ONTARIO POWER GENERATION

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Nuclear Procedure

TITLE
NUCLEAR ASSET MANAGEMENT AND INVESTMENT PLANNING

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PURPOSE AND SCOPE
This procedure defines the Asset Management process intended to optimize the Nuclear asset investment portfolio for Business Planning purposes.

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EXCEPTIONS
The Pickering Nuclear Generating Station is not required to comply with this procedure, as Pickering is approaching end of commercial operations and asset management principles are reflected in Pickering's life extension and shut down plans.

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1.0 DIRECTION

Asset Management is a systematic approach to manage tangible assets, both individually and in groups/classes of assets, with the intent to extract maximum asset value within constraints.

It enables the business to operate, maintain, and invest in its assets more efficiently, ensuring continued safe and reliable operation with an appropriate balance among cost, risk, and performance. Asset Management serves to identify and optimize long range capital investments, provision, and operating, maintenance and administration (OM&A) within business constraints.

2.0 ASSET MANAGEMENT PROCESS

The Nuclear Asset Management process applies to Darlington, Nuclear Waste Management (NWM), Inspection and Reactor Innovation (IRI), and Nuclear at the fleet level. The Pickering site may also implement the Asset Management process or incorporate selected elements into existing programs to meet specific business needs.

Each of these sites shall utilize an Asset Management Oversight Committee (AMOC), which shall be the respective Asset Owner in this process. Asset Owners shall assign Asset Managers to assess asset risk profiles, and identify, evaluate, and recommend asset investment options to the Asset Owners. A summary of the roles and accountabilities for Asset Owners and Asset Managers are provided in **Section 3.0 ROLES AND ACCOUNTABILITIES**. The detailed function of AMOC is described in **N-GUID-08120-00002, Asset Management Oversight Committee Terms of Reference**.

The Nuclear Asset Management process is a cycle that goes through the following phases:

1. Defining Strategic Asset Management Directives
2. Assessing and Updating Baseline Risk Profiles of Assets
3. Identifying, Evaluating, Recommending, and Updating Asset Investment Options
4. Screening and Pre-approving Asset Investment Options
5. Optimizing Asset Investments for Business Planning
6. Implementing Approved Investment Options
7. Results Measurement and Reporting

The flowchart in **Appendix A** provides an overall view of the Asset Management process. Asset Management Governance hierarchy is shown in **Appendix D**.

Approval for the Business Plan is governed by **OPG-PROG-0037, OPG Business Planning**, and **N-PROG-AS-0005, Nuclear Business Planning**.

Approval for Organizational Authority Register (OAR) to release project scope and funding for implementing asset investments, is governed by **OPG-STD-0076, Developing and Documenting Business Cases**.

Management of OAR-approved projects is governed by **OPG-STD-0148, Project Management**.

2.1 Defining Strategic Asset Management Directives

The objectives of Asset Management shall align with the OPG's strategic imperatives, OPG's Business Plans, as well as strategic asset management plans for the Nuclear operations assets, including objectives, equipment reliability performance, and constraints. These strategic directives shall constitute the overarching principles throughout the entire Asset Management process.

The Asset Management process is a continuous cycle that takes results and outcomes from asset management activities as feedback to strategic planning.

2.2 Assessment and Update of Baseline Risk Profiles of Assets

At maturity, the Asset Owners shall maintain a list of all material assets in accordance with the Asset Hierarchy. The Asset Owners should determine and review the Asset Hierarchy on a periodic basis. Assets within the Asset Hierarchy may be classified by a combination of factors, including: equipment/component type, the system to which equipment/component belongs, and facility or site.

2.2.1 Assessment of Baseline Risk Profiles of Assets

Asset Managers should assess all baseline risk profiles of assets under their responsibility based on the most updated asset condition assessments such as a Component Condition Assessment (CCA) and/or a reliability curve. Asset Managers should refer to the relevant existing program(s), such as the following list, to identify the causes of asset failures and aging, for baseline risk profile assessment.

- N-PROG-MA-0017, Component and Equipment Surveillance
- N-PROG-MA-0025, Major Components
- N-PROG-MA-0026, Equipment Reliability
- N-PROG-MP-0008, Integrated Aging Management
- N-PROG-RA-0016, Risk and Reliability

These programs also provide recommendations on asset management strategies including options to manage, reduce or eliminate asset risk either through base work program adjustments or by recommended investment. Refer to **Section 2.3 Identification, Evaluation, Recommendation, and Update of Asset Investment Options** for the process of evaluation of asset investment options.

Asset Managers may consult Subject Matter Experts (SMEs) as needed in respect of the risk areas before submission to Asset Owners for approval. These SME groups include: Safety, Regulatory, Environmental, Cyber Security, Stakeholder Relations, Generation Planning, and Finance. Refer to **N-GUID-08120-00003, Asset Management Value Framework** for the detailed description of the risk areas.

2.2.2 Update of Baseline Risk Profiles of Assets

Asset Managers should review and update the baseline risk profiles of assets in the Asset Management Tool by either validating the current risk profile or updating with a new risk profile, on a periodic basis or after:

- Any applicable event triggering a change in the baseline risk profile of assets, such as:
  - Post-implementation review of projects
  - Equipment replacement, overhauls, and significant maintenance
  - Predictive online equipment monitoring and diagnostic analyses
  - Preventive periodic asset condition assessments
  - Outage or on-line (innage) inspections
  - Operating and maintenance experience
  - Industry operations experience

The approval process is discussed in **Section 2.4 Screening and Approval of Asset Investment Options**.

2.3 Identification, Evaluation, Recommendation, and Update of Asset Investment Options

Asset Managers shall use the Asset Investment Options Template (AIOT) to evaluate all potential asset investment options that could mitigate the baseline risk of assets, as well as the preferred asset investment option. Asset Managers should complete an AIOT in accordance with the **AIOT Preparation Guide**, which is prepared by Investment Management. Existing AIOT should be validated by Asset Managers on a periodic basis and updated for approval if necessary.

Each AIOT should be reviewed, validated and accepted by Investment Management before submission to the respective Asset Owner – i.e., one of the AMOCs or the delegated site screening committee if the AMOC selects to engage one for initial screening (refer to **Section 2.4.1**).

2.3.1 AIOT Need Criteria

Asset Managers shall create or update an AIOT if the baseline risk of the assets can no longer be sufficiently mitigated by any of the following:

- Routine base OM&A work; or
- Non-routine work under:
  - Broke/Fix solution;
  - Engineering Change (EC);
  - Item Equivalence Evaluation (IEE);
  - Preventive Maintenance (PM) program; and

- Any other work with cost below the capitalization materiality limit prescribed in **FIN-STD-0006, Property, Plant and Equipment**, which is currently $200,000 per generating unit for generating asset classes.

This $200,000-threshold should apply to the following:

- A specific Plant Property and Equipment (PPE) or family of PPE of the same equipment type, including bundled commodity type equipment such as breakers and transmitters;
- Capital spares; and
- Incremental spares (inventory) or critical spares per item as a one time purchase.

Appendix B provides a decision flowchart to determine whether an AIOT is required. An AIOT may still be created even if the flowchart suggests otherwise in situations such as identification of an investment that would add value when being compared to the status quo routine maintenance plan.

2.3.2 Description of Potential Investment Options

Potential investment options are options that are expected to reduce the baseline risk profile of the asset to an acceptable level. At maturity, the time horizon of each investment option considered should extend to the end of life of the site or beyond, if required to maintain reliability during Safe Storage.[1]

Asset Managers shall provide a description of the scope and desired schedule of the work for each investment option. Each investment option may be comprised of but not limited to: one or more projects, no project, status quo maintenance and delayed project, increased predictive/preventive maintenance, or any combination of these.

2.3.3 Complexity Assessment

Asset Managers shall assess the complexity for each investment option in accordance with the **AIOT Preparation Guide**, and may consult groups such as Work Management, Generation Planning, Supply Chain, Engineering, Projects & Modifications, and Finance.

2.3.4 Asset Investment Net Value

Asset Managers shall provide the mitigated risk values, financial impact, and investment cost for each investment option, which are used as inputs for the calculation of the Asset Investment Net Value for each investment option based on the methodology described in **N-GUID-08120-00003, Asset Management Value Framework**.

Asset Managers should consult SME groups, as needed, as denoted in **Section 2.2.1 Assessment of Baseline Risk Profiles of Assets**, to provide inputs for and review the Asset Investment Net Value for each investment option.

[1] Examples of such assets are the Irradiated Fuel Bay, cooling systems, heating, ventilation, and air conditioning systems (HVAC), containment structures and components, and site access components.

2.3.5 Recommendation of the Preferred Investment Option

Asset Managers should recommend the asset investment option with the highest Asset Investment Net Value in the AIOT. In case the Asset Manager does not recommend the asset investment option with the highest Asset Investment Net Value, the rationale shall be based on robust analysis and/or significant qualitative information and shall be adequately documented within the AIOT. Moreover, the recommended option may be altered during asset investment portfolio optimization (refer to **Section 2.5 Optimization of Asset Investments for Business Planning**).

2.4 Screening and Approval of Asset Investment Options

Asset Owners shall be the authority to approve investment options (that are recommended by Asset Managers) as candidates to be included in the asset investment portfolio for Business Planning.

2.4.1 Site Screening Committee

Asset Owners may engage a site screening committee to assist with the quality assurance of AIOT submissions (both initial submissions and updates) for data integrity, accuracy, and completeness prior to submission for approval.

2.4.2 Site Asset Management Oversight Committee (SAMOC)

As the site Asset Owners, the Site Asset Management Oversight Committees (SAMOCs) shall review, challenge, and approve investment options (documented in AIOTs). As part of these activities, SAMOCs should review and approve all submissions and updates to the baseline risk profiles of site assets to ensure that the site is operating within equipment reliability margins.

Asset investment option approval limits, detailed function, structure, accountabilities, and deliverables of each SAMOC are documented in **N-GUID-08120-00002, Asset Management Oversight Committee Terms of Reference**.

The AMOC and Project Management Oversight Committee (PMOC) relationship and responsibilities are illustrated in **Appendix C**. See **Section 2.6.1** for PMOC.

2.4.3 Nuclear Asset Management Oversight Committee (NAMOC)

As the fleet Asset Owner, the Nuclear Asset Management Oversight Committee (NAMOC) shall review, challenge, and approve investment options (documented in AIOTs). As part of these activities, NAMOC should also review and approve all submissions and updates to the baseline risk profiles of fleet assets to ensure that the fleet is operating within equipment reliability margins.

Asset investment option approval limits, detailed function, structure, accountabilities, and deliverables of NAMOC are documented in **N-GUID-08120-00002, Asset Management Oversight Committee Terms of Reference**.

2.5 Optimization of Asset Investments for Business Planning

Optimization shall be conducted with a target of setting the start date of each approved investment option over the business planning period to maximize total portfolio asset investment net value within financial, resource and scheduling constraints. The start date should be determined based on consideration of asset risks to be mitigated, as well as the resources required and available to meet the target start date.

All approved asset investment options shall be included as candidates for the asset investment portfolio. The Asset Management Tool uses a multi-criteria decision analysis model for asset investment portfolio optimization. As part of optimization, input from SMEs for the asset risk areas may be consulted at the portfolio level. The optimization compares and re-arranges the combination, selection and timing of investments based on the Asset Investment Net Value to maximize portfolio value within the given constraints.

NAMOC shall ensure optimization is conducted at the portfolio level and direct any changes to the optimized investment portfolio, as required. Once finalized, AIOTs should be updated as needed to align with the outcome of optimization, such as updating the timing of investments or the preferred investment option.

The asset investment portfolio shall then be incorporated into the Business Plan for CNO, President – Nuclear, CFO, CEO and Board approval.

2.5.1 Optimization Constraints

Optimization should consider the following constraints at a minimum:

1. Financial constraints in respect of capital, project OM&A and provision funding limits
2. Resourcing constraints, including engineering design resources as well as capacity and capability to execute projects in a given time period
3. Scheduling constraints, including outage plans, outage window availability, project interdependencies and supply chain strategic sourcing opportunities

2.5.2 Integration with Business Plan

The approved business plan shall form the baseline for project new starts and planned outages.

Approval for the Business Plan is governed by **OPG-PROG-0037, OPG Business Planning**, and **N-PROG-AS-0005, Nuclear Business Planning**.

2.6 Implementation of Approved Investment Options

Investment options approved in the Business Plan may be implemented as base inspection and maintenance programs or projects. Asset Owners (who may delegate to Asset Managers) may engage Service Providers to execute and provide execution oversight of selected investments.

2.6.1 Projects – Project Management Oversight Committee (PMOC)

Once approved asset investments have been included in the Business Plan, each site Project Management Oversight Committee (PMOC) provides project execution oversight, all gate approvals, and recommends OAR approval of project scope and funding release in the form of a Business Case Summary (BCS). The intent of the PMOC is to ensure project objectives, risks, and performance throughout the project lifecycle are in line with the expectations of the approved asset investment option, and that the project is being delivered within its scope, cost and schedule commitments.

Detailed function, structure, accountabilities, and deliverables of PMOC are documented in Terms of Reference documents listed in **Section 5.3.1 Performance References – Asset Management**.

The BCS documentation and approval requirements, as well as materiality of changes, are described in **OPG-STD-0076, Developing and Documenting Business Cases**. The project management and oversight criteria are described in **OPG-STD-0148, Project Management**.

The AMOC and PMOC relationship and responsibilities are illustrated in **Appendix C**.

2.7 Results Measurement and Reporting

At maturity, the efficacy and efficiency of the asset management process shall be measured and reported to SAMOC and NAMOC on a periodic basis.

KPIs should cover a number of key performance areas, including:

- Financial performance
- Asset risk management/Equipment reliability
- Investment plan stability
- Asset management program efficiency and effectiveness

3.0 ROLES AND ACCOUNTABILITIES

3.1 Asset Owner

- An Asset Owner is an AMOC that owns the site/fleet asset reliability and performance, by carrying out a number of asset management activities, including the following:
  - Approves Asset Management Value Framework (NAMOC only)
  - Maintains a list of all material site assets under the Asset Hierarchy
  - Determines and reviews the Asset Hierarchy on a periodic basis
  - Establishes asset risk tolerance (NAMOC only)
  - Assigns Asset Managers
  - Approves AIOTs and updates to risk profiles of assets
  - Ensures optimization of the asset investment portfolio is conducted
  - Monitors Asset Management KPIs and directs follow-up actions

- Detailed function, structure, accountabilities, and deliverables of AMOCs are documented in **N-GUID-08120-00002, Asset Management Oversight Committee Terms of Reference**.

3.2 Asset Manager

- An Asset Manager is the person or group delegated or assigned by an Asset Owner to manage asset reliability and performance, asset lifecycle strategies and plans, by carrying out asset management activities, including the following:
  - Prepares, updates, and submits AIOTs to Asset Owners
  - Ensures risk profiles of assets being managed are properly characterized and updated
  - Provides all supportive material as required by the Asset Owners for prudent decision-making
  - Identifies and liaises with Service Providers for project execution

- Examples of Asset Managers may include Performance Engineering, Components Engineering, and Ops & Maintenance, etc.

3.3 Service Provider

- A Service Provider is an organization that supports any of the following asset management activities:
  - Replaces assets
  - Installs assets
  - Maintains assets
  - Repairs assets
  - Acquires and stock spares
  - Reports results

4.0 DEFINITIONS AND ACRONYMS

4.1 Definitions

- **Asset Hierarchy**: A systematic view of all existing and new assets under management based on (1) the criticality of the systems a given asset supports, (2) the asset value, and (3) the physical attributes of the asset. The intent is to have an asset hierarchy such that assets can be managed effectively and holistically.
- **Asset Investment Net Value**: The calculated value assigned to each asset investment option
- **Asset Investment Option Template (AIOT)**: A template to capture essential information of an asset, such as risk values over time, costs, scope, schedule, risks, and financial impact for each of the investment options, and the investment option recommended by Asset Managers. At maturity, each investment option should outline the potential strategy to maintain asset to end of station life. Refer to the **AIOT Preparation Guide**.

- **Asset Management Tool**: The technology platform used to support the Asset Management process
- **Asset Managers**: Refer to **Section 3.2**
- **Asset Owners**: Refer to **Section 3.1**
- **Asset Risk Profile**: A structure that describes how asset risk is considered. Refer to **N-GUID-08120-00003, Asset Management Value Framework**.
- **Business Case Summary**: A business document that outlines the justification for approving project scope and funding release. Refer to **OPG-STD-0076, Developing and Documenting Business Cases**.
- **Nuclear Asset Management Oversight Committee (NAMOC)**: A fleet-level executive committee that has the authority to oversee and approve the asset management policy, value framework, objectives, risk tolerance, constraints, baseline risk profile of fleet assets, asset investment options, and asset investment portfolio for inclusion in the business plan. Refer to **N-GUID-08120-00002, AMOC Terms of Reference**.
- **Optimization**: The process of setting the start date of all asset investment option candidates within a period of time to maximize the total portfolio asset investment net value while considering various financial, resource and scheduling constraints.
- **Portfolio**: A group of asset investment options.
- **Project Execution Organization**: A group specializing in project execution and project management. Projects & Modifications is the largest project execution organization in Nuclear operations. Other groups with project execution expertise and resource may also execute projects.
- **Project Management Oversight Committee (PMOC)**: A site-level management committee for project execution oversight and approval of project scope, all gate approvals, and funding release
- **Risk Value**: Values assigned to both the baseline and residual risks of assets. Each Value data point is defined by the probability of a failure of the asset and the consequence in the event of the failure. It is used to compare the value between investment options. Refer to **N-GUID-08120-00003, Asset Management Value Framework**.
- **Service Providers**: Refer to **Section 3.3**
- **Site Asset Management Oversight Committee (SAMOC)**: A site-level management committee that has the authority to oversee and approve baseline risk profile of site assets and asset investment options. Refer to **N-GUID-08120-00002, AMOC Terms of Reference**.
- **Value Framework**: A methodology that incorporates all risks, financial impact, and investment cost into a common scoring framework; thereby enabling comparison, and optimization of individual asset investment options.

4.2 Abbreviations and Acronyms

AIOT	Asset Investment Option Template

AMOC	Asset Management Oversight Committee
BCS	Business Case Summary
CCA	Component Condition Assessment
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CNO	Chief Nuclear Officer
EC	Engineering Change
IEE	Item Equivalency Evaluation
IRI	Inspection and Reactor Innovation
KPI	Key Performance Indicators
NAMOC	Nuclear Asset Management Oversight Committee
NWM	Nuclear Waste Management
OAR	Organization Authority Register
PM	Preventive Maintenance
PMOC	Project Management Oversight Committee
PPE	Property, Plant and Equipment
SAMOC	Site Asset Management Oversight Committee
SME	Subject Matter Expert
SPOC	Single Point of Contact
SRE	System Responsible Engineer

5.0 BASES, RECORDS AND REFERENCES

5.1 Bases

- ISO 55000, Asset management – Overview, principles and terminology
- ISO 55001, Asset management – Management systems: Requirements
- ISO 55002, Asset management – Management systems – Guidelines for the application of ISO 55001

5.2 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	Filing Information/Retention
Asset Investment Option Template	Asset Management Tool
Baseline Risk Profiles of Assets	Asset Management Tool
Asset Investment Portfolio Snapshots	Asset Management Tool
Business Plan	BPC
Long-Term Outlook (LTO)	BPC

5.3 References

5.3.1 Performance References – Asset Management

- AIOT Preparation Guide, prepared by Investment Management
- N-GUID-08120-00002, Asset Management Oversight Committee Terms of Reference
- N-GUID-08120-00003, Asset Management Value Framework
- D-GUID-01920-10024, Darlington Project Management Oversight Committee Terms of Reference
- I-REF-00120-00001, Inspection and Reactor Innovation Project Management Oversight Committee Terms of Reference
- W-REP-00120-00001, Project Management Oversight Committee Terms of Reference – Nuclear Waste Management Division
- P-GUID-01920-10020, Pickering Nuclear Project Approval Committee (PAC) Terms of Reference

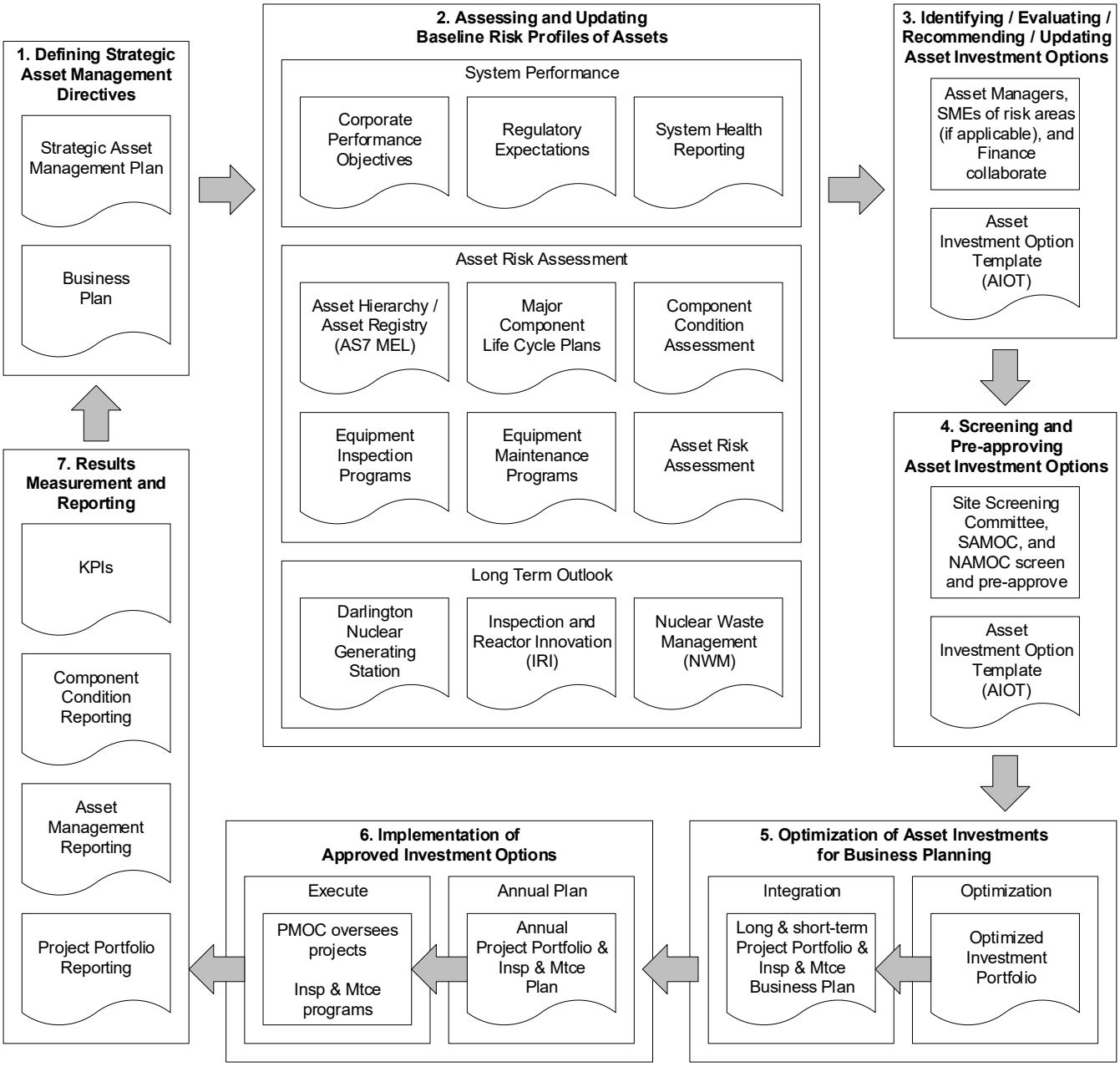
5.3.2 Performance References – Others

- FIN-STD-0006, Property, Plant and Equipment
- N-PROG-MA-0017, Component and Equipment Surveillance
- N-PROG-MA-0025, Major Components
- N-PROG-MA-0026, Equipment Reliability
- N-PROG-MP-0008, Integrated Aging Management
- N-PROG-RA-0016, Risk and Reliability
- OPG-PROG-0039, Project Management
- OPG-STD-0076, Developing and Documenting Business Cases
- OPG-STD-0148, Project Management

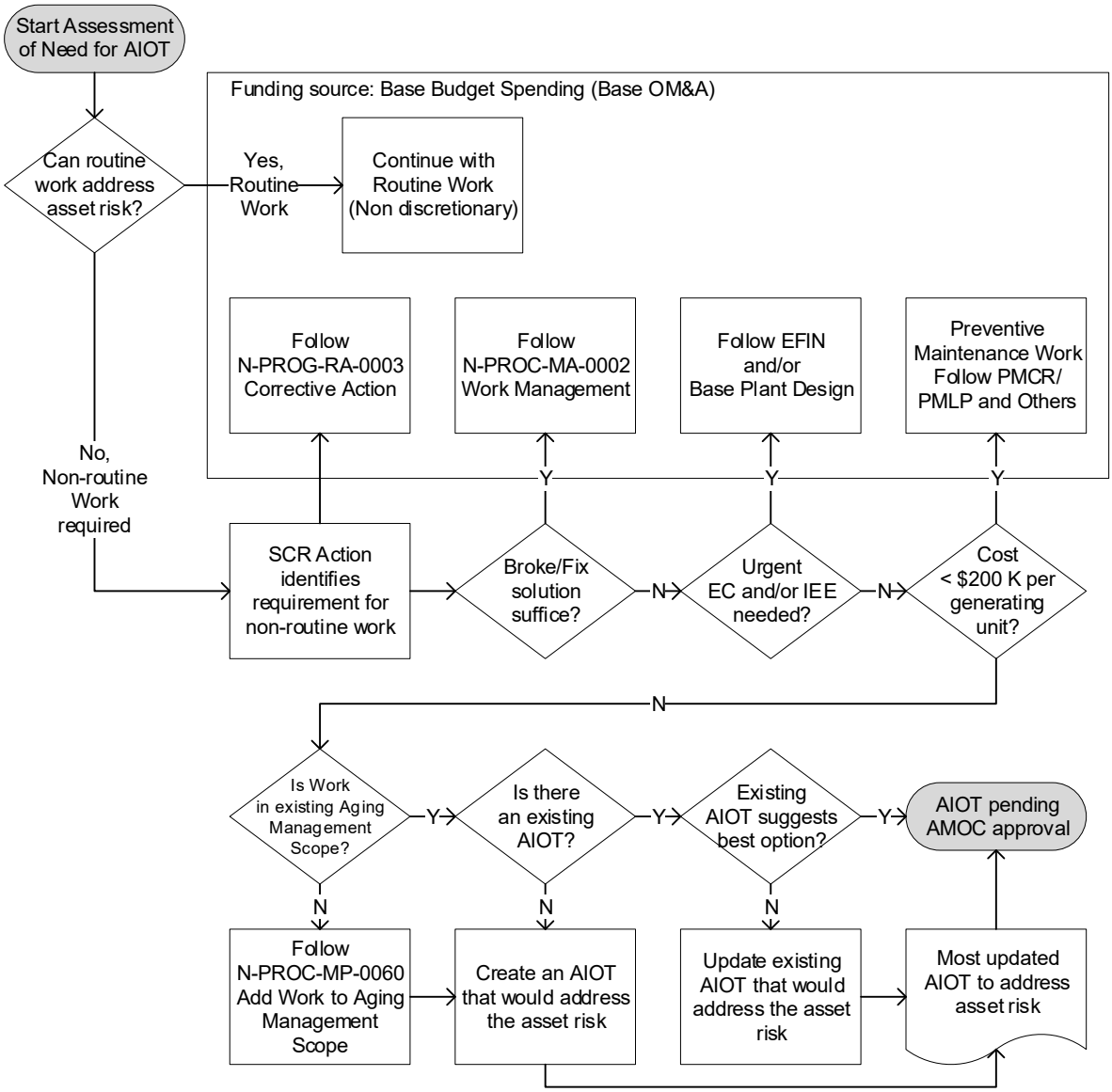
5.4 Development References

- N-PROG-AS-0005, Nuclear Business Planning
- OPG-PROG-0006, Investment Management
- OPG-PROG-0037, OPG Business Planning

Appendix A: Asset Management Process



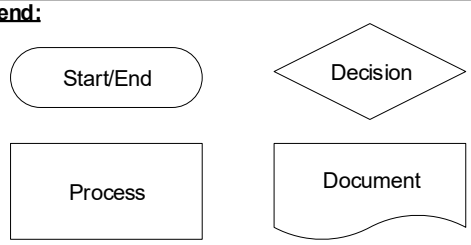
Appendix B: AIOT Need Criteria Flowchart



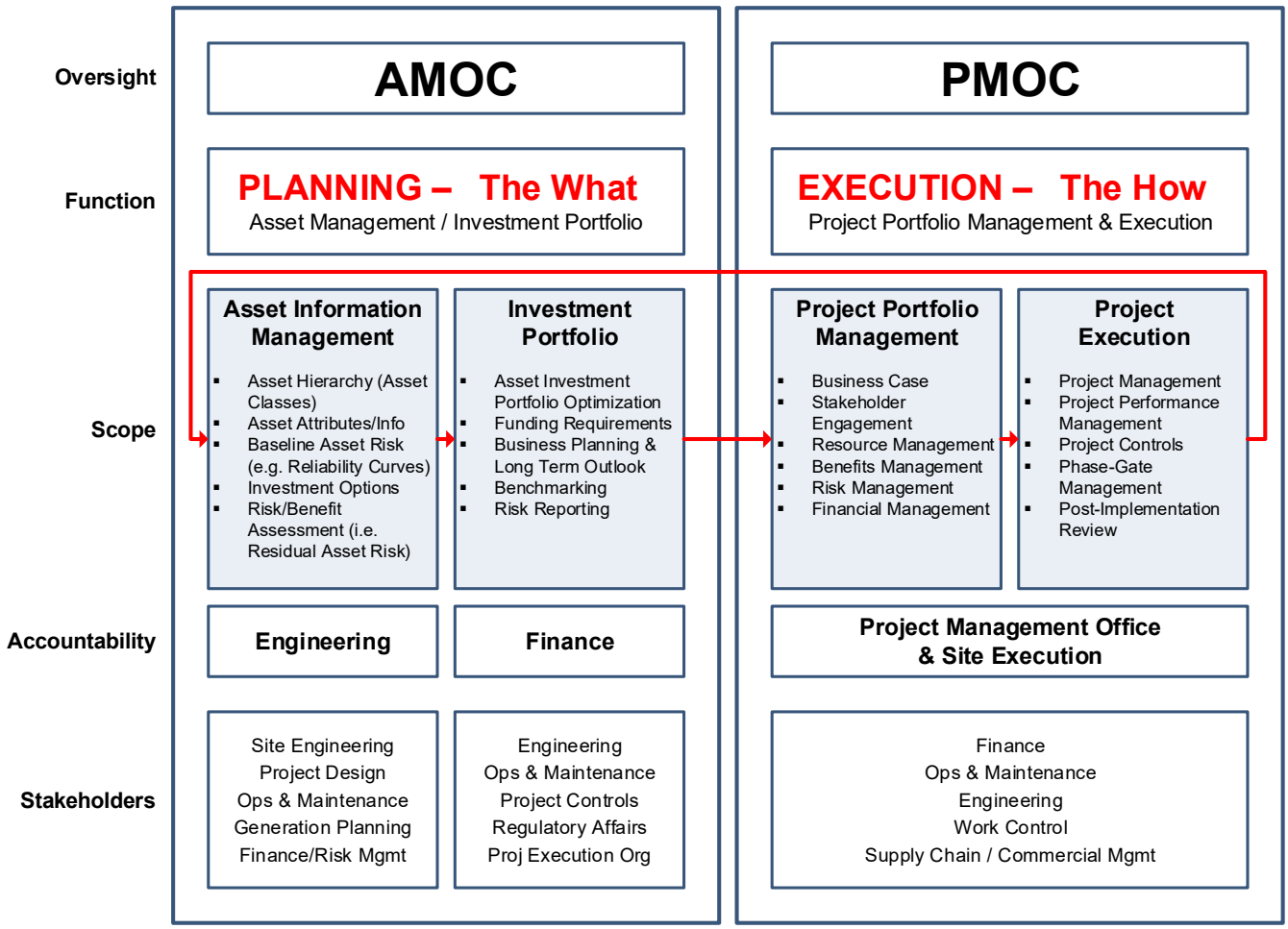
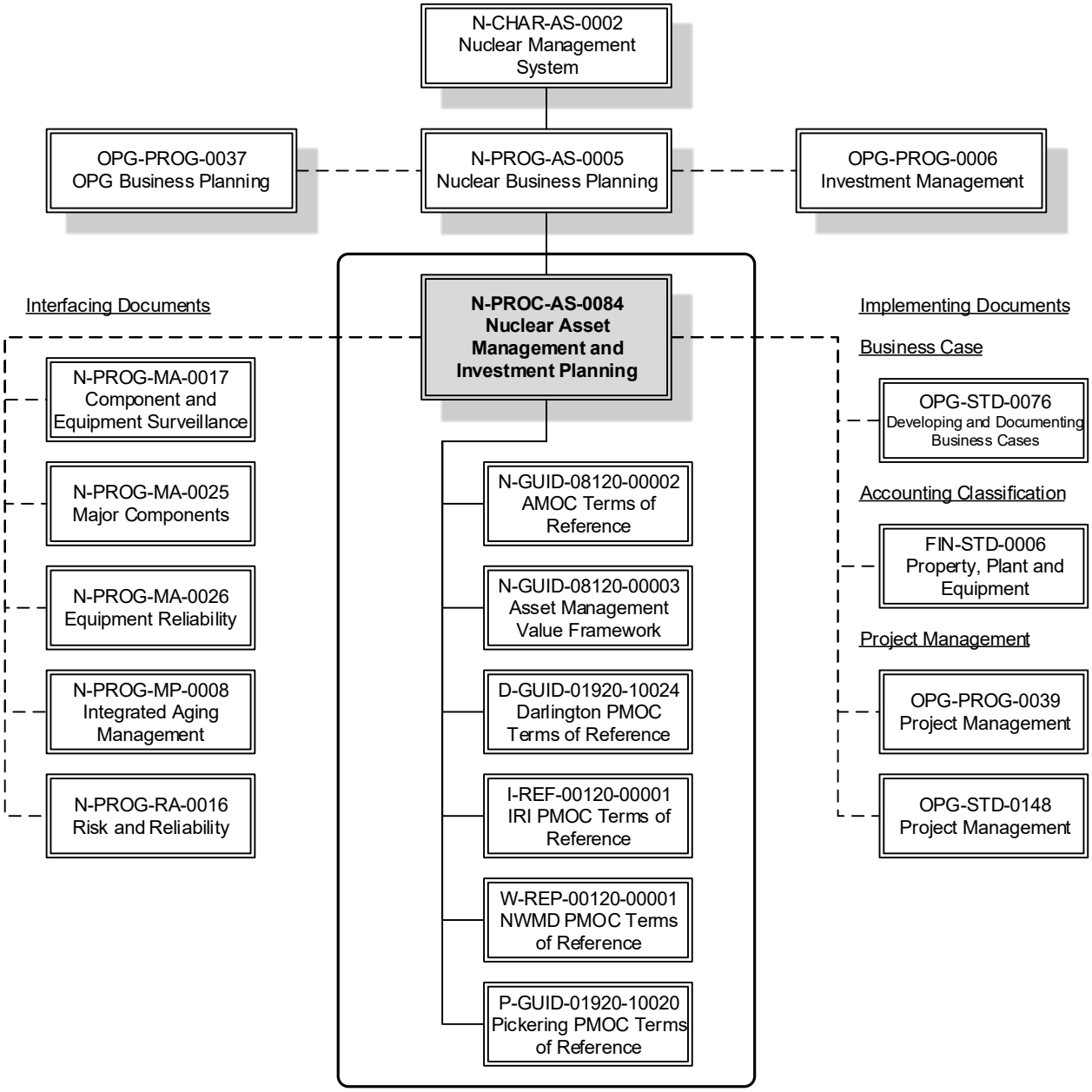
Acronyms

EC: Engineering Change
EFIN: Engineering Fix It Now
IEE: Item Equivalence Evaluation
PMCR: Preventive Maintenance Change Request
PMLP: Preventive Maintenance Living Program
SCR: Station Condition Record

Legend:



Appendix C: AMOC and PMOC Relationship and Responsibilities



Appendix D: Asset Management Governance Hierarchy