ONTARIO POWER GENERATION

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Nuclear **Program**

TITLE
EQUIPMENT RELIABILITY

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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-CHAR-AS-0002, Nuclear Management System

Document is Related to Pressure Boundary ☐	Document Requires CNSC Notification ☑

PURPOSE AND SCOPE
To ensure ongoing high levels of reliable performance of components important to nuclear safety, production, and environmental protection. Reliable performance of components means very low numbers of component failures, degraded equipment condition is minimized, and redundancy is maintained on key systems. This is achieved by adopting the INPO *Equipment Reliability* Process Description, AP 913 **[B1]**.

DATES (YYYY-MM-DD)

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PDF Creation Date:	2019-06-04
Compliance Date:	Immediate.

Exceptions

In the case of Nuclear Waste Management Division (NWMD), the following exceptions apply regarding this program.
a)) For NWMD, system and component engineering are integrated into one function.
b)) NWMD is exempt from system and component health teams.
c)) NWMD is exempt from N-STM-08130-10000, Plant Thermal Performance, N-PROG-RA-0016, Risk and Reliability Program and N-PROG-MA-0019, Production Work Management. Instead of N-PROG-MA-0019, NWMD should use W-PROG-WM-001, Nuclear Waste Program, and W-PROC-WM-008, Nuclear Waste Management - Work Management Process. NWMD, except for Pickering Waste Management Facility, is exempt from N-PROC-MA-0034, Predictive Maintenance Program Requirements.

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1.0 DIRECTIONS

1.1 Overview

1.1.1 The Equipment Reliability (ER) Program contains the following elements which ensure ongoing high levels of reliable performance of critical components:

(a) Identifying critical components that require focused attention.**[B1]**

(b) Specifying the required maintenance strategies to maintain high levels of reliability, and continuously improving the maintenance strategies based on corrective actions and maintenance feedback, **[B3] [B8] [B9] [B10].[B11].[B12] [B13]**

(c) Executing Predictive Maintenance (PdM), and Preventive Maintenance (PM) programs, **[B3] [B8] [B9] [B10].[B11].[B12] [B13]**

(d) *Monitoring* system and component condition and implementing plans to restore and maintain system and component health, **[B14] [B15] [B16].[B17].[B18].[B19]**

(e) Taking prompt and effective action, when critical equipment fails, to understand the technical and organizational causes and to prevent a recurrence. [B14] [B15] [B16] [B17] [B18] [B19].

(f) Identifying and predicting aging and obsolescence issues on important components and embedding mitigating strategies and actions into the business plan [B14] [B15] [B16].[B17].[B18].[B19].

1.1.2 These elements, which must be effective to ensure high levels of reliability, fall into one of two broad areas:

a) Specify the program.
b) Execute the program.

These items are shown in the Equipment Reliability program overview diagram in Figure 1.

1.1.3 Nuclear Waste Management Division Exceptions

The exceptions for Nuclear Waste Management Division regarding this program are provided in the Exceptions box located on the front cover of this document.

As noted in the Exceptions box, NWMD is exempt from using interfacing document N-PROG-MA-0019, Production Work Management shown in Figure 2. Instead, NWMD should use W-PROG-WM-001, Nuclear Waste Program, and W-PROC-WM-008, Nuclear Waste Management - Work Management Process.

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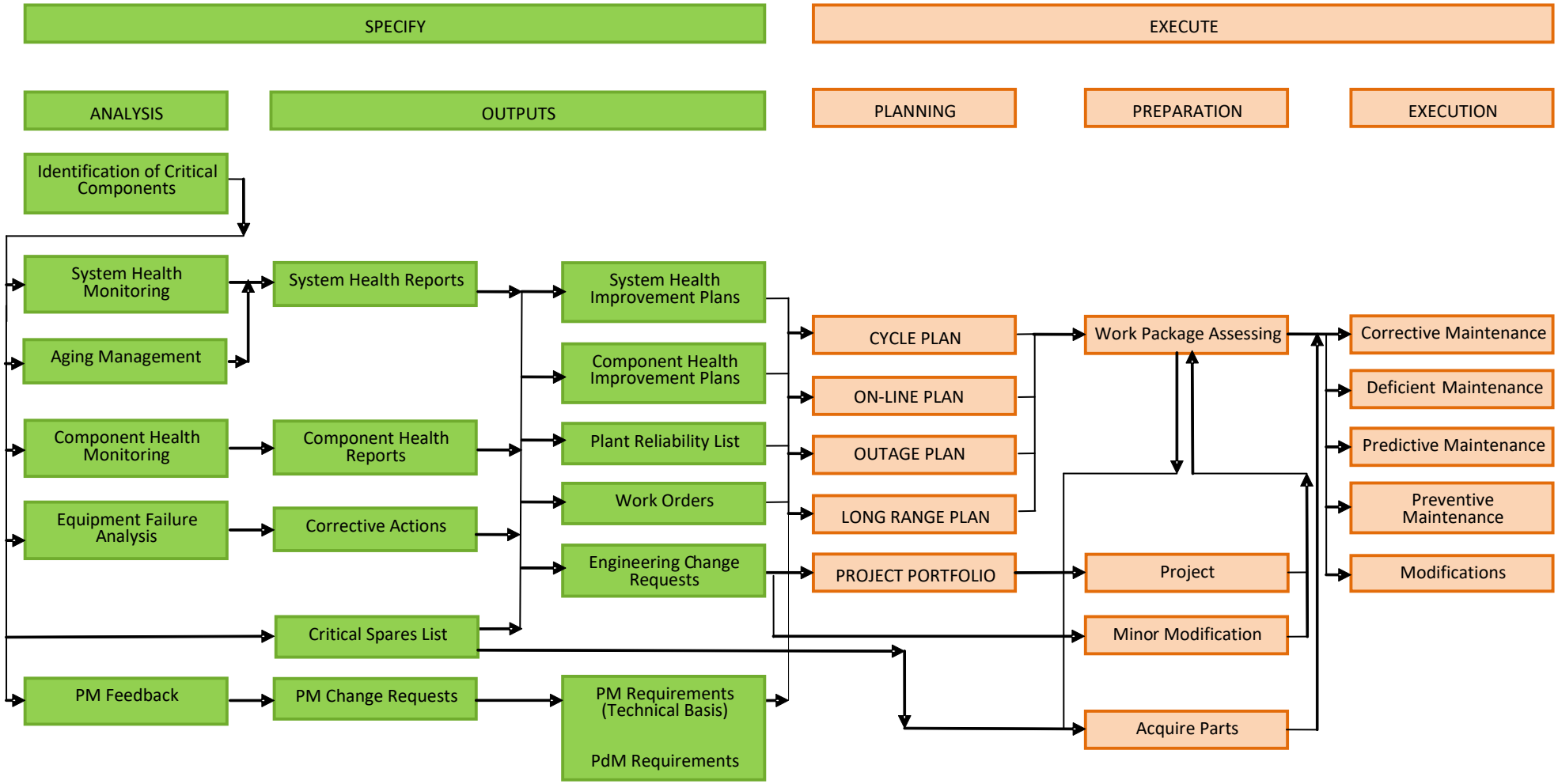

Figure 1: Equipment Reliability Overview

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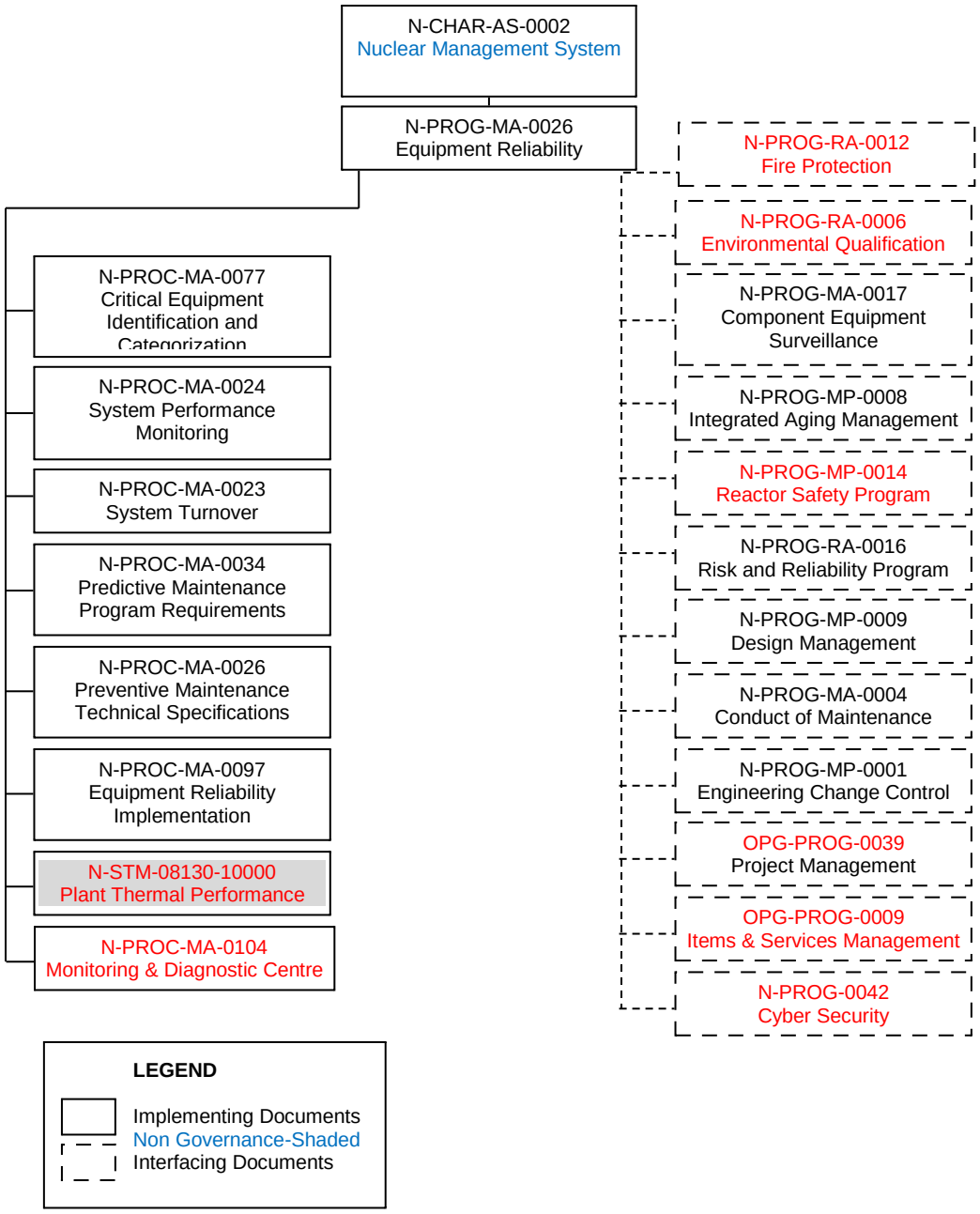

Figure 2: Equipment Reliability Document Hierarchy

1.2 Program Activities and Requirements

1.2.1 Scoping and Identification of Critical Components [B1]

1.2.1.1 Components in the Master Equipment List are classified according to their importance and risk significance from a nuclear safety, production, cost, conventional safety, regulatory compliance, and environmental impact, in accordance with N-PROC-MA-0077, Critical Equipment Identification and Categorization.

1.2.1.2 Categorization is used to focus the rest of the program elements on the most important equipment.

1.2.1.3 Single Point Vulnerabilities (SPVs), identified under N-PROC-MA-0077, are analyzed by site Engineering to determine if additional maintenance activities, modified operation, or design changes are required to reduce the risk of failure. Identified actions should be captured in the appropriate health report.

1.2.2 Performance Monitoring

1.2.2.1 System Monitoring **[B4] [B7] [B14] [B15] [B16].[B17].[B18].[B19].**

System Performance Monitoring is performed for all important functions associated with systems designated to have a System Health Report. The key activities outlined in N-PROC-MA-0024, System Performance Monitoring, include the following:

- System performance goals, indicators, and targets
- *Performance monitoring* (*direct monitoring* and *indirect monitoring*)
- Functional failure evaluations
- Field walk downs
- System health reports and system action plans.

1.2.2.2 System Engineer Activities in Support of System Performance and *ER*

Performance Engineers perform additional activities to ensure the operation, maintenance and engineering change for their systems is optimized for reliability and efficiency in accordance with N-PROC-MA-0024.

1.2.2.3 System Turnover

Performance Engineers assigned a new system should have a turnover performed using up-to-date system notebooks in accordance with N-PROC-MA-0023, System Turnover.

1.2.3 Component Monitoring [B4] [B7] [B14] [B15] [B16].[B17].[B18].[B19]

Component Monitoring should be conducted by Engineering staff to monitor the performance of critical components (CC1) and specific CC2 and CC3 components. *Monitoring* is conducted using a graded approach based on the criticality classification of the components being monitored, in accordance with N-PROC-MA-0097, Equipment Reliability Implementation.

1.2.4 Plant Thermal Performance Cycle Isolation Monitoring

Plant Thermal performance cycle isolation *monitoring* is performed according to N-STM-08130-10000, Plant Thermal Performance. This standard establishes requirements and recommended practices related to routine *monitoring* or turbine cycle isolation for Plant Thermal Performance at nuclear generating stations.

1.2.5 System and Component Health Teams

Multi discipline System Health and/or Component Health Teams should be established on important systems to provide input to and support for system health activities. The operation of these teams is described in N-GUID-01900-10003, System Health Team - Terms of Reference.

1.2.6 Predictive Maintenance [B3] [B8] [B9] [B10].[B11].[B12] [B13]

PdM should be specified by Engineering and conducted by Maintenance in accordance with N-PROC-MA-0034, Predictive Maintenance Program Requirements. The PdM program applies to selected equipment to ensure early detection of deterioration to ensure safe, reliable, and competitive operation.

1.2.7 Plant Reliability List [B2]

In order to provide a focus on work that is important to improve or sustain system and component health, a *Plant Reliability List (PRL)*, of work orders and modifications should be established based on the system and component health plans, in accordance with N-PROC-MA-0097.

1.2.8 Corrective Action

1.2.8.1 Equipment Failures and Degradation

Failures and degradation of CC1, CC2, and CC3 components are identified, evaluated, and trended on a graded basis. A standard equipment failure cause and methodology should be used for CC1 component failures to provide a consistent high quality evaluation and corrective action to prevent recurrence as per N-PROG-RA-0003, Performance Improvement.

An *ER* Clock Reset process should be utilized to communicate significant equipment failures and to develop an organizational intolerance for critical equipment failures [B5][B12]. These key activities are in accordance with N-PROC-MA-0097.

1.2.8.2 Plant Health Committee [B2]

A Plant Health Committee (PHC), at each site provides oversight, direction, and leadership for resolving *ER* issues and implementing actions from System and Component Health Plans. The PHC consists of Managers and/or Directors from the key functional organizations at the site involved in implementing *ER* actions. The key activities for the PHC are conducted in accordance with N-PROC-MA-0097.

1.2.9 Preventive Maintenance Strategies and Continuous Improvement [B3] [B8] [B9] [B10].[B11].[B12] [B13]

Maintenance strategies are developed for critical category 1, 2, and 3 components and include the necessary PM, PdM, condition, and *performance monitoring* tasks, necessary to manage the health of the component. The technical basis for the maintenance strategies is documented in accordance with N-PROC-MA-0026, Preventive Maintenance Technical Specifications.

N-PROC-MA-0026 requires consideration of vendor recommendations, risk analysis, and cost benefit analysis when developing, managing, maintaining, and providing specifications for PM templates and PM technical basis.

PM technical basis and PM templates should be developed to define requirements for, and the rationale for PM activities. The process, accountabilities for development, management, maintenance, and specification requirements for contents of the PM technical basis and PM templates should be in accordance with N-PROC-MA-0026. Refer to section 1.4.5 for governance of PM implementation and for Conduct of Maintenance.

1.2.10 Long Range Planning and Life Cycle Management

1.2.10.1 Aging Management

Aging of plant components should be managed using a graded approach to ensure continued reliability over the life of the facility, in accordance with N-PROG-MP-0008, Integrated Aging Management.

1.2.10.2 Long Range Planning

A Long Range Plan (LRP), should be developed and updated, based on the PRL, System and Component Health Plans, for major planned outage activities and on-line work, providing adequate duration (up to 10 years, or end of service for Pickering components), to address procurement requirements and allow integration into the Site Business Plan. The PHC endorses the list and ranking of *ER* activities on the LRP. The key activities associated with Long Range Planning are conducted in accordance with N-PROC-MA-0097.

1.2.10.3 Critical Spares **[B5][B6]**

Sourcing and stocking strategies for *Critical Spares*, is in accordance with OPG-PROG-0009, Items and Services Management.

1.2.11 Monitoring and Diagnostic Centre

The Monitoring and Diagnostic Centre uses Advanced Pattern Recognition software to build operational profiles and monitor condition and performance of Systems, Structures, and Components (SSCs) across the Ontario Power Generation (OPG) fleet in accordance with N-PROC-MA-0104, Monitoring and Diagnostic Centre.

1.3 General Requirements

1.3.1 Performance Monitoring

1.3.1.1 Where available*, ER* performance reporting should be reported using N-PROC-RA-0023, Fleetview Program Health and Performance Reporting, utilizing industry standard metrics and should be consistently reported across the fleet. **[B1]**

1.3.1.2 Critical Equipment failures should be evaluated and trended against *ER* program elements to identify systemic program weaknesses for correction. **[B5][B12]**

1.3.1.3 Personnel implementing *ER* should be trained and qualified in accordance with N-PROG-TR-0005, Training, where training has been identified as being required.

1.3.1.4 The Program Owner should establish an Equipment Reliability working group, as required.

1.4 Interfacing Programs

The following interfacing programs support this program:

1.4.1 N-PROG-MA-0017, Component and Equipment Surveillance

This program establishes scope, requirements and activities for implementation of component maintenance, inspection, and test programs to ensure that regulatory and licensing commitments are met, and to ensure specific component groups that have a history of long standing and repetitive system and equipment failures are effectively managed. *Monitoring* of components outside the scope of N-PROG-MA-0017, should be in accordance with Section 1.2.3.

1.4.2 N-PROG-MP-0008, Integrated Aging Management

N-PROG-MP-0008 provides direction on identifying and managing long term health requirements of critical systems and components and non-critical components involving major investment. Life cycle plans are developed for major components that are risk significant from a nuclear safety and business perspective.

Aging for the remaining critical and non-critical components should be managed through established engineering programs, condition *monitoring* activities, surveillances and other effective practices and routinely evaluated to ensure practices are effective.

Outputs from Aging Management are captured in System Health Reports.

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

This program ensures that the reliability requirements for *systems important to safety* and that station public safety risk goals are met.

1.4.4 N-PROG-MA-0004, Conduct of Maintenance

This program specifies the requirements for planning and executing maintenance in a manner which ensures the safety of the public and site personnel, protection of the environment, and availability of plant equipment. Specific to *ER*, the program specifies requirements for work planning, troubleshooting plant equipment, leak management, post maintenance testing, and equipment availability and reliability. In addition, the program specifies requirements for the implementation of PM activities including planning, scheduling, field execution, feedback for improvement, and deferrals.

1.4.5 N-PROG-MP-0001, Engineering Change Control

This program governs the initiation, design, installation and commissioning of physical changes to the site. This program requires evaluation of new designs to avoid single point vulnerabilities. In many cases engineering change control is required to resolve obsolescence and life cycle replacements of key site components.

1.4.6 OPG-PROG-0039, Project Management

This program establishes how the requirements, objectives and commitments for the management of projects across all business areas within OPG are fulfilled. A number of key *ER* actions, particularly related to aging management, require implementation of a project.

1.4.7 OPG-PROG-0009, Items and Services Management

This program supports Supply Chain activities across all of OPG.

1.4.8 N-PROG-MP-0009, Design Management

This program provides direction on material procurement, updating of material catalogue data, and verification of bills of material, to provide the necessary parts to maintain the plant and address component obsolescence.

1.4.9 OPG-PROG-RA-0042, Cyber Security

This program defines the OPG wide requirements and processes for cyber security. N-PROC-RA-0135, Cyber Security, is the implementing procedure in OPG Nuclear, which provides compliance requirements and System Engineer activities related to systems that are in the scope of the Cyber Security program.

1.4.10 N-PROG-MP-0014, Reactor Safety Program

This program includes three major components of safe operation:

(a) Safety Analysis Basis

(b) Safe operating Envelope

(c) Beyond Design Basis Accident Management

1.4.11 N-PROG-RA-0006, Environmental Qualification

Provides direction for establishing and maintaining Environmental Qualification in OPG nuclear plants.

1.4.12 N-PROG-RA-0012, Fire Protection

Provides a description of the fire protection organization, interfacing organizations, and their fire protection accountabilities.

1.4.13 N-PROG-AS-0001, Nuclear Management System Administration

Provides the business framework and processes established by OPG Nuclear and Interfacing Organizations to demonstrate effective implementation and compliance with the requirements set out in CSA N286-12, Management System Requirements for Nuclear Facilities.

2.0 ROLES AND ACCOUNTABILITIES

2.1 Senior Manager, Equipment Reliability and Asset Management

2.1.1 Assumes the role and accountabilities of program owner, in accordance with N-PROG-AS-0001, Nuclear Management System Administration, for the *ER* program.

2.1.2 Ensures engineering programs are consistent with the requirements of the *ER* Program.

2.1.3 Provides the necessary resources to support development and maintenance of assigned *ER* implementing procedures.

2.1.4 Owner ensures this program has been reviewed against N-STD-MP-0027, Configuration Management, and ensures that the requirements of N-STD-MP-0027 are met by the program and appropriate implementing documents.

2.2 Director, Station Engineering/ Director, Nuclear Waste Engineering

2.2.1 Provides oversight and sets standards for the implementation of *ER* requirements within Site Engineering, and the Engineering Functions in Fuel Handling, Common Services (Pickering only), and the Tritium Removal Facility (Darlington).

2.2.2 Ensures System and Component Health reports and action plans are prepared and presented to the PHC when specified.

2.2.3 Ensures the quality and rigor of follow up to critical component failures are adequate to minimize recurring failures and long standing equipment issues.

2.2.4 Ensures significant *ER* requirements including aging management actions are provided for inclusion in the Site LRP.

2.2.5 Ensures engineering input is provided for prioritization of the Project Portfolio.

2.3 Director, Operations and Maintenance/ Director, Nuclear Waste Operations

2.3.1 Ensures the PHC is effective in providing oversight and direction for *ER* issues.

2.3.2 Ensures Predictive and Preventive maintenance activities are managed and executed in support of *ER*.

2.3.3 Supports *ER* performance by ensuring *ER* performance indicators have effective action plans to drive *ER* improvement with respect to Operations and Maintenance.

2.4 Director, Work Management/ Manager, Nuclear Waste Work Management

2.4.1 Ensures that component criticality, *PRL* items, and PHC endorsed *ER* actions are considered when prioritizing both on line and outage work.

2.4.2 Ensures that PdM and PM tasks are scheduled as specified to support *ER*.

2.4.3 Supports *ER* performance by ensuring *ER* performance indicators have effective action plans to drive *ER* improvement with respect to Work Management.

2.5 Director, Controllership, Station Business Support/ Manager, Nuclear Waste Business Support

2.5.1 Supports *ER* performance by ensuring *ER* performance indicators have effective action plans to drive *ER* improvement with respect to Site Business Support.

2.5.2 Ensures *ER* actions including Aging Management actions from Health Reports are linked to the LRP as required.

2.6 Director, Supply Services

2.6.1 Ensures stocking strategies are developed and implemented, based on recommendations from Engineering, for identified c*ritical spares*.

2.6.2 Ensures oversight activities are developed and implemented to minimize stock outs of *critical spares*.

3.0 DEFINITIONS AND ACRONYMS

3.1 Definitions

Critical Spare is defined as a component or part needed to return SPV/ CC1 critical components to service, (it may include CC2/ CC3 components if decided on by Performance Engineering Manager) following normal and reasonably anticipated wear and tear, including credible failures that would not normally be predicted via monitoring and trending programs with sufficient advance warning to allow for procurement activities and reasonable lead times for the needed replacement times.

Direct Monitoring is periodic review of physical parameters to assess current system performance, and identify system degradation. One example would be the *monitoring* of system flow rate.

Equipment Reliability is the ability of an item to perform a required function under a stated set of conditions for a specific time period.

Indirect Monitoring is a periodic review of historical programming system information in order to predict future system performance. One example would be the *monitoring* of outstanding temporary modifications to a system.

Monitoring is periodic review of specific system information for the purpose of determining acceptability of current system conditions.

Obsolete describes a component or part that can no longer be purchased.

Performance Monitoring is a process of information gathering and evaluation, consisting of system selection criteria, system performance standards, and assessments of system performance producing actions to improve substandard system performance.

Plant Reliability List (*PRL*) is a list of activities and work orders required to improve or sustain system and component health. This list is used to align the site around a set of key work activities to improve reliability.

Systems Important to Safety are systems which contribute significantly to the initiation, prevention, detection, or mitigation of any failure sequence which could lead to damage of fuel or associated release of radionuclides or both, as described in CNSC Standard S-98, which sets out the requirements.

3.2 Abbreviations and Acronyms

CC	Criticality Code
CSA	Canadian Standards Association
EPRI	Electrical Power Research Institute
ER	Equipment Reliability
INPO	Institute of Nuclear Power Operations
LRP	Long Range Plan
NPP	Nuclear Power Plant
NWMD	Nuclear Waste Management Division
OPG	Ontario Power Generation
PdM	Predictive Maintenance
PHC	Plant Health Committee
PM	Preventive Maintenance
PRL	Plant Reliability List
SOE	Safe Operating Envelope
SPV	Single Point of Vulnerability
SSC	Structures, Systems, and Components

4.0 BASES AND REFERENCES

4.1 Bases

[B-1] INPO AP 913, Equipment Reliability Process Description

[B-2] INPO 01-004, Achieving High Equipment Reliability – A Leadership Perspective, December 2001

[B-3] CNSC Regulatory Standard S-210, Maintenance Programs for Nuclear Power Plants

[B-4] CSA-N286-12 Clause 4.8.1(g): **Generic requirements for the management system**, **Work management**, **Work Planning**, **Work shall be identified and planned with the following**. (g) The acceptance criteria for the finished product.

[B-5] CSA-N286-12 Clause 7.6.11, **Specific requirements for high energy reactor facilities**, **Supply Chain, Planning for replacement parts**: There shall be alignment and integration between the maintenance

[B-6] CSA-N286-12 Clause 7.6.11(a): **Specific requirements for high energy reactor facilities**, **Supply Chain**, **Planning for replacement parts**: **There shall be alignment and integration between the maintenance**, (a) Integration of the supply plan with the facility life-cycle plan

[B-7] CSA-N286-12 Clause 7.9.5(d): **Specific requirements for high energy reactor facilities, Operating**, **Surveillance testing**, **Structures, systems, and components credited on the safety analysis shall be identified and periodically tested to ensure the following:** (d) Test requirements are re-evaluated following modification.

[B-8] CSA-N286-12 Clause 7.9.9: **Specific requirements for high energy reactor facilities, Operating,** Maintenance**:** Structures, systems, and components shall be maintained in accordance with a maintenance strategy that includes:

[B-9] CSA-N286-12 Clause 7.9.9(a): **Specific requirements for high energy reactor facilities, Operating, Maintenance: Structures, systems, and components shall be maintained in accordance with a maintenance strategy that includes.** (a) A definition of the frequency and type of maintenance to be performed. This should take into account but not be limited to

[B-10] CSA-N286-12 Clause 7.9.9(a)(i): **Specific requirements for high energy reactor facilities, Operating, Maintenance: Structures, systems, and components shall be maintained in accordance with a maintenance strategy that includes: (a) A definition of the frequency and type of maintenance to be performed. This should take into account but not be limited to:** (i) Supplier recommendations,

[B-11] CSA-N286-12 Clause 7.9.9(a)(iv): **Specific requirements for high energy reactor facilities, Operating, Maintenance: Structures, systems, and components shall**

be maintained in accordance with a maintenance strategy that includes: (a) A definition of the frequency and type of maintenance to be performed. This should take into account but not be limited to: (iv) Operating experience

[B-12] CSA-N286-12 Clause 7.9.9(a)(v): **Specific requirements for high energy reactor facilities, Operating, Maintenance: Structures, systems, and components shall be maintained in accordance with a maintenance strategy that includes: (a) A definition of the frequency and type of maintenance to be performed. This should take into account but not be limited to:** (v) Cost benefit analysis

[B-13] CSA-N286-12 Clause 7.9.9(a)(vi): **Specific requirements for high energy reactor facilities, Operating, Maintenance: Structures, systems, and components shall be maintained in accordance with a maintenance strategy that includes: (a) A definition of the frequency and type of maintenance to be performed. This should take into account but not be limited to:** (vi) Service conditions

[B-14] CSA-N286-12 Clause 7.9.10(a): **Specific requirements for high energy reactor facilities, Operating, Systems health monitoring: Structures, systems, and components shall be evaluated in order to:**

[B-15] CSA-N286-12 Clause 7.9.10(a): **Specific requirements for high energy reactor facilities, Operating, Systems health monitoring: Structures, systems, and components shall be evaluated in order to:** (a) Gauge performance

[B-16] CSA-N286-12 Clause 7.9.10(b): **Specific requirements for high energy reactor facilities, Operating, Systems health monitoring: Structures, systems, and components shall be evaluated in order to: (b)** Identify common and recurring problems, and

[B-17] CSA-N286-12 Clause 7.9.10(c) **Specific requirements for high energy reactor facilities, Operating, Systems health monitoring: Structures, systems, and components shall be evaluated in order to: (c)** Recommend changes or improvements

[B-18] CSA-N286-12 Clause 7.9.11(b): **Specific requirements for high energy reactor facilities, Operating, Chemistry control: System chemistry shall be maintained in accordance with requirements related to: (b)** Chemistry parameter monitoring, and

[B-19] CSA-N286-12 Clause 7.9.11(c): **Specific requirements for high energy reactor facilities, Operating, Chemistry control: System chemistry shall be maintained in accordance with requirements related to: (c)** Data trending and evaluation

4.2 References

4.2.1 Performance References

CSA N286-12, Management System Requirements for Nuclear Facilities

N-GUID-01900-10003, System Health Team – Terms of Reference

N-PROC-MA-0023, System Turnover

N-PROC-MA-0024, System Performance Monitoring

N-PROC-MA-0026, Preventive Maintenance Technical Specifications

N-PROC-MA-0034, Predictive Maintenance Program Requirements

N-PROC-MA-0077, Critical Equipment Identification and Categorization

N-PROC-MA-0097, Equipment Reliability Implementation

N-PROC-MA-0104, Monitoring and Diagnostic Centre

N-PROC-RA-0023, Fleetview Program Health and Performance Reporting

N-PROG-AS-0001, Nuclear Management System Administration

N-PROG-MA-0004, Conduct of Maintenance

N-PROG-MA-0017, Component and Equipment Surveillance

N-PROG-MA-0019, Production Work Management

N-PROG-MP-0001, Engineering Change Control

N-PROG-MP-0008, Integrated Aging Management

N-PROG-MP-0009, Design Management

N-PROG-MP-0014, Reactor Safety Program

N-PROG-RA-0003, Performance Improvement

N-PROG-RA-0012, Fire Protection

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

N-PROC-RA-0135, Cyber Security

N-PROG-TR-0005, Training

N-STM-08130-10000, Plant Thermal Performance

OPG-PROG-0009, Items and Services Management

OPG-PROG-0039, Project Management

OPG-PROG-0042, Cyber Security

W-PROC-WM-008, Nuclear Waste Management - Work Management Process

W-PROG-WM-001, Nuclear Waste Program

4.2.2 Developmental References

EPRI 1000806, Demonstration of Life Cycle Management Planning for Systems, Structures and Components, January 2001

EPRI 1019161, Plant Support Engineering: Proactive Obsolescence Management, December 2009

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N-STD-MP-0027, Configuration Management

5.0 REVISION SUMMARY

This is an **intent** revision.

Throughout document

Updated bases references indicated in square brackets throughout the document (DCR 143735)

Cover of document

Updated names and titles.

Added Nuclear Waste Management Division exceptions. (DCR 143279)

Section 1.1

Updated text in Section 1.1.2 regarding Figure 1.

Added Section 1.1.3 regarding NWMD exceptions (DCR 143279)

Figure 2, Equipment Reliability Document Hierarchy

Updated title of N-CHAR-AS-0002

Replaced superseded N-PROG-MM-0001, Materials Management with OPG-PROG-0009, Items and Services Management. (DCR 131423).

Replaced superseded N-PROG-AS-0007, Project Management with OPG-PROG-0039, Project Management (DCR 140387).

Removed N-PROG-MP-0007, Conduct of Engineering (DCR 140526)

Added N-PROC-RA-0135, Cyber Security (DCR 141735)

Added N-PROG-RA-0006, Environmental Qualification (DCR 144240)

Added N-PROC-MA-0104, Monitoring and Diagnostic Centre. (DCR 144985)

Added N-PROG-MP-0014, Reactor Safety Program (DCR 140907)

Added N-PROG-RA-0012, Fire Protection (DCR 140907)

Updated text in the Legend box regarding the word implementing**.**

Added shading to N-STM-08130-10000 (DCR 140527)

Updated text in the Legend box regarding use of shading in the diagram

Removed documents indicating generic programs under N-PROG-AS-0001. N-PROC-RA-0023, N-PROG-TR-0005, N-PROG-AS-0005, N-PROG-RA-0003, N-PROG-MA-0019 (DCR 140907)

Added N-PROG-AS-0001, Nuclear Management System Administration (DCR 140907)

Removed footer from the bottom of the page.

Section 1.2 Program Activities and Requirements

In Section 1.2.1.3 updated word from station to site (DCR 143279)

In Section 1.2.3 updated text regarding CC1 components

In Section 1.2.8.1, replaced N-PROG-RA-0003, Corrective Action, with N-PROG-RA-0003, Performance Improvement. (DCR 144927)

In Section 1.2.8.1 updated text regarding CC1 components

In Section 1.2.8.2 updated the word station to site (DCR 143279)

In Section 1.2.10.3, replaced superseded N-PROG-MM-0001, Materials Management with OPG-PROG-0009, Items and Services Management. (DCR 131423).

Added Section 1.2.11, Monitoring and Diagnostic Centre (DCR 144985)

Section 1.4 Interfacing Programs

Removed N-PROG-MP-0007, Conduct of Engineering (DCR 140526)

In Section 1.4.5, updated the word station to site (DCR 143279)

In Section 1.4.6, replaced superseded N-PROG-AS-0007, Project Management with OPG-PROG-0039, Project Management (DCR 140387)

In Section 1.4.7, replaced superseded N-PROG-MM-0001 Materials Management with OPG-PROG-0009, Items and Services Management (DCR 131423).

In Section 1.4.9 added N-PROC-RA-0135, Cyber Security (DCR 141735)

In Section 1.4.11 added N-PROG-RA-0006, Environmental Qualification (DCR 144240)

In Section 1.4.12 added N-PROG-RA-0012, Fire Protection (DCR 140907)

Removed documents indicating generic programs under N-PROG-AS-0001.
N-PROG-MA-0019, N-PROG-AS-0005, N-PROG-RA-0003 (DCR 140907)

Added N-PROG-AS-0001, Nuclear Management System Administration (DCR 140907)

Section 2.0 ROLES AND ACCOUNTABILITIES

In Section 2.1, replaced Director, Components Engineering with Senior Manager, Equipment Reliability and Asset Management. (DCR 133808)

In Section 2.1.1, N-PROG-AS-0001 Managed Systems name change to Nuclear Management System Administration, (DCR 143731)

Added Section 2.1.4 with text regarding N-STD-MP-0027, Configuration Management (DCR 136139).

In Sections 2.2 to 2.5 updated text to include NWMD

In Section 2.5, updated title to Director, Controllership, Station Business Support

Section 3.1 Definitions

Updated definition of critical spares

Updated the word station to site under definition for PRL. (DCR 143279)

Section 3.2 Abbreviations and Acronyms

Added NWMD (DCR 143279)

Added OPG.

Added CSA

Section 4.1 Bases

Updated list of bases documents (DCR 143735)

Section 4.2.1 Performance References

Added CSA N286-12, Management System Requirements for Nuclear Facilities

Replaced superseded N-PROG-MM-0001, Materials Management with OPG-PROG-0009, Items and Services Management. (DCR 131423).

Replaced superseded N-PROG-AS-0007, Project Management with OPG-PROG-0039, Project Management (DCR 140387)

Removed N-PROG-MP-0007, Conduct of Engineering (DCR 140526)

Added N-PROG-MP-0014, Reactor Safety Program

Added N-PROC-RA-0135, Cyber Security (DCR 141735)

Updated title of N-PROG-AS-0001 from Managed Systems to Nuclear Management System Administration, (DCR 143731)

Added N-PROC-MA-0104, Monitoring and Diagnostic Centre (DCR 144985)

Added N-PROG-RA-0012, Fire Protection (DCR 140907)

Removed N-PROG-AS-0005, Nuclear Business Planning (DCR 140907)

Added OPG-PROG-0042, Cyber Security (DCR 141735)

Added W-PROC-WM-008, Nuclear Waste Management - Work Management Process

Added W-PROG-WM-001, Nuclear Waste Program

Section 4.2.2 Developmental References

Added N-STD-MP-0027, Configuration Management (DCR 136139).

Added CSA N286-12, Management System Requirements for Nuclear Facilities

ONTARIO POWER GENERATION

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Document Number: N-PROC-MA-0097		Revision R005
Usage Classification: Information	Sheet Number: N/A	Page: 1 of 27

Nuclear

Procedure

TITLE
EQUIPMENT RELIABILITY IMPLEMENTATION

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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-PROG-MA-0026, Equipment Reliability

Document is Related to Pressure Boundary ☐	Document Requires CNSC Notification ☐

PURPOSE
This procedure provides requirements and guidance for implementation of activities to support high levels of Equipment Reliability (ER). The activities are based on the Institute of Nuclear Power Operations (INPO) Advanced Process AP-913, Equipment Reliability Process, and Nuclear Industry best practices. The overall objective is to provide a consistent fleet methodology for the following: (a) Component and System Monitoring; (b) Response to Equipment Failures and Degradation; (c) Plant Health Committee operation; (d) Tracking and Directing Equipment Reliability Work; and (e) Equipment Reliability Performance Reporting and Follow Up.

DATES (YYYY-MM-DD)	
PDF Creation Date:	2020-04-20

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Compliance Date:	Immediate

EXCEPTIONS

This procedure does not apply to:

- Nuclear Waste Management Division (NWMD)
- Inspection and Reactor Innovation (IRI)
- Emergency preparedness equipment which is managed in accordance with N-PROC-RA-0040, Maintenance and Testing of Emergency Preparedness Facilities and Equipment
- Beyond design basis equipment which is managed in accordance with N-GUID-01130-10000, Modifications for Beyond Design Basis Accidents

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1.0 DIRECTION

1.1 Component and System Monitoring

Component and system monitoring activities should be performed by site engineers from organizations including Performance Engineering, Component and Equipment Engineering, and Computers and Control Engineering as assigned by the respective engineering managers.

Where there is agreement for the transfer of component and system monitoring between organizations (e.g., between Station and Nuclear Refurbishment), this procedure should be used to provide the basis for component and system monitoring while acknowledging the unique system and component conditions during shut-down and lay-up states. The transfer of component and system monitoring requirements should be documented in transfer communication plans. Additional information on the process for performing a turnover can be found in N-PROC-MA-0023, System Turnover.

1.1.1 Scope

1.1.1.1 Component and system monitoring is applied on a graded approach and is applicable to all Criticality Code (CC) 1 (including *Single Point Vulnerabilities* (SPVs)) and specific CC2 and CC3 components.

1.1.1.2 Specific component lines may have surveillance activities implemented for select critical categories via component programs authorized by N-PROG-MA-0017, Component and Equipment Surveillance. Where component programs have been implemented, results of component monitoring should be used by Component Engineers to establish the health of program components.

1.1.1.3 Important equipment needed to support plant safety or reliability, but not maintained directly by plant staff, should be included in life cycle strategies. Details are provided in Appendix C, Vendor Maintained Equipment Supporting the Plant.

1.1.2 Component and System Monitoring Inputs

1.1.2.1 Processes to identify critical equipment and aid in the creation, storage, and retrieval of component performance data and information should be in place to enable component and system monitoring activities.

1.1.2.2 The following provides the basis for the activities to enable component and system monitoring:

(a) Identification of critical components based on importance to nuclear safety, production, cost, conventional safety and environment is determined in accordance with N-PROC-MA-0077, Critical Equipment Identification and Categorization, to establish the scope and rigour of component and system monitoring activities.

(b) Critical component and system performance criteria and component and system performance monitoring parameters are established and integrated into System Performance Monitoring Plans (SPMPs) in accordance with N-PROC-MA-0024, System Performance Monitoring.

(1) Performance Monitoring Equipment List (PMEL) documents are available including critical component and system monitoring performance criteria, monitoring parameters, performance acceptance bands and remedial actions.

(2) Results are available for component and system monitoring through System Health Reports (SHRs) and Program Health Reports (PHRs).

(3) Station Condition Records (SCRs) should be initiated for critical *equipment failures* (EFs) and *equipment degradations*.

(c) Preventive Maintenance (PM) activities are identified and implemented in accordance with N-PROC-MA-0020, Predefined Process.

(d) *Predictive Maintenance* (PdM) technologies are implemented in accordance with N-PROC-MA-0034, Predictive Maintenance Program Requirements, to detect component degradation well in advance of potential failure, and to optimize component performance. Degrading performance is communicated to System or Component Engineers and SCRs are initiated for abnormal degradation and EFs.

(e) Where applicable, Advanced Pattern Recognition (APR) software is used by the Monitoring and Diagnostic Centre in accordance with N-PROC-MA-0104, Monitoring and Diagnostic Centre, to build operational profiles which detect anomalies at their initial stages, thereby providing early warning for prevention and reduction of EFs,.

1.1.2.3 Component and system monitoring is the aggregate of activities that:

- Identify EFs and degradation.
- Evaluate EFs.
- Initiate preventive or corrective action.
- Review and trend equipment condition data, failures and degradations.
- Monitor status and effectiveness of actions.

1.1.3 Component and System Health Reporting

1.1.3.1 Component health reporting is combined with program health reporting. PHRs are prepared in accordance with N-PROG-MA-0017, Component and Equipment Surveillance. Component Engineers may also prepare PHRs for components not under the scope of N-PROG-MA-0017 at the discretion of the Manager, Components and Equipment. For details of PHRs, refer to N-INS-01510-10001, Site Engineering Program Health Reporting Process.

1.1.3.2 SHRs are prepared in accordance with N-PROC-MA-0024, System Performance Monitoring. For details of SHRs, refer to N-INS-01071-10000, System Health Reporting.

1.2 Response to Equipment Failures and Degradation

1.2.1 Identification of Equipment Failures and Degradations

1.2.1.1 Performance Engineering Manager or delegate should implement periodic meetings, at least once a month to review the following:

- EFs, *equipment degradation* related SCRs, *Equipment Reliability Clock Resets* (ERCRs), and incoming work orders through the Critical Failure Review (CFR) process in accordance with N-GUID-01500-00001, Review of Critical Equipment Failures

- Equipment added to the CBM watch list

Note: Additional meetings are based on manager discretion and may be required depending upon the station's EF rate.

The Performance Engineering Manager or delegate shall direct the review meetings and include designated Engineering staff. The review activity may include representatives from Operations and Maintenance at the discretion of the Plant Health Committee (PHC).

1.2.1.2 The Performance Engineering Manager or delegate should ensure the following activities are conducted for all critical components, as defined in N-PROC-MA-0077.

(a) Confirm that an SCR has been input for all EFs and degradations or assign an individual to enter said SCR. The SCR should be flagged as an EF where applicable.

(b) Determine the impact, frequency, and certainty of the EF as well as the recommended level of analysis per N-GUID-01500-00001, Review of Critical Equipment Failures.

1.2.1.3 Based on the recommended level of analysis determined in section 1.2.1.2 (b), the Performance or Component Engineering Manager should direct the Engineering SCR Coordinator to set the SCR to the corresponding significance level and category.

Where required, the Manager should assign an individual to perform an *Equipment Apparent Cause Evaluation* (EACE) as specified in Section 1.2.2.1.

If further analysis is not required (SCR has been set to trending), the Manager should ensure an Engineer is assigned to select the trend codes as specified in Section 1.2.2.3.

1.2.1.4 Manager, Performance Engineering, should maintain a list of EFs requiring an EACE by utilizing the Equipment Failure Impact Codes in the SCR system. These Impact Codes are also listed in Appendix A.1.0.

1.2.1.5 If the EF or degradation is a margin issue, the SCR should be processed in accordance with N-PROG-MP-0009, Design Management, and N-INS-03600-10001, Margin Management Implementation.

1.2.2 Evaluation, Trending, and Follow Up on Equipment Failures and Degradations

1.2.2.1 Evaluation of Equipment Failures

The requirements specified in N-PROC-RA-0022, Processing Station Condition Records apply to SCRs related to EFs. The assigned Engineer for an EF should complete an EACE as follows:

(a) Complete N-FORM-11318, Equipment Apparent Cause Evaluation (EACE) Checklist, to determine the apparent cause.

(b) If the cause of the failure is unknown and/or not understood and it is necessary to establish corrective actions, the *Systematic Approach to Problem Solving* (SATPS) or Kepner Tregoe (KT) method may be used.

(c) Complete the SCR Analysis, and Corrective Actions sections of the SCR.

(d) Select ER Trend Codes as specified in Section 1.2.2.3.

(e) Attach one copy of N-FORM-11318 to the SCR and one copy to the System Notebook.

(f) If the SCR has been dispositioned as category A or B and requires a root cause investigation, N-FORM-11318 may be referenced during the investigation, to identify specific ER cause codes where applicable.

Additional guidance on performing an EACE is available in N-GUID-03000-10000, Equipment Apparent Cause Guide.

1.2.2.2 Evaluation of Non Critical Equipment Failures or Degradations

Evaluations are not required for non critical EFs at the discretion of the Manager. Trend codes should be applied based on existing knowledge and Engineering judgement.

1.2.2.3 Trend Coding of Equipment Failures and Degradations

The assigned Engineer should select trend codes and enter them in Section 5.16 of N-FORM-11318, Equipment Apparent Cause Evaluation (EACE) Checklist. Detailed guidance on selecting and applying trend codes is provided in Appendix C.

Note: Select the most appropriate ER Program code if not fully known. Do not leave blank or indeterminate.

A copy of the completed N-FORM-11318 should be provided to the Engineering SCR coordinator to assign or verify the trend codes in the SCR. The assigned Engineer is responsible for ensuring the codes are input by the SCR Coordinator.

1.2.2.4 Trending and Follow up on Equipment Failures and Degradations

(a) Quarterly, the Manager, Performance Engineering, or delegate shall produce equipment trending reports to highlight component type, failure mode and cause codes.

(1) Trending may require using more than one quarter of data to achieve meaningful trends.

(2) A common cause analysis may be used for the evaluation of an adverse trend.

(b) Semi-annually, the Manager, Performance Engineering, or delegate, should map cause codes for EFs on the *INPO/ WANO Equipment Reliability Bubble Chart* to identify adverse trends. Mapping from ER Trend Codes for the Bubble Chart is provided in Appendix A.2.0.

(c) Annually, the Manager, Fleet Equipment Reliability, should review SCRs and look for trends by specific component types across the fleet to determine if a fleet strategy or response is required.

(d) Annually, the Manager, Fleet Equipment Reliability, should conduct and present a fleet level review of equipment trends and status of key corrective actions to senior management, including Nuclear Executive Committee (NEC) members. The annual review should be conducted in Q1 to ensure outcomes can be used to adjust overall ER strategy for OPGN, prior to business planning.

Note: Adverse trends are addressed through the SCR Process.

1.2.3 Equipment Reliability Clock Resets

An *Equipment Reliability Clock Reset* (ERCR) process should be implemented at each station to increase awareness of unanticipated EFs, the associated risk to the station and to promote intolerance for these failures.

The ERCR process has the following attributes:

(a) Evaluation of EFs against the ERCR criteria outlined in Appendix A.1.0 and communication of clock resets to site workgroups should be done in a timely manner.

(b) If it is unclear whether an ERCR should be declared, the Engineering Director has final authority following input from Director of Operations and Maintenance (DOM).

(c) A historical record of ERCRs should be documented on the site web page.

(d) ERCRs should be trended.

(e) Sites may set ERCR targets to drive improved equipment performance.

1.3 Plant Health Committee

The purpose of the *Plant Health Committee* (PHC) is to improve plant reliability through identification and advocacy of plant health risks as per N-GUID-01500-00002, Plant Health Committee Guide. *System Health Teams* and Engineers identify, prioritize and capture actions from System and Component Health programs and present them to the PHC. Endorsement for proposed health strategies that address potential plant health risks is required from the PHC.

1.4 Tracking and Directing Equipment Reliability Work

1.4.1 The assigned Engineer should identify, prioritize and capture actions from SHRs and PHRs and update these actions in conjunction with Health Report updates.

(a) Each action shall be flagged for tracking as one or more of the following subsets of work:

- PHC Action
- Plant Reliability List (PRL)
- Action required to move a red system to yellow or white
- Action required to move a yellow system to white
- Action required to maintain a white or green system status or move a white system to green.

(b) Actions are flagged for execution in one of the following planning and execution processes. The selected process may be updated as the work progresses.

- Work Week (WW) Schedule including items identified on the cycle plan.
- Outage Scope
- Minor Modifications Portfolio
- Project Portfolio
- Long Range Plan (LRP)

(c) Actions from SHRs and PHRs to mitigate a known risk to reliability should be assigned an associated risk, consequence, and probability number as outlined in Appendix B.

Note: Maintenance backlog reduction actions would not typically require risk ranking unless the work order clearly mitigates an identified risk to the station.

(d) Each action should have a status field to identify current status for example, “Scheduled in WW 28,” or “Business Case Summary approved at Asset Investment Steering Committee.”

(e) Actions should be consolidated into one data source for integration and risk ranking and the format shall be the same for all sites to allow fleet roll up of information.

(f) Items identified as PRL are entered into the PRL database. Implementation of the PRL should be governed by site guides.

(g) Various site functional organizations and committees should sort the ER actions to ensure high value work is scheduled and tracked.

1.5 Equipment Reliability Performance Reporting and Follow Up

The primary performance indicators for ER are contained in the *Equipment Reliability Index* (ERI). The ERI is an industry-wide composite index which is developed by industry peers and kept current through regular revisions. The CANDU Owners Group (COG) produces a guideline which defines ERI for CANDU utilities.

The COG CANDU ERI guideline, N-GUID-01500-00004, is used as the reference for establishing OPGN ERI performance measures and the following requirements should be established and implemented:

(a) ERI is reported on a station basis.

Note: For Units that will be on an extended shutdown (e.g., Refurbishment), some of the ERI sub-indicators may not be applicable and the sites may need to establish how to manage ERI for the Unit during this period.

(b) ERI and sub-indicators are reported in the Electronic Performance Reporting (EPR) system quarterly, as a minimum.

(c) Targets for ERI and sub-indicators are based on site business targets.

(d) When ERI is reported as part of the ER program status, industry standards, site targets and industry benchmark performance is used and referenced where available.

(e) Each sub-indicator should have a designated owner.

(f) Where sub-indicators are scoring red against industry standards, a recovery plan should be established and a station owner should be appointed. The *Equipment Reliability Peer Team* should coordinate site recovery plans where more than one station has a recovery plan for a given sub-indicator to avoid overlap and maintain consistency.

(g) Recovery plans should be reviewed by the PHC as per N-GUID-01500-00002 and *Equipment Reliability Peer Team* yearly, as a minimum.

2.0 ROLES AND ACCOUNTABILITIES

2.1 Manager, Fleet Equipment Reliability

2.1.1 Ensures ER is consistently implemented at each of the OPGN sites.

2.1.2 Provides governance to ensure a consistent fleet methodology for ER.

2.1.3 Establishes a forum for the continual exchange of site ER information and continual improvements in fleet ER such as the *Equipment Reliability Peer Team*.

2.1.4 Reviews SCR trends by component types and determines if a fleet strategy is required.

2.1.5 Conducts and presents an annual fleet level review of equipment trends and key corrective actions to senior management, including NEC members.

2.2 Manager(s), Performance Engineering and Computers and Control Design

Note: The TRF Technical Section is included under Manager, Performance Engineering Nuclear Systems at Darlington.

2.2.1 Ensures review and disposition of EFs and degradations is completed in a timely and quality manner.

2.2.2 Ensures ERCR process is implemented.

2.2.3 Ensures actions from EFs are tracked.

2.2.4 Ensures SCRs are created as required for EFs and degradations.

2.2.5 Ensures trend codes are applied to SCRs assigned to System Engineers.

2.2.6 Ensures EACEs are completed by assigned System Engineers.

2.2.7 Ensures actions are identified, risk ranked and flagged in SHR action plans.

The following accountabilities may be delegated to another Station Engineering Manager at the discretion of the Engineering Director.

2.2.8 Trends EFs and degradations through quarterly equipment trend reports.

2.2.9 Maps cause codes for EFs to *INPO/ WANO Equipment Reliability Bubble Chart* semi-annually.

2.2.10 Collects input from others and recommends business plan targets for ER performance metrics.

2.2.11 Ensures station ER EPR and trend reports are created and communicated.

2.2.12 Ensures accountable metric owners are established for ER performance reporting.

2.2.13 Ensures ER performance data is provided for input to EPR through accountable metric owners.

2.3 Manager, Components and Equipment

2.3.1 Supports Manager, Performance Engineering in review and disposition of EFs and degradations.

2.3.2 Ensures SCRs are created as required for EFs and degradations.

2.3.3 Ensures trend codes are applied to SCRs assigned to Component Engineers.

2.3.4 Ensures EACEs are completed by assigned Component Engineers.

2.3.5 Ensures actions are identified, risk ranked and flagged in PHR action plans.

3.0 DEFINITIONS AND ACRONYMS

3.1 Definitions

Critical Component Failures are a type of *equipment failures* defined as any failure of a critical component (CC1) or failure of a critical component that results in a loss of redundancy. If a critical component is unable to operate, it is defined as a critical component failure, regardless of whether its function is demanded or not. If a critical component failure was discovered during PMT, it is only a critical component failure if it can be confirmed that the component failure was not due to the performed maintenance.

Equipment Apparent Cause Evaluation (EACE) is methodology adopted by the nuclear industry to assess and determine programmatic causes of *equipment failure*. An example of a programmatic cause is lack of preventive maintenance.

Equipment Degradation is a potential or actual degradation that is minor and does not threaten the component's design function or performance criteria. Maintenance is intended to be performed in the future, but the nature of the degradation is such that scheduling flexibility exists.

Equipment Failures are defined as a component which is unable to operate, regardless of whether its function is demanded or not. Equipment failures are categorized as either *critical component failures* or *functional failures*.

Equipment Reliability Clock Reset (ERCR) is an *equipment failure* event, based on a number of independent criteria specified in Appendix A.1.0, which measures the significance of the *equipment failure*. The measure of elapsed time since an ERCR *equipment failure* is used to communicate to station staff that an EF has occurred and to drive intolerance for unanticipated EFs.

Equipment Reliability Index (ERI) is a measure of Equipment Reliability adopted by the nuclear industry, consisting of numerous leading and lagging sub-indicators, reflected through a point score to a maximum of 100 points.

Equipment Reliability Peer Team is a forum for bringing together managers responsible for elements of the equipment reliability program in order to drive measurable improvement in areas of program execution, performance, convergence, efficiency, and cost reduction across the fleet.

Functional Failures are a type of *equipment failures* defined as any change in the characteristics of a structure, system, or component (SSC) that would result in the system being unable to carry out its minimum intended function or to operate within design specification. The intended function includes those related to safety as well as operational and production functions.

INPO/ WANO Equipment Reliability Bubble Chart is a chart used and promoted by INPO and WANO to categorize programmatic causes of *equipment failure*. Plotting a series of *equipment failures* on this chart visibly shows trends and programmatic weaknesses. These charts are typically used in Peer Evaluations to determine ER program effectiveness and organizational weaknesses.

Long Range Plan (LRP) is a tool used to identify and plan for major activities and projects which impact station costs, resources and outage durations. The LRP includes both ER and other actions and typically forecasts 5 or more years ahead.

Plant Reliability List (PRL) is a list of activities and work orders required to improve or sustain System and Component Health which is used to align the station around a set of key work activities to improve ER.

Plant Health Committee (PHC) at each site provides oversight, direction, and leadership for resolving *ER* issues and implementing actions from System and Component Health Plans. The PHC consists of Managers and/or Directors from the key functional organizations at the site involved in implementing *ER* actions.

Predictive Maintenance (PdM) is a process combining technologies and people skills to detect component degradation well in advance of potential failure, and to optimize component performance. PdM is specified by Engineering and conducted by Maintenance in accordance with N-PROC-MA-0034, Predictive Maintenance Program Requirements.

Repeat Failure is a failure of the same component with the same failure mode within a specified cycle or frequency (usually 2 years).

Single Point Vulnerability (SPV) is a component that upon failure, directly results in an immediate or imminent shutdown or de-rating of a unit or station. Criteria are defined in N-PROC-MA-0077, Critical Equipment Identification and Categorization.

System Health Team is a cross-functional team which includes members who are knowledgeable on system design, functionality, operational and maintenance issues. The team's role is to drive system health performance and improve reliability. The operations of these teams is described in N-GUID-01900-10003, System Health Team – Terms of Reference.

Systematic Approach to Problem Solving (SATPS) a methodology to systematically identify and evaluate potential physical causes of *equipment failures*.

3.2 Abbreviations and Acronyms

APR	Advanced Pattern Recognition
APS	Auxiliary Power System
CANDU	Canadian Deuterium Uranium
CC	Criticality Code
CFR	Critical Failure Review
COG	CANDU Owners Group
DOM	Director of Operations and Maintenance
EACE	Equipment Apparent Cause Evaluation
EF	Equipment Failure
EO	Evaluating Organization
EPG	Emergency Power Generator

EPR	Electronic Performance Reporting
ER	Equipment Reliability
ERCR	Equipment Reliability Clock Reset
ERI	Equipment Reliability Index
INPO	Institute of Nuclear Power Operations
KT	Kepner Tregoe
LRP	Long Range Plan
MRM	Management Review Meeting
NEC	Nuclear Executive Committee
NWMD	Nuclear Waste Management Division
PdM	Predictive Maintenance
PHC	Plant Health Committee
PHR	Program Health Report
PM	Preventive Maintenance
PMEL	Performance Monitoring Equipment List
PMOD	Permanent Modification
PMT	Post-Maintenance Testing
PRL	Plant Reliability List
SCR	Station Condition Record
SHR	System Health Report
SPMP	System Performance Monitoring Plan
SPV	Single Point Vulnerabilities
SSC	System, Structure or Component
TMOD	Temporary Modification
WANO	World Association of Nuclear Operators
WTP	Water Treatment Plant
WW	Work Week

4.0 BASES, RECORDS AND REFERENCES

4.1 Bases

None.

4.2 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 or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
EACE Checklist	N-FORM-11318	Y	Attach to SCRs flagged as EFs as per N-PROC-RA-0022.
Copy of EACE Checklist	N-FORM-11318	N	Retained by Department through a copy filed in the respective System Notebook.

4.3 References

4.3.1 Performance References

COG Guideline, COG-GL-2010-02, CANDU Stations Equipment Reliability Index

N-FORM-11318, Equipment Apparent Cause (EACE) Checklist

N-GUID-01130-10000, Modifications for Beyond Design Basis Accidents

N-GUID-01500-00001, Review of Critical Equipment Failures

N-GUID-01500-00002, Plant Health Committee Guide

N-GUID-01500-00004, COG Equipment Reliability Index (ERI) Guideline Rev 3

N-GUID-01900-10003, System Health Team – Terms of Reference

N-GUID-03000-10000, Equipment Apparent Cause Guide

N-INS-01071-10000, System Health Reporting

N-INS-01510-10001, Site Engineering Program Health Reporting Process

N-INS-03600-10001, Margin Management Implementation

N-PROC-MA-0020, Predefined Process

N-PROC-MA-0024, System Performance Monitoring

N-PROC-MA-0034, Predictive Maintenance Program Requirements

N-PROC-MA-0077, Critical Equipment Identification and Categorization

N-PROC-MA-0104, Monitoring and Diagnostic Centre

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

N-PROC-RA-0040, Maintenance and Testing of Emergency Preparedness Facilities and Equipment

N-PROG-MA-0017, Component and Equipment Surveillance

N-PROG-MA-0026, Equipment Reliability

N-PROG-MP-0009, Design Management

N-STD-OP-0033, Generation Communication

NK30-SOW-71600-00001, Scope of Work for Outsourcing Water Treatment Plant (WTP) Systems and Equipment to Produce and Supply Demineralised Water to Pickering Nuclear Generating Station.

4.3.2 Developmental References

EPRI 1009615, Equipment Reliability Implementation Strategy, A Strategy for Identifying and Prioritizing Nuclear Power Plant Equipment Reliability Improvement Opportunities and Action, April 2004.

EPRI TR-107668, Guideline for System Monitoring by System Engineers, Revision 1, March 2010

ERWG, Corrective Action and ER Interface, Revision 02, September 2008

ERWG, Guidance Attributes of an Effective Plant Health Committee

ERWG, Life Cycle Management Guidance Document for Implementation of the LCM Block of AP913, September 2008.

INPO AP-913, Equipment Reliability Process Description

N-PROG-AS-0005, Nuclear Business Planning

N-PROG-MA-0019, Production Work Management

N-PROG-MP-0008, Integrated Aging Management

N-PROG-RA-0003, Performance Improvement

N-STD-RA-0008, Incident Investigation

OPG-PROG-0039, Project Management

P-GUID-01900-00004, Process Guide for Timely Equipment Failure Resolution

5.0 REVISION SUMMARY

This is an **intent** revision.

- Single Point of Contact and Document Owner on cover page revised from Engineering Program Integration to Fleet Equipment Reliability.

- Purpose on cover page updated to align with key areas outlined in the body of the document.
- Exemptions updated to revise Inspection and Maintenance Service to Inspection and Reactor Innovation.
- Incorporated the following DCRs:
  - EC 139058 R000 – Aligned “Equipment Failure” and “Functional Failure” definitions in section 3.1 with N-GUID-01500-00001.
  - EC 140520 R001 – Replaced reference to N-STD-MP-0020, Margin Management, with N-PROG-MP-0009, Design Management in sections 1.2.1.5 and 4.3.1.
  - EC 141668 R000 – Updated wording surrounding critical components to reference N-PROC-MA-0077 in section 1.2.1.2, revised references to Significant Equipment Failures (SEFs) to EFs in sections 1.1.2.3, 1.2.1.4, 1.2.2.1, 1.2.2.4 and 2.2.3, removed SEF criteria from section 1.2.1.2 (c) and removed SEF from acronyms in section 3.2.
  - EC 144927 R004 – Revised the title of N-PROG-RA-0003 from “Corrective Action” to “Performance Improvement” in section 4.3.2.
- Additional updates made to simplify this governance and align with current ER practices include:
  - Section 1.0: Revised “component monitoring” to “component and system monitoring” throughout the document.
  - Section 1.1: Added reference to N-PROC-MA-0023, System Turnover.
  - Section 1.1.1.1: Added specific for CC2 and CC3 components and removed wording “irrespective of specific component program requirements”.
  - Section 1.1.1.3: Removed redundant wording.
  - Section 1.1.2.1: Updated wording for clarity.
  - Section 1.1.2.2 (b)(1) & (2): Updated wording for clarity.
  - Section 1.1.2.2 (e): Added use of APR by Monitoring and Diagnostic Centre.
  - Section 1.1.2.4: Section removed (redundant information).
  - Section 1.1.3.1: Consolidated former sections 1.1.3.1 and 1.1.3.2.
  - Section 1.1.3.2: Added new section to include governance for SHRs.
  - Section 1.2.1.1: Revised meeting frequency from once in two weeks to once a month, removed outdated information, updated to reflect current CFR practices and added note regarding additional meetings at the discretion of the manager.
  - Section 1.2.1.2: Consolidated information and added reference to N-GUID-01500-00001 for determination of determine impact, frequency, certainty and recommended level of analysis.
  - Section 1.2.1.3: Updated reference to section 1.2.1.2 (b) for recommended level of analysis and consolidated information duplicated in other sections.
  - Section 1.2.1.4: Added reference to codes in Appendix A.1.0.
  - Section 1.2.1.5: Updated wording for clarity.

- Section 1.2.2.1: Restructured section for clarity, consolidated information duplicated in other sections and removed paragraph discussing P-GUID-01900-00004.
- Section 1.2.2.2: Revised wording from “non significant” to “non critical” and added use of manager discretion.
- Section 1.2.2.3: Updated wording for clarity and consolidated information duplicated in other sections.
- Section 1.2.2.4: Removed two separate instances of addressing adverse trends through the SCR process and added as a note instead, removed (c) to reflect current practices and revised (c) and (d) (formerly (d) and (e)) from Manager, EPI to Manager, Fleet ER.
- Section 1.2.3: Updated wording for clarify, updated ERCR criteria to reference Appendix A.1.0, removed two business day requirement formerly included as (c) and removed reference to local ERCR guides.
- 1.3: Removed sub-sections, added reference to N-GUID-01500-00002 and aligned PHC purpose with the guide.
- 1.4: Updated wording for clarity, consolidated information and updated risk ranking reference to Appendix B.
- 1.5: Updated wording for clarity and added reference to N-GUID-01500-00004.
- 1.5 (a): Revised “unit basis where the data is applicable” to “station basis”.
- Section 1.5 (c): Removed “and colours”.
- Section 1.5 (f): Revised “ER Working Group” to “Equipment Reliability Peer Team”.
- Section 1.5 (g): Revised “ER Working Group” to “Equipment Reliability Peer Team” and added reference to N-GUID-01500-00002.
- Section 2.1: Added new section to document accountabilities of Manager, Fleet Equipment Reliability.
- Section 2.2: Added note regarding TRF, removed accountabilities related to PHC, and aligned accountabilities with equipment trend reports and cause code mapping required by section 1.2.2.4.
- Section 2.3: Removed accountabilities related to PHC.
- Section 2.4 & 2.5: Removed entirely (all PHC specific).
- Section 3.1:
  - Removed “AP913 Consequential Failure Event” definition and replaced with “Critical Component Failures”.
  - Consolidated “Equipment Reliability Clock” into “Equipment Reliability Clock Reset” definition.
  - Added “Equipment Reliability Peer Team” definition.
  - Updated “Plant Health Committee,” “System Health Teams,” and “Predictive Maintenance” definitions to align with N-PROG-MA-0026.
  - Removed “Predictive Maintenance Watch List” and “Reoccurrence Failure” definitions as these terminologies are no longer used in this document.

- Section 3.2:
  - Added the following acronyms: APR, CFR, DOM, EO, EPG, INPO, KT, NWMD, PHR, PMOD, PMT, SHR, TMOD and WTP.
  - Removed the following acronyms which are no longer used in this document: FME, HTS, LRV, OE, OPEX, SEF, and TCV.
- Section 4.2: Updated wording in Filing Information/Retention column for clarity.
- Section 4.3.1:
  - Added the following references: N-GUID-01500-00002, “Plant Health Committee Guide”, N-GUID-01500-00004, “COG Equipment Reliability Index (ERI) Guideline Rev 3”, N-GUID-01900-10003, “System Health Team – Terms of Reference”, N-GUID-03000-10000, “Equipment Apparent Cause Guide”, N-INS-01071-10000, “System Health Reporting”, N-PROC-MA-0104, “Monitoring and Diagnostic Centre” and NK30-SOW-71600-00001, “Scope of Work for Outsourcing Water Treatment Plant (WTP) Systems and Equipment to Produce and Supply Demineralised Water to Pickering Nuclear Generating Station”.
- Section 4.3.2:
  - Revised N-PROG-AS-0007, “Project Management”, to OPG-PROG-0039.
- Former Appendix A removed entirely.
- Former Appendix B information consolidated with Former Appendix C (now Appendix A).
- Appendix A: Consolidated information, added examples for ERCR-7 and removed recurrence failure.
- Appendix A.1.0: Removed High Critical Component Failures.
- Appendix A.2.0: Updated to newest INPO/WANO bubble chart codes, consolidated both primary and secondary codes into one table and added statement regarding use of prefixes “P” or “S”.
- Former Appendix D removed entirely.
- Appendix B (former Appendix E): Consolidated information and updated wording for consequence rating to align with N-PROC-MA-0077.
- Appendix C (former Appendix F): Consolidated switchyard information for both stations, updated N-PROC-MP-0060 to N-PROG-MP-0008 and updated EPG3 information to reflect current status per Project 13-84229.

Appendix A: Equipment Reliability Trend Codes

The following Trend Codes should be selected in the SCR for an EF or *equipment degradation* as specified in Section 1.2.2.3.

A.1.0 EQUIPMENT FAILURE IMPACT CODES

- The ER Impact Codes listed in the table below will be used to identify and categorize the following:
  - ERCRs
  - *Functional Failures* as defined by SPMPs
  - *Single Point Vulnerability*
  - *Repeat Failures*
  - Component Degradation.
- The Impact Codes can be found in the SCR database under the “Trending” tab, in the “Equipment Failure Impact” box. The SCR Program will allow up to 5 code selections.

Equipment Reliability Impact Codes		
Code Description	**Impact Code**	**Details**
Equipment Reliability Clock Reset (ERCR)	ERCR-1	Automatic Reactor Trip, Step back or Setback
	ERCR-2	Automatic Turbine or Generator Trip
	ERCR-3	Transient >5% Reactor Power
	ERCR-4	>250 on line MWhrs forced loss or delay to outage critical path of greater than 24 hours.
	ERCR-5	Category 1 or 2 Reactivity management event.
	ERCR-6	Unit/Station shutdown clock ≤ 72 hours duration.
	ERCR-7	Categorized as an Event reset (management discretion). Examples of event resets at the discretion of management include loss of a critical safety function or activation of a safety system due to an EF.
Functional Failure	ER-FF	*Functional failure* as defined by SPMPs
SPV Failure	ER-SPV	*Single Point Vulnerability*
Repeat Failure	ER-RF	Repeat Failure
Degradation	ER-D	Degradation but not an EF

A.2.0 ER PROGRAM CODES: ER PROGRAM TREND (CAUSE) CODES TO BUBBLE CHART RELATIONSHIPS

- The ER Program Codes listed in the table below will be used to identify the primary and secondary cause of an *equipment failure.* These codes are aligned with *INPO/ WANO Equipment Reliability Bubble Chart* codes.

- The Program Codes can be found in the SCR under “Trending” tab in the “ER Program” box. The SCR Program will allow up to 2 code selections, one for the primary code and one for the secondary code. The Program Codes listed in the table shall be prefixed by a “P” for the primary code and an “S” for the secondary code.

Equipment Reliability Program Codes	
Program Code	**Details**
101-OF1	Operational Priorities: Low Threshold for Equipment Issues (1)
102-OF1	Operational Priorities: Risk Assessment (2)
103-OF1	Operational Priorities: Plant Monitoring (3)
104-OF1	Operational Priorities: Problem Resolution (4)
105-OF1	Operational Priorities: Outage Effectiveness (5)
201-ER1	Equipment Performance: Alignment for Timely/Thorough Equipment Resolution (1)
202-ER1	Equipment Performance: Equip for Safety, Control, Monitoring, EP (2)
203-ER1	Equipment Performance: Resolution of Long-Standing & Repetitive Deficiencies (3,9)
204-ER1	**Equipment Performance: High Standards for Critical Equipment (4)**
205-ER1	**Equipment Performance: Engineers/Managers Drive System/Component Health (5,6)**
206-ER1	Equipment Performance: Troubleshooting/Causal Analysis/Corrective Action (7,8)
207-ER1	Equipment Performance: Temporary Repairs (10)
208-ER1	Equipment Performance: Use of Plant/System Outage Opportunities (11)
301-ER2	Prevention of Equipment Failures: Component Classification & Strategy (1)
302-ER2	Prevention of Equipment Failures: PM Bases, Process, Implementation (2-6)
303-ER2	Prevention of Equipment Failures: Predictive Maintenance (7,8)
304-ER2	Prevention of Equipment Failures: Health Reports Thorough/Challenged (9,10,16)
305-ER2	Prevention of Equipment Failures: Vulnerability, Identification, Strategies (11,13,14)
306-ER2	**Prevention of Equipment Failures: Operating Experience/Vendor Information Use (12)**
307-ER2	**Prevention of Equipment Failures: Engineering Programmes(15)**
308-ER2	Prevention of Equipment Failures: Collective Equipment Monitoring (17,18)
309-ER2	**Prevention of Equipment Failures: Engineers Input to Operational Decisions (19)**
401-ER3	Long Term Equipment Reliability: Business & Long Range Strategy (1)
402-ER3	**Long Term Equipment Reliability: Long Range Planning and Life Cycle Management (2,3,9)**
403-ER3	Long Term Equipment Reliability: Component/Sub-Component Age-Related Degradation (4)
404-ER3	Long Term Equipment Reliability: Engineers Long-Term Strategy (5)
405-ER3	**Long Term Equipment Reliability: Equipment Maintained by External Organizations (6)**
406-ER3	**Long Term Equipment Reliability: Feedback and Operating Experience in Long Range Planning (7,8)**
407-ER3	Long Term Equipment Reliability: Parts Availability (10,11)
408-ER3	Long Term Equipment Reliability: Parts Quality (12-14)
501-WM1	On-Line and Outage Work Management: Management Roles and Responsibilities (1-11)
502-WM1	On-Line and Outage Work Management: Identification and Prioritization (12,13)
503-WM1	On-Line and Outage Work Management: Work Scheduling and Scoping (14,15)

504-WM1	On-Line and Outage Work Management: Work Planning (16-19)
505-WM1	On-Line and Outage Work Management: Risk Assessment (20,21)
506-WM1	On-Line and Outage Work Management: Scheduling and Coordination (22-28,30)
507-WM1	**On-Line and Outage Work Management: Management of Resources (29)**
508-WM1	On-Line and Outage Work Management: Self-Assessment (31-33)
601-MA2	Conduct of Maintenance: Maintenance Management (1,2)
602-MA2	**Conduct of Maintenance: Use of Operating Experience (3)**
603-MA2	**Conduct of Maintenance: Post-maintenance, Post-modification Testing (4)**
604-MA2	Conduct of Maintenance: First Line Supervision (5-10)
605-MA2	Conduct of Maintenance: Work Practices (11,12,14,15,17,18)
606-MA2	Conduct of Maintenance: Procedures and Work Instructions (13)
607-MA2	**Conduct of Maintenance: Foreign Material Exclusion Control (16)**
608-MA2	Conduct of Maintenance: Maintenance Training (19-21)
609-MA2	Conduct of Maintenance: Supplemental Personnel (22-25)
610-MA2	Conduct of Maintenance: MA.1 Maintenance Fundamentals (1-29)
701-ER4	Materials Reliability: Critical Materials (1)
702-ER4	Materials Reliability: Passive Component Monitoring (2,4)
703-ER4	**Materials Reliability: Materials Operating Experience Response (3,5)**
704-ER4	Materials Reliability: Material Selection (6)
705-ER4	Materials Reliability: Plant Chemistry Control/Advocacy (7-9,11-14,16,17)
706-ER4	Materials Reliability: Large Component Layup (10)
707-ER4	Materials Reliability: Control of Chemicals (15)
801-CM3	Design Change Process: Design Change Preparation (1-8,14,16)
802-CM3	Design Change Process: Design Change Testing (9)
803-CM3	Design Change Process: Design Change Implementation (10-13,15)
901-EN1	Engineering Fundamentals: Monitor and Evaluate (1-6)
902-EN1	Engineering Fundamentals: Maintain Design (7,8)
903-EN1	Engineering Fundamentals: Design Change Control, Quality & Testing (9,12,13,14)
904-EN1	Engineering Fundamentals: Design Vulnerabilities & Final Solutions (10,11)
905-EN1	Engineering Fundamentals: Communicate, Advise and Advocate (15-21)
906-EN1	Engineering Fundamentals: Acquire and Maintain Expert Knowledge (22-26)
907-EN1	Engineering Fundamentals: Critical Thinking & Decision Making (27,28,30,31)
908-EN1	Engineering Fundamentals: Validate and Challenge (29,32,33)
1001-EN2	Technical Authority: Guardian of Design and Licensing (1)
1002-EN2	Technical Authority: Leaders Ensure Thorough Technical Reviews (2)
1003-EN2	Technical Authority: Leaders Technically Challenge (3)
1004-EN2	Technical Authority: Managers Advocate Engineering Position (4)
1005-EN2	Technical Authority: Managers Ensure Accountability of Evaluations (5)
1006-EN2	Technical Authority: Engineers Evaluate/Document Abnormal Conditions (6)
1007-EN2	Technical Authority: Managers Technical Input to Plant Decisions (7)
1008-EN2	Technical Authority: Managers Ensure Understanding of Design Req. (8)

1009-EN2	Technical Authority: Supervisors Understand Must-Know Operating Experience (OE)
1101-LF1	Leadership: Vision and Values (1-11)
1102-LF2	Leadership: Teamwork (12-18)
1103-LF3	Leadership: Accountability (19-23)
1104-LF4	Leadership: Employee (24-27)

A.3.0 FAILED EQUIPMENT CODES

- Failed Equipment Codes can be found in the SCR under the “Trending” tab in the “Failed Equipment Type” box.

A.4.0 LINE DEFINED TREND CODES

- Line Defined Trend Codes can be found in the SCR under the “Trending” tab in the “Line Defined Codes” box.
- These Trend Codes are site specific (maintained by the respective sites or departments) and are optional.

Appendix B: Risk Ranking of Actions from System and Component Health Reports

B.1.0 CONSEQUENCE RATING:

The criticality code (CC) is based on the consequence associated with the component's failure as per N-PROC-MA-0077. This includes the component's impact in the following 3 areas (sub-codes): Reactor Safety, Production and Conventional Safety & Environment.

Note: Component Criticality and sub-codes can be found in the following locations:

(1) Asset Suite TIM D030, Equipment /Component Header Panel under Additional details and Attributes.

(2) IQReview under the Maintenance Strategy Tab.

Criticality Code	Rating
CC1 (SPV)	5
CC1 (Non-SPV)	4
CC2	3
CC3	2
CC4	1

B.2.0 PROBABILITY OF FAILURE RATING:

Failure Category	Description	Rating
Failed	Component has already failed and, or, a final solution is not in place to fix the problem.	5
Imminent	Component is showing signs of significant wear and degradation.	3
Likely within 1-2 yrs	Component is showing some signs of wear and degradation.	2
Expected within 3-5 yrs	Component is not showing visible signs of degradation but is reaching life expectancy.	1

B.3.0 OVERALL RISK RANKING:

Overall Risk = Consequence X Probability

Overall Risk		Risk Matrix			
High	10 to 25	Probability			
Med	6 to 9				
Low	1 to 5	**Failed (5)**	**Imminent (3)**	**Likely (2)**	**Expected (1)**
Consequence		SSC has already failed and, or, a final solution is not in place to fix the problem.	SSC showing signs of significant wear and degradation.	SSC showing some signs of wear and degradation.	SSC not showing visible signs of degradation but is reaching life expectancy.
CC1 (5) SPVs		**25**	**15**	**10**	**5**
CC1 (4)		**20**	**12**	**8**	**4**
CC2 (3)		**15**	**9**	**6**	**3**
CC3 (2)		**10**	**6**	**4**	**2**
CC4 (1)		**5**	**3**	**2**	**1**

Appendix C: Vendor Maintained Equipment Supporting the Plant

This appendix outlines how vendor maintained equipment supporting plant safety or reliability is overseen by OPGN.

C.1.0 VENDOR MAINTAINED EQUIPMENT APPLICABLE TO BOTH STATIONS

C.1.1 Switchyard

Hydro One maintains the switchyard equipment at both Pickering and Darlington Stations in accordance with the Transmission Connection Agreement. A SHR for the Switchyard is prepared by Performance Engineering at the respective station and includes inputs from a report prepared by the Hydro One. Hydro One provides presentations to the respective PHC. N-STD-OP-0033, Generation Communication, provides the required protocols for communication of planning and operational information.

The Hydro One Asset Management Department maintains life cycle management plans for the switchyard equipment. The results of these plans regarding maintenance and upgrades are provided to OPGN.

C.2.0 VENDOR MAINTAINED EQUIPMENT SPECIFIC TO PICKERING

C.2.2 Auxiliary Power System (APS)

The APS is currently maintained by station staff however OPGN is in the process of contracting out the operation and maintenance of this equipment.

Performance Engineering prepares a paper version of the SHR rather than a SystemIQ database entry and the report is not presented to the PHC.

No APS equipment more critical than CC3 has been identified. As noted in N-PROG-MP-0008, Integrated Aging Management, CC3 and CC4 components are generally not included in the Aging Management scope.

C.2.3 Emergency Power Generator 3 (EPG3)

EPG3 has been temporarily installed at the Pickering site since 2009. It is maintained by the vendor, Aggreko, in accordance with the service agreement which includes testing and maintenance.

EPG3 is included in the SHR for the EPGs. The report includes trending of EPG3 availability and starting reliability but excludes EPG3 maintenance backlogs and deferrals. Project 13-84229 is currently in progress to convert the temporary installation (TMOD) to a permanent installation (PMOD). Once it is a PMOD, it will have full SHR requirements in line with the other EPGs.

Currently, EPG3 is expected to be installed until end of station life. A full spare is kept by the vendor for OPG use. EPG3 can be replaced by the vendor if required due to reliability.

C.2.4 Pickering Water Treatment Plant (WTP)

The Pickering WTP provides demineralised water supply for Pickering units. The Pickering WTP building is located above the Pickering 5-8 Condenser Cooling Water outfall on the east side of the station.

The vendor, General Electric Water and Process Technologies, owns the WTP. They operate and maintain the plant systems and equipment in accordance with the service agreement.

The scope of this work is described in NK30-SOW-71600-00001, Scope of Work for Outsourcing Water Treatment Plant (WTP) Systems and Equipment to Produce and Supply Demineralised Water to Pickering Nuclear Generating Station.

There is no System Engineer or SHR required for this system. Instead, the vendor provides reports and presentations to the PHC. The reports and presentations include the maintenance and upgrade programs used to maintain equipment reliability and life cycle activities.

As part of the service agreement, the vendor maintains a mobile unit that is ready as a back up to produce demineralised water.

ONTARIO POWER GENERATION

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Nuclear Standard

TITLE
OBSOLESCENCE MANAGEMENT

AUTHORIZATION	
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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-PROG-MP-0008 INTEGRATED AGING MANAGEMENT

Document is Related to Pressure Boundary ☐	Document Requires CNSC Notification ☐

PURPOSE AND SCOPE

PURPOSE

The purpose of the standard is to define and implement a sustaining process to manage the proactive and reactive *obsolescence issues* associated with critical equipment and components. The process activities should interface with equipment reliability and life-cycle management strategies designed to sustain continued safe and reliable plant operation.

SCOPE

The *Obsolescence Management Process* provides direction on managing *obsolescence issues* pertaining to all critical equipment and components related to the safe reliable operation of the site.

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DATES (YYYY-MM-DD)	
PDF Creation Date:	2018-05-08
Compliance Date:	Immediate

EXCEPTIONS
None

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1.0 DIRECTION

1.1 Overview

The intent of the *Obsolescence Management Process* is to provide:

- A strategy to mitigate *obsolescence issues*.
- A process to identify and manage *obsolescence issues* on critical equipment in a proactive manner before they are encountered through equipment failure or other emergent circumstance.
- An interface to the existing reactive processes. The current reactive process may continue to be used to support emergent and *T-week*/outage schedule demands.

Specific objectives of this standard are:

- Provide direction and guidance pertaining to:
  - Proactively identifying *obsolescence issues*;
  - Prioritizing and ranking *obsolescence issues*;
  - Evaluating and developing cost effective resolution strategies;
  - Executing and managing solutions to completion;
  - Obsolescence reporting;
  - Integrating with the existing reactive identification and resolution processes; and
  - Maintaining information in applicable databases up to date.
- Provide an interactive process for information exchange with Station Health, Equipment Reliability and Life-Cycle Management (LCM) activities to facilitate document updates such as Health Reports, LCM Plans and Component Assessment's (CA's).
- Provide interface to Integrated Aging Management (N-PROG-MP-0008) with respect to managing proactive and reactive obsolescence issues pertaining to critical equipment at OPGN.

1.2 Obsolescence Management Tools and Resources

To effectively implement the OPG *Obsolescence Management Process,* the Obsolescence Process Owner (OPO) should ensure that OPG uses the industry standard tools. A brief explanation of the tools and how they should be used is provided below.

1.2.1 Proactive Obsolescence Management System (POMS)

POMS is a software tool and database provided by Rolls Royce that proactively identifies when an *item* (equipment, component) has become obsolete (i.e., no longer supported by the manufacturer). This service is performed by collecting equipment information from member utilities and contacting each manufacturer of installed equipment on a regular basis to determine if the model number is still supported. In addition, the POMS priority mechanism looks at the manufacturer/model number, criticality of the equipment and stock availability. This use of POMS allows for timely identification of obsolescence vulnerabilities by forecasting

the impact in the station based on available stock. The equipment information in POMS should be accessed by work groups impacted by obsolescence to determine the obsolescence status of items.

1.2.2 Obsolescence Manager

Obsolescence Manager (OM) is a software application added to POMS, designed to facilitate the prioritization and resolution of obsolescence related issues. The goal of OM is to assist the Obsolescence Section Manager (OSM) in resolving a large amount of identified *obsolescence issues* in POMS. This should be done in three steps.

(a) Step 1: Integrate site data from several systems including material management stocking information, work order information, plant health short and long range improvement plan information and Master Equipment List (MEL) / Bills of Material (BOM) information.

(b) Step 2: Use the OPG Enterprise Prioritization Tool (EPT) score and/or the *Obsolescence Value Ranking (OVR)* score in OM to establish priorities. This should be accomplished by applying a proven algorithm that utilizes the integrated data sets into one prioritization score, allowing the station to quickly determine the high impact *obsolescence issues*. The prioritized list should be used for input into station long range plans, obsolescence process health reporting and system/component health reporting.

(c) Step 3: Obsolescence Management staff to create Action Plans (AP) for each issue starting at the highest scored items within OM tool. AP*'s* should be created for individual components or for manufacturer/model combinations for a comprehensive solution.

1.2.3 Obsolete Item Replacement Database

The Obsolete Items Replacement Database (OIRD) is a database that may be used for sharing information with other utilities which subscribe to OIRD about components and spare parts that have been determined to be obsolete or manufactured in a different form. Information shared includes manufacturer model and part numbers, impact of obsolescence on the utility and supplier inventory, replacement solutions including the supporting engineering equivalency evaluations.

OIRD interfaces with POMS and access to OIRD database may be gained through POMS.

1.2.4 Other Resources

OPG resources available to identify proactive *obsolescence issues* include Life Cycle Management Plans (LCMPs), Equipment Reliability Plans, Aging Management Plans and System Health Reports and Projects Risk Register.

1.3 Obsolescence Identification

1.3.1 General Identification Requirements

Work groups and personnel impacted by obsolescence should notify the OSM of any newly identified *obsolescence issues* and request a resolution. An overview of the obsolescence identification process is shown in Appendix A, Obsolescence Issue Identification.

The notification of *obsolescence issues* should include accurate and complete information as listed below:

- Full description of the *item(s)*/issue.
- Manufacturer make/model/part number of the *item(s)*.
- Applicable Cat ID's.
- Reference to associated technical information such as drawings, specifications, Maintenance manuals.
- Associated equipment or components
- Applicable end-use applications.
- Need date.

1.3.2 Notification

OPG personnel who identify an *obsolescence issue* may direct all obsolescence solution requests in accordance with the requirements of Section 1.3.1 to the OSM via email at obsolescence@opg.com mailbox.

1.3.3 Reactive Issue Identification

1.3.3.1 The reactive obsolescence process is driven by plant demand in support of emergent and scheduled work. Reactive issues are typically identified when an item is out for purchase, a Request for Quotation (RFQ) has been placed, an item has been ordered for maintenance activities, staged for outage work and/or identified in emergent or discovery work situations. The identification, prioritization and solution of reactive obsolescence issues follows current work practices.

1.3.3.2 PE may contact the OSM for support on reactive obsolescence issues. The OSM may use methodology identified in this standard to look at additional end uses for greater overall impact.

1.3.4 Proactive Issue Identification

1.3.4.1 Proactive identification resolves an obsolescence issue in advance of a station demand so that it is available for scheduled and emergent work, thereby minimizing the risk to plant

reliability and operation. Work groups involved with proactive identification and actions that should be taken are described in Table 1 below.

Table 1: Proactive Issue Identification

Work Group	Action/Responsibility	Resources/Support Available
Supply Chain Purchasing Inventory Management	Send vendor end-of-life notifications to the OSM and to components and equipment. If an *item* is found to be obsolete or NLA while procuring, the Analyst Buyer should set Cat ID to NOPURCH or H/USER as applicable and route AAA to PE with full description per Section 1.3.1 in the route notes. Notify the OSM of the obsolescence details.	POMS PE Obsolescence@opg.com
Performance Engineering	Incorporate Obsolescence vulnerability reviews and risks in System Health Reports and integrate with CA updates. Initiate Quarterly Health Reporting incorporating proactive obsolescence reviews. Notify the OSM when an *obsolete item* is discovered during equipment maintenance support activities, equipment reliability and/or LCM assessments.	CA info POMS Supply Chain Purchasing Manufacturer/Vendor PE Obsolescence Section Obsolescence@opg.com
Plant Design Projects Design	When preparing design change packages or modifications, obsolescence considerations should be considered and an *obsolescence issue* may be identified. Notify the OSM.	POMS PE Obsolescence Section Obsolescence@opg.com
Components and Equipment Engineering	Notify the OSM when an *obsolete item* is discovered during equipment maintenance support activities, equipment reliability and/or LCM assessments.	Manufactures/Suppliers PE Supply Chain Obsolescence Section Obsolescence@opg.com
Procurement Engineering	When contacting manufacturers/vendors to verify technical data to complete an evaluation, obtain an update on *item* availability and pending obsolescence status. Notify OSM of pending *obsolescence issues*.	POMS Manufacture/Vendor Obsolescence@opg.com
Life Cycle / Plant Aging Management	When preparing or updating a LCMP, Station Reliability Plan and/or Aging Management reports *obsolescence issues* may be identified. Send a notification to the OSM.	POMS Obsolescence@opg.com
Operations (OPS)	During normal work activities such as dealing with issues that require a workaround, Operating Manual preparation/revision, Supplier Operating Manual reviews etc., an *obsolescence issue* may be identified. Send a notification to OSM.	Obsolescence@opg.com

Work Group	Action/Responsibility	Resources/Support Available
Maintenance Assessing	At time of assessing critical equipment check Cat ID availability and status immediately when repair items are identified (prior to scheduling and Material Request (MR) generation). Notify the OSM of pending *obsolescence issues*. For Preventive Maintenance (PM) Work Orders (WO's) check availability and order/reserve materials 2 years in advance of the scheduled start date of the job. (Week T-104). For outage WOs check availability and order the material at T-104 or as early as possible when the job is approved.	POMS Supply Chain PE Obsolescence Section Obsolescence@opg.com
Maintenance	During routine contact with Manufacturers, warranty work, conference attendance, service maintenance contracts etc., identify potential *obsolescence issues*. Notify the OSM.	Manufacturer/Vendor Obsolescence@opg.com
Obsolescence Section Manager (OSM)	Access POMS information to identify new *obsolescence issues*.	POMS Reporting OM

1.3.4.2 The OSM should review obsolescence mailbox requests generated for potential obsolescence issues.

1.3.4.3 The OSM should review each issue and perform the following:

(a) Confirm whether the issue applies to critical plant equipment and is within the proactive work scope.

(b) Liaise with PE and Darlington Refurbishment Engineering. Assign work to Obsolescence Management staff.

(c) Confirm and/or obtain all relevant technical information as identified in 1.3.1.

(d) Confirm the obsolescence status of the issue.

(e) Identify other related *items* (equipment, components or parts) that may be affected by the obsolescence request so that a grouping of *items* can be included in the issue for a comprehensive resolution.

(f) Ensure the issue is on the s*ite Obsolescence List* for prioritization and ranking.

1.4 Prioritization

(a) To effectively manage obsolescence, the *obsolescence issues* (reactive and proactive) that are identified should be prioritized, ranked and tracked for resolution.

(b) The OSM should use the data in Asset Suite that has been prioritized using the EPT and combine this data with obsolescence information in POMS to generate the s*ite Obsolescence List*.

(c) To further refine the priority and ranking, the OSM may apply the *OVR* that is available in POMS for prioritization of *obsolescence issues* at the component and system level.

1.4.1 Priority Determination Process

The priority/ranking scheme may take various evaluating factors into consideration such as; equipment criticality, Single Point of Failure Vulnerability (SPV) classification, safety classification, maintenance and demand history, seismic/ environmental qualification, priority of scheduled work and any other relevant factors. Both the EPT and *OVR* ranking scheme apply similar methodologies by evaluating the various factors and applying a weighting to generate a priority/ranking score for a Cat ID or equipment ID.

The priority for known *obsolescence issues* linked to critical equipment should be determined by:

(a) Establishing a base priority by applying the EPT and/ or *OVR* algorithm to all equipment ID's. The EPT/*OVR* algorithm quantifies the risk caused by the *obsolescence issue* by automatically assigning a weighted numerical score based on importance of the equipment to the plant (extent of condition), plant demand and *item* availability (Inventory level) or difficulty to procure. EPT scoring scheme quantifies the risk by multiplying the Difficulty to Procure (D2P) by Importance to Plant (I2P). Sample *OVR*/EPT prioritization logic is shown in Appendix B, Typical Obsolescence Value Ranking Scheme.

(b) Establishing the final priority and ranking to create the s*ite Obsolescence List*. The OSM should present the base prioritized list with EPT/OVR scores to the key stakeholders for review. Adjustments in priority and ranking should be made taking into consideration the specific station needs.

Note: Details of the stakeholders and their accountabilities are outlined in Appendix F, Terms of Reference, and Stakeholder Review.

1.4.2 Site Obsolescence List

The *site Obsolescence List* is the prioritized listing of all *obsolete items* for each site. The single combined (reactive and proactive) list maybe separated into a reactive and proactive *item* lists if required.

The OSM should be responsible for managing and ensuring the quality of the site Obsolescence List. The site Obsolescence List may be the calculated list as found in the OM database.

1.4.3 Site Top 100 Obsolescence List

The Top 100 Obsolescence List is a subset of the highest ranking items on the *site Obsolescence Lists.*

It is a *ranked list* of the top 100 identified *obsolescence issues* for a site (Darlington or Pickering). *Item* priority can be confirmed by level of importance based on the EPT/*OVR* score and adjusted as required by the stakeholder review to reflect specific plant requirements for safety and reliability.

The OSM should be responsible for preparing and managing the Top 100 Obsolescence lists including:

- Preparing the Top 100 list by selecting the highest ranked items from each *site Obsolescence List as well as incorporating items requested as per section 1.3.2*.
- Adjusting priorities and ranking based on direction from the stakeholder review and/or PHC.
- Adding entries to the list.
- Ensuring the resolution status is tracked in POMS.

1.5 Obsolescence Solution(s)

1.5.1 Solution Paths

1.5.1.1 Table 2, Solution Paths defines the seven (7) possible solution paths available to resolve both proactive and reactive obsolescence issues. A description of the solution paths is outlined in Appendix C, Obsolescence Solution Paths (Ref NUOG NX1037). An overview of the process flow chart is shown in Appendix D, Obsolescence Solutions Path Flowchart.

The solution paths shown in Table 2 are listed in preferred priority order based on complexity, ease of implementation and cost.

Table 2: Solution Paths

	Solution Path
1	Surplus Market/Open Market Quote
2	Special Manufacturing Run
3	Substitution (Non-Identical Component Replacement (NICR), Item Equivalency Evaluation (IEE))
4	Cannibalization
5	Rebuild/Repair
6	Reverse Engineering
7	Design Change

1.5.1.2 The following general guidelines should be followed when selecting the appropriate solution path strategy:

(a) An internal OPG and external (industry) search should be completed to determine if a solution is available or in progress.

(b) Non-emergent situations (Proactive Process) - the least expensive solutions should be researched and taken to their practical conclusions before expending effort to the more complex alternatives.

(c) More emergent situations (Reactive) - a parallel path approach may be taken until the issue is resolved. In practice, ranking may vary depending on the plant need; a substitution may be the least expensive overall to meet time constraints.

(d) Utilize and share Industry knowledge and solutions - by using and posting obsolescence related information on the issue (problems, solutions, Equivalency Evaluations, contact information) in Industry Obsolescence Databases.

(e) Design Change is normally the last choice to resolve an *obsolescence issue* due to the complexity and expense to implement the change. If this option is being considered it must be justified and supported as the best choice as part of Asset Management Process. The design change option should follow the current modification process as outlined in N-PROC-MP-0090, Modification Process.

1.5.2 Search for Existing Solutions

1.5.2.1 Prior to proceeding with a designated solution path evaluation for an obsolescence issue, the OSM should arrange for an internal and external search to see if an existing solution is available or in progress by another source or process. If the issue is urgent, a solution may proceed in parallel with the search.

1.5.2.2 OPG internal sources available to identify efforts in progress to resolve obsolescence issues include:

- NICR/Equivalency documents.
- Bridging strategies.
- Small and Large projects.
- Design Changes.
- SCR/Action Tracking data.
- Darlington Refurbishment Engineering.

1.5.2.3 The information should be obtained by database searches and/or contacting the appropriate group who owns the information. A written response to the OSM or person requesting the information should be provided.

1.5.2.4 If a designated obsolescence issue resolution is already in progress by another OPG group, it should be completed by the group using the existing process. Guidance outlined in this procedure may be used to complement the solution that is in progress.

Note: Plant demand and/or oversight group may dictate a change in priority, in which case work may be transferred to the OSM for resolution).

External Solutions should be identified by searching industry databases and joint working groups including:

- POMS.

- OIRD.
- Nuclear Utility Obsolescence Group (NUOG) Website.
- CANDU Owners Group (COG).

1.5.2.5 In many cases direct contact with the manufacturer/supplier is required to validate the obsolescence status of an item. There are situations where the manufacturer may have sold a product line to another company and the identical item is available with a different manufacturer/model or part number. Consultation with SC should be considered when item investigation involves potential business merger or acquisition situations. SC should assist in identifying the potential new vendors, ensure they are on the Approved Suppliers List and if applicable arrange for an audit of their Quality Assurance (QA) program.

1.5.2.6 If an external solution (equivalent replacement) exists, the OSM should search for and use records of solutions developed by other utilities from the POMS vendor contact list. The solutions should be evaluated by completing a NICR or Item Equivalency Evaluation (IEE) to confirm acceptance of the solution for applicable end uses.

1.5.3 Develop Action Plans (APs)

1.5.3.1 If the obsolescence issue does not have a known solution, the Obsolescence Management staff member should create an action plan. The plan documents the solution path that was identified and implemented.

The *AP* should include:

- *Obsolescence Issue*(*s*)/ Problem to be addressed.
- Scope of the issue (single/ multiple items; short/long term strategies).
- Solution Path Strategy(s) selected with rationale.
- Priority
- Detailed Technical and QA Requirements.

AP authors should refer to Appendix E, Action Plans for details on plan contents and preparation.

1.5.3.2 The OSM or Plan author should consider the following when preparing the AP:

- Researching the potential solution paths and recommending a solution based on site needs using the graded approach outlined in Appendix C, Obsolescence Solution Paths (Ref NUOG NX1037) and/or Appendix D, Obsolescence Solutions Path Flowchart.

- Current plant demand and long term maintenance strategies.

- Parts availability to support scheduled and/or emergent work.

- Researching POMS, OIRD, Readily Accessible Parts Information Directory (RAPID), surplus warehouses or other industry solutions to identify potential replacements, Utility/Vendor contact information and *item*(*s*) availability.

- Opportunities for Utility collaboration.

- All technical information applicable to the issue (drawings, specifications, manuals, etc.).
- A detailed description of the equipment, components or items that are affected by the obsolescence.
- Applicable procurement QA program(s).
- Bundling logical groups of items to ensure a comprehensive solution.
- The need to support a short term bridging strategy in preparation for the long term solution (i.e., emergent situations).
- Use of current inventory or establishing new/alternate inventory.
- Reviewing and recommending inventory levels (ROP/TMAX) based on risk to the station.
- The need to evaluate replacement items for acceptability for all applicable end uses. In many cases an IEE or NICR may be required.
- Obsoleting/superseding existing Engineering documentation (OPG-PROC-0178, Controlled Document Management).
- Activities and schedule for implementation.

Note: The *AP* contents should be based on the complexity of the *Obsolescence issue* and contain sufficient detail as necessary to fully resolve the issue.

1.5.4 Action Plan Review and Approval

When the plan is being developed the OSM should:

(a) Prioritize the action plans.

(b) Present and obtain endorsement from the PHC only on those *obsolescence issues* that are more complex, higher cost and higher risk. This may apply to solutions that require a design change.

(c) Maintain the “status” of each *AP* for reporting purposes.

AP STATUS	
OPEN	*AP* Prepared
IN PROGRESS	*AP* approved/ implementation in progress
COMPLETE	Solution Implemented and verified

(d) Ensure AP information and STATUS are entered and updated in POMS in support of industry collaboration and sharing.

1.6 Implementation Oversight

1.6.1 Obsolescence Management Oversight

The PHC in conjunction with the OPO should provide corporate oversight by monitoring performance metrics and health of the *Obsolescence Management Process* to mitigate risk to the Plant. The PHC may perform the following on a periodic basis:

(a) Review quarterly progress and obsolescence health reports so the obsolescence impact, risk and mitigation is visible to the PHC.

(b) Review plant obsolescence performance vs. POMS industry obsolescence metrics to establish a comparative basis for obsolescence process performance.

(c) Recommend improvements as necessary to continuously improve obsolescence management process health.

1.7 Performance Measures/Monitoring

1.7.1 Performance Monitoring

Ongoing tracking and monitoring is necessary to ensure overall process effectiveness and continuous improvement. Performance monitoring should be accomplished as follows:

(a) Quarterly Obsolescence Management Health Report

An Obsolescence Health Report should be prepared by the OSM on a quarterly basis to provide an overview of process backlogs, accomplishments, implementation effectiveness, and risk. The report may include a collective summary and assessment of the monthly process metrics. Self assessments, benchmarking activities and improvement plans should be documented in the report.

(b) Monthly Progress Report

The OSM should prepare monthly obsolescence progress report for the OPO. Specific metrics should be used to continuously monitor and manage obsolescence *item* information for both Darlington and Pickering pertaining to:

- Population of obsolete equipment.
- Population of obsolete Critical Equipment.
- Population of obsolete SPV equipment.
- Population of obsolete Manufacturer/ Model Numbers with solutions.
- Population of obsolete Manufacturer/ Model Numbers without solutions.
- Population of completed solutions.

Specific performance indicators should be developed by OSM using industry best practices. Process monitoring and metrics should continue to evolve as the *Obsolescence Management Process* matures and data becomes available.

(c) Process Assessments (Independent and Self Assessments)

External evaluations and self assessments on the *Obsolescence Management Process* should be scheduled and align with OPG policy. The OPO should arrange additional assessments as required to identify areas for improvement and enhance process effectiveness.

1.8 Sustain Process

Ongoing staff resources and funding for the *Obsolescence Management Process* is the responsibility of the OPO (Manager, Asset Management). The OPO shall ensure that sufficient resources to sustain the process are identified and submitted as part of the annual Business Plan and Budgeting process. Business plan and budget submissions should consider required resources associated with:

- Staff capability.
- Solution development
- Industry collaboration and benchmarking initiatives.
- Potential inventory adjustments.
- Contract Services for tools and support (e.g., subscriptions to POMS/OIRD, reverse engineering activities, COG Joint resolution initiatives, Commercial Grade Dedication activities, external training etc.).

2.0 ROLES AND ACCOUNTABILITIES

2.1 Manager, Asset Management

2.1.1 Assumes the role of the OPO and is accountable for the overall administration, management and conduct of the Obsolescence Management Process.

2.1.2 Coordinates and schedules periodic self assessments to evaluate the effectiveness of the process and identify areas for improvement.

2.1.3 Provides overall oversight for the proactive and reactive obsolescence processes.

2.1.4 Arranges for resourcing to support long term sustainability.

2.2 Section Manager Obsolescence Management

2.2.1 Is the single point of contact for monitoring and managing the obsolescence process.

2.2.2 Maintains obsolete item records for OPG (proactive and reactive items) identified through station demand or programmatic sources.

2.2.3 Ensures data in POMS, RAPID, OIRD and Asset Suite is updated as required.

2.2.4 Develops site Obsolescence Lists for Darlington and Pickering.

2.2.5 Prepares and maintains the priority ranked obsolescence list(s) (Top 100, Top 10) using the site input.

2.2.6 Approves changes and maintains the OVR algorithm.

2.2.7 Performs monthly reviews of site Obsolescence Lists against the ranked list in OM to identify new issues.

2.2.8 Prepares the correspondence for the stakeholder review, receives and incorporates feedback as required.

2.2.9 Ensures that proactive obsolescence solutions are developed.

2.2.10 Generates obsolescence reports (proactive and reactive issues) to support and communicate to interfacing groups and organizations.

2.2.11 Coordinates and tracks proactive and/or reactive solutions undertaken by others (COG, PE, and Design).

2.2.12 Establishes metrics and monitors performance via monthly reports.

2.2.13 Assists in providing training of industry tools (POMS, OIRD) to site work groups to encourage use.

2.2.14 Performs and participates in benchmarking activities for continuous process improvement.

2.3 Manager, Performance Engineering

2.3.1 Participates in the stakeholder review.

2.3.2 Ensures system health reports incorporate obsolescence impact.

2.3.3 Ensures that Performance Engineers access POMS industry tools for information to update the obsolescence status in System Health Reports and other related technical reports.

2.3.4 Assists with identifying the appropriate replace vs. repair strategy on items pertaining to obsolescence.

2.4 Manager, Plant Design Engineering

2.4.1 Assists in executing obsolescence resolutions involving design changes using the existing OPG modification process.

2.4.2 Prepares and/or updates engineering specifications as requested to support applicable resolutions using existing processes.

2.4.3 Participates in the stakeholder review.

2.5 Section Manager, Procurement Engineering

2.5.1 Develops solution plans and manages solutions for reactive obsolescence issues to support emergent and scheduled work.

2.5.2 Enters and updates component data into industry tools (POMS, RAPID, OIRD, Asset Suite), including obsolescence attributes and status comments.

2.5.3 Interfaces with OSM on managing priorities, work assigned and status updates.

2.5.4 Provides assistance on obsolescence issues to interfacing groups and organizations.

2.5.5 Liaises with OSM for obsolescence status reports.

2.5.6 Assists with identification of manufacturer and model information for incomplete BOMs, if known, to improve accuracy of POMS data and to introduce these components into the vendor contact process that the POMS service provides.

2.6 Manager, Components and Equipment Engineering

2.6.1 Participates in the stakeholder review.

2.6.2 Assists with identifying the appropriate replace vs. repair strategy on items pertaining to obsolescence.

2.7 Manager, Maintenance Assessing

2.7.1 Participates in the stakeholder review.

2.8 Senior Manager, Supply Chain

2.8.1 Ensures recommended obsolescence solutions are procured via RFQ, Request for Information (RFI) or Request for Proposal (RFP) as applicable, requested by Engineering or the OSM regarding obsolescence issues.

2.8.2 Ensures vendor notifications related to item obsolescence (e.g., responses to RFQ, end-of-life notices) are forwarded to the OSM for evaluation.

2.8.3 Participates in the stakeholder review.

2.8.4 Monitors and investigates larger than expected price and delivery changes that may signify items becoming no longer available.

2.8.5 Ensures data and obsolescence attributes up to date in applicable databases (Materials Catalogue, Inventory System etc.) under SC control.

2.8.6 Communicates proposed inventory reduction recommendations to Engineering so that an obsolescence risk review may be performed.

2.9 Manager, Plant Maintenance

2.9.1 Notifies the OSM of current and future obsolescence issues identified while performing normal work activities (e.g., Supplier conferences, Service visits, contact with manufacturer for maintenance manuals and procedure preparation etc.).

2.9.2 Searches POMS and/or consults Obsolescence Management Section on items related to obsolescence during MR preparation.

2.10 Manager, Work Management

Participates in stakeholder review when requested.

3.0 DEFINITIONS AND ACRONYMS

3.1 Definitions

The following words are defined in N-LIST-01300-10008, Lexicon of Engineering Governance Terms. All of these defined terms are shown in italic font in this document's text, to alert users that the term has been defined.

Item
Obsolescence Issue
Obsolete Item
Obsolescence Management Process
Obsolescence Value Ranking (OVR)
Action Plan
Ranked List
Site Obsolescence List
T-Week

3.2 Abbreviations and Acronyms

AAA	Action Awareness Alert
AP	Action Plan
BOM	Bill of Material
CA	Component Assessment
COG	CANDU Owners Group
D2P	Difficulty to Procure
EPRI	Electrical Power Research Institute
EPT	Enterprise Prioritization Tool
I2P	Importance to Plant
IEE	Item Equivalency Evaluation
INPO	Institute of Nuclear Power Operations
LCM	Life Cycle Management
LCMP	Life Cycle Management Plan
MEL	Master Equipment List
MR	Material Request
NICR	Non-Identical Component Replacement
NLA	No Longer Available
NUOG	Nuclear Utility Obsolescence Group
OIRD	Obsolete Items Replacement Database
OM	Obsolescence Manager
OPG	Ontario Power Generation
OPGN	Ontario Power Generation Nuclear
OPO	Obsolescence Process Owner
OPS	Operations
OSM	Obsolescence Section Manager
OVR	Obsolescence Value Ranking
PE	Procurement Engineering
PGO	Parts Gone Obsolete
PHC	Plant Health Committee
PM	Preventive Maintenance
PO	Purchase Order
POMS	Proactive Obsolescence Management System
QA	Quality Assurance
RAPID	Readily Accessible Parts Information Directory
RFI	Request for Information

RFP	Request for Proposal
RFQ	Request for Quotation
ROP	Reorder Point
SC	Supply Chain
SPV	Single Point of Failure Vulnerability
TMAX	Target Maximum
ToR	Terms of Reference
WO	Work Order

4.0 BASES, RECORDS AND REFERENCES

4.1 Bases

CNSC Regulatory Document REG. DOC. 2.6.3, Aging Management – Fitness for Service, March 2014

4.2 Records

None

4.3 References

4.3.1 Performance References

N-LIST-01300-10008, Lexicon of Engineering Governance Terms
N-PROG-MP-0008, Integrated Aging Management
N-PROC-MP-0090, Modification Process
N-PROG-MA-0026, Equipment Reliability
OPG-PROC-0058, Procurement Activities
OPG-PROC-0178, Controlled Document Management

4.3.2 Developmental References

This Standard was developed taking into consideration the following INPO/EPRI/NUOG methodology, best industry practices and benchmarking reports:

- AP-913, Institute of Nuclear Power Operations Equipment Reliability Process Description, October 2013.
- Bruce Power Report: Effectiveness and Use of Obsolescence Management Tools, December 2010.
- Dominion: Equipment Obsolescence Program MS-AA-OBS-1001, Rev 0.
- EPRI TR 1016692 Plant Support Engineering: Obsolescence Management, Program Ownership and Development, November 2008.

- EPRI TR 1019161 Plant Support Engineering: Obsolescence Management, Program Implementation and Lessons Learned, December 2009.
- Nuclear Utility Obsolescence Group (NUOG) Obsolescence Guideline; INPO NX-1037, March 2013.
- OPG Nuclear NFI-07 Parts Improvement Initiative: AM2 Obsolescence Program.

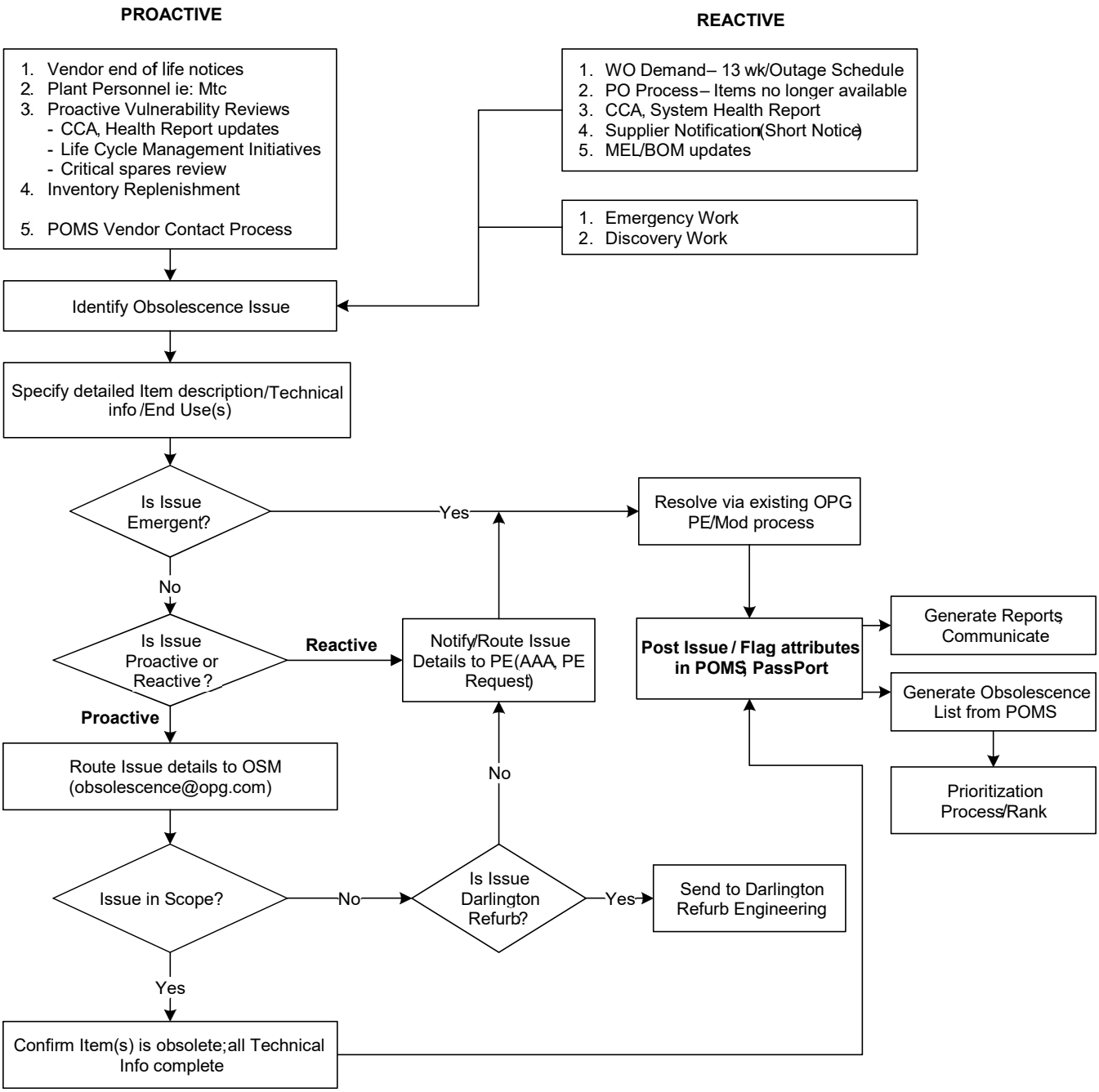
OPG Nuclear NFI-07 Benchmarking Report: DTE Energy-Fermi Power Station, April 2014.

5.0 REVISION SUMMARY

This is a non-intent revision.

- Throughout: Editorial corrections (no revisions bars shown).
- Throughout: Replaced “Obsolescence Management team” with Obsolescence Management staff”.
- Throughout: Reworded for clarity.
- 1.5.3.2 Added “Readily Accessible Parts Information Directory”.
- 1.5.4(e) Removed
- 2.2.4 Removed
- 2.6.2 Removed
- 2.6.3 Removed
- 2.7.1 Revised
- 2.8 Revised title
- 3.2 Replaced “Component Condition Assessment (CCA)” with Component Assessment (CA)” Added “Readily Accessible Information Directory (RAPID)”
- Appendix E.6.0 sequence order rearranged
- Appendix F Clarification added.

Appendix A
Obsolescence Issue Identification



Appendix B
Typical Obsolescence Value Ranking Scheme

The table below outlines a typical *OVR* algorithm for information purposes. The approved version of the algorithm is programmed and maintained in the POMS Obsolescence Manager application. The 'Actual Value' column contains values sent to POMS from OPG. The 'Points' column is determined by which points range the 'Actual Value' falls into. If this 'Actual Value' falls within the '10 Points', '5 Points', '3 Points' and '1 Point' column ranges, its 'Points' value is scored accordingly. The 'Score' column is equal to the 'Points' value multiplied by the 'Weight' value. This is then repeated for all of the rows. The final OVR Score is equal to the sum of entries in the 'Score' column.

OVR Score Ranges

Green Range	White Range	Yellow Range	Red Range
≤ 1.00	> 1.00 and ≤ 1.50	>1.50 and ≤ 2.00	> 2.00

OVR Score Component Work Order Stock

Parameter	10 Points	5 Points	3 Points	1 Point	Weight	Actual Value	Points	Score
Man/Model Install Count		≥ 200	≥ 20 and < 200	≥ 0 and < 20	5%	124	3	0.15
SPV		Yes			8%	No	0	0.00
Criticality		1, 2, Y			20%	2	5	1.00
Future Demand WO Co...		≥ 5	≥ 1 and < 5	< 1	11%		0	0.00
EP Score		≥ 90	≥ 75 and < 90	< 75	30%	94	5	1.50
Lead Time		≥ 366	≥ 112 and < 366	≥ 0 and < 112	6%	436	5	0.30
Stock Level		< Reorder Point	≥ 1 and < 6	≥ 6	20%	7	1	0.20

Note:

For more details on the EP Score refer to Section 1.4.1 "Priority Determination Process". The EP Score takes into consideration 55 factors that are important to the plant and have CatID demand.

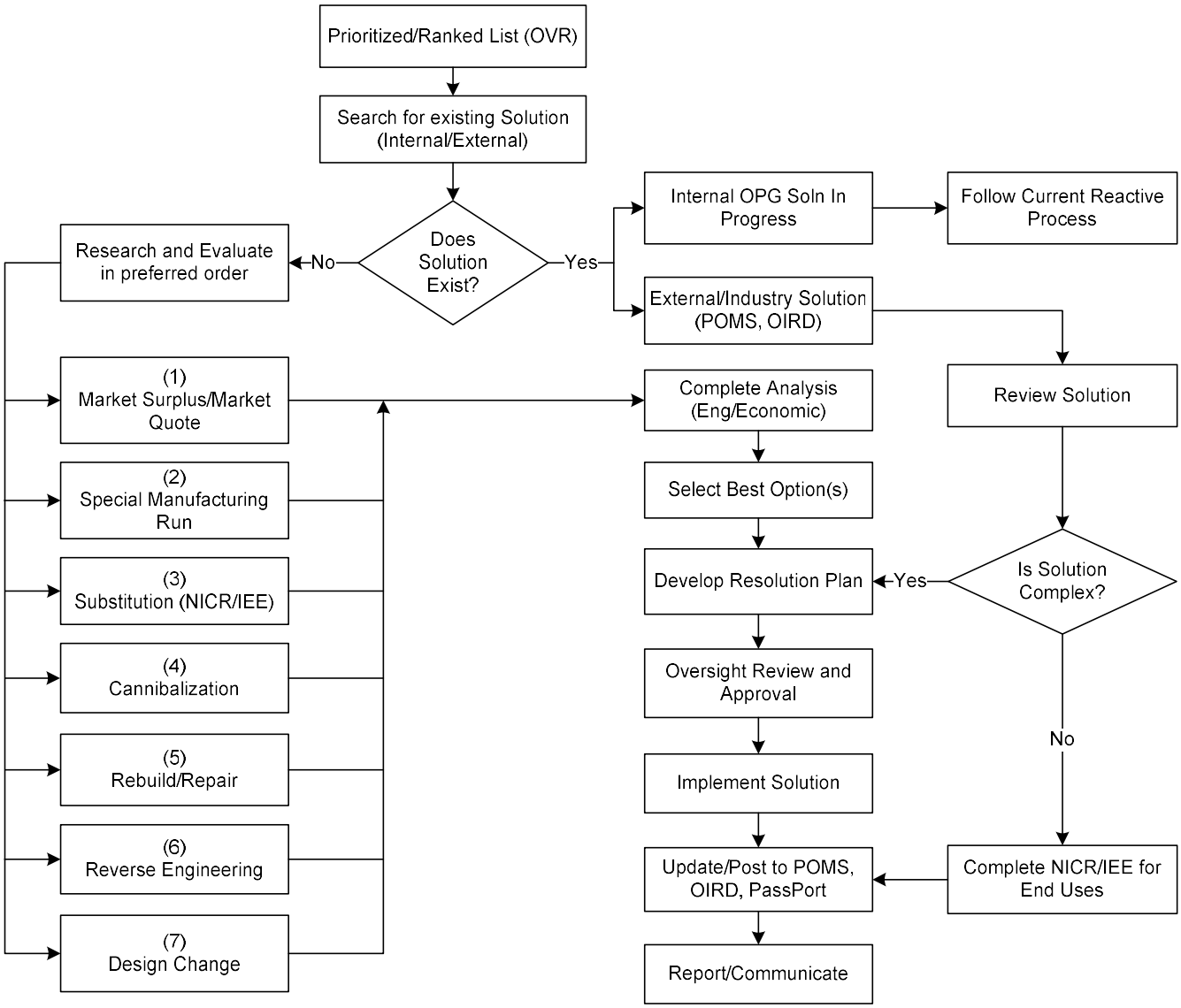
Appendix C
Obsolescence Solution Paths (Ref NUOG NX1037)

	Solution Path	Description	Actions/Considerations
1	Surplus Market/Open Market Quote	Surplus markets include vendors that specialize in the purchase and resale of discontinued items or other power plant items that have excess inventory. Procurement of surplus identical items is typically the quickest and most cost effective solution to an *obsolescence issue*.	Procure, if possible, sufficient inventory to cover projected plant life. Otherwise it is typically a shorter term solution. Acceptance testing of critical characteristics may be required.
2	Special Manufacturing Run	This solution path involves suppliers that no longer manufacturer an *item* but may be persuaded to tool up for a special manufacturing run. This may require negotiations for quantity and pricing incentives. This solution lends itself to utility purchasing collaboration to ensure sufficient quantities to make the run and reduce overall cost per *item*.	Use POMS, OIRD and COG to identify utilities that might collaborate. Purchase sufficient *item* quantities to last the life of the plant. Quality programs need to be in place if OPG has contractual access to Intellectual Property (IP), a third party company could undertake the production run.
3	Substitution (NICR/ Equivalency)	A substitution requires a formal engineering review to analyze and document the interchangeability of replacement items and its impact on the system. Applicable plant design drawings may also require revision. Typically a NICR or IEE should suffice. This solution path is more common due to its simplicity and provision of a dependable source of future supply of items.	Search POMS and OIRD records for existing solutions and copies of associated evaluation documents for reference. Evaluate for all end use applications.
4	Rebuild/Repair	This strategy is used where the manufacturer continues to support sub-components but not the higher assembly. Some equipment lends itself to long term rebuild/ repair strategy (i.e., circuit boards, pumps, motors). The rebuild/repair program can be done in-house or by establishing a long term service contract.	In-house refurbishment programs require a complete inventory of spare parts. A business case should assess cost versus reliability of the alternatives.
5	Cannibalization	This is a special case where spare parts to rebuild a component are taken from an identical component that is not in service or not operable. Parts may be taken from other utilities equipment that is not in service if they are willing to provide it. This solution may be expanded to include components and parts installed in a unit in safe storage or lay-up state. This is typically an interim solution and is used in emergent or bridging situations as it depletes inventory.	QA program and fitness for service check is required if *item(s)* is borrowed from another utility. Items taken from a unit in safe storage or lay-up state shall be in accordance with Memorandum “Harvesting Parts from Units 2&3” dated April 1, 2013. In some cases items taken may have to be replaced or returned to their original location.

Appendix C (Continued)

	Solution Path	Description	Actions/Considerations
6	Reverse Engineering	Reverse Engineering is a process of developing product specifications sufficient to duplicate an *obsolete item* by reviewing technical information and physical examination. The specifications may then be used to manufacture items necessary to resolve the *obsolescence issue*. This solution may be expensive and time consuming.	This solution path is typically done by an external vendor. Use POMS, OIRD and COG to identify collaboration opportunities to offset costs. Replication of form/fit/function utilizing newer technology for reverse engineering can be effective.
7	Design Change	This refers to a plant modification to introduce a new design and install new equipment and components. This solution path is typically the most comprehensive and expensive. This solution path is used where high maintenance and low reliability justify the design change. Design change is normally the last choice.	Approval for the Design Change should follow the existing Modification process. The obsolescence risk of the replacement equipment needs to be considered.

Appendix D
Obsolescence Solution Paths Flowchart



Appendix E
Action Plans

The following may be used as a guide when preparing *Action Plans*.

The *AP* should identify:

E.1.0 OBSOLESCENCE ISSUE(S)/PROBLEM TO BE ADDRESSED

(a) Provide detailed description of items including all equipment codes, make/model part numbers and associated Cat ID's.

(b) State *item(s)* criticality, priority and ranking (*OVR* score) of the issue.

E.2.0 SCOPE OF THE ISSUE (SINGLE/MULTIPLE ITEMS)

(a) State the extent to which the solution applies. Identify and list all end uses.
(b) Include the logical grouping of needs/items as applicable.
(c) Identify current demand and longer term requirements.
(d) Identify bridging strategies (short term fix) if applicable.

E.3.0 SOLUTION PATH STRATEGY SELECTED

(a) Specify which solution path or combination of solution paths was selected.

(b) Identify the solution used for interim fix or bridging strategy; and the long term permanent solution.

(c) Identify inventory adjustments and stocking levels.

(d) Identify evaluations required to ensure technical acceptability for applicable end uses (NICR/IEE).

E.4.0 RATIONALE

(a) State why the solution(s) was selected.
(b) Provide cost estimate (if required).
(c) State any specific station demand/emergent situations.

E.5.0 TECHNICAL REQUIREMENTS

(a) Identify part numbers, drawings, specifications, maintenance/operating manuals etc.
(b) Specify the appropriate Procurement QA requirement(s).
(c) Ensure all logical grouping items are clearly identified and captured.

Appendix E (Continued)

E.6.0 IMPLEMENTATION SCHEDULE (TO MONITOR/MANAGE IMPLEMENTATION)

(a) Outline all activities needed to complete implementation.
(b) Specific milestones
(c) Set target completion dates.

E.7.0 POSTING AND UPDATING REQUIREMENTS

Identify data update and/or information posting requirements to applicable databases (POMS, OIRD, and Asset Suite) during and after implementation, such as IEE's, replacement *item* descriptions, setting catalogue attributes etc.

Appendix F
Terms of Reference (ToR), Stakeholder Review

F.1.0 OBJECTIVE

The objective of the stakeholder review is to ensure that the expressed priorities of the Obsolescence Management process are aligned with the needs of Pickering and Darlington stations. Engineering solutions are created proactively to ensure future work orders can be performed on time, without causing churn in the organization. Due to the nature of proactive work we must ensure we are addressing the highest risk equipment such as CC1/CC2 or SPV with zero stock available. Feedback from the stakeholder review will ensure that the risk-based priorities are further scrutinized by those most familiar with plant operations and challenges. The end result is a top obsolescence list that both reflects the greatest risk items as well as the true needs of the plant.

F.2.0 SCOPE

Stakeholders shall:

(a) Review OPG's proposed site Top 100 Obsolescence List.

(b) Create a sub-list to advocate for increased prioritization of items near the top of Obsolescence List or emergent items. Include a justification.

(c) Request the removal of items from Top Obsolescence List, include a justification.

F.3.0 MEMBERS (PICKERING/DARLINGTON)

- Section Manager, Components and Equipment
- Section Manager, Performance Engineering
- Senior Manager, Supply Chain
- Manager, Asset Management
- Manager, Maintenance Assessing
- Section Manager, Procurement Engineering
- Manager, Work Management
- Manager, Plant Design
- Manager, Operations

F.4.0 FORMAT

(a) The stakeholder review may be in the format of an email correspondence created by the OSM.

(b) The frequency of the review should be annual or as required.

(c) The key stakeholders or their delegates should then review and respond.

(d) Upon receiving the feedback the OSM should review and incorporate the requests on a case by case basis.

ONTARIO POWER GENERATION

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Nuclear Program

TITLE
INTEGRATED AGING MANAGEMENT

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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-CHAR-AS-0002, Nuclear Management System

Document is Related to Pressure Boundary ☐	Document Requires CNSC Notification ☑

PURPOSE AND SCOPE

The objective of the Integrated Aging Management (IAM) Program is to ensure that the condition of critical nuclear facility equipment is understood and that required activities are in place to ensure the health of these components and systems while the plant ages **[B-1]**. This is accomplished by establishing an integrated set of programs and activities to ensure that the performance requirements of all critical station equipment are met on an ongoing basis.

The IAM program covers all Systems, Structures or Components (SSC) defined as critical based on a nuclear safety, production, environment and cost significance perspective.

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DATES (YYYY-MM-DD)	
PDF Creation Date:	2020-07-17
Compliance Date:	Immediate

EXCEPTIONS

This program does not apply to facilities, systems, equipment, and buildings, governed by OPG-PROG-0032, Facilities and Projects Management System, under authority of the Vice President, Real Estate and Services.

Aging Management process for Nuclear Waste facilities may not interface with all interfacing programs specified in this document.

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1.0 DIRECTION

1.1 Objectives

1.1.1 Aging management is a set of engineering, operational, inspection and maintenance processes and activities that control, within acceptable limits, the direct or indirect effects of physical aging and *obsolescence* of Systems, Structures or Components (SSCs) that occur over time or with use. The *Integrated Aging Management (IAM)* program is a set of policies, processes, procedures, arrangements and activities for managing the *aging* of SSCs at a nuclear facility.

1.1.2 The objective of the IAM program is to ensure the availability and reliability of required safety functions throughout the facility's *service life*. This requires Aging Management (AM) activities to be implemented proactively throughout the lifecycle of a nuclear facility (e.g. in design, fabrication and construction, commissioning, operation, extended shutdowns, and decommissioning).

1.1.3 This objective is accomplished through a systematic and integrated approach that is applied to establish, implement and improve appropriate programs to manage the *aging* and *obsolescence* of SSCs. These programs and associated activities serve an integral AM function, and allow the nuclear facility to remain within its licensing basis limits and continually meet its operational goals (refer to Appendix A).

1.1.4 The *IAM* program also requires assessment of *condition of critical* SSCs. The outcome of these evaluations should allow for the understanding of the conditions of *critical* SSCs, provide a summary of pertinent *aging* issues, and measure the effectiveness of AM plans. Effective AM Plans are plans that address the Nine Attributes of an Effective Aging Management Plan (Appendix C) and can include Component Condition Assessments, lifecycle management plans, accredited engineering programs, inspection programs, and maintenance programs. Furthermore, *condition assessments* should include recommendations for additional IAM activities and for nuclear facility-supporting programs in design, operation, system monitoring, component monitoring and maintenance, and identify areas for further research and development.

1.1.5 Information developed and collected resulting from the IAM activities drive, and are the technical and decision basis for a number of corporate and station program and processes, such as Corporate Asset Management, Equipment Reliability, and Periodic Safety Review in support of the nuclear station licensing process.

1.1.6 Figure 1 shows the hierarchy of the *IAM* program, its implementing procedure and interfacing programs.

Nuclear Program

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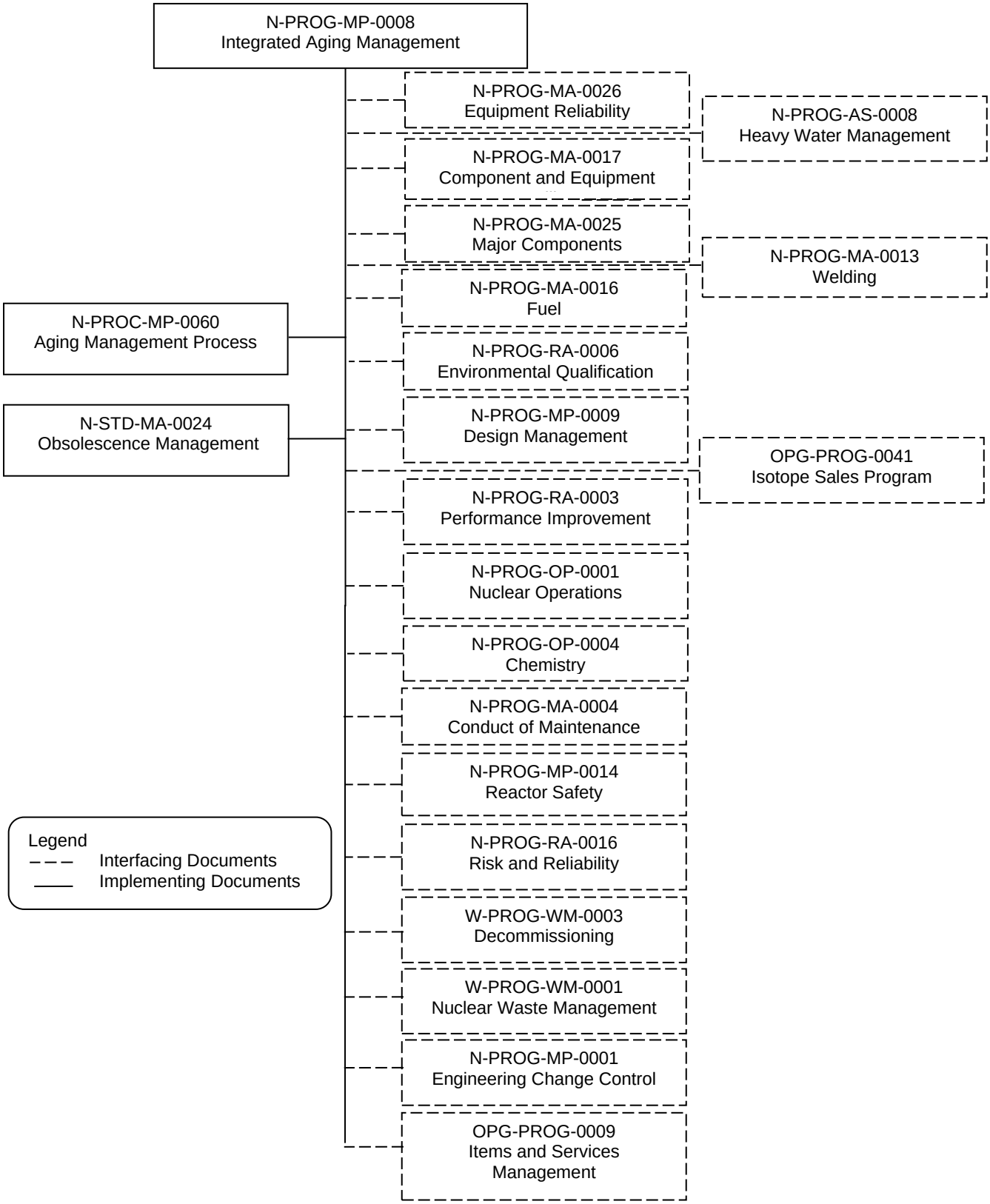
Title:
INTEGRATED AGING MANAGEMENT



1.2 Overview of the Aging Management Program

1.2.1 AM plans are developed for SSCs whose *aging degradation* or *aging effects* can, directly or indirectly, have an adverse impact on the safe and reliable operation of the nuclear facility.

1.2.2 SSC-specific AM plans can take the form of existing facility programs, such as life cycle management plans, engineering programs or inspection and maintenance programs provided they address the nine attributes of an effective AM plan as specified in Appendix C. Typically, these required attributes are implemented through several nuclear facility programs. These documents are reviewed periodically.

1.2.3 The AM program shown in Appendix B, Overview of the Aging Management Program, consists of the following basic elements:

(a) A set of programs that establish activities and conditions required to optimize equipment condition, such as maintenance, chemistry programs, operation and Environmental Qualification.

(b) A *condition assessment* process that periodically validates the effectiveness of AM plans, or credited programs, evaluates the health of *critical components,* addresses any aging related issues, addresses obsolescence management, and strategic and critical spares.

(c) Recommendations and corrective actions necessary to maintain plant health, which are input into business planning processes.

1.2.4 The method of *condition assessment* is determined on a process defined in N-PROC-MP-0060, Aging Management Process, and is accomplished through the following:

(a) Component and system surveillance for components important for safe and reliable operation.

(b) Fitness for service assessments and life cycle management plans (LCMPs) for major components such as fuel channels, steam generators, reactor components, turbine generators, and other strategic and long-lead SSCs.

(c) *Condition assessment* records for the balance of AM *critical* plant equipment.

1.2.5 In all cases, the *condition assessment* process has the same objectives and fundamental steps:

(a) Identifying and understanding component degradation mechanisms.

(b) Collecting data or conducting analyses, research or other activities to evaluate the degree of degradation experienced.

(c) Evaluating component condition by comparing experienced degradation against established limits.

(d) Establishing actions required to maintain acceptable component condition. Actions can take the form of modified operating and duty requirements, enhanced maintenance,

improved material condition, component replacement, addressing obsolescence, or the modification of program activities, such as, adjusting chemistry program parameters.

(e) Compilation of the AM actions, obsolescence issues, strategic and critical spares requirements into a station level condition report, to establish the technical basis for a risk-informed decision making process for integration into the station and corporate strategy implementation processes

1.2.6 The AM process follows a systematic, proactive life cycle approach as shown in Appendix A, Integrated Aging Management Process.

1.3 General Requirements

1.3.1 SSC IAM plans and *condition assessments* shall satisfy the following high level requirements:

(a) Meet Nuclear Safety requirements and maintain defined operating margins.

(b) Achieve high levels of equipment reliability.

(c) Activities needed to meet these requirements and for long term maintenance of the asset are defined and input into respective accountable health reports for tracking.

1.3.2 The *IAM* program shall be consistent with mandatory requirements of Canadian Nuclear Safety Commission (CNSC) Regulatory Documents REGDOC-2.6.3, Aging Management **[B-1].**

1.3.3 IAM processes and activities should be implemented throughout the nuclear facility's life cycle, including design, construction, commissioning, operation (including extended or long-term operations and *extended shutdowns*) and decommissioning.

1.3.4 All interfacing programs, as outlined in Section 1.6, affecting *critical* component condition should have all the necessary activities to address aging and optimize component condition and reliability. These programs should be comprehensive and sufficiently integrated to ensure critical information and assumptions used in evaluating and completing *condition assessments* remain valid. Periodic review of these programs and plan ensures the effectiveness of the process in addressing IAM requirements.

1.3.5 The scope of the *IAM* program should include applicable *SS*Cs and supporting equipment and structures. It should be determined through a defined and documented process in accordance with N-PROC-MP-0060, Aging Management Process.

1.3.6 All IAM plans and programs shall explicitly address the Nine Attributes of an Effective Aging Management Plan, as outlined in Appendix C.

1.3.7 LCMPs should be established and serve as the AM plan for station components of high nuclear safety importance and business risk. Some major components falling into this category include: Fuel Channels, Feeders, Steam Generators, Reactor Components and Structures (RC&S), Primary Heat Transport Pump Motors, Generator and Auxiliary, and other strategic and long-lead SSCs.

1.3.8 *Condition assessment* methodology to validate the effectiveness of SSC-specific AM plans and assess SSC condition is defined and documented, and follows a comprehensive and systematic approach specified in N-PROC-MP-0060, Aging Management Process.

1.3.9 Documented *condition assessments* should determine current performance, predict future performance, and obsolescence issues. *Condition assessments* should record the technical bases information, document any critical inputs, and include the rationale for decisions made in the quality or performance of the SSC.

1.3.10 The assessment of equipment condition should consider established limits, design basis, and licensing requirements for the applicable degradation mechanisms in determining equipment condition. It should also consider all applicable design requirements, such as environmental qualification, seismic, and others.

1.3.11 *Condition assessment* information should form the basis for assessing performance of the SSC to end of equipment, system, unit, and facility life, with allowance for potential life extensions.

1.3.12 The results of the evaluation should summarize the pertinent *aging* issues and effectiveness of current AM practices, such as existing lifecycle management plans, system health monitoring, and inspection and maintenance programs **[B-2]**.

1.3.13 The condition of *critical* SSCs should be monitored on an ongoing basis in accordance with programs: N-PROG-MA-0017, Components and Equipment Surveillance, and N-PROG-MA-0026, Equipment Reliability. *Condition assessments* require periodic review and updates to incorporate any new information (e.g. OPEX, design or field modifications) or to meet the review cycle for various programs including IAM, and license requirements.

1.3.14 IAM actions, including corrective or preventive actions identified in completed condition assessments should be documented either respective health reports, Integrated Implementation Plans (IIPs), or other auditable documents.

1.3.15 This program should have established program performance indicators.

1.3.16 *Obsolescence* is one mechanism leading to the unavailability of nuclear facility equipment. *Obsolescence* should be included in *condition assessments* and identified prior to having a significant station impact. Proactive obsolescence management optimizes equipment availability and reduces both maintenance and operator burden. *Obsolescence* mostly applies to systems and components (particularly instrumentation and control), and is less applicable to the main structural elements of a facility.

1.4 Nuclear Safety Requirements

1.4.1 IAM activities shall be completed to ensure all applicable regulatory and nuclear safety requirements are satisfied. The *IAM* program shall ensure that the impacts of *aging* related degradation potentially affecting nuclear safety are identified, understood and conservatively managed. This shall be accomplished by executing a set of programs all playing an integral role in IAM as identified in Section 1.6.

1.4.2 Evaluation of public safety risk posed due to the integrated impact of equipment *aging* shall be accomplished by completing the assessments and analyses performed in N-PROG-MP-0014, Reactor Safety Program. These consist of:

(a) Nuclear safety analyses documented in the Safety Report. To support these analyses, the *IAM* program shall demonstrate that credited parameters documented in the Operational Safety Requirements (OSR) documents meet defined performance requirements as the plant ages. In addition, the critical Safety Report analyses inputs shall take into account component *aging*.

(b) Probabilistic Risk Assessments (PRA) and Reliability Analyses of Systems Important to Safety: To support these assessments, the *IAM* program shall demonstrate that all *critical components* meet defined performance requirements. To support this, N-PROG-RA-0016, Risk and Reliability Program shall ensure that the failure rates used are representative of actual plant condition.

1.5 Equipment Reliability Requirements

1.5.1 Equipment reliability requirements to be satisfied in the IAM program are much the same as the nuclear safety requirements, but address a broader scope and encompass safety and non-safety related systems such as single point vulnerabilities causing a loss in production.

1.5.2 Equipment reliability activities, including equipment *obsolescence management*, should ensure that equipment performance meets design and operating requirements on an ongoing basis, resulting in predictable and reliable performance.

1.5.3 The AM program should identify the impacts of aging-related degradation potentially affecting equipment reliability, and understand and effectively manage them. This is accomplished through the integration with, and execution of, programs listed in Section 1.6.

1.6 Program Interfaces

The *IAM* program is implemented by fulfilling the requirements of interfacing programs having a role in managing equipment degradation and *aging*. This section describes the activities required in each program to ensure an effective *IAM* program is in place.

1.6.1 N-PROC-MP-0060, Aging Management Process

1.6.1.1 This implementing procedure, within IAM program governance, provides an overall description of the IAM process with specific instructions on:

(a) The scoping of SSCs into systems and commodity groups in order to manage the screening and *condition assessment* process.

(b) Screening criteria used to ensure the effectiveness of the *condition assessment* process and to establish the methodology to determine SSC condition.

(c) *Condition assessment* preparation.

(d) Sustaining the IAM program.

1.6.1.2 This process is not applicable for the development of major component LCMPs that are covered under N-PROG-MA-0025, Major Components and N-GUID-01060-00003, Life Cycle Plan Preparation Guide for other SSCs.

1.6.2 N-STD-MA-0024, Obsolescence Management

This standard under the Integrated Aging Management program provides direction on managing proactive and reactive *obsolescence* issues pertaining to all *critical* equipment and components related to the safe and reliable operation of a nuclear facility.

1.6.3 N-PROG-MA-0026, Equipment Reliability

1.6.3.1 This program contains the following elements which ensure ongoing high levels of reliable performance for SSCs important to nuclear safety, production, and environmental protection:

(a) Identifying *critical* SSCs that require focused attention.

(b) Specifying the required maintenance strategies to maintain high levels of reliability, and continuously improving the maintenance strategies based on corrective actions and maintenance feedback.

(c) Executing Predictive Maintenance (PdM), and Preventive Maintenance (PM) programs.

(d) Monitoring system and component condition.

(e) Implementing plans to restore and maintain system and component health.

(f) Taking prompt and effective action when a *critical* SSC fails, understanding the technical and organizational cause, and preventing recurrence.

(g) Identifying and predicting critical SSC *aging* and *obsolescence* issues on *critical* SSCs, and recommending mitigating strategies and actions into the business plan.

1.6.3.2 The Equipment Reliability program shall be implemented such that SSCs important to nuclear safety has been identified and defined activities are in place to ensure that *aging* issues are understood and effectively managed.

1.6.3.3 *Condition assessments* are performed on an ongoing basis through defined system surveillance activities. System health reports summarize condition assessment results and identify action plans required to resolve *aging* related issues.

1.6.4 N-PROG-MA-0017, Component and Equipment Surveillance

1.6.4.1 The Component and Equipment Surveillance program is implemented such that for equipment defined in various program areas, activities are completed to ensure equipment *aging* issues are identified, understood and effectively managed. This program also defines maintenance, inspection and other activities necessary to manage component *aging*.

1.6.4.2 *Condition assessments* are performed on an ongoing basis through defined component program activities if required. Program health reports summarize condition assessment results and identify action plans required to resolve *aging* related issues.

1.6.5 N-PROG-MA-0025, Major Components

1.6.5.1 The primary objective of the Major Components program is to establish an integrated set of processes and activities to justify fitness for service of four major component groups (i.e. Feeders, SGs, FCs and RC&S) and develop long-term Life Cycle Management Plan (LCMP) strategies that support preservation of these assets.

1.6.5.2 The Major Components program is implemented to ensure that equipment *aging* issues are identified, understood and effectively managed. Component specific activities are documented in LCMPs and results are documented in fitness for service assessments and health reports.

1.6.6 N-PROG-MA-0016, Fuel

1.6.6.1 This program establishes requirements to integrate and review fuel-related data in order to ensure fuel performs safely and reliably over the life of the station, consistent with design and licensing bases, while optimizing station reliability, production, and cost effectiveness.

1.6.6.2 Fuel-related data includes any information which may impact fuel throughout its life-cycle including (but not limited to) manufacturing, inspections, research, station operating conditions, and fuel channel interactions. This also includes fuel channel data, which may affect the safety analysis or safety report.

1.6.6.3 This program does not include responsibilities for fuel channel LCMP and fitness for service assessments, which are covered under N-PROG-MA-0025, Major Components.

1.6.7 N-PROG-RA-0006, Environmental Qualification

1.6.7.1 The objective of the Environmental Qualification (EQ) program is to ensure that specified components will function as required during the harsh conditions present following design basis accidents. It defines activities required for ongoing qualification, many of which address equipment *aging* due to normal environmental conditions. Therefore, this program plays a significant role in the AM of EQ qualified components.

1.6.7.2 An Environmental Qualification Assessment (EQA) documents the evaluation completed to demonstrate qualification of a component in consideration of environmental related *aging*. These form part of the overall *condition assessment* of an EQ component.

1.6.7.3 Surveillance activities should be completed in system, and component and equipment programs to ensure *aging* of equipment does not compromise the requirements of the EQ program.

1.6.8 N-PROG-MP-0009, Design Management

1.6.8.1 Appropriate measure shall be taken and design features shall be introduced in the design stage to facilitate effective AM throughout the lifetime of the nuclear facility.

1.6.8.2 Design activities shall be completed such that AM issues are given appropriate consideration.

1.6.8.3 The effective execution of AM practices (e.g., inspection and maintenance) is to be assured when evaluating and implementing design changes.

1.6.9 OPG-PROG-0009, Items and Services Management

1.6.9.1 This program addresses any potential disruptions to the supply of items and/or services that may adversely impact OPG. These disruptions shall be addressed in a consistent and expedient manner.

1.6.9.2 This program also addresses measures taken to store spare or replacement parts and consumables in appropriately controlled environments, while taking shelf life into account in order to preclude *aging degradation*.

1.6.10 N-PROG-MP-0001, Engineering Change Control

1.6.10.1 AM shall be considered in the design of modifications to existing operating facilities, and for design changes related to modifications and repairs or replacements of individual SSCs.

1.6.10.2 Provisions to monitor, manage and control aging degradation of an SSC shall be established and implemented, to ensure that the installation, commissioning and closeout processes do not adversely affect the aging resistance of SSCs.

1.6.10.3 These provisions should take account of current aging management knowledge and experience, and other relevant factors affecting the aging and aging management of the SSC.

1.6.11 N-PROG-RA-0003, Performance Improvement

This program establishes the processes that support the conduct of performance improvement and, by extension, employ the principles of problem prevention, detection and correction at Ontario Power Generation Nuclear (OPGN). This program covers the key areas of performance improvement, namely; corrective action, self-assessment, benchmarking, operating experience, and nuclear safety culture.

The implementing processes described by this program allow for the proactive identification and resolution of potential issues or opportunities for improvement as well as allowing for the prompt identification of adverse conditions. This includes non-conformances, deficiencies, or conditions that adversely impact – or may adversely impact – plant operations, personnel, nuclear safety, the environment or equipment and component reliability. These processes ensure that problems are corrected or dispositioned with a level of rigor and formality commensurate with their risk significance. For those problems deemed to be of a high level of significance or systemic in nature, these processes ensure appropriate levels of management are notified, causes identified, actions taken to minimize or prevent recurrence and lessons learned communicated. Actions taken to address the identified causes of significant or systemic problems are verified to be complete and effective.

To meet requirements of the AM program, relevant OPEX is used in the preparation of SSC *condition assessments*.

1.6.12 N-PROG-OP-0001, Nuclear Operations and N-PROG-OP-0004, Chemistry

Systems are to be operated and consistently tested using approved operating procedures and chemistry specifications, to ensure any *aging degradation* experienced remains as

documented in the design basis and completed *condition assessments*. Required operational activities are also completed (SRSTs, operator rounds, etc.) to verify equipment condition.

1.6.13 N-PROG-MA-0004, Conduct of Maintenance

1.6.13.1 The maintenance program includes activities required to ensure continued equipment reliability in accordance with defined equipment strategies, consisting of preventative and predictive elements. This program allows for information from maintenance activities to be fed back to engineering departments to enable effective completion of *condition assessments*.

1.6.13.2 Results of *condition assessments* should be implemented into maintenance programs as required to optimize equipment performance while the plant ages.

1.6.14 N-PROG-MP-0014, Reactor Safety

1.6.14.1 The reactor safety program defines activities related to the nuclear safety analysis which includes defining the Safe Operating Envelope (SOE).

1.6.14.2 The AM program establishes the activities required to maintain equipment performance such that the requirements of the safety analysis and licensing basis are met.

1.6.14.3 Safety limits for equipment performance used in *condition assessments* are defined in the SOE. Where component *aging* is not practical to mitigate, the rate of degradation is determined and taken into account in the safety analysis (e.g., pressure tube diametrical creep).

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

This program ensures that the risk and reliability requirements of systems important to nuclear safety and station public safety risk goals are met. Failure rates representative of actual plant condition are used in these analyses to ensure the conclusion is valid.

1.6.16 W-PROG-WM-0003, Decommissioning

This program establishes the requirements and processes required to safely and cost-effectively decommission OPG owned nuclear facilities. It establishes and implements AM activities in decommissioning plans and procedures for those SSCs that are required to remain available and functional during decommissioning.

1.6.17 W-PROG-WM-0001, Nuclear Waste Management

1.6.17.1 This program describes the organizational responsibilities, interfaces and key program elements for the management of nuclear waste. The Nuclear Waste Management Division has direct responsibility for safe handling, movement, processing, storage and monitoring of nuclear waste. This begins from the point it is ready for removal from the generating station, including the hazards associated with these processes.

1.6.17.2 The AM process and practices are considered in the hazard potential and complexity of affected systems in the nuclear waste facility.

1.7 Aging Management Considerations for Extended Shutdowns

1.7.1 Licensees shall review and, where necessary, revise SSC-specific AM plans to ensure that relevant factors affecting aging degradation are taken into account for SSCs placed in lay-up or safe-storage states during extended shutdowns.

1.7.2 Required provisions for aging management shall be defined in system lay-up specifications or preservation plans, including requirements for any condition assessments to be completed prior to the return to service of a reactor facility following an extended shutdown.

1.7.3 NK38-PLAN-09701-10258, Nuclear Refurbishment Aging Management – Extended Shutdown Plan

1.7.3.1 This plan provides the required provisions for AM to be defined in system lay-up specifications as part of the *extended shutdown* plan for the Darlington Nuclear Generating Station (DNGS) units undergoing refurbishment.

1.7.3.2 The aggregate of these activities supports the implementation of IAM program requirements for *extended shutdowns*, as well as incorporating industry best practice, OPEX, and a technical conscience to maintain OPG's assets.

2.0 ROLES AND ACCOUNTABILITIES

2.1 Director, Components Engineering

2.1.1 Assumes Program Owner roles and accountabilities in accordance with N-PROG-AS-0001, Nuclear Management System Administration for the *IAM* Program.

2.1.2 Provides oversight of the *IAM* program to ensure program effectiveness.

2.1.3 Ensures this program has been reviewed against N-STD-MP-0027, Configuration Management, and ensures that the requirements of N-STD-MP-0027 are met by the program and appropriate implementing documents.

2.2 Director, Station Engineering

2.2.1 Ensures applicable program requirements in this document are implemented at the station.

2.2.2 Ensures adequate resources are available to address the AM of SSCs effectively, as required in this program document.

2.3 Manager, Nuclear Asset Protection Department

2.3.1 Monitors program implementation for consistency and compliance with program requirements.

2.3.2 Monitors adequacy of the program through specific program performance assessments, review of audit findings, benchmarking, Station Condition Records, etc.

2.4 Director, Nuclear Safety

2.4.1 Ensures safety analysis takes into account the actual plant condition in consideration of *aging* and completes studies to determine the integrated impact of *aging* on nuclear safety.

2.5 Manager, Major Components Engineering Department

2.5.1 Accountable for major component programs which includes preparing and maintaining life cycle management plans and fitness for service assessments for these components.

2.6 Manager, Components and Equipment Engineering

2.6.1 Ensures component and equipment engineering program requirements, including those related to AM, are effectively implemented.

2.6.2 Ensures *condition assessments* or life cycle plans are completed and documented for components as required.

2.6.3 Ensures to update all the Equipment Maintenance Strategy Manuals –EMSMs, and review periodically to include IAM focussed actions.

2.6.4 Assists the Performance Engineering Department in preparation of *condition assessments* of *SSCs* as required.

2.6.5 Ensures that component health reports address AM issues of concern.

2.6.6 Identifies actions required to ensure the long term health of components.

2.6.7 Supplies information on component AM to the Performance Engineering Department for inclusion in respective system health reports.

2.7 Manager, Performance Engineering

2.7.1 Implements the AM program at the station.

2.7.2 Provides IAM oversight and facilitates IAM activities at the station level.

2.7.3 Ensures *condition assessments* are periodically reviewed, completed and documented for SSCs as required.

2.7.4 Ensures system health reports address AM issues of concern and track the condition assessment activities to completion.

2.7.5 Identifies actions required to ensure long term system health.

2.7.6 Supplies information on component AM to the Component Engineering Department for inclusion in respective program health reports.

2.8 Manager, Plant Design

2.8.1 Provides support in the preparation of *condition assessments*, with specific accountability for the preparation of *condition assessments* for civil structures in the scope of *IAM* (e.g., intake channel).

2.8.2 Ensures the implementation of AM considerations during design changes related to modifications and repairs or replacements of individual SSCs.

2.9 Manager, Engineering Mechanics

2.9.1 Provides requested support to address SSC *aging* and *obsolescence* issues requiring applicable design assessment or potential design change.

2.10 Manager, Computers and Control Design

2.10.1 Ensures *condition assessments* are completed and documented for SSCs covered in the digital control computers (DCCs) system health report as required.

2.10.2 Identifies actions required to ensure long term system health of DCCs.

2.11 Manager, Quality Engineering Nuclear Refurbishment

2.11.1 Ensures AM requirements are implemented during extended shutdowns and for long-term operation following the Darlington Nuclear Refurbishment (DNR).

2.11.2 Ensures the DNR implementing documents are periodically reviewed and reissued.

2.12 Manager, Performance Engineering Nuclear Waste Management

2.12.1 Ensures the implementation of the AM program at nuclear waste management facilities.

2.12.2 Ensures *condition assessments* or AM plans are completed and documented for required SSCs within the scope of the AM program.

2.12.3 Identifies actions or AM plans required to ensure long term system health.

2.13 Manager, Decommissioning and Safe Storage Engineering

2.13.1 Ensures the implementation of the AM program as appropriate for the decommissioning program.

2.13.2 Identifies actions required to ensure the long-term system health for in-service systems for the Safe Storage with Surveillance period.

2.13.3 Ensures condition assessments are considered for the Safe Storage project.

3.0 DEFINITIONS AND ACRONYMS

3.1 Definitions

Aging is a general process in which characteristics of a structure, system or component gradually change over time or with use. This process may proceed by a single *aging mechanism* or by a combination of several *aging mechanisms*. Non-physical aging is the process of becoming out-of-date (*obsolete*) owing to the evolution of knowledge and technology and associated changes in codes and standards. Physical aging is due to physical, mechanical, thermal, electrical, chemical, irradiation and/or biological processes (*aging mechanisms*).

Aging Degradation comprises the aging effects that could impair the ability of a structure, system or component to function within its acceptance criteria.

Aging Effects comprise the net change in the characteristics of a system, structure or component that occurs with time or use due to aging mechanisms.

Aging Management Plan refers to an SSC-specific or mechanistic-based aging management plan.

Aging Mechanism is a specific process that gradually changes characteristics of a structure, system or component with time or use, such as thermal or radiation embrittlement, corrosion, fatigue, creep, erosion, etc.

Condition Assessment is an assessment performed to determine the current performance and condition of a system, structure or component (including assessment of any age-related failures or indications of significant material degradation), and to predict future performance, extent and rate of aging degradation, and residual service life of a structure, system or component.

Critical describes systems, structures or components which can have an impact on nuclear safety and station costs as defined in N-PROC-MA-0077, Critical Equipment Identification and Categorization.

Extended Shutdown is a reactor shutdown lasting for a period exceeding one year and excludes regular maintenance outages.

Failure is the inability or interruption of the ability for a system, structure or component to function within its acceptance criteria.

Integrated Aging Management is the set of engineering, operations and maintenance actions to control within acceptable limits aging degradation and wearing out of structures, systems or components.

Life Cycle Management Plan (LCMP) is the integrated plan of aging management and economic planning activities to optimize the operation, maintenance, and service life of SSCs. LCMPs associated with Major Component are described within the scope of N-PROC-MA-0100, except for fuel channels, which are addressed in N-PROC-MA-0044.

Life Cycle Plans (LCP): LCPs are effective aging management plans which include periodic assessment activities to assess the adequacy of the SSCs long-range maintenance and/or replacement strategy.

Obsolescence is a term used to describe a piece of equipment, component, part, or consumable that is in service but no longer available from the Original Equipment Manufacturer (OEM), or is difficult to procure and qualify.

Service Life is the period from initial operation to final removal from service of a system, structure or component.

Stressor is an agent or stimulus stemming from pre-service and service conditions that can produce immediate or gradual aging degradation of a system, structure or component. Examples include heat, steam, chemicals, radiation, vibration and electrical cycling.

3.2 Abbreviations and Acronyms

AM	Aging Management
CCA	Component Condition Assessment
CNSC	Canadian Nuclear Safety Commission
DNR	Darlington Nuclear Refurbishment
EQ	Environmental Qualification
EQA	Environmental Qualification Assessment
FC	Fuel Channel
IAEA	International Atomic Energy Association
IAM	Integrated Aging Management
LCMP	Life Cycle Management Plan
OPEX	Operating Experience
OPG	Ontario Power Generation
OSR	Operational Safety Requirements
PM	Preventive Maintenance
PdM	Predictive Maintenance
PRA	Probabilistic Risk Assessment
RC&S	Reactor Components and Structures
SG	Steam Generators
SOE	Safe Operating Envelopes
SSC	System, Structure, or Component

4.0 BASES AND REFERENCES

4.1 Bases

[B-1] CNSC Regulatory Document REGDOC-2.6.3, Aging Management: Fitness for Service

[B-2] CSA N286-12 Clause 7.9.10 System Health Monitoring: “Structures, systems and components shall be evaluated in order to a) gauge performance; b) identify common and recurring problems; and c) recommend changes or improvements.”

4.2 References

4.2.1 Performance References

N-CORR-01060-0498325, Integrated Aging Management Working Group’s Terms of Reference

N-PROC-MA-0024, System Performance Monitoring

N-PROC-MA-0077, Critical Equipment Identification and Categorization

N-PROC-MP-0058, Equipment Bill of Materials

N-PROC-MP-0060, Aging Management Process

N-PROG-MA-0004, Conduct of Maintenance

N-PROG-MA-0016, Fuel

N-PROG-MA-0017, Components and Equipment Surveillance

N-PROG-MA-0025, Major Components

N-PROG-MA-0026, Equipment Reliability

N-PROG-MP-0001, Engineering Change Control

N-PROG-MP-0009, Design Management

N-PROG-MP-0014, Reactor Safety Program

N-PROG-OP-0001, Nuclear Operations

N-PROG-OP-0004, Chemistry

N-PROG-RA-0003, Performance Improvement

N-PROG-RA-0006, Environmental Qualification

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

N-STD-MA-0024, Obsolescence Management

N-STD-MP-0027, Configuration Management

OPG-PROC-0019, Records and Document Management

W-PROG-WM-0001, Nuclear Waste Management Program

W-PROG-WM-0003, Decommissioning Program

4.2.2 Developmental References

CNSC REGDOC-2.6.3, Fitness for Service: Aging Management

CSA N290-20-21 “Aging Management requirements for Nuclear Power Plants”, 2020

IAEA, “Periodic Safety Review”, Safety Standard and Guide, SSG-25, 2013

INPO "Equipment Reliability Process Description", AP-913, Revision 5 (2016)

IAEA Technical Report No. 338, “Methodology for the Management of Aging of NPP Components Important to Safety”, 1992

5.0 REVISION SUMMARY

This is an **intent** revision.

Summary of changes are as follows:

- Added CNSC REGDOCs 2.3.3 (per DCR 135887) and 2.6.3 to Developmental References section
- Added N-CORR-01060-0498325, “Integrated Aging Management Working Group’s Terms of Reference to the Performance References section (per DCR 138234)
- Updated titles of N-PROG-AS-0001 (DCR 143731) and N-PROG-RA-0003 (DCR 144927 and 146925)
- Added OPG-PROC-0019 to the Performance References section (per DCR 146925)
- Added N-PROC-MP-0058, Equipment Bill Of Materials, to the Performances References section (per DCR 138402)
- Added responsibility to Manager, Quality Engineering Nuclear Refurbishment to ensure implementing documents are reviewed and updated periodically (per DCR 134237).
- Changed N-STD-MA-0024, Obsolescence Management from an Interfacing document to an Implementing document (per DCR 141364). Moved section 1.6.8 to 1.6.2 and renumbered accordingly.
- Removed mention of CSA N286-05 and added **[B-2]** reference in appropriate section (per DCR 141535).
- Added responsibility to Program Owner to ensure Program meets requirements set out in N-STD-MP-0027, Configuration Management (per DCRs 140526 and 142209).

- Added N-PROG-AS-0008 Heavy Water Management; N-PROG-MA-0013, Welding; and OPG-PROG-0041, Isotope Sales Program as interfacing documents (per DCR 140907).
- Updated “Engineering Program Integration” to “Nuclear Asset Protection”.
- Updated Appendix A and Appendix C to match equivalent table and diagram from CNSC REGDOC-2.6.3 **[B-1]**.
- Removed Section 1.2.7 and reference to P-REF-09710-0586471, which is out of date.
- Updated definition of Obsolescence to match N-LIST-01300-10008.
- Updated definition of Performance Improvement (Sections 1.6.11.1, 16.11.2, and 1.6.11.3) to match current program.
- Editorial changes for clarity.

Appendix A:
Integrated Aging Management Process

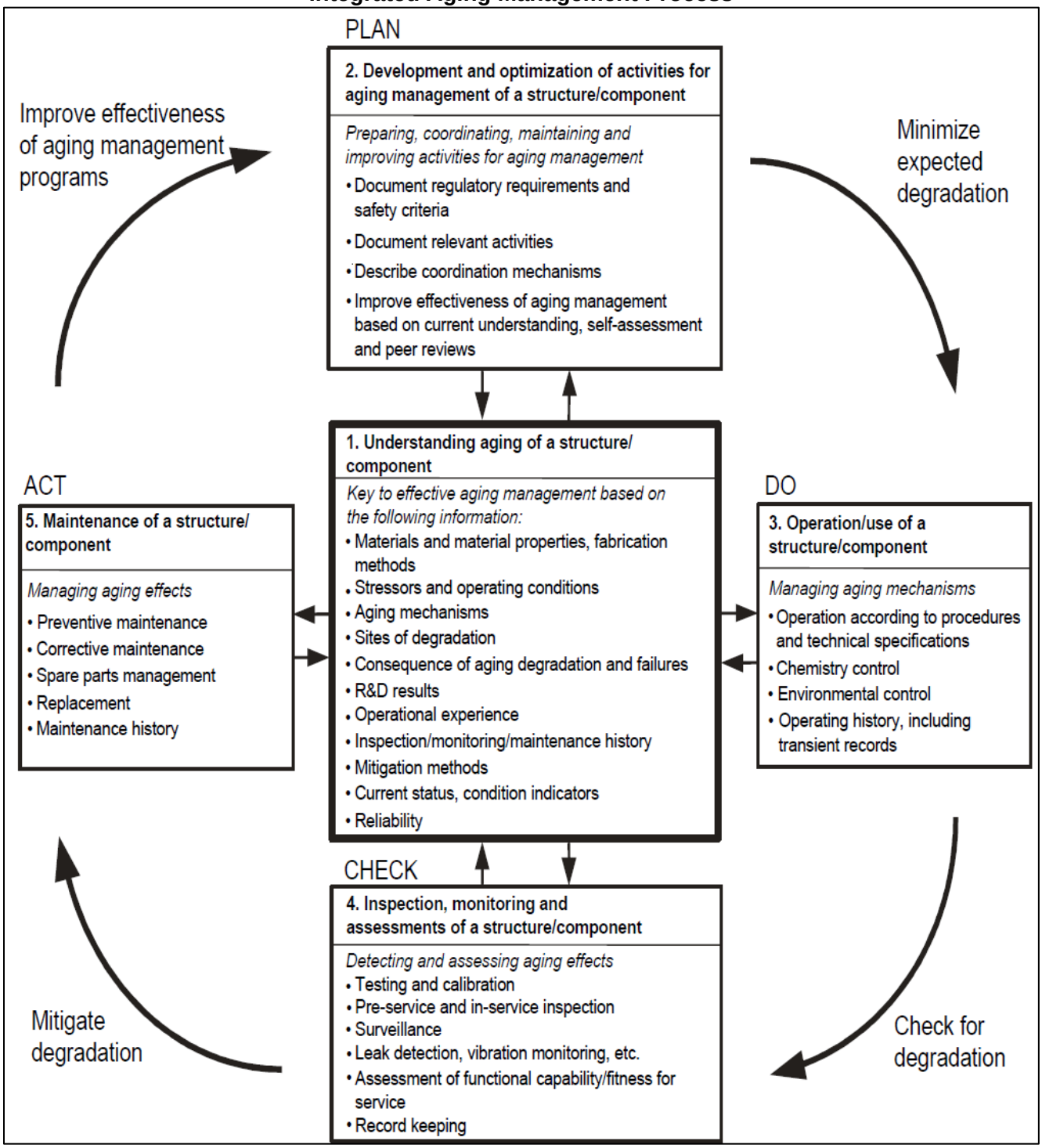
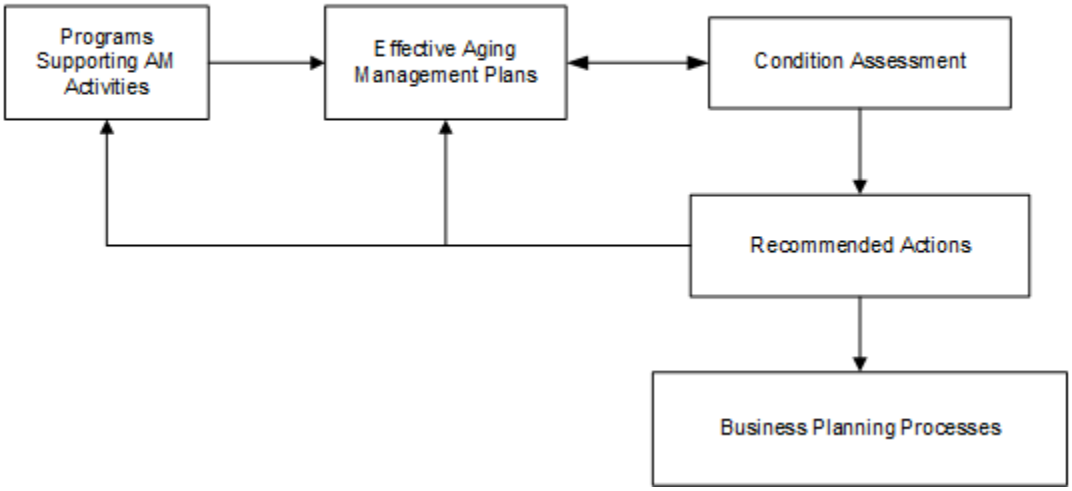


Figure 1 from REGDOC-2.6.3, Aging Management, Section 2.2.

Appendix B:
Overview of the Aging Management Program



Appendix C:
Attributes of an Effective Aging Management Plan

An Aging Management (AM) plan may be SSC-specific or degradation-specific. To ensure the adequacy and effectiveness of an AM plan, the following nine attributes shall be addressed:

Attribute		Description
1	Scope of the aging management (AM) plan, based on understanding of aging	Systems, structures and components (SSCs) subject to aging management (structures include structural elements) Understanding of aging phenomena (significant aging mechanisms, susceptible sites): • design and licensing basis requirements relevant to aging • SSC materials, service conditions, stressors, degradation sites, aging mechanisms and effects • SSC condition indicators and acceptance criteria • quantitative or qualitative predictive models of relevant aging phenomena
2	Preventive actions to minimize and control degradation due to aging	Identification of preventive actions Identification of parameters to be monitored or inspected Service conditions (i.e., environmental conditions and operating conditions)to be maintained and operating practices aimed at slowing down potential degradation of the structure or component
3	Detection of aging effects	Effective technology (inspection, testing and monitoring methods) for detecting aging effects before failure of the SSCs
4	Monitoring and trending of aging effects	Condition indicators and parameters to be monitored Data to be collected to facilitate assessment of structure or component aging Assessment methods (including data analysis and trending)
5	Mitigating aging effects	Operations, maintenance, repair and replacement actions to mitigate detected aging effects / degradation of SSCs
6	Acceptance criteria	Acceptance criteria against which the need for corrective action is evaluated
7	Corrective actions	Corrective actions if a component fails to meet the acceptance criteria
8	Operating experience feedback and feedback of research and development (R&D) results	Mechanism that ensures timely feedback of operating experience and R&D results (if applicable), and provides objective evidence that they are taken into account in the AM plan
9	Quality management	Organizational roles and responsibilities Administrative controls that document the implementation of the AM plan and actions taken Indicators to facilitate evaluation and improvement of the AM plan Confirmation (verification) process for ensuring that preventive actions are adequate and appropriate and all corrective actions have been completed and are effective Record-keeping practices to be followed

Existing life cycle management plans, equipment or component strategies, system health monitoring plans, maintenance or inspection programs or other documented practices may be eligible, individually or in combination, as AM plans provided they adequately address the nine attributes listed above.

Table adapted from REGDOC-2.6.3, Aging Management, Appendix A

ONTARIO POWER GENERATION

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Nuclear **Procedure**

TITLE
AGING MANAGEMENT PROCESS

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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-PROG-MP-0008, Integrated Aging Management

Document is Related to Pressure Boundary ☐	Document Requires CNSC Notification ☑

PURPOSE

The purpose of this procedure is to illustrate the process for performing the following aging management activities:

- Effective System, Structure and Component (SSC) specific Aging Management (AM) plans
- AM *Scoping* to identify and group SSCs based on aging related characteristics
- AM *Screening* to determine the method of *condition assessment*
- *Condition assessments* to identify actions required to ensure the health of SSCs as the plant ages and maintain the overall effectiveness of aging management plans

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DATES (YYYY-MM-DD)	
PDF Creation Date:	2017-07-10
Compliance Date:	July 15, 2017

EXCEPTIONS

- This procedure is also applicable to Nuclear Waste Facilities with due consideration of the differences compared to those of a power reactor facility in hazard potential and complexity of affected systems.
- Components within the scope of N-PROG-MA-0025, Major Components program including Life Cycle Management Plans (LCMPs) which serve as the AM plan for major component program scope.

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1.0 PROCESS

Aging Management (AM) is the set of engineering, operational, inspection and maintenance activities that control, within acceptable limits, the effects of physical aging and *obsolescence* of systems, structures and components (SSCs) that occur over time or with use [B-1].

The AM process should be consistent with Canadian Nuclear Safety Commission (CNSC) Reg. Doc. 2.6.3, Aging Management: Fitness for Service for managing the aging of critical SSCs in a nuclear power plant.

N-PROG-MP-0008, Integrated Aging Management (IAM) outlines the requirements of the overall integrated *aging management* program. The objective of the IAM program is to ensure the condition of critical nuclear power plant SSCs is understood and required activities are in place to manage the health of these components and systems while the plant ages.

The IAM program shall be applied through a systematic and integrated approach to establish, implement and improve appropriate programs to manage aging and obsolescence of SSCs. AM activities shall be implemented proactively throughout the life cycle of a reactor facility or SSC.

2.0 EFFECTIVE AGING MANAGEMENT PLANS

Effective AM ensures that the required safety functions of a nuclear power plant are reliable and available throughout their service life in accordance with the licensing basis.

An effective AM plan for a scoped SSC shall address the Nine Attributes of an Effective AM Plan as illustrated in Appendix A **[B-1]**. This is accomplished through the integration of multiple interfacing programs and processes. Conducting AM plans for SSCs may take on any of the following methods:

2.1 Condition Assessment Reports

A SSC's *condition assessment (CA)* report provides a "road map" of its respective AM plan through the application of the nine attributes which are embedded within the CA process. These CAs are also used to determine the health of the SSC and overall effectiveness of its AM plan.

Refer to N-GUID-01060-00001, Component Condition Assessment Preparation Guide.

2.2 Engineering Program Aging Management Plans

Engineering programs, procedures or other documented practices may also be eligible, individually or in combination, as AM plans for SSCs provided they adequately address the Nine Attributes of an Effective AM Plan as found in Appendix A. This is satisfied in the below respective engineering programs based on the referenced reports:

- N-REP-01060-10013, Evaluation of N-PROG-MA-0017, Component & Equipment Surveillance Program against the Nine Attributes of an Effective Aging Management

Plan has been developed to credit the component, and inspection and test sub-programs as effective AM plans.

- N-REP-01060-10014, Evaluation of System Engineering Implementation Programs against the Nine Attributes of an Effective Aging Management Plan has been developed to credit the integration of system engineering programs and processes in place as an effective AM plan.

- N-REP-01060-10015, Evaluation of Pump and Motor Managed Processes against the Nine Attributes of an Effective Aging Management Plan has been developed to credit the managed process for pumps and motors as an effective AM plan.

- N-REP-01060-10017, Evaluation of the Environmental Qualification (EQ) Program against the Nine Attributes of an Effective Aging Management Plan has been developed to credit the EQ program as an effective AM plan.

- Major component life cycle management plans (LCMP) have been developed for the major component program scope of N-PROG-MA-0025, and have been credited as effective AM plans as per the following reports:

    i. N-REP-33160-10012, Screening Report – Feeders Life Cycle Management Plan per N-PROC-MP-0060

    ii. N-REP-31100-10066, Screening Report – Fuel Channels Life Cycle Management Plan per N-PROC-MP-0060

    iii. N-REP-31200-10001, Screening Report – Reactor Components & Structures Life Cycle Management Plan per N-PROC-MP-0060

    iv. N-REP-33110-10021, Screening Report – Steam Generators Life Cycle Management Plans per N-PROC-MP-0060

- N-REP-01807-0527530, Evaluation of N-PROG-OP-0004 against Attributes of an Effective Aging Management Program has been developed to credit the Chemistry program as an effective AM plan.

2.3 Life Cycle Plans

Life Cycle Plans (LCPs) may be considered as effective aging management plans for SSCs not included in major component program scope provided that the nine attributes of an effective AM plan are documented as per Appendix A. These LCPs should be reviewed periodically to ensure their continued effectiveness.

3.0 AGING MANAGEMENT PROCESS

The AM process uses a systematic and comprehensive approach to assess the effectiveness of a SSC's AM plan and address any aging related issues. This process includes the following steps:

a) *Scoping*

b) *Screening*

c) Condition assessment

d) Recommended actions and rationalization

Nuclear Waste Management Division (NWMD) uses a separate method of AM scoping and screening as per W-CORR-01060-0615379, NWMD Integrated Aging Management Component Scoping and Screening.

3.1 Scoping

The first step in the AM process is *scoping*. The purpose of *scoping* is to:

- Determine the external boundaries of the station.
- Define the boundaries of each system within the station
- Identify and list the SSCs included in each system.
- Where applicable, group the SSCs within each system into Commodity Groups (CGs) to efficiently manage the *screening* and *condition assessment* stages. CGs consist of SSCs which have similar aging related characteristics and similar criticality and/or program accreditation (e.g., EQ components).

System Engineers (SE) should review the following:

(a) All component types should be included in the *scope* review, including passive SSCs, e.g., piping, cables, and instrument tubing.

(b) The Master Equipment List (MEL) should be used for *scoping*. However, not all component types are included in the MEL, and it should not be used as a sole source of information for this activity.

Note: Component types **not** in the MEL (i.e., passive components) should be reviewed with respect to *criticality coding* criteria as prescribed in N-PROC-MA-0077, Critical Equipment Identification and Categorization, for *criticality code* (CC) 1 and 2 functions.

(c) Scope review should include all components up to and including all support components dedicated to that system, e.g., components associated with electrical power, instrument air, service water, etc.

(d) Structures and other passive components should be considered based on a review of structural, piping, architectural and other relevant drawings.

(e) Structures and sub-structures that perform the following functions for equipment that is already in-scope should be considered:

- Provides structural support for the system or major components without which the system or component function would be impaired
- Provides shelter or protection for the system or major components without which the system or component function would be impaired
- Provides a pressure boundary or fission product retention barrier in the event of a design basis accident
- Provides a missile barrier
- Provides a pipe whip restraint (other than a MEL pipe support)
- Provides a flood protection barrier

A Plant Design Civil Engineer, in consultation with the Nuclear Safety Manager, should review the AM Scope for each of their designated systems to ensure common civil structures **not** in the MEL are included, e.g., structures sensitive to common mode events, concrete pump pedestals, etc.

AM scope should also include *critical components* that are not addressed within a monitored system.

The finalized AM scope for each system should be reviewed by the SE for completeness.

3.2 Screening

The purpose of the AM screening process is to evaluate whether or not a SSC within AM scope requires a CA report to be developed.

The *screening* process shall include SSCs susceptible to aging degradation or aging effects that can, directly or indirectly have an adverse effect on the safe operation of the reactor facility.

The *screening* process also allows resources to focus on critical components, components most susceptible to aging degradation, and those posing the highest risk from a nuclear safety, environmental and economic perspective.

There are two possible outcomes for any CG or SSC that is subjected to the AM Screening process:

- The CG or SSC is *screened out* from further evaluation
- The CG or SSC continues on to the CA reporting phase of the AM process

Screening should be performed by one of the following:

- A component engineer (CE) with the knowledge of the component's degradation mechanisms and the practices in place to manage aging

- A system engineer (SE) with the knowledge of the system and its degradation mechanisms
- A system engineer (SE) with the knowledge of computer controls design and its degradation mechanisms
- A system engineer, component engineer or design engineer for passive components as applicable (e.g., civil structures, piping)

The justification for *screening out* SSCs during the AM *screening* process should be included in the *screening* record.

3.2.1 Screening Criteria

This section contains a detailed description of the AM *screening* process as found in Appendix B, Aging Management Screening Process.

3.2.1.1 Component Criticality

This step *screens out* CGs or SSCs based on their *criticality codes* (CC). Refer to N-PROC-MA-0077, Critical Equipment Identification and Categorization for more information on criticality coding.

If a CG contains different c*riticality codes*, the criteria for the most critical CC should be applied, i.e. if a CG contains both CC1 and CC3, the CC1 criteria should be applied.

CC1 and CC2 components are the minimum scope of the IAM program and should be progressed to the next *screening* step. RS3 components may be added at Manager discretion for completeness of screening.

Note: Inclusion of all CC1, CC2 and RS3 components ensures that all safety related components, production critical components, and components which have an environmental impact or worker safety are addressed.

If a CC1, CC2 or RS3 component is screened-out at this step, justification should be documented in the *screening* record.

CC3 (based on P or CCSE scoring) and CC4 components are not normally in the scope of the IAM Program. However, they may be included at the discretion of the SE, and justification should be documented in the *screening* record.

If a CC3 (based on P or CCSE scoring) or CC4 CG is screened out at this step, the justification should state the following:

- The criticality code, e.g., CC4
- The CG is screened out from further review because it is CC3 (based on P or CCSE scoring) or CC4

CC4 components which are requested to be progressed in the *screening* process should be reviewed by the SE for potential revision to the component's *criticality code* as per N-PROC-MA-0077, Critical Equipment Identification and Categorization.

3.2.1.2 Effective SSC-Specific Aging Management Program or Plan

This step of the process may *screen out* SSCs or CGs that are in the scope of an effective SSC-Specific *Aging Management* program or plan.

For these SSCs, adverse degradation is not expected given the set of established activities in place to assure SSC health as the plant ages. This includes SSCs within the scope of an engineering program or plan as specified in Section 2.2.

Condition assessments and aging management practices of these SSCs are addressed through routine program or plan activities such as monitoring, testing, inspection, etc. However, a SSC should continue to be progressed through the AM screening process if aging related degradation or issues persist.

If a SSC or CG is screened out at this step, the justification should state the following:

- The effective *aging management* plan or report being used to credit the decision, e.g., N-PLAN-33110-10009, Steam Generators Life Cycle Management Plan

3.2.1.3 Effective Life Cycle Plans

This step of the process screens out SSCs or CGs that are in the scope of an effective Life Cycle Plan specified in Section 2.3.

Condition assessments and aging management practices of these SSCs are addressed through routine life cycle plan activities such as monitoring, testing, inspection, etc. However, a SSC should continue to be progressed through the AM screening process if aging related degradation or issues persist.

If a SSC or CG is screened out at this step, the justification should state the following:

- The life cycle plan document number being used to credit the decision

3.2.1.4 Nuclear Safety Screening

This step *screens out* SSCs or CGs that are non-safety related. SSCs that are SPVs or there is a cost/benefit to justify performing a CA should continue on to the next *screening* step.

Note: *Criticality coding* is the basis for determining whether SSCs are nuclear safety related. Clarification from the Nuclear Safety Department may be obtained during this review when required.

SPVs should **not** be screened out at this step.

Note: SPV SSCs are identified in Asset Suite, through a criteria defined by N-PROC-MA-0077. Failure of an SPV results in a forced outage or a significant delay to unit start-up (high cost impact).

For the remaining non-safety related SSCs or CGs, the requirement to perform a *CA* is driven on a cost-benefit basis.

Non-safety related SSCs or CGs can be screened out if their failure has an economic impact below the low-cost threshold value (suggested value of $100,000). However, the criteria for *screening* SSCs or CGs based on low-cost should be determined at the station level based on risk.

It is not necessary to perform additional CA*s* if the lifecycle and maintenance costs of the SSC are below the low-cost threshold value.

If a SSC or CG is screened out at this step, the justification should state the following:

- The *criticality code*, e.g., CC2
- It is **not** safety related and/or it is **not** an SPV
- It does not have an economic impact as per a threshold value of [insert dollar figure amount]

3.2.1.5 Preliminary Assessment in the Screening Process

A preliminary assessment should be performed for each SSC or CG based on the following AM information:

- Degradation Mechanisms (ARDMs) and limits
- Practices in place to manage degradation

(a) Degradation Mechanisms and Limits

Identifying and understanding SSC or CG degradation mechanisms is critical in the *screening* and CA process.

Degradation mechanisms can be extracted or referenced from information sources such as:

- System Performance Monitoring Plans (SPMPs) for monitored systems
- Equipment strategy manuals for SSCs addressed in engineering programs
- Electric Power Research Institute (EPRI) 1007933, Aging Assessment Field Guide
- EPRI 1009743, Aging Identification and Assessment Checklist, Mechanical Components
- EPRI 1011223, Aging Identification and Assessment Checklist, Electrical Components
- EPRI 1011224, Aging Identification and Assessment Checklist, Civil and Structural Components
- International Atomic Energy Agency (IAEA) reports available for specific components

- Other industry references for specific component types

Equipment *obsolescence* should also be considered as a degradation mechanism.

Established and other applicable degradation limits should be considered in the preliminary assessment for *screening*.

Not all degradation mechanisms have an established degradation limit. Available sources for determining degradation limits include:

- SPMPs for monitored systems (containing surveillance limits which typically are adjusted to provide margin to failure)
- Operating manuals
- Impairments manuals
- Operational safety requirements (OSR)
- Design manuals and reports for limits not addressed in safety reports or OSRs

(b) Practices in Place to Mitigate SSC Aging

A review of practices in place to mitigate SSC aging is an input for the *screening* process. The effectiveness of these practices is a factor in establishing the *condition assessment* process to follow. AM practices are activities completed to:

- Identify SSC degradation
- Maintain SSC performance within specified limits
- Determine the condition of the SSC to identify further measures to put in place

Practices should be identified for each applicable degradation mechanism. Examples of practices in place to identify and mitigate SSC aging include:

- Operational tests and predefines
- Engineering walkdowns
- Component Engineer review of maintenance results
- Defined engineering program activities – e.g., piping periodic inspection, valve program tests and maintenance
- Activities to maintain environmental qualification (EQ)
- Activities to maintain plant configuration and risk assessment

- Preventive maintenance (PM), predictive maintenance (PdM), and associated predefines
- In-plant inspections
- Repair and replace strategies
- *Obsolescence* strategies
- In-service testing
- Research and development (R&D) activities

3.2.1.6 Non-AM Critical SSCs

This step *screens out* SSCs or CGs that are non-AM critical. Non-AM *critical* SSCs or CGs fall into the following two categories:

- Assurance of Design Life
- Low Risk AM SSCs

The SE should perform a preliminary assessment to identify if the SSC or CG is non-AM critical.

The technical justification and assessments needed to *screen out* SSCs or CGs as non-AM critical should be documented in their respective *screening* record.

(a) Assurance of Design Life

In order to *screen out* SSCs or CGs at this step, it should be demonstrated that there are no degradation mechanisms which result in exceeding any defined performance limits over the design life of the station by reviewing the following:

- Design basis information for SSCs
- Manufacturing information and operating experience (OPEX)
- SSC operating history to ensure consistency with design assumptions

Examples of SSCs which fall into this category may include piping, hangers, cables, tubing, and civil structures.

(b) Low Risk AM SSCs

This category addresses SSCs or CGs of low cost and having simple degradation mechanisms.

The SSCs or CGs in this category should meet both of the following criteria:

(a) There is a low cost associated with the SSC, i.e. below the low-cost threshold value set by the station in Section 3.2.1.4

(b) There are limited and simple degradation mechanisms associated with the SSC for which there are practices in place to manage aging

Practices falling into this category include operator panel checks, and Safety Related System Tests (SRST).

Examples of SSCs which may fall into this *screening* category are simple electrical or I&C devices, e.g., hand switches, pushbuttons, etc.

For these SSCs, no adverse degradation is expected over the life of the plant or their aging poses limited station risk.

3.2.1.7 AM Critical SSCs with Effective Current Practices in Place

SSCs or CGs that are not *screened out* at this point are considered AM *critical components*.

This step of the *screening* process reviews the current AM practices in place for SSCs or CGs and assesses whether these AM practices will maintain the expected design life of the SSC or CG.

AM *critical components* with established periodic activities in place to determine and ensure required component condition is maintained should be *screened out* at this step, e.g., periodic and predictive maintenance, inspections, calibrations, etc.

An evaluation of the practices in place to maintain condition is required to determine if they are effective. A set of practices is considered effective if the following applies:

- It addresses all SSC degradation mechanisms and can predict or detect adverse performance prior to exceeding defined performance limits, and,
- Any one or more of the following:
    - i. Routine replacement of components is completed at a defined frequency to ensure life
    - ii. A review of results verifies effectiveness, e.g., instrument calibration results
    - iii. Is aligned with industry best practice
    - iv. Its use has prevented adverse conditions, demonstrated either via component performance or OPEX reviews

Examples of practices which do **not** allow a SSC or CG to be *screened out* include:

- No routine PM activity is in place

- Only functional testing is in place which does not effectively determine the extent of SSC degradation

- Engineering or operator surveillance which cannot adequately determine the extent of degradation

  Note: SSCs which require additional measures to assure component condition, either through calculation, other assessments, or unplanned inspections should not be *screened out* at this step.

Consideration should be given to sub-component issues when degradation is active in a sub-component and cannot be detected through existing practices.

The technical justification and assessments needed to *screen out* SSCs or CGs at this step should be documented in the *screening* record.

3.3 Condition Assessment Reports

If a SSC or CG is not *screened out* at this point, a *CA* report should be prepared to evaluate the condition and recommend any additional actions required to maintain the health of the SSC.

A *CA* report should document the parameters used to make this evaluation.

One *CA* report can be prepared for a CG of SSCs. However, unique issues (degradation mechanisms or OPEX) should be considered for individual SSC evaluations covered in that *CA* report.

A *CA* report should include the following:

- If applicable, a reference to the respective *screening* report

- Component ID(s) indicating system application

- Degradation mechanisms and limits, including whether *obsolescence* is applicable

- Operational factors including stressors and environmental conditions (e.g., temperature, radiation, etc.)

- Applicable operating history including a review of pertinent operating transients

- *Aging management* practices in place

- A review of component aging information sources

- Current physical condition of component

- Actions required to maintain performance

If a document is referenced, the *CA* report should:

(a) State the revision or approval date and the relevant section of the reference

(b) Indicate the relevant text, information, or section of the *CA* report

CA reports should be prepared by a qualified person.

CA reports should be reviewed by a qualified person.

The review should be performed according to N-PROG-MP-0007, Conduct of Engineering.

Note: Review is the act of providing expert input and/or feedback to a specific area of an engineering product to determine whether its content generally conforms to the design requirements. The technical expert providing the review has to ensure feedback is provided to the preparer on the quality of the engineering product, and is accountable for reasonable duty of care in doing the review and providing the feedback.

CA reports should be approved by the responsible Section Manager.

CA report approval should be based on Section 8.0, Roles and Accountabilities.

CA reports shall be issued in Asset Suite as controlled documents in accordance with N-PROC-AS-0003, Controlled Document Management.

Refer to N-GUID-01060-00001, Component Condition Assessment Preparation Guide for further direction on the content required for Component Condition Assessment (CCA) reports using the CCA database.

3.3.1 Degradation Mechanisms and Limits

Section 3.2.1.5 provides information on degradation mechanisms and limits.

For each degradation mechanism, a reference to established limits is required to identify the degree of acceptable degradation when evaluating SSC condition and when mitigating actions need to be put in place. However, not all degradation mechanisms have an established degradation limit.

Limits used in the *CA* must include a defined safety margin where appropriate, e.g., operating limits are to be used which are established by applying appropriate margin to safety analysis limits.

(a) All relevant mechanisms must be documented in this section of the *CA* report.

(b) Established and other applicable degradation limits should be considered.

(c) This section should indicate if *obsolescence* needs to be considered. Consideration should also be given to the quantity of spares available and predicted usage.

3.3.2 Operational Factors

Operational Factors (OF) are any condition or environment that accelerates or promotes material degradation (activates a DM). These conditions are **not** generated from a Degradation Mechanism.

3.3.3 Review of Applicable Operating History

The *CA* report must consider operating conditions and transients experienced which could have an impact on current or predicted future condition of the SSC.

3.3.4 Aging Management Practices

All relevant *aging management* practices should be reviewed for effectiveness and documented in this section of the *CA* report. Section 3.2.1.5 provides information on *aging management* practices.

3.3.5 Review of Aging Information Sources

This section of the *CA* report lists sources and summarizes the information relevant to SSC aging.

A review of information sources used to assess the degree of SSC degradation should include the following:

- Results of maintenance activities including maintenance feedback
- Engineering and operational surveillance, e.g., walkdowns, operational testing
- SSC inspections
- System and component health reports
- Station condition records (SCR)
- OPEX (internal, external, COG committee work, IAEA reports)
- R&D activities
- Industry trends
- Design/stress analyses

3.3.6 Evaluation of Physical Condition of Component

A condition evaluation should include information found in Sections 3.3.1 to 3.3.5 and performed using one of the following methods:

- First principles

- Experiential

A first principles approach evaluates aging degradation in a fundamental way, i.e., for each degradation mechanism, a prediction is made of expected performance versus established limits and margins to failure based on service condition, operating transient review and environmental conditions.

Experiential reviews evaluate aging degradation by examining feedback obtained via in-service tests and inspections, internal and external OPEX, manufacturer's information and other sources.

Note: Endeavour to establish expected service life for the component, where possible, by referencing resources that may have already reviewed this issue, such as an Environmental Qualification Assessment (EQA) document.

3.3.6.1 Evaluation Technique

The condition evaluation technique depends on the nature of the SSC, its degradation mechanisms and available information.

One of the following evaluation techniques should be used to determine SSC condition:

(a) In most cases, the condition of a SSC can be directly determined by reviewing obtained results pertaining to its performance, e.g., maintenance, testing, inspections.

(b) In some cases, where condition cannot be determined based on observed results (e.g., piping not subject to periodic inspection), special testing or inspections may be required. Also, specific analyses or R&D may be warranted, e.g., stress analysis for mechanical components.

(c) In special cases, SSC condition is determined through a Time Limited Aging Assessment (TLAA). TLAA considers parameters either directly or typically associated with operating time. Examples of these parameters considered in TLAA are:

- Number of allowable stress cycles, fatigue usage
- Corrosion rate
- Crack growth rate

Note: Examples of TLAAs are Environmental Qualification of Electrical and I&C components, metal fatigue calculations, and radiation induced deformation and embrittlement.

If a TLAA is required, the SE should request support from Plant Design.

3.3.6.2 Classification of Component Condition and Aging Management Practices

SSC condition and AM practices should be classified in accordance with Table 1, based on the following two factors:

(a) The SSC's physical condition at the time of assessment

(b) The condition of AM practices in place to manage SSC aging

Each factor should be assessed over a range of Very Good to Very Poor, as per the terminology listed under the first column of Table 1.

The condition classification of the SSC is determined based on the worst condition between a) and b).

Table 1: Aging Management Condition Classification

Condition Classification	Criteria
Very Good	(a) The component meets all functional design requirements, with no reduction in operating margin and exhibits no apparent degradation, (i.e., is in "like new" condition) and, (b) *Aging management* practices have been optimized to ensure the component remains in a "like new" condition.
Good	(a) The component meets all its functional design requirements, with only a slight reduction in operating margins. Some slight aging degradation is evident, or, (b) *Aging management* practices are adequate, but have not been optimized to ensure that the component remains in a "like new" condition.
Satisfactory	(a) The component still meets all its functional design requirements, but operating margins are significantly eroded. This can be attributed to evidence of significant aging degradation, or, (b) *Aging management* practices are ineffective in only one area and should be reviewed and/or changed.
Poor	(a) The component can only marginally meet its functional design requirements and has lost all operating margin. Severe aging degradation is evident, or, (b) *Aging management* practices are ineffective in a number of areas and need to be revised.
Very Poor	(a) The component cannot meet one or more of its functional design requirements. The component needs immediate or near term maintenance, repair and/or replacement to restore its condition, or, (b) Current *aging management* practices are completely ineffective and need revision.

The justification in the CA report for SSC condition should account for any uncertainties identified.

If an analysis was performed to determine the condition of the SSC, the analysis report should be documented in Asset Suite, and referenced in the *CA*.

3.3.7 Recommended Actions Required to Maintain Component Health as the Plant Ages

A proactive strategy requires the implementation of AM activities throughout the life cycle of a nuclear facility. A life cycle approach must be adopted, i.e., identify actions required over the next business planning period, or longer for significant cost items.

CA reports are the documented technical basis for identified actions and should include the following, if applicable:

(a) For all SSCs or CGs for which a time limiting factor requires action to maintain performance, these actions and timelines should be identified in the *CA* report, e.g., replacement of a component by a certain time period.

(b) For all SSCs or CGs falling into the Poor and Very Poor condition classifications, actions should be established to improve or further determine component condition. The actions must be specific and contain a scheduled completion date.

(c) Action plans should be prepared for SSCs with long lead times (e.g., obtaining replacement equipment) and spare part issues. Refer to N-INS-00680-10000, Identification of Critical Spares and N-GUID-09701-10027, Enhance Parts Focus in Aging Management Program.

(d) For equipment *obsolescence* issues, the action plan needs to contain an evaluation strategy to determine the optimal solution (including any actions required for design change solutions, or supply and procurement activities). Refer to N-STD-MA-0024, Obsolescence Management.

(e) In cases where assessed AM practices are insufficient, i.e. defined Poor or Very Poor as per Table 1, these should be identified in either respective accountable health reports or other documents as accepted by the program owner/SPOC, and initiate required corrective action(s).

3.4 Condition Assessment Rationalization Process of Recommended Actions

The rationalization of recommendations identified in CA reports will address the conservatism inherent in the AM process and justify the efficacy and applicability of these actions.

The justification for rationalization considers work programs in place (methods for detecting, monitoring, maintaining, operating and trending aging effects) that the station is already performing or will perform on a SSC, and the manner in which the station expects to utilize the SSC. The justification also ensures the safe and reliable operation of the station, while cost effectively reducing CA recommended actions.

3.5 Traceability of Condition Assessment Recommendations

All recommendations from *CAs* should be traceable to their disposition.

Tracking and disposition of recommendations in a *CA* report is according to N-PROC-MA-0024, System Performance Monitoring and N-INS-01510-10001, Site Engineering Program Health Reporting Process:

- A summary of significant issues in *CA* reports produced should be documented in respective accountable health reports
- Recommendations should be tracked to disposition or rationalization in respective accountable health reports
- Any rationalized recommended actions from CA reports should be included in respective accountable health reports with justification for rationalization

3.6 Condition Assessment Review

CA reports should be reviewed periodically by the CA owner. Detailed guidance for CA review frequency can be found in N-GUID-01060-00001.

The SE should review the *CA* for potential revision due to the following reasons:

- If the CC changes from non-critical to critical, i.e. from CC3/CC4 to CC1/CC2
- If there is significant OPEX, or level 1 or 2 Station Condition Records (SCR) on SSC failure that warrants additional *aging management* activities
- If there is a change in the SSC, i.e. new model or different manufacturer which may mean new or different ARDMs or failure modes
- If a decision to extend the life of the SSC is changed from what was assessed in the past
- If the length of an *extended shutdown* is significantly different from what was assumed in the system specification lay-ups
- If the SSC becomes obsolete
- If the operating conditions become more severe due to changes in environment or increased duty cycle
- If changes to AM practices occur due to station drivers (e.g., PM Optimization) or project work (e.g., Nuclear Refurbishment scope changes or cancelled work).

When new information becomes available which introduces uncertainty with respect to the SSC's continued performance, the *CA* report should be reviewed and revised, if necessary, to identify any additional required station activities.

Changes should be communicated to the owner of the *CA* report, i.e., the applicable document custodian manager, in order to assess its impact on SSC aging, urgency of update, and creation of Document Change Requests (DCR), in accordance with OPG governance OPG-PROC-0178, Controlled Document Management.

3.6.1 Non-intent Revisions

Revision and correction of *CA, screening* reports and LCPs shall be in accordance with OPG-PROC-0019, Records and Document Management, Section 1.2.7, Revision or Correction to Records.

A non-intent revision is defined as any change that does not affect the conclusion, the overall condition rating, the adequacy of current practices, or the action plan.

Examples of non-intent changes can include administrative changes (addition of tracking numbers, references, etc.) or minor editorial corrections.

3.6.2 Condition Assessment Review due to Extended Shutdown

CA reports should be reviewed as part of the return to service process. The purpose of the review of *CAs* prior to return to service is to re-evaluate AM practices when equipment has been refurbished or replaced. For example, requirements for *extended shutdowns* are currently applicable to the Darlington Nuclear Refurbishment (DNR).

Not all *CAs* need to be revised prior to return to service from an *extended shutdown*. The scope of *CA* revision should be based on lay-up conditions, refurbishment results, time since the last *CA* was performed, and the duration of shutdown.

4.0 DATA MANAGEMENT IN SUPPORT OF THE INTEGRATED AGING MANAGEMENT PROGRAM

A data collection and record keeping system is required to support AM activities and provide a basis for decisions on the type and timing of AM actions.

Management of data is in accordance with OPG-PROG-0001, Information Management. This program governs management of records and documents throughout their life cycle.

Data and records relevant to AM are divided into the following categories:

- Baseline information consisting of data on the design and condition of the SSC at the beginning of its service life
- Operating history regarding test and service data on the availability and failure of the SSC
- SSC maintenance history
- Records of SSC *screening*, *CA reports*, and LCPs

All records are maintained in an approved records repository, in accordance with OPG-PROC-0019, Records and Document Management.

5.0 DATA COLLECTION AND DOCUMENTATION REQUIREMENTS

SSC *screening* and CAs should be appropriately documented. The following should be recorded and stored in such a way that they are secure and retrievable:

(a) *Screening* records should be retained in Asset Suite.

(b) CAs should be documented and retained in Asset Suite as controlled documents

(c) Recommended actions should be traceable; for example, as action tracking assignments, in respective health report action plans, or in work management

Note: A *condition assessment* application (i.e. CCA database), has been developed in order to facilitate all steps required for this process, i.e. *Scoping*, *Screening*, and *Condition Assessment*. This application is **not** the official repository of the

aging management information. The output of this application (i.e. *CA* reports) are reviewed and approved, and then issued in Asset Suite.

Reports shall be complete, valid, legible, retrievable, and traceable to the parts and activities to which they refer, as outlined in CSA N286-12, Section 4.7 **[B-2]**.

6.0 PERSONNEL TRAINING AND QUALIFICATION REQUIREMENTS

Engineering personnel implementing *aging management* activities defined in this document should be trained and qualified in accordance with N-TQD-403-00001, Nuclear Engineering Support Personnel Training and Qualification Description.

Engineering staff performing these activities (i.e., *scoping*, *screening*, and *condition assessment*) should also be familiar with *aging management* concepts and IAM program requirements **[B-1]**.

Qualification and training requirements are provided in the following documents:

- N-QG-403-00019, Nuclear System Engineering Qualification Guide
- N-QG-403-00012, Nuclear Components Engineering Qualification Guide.
- N-QG-403-00008, Nuclear Design Engineering Qualification Guide

7.0 PROGRAM OVERSIGHT

The program owner maintains oversight on the implementation of the IAM program through the following activities; working group meetings, plant health committee meetings, self-assessments, OPEX reviews, and health reports.

The AM corporate program engineer should review and refresh user access permissions to the existing CCA database on an annual basis to ensure AM qualifications, as specified in Section 6.0, are being maintained as applicable. Refer to N-MAN-01060-10001, Condition Assessment – CCA – Software Administrator's Manual.

7.1 Site Administrators

On an annual basis, site administrators of the CCA database should produce a list of CCA reports requiring a review with respect to CCA review cycles as applicable. This may also require site administrators to create an AR with sub-assignments given to CCA owners to track their review process. Refer to N-MAN-01060-10001, Condition Assessment – CCA – Software Administrator's Manual.

7.2 Working Group

The IAM working group should be established with representation from all sites and corporate engineering. The primary role of the working group is to drive for continuous improvement and consistent program implementation across the nuclear fleet.

7.3 Self-Assessments

IAM program self-assessments should be conducted at site and corporate levels at a frequency determine by the Manager, Engineering Programs Integration department in accordance with N-PROC-RA-0097, Self-Assessment and Benchmarking.

N-PLAN-01060-10009, Integrated Aging Management Self Assessment Plan, provides the scope and schedule of self-assessments for a three-year cycle.

7.4 Integrated Aging Management Operating Experience

IAM program encounters two types of OPEX:

- OPEX specific to a degradation mechanism or certain SSCs
- OPEX on AM program implementation, e.g., a new AM plan or industry guideline

Review and documentation of OPEX should be conducted in accordance with N-PROC-RA-0035, Operating Experience Process.

7.5 Health Reporting

The IAM health report should be used as the primary tool for tracking and trending program implementation issues. Health reports should be prepared in accordance with the following two documents:

- N-PROC-RA-0023, Fleetview Program health and Performance Reporting
- N-INS-01510-10001, Site Engineering Program Health Reporting Process

The program health indicators and grading criteria should be periodically reviewed and changes recommended by the IAM working group.

8.0 ROLES AND ACCOUNTABILITIES

8.1 Manager, Engineering Program Integration

8.1.1 Provides corporate level support for the IAM program.

8.1.2 Provides program oversight to monitor compliance with the IAM program.

8.1.3 Assembles a working group across nuclear sites to address program issues and drive for continuous improvement.

8.1.4 Ensures the IAM program fleetview health report is prepared and issued as scheduled.

8.1.5 Participates in IAM industry groups such as the COG AM peer team.

8.1.6 Performs self-assessments at the corporate oversight level.

8.1.7 Provides oversight of the CCA database.

8.2 Manager, Performance Engineering

8.2.1 As SPOC for implementing of the IAM program, performs or delegates the following:

(a) Identifies critical items in systems to include in AM program scope.

(b) Applies *screening* to determine the method of condition assessment.

(c) Approves cost-benefit decisions made in non-safety related *screening* criteria.

(d) Prepares, reviews and updates CA reports and/or LCPs

(e) Ensures CA reports are prepared and reviewed by qualified personnel.

(f) Ensures periodic review of AM plans.

(g) Initiates actions for other groups to update CA reports and/or LCPs based on results of ongoing condition assessment.

(h) Establishes and maintains the condition assessment application (i.e. CCA database) as applicable.

(i) Ensures implementation of AM actions plans.

8.3 Manager, Components and Equipment Engineering

8.3.1 Provides support to perform or delegate the following activities to support Manager, Performance Engineering:

(a) Prepares, reviews and updates CA reports and/or LCPs for components.

(b) Ensures CA reports and/or LCPs are prepared and reviewed by qualified personnel.

(c) Ensures periodic review of AM plans.

8.4 Manager, Computers and Control Design,

8.4.1 Each group is accountable for preparing specific *CA* reports and/or LCPs.

8.4.2 Performs or delegates the following:

(a) Identifies critical items in systems to include in AM program scope.

(b) Applies *screening* to determine the method of condition assessment.

(c) Approves cost-benefit decisions made in the non-safety related *screening* criteria.

(d) Prepares, reviews and updates CA reports and/or LCPs.

(e) Ensures CA reports and LCPs are prepared and reviewed by qualified personnel.

(f) Ensures periodic review of AM plans.

(g) Ensures implementation of AM action plans.

8.5 Manager, Major Components

8.5.1 Ensures proper *screening* of components in the scope of the major component program.

8.6 Manager, Plant Design

8.6.1 Provides support and completes required assessments to determine if SSCs have aging mechanisms of concern over plant life, e.g., preparation of a TLAA.

8.6.2 Provides input and reviews *CA* reports.

8.6.3 For the civil engineering function, performs or delegates the following as appropriate:

(a) Identifies critical items in systems to include in AM scope.

(b) Applies *screening* to determine the method of condition assessment.

(c) Approves cost-benefit decisions made in the non-safety related *screening* criteria.

(d) Prepares, reviews and updates CA reports.

(e) Ensures CA reports are prepared and reviewed by qualified personnel.

(f) Ensures periodic review of AM plans.

8.6.4 Implementation of aging management considerations through the Engineering Change Control (ECC) process and repair/replacement of SSCs.

8.7 Manager, Engineering Mechanics

8.7.1 Provides requested support to address SSC *aging* and *obsolescence* issues requiring design assessment or potential design change.

8.8 Manager, Nuclear Refurbishment, System Engineering

8.8.1 Ensures system specification lay-up plans include requirements for any *condition assessment* to be completed prior to return to service.

8.9 Manager, Nuclear Safety

8.9.1 Provides clarification regarding criticality coding of SSCs based on system safety functions.

8.9.2 Identifies changes from nuclear safety analysis, safety report updates and annual reliability reports which impact aging management.

9.0 DEFINITIONS AND ACRONYMS

9.1 Definitions

Aging Management (AM) is the set of engineering, operational, inspection and maintenance actions that control, within acceptable limits, the effects of physical aging and *obsolescence* of SSCs that occur over time and with use.

Condition Assessment (CA) is the process resulting in the understanding of the health of critical station equipment and the actions required to maintain assurance of required ongoing health. This is accomplished through the completion of component condition assessments (CCA), existing maintenance or engineering program activities or through life cycle plan activities.

Criticality Code (CC) describes the criticality ranking number assigned (e.g., CC1- CC4) that is determined by the criticality categorization and ranking process, N-PROC-MA-0077.

Critical Components consist of CC1 and CC2 components subject to *condition assessment.*

Commodity Groups (CG) are groups of similar SSCs based on aging related characteristics.

Extended Shutdowns are reactor shutdowns lasting for a period exceeding one *year*, and exclude regular maintenance outages.

Life Cycle Plans are effective aging management plans which include periodic assessment activities to assess the adequacy of the SSC's long-range maintenance strategy.

Major Components include all components within the scope of N-PROG-MA-0025, Major Components program.

Obsolescence is the condition of equipment becoming out of date and unobtainable or not maintainable in comparison with current knowledge, standards and technology.

Scoping is performed to organize SSCs into CGs with similar aging related characteristics to efficiently manage the AM Screening and Condition Assessment stages of the AM process.

Screening is a preliminary assessment to ensure the appropriate level of effort is applied to the condition assessment.

Screen Out is the action of eliminating a component from further evaluation by providing the justification for not performing a *condition assessment*.

9.2 Abbreviations and Acronyms

AM	Aging Management
ARDM	Aging Related Degradation Mechanism
CC	Criticality code
CE	Component Engineer
CG	Component Group
CA	Condition Assessment
CNSC	Canadian Nuclear Safety Commission

COG	CANDU Owners Group
DCR	Document Change Request
DNR	Darlington Nuclear Refurbishment
ECC	Engineering Change Control
EPRI	Electric Power Research Institute
EQ	Environmental Qualification
EQA	Environmental Qualification Assessment
I&C	Instrumentation and Control
IAEA	International Atomic Energy Agency
IAM	Integrated Aging Management
ILCM	Integrated Life Cycle Management
LCMP	Life Cycle Management Plans
LCP	Life Cycle Plan
MEL	Master Equipment List
NWMD	Nuclear Waste Management Division
OF	Operational Factors
OPEX	Operating Experience
OPG	Ontario Power Generation
OSR	Operational Safety Requirements
PIP	Periodic Inspection Program
PdM	Predictive Maintenance
PM	Preventive Maintenance
PRD	Pressure Relief Devices
QA	Quality Assurance
R&D	Research and Development
SCR	Station Condition Record
SE	System Engineer
SPMP	System Performance Monitoring Plan
SPOC	Single Point of Contact
SPV	Single Point Vulnerabilities
SRST	Safety Related System Test
SSC	Systems, Structures and Components
TLAA	Time Limited Aging Assessment
USI/SCI	Universal Subject Index/System Classification Index

10.0 BASES, RECORDS AND REFERENCES

10.1 Bases

[B-1] CNSC Reg. Doc. 2.6.3 – Aging Management: Fitness for Service, March 2014

[B-2] CSA N286-12 Clause 7.9.10 System Health Monitoring: “Structures, systems and components shall be evaluated in order to a) gauge performance; b) identify common and recurring problems; and c) recommend changes or improvements.”

10.2 Records

10.2.1 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 or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
Condition Assessment (CA) Report	N/A	Y	Indexed in Asset Suite Controlled Doc. Document Number: Property Number-REP-System Classification Index/Uniform Subject Index (SCI/USI)-5 digits Controlled Document Sequence Number-Revision Number e.g., NK38-REP-32310-10001 R001 RETENTION LOF
Screening Report	N/A	Y	Indexed in Asset Suite Controlled Doc. Document Number: Property Number-REP-System Classification Index/Uniform Subject Index (SCI/USI)-5 digits Controlled Document Sequence Number-Revision Number e.g., NA44-REP-33100-00004 RETENTION LOF
Life Cycle Plan	N/A	Y	Indexed in Asset Suite Controlled Doc. Document Number: Property Number-REP-System Classification Index/Uniform Subject Index (SCI/USI)-5 digits Controlled Document Sequence Number-Revision Number e.g., NK38-REP-32310-10001 R001 RETENTION LOF

10.3 References

10.3.1 Performance References

N-CORR-01060-0498325, Integrated Aging Management Working Group's Terms of Reference

N-GUID-01060-00001, Component Condition Assessment Preparation Guide

N-GUID-09701-10027, Enhance Parts Focus in Aging Management Program

N-INS-00680-10000, Identification of Critical Spares

N-INS-01510-10001, Site Engineering Program Health Reporting Process

N-MAN-01060-10002, Condition Assessment - CCA - Software User Manual

N-MAN-01060-10001, Condition Assessment – CCA – Software Administrator's Manual

N-PLAN-01060-10009, Integrated Aging Management Self Assessment Plan

N-PROC-MA-0024, System Performance Monitoring

N-PROC-MA-0077, Critical Equipment Identification and Categorization

N-PROC-RA-0035, Operating Experience Process

N-PROC-RA-0097, Self-Assessment and Benchmarking

N-PROG-MP-0007, Conduct of Engineering

N-PROG-MP-0008, Integrated Aging Management

N-QG-403-00008, Nuclear Design Engineering Qualification Guide

N-QG-403-00012, Nuclear Components Engineering Qualification Guide

N-QG-403-00019, Nuclear System Engineering Qualification Guide

N-REP-01060-10013, Evaluation of N-PROG-MA-0017, Component & Equipment Surveillance Program against the Nine Attributes of an Effective Aging Management Plan

N-REP-01060-10014, Evaluation of System Engineering Implementation Programs against the Nine Attributes of an Effective Aging Management Plan

N-REP-01060-10015, Evaluation of Pump and Motor Managed Processes against the Nine Attributes of an Effective Aging Management Plan

N-REP-01060-10017, Evaluation of the Environmental Qualification (EQ) Program against the Nine Attributes of an Effective Aging Management Plan

N-REP-31100-10066, Screening Report – Fuel Channels Life Cycle Management Plan per N-PROC-MP-0060

N-REP-31200-10001, Screening Report – Reactor Components & Structures Life Cycle Management Plan per N-PROC-MP-0060

N-REP-33110-10021, Screening Report – Steam Generators Life Cycle Management Plans per N-PROC-MP-0060

N-REP-33160-10012, Screening Report – Feeders Life Cycle Management Plans per N-PROC-MP-0060

N-STD-MA-0024, Obsolescence Management

NK38-PLAN-01060-10010, Aging Management Plan for Darlington NGS Non-Containment Building Structures

OPG-FORM-0202, Controlled Document Request

OPG-PROC-0019, Records and Document Management

OPG-PROC-0178, Controlled Document Management

OPG-PROG-0001, Information Management

P-CORR-01060-0597958, Supervisor Guidelines for Assigning AM Work

W-CORR-01060-0615379, NWMD Integrated Aging Management Scoping and Screening

W-LIST-03673-00001, Safety Related Systems for Nuclear Waste Facilities

10.3.2 Developmental References

IAEA Safety Report, No. 57, Safe Long Term Operation of Nuclear Power Plants, 2008

IAEA Safety Report, No 62, Proactive Management of Ageing of Nuclear Power Plants, 2009

Organisation for Economic Cooperation and Development (OECD) Nuclear Energy Agency, Glossary of Nuclear Power Plant Ageing, 1999

11.0 REVISION SUMMARY

This is an **intent** revision.

Summary of changes are as follows:

- Added NK38-PLAN-01060-10010, Aging Management Plan for Darlington NGS Non-Containment Building Structures in Section 2.2 as an aging management plan as per DCR 126226.
- Updated referenced governance document numbers as per DCR 134238.
- Updated governance document to account for multiple grammatical errors and phrasing as per DCR 135139.
- Added a reference to N-STD-MA-0024, Obsolescence Management in Section 4.3.7 as per DCR 135904.
- Added a reference to N-INS-00680-10000, Identification of Critical Spares in Section 4.3.7 as per DCR 135907.

- Provided clarification for the definition of the acronym CG to be Commodity Group as per DCR 136310.
- Referenced N-GUID-01060-00001, Component Condition Assessment Preparation Guide in multiple locations throughout the governance document as per DCR 136894.
- Added screening report reference as part of the development of condition assessment reports in Section 1.6 as per DCR 137883.
- Additional changes to meet the requirements of the transition to CNSC REGDOC-2.6.3, Aging Management.
- Grammatical, document structure and phrasing changes as required.

Appendix A: Attributes of Effective Aging Management Plan

Aging Management (AM) is the set of engineering, operational, inspection and maintenance actions that control, within acceptable limits, the effects of physical aging and *obsolescence* of systems, structures and components (SSCs) that occur over time or with use.

As per CNSC REGDOC-2.6.3, each SSC-specific AM plan should cover the following nine attributes;

(1) Scope of the aging management plan based on understanding aging

(2) Preventive actions to minimize and control degradation due to aging

(3) Detection of aging effects

(4) Monitoring and trending of aging effects

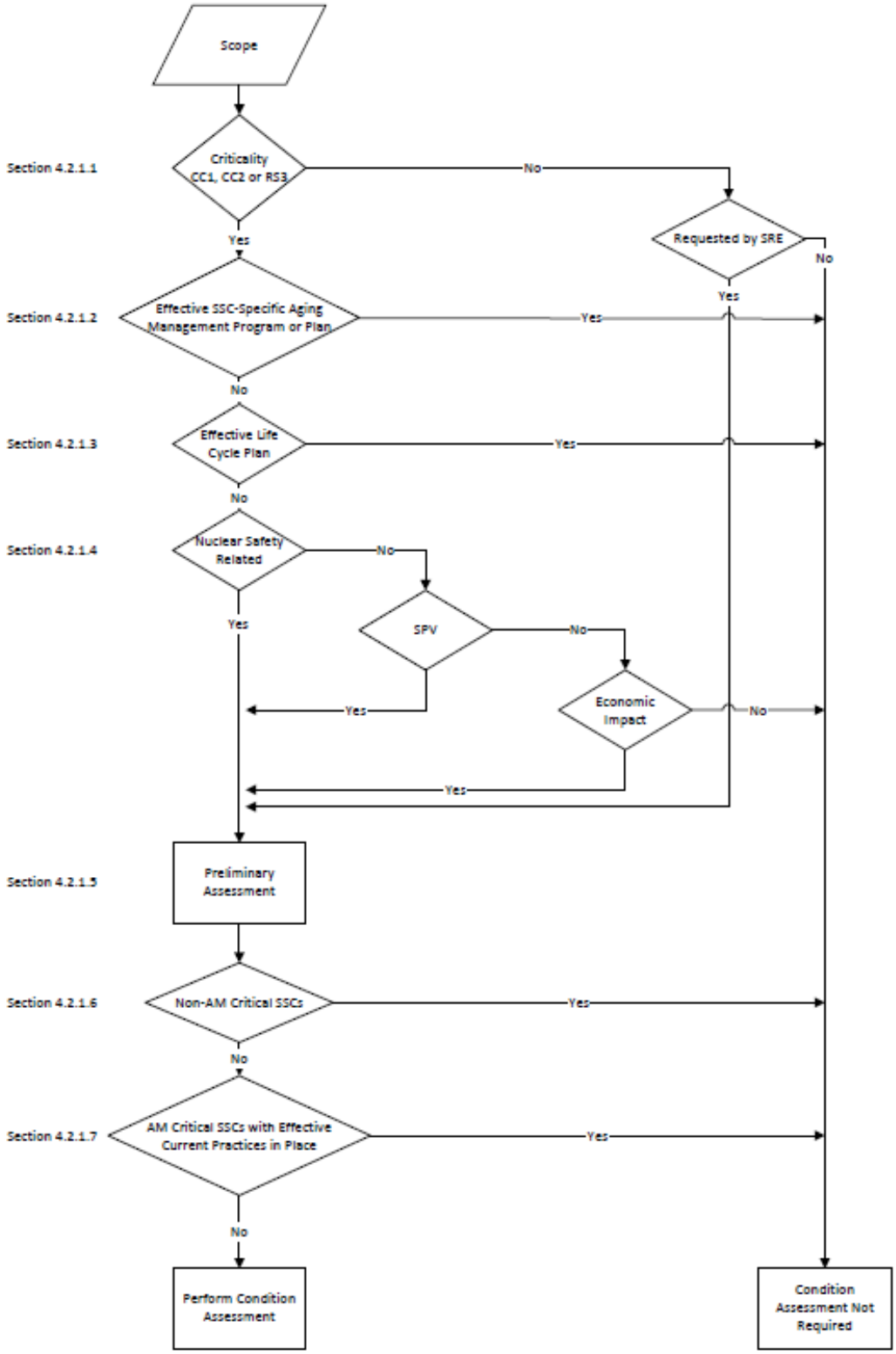
(5) Mitigating aging effects

(6) Acceptance criteria

(7) Corrective actions

(8) OPEX feedback and feedback of R&D results

(9) Quality management

Engineering programs, procedures or other documented practices may also be eligible, individually or in combination, as AM plans for SSCs provided they adequately address the above nine attributes of an effective AM plan.

Appendix B: Aging Management Screening Process