GE Hitachi Nuclear Energy

Ontario Power Generation Inc.
Darlington New Nuclear Project:

BWRX-300 Preliminary Safety Analysis Report

ONTARIO POWER GENERATION

OPG Document Number	
NK054-SR-01210-00001	
OPG Security Classification	
OPG Proprietary	
ACCEPTED	X
ACCEPTED AS NOTED	
REVISE AND RESUBMIT	
October 12, 2022	
Signature	**Date**
Name: Karim Osman	
Dept: New Nuclear Design Engineering	
This acceptance does not relieve the contractor from responsibility for errors or omissions or from any obligations or liability under this contract.	
Notes:	

Revision 0

September 30, 2022

GE Hitachi Nuclear Energy

NEDO-33950
Revision 2
October 7, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 1
Introduction and General Considerations

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ACI	American Concrete Institute
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOO	Anticipated Operational Occurrence
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
BIS	Boron Injection System
BPVC	Boiler and Pressure Vessel Code
BWR	Boiling Water Reactor
CANDU	CANada Deuterium Uranium
CB	Control Building
CNSC	Canadian Nuclear Safety Commission
CRD	Control Rod Drive
CSA	CSA Group
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DEC	Design Extension Condition
D-in-D	Defence-in-Depth
DL	Defense Line
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
EME	Emergency Mitigating Equipment
EOC	Emergency Operations Centre
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
ESBWR	Economic Simplified Boiling Water Reactor
FMCRD	Fine Motion Control Rod Drive
FPC	Fuel Pool Cooling and Cleanup System
FSF	Fundamental Safety Function

Acronym	Explanation
GEH	GE Hitachi Nuclear Energy
GSS	Guaranteed Shutdown State
HCU	Hydraulic Control Unit
HX	Heat Exchanger
IAEA	International Atomic Energy Agency
IC	Isolation Condenser
ICC	ICS Pool Cooling and CleanUp System
ICRP	International Commission on Radiological Protection
ICS	Isolation Condenser System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISFSI	Independent Spent Fuel Storage Installation
ISO	International Organization for Standardization
LCH	Licence Conditions Handbook
LOCA	Loss-of-Coolant Accident
LTC	Licence to Construct
MCR	Main Control Room
NBS	Nuclear Boiler System
NEI	Nuclear Energy Institute
NERC	North American Electric Reliability Corporation
NFPA	National Fire Protection Association
NPP	Nuclear Power Plant
NRCC	National Research Council of Canada
NSCA	Nuclear Safety and Control Act
OER	Operating Experience Review
OPG	Ontario Power Generation
PCCS	Passive Containment Cooling System
PIE	Postulated Initiating Event
PLSA	Plant Services Area
PSA	Probabilistic Safety Assessment
PSAR	Preliminary Safety Analysis Report
RB	Reactor Building

Acronym	Explanation
RCPB	Reactor Coolant Pressure Boundary
RG	Regulatory Guide
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
SAMG	Severe Accident Management Guideline
SCA	Safety and Control Area
SCCV	Steel-Plate Composite Containment Vessel
SCN	Non-Safety Class
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SFPE	Society of Fire Protection Engineers
SMR	Small Modular Reactor
SSC	Structures, Systems, and Components
TB	Turbine Building
USNRC	U.S. Nuclear Regulatory Commission

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION AND GENERAL CONSIDERATIONS

1.1 Introduction

The Darlington New Nuclear Project (DNNP) will provide a new Class I nuclear facility, as defined by the Nuclear Safety and Control Act (NSCA), that is a critical new source of clean electricity for the Province of Ontario's future energy needs and achieving Canada's commitment to be Net-Zero by 2050. The DNNP will be implemented at the existing Darlington Nuclear site that is owned and operated by Ontario Power Generation (OPG).

The Darlington Nuclear site (see Appendix A Figure A1.1-1), is located in the township of Darlington, on the north shore of Lake Ontario at Raby Head, approximately 70 km east of Toronto. The site is approximately 5 km southwest of the community of Bowmanville and 10 km southeast of the City of Oshawa. Immediately to the east of the site is St. Marys Cement limestone quarry and processing plant. The site is traversed by an east-west operating Canadian National (CN) railway and a 8.5m high berm that provides the site protection in the event of a railway accident. The site is also traversed by the Lake Ontario Waterfront Trail, which is a multi-use recreation trail extending from Niagara-on the-Lake to the Quebec border along the north shores of Lake Ontario and the St. Lawrence River.

Currently, the Darlington Nuclear site (see Appendix A Figure A1.1-2) is home to the 3512 megawatt-electric Darlington Nuclear Generating Station (DNGS), comprised of four operating CANada Deuterium Uranium (CANDU) pressurized heavy water generating reactors, the Tritium Removal Facility (TRF) that serves all of Ontario's CANDU nuclear reactors, and the Nuclear Sustainability Services-Darlington that stores spent nuclear fuel from the DGNS. The DNNP site is in the eastern one-third of the site bounded by the site property limits to the east and north, by Lake Ontario to the south, and by Holt Road to the west.

The DNNP site is also owned by OPG. OPG is the holder of a Nuclear Power Reactor Site Preparation Licence 18.00/2031. This licence permits OPG to perform activities to prepare the DNNP site for the future placement of a nuclear facility. In December 2021, OPG announced that the selected technology for this nuclear facility to be the grid-scale BWRX-300 Small Modular Reactor (SMR), designed by GE-Hitachi Nuclear Energy Americas, LLC (GEH). The BWRX-300 is approximately 300 megawatt-electric in size and, is capable of preventing between 0.3 and 2 megatonnes of carbon dioxide emissions per year, depending on the kind of alternative power generation technology it is displacing. OPG also announced that it will submit a Licence to Construct (LTC) application in accordance with the NSCA, Class I Nuclear Facilities Regulations (SOR/2000-204) and CNSC REGDOC-1.1.2 by the end of 2022. Once granted, the LTC will permit the construction of one BWRX-300.

In accordance with paragraph 5(f) of SOR/2000-204, this Preliminary Safety Analysis Report (PSAR) supports OPG's LTC application and demonstrates the adequacy of the design of BWRX-300. This PSAR has been prepared collaboratively between GEH and OPG and in accordance with the guidance of the International Atomic Energy Agency (IAEA) as documented in their Specific Safety Guide No. SSG-61, Format and Content of the Safety Analysis Report for Nuclear Power Plants.

1.1.1 Format of the Safety Analysis Report

It is recognized by the CNSC Regulatory Framework and IAEA guidance that Safety Analysis Reports (SARs) are developed in an iterative manner to support the appropriate licensing activities at the appropriate time. Since this release supports OPG's LTC application, this version of the SAR is a PSAR and contains sufficient design information commensurate with the stage of the design progression to assess and demonstrate that the plant can be safety constructed. The

PSAR will be updated to a Pre-Operational Safety Analysis Report with more detailed design information to support OPG's Licence to Operate application at the appropriate future time.

The following describes the format of the DNNP SAR and includes a brief description of the content of each chapter. Information presented in each chapter is commensurate with its importance to nuclear safety and PSAR purposes.

Chapter 1: Introduction and General Considerations

Information in this chapter describes the DNNP and the PSAR, including their purposes and objectives. It describes DNNP facilities at a high level and the national and international guidance applied to the BWRX-300.

Chapter 2: Site Characteristics

Information in this chapter describes the characteristics of the DNNP site on which the BWRX-300 facility is planned to be constructed. The information represents the baseline data which is used to ensure that site-related uncertainties are addressed and dispositioned in the final design and safety assessment of the BWRX-300 facility. This chapter describes the geological, seismological, hydrological, meteorological, and geotechnical features of the DNNP site and the surrounding region. It also describes the site-specific natural and human-induced external hazards including radiological conditions due to external sources and their dispersion characteristics. Furthermore, this chapter describes present and projected population distribution and land use relevant to the safe design and operation of the BWRX-300 facility over its expected 60-year operational life.

Chapter 3: Safety Objectives and Design Rules for Structures, Systems, and Components

This chapter is specific to the BWRX-300 and introduces the safety objectives and the safety strategy framework to meet those objectives for its design and construction at DNNP. Additionally, this chapter describes the design rules for classification of Structures, Systems, and Components (SSC) important to safety, and the design principles and safety requirements established for the BWRX-300.

Chapter 4: Reactor

This chapter is specific to the BWRX-300 and describes the design of its reactor and fuel assembly in more detail. It also provided the relevant information on the reactor that demonstrates its capability to fulfil relevant safety functions throughout the design life in all plant states.

Chapter 5: Reactor Coolant System and Associated Systems

This chapter is specific to the BWRX-300 and describes Nuclear Boiler System (NBS) and interfacing systems that form the Reactor Coolant Pressure Boundary (RCPB). Further, the information in this chapter demonstrates that the functional and structural integrity aspects of the various NBS SSC are designed with robustness, quality, independence, redundancy, and diversity to maintain adequate reactor coolant inventory during Anticipatory Operational Occurrences (AOOs), Design Basis Accidents (DBAs), and Design Extension Conditions (DECs).

Chapter 6: Engineered Safety Features

This chapter is specific to the BWRX-300 and describes its engineered safety features provided to mitigate the consequences of AOOs and DBAs. The engineered safety features are divided into three general groups: (1) Containment and Associated Systems; (2) Isolation Condenser System (ICS) functioning as the Emergency Core Cooling System; and (3) Control Room Habitability.

Chapter 7: Instrumentation and Control

This chapter is specific to the BWRX-300 and describes its Instrumentation and Control (I&C) systems. The information in this chapter is organized to systematically present the I&C design bases in the necessary context to support an understanding of the individual I&C system designs and safety features.

Chapter 8: Electrical Power

This chapter is specific to the BWRX-300 and describes its electrical system and requirements and how they interface with Darlington Nuclear site and Ontario's electrical transmission system.

Chapter 9A: Auxiliary Systems

This chapter is specific to the BWRX-300 and describes its auxiliary systems (e.g., fuel handling, water, air, HVAC, fire protection, diesel generators, cranes, etc.) that support its safe and reliable operations.

Chapter 9B: Civil Engineering Works and Structures

This chapter is specific to the BWRX-300 and describes how its general seismic design requirements are complied with in the design of the Reactor Building (RB). Information is also provided describing the general civil and structural design requirements for the Radwaste Building (RWB), Control Building (CB), Turbine Building (TB), Plant Service Area (PLSA), Intake and Discharge Structures, Forebay and tunnels to and from the lake and Fire Pump Enclosure.

Chapter 10: Steam and Power Conversion Systems

This chapter is specific to the BWRX-300 and describes design of the power conversion system, including the Main Turbine Equipment, which is comprised of the High Pressure and Low Pressure Turbines, Turbine Gland Seal System, Turbine Lubricating Oil System, Extraction Steam System, Electro-Hydraulic Controls System, and Turbine Auxiliary Steam Subsystem.

Chapter 11: Management of Radioactive Waste

Information in this chapter describes the main sources of liquid, gaseous and solid radioactive waste including the radiological source term used in calculating liquid and airborne effluent. Also described are the radioactive waste processing systems (i.e., pretreatment, treatment, and conditioning systems) as well as temporary waste storage located on the site. The SSCs that monitor and sample the process and effluent streams to measure and control the discharge of radioactive materials generated in operational states and accident conditions are described.

The measures proposed for the safe management of radioactive and hazardous waste of all types that will be generated throughout the lifetime of the plant as well as how these measures meet the relevant safety requirements including the measures taken for the safe management and disposal of this waste are described in OPG's Waste Management Program.

Chapter 12: Radiation Protection

Information in this chapter describes the administrative programs and procedures, in conjunction with facility design, that ensures occupational radiation exposure to personnel is kept As Low As Reasonably Achievable (ALARA). The systematic application of the ALARA philosophy during the design phase of the BWRX-300 that establishes the basic design criteria observed to reduce occupational exposure during plant operation and maintenance, decommissioning and post-accident ALARA are described.

Chapter 13: Conduct of Operations

Information in this chapter describes how OPG fulfils its prime responsibility for safety in the operation of the BWRX-300. Specifically, this chapter describes important operational issues relevant to nuclear safety, approaches adopted by OPG to address these issues through its operational programs and provisions made by OPG that establish and maintain an adequate number of qualified staff. The preparation of OPG operating procedures for the BWRX-300 that ensure its safety is supported by GEH.

Chapter 14: Plant Construction and Commissioning

Information in this chapter describes how OPG assures that the BWRX-300 will be suitable for service prior to entering the construction, commissioning, and operational stages. The commissioning program and organization intended to verify and validate the plant's performance against the design prior to the turnover of the facility to OPG for operation are described. Additionally, information is provided on how OPG qualified operating personnel at all levels are trained and directly involved in the commissioning process.

Chapter 15: Safety Analysis

This chapter is specific to the BWRX-300 and describes the results from the BWRX-300 plant safety analyses that includes the Deterministic Safety Analysis, Severe Accident Analysis, Hazard Analysis and Probabilistic Safety Assessment (PSA). It describes how the safety analysis verifies, throughout the iterative design and analysis process, that the design of the BWRX-300 adequately performs the Fundamental Safety Functions (FSF) of controlling reactivity, fuel cooling, long-term heat removal, and containment of radioactive materials.

Chapter 16: Operational Limits and Conditions for Safe Operation

Information in this chapter describes how the facility's safe operating envelope is evaluated and implemented through a set of operational limits and conditions that prescribe boundaries within which OPG must operate the BWRX-300 to assure compliance with the safety analysis inputs, assumptions, and results. The full set of operational limits and conditions are a key element of the licensing basis for a Licence to Operate.

Chapter 17: Management for Safety

Information in this chapter describes how the overall management of all safety related activities is assured throughout the entire lifecycle of the facility. It describes the general, specific, quality management, performance improvement, and safety culture elements of the management systems of OPG and the organizations, such as GEH, that support the development, operation, and eventual retirement of DNNP facilities.

Chapter 18: Human Factors Engineering

This chapter is specific to the BWRX-300 and describes the Human Factors Engineering program for the development lifecycle phases (i.e., design, construction, and commissioning) of the BWRX-300. This chapter demonstrates the effective integration of Human Factors Engineering requirements and analysis results into the design of the plant in an iterative process.

Chapter 19: Emergency Preparedness and Response

Information in this chapter demonstrates that in a very unlikely nuclear or radiological emergency occurring at the DNNP facility, timely and effective actions are taken that protect workers, the public, and the environment coordinated with off-site government agencies and supported by a documented decision-making process.

Chapter 20: Environmental Aspects

Information in this chapter describes the environmental aspects important for the development, operation, and retirement of the DNNP facilities. General aspects of the Environmental Impact Assessment, applicable principles, and regulations, OPG's Environmental Management System, and site characteristics are described. Features that minimize environmental impact of the facility throughout its entire lifecycle, including postulated accidents, are also described.

Chapter 21: Decommissioning and End of Life Aspects

Information in this chapter demonstrates their commitment to the production of energy in a sustainable manner through the effective and efficient life-cycle management of the nuclear facilities. The planning for decommissioning and end-of-life management of DNNP facilities, including the BWRX-300 reactor, is an integral aspect of the facility life-cycle management process that is described in this chapter.

Safeguards Annex: Safeguards and Nuclear Material Accountancy

Information is presented in the Safeguards Annex to demonstrate how OPG supports compliance with the IAEA safeguards agreement in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons and the Additional Protocol to the Safeguards Agreement. Under the NSCA, the CNSC has the mandate to achieve Canadian conformity with such international obligations. Specifically, this Safeguards Annex describes information related to the BWRX-300 reactor facility at the DNNP to demonstrate compliance with the international agreements, as well as compliance with the responsibilities included in the NSCA and the General Nuclear Safety and Control Regulations (SOR-2000-202).

Security Annex: Darlington BWRX-300 Security Assessment

Detailed information about the protected area and vital areas, including their structures and/or barriers, are provided in a separate security annex since the content contains prescribed information as defined by Section 21 of the General Nuclear Safety and Control Regulations (SOR/2000-202).

1.1.2 DNNP Project Delivery

OPG will implement DNNP through a project delivery model described in Section 1.2 having a target in service date as early as 2028. The DNNP is composed of the following five key projects that will assure its safe and efficient implementation:

1. Site Preparation Project
2. Power Block Project
3. Switchyard & Grid Connection Project
4. Intake / Discharge Water System Project
5. Digital Strategy Project

1.1.3 PSAR Verification Scope

The PSAR is a licensing basis document that is prepared, validated, and approved in accordance with GEH's Quality Assurance Program, which assures:

1. Accuracy of information against verified engineering source documentation
2. Sufficient information to support the Licence to Construct (LTC) in accordance with CNSC REGDOC-1.1.2

3. Alignment with the stage at which the design has progressed and its supporting safety analysis

1.1.4 PSAR Limitation of Use

The PSAR is a high-level summary document developed to support the LTC application activities for DNNP only. It is released for information and licensing purposes only and shall not be used for technical or construction purposes.

1.2 Project Implementation

For the DNNP development lifecycle phase, OPG will utilize an Integrated Project Delivery contract model which maximizes integration and collaboration with other contract partners involved with this phase. The Integrated Project Delivery contract agreement describes the relationship and accountabilities of the contract partners including Owner (OPG), Developer (GEH), Constructor, and Architect Engineer.

Key principles of the contract model include collaborative behaviours, common information systems, best athlete approach to staffing positions, risk and reward sharing, transparency between partners, and maximizing efficiencies.

Roles and responsibilities for all contract partners are defined and accepted through contractual agreements for the project. The partner roles are further described in Chapter 17, Subsection 17.2.1.

1.3 Identification of Interested Parties Regarding Design, Construction and Operation

The Developer, GEH, is the Design Authority for scoped design activities in accordance with the project execution model until turnover.

The Constructor is responsible for procurement, construction, and support of commissioning activities.

An Architect Engineering firm performs design and engineering activities required for the project.

The owner and the licence applicant, OPG, is ultimately responsible for DNNP operation and retains the overall accountability for ensuring the project lifecycle is executed with quality and safety.

The contractual agreement between the stakeholders details specific responsibilities and interfaces are further detailed in Chapter 17.

1.4 Information on the Plant Layout and Other Aspects

The DNNP site layout, infrastructure, intake and discharge water, Switchyard, BWRX-300 Power Block, and their respective interfaces are shown in Appendix A (see Figures A1.4-1 and A1.4-2).

Descriptions of the site layout, infrastructure, intake and discharge water, and Switchyard are provided in this Section.

Descriptions of the BWRX-300 Power Block are provided in Section 1.5.

1.4.1 Site Layout and Infrastructure

The DNNP site will contain infrastructure, including additional buildings, to support operations inside the Power Block.

Currently anticipated services include:

1. A demineralized water supply pipeline extending from the Darlington Demineralized Water Plant eastwards approximately 400m towards the DNGS/DNNP property line along the Third Line Road corridor. The demineralized water is used for the Power Block operations.
2. A potable water pipeline extension tying into the existing municipal water supply just south of the CN railway and west of Holt Road bridge on the west side of the road. This pipe carries potable water for use inside the power block as well as various outbuildings around the DNNP property including the administration building, warehouse, temporary construction buildings, and potentially other buildings to be determined.
3. Sanitary sewer connections to the existing Darlington East Sewage Lift Station are planned. These carry sewage from inside the power block as well as the administration building, warehouse, and potentially other buildings not yet determined, to the lift station. From here the effluent is pumped north and west towards the Courtice Water Pollution Control Plant for treatment and eventual discharge to Lake Ontario.
4. Fibre-optic cables for a business Local Area Network and copper telephone/public address cables to create a communications link between DNGS and DNNP. These run from the DNGS Engineering Support Services Building in an underground duct bank eastwards approximately 400m towards the DNGS/DNNP property line mostly along the Second Line Road corridor.
5. Additional fibre-optic cables for a security Local Area Network are brought from the Darlington Main Security Building approximately 600m east towards the DNGS/DNNP property line in an underground duct bank mostly along the Second Line Road corridor.
6. Up to 10MW of construction power are brought from the existing 54M15 feeder through Darlington DS5 substation at 13.8kV, located near the intersection of Park Road and Second Line, approximately 1km east to a new switchgear to be located near the northeast corner of the Nuclear Sustainability Services-Darlington. This switchgear is planned to feed construction loads as well as the new administration building and warehouse. A second feed will be taken from the same 54M15 through the existing Darlington DS1-F1 substation at 8.32kV and will supply construction loads including the construction trailers.

Planned structures/features include:

1. An administration building with office spaces and a simulator training space. The simulator space will support the SMR full scope simulator and desktop simulator plus limited maintenance training space.
2. A warehouse is necessary to provide long term storage space for SMR components and equipment. It has some maintenance space and a calibration shop suitable for the service of non-contaminated equipment.
3. There is a parking lot near the administration building. There is an existing parking lot south of the Canadian National Railway near the border between DNNP and St. Marys Cement that will also be utilized.
4. A Steel Bricks production facility is planned to be constructed on the northwest quadrant of the intersection of Maple Grove Road and Second Line. This facility produces the Steel Bricks components for the construction of the reactor building.
5. A concrete batching plant will be provided suitably located if it is determined that onsite concrete batching is required.
6. Holt Road will be improved in two phases:
   a. Phase 1 - The Holt Road extension is a new stretch of road to be built from the intersection of Second Line and Old Holt Road at the northwest corner of DNNP property. This will extend south along the DNGS/DNNP property line between the Nuclear Sustainability Services-Darlington and the SMR facility until it reaches Lake Ontario. At this point it turns west and continues until it connects with the existing Lakeshore Road. The portion of Holt Road along Lake Ontario will be reinforced, and form part of the heavy haul route used to transport heavy components from the DNGS wharf to DNNP.
   b. Phase 2 - The Holt Road expansion will add an additional northbound lane from Second Line north towards Highway 401. This additional lane will end south of Energy Drive and will be used by soil transport trucks to place soil onto the northern parts of DNNP property forming the spoils piles. There will also be a new southbound left turn lane to be created just south of the Holt Road bridge to aid traffic turning onto DNNP property.
7. The existing Old Holt Road that stretches diagonally across DNNP property will be kept intact up to the point it joins the ring road around the Power Block facility.
8. The heavy haul road along Lakeshore Road will extend east onto DNNP property to support the construction of the Power Block. It is planned to extend as far east as the Power Block facility and then extend only as far north as necessary to support the Power Block facility construction.
9. Maple Grove Road is planned to be improved and extended south and then west to join the heavy haul road at the south part of the DNNP property. The improvements will likely include a new bridge to cross over the Canadian National Railway.
10. A soil conditioning pile is created from excavated earth during the site preparation phase and located at the southeast quadrant of the Maple Grove Road and Second Line intersection. This soil will be reconditioned and placed back into the SMR facility foundation.

11. A soil spoils pile is located in the northern part of DNNP property south of Energy Drive and west of Maple Grove Road. Excavated earth from the site preparation phase will be placed here.

12. Storm water management features are part of the overall site layout. One known feature is the relocation of the existing Bowmanville SS drainage ditch that currently runs from Bowmanville SS through DNNP property, southeast along Old Holt Road and draining into Lake Ontario. This will be relocated west to run along the eastern edge of the new Holt Road Extension.

1.4.2 DNNP Switchyard

The local DNNP switchyard (see Appendix A, Figure A1.4-2) is located North of the SMR Facility, East of the Extended Holt Rd and South of the CN Rail tracks. The local switchyard consolidates power produced by the Power Block facility. The Power Block facility has two 230kV lines connected to the local DNNP switchyard. One line connects the Facility Generator Step Up Transformer, and one line connects to the Reserve Auxiliary Transformer. The local switchyard has two redundant 230kV connections with the transmitter. The transmitter is working to connect these lines to Clarington TS, 22km North of the DNNP site.

The operating organization is responsible for the ownership and operation of the local DNNP switchyard, containing the high voltage circuit breakers and disconnect switches, in addition to equipment within the Power Block facility. Hydro One, the transmitter for the electrical grid, is responsible for the ownership and operation of the two redundant 230kV lines connecting the local DNNP switchyard with Clarington Transformer Station.

1.4.3 Normal Heat Sink

The normal heat sink removes excess heat to a large water body. For the DNNP, water withdrawn from Lake Ontario flows through the plant surface condensers to remove the excess energy of the turbine exhaust steam. The amount of heat removed during this process depends on the flow rate and the temperature rise of the water passing through the condensers. The plant heat is rejected to Lake Ontario.

Cooling water from Lake Ontario is delivered to an intake structure for the nuclear facility through an intake tunnel. The intake structure sends the cooling water to the Pumphouse/Forebay that contains circulating water pumps which deliver the cooling water to plant surface condensers before returning the heated water back to the lake through the discharge tunnel.

The Normal Heat Sink includes, but is not limited to the following:

1. Intake Tunnel, located deep in Lake Ontario to meet regulatory commitments (D-C-1) to decrease potential impacts to fish habitat and is sized to provide the required flow of cooling water to the plant. It is also constructed to minimize the intake velocity to prevent impingement and entrainment of fish and effect on local currents.
2. Discharge Tunnel and diffusers are constructed deep in Lake Ontario to meet regulatory requirements by limiting the temperature increase to minimize thermal and flow effects of the plant cooling water discharge to ensure surface water temperature does not exceed 2 degrees C above ambient surface temperature and minimize impact to aquatic habitat.
3. Pumphouse/Forebay is composed of the forebay, pump bays and superstructures to house the Circulating Water System pumps and related equipment.

1.4.4 Security Building

A security building, known as the Protected Area Access Building, is provided on the protected area boundary to allow for ingress and egress to and from the protected area. Additionally, a sally port is provided adjacent to the security building to allow for vehicular traffic to enter the protected area. Detailed information about the protected area and vital areas, including their structures and/or barriers, are provided in a separate security annex since the content contains prescribed information as defined by Section 21 of the General Nuclear Safety and Control Regulations (SOR/2000-202).

1.5 General BWRX-300 Power Block Description

The BWRX-300 is a Boiling Water Reactor (BWR) that employs natural circulation and passive emergency cooling features and is rated at approximately 300 megawatts-electric.

The passive design features of the BWRX-300 provide decay heat removal capability using only installed systems with no reliance on operator actions or external resources for at least 72-hours. For the BWRX-300, a safe stable condition ("stable shutdown") is defined as safe shutdown with average reactor coolant temperature ≤ 215.6°C (420°F). Following 72-hours post-accident, on-site or off-site resources are used to power non-safety equipment for proceeding to cold shutdown conditions, as needed.

The BWRX-300 design applies a defence-in-depth process for safety assessment and safety analysis to ensure that radiological acceptance criteria are met. The leveraging of passive design features greatly simplifies the design and results in a significant reduction in total number active SSCs compared to conventional Nuclear Power Plants (NPPs).

The overall safety objectives and the safety strategy employed in the development of the BWRX-300 design are described in detail in Chapter 3.

1.5.1 Basic Technical Characteristics

The principal technical characteristics of the BWRX-300 are provided in Table 1.5-1.

Table 1.5-1: Principal Characteristics of Interest for the DNNP BWRX-300

Parameter Description	Value	Comments
Type of plant	Boiling Water Reactor	
Core coolant	Light Water	
Neutron moderator	Light Water	
Nuclear Steam Supply System layout	Direct-Cycle	
Primary circulation	Natural	
Thermodynamic cycle	Rankine	
Type of containment structure	Dry	
Reactor thermal power level	870 MWth	
Normal Heat Sink	Once Through Cooling System using water from Lake Ontario	
Ultimate Heat Sink	ICS pools	Pools are vented to atmosphere
Plant gross electrical power output	~ 300 MWe	
Plant Footprint	~ 9,800 m2	Rectangular building envelope
Site Footprint	~ 30,000 m2	Fenced area
Design life	60 years	
Exclusion Zone	350 m (radius)	Measured from exterior of the Reactor Building
Seismic Design (DBE)	0.310 g (horizontal and vertical) 0.532 g (horizontal) 0.516 g (vertical)	Bounding rock peak ground acceleration Bounding surface peak ground acceleration
Reactor Design Pressure	10.3 MPa	
Fuel	UO2 pellets	
Fuel enrichment	<5% U-235	
RPV diameter (ID)	~ 4 m	
RPV height (Inside)	~ 26 m	
Control rod drive type	Fine Motion Control Rod Drive (FMCRD)	
Containment Vessel type	Steel-plate Composite	
Fuel pool capacity	Up to 8 years of full-power operation	Fuel pool accommodates up to 8 years.of spent fuel plus one core load of new fuel and one full core off-load
Refueling cycle	12 - 24 months	

Parameter Description	Value	Comments
Emergency Power Supply	Safety Class 1 DC batteries	Capable of sustaining required loads for 72 hours

1.5.2 Primary Drawings

An overview of the primary buildings/structures in the Power Block of the BWRX-300 is shown in Figure A1.5-1 of Appendix A and is discussed below. The Reactor Building, Turbine Building, Radwaste Building, Control Building, and Plant Services Area (PLSA) are specifically referenced in the descriptions below.

The plant grade elevation of the power block is approximately 88 meters Canadian Geodetic Vertical Datum of 1928. The overall Power Block length is approximately 143 meters and width is approximately 69 meters. The approximate dimensions of the power block buildings are provided in Table 1.5-2.

Table 1.5-2: Approximate Dimensions of Power Block Buildings

Building	Length (m)	Width (m)	Highest Roof Elevation (m)
Reactor Building(1)	36 (Diameter)	36 (Diameter)	30 (Exterior Dome Top)
Turbine Building	70	69(3)	30(4)
Radwaste Building(2)	38	25	24(5)
Control Building	35	69(3)	10(5)
Reactor Auxiliary Bay(6) +	38	18(7)	10 m at the highest roof

(1) The bottom elevation of the Reactor Building foundation is approximately 36 m below grade.

(2) The Radwaste Building wraps around the Reactor Building. Width of Radwaste Building is given as the shortest dimension of the building measured in the east-west direction.

(3) The Turbine Building and Control Building width include portions of the Plant Services Area.

(4) The height of the Turbine Building does not include the stacks or stairwells.

(5) The height of the Radwaste Building and Control Building does not include chillers, ductwork, or other items on the roof.

(6) The Reactor Auxiliary Bay is a portion of the Plant Services Area, to the east of the Reactor Building, that is supported on an independent foundation with respect to the surrounding Reactor Building, Control Building, and Turbine Building.

(7) The Reactor Auxiliary Bay wraps around the Reactor Building. The width of Reactor Auxiliary Bay is given as the largest dimension of the building measured in the east-west direction.

(8) For consistency, the length and width values in the table are all in the same direction. For DNNP-1, length is north-south, and width is east-west.

Refer to Chapter 3, Subsection 3.3.1, and Chapter 9B, Section 9B.2 and 9B.3 of the PSAR for additional information on seismic design of structures.

1.5.2.1 Reactor Building

The RB is a Safety Category 1 and Seismic Category A structure. It is a cylindrical shaped structure embedded in a vertical shaft to a depth of approximately 36 m below grade. The Reactor Pressure Vessel (RPV), Steel-plate Composite Containment Vessel (SCCV) and other important systems and components are located in the deeply embedded RB vertical right-cylinder shaft to mitigate effects of external events, including aircraft impact, adverse weather, fires, and earthquakes. The Secondary Control Room (SCR) is located in the RB. The below-grade portion also contains reactor support and safety class systems and the Safety Class 1 power supply and equipment. The reactor cavity pool is above the containment dome. Also, within the RB, three separate Isolation Condenser System (ICS) pools sit next to the reactor cavity pool above the SCCV, with one isolation condenser located in each pool. The Fuel Pool is also located in the RB.

1.5.2.2 Turbine Building

The TB houses the steam turbine generator, standby diesel generators, main condenser, condensate and feedwater systems, turbine-generator support systems, and parts of the Offgas System (excluding the offgas charcoal adsorbers).

While considered a separate functional area from the Turbine Building, the northern portion of the PLSA is structurally integrated with the Turbine Building. See Section 1.5.2.5 for a description of the PLSA.

The TB is a Safety Class 2 structure and is categorized as Non-Seismic. Additionally, it is evaluated for seismic interaction to ensure that it will not compromise the structural integrity and safety functions of the adjacent Seismic Category A RB following a Design Basis Earthquake (DBE) or extreme Tornado wind conditions.

1.5.2.3 Control Building

The CB houses the MCR, Emergency Operations Centre (EOC), electrical, control, and instrumentation equipment. The CB is a Safety Class 2 structure and is categorized as Non-Seismic. Additionally, it is evaluated for seismic interaction to ensure that it does not compromise the structural integrity and safety functions of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions. The CB serves as main entrance and exit for the Power Block unit during normal operations.

While considered a separate functional area from the Control Building, the southern portion of the Plant Services Area (PLSA) is structurally integrated with the Control Building. See Section 1.5.2.5 for a description of the PLSA.

1.5.2.4 Radwaste Building

The RWB houses rooms and equipment for handling, processing, and packaging liquid and solid radioactive wastes as well as the Offgas System charcoal adsorbers that are used for processing radioactive gas. Some of these systems contain highly radioactive materials. The RWB is classified as a Safety Class 3 building and categorized as RW-IIa in accordance with Regulatory Guide (RG) 1.143, Rev. 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light Water-Cooled Nuclear Power Plants." Additionally, it is also evaluated for seismic interaction to ensure that it will not compromise the structural integrity or safety functions of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions.

1.5.2.5 Plant Services Area and Reactor Auxiliary Bay

The PLSA houses a decontamination area, a contaminated part/tool storage room, a I&C calibration room, a truck space for cask removal, a hot machine shop, laydown areas for new fuel and the Fine Motion Control Rods Drives (FMCRD), and a miscellaneous storage area.

While the PLSA is a separate functional area from the CB and TB, the northern portion of the PLSA shares a foundation and is structurally integrated with the TB and the southern portion of the PLSA shares a foundation and is structurally integrated with the CB (see Figure A1.5-1).

A portion of the PLSA, the Reactor Auxiliary Bay, is constructed on a separate foundation with respect to the portions of the PLSA that are adjacent to the CB and TB. The functions performed in the Reactor Auxiliary Bay include new fuel and spent fuel cask transit, equipment ingress and egress to the RB, and personnel access to the RB. The Reactor Auxiliary Bay is a Safety Class 2 structure and is categorized as Non-Seismic. Additionally, it is evaluated for seismic interaction to ensure that it does not compromise the structural integrity and safety functions of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions.

1.6 Comparison with Other Plant Designs

The BWRX-300 is based on the U.S. Nuclear Regulatory Commission (NRC) licensed, 1520 MWe Economic Simplified Boiling Water Reactor (ESBWR). The ESBWR is an evolution of the 600 MWe Simplified Boiling Water Reactor (SBWR) that has a significant testing and qualification program directly applicable to the BWRX-300.

The BWRX-300 is the tenth generation of the Boiling Water Reactor (BWR) that incorporates the lessons learned in design, construction, operations, and maintenance from over 100 previous BWRs that have been built, operated, and in some cases, decommissioned.

The BWRX-300 is specifically designed to enhance safety through simplification and reducing its dependence on human intervention. This is achieved through increasing its reliance on natural circulation and natural phenomena-driven safety systems. These safety enhancements, in combination with its reduction in scale and complexity, enable the reductions in operating staff, maintenance, and security requirements as well as being easier to decommission.

The BWRX-300 provides clean and flexible baseload electricity at a lifecycle cost that is much lower than the previous generation of NPPs operating today and competitive with other forms electricity generation such as natural gas combined-cycle plants and renewables.

1.6.1 Enhancements in Safety System Design

Though mostly traditional in BWR design, the BWRX-300 includes several design features that simplify the design and enhance safety, such as:

1. Reactor Isolation Valve location: The BWRX-300 RPV is equipped with Reactor Isolation Valves which rapidly isolate a ruptured pipe to help mitigate the effects of a LOCA. All large fluid pipe systems are equipped with double isolation valves which are integral to the RPV. The valves are located as close as possible to the RPV.
2. No Safety Relief Valves: Safety relief valves have been eliminated from the BWRX-300 design. The large capacity Isolation Condenser System (ICS) provides overpressure protection in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), Section III, Class 1 equipment. Historically on BWRs, the safety relief valve inadvertent actuation has been the most likely cause of a LOCA and have, therefore, been eliminated from the BWRX-300 design.
3. Dry containment: The BWRX-300 has a dry containment that is cooled through natural circulation during DBAs. This has been proven to effectively contain the releases of steam, water, and fission products after a LOCA.
4. No external reactor recirculation loops: Elimination of external reactor recirculation pumps and associated piping and a reimagined reactor pressure vessel provides a relatively large inherent reactor coolant volume and nozzle elevations significantly above the core. These features with a reliable passive emergency core cooling system provided by the isolation condensers eliminates the need for active emergency core cooling injection systems while ensuring larger safety margins than predecessor BWRs.
5. No need for emergency diesel generators: Elimination of active emergency core cooling systems eliminates the need for onsite emergency power systems. Standby diesel generators are provided for asset protection only.

Table 1.6-1 demonstrates how the BWRX-300 design has evolved to maximize passive safety features to achieve FSF in comparison to the design of previous BWR and other types of NPPs.

Table 1.6-1: Comparison of BWRX-300 to Other NPP Types

Fundamental Safety Function	BWRX-300	BWRs	PWRs	CANDU
Control Reactivity	Two Independent Means of Shut Down	Two Independent Means of Shut Down	Two Independent Means of Shut Down	Two Independent Means of Shut Down
Fuel Cooling	Passive Natural Circulation	Active Forced Circulation	Active Forced Circulation	Active Forced Circulation
Contain Radioactivity	Dry Passive Cooling	Wet Active Cooling	Dry Active Cooling	Dry Reactor Building Wet Vacuum Building Active Reactor Building Cooling

1.6.2 Industry Incident Reviews

Station Blackout events have historically been the most demanding for BWRs to cope with and have usually been the dominant sequence for Severe Accident scenarios. The BWRX-300 is an advanced passive reactor design that does not require active safety systems. The BWRX-300 design carried forward the passive ICS and containment cooling concepts from the ESBWR. DC power sources are assumed to be available. The systems that support FSF and plant monitoring are designed to operate for 72-hours, without AC power, and without an intake structure that normally provides cooling water. The ICS pools and spent fuel pool have enough inventory to provide adequate decay heat removal and fuel cooling for seven days, after which alternate water makeup sources (e.g., flexible mitigation/EME) are used to refill the pools. The Passive Containment Cooling System (PCCS) is designed to passively limit containment pressure and temperature by transferring heat to the equipment pool. The demonstration of plant safety functions during a beyond design basis external event such as an earthquake that creates these conditions is typically part of the diverse and flexible coping strategies that form the basis for compliance of regulatory requirements related to the Fukushima tsunami event.

In April 2012, the Institute of Nuclear Power Operations conducted an independent review of the Fukushima nuclear accident with the purpose of identifying operational and organizational lessons learned from the accident. The results of this review are well documented.

The Fukushima accident was a Beyond Design Basis event. Design extension conditions are a selected subset of Beyond Design Basis accident conditions.

The BWRX-300 is designed for Design Extension Conditions, and these are described in detail in the BWRX-300 Safety Strategy.

1.7 Drawings and Other More Detailed Information

A simplified representation of the major BWRX-300 systems and the flow of the reactor coolant is provided in Figure 1.7-1. A summary description of the major nuclear steam supply systems and components is provided below. Each of these systems are described in detail in applicable chapters of the PSAR.

1.7.1 Reactor Pressure Vessel and Internals

The RPV is a vertical, cylindrical pressure vessel fabricated with forged rings and rolled plate welded together, with a removable top head, head flange, seals, and bolting. The vessel also includes penetrations, nozzles, and the shroud support. The RPV has a minimum inside diameter of approximately 4 m, a wall thickness of approximately 14 cm with cladding, and a height of approximately 26 m. The bottom of the active fuel region is approximately 5.2 m from the bottom of the vessel and the active core is 3.8 m high. The vertical orientated and tall vessel permits the development natural circulation driving forces to produce sufficient core coolant flow.

A diagram of the BWRX-300 RPV assembly is shown in Figure 1.7-2. The RPV, together with its internals, provides guidance and support for the Fine Motion Control Rod Drives (FMCRDs).

The major reactor internal components include:

- Core (fuel, channels, control rods and instrumentation)
- Core support and alignment structures (shroud, shroud support, top guide, core plate control rod guide tube, CRD housings, and orificed fuel support)
- Chimney
- Chimney head and steam separator assembly
- Steam dryer assembly
- Feedwater spargers
- In-core guide tubes

The fuel assemblies (including fuel rods and channels), control rods, chimney head, steam separators, steam dryer, and in-core instrumentation assemblies are removable when the reactor vessel is opened for refueling or maintenance. The RPV shroud support is designed to support the shroud, as well as the components connected to the shroud, including the steam separator, chimney, core plate, and top guide. The fuel bundles are supported by the orifice fuel support, the control rod guide tube, and the CRD housing.

1.7.2 Reactor Pressure Vessel Isolation Valves

The BWRX-300 reactor incorporates isolation valves attached directly to the RPV. The function of the isolation valves is to close, limiting the loss of coolant from large and medium pipe breaks. The RPV isolation concept consists of two Reactor Isolation Valves in series. Each of the Reactor Isolation Valves is independently able to isolate the line.

1.7.3 Control Rod Drive System

The CRD system includes three major elements: FMCRD mechanisms; Hydraulic Control Unit (HCU) assemblies; and the Control Rod Drive Hydraulic subsystem. The FMCRDs are designed to provide electric-motor-driven positioning for normal insertion and withdrawal of the control rods and hydraulic-powered rapid control rod insertion (scram) in response to manual or automatic signals. The hydraulic power required for scram is provided by high-pressure water stored in the individual HCUs. In addition to hydraulic-powered scram, the FMCRDs also provide electric-motor-driven run-in of all control rods as a path to rod insertion that is diverse from the hydraulic-powered scram.

1.7.4 Isolation Condenser System

The ICS removes decay heat after any reactor isolation and shutdown event during power operations. The ICS decay heat removal limits increases in steam pressure and maintains the RPV pressure and water inventory at an acceptable level. The ICS consists of three independent loops that each contain a Heat Exchanger (HX) with capacity of approximately 33 MW, or approximately 3.7% of rated thermal power. Thermal energy removal condenses steam on the tube side and transfers heat by heating/evaporating water in the Isolation Condenser (IC) pools which are vented to atmosphere. The arrangement of the ICS HX is shown in Figure 1.7-3.

1.7.5 Instrumentation and Control

The BWRX-300 Distributed Control and Information System (DCIS) is an integrated control and monitoring system for the power plant. The DCIS is arranged in three safety classified DCIS segments and a non-safety class segment with appropriate levels of hardware and software quality corresponding to the system functions they control and their DL location, as described in Chapter 3, Section 3.2. The DCIS provides control, monitoring, alarming and recording functions. The various bus segments of the integrated DCIS are designed to operate autonomously.

Control of reactivity in various postulated events is achieved by the instrumentation and control systems. Channels, trip logic, trip actuators, manual controls, and scram logic circuitry initiates the rapid insertion of control rods by hydraulic force to scram the reactor when unsafe conditions are detected. The hydraulic scram is actuated on signals derived from safety analyses and includes signals such as high core neutron power, RPV pressure, low RPV level, high containment temperature, high steam line flow, etc.

1.7.6 Containment

The BWRX-300 Primary Containment Vessel encloses the RPV and some of its related systems and components. The Primary Containment Vessel is a leak-tight nitrogen inerted gas space surrounding the RPV and the Reactor Coolant Pressure Boundary (RCPB). It provides a leak-tight barrier to prevent the release of radioactive fission products, steam, and water in the unlikely event of a Loss of Coolant Accident (LOCA). The BWRX-300 uses a traditional containment system for the ultimate containment of radioactive materials for various postulated events. The containment shape is a vertical cylinder approximately 18 meters outside diameter and 38 meters high. It is integral to and surrounded by the Reactor Building (RB).

1.7.7 Passive Containment Cooling System

The Passive Containment Cooling System (PCCS) is a passive containment heat removal system that maintains the containment within its pressure limits for design basis accidents such as a LOCA. It consists of several low-pressure natural circulation heat exchangers that transfer heat from the containment to the reactor cavity pool which is located above the containment upper head and is filled with water during normal operation. The reactor cavity pool is vented to the atmosphere. PCCS operation requires no sensing, control, logic, or power actuated devices for operation.

1.7.8 Boron Injection System

The Boron Injection System (BIS) is a complementary design feature that provides an additional means to place the plant in a cold shutdown mode. The BIS provides an additional means of negative reactivity insertion to bring the reactor subcritical during events when the control rod insertion (hydraulic and motor) is not successful.

1.7.9 Reactor Water Cleanup System

The Reactor Water Cleanup System provides the design functions of a cleanup flow path from the RPV to filter/demineralizer skids during most reactor operating modes. The cleanup or filtration function and ion removal function is performed by the condensate system.

1.7.10 Shutdown Cooling System

The Shutdown Cooling (SDC) System is designed to support RPV Startup and Shutdown/ Cooldown Operations. The SDC consists of two independent trains with a motor driven pump, a heat exchanger, required valves, piping, controls, and power inputs.

1.7.11 ICS Pool Cooling and Cleanup System

The Isolation Condenser Pool Cooling and Cleanup System (ICC) is designed to maintain the water in the ICS pools cool and clean.

The primary function of the ICC is to remove heat from the Isolation Condenser System (ICS) pools such that the bulk temperature of water in the pools is maintained below prescribed limits, and thereby ensure the readiness of the ICS to perform its safety function. Secondary functions of the ICC include maintaining the cleanliness of the ICS pool water and providing the capability to add clean makeup water during normal reactor operations to offset the routine and minor loss of water inventory due to evaporation.

1.7.12 Fuel Pool Cooling and Clean System

The Fuel Pool Cooling and Cleanup System (FPC) provides continuous cooling by removal of the decay heat from the spent fuel and maintains the Fuel Pool temperature below specified values. The system also maintains water level and water quality in the fuel pool, and reactor cavity pool. The FPC consists of one cooling and clean-up train provided with 100% capacity during normal operation (including pool maximum heat load).

1.7.13 Containment Inerting System

The Containment Inerting System precludes the combustion of hydrogen and prevents damage to essential equipment and structures. It establishes and maintains an inert atmosphere (≤4% dry-basis-percent (DB%) oxygen) within containment during plant operating modes except during shutdown for refueling/maintenance and for limited periods of time during low power operation for inspection. The system also maintains a slightly positive pressure in containment to prevent air (oxygen) in-leakage into the inerted spaces from the Reactor Building.

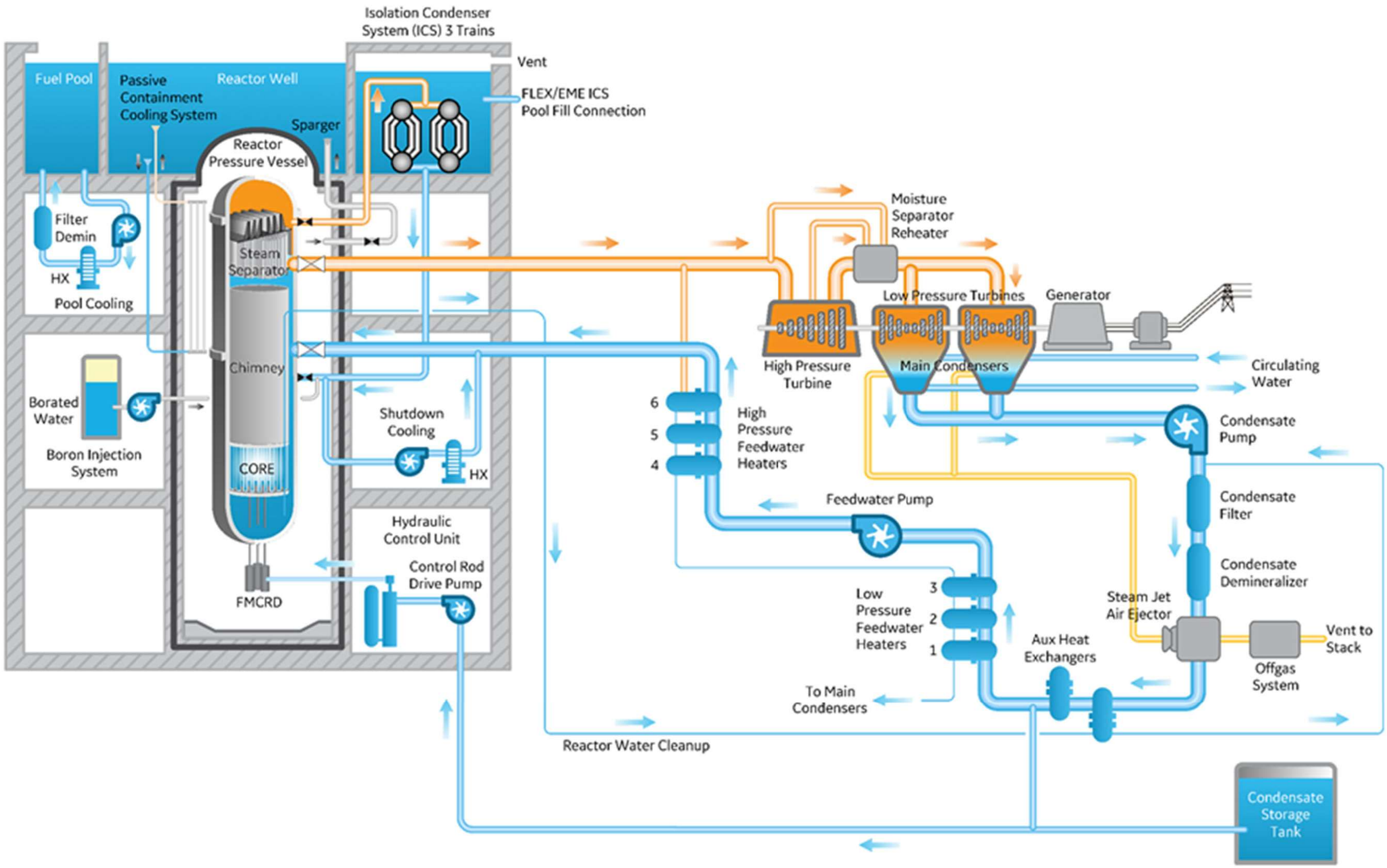

Figure 1.7-1: BWRX-300 Major Systems

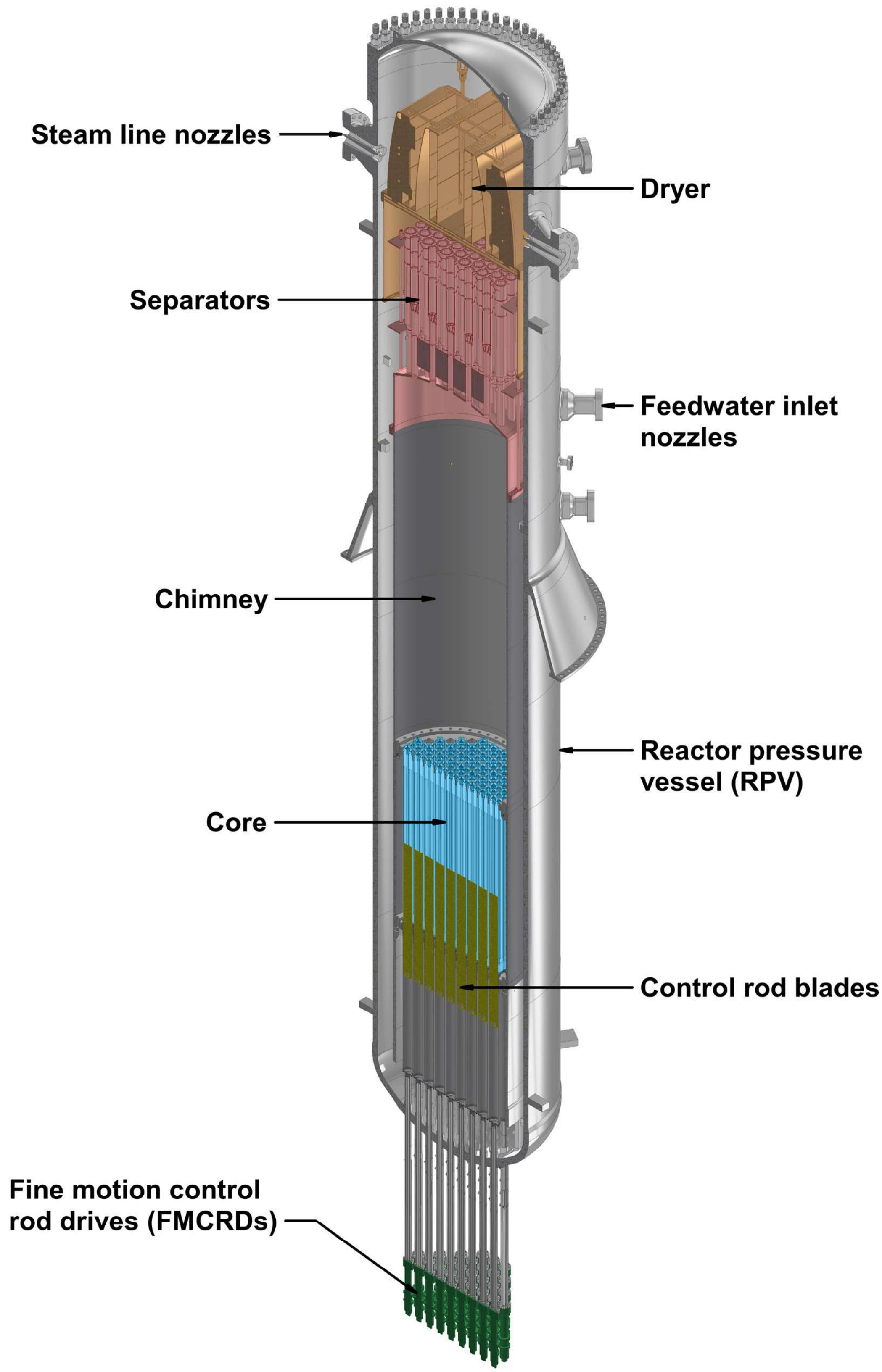

Figure 1.7-2: BWRX-300 RPV and Internals

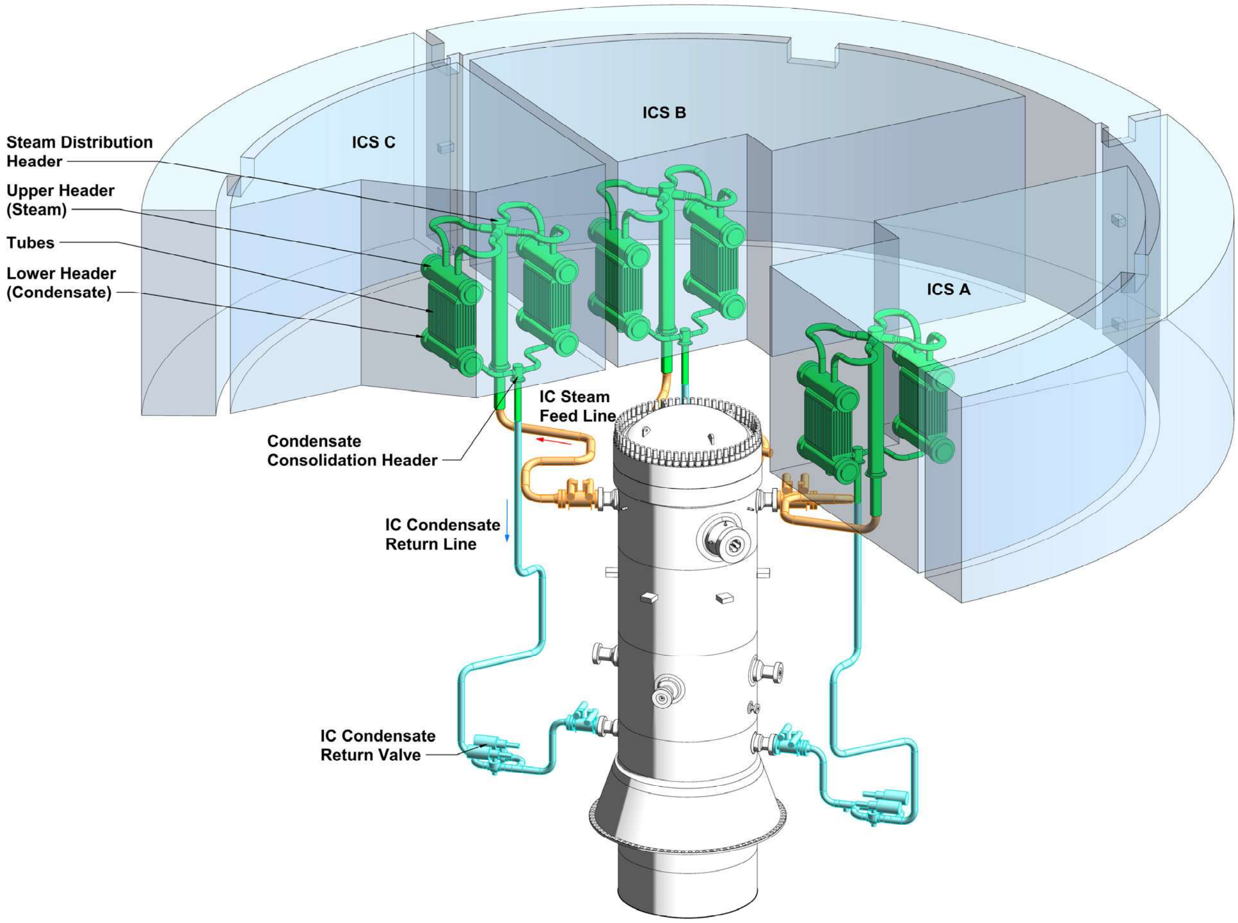

Figure 1.7-3: Isolation Condenser System

1.8 Modes of Normal Operation of the Plant

The normal operating modes are listed below and described in detail in Chapter 16. Chapter 15 includes a discussion of the plant design envelope, which comprises all plant states considered in the design, normal operation, Anticipated Operational Occurrence (AOO), Design Basis Accident (DBA), and Design Extension Condition (DEC).

Specific operational states and accident conditions and responses to these events for the BWRX-300 design are described in the deterministic safety analyses in Chapter 15.

The normal plant operational modes are listed below:

- Mode 1 Power Operation
- Mode 2 Startup
- Mode 3 Hot Shutdown
- Mode 4 Stable Shutdown
- Mode 5 Cold Shutdown
- Mode 6 Refueling

1.9 Principles of Safety Management

The prime responsibility for safety of the facility rests with OPG which is the owner, operator, and licensee. This responsibility includes operating activities performed by OPG and the oversight of activities performed by contracted organizations, such as design, procurement construction, commissioning, and decommissioning. All activities performed, either directly by OPG or indirectly under OPG's oversight, are controlled in accordance with OPG's N-CHAR-AS-0002, "Nuclear Management System" (Reference 1.9-1), which is the top management system of the facility. The system is implemented by a series of program documents which in turn define the required implementing procedures and standards. Chapter 17 of this PSAR provides details regarding the management for safety, including the different management processes aimed at ensuring safety is given the highest priority, the specific elements of the management system, quality management, and the nuclear safety culture framework.

The management system promotes safety culture by committing workers to adhere to its implementing practices that contribute to the excellence in worker performance, supporting workers in carrying out their tasks safely and successfully, and monitoring to improve the culture. The organizational structure implements the programs that make up the OPG management system with the Chief Nuclear Officer accountable for its implementation and effectiveness.

A structured operating organization is established having defined authorities, managerial responsibilities, interfaces between organizations and policies for use of contracted resources such that safety is the overriding priority. An organizational approach is taken that assures the required capabilities and qualifications necessary to always maintain nuclear safety and the integrity of the safety case. This includes maintaining sufficient capability within the operating organization to effectively manage the design and licensing basis of the facility and preventing the over-reliance on contractors. Additionally, the operating organization ensures changes having any potential impact on the safety of the public and workers, the environment, and Canada's international obligations are thoroughly assessed and demonstrated to be acceptable throughout the life of the facility.

1.9.1 References

1.9-1 N-CHAR-AS-0002, "Nuclear Management System," Ontario Power Generation.

1.10 Additional Supporting or Complementary Documents to the Safety Analysis Report

Table 1.10-1 lists all GE, GNF and GEH topical reports that are incorporated by reference in this PSAR document. These reports impose requirements on the BWRX-300 design.

Table 1.10-1: Topical Reports Incorporated by Reference

Report No.	Title	Section No.
EPRI NP-2660	Fire Tests in Ventilated Rooms-Extinguishment of Fires in Grouped Cable Trays, Electric Power Research Institute, Palo Alto, California, 1982	9A
EPRI NP-5479	Application Guide for Check Valves in Nuclear Power Plants, 1993	10.2
EPRI TR-102293	Guidelines for Determining Design Basis Ground Motions, Electric Power Research Institute, Palo Alto, California, Vol. 1-5, 1993	3.3
EPRI TR-103959	Methodology for Developing Seismic Fragilities, Electric Power Research Institute Palo Alto, California, 1994	3.5
EPRI TR-1002988	Seismic Fragility Application Guide, Electric Power Research Institute, Palo Alto, California, 2002	3.5
EPRI TR-1006756	Fire Protection Equipment Surveillance Optimization and Maintenance Guide, 2018	
EPRI TR-1011989 USNRC NUREG/CR-6850	Fire PRA Methodology for Nuclear Power Facilities, 2010	15.6
EPRI TR-1019200	Seismic Fragility Application Guide Update, Electric Power Research Institute, Palo Alto, California, 2009	3.5
EPRI TR-3002002623	BWR Vessel and Internals Project, Volumes 1&2: BWR Water Chemistry Guidelines – Mandatory, Needed, and Good Practice Guidance, Palo Alto, California, 2014	5.2
EPRI TR-3002012994	Seismic Fragility and Seismic Margin Guidance for Seismic Probabilistic Risk Assessments, 2018	3.5
NEDO-10871	General Electric Company, "Technical Derivation of BWR 1971 Design Basis Radioactive Material Source Terms," March 1973	11.1
NEDO-10958-A NEDE-10958P-A	General Electric Thermal Analysis Basis Data, Correlation and Design Application, January 1977	4.4
NEDO-11209-A	GE Hitachi Nuclear Energy, "GE Hitachi Nuclear Energy Quality Assurance Program Description," Class I (Non-proprietary), NEDO-11209-A, Revision 16, December 2020	9A.6, 13.3, 17.2
NEDE-24011-P-A-31	GNF General Electric Standard Application for Reactor Fuel, November 2020, U.S. Supplement	4.4, 4.7, 15.3
NEDC-32082P	BWR Steady-State Thermal Hydraulic Methodology (ISCOR), Revision 0, August 1992	4.3, 15.5
NEDE-32176P	Licensing Topical Report TRACG Model Description, Revision 4, January 2008	4.3
NEDO-32177 NEDE-32177P	"TRACG Qualification," Class I (Non-proprietary), Revision 3, August 2007	4.4, 4.7, 15.5

Report No.	Title	Section No.
NEDO-32601-A NEDC-32601P-A	Methodology and Uncertainties for Safety Limit MCPR Evaluations, August 1999	4.4
NEDO-32708	Radiological Accident Evaluation – The CONAC04A Code, August 1997	15.5
NEDC-32725P	TRACG Qualification for SBWR, Revision 1, Vol. 1 and 2, August 2002	4.7, 15.5
NEDC-33080 NEDC-33080P	TRACG Qualification for ESBWR, Revision 1, May 2005	4.7, 15.5
NEDO-33083-A NEDC-33083P-A	"TRACG Application for ESBWR," Revision 1, September 2010	15.5
NEDO-33083 Supplement 1-A NEDE-33083 Supplement 1P-A	TRACG Application for ESBWR Stability Analysis, Revision 2, September 2010	4.7
NEDC-33139P-A	Global Nuclear Fuel, Cladding Creep Collapse, July 2005	4.2
NEDC-33256P-A	GE Hitachi Nuclear Energy, Licensing Topical Report – The PRIME Model for Analysis of Fuel Rod Thermal-Mechanical Performance Part 1-Technical Bases, Revision 2, October 2021	4.2
NEDC-33257P-A	Licensing Topical Report – The PRIME Model for Analysis of Fuel Rod Thermal-Mechanical Performance Part 2-Qualification, Revision 2, October 2021	4.2
NEDC-33258P-A	Licensing Topical Report – The PRIME Model for Analysis of Fuel Rod Thermal-Mechanical Performance Part 3-Application Methodology, Revision 2, October 2021	4.2
NEDC-33270P	GE Nuclear Energy, GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTARII), Revision 11, August 2020	4.2
NEDE-33284 Supplement 1P-A	GE Hitachi Nuclear Energy, "Marathon-Ultra Control Rod Assembly", "Global Nuclear Fuels, Fuel Bundle Designs," Class III (Proprietary), Revision 1, March 2012	4.2
NEDO-33292 NEDC-33292P	Global Nuclear Fuel, GEXL17 Correlation for GNF2 Fuel, Revision 3	4.4
NEDO-33798-A NEDE-33798P-A	Global Nuclear Fuel, "Application of NSF to GNF Fuel Design," Revision 1, September 2015	4.2
NEDC-33840P-A	Global Nuclear Fuel, Class II (Internal), "The PRIME Model for Transient Analysis of Fuel Rod Thermal-Mechanical Performance," Rev 1, August 2017.	4.2
NEDC-33910P-A	GEH Licensing Topical Report, "BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection," Revision 2, June 20201	5.1, 6.2

Report No.	Title	Section No.
NEDE-33911P-A	GE Hitachi Nuclear Energy, BWRX-300 Containment Performance, Revision 3, January 2022	5.1, 6.2, 6.3
NEDO-33914-A	Licensing Topical Report, BWRX-300 Advanced Civil Construction and Design Approach, Revision 2, June 2022	21.3
NEDO-33914 NEDE-33914P	Licensing Topical Report, BWRX-300 Advanced Civil Construction and Design Approach, Revision 0, January 2021	3.2, 3.3, 3.5, 9B
NEDO-33922 NEDC-33922P	GEH Licensing Topical Report, “BWRX-300 Containment Evaluation Method,” Revision 3, June 2022	5.1, 6.3, 15.5
NEDC-33939	"Steady State Nuclear Methods TGBLA06/PANAC11 Application Methodology For BWRX-300", August 2022	4.3
NEDC-33940P NEDO-33940	GNF2 Fuel Assembly Mechanical Design Report for BWRX-300, September 2022	4.2
NEDC33941P NEDO-33941	Class II (Proprietary), “GNF2 Fuel Rod Thermal Mechanical Design Report,” R1 August 2022	4.2
NEDC-33946P	BWRX-300 Darlington New Nuclear Project (DNNP) Probabilistic Safety Assessment Methodology, Revision 0, September 2022.	15.6
NEDC-33974P	BWRX-300 Darlington New Nuclear Project (DNNP) REGDOC-2.5.2 Alternative Approach Report	3.2
NEDC-33976	GNF2 Pressure Drop Calculations, Rev 0, August ,2022	4.4
NEDC-33977P	BWRX-300 Darlington New Nuclear Project (DNNP) GNF2 Fuel Design Description, Qualification and BWR Fuel Licensing, Revision 0, August 2022	4.2
NEDC-33982P	BWRX-300 Darlington New Nuclear Project (DNNP) Human Factor Engineering Program Plan	18.1, 18.2, 18.3
NEDC-33985P	Nuclear Design Report for BWRX-300 Equilibrium 12 Month Cycle, Revision 1, July 2022	4.3
NEDCC-33987	BWRX-300 Darlington New Nuclear Project (DNNP) TRACG Application for BWRX-300, Rev. 0, September, 2022	4.3
NEDC-33992P-A	BWRX-300 Containment Evaluation Method, Revision 3, June 2022	6.2

1.11 Conformance with Applicable Regulations, Codes and Standards

The Nuclear Safety and Control Act (NSCA) establishes the Canadian Nuclear Safety Commission (CNSC) and provides the CNSC with the authority to regulate the development, production and use of nuclear energy and the production, possession and use of nuclear substances, prescribed equipment, and prescribed information in Canada. Class I Nuclear Facilities Regulations (SOR/2000-204) are applicable to nuclear fission reactors that includes the BWRX-300 at the DNNP facility. It provides the requirements for the different types of applications for Class I nuclear facilities.

The CNSC's regulatory framework, shown in Figure 1.11-1 below, consists of laws passed by Parliament that govern the regulation of Canada's nuclear industry, and regulations, licences, and documents that the CNSC uses to regulate the industry. The CNSC publishes regulatory documents (REGDOCs) that are instruments that clarify, resulting in consistent implementation of, regulatory requirements and expectations. Regulatory requirements and expectations are further supported by codes and standards published by domestic and international agencies.

Figure 1.11-1: CNSC Regulatory Framework

Laws, regulations, codes, and standards are one of numerous sources of design requirements that the design of a Nuclear Power Plant (NPP) must satisfy. The RCS applicable to the licensing basis and the design basis of SSCs within the Protected Area are managed in accordance with the GEH BWRX-300 requirement management plan that is depicted in Figure 1.11-2 below.

The identification and implementation of design requirements, which includes applicable RCS, is an iterative process that evolves with the maturity of the design and is managed throughout the design lifecycle. To align with the requirements management plan, the following levels of RCS are defined in support of the licensing process and the PSAR development:

- Source Level RCS (licensing basis)
- Plant Level RCS (design basis)
- System Level RCS (design basis)
- Component Level RCS (design basis)

Source Level RCS are those applicable jurisdictional requirements that establish part of the licensing basis of the SSCs within the Protected Area.

Plant System, and Component Level RCS are those that govern the design of the facility that establishes the design basis. As described above, the identification and implementation of the relevant level RCS is dependent on the maturity of the design and may not have been implemented from the onset of the design. For the purposes of the LTC and the PSAR, Plant Level RCS is commensurate with the state of design progression.

The above levels recognize that the identification and implementation of RCS is a managed and iterative process. As indicated in Figure 1.11-2, decisions that support the identification, selection, and implementation of design requirements, including RCS, at the various levels are documented and controlled. The repository used for the management of applicable RCS, including supporting decisions, throughout the design lifecycle of the facility is the requirements management tool.

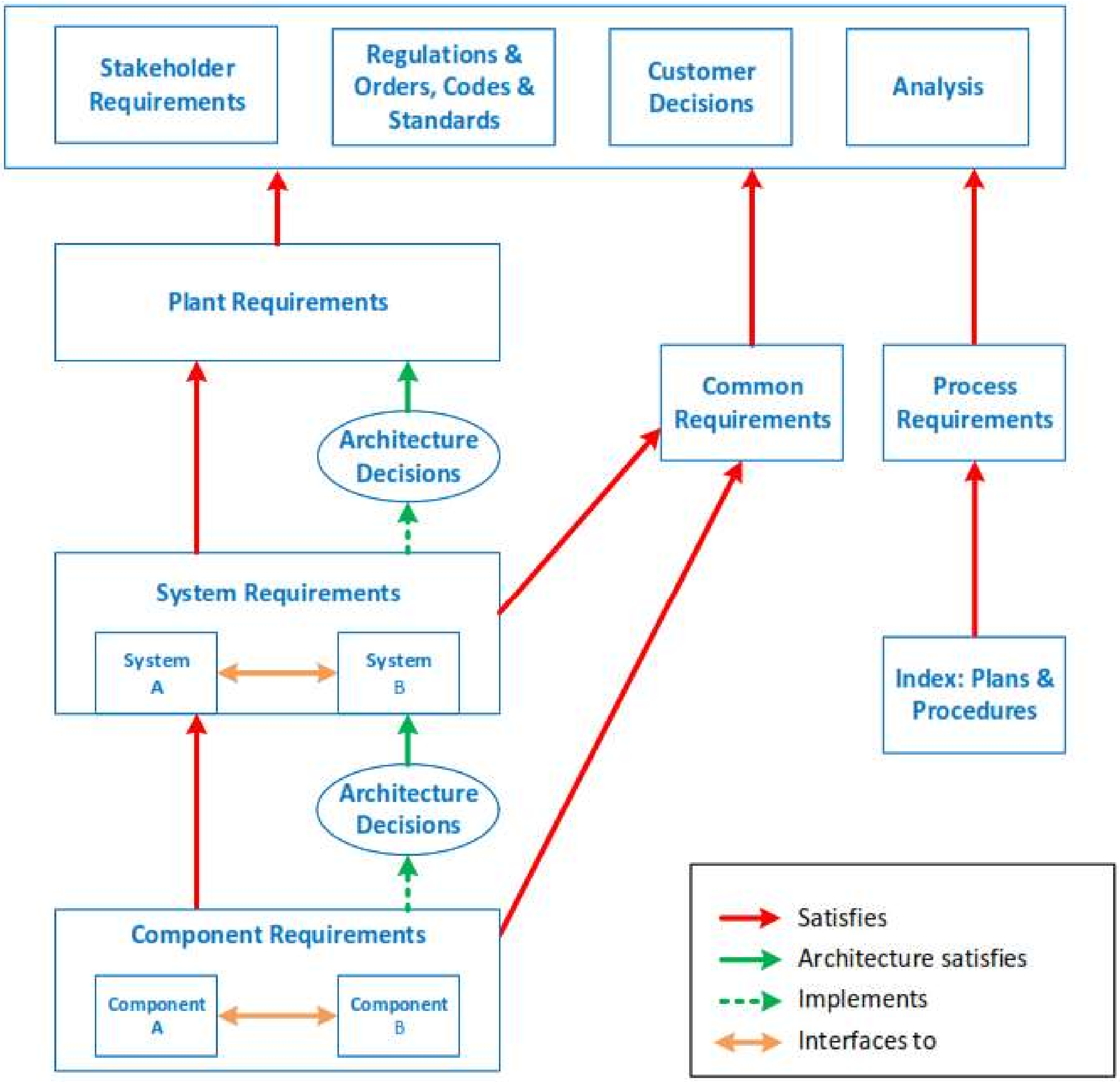

Figure 1.11-2: GEH Requirements Hierarchy

The Source Level licensing basis RCS that are applicable to the LTC of the facility along with the methodology used in its development are documented in NK054-REP-01210-00137, “DNNP License to Construct Regulatory Documents, Codes & Standards,” (Reference 1.11-1).

The design basis RCS that governs the design of the facility, including the BWRX-300 reactor, are documented in Appendix B. These RCS contain design related requirements applicable to the facility. RCS reference throughout the PSAR, not listed in Appendix B, are used for guidance only.

Table B1.11-1 includes the list of applicable Source Level design basis REGDOCs that originates from Source Level licensing basis REGDOCs documented in Reference 1.11-1 that are screened to eliminate those not applicable to the design of Power Block.

Table B1.11-2 includes the list of applicable Plant Level design basis codes and standards that originates from Source Level licensing basis codes and standards documented in Reference 1.11-1 that are screened to eliminate those not applicable to the design of the facility.

Table B1.11-3 includes the list of Plant Level US regulatory codes that are applicable to the facility. The method used to develop the lists followed this general process:

The strategy used to evaluate codes and standards for their applicability, sufficiency, and adequacy for the OPG BWRX-300 design is based on the licensing basis codes and standard provided by OPG.

1. The licensing basis list is evaluated to determine which of the codes and standards forms the design basis.
2. Subsequent review of the GEH documentation is completed to determine the remaining codes and standards to develop the plant level design basis.
3. The system level list is next developed with the codes and standards from the system design documentation.
4. Each code and standard are reviewed for applicability with the responsible design engineer.

1.11.1 References

1.11-1 NK054-REP-01210-00137, “DNNP License to Construct Regulatory Documents, Codes & Standards,” Ontario Power Generation.

1.12 Appendix A – Darlington Nuclear Site and DNNP General Arrangement Drawings

This Appendix A includes the following figures:

Figure No.	Description
A1.1-1	Darlington Nuclear Site Regional Location
A1.1-2	Darlington Nuclear Site (DNNP Proximity to DNGS)
A1.4-1	DNNP BWRX-300 Facility Site Layout
A1.4-2	DNNP Switchyard Site Plan
A1.5-1	BWRX-300 Power Block Plan View at Elevation 0

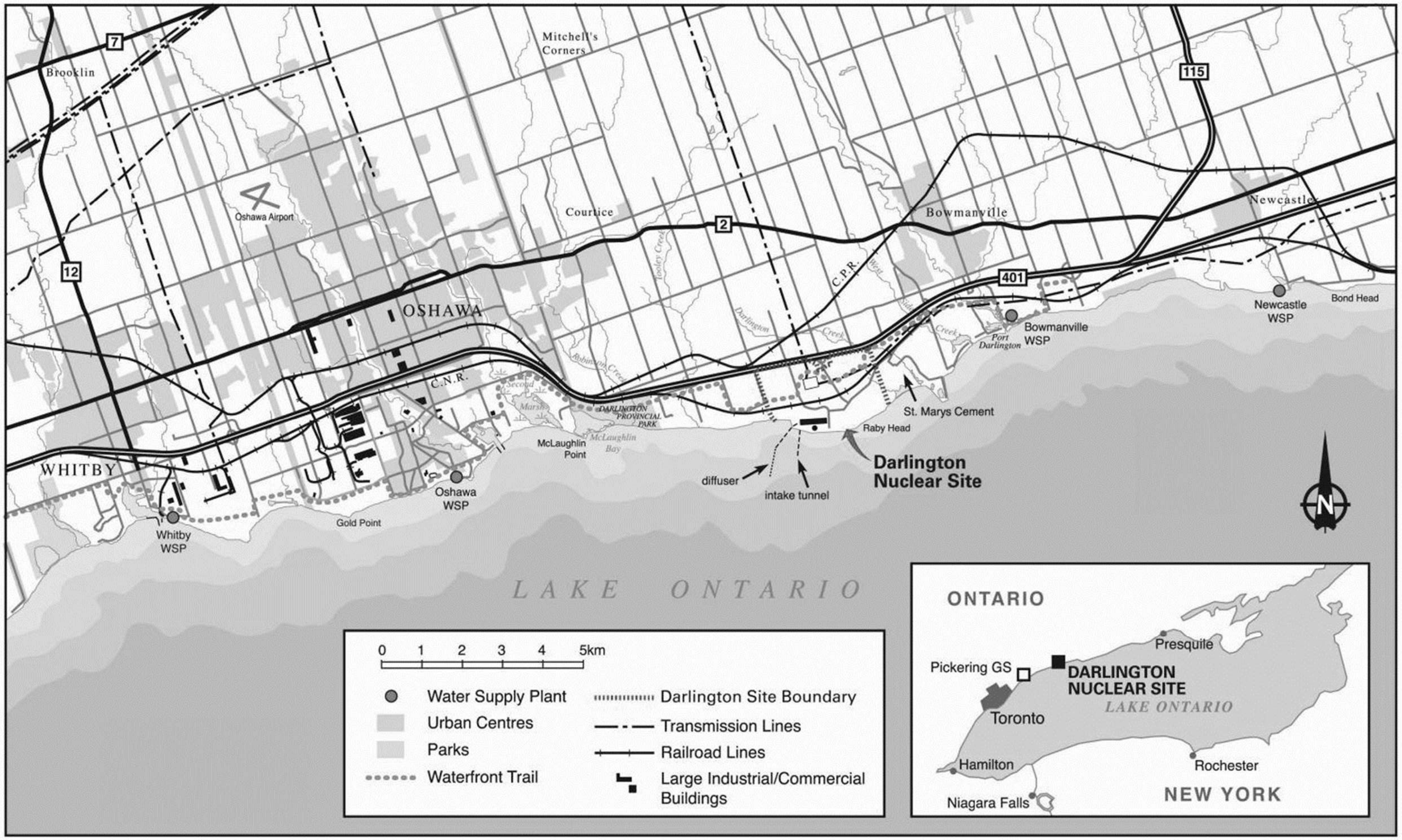

Figure A1.1-1: Darlington Nuclear Site Regional Location

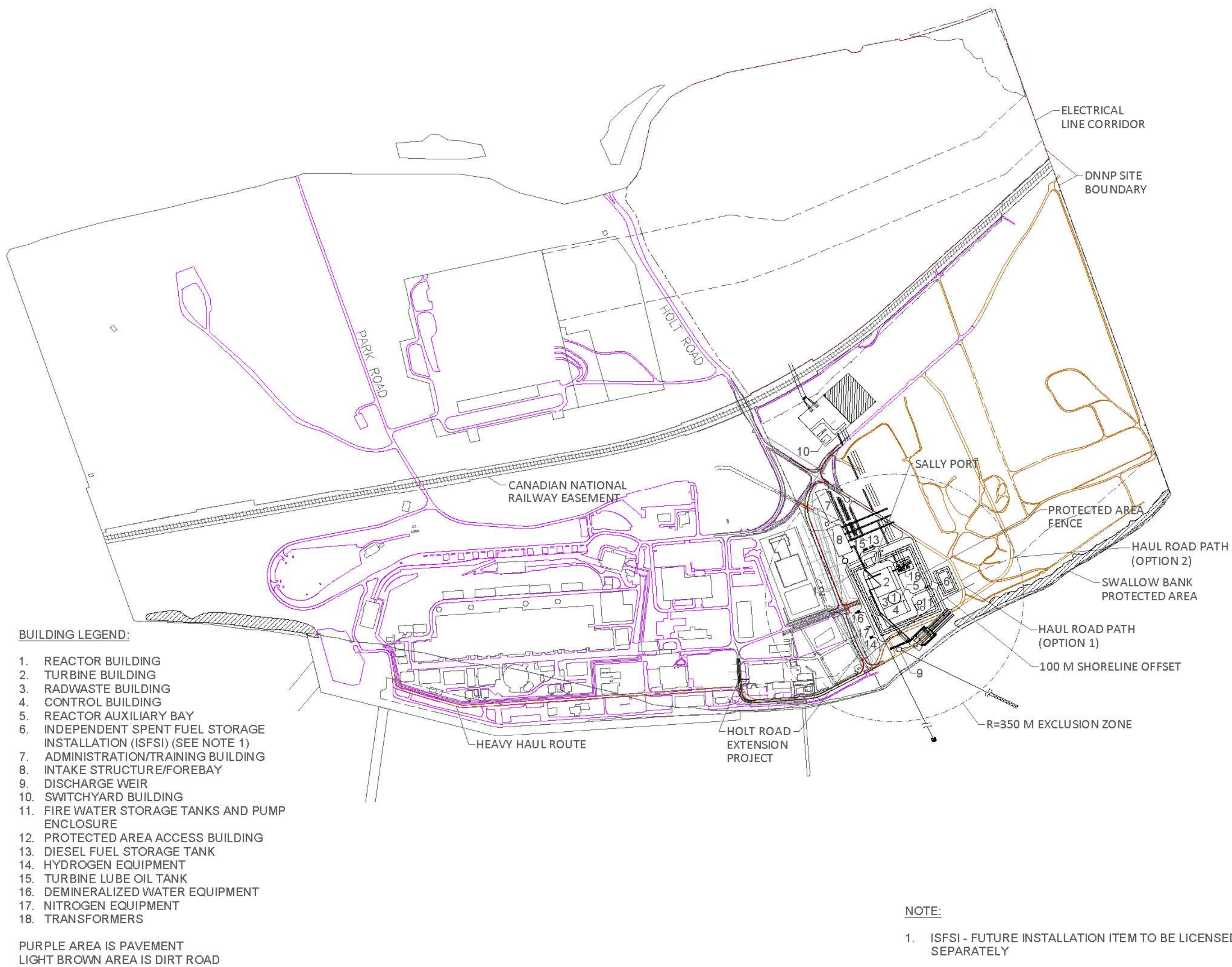

Figure A1.1-2: Darlington Nuclear Site (DNNP Proximity to DNGS)

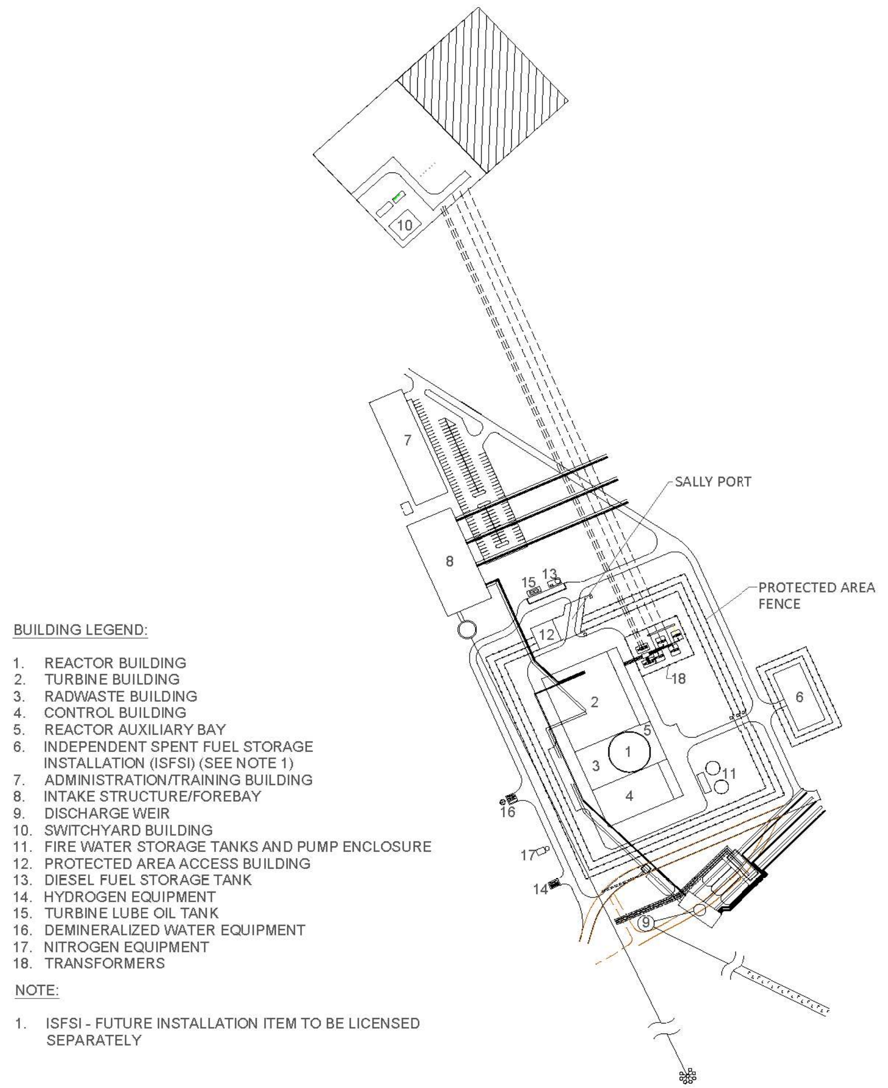

Figure A1.4-1: DNNP BWRX-300 Facility Site Layout

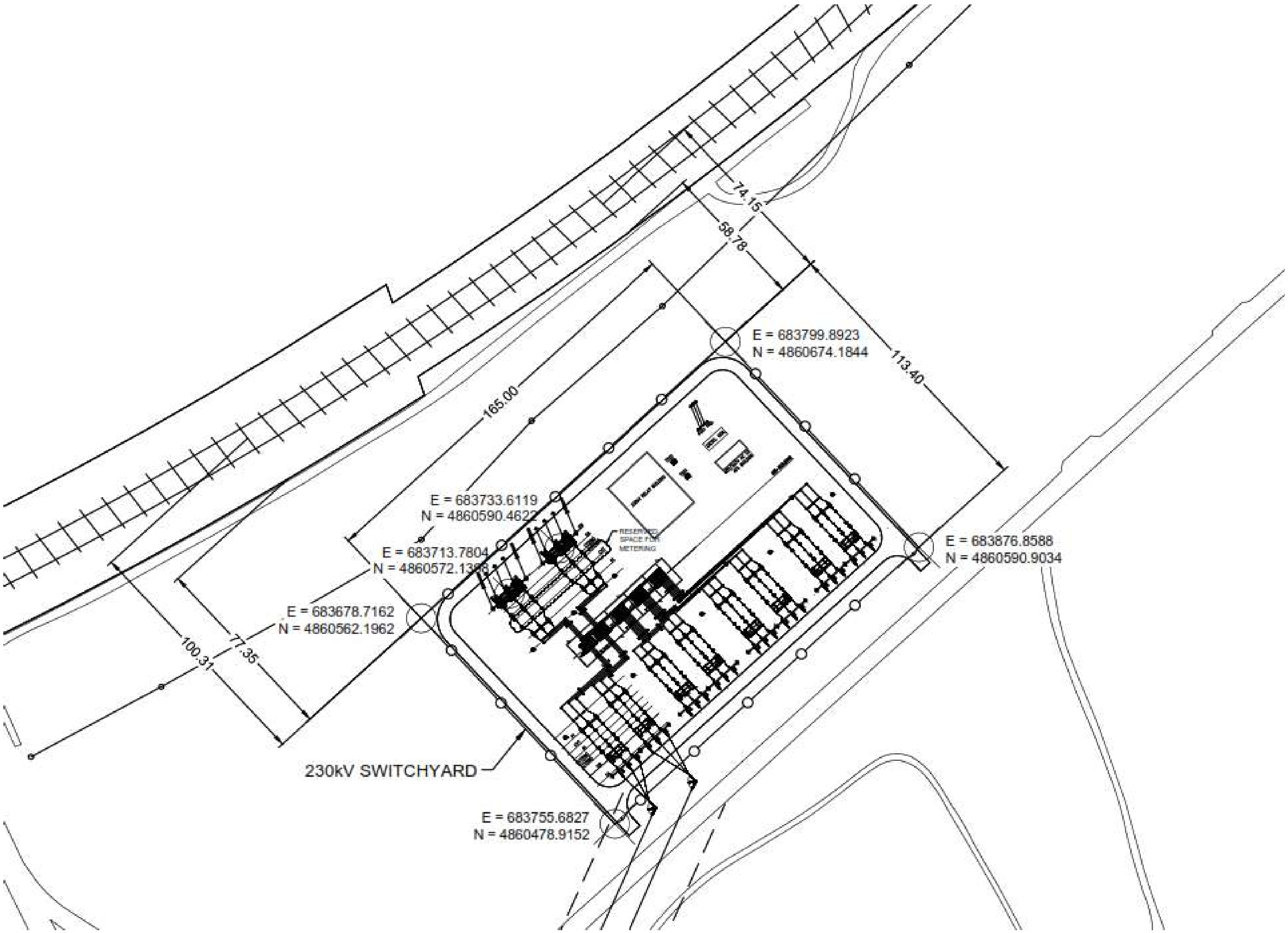

Figure A1.4-2: DNNP Switchyard Site Plan

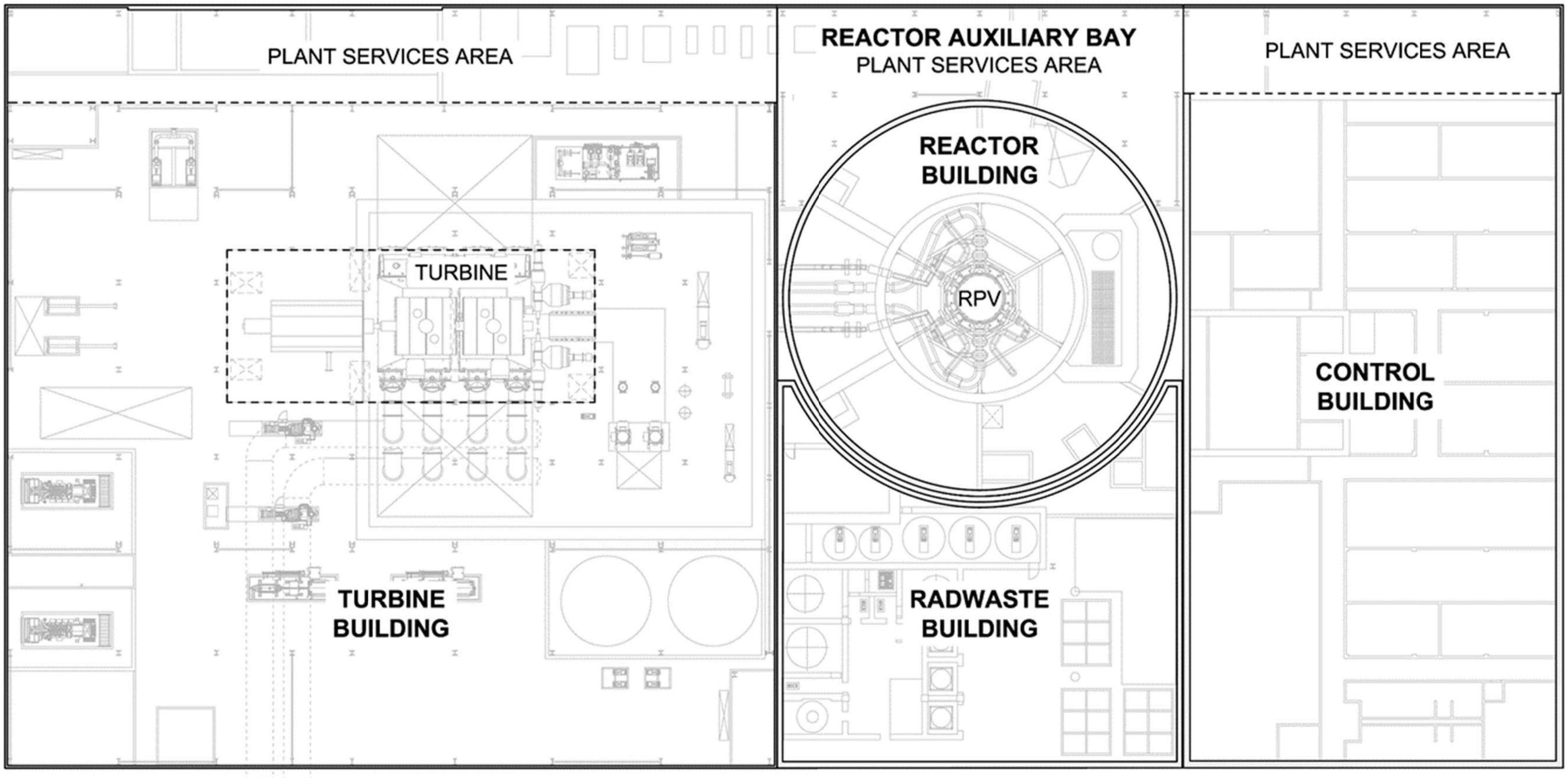

Figure A1.5-1: BWRX-300 Power Block Plan View at Elevation 0

1.13 Appendix B – Tables of Design Basis REGDOCs, Codes, and Standards

This Appendix includes the following Tables:

Table No.	Description
B1.11-1	List of Plant Level Design Basis Regulatory Documents
B1.11-2	List of Plant Level Design Basis Codes and Standards
B1.11-3	List of Plant Level Design Basis US Regulatory Documents

Table B1.11-1: List of Plant Level Design Basis Regulatory Documents

Document Number	Document Title	Doc Effective Date/Version
CNSC REGDOC -2.4.2	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2022
CNSC REGDOC -2.4.3	Nuclear Criticality Safety	2020
CNSC REGDOC 2.7.1	Radiation Protection	2021
CNSC REGDOC 2.9.1	Environmental Protection: Environmental Principles, Assessments and Protection Measures	2021
CNSC REGDOC-2.12.1	High Security Facilities, Volume I: Nuclear Response Force	2018
CNSC REGDOC-2.12.1	High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices	2018
CNSC REGDOC-2.13.1	Safeguards and Nuclear Material Accountancy	2018
CNSC REGDOC-2.3.2	Accident Management	2015
CNSC REGDOC-2.4.1	Deterministic Safety Analysis	2014
CNSC REGDOC-2.5.1	General Design Considerations: Human Factors	2019
CNSC REGDOC-2.5.2	Design of Reactor Facilities: Nuclear Power Plants	2014
CNSC REGDOC-2.6.1	Reliability Programs for Nuclear Power Plants	2017
CNSC REGDOC-2.6.3	Aging Management	2014

Table B1.11-2: List of Plant Level Design Basis Codes and Standards

Document Number	Document Title	Doc Effective Date/Version
ACI 350.3	Seismic Design of Liquid-Containing Concrete Structures	2006
ANSI/AISC N690	Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities	2018
API 620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks	12th edition
API 650	Welded Tanks for Oil Storage	13th edition
ASCE/SEI 4	Seismic Analysis of Safety-Related Nuclear Structures	2016
ASCE/SEI 43	Seismic Design Criteria or Structures, Systems, and Components in Nuclear Facilities	2019
ASCE/SEI 7	Minimum Design Loads for Buildings and Other Structures	2016
ASME B31.1	Power Piping	2020
ASME B31.3	Process Piping	2020
ASME BPVC Section II	Materials	2021
ASME BPVC Section III	Rules for Construction of Nuclear Facility Components	2021
ASME BPVC Section IX	Welding, Brazing, and Fusing	2021
ASME BPVC Section V	Non-Destructive Examination	2021
ASME BPVC Section VIII	Rules for Construction of Pressure Vessels	2021
ASME BPVC Section XI	Rules for Inservice Inspection of Nuclear Power Plant Components	2021
ASME/ANS RA-Sb-2013	Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications	2013
CSA A23.1	Concrete Materials And Methods Of Concrete Construction	2019
CSA A23.2	Test Methods And Standard Practices For Concrete	2019
CSA A23.3	Design of Concrete Structures	2019

Document Number	Document Title	Doc Effective Date/Version
CSA C22.1	Canadian Electrical Code, Part 1 Safety Standard for Electrical Installation	2021
CSA C22.2	Canadian Electrical, Part 2 General Requirement	2021
CSA N1600	General requirements for nuclear emergency management programs	2021
CSA N285.0/N285.6*	General Requirements For Pressure-Retaining Systems And Components In CANDU Nuclear Power Plants/Material Standards For Reactor Components For CANDU Nuclear Power Plant	2017
CSA N288.4	Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2019
CSA N288.5	Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2011
CSA N288.7	Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills	2020
CSA N289.1	General requirements for seismic design and qualification of nuclear power plants	2018
CSA N289.2	Ground motion determination for seismic qualification of nuclear power plants	2021
CSA N289.3	Design procedures for seismic qualification of nuclear power plants	2020
CSA N289.4	Testing procedures for seismic qualification of nuclear power plant structures, systems, and components	2012 (R2017)
CSA N289.5	Seismic instrumentation requirements for nuclear power plants and	2012
CSA N290.7	Cyber Security for nuclear power plants and small reactor facilities	2021
CSA N290.11	Reactor heat removal capability during outage of nuclear power plants	2021
CSA N290.12	Human Factors In Design For Nuclear Power Plants	2014 (R2019)
CSA N290.13	Environmental qualification of equipment for nuclear power plants	2018

Document Number	Document Title	Doc Effective Date/Version
CSA N290.14	Qualification of Digital Hardware and Software for Use in Instrumentation and Control Applications for Nuclear Power Plants	2015
CSA N291	Requirements for Safety-Related Structures for Nuclear Power Plants	2019
CSA N293S1	Supplement No. 1 to N293-12, Fire Protection for Nuclear Power Plants (Application to Small Modular Reactors)	2021
CSA S16	Design of Steel Structures	2019
CSA W59	Welded Steel Construction	2018
IEC 60034-1	Rotating Electrical Machines – Part 1: Ratings and Performance	2022
IEC 60099-5	Surge Arresters – Part 5: Selection and Application Recommendations – Edition 3.0	2018
IEC 60137	Insulated Bushings for Alternating Voltages Above 1000 V	2017
IEC 60152	Designation of Phase Differences by Hour Numbers in Three Phase AC Systems	2021
IEC 60255-1	Measuring Relays and Protection Equipment – Part 1: Common Requirements	2009
IEC 60772	Nuclear Power Plants - Instrumentation Systems Important to Safety - Electrical Penetration Assemblies in Containment Structures	2018
IEC 60880	Power Plants – Instrumentation and Control Systems Important to Safety – Software Aspects for Computer-Based Systems Performing Category A Functions	2006
IEC 60987	Nuclear Power Plants - Instrumentation and Control Important to Safety - Hardware Requirements	2021
IEC 61000-6-2	Immunity standard for industrial environments	2019
IEC 61500	Network Communication	2018
IEC 61513	Instrumentation and Control Important to Safety – General Requirements for Systems	2011
IEC 62040-1	Uninterruptible Power Systems (UPS) – Part 1: Safety Requirements	2021
IEC 62041	Transformers, power supplies, reactors, and similar products – EMC requirements	2017

Document Number	Document Title	Doc Effective Date/Version
IEC 62138	Nuclear Power Plants – Instrumentation and Control Systems Important to Safety – Software Aspects for Computer-Based Systems Performing Category B or C Functions	2018
IEC 62271-103	High-voltage Switchgear and Control gear – Part 103: Alternating Current Switches for Rated Voltages Above 1 kV Up To and Including 52 kV	2021
IEC 62566	Nuclear Power Plants – Instrumentation and Control Important to Safety – Development of HDL-Programmed Integrated Circuits for Systems Performing Category A Functions	2012
IEC 62566-2	Nuclear Power Plants – Instrumentation and Control Important to Safety – Development of HDL-Programmed Integrated Circuits – Part 2: HDL Programmed Integrated Circuits for Systems Performing Category B or C Functions	2020
IEC 62859	Nuclear power plants – Instrumentation and control systems – Requirements for coordinating safety and cybersecurity	2016
IEC 63147	Criteria for accident monitoring instrumentation for nuclear power generating stations	2017
IEEE Std 80	Guide for Safety in AC Substation Grounding	2019
IEEE Std 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System	2012
IEEE Std 384	Standard Criteria for Independence of Class 1E Equipment and Circuits	2018
NFPA 10	Standard for Portable Fire Extinguishers	2018
NFPA 13	Standard for the Installation of Sprinkler Systems	2022
NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection	2007
NRCC NBC	National Building Code	2020
NRCC NFC	National Fire Code	2020

*Pressure boundary and jurisdictional requirements call for the use of CSA N285 supplemented by ASME BPVC and US Regulatory guides. Pressure boundary requirements appropriate for the BWRX-300 are documented per NK054-REP-01210-00137 (Reference 1.11-1).

Table B1.11-3: List of Plant Level Design Basis US Regulatory Documents

Document Number	Document Title	Doc Effective Date/Version
US NRC 10CFR50 Appendix A	General Design Criteria for Nuclear Power Plants	N/A
US NRC 10CFR50 Appendix J	Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors	N/A
US NRC 10CFR50.55a	Codes and Standards	N/A
US NRC RG 1.143	Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants	2001
US NRC RG 1.180	Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems	2019
US NRC RG 1.243	Safety-Related Steel Structures and Steel-Plate Composite Walls for other than Reactor Vessels and Containments	2021
US NRC RG 1.26	Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants	2021
US NRC RG 1.61	Damping Values for Seismic Design of Nuclear Power Plants	2007
US NRC RG 1.97	Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants	2019
US NRC RG 5.71	Cyber Security Programs for Nuclear Facilities	2010

GE Hitachi Nuclear Energy

NEDO-33951
Revision 1
October 4, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 2
Site Characteristics

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AOO	Anticipated Operational Occurrence
BDBA	Beyond Design Basis Accident
BL-AOO	Baseline Abnormal Operational Occurrence
BWR	Boiling Water Reactor
BWRX-300	Boiling Water Reactor, 10th Design – 300 MWe
CB	Control Building
CEUS	Central Eastern United States
CGD	Canadian Geodetic Datum
CNSC	Canadian Nuclear Safety Commission
CWS	Circulating Water System
DBA	Design Basis Accident
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
DSA	Deterministic Safety Analysis
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Program
EPRI	Electric Power Research Institute
ERA	Environmental Risk Assessment
FIA	Foundation Interface Analysis
FPC	Fuel Pool Cooling and Cleanup System
HU	Hydrostratigraphic Unit
HVAC	Heating, Ventilation, and Air Conditioning
IAEA	International Atomic Energy Agency
ICC	ICS Pool Cooling and Cleanup System
INPO	Institute of Nuclear Power Operations
LOPP	Loss-of-Preferred Power
MCA	Main Condenser and Auxiliaries
MCR	Main Control Room
NHS	Normal Heat Sink
NSCA	Nuclear Safety and Control Act

Acronym	Explanation
OPG	Ontario Power Generation
PCW	Plant Cooling Water System
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PNERP	Provincial Nuclear Emergency Response Plan
PNGS	Pickering Nuclear Generating Station
PPE	Plant Parameter Envelope
PSA	Probabilistic Safety Assessment
PSHA	Probabilistic Seismic Hazard Assessment
RB	Reactor Building
RWB	Radwaste Building
SCR	Secondary Control Room
SMR	Small Modular Reactor
SPT	Standard Penetration Test
SRA	Site Response Analysis
SSC	Structures, Systems, and Components
TB	Turbine Building
TLD	Thermoluminescent Dosimeter
UHRS	Uniform Hazard Response Spectrum
USNRC	United States Nuclear Regulatory Commission
WPCP	Water Pollution Control Plant

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33952
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 3

Safety Objectives and Design Rules for Structures, Systems and Components

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrence
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
BDBA	Beyond Design Basis Accident
BPVC	Boiler and Pressure Vessel Code
CB	Control Building
CCF	Common Cause Failure
CNSC	Canadian Nuclear Safety Commission
CRD	Control Rod Drive
CSA	Canadian Standards Association
D-in-D	Defence-in-Depth
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DEC	Design Extension Condition
DL	Defense Line
DNNP	Darlington New Nuclear Project
FMEA	Failure Modes and Effects Analyses
FSF	Fundamental Safety Function
GEH	GE-Hitachi Nuclear Energy
HCLPF	High Confidence of Low Probability of Failure
HCU	Hydraulic Control Unit
I&C	Instrumentation and Control
ICS	Isolation Condenser System
ILRT	Integrated Leak Rate Test
NSCA	Nuclear Safety and Control Act
OLC	Operational Limits and Conditions
PAM	Post-Accident Monitoring
PIE	Postulated Initiating Event

Acronym	Explanation
PSA	Probabilistic Safety Assessment
PSAR	Preliminary Safety Analysis Report
RB	Reactor Building
RG	Regulatory Guide
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
SC	Safety Class
SC1	Safety Class 1
SC2	Safety Class 2
SC3	Safety Class 3
SCCV	Steel-plate Composite Containment Vessel
SEI	Structural Engineering Institute
SMR	Small Modular Reactor
SSC	Structures, Systems, and Components
TB	Turbine Building
USNRC	U.S. Nuclear Regulatory Commission

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33953

Revision 0

September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 4
Reactor

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ABWR	Advanced Boiling Water Reactor
AOO	Anticipated Operational Occurrence
APRM	Average Power Range Monitor
ARI	Alternate Rod Insertion
ASME	American Society of Mechanical Engineers
BWR	Boiling Water Reactor
CNSC	Canadian Nuclear Safety Commission
COLR	Core Operating Limits Report
CPR	Critical Power Ratio
CRD	Control Rod Drive
CST	Condensate Storage Tank
DBA	Design Basis Accident
DEC	Design Extension Conditions
DL	Defense Line
DPS	Diverse Protection System
DSA	Deterministic Safety Analysis
ERICP	Emergency Rod Insertion Control Panel
ESBWR	Economic Simplified Boiling Water Reactor
FMCRD	Fine Motion Control Rod Drive
GEH	GE Hitachi Nuclear Energy
GNF	Global Nuclear Fuel
GT	Gamma Thermometer
HCU	Hydraulic Control Unit
ISI	In-Service Inspection
IST	In-Service Testing
KKM	Kernkraftwerk Mühleberg (BWR/4 in Switzerland)
LHGR	Linear Heat Generation Rate
LPRM	Local Power Range Monitor
MFLCPR	Maximum Fraction Limiting Critical Power Ratio
MCPR	Minimum Critical Power Ratio
MFLPD	Maximum Fraction Limiting Power Density

Acronym	Explanation
MLHGR	Maximum Linear Heat Generation Rate
NBS	Nuclear Boiler System
OLMCPR	Operating Limit Minimum Critical Power Ratio
PA	Postulated Accident
PIE	Postulated Initiating Event
PRNM	Power Range Neutron Monitoring System
RC&IS	Rod Control and Information System
RCPB	Reactor Coolant Pressure Boundary
RPV	Reactor Pressure Vessel
SAFDL	Specified Acceptable Fuel Design Limits
SCRRI	Selected Control Rod Rapid Insertion
SDC	Shutdown Cooling System
TRACG	Transient Reactor Analysis Code General Electric
USNRC	U.S. Nuclear Regulatory Commission
ΔCPR/ICPR	Delta Critical Power Ratio Over Initial Critical Power Ratio

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33954
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analyses Report:

Chapter 5
Nuclear Boiler System and Associated Systems

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AOO	Anticipated Operational Occurrence
ASME	American Society of Mechanical Engineers
BDBA	Beyond Design Basis Accident
BIS	Boron Injection System
BPVC	Boiler and Pressure Vessel Code
BWR	Boiling Water Reactor
CFS	Condensate and Feedwater Heating System
CIV	Containment Isolation Valve
CNSC	Canadian Nuclear Safety Commission
CRD	Control Rod Drive
CRDM	Control Rod Drive Mechanism
CSA	CSA Group
CUW	Reactor Water Cleanup System
D-in-D	Defence-in-Depth
DBA	Design Basis Accident
DCIS	Distributed Control and Information System
DEC	Design Extension Condition
DL	Defense Line
DPS	Diverse Protection System
ECCS	Emergency Core Cooling System
EDM	Electro-Discharge Machining
EPRI	Electric Power Research Institute
ESBWR	Economic Simplified Boiling Water Reactor
FAC	Flow Accelerated Corrosion
FMCRD	Fine Motion Control Rod Drive
FSF	Fundamental Safety Function
FW	Feedwater
FWH	Feedwater Heater
FWRIV	Feedwater Reactor Isolation Valve

Acronym	Explanation
GEH	GE Hitachi Nuclear Energy
GT	Gamma Thermometer
HAZ	Heat Affected Zone
HCU	Hydraulic Control Unit
IAEA	International Atomic Energy Agency
IASCC	Irradiation Assisted Stress Corrosion Cracking
I&C	Instrumentation and Control
IC	Isolation Condenser
ICS	Isolation Condenser System
ICRRIV	Isolation Condenser Return Reactor Isolation Valve
ICSRIV	Isolation Condenser Supply Reactor Isolation Valve
IGSCC	Intergranular Stress Corrosion Cracking
ISI	In-Service Inspection
IST	In-Service Testing
LLRT	Local Leak Rate Testing
LOCA	Loss-of-Coolant Accident
LPRM	Local Power Range Monitor
LTC	Licence to Construct
LTR	Licensing Topical Report
LWM	Liquid Waste Management System
LWR	Light Water Reactor
MCR	Main Control Room
MS	Main Steam
MSCIV	Main Steam Containment Isolation Valve
MSL	Main Steam Line
MSR	Moisture Separator Reheater System
MSRIV	Main Steam Reactor Isolation Valve
NBS	Nuclear Boiler System
NDE	Non-Destructive Examination
NPS	Nominal Pipe Size
NR	Narrow Range
NRC	U.S. Nuclear Regulatory Commission

Acronym	Explanation
OD	Outside Diameter
OLC	Operational Limits and Conditions
OLNC	On-Line NobleChem^{TM}
OPEX	Operating Experience
P&ID	Piping and Instrumentation Diagram
PAM	Post-Accident Monitoring
PAS	Plant Automation System
PCS	Primary Containment System
PFD	Process Flow Diagram
PRNM	Power Range Neutron Monitoring System
RB	Reactor Building
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
RIV	Reactor Isolation Valve
RPV	Reactor Pressure Vessel
RTP	Rated Thermal Power
RTS	Reactor Trip System
SC	Safety Class
SCC	Stress Corrosion Cracking
SDC	Shutdown Cooling System
SIR	Seismic Interface Restraint
SSC	Structures, Systems, and Components
SCCV	Steel-Plate Composite Containment Vessel
TAF	Top of Active Fuel
TASS	Turbine Auxiliary Steam Subsystem
TB	Turbine Building
TBD	To Be Determined
TBV	Turbine Bypass Valve
TSV	Turbine Stop Valve
USNRC	U.S. Nuclear Regulatory Commission
UT	Ultrasonic Testing
WR	Wide Range

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33955

Revision 0

September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 6
Engineered Safety Features

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AC	Alternating Current
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrence
ARM	Area Radiation Monitoring Subsystem
ASME	American Society of Mechanical Engineers
BDBA	Beyond Design Basis Accident
BIS	Boron Injection System
BPVC	Boiler and Pressure Vessel Code
BWR	Boiling Water Reactor
CB	Control Building
CEPSS	Containment Equipment Piping Support Structure
CCS	Containment Cooling System
CFS	Condensate and Feedwater Heating System
CMon	Containment Monitoring Subsystem
CNSC	Canadian Nuclear Safety Commission
CIS	Containment Inerting System
CIV	Containment Isolation Valve
CRH	Control Room Habitability
CRE	Control Room Envelope
CSA	CSA Group
CUW	Reactor Water Cleanup System
CWE	Chilled Water Equipment
DBA	Design Basis Accident
DEC	Design Extension Condition
DL	Defense Line
DPS	Diverse Protection System
DPT	Differential Pressure Transmitter
DSA	Deterministic Safety Analysis
ECCS	Emergency Core Cooling System
EFCV	Excess Flow Check Valve

Acronym	Explanation
EFS	Equipment and Floor Drain System
EFU	Emergency Filter Unit
ESBWR	Economic Simplified Boiling Water Reactor
ESF	Engineered Safety Feature
FMCRD	Fine Motion Control Rod Drive
FSF	Fundamental Safety Function
FPS	Fire Protection System
FW	Feedwater
GEH	GE Hitachi Nuclear Energy
HEPA	High Efficiency Particulate Air
HCU	Hydraulic Control Unit
HVS	Heating Ventilation and Cooling System
IAEA	International Atomic Energy Agency
I&C	Instrumentation and Control
IC	Isolation Condenser
ICC	Isolation Condenser Cooling & Cleanup System
ICS	Isolation Condenser System
ILRT	Integrated Leak Rate Test
LLRT	Local Leak Rate Testing
LOCA	Loss-of-Coolant Accident
LWM	Liquid Waste Management System
MCR	Main Control Room
MSL	Main Steam Line
MSCIV	Main Steam Containment Isolation Valve
MSRIV	Main Steam Reactor Isolation Valve
NBS	Nuclear Boiler System
OLC	Operational Limits and Conditions
OPEX	Operating Experience
PCS	Primary Containment System
PCCS	Passive Containment Cooling System
PIE	Postulated Initiating Event
PPS	Plant Pneumatics System

Acronym	Explanation
POSAR	Pre-Operational Safety Analysis Report
PREMS	Process Radiation and Environmental Monitoring System
PRM	Process Radiation Monitoring Subsystem
PSA	Probabilistic Safety Assessment
RB	Reactor Building
RBS	Reactor Building Structure
RCPB	Reactor Coolant Pressure Boundary
RIV	Reactor Isolation Valve
RPV	Reactor Pressure Vessel
SA	Severe Accident
SCCV	Steel-Plate Composite Containment Vessel
SC	Safety Class
SCN	Non-Safety Class
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SSC	Structures, Systems, and Components
TAF	Top of Active Fuel
TGFU	Toxic Gas Filtration Unit
TRACG	Transient Reactor Analysis Code General Electric
UPS	Uninterruptible Power Supply
USNRC	U.S. Nuclear Regulatory Commission
WGC	Water, Gas, and Chemical Pads

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33956

Revision 0

September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 7
Instrumentation and Control

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
3D	Three-Dimensional
AOO	Anticipated Operational Occurrence
APRM	Average Power Range Monitor
ARI	Automatic Rod Insertion
ARMS	Area Radiation Monitoring Subsystem
ATLM	Automatic Thermal Limit Monitor
ATS	Anticipatory Trip System
BOP	Balance of Plant
BWR	Boiling Water Reactor
CCF	Common Cause Failure
CRD	Control Rod Drive
CUW	Reactor Water Cleanup System
D-in-D	Defence-in-Depth
DBA	Design Basis Accident
DCIS	Distributed Control and Information System
DL	Defense Line
DEC	Design Extension Condition
DPS	Diverse Protection System
EOC	Emergency Operations Centre
EOP	Emergency Operating Procedure
ERF	Emergency Response Facility
ERICP	Emergency Rod Insertion Control Panel
ERIP	Emergency Rod Insertion Panel
FMCRD	Fine Motion Control Rod Drive
FW	Feedwater
FWCIV	Feedwater Containment Isolation Valve
FWRIV	Feedwater Reactor Isolation Valve
GT	Gamma Thermometer
HCU	Hydraulic Control Unit
HFE	Human Factors Engineering
HSI	Human-System Interface

Acronym	Explanation
HVAC	Heating, Ventilation, and Air Conditioning
I&C	Instrumentation and Control
IC	Isolation Condenser
ICS	Isolation Condenser System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
LAN	Local Area Network
LPRM	Lower Power Range Monitor
MCR	Main Control Room
MRBM	Multi-Channel Rod Block Monitor
MSCIV	Main Steam Containment Isolation Valve
MSL	Main Steam Line
MSR	Moisture Separator Reheater System
MSRIV	Main Steam Reactor Isolation Valve
OLC	Operational Limits and Conditions
PIE	Postulated Initiating Event
PRNM	Power Range Neutron Monitoring System
RC&IS	Rod Control and Information System
RCPB	Reactor Coolant Pressure Boundary
RLC	Reactor Level Control
RPC	Reactor Pressure Control
RPV	Reactor Pressure Vessel
SAMG	Severe Accident Management Guideline
SC1	Safety Class 1
SC2	Safety Class 2
SC3	Safety Class 3
SCR	Secondary Control Room
SCRRI	Selected Control Rod Run-In
SDC	Shutdown Cooling System
SPDS	Safety Parameter Display System
SSC	Structures, Systems, and Components
STP	Simulated Thermal Power

Acronym	Explanation
TMR	Triple Modular Redundant
UPS	Uninterruptible Power Supply
VDU	Visual Display Unit
WRNM	Wide-Range Neutron Monitor

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33957
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 8
Electrical Power

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AC	Alternating Current
AOO	Anticipated Operational Occurrence
DBA	Design Basis Accident
DC	Direct Current
DCIS	Distributed Control and Information System
DL	Defense Line
EDS	Electrical Distribution System
FMCRD	Fine Motion Control Rod Drive
GEH	GE Hitachi Nuclear Energy
GSU	Generator Step Up Transformer
IAEA	International Atomic Energy Agency
I&C	Instrumentation and Control
LOOP	Loss-of-Offsite Power
LV	Low Voltage
MOD	Motor Operated Disconnect
MV	Medium Voltage
OPG	Ontario Power Generation
PPS	Preferred Power Supply
RAT	Reserve Auxiliary Transformer
RB	Reactor Building
RG	Regulatory Guide
RVT	Regulating Voltage Transformer
SBO	Station Blackout
SC	Safety Class
SC1	Safety Class 1
SC2	Safety Class 2
SC3	Safety Class 3
SCN	Non-Safety Category
SDG	Standby Diesel Generator
SMR	Small Modular Reactor
SSC	Structures, Systems, and Components

UAT	Unit Auxiliary Transformer
UPS	Uninterruptable Power Supply
VAC	Volts Alternating Current
VDC	Volts Direct Current

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33958

Revision 1

October 7, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 9A
Auxiliary Systems

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
AMCA	Air Movement and Control Association
AOO	Anticipated Operational Occurrence
AOV	Air Operated Valve
ARI	Air Conditioning and Refrigeration Institute
ASD	Adjustable Speed Drive
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
BIS	Boron Injection System
BOP	Balance of Plant
BPVC	Boiler and Pressure Vessel Code
CB	Control Building
CCS	Containment Cooling System
CNSC	Canadian Nuclear Safety Commission
CFD	Condensate Filters and Demineralizers System
CFS	Condensate and Feedwater Heating System
CHE	Cranes, Hoists, and Elevators
CIS	Containment Inerting System
CIV	Containment Isolation Valve
CON	Primary Containment System
CRD	Control Rod Drive
CRE	Control Room Envelope
CUW	Reactor Water Cleanup System
CWE	Chilled Water Equipment
CWS	Circulating Water System
D-in-D	Defence-in-Depth
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DCIS	Distributed Control and Information System

Acronym	Explanation
DEC	Design Extension Condition
DL	Defense Line
DL2	Defense Line 2
DL3	Defense Line 3
DL4a	Defense Line 4a
DL4b	Defense Line 4b
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
EFS	Equipment and Floor Drain System
EFU	Emergency Filter Unit
EHC	Electro-Hydraulic Control
EME	Emergency Mitigating Equipment
EPRI	Electric Power Research Institute
EQ	Environmental Qualification
FAC	Flow Accelerated Corrosion
FCU	Fan Coil Unit
FE	Flow Element
FHA	Fuel Handling Accident
FHA	Fire Hazards Assessment
FPC	Fuel Pool Cooling and Cleanup System
FPP	Fire Protection Program
FPS	Fire Protection System
FT	Flow Transmitter
FW	Feedwater
HCW	High Conductivity Waste
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
HVS	Heating Ventilation and Cooling System
HX	Heat Exchanger
I&C	Instrumentation and Control
IC	Isolation Condenser
ICC	ICS Pool Cooling and Cleanup System

Acronym	Explanation
ICS	Isolation Condenser System
IGSCC	Intergranular Stress Corrosion Cracking
INPO	Institute of Nuclear Power Operations
ISFSI	Independent Spent Fuel Storage Installation
ISI	In-Service Inspection
IST	In-Service Testing
LED	Light Emitting Diode
LOCA	Loss-of-Coolant Accident
LOOP	Loss-of-Offsite Power
LWM	Liquid Waste Management System
MCA	Main Condenser and Auxiliaries
MCR	Main Control Room
MSR	Moisture Separator Reheater System
MSRIV	Main Steam Reactor Isolation Valves
MTE	Main Turbine Equipment
NBCC	National Building Code of Canada
NBS	Nuclear Boiler System
NFPA	National Fire Protection Association
NHS	Normal Heat Sink
NPSH	Net Positive Suction Head
OGS	Offgas System
OLNC	On-Line NobleChem™
PAM	Post-Accident Monitoring
PAS	Plant Automation System
PCW	Plant Cooling Water System
PLSA	Plant Services Area
PPS	Plant Pneumatics System
PREMS	Process Radiation and Environmental Monitoring System
RB	Reactor Building
RBS	Reactor Building Structure
RCPB	Reactor Coolant Pressure Boundary
RES	Refueling and Servicing Equipment System

Acronym	Explanation
RFP	Reactor Feed Pump
RLC	Reactor Level Control
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
SBO	Station Blackout
SC1	Safety Class 1
SC2	Safety Class 2
SC3	Safety Class 3
SCCV	Steel-plate Composite Containment Vessel
SCN	Non-Safety Class
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SJAE	Steam Jet Air Ejector
SSC	Structures, Systems, and Components
SSE	Safe Shutdown Earthquake
SWM	Solid Waste Management System
TB	Turbine Building
TBS	Turbine Building Structure
TMR	Triple Modular Redundant
TS	Technical Specifications
UPS	Uninterruptible Power Supply
WGC	Water, Gas and Chemical Pads

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33959
Revision 1
October 7, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 9B
Civil Engineering Works and Structures

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As-Low-As Reasonably Achievable
AOO	Anticipated Operational Occurrences
BDBA	Beyond Design Basis Accident
BPVC	Boiler and Pressure Vessel Code
CEPSS	Containment Equipment and Piping Support Structure
CLE	Checking Level Earthquake
CWS	Circulating Water System
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DEC	Design Extension Condition
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
EQ	Environmental Qualification
FE	Finite Element
FIA	Foundation Interface Analysis
FIRS	Foundation Input Response Spectra
HELB	High-Energy Line Break
HVAC	Heating, Ventilation and Air-Conditioning
ICS	Isolation Condenser System
ILRT	Integrated Leak Rate Test
LOCA	Loss-of-Coolant Accident
MCC	Motor Control Center
MCR	Main Control Room
NBC	National Building Code of Canada
NS-DBE	Non-Seismic Design Basis Earthquake
OBE	Operating Basis Earthquake
OGS	Offgas System
PCW	Plant Cooling Water System
PIE	Postulated Initiating Event
PLSA	Plant Services Area
POSAR	Preliminary Operating Safety Analysis Report

Acronym	Explanation
PSA	Probabilistic Safety Assessment
RB	Reactor Building
RPV	Reactor Pressure Vessel
SC1	Safety Class 1
SC2	Safety Class 2
SC3	Safety Class 3
SCCV	Steel-plate Composite Containment Vessel
SCN	Non-Safety Class
SCR	Secondary Control Room
SIT	Structural Integrity Test
SMR	Small Modular Reactor
SSC	Structures, Systems and Components
SSI	Soil-Structure Interaction
SSSI	Structure-Soil-Structure Interaction

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33960

Revision 0

September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 10
Steam and Power Conversion Systems

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AC	Alternating Current
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AOV	Air Operated Valve
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
BPVC	Boiler and Pressure Vessel Code
BWROG	Boiling Water Reactor Owners' Group
CFD	Condensate Filters and Demineralizers System
CFS	Condensate and Feedwater Heating System
CIV	Containment Isolation Valve
CNSC	Canadian Nuclear Safety Commission
CRD	Control Rod Drive
CST	Condensate Storage Tank
CUW	Reactor Water Cleanup System
CWS	Circulating Water System
DC	Direct Current
DCIS	Distributed Control and Information System
DL	Defense Line
EFS	Equipment and Floor Drain System
EHC	Electro-Hydraulic Control
FAC	Flow Accelerated Corrosion
FW	Feedwater

Acronym	Explanation
GSU	Generator Step Up Transformer
HP	High Pressure
HPU	Hydraulic Power Unit
I&C	Instrumentation and Control
LOOP	Loss-of-Offsite Power
LP	Low Pressure
LWM	Liquid Waste Management System
MCA	Main Condenser and Auxiliaries
MCR	Main Control Room
MS	Main Steam
MSCIV	Main Steam Containment Isolation Valve
MSL	Main Steam Line
MSR	Moisture Separator Reheater System
MTE	Main Turbine Equipment
NBR	Nuclear Boiler Related
NBS	Nuclear Boiler System
NHS	Normal Heat Sink
PCW	Plant Cooling Water System
PREMS	Process Radiation and Environmental Monitoring System
PRM	Process Radiation Monitoring Subsystem
RLC	Reactor Level Control
RPC	Reactor Pressure Control
RPV	Reactor Pressure Vessel
RTP	Rated Thermal Power

Acronym	Explanation
SC	Safety Class
SCN	Non-Safety Class
SDC	Shutdown Cooling System
SIR	Seismic Interface Restraint
SJAE	Steam Jet Air Ejector
SSC	Structures, Systems, and Components
SWM	Solid Waste Management System
TASS	Turbine Auxiliary Steam Subsystem
TB	Turbine Building
TBS	Turbine Bypass System
TBV	Turbine Bypass Valve
TCV	Turbine Control Valve
TGCS	Turbine Generator Control System
TGSS	Turbine Gland Seal System
TLOS	Turbine Lube Oil System
TMA	Trip Manifold Assembly
TSV	Turbine Stop Valve

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33961
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 11
Management of Radioactive Waste

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AHU	Air Handling Unit
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARM	Area Radiation Monitoring Subsystem
BWR	Boiling Water Reactor
CFD	Condensate Filters and Demineralizers System
CFS	Condensate and Feedwater Heating System
CIV	Containment Isolation Valve
CMon	Containment Monitoring
CO	Carbon Monoxide
CRD	Control Rod Drive
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
CST	Condensate Storage Tank
CUW	Reactor Water Cleanup System
CWE	Chilled Water Equipment
DBA	Design Basis Accident
DCIS	Distributed Control and Information System
EFS	Equipment and Floor Drain System
FPC	Fuel Pool Cooling and Cleanup System
HEPA	High Efficiency Particulate Air
HIC	High Integrity Container
HVAC	Heating, Ventilation and Air Conditioning
HVS	Heating, Ventilation and Cooling System
IC	Isolation Condenser
ICC	ICS Pool Cooling and Cleanup System
ICS	Isolation Condenser System
LWM	Liquid Waste Management System
MCA	Main Condenser and Auxiliaries

Acronym	Explanation
MCR	Main Control Room
MSL	Main Steam Line
NBS	Nuclear Boiler System
NS	Non-Safety
OGS	Offgas System
PREMS	Process Radiation and Environmental Monitoring System
PRM	Process Radiation Monitoring Subsystem
PS	Process Sampling Subsystem
RB	Reactor Building
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
RWST	Refueling Water Storage Tank
SC	Safety Class
SCCV	Steel-plate Composite Containment Vessel
SCN	Non-Safety Class
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SJAE	Steam Jet Air Ejectors SJAE
SWM	Solid Waste Management System
TB	Turbine Building
WGC	Water, Gas and Chemical Pads

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33962
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 12
Radiation Protection

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrence
ARM	Area Radiation Monitoring Subsystem
BWR	Boiling Water Reactor
CAM	Continuous Air Monitor
CB	Control Building
CFD	Condensate Filters and Demineralizers System
CIS	Containment Inerting System
CMon	Containment Monitoring Subsystem
CNSC	Canadian Nuclear Safety Commission
CRD	Control Rod Drive
CST	Condensate Storage Tank
CUW	Reactor Water Cleanup System
DBA	Design Basis Accident
DNNP	Darlington New Nuclear Project
EFU	Emergency Filter Unit
FMCRD	Fine Motion Control Rod Drive
FPC	Fuel Pool Cooling and Cleanup System
GEH	GE Hitachi Nuclear Energy
HVAC	Heating, Ventilation, and Air Conditioning
HVS	Heating Ventilation and Cooling System
HEPA	High Efficiency Particulate Air
ICRP	International Commission on Radiological Protection
ICS	Isolation Condenser System
ISI	In-Service Inspection
LOCA	Loss-of-Coolant Accident
LWM	Liquid Waste Management System
MCR	Main Control Room
OGS	Offgas System
OLC	Operational Limits and Conditions
OPEX	Operating Experience

Acronym	Explanation
PAM	Post-Accident Monitoring
PLSA	Plant Services Area
POSAR	Pre-Operational Safety Analysis Report
PPE	Personal Protective Equipment
PREMS	Process Radiation and Environmental Monitoring System
PRM	Process Radiation Monitoring Subsystem
PS	Process Sampling Subsystem
RB	Reactor Building
RHX	Regenerative Heat Exchanger
RPV	Reactor Pressure Vessel
RW	Radwaste
RWB	Radwaste Building
SC	Safety Class
SCCV	Steel-Plate Composite Containment Vessel
SCN	Non-Safety Class
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SJAE	Steam Jet Air Ejector
TB	Turbine Building
URD	Utility Requirements Document
USNRC	U.S. Nuclear Regulatory Commission

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33963
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 13
Conduct of Operations

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AM	Aging Management
AOO	Anticipated Operational Occurrence
BWR	Boiling Water Reactor
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
DBA	Design Basis Accident
DNNP	Darlington New Nuclear Project
EME	Emergency Mitigating Equipment
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
GEH	GE Hitachi Nuclear Energy
HFE	Human Factors Engineering
IAEA	International Atomic Energy Agency
OPEX	Operating Experience
OLC	Operational Limits and Conditions
OPG	Ontario Power Generation
PSA	Probabilistic Safety Assessment
QA	Quality Assurance
SAMG	Severe Accident Management Guideline
SSC	Structures, Systems, and Components

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33964
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 14
Plant Construction and Commissioning

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ASME	American Society of Mechanical Engineers
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
DNNP	Darlington New Nuclear Project
GEH	GE Hitachi Nuclear Energy
GNF	Global Nuclear Fuel
OPEX	Operating Experience
OPG	Ontario Power Generation
QA	Quality Assurance
SSC	Structures, Systems, and Components

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33965
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 15
Safety Analysis

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AAZ	Automatic Action Zone
AC	Alternating Current
ACRW	All Control Rod Withdrawal at Power
ALWR	Advanced Light Water Reactor
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOO	Anticipated Operational Occurrence
ASME	American Society of Mechanical Engineers
AST	Alternative Source Term
ATLM	Automatic Thermal Limit Monitor
BDBA	Beyond Design Basis Accident
BE	Best Estimate
BIS	Boron Injection System
BL-AOO	Baseline Abnormal Operational Occurrence
BL-DBA	Baseline Design Basis Accident
BL-DSA	Baseline Deterministic Safety Analysis
BOP	Balance of Plant
BWR	Boiling Water Reactor
CAFTA	Computer Aided Fault Tree Analysis
CANDU	CANada Deuterium Uranium
CB	Control Building
CCDP	Conditional Core Damage Probability
CCF	Common Cause Failure
CDF	Core Damage Frequency
CET	Containment Event Tree
CIV	Containment Isolation Valve
CN-DBA	Conservative Design Basis Accident
CN-DSA	Conservative Deterministic Safety Analysis
CNSC	Canadian Nuclear Safety Commission
CPR	Critical Power Ratio
CRD	Control Rod Drive

Acronym	Explanation
CRDA	Control Rod Drop Accident
CRDM	Control Rod Drive Motor
CSA	CSA Group
CSAU	Code Scaling, Applicability, and Uncertainty
CUW	Reactor Water Cleanup System
CWS	Circulating Water System
DBA	Design Basis Accident
DCF	Dose Conversion Factor
DCIS	Distributed Control and Information System
DEC	Design Extension Condition
DF	Decontamination Factor
DL	Defense Line
D-in-D	Defence-in-Depth
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
DSA	Deterministic Safety Analysis
EAB	Exclusion Area Boundary
ECCS	Emergency Core Cooling System
EHE	External Hazard Evaluation
EOC	End of Cycle
EOP	Emergency Operating Procedure
EOR	End of Rated Cycle
EPRI	Electric Power Research Institute
ESBWR	Economic Simplified Boiling Water Reactor
EX-DBA	Extended Design Basis Accident
EX-DEC	Extended Design Extension Condition
EX-DSA	Extended Deterministic Safety Analysis
FFHE	Functional Failure Hazard Evaluation
FHA	Fuel Handling Accident
FLEX	Diverse and Flexible Coping Strategy
FMCRD	Fine Motion Control Rod Drive
FMEA	Failure Modes and Effects Analysis

Acronym	Explanation
FSF	Fundamental Safety Function
FV	Fussell-Vesely
FW	Feedwater
FWCIV	Feedwater Containment Isolation Valve
FWFI	Feedwater Flow Increase
FWPT	Feedwater Pump Trip
GEH	GE Hitachi Nuclear Energy
HCU	Hydraulic Control Unit
HEP	Human Error Probabilities
HFE	Human Factors Engineering
HOHE	Human Operation Hazard Evaluation
HRA	Human Reliability Analysis
HVAC	Heating, Ventilation, and Air Conditioning
I&C	Instrumentation and Control
IAEA	International Atomic Energy Agency
ICRW	Inadvertent Control Rod Withdrawal at Power – Single Rod
ICS	Isolation Condenser System
IE	Initiating Event
IHE	Internal Hazard Evaluation
IR	Inventory Reduction
LFWH	Loss of Feedwater Heating
LOCA	Loss-of-Coolant Accident
LOPP	Loss-of-Preferred Power
LPSD	Low Power Shutdown
LPZ	Low Population Zone
LRF	Large Release Frequency
LR-TT	Load Reduction – Turbine Trip
MAAP	Modular Accident Analysis Program
MCC	Motor Control Center
MCCI	Molten Core Concrete Interaction
MCPR	Minimum Critical Power Ratio
MCR	Main Control Room

Acronym	Explanation
MCS	Minimal Cutset
MOC	Middle of Cycle
MRBM	Multi-Channel Rod Block Monitor
MS	Main Steam
MSCIV	Main Steam Containment Isolation Valve
MSL	Main Steam Line
MSRIV	Main Steam Reactor Isolation Valve
NBS	Nuclear Boiler System
NBR	Nuclear Boiler Rated
NPP	Nuclear Power Plant
OBE	Operating-Basis Earthquake
ODE	Ordinary Differential Equation
OLC	Operational Limits and Conditions
OLMCPR	Operating Limit Minimum Critical Power Ratio
OOCC	Out Of Core Criticality
OPEX	Operating Experience
OPG	Ontario Power Generation
PA	Postulated Accident
PCCS	Passive Containment Cooling System
PCT	Peak Cladding Temperature
PCW	Plant Cooling Water System
PI-AOO	Pressure Increase- Abnormal Operational Occurrence
PIE	Postulated Initiating Event
PIRT	Phenomena Identification and Ranking Table
POS	Plant Operating State
PPS	Plant Pneumatics System
PRA	Probability Risk Assessment
PSA	Probabilistic Safety Assessment
PSAR	Preliminary Safety Analysis Report
PSIG	Pounds per Square Inch Gauge
PWR	Pressurized Water Reactor
QHO	Quantitative Health Objectives

Acronym	Explanation
RAW	Risk Achievement Worth
RB	Reactor Building
RCPB	Reactor Coolant Pressure Boundary
RI	Reactivity Increase
RI-AOO	Reactivity Increase- Abnormal Operational Occurrence
RIV	Reactor Isolation Valve
RPC	Reactor Pressure Control
RPF	Radial Peaking Factor
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
SA	Severe Accident
SAM	Severe Accident Management
SAMG	Severe Accident Management Guideline
SCR	Secondary Control Room
SDC	Shutdown Cooling System
SDG	Standby Diesel Generator
SMR	Small Modular Reactor
SPSA	Seismic Probabilistic Safety Assessment
SSC	Structures, Systems, and Components
SS-DBA	Safe-Shutdown Design Basis Analysis
STP	Simulated Thermal Power
TB	Turbine Building
TBV	Turbine Bypass Valve
TCV	Turbine Control Valve
TRACG	Transient Reactor Analysis Code General Electric
TSV	Turbine Stop Valve
URD	Utility Requirements Document
USNRC	U.S. Nuclear Regulatory Commission
ΔCPR/ICPR	Delta Critical Power Ratio Over Initial Critical Power Ratio

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33966
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 16
Operational Limits and Conditions

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ASME	American Society of Mechanical Engineers
CNSC	Canadian Nuclear Safety Commission
D-in-D	Defence-in-Depth
LCO	Limiting Condition for Operation
NBS	Nuclear Boiler System
OLC	Operational Limits and Conditions
OPEX	Operating Experience
PSA	Probabilistic Safety Assessment
RPV	Reactor Pressure Vessel
SDC	Shutdown Cooling System
SSC	Structures, Systems, and Components

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33967
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 17
Management for Safety

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ABWR	Advanced Boiling Water Reactor
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
DNNP	Darlington New Nuclear Project
ESBWR	Economic Simplified Boiling Water Reactor
GEH	GE Hitachi Nuclear Energy
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
NIRMA	Nuclear Information and Records Management Association
OPG	Ontario Power Generation
PSAR	Preliminary Safety Analysis Report
QA	Quality Assurance
QAPD	Quality Assurance Program Description
RM	Requirements Management
SMR	Small Modular Reactor
SSC	Structures, Systems, and Components
USNRC	U. S. Nuclear Regulatory Commission

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33968
Revision 0
September 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 18
Human Factors Engineering

ACRONYM LIST

Acronym	Explanation
AOF	Allocation of Functions
CBP	Computer-Based Procedures
CNSC	Canadian Nuclear Safety Commission
COO	Concept of Operations
COTS	Commercial-Off-The-Shelf
DCT	Data Connection Table
DNNP	Darlington New Nuclear Project
DSA	Deterministic Safety Analysis
EOP	Emergency Operating Procedure
FRA	Functional Requirements Analysis
GEH	GE-Hitachi Nuclear Energy
HED	Human Engineering Discrepancy
HF	Human Factors
HFE	Human Factors Engineering
HFEITS	Human Factors Engineering Issue Tracking System
HFEPP	Human Factors Engineering Program Plan
HPM	Human Performance Monitoring
HRA	Human Reliability Analysis
HSI	Human-System Interface
I&C	Instrumentation and Control
ISV	Integrated System Validation
MCR	Main Control Room
NUREG	Nuclear Regulatory Report
OE	Operating Experience
OER	Operating Experience Review
PSA	Probabilistic Safety Assessment
PSAR	Preliminary Safety Analysis Report
SAA	Severe Accident Analysis
SCR	Secondary Control Room
SPDS	Safety Parameter Display System
SSC	Structures, Systems, and Components

Acronym	Explanation
T&E	Testing and Evaluation
TA	Task Analysis
TSV	Task Support Verification
UIS	User Interface Specification
V&V	Verification and Validation

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33969
Revision 0
September 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 19
Emergency Preparedness and Response

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As Low As Reasonably Achievable
BDBA	Beyond Design Basis Accident
CB	Control Building
CNEP	Consolidated Nuclear Emergency Plan
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
DBA	Design Basis Accident
DEC	Design Extension Condition
DL	Defense Line
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
EME	Emergency Mitigating Equipment
EMEG	Emergency Mitigating Equipment Guideline
EOC	Emergency Operations Centre
EOP	Emergency Operating Procedure
ERF	Emergency Response Facility
ERO	Emergency Response Organization
IAEA	International Atomic Energy Agency
LTC	Licence to Construct
MCR	Main Control Room
OPG	Ontario Power Generation
PNERP	Provincial Nuclear Emergency Response Plan
PPE	Personal Protective Equipment
REGDOC	Regulatory Document (Canadian Nuclear Safety Commission)
SAMG	Severe Accident Management Guideline
SCR	Secondary Control Room
SPDS	Safety Parameter Display System
USNRC	U.S. Nuclear Regulatory Commission

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33970
Revision 1
October 7, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Chapter 20
Environmental Aspects

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
AECL	Atomic Energy of Canada Limited
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrence
BWR	Boiling Water Reactor
CANDU	CANada Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
DBA	Design Basis Accident
DEC	Design Extension Condition
DNGS	Darlington Nuclear Generating Station
DNNP	Darlington New Nuclear Project
EA	Environmental Assessment
EFS	Equipment and Floor Drain System
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Program
ERA	Environmental Risk Assessment
GEH	GE Hitachi Nuclear Energy
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
HVS	Heating, Ventilation, and Cooling System
ISO	International Organization for Standardization
LWM	Liquid Waste Management System
NRC	U.S. Nuclear Regulatory Commission
OGS	Offgas System
OPG	Ontario Power Generation
PREMS	Process Radiation and Environmental Monitoring System
PSAR	Preliminary Safety Analysis Report
SI	International System of Units
SMR	Small Modular Reactor
SSC	Structures, Systems, and Components

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33971
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report

Chapter 21
Decommissioning and End of Life Aspects

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
ALARA	As Low As Reasonably Achievable
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group
D&D	Dismantling and Demolition
DNNP	Darlington New Nuclear Project
GEH	GE Hitachi Nuclear Energy
HFEPP	Human Factors Engineering Program Plan
LLW	Low-Level Waste
OPEX	Operating Experience
OPG	Ontario Power Generation
SSC	Structures, Systems and Components
SMR	Small Modular Reactor

TABLE OF CONTENTS

GE Hitachi Nuclear Energy

NEDO-33972
Revision 0
September 30, 2022

Non-Proprietary Information

Ontario Power Generation Inc.
Darlington New Nuclear Project
BWRX-300 Preliminary Safety Analysis Report:

Safeguards Annex
Safeguards and Nuclear Material Accountancy

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

ACRONYM LIST

Acronym	Explanation
BWR	Boiling Water Reactor
CA	Complementary Access
CANDU	CANada Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
C/S	Containment and Surveillance
DIQ	Design Information Questionnaire
DNNP	Darlington New Nuclear Project
DNNP-1	Darlington New Nuclear Project, Unit 1
FPC	Fuel Pool Cooling and Cleanup System
GEH	GE-Hitachi Nuclear Energy
GNF	Global Nuclear Fuels
IAEA	International Atomic Energy Agency
NSCA	Nuclear Safety and Control Act
NWMO	Nuclear Waste Management Organization
OPG	Ontario Power Generation Inc.
RB	Reactor Building
RPV	Reactor Pressure Vessel
SMR	Small Modular Reactor
TRS	Technical Report Series

TABLE OF CONTENTS