INVESTMENT PROTECTION.....	16.3-1

**CHAPTER 17
QUALITY ASSURANCE**

17.1	QUALITY ASSURANCE DURING THE DESIGN AND CONSTRUCTION PHASES	17.1-1
17.2	QUALITY ASSURANCE DURING THE OPERATIONS PHASE.....	17.2-1
17.3	QUALITY ASSURANCE DURING DESIGN, PROCUREMENT, FABRICATION, INSPECTION, AND/OR TESTING OF NUCLEAR POWER PLANT ITEMS	17.3-1
17.4	DESIGN RELIABILITY ASSURANCE PROGRAM	17.4-1
17.5	QUALITY ASSURANCE PROGRAM DESCRIPTION - NEW LICENSE APPLICANTS	17.5-1
17.6	MAINTENANCE RULE PROGRAM	17.6-1
17.7	COMBINED LICENSE INFORMATION ITEMS.....	17.7-1
17.8	REFERENCES	17.8-1

**CHAPTER 18
HUMAN FACTORS ENGINEERING**

18.1	OVERVIEW	18.1-1
18.2	HUMAN FACTORS ENGINEERING PROGRAM MANAGEMENT...	18.2-1
18.3	OPERATING EXPERIENCE REVIEW	18.3-1
18.4	FUNCTIONAL REQUIREMENTS ANALYSIS AND ALLOCATION...	18.4-1
18.5	AP1000 TASK ANALYSIS IMPLEMENTATION PLAN	18.5-1
18.6	STAFFING.....	18.6-1
18.7	INTEGRATION OF HUMAN RELIABILITY ANALYSIS WITH HUMAN FACTORS ENGINEERING	18.7-1
18.8	HUMAN SYSTEM INTERFACE DESIGN	18.8-1
18.9	PROCEDURE DEVELOPMENT	18.9-1
18.10	TRAINING PROGRAM DEVELOPMENT.....	18.10-1

**Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR**

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
18.11	HUMAN FACTORS ENGINEERING VERIFICATION AND VALIDATION	18.11-1
18.12	INVENTORY.....	18.12-1
18.13	DESIGN IMPLEMENTATION.....	18.13-1
18.14	HUMAN PERFORMANCE MONITORING.....	18.14-1

**CHAPTER 19
PROBABILISTIC RISK ASSESSMENT**

19.1	INTRODUCTION.....	19.1-1
19.2	INTERNAL INITIATING EVENTS.....	19.2-1
19.3	MODELING OF SPECIAL INITIATORS.....	19.3-1
19.4	EVENT TREE MODELS.....	19.4-1
19.5	SUPPORT SYSTEMS.....	19.5-1
19.6	SUCCESS CRITERIA ANALYSIS.....	19.6-1
19.7	FAULT TREE GUIDELINES.....	19.7-1
19.8	PASSIVE CORE COOLING SYSTEM - PASSIVE RESIDUAL HEAT REMOVAL	19.8-1
19.9	PASSIVE CORE COOLING SYSTEM - CORE MAKEUP TANKS....	19.9-1
19.10	PASSIVE CORE COOLING SYSTEM - ACCUMULATOR	19.10-1
19.11	PASSIVE CORE COOLING SYSTEM - AUTOMATIC DEPRESSURIZATION SYSTEM	19.11-1
19.12	PASSIVE CORE COOLING SYSTEM - IN-CONTAINMENT REFUELING WATER STORAGE TANK.....	19.12-1
19.13	PASSIVE CONTAINMENT COOLING	19.13-1
19.14	MAIN AND STARTUP FEEDWATER SYSTEM.....	19.14-1
19.15	CHEMICAL AND VOLUME CONTROL SYSTEM.....	19.15-1
19.16	CONTAINMENT HYDROGEN CONTROL SYSTEM.....	19.16-1
19.17	NORMAL RESIDUAL HEAT REMOVAL SYSTEM	19.17-1
19.18	COMPONENT COOLING WATER SYSTEM.....	19.18-1
19.19	SERVICE WATER SYSTEM.....	19.19-1
19.20	CENTRAL CHILLED WATER SYSTEM.....	19.20-1
19.21	AC POWER SYSTEM	19.21-1
19.22	CLASS 1E DC & UPS SYSTEM.....	19.22-1
19.23	NON-CLASS 1E DC & UPS SYSTEM	19.23-1
19.24	CONTAINMENT ISOLATION.....	19.24-1
19.25	COMPRESSED AND INSTRUMENT AIR SYSTEM	19.25-1
19.26	PROTECTION AND SAFETY MONITORING SYSTEM	19.26-1
19.27	DIVERSE ACTUATION SYSTEM	19.27-1
19.28	PLANT CONTROL SYSTEM.....	19.28-1
19.29	COMMON CAUSE ANALYSIS.....	19.29-1
19.30	HUMAN RELIABILITY ANALYSIS	19.30-1
19.31	OTHER EVENT TREE NODE PROBABILITIES	19.31-1

Bellefonte Nuclear Plant, Units 3 & 4
COL Application
Part 2, FSAR

MASTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
19.32	DATA ANALYSIS AND MASTER DATA BANK	19.32-1
19.33	FAULT TREE AND CORE DAMAGE QUANTIFICATION	19.33-1
19.34	SEVERE ACCIDENT PHENOMENA TREATMENT	19.34-1
19.35	CONTAINMENT EVENT TREE ANALYSIS	19.35-1
19.36	REACTOR COOLANT SYSTEM DEPRESSURIZATION	19.36-1
19.37	CONTAINMENT ISOLATION	19.37-1
19.38	REACTOR VESSEL REFLOODING	19.38-1
19.39	IN-VESSEL RETENTION OF MOLTEN CORE DEBRIS	19.39-1
19.40	PASSIVE CONTAINMENT COOLING	19.40-1
19.41	HYDROGEN MIXING AND COMBUSTION ANALYSIS	19.41-1
19.42	CONDITIONAL CONTAINMENT FAILURE PROBABILITY DISTRIBUTION	19.42-1
19.43	RELEASE FREQUENCY QUANTIFICATION	19.43-1
19.44	MAAP4.0 CODE DESCRIPTION AND AP1000 MODELING	19.44-1
19.45	FISSION PRODUCT SOURCE TERMS	19.45-1
19.46	NOT USED	19.46-1
19.47	NOT USED	19.47-1
19.48	NOT USED	19.48-1
19.49	OFFSITE DOSE EVALUATION	19.49-1
19.50	IMPORTANCE AND SENSITIVITY ANALYSIS	19.50-1
19.51	UNCERTAINTY ANALYSIS	19.51-1
19.52	NOT USED	19.52-1
19.53	NOT USED	19.53-1
19.54	LOW POWER AND SHUTDOWN PRA ASSESSMENT	19.54-1
19.55	SEISMIC MARGIN ANALYSIS	19.55-1
19.56	PRA INTERNAL FLOODING ANALYSIS	19.56-1
19.57	INTERNAL FIRE ANALYSIS	19.57-1
19.58	WINDS, FLOODS, AND OTHER EXTERNAL EVENTS	19.58-1
19.59	PRA RESULTS AND INSIGHTS	19.59-1
APP. 19A	THERMAL HYDRAULIC ANALYSIS TO SUPPORT SUCCESS CRITERIA	19A-1
APP. 19B	EX-VESSEL SEVERE ACCIDENT PHENOMENA	19B-1
APP. 19C	ADDITIONAL ASSESSMENT OF AP1000 DESIGN FEATURES	19C-1
APP. 19D	EQUIPMENT SURVIVABILITY ASSESSMENT	19D-1
APP. 19E	SHUTDOWN EVALUATION	19E-1
APP. 19F	MALEVOLENT AIRCRAFT IMPACT	19F-1