Nuclear **Procedure**

TITLE
NUCLEAR REFURBISHMENT INTEGRATED SAFETY REVIEW - DARLINGTON

AUTHORIZATION

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COMPLIANCE DATE:	Immediate

PURPOSE

To ensure the *Integrated Safety Review (ISR)* performed to support *Life Extension* of the Darlington Nuclear Generating Station (NGS) meets the requirements of the *Life Extension* of Nuclear Power Plants (NPPs) *Regulatory Document* issued by the Canadian Nuclear Safety Commission (CNSC) and refurbishment program from Ontario Power Generation (OPG), including requirements related to Quality Assurance (QA). This procedure takes authority from N-PROG-MP-0008, Integrated Aging Management.

EXCEPTIONS

This procedure is not applicable to the following:
(a) Performance of Periodic Safety Reviews (PSRs) in order to secure operating licences at regular intervals typically for a period of ten years.
(b) Construction of new NGSs.

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1.0 DIRECTION

This procedure is used for the performance and documentation of the *ISR* to support plant *Life Extension* for Darlington NGS.

This procedure ensures the *ISR* to be performed by Nuclear Refurbishment (NR) to support *Life Extension* of the Darlington NGS shall meet specified QA and CNSC requirements. CNSC requirements have been documented in *Regulatory Document*, RD-360, Life Extension of Nuclear Power Plants.

RD-360 identifies that an *ISR* address the *Safety Factors* from the International Atomic Energy Agency (IAEA) Safety Standards Series, Safety Guide No. NS-G-2.10, Periodic Safety Reviews of Nuclear Power Plants and CNSC safety areas and programs listed in RD-360.

1.1 Objectives

Objective of an *ISR* is to determine:

(a) Extent to which the plant conforms to modern high-level safety goals and requirements.

(b) Extent to which the *Licensing Basis* remains valid.

(c) Adequacy and effectiveness of the arrangements that are in place to maintain plant safety for long-term operation.

(d) Safety improvements to address gaps with respect to modern safety requirements identified during the assessment.

1.2 Scope

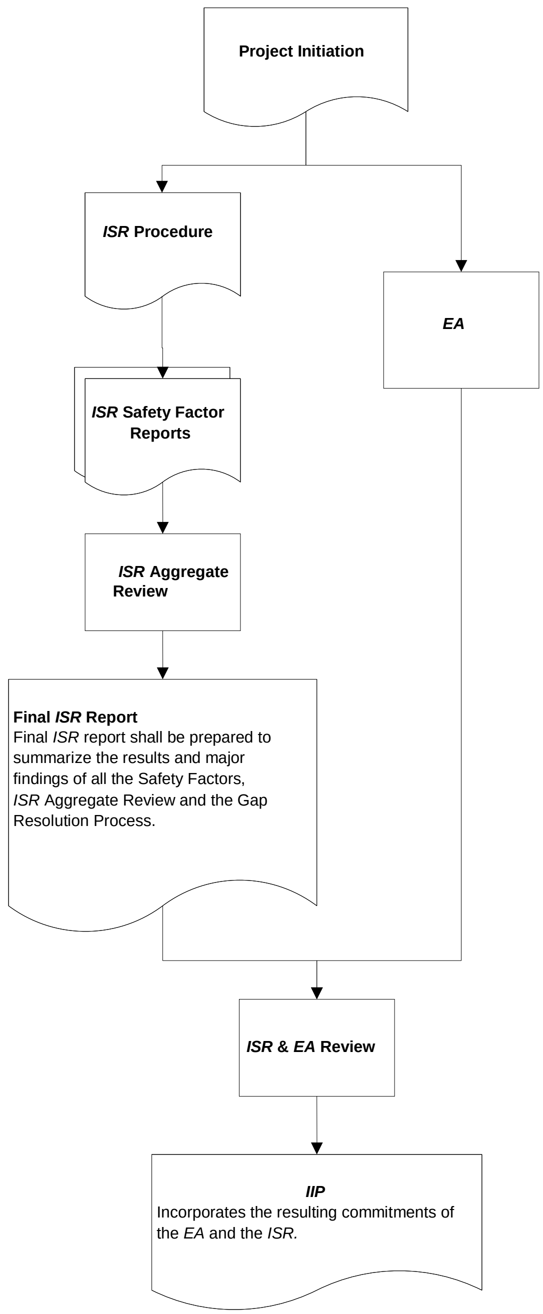
The OPG *Life Extension* process developed using RD-360 as a guide is shown in Figure 1, Life Extension Process. The *Life Extension* process is comprised of the *ISR*, *Environmental Assessment (EA)*, *Global Assessment (GA),* and *Integrated Implementation Plan (IIP)*. This procedure applies to the *ISR* portion of the *Life Extension* process. The *ISR* shall deal with the development of the *ISR Safety Factor* Reports, the *ISR Aggregate Review* and the Final *ISR* Report.

The *ISR* assesses the existing plant and its history including the programs under which it operates, its physical condition, and its performance whereas the *EA* is an assessment of the potential environmental impacts of the refurbishment and continued operation of Darlington NGS. The *EA* is conducted in accordance with NK054-PROC-0049, Conduct of Environmental Assessment, and is outside the scope of this procedure.

Required safety improvements from the *ISR* and *EA* reviews are included in the *IIP* in accordance with N-PROC-LE-0007, Nuclear Refurbishment - Global Assessment Report And Integrated Implementation Plan, Darlington. The *IIP* is outside the scope of this procedure.

The *IIP* identifies the schedule for implementing the safety improvements to be completed within a reasonable time frame.

OPG Process



Note: The *IIP* together with the Final *ISR* Report and the *EA* provide the necessary information to cover the intent of RD-360 and IAEA NS-G-2.10.

Figure 1: Life Extension Process

1.2.1 Life Extension Project

A *Life Extension* project is being considered for the Darlington NGS to enable operation of the Station for an additional 210,000 Effective Full Power Hours (EFPH).

As part of the *Life Extension* project, an *ISR* shall be performed to assess the condition of the plant and adequacy of the programs that are in place to maintain plant safety throughout the extended lifetime of the plant. Through this process, additional required modifications to plant equipment and programs may be identified and evaluated for inclusion in the proposed *Life Extension* project.

The *ISR* shall be performed for the Darlington NGS (a four unit generating station) which includes the Darlington Tritium Removal Facility (TRF), housed within the Heavy Water Management Building, at a site located in the Township of Darlington, in the Municipality of Clarington, in the Regional Municipality of Durham, in the Province of Ontario.

Darlington NGS is comprised of four nuclear reactors, four turbine generators, and associated equipment, services and facilities and contains the following buildings and structures:

- Four reactor building structures numbered 1 to 4, from west to east.
- Four reactor auxiliary bays that contain the reactor auxiliary systems.
- A Powerhouse that includes four turbine halls, four turbine auxiliary bays and a central service area (that serves the entire station) and runs the full length of the station.
- A Vacuum structure which connects to the fuelling duct via a pressure relief duct.
- Four combined cooling/service water pumphouses and standby generator buildings.
- An Emergency electrical power and water supply complex, consisting of an emergency service water pumphouse, emergency power supply generator sets buildings, emergency power supply fuel management structures, and emergency electrical rooms and associated tunnels.
- Two fuelling facilities auxiliary areas (east and west) with two irradiated fuel bays and two fuel handling and service areas.
- A Heavy water management building and the tritium removal facility (that reduces the levels of tritium in OPG NGS heavy water inventories).
- A Waste management facility (that provides interim site storage for the used fuel).

Note: The waste management facility located at the Darlington NGS will not be included in the *ISR* as it has a separate licence.

- Other site buildings including a water treatment building (for demineralised water), a flammable storage building, a high-pressure gas cylinder storage building, a hazardous material and D2O storage building, and a sewage treatment plant.

(a) Scope of the project shall:

(1) Include all site-specific facilities and Systems, Structures and Components (SSCs) on the site covered by the Darlington NGS Power Reactor Operating Licence (PROL) 13.02/2013, specifically, as described in the NK38-SR-03500-10001, Darlington Safety Report, Part 1 and Part 2.

(2) Address any applicable site-wide issues, such as dependencies on common services.

(b) Scope of the review for the Plant Subject Area *Safety Factors* (Plant Design, Actual Condition of SSCs, Equipment Qualification, and Ageing) shall:

(1) Encompass the *Safety Related Systems (SRS)* within NK38-LIST-06937-10001, List of Safety Related Systems and Functions.

(2) Focus in greater depth on a subset of this list comprised of the Systems Important to Safety (SIS) as defined by OPG in compliance with CNSC S-98, Reliability Programs for Nuclear Power Plants, and those systems defining the boundary of the Safe Operating Envelope (SOE). Such *SRS* are associated with the provision of the following safety related functions:

(i) Regulation (including controlled start-up and shutdown) and cooling of the reactor core under normal conditions (including all normal operating and shutdown conditions).

(ii) Regulation, shutdown, and cooling of the reactor core under anticipated transient conditions, accident conditions, and the maintenance of the reactor core in a safe shutdown state for an extended period following such conditions.

(iii) Limiting the release of radioactive material, and exposure of plant personnel, the public, and the environment to meet the criteria established by the licensing authority with respect to radiation exposure during and following normal, anticipated transient and accident conditions.

(3) Safety related SSCs, subject to review under Actual Condition of SSCs and Ageing *Safety Factors,* are identified using the criteria defined by N-PROC-MP-0060, Aging Management Process.

1.2.2 Safety Factors

Safety Factors to be considered for the *ISR* are based on IAEA NS-G-2.10 and three additional *Safety Factors* (i.e., Quality Management, Security, and Safeguards) recommended by RD-360.

(a) IAEA recommended *Safety Factors* are grouped into five subject areas to facilitate the review. In addition to the five subject areas identified by the IAEA, an additional subject area has been added to address Security and Safeguards. These subject areas and corresponding *Safety Factors* are listed in Table 1, Safety Factors. The Quality Management *Safety Factor* shall be added to the Management subject area.

Table 1: Safety Factors

Subject Area	Safety Factors
Plant	Plant Design
	Actual Condition of SSCs
	Equipment Qualification
	Ageing
Safety Analysis	Deterministic Safety Analysis
	Probabilistic Safety Assessment
	Hazard Analysis
Performance and Feedback of Experience	Safety Performance
	Use of experience from other plants and of research findings
Management	Organization and Administration
	Procedures
	Human Factors
	Emergency Planning
	Quality Management
Environment	Environment
Security and Safeguards	Security
	Safeguards

Note: The Environment *Safety Factor* addresses radiological and non-radiological impact.

(b) Due to the sensitive nature of the material, the Security *Safety Factor* shall be dealt with in a forum and manner that ensures the confidentiality and security of the material. Security *Safety Factor* report shall be classified and handled in accordance with OPG-STD-0030, Classification, Protection and Release of Information. The scope and methodology for the Security *Safety Factor* shall be included in this document but the Security Safety Factor Report will be submitted separately as Security protected correspondence. The Security *Safety Factor* shall not be included in the *ISR Aggregate Review* or Final *ISR* Report.

(c) IAEA *Safety Factors* are further broken into IAEA *Review Elements* to address specific areas within the broad categories defined by the *Safety Factors*.

(d) *Review Tasks* were generated, based on the IAEA *Review Elements*, to facilitate the *ISR* of Darlington NGS. *Review Tasks* shall be addressed using governance, plant design condition assessments, safety analyses, operation, etc. Appendix A, Safety Factors and Review Elements, lists *Safety Factors*, *Review Elements,* and corresponding *Review Tasks* to be addressed in the *ISR*.

(e) The *ISR* scope shall consider, as appropriate for each *Safety Factor*, all expected modes of operation (i.e., normal operation, maintenance, refuelling, shutdown, and start-up activities) to determine whether there is any potential for increased or unacceptable levels of risk. Darlington NGS safety analyses and OPG governance for operations in conjunction with the operating history of the plant addresses most of the topics to be covered by the *ISR*.

1.2.3 Codes and Standards

The *ISR* shall perform a review against modern Codes and Standards to assess the level of safety compared to that of modern NPPs.

(a) The set of modern Codes and Standards that shall be used or considered in the review is:

- Provided in Appendix B, Modern Versions of Codes and Standards, and the criteria for selection are provided in Section 1.3.3.
- Summarized for each *Safety Factor* in Appendix A.

1.2.4 Licensing Issues

The *ISR* shall include a comprehensive review of historical and current licensing issues for the station as applicable to various *Safety Factors*. The major groups of issues identified for this review are:

- CANDU Category 3 Safety Issues
- *Generic Action Items (GAIs)*
- *Station Specific Action Items*
- Safety Report Update Issues
- OPG and Site Regulatory Commitments.

For CANDU Category 3 Safety Issues, *GAIs* and *Station Specific Action Items*, open and closed items shall be reviewed and identified against the applicable *ISR Safety Factors* for relevance to *Life Extension*.

Open and applicable to *Life Extension CANDU Category 3 Safety Issues, GAIs* and *Station Specific Action Items* shall be recorded in the *Gap Management Database* as *Tracked Items*. Closed and applicable to *Life Extension* CANDU Category 3 Safety Issues, *GAIs* and *Station Specific Action items* shall be identified as gaps and managed in accordance with the *Gap Resolution Process* in Section 1.5.2.

For Safety Report Update Issues and Regulatory Commitments, open items shall be reviewed and identified against the applicable *ISR Safety Factors* for relevance to *Life Extension.*

Open and applicable to Life Extension Safety Report Update issues, existing Regulatory Commitment (REGC) and Regulatory Management Action (REGM) shall be reviewed and ensured that managed processes are in place to adequately deal with these issues. They will be added to the *Gap Management Database* as *Tracked Items*.

1.2.5 Gaps

The *ISR* process shall identify and address gaps between current and modern plant state and performance (i.e., based on requirements in the modern Codes and Standards). The *Gap*

Resolution Process shall identify reasonable and practical safety improvements that should be made in order to maintain a high level of safety and to improve the safety to a level approaching a modern NPP.

(a) Gaps, if any, in conformance to the modern Codes and Standards shall be compiled and managed in accordance with the *Gap Resolution Process* in Section 1.5.2.

(b) Recommended safety improvements shall be documented in the Final *ISR* Report and required safety improvements shall be documented in the *IIP* in accordance with N-PROC-LE-0007.

Gaps identified from the Security *Safety Factor* shall be managed by initiating an OPG Confidential - Security Protected *Station Condition Record (SCR)* in accordance with N-PROC-RA-0022.

1.3 Integrated Safety Review Methodology

Nuclear safety objectives require that NPPs be designed and operated to keep all sources of radiation exposure under strict technical and administrative control. These fundamental nuclear safety objectives are implemented through safety goals and by demonstrating that plant design and operation do not pose any significant additional risk to public health, safety, security, and the environment, in comparison with other risks to which the public is normally exposed.

One of the key methods to assess the state of the plant in a quantifiable manner is through safety analysis. The *ISR* requires that both probabilistic and deterministic methods be used for this assessment.

Probabilistic Safety Assessment (PSA), referred to as Probabilistic Risk Assessment (PRA) at OPG, is a comprehensive and structured approach to identify cross-link faults and effects of common cause events. The purpose of the review of the PRA is to confirm that OPG safety goals will continue to be met based on methodology, tools, and assumptions applicable to a modern NPP.

Purpose of the review of the Deterministic Safety Analysis shall be to determine whether the actual plant design is capable of meeting modern, prescribed, regulatory limits for radiation doses and radioactive releases resulting from postulated accidents. This assessment helps to identify any major weaknesses of plant design in relation to the application of defence in depth.

1.3.1 Risk-Based Safety Goals

N-PROG-RA-0016, Risk and Reliability Program, describes the development and use of PRA. The risk-based safety goals are numerical safety criteria to be used in association with PRA applications and against which the safety of the plant can be judged. These risk-based safety goals, outlined in Table 2, Risk Based Safety Goals, are comparable to industry good practice.

Table 2: Risk Based Safety Goals

Safety Goal	Average Risk (per year)		Instantaneous Risk (per year)
	Target	Limit	Limit
Latent Effects (per site)	10^{-5}	10^{-4}	N/A
Large Off-Site Release (per Unit)	10^{-6}	10^{-5}	3×10^{-5}
Severe Core Damage (per Unit)	10^{-5}	10^{-4}	3×10^{-4}

(a) Risk-based safety goals apply to estimated risk averaged over time, typically a one–year period. This implies that it is permissible for the risk to exceed the limit for a short period of time provided that the average risk remains below the limit. To ensure that reasonable bounds are placed on the allowable short-term risk, an instantaneous limit has been defined.

(b) The safety goal limit represents the limit of tolerability of risk exposure above which action shall be taken to reduce risk. The safety goal target represents the desired objective towards which the facility should strive, provided that measures to further reduce risk are cost-effective.

(c) The frequency of Latent Effects corresponds to the increase in the probability of serious irreversible injury arising from the release of radiation to the environment due to operation of a NGS when averaged over a one-year period. The calculation accounts for releases due to normal operation and those due to postulated accident events.

(d) The Severe Core Damage Frequency is the sum of the mean frequencies of events due to operation of a nuclear reactor that can lead to failure of both fuel and fuel channel when averaged over a one-year period.

(e) The frequency of Large Off-Site Release is the sum of the mean frequencies of events that can lead to the release of greater than 1% of core inventory of Cs-137 to the environment due to the operation of a nuclear reactor when averaged over a one-year period. Large Release requires Severe Core Damage with coincident failure of containment.

1.3.2 Radiological Safety Goals

A deterministic approach is used to confirm the overall design and operation of the NPP meets the prescribed limits for radiation doses and are as low as reasonably achievable (ALARA) for both normal operating conditions and accident conditions.

1.3.2.1 Normal Operation

The radiation dose limits for normal operation provided in Table 3, Effective Dose Limits for Normal Operation, are based on CNSC Radiation Protection Regulations enabled by the Nuclear Safety and Control Act (NSCA).

Table 3: Effective Dose Limits for Normal Operation

Item	Person	Period	Effective Dose (mSv)
1.	Nuclear energy worker, including a pregnant nuclear energy worker.	(a) One-year dosimetry period (b) Five-year dosimetry period	50 100
2.	Pregnant nuclear energy worker (after notification).	Balance of the pregnancy	4
3.	A person who is not a nuclear energy worker.	One calendar year	1

1.3.2.2 Accident Conditions

In accordance with CNSC *Regulatory Document* RD-310, Safety Analysis for Nuclear Power Plants, identified events shall be classified based on the results of probabilistic studies and engineering judgment, into the following three classes of events:

(1) Anticipated Operational Occurrences (AOOs) include all events with frequencies of occurrence equal to or greater than 10^{-2} per reactor year.

(2) *Design Basis* Accidents (DBAs) include events with frequencies of occurrence equal to or greater then 10^{-5} per reactor year but less than 10^{-2} per reactor year.

(3) Beyond *Design Basis* Accidents (BDBAs) include events with frequencies of occurrence less than 10^{-5} per reactor year.

(a) Other factors which shall be considered in the event classification are any relevant regulatory requirements or historical practices.

(b) Events with a frequency on the border between two classes of events, or with substantial uncertainty over the predicted event frequency, shall be classified into the higher frequency class.

(c) Credible common-cause events shall also be classified within the AOO, DBA, and BDBA classes.

(d) Because RD-310 does not prescribe dose limits and because the reference dose limits have not been formally issued as of the *ISR Code Effective Date*, the S-310 reference dose limits are proposed for the Darlington NGS *ISR* as shown in Table 4, Proposed Basis Reference Dose Limits for Darlington Nuclear Generating Station *Integrated Safety Review*.

Table 4: Proposed Basis Reference Dose Limits for Darlington Nuclear Generating Station Integrated Safety Review

Classification	**Annual Event Probability**	**Effective Dose (mSv)**
AOO	$\geq 10^{-2}$	0.5
DBA	$< 10^{-2}$ and $\geq 10^{-5}$	20
BDBA	$< 10^{-5}$	N/A

(e) For the Darlington NGS *ISR*, the Deterministic Safety Analysis review shall confirm compliance with the regulatory dose limits imposed as indicated above in Table 4.

1.3.3 Selection of Codes and Standards Applicable to Integrated Safety Review

The set of modern Codes and Standards considered for the review are provided in Appendix B and criteria for the selection of applicable Codes and Standards are documented in Section 1.3.3.1.

(a) Primary consideration has been given to CNSC *Regulatory Documents* that would apply to a modern facility, as well as to Codes and Standards referenced in the Darlington NGS PROL 13.02/2013. In addition, IAEA and other appropriate modern international Codes and Standards shall be reviewed for applicability.

(b) Modern versions of Codes and Standards referred to in the Darlington NGS PROL 13.02/2013 (Table B-1, Modern Version of Codes and Standards Referenced in Darlington NGS PROL 13.02/2013) shall receive a clause-by-clause review that will form the core of the *ISR*.

(c) Other Codes and Standards shall receive a high-level or clause-by-clause review of applicable clauses as specified in Table B-2, Modern Version of Additional Codes and Standards, to demonstrate that either the mandatory requirement or the intent of a clause (or set of clauses) is met in accordance with Section 1.5.1.4.

Note: PROL Codes and Standards are all subjected to a clause-by-clause type review in which compliance with mandatory requirements has to be accompanied by solid supporting evidence. For clauses that reference cascading Codes and Standards, the author is required to address these (sub-tier) requirements in determining compliance with the requirements of the parent clause.

Non PROL high level reviews provide evidence that the intent of the clause was met. For Non-PROL clause-by-clause reviews, compliance with mandatory requirements has to be accompanied by solid supporting evidence. For clauses that reference cascading Codes and Standards, the author is required to address these (sub-tier) requirements in determining the intent of the requirements of the parent clause.

For both type of reviews, results of code reviews are reviewed by subject matter experts and *ISR* Single Point of Contacts (SPOCs) to check that appropriate justification is provided to demonstrate compliance.

(d) The *ISR Code Effective Date* indicates which version of the issued modern codes and standards are to be addressed in the *ISR*. The Darlington NGS refurbishment *ISR Code Effective Date* is July 31, 2008 in accordance with NK38-CORR-00531-14244, Darlington NGS Refurbishment - Integrated Safety Review Code Effective Date.

Note: With the exception of Codes and Standards added by NK38-CORR-00531-00649, Darlington NGS A Refurbishment Integrated Safety Review (ISR) Basis – Response to CNSC Staff Assessment the ISR Code Effective Date remains the same.

1.3.3.1 Canadian Nuclear Safety Commission Regulatory Documents

A list of CNSC *Regulatory Documents* that shall be used in the preparation of the Darlington NGS *ISR* is included in Appendix B. The list is based on CNSC *Regulatory Documents* within the Darlington NGS PROL 13.02/2013 and other CNSC *Regulatory Documents* applicable to the *ISR*.

1.3.3.2 Other Codes and Standards

Darlington NGS PROL 13.02/2013 identifies mandatory Codes and Standards applicable to the design, construction, commissioning, and operation of the plant.

To ensure all relevant Codes and Standards for the Darlington NGS *ISR* have been captured, a list of Codes and Standards was developed based on the following sources:

- Codes and Standards referenced in Darlington NGS PROL 13.02/2013
- Codes and Standards referenced in the Darlington NGS Safety Report
- Codes and Standards from the initial list based on work for Pickering A Restart
- Codes and Standards used in the Bruce A and Point Lepreau refurbishments
- Codes and Standards used in the Pickering B NGS *ISR*
- Updates from Canadian Standards Association (CSA) and CNSC websites and the IAEA Safety Standards for NPP.

From these documents and current regulatory trends and requirements, a comprehensive list of Codes and Standards likely to apply to a new plant as of the *ISR Code Effective Date* was created and is included in Appendix B.

1.3.3.3 Emerging Issues

Independent of the Darlington *ISR*, and as part of normal operating practice, OPG has a robust framework of programs and processes to identify and manage emergent industry issues. This framework will remain throughout the refurbishment period as an effective mechanism to identify significant emergent industry issues that may arise between the *ISR Code Effective Date* of July 31, 2008 and the Refurbishment Licensing hearing.

Notwithstanding this effective provision, the results of an additional review shall be provided 6 months prior to the Refurbishment relicensing hearing. This is to identify and address any new revisions to the Darlington *ISR* Basis Codes and any new significant industry operating experience (OPEX). Given the breadth and depth of the *ISR* code review, this refresh mechanism shall provide reasonable demonstrated assurance of continued *ISR* validity within a timeframe commensurate with the hearings on relicensing for the refurbishment period.

In the event that new CNSC documents are issued prior to the relicensing hearing, new regulatory requirements will be addressed through separate formal correspondence as part of the normal relicensing process.

1.4 Current Licensing Basis

The *Licensing Basis* includes:

- Regulatory requirements from Applicable Laws & Regulations,
- Station specific Licence and documents directly referenced in that licence,
- Licence application and documents needed to support that licence application.

This information is within (or is referenced within) the Darlington NGS PROL 13.02/2013 and/or the licence application NK38-CORR-00531-13582, Darlington NGS - Application for Renewal of Darlington Nuclear Generating Station Power Reactor Operating Licence, March 29, 2007.

(a) Darlington NGS as of the Code Effective Date is licensed to operate under PROL 13.02/2013 (contents of its attached Appendices form part of the licence). Codes and Standards referenced in PROL 13.02/2013 are identified in Table B-1 Modern Version of Codes and Standards Referenced in Darlington NGS PROL 13.02/2013.

The latest versions of OPG Documents referenced in the Darlington NGS PROL 13.02/2013 that are available prior to issuance of the various *ISR* reports will be used in these reports.

The Darlington NGS Operating Licence also mandates the use of a number of industry Codes and Standards applicable to various aspects of the plant operation.

(b) OPG's Nuclear Management System is documented in N-CHAR-AS-0002, Nuclear Management System. This Charter and referenced supporting governing documents establish the Nuclear Management System which fulfills requirements of CSA N285 and N286 Standards, International Organization for Standardization (ISO) 14000 series, and American Society of Mechanical Engineers (ASME) Standards NCA 4000.

(c) The Darlington NGS Safety Report is updated on a regular basis (and the *Analysis of Record* establishes the current Safety Report *Licensing Basis* analysis). It contains a description of the plant and the site, and is the principal means of demonstrating compliance with the required Codes and Standards and the event class and reference dose limits specified in CNSC C-006 (Rev.0), Requirements for the Safety Analysis of CANDU Nuclear Power Plants.

(d) The effective date of the various Design Codes and Standards is usually the date of the issuance of the Construction Licence for the station which is June 8, 1981 for Darlington NGS. However, certain long lead-time items were designed to earlier codes and their code effective dates are specified in NK38-SCL-01345-10001, System Classification for Darlington Station.

The *ISR* should demonstrate that OPG has in place programs and assessments to ensure compliance with the current *Licensing Basis*.

1.5 Integrated Safety Review Process

The *ISR* process involves an assessment of the current state of the plant and plant performance to determine the extent to which the plant conforms to modern Codes and Standards, and requirements as described in Section 1.3 to identify any factors that would limit safe long-term operation. In addition to the review of Codes and Standards applicable to an *ISR* as described in Section 1.3.3, OPG governance shall be reviewed in the Execution Phase to determine the Darlington NGS applicable Policies, Programs, Standards, Procedures, and Manuals, which most closely align with the objectives associated with the *Safety Factors*.

A schematic of the *ISR* process is shown in Figure 2, Integrated Safety Review Process.

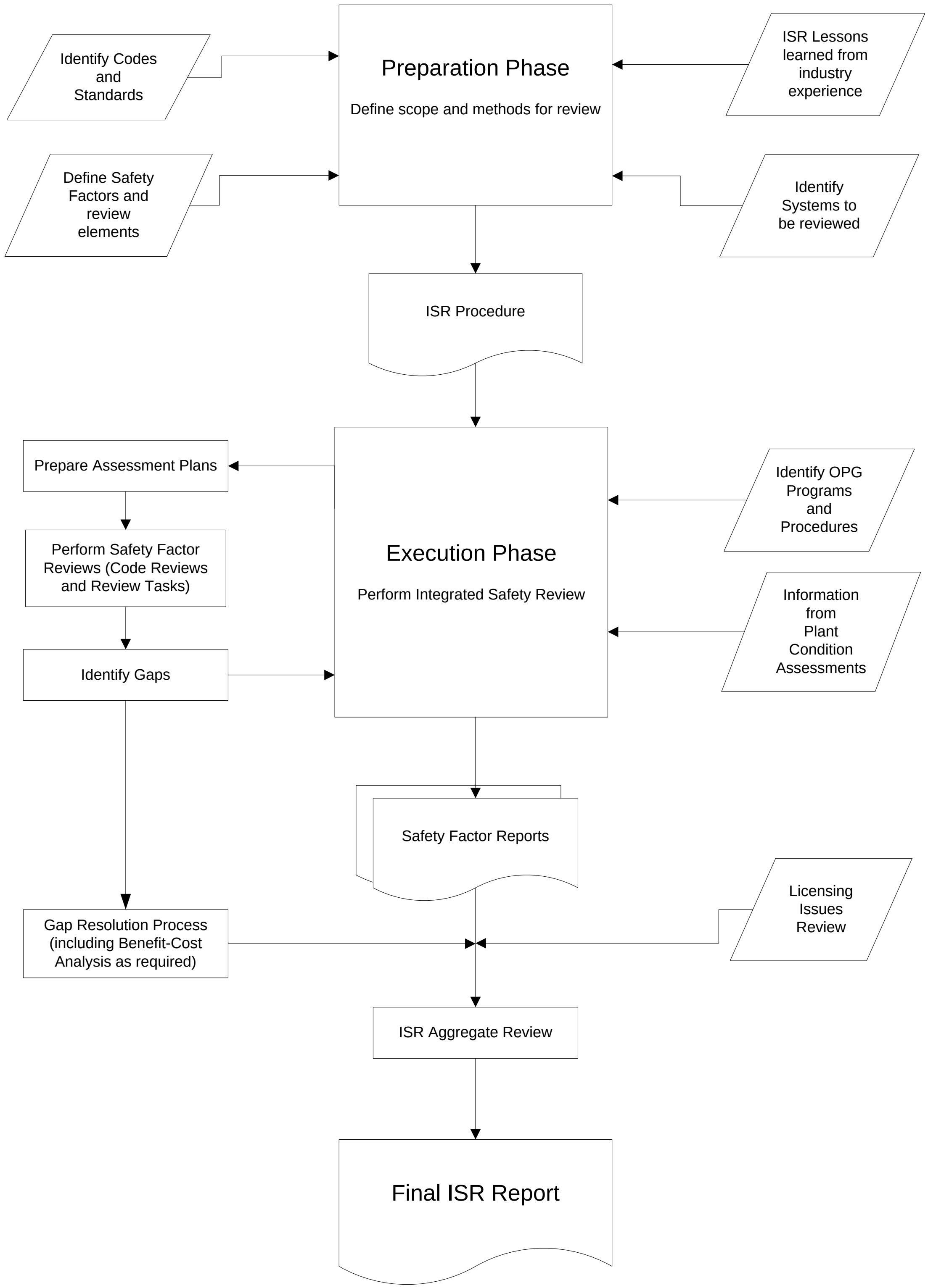


Figure 2: Integrated Safety Review Process

1.5.1 Integrated Safety Review Performance

1.5.1.1 Canadian Nuclear Safety Commission Expectations in RD-360

An *ISR* that follows the guidance of a PSR as outlined in IAEA NS-G-2.10 shall be completed to assess:

- Extent to which the plant conforms to modern national and international safety Codes and Standards.
- Extent to which the *Licensing Basis* remains valid.
- Adequacy and effectiveness of the arrangements that are in place to maintain plant safety to the end of plant lifetime.
- Safety improvements to be implemented to resolve the safety issues that have been identified.

(a) Scope and methodology to be followed during the *ISR* shall be planned, scheduled, developed, and documented.

(b) Codes and Standards to which a modern plant would be built shall be identified.

CNSC is to be kept informed of progress and their comments shall be considered in the conduct of the review.

1.5.1.2 Quality Assurance

The QA program described herein is applicable to the organizations and functions involved in the refurbishment of DNGS. The Quality Management processes for the NR organization define the quality policies, objectives and responsibilities to ensure that the Nuclear related aspects of the project shall satisfy the requirements of Senior Management, OPG's Board of Directors, stakeholders, and the nuclear regulator; i.e., the CNSC.

For Nuclear related activities, the QA program to be applied to refurbishment of DNGS is based on the requirements established in the OPG Darlington NGS PROL and CSA N286-05, Management System Requirements for Nuclear Power Plants. This QA program shall also align with the Nuclear programs and processes as defined by N-CHAR-AS-0002.

Contractors may perform work as part of the Project under their own QA program if specified in the contract documents and if approved by Supply Chain QA for the scope of services being provided. Those contractors working under their own QA Program are required to have established and implemented a QA program that is compliant with the applicable portions of CSA N286-05. Contractors retained by the Project may be required to produce a Project Quality Plan to document the elements of their QA program established to assure compliance to the applicable Codes and Standards.

OPG groups performing work as part of the refurbishment of the DNGS must do so under OPG governance policies and programs or as defined within the unique processes established within this procedure document.

1.5.1.3 Integrated Safety Review Preparation Phase

NR shall implement or follow appropriate governance to ensure each phase of the project has a quality process relevant to its needs. The following shall apply to the Initiation phase of the project and shall be revised as the project proceeds from one phase to the next. The phases are defined as follows:

(a) The Initiation Phase is where initial regulatory, outage and scope planning is done and a feasibility assessment on the economics of refurbishing and extending the operational life of the units by an additional 25 to 30 years is completed.

Deliverables in this phase include the following:

- Obtaining, to the extent possible, the necessary corporate, government and regulatory approvals (e.g., *EA*, *ISR*, etc.), such that the Darlington reactors can be refurbished in a timely and cost effective manner.
- Establishing regulatory certainty, to the degree possible, for the potential refurbishment and subsequently bounding the uncertainty prior to submitting the recommendation to the OPG board.
- Performing technical studies, a plant condition assessment, and other assessments.
- Based on results of the regulatory work programs and the technical work programs identify and approve the project scope and initial outage plans, including cost and schedule.
- Ensuring that where necessary long lead items are identified and procurement strategies are in place to support the refurbishment project.
- Incorporating lessons learned from OPG and external sources in determining the material condition of the plant and providing initial planning of the potential *Life Extension* of Darlington reactors, including recommendation on refurbishment outage timelines.
- Providing recommendations on potential sources of funds for the project and on recovering the costs of the project.
- Establishing and recommending contracting strategy and organization for subsequent phases of the proposed refurbishment project.

The regulatory related aspects of the Initiation Phase of the Darlington Refurbishment project that shall be controlled under the authority of this program have been defined as:

- *ISR*
- *EA*
- *GA*
- *IIP.*

(b) The Definition Phase of the project includes preliminary engineering and detailed outage planning in order to finalize project scope, cost and schedule. In this phase, a release quality estimate and Business Case Summary is developed to support the project recommendation to OPG Senior Management and Board of Directors.

(c) The Detailed Engineering and Outage Preparation phases shall include the establishment and release of direct work contracts to execute the major component replacement packages, establishment and release of contracts for long lead materials, completing detailed engineering and field package assessment, site preparation, and finalization of a detailed project schedule and cost estimate for the outage execution

1.5.1.4 Integrated Safety Review Execution Phase

(a) Manager, NSI, NR shall direct the preparation of the *ISR*.

(b) Some of the activities of the Execution Phase may be executed in parallel with the Preparation Phase.

(c) *Safety Factors* and *Review Tasks* (based on *Review Elements*) identified in the *ISR* shall be tailored to the Darlington NGS review. CNSC concurrence shall be sought for any significant deviation from the PSR recommended review scope and methodology.

(d) Several *Safety Factors* or *Review Tasks* may be grouped together to make best use of both the internal and external expert resources required to perform these reviews.

(e) Methodology for each of the *Safety Factors* shall be developed and documented. An *Assessment Plan* for each *Safety Factor* shall be developed to define scope and methodology, roles and responsibilities, and review plans.

(f) *Safety Factor* reviews shall be completed in accordance with the *Review Tasks* in Appendix A.

(g) *Safety Factor* reviews shall include the *Review Tasks* in Appendix A and a clause-by-clause review or a high-level review of the Codes and Standards listed in Appendix B in accordance with Section 1.3.3.

- A Clause-by-Clause review shall encompass a detailed review of all relevant clauses in the code/standard to demonstrate with solid supporting evidence whether the requirements identified in the code are met fully or not. The review results shall be presented in a table with a compliance statement for each relevant clause.

- High-level review is a review of all relevant clauses in the code/standard to demonstrate with solid supporting evidence whether the intent of the requirements identified in the code are met or not. For a high-level review of a national code/standard, the reviews shall be presented in a table with a compliance statement for each relevant clause. For a high-level review of an international code/standard, at minimum, clauses may be summarized with supporting evidence provided for the requirements of each relevant clause or group of clauses.

(h) The possible outcomes of the Safety Factor reviews are defined as follows in Table 5, Compliance Categorization for Darlington Nuclear Generating Station Integrated Safety Review.

Table 5: Compliance Categorization for Darlington Nuclear Generating Station Integrated Safety Review

Review Type	**PROL**		**Non-PROL**				Results of Review Task	
	Clause-by-Clause		Clause-by-Clause		High Level			
Compliance Level	Meets Require-ment	Does not Meet Require-ment	Meets Require-ment or Intent	Does not Meet Require-ment or Intent	Meets Intent	Does not Meet Intent	Meets Require-ment or Intent	Does not Meet Require-ment or Intent
Possible Outcomes	Compliant	ISR Gap	Indirect Compliance	ISR Gap	Indirect Compliance	ISR Gap	Indirect Compliance	ISR Gap

Note: If a gap has been accepted by the CNSC over the course of the original design life of the plant it shall be considered resolved for the current plant; however it shall be re-evaluated in light of the intended life extension period.

Note: Codes or standards having provisions in Darlington NGS PROL 13.02/2013 for current operations will be assessed for refurbishment with no use of grandfathering provisions.

Description of Compliance Level Categorization is as follows:

(1) *Compliant* -

(i) For PROL Codes and Standards the review demonstrates that the safety requirement of a clause is met.

(2) *Indirect Compliance* -

(i) For Non-PROL Codes and Standards the review demonstrates that either the safety requirement or the intent of a clause (or set of clauses) is met.

(ii) For a *Review Task* the assessment of the *Review Task* demonstrates that it meets either the safety requirement or the intent of the *Review Task*.

(3) *ISR Gap* –

(i) For PROL Codes and Standards the review finds that the safety requirement of a clause is not met.

(ii) For Non-PROL Codes and Standards the review finds that it does not meet either the safety requirement or the intent of a clause (or set of clauses).

(iii) For a *Review Task* the assessment of the *Review Task* finds that it does not meet either the safety requirement or the intent of the *Review Task*.

(i) *Gap Resolution Process* described in Section 1.5.2 shall be used to assess options for the disposition of gaps that have significant impact on nuclear safety.

(j) Reviews of codes and standards listed in Appendices B-1 and B-2 will be performed separately from the *Safety Factor* Reports. The code reviews should identify which clauses are relevant to each *Safety Factor*.

Note: Review of these Codes and Standards shall take into account the fact that in some cases only certain clauses of Codes and Standards are applicable (e.g., introduction, scope, definitions, terminology, etc. shall be excluded since they do not include requirements. Non-mandatory appendices and annexes shall also be excluded).

(k) A summary of the gaps from the applicable code reviews shall be provided in the applicable *Safety Factor* Reports.

(l) *ISR Safety Factor* Reports shall be produced in accordance with Section 1.6.2 to document the methodology, assumptions, and findings of the review.

1.5.2 Integrated Safety Review Gap Resolution Process

Gaps identified as part of the *ISR* (excluding those from the Security Safety Factor) shall be managed and resolved in accordance with N-INS-00770-10004, Nuclear Refurbishment Gap Resolution Process – Darlington.

N-INS-00770-10004 states that:

(1) *ISR Gaps* that represent gaps between the plant status and the current *Licensing Basis*, shall be identified and reported in Darlington NGS *SCRs* in accordance with N-PROC-RA-0022, Processing Station Condition Records and re-classified as *Tracked Items*.

(2) *ISR Gaps* shall be assigned to one or more *ISR Issue(s)*.

(3) *ISR Issues* shall be prioritized with respect to their importance to nuclear safety and assigned a recommended resolution method in accordance with N-INS-00770-10005, Nuclear Refurbishment Issue Prioritization Process - Darlington.

(4) *ISR Issues* shall be resolved in the following manner:

(i) *ISR Issues* with a recommended resolution of 'Perform BCA' shall be resolved in accordance with N-INS-00770-10006, Nuclear Refurbishment Benefit-Cost Analysis Process - Darlington. Due to the significance of *ISR Issues* with an impact on nuclear safety, options for resolution may include plant design or operational modifications or both.

(ii) *ISR Issues* with a recommended resolution method of 'Develop resolution outside of the BCA process' shall be resolved by proposing possible resolutions, analyzing the attributes of each possible resolution, and selecting the preferred resolution.

(iii) *ISR Issues* with an Overall Safety Significance of 3 or 4 and a recommended resolution method of 'No further action required' shall be re-classified as Acceptable Deviations.

(5) All *ISR Gaps*, *Tracked Items*, and *ISR Issues* shall be recorded and tracked in the Gap Management Database.

1.6 Integrated Safety Review Deliverables

1.6.1 Integrated Safety Review Assessment Plans

(a) *ISR Safety Factor Assessment Plans* shall be prepared to address all *Safety Factors*.

Note: Several *Safety Factors* or elements of *Safety Factors* may be grouped together to make best use of both the internal and external expert resources required to perform these reviews.

(b) Each *ISR Safety Factor Assessment Plan* shall contain the following:

- Scope of the *ISR Safety Factor*.
- Methodology for review of the specific Review Tasks.
- Roles and responsibilities of *ISR Safety Factor* Report preparers and reviewers.
- Review plan for the *ISR Safety Factor* Report.

(c) Each *ISR Safety Factor Assessment Plan* shall be produced with the following Table of Contents:

Cover Sheet
1.0 Introduction
2.0 Scope
3.0 Methodology
  3.1 Review Tasks
  3.2 Code Reviews
4.0 Resource Estimate
5.0 Roles and Functional Responsibilities
6.0 Deliverables and Milestones
7.0 Risk Management
8.0 Review Plan
9.0 Verification Plan
10.0 Nomenclature

(d) Manager, NSI, NR or delegate shall review and approve *ISR Safety Factor Assessment Plans*.

(e) Manager, NSI, NR or delegate shall ensure *Assessment Plans* produced as contract deliverables be managed in accordance with N-STD-MP-0014, Managing Contracted Nuclear Safety Services.

1.6.2 Integrated Safety Review Safety Factor Reports

(a) *ISR Safety Factor* Reports shall be prepared to address all *Safety Factors* as per the applicable *Assessment Plans.*

Note: Several *Safety Factors* or elements of *Safety Factors* may be grouped together to make best use of both the internal and external expert resources required to perform these reviews.

(b) *ISR Safety Factor* Reports shall contain the following:

- Review results for specific *Review Tasks*.
- Summary of gaps identified in the code reviews applicable to the *Safety Factor*.

(c) The *ISR Safety Factor* Reports shall be prepared after the Execution Phase. Results and major findings of all the *ISR Safety Factor* Reports (except for the Security *Safety Factor* in accordance with Section 1.2) shall be incorporated into the Final *ISR* Report (Section 1.6.4).

(d) Each *ISR Safety Factor* Report shall be produced with the following Table of Contents:

Cover Sheet
1.0 Introduction
2.0 Scope and Methodology of Review
  2.1 Scope
  2.2 Methodology
3.0 Findings
  3.1 Review Tasks
  3.2 Code Reviews
  3.3 Issues for Review in Other Safety Factors
4.0 Results and Conclusions
  4.1 Results
  4.2 Conclusions
Appendix A References
Appendix B Nomenclature
Appendix C Description of OPG Programs and Their Effectiveness

Note: Supplemental appendices may be added as required by the individual *Safety Factor* Report.

(e) *ISR Safety Factor* Reports shall receive review and verification as defined in Section 1.6.5.

1.6.3 Integrated Safety Review Aggregate Review

(a) An *ISR Aggregate Review* is an independent assessment of plant safety for long-term operation that takes into account all:

- Unresolved issues,

- Safety improvements, and
- Plant strengths

identified as part of the *ISR* to determine the aggregate risk.

(b) *ISR Aggregate Review* shall review:

- Results of the reviews, in particular the gaps and the strengths.
- Recommended safety improvements to address issues arising from the *Gap Resolution Process* as described in Section 1.5.2.
- Recommended safety improvements resulting from identified opportunities to reduce the overall plant risk.
- The extent to which the safety requirements of the defense in depth concepts are fulfilled, in particular for the basic safety functions of Control, Cool and Contain.

(c) *ISR Aggregate Review* shall:

- Assess interactions between recommended safety improvements.
- Estimate the aggregate risk associated with plant operation with *ISR Issues* with a resolution of ‘No further action required’.

(d) The *ISR Aggregate Review* shall be prepared at the conclusion of the Execution Phase and the results incorporated into the Final *ISR* Report (Section 1.6.4). *ISR Aggregate Review* shall not include review or discussion related to Security *Safety Factor* in accordance with Section 1.2.2.

(e) The *ISR Aggregate Review* shall receive review and verification as defined in Section 1.6.5.

1.6.4 Final Integrated Safety Review Report

(a) As an input to develop the *IIP*, a Final *ISR* Report to summarize the results of the *ISR* shall be prepared. Some of the activities of the Final *ISR* phase, such as transition of *ISR Issues* and the corresponding required safety improvements to the *IIP*, may be executed in parallel with the Execution Phase and the *ISR Aggregate Review*.

(b) Final *ISR* Report shall be prepared to summarize the results and major findings of all of the *Safety Factors*, the *ISR Aggregate Review* and *Gap Resolution Process*.

(c) Final *ISR* Report shall be produced with the following Table of Contents as guidance:

Cover Sheet
1.0 Introduction
2.0 Methodology and Governance
3.0 Integrated Safety Review Aggregate Review

3.1 Methodology
3.2 Conclusions and Results
4.0 Safety Factor Summary
4.1 Plant Design
4.2 Actual Conditions of Systems, Structures and Components
4.3 Equipment Qualification
4.4 Ageing
4.5 Deterministic Safety Analysis
4.6 Probabilistic Safety Assessment
4.7 Hazard Analysis
4.8 Safety Performance
4.9 Use of Experience from Other Plants and Research Findings
4.10 Organization and Administration
4.11 Procedures
4.12 Human Factors
4.13 Emergency Planning
4.14 Quality Management
4.15 Environment
4.16 Safeguards
5.0 Other Issues Considered for the Integrated Safety Review
5.1 Radiation Protection
5.2 Safety Significant Operating Experience Findings
Appendix A References
Appendix B Nomenclature
Appendix C Summary of Issues for Review from Safety Factor Reports
Appendix D Code Review Results
Appendix E Issues and Proposed Resolutions
Appendix F Cross Reference of CNSC Safety & Control Areas and Integrated Safety Review Safety Factors

Note: Supplemental sections and appendices may be added as required.

(d) Final *ISR* Report shall receive review and verification as defined in Section 1.6.5.

1.6.5 Review and Verification Process

The description of the review and verification process is given in N-GUID-01900-10000, Human Performance Event Free Tools for Knowledge Work. The *Safety Factor* Reports, *ISR Aggregate Review,* and Final *ISR* Report shall receive review and verification as follows:

(a) Technical Accuracy

(1) Manager, NSI, NR shall designate reviewer(s) and verifier(s) as applicable.

(2) Reviewer(s) and verifier(s) shall not have been involved in the preparation of the report.

(3) Reviewer(s) and verifier(s) shall have appropriate technical expertise.

(4) Reviewer(s) and verifier(s) may be a member of a corporate or station organization.

(5) Reviewer(s) and verifier(s) may be a consultant.

(b) Accuracy of Description of Status of the Plant

(1) Deputy Site Vice President, Darlington NGS shall approve selection of reviewer(s) and verifier(s) as applicable.

(2) At least one reviewer shall work at Darlington NGS.

(3) Reviewer(s) shall assess the impact of findings and recommendations on the station.

(c) Nuclear Safety Implications

Manager, NSI, NR shall designate reviewer(s).

(d) Regulatory Implications

Manager, Regulatory Affairs, Refurbishment Licensing Support, NR Programs shall designate reviewer(s).

(e) Compliance with this Procedure

Manager, NSI, NR shall designate reviewer(s).

(f) Compliance with Assessment Plans (where applicable)

(1) Manager, NSI, NR shall designate reviewer(s).

(2) Reviewer(s) shall ensure compliance with the applicable *Assessment Plans*.

(g) Contractor Compliance (where applicable)

(1) Manager, NSI, NR shall ensure contract deliverables be managed in accordance with N-STD-MP-0014.

(2) Deliverables prepared by contractors shall receive the same level of review and verification as documents prepared by OPG staff.

2.0 ROLES AND ACCOUNTABILITIES

2.1 Director, Engineering Programs, Refurbishment Engineering, Nuclear Refurbishment

- Authorizes governance for the performance and documentation of *ISR and IIP*.
- Ensures all affected stakeholders have been consulted prior to making any formal commitments to the CNSC that impact the stakeholder's area of accountability.

- Ensures an *ISR* and *IIP* is performed, documented, and submitted to CNSC in support of any request from OPG for amendments of an operating licence to permit *Life Extension* of a NGS.

- Acts as Chair, Nuclear Refurbishment – *Benefit-Cost Analysis* (NR-*BCA*) Sub-committee in accordance with Appendix C, Terms of Reference for the NR-*BCA* Sub-Committee.

2.2 Director, Engineering, Refurbishment Engineering, Nuclear Refurbishment

- Ensures the condition assessment portion of the *ISR* Actual Condition of SSCs *Safety Factor* Report is completed.

- Participates in NR-*BCA* Sub-committee in accordance with Appendix C.

2.3 Manager, Regulatory Affairs, Refurbishment Licensing Support, Nuclear Regulatory Programs

- Provides support for licensing issues.

- Designated Licensing Authority (DLA) for NR.

- Participates in NR-*BCA* Sub-committee in accordance with Appendix C.

2.4 Manager, Nuclear Safety Integration, Engineering Programs, Refurbishment Engineering, Nuclear Refurbishment

- Ensures a plan, schedule, and budget are prepared and maintained for the *ISR* Project.

- Ensures the plan, schedule, and budget are accepted by stakeholders.

- Reviews and approves *ISR Safety Factor Assessment Plans*.

- Oversees the preparation of the *ISR Safety Factor* Reports, the *ISR Aggregate Review* Report, and the Final *ISR* Report.

- Oversees selection of internal or external organizations and personnel with the relevant expertise to perform safety reviews.

- Designates reviewer(s) and verifier(s) as applicable for the *ISR Safety Factor* Reports, *ISR Aggregate Review*, Final *ISR* Report.

- Ensures compliance with this procedure.

- Ensures Emerging Issues process is performed in accordance with Section 1.3.3.3.

- Participates in presentations on conclusions of the reviews.

- Oversees administration of the *Gap Management Database* including:

- Determining gap nature (i.e., programmatic, engineering, nuclear safety analysis)
- Ensuring that the *Gap Management Database* is maintained
- Ensuring that gaps identified in the *ISR* are dispositioned.
- Ensuring that dispositions of the gaps are recorded.

- Accountable to propose the resolution of *ISR Gaps* identified in the *ISR*.
- Ensures *BCAs* are performed in accordance with N-INS-00770-10006.
- Acts as the SPOC with the CNSC for the *ISR* Deliverables.
- Ensures CNSC is kept informed of progress and their comments are considered in the conduct of the *ISR*.
- Reports progress and issues at regular intervals to NR Management and OPG Senior Management.
- Conducts *IIP*.

2.5 Deputy Site Vice President, Darlington Nuclear Generating Station

- Approves reviewer(s) at station for the *ISR Safety Factors* Reports, *ISR Aggregate Review*, and Final *ISR* Report.
- Concurs with resolution of gaps that require an operational change at Darlington NGS.
- Approves any formal commitments to the CNSC that may impact the operating station.
- Accepts *ISR* for Darlington NGS on behalf of the station.
- Participates in NR-*BCA* Sub-committee in accordance with Appendix C.

2.6 Vice President, Refurbishment Engineering, Nuclear Refurbishment

Participates in NR-*BCA* Sub-committee in accordance with Appendix C.

2.7 Manager, Environmental Assessment, Licensing, Darlington New Nuclear Project

Conducts *EA*.

2.8 Manager, Nuclear Security Programs, Nuclear Security, Nuclear Programs & Training

- Oversees the preparation of the Security *Safety Factor* Report.
- Ensures OPG Confidential – Security Protected *SCRs* are raised to address gaps.

2.9 Director, Planning and Controls, Nuclear Refurbishment

- Ensures appropriate support for estimating costs and concurs with the financial aspects of the *BCA*.
- Participates in NR-*BCA* Sub-committee in accordance with Appendix C.

3.0 DEFINITIONS AND ACRONYMS

3.1 Definitions

Acceptable Deviation is an *ISR Issue* with a low or very low safety significance that has been dispositioned in accordance with N-INS-00770-10004 as 'No further action required.'

Analysis of Record is the set of documents that establishes the current Safety Report Licensing Basis analysis for an OPG nuclear site. It consists of the latest Safety Report revision plus CNSC submissions that update or supersede analysis reported in the latest revision.

Assessment Plan is a documented process for the scope and completion of a *Safety Factor* Report in accordance with this document.

***Benefit-Cost Analysis* (*BCA*)** is a methodology used for evaluation of proposed alternatives for resolution of *ISR Issues* to ensure that costs of implementing a proposed course of action are commensurate with the benefits gained.

Compliant Safety Factor reviews shall include clause-by-clause review or a high-level review for all Codes, Standards, and Review Tasks identified. A clause is Compliant if:

- PROL Codes and Standards - the review demonstrates that the safety requirement of a clause is met.

Design Basis is the set of information that identifies the specific functions to be performed by a plant system, structure, or component and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. This includes Safety Report and Safety Analysis.

Environmental Assessment (EA) is an assessment carried out under the Canadian Environmental Assessment Act to identify whether a specific project is likely to cause significant environmental effects.

Gap Management Database is a database for recording and tracking all *ISR Gaps*, *Tracked Items* and *ISR Issues* identified during the performance of the Darlington Refurbishment project and their corresponding resolutions.

Generic Action Item is an unresolved generic safety related issue singled out by the CNSC.

Global Assessment provides an overall risk judgement on the acceptability of continued plant operation based on the significant *ISR* results and the *EA* commitments, including plant strengths. The *Global Assessment* takes into account the safety improvements to address the issues identified in the *EA* and the *ISR* and the safety improvements resulting from identified opportunities to reduce the overall plant risk. The *Global Assessment* also incorporates the results of the Defense-in-Depth assessment.

Indirect Compliance Safety Factor reviews shall include clause-by-clause review or a high-level review for all Codes, Standards, and Review Tasks identified. Indirect Compliance exists if:

- Non-PROL Codes and Standards – the review demonstrates that either the safety requirement or the intent of a clause (or set of clauses) is met.
- Review Task – the assessment of the Review Task demonstrates that it meets either the safety requirement or the intent of the Review Task.

Integrated Implementation Plan (IIP) is the integrated result of the *EA* and *ISR*, identifying all necessary safety improvements, proposed plant modifications, safety upgrades, compensatory measures and improvements to operation and management programs that will apply to the project and to long term operation.

Integrated Safety Review (ISR) is a comprehensive assessment of an existing nuclear generating station in order to determine:

- Extent to which the plant conforms to modern high-level safety goals and requirements.
- Extent to which the Licensing Basis remains valid.
- Adequacy and effectiveness of the arrangements that are in place to maintain plant safety for long-term operation.
- Safety improvements to address gaps with respect to modern safety requirements identified during the assessment.

ISR Aggregate Review is an independent assessment of plant safety for long-term operation that takes into account all unresolved issues, all safety improvements, and all plant strengths identified as part of the *ISR* to determine aggregate risk.

ISR Code Effective Date this date indicates which version of the issued modern codes and standards are to be addressed in the *ISR*.

ISR Gap Safety Factor reviews shall include clause-by-clause review or a high-level review for all Codes, Standards, and Review Tasks identified. An *ISR Gap* exists if:

- PROL Codes and Standards - the review finds that the safety requirement of a clause is not met.
- Non-PROL Codes and Standards – the review finds that it does not meet either the safety requirement or the intent of a clause (or set of clauses).

- Review Task - the assessment of the Review Task finds that it does not meet either the safety requirement or the intent of the Review Task.

ISR Issue is a compilation of *ISR Gaps* with similar scope. The categorization, prioritization, and resolution of an *ISR Issue* shall encompass all the included *ISR Gaps*.

Licensing Basis for a regulated facility or activity is a set of requirements and documents comprising:

(i) the regulatory requirements set out in the applicable laws and regulations

(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application.

Life Extension is a set of activities to replace major components (e.g. pressure tubes) in a NGS that have reached or are close to the end of their design lives, to modify a NGS and to maintain a NGS in order to prepare it for operation beyond the design life of its major components.

Regulatory Documents are non-binding policy documents produced by the CNSC that clarify and provide additional details to the requirements set out in the NSCA and the regulations made under the NSCA. A CNSC Regulatory Document or any part thereof becomes a legal requirement when it is referenced in a licence or other legally enforceable instrument.

Review Element is a sub-topic of a Safety Factor as defined in IAEA Safety Standards Series, Safety Guide No. NS-G-2.10.

Review Task is a task that represents one or more IAEA Review Elements or a task required to ensure that CNSC safety areas and programs in RD-360 are addressed.

Safety Factor is a topic required by the CNSC for inclusion in an *ISR* as listed in IAEA Safety Standards Series, Safety Guide No. NS-G-2.10, Periodic Safety Reviews of Nuclear Power Plants or as required to ensure CNSC safety areas and programs in RD-360 are addressed.

***Safety Related Systems* (*SRS*)** are those systems, and the components and structures thereof, which, by virtue of their failure to perform in accordance with the design intent, would have the potential to impact on the radiological safety of the public or plant personnel from operation of the NPP.

Station Condition Record (SCR) is a written report documenting circumstances related to an event or condition, and initial actions taken or planned. The *SCR* provides management with the factual summary of the event or condition including the initial actions and observations.

Station Specific Action Item is an unresolved station specific safety related issue singled out by the CNSC.

Tracked Item is an item recorded in the Gap Management Database which is reviewed as part of the *ISR* but is resolved through an existing OPG program.

3.2 Abbreviations and Acronyms

AECB	Atomic Energy Control Board (predecessor to the CNSC)
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrences
ASME	American Society of Mechanical Engineers
BCA	Benefit-Cost Analysis
BDBA	Beyond Design Basis Accidents
CANDU	Canadian Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DBA	Design Basis Accidents
DLA	Designated Licensing Authority
EA	Environmental Assessment
EFPH	Effective Full Power Hours
GA	Global Assessment
GAI	Generic Action Items
IAEA	International Atomic Energy Agency (an agency of the United Nations)
IIP	Integrated Implementation Plan
ISO	International Organization for Standardization
ISR	Integrated Safety Review
mSv	Milli-Sievert
NGS	Nuclear Generating Station
NPP	Nuclear Power Plant
NR	Nuclear Refurbishment
NSI	Nuclear Safety Integration
NSCA	Nuclear Safety and Control Act
OPEX	Operating Experience
OPG	Ontario Power Generation
PRA	Probabilistic Risk Assessment
PROL	Power Reactor Operating Licence
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
QA	Quality Assurance
REGC	Regulatory Commitment
REGM	Regulatory Management Action
SAMG	Severe Accident Management Guidelines
SCR	Station Condition Record
SIS	Systems Important to Safety
SSC	Systems, Structures and Components
SOE	Safe Operating Envelope
SPOC	Single Point of Contact
SRS	Safety Related Systems
TRF	Tritium Removal Facility

4.0 RECORDS AND REFERENCES

4.1 Records

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (PassPort Type/Sub-Type)
Reports on the results of the Integrated Safety Review (Code Review Reports, Safety Factor Reports*,* *ISR* Aggregate Review, Final *ISR* Report).	N-TMP-10010	N	Indexed in PassPort Controlled Documents Document Type – REP Document Number e.g. NK38-REP-03680-xxxxx Retention = LOF
Assessment Plans	N-TMP-10010	N	Indexed in Approved Document Management System. Document Type – PLAN Document Number e.g. NK38-PLAN-03680-xxxxx Retention = LOF

Controlled documents which may be produced as a result of this document shall be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

Records which may be produced as a result of this document shall be managed in accordance with N-PROC-AS-0042, Quality Assurance Records.

4.2 References

4.2.1 Performance References

IAEA Safety Standards Series, Safety Guide No. NS-G-2.10, Periodic Safety Reviews of Nuclear Power Plants, 2003

N-CHAR-AS-0002, Nuclear Management System

N-INS-00770-10004, Nuclear Refurbishment Gap Resolution Process - Darlington

N-INS-00770-10005, Nuclear Refurbishment Issue Prioritization Process - Darlington

N-INS-00770-10006, Nuclear Refurbishment Benefit-Cost Analysis Process – Darlington

NK38-CORR-00531-13582, Darlington NGS - Application for Renewal of Darlington Nuclear Generating Station Power Reactor Operating Licence, March 29, 2007.

NK38-LIST-06937-10001, List of Safety Related Systems and Functions

NK38-SCL-01345-10001, System Classification for Darlington Station

N-PROC-AS-0003, Controlled Document Management

N-PROC-AS-0042, Quality Assurance Records

NK054-PROC-0049, Conduct of Environmental Assessment

N-PROC-LE-0007, Nuclear Refurbishment - Global Assessment Report And Integrated Implementation Plan, Darlington

N-PROC-MP-0060, Aging Management Process

N-PROC-RA-0022, Processing Station Condition Records

N-PROC-RA-0047, Communications with the Canadian Nuclear Safety Commission

N-PROG-MP-0008, Integrated Aging Management

N-PROG-RA-0016, Risk and Reliability Program

N-STD-MP-0014, Managing Contracted Nuclear Safety Services

N-TMP-10010, Controlled Document or Record

OPG-STD-0030, Classification, Protection, and Release of Information

4.2.2 Developmental References

CAN/CSA-N286-05 incl. UPD1, Management System Requirements for Nuclear Power Plants, November 2007.

CNSC C-006 (Rev.0), Requirements for the Safety Analysis of CANDU Nuclear Power Plants

CNSC RD-310, Safety Analysis for Nuclear Power Plants, February 2008

CNSC RD-360, Life Extension of Nuclear Power Plants, February 2008

CNSC S-98, Reliability Programs for Nuclear Power Plants, July 2005

NK38-CORR-00531-14244, Darlington NGS Refurbishment - Integrated Safety Review Code Effective Date, July 22, 2008.

NK38-CORR-00531-00649, Darlington NGS A Refurbishment Integrated Safety Review (ISR) Basis – Response to CNSC Staff Assessment, August 6, 2010.

NK38-SR-03500-10001, Darlington Safety Report - Part 1: Plant/Site Description and Part 2: Design Description, R001, November 2004.

NK38-SR-03500-10002, “Darlington Safety Report -Part 3: Accident Analysis”, R001, December 2004.

Nuclear Power Reactor Operating Licence, Darlington Nuclear Generating Station, PROL 13.02/2013

Nuclear Safety and Control Act, 1997 c.9

5.0 REVISION SUMMARY

This is an Intent revision.

- Revision bars not used due to major rewrite.
- Titles, roles, and responsibilities updated based on organizational changes.
- Added treatment of Security Sensitive Information and treatment of Security ISR Gaps
- Removed Security related information required for an ISR from the Exceptions area.
- ISR Global Assessment renamed to ISR Aggregate Review to avoid confusion.
- Updated Governance and associated information contained within this document.
- Changed life extension period from 30 years to up to 210,000 Effective Full Power Hours
- Clarified treatment of Licensing Issues (e.g., GAIs, Station Specific Action Items, etc).
- Changed reference to current version of the DNGS PROL to DNGS PROL 13.02/2013.
- Clarified specific requirements from cascading references for codes.
- Provided examples of certain clauses of Codes and Standards that are not applicable.
- Removed “to be Considered” from Table B-2 title and from Appendix A tables.
- Clarified ISR Code Effective Date is the same with the exception of agreed to codes.
- Deleted reference to a list of 700 Codes and Standards typically used in the industry
- Added Darlington Safety Analysis Report as a source for Codes and Standards
- Treatment of Emerging Issues updated as indicated in correspondence to CNSC.
- Updated Licence Basis information and definition as agreed with the CNSC.
- Clarified that latest version of OPG documents from DNGS PROL that are available prior to issuance of ISR Reports will be used in these reports and removed Appendix C.

- Added definition for Clause-by-Clause and High Level Reviews.
- Clarified that there would be no grandfathering provisions in the PROL code reviews.
- Updated the information provided on ISR Gap Resolution Process.
- Removed ISR Gap Management Process Figure to avoid misalignment with Instructions.
- Fixed Table of Contents for ISR Assessment Plans, Safety Factor Reports and Final ISR
- Referred to description of review and verification process in N-GUID-01900-10000.
- Adjusted responsibility of IIP and responsibilities related to engineering gaps and BCA.
- Removed EA issues and responsibility for EA issues.
- Added roles and responsibilities for Security.
- Removed roles and responsibilities for Manager, Engineering Support, Engineering, NR.
- Updated definitions to align with ISR Gap Process Instructions and changes in document
- Changed ISR Aggregate review from third party review to independent review.
- Made safety factor objectives identical to IAEA NS-G-2.10 safety factor objectives.
- Updated code review scope as agreed to in correspondence with the CNSC.
- Updated Appendix A to address requested changes to Review Tasks by CNSC.
- Updated Appendix A and B to incorporate additional codes agreed to with CNSC.
- Removed paragraph indicating we are not re-writing Management SFR.
- Added Security Safety Factor to Appendix A and Security Codes to Appendix A and B.
- NUREG 0700 and NUREG 0711 codes removed from Human Factors and added to Plant Design.
- Added notes below Table B-2 regarding CAN/CSA-N289.1-08 and RD-337 delta review.Changed CNSC SOR/2000-202, 203 and 209 in Table B-2 to Clause-by-Clause reviews.
- Updated information in Terms of Reference for the NR – BCA Sub-Committee.
- Clarified in Table 5 that Results of Review Task versus Review Task may have gaps.
- Incorporated DCRs 0000105551, 0000106117, 0000106302 and 0000108864.

R003: This is a Non-Intent revision

- Updated Single Point of Contact to H. Paetzold
- Updated Authorization Authority to R. Martin
- Revised references to N-PROG-LE-0002 to N-PROG-MP-0008 throughout the document
- Removed all references to N-CHAR-AS-0003 throughout the document as it has been superseded by N-CHAR-AS-0002
- Updated title of N-PROC-LE-0007 to Nuclear Refurbishment - Global Assessment Report And Integrated Implementation Plan, Darlington
- Figure 2: Removed reference to N-PROG-LE-0002
- Revised section 1.5.1.2 to include the Quality Assurance requirements outlined in N-PROG-LE-0002
- Revised section 1.5.1.3 to include the Preparation Phase outlined in N-PROG-LE-0002
- 3.1: Updated definition of Benefit Cost Analysis to apply resolution to *ISR Gaps*, not *ISR Issues*
- 3.1: Updated definition of Design Basis to ensure a consistent definition is used throughout governance
- 4.2.2: Removed reference to N-PROC-LE-0001
- Incorporated DCRs 0000111957, 0000112970, 0000114513, 0000115648, 0000116504, 0000119107 and 0000118999

APPENDIX A

Safety Factors and Review Elements

RD-360 establishes the CNSC approach to *Life Extension* of NPPs. This *Regulatory Document* outlines the requirements for licensees seeking approval for *Life Extension* of NPPs. In accordance with RD-360, guidance on the *ISR* is found in the IAEA NS-G-2.10. The IAEA Safety Guide is designed to deal specifically with the PSR of an existing NPP.

IAEA NS-G-2.10 recommends 14 PSR *Safety Factors* to facilitate the review and is considered sufficient for a comprehensive review of safety. CNSC also expects that an *ISR* address 3 additional factors - Quality Management, Security and Safeguards. Security *Safety Factor*, due to the sensitive nature of the subject, shall be dealt with in a manner that ensures confidentiality and security of this information as defined in Section 1.2.

The Table of Contents for the subsections of Appendix A of this procedure is listed below. Each subsection contains a list of *Review Elements* as proposed by IAEA NS-G-2.10. These *Review Elements* have been converted to *Review Tasks* to define specific scope of the reviews to be performed as part of the *ISR* process. Each subsection contains a list of Codes and Standards that shall be considered in the review for each *Safety Factor*. Appendix B sets out the complete list of the Modern Version of Codes and Standards that shall be used or considered in the *ISR*.

The subsections for the 17 *Safety Factors* are as follows:

APPENDIX A

Safety Factors and Review Elements (Continued)

A.1.0 PLANT DESIGN

(a) Objective of the review of the design of the NPP is to determine the adequacy of the design and its documentation in an assessment against current international standards and practices.

IAEA Defined PSR Review Elements
A detailed description of the plant design, supported by drawings of the layout, systems and equipment.
A list of SSCs important to safety and their classification.
The documented design basis (original and updated).
Significant differences (strengths and shortcomings) between the present plant design and the current standards (used for comparison).
The safety significance of the identified shortcomings relating to the application of defence in depth.

Note: The systems identified by the IAEA as SSCs important to safety are referred to at OPG as *Safety Related Systems (SRS)*. These systems are listed in OPG document NK38-LIST-06937-10001, List of Safety Related Systems and Functions.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm that a detailed description of the plant design, documenting the *Design Basis* supported by layout, systems and equipment drawings exists.

(2) Assess the adequacy of design documentation.

(3) Identify the Systems Important to Safety in accordance with Section 1.2.1.

(4) Perform a review to identify safety significant differences between the present plant design and a design based on modern standards.

(5) Determine the safety significance of the identified gaps relating to the application of defence in depth.

(6) Confirm that the human–machine interface is considered in the design of the control room and other workstations, that analysis of human information requirements and task workload is performed, and that there is linkage to the PRA and Deterministic Safety Analyses.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.1.0 PLANT DESIGN (Continued)

Note: The above activity shall be dealt with in the plant design *Safety Factor* as it is the only human factors activity that deals with plant design. The others deal with human factor elements (e.g., procedures, programs, training, complement, etc).

(7) Assess the adequacy of the arrangements for providing radiological protection.

Safety Factor 1: Plant Design				
	CNSC Documents	**CSA and Other Canadian Standards**		**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC R-7, CNSC R-8, CNSC R-9	CAN/CSA-B51-03 (R2007), CAN/CSA-N285.0-08 / N285.6 Series-08, CAN/CSA-N286-05 incl. UPD1,	CAN/CSA-N286.7-99 (R2007), CAN/CSA-N293-07, NFPA-20, NFPA-24	ASME B&PV Code, Section III, ASME B31.1
Additional Codes and Standards	CNSC R-10, CNSC R-77, CNSC RD-337, CNSC G-276, CNSC G-278	CAN/CSA-N285.2-99 (R2004), CAN/CSA-N285.3-88 (R2005), CAN/CSA-N287.1-93 (R2004), CAN/CSA-N287.2-08, CAN/CSA-N287.3-93 (R2004), CAN/CSA-N289.1-80 (R2008), CAN/CSA-N289.1-08	CAN/CSA-N289.3-M81 (R2008), CAN/CSA-N289.5-M91 (R2008), CAN/CSA-N290.1-80 (R2001), CAN/CSA-N290.4-M82 (R2001), CAN/CSA-N290.5-06, CAN/CSA-N290.6-M82 (R2001), CAN/CSA-N291-08, NBC of Canada 2005, NFC of Canada 2005	ANSI NIRMA CM 1.0-2000, ASME B&PV Code, Section VIII, ASME N509, ASME N510, IAEA NS-G-2.7, IAEA NS-R-1, IAEA NS-R-3, NUREG-0700, NUREG-0711

APPENDIX A

Safety Factors and Review Elements (Continued)

A.2.0 ACTUAL CONDITION OF SYSTEMS, STRUCTURES AND COMPONENTS

(a) Objective of the review is to determine the actual condition of SSCs important to safety and whether it is adequate for them to meet their design requirements. In addition, the review should confirm that the condition of SSCs is properly documented.

IAEA Defined PSR Review Elements
A list of SSCs important to safety and their classification.
Information about the integrity and functional capability of SSCs important to safety, including material case histories.
Information on the existing or anticipated obsolescence of any SSCs important to safety.
Findings of tests that demonstrate the functional capability.
Results of inspections.
Maintenance records.
Description of the present condition of SSCs important to safety.
Description of the support facilities available to the plant both on and off the site, including maintenance and repair shops.

(b) The following *Review Tasks* in the *ISR* review for Darlington NGS are intended to facilitate review of the above elements:

(1) Scope of the review shall include the applicable safety related SSCs that were identified through the process within N-PROC-MP-0060, Aging Management Process.

(2) The reference sources as defined in N-PROC-MP-0060 shall be reviewed, where applicable, when conducting Component Condition Assessments. Examples are:

- Inspection and test results
- Commissioning results
- Maintenance records

(3) Assess and document present conditions of the safety related SSCs and propose appropriate safety improvements to deal with any significant ageing degradation.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.2.0 ACTUAL CONDITIONS OF SYSTEMS, STRUCTURES AND COMPONENTS (Continued)

Note: Any major difference between operating units with respect to ageing degradation mechanisms, present condition, or recommended actions shall also be presented.

(4) Confirm existence of a program to manage the existing and anticipated obsolescence of any safety related SSCs.

(5) Document description of resources and facilities (on and off site) available for ongoing plant maintenance.

Safety Factor 2: Actual Condition of Systems, Structures and Components			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	CAN/CSA-N285.4-05 incl. UPD1, CAN/CSA-N285.5-M90 (R2005),	None identified
Additional Codes and Standards	None identified	CAN/CSA-N285.8-05 incl. UPD1, CAN/CSA-N287.5-93 (R2004), CAN/CSA-N287.7-08	IAEA NS-G-2.6 IAEA NS-G-2.12, IAEA NS-R-2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.3.0 EQUIPMENT QUALIFICATION

(a) Objective of the review is to determine whether equipment important to safety is qualified to perform its designated safety function throughout its installed service life.

IAEA Defined PSR Review Elements
List of equipment covered by the equipment qualification programme and a list control procedure.
Qualification report and other supporting documents (e.g. equipment qualification specifications and qualification plan).
Verification that the installed equipment matches the qualified equipment.
Procedures to maintain qualification throughout the installed service life of the equipment.
Mechanisms for ensuring compliance with these procedures.
A surveillance program and a feedback procedure to ensure that ageing degradation of qualified equipment remains insignificant.
Monitoring of actual environmental conditions and identification of ‘hot spots’ of high activity.
Analysis of the effects of equipment failures on equipment qualification and appropriate corrective actions and/or safety improvements to maintain equipment qualification.
Protection of qualified equipment from adverse environmental conditions.
Physical condition and functionality of qualified equipment (to be confirmed by walkdowns).
Records of all qualification measures taken during the installed service life of the equipment.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm there exists a suite of Engineering programs or processes to ensure equipment qualification requirements are met and documented.

(2) Confirm equipment qualification has been adequately established for all service conditions expected during normal operation, anticipated operational occurrences and accident conditions. These service conditions are subdivided into environmental conditions and operational conditions. Environmental conditions include ambient temperature, pressure, humidity/steam, radiation, water/chemical sprays, fluid submergence and seismic vibration. Operational conditions include process related conditions such as vibration, load cycling, electrical loading parameters, electromagnetic interference, mechanical loads and process fluid conditions.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.3.0 EQUIPMENT QUALIFICATION (Continued)

(3) Perform an objective confirmation that the installed equipment is qualified to perform its *Design Basis* function for its operational life and that effective programs exist to monitor for timely maintenance or replacement of *SRS* as required.

(4) Confirm existence of a process for ensuring compliance with these programs and of documented previous qualification measures taken to ensure qualification throughout the equipment's installed life (i.e. prescribed testing, calibration, maintenance, and parts replacement).

(5) Confirm existence of a surveillance program and a feedback procedure to ensure ageing degradation of qualified equipment remains insignificant.

(6) Confirm existence of monitoring of actual environmental conditions and identification of 'hot spots' of high activity.

(7) Confirm existence of an assessment that determines the effects of equipment failures on equipment qualification and appropriate corrective actions and/or safety improvements to maintain equipment qualification.

(8) Confirm there is protection and adequate separation of qualified equipment from adverse environmental conditions.

(9) Confirm physical condition and functionality capability of qualified equipment by walkdowns.

Safety Factor 3: Equipment Qualification			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-210	CAN/CSA-N290.13-05	None identified
Additional Codes and Standards	None identified	CAN/CSA-N289.3-M81 (R2008), CAN/CSA-N289.4-M86 (R2008), CAN/CSA-N289.1-80 (R2008), CAN/CSA-N289.1-08	IAEA NS-G-3.3

APPENDIX A

Safety Factors and Review Elements (Continued)

A.4.0 AGEING

(a) Objective of the review is to determine whether Ageing in a NPP is being effectively managed so that required safety functions are maintained, and whether an effective Ageing Management Program is in place for future plant operation.

IAEA Defined PSR Review Elements
Programme policy, organization and resources.
A documented method and criteria for identifying SSCs covered by the ageing management programme.
A list of SSCs covered by the ageing management programme and records that provide information in support of the management of ageing.
Evaluation and documentation of potential ageing degradation that may affect the safety functions of SSCs.
The extent of understanding of dominant ageing mechanisms of SSCs.
The availability of data for assessing ageing degradation, including baseline, operating and maintenance history.
The effectiveness of operational and maintenance programmes in managing ageing of replaceable components.
The programme for timely detection and mitigation of ageing mechanisms and/or ageing effects.
Acceptance criteria and required safety margins for SSCs.
Awareness of physical condition of SSCs, including actual safety margins, and any features that would limit service life.

(b) Review shall make use of results of plant condition assessments of safety related SSCs that:

(1) Determine their current performance and condition, including assessment of any age-related failures or indications of significant material degradation.

(2) Estimate and justify their future performance, ageing degradation, and residual service life, where feasible.

(c) The following *Review Tasks* in the *ISR* review for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm there is a documented method and criteria for identifying safety related SSCs covered by the Ageing Management Program.

(2) Ensure there is an effective Ageing Management Program and dedicated organization with clearly defined roles and responsibilities with sufficient resources to continually assess ageing effects in safety related SSCs.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.4.0 AGEING (Continued)

(3) Establish a list of SSCs covered by the ageing management program and records that provide information in support of the management of ageing.

(4) Evaluate and document impact of potential ageing degradation of safety related SSCs.

(5) Confirm or develop understanding of dominant ageing mechanisms of safety related SSCs.

(6) Confirm existence of predictive maintenance program.

(7) Measure and document effectiveness of operational and maintenance programs in managing ageing of safety related SSCs.

(8) Ensure existence of programs for timely detection and mitigation of ageing mechanisms and/or ageing effects.

(9) Establish acceptance criteria and required safety margin for safety related SSCs for the duration of the plant *Life Extension* through reliability and risk assessments.

Safety Factor 4: Ageing			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-210	None identified	None identified
Additional Codes and Standards	None identified	None identified	IAEA NS-G-2.12, IAEA Safety Report Series No. 15

APPENDIX A

Safety Factors and Review Elements (Continued)

A.5.0 DETERMINISTIC SAFETY ANALYSIS

(a) Objective of the review of the Deterministic Safety Analysis is to determine to what extent the existing Deterministic Safety Analysis remains valid when the following aspects have been taken into account: actual plant design; the actual condition of SSCs and their predicted state at the end of the period covered by the *ISR*; current deterministic methods; and current safety standards and knowledge. In addition, the review should also identify any weaknesses relating to the application of the defence in depth concept.

(b) External and internal hazards shall be assessed as part of Deterministic Safety Analysis.

IAEA Defined PSR Review Elements
A compilation of the existing deterministic safety analyses and their assumptions.
Limits and permitted operational states.
Anticipated operational occurrences.
Postulated initiating events (for the existing safety analyses and a comparable list for a modern nuclear power plant).
Analytical methods and computer codes used in the existing deterministic safety analyses and comparable methods for a modern nuclear power plant, including validation.
Radiation doses and limits on radioactive releases for accident conditions.
Guidelines for deterministic safety analyses, including guidelines for single failure criterion, redundancy, diversity and separation.

(c) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm the existence of current deterministic safety analyses and the assumptions used to perform these analyses.

(2) Evaluate the documentation and processes for defining, implementing, and maintaining the SOE.

(3) Perform assessment of OPG's Deterministic Safety Analysis to determine if the postulated events, event sequences and event combinations covered by the existing analysis are sufficient when compared against those for a modern NPP in accordance with methodology in RD-310.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.5.0 DETERMINISTIC SAFETY ANALYSIS (Continued)

(4) Review adequacy of the documented guidelines for Deterministic Safety Analysis.

(5) Licensing issues shall be assessed in accordance with Section 1.2.4.

Safety Factor 5: Deterministic Safety Analysis			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC R-7, CNSC R-8, CNSC R-9	CAN/CSA-N286-05 incl. UPD1, CAN/CSA-N286.7-99 (R2007), CAN/CSA-N290.13-05	None Identified
Additional Codes and Standards	CNSC G-144, CNSC G-149, CNSC G-306, CNSC R-10, CNSC R-77, CNSC RD-310	CAN/CSA-N288.2-M91 (R2008), CAN/CSA-N289.1-80 (R2008), CAN/CSA-N289.1-08, CAN/CSA-N290.1-80 (R2001), CAN/CSA-N290.4-M82 (R2001), CAN/CSA-N290.5-06	IAEA NS-G-1.2, IAEA NS-R-1

APPENDIX A

Safety Factors and Review Elements (Continued)

A.6.0 PROBABILISTIC SAFETY ASSESSMENT

Note: Probabilistic Safety Assessment is referred to as PRA at OPG.

(a) Objective of the review of the PRA is to determine to what extent the existing PRA remains valid as a representative model of the plant when the following aspects have been taken into account: changes in the design and operation of the plant; new technical information, current methods; and new operational data.

IAEA Defined PSR Review Elements
Existing PSA and its assumptions.
Updating of PSA to reflect the current plant status.
Postulated initiating events (for the existing PSA and a comparable list for a modern nuclear power plant).
Analytical methods and computer codes used in the existing PSA and comparable methods for a modern nuclear power plant, including validation.
Guidelines for PSA of operator action, common cause events, cross-link effects, redundancy and diversity.
Consistency of the accident management programme for beyond design basis accidents with PSA results.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm existence of PRA and the assumptions used to perform this assessment.

(2) Confirm existence of process to assess the impact of changes in plant design, operation, and plant specific failure data and update PRA to reflect the current plant status as required.

(3) Confirm there are guidelines to account for operator actions, common cause events, cross-link effects, redundancy, and diversity.

(4) Compare assumptions, methodology, and events modeled in the current PRA against the requirements of modern Codes and Standards.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.6.0 PROBABILISTIC SAFETY ASSESSMENT (Continued)

Safety Factor 6: Probabilistic Safety Assessment			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-98 Rev. 1, CNSC S-294	CAN/CSA-N286.7-99 (R2007)	None identified
Additional Codes and Standards	CNSC G-149, CNSC G-306, CNSC RD-310	CAN/CSA-N288.2-M91 (R2008), CAN/CSA-N290.1-80 (R2001), CAN/CSA-N290.4-M82 (R2001), CAN/CSA-N290.5-06	IAEA NS-G-1.2, IAEA NS-R-1

APPENDIX A

Safety Factors and Review Elements (Continued)

A.7.0 HAZARD ANALYSIS

(a) Objective of the review of hazard analysis is to determine the adequacy of protection of the NPP against internal and external hazards with account taken of the actual plant design, actual site characteristics, the actual condition of SSCs and their predicted state at the end of the period covered by the *ISR*, and current analytical methods, safety standards and knowledge.

IAEA Defined PSR Review Elements
Internal hazards: fire (prevention, detection and suppression); flooding; pipe whip; missiles; steam release; spray; toxic gas; explosion.
External hazards: changes in site characteristics; flooding, including tsunami; high winds; temperature extremes; seismic hazards; aircraft crash; toxic gas; explosion.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Perform an assessment of the existing Deterministic and Probabilistic analyses to confirm existence of hazard analyses for hazards listed below, and assess these against the requirements of modern methods and codes applicable to a modern NPP. The following hazards are to be included in the assessment:

(i) Internal Hazards:

- Fire
- Pipe whip
- Steam release
- Toxic gas
- Flooding
- Missiles
- Spray
- Explosion.

(ii) External Hazards:

- Changes in site characteristics
- High winds (Tornado)
- Seismic
- Toxic gas
- Flooding
- Extreme temperatures
- Aircraft crash
- Explosions.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.7.0 HAZARD ANALYSIS (Continued)

Safety Factor 7: Hazard Analysis			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC R-7, CNSC R-8, CNSC R-9, CNSC S-294	CAN/CSA-N286.7-99 (R2007), CAN/CSA-N290.13-05, CAN/CSA-N293-07	None identified
Additional Codes and Standards	CNSC RD-310,	CAN/CSA-N289.2-M81 (R2008), CAN/CSA-N290.6-M82 (R2001)	IAEA NS-G-1.2, IAEA NS-G-3.3, IAEA NS-R-1

APPENDIX A

Safety Factors and Review Elements (Continued)

A.8.0 SAFETY PERFORMANCE

(a) Objective of the review of Safety Performance is to determine the safety performance of the NPP and its trends from records of operating experience.

IAEA Defined PSR Review Elements
A system for identifying and classifying safety related incidents.
Arrangements for root cause analysis of incidents and feedback of results.
Methods for selecting and recording safety related operational data, including those for maintenance, testing and inspection.
Trend analyses of safety related operational data.
Feedback of safety related operational data to the operating regime.
Analyses of safety performance indicators such as: • the frequency of unplanned trips while a reactor is critical; • the frequency of selected safety system actuations and/or demands; • the frequency of safety system failures; • safety system unavailability; • the collective dose of radiation per year; • trends in causes of failure (operator errors, plant problems, administration and control problems); • the backlog of outstanding maintenance; • the extent of repeat maintenance; • the extent of corrective (breakdown) maintenance; • the frequency of unplanned operator actions in the interests of safety and their success rate; • the rate of arisings of radioactive waste; • the quantities of stored radioactive waste.
Records of the integrity of physical barriers for the containment of radioactive material.
Records of radiation doses to persons on the site.
Records of data from off-site radiation monitoring.
Records of the quantities of radioactive effluents.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm existence of a system for identifying, classifying and recording safety related incidents.

(2) Confirm that safety related incidents are investigated using root cause analysis and that lessons learned from investigation of these incidents are fed back into the conduct of Operations and Maintenance.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.8.0 SAFETY PERFORMANCE (Continued)

(3) Confirm that the results of the root cause analysis are used to minimize the chances of the same incident reoccurring.

(4) Confirm that information from trend analysis of safety related incidents is fed back into the conduct of operation and/or maintenance.

(5) Confirm there is an adequate set of performance indicators that provides a systematic and comprehensive method to record, trend and analyze safety related data including the major system parameters, and maintenance and inspection records.

Performance indicators may include:

- Frequency of unplanned trips while the reactor is critical
- Satisfactory performance of safety system tests within required limits
- Special Safety System unavailability
- Reliability of SIS
- Collective annual radiation dose of plant staff
- Amount of gaseous and liquid radioactive release relative to permitted limits
- Heavy water escape and loss rates
- Fuel reliability
- Chemistry index
- Volume of Low Level radioactive waste
- Change control index
- Maintenance backlog
- Training
- Environment Index
- Non-radioactive effluents, including hazardous substances
- Non-radioactive wastes
- Spills.

(6) Review all relevant performance indicators which demonstrate that the functions important to safety are performing in an acceptable manner with regard to their safety functions.

(7) Confirm that for cases where performance indicators show an unsatisfactory trend, corrective action is taken.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.8.0 SAFETY PERFORMANCE (Continued)

(8) Review the adequacy of:

- Records of the integrity of physical barriers for the containment of radioactive material.
- Records of radiation doses to persons on the site.
- Records of data from off-site radiation monitoring and records of the quantities of radioactive effluents.
- Records of non-radioactive effluents, including hazardous substances.
- Records of radioactive and non-radioactive waste.
- Records of spills.
- Records of other environmental impacts.

(9) Review audit results of the radiation protection program to assess its effectiveness.

Safety Factor 8: Safety Performance			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-99, CNSC S-210	CAN/CSA-N286-05 incl. UPD1	None identified
Additional Codes and Standards	CNSC G-129 Rev. 1, CNSC G-228, CNSC R-116, SOR/2000-202, SOR/2000-203	None identified	IAEA NS-G-2.11, IAEA NS-G-2.7, IAEA NS-R-2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.9.0 USE OF EXPERIENCE FROM OTHER PLANTS AND OF RESEARCH FINDINGS

(a) Objective of the review of experience from other plants and research findings is to determine whether there is adequate feedback of safety experience from other NPPs and of the findings of research.

IAEA Defined PSR Review Elements
Arrangements for the feedback of experience relevant to safety from other nuclear power plants and relevant non-nuclear plants.
Assessments of and actions on the above experience.
Arrangements for the receipt of information on the findings of relevant research programmes.
Assessments of and actions on the research information.
Plant modifications resulting from the above.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm existence and adequacy of a program for the sending and receiving of experience relevant to safety to and from other NPPs and relevant non-nuclear plants.

(2) Confirm existence of a program for receiving of information on the findings of relevant research programs.

(3) Confirm there is a process for assessing the significance of operating experience from other plants and incorporating the lessons learned into improving safety performance at the station.

(4) Confirm that there is a process for assessing the significance of research findings and technology developments and for incorporating relevant improvements into the station's design and operation.

(5) Review adequacy and effectiveness of the feedback arrangements and timely implementation of assessment findings.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.9.0 USE OF EXPERIENCE FROM OTHER PLANTS AND OF RESEARCH FINDINGS (Continued)

Safety Factor 9: Use of Experience from Other Plants and Research Findings			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	None identified	None identified
Additional Codes and Standards	None identified	None identified	IAEA NS-G-2.11, IAEA NS-R-2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.10.0 ORGANIZATION AND ADMINISTRATION

(a) Objective of the review of organization and administration is to determine whether the organization and the administration are adequate for the safe operation of the NPP.

IAEA Defined PSR Review Elements
Safety policy stating that safety takes precedence over production and implementation of the policy.
Mechanism for setting operating targets and safety targets.
Documented roles and responsibilities of individuals and groups.
Procedures for the feedback of experience to the staff, including experience relating to organizational and management failures.
Mechanisms for maintaining configuration of the nuclear power plant and its documentation.
Formal arrangements for employing external technical, maintenance or other specialist staff.
Staff training facilities and programmes.
QA program and regular QA audits involving independent assessors.
Compliance with regulatory requirements.
Comprehensive, readily retrievable and auditable records of baseline information and operational and maintenance history.
Programme for continuous improvement and/or self-assessment.
Arrangements for control of any changes to the organizational structure or resources of the operating organization that may affect plant safety.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Review organization and administrative procedures to ensure they play a significant role in defining safety culture and evaluate the adequacy of safety culture indicators.

(2) Establish existence of a safety policy to ensure that safety takes precedence over production where a conflict between these two requirements exists.

(3) Identify the method for setting performance targets and confirm that these targets are regularly and systematically reviewed. Confirm that appropriate actions are initiated if safety targets are not met.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.10.0 ORGANIZATION AND ADMINISTRATION (Continued)

(4) Confirm that the published Nuclear organization clearly defines the roles and responsibilities of all individuals and work groups who are involved in activities that could influence the safe operation of the station. Ensure that this organization is understood and that adequate and effective procedures are in place to ensure the availability of these resources and control changes to this organization.

(5) Establish that mechanisms for maintaining configuration control of the *NPP* and its documentation are effective and up-to-date.

(6) Confirm that there are formal arrangements for employing external technical, maintenance or other specialist staff, and confirm that the contracting procedures ensure that contract employees are qualified to do the work assigned to them.

(7) Confirm that there is an approved QA program and that regular QA audits are conducted involving both internal and independent assessors.

(8) Confirm that a program for self-assessment and continuous improvement has been adequately and effectively implemented including feedback of experience relating to organizational and management failures.

(9) Confirm there is a system to ensure that comprehensive, easily retrievable, and auditable records exist of baseline design information, and operational and maintenance history.

(10) Confirm there is an effective framework in place to support the management of regulatory affairs.

Safety Factor 10: Organization and Administration			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	CAN/CSA-N286-05 incl. UPD1, CAN/CSA-N286.7-99 (R2007)	None identified
Additional Codes and Standards	CNSC G-323	None identified	IAEA GS-R-3, IAEA NS-G-2.11, IAEA NS-G-2.3, IAEA NS-G-2.4, IAEA NS-G-2.6, IAEA NS-G-2.8, IAEA NS-R-2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.11.0 PROCEDURES

(a) Objective of the review of the procedures of a NPP is to determine whether the procedures are of an adequate standard.

IAEA Defined PSR Review Elements
Formal approval and documentation of all safety related procedures.
Formal system for modification of a procedure.
Understanding and acceptance of these procedures by management and on-site staff.
Evidence that these procedures are followed.
Adequacy of these procedures in comparison with good practice.
Arrangements for regular review and maintenance of these procedures.
Clarity of procedures with human factor principles taken into account.
Compliance of these procedures with the assumptions and findings of the safety analysis, plant design and operating experience.
Symptom based emergency operating procedures for restoring critical safety functions.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Determine if there is a process for the development, approval, and documenting of all safety related procedures.

(2) Confirm there is a formal process for modifying procedures.

(3) Confirm there is a station program for assessing procedures and performance audits to determine if there is regular review and maintenance of these procedures.

(4) Confirm that self-assessments are performed to ensure that the procedures are followed.

(5) Establish that there is a means for assessing the adequacy of safety related procedures in comparison with the industry's good practices.

(6) Confirm that there are operating procedures that apply comprehensively to normal, abnormal and emergency conditions.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.11.0 PROCEDURES (Continued)

(7) Confirm there is a means for assuring the clarity of procedures taking into account human factors.

Note: Clarity of procedures shall also be addressed in A.12.0 Human Factors.

Safety Factor 11: Procedures			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	CAN/CSA-N286-05 incl. UPD1	None identified
Additional Codes and Standards	None identified	None identified	IAEA GS-R-3, IAEA NS-G-2.2, IAEA NS-G-2.4, IAEA NS-R-2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.12.0 HUMAN FACTORS

(a) Objective of the review of human factors is to determine the status of the various human factors that may affect the safe operation of the NPP.

IAEA Defined PSR Review Elements
Staffing levels for the operation of the nuclear power plant with due recognition of absences, shift working and overtime restrictions.
Availability of qualified staff on duty at all times.
Policy to maintain the know-how of the plant staff.
Systematic and validated staff selection methods (e.g. testing for aptitude, knowledge and skills).
Programmes for initial training, refresher training and upgrading training, including the use of simulators.
Training in safety culture, particularly for management staff.
Programmes for the feedback of operating experience for failures and/or errors in human performance that have contributed to safety significant events and of their causes and corrective actions and/or safety improvements.
Fitness for duty guidelines relating to hours of work, good health and substance abuse.
Competence requirements for operating, maintenance, technical and managerial staff.
Human–machine interface: design of the control room and other work stations; analysis of human information requirements and task workload; linkage to PSA and deterministic analyses.
Style and clarity of procedures.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm that there are procedures to ensure that a minimum number of qualified staff, appropriate to the operating state of the plant, is available at all times.

(2) Confirm that adequate staff training facilities, training staff and training programs exist.

(3) Confirm that the method of selecting staff for new positions and for promotions involves systematic and validated staff selection methods and a method for succession planning.

(4) Confirm that there are appropriate programs for initial, refresher, and upgrade training. For operating staff, this should include the use of simulators.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.12.0 HUMAN FACTORS (Continued)

(5) Establish that there is training in safety culture, including for management staff, that includes work supervision practices and internal communication practices and expectations.

(6) Confirm there are fitness for duty guidelines relating to hours of work, health and substance abuse.

(7) Confirm that the human–machine interface is considered in the design of the control room and other workstations, that analysis of human information requirements and task workload is performed, and that there is linkage to the PRA and Deterministic Safety Analyses.

Note: Above *Review Task* shall be dealt with in the plant design *Safety Factor* as it is the only human factors activity that deals with plant design. The others deal with human factor elements (e.g., procedures, programs, training, complement, etc).

(8) Confirm the style and clarity of procedures provides an appropriate level of detailed guidance for staff through a review of plant events identifying inadequate procedures as a contributing cause.

Note: Clarity of procedures shall also be addressed in A.11.0 Procedures.

Safety Factor 12: Human Factors			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	CAN/CSA-N286-05 incl. UPD1	None identified
Additional Codes and Standards	CNSC G-323 CNSC RD-204	None identified	IAEA GS-R-3, IAEA NS-G-2.11, IAEA NS-G-2.4, IAEA NS-G-2.8,

APPENDIX A

Safety Factors and Review Elements (Continued)

A.13.0 EMERGENCY PLANNING

(a) Objective of the review of emergency planning is to determine (a) whether the operating organization has adequate plans, staff, facilities and equipment for dealing with emergencies and (b) whether the operating organization's arrangements have been adequately co-ordinated with local and national systems and are regularly exercised.

IAEA Defined PSR Review Elements
Studies of the mitigation of accident consequences.
Strategy and organization for emergencies.
Plans and procedures for emergencies.
On-site equipment and facilities for emergencies.
On-site emergency centres.
Communications.
Emergency training, exercises and records of experience.
Interactions of relevant organizations such as the regulatory body, police, fire departments, hospitals, ambulance services, local authorities, public welfare authorities and the information media.
Arrangements for regular reviews of emergency plans and procedures.
Security arrangements for emergencies.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm the full range of accidents and radiation emergencies have been identified and studied.

(2) Confirm the appropriate response and mitigation strategies have been developed and have taken account of major changes at site and around the site (industrial, commercial, residential development).

(3) Confirm that the station organization includes dedicated Emergency Response personnel on duty at the plant at all times, to handle accidents and emergencies.

(4) Assess the adequacy of the training program for emergency response personnel including training, emergency exercises and qualification records.

(5) Confirm there is a process for notification of staff that will be brought in to assist in the management of the response in the longer term.

(6) Determine that there is a classification of accidents to guide the type of response. Confirm if there is a mechanism for notifying and informing government agencies and the public of the accident or emergency and their responses.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.13.0 EMERGENCY PLANNING (Continued)

(7) Confirm the availability of sufficient communications equipment at the plant and at the off site Emergency Centre to permit effective communications with Emergency Response Teams, both on and off site.

(8) Assess adequacy of the emergency response procedures and training and exercises for all site staff. Confirm that integrated and partial emergency exercises have been conducted to check satisfactory function of the emergency organization and its equipment.

(9) Confirm development or existence of a program to comply with Severe Accident Management Guidelines (SAMG) currently being developed as a joint industry initiative.

Safety Factor 13: Emergency Planning			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	None identified	None identified
Additional Codes and Standards	CNSC G-225	Province of Ontario Nuclear Emergency Plan	IAEA GS-G-2.1, IAEA GS-R-2, IAEA NS-G-1.13, IAEA NS-G-2.7, IAEA NS-G-3.2

APPENDIX A

Safety Factors and Review Elements (Continued)

A.14.0 QUALITY MANAGEMENT

(a) Objective of this review is to ensure all aspects of nuclear safety ranging from design to operations are managed at high quality standards. This review is in addition to the *Safety Factors* identified by the IAEA.

(b) The following *Review Tasks* are intended to facilitate the review in line with the above objectives:

(1) Confirm that Governance documents adequately address and are maintained current with respect to the detailed requirements defined by CSA N286 regulatory QA standards named in the Darlington NGS PROL 13.02/2013.

(2) Confirm that a method exists to review and confirm compliance with the requirements defined by CSA N286 Regulatory Quality Standards named in the Darlington NGS PROL 13.02/2013.

(3) Confirm existence of program to periodically communicate with the staff the quality standards.

(4) The review includes aspects, such as problem prevention systems, methods to identify and solve problems, integration and coordination across functional units and levels of management, and a focus on process as well as outcomes.

Safety Factor 14: Quality Management			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	None identified	CAN/CSA-N286-05 incl. UPD1, CAN/CSA-N286.7-99 (R2007)	None identified
Additional Codes and Standards	None identified	None identified	IAEA GS-R-3

APPENDIX A

Safety Factors and Review Elements (Continued)

A.15.0 ENVIRONMENT

(a) Objective of the review of the radiological (and non-radiological) impact of the NPP on the environment is to determine whether the operating organization has an adequate program for surveillance of the radiological (and non-radiological) impact of the plant on the environment.

IAEA Defined PSR Review Elements
Potential sources of radiological impact.
Release limits for effluents.
Records of effluent releases.
Off-site monitoring for contamination levels and radiation levels.
Alarm systems to respond to unplanned releases of effluents from on-site facilities.
Publication of environmental data.
Changes in the use of areas around the site.

(b) The following *Review Tasks* in the *ISR* for Darlington NGS are intended to facilitate review of the above elements:

(1) Confirm there are procedures in place to ensure that permitted release limits of radiological and non-radiological hazardous substances are not exceeded and, if they are, that appropriate corrective action is taken to minimize the possibility of limits being exceeded in the future.

(2) Confirm records of effluent release (both radiological and non-radiological hazardous substances) are maintained in accordance with regulatory requirements.

(3) Confirm that a program exists to define the requirements for alarm systems to respond to unplanned effluent releases from on-site facilities.

(4) Confirm the environmental data recorded by the station is published and is available on request to the general public.

(5) Review the environmental data recorded by the station and compare with the values measured before the NPP was put into operation.

(6) Confirm there is a process to address changes in the use of land external to the site with respect to the impact on public safety from facility releases.

APPENDIX A

Safety Factors and Review Elements (Continued)

A.15.0 ENVIRONMENT (Continued)

Safety Factor 15: Environment			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-99	None identified	None identified
Additional Codes and Standards	CNSC G-296, CNSC S-296	CAN/CSA-N288.1-M87 (R2008), CAN/CSA-N288.4-M90 (R2008), CAN/CSA-ISO 14001:2004, MISA Ontario Regulation 215/95	IAEA NS-G-1.13, IAEA NS-G-2.7, IAEA NS-G-3.2, IAEA NS-R-1

APPENDIX A

Safety Factors and Review Elements (Continued)

A.16.0 SAFEGUARDS

CNSC's regulatory mandate includes conformity with measures required to implement Canada's international obligations under the Treaty on the Non-Proliferation of Nuclear Weapons. Pursuant to the Treaty, Canada has entered into a Safeguards Agreement with the IAEA. This agreement provides the IAEA with the right and the responsibility to verify that Canada is fulfilling its international commitment on the peaceful use of nuclear energy.

CNSC provides the mechanism, through the NSCA and Regulations as well as licence conditions, for the IAEA to implement the Safeguards Agreement. Conditions for the application of the IAEA requirements are contained in PROLs, and compliance includes the timely provision of reports on the movement and location of all nuclear materials and measures for the application of IAEA safeguards.

(a) Objective of this review is to confirm that the Darlington NGS operating organization is able to comply with safeguards regulatory requirements prescribed by the CNSC. The following *Review Tasks* are intended to facilitate the review in line with the objective above:

(1) Confirm approved safeguards program is established to identify safeguards-related responsibilities and to provide appropriate documentation and resources in support of CNSC regulatory requirements.

(2) Confirm approved operating procedures provide detailed information on defined operator activities for safeguards implementation at the facility.

(3) Confirm all necessary safeguards measures are in place to facilitate compliance with the NSCA and CNSC's Regulatory Documents and licence conditions.

(4) Confirm system of nuclear material accountancy and reporting is established according to CNSC requirements.

Safety Factor 16: Safeguards			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	NSCA, CNSC S-99	None identified	None identified
Additional Codes and Standards	AECB-1049 Rev. 2, SOR/2000-202	None identified	IAEA INFCIRC/164, IAEA INFCIRC/164/ADD.1

APPENDIX A

Safety Factors and Review Elements (Continued)

A.17.0 SECURITY

(a) Objective of the review is to ensure the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

The following Review Tasks are intended to facilitate the review in line with the above objectives:

(1) Validation that the facility is maintaining compliance with all in scope security regulations and standards

(2) To ensure that security equipment is maintained and/or replaced for aging or obsolete equipment as required to ensure adherence to modern security levels

(3) To ensure that appropriate security arrangements are in place to support any type of security emergency

(4) Review of the security organization relating to roles within the facility organization, structure and organization of the nuclear security officer service, selection criteria for nuclear security officers, training of nuclear security officers, drills, equipment and vehicles for nuclear security officers, and records for the above

(5) Review of access and identification systems including the control of identification badges or access cards and use of identification badges or access cards

(6) Review of Access/egress controls for persons, vehicles, packages/equipment transmitting in and out of protected and inner area(s)

(7) Review of Access to prescribed information

(8) Review of Security detection and assessment systems including associated subsystems

(9) Review of Design and performance characteristics

(10) Review of Maintenance, testing and inspection programs

(11) Review of Contingency plans and procedures

(12) Review of Availability and duties of nuclear security officers

(13) Review of Reporting as per S-99 requirements

(14) Review of Protection arrangements with off-site response forces

(15) Review of Security awareness program

APPENDIX A

Safety Factors and Review Elements (Continued)

A.17.0 SECURITY (Continued)

(16) Review of Nuclear Response Force program.

(17) Security issues shall be assessed as follows:

A review of historical and current licensing issues for the station applicable to Security shall be conducted. Existing Regulatory Commitment (REGC) and Regulatory Management Action (REGM) items shall be reviewed to ensure that managed processes are in place to adequately deal with these issues. Any open items shall be reviewed and identified for applicability to Life Extension and safe long-term plant operation. Applicable open items will be tracked by Security through an (OPG Confidential – Security Protected) Station Condition Record in accordance with N-PROC-RA-0022.

Safety Factor 17: Security			
	CNSC Documents	**CSA and Other Canadian Standards**	**IAEA Guides and other International Standards**
Modern Version of Codes and Standards Referenced in DNGS PROL 13.02/2013	CNSC S-99 CNSC S-298 (Classified by Government of Canada as Secret)	None identified	None identified
Additional Codes and Standards	CNSC G-208, CNSC G-274, CNSC RD-363, SOR/2000-202 SOR/2000-209 Design Basis Threat (Classified by Government of Canada as Secret)	None identified	IAEA INFCIRC/225/Rev 4

Note: A high level review of the 2009 Darlington Site Security Report, identified in Table B-2 Modern Version of Additional Codes and Standards, shall be performed.

Note: For the Security Safety Factor, only security clauses of CNSC S-99 and SOR/2000-202 shall be reviewed.

APPENDIX B

Modern Versions of Codes and Standards

The criteria for the selection of applicable Codes and Standards are documented in Section 1.3.3. Primary consideration was given to CNSC *Regulatory Documents* that would apply to a new facility as of the *ISR Code Effective Date*, as well as to Codes and Standards currently referenced in the Darlington NGS PROL 13.02/2013. In addition, IAEA and other appropriate modern international Codes and Standards were considered.

The following Tables (B-1 and B-2) identify the Codes and Standards that are proposed as the benchmarks for the *Safety Factor* reviews for Darlington NGS plant *Life Extension*.

- Table B-1 Modern Version of Codes and Standards Referenced in Darlington NGS PROL 13.02/2013
- Table B-2 Modern Version of Additional Codes and Standards

Table B-1 includes the modern version of Codes and Standards that are referenced in Darlington NGS PROL 13.02/2013.

Table B-2 includes other modern Codes and Standards for each of the *Safety Factor* reviews including CNSC documents, CSA standards, IAEA Guides and other International Standards.

Safety Factor reviews shall include a clause-by-clause review or a high-level review of the Codes and Standards in the following Tables (B-1 and B-2) in accordance with instructions specified within Section 1.3.3

Table B-1: Modern Version of Codes and Standards Referenced in Darlington NGS PROL 13.02/2013

Licence Condition	Document Number per Operating Licence	Document Title	Modern Version used for ISR Comparison
2.5	NSCA	Nuclear Safety and Control Act	NSCA (1997)
1.1 App G	ASME Boiler and Pressure Vessel Code, Section III	Rules for Construction of Nuclear Power Plant Components	ASME Boiler and Pressure Vessel Code, Section III (July 2007)
8.1 App G	ASME B31.1	Power Piping	ASME B31.1 (December 2007)
5.1 & App G	CAN/CSA-B51-03	Boiler, Pressure Vessel, and Pressure Piping Code	CAN/CSA-B51-03 (R2007) (March 2003)
5.1 & App G	CAN/CSA-N285.0-06	General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants	CAN/CSA-N285.0-08 (June 2008) N285.6 Series-08 (June 2008)
5.2 c	CAN/CSA-N285.4-94	Periodic Inspection of CANDU Nuclear Power Plant Components	CAN/CSA-N285.4-05 incl. UPD1 (June 2007)
5.2 c	CAN/CSA-N285.5-M90	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	CAN/CSA-N285.5-M90 (R2005) (October 1990)
3.8 a	CAN/CSA-N286.0-92	Overall Quality Assurance Program for Nuclear Power Plants	CAN/CSA-N286-05 incl. UPD1 (November 2007) **Note**: Decommissioning of NPP is not included in scope of the ISR.
3.8 b	CAN/CSA-N286.1-00	Procurement Quality Assurance for Nuclear Power Plants	
3.8 c	CAN/CSA-N286.2-00	Design Quality Assurance for Nuclear Power Plants	
3.8 d	CAN/CSA-N286.3-99	Construction Quality Assurance for Nuclear Power Plants	
3.8 e	CAN/CSA-N286.4-M86	Commissioning Quality Assurance for Nuclear Power Plants	
3.8 f	CAN/CSA-N286.5-95	Operations Quality Assurance for Nuclear Power Plants	
3.8 g	CAN/CSA-N286.7-99	Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants	CAN/CSA-N286.7-99 (R2007) (March 1999)
7.1	CAN/CSA-N290.13-05	Environmental Qualification of Equipment for CANDU Nuclear Power Plants	CAN/CSA-N290.13-05 (February 2005)
6.1, 6.2 & 6.3	CAN/CSA-N293-95 CAN/CSA-N293-07* * Transition details as per the current licence.	Fire Protection for CANDU Nuclear Power Plants	CAN/CSA-N293-07 (January 2008)
3.9 a	CNSC R-7 (February 1991)	Requirements for Containment Systems for CANDU Nuclear Power Plants	CNSC R-7 (February 1991)
3.9 b	CNSC R-8 (February 1991)	Requirements for Shutdown Systems for CANDU Nuclear Power Plants	CNSC R-8 (February 1991)
3.9 c	CNSC R-9 (February 1991)	Requirements for Emergency Core Cooling System for CANDU Nuclear Power Plants	CNSC R-9 (February 1991)
3.10	CNSC S-98 Revision 1 (July 2005)	Reliability Programs for Nuclear Power Plants	CNSC S-98 Revision 1 (July 2005)
1.6 & 3.4	CNSC S-99 (March 2003)	Reporting Requirements for Operating Nuclear Power Plants	CNSC S-99 (March 2003)
3.6	CNSC S-210 (July 2007)	Maintenance Programs for Nuclear Power Plants	CNSC S-210 (July 2007)

Table B-1: Modern Version of Codes and Standards Referenced in Darlington NGS PROL 13.02/2013

Licence Condition	Document Number per Operating Licence	Document Title	Modern Version used for ISR Comparison
3.11	CNSC S-294 (April 2005)	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	CNSC S-294 (April 2005)
10.2	CNSC S-298 (January 2003)	Nuclear Response Force Standard	CNSC S-298 (January 2003)
8.2 (b) App G	NFPA-20	Standard for the Installation of Stationary Pumps for Fire Protection - 2007 Edition	NFPA-20 (August 2006)
8.2 (c) App G	NFPA-24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances - 2007 Edition	NFPA-24 (August 2006)

Note: The set of modern Codes and Standards that shall be used or considered in the review is also summarized for each *Safety Factor* in Appendix A.

Note: Codes and Standards relevant to the Security *Safety Factor* are outside the scope of the Final *ISR* and shall be submitted separately due to the sensitive nature of the material.

Note: NSCA is to be reviewed for all Safety Factors but it is only to be discussed as part of the Safeguards Safety Factor.

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
2009 Darlington Site Security Report	2009 Darlington Site Security Report	Security	High-Level
ANSI NIRMA CM 1.0-2000 (January 2000)	Guidelines for Configuration Management of Nuclear Facilities	Plant Design	High-Level
ASME Boiler and Pressure Vessel Code, Section VIII (July 2007)	Design and Fabrication of Pressure Vessels	Plant Design	High-Level
ASME N509 (April 2003)	Nuclear Power Plant Air-Cleaning Units and Components	Plant Design	High-Level
ASME N510 (December 2007)	Testing of Nuclear Air-Treatment Systems	Plant Design	High-Level
CAN/CSA-N285.2-99 (R2004) (May 1999)	Requirements for Class 1C, 2C and 3C Pressure-Retaining Components and Supports in CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N285.3-88 (R2005) (January 1988)	Requirements for Containment System Components in CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N285.8-05 incl. UPD1 (May 2007)	Technical Requirements for In-Service Evaluation of Zirconium Alloy Pressure Tubes in CANDU Reactors	Actual Condition of SSCs	Clause-by-Clause
CAN/CSA-N287.1-93 (R2004) (July 1993)	General Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N287.2-08 (March 2008)	Material Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N287.3-93 (R2004) (February 1993)	Design Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N287.5-93 (R2004) (July 1993)	Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	Actual Condition of SSCs	High-Level
CAN/CSA-N287.7-08 (May 2008)	In-Service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	Actual Condition of SSCs	Clause-by-Clause
CAN/CSA-N288.1-M87 (R2008) (January 1987)	Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities	Environment	High-Level
CAN/CSA-N288.2-M91 (R2008) (January 1991)	Guidelines for Calculating Radiation Doses to the Public from a Release of Airborne	Deterministic Safety Analysis	High-Level

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
	Radioactive Material Under Hypothetical Accident Conditions in Nuclear Reactors	Probabilistic Safety Assessment	
CAN/CSA-N288.4-M90 (R2008) (November 1990)	Guidelines for Radiological Monitoring of the Environment	Environment	High-Level
CAN/CSA-N289.1-80 (R2008) (December 1980)	General Requirements for Seismic Qualification for CANDU Nuclear Power Plants	Plant Design Deterministic Safety Analysis Equipment Qualification	Clause-by-Clause
CAN/CSA-N289.1-08 (September 2008)	General Requirements for Seismic Qualification for CANDU Nuclear Power Plants	Plant Design Deterministic Safety Analysis Equipment Qualification	Clause-by-Clause
CAN/CSA-N289.2-M81 (R2008) (April 1981)	Ground Motion Determination for Seismic Qualification of CANDU Nuclear Power Plants	Hazard Analysis	High-Level
CAN/CSA-N289.3-M81 (R2008) (January 1981)	Design Procedures for Seismic Qualification of CANDU Nuclear Power Plants	Plant Design Equipment Qualification	Clause-by-Clause
CAN/CSA-N289.4-M86 (R2008) (June 1986)	Testing Procedures for Seismic Qualification of CANDU Nuclear Power Plants	Equipment Qualification	Clause-by-Clause
CAN/CSA-N289.5-M91 (R2008) (January 1991)	Seismic Instrumentation Requirements for CANDU Nuclear Power Plants	Plant Design	Clause-by-Clause
CAN/CSA-N290.1-80 (R2001) (January 1980)	Requirements for the Shutdown Systems of CANDU Nuclear Power Plants	Plant Design Deterministic Safety Analysis Probabilistic Safety Assessment	Clause-by-Clause
CAN/CSA-N290.4-M82 (R2001) (January 1982)	Requirements for the Reactor Regulating Systems of CANDU Nuclear Power Plants	Plant Design Deterministic Safety Analysis Probabilistic Safety Assessment	Clause-by-Clause
CAN/CSA-N290.5-06 (December 2006)	Requirements for Electrical Power and Instrument Air Systems of CANDU Nuclear Power Plants	Plant Design Deterministic Safety Analysis Probabilistic Safety Assessment	Clause-by-Clause
CAN/CSA-N290.6-M82 (R2001) (January 1982)	Requirements for Monitoring and Display of CANDU Nuclear Power Plant Status in the Event of an Accident	Plant Design Hazard Analysis	Clause-by-Clause
CAN/CSA-N291-08 (March 2008)	Requirements for Safety Related Structures for CANDU Nuclear Power Plants	Plant Design	High Level
CAN/CSA-ISO 14001:2004 Standard (December 2004)	Environmental Management Systems - Requirements with guidance for use	Environment	Clause-by-Clause

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
AECB-1049 Rev. 2 (April 1988)	Reporting Requirements for Fissionable and Fertile Substances	Safeguards	High Level
CNSC G-129 Rev. 1 (October 2004)	Keeping Radiation Exposures and Doses "As Low As Reasonably Achievable (ALARA)"	Safety Performance	High-Level
CNSC G-144 (May 2006)	Trip Parameter Acceptance Criteria for the Safety Analysis of CANDU Nuclear Power Plants	Deterministic Safety Analysis	High-Level
CNSC G-149 (October 2000)	Computer Programs Used in Design and Safety Analysis of Nuclear Power Plants and Research Reactors	Deterministic Safety Analysis Probabilistic Safety Assessment	High-Level
CNSC G-208 (March 2003)	Transport Security for Category I, II, and III Nuclear Material	Security	High-Level
CNSC G-225 (August 2001)	Emergency Planning at Class I Nuclear Facilities and Uranium Mines and Mills	Emergency Planning	High-Level
CNSC G-228 (March 2001)	Developing and Using Action Levels	Safety Performance	High-Level
CNSC G-274 (March 2003)	Security Programs for Category I and II Nuclear Material or Certain Nuclear Plants	Security	High-Level
CNSC G-276 (June 2003)	Human Factors Engineering Program Plans	Plant Design	High-Level
CNSC G-278 (June 2003)	Human Factors Verification and Validation Plans	Plant Design	High-Level
CNSC G-296 (March 2006)	Developing Environmental Protection Policies, Programs and Procedures at Class 1 Nuclear Facilities and Uranium Mines and Mills	Environment	High-Level
CNSC G-306 (May 2006)	Severe Accident Management Programs for Nuclear Reactors	Probabilistic Safety Assessment Deterministic Safety Analysis	High-Level
CNSC G-323 (August 2007)	Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement	Organization & Administration Human Factors	High-Level
CNSC R-10 (January 1977)	The Use of Two Shutdown Systems in Reactors	Plant Design Deterministic Safety Analysis	Clause-by-Clause
CNSC R-77 (October 1987)	Overpressure Protection Requirements for Primary Heat Transport Systems in CANDU Power Reactors Fitted with Two Shutdown Systems	Plant Design Deterministic Safety Analysis	Clause-by-Clause
CNSC R-116 (January 1995)	Requirements for Leak Testing Selected Sealed Radiation Sources	Safety Performance	High-Level
CNSC RD-337 (November 2008)	Requirements for the Design of Nuclear Power Reactor	Plant Design	High-Level
CNSC RD-363 (October 2008)	Nuclear Security Officer Medical, Physical and Psychological Fitness	Security	High-Level

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
CNSC S-296 (March 2006)	Environmental Protection Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills	Environment	High-Level
CNSC RD-204 (February 2008)	Certification of Persons Working at a Nuclear Power Plants	Human Factors	High-Level
CNSC RD-310 (February 2008)	Safety Analysis for Nuclear Power Plants	Deterministic Safety Analysis Probabilistic Safety Assessment Hazard Analysis	High-Level
Design Basis Threat	Design Basis Threat	Security	High-Level
IAEA GS-G-2.1 (May 2007)	Arrangements for Preparedness for a Nuclear or Radiological Emergency	Emergency Planning	High-Level
IAEA GS-R-2 (November 2002)	Preparedness and Response for a Nuclear or Radiological Emergency	Emergency Planning	High Level
IAEA GS-R-3 (August 2006)	The Management System for Facilities and Activities Safety Requirements	Human Factors Quality Management Procedures Organization & Administration	High-Level
IAEA INFCIRC/164 (February 1972)	Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons	Safeguards	High-Level
IAEA INFCIRC/164/ADD.1 (October 2000)	Protocol Additional to the Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons	Safeguards	High-Level
IAEA INFCIRC/225/Rev 4 (June 1999)	The Physical Protection of Nuclear Material and Nuclear Facilities	Security	High-Level
IAEA NS-G-1.13 (December 2005)	Radiation Protection Aspects of Design for Nuclear Power Plants Safety Guide	Environment Emergency Planning	High-Level
IAEA NS-G-1.2 (January 2002)	Safety Assessment and Verification for Nuclear Power Plants	Deterministic Safety Analysis Probabilistic Safety Assessment Hazard Analysis	High-Level
IAEA NS-G-2.11 (July 2006)	A System for Feedback of Experience from Events in Nuclear Installations	Safety Performance OPEX	High-Level

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
		Organization and Administration Human Factors	
IAEA NS-G-2.12 (March 2009)	Ageing Management Programs for Nuclear Power Plants	Actual Condition of SSCs Ageing	High-Level
IAEA NS-G-2.2 (December 2000)	Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants	Procedures	High-Level
IAEA NS-G-2.3 (November 2001)	Modifications to Nuclear Power Plants Safety Guide	Organization and Administration	High-Level
IAEA NS-G-2.4 (January 2002)	The Operating Organization for Nuclear Power Plants	Human Factors Procedures Organization and Administration	High-Level
IAEA NS-G-2.6 (November 2002)	Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants Safety Guide	Actual Condition of SSCs Organization and Administration	High-Level
IAEA NS-G-2.7 (December 2002)	Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants Safety Guide	Safety Performance Plant Design Emergency Planning Environment	High-Level
IAEA NS-G-2.8 (December 2002)	Recruitment, Qualification, and Training of Personnel for Nuclear Power Plants Safety Guide	Human Factors Organization and Administration	High-Level
IAEA NS-G-3.2 (April 2002)	Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants Safety Guide	Environment Emergency Planning	High-Level
IAEA NS-G-3.3 (March 2003)	Evaluation of Seismic Hazards for Nuclear Power Plants Safety Guide	Equipment Qualification Hazard Analysis	High-Level
IAEA NS-R-1 (October 2000)	Safety of Nuclear Power Plants: Design	Plant Design Deterministic Safety Analysis Probabilistic Safety Assessment Hazard Analysis Environment	High-Level
IAEA NS-R-2 (October 2000)	Safety of Nuclear Power Plants: Operation	Actual Condition of SSCs Safety Performance	High-Level

Table B-2: Modern Version of Additional Codes and Standards

Document Number	Document Title	Applicable Safety Factor(s)	Type of Review
		Organization and Administration Procedures Opex	
IAEA NS-R-3 (December 2003)	Site Evaluation for Nuclear Installations	Plant Design	High-Level
IAEA Safety Report Series No. 15 (May 1999)	Implementation and Review of Nuclear Power Plant Ageing Management Programme	Ageing	High-Level
National Building Code of Canada (2005)	National Building Code of Canada	Plant Design	Clause-by-Clause
National Fire Code of Canada (2005)	National Fire Code of Canada	Plant Design	Clause-by-Clause
MISA Ontario Regulation 215/95 (August 2007)	Effluent Monitoring and Effluent Limits - Electric Power Generation Sector	Environment	High-Level
Province of Ontario Nuclear Emergency Plan (March 1999)	Action Plan for a Nuclear Emergency	Emergency Planning	High-Level
SOR/2000-202 (May 2000)	General Nuclear Safety and Control Regulations	Security Safeguards Safety Performance	Clause-by-Clause
SOR/2000-203 (May 2000)	Radiation Protection Regulations	Safety Performance	Clause-by-Clause
SOR/2000-209 (May 2000)	Nuclear Security Regulations	Security	Clause-by-Clause
NUREG-0700 Revision 2 (May 2002)	Human System Interface Design Review Guidelines	Plant Design	High-Level
NUREG-0711 Revision 2 (February 2002)	Human Factors Engineering Program Review Model	Plant Design	High-Level

Note: A delta review of CAN/CSA-N289.1-08 (R2008) (December 1980), General Requirements for Seismic Qualifications for CANDU Nuclear Power Plants shall be performed against the previous version CAN/CSA-N289.1-08 (September 2008).

Note: A clause-by-clause high-level intent review (demonstrating that OPG meets the intent of clauses) against the clauses in CNSC RD-337, Requirements for the Design of Nuclear Power Reactor that are not requirements in IAEA NS-R-1, Safety of Nuclear Power Plants: Design shall also be performed.

APPENDIX C

Terms of Reference for the Nuclear Refurbishment – Benefit-Cost Analysis Sub-Committee

GOAL: To *ISR Gaps* identified through the NR *Life Extension* project receive an appropriate disposition through the *BCA* process.

MANDATE:

(a) To concur with any alternative acceptance criteria (to benefit-cost ratios) that may be used to consider options for disposition of the *ISR Gap*.

(b) To review and concur with the recommendations from the *BCA* for disposition of the *ISR Gap*.

(c) To review the status of *ISR Gaps* that are being assessed through the *BCA* process.

MEMBERSHIP:

Executive Sponsor – VP, Refurbishment Engineering, NR
Sub-committee Chair – Director, Engineering Programs, Refurbishment Engineering, NR

<u>Sub-committee Members</u>:
Deputy Site Vice President, Darlington NGS
Director, Engineering, Refurbishment Engineering, NR
Director, Planning and Control, NR
Controller, Nuclear Refurbishment
Manager, Regulatory Affairs, Refurbishment Licensing Support, NR Programs
Manager, Nuclear Safety Integration, Engineering Programs, Refurbishment Engineering, NR
Independent Reviewer(s) – Identified by Manager, Nuclear Safety Integration, Engineering Programs, Refurbishment Engineering, NR to provide expert judgment. Reviewer(s) will vary according to the *ISR Gap* under consideration.
Use of Delegates – Delegates must be empowered to make decisions, and address and accept actions on behalf of the NR-*BCA* sub-committee member.

MEETING FREQUENCY: Quarterly or as required.