babcock & wilcox nuclear energy
13024 ballantyne corporate place, suite 500 • charlotte, nc 28277
phone 704.625.4800 • fax 704.625.4801 • www.babcock.com

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Babcock & Wilcox Company, Nuclear Energy
Docket No. PROJ0776
Project No. 776

Subject: Submittal of Technical Report 08-00000341-000(P), "B&W *mPower*™ Reactor Design Overview"

On May 27, 2010, Babcock & Wilcox Nuclear Energy (B&W NE) transmitted Technical Report 08-00000341-000(P), "B&W *mPower*™ Reactor Design Overview," which contained B&W NE Confidential Commercial Information that was requested to be withheld from public disclosure. At that time, B&W NE committed to provide a non-proprietary version under a separate letter.

Accordingly, enclosed is Technical Report 08-00000341-000(NP), a non-proprietary version of the "B&W *mPower*™ Reactor Design Overview."

Questions concerning this submittal may be directed to T. J. Kim at 434-382-9791 (email: tjkim@babcock.com) or to J. A. Halfinger at 434-316-7507 (email: jahalfinger@babcock.com).

Jeffrey A. Halfinger
Vice President, B&W mPower Development
B&W NE

JHA/

cc: Joelle L. Starefos, NRC, TWFN-6 E4
Stewart L. Magruder, Jr., NRC, TWFN-6 E4

YG01
NRO

Redacted Non-Proprietary Version

B&W babcock & wilcox nuclear energy

B&W *mPower*™ Reactor Design Overview Technical Report 08-00000341-000(NP) May 2010

B&W *mPower*™ a progressive energy solution

B&W *mPower*™ Reactor Program
Babcock & Wilcox Nuclear Energy, Inc.
109 Ramsey Place
Lynchburg, VA 24501

Confidential Commercial Information Is Enclosed in Square Brackets; and Reasons for Withholding the Identified CCI to from Public Disclosure Are Provided in an Accompanying Affidavit.

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Document No.	Title:
08-00000341-000(NP)	B&W *mPower*™ Reactor Design Overview

Babcock & Wilcox Nuclear Energy, Inc.

B&W *mPower*™ Reactor Design Overview

SIGNATURES			
Prepared By:	Michael D. Haggerty	[signature]	03 JUN 10
	Risk Manager	Signature	Date
Reviewed By:	Michael T. Childerson	Kenneth W. Baity for M.T. Childerson	6/3/10
	Modular Reactors Engineering Manager	Signature	Date
Approved By:	Jeff A. Halfinger	[signature]	6/3/10
	Vice President, B&W mPower Development	Signature	Date

This Report Contains 82 Pages Including the Cover Page

Document No.	Title:
08-00000341-000(NP)	B&W *mPower*™ Reactor Design Overview

REVISION HISTORY

Revision	Section(s) or Page(s)	Description of Change
0		Initial Issue

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ABSTRACT

This report provides an overview of the design of the B&W *mPower*™ reactor. A general introduction to this simplified, passive, modular, light-water-cooled, pressurized water reactor nuclear power plant, along with the background of the design is presented. The reactor core, reactor coolant system, reactor safety and support systems, instrumentation and control systems, nuclear island structures, and balance of plant facilities are described. Plant, structure, system and component illustrations are provided. B&W *mPower* reactor features that improve constructability, reduce overall plant complexity, enhance availability and improve overall safety are also highlighted.

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CONTENTS

TABLES

FIGURES

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ACRONYMS

Ag-In-Cd	Silver-Indium-Cadmium
AHU	Air Handling Unit
Al_2O_3	Aluminum Oxide
B_4C	Boron Carbide
BPR	Burnable Poison Rod
CRA	Control Rod Assembly
CRDM	Control Rod Drive Mechanism
ECCS	Emergency Core Cooling System
Gd_2O_3	Gadolinium Oxide
HVAC	Heating, Ventilation and Air Conditioning
I&C	Instrumentation and Control
LOCA	Loss-of-Coolant Accident
PWR	Pressurized Water Reactor
RCIPS	Reactor Coolant Inventory and Purification System
RCS	Reactor Coolant System
RWST	Refueling Water Storage Tank
UO_2	Uranium Oxide
UPS	Uninterruptible Power Supply

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1.0 INTRODUCTION

1.1 Overview

The B&W *mPower*™ reactor is a simplified, passive, modular, light-water-cooled, pressurized water reactor (PWR) nuclear power plant that uses an integral arrangement in which the reactor core, steam generator and pressurizer are combined into a common pressure vessel. The control rod drive mechanisms and reactor coolant pumps are also located inside the pressure vessel. See Figure 1-1.

The B&W *mPower* reactor has a rated power output of approximately 125 MWe; and the reactor can be operated for up to four years between refuelings, for a design life of 60 years. Primary and secondary loop flows and nominal operating conditions are shown in Figure 1-2.

The B&W *mPower* reactor nuclear island is small compared to conventional PWRs; and the Containment Building and other critical structures are located below grade level. Figure 1-3 is a cutaway view of the Containment Building. Figure 1-4 is a cutaway view of the Reactor Service Building and Fuel Handling Building for an arrangement housing two B&W *mPower* reactor modules. Figures 1-5 and 1-6 illustrate prospective two-unit and four-unit plant layouts, respectively.

[

] [CCI per Affidavit 4(a) – 4(d)]

Inherent safety features of the B&W *mPower* reactor include the absence of large reactor coolant system (RCS) piping and the lack of reactor vessel penetrations below the top of the core.
The B&W *mPower* reactor design also incorporates features aimed at increasing plant availability. These include an extended refueling cycle, inherently smaller and simpler components, and the use of proven, standard technology.

1.2 Background

The B&W *mPower* reactor is a direct descendent of the B&W maritime reactor program, which produced a number of reactor designs known as consolidated nuclear steam generators. One of these designs was used in the nuclear powered merchant ship Otto Hahn.

The Otto Hahn's keel was laid in 1963 and the ship was launched in 1964. Subsequently, the reactor was installed and was then taken critical in 1968. The reactor was refueled in 1972 and remained in operation until 1979, when it was removed and replaced with a conventional diesel engine. Over the operating life of the reactor, the ship sailed approximately 250,000 nautical miles, successfully demonstrating the viability of surface ship propulsion using nuclear power.

Key parameters for the Otto Hahn reactor are given in Table 1-1. A schematic diagram of the nuclear power system is shown in Figure 1-7.

The Otto Hahn reactor operated at relatively low pressures and at saturated conditions at the top of the core. This allowed a steam bubble to be generated in the reactor vessel upper head to provide pressurization, eliminating the need for a separate, electrically-heated pressurizer. Three canned reactor coolant pumps were located on stalks at the bottom of the reactor vessel to provide coolant flow. Helical, once-through, steam generators in the outer annulus of the reactor vessel provided superheated steam. This steam drove a 10,000 hp turbine and two 450 kW turbine-generators.

Key features of the Otto Hahn reactor design are incorporated in the B&W *mPower* reactor design. These include:

- Placement of nuclear steam supply system components within a single pressure vessel.
- Use of an integral, once-through steam generator.
- Use of PWR type fuel assemblies.
- [ ] [CCI per Affidavit 4(a) – 4(d)]

The B&W *mPower* reactor design also updates the Otto Hahn design to enhance economics and inherent safety. Changes include:

- Increased reactor core power (425 MWt, versus 38 MWt).
- [ ] [CCI per Affidavit 4(a) – 4(d)]
- Internal versus external reactor coolant pumps.

- Internal versus external control rod drive mechanisms.
- Passive safety systems.

Table 1-1 – Otto Hahn Reactor Characteristics

PARAMETER	VALUE
Reactor Power	38 MWt
Reactor Coolant Volume	1200 ft^3
Reactor Coolant Pressure (Design/Operating)	1204/918 psia
Reactor Coolant Temperature (Design/Operating)	572/523 °F
Reactor Coolant Flow Rate	5.28 Mlbm/hr
Steam Generator Outlet Pressure	440 psia
Steam Generator Outlet Temperature	523 °F
Feedwater Inlet Temperature	365 °F
Steam Flow Rate	141,000 lbm/hr
Active Reactor Core Height	32.7 in
Equivalent Reactor Core Diameter	32.7 in
Number of Fuel Assemblies (Type)	12 (16x16)
Uranium Enrichment	3.5-6.6%
Average Fuel Burnup	23,000 MWd/t

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 1-1 – B&W *mPower* Reactor (Integral Arrangement)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 1-2 – B&W *mPower* Reactor (Loop Flows and Nominal Operating Conditions)

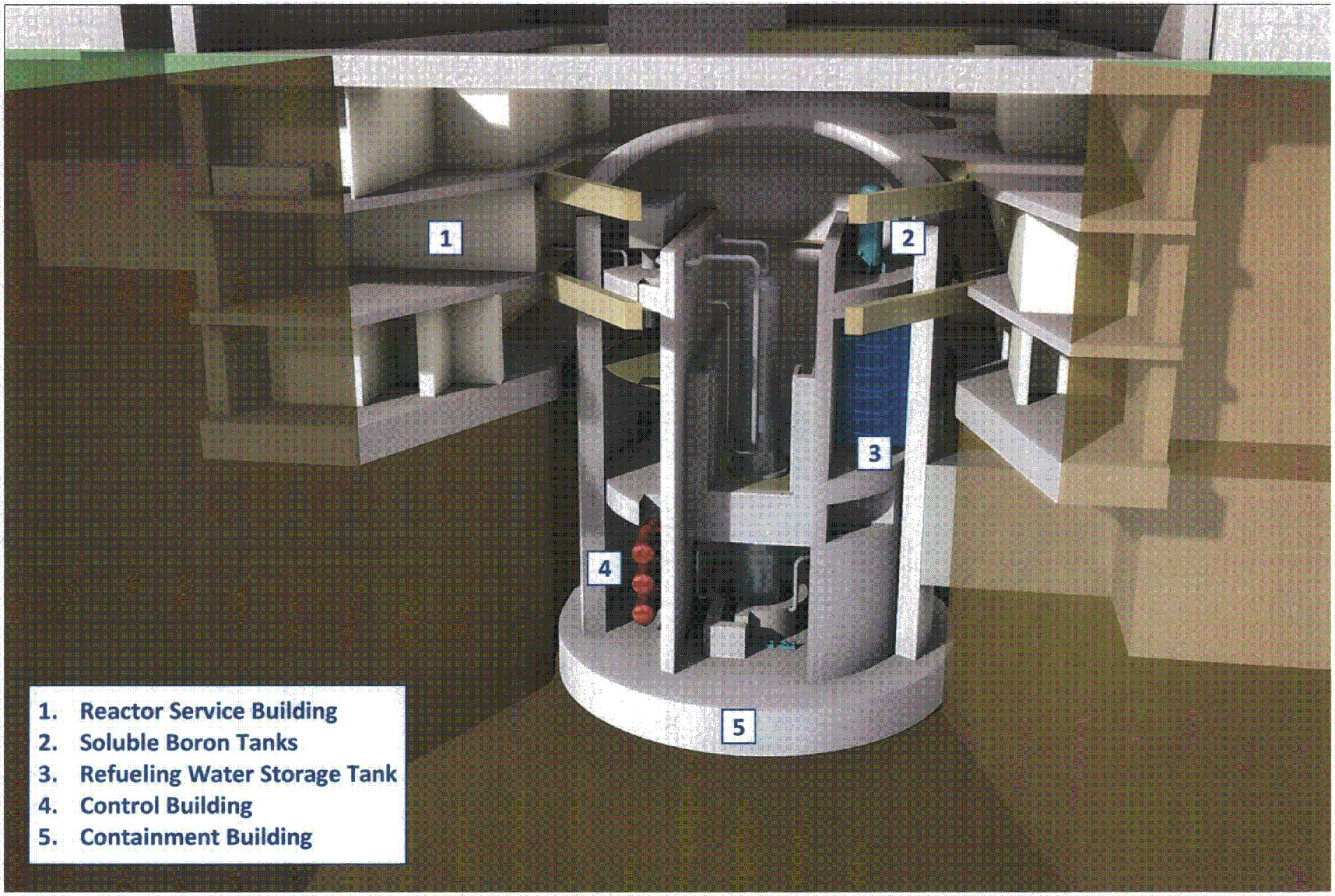

Figure 1-3 – Containment Building (Cutaway View)

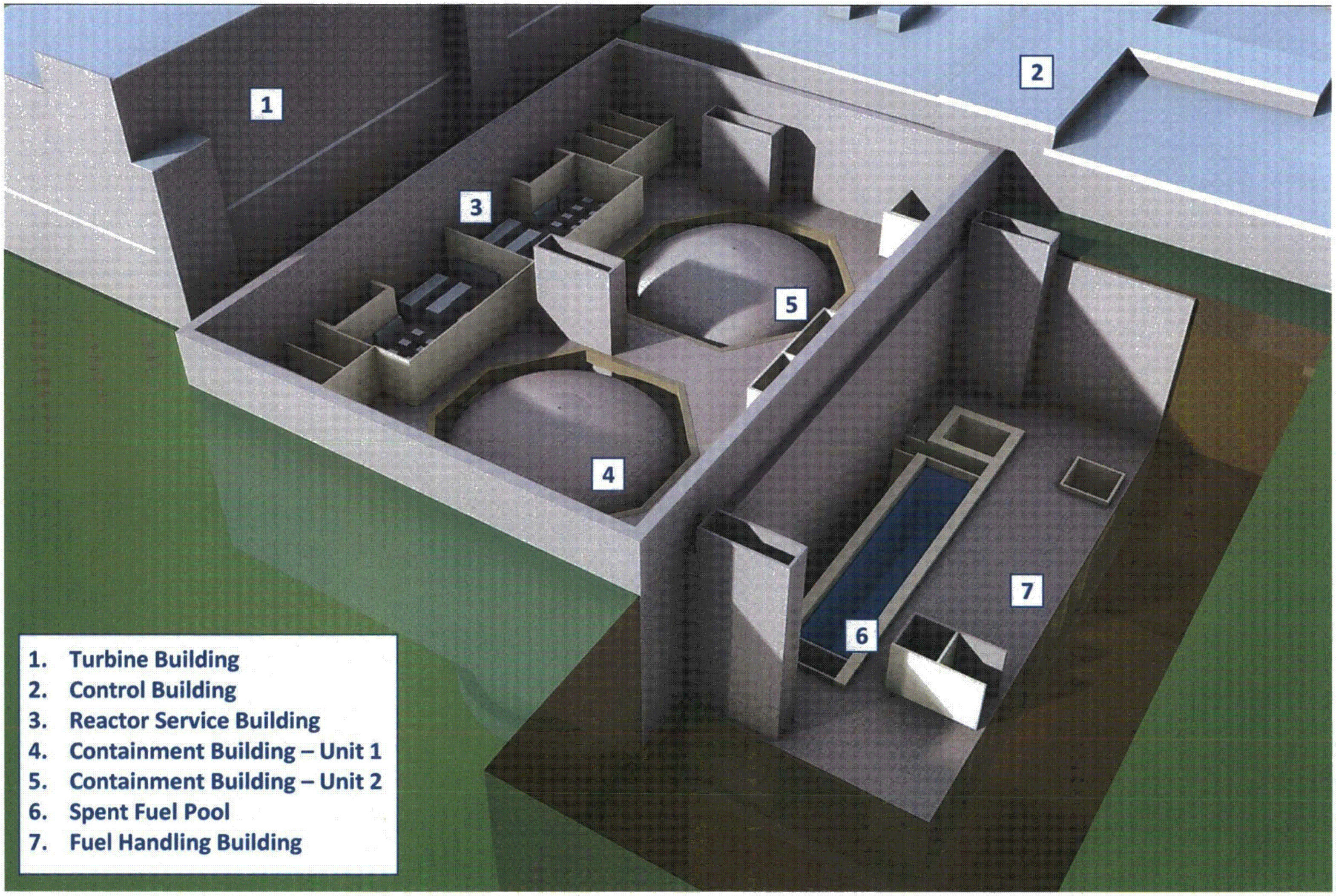

Figure 1-4 – Reactor Service Building and Fuel Handling Building (Two-Unit Cutaway View)

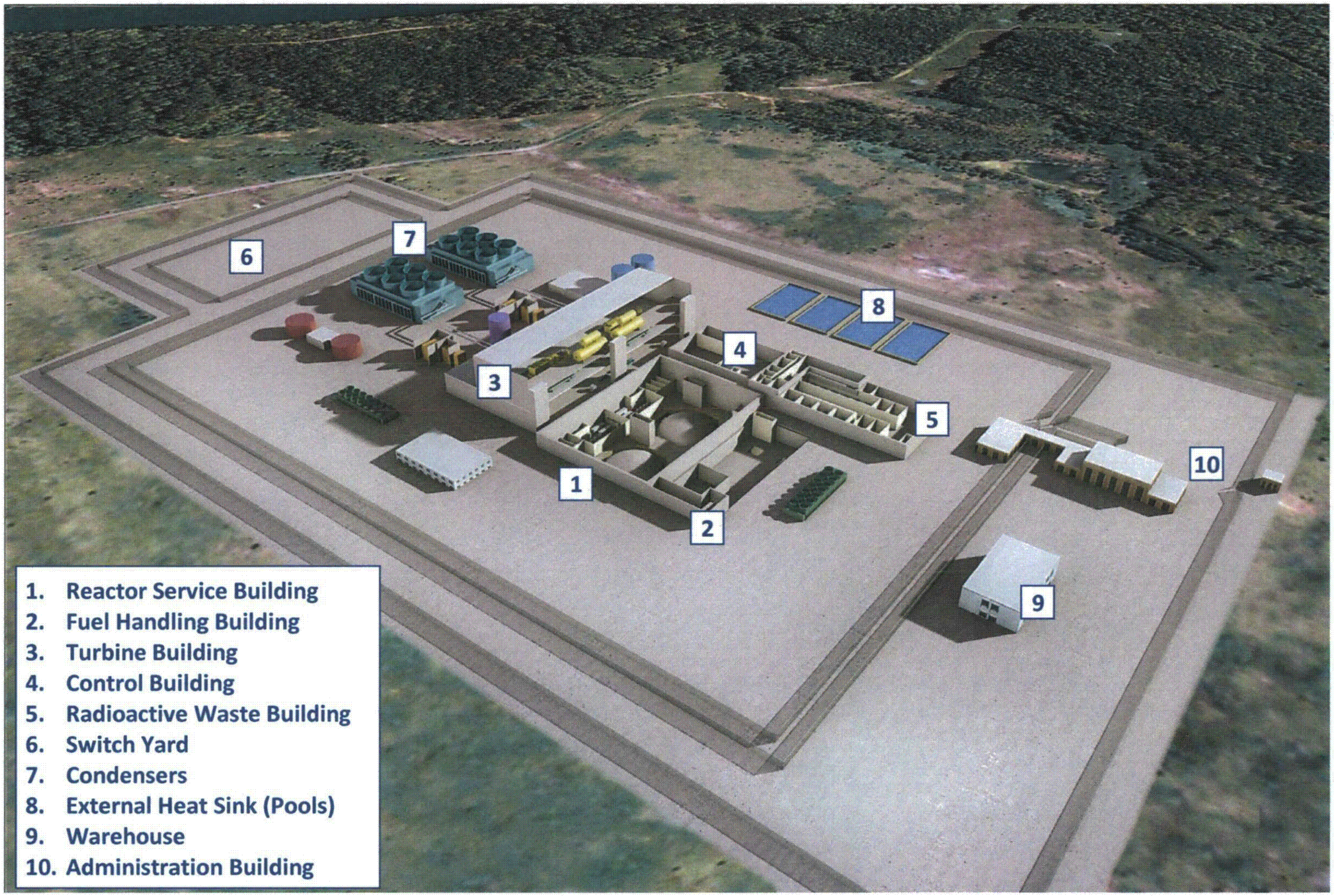

Figure 1-5 – Two-Unit Plant Layout

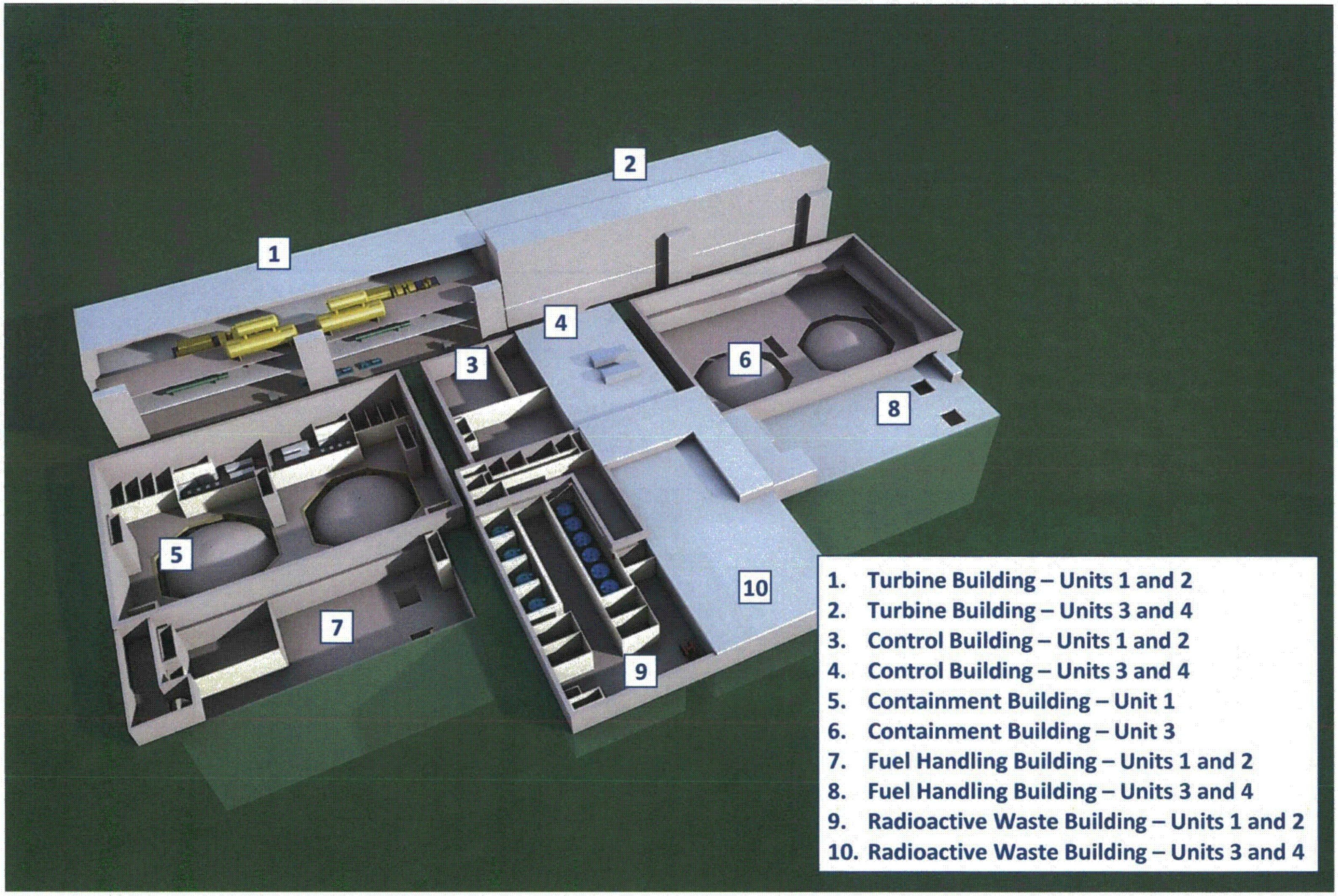

Figure 1-6 – Four-Unit Plant Layout

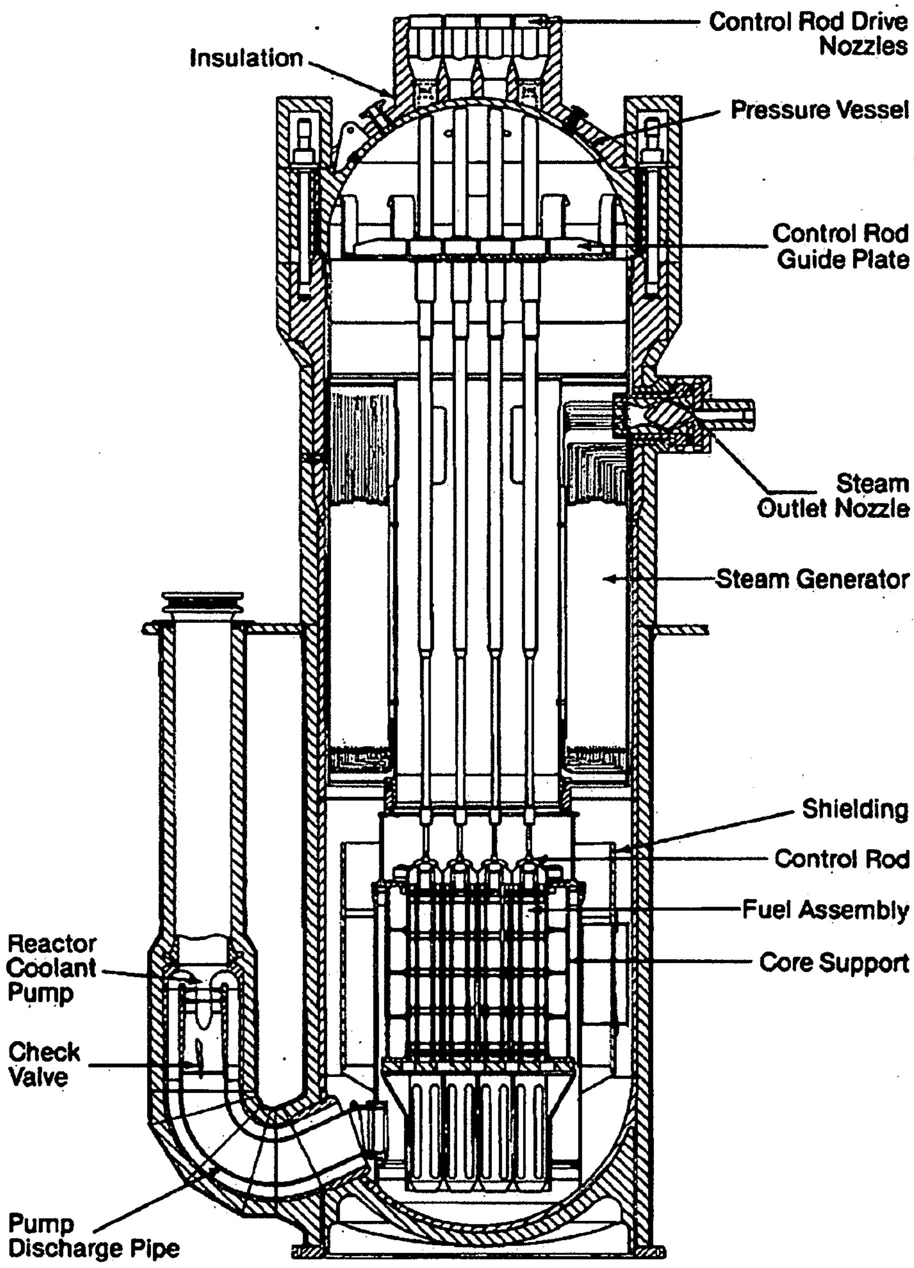

Figure 1-7 – Otto Hahn Power System Schematic

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2.0 REACTOR CORE

2.1 General Description

[ ] [CCI per Affidavit 4(a) – 4(d)] This section provides a description of the core, including the fuel assemblies and control rod drive mechanisms (CRDMs).

[ ] [CCI per Affidavit 4(a) – 4(d)]

[ ] [CCI per Affidavit 4(a) – 4(d)] Each fresh, unirradiated core is loaded with sufficient excess reactivity to meet core design lifetime (cycle length) and design discharge burnup requirements.

[[CCI per Affidavit 4(a) – 4(d)]

[

] [CCI per Affidavit 4(a) – 4(d)] Accordingly, the core can produce the desired thermal power without exceeding fuel or fuel clad temperature, heat flux or strain limitations. Fuel rod integrity is maintained for all normal and anticipated abnormal operating conditions, ensuring no release of fission products from the fuel rods. Coupled thermal-hydraulic and neutronics stability is also maintained.

2.2 Fuel Assembly

2.2.1 General Description

[

] [CCI per Affidavit 4(a) – 4(d)]

2.2.2 Fuel Rods

[

] [CCI per Affidavit 4(a) – 4(d)]

2.2.3 End Fittings

[

] [CCI per Affidavit 4(a) – 4(d)]

2.2.4 Control Rod Guide Tubes

[

] [CCI per Affidavit 4(a) – 4(d)]

2.2.5 Spacer Grids

[

] [CCI per Affidavit 4(a) – 4(d)]

2.3 Control Rod Drives

[

] [CCI per Affidavit 4(a) – 4(d)]

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-1 – Core Configuration

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-2 – Fuel Assembly

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-3 – Fuel Assembly End Fittings

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-4 – Fuel Assembly Spacer Grid

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-5 – Fuel Rod

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-6 – Control Rod Drive Mechanism (Overall Mechanism – Withdrawn)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-7 – Control Rod Drive Mechanism (Overall Mechanism – Inserted)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-8 – Control Rod Drive Mechanism (Latching System – Inserted – Engaged)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 2-9 – Control Rod Drive Mechanism (Latching System – Inserted – Disengaged)

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3.0 REACTOR COOLANT SYSTEM

3.1 General Description

The B&W *mPower* reactor integrates the traditional nuclear steam supply system into a single pressure vessel that includes the core, steam generator and pressurizer. The control rod drive mechanisms and reactor coolant pumps are also located inside the pressure vessel. The integral reactor arrangement is detailed in Figure 1-1, and primary loop (reactor coolant) flow through the pressure vessel is as shown in Figure 1-2.

[

] [CCI per Affidavit 4(a) – 4(d)]

The reactor is supported from the lower vessel flange by a support skirt, as shown in Figure 3-1.

The following sections provide a description of the lower vessel assembly and the upper vessel.

3.2 Lower Vessel Assembly

[

] [CCI per Affidavit 4(a) – 4(d)]

3.3 Upper Vessel, Steam Generator and Pressurizer

3.3.1 Upper Vessel

[

] CCI per Affidavit 4(a) – 4(d)]

3.3.2 Steam Generator

[

] [CCI per Affidavit 4(a) – 4(d)]

3.3.3 Pressurizer

[

] [CCI per Affidavit 4(a) – 4(d)]

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[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 3-1 – Lower Vessel Assembly

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 3-2 – Core Basket

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 3-3 – Upper Internals

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 3-4 – Reactor Coolant Pump (Conceptual View)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 3-5 – Upper Vessel

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4.0 REACTOR SAFETY AND SUPPORT SYSTEMS

4.1 General Design Philosophy

The primary function of reactor safety systems is to prevent core damage due to overheating and to assure reactor coolant pressure boundary integrity. In a PWR, this requires that the core remain covered with water and that energy added to the cooling water is removed. Reactor safety systems must also be able to assure that the core remains subcritical when needed. Additionally, the reactor containment structure must be capable of preventing the release of radionuclides to the environment following an accident.

Conventional PWRs perform these functions through design features such as multiple high pressure and low pressure injection pumps; low pressure, closed loop, decay heat removal systems that rely on the steam generators when the plant is at or near operating pressure; and active cooling systems to maintain containment pressure within design basis limits.

The B&W *mPower* reactor design takes a fundamentally different approach. This approach comprises the following elements:

- The nuclear steam supply system consists of an integral reactor arrangement with all system components located in a single pressure vessel. [

] [CCI per Affidavit 4(a) – 4(d)]

These systems and features work in concert to protect the core during accidents, to provide long-term core cooling, and to prevent the release of radioactive materials to the environment, without reliance on AC power or operator action for at least 72 hours following an accident.

4.2 Emergency Core Cooling System

The B&W *mPower* reactor ECCS is a passive engineered safety system that performs the following functions:

- [

] [CCI per Affidavit 4(a) – 4(d)]

The B&W *mPower* reactor ECCS also performs the following collateral functions:

- [

] [CCI per Affidavit 4(a) – 4(d)]

Figure 4-1 provides a simplified diagram of the B&W *mPower* reactor ECCS.

4.3 Reactor Coolant Inventory and Purification System

[

] [CCI per Affidavit 4(a) – 4(d)]

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Document No.	Title:
08-00000341-000(NP)	B&W *mPower*™ Reactor Design Overview

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 4-1 – Emergency Core Cooling System

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 4-2 – Reactor Coolant Inventory and Purification System

5.0 INSTRUMENTATION AND CONTROL

5.1 General Description

B&W *mPower* reactor instrumentation and control (I&C) systems provide the following:

- Control of plant processes during all postulated operating conditions.
- Automatic initiation signals to mitigate the consequences of accidents.
- Data for post-event assessment and response, in the event of abnormal operational occurrences or postulated accidents.

The B&W *mPower* reactor I&C equipment is grouped into three functional categories, or layers, which are described further in subsequent sections:

- Plant Protection
- Plant Control
- Plant Management

The B&W *mPower* reactor I&C equipment is also classified as either safety related or non-safety related, according to its function. Safety related equipment is essential to emergency reactor shutdown, containment isolation, core cooling or reactor heat removal, or otherwise essential in preventing a significant release of radioactive material to the environment.

The B&W *mPower* reactor utilizes advanced digital equipment as the backbone of the plant I&C systems. Supplementing the digital equipment is analog equipment where time-proven technologies are better suited to perform mission critical activities. To improve overall plant operation, a high degree of automation is also designed into the systems.

5.2 Plant Protection Layer

The plant protection layer of the B&W *mPower* reactor I&C systems measures, processes, assesses and actuates plant subsystems required to protect the reactor and supporting systems from exceeding design limits. The plant protection layer performs all required plant safety related I&C functions. Additionally, the plant protection layer provides safety related parameter displays for use in assessing conditions after an accident.

The design function of the plant protection layer is to perform safety related, automatic protection functions. The plant protection layer does not perform any control functions; it only acts automatically to maintain process variables within design limits. The plant control layer (discussed below) performs anticipatory control actions to limit challenges to the safety systems; and, if not successful, the plant protection layer performs appropriate protective actions.

[

] [CCI per Affidavit 4(a) – 4(d)]

Plant protection layer equipment is powered from safety related power sources from separate power channels. The choice of power sources for plant protection layer equipment depends upon the tolerance of a component for power disruptions.

5.3 Plant Control Layer

The plant control layer of the B&W *mPower* reactor I&C systems measures and processes data, performs control computations, displays information, and actuates plant subsystems required for normal operational control and shutdown of the reactor and supporting systems. The plant control layer is the primary method for plant startup, operating the plant at power, and performing an orderly and controlled shutdown. The plant control layer does not perform any safety related functions.

The design function of the plant control layer is to provide operators with automatic and manual control of the plant. The design goal of the plant control layer is to provide as much automatic control as possible to reduce operator burden. Included in these functions are the parameter displays for making operating decisions during normal plant conditions.

While the plant control layer is not credited with performing any safety related functions, it is important in that it maintains the plant in a safe condition during all modes of operation. The plant control layer performs anticipatory control actions to limit challenges to the safety systems. The plant control layer is also required to bring the reactor to safe shutdown during some off-normal conditions, such as design basis fires.

The plant control layer includes the I&C functions of the systems and equipment such as those listed in Table 5-1. The systems and equipment that comprise the plant control layer are required to be reliable and dependable, and are designed to ensure that a single-failure does not trip the plant. Additionally, a single-failure is not permitted to result in the operation of a safety related system.

[

] [CCI per Affidavit 4(a) – 4(d)]

5.4 Plant Management Layer

The plant management layer of the B&W *mPower* reactor I&C systems measures, processes, trends, displays, and performs computations and assessments on plant variables required to assess the

performance of the station. The plant management layer does not perform any control functions; and cannot change the state of any equipment or field devices it monitors.

The design function of the plant management layer is to provide operators, engineers, managers, etc. with the ability to assess station performance with respect to generation and efficiency goals.

The plant management layer is not credited with performing any safety related functions and, as such, is non-safety related. The systems that comprise this layer are required to be highly reliable and dependable, but are not single-failure proof. The plant management layer is powered from non-safety related power and is not credited for any safe shutdown, post-accident assessment, or emergency plan implementation functions.

Table 5-1 – Plant Control Layer Systems and Equipment (Representative)

[

] [CCI per Affidavit 4(a) – 4(d)]

6.0 NUCLEAR ISLAND

6.1 Containment Building

The B&W *mPower* reactor Containment Building, shown in Figures 6-1 – 6-3, is a low-leakage, reinforced concrete, steel-lined, Seismic Category I structure that is located below grade level. The Containment Building is designed to confine radioactive material released in the event of a design basis accident and houses the following, or portions thereof:

- [

] [CCI per Affidavit 4(a) – 4(d)]

Normal access to the Containment Building is via two personnel hatches, and a removable equipment hatch (access dome) on the top of the building provides access for large component replacement.

6.2 Reactor Service Building

The Reactor Service Building for the B&W *mPower*, shown in Figures 6-4 – 6-7, is a reinforced concrete, Seismic Category I structure that surrounds the Containment Building and is located partially below grade level. The Reactor Service Building houses the following, or portions thereof:

- [

] [CCI per Affidavit 4(a) – 4(d)]

6.3 Control Building

The B&W *mPower* reactor Control Building, shown in Figure 6-8, is a reinforced concrete, Seismic Category I structure that is located below grade level. [ ] [CCI per Affidavit 4(a) – 4(d)]

6.4 Fuel Handling Building

The B&W *mPower* reactor Fuel Handling Building, shown in Figures 6-9 and 6-10, is a reinforced concrete structure that is located below grade level. [

]

[CCI per Affidavit 4(a) – 4(d)]

6.5 Turbine Building

The B&W *mPower* reactor Turbine Building, shown in Figures 6-11 and 6-12, is a steel frame structure that is located above grade level. [

]

[CCI per Affidavit 4(a) – 4(d)]

6.6 Radioactive Waste Building

The B&W *mPower* reactor Radioactive Waste Building is a reinforced concrete and steel frame structure that is located partially below grade level. [

] [CCI per Affidavit 4(a) – 4(d)]

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-1 – Containment Building (Plan View – Elevation 30')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-2 – Containment Building (Section View – Section A-A)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-3 – Containment Building (Section View – Section B-B)

Document No.	Title:
08-00000341-000(NP)	B&W *mPower*™ Reactor Design Overview

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-4 – Reactor Service Building (Plan View – Elevation 60')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-5 – Reactor Service Building (Plan View – Elevation 80')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-6 – Reactor Service Building (Plan View – Elevation 100')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-7 – Reactor Service Building (Plan View – Elevation 124')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-8 – Control Building (Plan View – Elevation 100')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-9 – Fuel Handling Building (Plan View – Elevation 60')

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-10 – Fuel Handling Building (Elevation View)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-11 – Turbine Building (Plan View)

[

] [CCI per Affidavit 4(a) – 4(d)]

Figure 6-12 – Turbine Building (Section View – Section A-A)

7.0 BALANCE OF PLANT

7.1 Steam and Power Conversion System

The B&W *mPower* reactor steam and power conversion system comprises the following systems and equipment, or portions thereof:

- Turbine-Generator – The turbine is a 3600 rpm tandem compound double-flow unit containing one high pressure turbine and one low pressure turbine. The generator is a 125 MWe unit rated at approximately 139 MVA at 0.9 pf. Turbine-generator support systems include a turbine bearing lubrication oil system, an electro-hydraulic control system, a turbine gland seal system, turning gear, overspeed protective devices, a generator rectifier section and a voltage regulator. The turbine-generator serves no safety related functions.

- Main Steam System – The main steam system supplies steam from the steam generator to the turbine during normal operation. Main steam isolation valves isolate the secondary side of the steam generator to prevent uncontrolled blowdown and to isolate non-safety related portions of the system; and main steam safety valves provide overpresssure protection for the secondary side of the steam generator. Only non-safety related components of the main steam system are located in the Turbine Building.

- Condenser – The condenser cools and condenses steam from the turbine and returns the resulting condensate to the condensate and feedwater systems. [

  ] [CCI per Affidavit 4(a) – 4(d)] The condenser serves no safety related functions.

- Condensate and Feedwater Systems – The condensate and feedwater systems provide feedwater at the required temperatures, pressures and flow rates to the steam generator. Condensate from the condenser hot wells is pumped by condensate pumps through low pressure feedwater heaters to a deaerator heater. Feedwater pumps, with suction from the deaerator heater, pump the feedwater through high pressure feedwater heaters and into the steam generator. Only non-safety related components of the main steam system are located in the Turbine Building.

- Condensate Polishing System – The condensate polishing system removes corrosion products and ionic contaminants from the feedwater. The condensate polishing system serves no safety related functions.

- Extraction Steam System – The extraction steam system transports extraction steam from the turbine to a deaerator and the feedwater heaters to improve unit efficiency. The extraction steam system serves no safety related functions.

- Air Extraction System – The air extraction system removes air and other non-condensable gases from the condensate system during plant startup, shutdown and normal operation from the steam side of the condenser shell(s) and exhausts them to the atmosphere. The air extraction system serves no safety related functions.

- Turbine Vents and Drains System – The turbine vents and drains system allows steam flow through the steam lines prior to operation of the steam turbine for the purpose of warming the lines and removes accumulated condensate from the steam lines during start-up and operation. The turbine vents and drains system serves no safety related functions.

- Turbine Gland Seal System – The turbine gland seal system prevents air in-leakage and steam out-leakage from the shaft/casing seals of the turbine. The system returns condensed steam to the condenser. The turbine gland seal system serves no safety related functions.

- Turbine Lube Oil System – The turbine lube oil system supplies lubricating oil to the main bearing, thrust bearing and turning gear of the main turbine. The turbine lube oil system serves no safety related functions.

- Auxiliary Steam System – The auxiliary steam system supplies steam from the auxiliary boiler or main steam system for plant usage during start-up. The auxiliary steam system serves no safety related functions.

7.2 Electrical Systems

[

] [CCI per Affidavit 4(a) – 4(d)]

The main generator supplies power to plant auxiliaries during normal plant operation through an isolated phase bus duct and the unit auxiliary transformer. Offsite power to plant auxiliaries during startup, shutdown and outage conditions is supplied via back-feed from the main transformer and the unit auxiliary transformer, with the generator circuit breaker open. If the unit auxiliary transformer is not available, offsite power is supplied via the reserve auxiliary transformer.

[

] [CCI per Affidavit 4(a) – 4(d)]

Non-safety related circuits are physically separated from Class 1E safety circuits throughout the plant. Redundant Class 1E circuits and equipment are also physically separated and electrically isolate; and cross-ties between buses or circuits of redundant channels are not permitted.

The arrangement of the safety related and non-safety related equipment and circuits is also such that safe shutdown can be achieved if a fire (including the effects of smoke, hot gases, fire suppressant, etc.) in one area renders all equipment located in that area inoperable.

7.3 Auxiliary Equipment, Facilities and Systems

B&W *mPower* reactor auxiliary equipment, facilities and systems include the following, or portions thereof:

- Administration Building – The Administration Building is a standard commercial quality structure that provides office space for engineering, operations support and administrative personnel. The Administration Building serves no safety related functions.

- Component Cooling Water System – The component cooling water system is a closed-loop system that transfers heat from various plant components to the service water system. The component cooling water system serves no safety related functions.

- Condensate Storage Tank – The condensate storage tank provides storage for condensate that is used for secondary side make-up. The condensate storage tank serves no safety related functions.

- Demineralized Water System – The demineralized water system provides demineralized water for use throughout the plant. The demineralized water system serves no safety related functions.

- Diesel Fuel Oil Tanks – The diesel fuel oil tanks provide storage of fuel oil for the standby diesel generators. The tanks are enclosed by a berm to ensure containment of potential spills. The diesel fuel oil storage tanks serve no safety related functions.

- [ ] [CCI per Affidavit 4(a) – 4(d)]

- Fire Protection Enclosure – The fire protection enclosure houses a diesel fire pump, an electric fire pump, and a jockey pump. The fire protection enclosure is a standard commercial quality structure that provides weather protection for the equipment housed therein. The fire protection enclosure serves no safety related functions.

- Fire Protection System – The fire protection system serves to prevent injury, loss of life and minimize equipment damage in the event of a fire via the use of detection and suppression systems. The fire protection system serves no safety related functions.

- Fire Water Storage Tanks – The fire water storage tanks are the primary water source for the fire pumps. The fire water storage tanks serve no safety related functions.

- Guardhouses – The guardhouses are enclosed and elevated structures that provide ballistic protection, permit visual surveillance of the station area, and provide clear fields of fire. The guardhouses serve no safety related functions.

- Instrument and Service Air Systems – The instrument and service air systems provide compressed air for various components and usages. Instrument air provides filtered, dried and oil-free air to valves, dampers and instrumentation that use air as a motive source. Service air provides filtered, oil-free air to various locations for air-operated tools and other equipment. Except for containment isolation, the instrument and service air systems serve no safety related functions.

- Material Handling Equipment – Material handling equipment includes cranes, hoists, trolleys and associated supporting rails, etc. The material handling equipment serves no safety related functions.

- Service Water System – The service water system provides pre-treated water to the demineralized water system and to the blowdown sump pits in the turbine vents and drains system. The service water system also provides service water for plant areas such as the water treatment building, air-cooled condenser, maintenance shops and fire protection enclosure. The service water system serves no safety related functions.

- Plant Communication System – The plant communication system provides intra-plant communications and offsite communications during normal, off-normal and accident conditions including loss of off-site power. The plant communication system serves no safety related functions.

- Plant Lighting System – The plant lighting system includes normal, emergency, panel and security lighting. The plant lighting system serves no safety related functions.

- Potable Water System – The potable water system provides potable water for domestic use and human consumption. The potable water system serves no safety related functions.

- Raw Water System – The raw water system provides water for plant needs including fire protection, cooling water fill and makeup, and other uses. The raw water system serves no safety related functions.

- Security Building – The Security Building is designed to withstand vehicle-borne threats. The building contains the plant worker access control point and the central alarm station. The worker access control point includes metal detection, explosives detection and package screening equipment. The Security Building serves no safety related functions.

- Training Center – The Training Center is a standard commercial quality structure that provides space for general employee training, radiation worker training, industrial safety training, etc. The Training Center serves no safety related functions.

- Turbine Building Closed Cooling Water System – The turbine building closed cooling water system provides a clean, non-fouling, non-scaling source of cooling water to equipment in the Turbine Building. The turbine building closed cooling water system transfers heat from serviced equipment to the atmosphere via fin-fan coolers. The turbine building closed cooling water system serves no safety related functions.

- Warehouses – The warehouses are standard commercial quality structures that house station consumables, replacement parts, shops, etc.. The warehouses store material and provide a work location for pre-fabrication of assemblies to be installed as part of maintenance and outage work. The warehouses serve no safety related functions.

- Waste Water System – The waste water system collects and processes equipment and floor drains in the Turbine Building. The waste water system serves no safety related functions.

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8.0 SUMMARY

The B&W *mPower* reactor is an evolutionary PWR design, with roots back to the nuclear steam propulsion system used on the merchant ship Otto Hahn in the 1960's. In particular, the B&W *mPower* reactor is a light-water-cooled reactor based on conventional PWR fuel and core design attributes, conventional containment design, and conventional defense-in-depth principles.

Incorporated in the B&W *mPower* reactor are a number of features to improve constructability, reduce overall plant complexity, and enhance availability. These include:

- Proven Standard Technology
- Rail and Heavy Truck Shippable Components
- Fewer, Smaller, Simpler Components
- Passive Safety Functions
- Four Year Operating Cycle
- 60-Year Plant Life

The B&W *mPower* reactor also includes a number of significant technological enhancements, relative to conventional reactor designs, the result of which is to preclude the need for active engineered safety features and reduce or eliminate the consequences of a number of traditional design basis accidents. These enhancements are summarized in Table 8-1 and include, but are not limited to, an integral reactor arrangement, no active safety systems, a below-grade containment, and no reliance on emergency AC power or operator action for at least 72 hours following a postulated accident.

Table 8-1 – B&W *mPower* Reactor Safety Features

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] [CCI per Affidavit 4(a) – 4(d)]