EXECUTION COPY

AMENDMENT AGREEMENT NUMBER 7

This Amendment Agreement Number 7 (this "**Agreement**") is made as of July 1, 2017 between

ONTARIO POWER GENERATION INC., a corporation existing under the laws of Ontario ("**OPG**"),

and

SNC-LAVALIN NUCLEAR INC. a corporation existing under the laws of Canada, and **AECON CONSTRUCTION GROUP INC.**, a corporation existing under the laws of Canada, acting jointly and severally (collectively, the "**Contractor**") doing business as a contractual joint venture known as the "SLN-AECON Joint Venture".

Recitals

A. OPG and the Contractor entered into an engineering, procurement and construction agreement dated as of March 1, 2012, as amended on October 1, 2012, February 28, 2014, November 2, 2015, January 11, 2016, February 1, 2016, and June 7, 2016 (the "**RFR EPC Agreement**"). Under the RFR EPC Agreement, the Contractor is obliged to provide the Work in respect of the retube and feeder replacement project involving the nuclear reactors located at the Darlington nuclear generation station ("**DNGS**") in Clarington, Ontario, on the terms and conditions set out in the RFR EPC Agreement.

B. OPG and the Contractor have agreed to amend the RFR EPC Agreement to incorporate:

1. Project Change Directives numbers 012 (R02), 015(R02), 017, 023 (R01), 024 (R01), 029, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 040, 042, 046, 047 and 049 into the RFR EPC Agreement through changes in the following exhibits:

   (a) Exhibit 1.1 (III) EPCIR;

(b) Exhibit 2.1 (RFR Scope of Work) Part I (Darlington Retube and Feeder Replacement Scope of Work) and Part II (Darlington Nuclear Refurbishment – Outage Unit Containment Isolations);
(c) Exhibit 3.1(a) (Definition Phase Milestone Schedule);
(d) Exhibit 3.1(b) (Execution Phase Milestone Schedule);
(e) Exhibit 4.7 (Economic Cost Adjustments);
(f) Exhibit 6.1 (Pricing);
(g) Exhibit 7.1(b) (Tooling Milestone Payment Table); and

2. other changes to the RFR EPC Agreement, as specified in this Agreement.

For value received, the Parties agree as follows.

1. Interpretation

Any defined term used in this Agreement that is not defined in this Agreement has the meaning given to that term in the RFR EPC Agreement.

2. Change to Exhibit 1.1(III) (EPCIR)

Exhibit 1.1(III) (EPCIR) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 1.1(III) – EPCIR" attached to this Agreement as Attachment A.

3. Change to Exhibit 2.1 (RFR Scope of Work)

Part I (Darlington Retube and Feeder Replacement Scope of Work) and Part II (Darlington Nuclear Refurbishment – Outage Unit Containment Isolations) of Exhibit 2.1 (RFR Scope of Work) of the RFR EPC Agreement are deleted in their entirety and replaced with the revised versions of the documents entitled "Part I – Darlington Retube and Feeder Replacement Scope of Work" and "Part II – Darlington Nuclear Refurbishment – Outage Unit Containment Isolations" attached to this Agreement as Attachment B. For clarity, Part III (Preliminary Design Requirements for Containment Isolations Designs), Part III(a) (R00 Addendum 001: Preliminary Design Requirements For Containment Isolation Designs) and Part IV (Retube Waste Processing Building (RWPB) Scope of Work) of Exhibit 2.1 (RFR Scope of Work) remains in effect, unamended.

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4. Change to Exhibit 3.1(a) (Definition Phase Milestone Schedule)

Exhibit 3.1(a) (Definition Phase Milestone Schedule) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 3.1(a) – Definition Phase Milestone Schedule" attached to this Agreement as Attachment C.

5. Change to Exhibit 3.1(b) (Execution Phase Milestone Schedule)

Exhibit 3.1(b) (Execution Phase Milestone Schedule) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 3.1(b) – Execution Phase Milestone Schedule" attached to this Agreement as Attachment D.

6. Change to Exhibit 4.7 (Economic Cost Adjustments)

Exhibit 4.7 (Economic Cost Adjustments) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 4.7 – Economic Cost Adjustments" attached to this Agreement as Attachment E.

7. Change to Exhibit 6.1 (Pricing)

Exhibit 6.1 (Pricing) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 6.1 – Pricing" attached to this Agreement as Attachment F.

8. Change to Exhibit 7.1(b) (Tooling Milestone Payment Table)

Exhibit 7.1(b) (Tooling Milestone Payment Table) of the RFR EPC Agreement is deleted in its entirety and replaced with the revised version of the document entitled "Exhibit 7.1(b) – Tooling Milestone Payment Table" attached to this Agreement as Attachment G.

9. Change to Section 11.3(a) (Tooling IP Arrangements)

Section 11.3(a) (Tooling IP Arrangements) of the RFR EPC Agreement is deleted in its entirety and replaced with the following:

"For the purposes of permitting OPG to enjoy the full benefit of the Tooling IP and the Tooling IP Rights where OPG is entitled to obtain all rights or license such rights in accordance with section 11.2(b), the Contractor will, within sixty (60) days of execution of this Agreement, identify the Documents required to give OPG the full benefit of the Tooling IP and the Tooling IP Rights, including those Documents relating to items and materials included in the categories listed in Exhibit 11.3(a) (the "Tooling IP List") (collectively, the "Initial Tooling Documents") and provide a list of the Initial Tooling Documents to OPG. The Contractor will update the Tooling IP List on a quarterly basis, to include any new Documents relating to items or materials included in the categories listed in the Tooling IP List conceived, authored, designed, invented, otherwise created, acquired, made or used, or Tooling IP created, in the performance of the Tooling Work (the "Additional Tooling Documents") (the Initial Tooling Documents and the Additional Tooling Documents, collectively, the "Tooling Documents") and, within each such quarterly period, provide to OPG notice of the update to the Tooling IP List. The Contractor will place the Tooling Documents into escrow or other secure arrangement as may be agreed by the Parties, and will enter into any agreement(s) required to give effect to such arrangement, including the escrow agreement referenced in section 11.3(b)."

10. RFR EPC Agreement Remains in Full Force

Except for changes to the RFR EPC Agreement set out in this Agreement and any previous Amendment, the RFR EPC Agreement remains in full force, unamended.

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The Parties have duly executed this Agreement.

ONTARIO POWER GENERATION INC.

By: _____
Name: Robby Sohi
Title: CSO

SNC-LAVALIN NUCLEAR INC.

By: _____
Name: ROBERT STEWART
Title: SR. VICE PRESIDENT, OPERATIONS

AECON CONSTRUCTION GROUP INC.

By: _____
Name: Ian Turnbull
Title: Sr. V.P. Aecon Energy East

Attachment A

Exhibit 1.1(III) – EPCIR

See attached.

ONTARIOPOWER GENERATION

Deliverables and Activities Interface Agreement

Internal Use Only
Document Number: NK38-DAI-09701-10008
Revision: R003

Title:
RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

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NK38-DAI-09701-10008

RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

(Purchase Order 213497)
22 June 2017

Associated Project Number: 73100

Internal Use Only

Prepared by: Chad Da Maren
Section Manager, OSM&MODs
Retube and Feeder Replacement
Date: 22JUNE17

Approved by: Mark Small
Senior Manager, Supply Chain Quality Services
Supply Services Projects-Nuclear/Refurb
Date 22-JUN-2017

Approved by: Emily Tarle
Director Refurbishment Engineering
Nuclear Projects
Date 23-June-2017

Revision Summary

Revision No.	Description of Revision:
R000	Initial Issue
R001	Obsolete. All subsequent revisions are made against the R000 version of the document

R002	• Incorporation deviation list previously agreed to in September 2013;
	  o Item 3.25: Reference updated
	  o Item 4.11: Contractor's procurement activities to be in accordance with the EPC agreement. Where sub-contractors are not on OPG ASL, the Contractor shall follow the agreements submittal process. Appendix E added to clarify.
	• Updates since September 2013
	• General:
	  o replaced 'PassPort' with 'Asset Suite'
	  o replaced 'SDH' with 'VenDM'
	  o replaced 'OPG Project Representative' with 'OPG'
	  o replaced 'Contractor Project Representative' with 'Contractor'
	• Section 2.1 Process:
	  o Deleted text qualifying the scope of application; i.e., limiting scope to only 'nuclear related' work. Included explanation of the use of deviation list.
	  o Removed engineering and procurement gap analysis reference.
	• Section 2.2; added "and Project Quality Assurance Plan"
	• Section 2.2.1:
	  o Text updated to align COIR with OPG/JV RFR project agreement.
	  o Clarified applicability of Category 1 tooling.
	  o Included reference to N-PROC-MP-0105
	  o OPG Enterprise Asset Management – Asset Suite 7
	  o Identified N-GUID-08133-10072 as a new reference
	• Section 2.2.2: revised wording with respect to PEO Act and removed reference to Bounded Set.
	• Section 2.3 OPG Roles and Accountabilities
	  o Item (e) removed; "OPG shall be involved in developing Commissioning work plans (or comprehensive work packages) for OPG approval." Accountabilities are now detailed in Section 5.
	• Section 2.4: Added 'It is expected the Contractor will retrieve the latest version of OPG forms, templates and procedures etc. at the beginning of each Contractor activity.'
	• Section 2.5 Deviations from the IR:
	  o Identified the use of N-FORM-11070
	• Engineering (Section 3) updates
	  o Section 3.0: deleted 'All Category 1 tooling and' from introductory

	sentence. o Item 3.2; Removed 'Business Services (where not otherwise specified in this document as required to support OPG's QA program. o Item 3.5 'Reports' reitemized as 3.5 a). Clarified that OPG accountability includes Review in the title. Added 3.5 b) 'Certified Design Report' to distinguish the OPG and Contractor references to be used for each. o Item 3.9; added N-FORM-11524 as reference and deliverable. o Item 3.13: deleted 'or equivalent' from deliverable. o Item 3.17; updated to reflect OPG is accountable for Master EC preparation. Contractor to support as required. Added N-GUID-08133-10072. o Item 3.28, 3.37, 3.39, 3.72, 3.76, 3.77, 3.88; Clarified use of N-GUID-08133-10072. o Item 3.19; clarified OPG to support as required. o Item 3.20: 'Modification Design Requirements': Title changed to Package Design Requirements. Accountabilities updated; Modification Design Requirements are to be prepared by OPG. Package Design requirements are to be developed by the Contractor. Contractor references added. o Item 3.21; Cross reference corrected to 3.87. o Item 3.23; Changed 'Field Verifies' to 'Verifies' in Contractor Accountability. Contractor references updated. o Item 3.25: Changed reference from 2206-07-20-TF0001 to -TF0038. o Item 3.27: specified that Issue Tracking File deliverable will be included in Section 4 of the Design Plan and that a copy will reside in the working files folder. o Item 3.32: Item titled changed from 'Design Manuals – New' to 'Design Manuals'. o Item 3.34: added N-PROC-MP-0089 reference. o Item 3.37: OPG APPROVE Accountability removed. Provided clarity on support role. o Item 3.39: Replaced 'N-INS-03561-10007' with 'N-GUID-03651-10002' o Item 3.44; added NK38-GUID-50000-10001 reference o Item 3.46: clarified OPG accountability is ACCEPT o Item 3.47; added 2206-07-WI-0003 reference and HF Engineering Program Plan and HF work sheets as deliverables. o Item 3.51; editorial – ACCEPT added to title to reflect existing text. o Item 3.52: added NK38-GUID-01900-10001, Darlington Refurbishment: Design Completion Assurance to references o Item 3.54; reference N-GUID-01900-10001 replaced with NK38-GUID-01900-10001.Verification 'Report' deliverable changed to Verification 'Package' o Item 3.58: changed reference 'N-PROC-MA-0095' to 'N-INS-

	08125-10001' o Item 3.64: editorial – ACCEPT added to title to reflect existing text. Cross reference to items 3.66 and 3.67 corrected to 3.65 and 3.66 o Item 3.65; changed reference list to include Contractor references only. Deleted 'per an OPG approved process for controlling change' from Contractor Accountability. o Item 3.70; added Derived Requirements to contractor accountability. o Item 3.71; cross reference corrected to identify item 3.72 • Procurement (Section 4) updates o Item 4.3: Reference to '3.78' corrected to '3.77'. o Item 4.7: Clarified Procurement Evaluation is for Maintenance Spare Parts and added N-PROC-MP-0098. o Item 4.13: removed text 'if disposition suggests use as is or requires repair/rework'. Contractor reference updated. o Item 4.14 a) retitled as 'Non Conformances (Not applicable to OSM Tooling). Contractor reference updated. o Item 4.14 b) retitled as 'Non Conformances (Applicable to OSM)' and added accountabilities. Previous item listed as 4.14 b), 'Non-conformance post execution' reitemized as 4.14 c) • Construction (Section 5) updates o Items 5.1; added Reference. Specified that deliverable is a Construction Quality Assurance Plan. o Item 5.2; separated into a) Safety Program and b) Environmental Program. No change in accountabilities. o Item 5.4 'Control of Field Changes'; clarified work to be performed under a) ECC - OPG governance and work to be performed under b) Non ECC - Contractor governance. Accountabilities for non ECC changes clarified. o Item 5.5: Contractor References Added. Removed OPG accountability to approve the schedule. o Item 5.6: clarified 'Work Order Assessing/Planning' to be performed under a) OPG governance and b) Contractor governance. o Item 5.7: retitled 'Work Plans'; clarified work to be performed under OPG governance. Update OPG references. o Item 5.8: retitled 'Preparation of Comprehensive Work Package'. Preparation and content clarified in 5.8 a) thru 5.8 j). Contractor references added. o Item 5.9: specified readiness/challenge meeting and work release to be performed under a) OPG governance and b) Contractor governance. o Item 5.10: specified permitry planning for a) OPG equipment and b) Contractor Tools and Equipment. o Item 5.11: specified permitry execution for a) OPG equipment and b) Contractor Tools and Equipment o Item 5.12; clarifies OPG is the approving authority. Updated

references and deliverables.

- Item 5.13: specified Calibration for a) permanent station equipment and b) Contractor Equipment. Replaced reference 'N-INS-01516-10009' to 'N-INS-09100-10012'.
- Item 5.13 a) Changed reference 'N-INS-01983.1-10012' to 'N-MAN-01983-10000'.
- Item 5.13 a) OPG accountability changed from Support to Review and Accept.
- Item 5.14: title changed from 'Construction Completion Certificate' to 'Construction Completion Declaration (Return to Service)'. OPG References replaced with Contractor References.
- Item 5.15: retitled 'Contract Construction Completion'; updated to reflect contract requirements
- Item 5.16: Added N-GUID-09701-10020
- Item 5.17: modified to reference Item 3.69
- Item 5.18: modified to reference Item 3.70
- Item 5.19 'Vault Access'; New. Accountabilities clarified.
- Item 5.20 'Plant Status Control'; New. Added to reflect OPG governance.

- Appendix A updates
  - Replaced 'N-INS-01516-10009' with 'N-INS-09100-10012' which superseded it. It was a duplication of work reporting requirements for M&TE.
  - Removed reference to N-INS-08132-10000 as it has been obsoleted as this legacy document under N-PROG-MP-0001 was rarely used.
  - Replaced 'N-PROC-MA-0095' with 'N-INS-08125-10001' which superseded it. N-INS-08125-10001 gets direct authority from N-PROC-MP-0034 under N-PROG-MA-0026.
  - Removed reference to FIN-MAN-CM-001 as it has been obsoleted as each BU developed governance for management of contractors which replaces OPG wide FIN-MAN documents.
  - Replaced 'N-INS-01983.1-10012' with 'N-MAN-01983-10000' which superseded it. The governing document framework specified in N-PROG-AS-0007 has been changed.
  - Replaced 'N-PROC-AS-0069' with 'N-MAN-01983-10000' which superseded it. The governing document framework specified in N-PROG-AS-0007 has been changed.
  - Reference 'N-GUID-08130-10008' removed as it has been replaced by the Assessing On-Line Guide.

R003	Changes as per NK38-DAI-09701-0586750 R000 (Reference: NK38-CORR-09701-0586892) COIR List of Deviations February 29, 2016: Line item #: 3.36, 3.70, 4.14(b). Changes as per NK38-DAI-09701-10008 (Reference: NK38-CORR-09701-0613758) COIR List of Deviations November 20, 2015 Section 2.2.1, Line item #: 3.18, 3.19, 3.20, 3.22, 3.23, 3.24, 3.25, 3.27, 3.42, 3.80 RWPB COIR List of Deviations February 11, 2016 Line item #: 3.2, 3.5 (a), 3.5 (b), 3.17, 3.22, 3.28, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.39, 3.40, 3.43, 3.44, 3.45, 3.46, 3.47, 3.48, 3.49, 3.50, 3.51, 3.56, 3.57, 3.58, 3.59, 3.64, 3.65, 3.66, 3.78, 3.79, 3.80, 3.81, 3.82, 3.83, 3.84, 3.85, 3.86, 3.87, 3.88, Note 1 Changes as per NK38-DAI-09701-0608152 (Reference: NK38-CORR-09701-0608283) COIR List of Deviations July 26, 2016 Line Item #: 3.36 (a), 3.36 (b) Added "Item 5.13 a) OPG accountability changed from Support to Review and Accept." to the list of Revision 2 change.

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1.0 INTRODUCTION

1.1 Scope

This Interface Requirements (IR) outlines the specific responsibilities and interfaces between OPG and the SNC Lavalin-Aecon Joint Venture ("the Contractor") while performing activities in support of the Retube Feeder Replacement (RFR) Project for the Darlington Refurbishment.

1.2 Purpose

The purpose of the IR is to facilitate the successful implementation of the RFR Project by ensuring that Engineering, Procurement, and Construction activities are in conformance with OPG and other regulatory requirements.

1.3 Safety

Safety is the paramount priority when conducting any business activity in OPG Nuclear.

Safety includes Nuclear, Conventional, Environmental, and Radiological safety aspects. Our business needs to comply with all applicable Federal and Provincial regulatory requirements.

2.0 DESCRIPTION

2.1 Process

This IR is to be used for any work conducted under the RFR project.

Specific work packages including modifications, replacement and repair activities may be required to use only some portions of this document. These will be documented in a deviation list (see section 2.5), signed by OPG and the contractor. Contractor steps may not apply to all work and are illustrative to support the OPG/Contractor Interface Requirements. The items in this IR are intended to outline the interface with OPG and the Contractor, and may or may not be sequential or reflective of business processes within OPG.

A gap analysis (NK38-REP-09701-10121) was completed to determine what processes and procedures under the Contractor's quality assurance program were deemed equivalent to OPG standards and requirements. Those processes and procedures acceptable to OPG are cited in Sections 3 and 4. A summary of both OPG and SLN-A governance has been provided in section Appendix A. Sections 3 to 5 of this document details typical deliverables or items related to projects where there is an OPG/Contractor interface in the delivery of work.

2.2 Contractor Responsibilities

The Contractor shall have and maintain full working knowledge of OPG's Design and Configuration Management standards and procedures to ensure that design basis and plant configuration management standards are maintained throughout the project life cycle.

The Contractor has responsibility for maintaining accuracy of technical content and compliance with the Contractor's Quality Assurance Program and Project Quality Assurance Plan.

2.2.1 Governing Procedures

All design packages will be performed in accordance with the Contractor' s Quality Assurance Program, the Scope of Work which includes OPG Specification for each project, and any related Engineering Plans as defined in this IR.

All modifications will follow OPG Risk Based Modification Process N-PROC-MP-0090, with the exception of Category 1, 2, 3 and 4 Tooling engineering and Mock-ups engineering. With respect to procurement activities, in case of conflict, the provisions in Exhibit 2.11- Procurement Work, shall take precedence over the interface requirements set out in this document.

Category 1 Tooling tie-ins to the station follow N-PROC-MP-0090.

Category 1, 2 and 3 Tooling follows N-PROC-MP-0105.

Category 1, 2, 3 and 4 Tooling will follow Tooling Quality Design Plan NK38-DP-31110-10001 and are not subject to these interface requirements.

Mock-ups engineering will follow the Contractor's Quality Assurance Program and Project Quality Assurance Plan (SLN 509407-000-00D00-38QP-0001).

Tooling design will follow the requirements set out In section 4.6 of NK38-DR-31110-10000 (Contract Exhibit 1.1 (hhhhhhh) - Tooling Design Requirements).

Mock-up design will follow the requirements in Darlington Energy Complex (DEC) Mockup Scope of Work (Schedule 1.1 (oo) -Mock-Ups Scope of Work within Contract Exhibit 1.1 (wwww) - Mock-Ups Contract).

The Preparer, Verifier, and Approver of the Design Packages must be qualified to the Contractor's quality assurance program.

OPG Enterprise Asset Management - Asset Suite 7 (Formerly PassPort)

Asset Suite will remain as a repository for EC changes and to control modification packages as per the CNE Directive.

Population of Asset Suite will not be sequential with modification progression. Rather only relevant Asset Suite panels will be populated as needed to progress work and maintain configuration management (per N-GUID-08133-10072). The Contractor will be required to populate the relevant Asset Suite panels at the end of the following modification phases:

(a) At the end of **Modification Planning** to register Design ECs and flag the Associated Document List (ADL)/Associated Equipment List (AEL).

(b) At the end of **Design Completion** and prior to **Available for Service** to incorporate all field, and non-intent changes.

(c) Prior to **Closeout** to launch the AEL, and populate closeout related panels.

A scanned version of the Design Package shall be uploaded to VenDM. When the opportunity arises to populate Asset Suite, the EC packages shall be attached to the RDL of the relevant Master or Design EC.

Approval of the EC resides with the scanned copies of the packages in VenDM or Asset Suite

2.2.2 Professional Engineers of Ontario (PEO)

The Contractor shall comply with the Professional Engineers Act, R.S.O. 1990 and any applicable regulations and guidelines.

2.3 OPG Roles and Accountabilities

OPG shall appoint single points of contact for project related work utilizing this document.

> **NOTE:** OPG does not accept accountability for the accuracy of technical content of any document produced by the Contractor, including verifications of any assumptions regarding existing condition of the equipment/system interfacing with the new modification.

OPG roles / accountabilities as defined in sections 3 to 5 of this document are defined as follows:

(1) Review

Review means that when stated in the Design Plan or in the approved IR document or in the agreement between OPG and Contractors, a signed copy of the specific Engineering Document will be transmitted to OPG for comments, and an acknowledgment of receipt is to be recorded by the Contractor.

An OPG review is to ensure that the deliverable satisfies the project scope & design requirements, and procedural compliance to the specified governance within this IR. OPG reserves the right to conduct a further detailed review of the deliverable if OPG feels necessary.

(2) Accept

Accept means that the document or deliverable is suitable for its intended use, and meets process, format and content per Section 3.0, 4.0, and 5.0 as required for its input into the OPG's Enterprise Asset Management System (Asset Suite).

(3) Authorize

Means to permit or allow the use of the engineering product by others.

(4) Support

As applicable, Support means to lend the Contractor verbal and process guidance by:

- Attending and contributing at meetings.
- Participating in discussions and providing informal undocumented comments.

(5) Approve

(a) Engineering Approval is conducted by the Contractor under the Contractor's QA program. Approval of engineering design documentation may require a Professional Engineer's (P. Eng) signature and seal. Such approval means taking professional design responsibility for the engineering document. P. Eng. Signature requirements are specified in N-LIST-01300-10000, Bounded Document Set.

(b) OPG or Design Authority (DA) approval shall be performed by OPG to signify OPG's acceptance that the product(s) is prepared, reviewed, and verified by competent persons and that appropriate processes/procedures including codes and standards were applied. In addition, the approval shall ensure that the document or deliverable is suitable for its intended use, and meets process, format and content requirements as required for its input into the OPG Records Management system.

(c) Director of Operations & Maintenance (DOM) approval signifies the deliverable has no significant impact on Plant Operations and License obligations (e.g., Safety, Environmental, Production etc.).

(d) OPG shall be actively involved and have ownership of the development of the Modification Design Requirements and Commissioning Specifications for OPG approval.

2.4 Forms and Template Revisions

It is expected the Contractor will retrieve the latest version of OPG forms, templates and procedures etc. at the beginning of each Contractor activity.

If a revision to an EC or document is required, the forms and templates originally used in preparation of the initial EC or initial document shall not need to be updated to the most current form or template revision unless required to do so by the Design Authority.

2.5 Deviations from the IR

Deviations from this IR will be documented via N-FORM-11070, the Scope of Work or Applicable Master EC Package.

2.6 Abbreviations and Acronyms

ADL	- Affected Document List
AEL	- Affected Equipment List
AFS	- Available for Service
ANI	- Authorized Nuclear Inspector
ANIA	- Authorized Nuclear Inspection Agency
BOM	- Bill of Materials (Spare Parts for Equipment)
CCD	- Computer & Control Design Specialist
CD	- Control Document
CNSC	- Canadian Nuclear Safety Commission
COMS	- Constructability, Operability, Maintainability and Safety
DA	- Design Authority, Darlington Nuclear of Darlington Refurbishment
DBOM	- Drawing Bill of Materials
DE	- Design Engineer
DO	- Drawing Office
DOM	- Director of Operations and Maintenance
DP	- Design Plan
DLA	- Designated Licensing Authority
DR	- Design Requirements
EBOM	- Equipment Bill of Materials (Spare Parts)
EC	- Engineering Change
EQ	- Environmental Qualification
FIC	- Field Initiated Change
HFE	- Human Factor Engineering Specialist
JHSC	- Joint Health and Safety Committee
LOTO	- Lock Out Tag Out
MDR	- Modification Design Requirements
MEL	- Master Equipment List
MO	- Modification Outline
MR	- Material Request
OHSA	- Occupational Health and Safety Act
OLW	- On-Line Wiring
P. Eng	- Professional Engineer (Licensed in Ontario)
PMID	- Preventative Maintenance ID
PSR	- Pre-Start Health and Safety Review
QA	- Quality Assurance
RFP / Q	- Request for Proposal / Quote

RDL	- Reference Document List
SCL	- System Classification List
SPOC	- Single Point of Contact
SRE	- System Responsible Engineer
SM	- Section Manager
SME	- Subject Matter Expert
SPMP	- System Performance Monitoring Plan
SSC	- System, Structure or Component
TPAR	- Technical Procedures Action Request
TSSA	- Technical Standards and Safety Authority
VenDM	- Vendor Document Management

3.0 ENGINEERING INTERFACE MATRIX

Modifications associated with the project shall be carried out in accordance with the N-PROC-MP-0090. The Preparer, Reviewer, Verifier, and Approver of the Design Packages shall be qualified to the Contractors quality assurance program.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.1	Reservation, Superseding & Obsolescence of Controlled Document / Record Numbers	N-PROC-AS-0003 N-FORM-10027	**SUPPORT** OPG to provide support if required	**ACCOUNTABLE** Prepare Controlled Document Request Form as per procedure and template and forward electronically to OPG Controlled Documents inbox. For Superseding and Obsoleting, obtain concurrence from OPG Document Owner prior to submission.	N-FORM-10027
3.2	Submission of Controlled Documents / Records to OPG	N-PROC-AS-0003 N-FORM-10027 N-FORM-10653	**ACCOUNTABLE** OPG to receive approved documents in VenDM and submit necessary documents to into Asset Suite. For RWPB see Note 1.	**ACCOUNTABLE** Submit documents to OPG for acceptance via VenDM and flag if the documents are to be kept as permanent record in Asset Suite. For RWPB see Note 1.	Accepted Documents in VenDM Issued Documents or Records into Asset Suite. For RWPB see Note 1.
3.3	Comment & Disposition Document		**SUPPORT** OPG to provide comments as required to the Contractor.	**ACCOUNTABLE** Submit signed documents to OPG for Review and Comment. One (1) Review Cycle will be the target (complete when Dispositions have been concurred by OPG)	Comment and Disposition Sheet

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.4	Station Condition Records (SCR)	SCR Database N-PROC-RA-0022	**ACCOUNTABLE** OPG to submit SCRs documenting the OPG related adverse condition or issue. OPG to process the SCR's to completion including the development and completion of Corrective Action Plan identified through the OPG SCR Process.	**SUPPORT** Adverse conditions or issues related to OPG (eg. Safety, Configuration Management, Delays) are communicated to OPG. Design errors and non-conformances related to the Contractors own QA program are to be resolved by the Contractor corrective action program outside the OPG SCR Process.	
	REPORTS				
3.5 a)	Reports (As required) [eg. Technical / Design Review Report, Assessment Report / Assumption Validation Report , Miscellaneous Reports, Conceptual Design /Value Engineering Report etc.]	SLN 2206-07-20-OP-0001 2206-07-20-TF-0012 2206-07-20-TF-0013 2206-07-20-TF-0001	**SUPPORT / REVIEW/ ACCEPT** OPG to provide stakeholder input and review (as required), and accept. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify / Review, Approve and P. Eng. seal the report and submit to OPG. For RWPB see Note 1.	Report For RWPB see Note 1.
3.5 b)	Certified Design Report	SLN 2206-07-20-OP-0001 2206-07-20-TF-0012 2206-07-20-TF-0013	**SUPPORT / REVIEW / ACCEPT** OPG to review (as required), and accept. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify / Review, Approve and P. Eng. seal the report and submit to OPG. For RWPB see Note 1.	Report For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.6	Pre-Start Health & Safety Report (If required)	Section 7 of O. Reg. 851/90 under OH&S Act. N-FORM-10853 N-INS-08121.3-10000 2206-07-20-TF-0001	**SUPPORT / ACCEPT** OPG to provide stakeholder input (as required) and accept.	**ACCOUNTABLE** Where a review is required per N-FORM-10853, prepare PSR report if required based on the assessment. Perform any required pre-start inspections as required by the review before the apparatus, structure, or protective element is operated or used, and confirm the report has been provided to OPG JH&SC. Submit PSR Report to OPG.	PSR Report
	REGULATORY APPROVALS				
3.7	CNSC Code Classification	N-PROC-MP-0040	[redacted]		
3.8	Preparation / Revision of System Classification List	N-PROC-MP-0040 N-FORM-10250	**ACCEPT** OPG to accept.	**ACCOUNTABLE** Prepare, Verify, & Approve, applicable Flow Diagram (Change Paper Format). Prepare, Verify, & Approve, applicable System Classification List (Change Paper Format) Submit to OPG as part of design package.	N-FORM-10250

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.9	Code Classification Approval and Exemptions Form	N-PROC-MP-0040 N-FORM-11003 N-FORM-11045 N-FORM-10250 N-FORM-11524	**ACCEPT** OPG to accept.	**ACCOUNTABLE** Prepare, Review, & Approve N-FORM-11003 Code Class Approval and Exemption per Contractor CofA. Prepare, Review / Verify, & Approve Code Class Exempt Assessment (if applicable).	N-FORM-11003 N-FORM-11045 Code Class Exempt Assessment (if applicable) N-FORM-11524 Code Class Exempt Assessment (if applicable) and Portable Assembly Exclusions
3.10	CNSC Code Class Approval Submission (if required)	N-PROC-MP-0040	**SUPPORT/APPROVE** If CNSC submission is required as per N-FORM-11003, OPG will review the CNSC submission package as per N-PROC-MP-0040. Designated OPG Licensing Authority to approve and submit to CNSC. OPG to notify Contractor upon classification approval by the CNSC. OPG to submit record to Business Services.	**ACCOUNTABLE** Provide a draft CNSC submission letter with technical details to OPG for review with Regulatory Affairs. Incorporate Reviewer Comments. Route final CNSC submission packages to Designated OPG Licensing Authority (Regulatory Affairs) for submission to CNSC. Confirm CNSC approval has been obtained.	Standard Submission Package
3.11	ANIA Registration and associated Documents	N-PROC-MP-0082 SLN 2206-07-30-OP-0013	[redacted]		

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.12	ANIA Registration Submission and Associated Documentation (if TSSA registration is required as per N-FORM-11003)	SLN 2206-07-30-OP-0013 N-FORM-11003 Code Classification Registration Approvals And Exemptions	**SUPPORT** OPG to issue Letter of Authorization to Contractor to process ANIA submission on OPG behalf for CofA. OPG will coordinate resolution of legacy issues related to registered systems.	**ACCOUNTABLE** Prepare/assemble design registration packages and submit to the ANIA for registration on OPG's behalf. Consult with OPG re resolution of legacy issues if necessary. Resolve any issues raised by ANIA during the Registration Process.	Registration Package
3.13	ANIA (TSSA) Registration Exemption (as per N-FORM-11003)	SLN 2206-07-30-OP-0013 N-FORM-11003 Code Classification Registration Approvals And Exemptions	**SUPPORT** As required.	**ACCOUNTABLE** Prepare, review and approve N-FORM-11003.	N-FORM-11003
3.14	ANIA (TSSA) Reconciliation Statement	SLN 2206-07-30-OP-0013 Standard Reconciliation Statements from CSA N285.0	**SUPPORT** As required.	**ACCOUNTABLE** If required, prepare Reconciliation Statement for the system and for material. Include signed Documentation as required. Coordinate registration of Reconciliation Package with ANIA (TSSA), if required.	Standard Reconciliation Statements from CSA N285.0

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.15	CNSC Modification Notification or Approval, and other Correspondence		**SUPPORT/APPROVAL** Review CNSC letter. Designated OPG Licensing Authority to approve and submit to CNSC. OPG to notify Contractor upon approval or concurrence by the CNSC. OPG to submit record to Business Services.	**ACCOUNTABLE** Prepare CNSC correspondence letter and submit to OPG for review. Route final CNSC submission packages to Designated OPG Licensing Authority (Regulatory Affairs) for submission to CNSC. Confirm CNSC approval has been obtained.	Submission Package
3.16	Other Regulatory Approval correspondence (e.g. Ministry of Labour, Ministry of Environment, Coast Guard, Bldg Permits Electrical Safety Authority,etc.)		**SUPPORT/REVIEW** Review Regulatory letter.	**ACCOUNTABLE** Prepare Regulatory correspondence letter and submit to OPG. Once letter has been reviewed by OPG proceed to obtain approval. Submit to OPG Records.	Submission Package
	Master EC RELATED ACTIVITIES Note: all forms, checklists and assessments identified in this section shall be the Contractor's accountability unless stated otherwise. OPG should be copied on Contractor correspondence with stakeholders.				
3.17	Master EC: General	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	**APPROVE** Create Master EC package and obtain approval as noted in the Modification Outline. For RWPB see Note 1.	**ACCOUNTABLE** Support as required For RWPB see Note 1.	For RWPB see Note 1.
3.18	Modification Outline	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10958	**ACCOUNTABLE** OPG to prepare/update, verify and approve Modification Outline including all required forms.	**SUPPORT/APPROVE** Contractor to support as required.	N-PROC-MP-0065 N-INS-00700-10007 N-TMP-10187 NK38-CORR-09701-0562216

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.19	Design Scoping Checklist (Is Optional but Recommended)	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10959	**ACCOUNTABLE** OPG to prepare Design Scoping Checklist including coordination with Subject Matter Experts and Stakeholders.	**SUPPORT** Contractor to support as required.	N-PROC-MP-0065 N-INS-0070-10007 N-TMP-10187 NK38-CORR-09701-0562216
3.20	Package Design Requirements	509407-0000-00000-38QP-0001 509407-0000-00000-40EP-0001 2206-07-20-TF-0039	**ACCOUNTABLE** OPG to prepare Modification Requirements" OPG to update Unit 2 Package Design Requirements to allow use on Units 1, 3 and 4 (either as cover sheet onto existing JV documents or transfer of contents into OPG MDR format).	**SUPPORT/APPROVE** Contractor to support as required including provisions of PDR in Word format.	N-PROC-MP-0065 N-INS-00700-10007 N-TMP-10187 NK38-CORR-09701-0562216
3.21	Design Plan	SLN 2206-07-10-OP-0001 2206-07-20-TF-0032	**AUTHORIZE** OPG to attach coversheet and DA to Authorize.	**ACCOUNTABLE** Prepare, Review, and Approve Design Plan. Maintain Status & Accuracy of Design Plan and submit updated plans to OPG as part of EC approval or releases. Refer to Item 3.87 for update of Design Plan upon completion of applicable EC(s).	Design Plan

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.22	Constructability Operability, Maintainability, and Safety (COMS) Stakeholder Declaration	N-PROC-MP-0083 N-FORM-10007 N-FORM-10480 N-PROC-MP-0090	**SUPPORT** Provide stakeholders to participate in COMS meetings and walkdowns. Sign-off COMS declaration form as required. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to coordinate and lead COMS meetings, walkdowns and stakeholder input (Construction, Operations, Maintenance, Engineering, etc.) Chair, take minutes, record actions and distribute to stakeholders. Disposition any Design related issues identified during COMS with the Stakeholder. Participate and lead COMS walkdowns. For RWPB see Note 1.	N-PROC-MP-0065 N-INS-00700-10007 N-TMP-10187 NK38-CORR-09701-0562216 For RWPB see Note 1.
3.23	Item moved to Design EC, 3.28 c)				
3.24	Item moved to Design EC, 3.28 d)				
3.25	Item moved to Design EC, 3.28 e)				
3.26	Design EC Release Plan	SLN 2206-07-10-OP-0001	**SUPPORT/ ACCEPT** OPG DA to accept via Design Plan (Item 3.21)	**ACCOUNTABLE** Prepare as part of Design Plan (Item 3.21)	Design EC Release within Design Plan

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.27	Issue Tracking File		**SUPPORT** OPG to communicate potential issues to Contractor	**ACCOUNTABLE** Contractor to maintain an up to date Issue Tracking File and provide to OPG as requested. The ITF should be provided to OPG as part of any ECC submittals such as Design Package.	Issue Tracking File (included in the Design Plan, Section 4 – Assumptions and Open Items) A copy will reside in the working files folder (Sharepoint)
	Design EC Related Activities Note: all forms, checklists and assessments identified in this section shall be the Contractor's accountability unless stated otherwise. OPG should be copied on Contractor's correspondence with stakeholders				
3.28 a)	Design EC: General	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	**ACCEPT** OPG to Accept and Release as required in the modification outline. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify, Approve Design EC Package. Contractor to submit approved Design EC Package to OPG. Upon registering the Design EC in Asset Suite, Contractor to populate the appropriate milestones and add "DNREFURB" in the Mod Number field. In addition, the Contractor to populate the ADL and AEL to flag equipment and documents requiring changes under the EC. Contractor to follow N-GUID-08133-10072 for Asset Suite requirements. For RWPB see Note 1.	Release Plan as per Item 3.21 Design Plan For RWPB see Note 1.

Title: RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.28 b)	Constructability Operability, Maintainability, and Safety (COMS) Stakeholder Declaration	N-PROC-MP-0083 N-FORM-10007 N-FORM-10480 N-PROC-MP-0090	**SUPPORT** Provide stakeholders to participate in COMS meetings and walkdowns. Sign-off COMS declaration form as required. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to coordinate and lead COMS meetings, walkdowns and stakeholder input (Construction, Operations, Maintenance, Engineering, etc.) Chair, take minutes, record actions and distribute to stakeholders. Disposition any Design related issues identified during COMS with the Stakeholder. Participate and lead COMS walkdowns. For RWPB see Note 1.	N-PROC-MP-0065 N-INS-00700-10007 N-TMP-10187 NK38-CORR-09701-0562216 For RWPB see Note 1.
3.28 c)	Field Verification of existing plant configuration prior to start of design	SLN 2206-07-30-OP-0006 2206-07-30-CF-0002 2206-07-20-CF-0030 2206-07-20-TF-0031	**SUPPORT** OPG to provide Field Assistance if requested (e.g. Radiation Sponsorship etc) OPG to review the discrepancies and resolutions. File SCR if required regarding any field conditions not in alignment with plant documentation.	**ACCOUNTABLE** Verifies all field conditions related to modifications. Communicate adverse conditions or configuration management deficiencies to OPG. Where practical incorporate configuration management issues as part of the design.	NK38-CORR-09701-0562216
3.28 d)	Review of Pending Changes Impacting Project Scope	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT** OPG to support as required.	**ACCOUNTABLE** Contractor to review Asset Suite databases (impacted drawings, AEL etc.) for other modifications that might impact on this modification, and coordinate activities with other organization (e.g. Terminal Points).	NK38-CORR-09701-0562216

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.28 e)	OPEX (Operating experience) Search	SLN 2206-07-30-OP-0003 2206-07-20-TF-0038 OPEX Website and SCR database WANO & INPO database Stakeholder Interviews	Upon request, OPG to provide known internal OPEX to Contractor.	**ACCOUNTABLE** Prior to *completion of preliminary engineering* of DECs, review current OPEX and update report via change paper as required.	NK38-CORR-09701-0562216
3.29	Associated Documents List (ADL)	N-PROC-MP-0090 N-GUID-00700-10000	**ACCEPT** OPG to Accept as part of the Design EC.	**ACCOUNTABLE** Populate ADL in Asset Suite. Review any Pending Changes on Affected Documents for potential conflicts. Prepare, Verify, and Approve as part of Design EC.	ADL Populated

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.30	Change Papers Including Non-drawing change papers of existing OPG documents (Existing DM, Safety Report, Operational Safety Requirements, Instrument Uncertainty Calculations, Reliability Report, Fire Safe Shutdown Analysis, Lists etc.)	N-PROC-MP-0090 N-GUID-00700-10000 Drafting procedure: N-ST-01161-10000 Non-Drawing References: N-PROC-MP-0086 N-ST-08131.02-10000 N-STI-03602-10000 N-STD-RA-0033 N-STD-RA-0038 SLN 2206-07-60-OP-0001 SLN 2206-07-20-OP-0001	**ACCEPT** OPG to Accept Change Papers as part of Design EC. OPG to scan Change Papers into Asset Suite prior to AFS. For RWPB see Note 1.	**ACCOUNTABLE** Review Document Scoping Checklist and other related ECC Screens to identify OPG documents which are impacted by Design Change. Prepare list of drawings required for the Design EC and send to OPG. Prepare, Verify and Approve Change Papers as per the Contractor's QA program. Where applicable prepare AutoCAD (version as identified in P.O) drawings as change papers. Prepare, Verify, and Approve Change Papers. Submit Change Papers to OPG via Design EC submittal. Prior to AFS confirm all Change Papers have been scanned into Asset Suite. For RWPB see Note 1.	Change Papers For RWPB see Note 1.
3.31	Drawing Bill of Materials (DBOM)	2206-07-20-OP-0001 2206-07-20-TF-0024	**ACCEPT** OPG to Accept DBOM . For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Review, and Approve DBOM for each drawing / group of drawings for associated Design EC. See 3.37 for selection and use of existing CatIDs. For RWPB see Note 1.	Design Bill of Material For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.32	Design Manuals	N-PROC-MP-0065 N-INS-00700-10002 N-TMP-10143 N-TMP-10188 N-TMP-10189	**ACCEPT** OPG to Accept Change Papers as part of Design EC. For RWPB see Note 1.	**ACCOUNTABLE** New Design Manual Change Paper: Prepare Design Manuals as per procedure. Submit signed document, as part of Design EC. For existing Design Manual process as Change Papers as per 3.30. For RWPB see Note 1.	Design Manual Change Paper For RWPB see Note 1.
3.33	Reference Document List / RDL Items	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT** OPG to support as required.	**ACCOUNTABLE** Populate RDL in Asset Suite Prepare, Review, and Approve as part of Design EC Ensure all RDL items are in OPG Records system (forward with required Controlled Documents paperwork to facilitate) prior to EC approval.	Asset Suite Action
3.34	Engineering Specifications for new equipment (including Tech Spec Data sheets and Design Specifications)	N-PROC-MP-0089 SLN 2206-07-20-OP-0001 2206-07-20-TF-0003 2206-07-20-TF-0029	**ACCEPT** OPG to Accept. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Review, and Approve. Submit specification for OPG acceptance as part of Design EC. Create a Procurement Specification. For RWPB see Note 1.	Engineering Specifications For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.35	Engineering Calculations	SLN 2206-07-20-OP-0001 2206-07-20-TF-0004 2206-07-20-TF-0013	**ACCEPT** OPG to Accept For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify, and Approve. Any Engineering Tooling or Analytical Software used shall meet the applicable requirements of CSA N286.7. Submit to OPG as part of Design EC. For RWPB see Note 1.	Design Reports and Calculations For RWPB see Note 1.
3.36 a)	OSM Vendor Technical Documents -Drawings -Operating & Maintenance Manuals -Inspection Test Plans -Factory Acceptance Procedures -Recommended spare parts lists This includes documents submitted by Equipment Sub-Contractors or their Representative and excludes documents produced by the Contractor.	2206-01-20-OP-0003 2206-01-20-CF-0011	**ACCEPT** OPG to Accept. For Goods Procurement Inspection Test Plans: **SUPPORT/REVIEW/ACCEPT** Where OPG stakeholder input is required, OPG Representative will coordinate input and provide comments as required. For RWPB see Note 1.	**ACCOUNTABLE** Verify sub-contractor/vendor technical documents for accuracy of technical content and meeting design requirements. Resolve comments with sub-contractor/ Vendor and accept documentation on behalf of OPG acceptance. Submit accepted sub-Contractor/Vendor Technical Documents to OPG. For RWPB see Note 1.	Vendor Technical Documents For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.36 b)	Vendor Technical Documents (excluding OSM) For example: -Drawings -Operating & Maintenance Manuals -Inspection Test Plans -Factory Acceptance Procedures -Recommended spare parts lists -Etc. This includes documents submitted by Sub-Contractors or their representative and excludes documents produced by the Contractor.	2206-01-20-OP-0003 2206-01-20-CF-0011	**SUPPORT/REVIEW/ACCEPT** OPG to accept for items that are: • Pressure Boundary • Safety Related • Environmental Qualified • Not being solely in Contractor control in all scenarios Where OPG acceptance is required, OPG to accept final Vendor Technical documentation following Contractor acceptance of such documents and Contractor final recommendation for OPG acceptance. All contractor "Accepted as Noted" material to be submitted to OPG "for information only" purposes. For RWPB see Note 1.	**ACCOUNTABLE** Verify sub-contractor/vendor technical documents for accuracy of technical content and meeting design requirements. Resolve comments with sub-contractor/ Vendor and accept documentation on behalf of OPG acceptance. Submit accepted sub-Contractor/Vendor Technical Documents to OPG. For RWPB see Note 1.	Vendor Technical Documents For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.37	Creation of New Cat IDs for Modifications and OSM.	N-PROC-MP-0090 N-PROC-MP-0098 N-GUID-00700-10000 N-PROC-MM-0008 N-GUID-08133-10072	**SUPPORT** OPG will provide new CatID. As required, OPG will set CATID to "Ready", "BOMONLY", and "NOPURCH" status in Asset Suite.	**ACCOUNTABLE** Select CatIDs from OPG inventory where required. If CatID does not exist in OPG inventory initiate creation of Cat IDs for new items for Design EC / DBOM. Submit Action Request Process to initiate new CatIDs. OR Prepare, verify and provide to OPG Asset Suite panel mandatory information requirements for building new Cat-ID or modifications to existing Cat-IDs' as per Appendix B.	CatID at "Ready". "BOMONLY", and "NOPURCH" Status as required.
3.38	Inventory CatID Reconciliation	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MM-0008	**ACCEPT** OPG to accept recommendations.	**ACCOUNTABLE** Contractor to identify CatIDs to be retired and current materials to be surplus as required. Provide recommendations following AFS.	Inventory CatID Reconciliation Report.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.39	Affected Equipment List (AEL) Updates And Reserve New Equipment Codes	N-PROC-MP-0090 N-GUID-00700-10000 N-MAN-08135-10000 N-PROC-MA-0077 N-PROC-MP-0077 D-ED-01520-10001 N-INS-08135-10116 N-INS-03651-10025 N-GUID-08133-10072	**SUPPORT / APPROVE** OPG to support review process and provide comments as required. OPG Plant Status Control approve new equipment AEL tagging. OPG Equipment Reliability Group & Reactor Safety to review / approve new equipment criticality codes. OPG to provide serial code number for equipment. OPG Drawing Office to reserve Equipment Codes. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to coordinate and disposition of review comments on AEL updates as required. Obtain Plant Status Control input on new AEL tags. Identify Q List requirements and obtain OPG Reactor Safety support/input as required (refer to N-INS-08135-10116). Identify EQ requirements (refer to N-INS-03651-10025 & N-GUID-03651-10002) Identify Criticality code requirements per N-PROC-MA-0077. Identify Seismic requirements. Populate AEL panel in Asset Suite with required information and formatting (including Q-list. Criticality Codes, and EQ requirements). Prepare, Verify, and Approve as part of Design EC. Request reserved equipment codes from OPG Drawing Office. Obtain OPG Plant status Control acceptance of new AEL tags prior to submission of EC for acceptance. For RWPB see Note 1.	Asset Suite AEL EQ, Q-List, Seismic and Criticality Code Requirements Defined For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.40	Spare Parts List / Equipment Bill of Material / Maintenance Strategies	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058 N-PROC-MM-0008 N-INS-00680-10000	**SUPPORT / ACCEPT** OPG Equipment Reliability, SRE, Maintenance Assessing, Supply Chain, stakeholder review of Spare Parts list & Maintenance Strategies. OPG to update Spare Part CatIDs and ROP/TMAX and Auto-Reorder/and or Critical Spare Flags. OPG to accept the Spare Parts List, Maintenance and Stocking Strategy For RWPB see Note 1.	**ACCOUNTABLE** Prepare Spare Parts List for new parent Identify all Spare Parts to new parent Prepare spare parts list, maintenance and stocking strategy for OPG Acceptance. Solicit stakeholder input. Incorporate stakeholder feedback into Maintenance Strategy. Spare Parts List and EBOM to be prepared as a paper based for submission to OPG for acceptance. For RWPB see Note 1.	Spare Parts List Maintenance Strategy Stocking Strategy Equipment Bill of Materials Asset Suite spare parts CatIDs update with ROP/TMAX and Auto-reorder and/or Critical Spare flags. For RWPB see Note 1.
3.41	Lube List (For Permanent Modifications Only)	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058 N-PROC-MM-0008	**SUPPORT** OPG Components and Equipment Group to update station lube list.	**ACCOUNTABLE** Provide information for Lube List Update to OPG Components and Equipment Group and confirm lube list updated.	Lube List Update
3.42	Design Review Meetings (DRM)		**SUPPORT** Support and participate as required to provide stakeholder input at each meeting.	**ACCOUNTABLE** As required facilitate review meetings throughout the Modification Planning and Detailed Design Phases.	Design Review Meetings

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	Miscellaneous Items – Electrical Design EC				
3.43	Online Wiring updates (OLW) Note: Accountability items includes numbering for sequence clarity.	N-PROC-MP-0076 N-INS-60110-10000 N-PROC-MP-0090 D-STE-60110-10001	**SUPPORT / ACCEPT** OPG Drafting Office or delegate to update OLW based on change papers and provide the printouts to Contractor. OPG to accept as part of Design EC. For RWPB see Note 1.	**ACCOUNTABLE** For each Design EC that affects On-Line Wiring (OLW) information, Contractor to initiate a request to OPG DO to prepare an OLW Package and Independent Verification (IV) Report (if applicable) in accordance with the Design EC's change paper. Ensure walkdowns / field inspections are completed re proposed OLW changes prior to Design EC approval. Obtain OPG DA Approval for separation/channelization standard deviations. Verify, Approve, and issue OLW updates as part of Design EC. For RWPB see Note 1.	OLW Package Independent Verification Report for Safety Related Modifications. For RWPB see Note 1.
3.44	Electrical Distribution System analysis	NK38-GUID-50000-10001	**SUPPORT / ACCEPT** OPG to provide most current Station electrical distribution system model to Contractor. OPG to accept as part of Design EC acceptance. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify and Approve Electrical distribution system analysis using ETAP. Provide any updated models to OPG along with Design EC. For RWPB see Note 1.	ETAP Analysis (Calculation Report and Updated Model) For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.45	Protective Relay Setting Lists (PRLs) and Relay coordination study.	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	**ACCEPT** OPG to Accept relay coordination study and pre-install ICS or legacy PRL change paper as part of Design EC acceptance. (Refer to 3.35 and 3.46) For RWPB see Note 1.	**ACCOUNTABLE** Relay coordination study to be submitted as a design calculation (see 3.35). Where legacy PRLs are to be superseded by ICSs enter new ICS data into ICS program (pre-install ICS) per Section 3.46, and prepare Controlled Docs form to supersede legacy PRL with new ICS document number, submitting both to OPG as part of Design EC. When installation commences and legacy PRL is no longer valid submit Controlled Document form for superseding legacy PRL to OPG Business Services. Where legacy PRLs are to be retained, Prepare, Verify and Approve PRL change paper as part of Design EC. For RWPB see Note 1.	Legacy PRL Change Paper or Pre-Install ICS (Form to be developed) For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	Miscellaneous Items – Instrumentation and Control Design EC				
3.46	Instrument Calibration Sheets (ICS)	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	**SUPPORT / ACCEPT** OPG or delegate to Update pre-install ICS into the ICS Program. OPG to Accept pre-install ICS as part of Design EC acceptance. For RWPB see Note 1.	**ACCOUNTABLE** Prepare & Verify pre-install-ICS (Paper Based) and submit to OPG or delegate Print out hard copy of preinstall ICS and submit as part of Design EC. After installation is complete, ICS is to be revised and submitted to OPG for acceptance. For RWPB see Note 1.	Pre-install ICS For RWPB see Note 1.
3.47	Human Factors Engineering	N-INS-06700-10000 N-PROC-MP-0090 N-FORM-10580 N-FORM-10221 2206-07-WI-0003	**ACCEPT** OPG to accept HFE report / Forms For RWPB see Note 1.	**ACCOUNTABLE** Provide HFE Plan and HFE preliminary report during engineering phase. Where Contractor HFE and CCD specialists require input, interface with OPG HFE and CCD Specialist as required. Provide HFE final report during commissioning stage. Incorporate OPG HFE and CCD Specialist comments relating to HFE and Software. For RWPB see Note 1.	HFE Report (For OPG Permanent Modifications) HF Validation Plan 2206-07-20-TF-0101 HFE Assessment Plan 2206-07-20-TF-0102 HF Engineering Program Plan 2206-07-20-TF-0001 HF Worksheet 2206-07-20-TF-0103 For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.48	Software Review	N-PROC-MP-0049 N-PROC-MP-0090 N-FORM-10445 N-FORM-10446 N-FORM-10408 N-FORM-10409	**ACCEPT** OPG to accept SQA report /Forms For RWPB see Note 1.	**ACCOUNTABLE** Where Contractor CCD specialists require input, interface with OPG CCD Specialist as required. Ensure Software Quality Assurance (SQA) requirements are met. Incorporate OPG CCD Specialist comments relating to Software. For RWPB see Note 1.	Software Report For RWPB see Note 1.
3.49	Software Maintenance Plan	N-STI-69000-10001 Software Maintenance	**ACCEPT** OPG CCD Specialists to provide oversight reviews. OPG to accept. For RWPB see Note 1.	**ACCOUNTABLE** Prepare/revise/issue Software Maintenance Plan and Software Release for any new or revised software that requires it. For RWPB see Note 1.	Software Maintenance Plan For RWPB see Note 1.
	Miscellaneous Items – Mechanical Design EC				
3.50	Over Pressure Protection Report	SLN 2206-07-20-OP-0001 2206-07-20-TF-0001 2206-07-20-TF-0013	**ACCEPT** OPG to Accept. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, Verify, and Approve Over Pressure Protection Report. For RWPB see Note 1.	Over Pressure Protection Report For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.51	Mechanical Piping Analysis	STANPIPES or equivalent. SLN 2206-07-20-OP-0001 2206-07-20-TF-0001 2206-07-20-TF-0004 2206-07-20-TF-0013	**SUPPORT/ACCEPT** OPG to provide latest piping model/report where available. [Note: this will in most cases be a legacy non-QA'd model]. Provide guidance regarding acceptable software/versions for piping model to be used (to ensure future usability by OPG). OPG to accept analysis calculation/report and model. For RWPB see Note 1.	**ACCOUNTABLE** Perform, verify and approve piping analysis in support of design ECs. Submit QA'd model(s) and associated analysis calculations/reports for acceptance along with associated design EC(s) For RWPB see Note 1.	QA'd piping model in usable format (Software/Version). Associated Calculations/Reports For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	Miscellaneous Items – Cross Functional				
3.52	Review of Design EC prior to EC Release	N-PROC-MP-0090 NK38-GUID-01900-10001 SLN 2206-07-20-TF-0032	**SUPPORT/APPROVE** OPG to provide comments as required, and to communicate issues to Contractor. Approval by DA/DOM or delegate as required.	**ACCOUNTABLE** Contractor to coordinate review on Design EC and disposition of comments. Contractor to coordinate review on Drawing / Change Papers for compliance with OPG Drafting standards, and disposition of comments. Provide support as requested for resolution of issues communicated by OPG and update Design EC accordingly. Upon resolution of issues communicated by OPG, Contractor to obtain approval for each Release as required by the Modification Outline and/or per Design Plan. Contractor to approve release if DA/DOM or additional OPG releases are not required per the Modification Outline.	Approved EC Release

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.53	Third Party Fire Review Report	N-INS-09076-10004 Template as per Contractor approved Quality Assurance Plan	**SUPPORT / ACCEPT** OPG to provide comments as required. OPG to Accept Third Party Fire Review Report.	**ACCOUNTABLE** Contractor to coordinate with a Third Party the preparation, review and approval of a Third Party Fire Review report and submit to OPG for acceptance. Contractor to prepare CNSC submission of Third Party Report (refer to Section 3.15) and submit to OPG. Disposition comments from the CNSC per submission.	Third Party Fire Review Report
3.54	Design Completion Assurance Verification Review.	NK38-GUID-01900-10001	**ACCEPT** Based on OPG feedback, OPG will request the Contractor to resolve design issues as required including Non-intent revisions until work is ready to be executed. OPG to accept DCAVR.	**ACCOUNTABLE** Contractor to provide Design Completion Assurance Verification (DCAVR) reports listing all deliverables submitted with dates as well as any outstanding issues or deliverables if any, complete with dates and path forward to resolve.	Design Completion Assurance Verification Package
	Project EC Related Items				
3.55	Safety System Tests Operating Procedures Operator Field Instructions/Rounds Maintenance Procedures Chem. Lab Procedures	N-PROC-AS-0028	**SUPPORT/APPROVE** OPG to process procedure revisions and approval.	**ACCOUNTABLE** Initiate TPARs with procedure mark-ups for new or revised procedures. Support, review and approval process.	TPARs and mark-ups

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.56	Operational Flowsheets, ESM II, Tagging, & Position Assured Components & Registered locks (Not Applicable for Tooling or Permanent Modifications)	N-PROC-MP-0076 (FS) N-PROC-OP-0023 (PAC)	**SUPPORT/APPROVE** Support master mark-up process and approval. For RWPB see Note 1.	**ACCOUNTABLE** Initiate operational flowsheet ,ESM II, equipment tagging, and PAC list updates as part of installation and commissioning activities. Complete formal update as part of EC closeout process. Ensure new registered locks in OPG Operations' possession and control prior to AFS. Support, review and approval process. For RWPB see Note 1.	Updated Flowsheets, PAC List and Registered Locks For RWPB see Note 1.
3.57	System Performance Monitoring Plans (As Required)	N-PROC-MA-0024	**SUPPORT** Finalize / implement SPMP revisions related to applicable systems. For RWPB see Note 1.	**ACCOUNTABLE** Notify SRE of required changes needed to issued SPMP(s) in support of AFS process. Develop new SPMPs for new systems. For RWPB see Note 1.	Notification to the SRE For RWPB see Note 1.
3.58	Components Programs / PIP (e.g. pressure vessel, periodic inspection, thermography, vibration monitoring, valve / RV programs, Hangers, Buried Piping, etc.) (As Required)	N-PROC-MA-0034 (Predictive Mtce) N-PROC-MA-0090 (HX) N-PROC-MA-0092(POV) N-PROC-MA-0093(Check Valves) N-INS-08125-10001 (Lubrication)	**SUPPORT** OPG to identify Components Program Project Representatives to liaise with Contractor. OPG to provide guidance re: Information required from Contractor in order to update respective Components Program. For RWPB see Note 1.	**ACCOUNTABLE** Provide information requested by OPG to update OPG Components Programs. Status Components Program Updates at AFS meeting and track updates to completion. For RWPB see Note 1.	Updated Components Program For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.59	Predefined Mtce Program (Eg. Winterization and Summarization etc.) (As Required)	N-PROC-MA-0020 N-INS-09100-10012	**SUPPORT/ACCEPT** SRE to review and accept Change Requests (CRs). Implement CRs in Asset Suite. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to provide input as required to the OPG System Engineer. Ensure implementation of critical change requests prior to AFS. Initiate PMID Change Requests in OPG Predefined System (PMLP). Provide technical basis for requests and facilitate SRE review and confirm acceptance. For RWPB see Note 1.	PMLP Request Accepted and Asset Suite PMIDs setup For RWPB see Note 1.
3.60	Power and Air Supply Lists / IEDS	D-PROC-MP-0011	**SUPPORT** Support update process.	**ACCOUNTABLE** Complete air and power supply list updates as part of installation and commissioning activities.	Updated Air and Power Supply Lists
3.61	Simulator Updates	N-PROC-TR-0023 (Simulator QA)	**SUPPORT** Schedule and complete simulator updates as required.	**ACCOUNTABLE** Initiate required simulator upgrades through OPG Simulator group.	Request Update to Simulator
3.62	Corrective Mtce / Preventative Mtce Backlogs		**SUPPORT** Provide concurrence or cancellation / credits.	**ACCOUNTABLE** Review Corrective Mtce and Preventative Mtce backlog on components impacted by applicable modifications and prior to AFS: 1) Recommendations for cancellation of any no longer required WO's 2) Recommendations to credit any predefined WOs via completed commissioning activities where possible Provide summary into AFS Report.	WO Cancellation/Credit Recommendations to Work Control.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.63	Training (for OPG Ops, Mtce, Chemistry and Engineering)	N-GUID-00700-10000	**SUPPORT** Perform Training needs assessments as required. Participate in / attend training.	**ACCOUNTABLE** Initiate Action request for training needs assessments.	SAT Compliant Training as required by Needs Assessment. Crew Familiarization Training (if required)
	INSTALLATION RELATED ACTIVITIES Note: The following activities will be Contractor's accountability unless stated otherwise.				
3.64	Installation Field Technical Support	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT / REVIEW / ACCEPT** OPG to review/ accept EC revisions per 3.65 to 3.66 below. For RWPB see Note 1.	**ACCOUNTABLE** Provide Field Support during Installation of Design EC. Review Field Installation issues and provide resolution. Provide support to Design EC revision (Intent / Non Intent). Drafting and P.Eng support for scaffolding etc. Assess and process work planning holds for the project including but not limited to Engineering Scaffolding, Pressure Boundary Item Releases, Valve Block approvals etc. For RWPB see Note 1.	Engineering Support for Field Installation For RWPB see Note 1.
3.65	Non-Design Intent, (Including Field) Changes	509407-0000-00000-40WI-0002 509407-0000-00000-40TF-0001	**SUPPORT** Support as required. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to initiate, review and approve and executes procedural and non-intent design changes For RWPB see Note 1.	Approved Non Design Intent Changes For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.66	Design Intent Revision	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT / ACCEPT / APPROVE** Process same as Section 3.17 to 3.42 Master and Design EC related activities. For RWPB see Note 1.	**ACCOUNTABLE** Process same as Section 3.17 to 3.42 Master and Design EC related activities. For RWPB see Note 1.	Revised EC For RWPB see Note 1.
3.67	Workplans / Installation Instructions (Prerequisites, Pre-testing/Calibration)		Refer to Item 5.7.	Refer to Item 5.7.	Refer to Item 5.7.
3.68	Construction Completion Declaration		Refer to Item 5.14.	Refer to Item 5.14.	Refer to Item 5.14.
	COMISSIONING RELATED ACTIVITIES Note: The following activities will be Contractor's accountability unless stated otherwise.				
3.69	Commissioning Technical Field Support		**SUPPORT/ACCEPT** OPG will support Commissioning Technical Field Support OPG will accept commissioning results.	**ACCOUNTABLE** Contractor to provide Commissioning Technical Field Support and arrange, schedule OPG support as required. Provide Commissioning Support, fix outstanding issues when identified. Provide qualified staff knowledgeable of the installation status to support Commissioning program and rectify outstanding issues when identified	Field Support

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.70	Commissioning Specifications and Pre-Commissioning Site Acceptance Test (SAT)	N-INS-00960-10000 N-PROC-MP-0090 N-GUID-00700-10000 N-TMP-10010	**SUPPORT/ACCEPT** OPG to provide support as required. OPG to accept Commissioning Specifications OPG Reactor Safety to provide concurrence only if required.	**ACCOUNTABLE** Identify Critical Attributes as per Section 1.4.9 of N-PROC-MP-0090 & the Modification Design Requirements and Derived Requirements. Prepare, Verify, Review, and Approve Commissioning Specifications.	Approved Commissioning Specification
3.71	Commissioning Reports and Pre-Commissioning Site Acceptance Tests (SAT)	N-INS-00960-10000 N-PROC-MP-0090 N-GUID-00700-10000 N-TMP-10010	**SUPPORT / ACCEPT** OPG to provide support as required. OPG to accept and sign Commissioning Report. OPG Reactor Safety to provide concurrence only if required.	**ACCOUNTABLE** Prepare, Verify, and Approve Commissioning Reports. Contractor to provide documented evidence of design acceptance of commissioning results (See Section 3.72). Contractor to issue Commissioning Report in Asset Suite after OPG Acceptance.	Approved Commissioning Report.
3.72	Acceptance of Installation / Commissioning Results	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	**SUPPORT/ACCEPT** OPG to accept Commissioning Results as required.	**ACCOUNTABLE** Contractor to complete the DSGN I/C ACCEPT milestone for each Design EC, adding notes as required.	Asset Suite Action
3.73	EQ Completion Assurance Process Commissioning	N-FORM-10649	**SUPPORT** Provide support as required.	**ACCOUNTABLE** Complete EQ Completion assurance as part of AFS process. Submit to Records to file under EC in Asset Suite.	N-FORM-10649
3.74	Work plans / Commissioning Instructions and Pre-Commissioning Site Acceptance Test (SAT)		Refer to 5.16	Refer to 5.16	Refer to 5.16

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.75	Available For Service (AFS) Strategy		**SUPPORT / APPROVE** DA or delegate to approve the AFS Strategy Memo.	**ACCOUNTABLE** Prepare and obtain approval for AFS strategy memo/plan as required.	AFS Strategy Memo
	AVAILABLE FOR SERVICE AND RELATED ACTIVITIES Note: The following activities will be Contractor accountability unless stated otherwise.				
3.76	Available For Service (AFS), Walkdown, Declaration / OPS Acceptance	N-PROC-MP-0090 N-FORM-10091 N-GUID-00700-10000 N-TMP-10209 N-GUID-08133-10072	**SUPPORT / ACCEPT / APPROVE** OPG to participate in the AFS walkdown and meeting as required per Mod Outlines / Design Plan. OPG to accept AFS report. OPG to approve AFS declaration or OPS acceptance FORM.	**ACCOUNTABLE** Where required based on the approved Modification Outline, Contractor to prepare, review & approve for OPG acceptance the: - AFS Declaration/ Ops Acceptance and - Report (as required) Contractor to sign AFS Declaration. Contractor to coordinate and chair the AFS walkdown and meeting as required. Contractor to manage and track open item list and closeout process. Contractor to update Asset Suite milestones to reflect completed AFSs (final or partial) and / or Ops Acceptances. Submit documents to Business Services for issuance in Asset Suite.	N-FORM-10091 AFS Report Asset Suite EC Milestone Update

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.77	Update Status of Master Equipment List	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	**SUPPORT** OPG to provide support as required.	**ACCOUNTABLE** Review AEL for accuracy prior to AFS and make any changes required. Initiate launch of Asset Suite AEL / MEL to "Operating" status and confirm successful. Contractor DE to complete "MEL Update" milestone and resolve any MEL conflicts encountered during the launch process	Asset Suite Action
3.78	As Built Change Papers	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT/ACCEPT** Review & Accept Design EC Revisions as required. For RWPB see Note 1.	**ACCOUNTABLE** Prior to AFS Meeting, review latest Design EC & Change Papers to confirm they reflect the As-Built Field Condition, and initiate Design EC Revision as required. For RWPB see Note 1.	Change Papers Approved EC Revision For RWPB see Note 1.
3.79	Status On Line Wiring as "Currently Built"	N-PROC-MP-0090 N-GUID-00700-10000	**SUPPORT** OPG Drawing Office to status OLW to currently built status following Contractor request. For RWPB see Note 1.	**ACCOUNTABLE** Review OLW for accuracy and completeness, request OPG Drafting Office to status OLW to currently built status. Confirm OLW status update is successful. Contractor DE to complete "OLW Statused" milestone in Asset Suite. For RWPB see Note 1.	Asset Suite EC Milestone OLW Status to Currently Built Status. For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	CLOSEOUT RELATED ACTIVITIES Note: The following activities will be Contractor's accountability unless stated otherwise.				
3.80	Design EC/ Project EC/ Master EC Close Out phase	N-FORM-10653	**SUPPORT/ACCEPT** OPG will coordinate final acceptance of Contractor produced drawing and document revisions including issuing final deliverables in Asset Suite. **ACCOUNTABLE:** Closeout MEC For RWPB see Note 1.	**ACCOUNTABLE** Review ADL / Change Papers of Final Design EC revisions for accuracy / completeness of final as-built configuration. Review Pending Changes of Affected Documents and notify OPG of any other EC's in "Modified" status which may impact Close Out of Design EC (e.g. DCRs, other installed Design EC's). DE to coordinate any other Signatures for other Issue original drawings/documents (electronic and paper format) to OPG with QA transmittal form (N-FORM-10653) filled in. Electronic documents will be in editable format in compact discs with labelling and identifying the contents. Pending Changes that may have been Incorporated into the same document revision. **SUPPORT:** Support MEC Closeout. For RWPB see Note 1.	Final Documents and electronic records. N-PROC-MP-0090 N-GUID-00700-10000 For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.81	Drawings: Incorporation of Change Papers to existing OPG Drawings	N-PROC-MP-0076 N-PROC-MP-0090	**SUPPORT/ACCEPT** OPG Drawing Office to revise OPG Drawings and route to Contractor for Review & Signature. OPG to Accept Drawings. If other EC Closeouts are included in this revision, coordinate signatures. For RWPB see Note 1.	**ACCOUNTABLE** Review latest Design EC Change Papers in Asset Suite for completeness and accuracy and provide As-Built design EC revision as required. For each ADL item, review "Pending Changes" in Asset Suite, and identify any other Engineering Changes which require incorporation (i.e. Asset Suite status of "Installed or Modified") to OPG Drafting Office. Notify OPG that Change Papers are ready for Close Out and provide any AutoCAD files as required. Prepare, Verify, and Approve OPG Drawings upon revision by OPG Drawing Office. Prepare Control Document Form N-FORM-10027 to issue documents. Submit to OPG for Review & Acceptance. If other EC Closeouts included in this revision, are not related to the Contractor, submit to OPG for co-ordination of other signatures. P.Eng sealing of final record drawings / documents is not required if the changes are related to the original Design EC's prepared by the Contractor. Contractor to submit documents to OPG Business Services for Issuing. For RWPB see Note 1.	Final Documents and electronic records. For RWPB see Note 1

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.82	Drawings: Incorporation of Change Papers of – Contractor Drawings	N-PROC-MP-0076 N-PROC-MP-0090	**SUPPORT/ACCEPT** OPG to Review & Accept Drawings. For RWPB see Note 1.	**ACCOUNTABLE** Incorporate Change Papers as required. Prepare, Verify, and Approve. Prepare Control Document Form N-FORM-10027 to issue documents. Submit to OPG for Review & Acceptance. P.Eng sealing of final record drawings / documents is not required if the changes are related to the original Design ECs prepared by the Contractor. Contractor to submit documents to OPG Business Services for Issuing. For RWPB see Note 1.	Final Documents and electronic records. For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.83	Drawing Bill of Material	2206-07-20-OP-0001 2206-07-20-TF-0024	**SUPPORT/ACCEPT** OPG to Accept Bill of Material. For RWPB see Note 1.	**ACCOUNTABLE** Incorporate Change Papers and revise Drawing Bill of Material as required. Prepare, Verify, & Approve. Prepare Control Document Form N-FORM-10027 to issue document. P.Eng sealing of final record drawings/documents is not required if the changes are related to the original Design ECs prepared by the Contractor. Contractor to submit documents to OPG Business Services for Issuing. For RWPB see Note 1.	Updated Design Bill of Materials For RWPB see Note 1.

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.84	Design Manuals – New / Revision of Existing Design Manual	N-PROC-MP-0065 N-TMP-10143	**SUPPORT/ACCEPT/ AUTHORIZE** OPG to Accept. OPG Design Authority to Authorize. For RWPB see Note 1.	**ACCOUNTABLE** Review Change Paper version of Design Manual and revise if required based on As-Built information. **Existing Design Manual Change Paper**: Request electronic copy of existing Design Manual from OPG Word Processing via Control Document Form N-FORM-10027. If Word-editable version does not exist, convert paper copy to word editable version. Review outstanding DCRs against DMs. Revise electronic version, incorporating outstanding DCRs, and submit to OPG for review **New Design Manual:** Use OPG Template for new Design Manual Review formatted document and submit to OPG for review. Return reviewed document back to OPG for revision if required and sign Prepared, Verified, and Approved Design Manual. Route to OPG for remaining signatures. Issue approved final document to OPG Business Services/Asset Suite and confirm issued. For RWPB see Note 1.	Updated/New Design Manual For RWPB see Note 1.

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.85	Documents with Defined Revision Cycles (as per Section 1.4.4.1 of N-GUID-00700-10000) e.g. Safety Report, Fire Safety Shutdown Analysis etc.	N-GUID-00700-10000 N-LIST-01300-10000 Bounded Document Set	**ACCOUNTABLE** To be discussed with Document Owners on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to liaise with OPG Document Owner. For RWPB see Note 1.	**SUPPORT** To be discussed on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to Support Document Owner as required when document is to be revised. For RWPB see Note 1.	Updated Documents with Defined Revision Cycles. For RWPB see Note 1.
3.86	Instrumentation Calibration Sheets (ICS)	N-PROC-MA-0068	**SUPPORT / ACCEPT** Accept completion as part of Design EC closeout process. For RWPB see Note 1.	**ACCOUNTABLE** Convert pre-install ICS to permanent ICS as part of EC closeout. For RWPB see Note 1.	Approved ICS Updated ICS Program For RWPB see Note 1.
3.87	Design Plan (Final rev for design completion assurance)	2206-07-10-OP-0001	**SUPPORT / REVIEW/ACCEPT / AUTHORIZE** OPG will coordinate review and providing comments. OPG to Accept. OPG Design Authority to Authorize. For RWPB see Note 1.	**ACCOUNTABLE** Prepare, review, approve Close out. Design Plan upon completion of Project. Contractor to submit authorized documents to OPG Business Services for Issuing. For RWPB see Note 1.	Final Design Plan Updated For RWPB see Note 1.
3.88	Asset Suite Update	N-GUID-00700-10000 N-GUID-08133-10072	**SUPPORT** As required. For RWPB see Note 1.	**ACCOUNTABLE** Contractor to follow N-GUID-08133-10072 for Asset Suite requirements For RWPB see Note 1.	Asset Suite Actions For RWPB see Note 1.

4.0 PROCUREMENT INTERFACE MATRIX

Contractor is responsible for the management, planning, execution, progress, monitoring and reporting of all Owner or Contractor Specified Materials, Goods and Services procurement functions and activities during the life of the Project, including preparation of procurement and contracting strategies and the Procurement Plan as applicable. Procurement and contracting strategies will be reflected in the Procurement Plan if required.

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
	PROCUREMENT PLANNING				
4.1	Materials/Procurement Management Plan (Including Storage, Logistics, Security Screening, Warehousing etc.)	Refer to Appendix C for Elements to be Considered within a Procurement Plan Materials/Procurement/ Management Plan 509407-0000-00000-50IM-0001 2206-06-30-OP-0008 N-STM-03651.03-10000	**REVIEW** OPG will provide feedback on the Materials/Procurement Management Plan and review the plan when comments are incorporated.	**ACCOUNTABLE** Develop a Materials/ Procurement Management Plan for procurement of the Owner or Contractor Specified materials and Services required for implementation of the specified OPG Specification. The plan shall include requirements for storage, security screening, maintenance and shelf life. Provide any deviations of mandatory criterion from the Materials/ Procurement Management Plan for OPG review	Materials/ Procurement Management Plan
	ENGINEERING DELIVERABLES				
4.2	Update Master Catalogue / Create CATID	Refer to Item 3.37	Refer to Item 3.37	Refer to Item 3.37	Refer to Item 3.37
4.3	Changes or updates to Master Equipment List (MEL) Records	Refer to Item 3.77	Refer to Item 3.77	Refer to Item 3.77	Refer to Item 3.78
4.4	Technical Specifications or Tech Spec Data Sheets	Refer to Item 3.34	Refer to Item 3.34	Refer to Item 3.34	Refer to Item 3.34

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
4.5	Approved Equipment Bill of Materials	Refer to Item 3.39	Refer to Item 3.39	Refer to Item 3.39	Refer to Item 3.39
4.6	Spare Parts List	Refer to Item 3.40	Refer to Item 3.40	Refer to Item 3.40	Refer to Item 3.40
4.7	Procurement Evaluation (for Maintenance Spare Parts Only)	Contractor Specific N-PROC-MP-0098 Contract Exhibit 2.11, sections 1.2, 1.3, & 2.2 PMMP 509407-0000-00000-50IM-0001 2206-06-30-CF-0005 2206-06-10-OP-0004 2206-06-30-OP-0003 2206-06-00-OP-0001 2206-07-30-OP-0010	**ACCEPT** OPG will accept procurement evaluations. Input into Asset Suite Provide Asset Suite approval (as required)	**ACCOUNTABLE** Contractor to prepare, verify and approve procurement evaluations as per the Contractor's process. Contractor to provide information in prescribed format per Appendix B for OPG to populate Asset Suite.	Procurement Evaluation
4.8	Drawing Bill of Materials	2206-07-20-OP-0001 2206-07-20-TF-0024	Refer to Item 3.31	Refer to Item 3.31	Refer to 3.31
	IDENTIFICATION REQUIREMENTS				
4.9	Additional Requirements to Support OPG Business Processes and Requirements	509407-0000-00000-50IM-0001 Appendix B	**SUPPORT/ACCEPT** For elements that are in addition to the standard CSA N286 QA Standard, OPG to specify the specific content and format requirements for information and documentation required to support operation of the plant. Appendix B provides a representative list. OPG to accept requirements to populate into Asset Suite OPG to input into Asset Suite	**ACCOUNTABLE** Apart from the requirements of N286-05 and Z299.1 and the Contractor's processes, OPG specific business processes and requirements are to be provided by the Contractor as per Appendix B.	Material Information to Support OPG Databases Asset Suite Action

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
	PURCHASING ACTIVITIES				
4.10	Establish Terms and Conditions	509407-0000-00000-50IM-0001 2206-06-00-OP-0001 2206-06-30-CF-0013	**REVIEW** OPG to provide feedback and accept terms and conditions.	**ACCOUNTABLE** Contractor to provide their commercial terms and conditions to OPG for review and acceptance prior to RFP issuance.	Commercial Terms and Conditions
4.11	OPG Approved Suppliers List (ASL)	N-PROC-MM-0010 N-FORM-10170 2206-06-30-OP-0003 2206-06-30-CF-0003	**SUPPORT** At Contractor's request, and periodically OPG to provide a list of vendors qualified on OPG's ASL complete with specific QA data when requested. OPG to respond to submittal as per 2.9 of the RFR EPC Agreeement.	**ACCOUNTABLE** The Contractor shall engage only Sub Contractors listed on OPG's ASL and/or the Contractor's ASL. When using OPG's ASL, the Contractor shall select Suppliers only if the Contractor determines that the information provided is sufficient and meets the requirements of applicable standards and the Contractor's own quality program.	Submit documentation on suppliers including audit report & checklist
4.12	Commercial Grade Dedication (if required)	2206-01-50-CF-0062 2206-01-50-OP-0002 2206-06-40-OP-0002 2206-06-40-OP-0001	**ACCEPT** OPG to accept the CGD plan. OPG to accept the inspection and test results for CGDs.	**ACCOUNTABLE** SLN shall submit CGD plan to OPG for acceptance. SLN shall submit completed CGD package to OPG for acceptance.	Commercial Grade Dedication Plan Inspection and test Report
4.13	Concessions and Exceptions Process	509407-0000-00000-38QP-001	**ACCEPT** Accept Concession.	**ACCOUNTABLE** Submit concession for OPG acceptance.	Accepted Concession
4.14 (a)	Non Conformances (Not applicable to OSM or Tooling)	509407-0000-00000-38QP-001	**ACCEPT** Accept Non conformance disposition.	**ACCOUNTABLE** Submit non-conformance disposition for OPG acceptance if disposition suggests use as is or requires repair/rework.	Non Conformance Disposition.
4.14 (b)	Non Conformances (Applicable to OSM)	509407-0000-00000-38QP-001	**ACCEPT**	**ACCOUNTABLE** The Contractor shall submit Nonconformance Reports (NCRs) for	Non Conformance Disposition

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
				any items and services discovered by the Contractor during the execution of the Purchase Order. All nonconformities discovered by the Contractor's Sub-Suppliers which do not conform to the OPG Purchase Order/Contract Requirements shall be documented by using the Contractor's Sub-Suppliers NCR form. Acceptance from Contractor and OPG shall be obtained by using the form "RFR Acceptance of Supplier's Documents", 509407-0000-00000-38CF-0020 which shall include Contractor recommended disposition and technical justification. As a minimum, the following type of non-conformance must be submitted for OPG evaluation: Nonconformances, which have been Dispositioned by the Contractor or Contractors Sub Supplier as "Use as-is" or "Repair", require OPG acceptance if they meet any of the following conditions: • A technical or material requirement is violated • The Contractor has violated a requirement in supplier documents Including procedures (e.g welding), which have been accepted by OPG • The Contractor cannot correct the nonconformance by continuation of the original manufacturing process	

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
				unless a rework or repair procedure is accepted by the contractor and OPG as required. • The item does not conform to the original procurement requirement even though the item can be restored to a condition such that the capability of the item to function is unimpaired. No OPG acceptance is required for a NCR documented non-compliance with the contractor or supplier program. Where required, these NCRs shall be compiled in the History Docket/History File to meet code requirements.	
4.14 (c)	Reporting of Non-Conformance Post Execution	RFR EPC Agreement Article 13.8	**ACCEPT** Accept reporting of non conformance.	**ACCOUNTABLE** Notify OPG in writing when a known or suspected defect or non-conformance is discovered that affects, or may affect, a product that has already been turned over to OPG as per Appendix D.	Notification of Non Conformance on the Contractor's Letterhead
4.15	Source Surveillance & Factory Testing	CSA N285 CSA N286 2206-06-40-OP-0002 2206-06-40-OP-0001 2206-06-40-CF-0004 2206-01-30-CF-0010	**SUPPORT** OPG may elect to witness factory testing Accept per item 3.36 Vendor Technical Documents	**ACCOUNTABLE** Contractor to advise OPG of any Source Surveillance/Factory Testing activities. Accept documents on OPGs behalf per Item 3.36 Vendor Technical Documents	Refer to item 3.36
	RECEIVING AND INSPECTION				

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
4.16	Receipt and Inspection Transfer for Spare Parts	N-PROC-MM-0021, Receiving QC Inspection 2206-06-40-OP-0002 2206-01-30-OP-0009 2206-01-30-CF-0010	**SUPPORT/ACCEPT** OPG to accept parts into inventory. Refer to item 3.40.	**ACCOUNTABLE** Establish a process for the transfer of spares from the Contractor to OPG. Contractor receiving documents shall accompany the materials transferred to OPG stock. Refer to item 3.40.	Parts accepted into OPG Inventory.
4.17	Materials Management (Storage, Logistics, Security Screening, Warehousing etc.)		Refer to Item 4.1	Refer to Item 4.1	Refer to Item 4.1
DOCUMENTATION CONTROL AND RECORDS MANAGEMENT					
4.18	History Docket	N-PROC-MM-0021, N-FORM-10396, N-TS-08173-10001,	**REVIEW / ACCEPT** OPG to accept History Docket as a permanent record.	**ACCOUNTABLE** Contractor is accountable to prepare and verify the History docket for Owner or Contractor Specified Materials and Goods purchased and received.	History Docket N-FORM-10396
CONTRACT COMPLETION (CONTRACTS BETWEEN CONTRACTOR AND SUB-SUPPLIERS)					
4.19	Performance OPEX Evaluation / Continuous Improvement	2206-06-70-OP-0002	**REVIEW** OPG to review Non Conformance OPEX.	**ACCOUNTABLE** The Contractor will provide OPG with Non Conformance OPEX of suppliers.	Non Conformance OPEX Report of Suppliers

5.0 CONSTRUCTION INTERFACE MATRIX

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.1	Construction Quality Assurance Plan	509407-0000-00000-38QP-0001: Project Quality Plan	**SUPPORT/ACCEPT** OPG provide feedback to Contractor and accept QA Plan.	**ACCOUNTABLE** Contractor to prepare and approve QA Plans for Construction activities and execute per its QA program. Submit approved construction QA plan to OPG for acceptance.	Construction Quality Assurance Plan
5.2 a)	Safety Program	N-GUID-09701-10011: DN Refurbishment Safety Management Essentials	**SUPPORT/ACCEPT** As Owner/Constructor, OPG is to establish Health and Safety standards, expectations, measures and targets for the Contractor. OPG to accept Contractor Safety Program, Plan, Safe Work Practices and Processes.	**ACCOUNTABLE** The work will be executed by the Contractor and sub-contractors under the Contractor's safety management program and project specific safety plans. Contractor to submit program, plans for acceptance.	Safety Program & Plans to manage worker safety including sub-contractors. Job Safety Analysis
5.2 b)	Environment Program	N-GUID-09701-10013: Nuclear Projects – Environmental Requirements Guideline	**SUPPORT/ACCEPT** As Owner/Constructor, OPG is to establish Environmental standards, expectations, measures and targets for the Contractor. OPG to accept Contractor's Environment Management Program and Environmental Protection Plans and Processes.	**ACCOUNTABLE** The work will be executed by the Contractor and sub-contractors under the Contractor's Environmental management program and project specific Environmental Protection plans. Contractor to submit program, plans for acceptance.	Environmental Management Program & Environmental Protection Plans
5.3	Construction Management	Labour Agreements	**SUPPORT** As required	**ACCOUNTABLE** The Contractor is to manage construction staff in accordance with the applicable project labour agreements	Mark-up Meeting

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.4 a)	Control of Field Changes (ECC)		Refer to items 3.65-3.66	Refer to items 3.66-3.67	Refer to items 3.65-3.66
5.4 b)	Control of Field Changes (non-ECC)	2206-07-60-OP-0001: Design Change Control	**SUPPORT** OPG to support as required	**ACCOUNTABLE** Prepare, Review, Approve	Engineering Change Request
5.5	Project Construction Plan/Schedule	P6 Schedule 509407-0000-00000-32IM-0001: Schedule Management Plan	**SUPPORT** OPG to provide support to integrate station/project and Contractor schedules.	**ACCOUNTABLE** The Contractors to prepare and submit to OPG field execution schedule.	Integrated Schedule
5.6 a)	Work Order Assessing / Planning (for work impacting operating systems or units)	N-PROC-MA-0022 N-GUID-08130-10008 NK38-MAN-09701-10005	**SUPPORT** OPG to review WO and provide support as required.	**ACCOUNTABLE** The Contractor is to prepare and assess WO's in Asset Suite, and insert OPG support tasks.	Assessed Work Order
5.6 b)	Work Order Assessing / Planning (for work not impacting operating systems or units)	QCP 309.67	**SUPPORT** OPG to review WO as required and provide support	**ACCOUNTABLE** The Contractor is to prepare and assess Work Orders. Contractor is to insert required OPG support tasks into Asset Suite.	Assessed Work Order
5.7	Workplans (required for work impacting operating systems or units)	N-INS-08120-10011 N-TMP-10208 N-GUID-09701-10019	**SUPPORT / AUTHORIZE /APPROVE** Provide SME reviews for particular subject areas. OPG to approve and authorize Workplans.	**ACCOUNTABLE** Prepare and verify workplans (including Prerequisites, Pre-testing/Calibration) where required to coordinate field activities.	Workplan, CMP, MMP, CTP and/or Installation Instructions
5.8	Preparation of Comprehensive Work Package	QCP 309.67	**SUPPORT/REVIEW** OPG to support and review.	**ACCOUNTABLE** Prepare, review and approve	Comprehensive Work Package
5.8 a)	Work Instruction	Form G084	**SUPPORT** OPG to support and review.	**ACCOUNTABLE** Prepare, review and approve.	Work Instruction

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.8 b)	Inspection and Test Plan	QCP 510.8 Form Q040	**REVIEW** OPG to review ITPs OPG to indicate OPG witness/hold points as required	**ACCOUNTABLE** Prepare review and approve ITPs. (Refer to Check and Test as a guide to develop the ITP)	Inspection Test Plan
5.8 c)	Job Safety Analysis	Redbook - JSA Section Form EHS_RBF_107	**SUPPORT** OPG to provide support as required	**ACCOUNTABLE** Prepare, review and approve	JSA
5.8 d)	Foreign Material Exclusion Plan (if required)	509407-0000-00000-60IM-0062 Form N051	**SUPPORT/REVIEW** OPG to Review FME program OPG to provide support on job FME planning as required.	**ACCOUNTABLE** Prepare, review and approve	FME Job Plan
5.8 e)	Lifting and Material Handling Plans (if required)	Redbook – Lifting and Rigging Safe Work Practices Section 34, Hoisting, Rigging and Material Handling	**SUPPORT/REVIEW** OPG to Review and provide support as required.	**ACCOUNTABLE** Prepare, review and approve.	Complex/ Critical/ Common Lift Plan Material Handling Plan
5.8 f)	Welding (if required)	Procedure Qualification Record Welding Procedure Specification Form Q12 Form W08	**REVIEW** OPG to Review welding procedure.	**ACCOUNTABLE** Prepare, review and approve. Contractor to engage Authorized Inspection Agency.	Weld Map Procedure Qualification Record Welding Procedure Specification
5.8 g)	Non Destructive Examination (if required)	QCP 310.21 QCP 410.4 QCP 410.5 QCP 310.6 QCP 310.7	**SUPPORT** OPG to support as required.	**ACCOUNTABLE** Qualify and perform work as per Contractor's QCPs. If the work is subcontracted out, then the subcontractor will be audited and procedures will be accepted by the Contractor.	NDE Report

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.8 h)	Non-conformances	QCP 501.1 Form Q001 Form Q002	**REVIEW** OPG to review as required	**ACCOUNTABLE** Prepare, Verify, Approve NCRs per Contractor program Submit non-conformance disposition to OPG as required	NCR
5.8 i)	Open Items	Form G008	**SUPPORT** OPG to provide support as required	**ACCOUNTABLE** Prepare and reconcile open items list. Open items that remain unresolved at CWP completion, shall be compiled and submitted to OPG with the Construction Completion Declaration package (refer to 5.14)	Form G008
5.8 j)	Records	QCP 505.21	**SUPPORT** OPG to provide support as required	**ACCOUNTABLE** Contractor is responsible to ensure records are maintained and are available upon request. Turnover of history docket will be completed as per Construction Completion Declaration process (refer to 5.14)	History Docket
5.9 a)	Readiness/Challenge Meeting and Work Release (for any work impacting operating units or systems)	N-PROC-MA-0022 N-PROC-MA-0013, NK38-MAN-00120-10001	**SUPPORT/AUTHORIZE** OPG to attend review meeting and challenge Contractor readiness. OPG to authorize contract work release form.	**ACCOUNTABLE** Contractor to conduct readiness/challenge review meeting with appropriate stakeholders. Contractor to respond to challenge comments and disposition or incorporate into Work Release.	Readiness/ Challenge Meeting, Contract Work Release FORM

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.9 b)	Readiness/Challenge Meeting and Work Release (for any work not impacting operating units or systems)	N-MAN-00120-10001	**SUPPORT/AUTHORIZE** OPG to attend review meeting and challenge Contractor readiness. OPG to authorize contract work release form.	**ACCOUNTABLE** Contractor to conduct readiness/challenge review meeting with appropriate stakeholders. Contractor to respond to challenge comments and disposition or incorporate into Work Release.	Readiness/ Challenge Meeting, Contract Work Release FORM
5.10	Permitry Planning – OPG Equipment	N-PROC-MA-0012	**ACCOUNTABLE** OPG to prepare and integrate permitry into OPG plan. OPG to determine terminal & boundary point locations.	**ACCOUNTABLE** Contractor is to initiate the request of permitry for OPG equipment. Contractor to identify test planning activities	Request for Permit PC1 PC14
5.10b	Permitry Planning – Contractor Provided Tools and Equipment	Redbook Lock Out-Tag Out Safe Work Procedures	**ACCOUNTABLE** OPG to integrate contractor permitry into OPG plan. OPG to verify contractor LOTO procedures meet OHSA requirements. OPG to review contractor LOTO procedures to verify equivalency. OPG to determine terminal & boundary point locations.	**ACCOUNTABLE** Contractor to identify isolating points. Contractor to prepare permitry for Contractor provided equipment per Contractor procedures. Contractor to identify test planning activities. Contractor to identify locations for temporary equipment.	LOTO Work Instruction (Project Specific)

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.11	Permitry Execution – OPG Equipment	N-PROC-MA-0012 N-NR-PROC-09701-10001	**ACCOUNTABLE** OPG to apply the permits and provide Controlling Authority and Issuing Authority. OPG to operate terminal points at contractor request	**ACCOUNTABLE** Contractor to provide Holder of Record and Holder of Record Coordinator, to support the permitry application. Contractor shall follow NR Work Protection Procedure on all OPG equipment. Contractor to identify additional testing, as required. Contractor to initiate permit termination as per OPG governance.	Applied Permit PC14
5.11 b	Permitry Execution – Contractor Provided Tools & Equipment	Redbook Lock Out – Tag Out Safe Work Procedure	**ACCOUNTABLE** OPG to operate terminal & boundary points at contractor request. OPG to terminate and remove permits on OPG owned equipment.	**ACCOUNTABLE** Contractor to apply permits for Contractor provided equipment downstream of terminal points as per Contractor procedures. Contractor to operate Isolating points as required. Contractor to isolate/operate all in vault equipment downstream of identified Terminal Points, including but not limited to: Vault Cranes, RTP (including equipment used on the RTP), AGVs, and power distribution equipment.	Contractor LOTO permits

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.12	Radiation Protection	N-PROG-RA-0013 N-FORM-11047 QCP 509.11	**SUPPORT/APPROVE** OPG to provide approved Radiation Protection Program and procedures to support unit refurbishment activities including; RPC resourcing, organization & administration, office facilities, portable RP instrumentation, bioassay and dosimetry supply, teledosimetry system, RP training & facilities, laundry and RPPE. OPG to review and approve Contractor ALARA plans and dose estimates to ensure compliance with OPG radiation protection programs and implementing procedures.	**ACCOUNTABLE** Contractor to prepare, verify and submit ALARA plans and dose estimates for approval.	ALARA Plans Dose Estimates
5.13 a)	Calibration (Permanent Station Equipment)	N-PROC-MA-0070 (Field Cal'n) N-INS-09100-10012 - (UTC) N-INS-01516-10003 (Software) N-MAN-01983-10000 (FE Cal'n)	**REVIEW/ACCEPT** OPG to review and accept.	**ACCOUNTABLE** Maintain calibration records of all instruments calibrated and specific calibration equipment used to required standards (UTC & Field Calibration Process or accepted equivalents). Forward calibration records to OPG prior to AFS. Calibration records to be compiled in the History Docket	Calibration Records
5.13 b)	Calibration (Contractor Equipment)	QCP 311.0 Form G006 Form G026 Form G063 Form G064 Form G006A	**SUPPORT** As required	**ACCOUNTABLE** Maintain calibration records of all instruments calibrated and specific calibration equipment used to required standards.	Calibration Records

Title:
RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.14	Construction Completion Declaration (Return to Service)	QCP 511.2 QCP 505.21	**SUPPORT/REVIEW/ACCEPT/APPROVE** OPG to review and approve Construction Completion Declaration Package. OPG to accept QA records.	**ACCOUNTABLE** Contractor to prepare Construction Completion Declaration Package. Contractor to provide completed CWPS, History Dockets and as built construction QA records.	Construction/Installation Completion Assurance Certificate Form G008
5.15	Contract Construction Completion		**REVIEW/APPROVE** OPG to review and approve Unit Mechanical Completion	**ACCOUNTABLE** Contractor to prepare and submit Notice of Unit Mechanical Complete for OPG Approval.	Notice of Unit Mechanical Complete
5.16	Work plans / Commissioning Instructions and Pre-Commissioning Site Acceptance Test (SAT)	N-INS-08120-10011 N-GUID-09701-10020	**SUPPORT / APPROVE** OPG support reviews for particular subject areas. OPG to Approve OPG to authorize Workplan/ Commissioning Instructions	**ACCOUNTABLE** Prepare, verify and approve commissioning work plans /Instructions where required to coordinate field activities. Prepare and obtain approval for Commissioning Work Plan/Instructions as required.	Commissioning Work Plan/Instructions
5.17	Pre-Commissioning Activities		Refer to item 3.69	Refer to item 3.69	Refer to item 3.69
5.18	Commissioning Activities		Refer to item 3.70	Refer to item 3.70	Refer to item 3.70

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.19	Vault Area Co-ordination	NK38-MAN-09327-00003 N-PROC-RA-0011 D-INS-09071-10010	**ACCOUNTABLE** OPG to co-ordinate vault activities when bulkhead containment boundary is not established. During this time OPG to co-ordinate all vault activities such that Contractor critical path is not delayed. OPG to mentor Contractor Construction Field Integration Officer (CFIO) prior to establishing bulkhead containment boundary.	**ACCOUNTABLE** Contractor to co-ordinate vault activities when bulkhead containment boundary is established. Incorporate windows for integration of other contractors and OPG staff to maximize productivity during critical path. Contractor CFIO will, in compliance with the Unit P6 Outage schedule, will work collaboratively with the Unit Outage Manager to determine on a daily basis work streams in the vault when bulkhead containment boundary is established.	NA
5.20	Plant Status Control	D-INS-09110-10013 N-PROC-OP-0034	**ACCOUNTABLE** OPG will make and verify tags.	**ACCOUNTABLE** Contractor will request new or replacement tags. Contractor will hang tags.	N-FORM-10407

Note 1:

For the purposes of the RWPB, the JV will own and operate certain SSCs and clarifies that the following documentation will be provided to OPG through our ECC submittals, for the systems identified below. The systems are:

- Pilecap / Mat;
- Superstructure;
- Power Distribution (within the structure);
- Stack and Radiation Monitoring (within the structure);
- PA & Telephone (within the structure);
- Fire Protection (within the structure);
- Active Ventilation;
- Air Supply; and
- Mechanical Overhead Cranes.

Each of the systems above are currently defined by their own individual DECs, however the JV may decide in the future to combine some of the systems to reduce the amount of DECs required in those cases where it will lead to an improvement in the schedule.
The JV will continue to follow the OPG ECC Modification Process for the above systems however the JV will decide the level of involvement of OPG personnel on a case by case basis. The JV will also commit to performing enhanced COMS for the pilecap and superstructure with participation from OPG staff.

Pilecap / Mat
The pilecap / mat will be a reinforced concrete mat which will serve as the base of the RWPB superstructure and will be attached to the caissons.

The JV will provide OPG with the following documents:
- Any GA drawings produced.

Superstructure
The superstructure will be a steel-cladded frame structure, approximately 75 metres by 45 metres in plan that will house the WTS along with its associated systems such as a control room, mechanical and electrical rooms, truck bay, etc.

The JV will provide OPG with the following documents:
- A safety assessment document;
- A radiation protection shielding report; and
- Any GA drawings produced.

Power Distribution
Power distribution inside the building involves design and installation of the disconnect switches, 4.16kV Switchgear, 4.16kV Transformer, a diesel generator, required step down transformers and all required power distribution panels. It also involves providing lighting in the building, providing receptacles at the required locations and sizing and routing of cables from the power distribution panels to the WTS, I&C and mechanical equipment in the RWPB.

The JV will provide OPG with the following documents:
- A technical specification;
- Equipment data sheets; and
- Any GA drawings.

Stack and Radiation Monitoring (within the structure)
Stack monitoring related to the AVS system will be provided in the building and any related alarms will be provided in the RWPB Control Room.

All required radiation monitoring equipment (i.e., WBM, SAM and gamma monitors) will be provided in the building and any related alarms will be provided in the RWPB Control Room.

Stack and radiation monitoring tie-ins to the plant will follow the OPG ECC process however all items for this system within the building will be excluded.

The JV will provide OPG with the following documents:
- Maximum Probable Emissions Rate (MPER) Report; and
- Any GA drawings.

PA & Telephone (within the structure)
A PA and telephone system will be provided in the building and any PA related alarms will be provided in the RWPB Control Room.
PA and telephone tie-ins to the plant will follow the OPG ECC process however all items for this system within the building will be excluded.

The JV will provide OPG with the following documents:
- Any GA drawings.

Fire Protection (within the structure)
A fire protection system will be provided in the building and any related alarms will be provided in the RWPB Control Room.
Fire protection tie-ins to the plant will follow the OPG ECC process however all items for this system within the building will be excluded.

- Fire Hazard Assessment and 3rd party review report;
- Any GA drawings.

Active Ventilation
The Active Ventilation System is primarily required to control the spread of radioactive contamination that is either airborne or has the potential to become airborne in the RWPB. The primary source of airborne contamination is generated by the WTS during waste processing and packaging operations. In addition to airborne contamination control, the AVS shall satisfy the Heating, Ventilating and Air Conditioning (HVAC) requirements for all areas in the RWPB including the control room under all normal operating conditions during winter and summer.

The AVS for the tooling is under negative pressure, providing local containment at source, as well as, for all areas in the RWPB classified as either Zone 2 or Zone 3, maintaining satisfactory operating conditions for personnel and operating equipment in the RWPB throughout the year. The air from the local vacuum systems is subject to a series of HEPA filtration and exhausted to the atmosphere through a dedicated stack for the RWPB. The AVS also removes smoke from the trucks that may be parked in the truck bay within the RWPB.

The JV will provide OPG with the following documents:
- Maximum Probable Emissions Rate (MPER) Report;
- A technical specification and data sheets for all equipment;
- Equipment arrangement drawings;
- Acceptance (Functional) Testing Records; and
- Detailed Commissioning Report.

Air Supply
Compressed air systems will provide service, instrument and breathing air to supporting operations of the WTS and packaging operations.

The JV will provide OPG with the following documents:
- A technical specification and data sheets for all equipment;
- Equipment arrangement drawings;
- Acceptance (Functional) Testing Records; and
- Detailed Commissioning Report.

Mechanical Overhead Cranes
The RWPB will house three cranes; two 30-ton cranes and one 60-ton crane. The cranes will be used to handle the flasks and DSO used in the RWPB along with any other handling needed. The cranes will have automatic controls and limiting devices to ensure that component or system malfunction will not prevent the crane from stopping and holding the load safely.

The JV will provide OPG with the following documents:
- A technical specification and data sheets for all equipment;
- Equipment arrangement drawings;
- Acceptance (Functional) Testing Records; and
- Detailed Commissioning Report.

No exception to the COIR is sought for the deliverables provided. The exception to the COIR relates only to those items that will not be provided to OPG as described above.

(End of Note 1)

APPENDIX A: REFERENCED DOCUMENTS IN THE INTERFACE REQUIREMENTS

OPG Engineering Related References

D-ED-01520-10001 Darlington Equipment Identification

D-PROC-MP-0011 Power Supply List Change Control

D-STE-60110-10001 Computer Wiring Applications And Wiring Practices

N-FORM-10007 COMS Stakeholder Declaration

N-FORM-10091 Available For Service Declaration Or Operations Acceptance Declaration

N-FORM-10221 Human Factors Worksheet

N-FORM-10250 System Classification List

N-FORM-10408 Software Procurement Planning

N-FORM-10409 Software Quality Assurance Requirements

N-FORM-10446 Software Categorization Results

N-FORM-10480 COMS Checklist

N-FORM-10580 Identifying Human Factors Level Of Activity

N-FORM-10649 Environmental Qualification (eq) Completion Assurance

N-FORM-10653 Document Transmittal Request

N-FORM-10853 PSR Determination Checksheet For OPG Nuclear

N-FORM-10958 Modification Outline

N-FORM-10959 Design Scoping Checklist

N-FORM-11003 Code Classification\registration Approvals And Exemptions

N-FORM-11045 Code Classification Exemption Assessment

N-FORM-11070 Scope of Work or Applicable Master EC Package

N-FORM-11128 Field Initiated Change Cover Sheet

N-FORM-11524 Code Class Exempt Assessment

N-GUID-00700-10000 Guide To Modification Process

NK38-GUID-01900-10001 Darlington Refurbishment: Design Completion Assurance

N-GUID-08133-10072 Asset Suite Responsibilities for EPC Suppliers on the Darlington Refurbishment Project

NK38-GUID-50000-10001 DNGS ETAP Model Update Guidelines

N-INS-00680-10000 Identification Of Critical Spares

N-INS-00700-10007 Preparation Of Modification Design Requirements

N-INS-00960-10000 Detailed Commissioning Specifications And Commissioning Reports

N-INS-03651-10025 Environmental Qualification Evaluations (eqe)

N-INS-06700-10000 Preparation Of Human Factors Worksheet

N-INS-08120-10011 Workplan Preparation And Development Process

N-INS-08121.3-10000 Implementation Of Pre-start Health And Safety Reviews (psr)

N-INS-08135-10116 Determining Risk Critical And Safety Significant Equipment And Components For The Q-list

N-INS-09076-10004 Fire Protection Third Party Review

N-INS-09100-10012 Maintenance Work Reporting And Feedback

N-INS-60110-10000 On-line Wiring Updating And Design

N-LIST-01300-10000 Bounded Document Set

N-MAN-08135-10000 Ontario Power Generation Nuclear Data Dictionary For Passport Master Equipment List Configuration Data

N-PROC-MA-0020 Predefined Process

N-PROC-MA-0024 System Performance Monitoring

N-PROC-MA-0034 Predictive Maintenance Program Requirements

N-PROC-MA-0068 Engineering Requirements Supporting The Calibration Process

N-PROC-MA-0070 Calibration Of Field Equipment

N-PROC-MA-0077 Critical Equipment Identification And Categorization

N-PROC-MA-0090 Heat Exchanger Program Requirements

N-PROC-MA-0092 Power Operated Valve Program

N-PROC-MA-0093 Check Valves

N-INS-08125-10001 Lubrication Selection Process

N-PROC-MM-0008 Create And Maintain Catalog Information

N-PROC-MP-0040 System And Item Classification

N-PROC-MP-0049 Procurement Of Software And Products Containing Software

N-PROC-MP-0058 Equipment Bill Of Materials

N-PROC-MP-0065 Preparation And Revision Of System Design Manuals

N-PROC-MP-0076 Preparation Review And Approval Of Engineering Drawings Design Flow Diagrams And Operational Flow Sheets

N-PROC-MP-0083 Constructability Operability Maintainability And Safety

N-PROC-MP-0086 Safety Analysis Basis And Safety Report Updates

N-PROC-MP-0089 Design Specifications Design Reports And Overpressure Protection Reports

N-PROC-MP-0090 Modification Process

N-PROC-MP-0098 Procurement Engineering Activities

N-PROC-MP-0105 Quality Design Plans

N-PROC-OP-0008 Use And Control Of Plant Status Tags

N-PROC-OP-0023 Position Assured Components

N-PROC-OP-0027 Temporary Change Records

N-PROC-TR-0023 Simulator Quality Assurance

N-ST-01161-10000 Drafting Presentation Standard And Practices

N-ST-08131.02-10000 Preparation Of Operational Safety Requirements

N-STD-RA-0033 Reliability Monitoring And Reporting Of Systems Important To Safety

N-STD-RA-0038 Requirements Of Fire Safety Assessments

N-STI-03602-10000 Soe Instrument Uncertainty And Allowable Value Calculations

N-STI-69000-10001 Software Maintenance

N-TMP-10010 Controlled Document Or Record

N-TMP-10143 Preparation And Revision Of System Design Manual

N-TMP-10187 Modification Design Requirements

N-TMP-10189 Darlington Design Manual

N-TMP-10209 Available For Service (afs) Report

OPG Procurement Related References

N-FORM-10170 ASL Action Request

N-FORM-10396 History Docket/Nuclear Material

N-FORM-11524 Portable Assembly Exclusions

N-PROC-MM-0010 Establishing and Maintaining OPGM ASL

N-PROC-MM-0021 Receiving QC Inspection

N-PROC-MM-0021Receiving QC Inspection

N-STM-03651.03-10000, Shelf-Life Requirements

N-TS-08173-10001 History Docket/Nuclear Material Documentation Release

OPG Construction Related References

N-INS-09100-10012 - Recording Field Calibration Equipment UTC Numbers

N-MAN-01983-10000Field Engineering Quality Control Manual

N-NR-PROC-09701-10001 - Work Protection Nuclear Refurbishment

N-MAN-01983-10000 Field Engineering Quality Control Manual

N-PROC-MA-0012 Work Protection

N-PROC-MA-0013 Planned Outage Management

N-PROC-MA-0022, Integrated On-line Work Schedule

N-PROC-MA-0070 Calibration Of Field Equipment

N-PROC-OP-0034 Equipment Labeling

N-PROC-RA-0011 Radiation Protection Coordinator Protection Assistant And Access Controller

D-INS-09071-10010 Radiation Protection Access Control

D-INS-09110-10013 Operations Manager Expectations - Plant Status Control

N-PROC-RA-0027 Radioactive Work Planning Execution And Close Out
N-PROG-RA-0013 Radiation Protection
N-GUID-09701-10011 DN Refurbishment Safety Management Essentials
N-GUID-09701-10013 Nuclear Projects – Environmental Requirements Guideline
N-GUID-09701-10019 Nuclear Refurbishment Construction Check And Test Requirements N-GUID-09701-10020 Nuclear Refurbishment Commissioning Process
N-FORM-11047 Alara Planning And Post Work Review
NK38-MAN-09701-10005 Nuclear Refurbishment Planned Outage Management
NK38-MAN-00210-10001
NK38-MAN-09327-00003 Darlington Outage Manual - Vault Coordinators Activities
N-TMP-10208 Work Plan

RFR Joint Venture - Engineering Related References

2206-01-00-QM-0001 Quality Assurance Manual
2206-07-10-OP-0001 Design Planning
2206-07-20-OP-0001 Preparation of Engineering Documents
2206-07-20-TF-0001 HF Engineering Program Plan
2206-07-20-TF-0012 Design Report - Study
2206-07-20-TF-0013 Design Report - Analysis
2206-07-20-TF-0024 Bill of Materials
2206-07-20-TF-0026 Field Walkdown Package
2206-07-20-TF-0031 Walkdown Report Design Plan
2206-07-20-TF-0032 Design Plan
2206-07-20-TF-0038 OPEX
2206-07-20-TF-0039 Package Design Requirements
2206-07-20-TF-0040 Certified Design Specifications
2206-07-20-TF-0101 Human Factors Validation Plan
2206-07-20-TF-0102 Human Factors Assessment – Major
2206-07-20-TF-0103 HF Worksheet
2206-07-30-OP-0003 Feedback Information for Design Input
2206-07-30-OP-0005 Acceptance of Design Inputs
2206-07-30-OP-0006 Field Walkdown Procedure
2206-07-30-OP-0013 Registration of Pressure Retaining Systems and Components
2206-07-50-OP-0001 Design Verification
2206-07-60-OP-0001 Design Change Control
2206-01-20-OP-0003 R5 Document Control Routines
2206-01-20-CF-0011, Vendor Document Coordination Cover Sheet
2206-07-30-CF-0002 Walkdown Checklist
2206-07-20-CF-0030 Field Condition Report2206-07-WI-0003
509407-0000-00000-40WI-0002 Field Change Notice Instruction
509407-0000-00000-40TF-0001 Field Change Cover Sheet
509407-0000-00000-38QP-0001 Project Quality Plan
509407-0000-00000-40EP-0001 Engineering Plan

RFR Joint Venture - Procurement Related References

2206-01-20-OP-0002 Control of Quality Records
2206-01-30-CF-0002 Nonconformance Report
2206-01-30-CF-0003 Deviation Disposition Request
2206-01-30-CF-0010 Receiving Report
2206-01-30-OP-0002 Control of Nonconforming Items and Services
2206-01-30-OP-0009 Receiving Inspection
2206-01-50-CF-0062 Dedication Plan Commercial Grade Items
2206-01-50-OP-0002 Dedication of Commercial Grade Items
2206-06-00-OP-0001 Purchasing Strategy
2206-06-10-OP-0004 Quality Assurance Evaluation of Tenders
2206-06-30-CF-0003 Supplier Qualification Record
2206-06-30-CF-0005 Recommendation and Authorization to Purchase
2206-06-30-CF-0013 General Purchasing Conditions Nuclear Mat'ls
2206-06-30-OP-0003 Evaluation and Selection of Suppliers
2206-06-30-OP-0008 Logistics and Material Control
2206-06-40-CF-0004 Surveillance Plan
2206-06-40-CF-0006 Quality Assurance Release
2206-06-40-CF-0007 History Docket/History File Acceptance
2206-06-40-OP-0001 Preparation of Surveillance Plans
2206-06-40-OP-0001 Preparation of Surveillance Plans
2206-06-40-OP-0002 Performance of Quality Surveillance
2206-06-70-OP-0002 Supplier Performance Evaluation
2206-07-30-OP-0010 Tender Technical Evaluation
509407-0000- 00000-50IM-0001Procurement Mgmt Plan
509407-0000-00000-38QP-0001 Project Quality Plan

RFR Joint Venture – Construction Related References

509407-0000-00000-38QP-0001 Project Quality Plan
509407-0000-00000-32IM-0001: Schedule Management Plan
509407-0000-00000-40AG-0001
Aecon CSA N286 QA Manual – EPC Contracts
Procedure Qualification Record
Welding Procedure Specification
QCP 310.21

QCP 410.4	Form G008
QCP 410.5	Form G026
QCP 310.6	Form G063
QCP 310.7	Form G064
QCP 311.0	Form G084
QCP 309.67	Form Q040
QCP 501.1	Form N051
QCP 505.21	Form Q001
QCP 509.11	Form Q002
QCP 510.8	Form Q12
QCP 511.2	Form W08
Form EHS RBF 107	Redbook JSA Section
Form G006	Redbook – Lifting and Rigging Safe Work Practices
Form G006A	Redbook Lock Out-Tag Out Safe Work Procedures

APPENDIX B: PROCUREMENT ASSET SUITE TEMPLATE

In addition to the following table, Contractor to also prepare/approve and submit to OPG details of evaluation of Cat Ids. These details may include but not limited to "PE Request Log Disposition" (Asset Suite Panel Q102), "PE Safety Basis Summary" (Asset Suite Panel Q120), "PE Item Equivalency Evaluation and Configuration" (Asset Suite Panel Q150). Copies of templates for these panels will be provided by OPG.

No.	Cat ID	Level (L1, L2, L3, L4)	QE	Description	PB (Yes/No)	EQ (Yes/No)	SQ (Yes/No)	QA Program	Applicable Code	TSSA REGISTRATION (CRN) X Number	Vendor Documentation Requirements	End Use (Equipment Code)	SR/NSR	Applicable Specification Number	Drawing Number	Item # In Drawing	Manufacturer	Manufacturer Location	Model and/or Part Number	Quantity	Manufacturer ASL Qualification (Y/N)	Vendor	Manufacturer ADP/ASL	Vendor Type	Material Safety Data Sheet MSDS (Y/N)	Limited Shelf Life (Y/N)	REMARKS (e.g. Procurement Option, Alternate Equivalency, Substitution)
EXAMPLE	123456	L1	E	CAVITY SAFETY VALVE BETWEEN VALVES	Y	N	N	CSA Z299.3	ASME SEC III	NB-1234	ENTIRE LOOP SEISMIC REPORT	NOT APPLICABLE					WEAN				Y	WEAN	TYPE	N			
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2																											
3																											
4																											
5																											
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PB	Pressure Boundary
EQ	Environmental Qualification
SQ	Seismic Qualification
Code	B51, B31.1, ASME - NB, NC, ND, etc.
ASL	OPG Approved Supplier List

Vendor Documentation

C OF C	Certificate of Compliance
CMTR	Certified Material Test Report
HDOC	History Documentation
C OF A	Certificate of Analysis

Legend

	Required Information
	Provide information if available

Level X Spare Parts List (L2, L3, L4)

Applicable Code

ASME SECTION III (EXAMPLE) NC1
ASME SECTION VIII
B51

QA Program

CSA Z299.1
CSA Z299.2
CSA Z299.3
CSA Z299.4
ISO 9001

APPENDIX C: PROCUREMENT PLAN TEMPLATE

The Procurement Plan shall be prepared and include the Owner or Contractor Specified Materials and Services procurement activities. The Procurement Plan shall be based upon the Contractor's qualified procurement program.

The plan may include, but not limited to, the following elements:

1. Executive Summary
2. Background Information
3. General Description of Product/Services
4. Technical and Regulatory Requirements
5. Historical and Future OPG Usage
6. Vendor/Marketplace Capabilities & Supply Restrictions
7. Existing OPG/Vendor Relationships
8. Bidder Prequalification
9. Competitive Tendering
10. Evaluation/Negotiation & Contract Award
11. Subcontract Management
12. Scheduling.
13. Staffing and Succession Plans
14. Source Surveillance
15. Concessions and Exceptions
16. Sourcing Strategy
17. Success Criteria
18. Risks and Mitigations
19. Commercial/Contractual Requirements
20. Contract Administration Considerations
21. Quality Assurance
22. Quality Control
23. Expediting
24. Transportation/logistics,
25. Site Receipt of Goods, Warehousing
26. Claims Resolution
27. Invoice Approval
28. Contract Closeout
29. Post Contract Considerations
30. References

APPENDIX D: NON-CONFORMANCE POST-INSTALLATION REPORTING

The Contractor shall submit a notification on company letterhead endorsed by Senior Quality Management addressing the following as a minimum:

(a) A clear description of the defect or non-conformance.

(b) An assessment on the impact of the defect or non-conformance to the product form, fit or function. Also address the potential impact on safety if known.

(c) Identify OPG CatID numbers(s) that are affected including OPG PO and line item numbers, ship date, quantity, manufacturer product identification / traceability (i.e. serial number, lot number, batch number, manufacturing date, etc.).

(d) Immediate short term actions to be taken to remedy the situation at OPG (address the availability of replacement item(s) and delivery time lines).

(e) Long term corrective action plan to address the root cause for the defect or non-conformance, including completion / implementation commitments.

Contractor to submit notification by email to: scqs.suppliers@opg.com

APPENDIX E : OPG APPROVED SUPPLIER LIST

(a) **Use of OPG's ASL.**

Subject to the other requirements of the Agreement, the Contractor will be able to utilize vendors on OPG's Approved Supplier List (ASL). All vendors which are active on OPG's ASL are maintained up to date and their qualification is current. OPG's ASL is maintained using OPG's QA Program.

OPG will provide to the Contractor a list of vendors qualified on OPG's ASL periodically or as requested by the Contractor. The list will contain the following information: the Asset Suite Vendor Code, Vendor name, supplier web page – when available, Quality level (QL1 or QL3), qualification result (SAT or UNSAT), detailed scope of qualification, including scope restrictions, if the vendor has Corrective Actions issued or restrictions and warnings (only Yes or No – no additional details), qualification effective date and expiry date, scope of supply – manufacturer, services, distributor, etc, Pressure Boundary (PB), non PB flag, and quality standard used. The Contractor may use the list for the sole purpose of work to be performed for OPG.

Vendors on OPG's ASL may be used by the Contractor only if the Contractor determines that the information provided is sufficient and meets the requirements of the applicable standards and the Contractor's own quality program. The Contractor is responsible to use the vendors on OPG's ASL only for the specific purpose(s) for which they have been approved on OPG's ASL. The Contractor is solely responsible for taking all necessary actions to ensure that its sub-suppliers have the technical and quality assurance capability for the scope of work they are utilized for, and the ability to provide the required product or service. This includes obtaining assurance that the sub-suppliers have an appropriate and effective quality program implemented in accordance with the Contractor's own quality program and applicable standards requirements.

The use of vendors on OPG's ASL does not preclude or limit in any way the Contractor's responsibility for and obligation to provide OPG with quality parts and services meeting all requirements under the Agreement.

(b) **Use of sub-contractors not on OPG ASL**

If the Contractor's requirement is not satisfied by vendors on the OPG's ASL, or the scope of qualification for a vendor on OPG's ASL needs to be changed, the Contractor shall submit to OPG notification to use a new sub-contractor when required as identified below:

(i) **A submittal to OPG is required for the use of sub-Contractors only when:**

The contractor acts a procurement organization as per CSA N286-05 for the purchase of items and services:

- For QL1 and QL3 items only when a quality program is specified
- For QL1 and QL3 items, when the specified quality program is for CSA Z299.3 or higher (e.g. CSA Z299.1/.2/.3, NCA 3800 Material Organizations)

- When a primary CSA N286-05 engineering, procurement or construction is subcontracted in its entirety

(ii) **A submittal to OPG is not required for sub-contractors:**

- When the contractor purchase materials/ components following a CSA Z299 program as part of their manufacturing process (i.e. the contractor is the manufacturer or the manufacturer of record)
- When there is no quality program specified
- When the specified quality program is CSA Z299.4 or ISO 9001
- Service suppliers (other than those primary N286-05 engineering, procurement, or construction service suppliers identified above in (i))
- Software suppliers
- Related to the Mock-up Scope of Work
- Tooling Suppliers

The Contractor shall evaluate, audit as appropriate, and approve the new supplier, according to the Contractor's own quality program. When a submittal to use a supplier is required, the Contractor shall provide the audit report, checklist, corrective action requests and certificates to OPG. The Contractor should assist OPG in providing business justification as to why OPG should accept using these potential Sub-Contractors.

When a submittal is not required, the Contractor shall maintain the audit report and checklists according to their own quality program requirements and provide it to OPG upon request.

Attachment B

Parts I and II of Exhibit 2.1 – RFR Scope of Work

PART I - NK38-SOW-31100-10016: DARLINGTON RETUBE AND FEEDER REPLACEMENT SCOPE OF WORK

See attached.

ONTARIOPOWER GENERATION

OPG Proprietary Commercially Sensitive	
Document Number: NK38-SOW-31100-10016	Usage Classification:
Sheet Number: N/A	Revision: R005

Title: DARLINGTON RETUBE AND FEEDER REPLACEMENT SCOPE OF WORK

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DARLINGTON RETUBE AND FEEDER REPLACEMENT SCOPE OF WORK

NK38-SOW-31100-10016-R003

Order Number: N/A
Other Reference Number: N/A

OPG Proprietary
Commercially Sensitive

Prepared by: 23 June 2017

David Fennell — Date
Sr Procuremetn Specialist
Refurbishment Supply Services

Reviewed by: 23 June 2017

Marc Paiment — Date
Project Manager
Retube and Feeder Replacement
Refurbishment Execution

Approved by: 2017-JUNE-26

Perrik LeDreff — Date
Deputy Project Director
Retube and Feeder Replacement
Refurbishment Execution

Revision Summary

Revision Number	Date	Comments
R005	2017-06-22	Section 2.2.1 – Added Two (2) End Fitting Transfer sets (PCD #042) and upgrade to ASRT Tooling (PCD #047) Section 2.2.7 – Added section for annulus spacers redesign impact to SSDO tools (PCD #30) Section 2.2.8 – Added section for Waste Tooling System Rehearsals (PCD #031) Section 2.2.9 – Added section for Expansion of the VCS for Radiation Protection (PCD #34) Section 3.5.2 – Replaced text for Feeder Cabinet Insulation Panels Scope Reduction (PCD #046) Section 3.5.3.1 – Added section for Feeder Weld Procedure Qualification (PCD #35) Section 3.5.7.1 – Added section for Caladria Tubes (CT) Inserts Process Qualification (PCD #040) Section 3.6.1.10 – Added section for Calandria Vessel Inspection Post Imaging Analysis (PCD #040) Section 3.6.3.1 – Added section for Calandria Tube Sheet Bore Inspection, Preparation and Refurbishment Process Qualification (PCD #040) Section 3.6.4 – Updated to inspect two bellows on each reactor face simultaneously (PCD #039) Section 3.6.4.1 – Added Section for Measuring Single Fuel Channel Replacement Bellows Flange Length (PCD #040) Section 3.6.8.1 – Added Section for Instrument Tubing ID Cleaning (PCD #040) Section 3.9 – Updated for capability to load fuel into four fuel channels simultaneously (PCD #037) Section 5.1.1 – Added language to build six (6) Intermediate Level Waste End Fitting containers (PCD #042)
R004	2014-09-29	Section 1.1 – updated language regarding anticipated Unit sequencing Section 2.1, 2.2.1, 2.2.1.2, 3.5.1, 7.1.1- Added requirement to retrieve annulus spacers dry the PHTS and Moderator Auxiliaries bulk vacuum drying and contingency Tools. Section 2.3.1.3 – Added section for Rehearsals at DEC Section 2.3.1.4 Added section for Tool Management System Section 3.3.3- Removed reference to Contract Amendment from last sentence of this section. Section 3.4- Removed OPG Obligations to have "PHTS and auxiliary systems isolated" and "Moderator and auxiliary systems isolated". Added OPG obligation for wire rope replacement on Reactor vault cranes for last three units. Added manpower obligations after vault turnover. Added OPG fueling activity impact on refurbishment unit. Section 3.5.3- Fixed spelling mistake. Updated requirement for feeder scanners and guide tubes Section 3.5.6- Made several changes to remove the requirement that FROBs and DBs be collapsible and be volume reduced and disposed of with the pressure tube. Section 3.6.1.1- Removed requirement to provide tooling and complete a general visual inspection of the LISS Nozzles as per PCD. Section 3.6.1.9- Removed section. Section 3.6.2- Removed section. Section 3.6.6- Removed section.

		Section 3.6.8- Reworded expectations for routing of new instrument tubing and support trays. Section 3.6.9 and 3.6.10- Added sections to document required scope related to RAB and Carriage System Component Replacements and Reactor Vault and Fuelling Duct Cooling Coils and Fan Motors as per PCDs. Section 5.1.2- Corrected acronyms and wording. Add provision for primary and secondary transportation method. Section 5.1.3.1- Corrected acronyms and removed requirement for FROBs to be crushable and processed with the pressure tube. Section 5.1.3.3- General corrections to wording for clarity on process for processing EFs. Section 5.1.3.4- Removed section. Section 6.1.1- Clarified Seismic Requirements for tooling. Added potential for integrated streamlined quality plan. Section 7.2.2 – Added exposure control limit for Boilermakers, Millwrights, and Pipefitters established at 1600 mRem Section 10.1- Added reference. Section 11- Added/corrected acronyms. Appendix A- Removed Reactor Outlet Headers and LISS Nozzles from Parts List.
R003	2013-06-28	Section 1.1 - Identified order in which units will be refurbished. Section 3.3.3 - Added wording to identify that isolation bulkhead falls under the Contractor's work. Section 3.4 – removed isolation bulkhead from OPG obligations. Section 3.5.3 – removed Fixed on-line thickness measurement equipment, reworded instructions on Feeder scanners. Section 3.6.1.9 – reworded instructions on LISS nozzle inspection Section 3.6.2 – removed from scope Section 3.6.6 – removed from scope Section 3.6.8 – reworded instructions on the D2O transmitter impulse lines Section 5.1.2 – Added that the Retube Waste Processing Building is the responsibility of the Contractor. Replaced Waste Volume Reduction Facility with Retube Waste Processing Building. Section 6.1.1 – added code effective date for relevant standards Section 7.1.2 – added code effective date Section 10.1 – updated references Appendix A: corrected # of calandria tube inserts from 480 to 960 Appendix G: added note
R002	2012-01-04	The signature page has been updated. Section 2.3.2.3 – The information originally contained in Section 2.3.2.3 has been moved to the newly created Section, 2.2.1.2. PHTS Draining, Vacuum Drying and Calandria Drying is now included in the Tooling fixed price. Section 2.2.6 – The Tooling Commissioning & Integration Section has been updated. Testing details are now captured in the main R&FR agreement.
R001	2011-09-22	Several changes made throughout the Document based on requests for clarification from proponents. Intent changes include: Section 2.1 - Change to the naming of "plans" to be provided by the contractor to line up with commercial documentation. Section 2.2 - Added requirement to provide Tooling for waste management processing and

		replacement of helicoils for positioning assemblies. Section 2.2.2 – OPG will stipulate Tooling design hold points – COMS as a minimum. Section 2.2.6 – Clarified that certain tools cannot be integrated tested on the mock-up such as vacuum dry, reactor face insulation removal, feeder cabinet removal. Section 2.3.2 – Clarified that ITPs, CWPs, JSAs will be prepared by contractor in the Definition Phase. Section 2.3.2 – added paragraph to discuss modifications to owner specified materials. Section 2.3.3 – OPG will be the designer of record for the long lead items. Section 3.2 - change from TIMS database use by contractor to a "contractor database". Section 3.2.2 – change from the contractor use of the SCR database for reporting to a contractor reporting method. Section 3.4 – change from OPG providing the Unit with both airlock doors open to having the mod completed to allow for airlock doors open. Vault conditions and CNSC Approvals will dictate timing of when doors can be open. Section 3.5.1 – bulk helium for moderator drain will be provided by OPG. Section 3.5.2 – insulation will be replaced with new but will not be modified. Feeder cabinet framing can be re-used if in good condition. Section 3.5.3 – UT flow meas., RTDs and guide tubes, FOLTMs will all be replaced with new. Section 3.5.6 – added requirement to interface with FROBs and dummy bundles for PT removal and volume reduction. Section 3.6.1 – added moderator inlet pipe UT inspection of welds, guide tube gap inspection, LISS nozzle gap inspections. Section 3.6.6 – added clarification on the scope of header replacement preparations. Section 3.10 – clarified contractor will provide commissioning specifications during Execution Phase and OPG will provide commissioning plans. Section 7.2.4 – removed information on PHT decontamination. Section 8 – conventional safety section reduced since this subject is addressed in the commercial documentation. Section 10.1: Several Documents added. Appendix E: Several deletions. Appendix F: Several deletions, additions and changes. Appendix G added – tooling categorization information.
R000	2011-03-04	Initial issue.

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1.0 INTRODUCTION

1.1 Purpose

In 2010, Ontario Power Generation Inc. ("**OPG**") decided to pursue refurbishment of the four existing reactor Units at the Darlington nuclear generating station ("**DNGS**"). This scope of Work ("**SOW**") Document specifically addresses the retube and feeder replacement ("**R&FR**") portion of the refurbishment Work.

OPG's current planning assumption is Unit 2 will be refurbished first, followed by Units 3, 1 and then 4. The Units will be shut down in a partially overlapping sequence. Unit 2 will be shut down and then returned to service before the shut down of Unit 3. The Unit 1 shutdown will commence after the removal of all reactor components in Unit 3 is complete (i.e., the end of the removal phase of Unit 3). The Unit 4 Shutdown will commence after the removal phase of Unit 1 is complete, and after Unit 3 is returned to service, so that no more than two units are shut down for refurbishment at any time. OPG plans to operate the four existing Units at DNGS for another 30 calendar years post-refurbishment.

The purpose of this SOW is to provide the basis for the Target Cost estimate and a high level functional scope of Work for the contracted portion of the retube and feeder replacement Work, and to provide sufficient detail to convey OPG's current plans, OPG's expectations, and currently known major constraints. The Contractor will provide input into the scoping, planning, business case refinements for the Work, and will develop the programs or provide support to the OPG programs to meet the programmatic requirements of the CNSC Regulatory Document "Life Extension of Nuclear Power Plants", RD-360. Certain deliverables are requested in this SOW in order to meet the requirements of RD-360.

The general approach for the Work is that the Contractor will provide complete engineering, procurement and construction services to OPG, and OPG will be the Constructor overseeing the Work. OPG intends to isolate ("island") the Unit(s) that are being refurbished to the extent possible, in order to facilitate access and gain efficiency. This will be accomplished by the use of physical barriers and administrative controls. OPG will have dedicated personnel to

provide overall program management, review and accept documentation and ensure adherence to quality assurance requirements as specified in this Document and the EPC Agreement.

The OPG Refurbishment Program organization will also be managing Work that is outside the scope of Work of the R & FR Contractor. This OPG scope is currently being defined and will include:

- Unit layup
- Unit Islanding
- Fuel handling equipment inspection and overhauls
- Steam generator inspection, cleaning and layup
- Turbine/generator overhauls
- Balance of plant maintenance activities & modifications
- Routine preventative maintenance that is due for completion
- Other scopes, including but not limited to safety improvement optimization, integrated safety review, Environmental Assessments, etc.

This OPG Work will have an impact on the Contractor in terms of potential interferences, space allocation inside the powerhouse, and general congestion. This risk will be mitigated by space allocation planning and development of an integrated schedule. During the Definition Phase, the Contractor will work co-operatively with OPG and other contractors with the goal of minimizing overall program cost and schedule impacts to OPG.

1.2 General Process Considerations

This SOW has been prepared on the basis that the Contractor will develop processes, methods and procedures for completing the Work, following general ALARA principles. Hence, some elements of the Work are described at a high level in order for the Contractor to have flexibility in developing these processes, methods and procedures. However, as indicated below, OPG has some preferences with regard to such processes that may be considered as a starting point. These preferences may be challenged by the Contractor if, in the initial planning stages of the Definition Phase, they are shown to be undesirable or it can be shown that a better product or service is available, based on the Contractor's own experience or research. The Contractor will provide OPG with the alternative approach and rationale for its use.

1.3 Document Structure

This SOW is separated into three major sections:

The terms **Definition Phase, Execution Phase** and **Commissioning Phase** are defined in the RFR EPC Agreement. In general, the Definition Phase covers all planning activities for the Work to be carried out in the Execution Phase and also the development of the required Tooling. The Execution Phase covers the actual carrying out of the Work on a Unit by Unit basis, and the Commissioning Phase covers the Work required to return the Units to service.

2.0 DEFINITION PHASE

2.1 General

The Contractor will perform a turn-key service to complete the Definition Phase Work, which will include the specific elements identified in this section. The following sets out a high level itemized listing of the Work for the Definition Phase. This is a functional specification and is not intended to prescribe how the Work will be performed, nor is it intended to be an exhaustive list of the necessary Work. The Contractor will be obligated to develop a program that includes the items below, in order to complete the Work. The Contractor will develop all Tooling, procedures, procurement of materials and Goods, and will qualify, test and commission the Tooling. The Contractor shall ensure that the Tooling is sufficient to perform the Work.

1. Tooling Work

    a. Tooling Preliminary Engineering
    b. Tooling Detailed Engineering
    c. Tooling Prototyping and Manufacturing
    d. Tooling Procedures
    e. Tooling Testing, Commissioning and Integration

2. Definition Phase Work

    a. Retube and Feeder Replacement process management plans preparation and updates

    b. Modification Documentation

        i. Temporary modifications to structures, systems and components.
        ii. PHTS vacuum dry, PHTS auxiliaries dry, and moderator and auxiliaries dry
        iii. permanent modifications to reactor structures, systems and components

    c. Procurement of Materials (See the procurement Section 2.3.3)

d. Release Quality Estimate
   i. Execution Phase Risk Register
   ii. Interim Execution Phase Schedule Development
   iii. Interim Execution Phase Cost Estimates
   iv. Execution Phase Level 5 Schedule
   v. Execution Phase Target Cost (AACE Class 2)

2.2 Tooling Work

2.2.1 Tooling

Below is an itemized listing of Tooling that the Contractor will supply ("**Tooling**"), in accordance with the Design Requirements Document, NK38-DR-31110-10000, as found in R&FR Exhibits. The following sections contain the requirements and information concerning each item listed below. The Tooling will include all tools for:

- Removal of the reactor components and hardware listed in Appendix A
- Removal of the reactor face insulation and feeder cabinets
- Installation of the new reactor components and hardware listed in Appendix A
- Annulus bellows inspection and repair/replacement
- Fuel channel drainage (channel drain tools)
- Calandria vessel internal inspections (more details on what Tooling is required are included in Section 3.6.1)
- Calandria tube sheet bore inspection, preparation and refurbishment
- Header nozzle inspection and repair
- Replacement of instrumentation tubing
- All other inspection Tooling described in this Document and in the Design Requirements Document
- Tooling required for waste management & processing
- Tooling for replacement of helicoils for positioning assemblies
- Calandria vessel drying equipment
- Vacuum Drying Equipment
- New Fuel Loading Tools
- Recovery of six sets of four annulus spacers from the OPG-designated fuel channels (N13, N15, O17, O21, O23, O24) on the first Unit only, in a manner

that minimizes damage to the items on a best efforts basis, for delivery to OPG. OPG will accept delivery of the recovered annulus spacers once they are transferred into OPG containers.

- Upgrade ASRT Tooling to reduce risk of failure of the Tool. The Contractor will use the Mark III design input to design, test, build and deliver seven (7) cartridges, four (4) push tools and three (3) PT extension tools.
- Two (2) End Fitting Transfer System Tool sets as contingency to allow for End Fitting removal and disposal without cutting the outboard End Fitting.

2.2.1.1 Feeder Tooling Considerations

OPG has a preference that feeder removal be performed manually. This is due to operational experience that setup and use of automated Tooling for feeder removal is complex. However, all manual tools must be developed and used in a manner that minimizes radiation exposure to workers and ensures that contamination is controlled at the source.

2.2.1.2 Primary Heat Transport System Draining, Vacuum Drying and Calandria Drying

Vacuum drying has been used at several nuclear facilities and a similar process shall be used by the Contractor to dry the primary heat transport system "PHTS"). Drying of the PHTS and PHTS auxiliaries will also be required. PHTS very low level bulk draining, including PHTS main headers, will be performed by OPG. Provision of draining tool(s) will be maintained by the Contractor to allow for channel by channel draining as a contingency. The Contractor shall perform an evaluation of the components of the PHTS and PHT auxiliary systems (if applicable) that will be exposed to the vacuum pressure in order to define the operational limits of the vacuum system. The Contractor will also complete a report providing technical justification for the continued operation of the PHTS and auxiliaries after exposure to the vacuum pressure. The Contractor shall vacuum dry the entire PHTS main circuit including the steam generators. The Contractor shall also dry the PHTS auxiliaries. It must be demonstrated that the vacuum pressure will not in any way damage the steam generators or any other PHTS components as stated above for the process to be acceptable for use. As part of the Definition Phase Work, the Contractor shall design, procure, and manufacture the vacuum dry system. The system will undergo a factory

acceptance test that will be witnessed by OPG. The Contractor will develop a qualification and commissioning plan for OPG's review and acceptance. The qualification and commissioning plan will demonstrate that the system will perform the intended function, within the desired timeframes, and without damaging or creating latent defects in the PHTS and PHTS auxiliary systems. The Contractor will generate a qualification and commissioning report that confirms the system has met OPG's requirements. OPG has OPEX with regard to the drying criteria and will work with the Contractor to establish criteria that considers the requirements of the tooling, waste container acceptance criteria, tritium reduction requirements, and is cost effective. This qualification and commissioning report will be submitted for DA acceptance.

As well as the PHTS, the Contractor shall design, procure, and manufacture a system to dry the moderator side of the calandria and the moderator auxiliary systems in order to ensure that the calandria is as dry as possible prior to starting the Execution Phase Work.

The Contractor shall specify tooling required to complete a gravity drain for a single fuel channel as a contingency operation.

The Contractor shall specify tooling required to remove remaining D20 not removed by the bulk drain process by OPG.

2.2.2 Tooling Design

The Tooling design will be completed in accordance with the Definition Phase Target Schedule, meeting the requirements of this SOW and the Design Requirements Document NK38-DR-31110-10000. The Contractor will be accountable for any required license, Approvals or registrations for the Tooling.

Tooling design will also be performed in accordance with N-PROC-MP-0105, "Quality Design Plan", and associated procedures. The Contractor will categorize the Tooling in accordance with the guidelines in Appendix G, then will produce quality design plans according to the guidelines for OPG's review and acceptance. OPG will ensure that reviews and/or quality gates (eg COMS reviews) are specified in the quality design plans in a manner consistent with the procedure and in accordance with the tool categorization criteria provided in Appendix G. Note that additional information is provided in the program

Document, "Engineered Tooling Change Control", N-PROG-MP-0010, which must be read in conjunction with N-PROC-MP-0105.

2.2.3 Tooling Procedures

During the Definition Phase, the Contractor will develop all procedures required for the use and the maintenance of the Tooling to complete the Work specified in this SOW in final draft format prior to the end of Tooling manufacture. This will allow sufficient time to make changes during the testing and commissioning of the Tooling prior to the Execution Phase. Procedures will be finalized by the date set out in the Definition Phase Milestone Schedule.

2.2.4 Tooling Manufacture/Prototyping

The Contractor will manufacture and/or assemble the Tooling in sufficient time for qualification, commissioning and integration, by the dates set out in the Definition Phase Milestone Schedule. All parts required to manufacture the Tooling will be procured by the Contractor.

2.2.5 Tooling Qualification

The Contractor will qualify all Tooling in accordance with the Tooling Qualification Plan submitted in accordance with the Submittals Schedule for the Definition Phase Work. The qualification plan will document the process, which will be demonstrated on dummy reactor components where practical and representative of current known field conditions (e.g., pressure tube sag, movements, etc.). The qualification will provide evidence, to OPG's satisfaction, that the Tooling conforms to this SOW and NK38-DR-31110-10000, will not damage or leave latent defects in the Units, can perform the intended function within the specified timeframes, will last for the intended duration between maintenance intervals, and will not fail prior to planned end of service. All Tooling that is to be used on the reactor face must be subject to this qualification process. A qualification report will be generated by the Contractor. This Document will be accepted by the Darlington refurbishment Design Authority ("**DA**"), and OPG's Project Manager.

2.2.6 Tooling Commissioning & Integration

The Contractor will provide a Tooling commissioning and integration plan, for OPG review and acceptance, in accordance with the Definition Phase Target Schedule and the RFR EPC Agreement. All Tooling, with the exception of the vacuum dry Tooling, reactor face insulation removal Tooling, and feeder cabinet remove/install Tooling, must be tested and commissioned both individually and as an integrated set prior to the use of the Tooling on the reactor face. Spare sets of tools and training sets of tools do not require integrated testing. It is presumed that the tool used in the integrated test is identical to the spare and training equivalent. The integration of the Tooling will be demonstrated by the Contractor on the "Mock-Ups" to be located in the Darlington Energy Complex ("**DEC**"). The Integration test will be performed in accordance with the RFR EPC Agreement. The Contractor will produce a commissioning specification prior to the start of testing and commissioning detailing all requirements for commissioning of the Tooling for OPG's review and acceptance. A detailed commissioning report will be produced and signed by the Contractor after commissioning of the Tooling is completed. This Document will be reviewed and accepted by the DA, and OPG's Project Manager. All such documentation shall be submitted in accordance with the dates in the Definition Phase Submittal Schedule. The rates/durations demonstrated during the commissioning and integration Work will be used to determine if there is any reduction in Tooling Fixed Price (as specified in the RFR EPC Agreement). Commissioning and integrated testing are Definition Phase activities; training is an Execution Phase activity.

2.2.7 Annulus spacer redesign impact to SSDO Tools

The fuel channel annulus spacer design to be used for the Darlington Refurbishment Project is a Zr-2.5Nb-0.5Cu spring coil joined by Zircaloy-4 sleeve connector, with Zircaloy-2 90° overlapped girdle wire.

The fuel channel annulus spacer positioning along the pressure tube shall be symmetrical for the Darlington Refubishment Project in accordance with the "Optimized Symmetrical Annulus Spacer Design Locations" as defined by the Annulus Spacer Positioning Study (Vendor Doc No. 38RF-31160-AR-001 Rev. 1). These symmetrical annulus spacer design locations shall coincide with a back-end inlet pressure tube configuration.

The contractor will make the required modifications to the existing Fuel Channel Installation and Single Fuel Channel Replacement SSDO Tooling that are impacted by this change. The Contractor will perform functional testing only of the modified tooling. Existing CWP's, training packages and tooling documentation will be updated as required.

2.2.8 Waste Tooling System Rehearsals

The Contractor will perform the following Waste Tooling System Rehearsals, at the vendors facility:

- Trolley Rehearsals
- End Fitting Station Rehearsals
- Pressure Tube, Calandria Tube and Clandria Tube Insert Station Rehearsals
- Lidding and Hardware Station Rehearsals
- SCADA and Local Pendant Rehearsals

The Contractor will facilitate the OPG project team and OPG's radiation protection coordinators/assistants to observe and participate in the rehearsals as necessary to gain familiarity with the design and operation of the Waste Tooling System. Based on results of the rehearsals, the Contractor will complete the following:

- Produce a lessons learned report
- Revise CWP's and training material to incorporate improvements.

2.2.9 Expansion of the VCS for Radiation Protection

OPG's Radiation Protection (RP) resources require the ability to communicate with Contractor staff throughout the execution phase of the project as part of their support of the Work. RP will require at a minimum access to the Vault Communication System (VCS) from the RP trailers supporting each Unit and the RWPB. For each Unit a minimum of 6 RP personnel with Wireless Belt Packs (WBP) will be required to access the Vault Communication System. The RWPB

location will require a minimum of 2 RP personnel with WBPs access to the VCS. The Contractor will enhance the VCS to facilitate RP access.

Identified OPG RP operational personnel will be enrolled to RCC VOS/VCS training modules as currently planned for the JV construction staff.

At a minimum, the JV will provide the following (or equivalent):

1. Update RCC Internals Tooling (including VCS/VOS) to accommodate incremental RP needs including equipment specific to RP operator (such as Command Talk Back station)

2. Consolidate and integrate existing planned communication systems to provide enhanced communication ability at required site locations. The enhanced communication systems shall have no interference within the area of deployment.

3. Update CWPs, training packages, Project Supply List as required.

2.3 Definition Phase Work

2.3.1 Retube & Feeder Replacement Process

2.3.1.1 Plans to Update

The following is a list of Submittals that will be updated during the Definition Phase to their final form to account for the progression of the Tooling and development of the Execution Phase Work.

- Project Management Plan – Definition Phase
- Process Flow Chart for Component Replacement
- Tooling Management Plan
- Materials Management Plan
- Waste Management Plan
- Site Infrastructure and Layout Plan
- Interface Coordination Plan
- Resources Management Plan
- Space Allocation and Requirements Plan

- Quality Assurance Plan
- Project Estimate Plan
- Site Specific Safety Plan

2.3.1.2 Plans to Prepare

- Project Management Plan – Execution Phase
- Project Controls Strategy
- Project Integration Plan
- Engineering Plan
- Procurement Management Plan
- ALARA plan – to be prepared in accordance with N-PROC-RA-0027, and submitted to ALARA section for responsible Health Physicist and Project Manager approval
- FME Plan – OPG has extensive controls and procedures regarding FME during field Work execution to prevent foreign material from entering systems and equipment. The reference procedures are N-PROC-MA-0018 and N-INS-09106-10001. The Contractor will incorporate similar procedures in the Work, in a manner acceptable to OPG. Work package preparations and assessing should also include all required precautions to prevent the entry of any foreign materials into any DNGS systems.

2.3.1.3 Rehearsals at Darlington Energy Centre

The Contractor will prepare a detailed plan and schedule for the rehearsals activity to be performed at the Darlington Energy Centre after Tooling Commissioning is complete (the "**RFR Rehearsal Plan**"). Rehearsal activity will include rehearsing work series including contingency and failure recovery operations as well as logistics and transitions.

Following OPG's acceptance of the Contractor's RFR Rehearsal Plan the Contractor will perform all activities included in the RFR Rehearsal Plan, including the following:

- Feeder Removal Series Rehearsals;
- Feeder Installation Series Rehearsals;

- Fuel Channel Removal series Rehearsals;
- Fuel Channel Inspection series Rehearsals; and
- Fuel Channel Installation series Rehearsals.

Based on results of the rehearsals, the Contractor will complete the following:

- Produce a lessons learned report on a per series basis;
- Revise CWPs and associated documentation to incorporate improvements;
- Revise training material to incorporate improvements;
- Revise work instructions and operating manuals to incorporate improvements;
- Revise Project Supply List;
- Produce a Tooling Improvement List; and
- Revise the Execution Phase Schedule, Cost Estimate, and Risk Reviews; however, for greater certainty, the Contractor shall not be required to revise the Execution Phase Plan, if already agreed to by OPG

2.3.1.4 Tool Management System

The Contractor will set up a Tool management system ("**TMS**") to allow for close tracking as part of Tooling lifecycle management and which will drive faster and more efficient work performance in the field.

TMS is intended to significantly improve the ability and reliability of the Tooling to operate at peak performance on critical path by providing improved ability to manage Tooling:

- in the field (both pre and post series);
- in storage;

- during scheduled maintenance activities; and
- between units with preventive and readiness maintenance.

Additionally TMS will allow for transparent and auditable tracking of costs for tool maintenance, spare parts, warranty claims, and costs for modifications or improvements to Tooling if design changes are undertaken. TMS will allow for clear delineation between Allowed Costs and Disallowed Costs with respect to Tooling.

The Contractor will develop the following and populate TMS appropriately:

1. **Tooling Readiness Program.** Using data collected during previous campaigns, Tooling Performance Guarantee proving activities, and from other Definition Phase activities including rehearsals, the Contractor will develop a well defined Tooling readiness program to ensure adequate time and resources are assigned to each tool set required for critical path series work in support of the execution phase schedule. The Tooling readiness program will be incorporated into TMS.

2. **Procedures for Scheduled and Preventative Tooling Maintenance.** Using data collected during Tooling Performance Guaranty proving activities and other Definition Phase activities, including rehearsals, the Contractor will develop tool-specific maintenance procedures and decision-making protocols for use of contingency tools. The Contractor will develop decommissioning procedures for the end of each series including tooling assessments to assess the level of effort required to service the Tooling in the preventative maintenance window.

3. **Tooling-specific Material Management Plan**. The Contractor will develop a material management plan that incorporates tool numbering and cataloguing and restructure existing inventory data to a Parent/Assembly/Sub-Assembly/Part structure.

4. **Scope of Work for Off-Site Tooling Shipping and Packaging.** Tooling will need to be shipped to various sites other than the Darlington Energy Centre as part of the Tooling Work potentially commencing

in 2015. The Contractor will develop the scope of work for this activity and ensure its requirements align with TMS requirements.

5. **Scope of Work for Off-Site Tooling Storage Facilities**. Tooling will need to be shipped to various sites other than the Darlington Energy Centre as part of the Tooling Work potentially commencing in 2015. The Contractor will develop the scope of work for this activity and ensure its requirements align with TMS requirements.

6. **TMS Hardware and Software Management Plan**. The Contractor will develop a TMS Hardware and Software Management Plan for management of the TMS software and hardware which will incorporate back-up and recoverability procedures to ensure full system recoverability with minimal impact to critical path in case of hardware or software failure. As part of the full system recoverability process OPG will be provided with full ability to assume control, access, and management of the hardware and software and administrative controls.

Following the establishment and population of TMS the Contractor will, if necessary, complete the following:

- Revise CWPs and associated documentation to incorporate requirements of TMS;
- Revise training material to incorporate requirements of TMS;
- Revise work instructions and operating manuals to incorporate requirements of TMS ; and
- Revise the Execution Phase Schedule, Cost Estimate, and Risk Reviews; however, for greater certainty, the Contractor shall not be required to revise the Execution Phase Plan, if already agreed to by OPG.

Note: These updates and revisions are intended to be completed concurrently with the same activity to be completed under the Rehearsals at DEC activity.

2.3.2 Modifications

The Design Work will be completed in accordance with the Document "Contractor/Owner Interface Requirements", N-DAI-00150-10000, and N-PROC-MP-0090, "Modification Process". Outlined below are examples of modifications the Contractor is to complete. The listing below is not exhaustive; the Contractor is accountable to identify all required modifications to support the Work.

During the Definition Phase, the Contractor will produce all modification documentation to support the field execution of the modifications in the Execution Phase. The actual field implementation of these modifications will be performed as part of the Execution Phase Work. However, if the Contractor requires early Works to support their work program this will be clearly identified and priced in the Definition Phase reimbursable Work.

2.3.2.1 Modifications to Systems, Structures and Components

The Contractor shall complete all modification documentation relating to systems, structures and components that are required to complete the execution scope of Work, unless otherwise specified in this Document. The Contractor will develop a commissioning plan for OPG's review and acceptance. The commissioning plan will demonstrate that the modification will perform the intended function, within the desired timeframes, and without damaging or creating latent defects to any OPG Station Systems. This Document will be reviewed and accepted by the Design Authority.

During the Definition Phase, the Contractor will complete the required design packages to support field implementation of the modifications as identified by the Contractor and approved by OPG. This may involve engineering assessments of existing OPG SSCs by the Contractor, if there is an interface. An example of this is a floor loading assessment. This will also include development of any required Tooling, procedures, documentation, licenses, permits and Approvals from regulatory bodies to complete the Work. The Contractor will also procure all Goods required to install the modification for the first Unit. The Goods associated with subsequent Units will be procured during Execution Phase Work on such Units. The modifications will be completed to the point at which field execution of the modification in the first Unit can commence. Inspection & Test Plans, Job Safety Analysis,

Comprehensive Work Packages will be prepared in the Definition Phase, for the first Unit and approved by OPG in the Execution Phase.

Any interfaces with OPG supplied equipment or existing SSC's required by the Contractor to complete the Work may result in the need for a modification that shall be performed by the Contractor. This may include any modifications to the containment bulkheads, vault vapour recovery or ventilation, power, air, communications, bridge configuration etc.

2.3.2.2 Modification to Owner Specified Materials

OPG may elect to modify the Owner Specified Materials based on OPEX and consultation with the Original Equipment Manufacturer. If this occurs, OPG will initiate the ECC process in order to update specifications and procurement documentation. However, the Contractor will be required to perform duties in accordance with ECC for the installation portion and AFS portions of the Work since it is the Contractor's responsibility to install the modified components.

2.3.2.3 Primary Heat Transport System Draining, Vacuum Drying and Calandria Drying

As a result of revision 2, the information originally contained in this section has been moved to Section 2.2.1.2.

2.3.2.4 Infrastructure

The Contractor must satisfy itself that it has reviewed all Site infrastructure provided by OPG (see Ref 4, DNGS Refurbishment- Infrastructure Summary Report, 2010), and can complete the Work with the infrastructure provided. The Contractor may have a requirement for additional equipment, systems or Work stations that are required within the infrastructure provided by OPG. The Contractor will design, procure and manufacture the additional equipment, systems, or Work stations to support the Work. For example, an audio/video communication system will be required which will be developed, designed and supplied by the Contractor meeting the applicable OPG requirements for such systems. During the Definition Phase, only the Goods required for the first Unit will be purchased, and the Goods associated with subsequent Units will be procured during Execution Phase Work on such Units. The Contractor will demonstrate that the equipment or systems meet OPG's requirements. The

following is a non-exhaustive list of some infrastructure that the Contractor may need to provide:

- Site lay-down areas
- Tooling staging area
- Tooling decontamination area
- Retube Control Center furnishings
- Communication systems
- Staging areas for all Goods & Owner Specified Materials
- Waste Processing Areas

The items listed above as well as any other infrastructure requirements are to be included in the Site Infrastructure and Layout Plan.

2.3.3 Procurement

The Contractor will procure all owner-specified replacement components (Owner-Specified Materials) and the Intermediate level waste containers required for the Work on behalf of OPG in accordance with the procurement process described in the Document, "Contractor/Owner Interface Requirements for Nuclear", N-DAI-00150-10000. A list of Materials to be procured by the Contractor is provided in Appendix A: Parts List. OPG or a delegate will review and update selected technical specifications required to procure long lead items and will be the designer of record for the Owner Specified Materials. The Contractor will identify potential delivery risks in procurement of long lead items and initiate required purchasing activities to maintain the established schedules. Delivery risks are to be documented in the Material Management Plan and the Risk Register. Depending on lead times, OPG may elect to initiate procurement of select components prior to contract award.

As part of the procurement process, the Contractor will be required to have a comprehensive material management program that will individually track and account for all components. During the material procurement process (from acquiring the components to installation into the reactor), OPG will conduct periodic reviews and assessments for quality assurance program compliance through OPG Supply/Quality Services and the Quality Assurance department.

The major components required for Work are listed in Appendix A: Parts List. The Contractor will verify and ensure the list is complete, to determine appropriate spares and provision of contingency items, and present any corrections to OPG for review and acceptance. Prior to commencing procurement, the Contractor will verify that all applicable modifications are approved and all related documentation is issued in order to procure without risk.

Feeder lengths have not been specified in the parts list. The Contractor will be required to review the feeder isometric drawings in order to establish the appropriate lengths for each feeder sizing.

After the components are procured, the Contractor will be required to temporarily store the components prior to transporting them to the DNGS in accordance with the Contractor's materials management plan. The Darlington Energy Complex (DEC) will have a pressure boundary warehouse to store retube and feeder components. The warehouse facility will provide access controlled storage space, which can be used by the Contractor to store Tooling, equipment, components and materials. The DEC will not hold a complete Unit's worth of components and Tooling, so the Contractor will have to have additional warehousing facility and will have to stage the transport of Goods to the DEC according to schedule. All material tracking and receipt inspections will be the Contractor's responsibility under the Contractor's quality assurance program. The DEC will be built by OPG close to the DNGS.

All other Goods required to complete the Work will be purchased under the Contractor's purchasing and quality assurance programs.

During the Definition Phase, the Contractor will only procure sufficient material, Goods and waste containers for the first Unit. Subsequent Unit supply will be completed during the Execution Phase Work on the respective Units.

2.3.4 Release Quality Estimate (Execution Phase Plan)

2.3.4.1 Risk Identification, Register and Management

During the Definition Phase, OPG will Work with the Contractor in the development of a comprehensive Risk Register that will capture all risks associated with both the Definition Phase and the Execution Phase Work.

Multiple risk workshops will be required to assess the cost and schedule risks associated with the Work. The Contractor will prepare a first draft of the Risk Register and risk management plan for OPG's review prior to the commencement of the workshops. OPG may provide a third party to facilitate these workshops and the Contractor will be required to participate in full with the appropriate people in attendance. Once the Risk Register is agreed to, it will be incorporated into the OPG refurbishment risk database. The OPG procedures, OPG-PROC-0025, N-PROC-LE-0008 and N-PROC-LE-0013, will be used as guidelines in the development of the Risk Register.

2.3.4.2 Interim Schedule Development

The Contractor will prepare interim Execution Phase schedules as required by OPG by the dates set out in the Definition Phase Submittals Schedule. The Contractor will prepare the schedules in accordance with Exhibit 3.5 of the Agreement.

2.3.4.3 Interim Cost Estimates

The Contractor's estimating plan will clearly identify the methodology proposed to be utilized in estimate preparation and the basis for such estimate which will include, as a minimum, any standards or estimating references that will be used, Units of measure, productivity rates, modified productivity rates from base resource and rationale, resource type, resource numbers by type, regular and premium time, contingency, etc.

During the Definition Phase Work, the Contractor will develop cost estimates for the Execution Phase Work, in accordance with Exhibit 3.5 of the Agreement and provided by the dates set out in the Submittals Schedule.

2.3.4.4 Execution Phase Target Schedule

The Contractor will develop a Level 5 Execution Phase Target Schedule in accordance with Exhibit 3.5 of the Agreement, by the time specified in the Definition Phase Milestone Schedule.

2.3.4.5 Execution Phase Target Cost

The Contractor will develop an Execution Phase Target Cost, conforming to AACE Class 2, in accordance with Exhibit 3.5 of the Agreement, by the time

specified in the Definition Phase Milestone Schedule.

3.0 EXECUTION PHASE WORK

This section describes the Work for the Execution Phase. This is a functional specification and is not intended to prescribe how the Work is to be performed nor is it intended to be an exhaustive listing. The Contractor shall develop a program which includes the elements below to complete the Work fully. All field execution Work will be performed by the Contractor under the Contractor's Certificate of Authorization.

- Procurement
- Training
- Outage prerequisites – infrastructure and modification installations
- Component removal
- Inspections and repairs/replace
- Component install – including post-maintenance testing
- Tool management
- Material management
- New fuel load
- Vault turnover
- Post requisites
- Demobilization
- Turnover/closeout

3.1 Procurement

During the Execution Phase, the Contractor will procure all materials, Goods and waste containers in accordance with Section 2.3.3 as are required for each Unit to meet the schedule requirements.

3.2 Training

All personnel who perform the Work will require appropriate training. This section outlines the training requirements for the Work and assumptions regarding training. Training requirements are currently under review with the goal of minimizing the required training to perform the Work to the extent practical.

3.2.1 General Training

The Contractor will develop a detailed training plan that clearly shows how each trade, professional and supervisory staff will be processed and trained to meet the requirements to Work at DNGS, as well as processed through security clearance. General training is the responsibility of the Contractor. "Supplemental BTU Direct Hire and Contract Management Training and Qualification Description", N-TQD-510-00001 describes the training requirements for BTU direct hire, and Contractor personnel including BTU, supervisor, and trainer personnel while performing Work for OPG. Based on previous OPG experience in training large numbers of workers for planned outages, it is expected that general training can be provided in five to ten continuous days. The Contractor will be required to provide its own training to support this qualification. If the Contractor cannot provide such training (e.g., radiation protection training), the Contractor will identify the specific courses to OPG at least one (1) year prior to the date on which the training is required. OPG will make all efforts to assist in the delivery of this training. This training is anticipated to take place at the Darlington Energy Complex (DEC). All training Records must be maintained in the OPG TIMS II database or an equivalent Contractor's training database to demonstrate qualifications.

3.2.2 Rehearsal Training – Mock-Up

The Contractor will develop and provide a detailed training plan for the execution staff/crews. The Contractor's specific technical training and qualifications (eddy current, welding, and all training required to operate the Tooling) will be the responsibility of the Contractor. The training is expected to be performed at the DEC or at the Contractor's own facility. The type and amount of specific training will vary significantly between job functions, and even between individuals within a job function. The Contractor is accountable to organize the Work in an efficient and cost effective manner and the training plan and program should reflect this.

Personnel need to be trained on working as an integrated team, and will be required to participate in at least five rehearsal exercises prior to achieving qualification for their respective Work.

The Contractor will be responsible to set up its workforce and staff training program and submit this training program as part of the training plan for OPG's review and acceptance.

For example, all supervisory personnel need to be trained in a "Train-the-Trainer" program in advance of the main crew complement, and these supervisory personnel will become the first-line instructors to the main crew complement. All supervisory personnel (i.e., first line manager level) will also be required to obtain all necessary training applicable to that position. This will allow all supervisory personnel to deal with situations that may arise (i.e., personal injury, leaks, spills, etc.) and Document all incidents. It will be the Contractor's responsibility to deal with these situations per OPG policies and procedures and Document all incidents.

As part of the training plan, the Contractor will clearly identify how each worker will be qualified to perform the Work. These qualifications will be clearly documented and retained throughout the duration of the Work either in a Contractor-controlled database or in TIMS II, whichever is more suitable. The documented proof of qualification will be included in the turnover Documents to OPG at the completion of the Execution Phase Work for each Unit or series. This will aid in demonstrating to the applicable regulatory authorities that the Work was completed in accordance with this SOW and that the workers were adequately qualified to perform the Work.

3.2.3 Mock-Ups Reconfiguration

As part of the Definition Phase Work, the Contractor will develop full scale Mock-Ups of a reactor at the DEC per NK38-SOW-09701-10002. These Mock-Ups will be utilized to perform Tooling testing and commissioning as well as integration demonstrations and trades training. Prior to commencing Work on a Unit, the Contractor will identify key critical dimensions of such Unit to field verify. The Contractor will schedule, in accordance with Section 4.1, the performance of these field measurements in planned outages for a Unit in advance of commencing Work on such Unit, as permitted by OPG outage planning and scheduling. As part of the Execution Phase Work, the Contractor will reconfigure the Mock-Ups to reflect the actual field conditions in advance of completing the trades training.

3.3 Refurbishment Outage Pre-requisites

3.3.1 Infrastructure

The Contractor will set up the required infrastructure to support the Work as identified in the Contractor's Interface Coordination Plan and Site infrastructure and Layout Plan, and as planned during the Definition Phase. If Unit and Site conditions permit, this Work will take place in advance of commencing Work on a Unit in order to ensure that the infrastructure is in place in a timely fashion to support the Work. Where the Work must be completed while a Unit is in a planned outage prior to Refurbishment, the Work will be scheduled and executed in accordance with Section 4.1.

3.3.2 Modifications - Outside the Reactor Vault

During the Execution Phase, the Contractor will install all modifications as designed and planned during the Definition Phase. Some of the modifications will likely be required outside of the reactor vault. If Unit and Site conditions permit, the Contractor will schedule this Work to occur during prior planned outages for a Unit in accordance with Section 4.1. If the modifications are to be installed after Work on a Unit has commenced, the refurbishment Work management process will be followed in accordance with Section 4.2.

3.3.3 Modifications - Inside the Reactor Vault

During the Execution Phase, the Contractor will install all modifications as designed and planned during the Definition Phase. Some of the modifications will be required inside of the reactor vault, such as PHTS vacuum drying, reactor area bridge ("**RAB**"), etc. If Unit and Site conditions permit, the Contractor will schedule this Work to occur during prior planned outages for a Unit in accordance with Section 4.1. If the modifications are to be installed after Work on a Unit has commenced, the refurbishment Work management process will be followed per Section 4.2. Isolation bulkheads are the responsibility of the Contractor. See NK38-SOW-09701-10005 & NK38-DR-21126-10001 for full details.

3.4 Vault Turnover – OPG Obligation

The following is a high level description of the condition in which the reactor vault and systems will be turned over to the Contractor.

- Unit defueled
- PHTS bulk drain (not including water in feeders and fuel channels)
- Annulus gas system isolated and a purge completed.
- Calandria drained and a dry air purge established
- End shield cooling system is in service
- RAB parked at 100M elevation (floor of vault, above bulkhead), carriage will still be on the bridge.
- Airlock 1 Modification EC packages completed to enable both doors open
- Vault vapour recovery systems (VVRS) and HVAC modifications completed to allow airlock 1 to be open
- Breathing air modifications to support the Work
- Temporary power supplied per the Site infrastructure and Layout plan (Contractor to provide any transformers and/or distribution panels downstream from the OPG-supplied power source)
- Demineralised water to a location agreed to between OPG and the Contractor
- Instrument air and service air systems available
- Existing reactor vault lighting – the Contractor will supply any additional lighting that it requires
- Reactor vault crane will be refurbished – the Contractor will continue with maintenance of the crane once the vault is turned over if required. OPG will complete wire rope replacement on Reactor vault cranes for the last three Units prior to breaker open for each unit.

The Contractor is required to perform all additional Work to complete whatever activities are required to configure the reactor vault for completion of the Work. Work will be performed by both the Contractor and OPG in parallel during prerequisite activities until OPG has completed its obligation.

Once the Vault has been turned over to the Contractor any manpower restrictions will be in accordance with the Contractor's planning subject to the requirements of Section 7.2.1 of this Scope of Work.

Additionally, once the Contractor puts the bulkhead panels in place in accordance with the Contractor's obligations under this agreement for each Unit the Contractor will not be impeded in carrying out its Work by OPG fueling activities on operating units

3.5 Reactor Component Removal/Installation

During the Execution Phase, the Contractor will install, commission and use the Tooling (in accordance with the applicable procedures as supplied by the Contractor in the Definition Phase) to complete the removal/installation of all of the reactor components identified in Appendix A. The Contractor will decontaminate to the extent practical, and remove the Tooling from the vault upon completion of the applicable removal/install series. Below is a high level description of this Work, which is not exhaustive and is for illustrative purposes and does not remove the Contractor's accountability to complete all of the Work in accordance with this SOW.

3.5.1 Channel by Channel Drain, PHTS Vacuum Drying and Calandria Drying

Once the Contractor has access to the vault, bulk PHTS vacuum drying will be required (a channel by channel drain capability for a single fuel channel will be required as contingency), followed by drying of the PHTS auxiliaries, using the procedures developed during the Definition Phase. If the channel by channel contingency tool is required, the channel will be drained into drums. As well as the PHTS and PHTS auxiliaries, the Contractor will dry the calandria vessel and moderator auxiliaries using the process and procedures developed during the Definition Phase. Interface with OPG will be required for this process. Helium or nitrogen gas may be used to control the formation of nitric acid during the moderator draining process. If this is required, the helium or nitrogen gas will be supplied by OPG. Note that OPG will be obtaining additional storage for the moderator and contingency channel draining processes. No additional storage capability is required by the Contractor for draining of these systems.

3.5.2 Reactor Face and Feeder Cabinet Insulation and Frame

The Contractor shall replace with new, the flexible "jig saw" panels surrounding the Fuel Channel End Fittings on the reactor face. The Contractor may remove other insulation on the face of the shield tank, and within the feeder cabinets as required to perform the feeder replacement work and may either reuse the

items removed if undamaged, or replace with new. Feeder cabinet frames may also be removed if the Contractor deems it necessary for feeder replacement. If the frames are deemed in good condition, they may be reused. Installation will be in accordance with the procedures developed by the Contractor during Definition Phase.

The removed insulation panels and frame that are not reused will be disposed of in accordance with the Waste Management Plan. Insulation may require off-gassing of tritium prior to storage or disposal. The Contractor will supply insulation and replacement cabinet frames for the first Unit during the Definition Phase, and will replenish items used on the first unit as needed for use on later units.

3.5.3 Feeders

The Contractor will replace the upper and lower feeders (from the header nozzle to the end fittings) including all associated hardware, including:

- Pipe supports
- Spacers
- RTDs & guide tubes
- Ultrasonic flow measuring equipment
- Orifice plates and venturi flow measuring devices on feeders
- Feeder scanner guide tubes.

Feeder scanners will be removed and stored by Contractor and replaced by Other OPG Contractors.

It should be noted that on unit 3, fixed on line thickness measurement devices exist. These are to be removed and not replaced.

3.5.3.1 Feeder Weld Procedure Qualification

The Contractor will qualify the following processes:

1. Feeder Welding Process Qualification

A Pre-production weld qualification program is to be executed per the following specifications: 38RF-33160-TS-006, 38RF-33140-TS-001 and 38RF-63000-TS-002. The requirements for the qualification process are specified in 38RF-33160-CVS-002, 38RF-33160-CVS-001, 38RF-33140-CVS-001 and 38RF-63300-CVS-001.

2. Feeder Welding Inspection Process Qualification

   - **Phased Array Ultrasonic Testing Program Development:** A Phased Array Ultrasonic Testing (PAUT) program is to be developed for the examination of Feeder field welds as per the requirements of specification 38RF-33160-TS-008.
   - **Instrumentation Tube Bending Pre-Production Qualification:** Perform a Tube bending PPQ program per the requirements of 38RF-63000-TS-002.
   - **Ultrasonic Testing on Feeder Hub Bolts:** Develop procedures for performing Ultrasonic Testing on Feeder Hub Bolts per the requirements of 38RF-33160-TS-006. Provision of equipment to perform this scope will be considered "Goods".
   - **Ultrasonic Testing on Cantilever Support Mounting Studs:** Develop a UT measurement process and qualified program for use in Cantilever Support Mounting Stud installation per the requirements of 38RF-33160-TS-006.

3.5.4 Position Assembly (PA) Hardware

The Contractor will replace all position assembly hardware ("**PA Hardware**"). The nuclear waste generated will be disposed of in accordance with the Waste Management Plan. There is a preference for the Contractor to leave the west side PA Hardware locked after the fuel channel has been adequately positioned but this is not essential and can be revisited if there is an advantage to locking the east side. The Contractor will also provide OPG with the number of spacer clips installed on the locked side for each fuel channel.

The Contractor will also replace any helicoils that may be damaged during PA hardware removal or the Contractor can choose to replace all helicoils.

3.5.5 End Fittings, Shield Plugs and Closure Plugs

The Contractor will replace all end fittings (with closure plug, shield plugs and associated feeder coupling hardware). Currently, when the end fittings are ready to be removed, they will have a closure plug and shield plug inside. Volume reduction will be required to separate the ILW portion of the end fittings from the LLW portion. The shield plugs shall be a part of the ILW.

3.5.6 Fuel Channels

The Contractor will replace all fuel channels (including the pressure tube and channel annulus spacers). Each pressure tube will contain a single flow reducing orifice bundle (FROB), or up to eleven(11) dummy bundles.

Prior to installation, the Contractor will prepare all pressure tube lengths per NK38-GEN-31100-0003 Sheets 1 and 2 to ensure that the fuel channels are "dished" per the Design Manual, NK38-DM-31100.

3.5.7 Calandria Tubes and Calandria Tube (CT) Inserts

The Contractor will replace all calandria tubes and associated calandria tube inserts ("**CT Inserts**"). During removal of the calandria tubes, the Contractor will ensure that no damage occurs to the calandria tube sheet bores, such that a proper leak tight seal can be achieved during installation of the new calandria tubes, as tested and demonstrated in accordance with the Contractor's inspection and test plans.

3.5.7.1 Calandria Tubes and Calandria Tube (CT) Inserts Process Qualification

The Contractor will perform process qualification of Calandria Tube Rolled Joints (CTRJ) per the requirements of 38RF-31230-TS-003, 38RF-31230-TS-006 and 38RF-31230-TS-008. The Contractor will perform process qualification of Calandria Tube Rolled Joint (CTRJ) Leak Test Tool (LTT) per the requirements of 38RF-31230-TS-005.

3.6 Inspections and Repairs/Replace

The Contractor will develop the procedures which will include acceptance criteria to demonstrate that the Work has been completed according to the design, and this scope of Work Document. This includes any inspections

dictated by this Document or required for the progression of the Work. The inspection and acceptance criteria will clearly Document the bounding conditions of the item/parameter being tested or inspected and a clear path forward if the conditions are outside of those bounding conditions. The Contractor will complete all the necessary testing and inspections required to demonstrate that the Work has been performed correctly in accordance with the Contractor's procedures and this scope of Work Document. As a result of all inspections, if repairs or replacements are required due to the fault of the Contractor, the Contractor will perform these activities during the Execution Phase. Repairs or replacements required resulting from these inspections will be deemed Concealed Conditions per the applicable Article in the R&FR Agreement, as applicable (e.g. access for inspections could not be obtained in the Definition Phase).

3.6.1 Calandria Vessel Internal Inspection

The final scope of Work for the calandria vessel internal inspection will be based on the results of COG JP 4271: Calandria and Internals Fitness for Life Extension Guidelines, supplemented by the LCMP, "Reactor Assembly Aging Management Strategy and Plan", recommendations (Ref 1). Any new requirements as a result of the COG project or revisions to the LCMP which increase scope as described in this section will follow the scope change process. OPG will provide acceptance criteria for the inspections described in this section, which will be based on input from the COG JP.

This section also provides some additional information about what Tooling is required for the calandria vessel internal inspection; however, all Tooling is to be provided in the Definition Phase in accordance with Section 2.2.1. Performing the inspections will be execution Work. Repairs or replacements required resulting from these inspections will be deemed Concealed Conditions per the applicable Article in the R&FR Agreement, as applicable (e.g. access for inspections could not be obtained in the Definition Phase).

The Contractor shall provide an inspection report detailing the Work and findings from the Calandria internal inspection scope described below.

3.6.1.1 General Visual Inspection

Provide Tooling and perform a general visual inspection of the inside of the calandria and of the LISS Nozzles and note any of the following:

1. loose/missing or damaged components
2. foreign material that would prevent any component from performing its design function
3. contact between components not intended by design
4. degradation that could prevent any component from performing its design function
5. components outside their design configuration

3.6.1.2 Moderator Inlet Nozzle Inspection

Provide Tooling and perform a visual inspection of central stiffening bars located within the inlet nozzles for damage. There are 12 moderator inlet nozzles in total which could be accessed through different channels for camera viewing.

3.6.1.3 Moderator Inlet Piping Inspection

OPG may require the Contractor to perform UT inspections of the moderator inlet piping welds, inside the shield tank. Details of the scope of this Work are not yet available. If OPG wishes to pursue these inspections, it will be via the scope change process.

3.6.1.4 Reactivity Mechanism Locators at the Bottom of Calandria

Provide Tooling and perform a visual inspection of the welds connecting the locators to the calandria wall to ensure no cracking due to continuous dynamic loads. There are 94 reactivity mechanism locators at the bottom of the calandria. Dimensions and weld locations for these locators can be found in Reference 5 - item 10. Included in this inspection are the guide tube inspections which are to be visually inspected to ensure there is sufficient gap between the guide tube and the bottom of the locator.

3.6.1.5 Horizontal Flux Detector Flow Splitters

Provide Tooling and perform a visual inspection of all flow splitters. Flow splitters installed at the far end of the reactivity mechanisms are exposed to continuous dynamic loads caused by turbulent flow of the moderator.

3.6.1.6 Calandria Main Welds

The guideline to address the inspection requirements of calandria main welds will be developed in accordance with COG JP 4271 as required. OPG will provide acceptance criterion of the inspection results and follow up with remedial actions, if any, in consultation with the Contractor. The Contractor will assume in the basis of estimate that this inspection will be visual only.

3.6.1.7 Calandria Vessel Manhole Inspection

Provide Tooling and perform visual inspection of the condition of the manhole located at the bottom of calandria and for any evidence of debris (which is a major indicator of possible damage/degradation elsewhere in the calandria). The Contractor must develop Tooling capable of removing any foreign material that may be found as a result of inspection.

3.6.1.8 Final FME inspection/cleaning of the calandria floor

Prior to completion of installation of the calandria tubes, a final foreign material inspection and cleaning will be completed. The Contractor shall develop tooling to vacuum and remove small debris from the Calandria. The best time to complete this inspection is prior to the installation of the calandria tubes on the bottom rows.

3.6.1.9 Section Removed

3.6.1.10 Calandria Vessel Inspection (CVI) Post Imaging Analysis

The Contractor will develop and qualify a method for measuring findings in the Calandira Vessel that meets the requirements of 38RF-31200-TS-005.

3.6.2 Section Removed

3.6.3 Calandria Tube Sheet Bore Inspection, Preparation and Refurbishment

After calandria tube removal is complete, the Contractor will complete a visual inspection of the calandria tube sheet bores for any non-conformity that may hinder a proper sealing surface for the new calandria tubes. Also, the Contractor will refurbish the tube sheet bore in the event that damage has occurred, prior to calandria tube installation.

3.6.3.1 Calandria Tube Sheet Bore Inspection, Preparation and Refurbishment Process Qualification

The Contractor will perform process qualification of Calandria Tube Sheet Bore (CTSB) Inspection per the requirements of 38RF-31230-TS-008.

3.6.4 Channel Annulus Bellows Inspection

All channel annulus bellows will be inspected by the Contractor for any damage and/or deformation. Replacement of the channel annulus bellows will be required only if damage is found. The Contractor will provide the capability to inspect two bellows on each reactor face simultaneously. The Contractor will procure an appropriate number of spare channel annulus bellows as contingency.

3.6.4.1 Measuring Single Fuel Channel Replacement (SFCR) Bellows Flange Length

The Contractor will develop a method for measuring the bellows flange length per requirements of 38RF-31180-TS-002 to ensure flange length meets the requirements of 38RF-31100-TS-004 (requirement of being 0.250" or greater).

3.6.5 Outlet Header Nozzle Inspection and Repair

After upper feeder removal has been completed, the Contractor will inspect all outlet header nozzles for wall thickness thinning and repair/restore them using internal diameter weld build-up to base material. OPG will provide acceptance criteria based on design documentation.

3.6.6 Section Removed

3.6.7 Flow Elements

OPG will perform an assessment and may pursue redesign of some or all flow elements for SDS1/SDS2/ECI/FINCH. OPG will provide the applicable technical specifications and drawings to the Contractor, and will initiate the ECC process. The Contractor will install the new flow elements as part of the feeder installation process, and complete the ECC and AFS process.

3.6.8 Instrumentation Tubing Inside the Feeder Cabinet

The scope of Work to be performed on the D2O transmitter impulse lines of all systems penetrating the feeder cabinets is as follows:

- OPG will provide to the Contractor a general cut location which takes into consideration trans-granular stress corrosion cracking (TGSCC) concerns.
- The Contractor will:
    - Determine the exact cut location and remove instrument tubing lines inside the feeder cabinet at a minimum, up to and including the first anchor point outside the feeder cabinet, based on the general cut location provided by OPG.
    - Remove the required sections of the instrument tubing lines
    - Replace the removed sections of instrument lines per existing design while taking into consideration field conditions requiring fret mitigation.
- OPG will be conducting the engineering analysis of instrument lines to dampen the vibrations and to qualify the tubing for the seismic requirements of the associated system by re-designing the support systems. Additional supports and enlargement of feeder cabinet penetration seal plates may be required.
- The Contractor shall route new instrument tubing and support trays utilizing the Unit 3 layout.

3.6.8.1 Instrument Tubing ID Cleaning

The Contractor will develop a method to clean the ends of the instrument tubing prior to welding per requirements of 38RF-63000-TS-002.

3.6.9 Reactor Area Bridge and Carriage System Component Replacements

During the Execution Phase, the contractor will replace the following components on the Reactor Area Bridge and Carriage System as per the Darlington Fuel Handling Refurbishment Scope of Work (NK38-SOW-35000-10000) - Appendix D. It is expected that this work can be completed while returning the Reactor Area Bridge and Carriage to service following the R&FR activities.

Replacement components will be provided to the Contractor by OPG as "free issue" items. The Contractor is required to determine all steps and processes to complete installation successfully. OPG will perform Engineering and Procurement roles necessary to complete the component replacements.

The components to be replaced include:

- TSO400-13: Ball-Screw and Jack Assembly
- TSO400-8: Power Cables
- TSO400-9: Signal Cables
- TSO400-11: RA Bridge and Carriage Motors
- TSO400-12: Limit Switches
- TSO400-14: Carriage Speed Reducer
- TSO400-19: RA Bridges Cross-Shaft and Pillow Block
- TSO400-22: RA Bridges Y and X Drive

3.6.10 Reactor Vault and Fuelling Duct Cooling Coils and Fan Motors

During the Execution Phase, the Contractor will replace the following components associated with the Reactor Vault and Fuelling Duct Air Conditioning Units (ACUs).

Replacement components will be provided to the Contractor by OPG as "free issue" items. The Contractor is required to determine all steps and processes to complete installation successfully. OPG will perform Engineering and Procurement roles necessary to complete the component replacements.

The components to be replaced include:

2-73720-ACU1, 2-73720-ACU2, 2-73720-ACU3, 2-73720-ACU4:

1. Left Hand Coil (CID194025)- Quantity 2 per ACU
2. Right Hand Coil (CID654798)- Quantity 2 per ACU

2-73720-FM1, 2-73720-FM2, 2-73720-FM3, 2-73720-FM4, 2-73720-FM5, 2-73720-FM6, 2-73720-FM7, 2-73720-FM8:

1. Fan Motor (CID258902)- Quantity 1 per FM

3.7 Tool Management

During the Execution Phase, the Contractor will manage the Tooling in accordance with its tool management plan as developed during the Definition Phase. The Contractor will be accountable for the complete lifecycle of the Tooling including, but not limited to, storage, transit from the DEC to the Work face, lay-down and staging areas, and movement in and out of the reactor vault, including decontamination, calibration and testing before/during/after execution, maintenance before/during/after execution and final decontamination and disposal.

3.8 Material Management

During the Execution Phase, the Contractor will manage the Owner-Specified Materials, Goods and waste containers in accordance with the Material Management Plan developed during the Definition Phase. The Contractor will be accountable for the complete lifecycle of all Owner-Specified Materials, Goods and waste containers including, but not limited to, storage, all required transportation, lay-down and staging areas, and movement in and out of the reactor vault, including decontamination and final decontamination and disposal.

3.9 New Fuel Load

During the Execution Phase, OPG may choose to utilize the Contractor to load new fuel in all fuel channels following the procedures developed in the Definition Phase and in accordance with the schedule. The Contractor will provide the capability to load fuel into four fuel channels simultaneously. OPG will provide the fuel in a timely fashion to support the Work. OPG and the Contractor will agree on a location for delivery/staging of the new fuel. The Contractor will properly dispose of all waste generated by the fuelling activity (e.g., boxes and packaging). OPG will be required to oversee this portion of the work as tracking of fuel, as holder of the license for prescribed material, is an OPG responsibility.

3.10 Commissioning Specifications

The Contractor will write and provide OPG with commissioning specifications for all equipment and components that were altered, modified or affected

during the Execution Phase. OPG will produce the Commissioning Phase plan that will outline all Commissioning Phase activities.

3.11 Condition of Vault at Mechanical Completion

As part of the completion of the Work on each Unit, prior to Unit Mechanical Completion, the Contractor will restore the vault to the same (or better) condition as it was provided to the Contractor by OPG, as detailed in Section 3.4. This will include, but not be limited to, the removal of all Tooling, Owner-Specified Materials and Goods, modifications and support equipment, installation of feeder cabinets, hangers, support hardware and reactor face insulation. All Work will be completed by the Contractor in accordance with the procedures developed by the Contractor during the Definition Phase. The following is a list of additional requirements of the Contractor with respect to final condition of the vault for turnover of the vault to OPG. This list is not exhaustive and is only meant as a guideline.

- The Contractor will ensure that, upon completion of the Work, all Work areas will be cleaned and decontaminated, such that the areas are left in a radiological state similar to, or better than, the state at the commencement of Work activities, in consultation with the refurbishment Radiation Protection personnel.
- All equipment, Tooling and garbage removed from the vault.
- All temporary barriers installed by the Contractor removed from the vault.
- All final walk downs will have been completed by the Contractor and accepted by OPG's Operations Manager, Nuclear Refurbishment or delegate.
- All AFS prerequisites will have been completed.
- The vault area will be left in a state of cleanliness that meets OPG Station Material Condition, House Keeping and Inspection Standard, N-STD-MA-0008.

3.12 Mechanical Completion

The Contractor will remove all the temporary infrastructure and modifications installed outside of the vault prior to the commencement of Work on the applicable Unit. This Work will be completed as a requirement to obtain Unit Mechanical Completion Milestone and must be done in parallel with the

commissioning of the Unit and must not affect the critical path for Unit return to service. All Work will be completed by the Contractor in accordance with the procedures developed by the Contractor during the Definition Phase.

3.13 Demobilization

As part of the completion of the Execution Phase Work for each Unit, the Contractor will demobilize the applicable workforce in accordance with the Resource Management Plan developed during the Definition Phase. The Contractor will be responsible for ensuring that all applicable security, human resources, radiological and other procedures/requirements are complied with during the demobilization.

3.14 Unit Closeout

The Contractor will complete and deliver formal turn over/closeout Documents to OPG, by the dates agreed to in the Execution Phase Milestone Schedule. These Documents will include, but are not limited to, all completed inspection and test plans, all history dockets as specified below, all qualification documentation, all testing/inspection reports/results, as built drawings/documentation and any other documentation required by OPG to support the AFS criteria and license conditions required in order to return the Unit to service. The turn over/closeout Documents will also include a complete report on the Work, including cost and schedule performance against plan, risk management success, lessons learned and final account of Reimbursable Costs, budget variances, final waivers and declarations.

Once a component has been installed by the Contractor, all history docket information will be provided to OPG in accordance with N-TS-08173-10001: History Docket/Nuclear Material Documentation Release and will be issued into Passport by OPG.

4.0 WORK MANAGEMENT

4.1 Work Performed in Planned Outages

It is anticipated that the Contractor will perform early Works in prior planned outages. The Contractor will follow N-PROG-MA-0019 "Production Work Management" to schedule and perform this Work on the operating Units. The

Contractor will follow all Work planning practices (e.g., Work planning, Work protection, radiation protection, etc.) applicable to online and maintenance outage work at OPG which are further detailed in N-PROC-MA-0002, "Work Planning". The Contractor will plan, organize, schedule and execute the Work. The Contractor will identify and manage the required OPG interfaces both with other contractors and OPG in order to successfully complete the Work.

The Contractor must identify the scope of the Work to be performed in the planned outages, and DNGS areas to be walked down, and any other additional requirements to support the Work and submit this scoping information to OPG accordance with the applicable procedures. This is necessary in order to carry out preparatory arrangements and meet outage scoping milestones.

4.2 Work Performed in Refurbishment Outages

OPG is currently developing the refurbishment Work management process to be used during the refurbishment outages. Depending on Unit conditions, Work scope and interfaces, the process may include a Contractor administered and controlled Work management program. OPG will Work with the Contractor to further develop the most economical and safe approach to execute the Work. The details of the program will be further defined with the Contractor during the Definition Phase.

5.0 NUCLEAR WASTE

The Contractor will be responsible for handling all wastes generated by the Work, making sure they are correctly packaged into a form suitable for transfer to OPG personnel. Details of how and where this will be performed will be documented in the Waste Management Plan and the Site Infrastructure and Layout Plan.

The Contractor shall perform volume reduction of the removed components as prescribed below. This section describes the various types of nuclear waste and states basic waste management criteria for developing an overall waste management strategy that the Contractor must comply with.

The location of the volume reduction will be agreed upon between the Contractor and OPG post award, but will be within the protected area. The current baseline is to perform volume reduction away from the Reactor Face (i.e. off critical path), however OPG is considering the benefits and trade-offs of volume reduction on the Reactor Face and impacts on cost and schedule.

The Contractor shall complete a feasibility study that addresses the following:

- Comparison of critical path time required to complete volume reduction on or off the Reactor Face
- Comparison of additional tooling requirements or changes needed to tooling to perform on or off the Reactor Face at Darlington
- Bridge location and weight restriction issues and changes required to address, if any
- Changes to the logistical planning in terms of bringing in larger tooling and waste container movement
- Comparison of cost additions for additional tooling vs. cost savings derived from less shielded flasks and elimination of volume reduction facility infrastructure
- Other possible considerations that may benefit OPG not already discussed above, e.g. single use flasks, specialized tooling for lower rows, or other possible alternatives

OPG will require reassurances that flow of containers and personnel are carefully planned to minimize congestion and the potential for injury.

5.1.1 Nuclear Waste Containers

One of the requirements for the Contractor is the manufacture and delivery of nuclear waste containers for the intermediate level waste. OPG will provide the necessary specifications and drawings to facilitate the procurement, and the Contractor will procure in accordance with Section 2.3.3.

The Contractor will design and build six (6) Intermediate Level Waste End Fitting containers (ILWEF) as contingency that will facilitate not cutting the outboard end fitting. The Contractor may base the design using MDR W-MDR-79010-00001 and MEC#137008 as reference material.

5.1.2 General Considerations

Nuclear waste management is one of the more technically challenging aspects of the Work. The following general requirements must be considered when developing a Waste Management Plan:

- To minimize quantities of contaminated package materials, always remove excess packaging from materials to be taken into radiological zones.
- Fabricate components (including the Tooling) that can be easily cleaned of surface contamination, or make provisions for sealed compartments for complex parts.
- Where equipment will be exposed to contamination, use plastic bags to protect surfaces from gross contamination. This will reduce the amount of materials generated in subsequent decontamination efforts.
- Minimize (and eliminate if possible) the spread of loose contamination.
- Materials that are contaminated with tritium must be off-gassed (dried) in a suitable facility prior to being sent for further waste handling.
- Waste streams should be separated into contaminated or likely clean waste.
- Contaminated waste must be further separated into incinerable, compactable, or non-processible waste. Waste volume reduction is achieved by incineration or compaction. Examples: Tyvecs are incinerable; pressure tubes are compactible; end fittings are non-compactible.

The Contractor will be responsible for handling all wastes generated by the Work, making sure they are correctly packaged into a form suitable for transfer to OPG personnel. Details of how and where this will be performed will be documented in the Waste Management Plan and the Site Infrastructure and

Layout Plan. The Retube Waste Processing Building (RWPB) is the responsibility of the Contractor.

The Contractor's waste handling system must:

- Process material in a fashion that minimizes conventional safety hazards.
- Minimizes labour and dose intake for labour, while being cost effective.
- Minimize infrastructure demands.
- Meet Project schedule requirements (i.e., to minimize risk to the critical path).
- Package waste material in appropriate shipping containers.
- Arrange container shipping requirements.
- Provide a primary and secondary transportation method to take ILW from the Unit to the RWPB.
- Provide trailers/drivers to both load and transport filled Darlington Storage Overpack/Retube Waste Containers (DSO/RWCs) from the RWPB to the Retube Waste Storage Building (RWSB).
- Coordinate on-site transfers to the RWSB with Darlington Waste Management Facility ("**DWMF**") personnel.
- Coordinate transfers of nuclear waste material being sent directly to a licensed facility with NWMD transportation group, which would be ILW resins from purification systems and low level waste such as appropriately packaged feeder pipes.
- Transport low level nuclear waste to a mutually agreed transfer point on the DNGS Site for DNGS Civil Maintenance staff to pick-up and process.

The Contractor will perform an assessment to provide estimates for volume of the waste that will be produced during the Work as documented in the Waste Management Plan. Based on this assessment, the Contractor will then consult with OPG to identify the number of each type of waste container that will be required to support the Work.

OPG will be responsible for the following:

- Accepting volume reduced nuclear waste in sealed Darlington Storage Overpack (DSO)/Retube Waste Containers (RWC) delivered to the on-site RWSB for hand over and safe storage. Dose targets for the DSO/RWC once filled will be provided during the Definition Phase.

- Assist where stated in the following paragraphs of this section.

All nuclear waste generated by the Work can be separated into two levels of waste:

- Intermediate Level Waste ("**ILW**")
- Low Level Waste ("**LLW**")

The full definition of ILW and LLW can be found in the latest revision of the Waste Acceptance Criteria, W-PROC-WM-0025.

5.1.3 Intermediate Level Waste (ILW)

Reactor components that are considered ILW will be stored in the RWSB at DNGS prior to placement in the Deep Geological Repository ("**DGR**"). This section describes the expected process for handling components that are to be treated as ILW.

5.1.3.1 Pressure Tube and Calandria Tubes

Due to the gross contamination levels and absorbed tritium, both pressure tubes (PT) and calandria tubes (CT) will need to be removed using remotely operated Tooling, shielded tooling, or other means as demonstrated to meet the ALARA principle. During the removal process, the PT and CT will be required to be taken away from the reactor face in interim shielded flasks and transported to a Contractor established RWPB for volume reduction and waste processing. The Contractor will be required to provide the necessary shielded flasks to accomplish PT and CT removal from the reactor face. As with the removal process, volume reduction will need to be completed using remotely operated Tooling to stay within ALARA principles. The Contractor will perform volume reduction of the removed components prior to placing the waste into the DSO/RWCs, in accordance with the Contractor's waste management plan. The Contractor will then move these containers from the RWPB to the Retube Waste Storage Building ("**RWSB**"), which is located outside of the protected area.

Airlock constraints must be considered to ensure that the shielded flasks chosen are sized accordingly. The Contractor must design, license,

manufacture and supply any interim shielding flasks that are required to complete the Work.

5.1.3.2 Calandria Tube Inserts (or Sleeves)

Due to the gross contamination levels and absorbed tritium, calandria tube inserts (CTI) will need to be removed using remotely operated Tooling. Due to the size of the CTI, once they are removed, they can be inserted directly into a waste container without volume reduction.

5.1.3.3 End Fittings

End fitting volume reduction will be completed to separate the ILW from the LLW in order to reduce the number of DSO/RWCs required for end fittings. The Contractor will cut the end fitting outboard of the associated shield plug to ensure that the entire shield plug remains with the ILW. Due to space restrictions within the DSO/RWC, the end fitting waste processing tooling must be capable of ensuring that the ILW portion of the End Fitting will fit within the DSO/RWC.

5.1.4 Section Removed

5.1.4.1 Miscellaneous Active Intermediate Level Waste

Other ILW not covered above may include feeder pipe hot spots, cutting tool shavings and highly contaminated Tooling. Volume reduction will likely not be required for these items. The Contractor will be required to break down any large components to fit in the chosen waste container.

5.1.5 Radioactive Liquid Waste Handling

Radioactive liquid wastes will go directly as ILW to a Licensed Facility, if it meets the acceptance criteria as documented in W-PROC-WM-0025. Radioactive liquid wastes may include contaminated hydraulic fluids, Tooling lubricants and Tooling decontamination water.

All radioactive liquid waste handling is covered in the following procedures:

- N-PROC-RA-0017: Segregation and Handling of Radioactive Waste
- D-PROC-RA-0083: Radioactive Liquid Waste Handling

In general, all cleaning liquids used for the decontamination of tools and equipment will need to be collected into waste containers. On occasion, the active liquid waste system may be used if the liquids fall under the criteria of N-PROC-RA-0017.

All personnel working at DNGS who collect radioactive waste are responsible for ensuring that it is disposed of in the proper pathway as documented in the Waste Management Plan. This is to ensure that the radioactive exposure to DNGS and its environment is kept within the ALARA standard. The Contractor, with the assistance of OPG's radiation protection coordinator, will collect all radioactive liquid waste in suitable containers provided by OPG and will deliver them to OPG at the appropriate location.

5.1.6 Low Level Waste

The components below will, in general, be classified as LLW. LLW will typically be put into high capacity non-processible bins and transported to a licensed facility in ISO shipping packages provided by OPG. The following components will be processed as LLW:

5.1.6.1 Feeder Piping

There are 960 feeder pipes per Unit ranging from 8-20m in length and, in general, will be considered LLW; however, there may be the occasional hot spots that must be treated as ILW (≥ rem/hr at 30 cm). These piping segments will have to be separated from the standard LLW and treated as ILW.

Feeder piping will have to be cut to size to fit into the waste containers used. To minimize the number of containers used, feeder piping would need to be cut into 1.8m lengths approximately. It is preferable to complete volume reduction in the vault.

5.1.6.2 Position Assembly (PA) Hardware

As with feeder piping, all 960 PA Hardware per Unit will be put into high capacity non-processible waste containers and transported to a Licensed Facility in ISO 40 ft shipping packages. No ILW is anticipated with PA Hardware.

5.1.6.3 Tooling and Equipment

On completion of the Work, the Contractor will segregate the ILW, LLW and clean Tooling and dispose of it accordingly. The Contractor, with the assistance of OPG's radiation protection coordinator, will decontaminate all Tooling and other equipment to the extent practical in order to minimize the volume of radioactive waste. The Contractor may also break down and dispose of some equipment in accordance with nuclear waste practices. This equipment is mainly expected to be considered LLW with some ILW.

5.1.6.4 Reactor Face and Feeder Cabinet Insulation and Frame

Insulation may require off-gassing for tritium abatement prior to further handling. Once this is completed, the Contractor will hand off to OPG at the appropriate location.

5.1.6.5 Miscellaneous Active Low-Level Waste

This is standard LLW generated which includes items such as rubber gloves, over boots, tape, sticky mats, protective clothing, wrapping material, etc. It is estimated there will be about 500 cubic metres a year of LLW per Unit (to be confirmed by the Contractor). As with standard LLW, the Contractor will appropriately bag all LLW and then deliver it to OPG with the assistance of OPG's radiation protection coordinator.

5.1.7 Non-Active Waste

This waste is classified as "Likely Clean" and can be put into bins that are provided and taken care of by OPG. This may also include miscellaneous mechanical and electrical equipment (such as pumps, valves, wiring, etc.).

6.0 QUALITY ASSURANCE

6.1.1 Quality Assurance Programs

The following are general requirements with regards to quality assurance that must be implemented and maintained throughout the Work. The Contractor will:

- implement and maintain a quality program in accordance with OPG's requirements consistent with the latest revision of CSA-N286-05: Management system requirements for nuclear power plants. This quality plan may include an integrated streamlined approach with elements of both SNC Lavalin Inc. and Aecon Construction Group Inc quality programs
- assure that any pressure boundary activities (e.g., procurement, fabrication or installation) included in the Work will be performed in accordance with the requirements of CSA- N285.0-08 and Update No. 2* and Annex M: General requirements for pressure-retaining systems and components in CANDU nuclear power plants/Material Standards for reactor components for CANDU nuclear power plants
- demonstrate that a satisfactory quality assurance program exists for conducting the pressure boundary activities included in the Work in the form of a TSSA Certificate of Authorisation or equivalent documentation acceptable to the TSSA
- implement and maintain a quality program in accordance with OPG's requirements consistent with the latest revision of Z299.2-85: Quality Assurance Program – Category 2 for all non-pressure boundary Work
- implement and maintain a quality program in accordance with OPG's requirements consistent with the latest revision of Z299.2-85: Quality Assurance Program – Category 2 for all Tooling with justifiable exceptions to be approved by the Design Authority
- be responsible for any registration requirements with applicable authorities for any equipment supplied by the Contractor
- ensure that components and systems that are seismically qualified, and are being procured and/or designed by the Contractor, are designed and procured according to N289.1-08 - General Requirements for Seismic Design and Qualification of CANDU Nuclear Power Plants
- ensure that Tooling meets the Seismic Requirements specified in NK38-DR-31110-10000

- Design and procurement shall follow the code effective dates as identified below

Standard Title	Approved Effective Dates
General Requirements for Pressure Retaining Systems and Components in CANDU Nuclear Power Plants	N285.0-08 and Update No. 2 and Annex M
Fire Protection for CANDU Nuclear Power Plants	N293-07
Environmental Qualification of Equipment for CANDU Nuclear Power Plants	N290.13-05 and Update No. 1
Installation of Stationary Fire Pumps	NFPA 20-2010 Amendment 1 &2
Installation of Private Fire Service Mains	NFPA-24-2010
General Requirements for Concrete Containment Structures for CANDU NPP	N287.1-93 (Reaffirmed 2009)
Material Requirements for Concrete Containment Structures for CANDU NPP	N287.2-08
Design Requirements for Concrete Containment Structures for CANDU NPP	N287.3-93 (Reaffirmed 2009)
Construction, fabrication, and installation requirements for concrete containment structures for CANDU NPP	N287.4-09
Pre-Operational Proof and Leakage Rate Testing Requirements for Concrete Containment Structures for CANDU NPP	N287.6 11
General Requirements for Seismic Design and Qualification of CANDU NPP	N289.1-08
Ground Motion Determination for Seismic Qualification of CANDU NPP	N289.2-10
Design Procedures for Seismic Qualification of CANDU NPP	N289.3-10
Testing Procedures for Seismic Qualification of CANDU NPP	N289.4-12
Seismic Instrumentation Requirements for CANDU NPP	N289.5-12
Requirements for Electrical Power and Instrumentation Air Systems of CANDU NPP	N290.5-06
Requirements for Safety-Related Structures for CANDU NPP	N291-08

6.1.2 Quality Documentation

The Contractor will be expected to submit a preliminary list of all quality Documents prior to the outages for OPG's review per the Submittals Schedule. Prior to the commencement of the Work on a Unit, the Contractor will be required to provide a detailed listing of all quality Documents that are required for turnover/AFS. Upon satisfactory completion of component installation, the Contractor will provide signed and dated original or legible copies of all inspection Documents pertinent to such installation or testing of the Work. Such Documents (as applicable) will include, but not be limited to the following:

- Weld inspection reports
- Welding qualification Records
- Material test reports
- Radiographic film and interpretation reports
- Inspection and test plans
- Pressure vessel and piping installation data reports

7.0 REGULATORY INTERFACE

This section provides an overview of the regulatory Approvals and modification registration requirements involved during the Work. Both the Contractor and OPG will be involved with the regulatory interface required for the Work. This section defines the requirements as they are currently known. For more information, refer to the ECC process described in "Contractor/Owner Interface Requirements for Nuclear", N-DAI-00150-10000.

7.1.1 CNSC Approval & Reviews:

OPG will complete all the required operating policy and procedure revisions and reactor operating license amendments to suit the modified nuclear core conditions resulting from the complete defueling, draining and drying of PHTS , PHTS auxiliaries and moderator and moderator auxiliaries systems. The Contractor will be responsible for assisting OPG to secure the required CNSC Approvals by providing design documentation for all modifications involved, fitness for service determinations, proof of scope completion, and approval for the restart. The Contractor will be responsible for providing the necessary information for CNSC submissions in accordance with established CNSC hold points, some of which are identified in RD-360.

7.1.2 Pressure Boundary Modification Work:

Pressure boundary activities included in the Work are to be conducted in accordance with the requirements of CSA N285.0-08, Update No. 2* and Annex M.

Modifications and new designs involving pressure boundary components or systems will be designed in accordance with the OPG ECC process described in N-PROC-MP-0090 and may be subject to approval of the CNSC and registration with the inspection agency (TSSA). Any Tooling pressure boundary components will also require TSSA registration. The Contractor will obtain the registrations with the TSSA directly.

The Contractor will identify the code classification and system classification requirements of all modifications involving systems, structures and components and develop required design documentation packages in accordance with CSA Standard N285.0-08, Update No. 2* and Annex M. The Contractor will

complete the mandatory N-FORM-10370, Canadian Nuclear Safety Commission Approvals and Notification Screening and N-FORM-10369, Licensing Review Determination, and provide all supporting design documentation for all modifications for further OPG processing with CNSC in order to obtain code classification approval as required.

7.2 Environmental Considerations

OPG has initiated the environmental assessment (EA) for the Work in order to ensure the EA is approved in time for the first Unit shutdown. In order to start the EA, studies were conducted regarding the R&FR in order to establish the basis of the EA. Due to the need to progress the EA in accordance with the schedule, the Contractor will be bound to the assumptions made in the EA in order not to invalidate this basis. This section discusses these assumptions. If, in planning the Work, the Contractor discovers that keeping within the limits stated in this section is not possible, OPG must be notified immediately as the implications are a possible revision to the EA, with accompanying schedule implications.

7.2.1 Personnel Loading

Personnel loading and bounding environmental footprint of the Work as an environmental factor is discussed in this section. Table 3.1-A provides estimated average and peak number of personnel on the DNGS Site performing the Work. The Contractor will be responsible for estimating the number of staff on Site that is required for the Work and report to OPG if those estimates are not within the ranges or within the bounding values listed in the Table 3.1-A.

Table 3.1-A: Estimated R&FR Personnel Loading

Applicable case	Number of Personnel
Average # of Personnel Inside Protected Area (1)	225-300
Peak # of Personnel Inside Protected Area (2)	1260
Average # of Total Personnel On Site (1)	295-390
Peak # of Total Personnel On Site (2)	1360

(1) Assumed within a Work shift, during day shift, on a weekday. Includes OPG radiation protection personnel assigned to support the Work.

(2) Assumed at shift turn-over, on a week day. Includes OPG radiation protection personnel assigned to support the Work. Peak number of personnel within a shift would be expected to be half the listed value.

7.2.2 Radiation Dose Estimates

The Contractor shall develop an ALARA (As Low As Reasonably Achievable) Plan that is required to be approved by OPG. The Contractor will provide dose estimates broken down to different phases of the Work and cumulative dose calculations in accordance with its own analysis.

The exposure control limit (ECL) for Boilermakers, Millwrights, and Pipefitters will be established at 1600 mRem applied in a manner to be consistent with OPG procedures.

7.2.3 Emissions

7.2.3.1 Limits

Radiological releases are regulated by the CNSC to limit annual public and worker dose. Current OPG governance specifies the CNSC limits for radionuclide releases in airborne and liquid effluents from the DNGS. Different levels including Normal Operating Level (NOL), Internal Investigation Level (IIL), and Action Level (AL) have been established to ensure that the level of release is always kept within OPG's expected range and below the specific regulatory limits.

The current approved values for ALs, IILs and NOLs, and also CNSC Derived Release Limits (DRLs) for each radionuclide group and Site combined Emission Effective Dose (EED) are available in Reference 10 and 11 as listed in Section 10.1.

The maximum permissible estimated airborne and waterborne releases for the Work, as assumed in the preparation of the EA, is provided in Table 3.3.1-A.

Table-3.3.1-A: Expected Limiting Release from Work on four Units

Radionuclide Release Group	Unit	Maximum release from the Work*
Airborne release		
Tritium Oxide	Ci	1386
C-14	Ci	11.4
Waterborne Release		
Tritium Oxide	Ci	3116
Atomic Tritium	Ci	None Expected
C-14	Ci	N/A

*Reference N-CORR-07720-0351305-T10

The Work flow must be designed to ensure that release from the DNGS is kept within the expected limiting estimated releases as per Table 3.3.1-A. The Contractor will provide an estimate in the definition phase for the total release, weekly release for airborne and monthly release for waterborne for each radionuclide group identified in Tables 3.3.1-A. If the Contractor's estimated values for the release of these radionuclides during the Work exceeds the estimated limiting values of EA assumptions provided in Tables 3.3.1-A, OPG must be notified immediately and mitigating actions may be required.

7.2.3.2 Monitoring Releases

To ensure limits from all sources including the Work meet the ALARA requirement, all airborne / waterborne releases from the DNGS will be monitored by OPG on a weekly / monthly basis. An Internal Investigation Level (IIL) identifies abnormally high releases from the DNGS. Releases that exceed the IIL require a report from the Contractor and investigation.

The following are the administrative individual stack releases (Reference 11) that are being followed for the DNGS stack release monitoring to be in compliance with IIL.

Administrative Levels for Individual Stack Releases:

Radionuclide Release Group	Units	Permissible Levels
Noble gases	Ci-Mev/week	3
Particulates	µCi/week	15
Iodines	µCi/week	13
Carbon-14 (as CO_2)	Ci/week	1.32

These limits are not to be exceeded during the Work and suitable mitigating actions are to be taken to limit the releases within the permissible levels.

In addition to radioisotope group specific targets for DNGS releases, there are combined targets (i.e., ILC, ALC, DRLC) for all releases to air and water combined. Combined Emissions Effective Dose (EEDs) are monitored when release information is analyzed by the Environmental Compliance Section for the entire DNGS.

For detailed information refer to OPG Environmental Manual – NK38-MAN-03480-10001 Reference 11.

7.2.4 Conventional Emissions

The Contractor will have its own Certificate of Approval for conventional airborne and waterborne emissions and will comply with its requirements. The Contractor will ensure that the appropriate Certificate of Approval Documents are in effect and that discharge limits and monitoring requirements are followed. For further details, refer to Reference 15.

8.0 SAFETY

8.1 Conventional Safety

8.1.1 Fire Protection

The Contractor will be responsible for providing a fire safety plan (FSP) for the different portions of the Work in accordance with standard CSA N-293-07, and OPG procedure N-PROG-RA-0012, "Fire Protection".

8.1.2 Fire Safety Plan

The Contractor's FSP will also meet the requirements specified in the following:

- CAN/CSA N293-07 Fire Safety Plan, Section 5.8.4
- National Fire Code of Canada, Section 2.8.2 Fire Safety Plan
- N-PROG-RA-0012, "Fire Protection"

As a minimum, the Contractor's FSP will include:

- Emergency procedures to be used in case of fire (e.g., preparation of evacuation procedures and assembly areas for accounting).
- Appointment and organization of designated fire prevention staff to carry out safety duties. The emergency response team will be accountable for emergency response. The emergency response team may need to hire augmented staff accordingly based on the nature of the Work and any increased fire hazard that it creates.
- Training of fire prevention staff and other occupants in their responsibilities for fire safety.
- Documents, including diagrams, showing the type, location and operation of the building fire emergency systems. The emergency response team may require the Contractor to procure, inspect and maintain additional portable firefighting equipment to be deployed in strategic areas.
- Performing fire drills.
- Control of fire hazards in the building (i.e., minimizing combustibles, controlling transient material, and use of ignition source permits, etc.)
- Inspection and maintenance of building facilities and portable firefighting equipment provided for safety of the occupants.

Contractor Responsibilities:

- Provide medical staff and qualify some staff as first aiders and fire prevention officers.
- Provide fire watch in areas where hot Work is taking place and, after the hot Work is completed, check and verify that the area is left in a safe condition. The individual(s) performing the fire watch must be trained and qualified and will be responsible for ensuring that any sparks or ignition sources that are created while performing hot Work are extinguished and do not cause

further damage. The Contractor will provide the number of staff requiring training as fire watch, and their training may be provided by OPG using N-TQD-508-00001 "Nuclear Fire Protection Section Training and Qualification Description".

- The Contractor will provide staff (one per shift plus reserve) for the position of hot Work permit coordinator, who will be responsible for issuing and the status of all the hot Work permits. OPG fire safety staff will reserve the right to control the activity of the Contractor's hot Work permit coordinator.

The Contractor will submit the FSP for review and acceptance by OPG and the municipal fire department as a schedule milestone.

8.1.3 Space Allocation for Transient Materials (SATM)

Control of space allocation for transient materials is governed by OPG procedure N-PROC-RA-0054, "Control of Space Allocation for Transient Material", which receives its authority from N-PROG-RA-0012, "Fire Protection". This procedure prescribes the administrative requirements regarding control of space allocation for transient materials, re-locatable structures and temporary lay-down areas within the DNGS.

The Contractor will be required to perform a walk-down and to identify the areas within the DNGS that are required for the Work. These areas are to be requested by the Contractor in writing by preparing a

Site Infrastructure and Layout Plan that will identify space requirements for transient materials via SATM permits. OPG will review this plan and will make any necessary corrections. OPG may have areas/ locations that are typically used for lay-downs, but it will be the Contractor's responsibility to review the space requirements and assess the flow of Work to obtain an optimized Work flow and efficiency.

8.2 Radiation Protection

The Contractor will comply with all radiation protection requirements in accordance with N-PROG-RA-0013, "Radiation Protection", and all its implementing procedures, all of which are intended to achieve and maintain high standards of radiation protection.

OPG will provide the required radiation protection coordinators/assistants to assist the Contractor in completing the Work. The Contractor will identify its resource requirements during development of the Execution Phase Target Schedule and will provide this information to OPG. OPG will thereafter assign the required radiation protection coordinators/assistants to the Work. OPG will also provide all monitoring equipment.

ALARA Plan Submission and Approval

The Contractor shall develop an ALARA (As Low As Reasonably Achievable) Plan that is required to be approved by the OPG Radiation Protection – Nuclear Refurbishment Department. The Contractor will provide dose estimates broken down to different phases of the Work and cumulative dose calculations in accordance with its own analysis.

This ALARA plan will be reviewed and accepted by the OPG Radiation Protection – Nuclear Refurbishment, ALARA section, prior to use at site and meet the requirements of N-STD-RA-0018 "Controlling Exposures As Low As Reasonably Achievable". This may include, but not be limited to, completion of the following documentation;

(i) N-FORM-10103 Pre-Work Execution Checklist
(ii) N-FORM-10862 ALARA Checklist for Planners
(iii) N-FORM-10863 Post Work ALARA Review
(iv) N-FORM-10864 High Hazard Checklist for Job Coordinator
(v) N-FORM-10865 ALARA Observation and Coaching Report
(vi) N-FORM-10866 ALARA In-Progress Review

The accepted collective dose and ALARA plan shall be used to assign the dose budget for the activities described in this Scope of Work (SOW) Document. This dose budget will include all trades/supervisory for the specified in this SOW Document.

9.0 COMMISSIONING SUPPORT WORK

For the Commissioning Phase, the control of the reactor vault and Work management will be turned over to OPG; however, the Contractor will continue to have managed Work tasks within the Commissioning Phase and will be expected to provide OPG with commissioning support for each Unit. All commissioning activities will take place under OPG's commissioning quality assurance program.

9.1 List of Commissioning Tasks to be Performed by the Contractor:

- Restore all temporarily removed interferences and restore temporary modifications for Work to the original configuration. This includes return of the RA Bridge to its original configuration.
- Final QA/QC acceptance of the Work.
- Completion of PHTS operational pressure test with support from OPG operations staff.
- Preparation of a commissioning report for fuel channels and feeders as a record of commissioning activities and engineering acceptance.
- Commissioning of RA Bridge and confirm its functionality.
- Repair any deficiencies, leaks identified during the Commissioning Phase.
- Disposition/process all non-conformance.
- Submit all required documentation in support of processing CNSC submissions and Approvals.
- Support OPG in the commissioning of the systems as directed by OPG.
- Provide commissioning specifications detailing the items or equipment, commissioning parameters for equipment/components that the Contractor has installed, repaired or refurbished during the R&FR activities.

9.2 Closeout

- Perform all closeout duties described in the "Contractor/Owner Interface Requirements for Nuclear", N-DAI-00150-10000 Document.
- Open items completed.
- Milestone achievement update.
- Risk assessment accuracy review.
- Target Cost variance explanation.
- Records update received by OPG and input into controlled documents.

- "Lessons learned" report.
- Submit information for post-implementation review.

10.0 REFERENCES

10.1 Developmental References

Item	Document Number	Document Title
1	N-PLAN-01060-10003	Reactor Assembly Aging Management Strategy And Plan
2	I-PLAN-31200-50000	DNGS Calandria Inspection Plan, 2009
3	TD 38-01210-096-002	Darlington NGD Retube And Feeder Replacement Study-Technical Assessment, 2009
4	NK38-REP-09701-10001	DNGS Refurbishment- Infrastructure Summary Report, 2010
5	NK38-DEN-31210-0004-001	Calandria Shell Nozzle & Bracket Details
6	TD 38-31140-024-102	Darlington NGD - Investigation and Improvement Recommendations on Channel Closure Leakage", 2007
7	NK38-OM-62030	Operating Manual – Access Control –Normal Operation
8	D-INS-09071-10010	Radiation Protection Access Control
9	NK38-OM-75130	Operating Manual – Breathing Air – Hazards and Practices
10	NK38-REP-03480-10002	Action Levels, Internal Investigation Levels And Normal Operating Levels For Radionuclide Releases In Airborne And Liquid Effluents From The Darlington Nuclear Generating Station
11	NK38-MAN-03480-10001	Environment Manual
12	FIN-MAN-CM-001	Contractor Management Process Manual
13	TD 38-01210-096-003	Retube And Feeder Replacement Study- Input To The Environmental Assessment
14	N-PROG-RA-0013	Radiation Protection
15	N-PROC-OP-0037	Certificates Of Approval
16	W-REP-03460-00015	Reference Plan For The Management Of Low And Intermediate Level Waste From Darlington A Refurbishment
17	W-PROC-WM-0025	Waste Acceptance Criteria For Low & Intermediate Level Radioactive Waste
18	N-PROC-LE-0009	Nuclear Refurbishment – Schedule Management
19	N-PLAN-01060-10001	Feeders Life Cycle Management Plan
20	N-PLAN-01060-10002	Fuel Channels Life Cycle Management Plan
21	N-PLAN-01060-10007	Feeder Piping Aging Management Strategy And Plan

Item	Document Number	Document Title
		Technical Basis Document
22	N-PLAN-01060-10008	Reactor Components & Structures Life Cycle Management Plan: Technical Basis Document
23	NK38-SOW-09701-10005	Darlington Nuclear Refurbishment – Outage Unit Containment Isolations
24	NK38-DR-21126-10001	Preliminary Design Requirements For Containment Isolation Designs
25	NK38-PLAN-09701-10067 SHT 0004	Program Schedule Management Plan
26	NK38-SOW-35000-10000	Darlington Fuel Handling Refurbishment- Scope of Work

10.2 Performance References

OPG Governing Documents- Please refer to Appendix E for a complete list

Document List- Please refer to Appendix F for a complete list

11.0 ACRONYMS & DEFINITIONS

AFS	Available For Service
ALARA	As Low As Reasonably Achievable
ANO	Authorized Nuclear Operator
ASB	Auxiliary Security Building
C of A	Certificate of Authorization
CI	Construction Island
CWP	Comprehensive Work Package
DA	Design Authority
DAIA	Design Agency Interface Agreement
DEC	Darlington Energy Complex
DSO	Darlington Storage Overpack
ECC	Engineering Change Control
EPCM	Engineering Procurement Construction Management
FAC	Flow Accelerated Corrosion
FME	Foreign Material Exclusion
GSS	Guaranteed Shutdown State
ILW	Intermediate Level Waste
ITP	Inspection And Test Plan
LLW	Low Level Waste
MSB	Main Security Building
NOL	Normal Operating Level
NR	Nuclear Refurbishment
NWMD	Nuclear Waste Management Division
OHSA	Ontario Health And Safety Act
OI	Operating Island
OPG	Ontario Power Generation Inc.
PMO	Project Management Office
PMOD	Permanent Modification
R&FR	Retube And Feeder Replacement
RAB	Reactor Area Bridge
REP	Radiation Exposure Permits
RWC	Retube Waste Container

RWPB	Retube Waste Processing Building
RWSB	Retube Waste Storage Building
SATM	Space Allocation For Transient Materials
SCC	Stress Corrosion Cracking
SPOC	Single Point Of Contact
SSC	System Structure And Components
TDSE	Temporary Decontamination System and Equipment
TGSCC	Transgranular Stress Corrosion Cracking
TMOD	Temporary Modification
TSSA	Technical Standards and Safety Authority
WBS	Work Breakdown Structure

Appendix A: Parts List

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
FUEL CHANNEL				
Fuel Channel General				NK38-GEN-31100-0003 NK38-GEN-31100-0016 NK38-DEN-31100-0004-UX
Pressure Tubes	480	621778 99579	518N0196 518N0203	NK38-DDN-31110-0001-UX NK38-DDN-31110-0002-UX
Channel Annulus Spacer (Garter Spring)	1920	17121	590B8495	NK38-DDN-31160-0004-UX
CALANDRIA TUBES				
Calandria Tubes	480	207906	590B4645	NK38-DEN-31230-0001-UX
Calandria Tube Insert	960	207632	590A3511	NK38-DDN-31230-0002-UX
CLOSURE PLUGS				
Channel Closure Plug	960	216945		NK38-GDK-31140-0001 NK38-MAK-31140-0001
SHIELD PLUGS				
Shield Plug-Inlet	480	207778	590B0144	NK38-GDK-31130-0004 NK38-DEK-31130-0002
Shield Plug-Outlet	480	207777	590B0130	NK38-GDK-31130-0003 NK38-DEK-31130-0001
POSITION ASSEMBLY				
Position Assembly General				NK38-GEN-31124-0005-UX NK38-DCN-31124-0014-UX
Nut Assembly - Nut Lock - Nut - Stud Lock - Coil Spring - Wave Spring - Lock Pin - Nut Lock Holding Clip	960	207747	590A9195	NK38-GDN-31124-0013-UX NK38-DCN-31124-0008-UX NK38-DDN-31124-0009-UX NK38-DDN-31124-0010-UX NK38-DDN-31124-0011-UX NK38-DDN-31124-0011-UX NK38-GDN-31124-0013-UX NK38-GDN-31124-0013-UX
Stud	960	207750	590A9223	NK38-DDN-31124-0006-UX
Yoke	960	207749	590A9216	NK38-DEN-31124-0007-UX
Clamp (Saddle)	960	83649		NK38-GEN-31124-0017-UX
Spirol Pin	960	207746	590A9181	NK38-GEN-31124-0005-UX
Spacer Clip	1920	208217	590C3140	NK38-DCN-31124-0021-UX

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
Spacer Clip Retainer	960	208218	590C3154	NK38-DCN-31124-0022-UX
Locking Tab (Clamp)	C	208135		NK38-GEN-31124-0016-UX
Adjustable Tab (Clamp)	1920	208136	590C1236	NK38-GEN-31124-0017-UX
Threading Insert (Helicoil)	C	618934		None available
CHANNEL ANNULUS BELLOWS				
Bellows Assembly- Normal	C	207669	590A7543	NK38-DEN-31180-0001-UX
Bellows Assembly- Oversize	C	207690	590A7550	
Flange	C			NK38-DBN-31180-9003-UX
Ferrule	C			NK38-DBN-31180-9004-UX
Oversize Ferrule	C			NK38-DBN-31180-9006-UX
END FITTINGS				
End Fitting Assembly Type 1	16	207761	590A9552	NK38-GEN-31120-0005-UX
End Fitting Assembly Type 2	238	207762	590A9566	NK38-GEN-31120-0001-UX
End Fitting Assembly Type 3	216	207763	590A9573	NK38-DFN-31120-0002-UX
End Fitting Assembly Type 4	20	207764	590A9580	All Sheets
End Fitting Assembly Type 5	216	207765	590A9594	
End Fitting Assembly Type 6	238	207766	590A0601	
End Fitting Assembly Type 7	16	207767	590A9615	
Bellows Attachment Ring	960	208473	590D0144	NK38-DCN-31120-0004-UX NK38-DCN-31120-0003-UX
Shielding Sleeve	960	207610	590A2622	NK38-DDN-31120-0009-U3,4
Retaining Ring- General				NK38-DAN-31120-0013-UX All Sheets
Retaining Ring-Shielding Sleeve	960	208847	590N7235	NK38-DCN-31120-0012-UX
Retaining Ring-Inboard Journal Ring	960	208848	590N7242	NK38-DCN-31120-0011-UX
Journal Ring- Outboard End	C	212542	591P1553	NK38-DCN-31150-0001-UX
Journal Ring- Outboard End (Oversize)	C	207776	590B0095	NK38-GEN-31100-0003 Sht 3 NK38-DCN-31150-0005-UX
Journal Ring- Inboard End	960	212543	591P1560	NK38-DCN-31150-0004-UX
Bearing Sleeve- Outboard End	960	212541	591P1546	NK38-DCN-31150-0002-UX
Bearing Sleeve- Inboard End	C	207526	590A1425	NK38-DCN-31150-0003-UX
			590C4386	NK38-DCN-31150-0006-U3,4
Bearing Sleeve- Inboard End- Item 1	C		590B2573	NK38-GEN-31100-0003 Sht 3
Bearing Sleeve- Inboard End- Item 2	C		590B2580	NK38-DEN-31150-0006-UX
Bearing Sleeve- Inboard End- Item 3	C	207843	590B2594	
Bearing Sleeve- Inboard End- Item 4	C		590B2601	

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
Bearing Sleeve- Inboard End- Item 5	C		590B2615	
Bearing Sleeve- Inboard End- Item 6	C		590B2622	
Bearing Sleeve- Inboard End- Item 7	C		590B2636	
Bearing Sleeve- Inboard End- Item 8	C		590C0046	
FUEL LINER LATCH ASSEMBLY				
Fuel Liner Latch Assembly- General				NK38-GEK-31100-0006-UX
Liner Latch Assembly	480	209657	591A7125	NK38-GEK-31190-0008
Liner Spacer Assembly	480	209658	591A7132	NK38-GEK-31190-0009
Liner Key	960	208665	590M8103	NK38-DBK-31190-0015
Liner Retaining Ring	960	208666	590M8110	NK38-DBK-31190-0016
FEEDER COUPLING				
Feeder Coupling- General				NK38-GDN-31170-0004 NK38-GDN-31170-0006
Cap Screw	3840	86420	421B5434	NK38-DBN-31170-0014-UX
Oversize Cap Screw	C	591338	255D9743	NK38-DBN-31170-0023-UX
Hub (2.5")	672	104704	523H2852 529N7043	NK38-DEN-31170-0001 NK38-DEN-31170-0007
Hub (2.0")	233	104705	523H2866 529N7036	NK38-DEN-31170-0001 NK38-DEN-31170-0007
Hub (1.5")	55	104706	523H2873 529N7022	NK38-DEN-31170-0001 NK38-DEN-31170-0007
Flange	960	212661	591P4353	NK38-DEN-31170-0003
Star Washer	3840	207679	590A6444	NK38-DCN-31170-0017-UX
Tab Washer	1920	207678	590A6430	NK38-DCN-31170-0019-UX
Thick Washer	3840	43904	253A7520	NK38-DBN-31170-0015-UX
Oversize Washer	C	637944		NK38-DBN-31170-0015-UX
Seal Ring	960	167110	565N7906	NK38-DCN-31170-0022-UX
		14233		NK38-DCN-31170-9001-U1,2
Oversize Seal Ring #0	C	632352	Ring#0	NK38-DRAW-31170-10001
Oversize Seal Ring #1	C	632356	Ring#1	
Oversize Seal Ring #2	C	632359	Ring#2	
Oversize Seal Ring #3	C	632361	Ring#3	
Oversize Seal Ring #4	C	632362	Ring#4	
Oversize Seal Ring #5	C	632363	Ring#5	
Oversize Seal Ring #6	C	632370	Ring#6	
Oversize Seal Ring #7	C	632380	Ring#7	

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
Oversize Seal Ring #8	C	632381	Ring#8	
Oversize Seal Ring #9	C	632382	Ring#9	
Oversize Seal Ring #10	C	632383	Ring#10	
FEEDER PIPE				
1.5" NPS		524559		NK38-DEN-33169-0001 to NK38-DEN-33169-0041 All Sheets
2" NPS		524565	510N3890-D	
2.5" NPS		524568	510N3904-D	NK38-GEN-33168-0016-001
3" NPS		524562		
3.5" NPS		524579		
FEEDER SUPPORTS ASSEMBLY				
Upper feeder Frame support assembly	8		590A1481	NK38-GEN-33168-0015-001
Upper feeder Frame assembly	8			
Upper feeder Hangers and Feeder clamps - Frame # 1 West	1			NK38-GEN-33168-0005-001
Upper feeder Hangers and Feeder clamps - Frame # 2 West	1			NK38-GEN-33168-0006-001
Upper feeder Hangers and Feeder clamps - Frame # 3 West	1			NK38-GEN-33168-0007-001
Upper feeder Hangers and Feeder clamps - Frame # 4 West	1			NK38-GEN-33168-0008-001
Upper feeder Hangers and Feeder clamps - Frame # 1 East	1			NK38-GEN-33168-0009-001
Upper feeder Hangers and Feeder clamps - Frame # 2 East	1			NK38-GEN-33168-0010-001
Upper feeder Hangers and Feeder clamps - Frame # 3 East	1			NK38-GEN-33168-0011-001
Upper feeder Hangers and Feeder clamps - Frame # 4 East	1			NK38-GEN-33168-0012-001
Lower feeders pipe supports				NK38-GEN-33168-0050 to NK38-GEN-33168-0079 All Sheets
Upper and Lower Feeder spacers			590A4505	NK38-GEN-33168-0022 through 0041;

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
FLOW ELEMENTS				
Pressure Breakdown Orifice- General				NK38-DCN-33160-0020-UX
Pressure Breakdown Orifice Type 1	4		608N1965	
Pressure Breakdown Orifice Type 2	10		608N1951	
Pressure Breakdown Orifice Type 3	6		608N1944	
Pressure Breakdown Orifice Type 4	8		608N1930	
Pressure Breakdown Orifice Type 5	8		608N1923	
Pressure Breakdown Orifice Type 6	4		608N1916	
Pressure Breakdown Orifice Type 7	6		608N1902	
Pressure Breakdown Orifice Type 8	4		608N1895	
Pressure Breakdown Orifice Type 9	4		608N1881	
Pressure Breakdown Orifice Type 10	4		608N1874	
Pressure Breakdown Orifice Type 11	8		608N1860	
Pressure Breakdown Orifice Type 12	10		608N1853	
Pressure Breakdown Orifice Type 13	6		608N1846	

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
Pressure Breakdown Orifice Type 14	8		608N1832	
Pressure Breakdown Orifice Type 15	2		608N1825	
Pressure Breakdown Orifice Type 16	8		608N1811	
Pressure Breakdown Orifice Type 17	6		608N1804	
Pressure Breakdown Orifice Type 18	2		608N1790	
Pressure Breakdown Orifice Type 19	4		608N1783	
Pressure Breakdown Orifice Type 20	2		608N1776	
Pressure Breakdown Orifice Type 21	2		608N1762	
Pressure Breakdown Orifice Type 22	10		608N1755	
Pressure Breakdown Orifice Type 23	2		608N1741	
Pressure Breakdown Orifice Type 24	2		608N1734	
RRS Nozzle Venturi (Inlet)	22	242108	611N8005	NK38-D1N-60444-9002-UX
RRS Nozzle Venturi (Inlet)	16	242111	611N8033	NK38-D1N-60444-9003-UX
RRS Nozzle Venturi (Inlet)	6	242107	611N7991	NK38-D1N-60444-9001-UX
RRS Venturi (Outlet)	2	242115	611N8103	NK38-D1N-60444-9004-UX
RRS Venturi (Outlet)	8	242109	611N8012	NK38-D1N-60444-9005-UX
RRS Venturi (Outlet)	2	242229	611E9762	NK38-D1N-60444-9008-UX
RRS Venturi (Outlet)	30	242110	611N8026	NK38-D1N-60444-9006-UX
RRS Venturi (Outlet)	2	239015	611E9776	NK38-D1N-60444-9009-UX
SDS 1 Flow Elements	12	242113	611N8082	NK38-D1N-60444-9007-UX
SDS 2 Flow Elements	12	242113	611N8082	
RRS RTD (inlet) item # 17	28	240379	611J8243	NK38-D2N-60442-9002-UX
RRS RTD (inlet) item # 18	24	240380	611J8250	
RRS RTD (inlet) item # 19	12	240381	611J8264	
RRS RTD (inlet) item # 20	16	240382	611J8271	
RRS RTD (inlet) item # 21	4	240383	611J8285	
RRS RTD (inlet) item # 22	4	240384	611J8292	
RRS RTD (outlet) item # 1A	32	240382	611J8271	
RRS RTD (outlet) item # 3A	20	240381	611J8264	
RRS RTD (outlet) item # 5A	8	240380	611J8250	
RRS RTD (outlet) item # 7A	24	240379	611J8243	
RRS RTD (outlet) item # 9A	4	240383	611J8285	
RTD #5A (Channel Temp Monitoring)	26	240379	611J8243	
RTD #6A (Channel Temp Monitoring)	172	240380	611J8250	
RTD #8A (Channel Temp Monitoring)	94	240382	611J8271	
RTD #9A (Channel Temp Monitoring)	188	240383	611J8285	

COMPONENT	PER UNIT	CAT IDs	STOCK CODE#	DRAWINGS
ECI Flow Elements	12	None	None	NK38-E3H-63432-0016
Tubing		99475 13200	517N3330	
RRS Guide tube assy (inlet) type 11A	28		611K8593	NK38-GEN-63106-0010-001
RRS Guide tube assy (inlet) type 12B	10		611K8600	
RRS Guide tube assy (inlet) type 12C	14		611K8600	
RRS Guide tube assy (inlet) type 13B	6		611K8614	
RRS Guide tube assy (inlet) type 13C	6		611K8614	
RRS Guide tube assy (inlet) type 14B	8		611K8621	
RRS Guide tube assy (inlet) type 14C	8		611K8621	
RRS Guide tube assy (inlet) type 15B	2		611K8635	
RRS Guide tube assy (inlet) type 15C	2		611K8635	
RRS Guide tube assy (inlet) type 16B	2		611K8642	
RRS Guide tube assy (inlet) type 16C	2		611K8642	
RRS Guide tube assy (outlet) type 1	14		611K8621	NK38-GEN-63106-0008-UX
RRS Guide tube assy (outlet) type 2	14		611K8621	
RRS Guide tube assy (outlet) type 10	4		611K8621	
RRS Guide tube assy (outlet) type 3	10		611K8614	
RRS Guide tube assy (outlet) type 4	10		611K8614	
RRS Guide tube assy (outlet) type 5	4		611K8600	
RRS Guide tube assy (outlet) type 6	4		611K8600	
RRS Guide tube assy (outlet) type 7	12		611K8593	
RRS Guide tube assy (outlet) type 8	12		611K8593	
RRS Guide tube assy (outlet) type 9	4		611K8635	
Thermowell Guide Tube assembly	26	239371	611G3735	NK38-DEN-63102-0003-001
	172	239372	611G3742	NK38-DDN-63102-0005-001
	94	239373	611G3763	NK38-DDN-63102-0007-001
	188	239374	611G3770	
Clamp assembly	260	None	392N5075	
	416	None	392N5082	
	204	None	392N5096	
	80	None	392N5103	
Retube Waste Containers				
Feeder weld wire				

Appendix B: Reactor Face Dose Rates

Note: The gamma dose rates are measured using telepads set at a distance of 4 to 6 inches from the end fittings.

Dose Rates in mrem/h

D721 East Reactor Face Surveys

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
A																									A
B																									B
C					74	73	76	76	84	73	76	75	78	77		90	89		98	100					C
D				64	82	58	76	62	51	61	67	78	83	89		90	88		118	68	92				D
E			86	67	67	88	62	78	62	68	60	59	68	67		76	98		104	89	79	83			E
F		68	71	71	76	56	58	54	50	73	71	82	82	78		86	113		76	85	102	80	61		F
G		77	62	85	64	62	62	62	51	51	53	79	79	85		104	88		93	88	87	88	69		G
H		62	76	54	54	50	62	60	46	63	56	62	83	76		77	107		86	57	101	93	61		H
J		64	59	78	56	60	61	52	62	56	64	70	86	69		83	90		91	77	94	82	56		J
K		70	80	61	61	52	52	51	49	63	67	78	76	73		82	88		95	66	99	76	74		K
L		51	62	50	48	57	69	51	66	50	53	63	82	77		81	92		77	76	64	100	61		L
M		73	50	53	64	51	75	49	66	58	59	75	65	71		83	76		98	57	65	78	72		M
N		61	67	54	56	44	60	56	51	58	51	78	60	70		105	94		104	71	88	76	64		N
O		55	54	50	65	56	38	56	42	51	65	74	76	62		86	60		93	72	71	94	83		O
P		62	60	52	64	44	43	51	44	45	51	66	69	67		74	106		96	79	85	64	56		P
Q		54	58	48	58	59	53	49	54	55	56	68	62	70		73	86		74	101	72	82	66		Q
R		51	50	54	54	48	52	54	54	70	65	65	64	70		78	83		101	76	95	76	72		R
S		48	45	47	60	48	41	48	61	48	56	83	62	81		88	96		86	81	67	75	75		S
T		57	55	45	46	55	55	43	54	50	62	56	62	76		101	87		90	81	79	104	68		T
U			47	43	58	51	48	43	45	50	48	75	61	75		98	93		79	75	67	76			U
V				53	44	49	50	42	62	63	59	69	71	70		86	84		83	84	91				V
W					53	46	42	50	51	49	56	82	82	65		90	80		84	68					W
X						54	41	54	50	65	62	72	75	68		75	83		98						X
Y								54	44	47	49	69	58	58		68	65								Y
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Dose Rates in mrem/h

D721 West Reactor Face Survey

	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A																									A
B																									B
C																									C
D				104	106			104	108	107	79		81	64	75	96	107	83	101	95	88				D
E			103	94	82			90	81	86	65		88	85	85	86	86	67	78	85	78	76			E
F		93	93	85	101			64	82	68	78		82	92	84	85	78	75	69	68	78	71	86		F
G		87	78	94	73			81	62	81	62		65	72	76	66	70	87	77	74	93	75	64		G
H		79	87	74	77			65	64	70	73		67	71	73	91	90	91	82	60	83	74	68		H
J	84	82	85	74	83			65	62	61	54		64	75	64	70	76	60	81	91	84	77	78	68	J
K	82	60	68	68	53			63	69	62	54		81	79	75	64	70	67	73	73	90	72	82	66	K
L	78	82	68	64	66			60	64	79	70		80	75	85	80	67	84	82	81	81	92	85	68	L
M	78	78	75	81	66			60	64	62	54		79	76	79	82	80	84	92	76	87	90	75	83	M
N	80	81	64	64	47			66	76	61	63		72	79	88	91	71	71	71	91	71	86	73	76	N
O	78	70	76	79	72			78	74	76	62		96	79	77	86	96	66	80	70	82	69	72	70	O
P	95	95	69	74	56			60	69	64	65		68	67	71	78	63	95	71	92	71	78	84	96	P
Q	91	68	83	62	60			65	55	74	71		90	85	84	82	81	75	69	64	74	90	85	85	Q
R		69	64	70	68			66	72	68	55		88	90	76	90	72	83	88	90	82	90	88		R
S		69	70	71	59			66	64	64	76		83	85	88	85	86	74	92	82	104	91	85		S
T		81	82	69	62			71	74	71	60		75	70	68	83	79	109	92	91	76	93	109		T
U			96	95	67			72	62	76	76		68	81	85	83	98	97	97	83	96	85			U
V				71	64			55	77	64	62		67	87	68	80	82	78	86	81	77				V
W					66			64	73	52	55		80	74	73	93	90	77	77	83					W
X								60	55	75	75		56	79	68	72	54	77	79						X
Y								47	45	54	40	54	76	53	50	56	54								Y
	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Dose Rates in mrem/h

D811 East Reactor Face Surveys

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
A								83	83	70	60	72	70	71	85	76	84								A
B						75	54	58	67	56	64	62	64	70	64	73	72	69	77						B
C					68	63	55	62	71	51	58	67	80	58	65	70	69	58	70	71					C
D				70	70	67	69	64	64	62	51	51	53	64	55	47	41	49	76	75	74				D
E			41	44	45	47	49	54	47	38	57	57	54	54	46	67	70	70	79	81	86	85			E
F		31	35	54	50	48	44	53	47	52	58	60	64	65	64	68	52	68	68	74	71	71	70		F
G		26	31	35	40	45	49	44	42	42	50	49	56	58	61	62	58	59	74	67	69	64	65		G
H		31	35	39	41	41	42	43	47	45	51	49	50	49	54	56	64	66	67	70	67	66	68		H
J	31	32	48	42	43	43	44	46	47	47	49	47	48	45	52	52	60	62	62	65	68	70	73	71	J
K	31	35	36	47	47	38	39	29	47	32	43	49	50	54	55	54	53	60	60	59	65	64	54	61	K
L	31	35	42	35	36	45	36	38	44	30	44	47	47	49	51	51	54	58	62	64	64	64	65	66	L
M	31	35	35	42	46	33	46	37	36	39	42	49	58	66	70	66	52	52	51	62	67	67	73	74	M
N	31	35	33	38	39	37	38	44	43	32	46	38	68	48	48	49	50	50	58	61	74	62	64	79	N
O	33	35	36	36	37	36	38	38	47	50	49	55	49	55	53	50	47	55	61	66	67	70	71	83	O
P	31	35	34	31	37	38	41	38	41	42	42	45	47	50	50	58	59	57	62	64	64	62	62	62	P
Q	31	30	30	31	35	35	36	28	47	47	45	46	47	50	51	62	56	51	50	54	55	60	62	68	Q
R		32	35	36	39	36	31	34	32	32	35	47	38	47	49	51	54	55	55	59	59	61	70		R
S		31	32	34	35	37	37	38	38	40	42	47	44	42	44	50	51	54	60	58	59	57	57		S
T		31	33	31	32	35	36	36	41	37	35	36	36	42	43	43	47	48	52	54	57	56	62		T
U			31	31	34	35	36	37	40	41	41	42	44	45	47	47	50	51	53	52	54	54			U
V				31	31	34	35	39	43	45	46	50	51	59	59	47	51	52	53	60	52				V
W					29	32	34	35	36	46	44	47	55	55	54	54	57	58	50	56					W
X						31	33	36	34	34	35	36	40	40	43	51	52	47	47						X
Y								30	35	33	35	40	42	39	44	51	46								Y
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Damp Scrape Channels
Adjacent Channels

Dose Rates in mrem/h

D811 West Reactor Face Surveys

	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A								77	82	84	93	52	67	68	73	64	58								A
B						75	78	68	82	81	95	73	75	79	52	62	65	69	62						B
C					89	85	69	78	85	78	75	60	59	53	61	58	58	53	59	62					C
D				87	59	65	68	78	62	59	62	55	50	52	64	47	47	60	55	58	54				D
E			87	69	70	63	65	75	58	60	58	51	44	53	47	62	56	49	53	52	51	60			E
F		70	61	62	58	60	50	50	47	53	64	53	55	48	56	48	56	51	52	52	49	52	42		F
G		61	62	70	66	57	56	50	45	41	44	56	43	44	41	46	45	54	59	67	45	53	56		G
H		56	52	56	45	41	43	48	49	55	52	49	50	45	62	43	46	62	53	64	62	43	58		H
J	60	54	62	62	58	55	44	45	47	45	36	50	51	41	42	48	57	46	45	65	49	57	58	68	J
K	51	53	56	49	35	51	38	46	35	40	45	41	42	49	47	52	57	43	60	56	48	47	48	59	K
L	62	53	53	45	53	46	45	38	54	51	47	62	42	46	46	48	47	56	50	65	50	58	48	49	L
M	68	79	62	54	47	45	43	44	36	54	51	43	48	56	47	43	48	50	56	48	58	50	45	48	M
N	71	61	50	41	54	40	43	44	43	42	44	42	39	40	41	40	53	51	44	43	39	50	51	46	N
O	78	64	44	45	43	46	40	40	40	42	44	44	44	43	47	32	38	42	59	47	43	48	36	48	O
P	71	45	43	56	47	51	46	48	49	47	39	39	51	33	46	42	42	52	56	45	43	41	41	51	P
Q	61	66	48	40	47	53	45	42	43	45	38	41	39	42	42	36	54	47	48	51	41	58	46	51	Q
R		47	51	50	45	49	51	34	40	42	35	51	44	48	47	49	42	46	53	53	38	49	57		R
S		51	47	56	47	45	46	42	39	40	47	42	41	38	51	52	51	54	49	61	44	43	42		S
T		49	49	45	42	40	42	36	39	38	46	44	35	41	45	60	70	64	60	62	43	42	52		T
U			42	36	36	39	46	48	44	39	55	37	61	41	67	54	57	62	62	58	51	51			U
V				50	48	41	44	40	44	42	32	51	43	50	40	37	58	62	44	51	62				V
W					37	38	37	33	51	53	44	43	46	40	37	50	51	53	46	46					W
X						38	39	32	47	49	35	42	36	40	43	54	44	60	47						X
Y								39	43	35	36	39	40	30	41	38	56								Y
	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Dose Rates in mrem/h

D931 East Reactor Face Survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
A																									A
B																									B
C					84	98	98	95	62	107	77	70	83	88	70	88	92	90	78	96					C
D				100	86	68	75	64	68	54	77	84	75	58	97	66	75	75	62	78	86				D
E			77	86	74	81	75	66	51	76	51	56	61	53	54	62	49	82	62	68	71	94			E
F		83	104	72	78	66	58	50	58	48	72	70	68	58	60	61	69	62	79	85	85	82	79		F
G		74	51	85	47	63	58	54	54	65	56	52	49	72	64	66	43	54	57	66	68	71	70		G
H		54	50	60	56	46	49	51	53	54	61	63	64	68	66	68	92	64	75	64	64	72	72		H
J	94	60	45	62	54	54	51	48	46	54	51	51	50	63	61	64	52	82	62	66	54	104	55	86	J
K	100	55	64	45	50	52	52	51	64	46	54	54	53	51	71	49	60	60	63	50	70	59	55	71	K
L	59	52	52	57	51	53	45	38	44	51	66	60	54	65	62	53	58	64	43	56	58	68	52	73	L
M	81	66	58	43	51	45	50	54	47	43	61	60	58	41	62	52	59	45	54	63	73	47	79	71	M
N	73	68	44	46	42	45	48	50	45	49	53	58	62	55	62	73	48	72	68	68	56	69	43	65	N
O	73	60	51	51	46	39	41	43	39	46	51	56	60	53	66	54	98	68	52	72	62	44	60	61	O
P	58	59	50	47	42	44	48	51	51	47	40	47	53	76	62	61	60	78	54	65	60	70	53	74	P
Q	72	68	75	42	49	52	48	43	44	52	50	50	50	47	58	51	55	51	64	58	76	61	64	71	Q
R		51	51	64	56	46	45	43	48	50	51	48	45	53	54	59	51	73	64	83	59	70	60		R
S		65	60	64	52	46	45	43	38	47	46	51	56	47	65	64	64	55	62	58	78	73	93		S
T		64	54	57	42	49	49	48	42	43	41	47	52	53	36	58	54	68	56	66	53	70	70		T
U			54	58	64	44	42	39	42	39	53	58	62	53	61	51	74	50	76	51	92	64			U
V				51	52	65	56	46	44	43	45	48	50	78	43	76	56	90	54	72	62				V
W					53	58	56	53	47	51	59	69	78	66	63	68	78	43	56	44					W
X						50	47	43	36	37	52	51	49	77	52	70	45	62	52						X
Y								42	31	39	42	46	51	48	46	55	63								Y
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

East Face Average Dose Rate = 84 mrem/h

Dose Rates in mrem/h

D931 West Reactor Face Survey

	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A																									A
B																									B
C					101	112	111	85	96	94	81	81	81	98	68	91	76	83	89	98					C
D				100	101	64	84	71	79	69	66	80	94	79	72	75	78	86	93	82	67				D
E			108	98	87	86	64	90	64	69	61	65	68	86	56	68	64	70	76	81	100	73			E
F		92	100	72	90	64	80	51	54	67	78	80	81	50	82	66	77	78	78	68	66	64	84		F
G		104	62	85	58	66	69	64	56	69	48	60	72	64	60	80	67	74	80	87	64	86	64		G
H		76	70	73	52	58	64	53	48	54	69	65	61	62	64	64	56	65	73	71	74	70	72		H
J	105	69	76	78	71	58	47	42	49	61	48	52	56	67	50	60	58	55	52	68	81	85	73	84	J
K	115	78	67	50	52	52	57	44	52	44	54	54	54	64	67	54	62	63	63	57	87	62	86	70	K
L	84	101	64	72	42	65	49	63	48	51	50	51	51	61	59	74	70	71	72	72	65	62	71	92	L
M	82	72	59	57	50	54	50	52	53	54	69	65	62	85	48	62	54	60	66	67	65	67	60	70	M
N	98	78	73	53	51	56	62	47	54	61	53	57	60	60	72	62	53	64	74	66	62	61	62	90	N
O	82	60	50	67	64	58	52	53	49	54	49	54	59	60	54	59	58	72	86	66	66	60	64	62	O
P	83	70	60	71	50	59	47	52	51	58	52	57	62	66	55	59	74	63	52	70	69	76	62	90	P
Q	105	62	65	55	51	51	51	46	43	47	56	55	54	48	53	49	64	58	51	83	65	77	65	90	Q
R		67	60	66	58	51	57	53	46	51	59	54	48	72	66	70	58	62	65	76	60	65	65		R
S		66	65	67	48	44	44	56	62	49	51	52	54	55	68	54	62	68	74	54	60	50	72		S
T		61	55	76	51	54	54	46	56	54	52	53	54	55	42	58	57	55	52	64	58	56	83		T
U			66	57	46	44	64	53	56	49	52	60	69	81	66	51	66	55	44	51	62	64			U
V				64	58	51	62	46	53	51	46	54	62	65	58	73	64	61	58	50	64				V
W					70	54	62	50	58	56	57	59	60	46	75	51	58	57	56	51					W
X						63	56	48	54	44	48	47	46	50	51	42	52	50	48						X
Y								45	64	71	56	60	64	46	52	54	71								Y
	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

ARM 13 & 7 not working # represents an average of surrounding channels

West Face Average Dose Rate = 91 mrem/h

Dose Rates in mrem/h

D1041 East Reactor Face Surveys

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
A								91	100	107	79	112	77	82	94	120	96								A
B						108	97	95	83	84	79	92	104	66	87	78	97	100	116						B
C					80	91	68	87	78	84	85	106	85	75	81	73	77	87	77	80					C
D				82	93	69	59	78	67	90	81	72	77	80	78	67	88	86	76	74	78				D
E			76	90	66	74	78	64	46	59	72	79	87	69	82	58	72	73	66	63	80	76			E
F		68	64	75	64	70	58	68	53	67	79	61	64	70	88	75	68	65	84	50	74	62	77		F
G		61	67	66	76	88	52	62	45	65	54	71	72	76	72	81	56	91	86	86	64	67	61		G
H		75	66	51	54	58	53	83	67	38	69	68	65	64	76	64	71	77	82	73	87	67	76		H
J	77	52	42	64	61	62	58	52	50	54	64	53	64	69	66	86	77	91	77	66	64	81	62	84	J
K	78	65	63	51	59	54	50	68	64	50	64	70	61	55	71	58	62	74	77	70	86	61	62	72	K
L	58	49	54	60	47	72	47	64	66	52	61	69	60	67	66	74	72	74	58	66	62	64	70	68	L
M	59	60	54	57	58	44	45	54	51	52	58	83	87	60	72	55	76	56	68	86	74	74	65	74	M
N	54	67	55	60	50	62	40	56	52	69	61	82	65	68	76	79	71	75	64	86	62	71	58	66	N
O	68	61	52	57	50	64	47	52	51	55	51	74	70	44	82	68	82	62	77	67	68	65	85	66	O
P	54	57	56	51	42	49	50	64	64	51	44	64	71	72	79	76	66	77	64	91	73	65	70	60	P
Q	71	73	66	47	54	56	45	53	54	39	51	51	66	52	83	62	94	69	79	64	71	56	67	65	Q
R		65	47	55	56	57	56	54	50	46	55	59	69	65	56	81	67	72	71	85	67	69	66		R
S		64	50	40	60	46	42	46	50	59	57	58	86	45	88	64	67	68	70	68	78	52	70		S
T		64	42	51	49	62	42	47	46	47	43	62	63	48	59	81	51	53	79	70	55	62	59		T
U			55	43	41	57	40	46	40	44	53	56	66	48	70	60	64	62	59	52	76	68			U
V				51	48	51	42	45	47	43	49	61	56	69	61	84	61	77	59	70	72				V
W					54	47	51	49	43	48	51	78	67	56	81	66	60	62	67	59					W
X						49	44	42	39	43	45	65	61	52	64	69	56	59	46						X
Y								35	47	42	44	53	51	43	55	61	64								Y
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Dose Rates in mrem/h

D1041 West Reactor Face Surveys

	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A																									A
B																									B
C					101	94	88	86	90	104	100	77	98	80	68	80	86		84	86					C
D				120	110	90	104	90	112	76	79	80	90	68	80	75	86		91	104	97				D
E			112	100	87	93	87	64	83	69	65	68	88	93	75	89	83		77	105	83	85			E
F		114	100	93	87	100	81	67	79	79	66	78	85	82	80	80	68		82	95	85	88	85		F
G		104	105	107	71	70	87	54	62	71	67	82	92	74	90	85	81		69	90	100	90	78		G
H		60	100	87	85	75	66	60	66	52	79	66	81	81	84	83	98		88	91	104	76	78		H
J	100	70	86	78	56	83	49	60	56	73	70	67	70	71	64	88	76		69	93	71	97	87	95	J
K	98	64	79	78	66	58	55	45	65	58	75	68	83	86	80	70	98		78	88	87	75	102	74	K
L	76	70	75	68	67	66	37	53	68	68	68	87	66	81	76	81	62		61	93	80	104	76	104	L
M	96	87	81	70	71	71	75	54	75	68	61	71	98	90	79	72	83		100	93	88	85	62	97	M
N	90	90	62	71	65	50	66	60	63	67	88	70	84	83	88	83	98		95	112	83	88	104	104	N
O	88	73	65	67	64	64	64	64	62	62	82	61	83	101	83	96	106		93	88	95	100	90	89	O
P	108	87	81	75	58	51	49	64	70	62	72	75	74	101	78	88	64		75	87	73	104	96	111	P
Q	93	74	83	73	54	74	62	61	71	68	55	64	96	81	100	83	112		88	60	85	83	83	93	Q
R		79	79	92	67	64	86	58	55	62	55	78	76	96	88	101	90		91	95	90	100	95		R
S		80	67	64	62	64	51	61	64	73	67	67	95	83	93	98	106		96	91	95	84	83		S
T		87	83	67	71	75	77	69	60	69	79	81	82	82	93	95	96		76	74	82	101	91		T
U			81	85	76	57	74	62	69	56	70	74	85	71	92	90	104		92	85	83	63			U
V				91	78	75	68	73	74	65	64	92	90	104	85	101	90		78	93	104				V
W					71	75	88	56	65	69	87	69	90	79	105	70	90		102	88					W
X						56	64	64	75	64	60	96	65	68	85	90	68		64						X
Y								46	62	56	54	63	81	69	64	72	70								Y
	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Appendix C: Feeder Cabinet/Feeder Piping Dose Rates

Data will be included later in form of attachment as the size of the file is large

Appendix D: SDS2 Room 113 Bunker Dose Rates History

Measurement Location	Survey Location (distance from source) All Dose Rates are in mrem/h	Unit 1 (April 2008)	Unit 2 (September 2007)	Unit 3 (April 2006 and Oct 2004)	Unit 4 (October 2005)
LI 1	Contact	30,000	50,000	15,000	7,000
	30 cm (Working Distance)	1,000	750	No Survey	800
	General	No Survey	190	No Survey	90
LI 2	Contact	17,000	50,000	5,000	6,100
	30 cm (Working Distance)	1,000	1,100	1,200	100
	General	No Survey	250	No Survey	90
LI 3	Contact	24,000	52,000	7,000	10,000
	30 cm (Working Distance)	1,000	2,500	No Survey	800
	General	No Survey	120	No Survey	100
LI 4	Contact	24,000	4,600	No Survey	4,500
	30 cm (Working Distance)	1,000	1,800	No Survey	800
	General	No Survey	250	No Survey	210
LI 5	Contact	24,000	4,500	No Survey	7,500
	30 cm (Working Distance)	1,000	2,500	No Survey	720
	General	No Survey	650	No Survey	220
LI 6	Contact	21,000	50,000	25,000	10,000
	30 cm (Working Distance)	925	600	640	650
	General	No Survey	350	No Survey	90
LI 7	Contact	20,000	35,000	30,000	1,800
	30 cm (Working Distance)	1,000	3,000	1,600	280
	General	No Survey	495	No Survey	110
LI 8	Contact	28,000	70,000	30,000	9,500
	30 cm (Working Distance)	100	2,000	1,100	800
	General	No Survey	450	No Survey	100
HFD 1	Contact	8,000	27,000	300	280
	30 cm (Working Distance)	800	235	200	150
	General	45	135	120	50
HFD 2	Contact	7,000	22,000	320	300
	30 cm (Working Distance)	700	300	190	230
	General	150	150	100	60
HFD 3	Contact	8,500	29,000	330	280
	30 cm (Working Distance)	625	235	180	210
	General	850	125	90	40
HFD 4	Contact	3,500	16,000	300	700
	30 cm (Working Distance)	500	425	250	220
	General	235	275	100	160
HFD 5	Contact	7,000	31,000	350	850
	30 cm (Working Distance)	700	550	280	380
	General	150	270	130	160

Measurement Location	Survey Location (distance from source) All Dose Rates are in mrem/h	Unit 1 (April 2008)	Unit 2 (September 2007)	Unit 3 (April 2006 and Oct 2004)	Unit 4 (October 2005)
HFD 6	Contact	3,000	21,000	400	420
	30 cm (Working Distance)	400	480	300	130
	General	250	350	150	100
HFD 7	Contact	7,500	25,000	500	400
	30 cm (Working Distance)	750	350	300	280
	General	340	250	300	120
HFD 8	Contact	8,000	25,000	No Survey	600
	30 cm (Working Distance)	800	365	700	280
	General	225	228	No Survey	120
HFD 9	Contact	10,500	35,000	330	300
	30 cm (Working Distance)	700	535	250	190
	General	425	300	200	90
HFD 10	Contact	9,000	25,000	450	250
	30 cm (Working Distance)	700	575	350	140
	General	100	325	300	110
HFD 11	Contact	8,500	30,000	280	180
	30 cm (Working Distance)	1,150	470	380	150
	General	330	330	210	210
HFD 12	Contact	11,000	26,000	300	140
	30 cm (Working Distance)	1,000	425	300	90
	General	425	355	230	80
HFD 13	Contact	9,000	30,000	370	300
	30 cm (Working Distance)	750	650	350	120
	General	450	350	300	80
HFD 14	Contact	13,000	36,000	280	260
	30 cm (Working Distance)	800	500	520	180
	General	450	370	400	95
IC 1	Contact	No Survey	400	No Survey	500
	30 cm (Working Distance)	No Survey	1,200	300	190
	General	No Survey	460	No Survey	220
IC 2	Contact	No Survey	295	No Survey	No Survey
	30 cm (Working Distance)	No Survey	800	250	No Survey
	General	No Survey	350	No Survey	No Survey
IC 3	Contact	No Survey	435	No Survey	150
	30 cm (Working Distance)	No Survey	575	160	130
	General	No Survey	500	No Survey	150

Appendix E: OPG Governing Documents

DOMAIN	PROGRAM		OPG PROCEDURE	
Work Management	N-PROG-MA-0019	Production Work Management	N-PROC-MA-0008	Work Initiation, Approval and Prioritization
			N-PROC-MA-0002	Work Planning
			N-PROC-MA-0006	Work Performance
			N-PROC-MA-0013	Planned Outage Management
			N-PROC-MA-0003	Equipment Groups
			N-PROC-MA-0046	Performing welding and related activities Non Destructive Examination
			N-PROC-MA-0018	Foreign material exclusion
Work Protection	N-PROG-MA-0015	Work Protection program	N-STD-MA-001	Work Protection
			N-PROC-MA-0011	Maintenance Authority Roles and Responsibilities
			N-PROC-MA-0012	Work Protection
			N-PROC-MA-0041	Work Protection Coordination
			N-PROC-MA-0039	Approved Isolation Procedures
			N-PROC-MA-0040	Issuance of Personal Protection Tag Out tags
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			N-PROC-TR-0002	Control of Vendor training
			N-PROC-TR-0003	Training exemption, equivalency or hard credit
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			N-PROC-TR-0021	Training and Qualification approval process
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			N-PROC-RA-0010	Facility access and working rights
			N-PROC-RA-0019	Dose Limits and Exposure Control
			N-STD-RA-0018	Controlling exposure ALARA
			N-PROC-RA-0024	Hazard surveys, posting, and radiological log
			N-PROC-RA-0027	Radiological Work planning and execution
			N-PROC-RA-0011	RPC, Access controller and protection assistant
			N-PROC-RA-0025	Selection of Radiation PPE
			N-PROC-MA-0025	Conduct of radiography
Radiation Protection	N-PROG-RA-0013	Contamination Control	N-PROC-RA-0015	Contamination control
			N-PROC-RA-0017	Segregation and handling of Radioactive waste
			N-PROC-RA-0014	Radiological zoning, personnel/material transfer
			N-PROC-RA-0054	Control of space allocation for transient material
Radiation Protection	N-PROG-RA-0013	Dosimetry	N-PROC-RA-0012	Dosimetry and Dose reporting
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			N-PROC-MM-0004	Item putaway and distribution
			N-PROC-MM-0006	Receive items
			N-PROC-MM-0007	Pick, stage and issue items
			N-PROC-MM-0008	Create and maintain catalog information
			N-PROC-MM-0011	Replenishment of material
			N-PROC-MM-0012	Material request
			N-PROC-MM-0018	PO Maintenance
			N-PROC-MM-0019	Expedite Delivery
			N-PROC-MM-0020	Procurement Inquiry
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			N-PROC-MM-0023	Items Non-conformance
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			N-PROC-MM-0034	Planned warehouse item inspection
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			N-PROC-MP-0077	Equipment Data Maintenance
			N-PROC-MP-0098	Procurement Engineering Activities
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	0004		N-PROC-OP-0013	Control of system chemistry
			N-PROC-OP-0014	Chemistry Measurement and Analysis
			N-PROC-OP-0017	Laboratory Work and Data Management
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			N-STD-RA-0038	Requirements for Fire safety assessments
			N-STD-MA-0008	Station Material Condition Housekeeping
			N-STD-RA-0022	Fire Protection associated with H2, D2, and H3 gas.
			N-PROC-RA-0057	Control of Ignition sources
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			N-STD-RA-0040	Requirements for the inspection, testing , maintenance of fire protection equipment
			N-INS-78000-10000	Inspection of fire barriers
			N-STD-RA-0026	Fire protection surveillance availability compensatory measures
			N-STD-RA-0008	Incident investigation
			N-INS-09076-10003	Fire prevention, protection, evacuation and assembly
			N-INS-09076-10006	Development and maintenance of fire safety plans
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			N-INS-08965-10028	Heat and Cold stress in the workplace
			N-INS-08965-10020	Confined spaces
			N-INS-08965-10035	Falling objects prevention
			N-INS-08965-10041	Noise Control program
			N-INS-08965-10039	Control of biological hazards
			N-INS-08965-10004	Lead Work activities and storage areas in Nuclear facilities
			N-INS-08965-10021	Electrical Safety
			N-INS-08965-10013	Warning signs and barricades
			N-INS-07080-10000	Hazardous materials controls
			N-INS-07080-10002	Labelling, storage, use and disposal of hazardous materials
			N-INS-07080-10001	Request and approval of new hazardous materials
			N-INS-08965-10003	Musculoskeletal disorder management
			N-INS-08965-10012	Requirements for conventional respiratory protection
			N-INS-08965-10001	Working at Heights
			N-INS-08965-10029	Conventional Protection Instrumentation
			N-INS-08965-10027	Steam suits
			N-INS-08965-10014	Job Safety Analysis process
			N-STD-MA-0018	Hoisting and Rigging
			N-INS-09180-10012	Inspection and maintenance requirements for rigging and hoisting equipment
			N-STD-HR-0046,	PPE For Conventional Safety Hazards
Conventional Safety	N-PROG-HR-0004	Personnel Hazard - Conventional Safety	N-INS-08176-10002	Receipt, issue, inspection for Fall protection equipment
			N-PROC-OP-0005	Pre-job briefing and post job briefing
			N-INS-01983.2-10008	Concrete Drilling and Chipping
			N-STD-MA-0006	Scaffolds and temporary Work structures
			N-STD-MA-0009	Temporary Grounding Bonding And Drains
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			N-PROC-MP-0090	Modification Processes
			N-PROC-MP-0009	Installation of Permanent Modification
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			N-PROC-MP-0011	Close-out of Permanent Modification
			N-PROC-MP-0047	Design Verification
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			N-PROC-MP-0083	Constructability, Operability, Maintainability, and Safety
			N-PROC-MP-0093	Engineering Work Management
			N-PROC-AS-0069	Field Engineering Installation Quality Processes
			N-INS-00960-10000	Detailed Commissioning Specifications and Reports

			N-INS-00700-10005 N-STD-MP-0009	Field Change Design Agency Control
Change Control	N-PROG-OP-0003 N-PROG-MP-0005	Plant Status Control Configuration management	N-PROC-OP-0027 N-PROC-MP-0098 N-FORM-11239	Temporary Change Records Procurement Engineering Activities NICR Justification
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Others	NK38-OPP-03600 N-PROG-RA-0001	Operations	Operating Policies and Principles Consolidated Nuclear Emergency Plan	

Appendix F: Document List

Document Number	Document Title
	CALANDRIA
NK38-DEN-31210-0001-U1234	Calandria Shell Front Elevation and Plan View
NK38-DEN-31210-0004-U1234	Calandria Shell Nozzle and Bracket Details
NK38-DEN-31210-0005-U1234 Sht 1	Calandria-End Shield Assy Calandria Shell Moderator Inlet Nozzle Deflector
NK38-DEN-31210-0005-U1234 Sht 2	Moderator Inlet Nozzle Deflector Details
NK38-DEN-31220-0001-U1234	Calandria-End Shields Gen Arrgt Fuelling Machine Side-tube Sht Face 480 Channels
NK38-DEN-31220-0003-U1234	Calandria End Shield Tapped Holes Orientation F/channel Positioning Assy
NK38-DDN-31822-0003-U1234	Reactivity Control Units Liquid Injection Shutdown Unit Injection Tube
NK38-DEN-31821-0001-U1234	Reactivity Control Units Liquid Injection Shutdown Unit Injection Nozzle
NK38-DEN-31220-0002-U1234	Calandria End Shields: Partial Section through End Shield
NK38-DEN-31220-0012-U1234	Calandria End Shields: Lattice Tube Detail
NK38-DM-31000-1	Calandria and Shield Tank Assembly Design Manual
NK38-FEN-34710-0001-U1234	Liquid Injection Shutdown System Flow Sheet
NK38-FEN-34810-0001-U1234 Sht 1	Liquid Zone Control Circuit Flowsheet
NK38-FEN-34810-0001 Sht 2	Liquid Zone Control Circuit Flowsheet
NK38-FEX-31700-1501	Reactivity Mechanisms General Arrangement
NK38-FEX-31770-1501	Reactivity Mechanisms Control Absorbers Assembly
NK38-FEX-32110-1501	Main Moderator System
NK38-FEX-34110-1501	End Shield and Shield Tank Cooling System
NK38-FXX-31780-1501	Reactivity Mechanisms Control Adjuster Assemblies
NK38-FXX-34710-1501	Liquid Injection Shutdown System
NK38-GDN-31230-0003-U1234	Calandria End Shields Calandria Tube Rolled Joint Assembly
NK38-GEN-31270-0003 Sht 1	Reactor Calandria End Shields And Shield Tank General Arrangement
NK38-GEN-31270-0003 Sht 2	Reactor Calandria End Shields And Shield Tank General Arrangement
NK38-GEN-31270-0003 Sht 3	Reactor Calandria End Shields And Shield Tank General Arrangement
NK38-GEN-31001-0001-U1234	Assembly of Calandria Shell and End Shields with Shield Tank
NK38-GEN-31820-0001	Reactivity Control Units Liquid Injection Shutdown Unit General Arrangement Li-2 And Li-7
NK38-GEN-31820-0002	Reactivity Control Units Liquid Infection Shut Down Unit Gen. Arrgt Li-1 Li-3 Li-6 Li-8
NK38-GEN-31820-0003	Reactivity Control Units Liquid Injection Shut Down Unit Gen Arrangement Li-4 & Li-5
NK38-GEN-31820-0005-U1234	Reactivity Control Units Liquid Injection Shut-down Unit Classification Information
FUEL CHANNELS	
NK38-DM-35200	Fuel Changing System: CGE
DR-38-34880	Annulus Gas System
NK38-DAN-31120-0013-U1234 Sht 1	Fuel Channel Assemblies Retaining Rings Spec
NK38-DAN-31120-0013-U1234 Sht 2	Fuel Channel Assemblies Retaining Rings Specs
NK38-DBK-31140-0004	Fuel Channel Assembly: Channel Closure Spring Detail

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NK38-DBK-31140-0005	Fuel Channel Assembly: Channel Closure Sealing Disc- Nickel Plating
NK38-DBK-31140-0006	Fuel Channel Assembly: Channel Closure Locking Plunger Detail
NK38-DBK-31140-0007	Fuel Channel Assembly: Channel Closure Operating Plunger Detail
NK38-DBK-31140-0008	Fuel Channel Assembly: Channel Closure Tab Washer Detail
NK38-DBK-31140-0010	Fuel Channel Assembly: Channel Closure Spring Detail
NK38-DBK-31140-0011	Fuel Channel Assembly: Channel Closure Sealing Disc- Machined Forging
NK38-DBK-31190-0015	Fuel Channel Assy End Fitting Liner Key
NK38-DBK-31190-0016	Fuel Channel Assy End Fitting Liner Retaining Ring
NK38-DBN-31170-0014-U1234	Fuel Channel Assemblies Feeder Coupling Screw Detail
NK38-DBN-31170-0015	Fuel Channel Assemblies: Feeder Connections Washer Special
NK38-DBN-31170-0023-U1234	Fuel Channel Assemblies Feeder Coupling Screw Oversize Replacement
NK38-DBN-31180-9003-U1234	Flange
NK38-DBN-31180-9004-U1234	Ferrule
NK38-DBN-31180-9006-U1234	Oversize Ferrule
NK38-DCK-31130-0005	Fuel Channel Assembly: Shield Plug Lock Spring Detail
NK38-DCK-31140-0002	Fuel Channel Assembly: Channel Closure Sealing Disc Detail
NK38-DCK-31140-0003	Fuel Channel Assembly: Channel Closure Load Bar Detail
NK38-DCN-31120-0003-U1234	End Fitting: Bellows Attachment Ring
NK38-DCN-31120-0004-U1234	SFCR End Fitting: Bellows Attachment Ring
NK38-DCN-31120-0011-U1234	End Fitting Inboard Journal Ring- Retaining
NK38-DCN-31120-0012-U1234	End Fitting Shielding Sleeve Ring- Retaining
NK38-DCN-31124-0008-U1234	Fuel Channel Assemblies Quick Lock Positioning Assy Nut Lock
NK38-DCN-31124-0014-U1234	Fuel Channel Assemblies Quick Lock Positioning Assy General Notes
NK38-DCN-31124-0021-U1234	Quick Lock Positioning Assembly Spacer Clip
NK38-DCN-31124-0022-U1234	Quick Lock Positioning Assembly Spacer Clip Retainer
NK38-DCN-31150-0001-U1234	Fuel Channel Assembly: End Fitting Journal Ring- Outboard End
NK38-DCN-31150-0002-U1234	End Fitting Bearing Sleeve Outboard End
NK38-DCN-31150-0003-U1234	End Fitting Bearing Sleeve Inboard End (Split)
NK38-DCN-31150-0004-U1234	End Fitting Journal Ring Inboard End
NK38-DCN-31150-0005-U1234	Fuel Channel Assembly: End Fitting Journal Ring- Outboard End (Oversize)
NK38-DCN-31150-0006-U34	Fuel Channel Assembly End Fitting Bearing Sleeve Inboard End (split)
NK38-DCN-31170-0017-U1234	Fuel Channel Assemblies: Feeder Connections Star Washer
NK38-DCN-31170-0019	Fuel Channel Assemblies: Feeder Connections Tab Washer
NK38-DCN-31170-0022-U34	Fuel Channel Assemblies Feeder Coupling Seal Ring (uncoated)
NK38-DD-31130	Fuel Channel Assembly Internal End Fitting Components
NK38-DDK-31140-0009	Fuel Channel Assembly: Channel Closure Body Detail
NK38-DDN-31110-0001-U1234	Pressure Tube Detail (as Drawn and Honed)- Zr 2.5% Wt Nb
NK38-DDN-31110-0002-U1234	Pressure Tube Detail (Stress Relieved Condition)- Zr 2.5% Wt Nb
NK38-DDN-31120-0002-U1234	Fuel Channel End Fitting Finished Machine Body General Notes

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NK38-DDN-31120-0008-U1234	Fuel Channel Assemblies: End Fitting Forging Blank- Dimensions for Tendering
NK38-DDN-31120-0009-U34	Fuel Channel Assemblies: End Fitting Shielding Sleeve
NK38-DDN-31124-0006-U1234	Fuel Channel Assemblies: Quick Lock Positioning Assembly- Stud
NK38-DDN-31124-0009-U1234	Fuel Channel Assemblies- Quick Lock Positioning Assembly- Nut Detail
NK38-DDN-31124-0010-U1234	Fuel Channel Assemblies Quick Lock Positioning Assy Stud Lock Dtl
NK38-DDN-31124-0011-U1234	Fuel Channel Assemblies Quick Lock Positioning Assy Spring Dtl
NK38-DDN-31160-0004-U1234	Fuel Channel Pressure Tube to Calandria Tube Annulus Spacer Detail (Inconel X-750)
NK38-DDN-31230-0002-U1234	Calandria & End Shields Calandria Tube Assy Insert Detail
NK38-DEK-31130-0001	Fuel Channel Assembly: Outlet Shield Plug Body Detail
NK38-DEK-31130-0002	Fuel Channel Assembly: Inlet Shield Plug Body Detail
NK38-DEN-31100-0004	Fuel Channel Assembly Showing Pressure Boundary
NK38-DEN-31124-0007-U1234	Fuel Channel Assemblies: Quick Lock Positioning Assembly- Yoke Detail
NK38-DEN-31150-0006-U1234	Fuel Channel Assembly- End Fitting- Bearing Sleeve- Inboard (Special Sizes)
NK38-DEN-31160-0003-U1234	Fuel Channel Assemblies: Pressure Tube to Calandria Tube Spacer- Detail
NK38-DEN-31170-0001	Fuel Channel Assemblies: Feeder Coupling- Hub Details
NK38-DEN-31170-0003-U1234	Fuel Channel Assemblies: Feeder Connections Flange (2.15THK) Detail
NK38-DEN-31170-0007-U34	Fuel Channel Assemblies: Feeder Connections Hub Details
NK38-DEN-31180-0001-U1234	Fuel Channel Assembly: Annulus Channel Bellows Detail
Nk38-DEN-31230-0001-U1234	Calandria-End Shields Calandria Tube Detail
NK38-DEN-34880-0005-U1234	Annulus Gas System: Connecting Tubing Details- Reactor Face Sheet 1
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NK38-DFN-31120-0002 Sht 1	Fuel Channel End Fitting: Finished Machine Body Details- Sheet 1
NK38-DFN-31120-0002 Sht 2	Fuel Channel End Fitting: Finished Machine Body Details- Sheet 2
NK38-DFN-31120-0002 Sht 3	Fuel Channel End Fitting: Finished Machine Body Details- Sheet 3
NK38-DM-31100-1	Fuel Channel Assemblies
NK38-DR-31130-10001	Low Flow Restricting Outlet Shield Plug
NK38-DR-33100-10001	Primary Heat Transport System
NK38-DRAW-31130-10001	F/C Assembly Flow Restricting Outlet Shield Plug Flow Hole Plug Assembly
NK38-DRAW-31130-10002	F/C Assembly Flow Restricting Outlet Shield Plug Flow Hole Plug
NK38-FEX-34880-1501	Annulus Gas System
NK38-FEX-34880-1502	Annulus Gas System- Annuli String Configuration
NK38-FXX-31100-1501	Fuel Channel Flow Direction Diagram
NK38-GDK-31130-0003 Sht G	Fuel Channel Assembly: Outlet Shield Plug Assembly
NK38-GDK-31130-0004 Sht G	Fuel Channel Assembly: Inlet Shield Plug Assembly
NK38-GDK-31140-0001 Sht G	Fuel Channel Assembly Channel Closure Assembly
NK38-GDN-31124-0013-U1234	Fuel Channel Assemblies Quick Lock Positioning Assy Nut Sub-assy
NK38-GDN-31170-0004 Sht 1	Fuel Channel Assemblies: Feeder Connections Assembly
NK38-GDN-31170-0006-U34	Fuel Channel Assemblies Feeder Connections Assembly
NK38-GEK-31100-0006 Sht G001	Fuel Channel Assembly Internal End Fitting Components Assembly

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NK38-GEK-31100-0009 Sht 1	Fuel Channel Assembly - Internal End Fitting Components - Control Dimensions
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NK38-GEK-31100-0009 Sht 3	Fuel Channel Assembly - Internal End Fitting Components - Control Dimensions
NK38-GEK-31100-0009 Sht 4	Fuel Channel Assembly - Internal End Fitting Components - Control Dimensions
NK38-GEK-31130-0012	Modified Inlet Shield Plug Flow Straightener (MK III C): Detail and Assembly
NK38-GEK-31190-0008	Fuel Channel Assy End Fitting Liner Latch Assy
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NK38-GEK-31922-9002	Inlet/Outlet Shield Plug Lock Spring Assembly Tool
NK38-GEN-31100-0003 Sht 0001	Fuel Channel Assemblies: Major Channel Installation Requirements
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NK38-GEN-31100-0003 Sht 003	Fuel Channel Assemblies: Major Channel Installation Requirements
NK38-GEN-31100-0003 Sht 0A01	Fuel Channel Assemblies: Major Channel Installation Requirements
NK38-GEN-31100-0003 Sht 0B01	Fuel Channel Assemblies: Major Channel Installation Requirements
NK38-GEN-31100-0003 Sht 0C01	Fuel Channel Assemblies: Major Channel Installation Requirements
NK38-GEN-31100-0003 Sht 0D01	Fuel Channel Assemblies: Major Channel Installation Requirements
NK38-GEN-31100-0016 Sht A01	Fuel Channel Assemblies Major Assembly - SFCR Installation Requirements
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NK38-GEN-31120-0001-U1234	End Fitting Assembly
NK38-GEN-31120-0005-U1234	SFCR End Fitting Assembly
NK38-GEN-31124-0005-U1234	Quick Lock Positioning Assembly
NK38-GEN-31124-0016-U1234	Yoke Positioning Assembly- Fixed
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NK38-MAK-31140-0001 Sht M001	Fuel Channel Assembly- Channel Closure Assembly
NK38-MAK-31140-0001 Sht M002	Fuel Channel Assembly- Channel Closure Assembly
TD 38-31100-22-101	Fuel Channel Assembly: Internal End Fitting Components
TD 38-31100-023-101	Fuel Channel Assembly: Internal End Fitting Components DD
TD 38-31130-013-101	Shield Plug Drawing List
TD 38-31130-021-101	Shield Plug- Introduction
TD 38-31130-022-101	Shield Plug- Design Requirements
TD 38-31130-022-202	Fuel Supporting Outlet Shield Plug- Interim Design
TD 38-31130-022-300	Flow Straightening Inlet Shield Plug
TD 38-31130-022-400	Flow Restricting Inlet/Outlet Shield Plug Design Requirements
TD 38-31130-023-101	Shield Plug Design Description
TD 38-31130-023-101	Shield Plug- Design Description

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TD 38-31130-023-202	Fuel Supporting Outlet Shield Plug- Design Description
TD 38-31130-023-301	Flow Straightening Inlet Shield Plug- MKIII C
TD 38-31130-023-401	Flow Restricting Inlet/Outlet Shield Plug- Design Description
TD 38-31130-023-402	Low Flow Restricting Outlet Shield Plug- Design Description
TD 38-31130-023-600	Fuel Channel Assembly- Shield Plug
TD 38-31130-073-101	Shield Plug- Protective Interlocks
TD 38-31130-A-002	Material Specification for Darlington 'A' Shield Plugs
TD 38-31140-021-101	Channel Closure- Introduction
TD 38-31140-022-101	Fuel Channel Assembly: Channel Closure Design Requirements
TD 38-31140-022-102	Special Channel Closure for Shutdown Use only- Reduced Lug/Elastomeric Config Design Req
TD 38-31140-022-103	Special Channel Closure- Six Lug/Elastomeric Design Requirements
TD 38-31140-023-101	Channel Closure- Design Description
TD 38-31140-023-102	Channel Closure- 12 Lug Design- Design Description
TD 38-31140-023-103	Channel Closure- Soft Seal Disc- Design Description
TD 38-31140-023-104	Special Channel Closure for Shutdown Use only- Reduced Lug/Elastomeric Config Design Desc
TD 38-31140-023-105	Pressure Sensing Channel Closure Assembly Design Description
TD 38-31140-023-106	Channel Closure Assembly for Monitoring Design Description
TD 38-31140-023-107	Channel Closure 'Extended Reach' Seal Discs
TD 38-31140-023-108	Channel Closure Six Lug Elastomeric Design Description
TD 38-31140-023-600	Fuel Channel Assembly Channel Closure
TD 38-31140-073-101	Channel Closure- Protective Interlocks
TD 38-31190-023-101	End Fitting Internal Components: Liner, Fuel Latch and Spacer Sleeve- Design Description
TD 38-31190-A-101	Fuel Latch Assembly Components: Material Specification for Fuel Latch Segment
TD 38-31190-A-102	Fuel Latch Assembly Components: Material Specification for Fuel Latch Cage
TD 38-31190-A-103	Fuel Latch Assembly Components: Material Specification for Fuel Latch Cage
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TD 38-31190-A-106	Fuel Latch Assembly Components: Material Specification for End Fitting Liner Locking Lug
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TD 38-31190-A-108	Fuel Latch Assembly Components: Material Specification for Retaining Wire
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TD 38-31190-A-110	Fuel Latch Assembly Components: Material Specification for End Fitting Liner Rivets
TD 38-31190-A-111	Fuel Latch Assembly Components: Material Specification for End Fitting Liner Key
TD 38-31190-C-101	E/F Liner Fuel Latch and Spacer Sleeve
TD 38-31921-051-115	Non-Radioactive Fuel Channel Replacement: Proc for PT and E/F Installation - Gen Spec
TD 38-31921-051-118	Non-Radioactive Fuel Channel Replacement: Procedure for Pressure Tube Installation
TD 38-31921-051-201	Fuel Channel Installation Procedure
TD 38-31921-051-202	Fuel Channel Installation Procedure: Establishment of Reference Planes R and R' Procedure
TD 38-31921-051-407	Fuel Channel Installation Procedure: Second End Fitting Installation Procedure
TD 38-31921-051-410	Fuel Channel Installation Procedure: Fuel Channel Removal and Installation Procedures

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TD 38-31921-051-411	Fuel Channel Installation Procedure: Rerolling after both Bellows are Welded
TD 38-31922-081-150	Active Fuel Channel Replacement Procedure- General Specifications
TD 38-31950-052-101	E/F Internals Installation Equipment: Commissioning
TD 38-31950-061-101	E/F Internals Installation Equipment: Commissioning
TD 38-31950-071-103	E/F Internals Installation Equipment: Operating Procedure for Shield Plug Installation Tool
TD 38-31950-074-101	E/F Internals Installation Equipment: List of Trips and Alarms
TD 38-31950-075-101	E/F Internals Installation Equipment: Limitations and Hazards
TD 38-31950-076-101	E/F Internals Installation Equipment: Malfunction
TD 38-31950-081-102	E/F Internals Installation Equipment: Maintenance
TD 38-31950-73-101	E/F Internals Installation Equipment: Protective Interlocks
TS-38-31170-5	Installation Requirements for Attaching Feeder Pipes to End Fittings
TS-38-31921-1	Fuel Channel Installation Requirements
TS-38-31921-6	General Requirements for Tooling and Equipment Supply
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TS-XX-31110-5	Cold Worked Zirconium-2.5 Wt% Niobium Extruded and Drawn Pressure Tubes
TS-XX-31120-2	Fuel Channel End Fitting Assemblies
TS-XX-31120-3	Fuel Channel End Fittings
TS-XX-31120-4	Stainless Steel Blanks for Fuel Channel End Fitting Bodies
TS-XX-31150-002	Fuel Channel Bearing Sleeves and Journal Rings
TS-XX-31160-3	Fuel Channels- Garter Spring Type Annulus Spacers: Inconel X-750
TS-XX-31170-004	Screws for the Fuel Channel/Feeder Pipe Connections
TS-XX-31170-008	Suggested Repair Procedures for Resurfacing or Refurbishing Seats in Feeder Coupling Hubs
TS-XX-31170-1	Screws for Fuel Channels/Feeder Pipe Connections
TS-XX-31170-10	Seal Rings for the End Fitting to Feeder Pipe Connection
TS-XX-31170-3	Hubs for the End Fitting/Feeder Pipe Connection
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FEEDERS	
NK38-CALC-D1017033	Reinforcement Calculation for ROH Extension Tee
NK38-D1N-60444-9001-U1234	Nuclear Cl 1 Flow Element Nozzle Venturi Type Id 1939 Cdn Regn No. Nf 1-1097.5 Adjoining Pipe
NK38-D1N-60444-9002-U1234	Nuclear Cl 1 Flow Element Nozzle Venturi Type Id 2323 Cdn Regn No. Nf 1-1097.5 Adjoining Pipe
NK38-D1N-60444-9003-U1234	Nuclear Cl 1 Flow Element Nozzle Venturi Type Id 2900 Cdn Regn No. Nf 1-1097.5 Adjoining Pipe
NK38-D1N-60444-9004-U1234	Nuclear Cl 1 Flow Element Venturi Type ID 2 323 Cdn Regn No Nf 1-1098.5 Adjoining Pipe
NK38-D1N-60444-9005-U1234	Nuclear Cl 1 Flow Element Venturi Type ID 2 900 Cdn Regn No. Nf 1-1098.5 Adjoining Pipe
NK38-D1N-60444-9006-U1234	Nuclear Cl 1 Flow Element Venturi Type ID 3 364 Cdn Regn No. Nf 1-1098.5 Adjoining Pipe
NK38-D1N-60444-9007-U1234	Nuclear Cl 1 Flow Element Orifice Type ID 2 900 Cdn Regn No Nf 1-1097.5 Adjoining Pipe
NK38-D1N-60444-9008-U1234	Nuclear Cl 1 Flow Element Venturi Type ID 3 900 Cdn Regn No. Nf 1-1098.5 Adjoining Pipe
NK38-D1N-60444-9009-U1234	Nuclear Cl 1 Flow Element Venturi Type ID 3 364 Cdn Regn No. Nf 1-1098.5 Adjoining Pipe
NK38-D2N-60442-9002-U1234	Resistance Temperature Detector For Nuclear Pwr Plant Extension Type

Document Number	Document Title
NK38-D4N-33163-0068-U1234	PHTS Feeder Cabinet Panel Details
NK38-GEN-33163-0001-001	PHTS Feeder Cabinet Drawing Index
NK38-DCN-33140-9623-U1234	Extension Section Tee For Reactor Outlet Header
NK38-DCN-33160-0020-U1234	Main Heat Transport Circuit Feeders Pressure Breakdown Orifice
NK38-DCN-31170-9001-U12	Grayloc Seal Ring
NK38-DCN-33140-9604-U1234	Reactor Headers: Details of 3/8 Process Tap
NK38-DDN-33140-9605-U1234	Outlet Header-33140- HD 5-A
NK38-DDN-33140-9606-U1234	Outlet Header-33140- HD 5-B
NK38-DDN-33140-9607-U1234	Inlet Header-33140- HD 6-A
NK38-DDN-33140-9608-U1234	Inlet Header-33140- HD 6-B
NK38-DDN-33140-9609-U1234	Inlet Header-33140- HD 1-A
NK38-DDN-33140-9610-U1234	Inlet Header-33140- HD 1-B
NK38-DDN-33140-9611-U1234	Inlet Header-33140- HD 2-A
NK38-DDN-33140-9612-U1234	Inlet Header-33140- HD 2-B
NK38-DDN-33140-9613-U1234	Outlet Header-33140- HD 3-A
NK38-DDN-33140-9614-U1234	Outlet Header-33140- HD 3-B
NK38-DDN-33140-9615-U1234	Inlet Header-33140- HD 4-A
NK38-DDN-33140-9616-U1234	Inlet Header-33140- HD 4-B
NK38-DDN-33140-9617-U1234	Outlet Header-33140- HD 7-A
NK38-DDN-33140-9618-U1234	Outlet Header-33140- HD 7-B
NK38-DDN-33140-9619-U1234	Inlet Header-33140- HD 8-A
NK38-DDN-33140-9620-U1234	Inlet Header-33140- HD 8-B
NK38-DDN-33140-9621-U1234	Inlet Headers Outlets & Weld End Preparation Details
NK38-DDN-33140-9622-U1234	Outlet Headers Outlets & Weld End Preparation Details
NK38-DDN-33164-0002-U1234 Sht 4	Feeder System End Fitting Insulation Panels Detail of Cloth Stitching
NK38-DDN-33164-0002-U1234 Sht 5	Feeder System End Fitting Insulation Panels Details
NK38-DDN-63102-0005-U1234	Channel Temp Monitoring Clamp On Thermowell Detail Of Clamp
NK38-DDN-63102-0007-U1234	Channel Temp Monitoring Clamp On Thermowell Assembly & Dtl
NK38-DEN-33160-0012-U1234 Sht 1	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 1 W
NK38-DEN-33160-0012-U1234 Sht 2	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 2 W
NK38-DEN-33160-0012-U1234 Sht 3	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 3 W
NK38-DEN-33160-0012-U1234 Sht 4	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 4 W
NK38-DEN-33160-0012-U1234 Sht 5	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 1 E
NK38-DEN-33160-0012-U1234 Sht 6	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 2 E
NK38-DEN-33160-0012-U1234 Sht 7	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 3 E
NK38-DEN-33160-0012-U1234 Sht 8	Main Heat Transport Circuit: Feeder Header and Frame Assembly- Drawing Chart Section 4 E
NK38-DEN-33163-0035-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults
NK38-DEN-33163-0036-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults
NK38-DEN-33163-0037-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults

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NK38-DEN-33163-0038-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults
NK38-DEN-33163-0039-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults
NK38-DEN-33163-0040-U1234	PHTS Feeder Cabinet Typical Frame Connections East & West F/M Vaults
NK38-DEN-33163-0041-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0042-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0043-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0044-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0045-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0046-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0048-U1234	PHTS Feeder Cabinets Shield Tank Insulation Sections East & West F/M Vaults
NK38-DEN-33163-0050-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0051-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0052-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0053-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0054-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0055-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0056-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0057-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0058-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0059-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0060-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0061-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0062-U12324	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0063-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0064-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0065-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0066-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0069-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0070-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0071-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0072-U1234	PHTS Feeder Cabinet Pnl Closure Details Instrumentation Tubing
NK38-DEN-33163-0074-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0075-U1234	PHTS Feeder Cabinet End Shield Cooling Pipes Penetration Pnl Details
NK38-DEN-33163-0076-U1234	PHTS Feeder Cabinet Typical Pnl To Frame Sections East & West F/M Vaults
NK38-DEN-33163-0077-U1234	PHTS Feeder Cabinet Rtd Penetration Pnl Details
NK38-DEN-33163-0079-U1234	PHTS Feeder Cabinet Details Of Flexible Pnls
NK38-DEN-33163-0080-U1234	PHTS Feeder Cabinet Details Of Tees
NK38-DEN-33163-0081-U1234	PHTS Feeder Cabinet Details Of Tees
NK38-DEN-33163-0082-U1234	PHTS Feeder Cabinet Details Of Tees

Document Number	Document Title
NK38-DEN-33163-0083-U1234	PHTS Feeder Cabinet Details Of Angles
NK38-DEN-33163-0084-U1234	PHTS Feeder Cabinet Details Of Angles
NK38-DEN-33163-0085-U1234	PHTS Feeder Cabinet Details Of Angles
NK38-DEN-33163-0086-U1234	PHTS Feeder Cabinet Dtls Of Composite Members
NK38-DEN-33163-0087-U1234	PHTS Feeder Cabinet Details Of U Channels
NK38-DEN-33163-0088-U1234	PHTS Feeder Cabinet Details Of U Channels And Angles
NK38-DEN-33163-0089-U1234	PHTS Feeder Cabinet Trim Details
NK38-DEN-33163-0090-U1234	PHTS Feeder Cabinet Flexible Pnl Dtls Penetrations For Annulus Gas Tubing
NK38-DEN-33163-0091-U1234	PHTS Feeder Cabinet Dtls Of Flexible Pnls
NK38-DEN-33163-0092-U1234	PHTS Feeder Cabinet Lower Body Support Frame Dtls
NK38-DEN-33163-0093-U1234	PHTS Feeder Cabinet Trim Details
NK38-DEN-33163-0095-U1234	PHTS Feeder Cabinet Dr Frames Upper Body East & West F/M Vaults
NK38-DEN-33163-0096-U1234	PHTS Feeder Cabinet Dr Frames Lower Body East & West F/M Vaults
NK38-DEN-33163-0097-U1234	PHTS Feeder Cabinet Press Equalizing Drs Outflow & Inflow Dtls E & W F/M Vaults
NK38-DEN-33163-0098-U1234	PHTS Fdr Cabinet Press Equalizing Drs Outflow & Inflow Dtls East & West F/M Vaults
NK38-DEN-33163-0099-U1234	PHTS Fdr Cabinet Trim Details At Flexible Pnls
NK38-DEN-33163-0100-U1234	PHTS Fdr Cabinet Lower Body Support Assy Sections & Dtls East & West F/M Vaults
NK38-DEN-33163-0101-U1234	PHTS Fdr Cabinet Lower Body Fl Grating Sections & Dtls East & West F/M Vaults
NK38-DEN-33163-0102-U1234	PHTS Fdr Cabinet Tie Rods-details East & West F/M Vaults
NK38-DEN-33163-0103-U1234	PHTS Fdrs Cabinet Pipes & Hanger Rods Penetration Dtl East & West F/M Vaults
NK38-DEN-33163-0104-U1234	PHTS Fdr Cabinet Typical Pnl To Frame Sections El 112980 East & West F/M Vaults
NK38-DEN-33163-0106-U1234	PHTS Feeder Cabinet Pnl Details Scanner Guide Tube Thermal Seal
NK38-DEN-33163-0107-U1234	PHTS Feeder Cabinet Pnl Dtls Scanner Guide Tube Thermal Seal
NK38-DEN-33163-0110-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Sections East & West F/M Vaults
NK38-DEN-33163-0111-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Sections East & West F/M Vaults
NK38-DEN-33163-0112-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Sections East & West F/M Vaults
NK38-DEN-33163-0113-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Sections East & West F/M Vaults
NK38-DEN-33163-0114-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Cover Dtls
NK38-DEN-33163-0115-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation Cover Dtls
NK38-DEN-33163-0116-U1234	PHTS Fdr Cabinet Grating Dtls
NK38-DEN-33163-0117-U1234	PHTS Fdr Cabinet Grating Dtls
NK38-DEN-33163-0118-U1234	PHTS Fdr Cabinet Grating Arrgt At El 111254 Sections
NK38-DEN-33163-0119-U1234	PHTS Fdr Cabinet Dr Assy Hinge On Right Hand Side East & West F/M Vaults
NK38-DEN-33163-0120-U1234	PHTS Fdr Cabinet Dr Assyhinge On Left Hand Side East & West F/M Vaults
NK38-DEN-33163-0121-U1234	PHTS Fdr Cabinet Press Equalizing Drs Pnl Dtls East & West F/M Vaults
NK38-DEN-33163-0122-U1234	PHTS Fdrs Cabinet Pnl Closure Dtls
NK38-DEN-33163-0123-U1234	PHTS Fdr Cabinet Pnl Dtls
NK38-DEN-33163-0124-U1234	PHTS Feeden Cabinet Panel Details
NK38-DEN-33163-0125-U1234	PHTS Feeder Cabinet Panel Details

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NK38-DEN-33163-0126-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0127-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0128-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0129-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0130-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0131-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0132-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0133-U1234	PHTS Feeder Cabinet Panel Details
NK38-DEN-33163-0141-U12	PHTS Feeder Cabinet Panel And Panel Closure Details
NK38-DEN-33164-0002-U1234 Sht 1	Feeder System End Fitting Insulation Panels Details
NK38-DEN-33164-0002-U1234 Sht 2	Feeder System End Fitting Insulation Panels Details
NK38-DEN-33164-0002-U1234 Sht 3	Feeder System End Fitting Insulation Panels Details
NK38-DEN-33168-0013-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Damper Details
NK38-DEN-33168-0014-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Damper Details
NK38-DEN-33168-0017-U1234	Main Heat Transport Circuit Upper Feeder Hangers Dampers Site Installed Hardware
NK38-DEN-33168-0042-U1234	Main Heat Transport Circuit Details Of Clamp Blocks Spacer Bars Extension Bars & Misc Items
NK38-DEN-33168-0075-U1234	Main Heat Transport Circuit Lower Feeder Pipe Supports Details Of Base Plates Nw & Se
NK38-DEN-33168-0076-U1234	Main Heat Transport Circuit Lower Feeder Pipe Support Details Of Base Plates Sw & Ne
NK38-DEN-33168-0077 Sht 1	Main Heat Transport Circuit: Lower Feeder Pipe Supports- Sundry Details
NK38-DEN-33168-0077 Sht 2	Main Heat Transport Circuit: Lower Feeder Pipe Supports- Sundry Details and Parts List
NK38-DEN-33168-0078-U1234	Main Heat Transport Circuit: Lower Feeder Pipe Supports- Details of Spacers
NK38-DEN-33168-0079-U1234	Main Heat Transport Circuit: Lower Feeder Pipe Supports- Cantilever Beam NW, SE, SW, NE
NK38-DEN-33169-0001-U1234	Main Heat Transport Circuit: Feeders Isometric Piping Details
NK38-DEN-33169-0002-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0003-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0004-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0005-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0006-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0007-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0008-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0009-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0010-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0011-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0012-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0013-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0014-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0015-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0016-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0017-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details

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NK38-DEN-33169-0018-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0019-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0020-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0021-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0022-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0023-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0024-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0025-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0026-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0027-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0028-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0029-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0030-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0031-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0032-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0033-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0034-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0035-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0036-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0037-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0038-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0039-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0040-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-33169-0041-U1234	Main Heat Transport Circuit: Feeders- Isometric Piping Details
NK38-DEN-63102-0003-U1234	Channel Temp Monitoring Rtd Guide Tube Arrgt Assy Details
NK38-DM-33100	Main Heat Transport Circuit
NK38-DM-63107.1	Feeder Scanning System
NK38-DON-33163-0134-U1234	PHTS Feeder Cabinet Panel Details
NK38-DON-33163-0135-U1234	PHTS Feeder Cabinet Panel Details
NK38-E3H-63432-0016	ECI Syst Pht Gross Flow - Initiation Signal H2o Injection Valves And Hp Pump Control Diagram
NK38-F0H-33100-0001-U1234	Reactor Building: Main Heat Transport Circuit Flow Diagram
NK38-FEX-33000-1501	Heat Transport Overview
NK38-FEX-33140-1501	North-West Quadrant of Feeder Cabinet Pressure/Flow Tubing
NK38-FEX-33140-1502	North-East Quadrant of Feeder Cabinet Pressure/Flow Tubing
NK38-FEX-33140-1503	South-West Quadrant of Feeder Cabinet Pressure/Flow Tubing
NK38-FEX-33140-1504	South-East Quadrant of Feeder Cabinet Pressure/Flow Tubing
NK38-FEX-33910-1502	Heat Transport Feeder and Panel Arrangements E/W
NK38-FXX-33100-1501	Heat Transport Main Circuit
NK38-GCN-33169-0046-U1234	Main Heat Transport Circuit: Feeders Thermowell Welded Assembly

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NK38-GEN-33160-0001-U1234	Reactor, Boiler and Auxiliaries: Feeder System- General Arrangement- Plan at El. 114.600
NK38-GEN-33160-0002-U1234	Reactor, Boiler and Auxiliaries: Feeder System- General Arrangement- West Vault Elevation
NK38-GEN-33160-0003-U1234	Reactor, Boiler and Auxiliaries: Feeder System- General Arrangement- East Vault Elevation
NK38-GEN-33160-0004-U1234	Reactor, Boiler and Auxiliaries: Feeder System- General Arrangement- Elevation Looking North
NK38-GEN-33160-0006-U1234 Sht 1	Main Heat Transport Circuit: Feeder, Header Arrangement Front Elevation West
NK38-GEN-33160-0006-U3 Sht 2	Unit 3 Feeder On-line Thickness Monitoring (foltm) Transducer Locations
NK38-GEN-33160-0007-U1234	Main Heat Transport Circuit: Feeder, Header Arrangement W.- Sectional Plan
NK38-GEN-33160-0008-U1234	Main Heat Transport Circuit: Feeder, Header Arrangement W.- Sections of Typical Feeder Rows
NK38-GEN-33160-0009	Main Heat Transport Circuit: Feeder, Header Arrangement Front Elevation East
NK38-GEN-33160-0010-U1234	Main Heat Transport Circuit: Feeder, Header Arrangement E.- Sectional Plan
NK38-GEN-33160-0011-U1234	Main Heat Transport Circuit: Feeder, Header Arrangement E.- Sections of Typical Feeder Rows
NK38-GEN-33161-0001-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 1 West
NK38-GEN-33161-0002-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 2 West
NK38-GEN-33161-0003-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 3 West
NK38-GEN-33161-0004-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 4 West
NK38-GEN-33161-0005-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 1 East
NK38-GEN-33161-0006-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 2 East
NK38-GEN-33161-0007-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 3 East
NK38-GEN-33161-0008-U1234	Main Heat Transport Circuit: Feeder Header Frame Assembly 4 East
NK38-GEN-33161-0017-U1234	Main Heat Transport Circuit: Feeder Header Frame- Header Support Assemblies
NK38-GEN-33161-0019-U1234	Main Heat Transport Circuit Feeder Header Frames Transport Carriage Assy
NK38-GEN-33161-0020-U1234	Main Heat Transport Circuit Feeder Header Frames Transport Bracing Assy & Details
NK38-GEN-33161-0031-U1234	Main Heat Transport Circuit Feeder Header Frame Assy Structural Support Bracing West Plan
NK38-GEN-33161-0032-U1234	Main Heat Transport Circuit Feeder Header Frame Assy Structural Support Bracing East Plan
NK38-GEN-33161-0039-U1234	Main Heat Transport Circuit Feeder Header Frames Gen. Arrgt-walkways
NK38-GEN-33161-0042-U1234	Main Heat Transport Circuit Feeder Header Frame & Header Support Location
NK38-GEN-33163-0001-U1234	PHTS Feeder Cabinet Drawing Index 056903
NK38-GEN-33163-0002-U1234	PHTS Feeder Cabinet Front Elevation Arrgt East F/M Vault
NK38-GEN-33163-0003-U1234	PHTS Feeder Cabinet North Elevation Arrg't East and West F/M Vaults
NK38-GEN-33163-0004-U1234	PHTS Feeder Cabinet South Elevation Arrg't East and West F/M Vaults
NK38-GEN-33163-0005	PHTS Feeder Cabinet Front Elevation Panel Assembly East F/M Vault
NK38-GEN-33163-0006-U1234	PHTS Feeder Cabinet Front Elevation Frame Assembly East F/M Vault
NK38-GEN-33163-0007-U1234	PHTS Feeder Cabinet Rear Elevation Panel Assembly East F/M Vault
NK38-GEN-33163-0008-U1234	PHTS Feeder Cabinet Rear Elevation Frame Assembly East F/M Vault
NK38-GEN-33163-0009-U1234	PHTS Feeder Cabinet Shield Tank Insulation Arrgt East F/M Vault
NK38-GEN-33163-0010-U1234	PHTS Feeder Cabinet Shield Tank Insulation Pin Arrg't East F/M Vault
NK38-GEN-33163-0011-U1234	PHTS Feeder Cabinet North Elevation Panel and Frame Assembly East F/M Vault
NK38-GEN-33163-0012-U1234	PHTS Feeder Cabinet South Elevation Panel and Frame Assembly East F/M Vault
NK38-GEN-33163-0013-U1234	PHTS Feeder Cabinet Plan Panel Ass'y at El 112.980 East F/M Vault

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NK38-GEN-33163-0014	PHTS Feeder Cabinets Plan Pnl Assy At El 111254 East & West F/m Vault
NK38-GEN-33163-0015	PHTS Feeder Cabinet Inverted Plan Soffit Pnl & Frame Assembly East F/m Vault
NK38-GEN-33163-0016-U1234	PHTS Feeder Cabinet Inverted Plan Floor Pnl & Frame Assembly East & West F/m Vault
NK38-GEN-33163-0017-U1234	PHTS Feeder Cabinets Rear Wall Panel & Frame Assy El 111254 To El 112666
NK38-GEN-33163-0018-U1234	PHTS Feeder Cabinet Front Elevation Arrg't West F/M Vault
NK38-GEN-33163-0019	PHTS Feeder Cabinet Front Elevation Panel Assembly West F/M Vault
NK38-GEN-33163-0020-U1234	PHTS Feeder Cabinet Front Elevation Frame Assembly West F/M Vault
NK38-GEN-33163-0021-U1234	PHTS Feeder Cabinet Rear Elevation Panel Assembly West F/M Vault
NK38-GEN-33163-0022-U1234	PHTS Feeder Cabinet Rear Elevation Frame Assembly West F/M Vault
NK38-GEN-33163-0023-U1234	PHTS Feeder Cabinet Shield Tank Insulation Pin Arrg't West F/M Vault
NK38-GEN-33163-0024-U1234	PHTS Feeder Cabinet Shield Tank Insulation Arrg't West F/M Vault
NK38-GEN-33163-0025-U1234	PHTS Feeder Cabinet North Elevation Pnl & Frame Assy West F/M Vault
NK38-GEN-33163-0026-U1234	PHTS Feeder Cabinet South Elevation Panel and Frame Assembly West F/M Vault
NK38-GEN-33163-0027-U1234	PHTS Feeder Cabinet Plan Panel Ass'y at El 112.980 West F/M Vault
NK38-GEN-33163-0028	PHTS Feeder Cabinet Inverted Plan Soffit Panel and Frame Ass'y West F/M Vault
NK38-GEN-33163-0029-U1234	PHTS Feeder Cabinet Sectional Arrangement East and West F/M Vaults
NK38-GEN-33163-0030-U1234	PHTS Feeder Cabinet Stud Arrangement at El 111.254 East and West F/M Vaults
NK38-GEN-33163-0031-U1234	PHTS Feeder Cabinet General Arrangement of Grating at El 111.254 East and West F/M Vaults
NK38-GEN-33163-0032-U1234	PHTS Feeder Cabinet Lower Body-floor Grating General Arrgt East & West F/M Vaults
NK38-GEN-33163-0033-U1234	PHTS Feeder Cabinet Lower Body Support Assembly East F/M Vault
NK38-GEN-33163-0034-U1234	PHTS Feeder Cabinet Lower Body Support Assembly West F/M Vault
NK38-GEN-33163-0047-U1234	PHTS Feeder Cabinet Panel Hold Down Studs at El. 112.980 Gen Argt E and W F/M Vault
NK38-GEN-33163-0049-U1234	PHTS Feeder Cabinet Shield Tank Flexible Panel Securing Nuts Arrgt East and West F/M Vaults
NK38-GEN-33163-0067-U1234	PHTS Feeder Cabinet Panel Closure Assemblies
NK38-GEN-33163-0082-U1234	PHTS Feeder Cabinet Details of Tees
NK38-GEN-33163-0105-U1234	PHTS Feeder Cabinet Scanner Guide Tube Thermal Seal General Arrgt
NK38-GEN-33163-0108-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation East F/M Vault
NK38-GEN-33163-0109-U1234	PHTS Fdr Cabinet Fdr Header Frame Insulation West F/M Vault
NK38-GEN-33164-0001-U1234 Sht 1	Feeder System End Fitting Insulation Panels General Assembly
NK38-GEN-33164-0001-U1234 Sht 2	Feeder System End Fitting Insulation Panels General Assembly
NK38-GEN-33168-0001-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Plan
NK38-GEN-33168-0002-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Sections
NK38-GEN-33168-0003-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Side Elev S4
NK38-GEN-33168-0004-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Front Elev S5
NK38-GEN-33168-0005-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #1 W
NK38-GEN-33168-0006-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #2 W
NK38-GEN-33168-0007-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #3 W
NK38-GEN-33168-0008-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #4 W
NK38-GEN-33168-0009-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #1 E

Document Number	Document Title
NK38-GEN-33168-0010-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #2 E
NK38-GEN-33168-0011-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #3 E
NK38-GEN-33168-0012-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Gen Arrangement- Frame #4 E
NK38-GEN-33168-0015-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Frame Assembly and Details
NK38-GEN-33168-0016-U1234	Main Heat Transport Circuit: Upper Feeder Hangars- Dampers- Frame Support Assy and Details
NK38-GEN-33168-0021-U1234	Main Heat Transport Circuit Upper & Lower Feeder Spacers General Arrangement
NK38-GEN-33168-0022-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 1 2 & 3
NK38-GEN-33168-0023-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 4 5 & 6
NK38-GEN-33168-0024-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 7 8 & 9
NK38-GEN-33168-0025-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 10 11 & 12
NK38-GEN-33168-0026-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 13 14 & 15
NK38-GEN-33168-0027-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 16 17 & 18
NK38-GEN-33168-0028-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 19 20 & 21
NK38-GEN-33168-0029-U1234	Main Heat Transport Circuit Upper Feeder Spacers Assembly Nos. 22 23 & 24
NK38-GEN-33168-0030	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 25 26 & 27
NK38-GEN-33168-0031	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 28 29 & 30
NK38-GEN-33168-0032	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 31 32 & 33
NK38-GEN-33168-0033	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 34 35 & 36
NK38-GEN-33168-0034	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 37 38 & 39
NK38-GEN-33168-0035	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 40 41 & 42
NK38-GEN-33168-0036	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 43 44 & 45
NK38-GEN-33168-0037	Main Heat Transport Circuit Lower Feeder Spacers Assembly Nos. 46 47 & 48
NK38-GEN-33168-0038	Main Heat Transport Circuit Upper Feeder Spacers End Elevations E1 Thru E9
NK38-GEN-33168-0039	Main Heat Transport Circuit Upper Feeder Spacers End Elevations E10 Thru E16
NK38-GEN-33168-0040	Main Heat Transport Circuit Lower Feeder Spacers End Elevations E17 Thru E25 & E36
NK38-GEN-33168-0041	Main Heat Transport Circuit Lower Feeder Spacers End Elevations E26 Thru E34
NK38-GEN-33168-0050-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Base Plate Loc- Gen Arrangement
NK38-GEN-33168-0051-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'M' NW and SE
NK38-GEN-33168-0052-U1234	Main Heat Transport Circuit Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'M' SW and NE
NK38-GEN-33168-0053-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'N' NW and SE
NK38-GEN-33168-0054-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'N' SW and NE
NK38-GEN-33168-0055-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'O' NW and SE
NK38-GEN-33168-0056-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'O' SW and NE
NK38-GEN-33168-0057-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'P' NW and SE
NK38-GEN-33168-0058-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'P' SW and NE
NK38-GEN-33168-0059-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'Q' NW and SE
NK38-GEN-33168-0060-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'Q' SW and NE
NK38-GEN-33168-0061-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'R' NW and SE
NK38-GEN-33168-0062-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'R' SW and NE

Document Number	Document Title
NK38-GEN-33168-0063-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'S' NW and SE
NK38-GEN-33168-0064-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'S' SW and NE
NK38-GEN-33168-0065-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'T' NW and SE
NK38-GEN-33168-0066-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'T' SW and NE
NK38-GEN-33168-0067-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'U' NW and SE
NK38-GEN-33168-0068-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'U' SW and NE
NK38-GEN-33168-0069-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'V' NW and SE
NK38-GEN-33168-0070-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'V' SW and NE
NK38-GEN-33168-0071-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'W' NW and SE
NK38-GEN-33168-0072-U1234	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'W' SW and NE
NK38-GEN-33168-0073-U1234 Sht 1	Main Heat Transport Circuit: Lower Fdr Pipe Supports-Gen Argmt & Details- Row 'X' NW and SE
NK38-GEN-33168-0073-U1234 Sht 2	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'Y' NW and SE
NK38-GEN-33168-0074-U1234 Sht 1	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'X' SW and NE
NK38-GEN-33168-0074-U1234 Sht 2	Main Heat Transport Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Row 'Y' SW and NE
NK38-GEN-33168-0075-U1234 Sht 1	Main HT Circuit: Lower Fdr Pipe Supports- Gen Argmt & Details- Cantilever Beam- NW & SE
NK38-GEN-33168-0075-U1234 Sht 3	Main HT Circuit: Lower Fdr Pipe Supports- Details of Cantilever Beam- Item #1- NW & SE
NK38-GEN-33168-0076-U1234 Sht 1	Main HT Circuit: Lower Feeder Pipe Supports- Gen Argmt & Details- Cantilever Beam- SW and NE
NK38-GEN-33168-0076--U1234 Sht 3	Main HT Circuit: Lower Feeder Pipe Supports- Details of Cantilever Beam- Item #1- SW and NE
NK38-GEN-63106-0008-U1234	Reactor & Auxiliaries Channel Pwr Measurement Rtd Guide Tube & Thermowell On Outlet Fdrs
NK38-GEN-63106-0010-U1234	Reactor & Auxiliaries Channel Pwr Measurement R.t.d. Guide Tube Arrgt On Inlet Fdrs Locs & Isos
NK38-GEN-63107-0001-U1234	Reactor and Auxiliaries: Feeder Scanner System- General Arrangement Plan
NK38-REP-D1028028	Darlington GS: Qual of Reactor Header Mtl for Operation at a Low Serv Temp of 26.6 C (80 F)
NK38-REP-D1116001	Darlington GS 'A' Reactor Outlet Headers
NK38-REP-D1116004	Darlington GS 'A' Reactor Inlet Headers
NK38-REP-D1244019	Darlington GS 'A' Primary Heat Transport System Feeder Pipes- Units 1-4
SR Reactor Inlet	Reactor Inlet Headers
SR Reactor Outlet	Reactor Outlet Headers
SR-38-33160-001	Primary Heat Transport System Feeder Pipes Units 1 to 4
TS-38-33140-002	Extension Sections (Tees) for Reactor Outlet Headers Design and Service Levels A, B and C
TS-38-33140-1	Reactor Headers for Darlington 'A'
TS-38-33140-3	Design Specification for Reactor Outlet Header Support
TS-38-33160-001	Nuclear Class 1 Seamless Carbon Steel Pipe for Fabrication of HTS Feeders for Darlington 'A'
TS-38-33160-002	Pressure Breakdown Orifices for Feeder Assemblies
TS-38-33160-003	Installation Requirements for Lower Feeders, Feeder Header Frame Assemblies and Assoc Equip
TS-38-33160-004	Design Specification for Feeders
TS-38-33160-006	Unit 2 Feeder Commissioning Specification
TS-38-33160-2	Pressure Breakdown Orifices for Feeder Assemblies
TS-38-33160-5	Design Specification for Lower Cantilever Beam Support
TS-38-33161-1	Feeder and Feeder Frame Assemblies for Darlington 'A' (Units 1-4)

Document Number	Document Title
TS-38-33163-1	PHTS Feeder Insulation Cabinet
TS-XX-60443-003	Flow Elements for Class 1 Piping in a Nuclear Station
TS-XX-60610-17	Austenitic Seamless Cold Drawn Stainless Steel Tubing
VAULT-GENERAL	
NK38-D0H-21022-2001-U1234	RB El. 100.000 Pers & Equip A/L Int Clearances Arrangement for CIGAR Drive and Bleed Cooler
NK38-D0H-21185-0560-U1234	Reactor Building Shielding Door at Equipment Airlock Shielding Door Details
NK38-D0S-57410-0104-U2 Sht 1	Reactor Building and RAB Col Row A-T Col Line 11-16.5 Fl El 100.000 Cable Tray Arrangement
NK38-D0S-57410-0104-U134 Sht 2	Reactor Building and RAB Col Row A-T Col Line 11-16.5 Fl El 100.000 Cable Tray Arrangement
NK38-D0S-57410-0105-U134 Sht 2	Reactor Auxiliary Bay Col Row A-T Col Line 11-16.5 Fl El 107.500 Cable Tray Arrangement
NK38-D0S-57410-0105-U2 Sht 1	Reactor Auxiliary Bay Col Row A-T Col Line 11-16.5 Fl El 107.500 Cable Tray Arrangement
NK38-D0S-57410-0106-U1 Sht 1	Reactor Building and RAB Col Row A-T Col Line 11-16.9 Fl El 111.000 Cable Tray Arrangement
NK38-D0S-57410-0106-U2 Sht 2	Reactor Building and RAB Col Row A-T Col Line 11-16.5 Fl El 111.000 Cable Tray Arrangement
NK38-D0S-57410-0106-U34 Sht 3	Reactor Building and RAB Col Row A-T Col Line 11-16.5 Fl El 111.000 Cable Tray Arrangement
NK38-D0S-57410-0107-U134 Sht 2	Reactor Auxiliary Bay Col Row A-T Col Line 11-16.5 Fl El 115.000 Cable Tray Arrangement
NK38-D0S-57410-0107-U2 Sht 1	Reactor Auxiliary Bay Col Row A-T Col Line 11-16.5 Fl El 115.000 Cable Tray Arrangement
NK38-D0S-57410-0137-U2 Sht 1	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Arrangement
NK38-D0S-57410-0137-U134 Sht 2	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Arrangement
NK38-D0S-57410-0137-U134 Sht 3	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Details
NK38-D0S-57410-0167-U1234	Reactor Building and RAB Col Row C,H,M Col Line 11, 12 Fl El 100.000 Cable Tray Arrangement
NK38-D0S-57410-0204-U1 Sht 2	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 100.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0204-U2 Sht 1	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 100.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0204-U34 Sht 3	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 100.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0206-U1 Sht 1	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 111.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0206-U2 Sht 2	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 111.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0206-U34 Sht 3	Reactor Building and RAB Col Row A-T Line 11-16.5 Fl El 111.000 Cable Tray Hangar Arrangement
NK38-D0S-57410-0237-U2 Sht 1	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Hangar Arrangement
NK38-D0S-57410-0237-U134 Sht 2	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Hangar Arrangement
NK38-D0S-57410-0237-U134 Sht 3	Reactor Building Col Row H-M Col Line 12-15 Fl El 116.400 Cable Tray Hangar Details
NK38-D1F-21022-0003-U1234	Reactor Building Equipment Airlock and 100.000 El. Installation Support Bunks Argmt & Details
NK38-D1F-21200-0001	Reactor Vault Internal Steel 35 Ton and 45 Ton Grove Crane
NK38-D1H-21022-0100	Standard Personnel Airlock- General Arrangement
NK38-D1H-21022-0200	Standard Personnel and Equipment Airlock- General Arrangement
NK38-D1H-76111-9030-U1234	Bridge Travel Limit Switch
NK38-D1H-76112-0001-U123	Reactor Deck Area Crane Clearances and Requirements
NK38-D1H-76118-9002	End Truck Arrangement
NK38-D1H-76118-9003	Conductor Catenary and Control Station
NK38-D1H-76118-9004	Runway Assembly #60
NK38-D1H-76118-9005	Runway Assembly #59
NK38-D1H-76118-9006	Runway Assembly #58

Document Number	Document Title
NK38-D1H-76118-9007	Runway Assembly #61
NK38-D1H-76118-9008	Crane Bumper and Runway End Stop Assembly
NK38-D1H-76118-9009	End Truck Hand Crank Assembly
NK38-D1H-76118-9010	End Truck Locking Pin Assembly
NK38-D1H-76118-9011	Hoisting Frame
NK38-D4H-76118-9012	Driving Wheel 220
NK38-D4H-76118-9013	Trailing Wheel 220
NK38-D4H-76118-9014	Axle
NK38-D4H-76118-9015	End Plate
NK38-D4H-76118-9016	Keeper Bar
NK38-D4H-76118-9017	Locking Collar
NK38-D4H-76118-9018	Flanged Bearing
NK38-D5F-76111-0001-U1234	Reactor Building Containment Vault Crane Installation Details
NK38-D5F-76111-0003-U134	Reactor Building Containment Vault Crane Installation Method #2 Arrangement and Details
NK38-D5H-21133-2046	RBS Vault Walls El. 100.000-107.500 Elevation E2 and E6 N-E Area Embedded Parts Location
NK38-D5H-21133-2052-U1234	RBS Vault Walls El. 100.000-107.500 Elevation E1 and E5 N-W Area Embedded Parts Location
NK38-D5H-21133-2053-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E11 and E15 N-E Area Embedded Parts Location
NK38-D5H-21133-2054-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E12 and E16 N-E Area Embedded Parts Location
NK38-D5H-21133-2056-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E13 and E17 S-E Area Embedded Parts Location
NK38-D5H-21133-2057-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E13 and E17 S-W Area Embedded Parts Location
NK38-D5H-21133-2058-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E14 and E18 S-W Area Embedded Parts Location
NK38-D5H-21133-2059-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E14 and E18 N-W Area Embedded Parts Location
NK38-D5H-21133-2060-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E11 and E15 N-W Area Embedded Parts Location
NK38-D5H-21190-2001-U1234	RBS Vault Walls El. 100.000-114.600 Drawing Index Concrete
NK38-D5H-21190-2002-U1234	RBS Vault Walls El. 100.000-107.500 Plan P1 at 107.500 N-E Area Concrete
NK38-D5H-21190-2004-U1234	RBS Vault Walls El. 100.000-107.500 Elevation E2 and E6 N-E Area Concrete
NK38-D5H-21190-3701-U1234	RBS Vault Walls El. 100.000-107.500 Elevation E3 and E7 S-W Area Reinforcing (Cut Bar Location)
NK38-D5H-21190-3704-U1234	RBS Vault Walls El. 100.000-107.500 Elevation E1 and E5 N-W Area Reinforcing (Cut Bar Location)
NK38-D5H-21190-3713-U1234	RBS Vault Walls El. 107.500-114.600 Elevation E18 N-W Area Reinforcing (Cut Bar Location)
NK38-D5H-21259-5020-U1234	RB Internal Structure Ion Chamber Platform and Ladder El 102.900 R-101 Misc Steel
NK38-D5H-21259-5021-U1234	RB Internal Structure Feeder Freezing and RTF Platform El 111.000 R-101 Misc Steel
NK38-D5H-21259-5022-U1234	RB Internal Structure Feeder Freezing and RTF Platform El 111.000 R-101 Misc Steel
NK38-D5H-21359-5102-U1234	RAB Hoist Rails #58, 59, 60, 61 Fl. El. 100.000 R to 130-R-133 Miscellaneous Steel
NK38-D5H-21359-5162-U234	RAB Tornado Gate Fl El 100.000 Rm R-117 Miscellaneous Steel
NK38-D5H-21359-5173-U1234	RAB Monorail No 43 Fl El 100.000 R-123 Miscellaneous Steel
NK38-D5H-76111-0001-U1234	Reactor Building 15 Mg reactor Vault Cranes Clearances and Requirements
NK38-DBK-35221-9053	Reactor Area Bridge Column Base Plate
NK38-DM-76100	Cranes and Hoists
NK38-D0H-20114-0001-U1234	Reactor Building Structure General Arrangement

Document Number	Document Title
NK38-DOH-20114-0002-U1234	Reactor Building Structure General Arrangement
NK38-DRAW-21133-10004	RBS Vault Wall E3 @ 87.700 to 114.600 EP Leak Test Inspection Containment EP Location
NK38-DRAW-38310-10001-U1	Reactor Building Boiler Drying and Contamination Exhaust Flow Diagram
NK38-FOH-33100-0001-U1234	Reactor Building Main Heat Transport Circuit Flow Diagram
NK38-FOH-75120-0001-U1234	Reactor Auxiliary Bay Instrument Air System Air Supply Flow Diagram
NK38-FOH-75130-0003-U1234	React Bldg and React Aux Bay Breathing Air System Unit Distribution Flow Diagram
NK38-F5H-32100-0001-U1234	Reactor Building and RAB Main Moderator and Auxiliary System Flow Diagram
NK38-F5H-32300-0001-U1234	Reactor Building and Reactor Auxiliary Bay Moderator Cover Gas System Flow Diagram
NK38-F5H-33210-0001-U1234	RB and RAB Primary Heat Transport System High Temperature Filtration Circuit Flow Diagram
NK38-F5H-33220-0001-U1234	Reactor Aux Bay Primary Heat Trpt Syst Purification Circuit Flow Diagram
NK38-F5H-38310-0001-U1234	Reactor Vault and Fuelling Duct Vapour Recovery System Flow Diagram
NK38-FEX-20100-1501	Reactor Building, RAB and Turbine AB Col Row A-T Col Line 8-16.5 Fl. El. 87.700 Plan
NK38-FEX-20100-1503	R.B., R.A.B. Turbine A.B. Turbine Hall, Row A-T, Line 2-16.5 Fl. El. 100.000m Plan
NK38-FEX-20100-1504	Reactor Building and RAB Row A-T Line 11-16.5 Fl. El. 104.400 Plan
NK38-FEX-20100-1510	Reactor Building and RAB Col Row A-T Col Line 11-16.5 Fl. El. 138.800 Rf. El. 145.900 Plan
NK38-FEX-20100-2508	R.B., R.A.B. and Turbine Aux Bay Col A-T Line 7.9-16.5 Fl. El. 122.500 Plan
NK38-FEX-20100-2509	R.B., R.A.B. and Turbine Aux Bay Col A-T Line 7.9-16.5 Fl. El. 131.500, 133.300 and 133.980 Plan
NK38-FEX-20102-2501	Equipment Layout El 87.70 RB, RAB and TB
NK38-FEX-20102-2502	Equipment Layout El 92.50 RB, RAB and TB
NK38-FEX-20102-2503	Equipment Layout El 100.000 RB and RAB
NK38-FEX-20102-2505	Equipment Layout El 107.500 RB and RAB
NK38-FEX-20102-2506	Equipment Layout El 111.0 RB and RAB
NK38-FEX-20102-2507	Equipment Layout El 115.0 RB and RAB
NK38-FEX-20102-2508	Equipment Layout El 122.5 RB and RAB
NK38-FEX-20102-2509	Equipment Layout El 131.5 RB and RAB
NK38-FEX-20102-2510	Equipment Layout El 138.0 RB and RAB
NK38-FEX-20102-2517	Equipment Layout El 116.4 RB and RAB
NK38-FEX-20102-2531	Equipment Layout Roof of RB, RAB, TH and TAB
NK38-FEX-21002-1501	Reactor Building Col. Row D-R , Line 12-15, Fl. El. 100.000m Equipment Location
NK38-FEX-21002-1502	Reactor Building Col. Row D-R , Line 12-15, Fl. El. 104.000m Equipment Location
NK38-FEX-21002-1503	Reactor Building Col. Row D-R , Line 12-15, Fl. El. 107.500m Equipment Location
NK38-FEX-21002-1504	Reactor Building Col. Row D-R , Line 12-15, Fl. El. 111.000m Equipment Location
NK38-FEX-21002-1505	Table for Equipment Located Inside Unit 1 Reactor Building
NK38-FEX-21065-1501	RB & RAB., Turbine A.B., Turbine Hall Row A-T, Line 2-16.5 Fl. El 100.00m Overhead Door Loc
NK38-FEX-35220-1501	Reactor Area Bridge and Carriage Equipment
NK38-G1H-76111-9001-U1234	Containment Vault Cranes- General Arrangement
NK38-G1H-76118-9001	General Arrangement Portable Hoisting Device 60 Mg Capacity
NK38-G1H-76147-9006	Central Service Area Lapping Room S114 500kg Overhead Crane General Arrangement
NK38-GEK-35220-0001-B1234	Reactor Area Bridge Control Dimensions

Document Number	Document Title
NK38-GEK-35221-0002-B1234 Sht 1	Reactor Area Bridge Column Specification
NK38-GEK-35221-0002-B1234 Sht 2	Reactor Area Bridge Column Specification
NK38-GEK-35221-9084 Sht 1	Fuel Handling Reactor Area Bridge R.H. Elevator Assembly
NK38-GEK-35221-9084 Sht 2	Reactor Area Bridge Right Hand Elevator Assembly
NK38-GEK-35221-9084 Sht 3	Reactor Area Bridge Right Hand Elevator Assembly
NK38-GEK-35221-9085 Sht 1	Fuel Handling Reactor Area Bridge L.H. Elevator Assembly
NK38-GEK-35221-9085 Sht 2	Reactor Area Bridge Left Hand Elevator Assembly
NK38-GEK-35221-9085 Sht 3	Reactor Area Bridge Left Hand Elevator Assembly
NK38-LAH-21022-1140	Personnel Airlock List of Materials
NK38-LAH-21022-1240	Personnel and Equipment Airlock List of Materials
NK38-SSP-76100-001	System Surveillance Plan for Cranes and Hoists

Appendix G: Overview of Tooling Change Control Categories

This PowerPoint presentation is included for reference only. Please refer to NK38-DR-31110-10000 & NK38-DP-31110-10001.

OPG Nuclear

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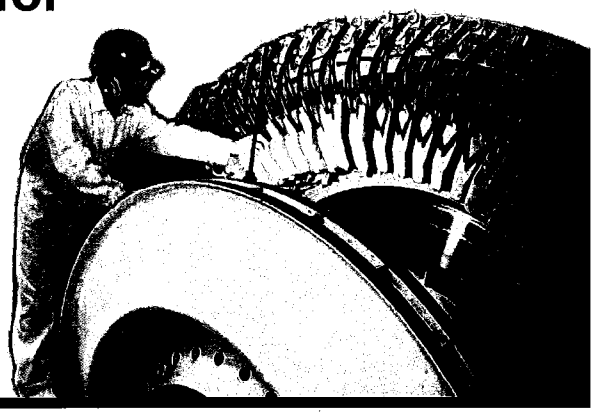
Modification Criteria for R&FR Tooling

Santosh Panda
Sr. Technical Engineer

September 2011



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Tooling Categories

All tooling falls into four categories summarized in the next few slides. They are as follows:

Category 1: Systems, Structures and Components Modifications

Category 2: Tooling that interfaces with permanent components (i.e. CTSB Bore) or with a Level 1 FME concern

Category 3: Tooling with FME concern lower than Level 1

Category 4: Off-the-shelf items and previously designed items

Category 1: Structures, Systems & Components

- Follow N-PROC-MP-0090 through the Engineering, Procurement, Construction Interface Requirements (N-DAI-00150-10000)
- This applies to all modifications to existing infrastructure within or around the Reactor Building as well as new additions to support tooling
- Eg. Retube Control Centre, Power Distribution System etc.
- Tie-ins in Station Structures, Systems & Components Eg. Tie-in to PHTS for Vacuum Dry System but not the skid itself

Category 2: Permanent Component Interface

- Use N-PROC-MP-0105 Process (Contractor Change Control Process) with COMS review process used in N-PROC-MP-0090
- As the tooling is owned by the Contractor, documents such as detailed drawings and technical specifications would be available for review only during the COMS reviews and not be entered into Passport nor be required to be accepted by OPG
- Commissioning required
- Eg. Calandria Tube Sheet Bore (CTSB) Polishing Tool, CTSB Refurbishment Tool, Vacuum Dry System Skid, Channel Drain Tool

Category 2: Tooling with Level 1 FME Concern

- All tools that will go inside the Calandria (i.e. beyond the e-face) falls into this category.
- Per N-PROG-MP-0010, "If an *engineered tool is taken inside Ontario Power Generation (OPG) equipment and could* leave foreign material behind, formal *Constructability, Operability, Maintainability and Safety* (*COMS*) *and design requirements shall be used to minimize the risk.*"
- Commissioning required
- Eg. CT Removal Tooling, FC Installation Tooling etc.

Category 3: Standard Designed Tooling

- No FME concerns or direct interface with permanent station systems or components.
- No COMS review required.
- Validation of Performance required.
- Eg. Feeder Coupling Shearing Tooling

Category 4: Off-the-Shelf Tooling

- Purchased tools that are commercially available
- Also applies to tooling that was previously designed, commissioned and executed with
- Minimal risk involved
- No Validation of Performance required.
- Eg. Welding machines, Reciprocating saws, PA Hardware Tooling etc.

Tooling Category Matrix

NOTE: For Category 1, all aspects of N-DAI-00150-10000 shall be followed. Below are select items from N-DAI-00150-10000.

Title	1	2	3	4
Submission of Controlled Documents (3.2)	*			
Modification Design Requirements (3.6)	*	*		
Design Plan (3.7)	*	*		
Regulatory Approvals (if req'd) (3.16-3.25)	*	*	*	*
Modification Outline (3.27)	*	*		
Design Scoping Checklist (3.28)	*	*		
COMS Review (3.29-3.31)	*	*		

Tooling Category Matrix (Con't)

NOTE: For Category 1, all aspects of N-DAI-00150-10000 shall be followed. Below are select items from N-DAI-00150-10000.

Title	1	2	3	4
Change Papers (3.39-3.42)	*			
Affected Equipment List Updates (3.50)	*			
Design EC Approval (3.64)	*			
Temporary Change Requests (TCRs) (3.70)	*			
Work Plan/Installation Instructions (3.80)	*	*		
Commission Specification (3.82)	*	*		
AFS Strategy (3.87)	*	*		
Closeout (3.92)	*			

PART II - NK38-SOW-09701-10005: DARLINGTON NUCLEAR REFURBISHMENT – OUTAGE UNIT CONTAINMENT ISOLATIONS

See attached.

ONTARIOPOWER GENERATION

Plan

OPG Proprietary General Business	
Document Number: NK38-SOW-09701-10005	Usage Classification: N/A
Sheet Number: N/A	Revision: R001 R3

Title:
DARLINGTON NUCLEAR REFURBISHMENT - OUTAGE UNIT CONTAINMENT ISOLATIONS

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Darlington Nuclear Refurbishment - Outage Unit Containment Isolations

NK38-SOW-09701-10005-R001
2017-06-16

Order Number: N/A
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General Business

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Feeder Replacement
Nuclear Refurbishment

Revision Summary

Revision Number	Date	Comments
R000	2011-11-01	Initial issue.
R001	2017-06-16	Internal and JV comments incorporated. Section 2.2.8 added (PCD #023).

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1.0 INTRODUCTION

OPG's Board of Directors, in November 2009, approved the refurbishment of the Darlington Nuclear Generating Station (DNGS) Reactor Units. A major component of Refurbishment involves the replacement of the reactor pressure tubes and feeders on all Units.

The feeders and pressure tubes are reaching their nominal design end of life. In order to continue to operate DNGS, these components are required to be replaced or refurbished.

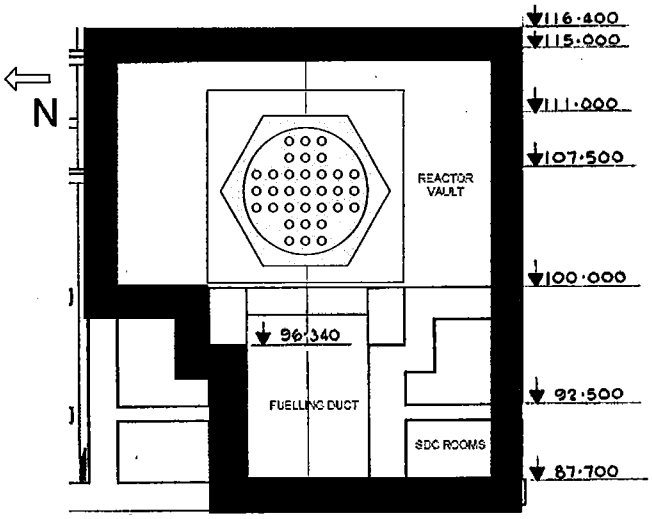


Figure 1: Normal Containment Boundary

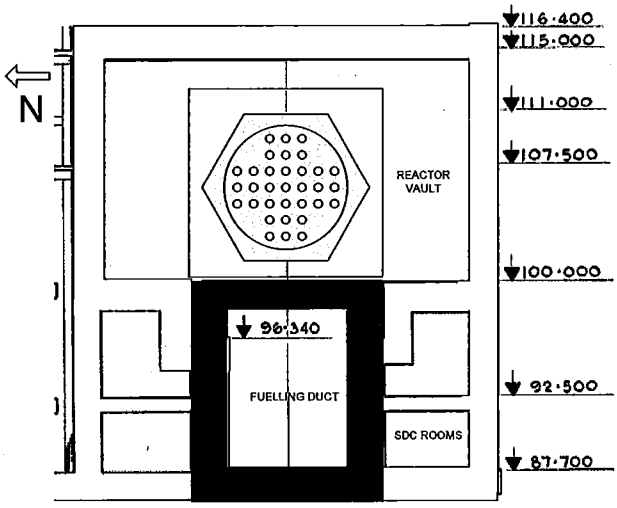


Figure 2: Refurbishment Containment Boundary

The Refurbishment of Units requires the containment boundary to be moved from the exterior reactor building structure to the reactor building and shutdown cooling room fuelling duct interfaces (See Figure 1 and Figure 2). This is required for three reasons:

(1) Per standard industry safe practice, the outage reactor vault will be isolated, from both the fuelling duct and other non-outage Units and adequate shielding will be installed. Movement of the containment boundary supports approval for leaving the airlocks open. This will support free movement of materials and personnel in and out of the work area and reduce the duration of refurbishment Unit critical path work and improve refurbishment worker efficiency.

(2) Operating Units need to be protected from the work occurring in the refurbishment Unit. This includes prevention of refurbishment work foreign material interfering with fuelling trolley operations and ensuring no impact on operating Unit systems.

(3) The refurbishment Unit needs to be protected from activities or events in the operating Units.

During normal operation, the reactor vault is connected to the fuelling duct through four systems:

1) The Reactor Vault Atmospheric System (RVAS) – The RVAS provides the HVAC cooling needs for a running Unit. It consists of reactor vault Air Conditioning Units that circulate air between 1) the fuelling duct area right under the vault, 2) the shutdown cooling room, and 3) the reactor vault interior.

2) The D_2O Collection Recovery Circuit penetrations – This provides a drain and collection path for leaked D_2O. The Shutdown cooling (SDC) rooms includes a system of penetrations that allow for the draining of collected D_2O from collection trenches in the SDC rooms to the fuelling duct D_2O recovery trench, where it is then pumped to the collection tanks. During normal operation these penetrations provide flood protection. Prior to opening the reactor vault airlocks, in order to maintain containment integrity these openings will need to be temporarily sealed. There are at least three sets of Embedded Parts (EPs) that need to be sealed.

3) Fuelling Trolley openings – These consist of openings in the reactor building floor through which the fuelling machine head, transported by trolley, delivers new fuel and removes irradiated fuel. These openings have vertical bulkheads installed around them that allow for the installation of temporary bulkheads for Unit containment commissioning and maintenance purposes. Since the initial commissioning of the station, an opening was installed in these vertical bulkheads in order allow inspection personnel to access the fuelling duct from inside the reactor vault.

4) The Fuelling Duct/Reactor Vault and Shutdown Cooling Room/Reactor Vault Interface Walls - The fuelling duct walls and ceiling are shared with the reactor building interior structure walls and shutdown cooling room structural walls.. In normal operating mode, these walls are not considered part of the containment boundary. However, during refurbishment when the airlocks are opened, these walls will become part of the containment boundary. Penetrations through these walls must be sealed, in order to maintain containment boundary integrity.

In order to support moving the containment boundary to the interface between the fuelling duct and the reactor vault and shutdown cooling rooms, the following must be done on the refurbishment Units:

1) The reactor vault fuelling duct openings must be closed with temporary bulkheads that meet the latest containment requirements.

2) The RVAS needs to have containment qualified isolations applied in order to isolate the reactor vault atmosphere from the fuelling duct atmosphere.

3) All Physical openings between the SDC room and the fueling duct need to be temporarily sealed, with containment qualified seals.

4) All physical openings between the reactor vault and the fuelling duct need to be temporarily sealed, using containment qualified methods.

5) The sealing methods, including the temporary bulkheads, must be commissioned after they are installed in the field, in order to prove that the containment integrity and the design basis of the plant is maintained.

6) All sealing methods must have sufficient shielding installed in order to protect workers in the refurbishment Unit from the radiation hazards of the operating Units. This includes the radiation fields from irradiated fuel being transported through the fuelling duct.

This document details the scope for work for the design, construction, testing, commissioning, maintenance and removal for the Outage Unit Containment Isolation. The work shall be executed on all four Reactor Units at Darlington.

2.0 DEFINITION PHASE WORK

2.1 General

The Contractor shall perform a turn-key service based on the Definition Phase Target Cost Structure. All aspects of the Work shall follow an Engineering, Procurement and Construction (EPC) model using the Contractor/Owner Interface Requirements [R-2]. The Work shall be completed in accordance with the Definition Phase Target Schedule.

2.2 Contractor Responsibilities

The Contractor shall provide all elements of the Work as described below. The following list is intended to be a high level list of required items and is not intended to be an exhaustive list. The Contractor is responsible for building an overall program that meets the intent of the scope of work.

2.2.1 Containment Isolation Component Design

The Contractor shall design all components required to complete the scope of work as described in the Section 3.2: Scope of Work. The design of all components shall be completed per the Preliminary Design Requirements [R-19]. After detailed design has been completed, the design shall be verified using appropriate modelling techniques.

At a high level, the components must be designed:

1. to act as the new or extensions to the existing containment boundary

2. to provide adequate isolation and shielding for workers for the refurbishment Unit from the rest of the operating DNGS Units,

3. not to interfere with the fuelling trollies of the operating Units,

4. interface with the Retube and Feeder Replacement (R&FR) Tooling and platform setup as required.

The Contractor shall also determine whether the existing DNGS commissioning bulkheads can be used based on the updated design requirements. If the Contractor chooses to reuse the original bulkheads, the Contractor shall be responsible for all dispositions (including physical inspections and technical evaluation) to prove that the existing bulkheads are adequate to complete the scope of work. The Contractor will also be responsible for the re-registration of the existing bulkheads.

2.2.2 Component Procurement

The Contractor shall procure all necessary components, material, Tooling and any other Goods and services required to complete this scope of work to support a maximum of two Unit refurbishments simultaneously. All procurement shall be completed in accordance with the Contractor/Owner Interface Requirements[R-2] and shall use vendors on the OPG approved supplier list.

The Contractor shall assume that there will be no long term storage available at DNGS for material, Tooling and Goods related to this scope of work. The Contractor shall arrange for warehousing to store all material, Tooling and Goods until the time they are needed. The Contractor shall apply for staging space at DNGS through the Nuclear Refurbishment Space Allocation of Transient Materials (SATM) process SPOC.

The Contractor will also be required to develop a comprehensive material management program to individually track and account for all material, Tooling and Goods related to this scope of work. The Contractor shall identify all long lead items related to the scope of work. The Contractor shall initiate the procurement process in time to meet established milestones and document any delivery risks in the Material Management Plan and the Risk Register.

2.2.3 Documentation

The Contractor shall use the Retube and Feeder Replacement (R&FR) Definition Phase Submittal Schedule as a guideline for all Submittals required during the Definition Phase. Many of the Submittals can be done in conjunction with the R&FR deliverable; however, due to the nature of the work, some Submittals may have to be done independent of R&FR.

The following is a list of Documentation that shall be required during the Definition Phase. For milestone dates, please refer to the R&FR Definition Phase Submittal Schedule.

2.2.3.1 Documentation in conjunction with R&FR

For the following Documents, information pertaining to containment isolation can be integrated into the R&FR equivalent Document.

- Quality Design Plan
- Unit Outage Walkdown Reports
- Project Estimating Plan
- Project Management Plan- Definition Phase
- Project Management Plan- Execution Phase
- Schedule Management Plan
- Engineering Plan
- Cost Management Plan
- Communication Plan
- Resource Management Plan
- Scope Management Plan
- Risk Management Plan
- Deliverables Plan
- Materials Management Plan
- Waste Management Plan
- Site Infrastructure and Layout Plan
- Site Specific Safety Plan- Mock-Ups
- Site Specific Safety Plan- Execution
- Class 5 Estimate, Level 2 Schedule
- Class 4 Estimate, Level 3 Schedule
- Class 3 Estimate, Level 4 Schedule
- Class 2 Estimate, Level 5 Schedule
- Interface Coordination Plan
- Procurement Management Plan
- Trades Onboarding Plan
- Training Plan (Execution)
- Mock-ups Training Plan

2.2.3.2 Documentation independent of R&FR

The following Documents shall be prepared separately from R&FR Documentation following the milestone dates in the R&FR Definition Phase Submittal Schedule. These Documents shall be reviewed and accepted or approved by OPG.

- Conceptual Design Report
- Modification Preliminary Design Review and COMS
- Modification Final Design and COMS
- Ops/Maintenance Documentation updates
- Walkdown Field Condition Reports
- Quality Assurance Plan
- ALARA Plan
- FME Plan
- Inspection and Test Plans (ITPs)
- Comprehensive Work Packages (CWPs)
- Job Safety Analysis (JSAs)
- Workplans for Installation and Commissioning (OPG format) [R-14 to R-18]
- Space Allocation of Transient Materials (SATM) Permits
- CNSC Approval package to support modification to Special Safety Systems
- A detailed Record of all inspections, evaluations and repairs performed shall be turned over to OPG as part of turnover activities.

2.2.3.3 Commissioning Documentation

The Contractor shall also provide all workplans and procedures to meet the requirements of Section 3.2.3: Bulk Head Commissioning and Reactor Vault Containment Tests. These Documents shall be reviewed and authorised by OPG.

The Contractor shall produce the following Documentation, which will be used as the baseline for commissioning:

a) Bulkhead Commissioning Specification

b) Testing Strategy and Requirements

c) Bulkhead Commissioning and Reactor Vault Containment Test Acceptance Criteria

d) Test Equipment Specifications

e) Calculation Methodology

f) Instrumentation Calibration Records

g) Analysis Software /Analysis Calculation Documentation

h) CNSC Approval of Testing Strategy

i) Test Equipment and Instrumentation Specification

j) Copy of Electronic Test Data - including one copy in a comma delimited format.

k) Preliminary Test Results

l) Final Commissioning Reports

m) Final Test Reports and results

n) List of Software used in analysis and record of OPG Grade One or N286.7 compliance

o) All test analysis documentation required under N286.7 for grade 1 software requirements

The Contractor shall provide the specification, documentation and seek approval of a testing strategy for the Containment Commissioning Tests and the Reactor Vault Containment Tests. This includes all documentation and support required to document testing for OPG NR acceptance, regulatory compliance, regulatory approval and execution purposes. This includes examining the use of existing plant in-service leakage tests for use in the testing. The Contractor shall also define measurable, practical and repeatable Acceptance Criteria, and tolerances for the tests.

2.2.3.4 Design Requirements

Using the Preliminary Design Requirements [R-19], the Contractor shall produce a Conceptual Design Report (CDR) outlining the various options to complete Containment Isolation for the DNGS Units. The basic format for a CDR is as follows:

- Introduction/Background
- Scope
- OPEX
- Basis and Methodology- Decribe the minimum requirements covered by each option
- Assumptions- Assumptions and associated risks
- Description- Describe each option (including testing and commissioning provisions).
- Comparison- Compare the options above
- Recommended Option- Make a recommndation and justify

- References
- Appendices

The Contractor shall complete a review of the most recent relevant design manuals, preliminary Containment Analysis, updated Nuclear Safety Analyses, updated Nuclear Safety Design Guides, and updated License requirements. This includes, but is not limited to, the following:

- Darlington Design Manual, "Isolation and Containment Bulkheads," NK38-DM-21126
- Darlington Design Manual, "Reactor Building Structure," NK38-DM-21100
- Darlington Design Manual, "Containment System - System Overview," NK38-DM-34200
- Darlington Design Requirements, "NK38-DR-34200-10001, Negative Pressure Containment System (npcs) – Overview"
- NK38-CORR-03610-0406650 Unit Islanding - Bulkhead Design Assist: Shielding Analysis. This document is expected to be issued in December 2011 by the Nuclear Safety Analysis group.
- NK38-REP-03610-0406651 Unit Islanding - Bulkhead Design Assist: Containment Analysis. This document is expected to be issued in December 2011 by the Nuclear Safety Analysis group.
- Darlington Design Manual, "Personnel And Personnel/equipment Airlocks," NK38-DM-21022
- NK38-DG-03650.6, Containment The updated revision of this guide is not currently available. Update of this guide is the responsibility of OPG Nuclear Safety Compliance group
- Seismic Spectra as specified in updated Nuclear Safety Design Guide, "Common Mode Incidents - Seismic Design," NK38-DG-03650.2B-R01. The updated revision of this guide is not currently available. Update of this guide is the responsibility of OPG Nuclear Safety Compliance group
- Updated Nuclear Safety Design Guide, "Extensions of the Containment Envelope," NK38-DG-03650.7. The updated revision of this guide is not currently available. Update of this guide is the responsibility of OPG Nuclear Safety Compliance group.
- NK38-DG-03650.2A- Common Mode Incidents Overview and Design Requirements

- NK38-DG-03650.8- Environmental Qualification of Safety Related Equipment
- Updated Nuclear Safety Analysis
- Updated Environmental Qualification analysis

The Contractor will then incorporate the information from these sources, into a Modification Design Requirements (MDR) per the Contractor/Owner Interface Requirements for Nuclear [R-2] for the bulkhead design, bulkhead seal plates and bulkhead supporting structure. The new MDR shall be approved by the OPG Nuclear Refurbishment Design Authority.

The Contractor shall also update the Darlington Nuclear Design Manual for "Isolation and Containment Bulkheads," NK38-DM-21126, to incorporate changes resulting from the updated bulkhead design, updated Nuclear Safety Design Guides and updated Nuclear Safety Analyses.

2.2.4 Installation and Removal Tooling

The Contractor shall provide all Tooling necessary to assist in the installation and removal of all designed components in this scope of work.

For all custom Tooling design, the Contractor shall follow N-PROC-MP-0105: Quality Design Plan and N-PROG-MP-0010: Engineered Tooling Change Control, as well as the Contractor/Owner Interface Requirements. The Contractor shall produce a Quality Design Plan for OPG's review and acceptance

2.2.5 Pre-Refurbishment Outages

In general, the Contractor shall attempt to complete any preparatory work or modifications required to complete Containment Isolation in the outages prior to Refurbishment. The Contractor shall also verify, in the field, all information provided by OPG. OPG shall provide all applicable drawings and 3-D Laser Scans of Units 1 and 2. Laser scans for Unit 3 and 4 are currently in the planning stages and shall be provided to the Contractor when completed. If, for some reason, OPG cannot complete the laser scans on the last two Units, the Contractor will be required to depend on field walkdowns during Unit outages and drawings. Field walkdowns can be arranged by OPG at the request of the Contractor for any upcoming outage with adequate Notice.

The following are upcoming outage dates at Darlington NGS (all dates tentative):

Unit 3- Spring 2012

Unit 4- Spring 2013

Unit 2- Fall 2013

Unit 1- Spring 2014

Unit 3- Spring 2015

Unit 4- Spring 2016

2.2.6 Nuclear Safety Analyses

The analysis required for an updated Nuclear Safety Analysis, Safety Report, Nuclear Safety and Design Guides and Licensing document, based upon the reduced containment volume, resulting from bulkheads installation and the LOCA location sensitivity analysis, is not within the scope of this work. It will be the responsibility of the Contractor to provide detailed design information for the Nuclear Safety Analysis update. The Contractor will then incorporate the Nuclear Safety Analysis results into the final design, design packages and commissioning requirements for the scope of work, as per the Contractor/Owner Interface Requirements for Nuclear [R-2].

2.2.7 Operational Experience

The Contractor shall obtain and incorporate into the design and execution, any relevant lessons learned from Operational Experience (OPEX) through sources such as Darlington Commissioning, Bruce Retube and Feeder Replacement work and the nuclear industry. OPEX from preliminary reviews of DNGS Commissioning and Design Documentation are provided in Appendix C. OPEX reviews are to be documented as part of the Engineering Change Packages as per Contractor/Owner Interface Requirements for Nuclear, [R-2].

2.2.8 Pre-Refurbishment Field Work

The Contractor will be responsible for completing the field work for temporary sealing of the Flood Protection Openings located between the Shutdown Cooling Room and the Fueling Duct per the Table below:

Table 1: Flood Protection Openings to be sealed

Applicable Unit	EP Number	System	EP Location Drawing NK38-DOH-
2	00795	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00794	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00804	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00793	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00792	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00788	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00791	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX
2	00800	Fueling Duct D2O Recovery Trench, South Side of Fueling Duct	21133-2023-UX

2.3 OPG Responsibilities

For this scope of work, OPG is responsible for the following:

1. Provide preliminary design requirements
2. Updated Nuclear Safety Analysis and Design Guides.
3. Radiation Protection support for the installation of radiation monitoring equipment after installation and successful commissioning of the bulkhead.
4. Periodic testing of containment under the Darlington Operating License N287.
5. Seeking exemption from the time restrictions on Temporary Modifications from the Chief Nuclear Engineer (CNE).
6. All Document approvals per Contractor/Owner Interface Requirements
7. Coordination between interfacing projects (See Appendix B)

2.4 Modification Process

The Contractor shall be responsible for completing all modifications to Structures, Systems and Components required to complete the Work. The design work relating to the Containment Isolation shall be completed in accordance with the Contractor/Owner Interface Requirements for Nuclear [R-2] and the Modification Process [R-3]. This includes, but is not limited to the following:

- Design and fabrication drawings

- Design manual update submissions
- Requests for operations manual updates, and supporting documentation
- CNSC approval/notification submission package

The Contractor will provide and execute Non-Identical Component Replacement (NICR) packages as required, where materials specified on existing drawings are no longer available or obsolete. This includes the specification of replacement materials, and updates of documentation such as Master Equipment Lists (MEL), Bill of Materials (BOM) and Affected Drawings.

All modifications and repairs must be designed, built and commissioned, as required, in compliance with DNGS PROL N287 and N285 standards and the updated Nuclear Safety Analysis.

All permanently installed repair materials and systems used on civil containment structures, and plant equipment, systems and structures shall have a minimum 40 year lifespan. Materials used on civil containment structures shall be containment boundary qualified and installed as per approved design, specification or technical procedure.

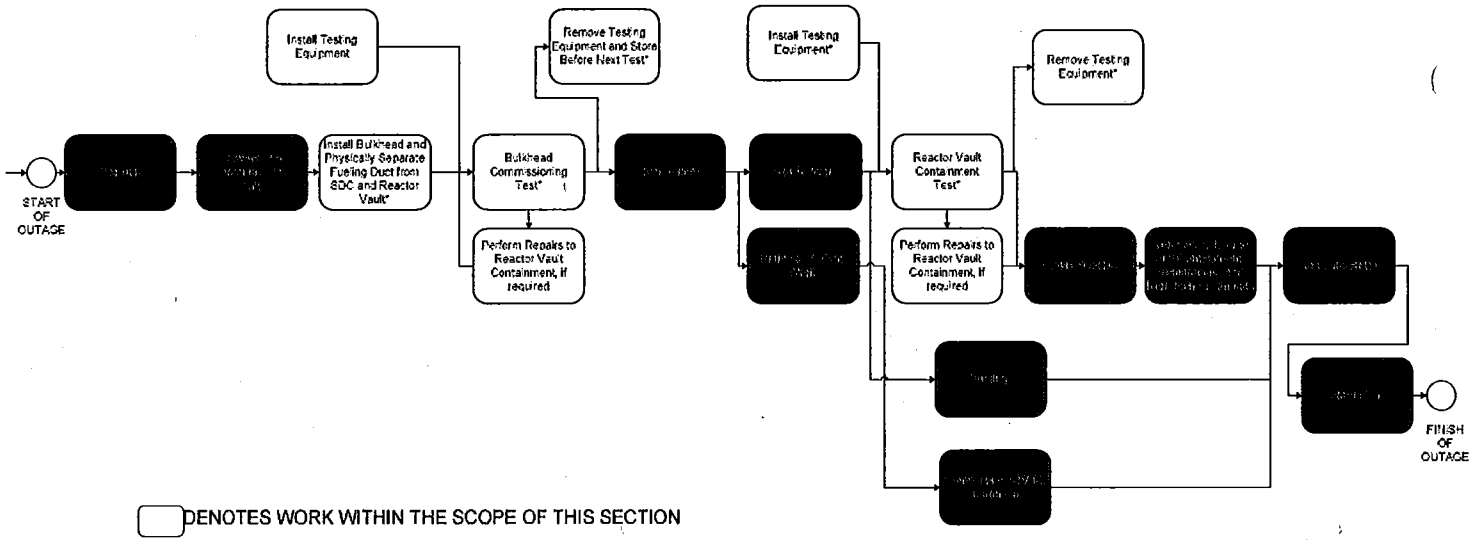
2.5 Release Quality Estimate

For guidance on the development of the release quality estimate, please refer to the RFR Scope of Work, NK38-SOW-31100-10016, Section 2.3.4.

3.0 EXECUTION PHASE WORK

3.1 Overview

The following illustrates the general logic and dependencies between the Execution Phase of the scope of work and other vault projects. It does not reflect tasks scheduled on the OPG integrated schedule, and is not meant to be used for scheduling purposes by the Contractor. The Contractor is responsible for their own Project schedule and the scheduling and coordination of their work on the OPG integrated refurbishment schedule.



DENOTES WORK WITHIN THE SCOPE OF THIS SECTION

NB: FLUSHING OF THE FUEL CHANNELS IS NOT INCLUDED IN THIS LOGIC

Figure 3: Outage Logic

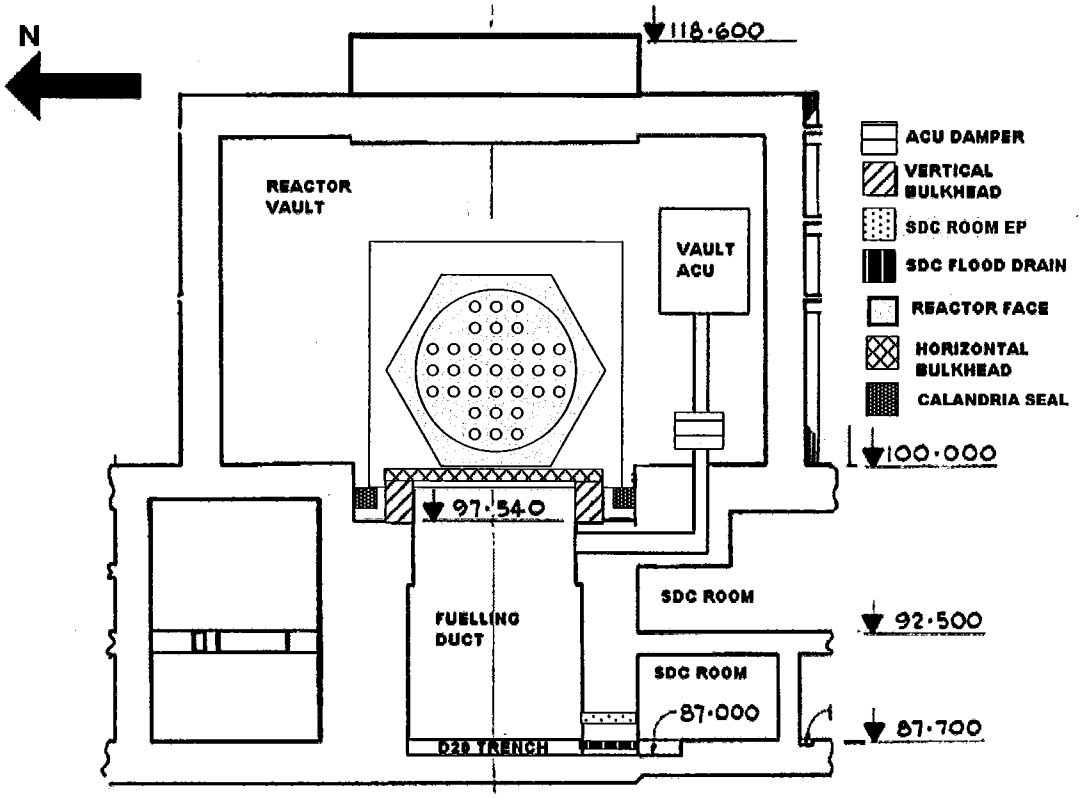


Figure 4: Illustration of the Reactor Vault

The scope of work can be divided into three components:

1) Bulkhead and Support Structures

2) Sealing Of Fuelling Duct Openings into the Reactor Vault and Shutdown Cooling Rooms

3) Bulk Head Commissioning and Reactor Vault Containment Tests

The Contractor will need to address the specific requirements for these components of work. The following sections describe the specific requirements, for each major phase of work, that need to be executed by the Contractor for this SOW.

3.2 Scope of Work

3.2.1 Bulkhead and Support Structures

This component of the Work supports the movement of the containment boundary from the reactor vault walls, to the interface between the reactor vault and fuelling duct shared walls. The Work involves closing off the fuelling trolley openings, located in the reactor vault floor, using containment isolation bulkheads or another appropriate design.

Installation of containment isolation bulkheads includes:

1) The installation/modification of structural supports to hold and secure the bulkheads
2) The installation of shielding to protect the reactor vault interior and personnel from irradiated fuel being transported through the fuelling duct.
3) Installation of seal plates and seals between and around the sections of isolating bulkhead. These seal plates will act as a barrier to prevent radiological contamination being released into the refurbishment Unit, while the reactor vault airlocks are kept open during refurbishment work.
4) Repair and sealing of discontinuities on existing supporting structures (Vertical Bulkheads), in order to allow for installation of the bulkheads and ensure containment integrity.

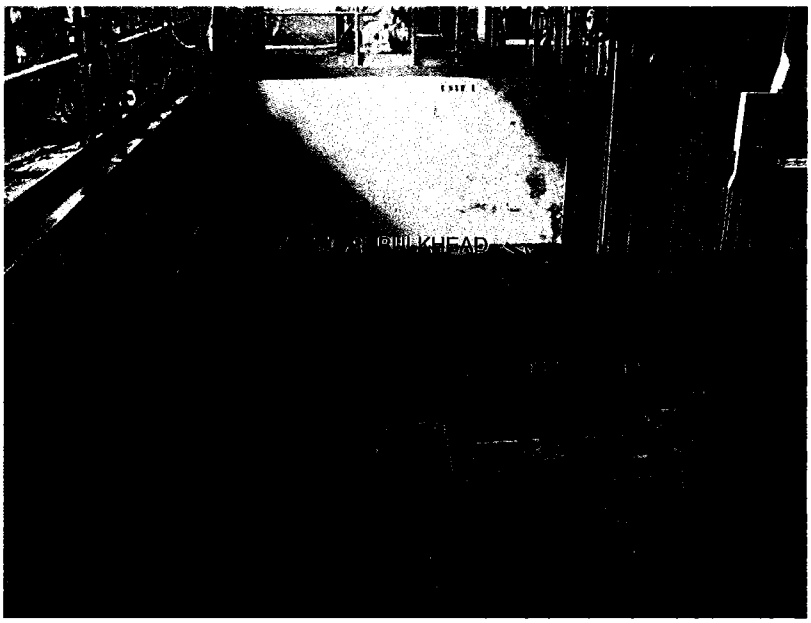
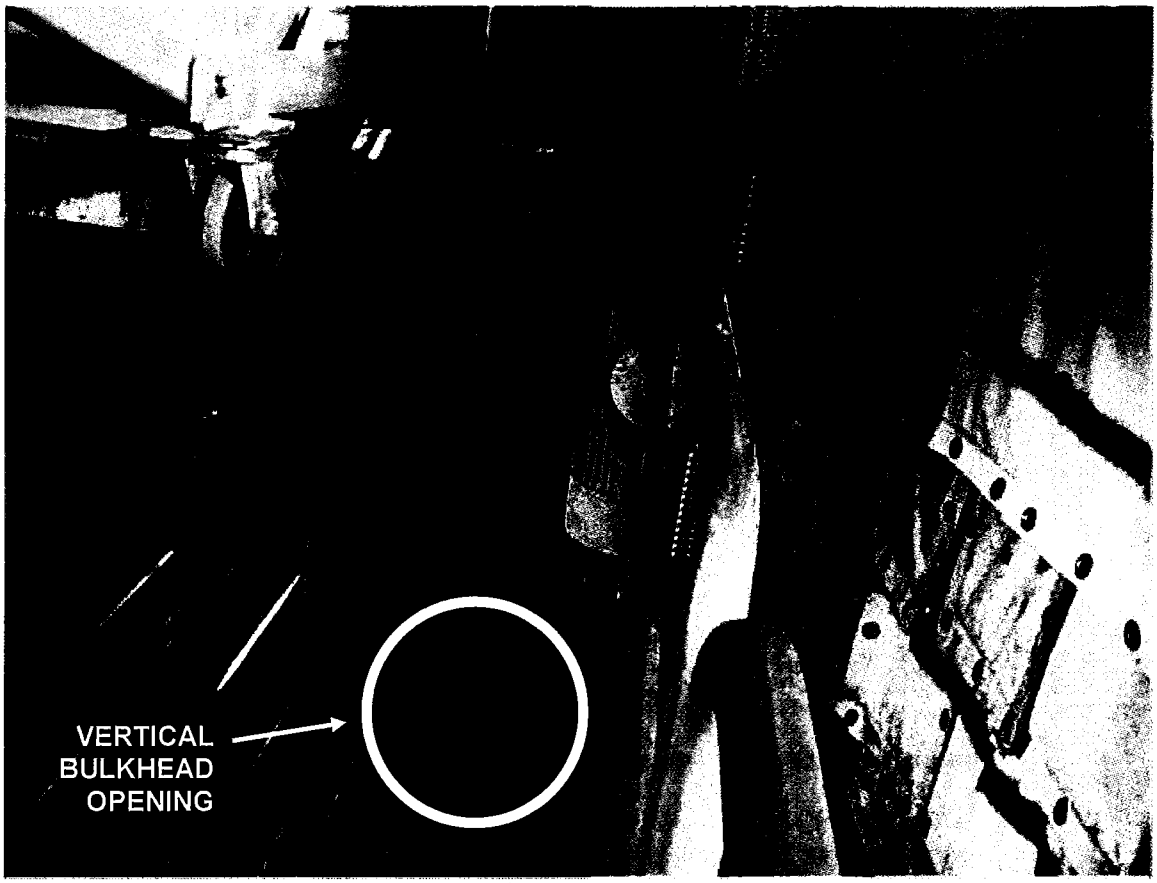


Figure 5: Vertical Support Bulkhead and Catenary Deflector

This includes but is not limited to the following scope:

The Contractor shall review the current sealing methods for the drain holes in the vertical bulkheads of each Unit (refer to NK38-D0H-21126-5013- U1/U2/U3/U4 drawings) against the design requirements for containment from updated Nuclear Safety Analysis and updated Nuclear Safety Design Guide. The Contractor will be responsible to modify the design, as required, to ensure containment integrity is maintained during refurbishment. The designs for sealing these openings must be removable.

The Contractor will remove the Catenary Deflector prior to the installation of the isolation bulkheads. The Catenary Deflector is currently installed on the bulkhead supports located in the fuelling duct and is used to protect the fuelling head Catenary from becoming snagged on the support during fuelling operations.



The Contractor will be required to modify the vertical bulkhead (MK14) openings in each Unit to ensure an adequate containment boundary. Post-refurbishment access will be required to support inspection work, such as the Universal Delivery Machine. Design should consider either developing a solution that can either be easily removed after the completion of refurbishment or implementing a permanent modification that allows simple access.

3.2.2 Sealing Of Fuelling Duct Openings into the Reactor Vault and Shutdown Cooling Rooms

This Work involves establishing the following interfaces as the new containment boundary:

(1) The interface between the Fuelling Duct and the SDC

(2) The interface between the Reactor Vault and the Fuelling Duct.

This Scope of Work involves the isolation of the physical civil containment structure of the Reactor Vault (RV) and Shutdown Cooling Rooms (SDC) from the operating Fuelling Duct (FD), by temporarily sealing openings in the civil structure with airtight, shielded and containment qualified methods. The work within this scope should be tested independently to the extent practical and prior to the execution of the bulkhead commissioning tests. This includes the following scope:

1. Closure of Reactor Vault Atmosphere System Dampers and installation of Isolation Blanks on the system

   This involves the closure of manual and motorized dampers and installation of containment qualified blind flanges and air tight seals, to ensure separation of the vault atmosphere cooling system from the fuelling duct cooling system. All Work relating to the RVFDACS includes but is not limited to the following equipment:

Unit	USI	Equipment Description	Flowsheet Reference
1	1-73720-DP12	ACU 1 Damper	NK38-FEX-73720-1501
	1-73720-DP19	ACU 2 Damper	
	1-73720-DP47	ACU 3 Damper	
	1-73720-DP48		
	1-73720-DP51	ACU 4 Damper	
	1-73720-DP52		
2	2-73720-DP12	ACU 1 Damper	NK38-FEX-73720-2501
	2-73720-DP19	ACU 2 Damper	
	2-73720-DP47	ACU 3 Damper	
	2-73720-DP48		
	2-73720-DP51	ACU 4 Damper	
	2-73720-DP52		
3	3-73720-DP12	ACU 1 Damper	NK38-FEX-73720-3501
	3-73720-DP19	ACU 2 Damper	
	3-73720-DP47	ACU 3 Damper	
	3-73720-DP48		
	3-73720-DP51	ACU 4 Damper	
	3-73720-DP52		
4	4-73720-DP12	ACU 1 Damper	NK38-FEX-73720-4501
	4-73720-DP19	ACU 2 Damper	
	4-73720-DP47	ACU 3 Damper	
	4-73720-DP48		
	4-73720-DP51	ACU 4 Damper	
	4-73720-DP52		

2. Temporary sealing of Flood Protection Openings located between the Shutdown Cooling Room and the Fuelling Duct

   This involves producing air tight, shielded and containment qualified seal plugs/ sealing flanges for the SDC room flood control penetrations. The Contractor will

also be responsible for the inspection, assessment and execution of permanent repairs [R-23] to the concrete structure to support this work. A preliminary list of the affected EPs, includes, but are not limited to, the following:

Applicable Unit –X	EP Number	System	EP Location Drawing
1,2,3,4	DP 01466	Shutdown Cooling Drains	NK38-D0H-21133-2027-UX
1,2,3,4	DP 01464	Shutdown Cooling Drains	NK38-D0H-21133-2023-UX
1,2,3,4	DP 01465	Shutdown Cooling Drains	NK38-D0H-21133-2023-UX

3. Isolation of the drain paths and miscellaneous unsealed penetrations located between the Shutdown Cooling Room Sump and the Fuelling Machine Duct Unit Recovery Trench

   This involves producing air tight, shielded and containment qualified seal plugs/ sealing flanges for the spare open Civil EPs and process EPs. The Contractor shall assess and design or specify the repairs [R-23] or sealing methods for openings or deficiencies (i.e. cracks, holes) of the concrete structure and EPs that will be found during pre-outage inspections, pre-containments test inspections and post-containment test inspections.

   The Contractor will be responsible for the execution and commissioning of permanent repairs [R-23] to the concrete structure and EPs, based upon designs provided by the Contractor, prior to the conducting the containment tests. This includes the following:

   a) Inspection of the duct engineered penetrations and Record of inspection findings

   b) General condition assessment of the duct/RV containment boundary structural components

   c) Detailed Record of areas that require repair and Records of the repair performed, as per specified design

   d) Record of repair commissioning/post maintenance testing results

A preliminary list of the affected EPs, includes, but are not limited to, the following:

Applicable Unit –X	EP Number	System	EP Location Drawing	Notes
1,2,3,4	EP 06005S	Possible Upper Set Drainage Holes	NK38-DOH-21133-2027-UX	Needs to confirm if this is an open EP.

Applicable Unit –X	EP Number	System	EP Location Drawing	Notes
1,2,3,4	EP 06006S	Possible Upper Set Drainage Holes	NK38-DOH-21133-2027-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 06008	Possible Upper Set Drainage Holes	NK38-DOH-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 06007	Possible Upper Set Drainage Holes	NK38-DOH-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00788	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00789	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00790	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00791	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00792	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00793	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00794	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00795	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00801	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00802	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00803	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,3,4	EP 00804	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on South side of Fuel Duct.	NK38-D0H-21133-2023-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00808	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on North side of Fuel Duct.	NK38-D0H-21133-2021-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00809	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on North side of Fuel Duct.	NK38-D0H-21133-2021-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00820	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on North side of Fuel Duct.	NK38-D0H-21133-2021-UX	Needs to confirm if this is an open EP.

Applicable Unit –X	EP Number	System	EP Location Drawing	Notes
1,2,3,4	EP 00821	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on North side of Fuel Duct.	NK38-D0H-21133-2021-UX	Needs to confirm if this is an open EP.
1,2,3,4	EP 00822	Possible Fuelling Duct D_2O Recovery Trench Drainage/Open EP, Located on North side of Fuel Duct.	NK38-D0H-21133-2021-UX	Needs to confirm if this is an open EP.

4. Installation of seals/blanks, seal plates and shielding on existing EPs, in order to support the definition of the Fuelling Duct/Reactor Vault and SDC Room interface structures as the new containment boundary.

   All EPs that penetrate the interface between the Reactor Vault and Shutdown Cooling Rooms and the Fuelling Machine Duct shall be reviewed by Contractor in order to ensure that they are properly sealed and containment integrity is maintained throughout Refurbishment. These EPs must be reviewed in order to identify the EPs that require additional shielding and sealing requirements in order to be qualified as containment EP. This work will require the Contractor to do a full evaluation of the system, including verification of drawings and verification of affected equipment scope. Based on this evaluation, the Contractor shall specify and install air tight, shielded and containment qualified requirements and designs for those EPs that cannot be qualified as containment EPs under their current configuration.

   The Contractor will also be responsible for assessing and design or specify the repairs [R-23] or sealing methods for openings or deficiencies (i.e. cracks, holes) of the concrete structure and EPs that will be found during pre-outage inspections, pre-containments test inspections and post-containment test inspections.

   The Contractor will be responsible for the execution and commissioning of permanent repairs [R-23] to the concrete structure and EPs, based upon designs provided by the Contractor, prior to the completion of the containment tests. This includes the following:

   a) Inspection of the duct engineered penetrations and Record of inspection findings

   b) General condition assessment of the duct/RV containment boundary structural components

   c) Detailed Record of areas that require repair and Records of the repair performed, as per specified design

   d) Record of repair commissioning/post maintenance testing results

The EPs, to be reviewed include, but are not limited to, those listed on the following drawings:

Applicable Unit -X	EP Location Drawing	Area
1,2,3,4	NK38-D0H-21133-2021-UX	North West Fuelling Duct/Reactor Vault Interface, el. 87 to 100
1,2,3,4	NK38-D0H-21133-2023-UX	South West East Fuelling Duct/Reactor Vault Interface, el. 87 to 100
1,2,3,4	NK38-D0H-21133-2025-UX	North East Fuelling Duct/Reactor Vault Interface, el. 87 to 100
1,2,3,4	NK38-DOH-21133-2027-UX	South East Fuelling Duct/Reactor Vault Interface, el. 87 to 100

5. Inspection and repair, replacement or modification, as required, of the calandria seal and calandria seal supporting frame in order to seal the opening from the reactor vault into the fuelling duct, located under calandria shield tank with containment qualified designs. As of the date of this SOW, a preliminary evaluation of the currently installed materials has been conducted. OPG cannot confirm the installed configuration of the Calandria Seals for Units 2 and 3. Also, the materials that are currently specified on drawings and are currently installed on the field cannot meet the current standard for environmental qualifications. As a result the contractor will be responsible for either specification of a new material to act as a seal, or complete re-design of the system in order to provide a containment barrier.

   The Contractor will be responsible for the inspection and design of modifications to the calandria seal and calandria assembly or, replacement with a different sealing system prior to the start of the containment tests. This includes the following:

   a) General feasibility assessment of the current calandria seal mounting assembly design and evaluation of replacement or modification of design to allow the assembly to act as an containment boundary (to be included in the CDR).

   b) Specification of the repairs, replacement or execution of the modification required to provide a containment qualified closure. This includes specification/ design of any required repairs [R-23] or sealing methods for openings or deficiencies (i.e. cracks, holes).

   c) If replacement is being performed, the Contractor's responsibilities include conducting the updated Environmental Qualification for the calandria seal design (if required), and containment and design analysis for qualification of the calandria seal as containment boundary. Responsibilities under replacement work include specification and supply of the replacement calandria seal.

d) The Contractor will be responsible for any repair work required to install the closure method over the calandria seal area. This includes providing the inspection criteria, detailed record of inspections and areas requiring repair, records of the repair performed and the specification and approval of any repair materials being used at site.

e) Commissioning/post maintenance testing of repairs as required by the operating license and code requirements. (Section 6.1)

3.2.3 Containment Commissioning and Reactor Vault Containment Tests/Shutdown Cooling Rooms

The Contractor shall be responsible to repeat of the containment commissioning tests and the reactor vault commissioning tests as required until a successful test is achieved.

Where practical, all seals, blanks, isolation measures, repairs and designs shall be commissioned and/or tested prior to the Containment Commissioning Test in order to ensure that the test results are indicative of the bulkhead performance (i.e. leakage is not from improperly sealed EPs).

There are two containment tests associated with this Work.

1. The Containment Commissioning Test- This test commissions the newly installed bulkheads and seals on fuelling duct openings to the Reactor Vault and SDC and can act as the new containment boundary for the refurbishment unit. The commissioning of containment must be successfully completed before the airlocks on the unit can be opened and R&FR work can be started in the unit.

2. The Reactor Vault Containment Test is done before the Reactor Vault Containment structure can be returned to service and the isolation from the fuelling duct can be removed.

More detailed information of the test strategy will be provided at a later date.

For both tests listed above, the Contractor shall be responsible for the following:

1) Develop a testing system and provide all necessary equipment to adequately ensure that the total containment isolation system meets the modificatation design requirements and regulatory requirements

2) Provide all commissioning documentation per Section 2.2.3.3.

3) Preparatory work required to ensure that the bulkheads and the sealing of openings through the Reactor Vault and the SDC rooms pass the first time the Bulkhead Commissioning Test is performed to the extent practical.

4) Install all equipment required for all testing.

5) Ensure that all equipment is calibrated prior to test execution.

6) Provide onsite support during test execution and provide preliminary result analysis.

7) Provide the necessary repairs or modifications in the event that the test fails on all new or existing equipment and structures.

8) Provide approved Commisioning Test Report for OPG acceptance (and possible submission to the CNSC) including signed and dated original or legible copies of documentation pertinent to commissioning of the scope of work, including, but not limited to:

   (a) Commissioning test results
   (b) Inspection results
   (c) Corrective action documentation

9) Removal of Testing Equipment after the successful pass of the Containment Commissioning Test or Reactor Vault Containment Tests.

3.3 Training

The Contractor will be responsible for the training required in order to complete this scope of work. Please refer to the Darlington RFR Scope of Work, NK38-SOW-31100-10016, Section 3.2: Training, for all requirements for training with regards to this Work.

3.4 Maintenance/Testing

OPG will conduct periodic testing of the containment isolation system during R&FR activities. The Contractor shall be responsible for any maintenance or repairs required to maintain the containment isolation system during R&FR activities.

The Contractor shall specify the maintenance requirements, including spare material, in order to support the components and equipment meeting their design basis, for the duration of the Refurbishment Unit outage. This includes the following:

(a) Maintenance procedures, specifications and plans

(b) Inspection procedures and acceptance criteria as applicable

(c) Specification of spares and repair material for regular maintenance to support the duration of the outage.

(d) Identification of critical spares.

(e) Maintenance plans for execution equipment.

The Contractor shalll maintain all test equipment related to this scope, in order to support repeat installation, use and removal on all 4 Units, until the successful completion of Refurbishment Work on the last Unit.

3.5 Removal and Demobilisation

The Contractor will be responsible for the removal of modifications and return of the system back to its approved post-refurbishment operating and design condition after successful pass of the test. OPG may decide to leave some modifications as permanent modifications if the change is deemed an improvement.

After the successful return to service of the Reactor Vault containment, the Contractor shall remove the bulkheads and any temporary equipment.

The Contractor will re-install the Catenary Deflector on bulkhead supports located in the fuelling duct, after the removal of the bulkheads.

4.0 WORK MANAGEMENT

For guidance on Contractor work management responsibilities, please refer to the RFR Scope of Work, NK38-SOW-31100-10016, Section 4.0.

5.0 WASTE MANAGEMENT

The Contractor shall develop a waste management plan for the scope of work. The Contractor will be responsible for handling all wastes generated by the scope of work, making sure they are correctly packaged into a form suitable for transfer to OPG personnel. All Contractor personnel working at DNGS, who generate or collect waste, are responsible for ensuring that it is disposed of in the proper pathway as documented in the Waste Management Plan. The following general requirements must be considered when developing a Waste Management Plan:

- Minimize quantities of contaminated package materials by removing excess packaging from materials before it is taken into radiological zones.
- Fabricate components (including the Tooling) that can be easily cleaned of surface contamination or make provisions for sealed compartments for complex parts.
- Where equipment will be exposed to contamination, use plastic bags to protect surfaces from gross contamination where practical. This will reduce the amount of materials generated in subsequent decontamination efforts.

- Minimize (and eliminate if possible) the spread of loose contamination.
- Materials that are contaminated with tritium must be off-gassed (dried) in a suitable facility prior to being sent for further waste handling.
- Waste streams should be separated into contaminated or likely clean waste.
- Contaminated waste must be further separated into unincinerable, compactable, or non-processable waste. Waste volume reduction is achieved by incineration or compaction. Examples: Tyveks are incinerable, pressure tubes are compactible, end fittings are non-compactible

After the successful completion of Work on the last Unit, the Contractor shall prepare one Unit set of the bulkhead components for storage in outdoor facilities. The Contractor will obtain OPG approval for a storage location and will store the bulkheads for a year after completion of return of to service on the last refurbishment Unit. After the year, the Contractor, unless otherwise informed by OPG, will dispose of the bulkheads. The Contractor shall inform station operations and maintenance of their intent to dispose of the bulkheads, at least 1 month prior to disposal.

6.0 QUALITY ASSURANCE REQUIREMENTS

6.1 General Quality Requirements

6.1.1 The following are general requirements with regards to quality assurance that must be implemented and maintained throughout the work. The Contractor shall design and procure according to the determined Nuclear Refurbishment Code Effective Date. Note, as of the issue of this scope of work, OPG has not yet determined (in consultation with the CNSC) a "code effective date" for Refurbishment work.

The Contractor shall:

a) Implement and maintain a quality program in accordance with OPG's requirements for Engineering, Procurement and Construction Contracts consistent with the latest revision of CSA-N286-05: Management system requirements for nuclear power plants as per N-CORR-01930-0387907.

b) For work that is done by a qualified associate, or Subcontractor, the Contractor's quality program shall cover the oversight of the subcontracted activities.

c) Assure that any pressure boundary activities (e.g. procurement, fabrication or installation) included in the scope of work will be performed in accordance with the requirements of CSA-N285.0/N285.6 Series-08: General Requirements For Pressure-Retaining Systems and Components in CANDU Nuclear Power

Plants/Material Standards for Reactor Components for CANDU Nuclear Power Plants.

d) Demonstrate that an adequate quality assurance program exists for conducting the pressure boundary activities included in the work in the form of a TSSA Certificate of Authorisation or equivalent documentation acceptable to the TSSA

e) Assure that any concrete containment work (e.g. specification, procurement, repairs, fabrication, maintenance or installation) included in the scope of work will be performed in accordance with the requirements of the following:

(1) CAN/CSA-N287.1, General Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants

(2) CAN/CSA-N287.2, Material Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants

(3) CAN/CSA-N287.3, Design Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants

(4) CAN/CSA-N287.5, Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants

(5) Code Effective CAN/CSA-N287.6 Pre-operational proof and leakage rate testing requirements for concrete containment structures for nuclear power plants

(6) Code Effective CAN/CSA-N287.7, In-Service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants

f) Implement and maintain a quality program in accordance with OPG's requirements consistent with the laterst revision of Z299.1-85: Quality Assurance Program- Category 1 for all non-pressure boundary work and Tooling with justifiable exception to be approved by the Design Authority.

g) Execute the scope of work according to the latest version of the latest Applicable Laws and regulations of Canada, Province of Ontario, and local authorities including but not limited to:

(1) National Building Code of Canada

(2) National Fire Code of Canada

(3) Occupation Health and Safety Act

(4) MISA Ontario Regulation 215/95 (August 2007)

(5) Darlington Ministry of Enviroment Certificate of Approval

(6) Effluent Monitoring and Effluent Limits – Electric Power Generation Sector Environment High-Level

h) Ensure components and systems that are seismically qualified, and are being procured and/or designed by the Contractor, must be designed and procured according to N289.1 -General Requirements for Seismic Design and Qualification of CANDU Nuclear Power Plants

i) Ensure all Engineering Tools & Analytical Software shall be acquired, developed, maintained and used in accordance with a quality program that meets the applicable requirements of the code effective revision of CSA N286.7 "Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants." For this scope of work, the Contractor shall provide an audit trail which can demonstrate conformance and compliance. If the Contractor does not have a N286.7 qualification, than all software related to the calculation of results of the Containment Commissioning Test and Reactor Vault Containment Tests, shall be qualified to OPG Grade 1 software requirements, as per Nuclear Procedure, "Qualification of Scientific, Engineering, and Safety Analysis Software," N-PROC-MP-0095.

6.2 Quality Assurance Documentation

Prior to the commencement of the work on a Unit, the Contractor will be required to provide a detailed listing of all quality documents that are required for quality assurance document turnover, which will be used as a baseline during Project turnovers. Upon satisfactory completion of component installation and removal, the Contractor will provide signed and dated original or legible copies of all quality assurance documents pertinent to the scope of work. Such documents (as applicable) will include, but not be limited to the following:

- Weld inspection reports
- Welding qualification Records
- Material test reports
- Radiographic film and interpretation reports
- Inspection and test plans
- Inspection reports
- Pressure vessel and piping installation data reports
- Critical attribute inspections reports
- Completed repair and repair inspection reports
- Completed work packages and workplans

- Verification documentation for calculations and analyses
- Testing instrumentation calibration sheets
- Preliminary and final test reports
- Software quality assurance plans
- Software qualification reports
- For software provided/used by vendor for analysis of test results, memo indicating compliance to N286.7 standard.

7.0 REGULATORY INTERFACE

For guidance on Contractor regulatory interface responsibilities, please refer to the RFR Scope of Work, NK38-SOW-31100-10016, Section 7.0. For reference, any regulatory interface requirements for the modification process is addressed in Section 2.4.

8.0 SAFETY

The Contractor will be responsible for all items required to safely perform the scope of work and that is compliant with OPG Site requirements (i.e. safety, nuclear safety and seismic requirements).

8.1 Conventional Safety

For guidance on Contractor conventional safety responsibilities, please refer to the RFR Scope of Work, NK38-SOW-31100-10016, Section 8.1.

8.2 Radiological Safety

For guidance on Contractor conventional safety responsibilities, please refer to the RFR Scope of Work, NK38-SOW-31100-10016, Section 8.3.

9.0 REFERENCES

The Contractor shall comply with the latest revision of all governance and procedures required for performing work on Darlington Nuclear Generating Station (DNGS) as per the RFR Scope of Work [R-10].

For a complete set of OPG drawing and OPEX references, per area of focus, please refer to Appendix A. The reference dates and revisions of the below documentation were current at the time of SOW approval date. The Contractor will need to use the latest revisions at the time of the execution of the SOW.

[R-1] OPG Document, "DNGS Islanding Study Integrated Report," NK38-REP-09701-10003-R000, December 16, 2009

[R-2] OPG Document, "Contractor/Owner Interface Requirements For Nuclear", N-DAI-00150-10000-R000

[R-3] OPG Nuclear Procedure, N-PROC-MP-0090-R007 Modification Process, May 26, 2011

[R-4] OPG Correspondence, N-CORR-01930-0387907, "CSA N286-05 Applicable Elements for Design, Procurement and Construction Service Suppliers for Nuclear Refurbishment, July 11, 2011

[R-5] OPG Nuclear Procedure, N-PROC-MP-0097-R002, Grading Of Scientific Engineering And Safety Analysis Software, November 17, 2010

[R-6] OPG Nuclear Procedure, N-PROC-MP-0095-R001, Qualification Of Scientific Engineering And Safety Analysis Software, November 17, 2010

[R-7] OPG Nuclear Procedure, N-PROC-MP-0096-R001, Use Of Scientific Engineering And Safety Analysis Software, November 17, 2010

[R-8] OPG Nuclear Program, N-PROG-MP-0006-R007, Software, June 1, 2010

[R-9] OPG Nuclear Standard, N-STD-MP-0008-R003, Development Qualification And Use Of Scientific Engineering And Safety Analysis Software, November 17, 2010

[R-10] OPG Document, NK38-SOW-31100-10016-R000, Darlington Retube And Feeder Replacement Scope Of Work, March 4, 2011

[R-11] OPG Nuclear Guide, N-GUID-09701-10011-R000, Darlington Refurbishment - Safety Management Essentials, May 18, 2011

[R-12] OPG Document, TD 38-35000-022-106-R004, Maintenance Information-Radiation Fields, February 10, 1984

[R-13] OPG Nuclear Instruction, N-INS-09701-10005-R000, Nuclear Project-Gated Process, July 20, 2011

[R-14] OPG Template, N-TMP-10208 , "Workplan template"

[R-15] OPG Nuclear Instruction, N-INS-08120-10011, "Workplan Preparation and Development Process"

[R-16] OPG Nuclear Standard, N-STD-AS-0002 "Procedure Use and Adherence"

[R-17] OPG Nuclear Standard, N-STD-AS-0014, "Requirements for Technical Procedures"

[R-18] OPG Nuclear Procedure, N-PROC-AS-0028"Development, Review and Approval of Technical Procedures"

[R-19] OPG Nuclear Design Requirements, NK38-DR-21126-10001, "Nuclear Refurbishment Containment Isolation Design Requirements"

[R-20] OPG Nuclear Procedure, N-PROC-RA-0053, "Evaluation Of Proposed Changes For Canadian Nuclear Safety Commission Approval Or Notification"

[R-21] OPG Document, "Unit Islanding - Bulkhead Design Assist: Shielding Analysis. This document is expected to be issued in December 2011 by the Nuclear Safety Analysis group," NK38-CORR-03610-0406650

[R-22] OPG Document, "Unit Islanding - Bulkhead Design Assist: Containment Analysis," NK38-REP-03610-0406651 This document is expected to be issued in December 2011 by the Nuclear Safety Analysis group.

[R-23] OPG Engineering Standard, N-STC-20530-10000-R001, "Repair of Concrete Containment Structures"

10.0 ABBREVIATIONS AND DEFINITIONS

ACU - Air Conditioning unit

AFS - Available For Service

ALARA - As Low As Reasonably Achievable

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers

BOM - Bill of Materials

CATID - Catalogue Identification Number

CANDU - Canadian Deuterium Uranium

CNE - Chief Nuclear Engineer

CNSC - Canadian Nuclear Safety Commission

COMS - Constructability, Operability, Maintainability and Safety

CPI - Cost Performance Index

CSA - Canadian Standards Association

DA - Design Authority

DBA - Design Basis Accident

DEC - Darlington Energy Center

DNGS - Darlington Nuclear Generating Station

DOM - Director of Operations and Maintenance

DTL - Design Team Leader

EC - Engineering Change

ECC - Engineering Change Control

ECI - Emergency Coolant Injection

EP - Embedded Part

FD - Fuelling Duct

FH - Fuel Handling

FMD - Fuel Management Duct

FME - Foreign Material Exclusion

GSS - Guaranteed Shutdown State

HVAC - Heating, Ventilation and Air Conditioning

IMCS - Inspection, Maintenance and Common Services

IMS - Inspection and Maintenance Services

JSA - Job Safety Analysis

LOCA - Loss Of Coolant Accident

MEL - Master Equipment List

MISA - Municipal Information Systems Association

MTL - Modification Team Leader

NICR - Non Identical Component Replacement

NR - Nuclear Refurbishment

NSAD - Nuclear Safety Analysis Department

NSCA - Nuclear Safety and Control Act

OCC - Outage Control Center

OHSA - Occupational Health and Safety Act

OPEX - Operating Experience

OPG - Ontario Power Generation

PAM - Post Accident Monitoring

PCC - Project Control Center

PNGS - Pickering Nuclear Generating Station

PRD - Pressure Relief Duct

PROL - Power Reactor Operating License

QA - Quality Assurance

REP - Radiation Exposure Permits

RFP - Request For proposal

RP - Radiation Protection

RPPE - Radiation Personal Protective Equipment

RV - Reactor Vault

RVFDACS - Reactor Vault and Fuelling Duct Atmosphere Cooling System

RVAS - Reactor Vault Atmospheric System

R&FR - Retube & Feeder Replacement

SATM - Space Allocation Transient Material

SDC - Shut Down Cooling

SSC - Structures, Systems and Components

SOW - Scope of Work

SPI - Schedule Performance Index

SPOC - Single Point of Contact

SRE - System Responsible Engineer

SSC - Structures, Systems and Components

TMOD - Temporary Modification

TSSA - Technical Standards and Safety Authority

UDM - Universal Delivery Machine

VBO - Vacuum Building Outage

Appendix A: Drawings and References

Reference Type	Passport Number	Title	Notes
Centenary Deflector			
Design Requirements	TD 38-35730-022-001	Catenaries & Supports - Design Requirements	
Drawing	NK38-GDK-35730-0044-T4	Catenary Duct Deflector Installation	
Drawing	NK38-GDK-35730-0044-T2	Catenary Duct Deflector Installation	
Drawing	NK38-GDK-35730-0044-T3	Catenary Duct Deflector Installation	
Drawing	NK38-GDK-35730-0044-T1	Catenary Duct Deflector Installation	
Drawing	NK38-GDK-35730-0044-T6	Catenary Duct Deflector Installation	
Drawing	NK38-GDK-35730-0044-T5	Catenary Duct Deflector Installation	
Correspondence	NK38-CORR-21126-{83114}	Technical Document Catenaries Installation Of Duct Deflectors	
Correspondence	TD 38-35730-051-102	Catenaries-Installation of Duct Deflectors	Includes details of the hardware used for installing the deflectors
Negative and Positive Containment Tests			
Workplan	88-005314-00-{27714}	Negative Proof And Leak Rate Tests	U2 Test, contain commissioning of U1 bulkhead
Workplan	88-005315-00-{27715}	Positive Leak Rate Tests	U2 Test, contain commissioning of U1 bulkhead
Workplan U4, completed	92-012514-00-{36983}	Negative Proof And Leak Rate Test For U4 Reactor Vault And SDC Rooms	Unit 4 Leakage Rate Test
U3 Workplan	91-006398-00-{34331}	Containment Positive Leak Rate Tests For U3 Containment	Contains commissioning of Unit 4 bulkhead
U3 Workplan	91-006397-00-{34328}	Containment Negative Proof And Leak Rate Test For U3 Containment	Contains commissioning of Unit 4 bulkhead
U3 Workplan	91-006397-00-{34327}	Containment/Negative Proof And Leak Rate Test For U3 Containment	Contains commissioning of Unit 4 bulkhead
U4 Workplan	92-012513-01-{36981}	Vacuum Priming System Support For U4 Containment Test	
U4 Workplan	92-012513-11-{36982}	Pressurize The Liquid Zone Control System	
Workplan	92-012513-00-{36980}	Positive Proof Test For U4 Reactor Vault And SDC Rooms	includes Reactor Vault Containment Test (operations T/s Log)

Reference Type	Passport Number	Title	Notes
Workplan	87-313-H-{313217}	87-313-H: Darlington GS Vacuum Structure Instrumentation Pre-operational Negative Pressure Proof Test (August 31 - September 8 1987)	
Workplan	90-006660-00-{32293}	Negative Proof And Leak Rate Tests	
Workplan	87-005395-{67097}	Main Vacuum Chamber Pump Operation During Negative Proof Test	
Drawing	NK38-D5H-21133-2046	React Building Structure Vault Walls EL 100.000-107.500 Elevation E2 & E6 N-E Area Embedded Parts Location	Location of EP used during commissioning for positive pressure test.
EC	95786	0-38350-MASTER-Create an RTA for Containment Pressurizing Equipment Installation	2009 Pressure Test EC
Specification for Test	NK38-XH-21021-{81738}	Specification For Pre-operational Proof And Leakage Rate Testing For Concrete Containment Structures Specification NK38-XH-21021 L1171-83	
Containment Operating Manual	OM-34200	Containment Operating Manual	
Containment Boundary Manual	NK38-DBD-34280-00001	Containment Boundary Manual	
Operational Safety Requirements	NK38-OSR-08131.02-10006	Darlington NGS Containment	
Design Manual for Test	NK38-DM-63427	Containment In-service Leakage Rate Testing System	
Workplan	92-010319-00-{36797}	Containment In Service Leak Rate Testing	
Workplan	90-010638-00-{32712}	Containment In Service Leak Rate Testing	
Master Workplan	90-009221-00-{32589}	Positive Leak Rate Tests	
Master Workplan	91-021149-00-{35762}	Stage 3 Containment In Service Leak Rate Test	
Common Technical Procedure	NK38-CTP-34200-10001	Unit Alignment Procedure For The Containment Positive Pressure Test	
Common Technical Procedure	NK38-CTP-34200-10003	Unit 0 Restoration Procedure Following Containment Positive Pressure Test	
Common Technical Procedure	NK38-CTP-34200-10005	Unit 0 Alignment Procedure For The Containment Positive Pressure Test	
Common Technical Procedure	NK38-CTP-34200-10007	Unit Restoration Procedure Following Containment Positive Pressure Test	
Airlock Dimension Drawings			
Drawing	NK38-D0H-21022-0210	Standard Personnel & Equipment A/L Details Of Shell Bulkheads Seal Rings Cable Port Bracket Location & Penetrations	Not the only document to be reviewed. Should also look at piping arrangements and other airlock service piping arrangements.
Drawing	NK38-D1H-21022-0200	Standard Personnel & Equipment A/l General Arrangement	

Reference Type	Passport Number	Title	Notes
Drawing	NK38-D1H-21022-0100	Std Personnel Airlock General Arrangement	
		Bulkhead Documentation	
Bulkhead Location Drawing	NK38-D0H-20110-0002	Buildings & Structures Bulkheads Location Plan	
Design Manual	NK38-DM-21126	Isolation and Containment Bulkheads	
Design Manual	NK38-DM-21100	Reactor Building Structure	
Design Manual	NK38-DM-34200	Containment System - System Overview	
Design Manual	NK38-DM-21022	Personnel And Personnel/equipment Airlocks (includes Dr-62110-r2)	
Design Guide	NK38-DG-03650.2B	Common Mode Incidents - Seismic Design	
Design Guide	NK38-DG-03650.2A	Common Mode Incidents Overview And Design Requirements	
Design Manual	NK38-DM-03200	Shielding	
System Design Requirements	NK38-DR-73720-10001	Reactor Vault & Fuelling Duct Atmosphere System	
Technical Specification	L-1184	Isolation Bulkhead Specification (L-1184-84)	Used for purchasing requisition
Technical Specification	L-1171	Pre-operational Proof And Leakage Rate Testing For Concrete Containment Structures Specification NK38-XH-21021 (L-1171-89)	Used for purchasing requisition
Technical Specification	L-1149	Fuelling Machine Support Structures And Isolation Bulkhead Support Frames - Darlington GS "A" (L-1149-83)	Used for purchasing requisition.
Bulkhead Calculations	NK38-CALC-D0940002	DC 21126-1 Isolation Bulkhead	
Design Verification	NK38-REF-21126-{46580}	Design Verification For Reactor Building Containment And Pressure Testing Bulkhead	
Design Verification	NK38-REF-21126-{46636}	Design Verification For Isolation Bulkhead - RBS	
Design Verification	NK38-REF-21126-{46637}	Design Verification For Reactor Building Isolation bulkhead Support	
Drawings	NK38-D0H-21126-5011-U1	Reactor Building Structure Permanent Bulkhead Details MK11 And 14 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5011-U2	Reactor Building Structure Permanent Bulkhead Details MK11 And 14 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5011-U3	Reactor Building Structure Permanent Bulkhead Details MK11 And 14 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5011-U4	Reactor Building Structure Permanent Bulkhead Details MK11 And 14 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5012-U1	Reactor Building Structure Permanent Bulkhead Details MK12 And 13 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5012-U2	Reactor Building Structure Permanent Bulkhead Details MK12 And 13 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5012-U3	Reactor Building Structure Permanent Bulkhead Details MK12 And 13 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5012-U4	Reactor Building Structure Permanent Bulkhead Details MK12 And 13 Miscellaneous Steel	
Drawings	NK38-D0H-21126-5013-U1	Reactor Building Structure Permanent Bulkhead Installation Details Miscellaneous Steel	Permanent Bulkhead Details. This drawing contains under section 4, methods of sealing the drain hole in the vertical bulkhead.

Reference Type	Passport Number	Title	Notes
Drawings	NK38-D0H-21126-5013-U2	Reactor Building Structure Permanent Bulkhead Installation Details Miscellaneous Steel	Permanent Bulkhead Details. This drawing contains under section 4, methods of sealing the drain hole in the vertical bulkhead.
Drawings	NK38-D0H-21126-5013-U3	Reactor Building Structure Permanent Bulkhead Installation Details Miscellaneous Steel	Permanent Bulkhead Details. This drawing contains under section 4, methods of sealing the drain hole in the vertical bulkhead.
Drawings	NK38-D0H-21126-5013-U4	Reactor Building Structure Permanent Bulkhead Installation Details Miscellaneous Steel	Permanent Bulkhead Details. This drawing contains under section 4, methods of sealing the drain hole in the vertical bulkhead.
Drawings	NK38-D0H-21126-5016-U1	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawings	NK38-D0H-21126-5016-U2	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawings	NK38-D0H-21126-5016-U3	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawings	NK38-D0H-21126-5016-U4	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawings	NK38-DRAW-21126-10001-U1	Reactor Building Structure Access Gate In Permanent Bulkhead Misc. Steel	Modifications to Vertical Bulkheads for IMS use.
Drawings	NK38-DRAW-21126-10001-U2	Reactor Building Structure Access Gate In Permanent Bulkhead Misc. Steel	Modifications to Vertical Bulkheads for IMS use.
Drawings	NK38-DRAW-21126-10001-U3	Reactor Building Structure Access Gate In Permanent Bulkhead Misc. Steel	Modifications to Vertical Bulkheads for IMS use.
Drawings	NK38-DRAW-21126-10001-U4	Reactor Building Structure U4-udm-fuel Handling Duct Removable Gate Access way Miscellaneous Steel Details	Modifications to Vertical Bulkheads for IMS use.
Drawings	NK38-D5H-21126-5021	Reactor Building Structure Permanent Bulkheads Support Modifications Miscellaneous Steel	Modifications to Vertical Bulkheads for IMS use.
Drawings	NK38-D0H-21126-5004-U1	Reactor Building Structure Isolation Bulkhead Location Plan Miscellaneous Steel	Temporary Bulkheads. Contains load details, including shielding load.
Drawings	NK38-D0H-21126-5004-U2	Reactor Building Structure Isolation Bulkhead Location Plan Miscellaneous Steel	Temporary Bulkheads. Contains load details, including shielding load.
Drawings	NK38-D0H-21126-5004-U3	Reactor Building Structure Isolation Bulkhead Location Plan Miscellaneous Steel	Temporary Bulkheads. Contains load details, including shielding load.
Drawings	NK38-D0H-21126-5004-U4	Reactor Building Structure Isolation Bulkhead Location Plan Miscellaneous Steel	Temporary Bulkheads. Contains load details, including shielding load.
Drawings	NK38-D0H-21126-5005-U1	Reactor Building Structure Isolation Bulkhead Panel Details MK1 To 5 7 & 8 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5005-U2	Reactor Building Structure Isolation Bulkhead Panel Details MK1 To 5 7 & 8 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5005-U3	Reactor Building Structure Isolation Bulkhead Panel Details MK1 To 5 7 & 8 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5005-U4	Reactor Building Structure Isolation Bulkhead Panel Details MK1 To 5 7 & 8 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5006-U1	Reactor Building Structure Isolation Bulkhead Panel Details MK6 9 & 10 Miscellaneous Steel	Temporary Bulkhead details

Reference Type	Passport Number	Title	Notes
Drawings	NK38-D0H-21126-5006-U2	Reactor Building Structure Isolation Bulkhead Panel Details MK6 9 & 10 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5006-U3	Reactor Building Structure Isolation Bulkhead Panel Details MK6 9 & 10 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5006-U4	Reactor Building Structure Isolation Bulkhead Panel Details MK6 9 & 10 Miscellaneous Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5007-U1	Reactor Building Structure Isolation Bulkhead Sections & Details Misc Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5007-U2	Reactor Building Structure Isolation Bulkhead Sections & Details Misc Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5007-U3	Reactor Building Structure Isolation Bulkhead Sections & Details Misc Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5007-U4	Reactor Building Structure Isolation Bulkhead Sections & Details Misc Steel	Temporary Bulkhead details
Drawings	NK38-D0H-21126-5008-U1	Reactor Building Structure Isolation Bulkhead Seal Plate Details MK15 to 29 Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5008-U2	Reactor Building Structure Isolation Bulkhead Seal Plate Details MK15 To 29 Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5008-U3	Reactor Building Structure Isolation Bulkhead Seal Plate Details MK15 To 29 Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5008-U4	Reactor Building Structure Isolation Bulkhead Seal Plate Details MK15 To 29 Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5009-U1	Reactor Building Structure Isolation Bulkhead Installation Details Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5009-U2	Reactor Building Structure Isolation Bulkhead Installation Details Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5009-U3	Reactor Building Structure Isolation Bulkhead Installation Details Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D0H-21126-5009-U4	Reactor Building Structure Isolation Bulkhead Installation Details Miscellaneous Steel	Contains the seal plate designs.
Drawings	NK38-D1F-21126-0010	Reactor Building Structure Horizontal Contamination Barrier Fabrication Details	Possible Seal Plate details
Drawings	NK38-D1F-21126-0011	Reactor Building Structure Horizontal Contamination Barrier Blow Out Panel Fabrication Details	Possible Seal Plate details
Drawings	NK38-D1F-21126-0013	Reactor Building Structure Horizontal Contamination Barrier Lower Panel Modifications General Assembly & Fabrication Details	Possible Seal Plate details
Drawings	NK38-D5F-21126-0009	Reactor Building Structure Horizontal Contamination Barrier Location Plan Sections & Details	Possible Seal Plate details
Welding Procedure Specification	NK38-C4H-21126-9001	Welding Procedure Specification 7 Pages Shielded Metal Arc Welding	
Welding Procedure Specification	NK38-C4H-21126-9002	Welding Procedure Specification Flux Cored Arc Welding (FLAW)	
Welding Procedure Specification	NK38-C4H-21126-9003	Welding Procedure Specification Submerged Arc Welding (SAW)	
Weld Repair Procedure	NK38-C4H-21126-9004	Weld Repair Procedure No: WRP-01	
Visual Examination Procedure	NK38-C4H-21126-9005	Visual Examination Procedure Isolation And Containment Bulkheads No: VEP-602	
Visual Examination Procedure	NK38-C4H-21126-9006	Visual Examination Procedure Isolation And Containment Bulkheads No: VEP-603	

Reference Type	Passport Number	Title	Notes
Liquid Penetrant Examination Procedure	NK38-C4H-21126-9007	Liquid Penetrant Examination Procedure Isolation And Containment Bulkheads LP-201	
Vacuum-box Examination Procedure	NK38-C4H-21126-9008	Vacuum-box Examination Procedure For Welded Joints VAC-701	Vacuum Box Examination Procedure for Welded joints
Surface Preparation and Painting Procedure	NK38-C4H-21126-9009	Surface Preparation And Painting Procedure Isolation and Containment Bulkheads, 7321-RSP	
Packing And Shipping Procedure	NK38-C4H-21126-9010	Packing And Shipping Procedure, 7321-RPS	Gives instruction on shipping the isolation bulkheads
Air Leak Test Procedure	NK38-C4H-21126-9011	Air Leak Test Procedure AT-504	
Straightening Procedure By Heat	NK38-C4H-21126-9012	Straightening Procedure By Heat 7321-SP	
Post weld Heat Treatment Procedure	NK38-C4H-21126-9032	Post weld Heat Treatment Procedure For Carbon & Low Alloy Steel RHT-202	
Bulkhead Support Frame			
Drawing	NK38-D5H-21250-4030	Reactor Building Isolation Bulkhead Support Frame Plans And Elevation Structural Steel	Bulkhead Support Frame Has the top most elevation of the bulkhead assembly - the top of the central frame.
Drawing	NK38-D5H-21250-4031-U1	Reactor Building Isolation Bulkhead Support Frame Sections And Details Structural Steel	
Drawing	NK38-D5H-21250-4031-U2	Reactor Building Isolation Bulkhead Support Frame Sections And Details Structural Steel	
Drawing	NK38-D5H-21250-4031-U3	Reactor Building Isolation Bulkhead Support Frame Sections And Details Structural Steel	
Drawing	NK38-D5H-21250-4031-U4	Reactor Building Isolation Bulkhead Support Frame Sections And Details Structural Steel	
Drawing	NK38-D5H-21250-4032	Reactor Building Isolation Bulkhead Support Frame Sections And Details Structural Steel	
Calandria Seal			
Technical Specification	L-1227	Reactor Building Elastomer Seal (L-1227-89)	Elastomeric Seal between the Calandria Seal and the temporary Bulkheads.
Construction Specification	L-964	Construction Specification L-964-79	Contains some information on testing
Drawing	NK38-D0H-21126-5015-U1	Reactor Building Structure Calandria Seal MK30 Miscellaneous Steel	
Drawing	NK38-D0H-21126-5015-U2	Reactor Building Structure Calandria Seal MK30 Miscellaneous Steel	
Drawing	NK38-D0H-21126-5015-U3	Reactor Building Structure Calandria Seal MK30 Miscellaneous Steel	
Drawing	NK38-D0H-21126-5015-U4	Reactor Building Structure Calandria Seal MK30 Miscellaneous Steel	
Drawing	NK38-D0H-21126-5016-U1	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawing	NK38-D0H-21126-5016-U2	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawing	NK38-D0H-21126-5016-U3	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.

Reference Type	Passport Number	Title	Notes
Drawing	NK38-D0H-21126-5016-U4	Reactor Building Structure Calandria Seal Installation Details Miscellaneous Steel	Shows some edge fabrication details for the bulkheads.
Drawing	NK38-D4H-21128-9002-U1	Calandria Shield Tank Seal	
Drawing	NK38-D4H-21128-9002-U2	Calandria Shield Tank Seal	
Drawing	NK38-D4H-21128-9002-U3	Calandria Shield Tank Seal	
Drawing	NK38-D4H-21128-9002-U4	Calandria Shield Tank Seal	
Drawing	NK38-D5H-21128-2001-U1	Reactor Building Structure Calandria Shield Tank Seal Detail Elastomer Seals	
Drawing	NK38-D5H-21128-2001-U2	Reactor Building Structure Calandria Shield Tank Seal Detail Elastomer Seals	
Drawing	NK38-D5H-21128-2001-U3	Reactor Building Structure Calandria Shield Tank Seal Detail Elastomer Seals	
Drawing	NK38-D5H-21128-2001-U4	Reactor Building Structure Calandria Shield Tank Seal Detail Elastomer Seals	
Test Results	NK38-CORR-21128-0083746	Darlington G.s. Reactor Building Calandria Seal	
Field Splicing Instructions	NK38-C4H-21128-9003	Field Splicing Instructions For Calandria Shield Tank Seal	
Packing & Shipping Procedure	NK38-C4H-21126-9031	Packing & Shipping Procedure (shipping Of Calandria Seal Clamping Bars) 7808-RPS	
Shutdown Cooling EPs and Vault Atmosphere Dampers			
Design Guide	NK38-DG-03650.7	Extensions of the Containment Envelope	Design Guide for Containment Extensions, including penetrations
Drawing	NK38-D0H-73729-0002-U1	Reactor Building Reactor Vault Atm. Sys. Fl EL 92 500 & 100 000 Embedded Ducting	EPs 337,338,339,340 for Vault Cooling Units in FD
Drawing	NK38-D0H-73729-0002-U2	Reactor Building Reactor Vault Atm. Sys. Fl EL 92 500 & 100 000 Embedded Ducting	EPs 337,338,339,340 for Vault Cooling Units in FD
Drawing	NK38-D0H-73729-0002-U3	Reactor Building Reactor Vault Atm. Sys. Fl EL 92 500 & 100 000 Embedded Ducting	EPs 337,338,339,340 for Vault Cooling Units in FD
Drawing	NK38-D0H-73729-0002-U4	Reactor Building Reactor Vault Atm. Sys. Fl EL 92 500 & 100 000 Embedded Ducting	EPs 337,338,339,340 for Vault Cooling Units in FD
Drawing	NK38-D1F-21126-0012	Reactor Bldg. Structure Temp. Contamination. Seal Plates EL.87.700 F/M Duct Assembly & Fabrication. Details	Method used for sealing during commissioning
Drawing	NK38-D5F-21140-0008	Reactor Building Structure EL 87.700 Rms R015 R016 & R019 Removal Of Drilled Out Concrete Plugs General Arrangement Plan Sect & Details	
Drawing	NK38-D5F-21140-0006	Reactor Building Structure EL 100.000 Removal Of Drilled Out Concrete Plugs General Arrangement And Details	
Drawing	NK38-D0H-21133-2021-U1	Reactor Building Structure E1 & E2 EL 87.700 To 100.000 Line C To Cl Reactor At Row 13 EP Location	
Drawing	NK38-D0H-21133-2021-U2	Reactor Building Structure E1 & E2 EL 87.700 To 100.000 Line C To Cl Reactor At Row 13 EP Location	
Drawing	NK38-D0H-21133-2021-U3	Reactor Building Structure E1 & E2 EL 87.700 To 100.000 Line C To Cl Reactor At Row 13 EP Location	

Reference Type	Passport Number	Title	Notes
Drawing	NK38-D0H-21133-2021-U4	Reactor Building Structure E1 & E2 EL 87.700 To 100.000 Line C To Cl Reactor At Row 13 EP Location	
Drawing	NK38-D0H-21133-2023-U1	Reactor Building Structure E5 & E6 EL 87.700 To 100.000 Line C To Cl Reactor At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2023-U2	Reactor Building Structure E5 & E6 EL 87.700 To 100.000 Line C To Cl Reactor At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2023-U3	Reactor Building Structure E5 & E6 EL 87.700 To 100.000 Line C To Cl Reactor At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2023-U4	Reactor Building Structure E5 & E6 EL 87.700 To 100.000 Line C To Cl Reactor At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2025-U1	Reactor Building Structure E9 & E10 EL 87.700 To 100.000 & Cl Reactor To Line S At Row 13 Embedded Parts Location	
Drawing	NK38-D0H-21133-2025-U2	Reactor Building Structure E9 & E10 EL 87.700 To 100.000 & Cl Reactor To Line S At Row 13 Embedded Parts Location	
Drawing	NK38-D0H-21133-2025-U3	Reactor Building Structure E9 & E10 EL 87.700 To 100.000 & Cl Reactor To Line S At Row 13 Embedded Parts Location	
Drawing	NK38-D0H-21133-2025-U4	Reactor Building Structure E9 & E10 EL 87.700 To 100.000 & Cl Reactor To Line S At Row 13 Embedded Parts Location	
Drawing	NK38-D0H-21133-2027-U1	Reactor Building Structure E13 & E14 EL 87.700 To 100.000 Cl Reactor Line S At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2027-U2	Reactor Building Structure E13 & E14 EL 87.700 To 100.000 Cl Reactor Line S At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2027-U3	Reactor Building Structure E13 & E14 EL 87.700 To 100.000 Cl Reactor Line S At Row 14 Embedded Parts Location	
Drawing	NK38-D0H-21133-2027-U4	Reactor Building Structure E13 & E14 EL 87.700 To 100.000 Cl Reactor Line S At Row 14 Embedded Parts Location	
Drawing	NK38-FEX-73720-3501	Reactor Vault & Fuelling Duct Atmosphere Cooling System	FS for Vault Atmosphere Dampers
Drawing	NK38-FEX-73720-1501	Reactor Vault & Fuelling Duct Atmosphere Cooling System	FS for Vault Atmosphere Dampers
Drawing	NK38-FEX-73720-2501	Reactor Vault & Fuelling Duct Atmosphere Cooling System	FS for Vault Atmosphere Dampers
Drawing	NK38-FEX-73720-4501	Reactor Vault & Fuelling Duct Atmosphere Cooling System	FS for Vault Atmosphere Dampers
Report	NK38-REP-20600-10004	Passive Safety Features Review And Analysis	Indicates the drainage locations for the RV.
Drawing	NK38-D2H-33829-2003-U2	Reactor Building Reactor Vault PHT D2O Recovery System Cover Plate Details	
Drawing	NK38-D2H-33829-2003-U4	Reactor Building Reactor Vault PHT D2O Recovery System Cover Plate Details	

Reference Type	Passport Number	Title	Notes
Drawing	NK38-D2H-33829-2003-U3	Reactor Building Reactor Vault PHT D2O Recovery System Cover Plate Details	
Drawing	NK38-D2H-33829-2003-U1	Reactor Building Reactor Vault PHT D2O Recovery System Cover Plate Details	
Drawing	NK38-D5H-21133-2061-U1	Reactor Building Structure Vault Walls EL 100.000 - 114.600 Sections & Install Details Embedded Parts Location	
Drawing	NK38-D5H-21133-2061-U2	Reactor Building Structure Vault Walls EL 100.000 - 114.600 Sections & Install Details Embedded Parts Location	
Drawing	NK38-D5H-21133-2061-U3	Reactor Building Structure Vault Walls EL 100.000 - 114.600 Sections & Install Details Embedded Parts Location	
Drawing	NK38-D5H-21133-2061-U4	Reactor Building Structure Vault Walls EL 100.000 - 114.600 Sections & Install Details Embedded Parts Location	
South D2O Trench EP - Possible Drain EP Candidates			
Drawing	NK38-D5H-38009-2002	Reactor Building & RAB D2O Supply & Transfer Header 3385 3811 And 3850 Piping To D2O Mgmt Bldg	U2 Only, Piping for EPs 788,791,792,793,794,795, 804
Drawing	NK38-D1H-33419-2022-U1	Reactor Building Fl EL 87.700 Line No. 3341-L22 & L61 Shutdown Cooling Piping	Shutdown Cooling Piping, EP 796
Drawing	NK38-D1H-33419-2022-U2	Reactor Building Fl EL 87.700 Line No. 3341-L22 & L61 Shutdown Cooling Piping	Shutdown Cooling Piping, EP 796
Drawing	NK38-D1H-33419-2022-U3	Reactor Building Fl EL 87.700 Line No. 3341-L22 & L61 Shutdown Cooling Piping	Shutdown Cooling Piping, EP 796
Drawing	NK38-D1H-33419-2022-U4	Reactor Building Fl EL 87.700 Line No. 3341-L22 & L61 Shutdown Cooling Piping	Shutdown Cooling Piping, EP 796
Drawing	NK38-D5H-33819-2012-U1	Reactor Building EL.87.700 R-025 & R-019 F/M Duct & Shutdown Cool Sump Room D2O Recovery Trenches PHT D2O Leakage Collection Piping	PHT D20 Leakage Collection Piping through EP 797,798,805
Drawing	NK38-D5H-33819-2012-U2	Reactor Building EL.87.700 R-025 & R-019 F/M Duct & Shutdown Cool Sump Room D2O Recovery Trenches PHT D2O Leakage Collection Piping	PHT D20 Leakage Collection Piping through EP 797,798,805
Drawing	NK38-D5H-33819-2012-U3	Reactor Building EL.87.700 R-025 & R-019 F/M Duct & Shutdown Cool Sump Room D2O Recovery Trenches PHT D2O Leakage Collection Piping	PHT D20 Leakage Collection Piping through EP 797,798,805
Drawing	NK38-D5H-33819-2012-U4	Reactor Building EL.87.700 R-025 & R-019 F/M Duct & Shutdown Cool Sump Room D2O Recovery Trenches PHT D2O Leakage Collection Piping	PHT D20 Leakage Collection Piping through EP 797,798,805
Drawing	NK38-D1H-33349-2006-U1	Reactor Building Fl EL 87.700 3334-I5 PHT & SDC Pumps Gland Seal Piping	SDC Pump Gland Seal Piping through EP 799
Drawing	NK38-D1H-33349-2006-U2	Reactor Building Fl EL 87.700 3334-I5 PHT & SDC Pumps Gland Seal Piping	SDC Pump Gland Seal Piping through EP 799
Drawing	NK38-D1H-33349-2006-U3	Reactor Building Fl EL 87.700 3334-I5 PHT & SDC Pumps Gland Seal Piping	SDC Pump Gland Seal Piping through EP 799
Drawing	NK38-D1H-33349-2006-U4	Reactor Building Fl EL 87.700 3334-I5 PHT & SDC Pumps Gland Seal Piping	SDC Pump Gland Seal Piping through EP 799

Reference Type	Reference Number	Title	Notes
Drawing	NK38-D5H-79819-2003-U1	Reactor Building RAB Floor EL 87.700 To 100.000 Off-gas Management System Piping	Off Gas Management Piping through EP 800
Drawing	NK38-D5H-79819-2003-U2	Reactor Building RAB Floor EL 87.700 To 100.000 Off-gas Management System Piping	Off Gas Management Piping through EP 800
Drawing	NK38-D5H-79819-2003-U3	Reactor Building RAB Floor EL 87.700 To 100.000 Off-gas Management System Piping	Off Gas Management Piping through EP 800
Drawing	NK38-D5H-79819-2003-U4	Reactor Building RAB Floor EL 87.700 To 100.000 Off-gas Management System Piping	Off Gas Management Piping through EP 800
Drawing	NK38-D1H-33419-2012-U1	Reactor Building FI EL 87.700 Line No 3341-I12 & L60 Shutdown Cooling Piping	Shutdown Cooling Piping through EP 806
Drawing	NK38-D1H-33419-2012-U2	Reactor Building FI EL 87.700 Line No 3341-I12 & L60 Shutdown Cooling Piping	Shutdown Cooling Piping through EP 806
Drawing	NK38-D1H-33419-2012-U3	Reactor Building FI EL 87.700 Line No 3341-I12 & L60 Shutdown Cooling Piping	Shutdown Cooling Piping through EP 806
Drawing	NK38-D1H-33419-2012-U4	Reactor Building FI EL 87.700 Line No 3341-I12 & L60 Shutdown Cooling Piping	Shutdown Cooling Piping through EP 806
Drawing	NK38-FEX-33820-1501	Primary Heat Transport D2O Recovery Circuit	(recovery tank vents into the reactor vault), D20 Recovery Flowsheet
Drawing	NK38-FEX-33820-2501	Primary Heat Transport D2O Recovery Circuit	Flowsheet
Drawing	NK38-FEX-33820-3501	Primary Heat Transport D2O Recovery Circuit	Flowsheet
Drawing	NK38-FEX-33820-4501	Primary Heat Transport D2O Recovery Circuit	Flowsheet
Drawing	NK38-F1H-33820-0001-U1	Reactor Auxiliary Bay Primary Heat Transport D2O Recovery Circuit Flow Diagram	Flowsheet
Drawing	NK38-F1H-33820-0001-U2	Reactor Auxiliary Bay Primary Heat Transport D2O Recovery Circuit Flow Diagram	Flowsheet
Drawing	NK38-F1H-33820-0001-U3	Reactor Auxiliary Bay Primary Heat Transport D2O Recovery Circuit Flow Diagram	Flowsheet
Drawing	NK38-F1H-33820-0001-U4	Reactor Auxiliary Bay Primary Heat Transport D2O Recovery Circuit Flow Diagram	Flowsheet
Vault Scanning			
Scope of Work	NK38-SOW-20100-10000	Darlington Vault 3D Laser Scanning	Includes data on Scan Scope from RV laser scans
Safety Reports			
Safety Reports	NK38-SR-03500-10001	Darlington Safety Report - Part 1: Plant/Site Description And Part 2: Design Description	Includes description of fuelling duct and machines.
Safety Reports	NK38-SR-03500-10002	DN-1-4 Safety Report: Part 3- Accident Analysis	
Cranes and Other Supports for Installation and Removal			
Design Manual	NK38-DM-76100	Cranes and Hoists	
Drawing	NK38-G1H-76111-9001-U1	General Arrangement Containment Vault Cranes	Containment Cranes
Drawing	NK38-G1H-76111-9001-U2	General Arrangement Containment Vault Cranes	Containment Cranes
Drawing	NK38-G1H-76111-9001-U3	General Arrangement Containment Vault Cranes	Containment Cranes
Drawing	NK38-G1H-76111-9001-U4	General Arrangement Containment Vault Cranes	Containment Cranes
Drawing	NK38-D1F-21126-0002	Reactor Building Structure Fuelling Duct Vertical Containment Bulkhead Installation Details	

Reference Type	Passport Number	Title	Notes
Drawing	NK38-D1F-21126-0003	Reactor Building Structure Horizontal Bulkhead Transport Trolley Fabrication Details	Temporary Hoisting Devices
Drawing	NK38-D5F-21126-0004	Reactor Building Structure Horizontal. Bulkhead Installation Monorail & Misc. Steel Plan	
Drawing	NK38-D5F-21126-0005	Reactor Building Structure Horizontal. Bulkhead Installation Monorail & Misc Steel Fabrication. Details	
Drawing	NK38-D1F-21126-0006	Reactor Building Structure Horizontal. Bulkhead Installation Monorail & Misc. Steel Fabrication Details	
Drawing	NK38-D1F-21126-0008	Reactor Building Structure Isolation Bulkhead Temporary Monorail	
Fuelling System Description			
Technical Document	TD 38-35000-022-100	Fuel Handling System - General - Design Requirements	Overview of System
Technical Document	TD 38-35700-022-0016	Fuelling Machine Transfer-Design Requirements	Overview of System
Technical Document	TD 38-35000-022-106-R004	Maintenance Information-Radiation Fields	Radiation Fields off Fuelling Trolley

Appendix B: Other Project Considerations

B.1.0 The following isolations, with associated modifications, will be required in order to maintain containment integrity but will not form part of the scope of work for this Project. This work will be supported by other projects:

(1) Containment Button Up/Hydrogen Ignition Modifications and Isolations –Modifications to prevent the following button up actions:

(i) outage Unit initiating button up actions on the outage Unit due to spurious signal

(ii) outage Unit initiation button up actions on operating Units due to spurious signal

(iii) initiation of button up action on outage Units due to test signal

(iv) initiation of button up action on outage Units due to signals received from non outage Units

(v) initiation of the outage Unit hydrogen ignition system due to spurious, test or operating Unit signal for work protection purposes

(2) Isolation of the D_2O Collection System – isolation of the collection pathways from the D_2O Collection Trench, located in the Fuel Handling Duct, from its connection back into the Unit containment area. This includes isolation of 1/2/3/4-33810-THK1 vent into the reactor vault.

(3) System Isolations- The assessment and execution of the system isolations required for the duration of the Unit refurbishment outage until the bulkheads are removed, in order to maintain containment integrity.

(4) Fuelling Head, Reactivity Bridge Interlock Modifications – The modification to the fuelling bridge to prevent collision with the bulkheads, and to prevent "fuelling" logic being initiated while the reactor vault openings are obstructed by bulkhead work or structures.

B.2.0 The following work will be impacted by the isolation of the reactor building from the fuelling duct but will not form part of the scope of work for this Project.

(1) Containment Safety Monitoring- Modification required to maintain Post Accident Monitoring (PAMs) capability for Containment pressure when Unit 2 is isolated from containment.

(5) In-Service Leakage Testing System- Modification to the In-service Leak Rate System, to allow for the Containment Leakage Test to continue while refurbishment outages are in progress and while Unit 2 is Fuel Management Duct (FMD).

(6) Reactor Vault Vapour Recovery System HVAC Modification- Assessment and modification of the Vault and Fuel Duct Atmospheric system to support OHSA and

ASHRAE requirements resulting from the opening of the airlock and transfer chamber doors during refurbishment and work occurring inside the reactor vault. These modifications are required to provide adequate fresh air flow, radiological control, and contamination control and maintain the vault sub-atmospheric, when the reactor vault is separated from containment by bulkheads and both sets of airlock doors are open.

(7) Reactor Vault and Fuel Duct Atmospheric Cooling System (RVFDC) modifications – Assessment and modification of the Vault and Fuel Duct Atmospheric system to support OHSA and equipment protection requirements resulting from Unit being in refurbishment. These modifications do not include the work to physically isolate the reactor vault atmosphere from the fuelling duct atmosphere.

(8) Airlocks - Modification required to permit both sets of airlock doors and transfer chamber doors to be open at the same time.

B.3.0 The following work will impact the execution schedule of this Project but will not form part of the scope of work for this Project.

1) R&FR Work – Tooling, platforms and execution schedule will be impacted by the installation of the bulkheads.

2) Heat Transport Drain – Execution will be impacted by the installation of the bulkhead.

3) Heat Transport Vacuum Dry – Execution will be impacted by the installation of the bulkhead and must be coordinated with this Project.

Appendix C: Collected OPEX

The following is a set of OPEX and considerations resulting from a preliminary review. The Contractor shall conduct a more extensive review and incorporate findings as appropriate. OPEX from DNGS commissioning needs to be incorporated into planning and risk mitigation of this SOW, in order to prevent the delays and problems that occurred during DNGS commissioning from repeating during execution of this SOW.

C.1.0 STAKEHOLDER INVOLVEMENT

DNGS Director of Operations and Maintenance (DOM) and the DNGS Design Authority (DA) will be involved in the turnover and AFS, however, they will not be the signing authority for the acceptance of any modifications or temporary modifications. The Design Work Overview and Execution Overview will be handled by Nuclear Refurbishment.

C.2.0 BULKHEAD OPEX

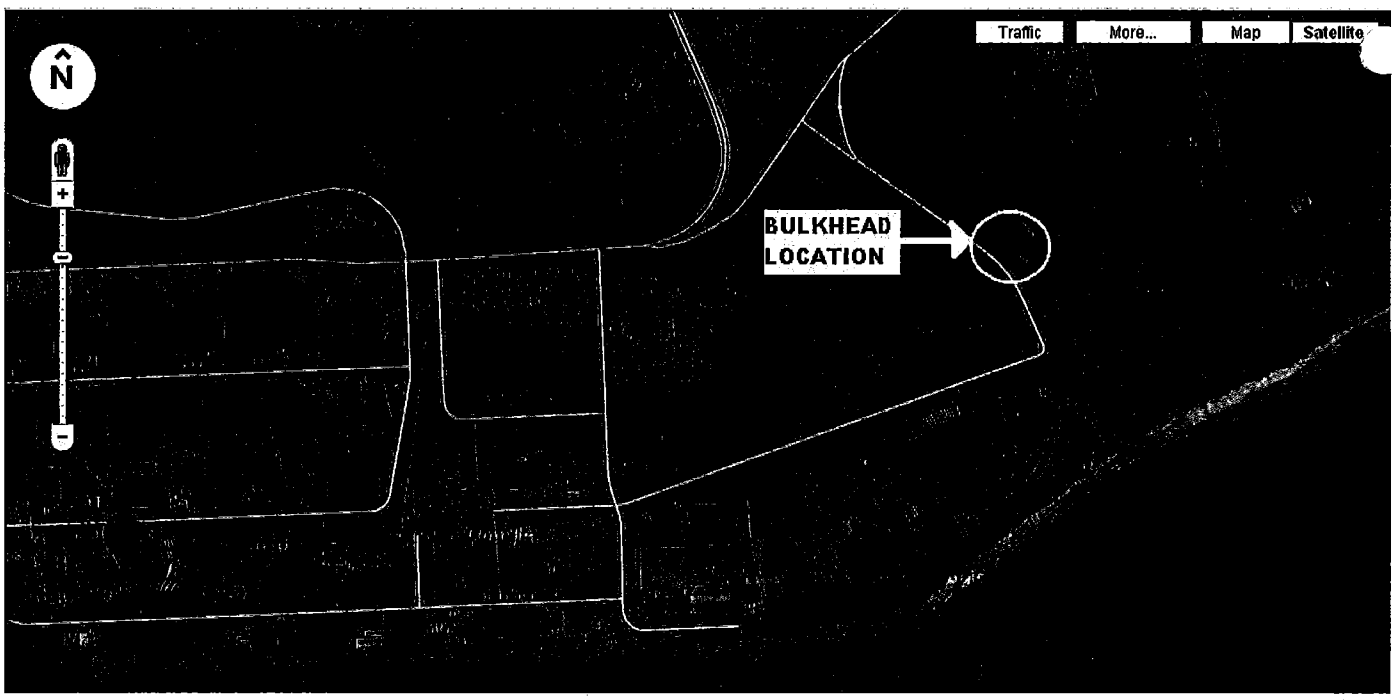


Figure 6: Location of Commissioning Bulkheads as of 08JUL2011

C.2.1 Bulkhead Design

C.2.1.1 Unit 2 and Unit 3 never had isolation bulkheads installed.

C.2.1.2 A shielding load is specified in the original DNGS commission drawing NK38-D0H-21126-5004-U1, U2, U3, U4, however details of shielding were not provided in the design drawings.

C.2.1.3 Current plant drawings show installation of the bulkheads. If the design does not change due to updated requirements, and the design can be verified against updated requirements, the fabrication and installation may be classified as an alternative system configuration and an EC may not be required.

C.2.1.4 On current drawings, without shielding installed, the highest elevation of the bulkhead structure is el. 98.525 (See Drawing NK38-D0H-21126-5009-UX). This high point is located on the central east west seam (directly above the bulkhead support located in the fuel duct).

C.2.1.5 Shielding design should consider availability of shielding materials. DNGS currently does not keep any extensive inventories of shielding materials at Site. Shielding materials may be long lead items.

C.2.1.6 Due to space constraints (possible interferences with R&FR, dewatering activities) shielding may have to be installed on the inside of the bulkheads itself. This may include installation of lead shot, sand, filling with concrete or other shielding materials or structures.

C.2.1.7 Design of the bulkhead shielding requires engagement of the RP, ALARA, R&FR Contractor and major refurbishment project groups, especially in the COMS process in order to ensure their needs are met and to prevent unnecessary rework.

C.2.1.8 During the preliminary reviews, no CATIDs for the original shutdown cooling room to fuelling duct penetrations were found. This may require a NICR.

C.2.1.9 If a replacement fuelling bridge is used, its lower limits will have to be set or modified so that the bridge cannot collide with the containment bulkhead or installed shielding.

C.2.1.10 If the fuelling bridge is not removed or replaced during the outage, prior to bulkhead installation, interlocks will need to be installed or modified on the fuelling bridge, or it will need to be locked out, in order to prevent an accidental collision with the containment bulkhead. It will need to remain locked out and/or have interlocks applied until the bulkhead is removed.

C.2.1.11 Unit 2 contains pressure sensing equipment for common containment pressure that is used for Emergency Filtered Air Discharge, In-service Leakage Testing and Critical Safety Parameter monitoring, that will rendered unavailable once the Unit 2 bulkhead is in place. The design of the bulkhead will need to be coordinated with the plans of

these projects. It is recommended that instrumentation does not penetrate the reactor vault to fuelling duct boundary through the bulkhead.

C.2.1.12 Nuclear Safety Analysis may also include LOCA scenario during commissioning test. As this scenario was not included under the safety analysis originally performed for the bulkheads during the commissioning of DNGS, unless a time at risk argument is made, the bulkhead and supports may require significant modification in order to meet new requirements.

C.2.1.13 Bruce OPEX indicates that they anchored the bulkheads and supports into the bed rock. This was required in order to accommodate the weight of the additional support frame they installed over top the bulkheads to allow for fork trucks on top of the bulkhead. The additional anchors and supports were also required to accommodate the weight of waste flasks on the bulkhead. It was indicated, that for remaining Unit outages, they are not going to use horizontal bulkheads for isolation, and were instead, going to use vertical bulkheads in the fuelling duct.

C.2.1.14 There is a risk of the bulkheads failing due to leakage through penetrations and concrete defects. In addition, the vertical bulkheads on Units 2 and 3 were never commissioned. This risk needs to be evaluated via pre outage inspection. In addition, contingency repair designs and materials may be required in order to avoid critical path outage delays. One possible risk mitigation activity is to prepare for inspection and possible repair completion, prior to the outage start so that any repairs may be done before the commissioning test is performed.

C.2.1.15 Given the high radiological hazards associated with vertical bulkhead location in front of the reactor face, proper examination of the bulkheads prior to test may only be possible during the outage, after the Unit is defueled. As a result, contingency plans and support needs to be in place, in case deficiencies are found during pre test inspections of vertical bulkhead or if a failure occurs during testing.

C.2.1.16 General reactor vault walkdowns can only be done during outages. Scans of the vault are also available, but they are not expected to be complete representations of the vault area.

C.2.1.17 During preliminary review of documentation, CATIDs were not found for the seal plates used on the bulkheads. If existing designs are used design support for specification of existing off the shelf CATIDs, or NICRS to provide the materials for execution, may be required.

C.2.1.18 A CATID will need to be specified for the Catenary Duct Deflector Support Anchors, or a NICR, if the appropriate anchor no longer meets required nuclear requirements for seismic requirements or materials. Changes in the centenary bolting pattern will require an Engineering Change.

C.2.1.19 IMCS has indicated that they would like to retain the existing type of access, installed as per EC 23366 after completion of the refurbishment work, since it is used to access

the tooling station on the UDM used for scrapping etc. IMCS is to be consulted as a stakeholder for proposed changes to vertical bulkhead. Single Point of Contact, for IMS for project EC support, as of 08JUL2011, is John Stopar, Field Operations Manager, Reactor Maintenance Projects, Inspection and Maintenance Services.

C.2.1.20 Aluminum is not allowed in construction or temporarily installed components, or Tooling due to nuclear safety requirements.

C.2.2 Bulkhead Installation

C.2.2.1 Once fuel is removed, the Bulkhead Commissioning Test becomes critical path to refurbishment.

C.2.2.2 The Catenary Duct Deflector is required for defueling during the refurbishment outage. As a result, it can only be removed after the Unit is in GSS and de-fuelling has been completed.

C.2.2.3 Only one set of bulkheads exist from DNGS commissioning. These bulkheads will need to be inspected if they are to be reused. As a result, at least one set of bulkheads will need to be built to support the refurbishment outage schedule.

C.2.2.4 A station wide outage is only scheduled just before the start of the actual outage. Designs will have to be done in advance, based on best available engineering knowledge. There is a risk that any repairs specified, will not address field conditions. The following risk mitigation may be required.

a) Provision of On-call Civil Engineering expertise during the outage

(b) Advance agreement with Design Agency, Plant, Outage on execution and commissioning, AFS of any repairs. Includes gaining CNSC Approvals ahead of time.

(c) Advance agreement on contingency EC and emergency CNSC Approvals should be arranged for ahead of time.

C.2.2.5 Work should be done, as much as possible, before the start of the Refurbishment outages, through regular scheduled outages, or other safe methods of access in order to minimize work on outage critical path.

C.2.2.6 Prior to installation work occurring in the Fuelling duct or reactor vault of an outage Unit, isolation of the hydrogen ignition system is required, in order to protect workers on the outage Unit from spurious activation of the H_2 ignition via test signal from the Main Control Room, from the outage Unit or non outage Unit. While this work will be executed under another project, completion of this work will be a prerequisite to execution of installation and testing. Both the vertical bulkhead repairs and the removal of the Catenary work are located in the fuel duct.

C.2.2.7 Removal of Catenary Duct Deflector will be high hazard radiological work due to its location in the fuel duct opening, and the hazard from passing fuelling trolleys. Shift manager approval and lock out of the Unit, is required, prior to entry to the duct, in order to assure fuelling machines do not pass by while work is in progress. This work will require a minimum of a JSA.

C.2.2.8 Fuelling has been locked out on the Unit- in order to prevent accidental fuelling attempt on outage Unit

C.2.2.9 Darlington commissioning OPEX refers to the use of a monorail to install bulkheads near reactor face, due to inability of overhead cranes to reach the area, i.e. Fuelling Bridge interferences.

C.2.2.10 Currently there are only two cranes per Unit that are available for lifting, each with a maximum capacity of 15 Mg each. There is one 4.5 Mg capacity crane that services the reactor deck. The existing cranes in the reactor vault must be assessed to determine if they can be used for the transport and placement/removal of the bulkheads.

C.2.2.11 Work on the Catenary Duct Deflector may require breathing air supplies, since it is below 100 m elevation, may be oxygen deficient and because of the tritium hazards.

C.2.2.12 Drawings for lifting devices used to move the bulkheads during DNGS commissioning exist.

C.2.2.13 Repair of the opening in the vertical bulkhead will be a challenge for construction. Construction OPEX indicates these bulkheads were fabricated offsite, heat treated and then installed.

C.2.2.14 During installation at Bruce, the amount of welding in the vault and duct caused visibility and vault environment issues. The vault interior at DNGS is considerably smaller and may face similar problems. In addition to inclusion of welding hazards on safety plans, the contractors may need to include equipment to assure the same problems do not occur.

C.2.2.15 Bruce NGS made use of scaffolding mounted on trolleys for work on the underside of the bulkhead. Cost savings, due to not having to remove and rebuild the scaffold every six weeks to accommodate FM Trolley Power Track Inspection was approximated at 75% at Bruce. DNGS has the added consideration that our fuelling machines will be actively using the trolley track to deliver fuel and irradiated fuel throughout unit refurbishment.

C.2.2.16 There are a lot of nuclear systems and safety systems within the vicinity of the bulkhead openings. Lifting over, near these systems will require critical lift planning. In addition to the standard lift planning used in outside industry, this includes obtaining shift manager work authorization, seismic SPOC and nuclear safety approvals as per latest revision of OPG governance.

C.2.2.17 The approximate timing for field execution for this scope of work is included below:

a) Catenary Duct Deflector can only be removed after the Unit is in GSS and de-fuelling has been completed. It must be replaced before fuelling begins.

(d) Bulkheads can only be installed after the fuel has been removed, H_2 ignition disabled, reactivity bridge interlocks installed and the vertical bulkhead is repaired.

(e) Seals, Plugs/Shielding required for containment integrity are to be installed after GSS and the fuel has been removed. Commissioning of these seals and plugs is to occur prior to the Bulkhead Commissioning Test.

(f) Removable Bulkhead Shielding must be installed after GSS, fuel removal and the Bulkhead Commissioning Test is performed.

(g) Vertical Bulkhead repairs need to be performed after GSS, fuel removal, and after the outage Unit H_2 ignition is isolated. Vertical bulkhead repairs must be complete before the horizontal bulkheads are installed.

(h) The pre-outage installation of Commissioning Test Equipment and instrumentation should be maximized, with final connections after GSS established as soon as Reactor Safety allows. This includes set up of temporary power supplies.

C.3.0 SEALING OF FUELLING DUCT OPENINGS IN THE REACTOR VAULT AND SDC ROOM

C.3.3 Penetration Plugs and Sealing Design

C.3.3.1 OPEX from the Commissioning of Darlington include closure methods for a number of openings and penetrations (see Appendix A). However, these designs will require evaluation against available materials, updated construction standards and the updated requirements resulting from the updated Nuclear Safety Analysis. These designs may have to be modified to accommodate new closure/sealing methods

C.3.4 Penetration Plugs and Sealing Installation

C.3.4.1 Once the bulkheads are placed in the reactor vault openings and the D_2O Recovery penetrations are sealed, the drainage path for any large D_2O spill will not be available. The completion of the D_2O recovery penetrations seals may need to be coordinated with the dewatering activities.

C.3.4.2 Shutdown cooling rooms and areas under the el. 100 m are considered a confined space, due to the radiological hazard of the fuelling trolleys, and the enclosed nature of the area (possibly oxygen deficient). To enter these areas, permission of the Shift Manager must be obtained, (with possible lock out of fuelling system) and proper

confined space planning is required. During the refurbishment outage, ventilation/air supply may be required to work in the shutdown cooling/ fuelling duct areas.

C.3.4.3 Workers placing their face in the vicinity of the shutdown cooling room drain EPs can be exposed to radiological fields in the duct, and coming off fuel trolleys that contain used fuel.

C.4.0 BULKHEAD COMMISSIONING TESTING

C.4.5 Testing Design

C.4.5.1 Bulkheads were commissioned, during Darlington construction, by applying pressure/vacuum from the fuelling duct side of the Unit.

C.4.5.2 During commissioning of DNGS, compressors were connected via spare EPs, in the reactor wall of Units 2 and 3. These penetrations may no longer be available. The known EPs are the following:

Unit	EP Number	Reference Drawing
1	EP not used during commissioning for test.	NK38-D5H-21133-2046
2	07837S	NK38-D5H-21133-2046
3	07837S	NK38-D5H-21133-2046
4	EP not used during commissioning for test.	NK38-D5H-21133-2046

Table 2: DNGS Commissioning EP List

C.4.5.3 There is a high likelihood that the testing equipment, (compressors, relief valves, distribution piping/hosing, instrumentation) will require pressure boundary registration.

C.4.5.4 If a vacuum test is required, the design will require taking into consideration the need to capture and dispose of any condensed D_2O or tritium vapour resulting from liquid vaporizing under the reduced vault pressures and being suctioned into the compressor systems. These liquids shall be captured, sampled and disposed of as per OPG requirements for Radiological Waste. Failure to do so correctly is a violation of Site license, and is reportable to the CNSC.

C.4.5.5 The compressors and distribution Tees need to meet TSSA design, registration and testing requirements, as required. This includes the provision of over pressure protection.

C.4.5.6 A list of systems, based on a preliminary review of OPEX for the bulkhead commission test and reactor vault containment testing that may require either special operation, or protection requirements during testing are as follows:

(1) The liquid zone control system – commission test workplans indicate that the liquid zone control system remains pressurized to protect it from the test conditions.

(2) Cover gas System – OPEX from leakage tests. With the moderator drained, modifications may be need to be put in place.

(3) Any temporary power / lighting that are installed for the refurbishment outage needs to be isolated as part of the test isolations.

(4) Vault Vapour Recovery System – must be shutdown or isolated.

(5) Vault Vapour Recovery System – button up valves must be shut during the test, and opened in order to vent pressure.

(6) Air Conditioning unit – must be reviewed.

(7) Breathing Air Isolation to Reactor Vault

(8) Moderator Cover Gas System - if not isolated will have to remain pressurized to different set points.

(9) Annulus Cover Gas - if not isolated, will have to remain pressurized to different set points.

(10) Main Moderator Rupture Disks – possible caps to prevent reverse rupture.

(11) End Shield Cooling system pressure over protection provided while 34110-RV55 and 34110-RV125 are isolated by opening 34110-PV50 and PV51.

(12) Airlock and Transfer Chamber Pumps – shutdown in order to prevent damage

(13) Temporary isolations of electrical motors and equipment in order to reduce temperature effects.

C.4.6 Testing Execution

C.4.6.1 A preliminary list of projects that could impact successful completion of the bulkhead tests, including whether the test may be passed and failed, are included in Appendix B, section B.1.0.

C.4.6.2 The Shutdown cooling room to fuelling duct penetrations are drilled in concrete openings. In commissioning, the caulking around these penetrations leaked. When pressure is applied from the vault side, these penetrations leaked greater than when pressure differential was applied from the Fuelling duct side. This resulted in a non-linear test result that was not accepted by the CNSC. As a result, the Darlington Bulkhead Commissioning Tests had to be redone a number of times, because any leaks experienced during the test for the bulkhead are attributed to the bulkheads.

Inspection and repairs must be done prior to the Bulkhead Commissioning Tests, in order to prevent critical path delays during the outage.

C.4.6.3 The following are considerations that were used during the Darlington Commissioning tests workplans:

a) All pressure sensitive equipment was removed from the interior of the reactor vault during the test.

(i) The test required the removal of all compressed gas cylinders from inside the Unit.

(j) No personnel shall enter the reactor vault when a negative pressured is applied to the vault and pressure duct.

(k) The reactor vault is required to be kept above 15 degrees Celsius in order to protect reactor vault equipment.

(l) Temporary lighting that is not rated for the pressure conditions will need to be removed to prevent destruction and fire hazard.

(m) All lighting, motors, heat sources, may need to be turned off, in order for their heat not to affect the leakage results.

(n) Fans may only be required to run in the reactor vault, to circulate air, if there is a large temperature differential. Temperature effects created by excessive use of fans and air convection may need to be minimized.

(o) A preliminary test, to familiarize people with running equipment, was used during commissioning.

(p) There was a provision for purging air in the building to reduce humidity to less than 50%.

(q) Removable shielding placed on bulkheads surface must be removed prior to pressure testing in order to prevent projectile hazards during the test.

C.4.6.4 The following is the Bruce OPEX regarding the Bulkhead Commissioning Tests:

a) Vacuum and Pressure were applied to the reactor vault side of the bulkhead.

(r) Both positive and negative test pressure tests were performed.

(s) Personnel were inside the vault at -8 kPa(g) for manual leak searches, during the Bulkhead Commissioning Test.

C.4.6.5 OPEX from workplans include the requirement to have all temporary electrical sources and lights removed while the test is occurring. Since temporary power supplies are

required for R&FR work, the test will need to be coordinated with the installation of power supplies, and refurbishment work crews and Contractors in order to prevent scheduling conflicts and rework.

C.4.6.6 There is a risk of contamination to the rental vacuum pumps. A contingency for decontamination or compensation of the rental equipment may need to be provided, in addition to inclusions of dryers and filters to capture radiological contaminants and D_2O.

C.4.6.7 PNGS 2010 VBO PRD pressuring test OPEX indicates that installation of compressors should occur prior to outage, with final connections to plant systems occurring during the outage as soon as reactor safety permits it.

C.4.6.8 Shielding and sealing penetration details exist for Containment EPs, however a NICR or CATID may be required in order to have the material on hand for repairs or post test sealing work.

Attachment C

Exhibit 3.1(a) – Definition Phase Milestone Schedule

See attached.

Exhibit 3.1(a) - Definition Phase Milestone Schedule

1. RFR Program Milestones	Finish	% Fee	Milestone Definition
Contract Effective Date	1-Mar-2012	0	Baseline Date when Contract Effective Date Occurs
Darlington Energy Centre (DEC) Complete	15-Jul-2013	0	Baseline Date when OPG Darlington Energy Centre (DEC) Complete and ready for RFR Contractor construction island
Release Quality Estimate (RQE) Complete	15-Jun-2015	0	Baseline Date when OPG Release Quality Estimate (RQE) Complete
1st Unit Breaker Open	15-Oct-2016	0	Baseline Date when 1st Unit Breaker Open
RFR 1st Unit Removal Starts/Vault Turnover to Contractor	16-May-2017	0	Baseline Date when RFR 1st Unit Removal Starts/Vault Turnover to Contractor
2. Mockup	**Finish**	**% Fee**	**Milestone Definition**
Mockup Preliminary Design Review Complete	31-Aug-2012	3	Finish no later than Date when Mock-up Preliminary 50% Design Review Complete and Reviewed / Accepted / Accepted as Noted by OPG
Mockup Design Issue for Construction	30-Jan-2013	3	Finish no later than Date when Mockup Design Issue for Construction Reviewed / Accepted / Accepted as Noted by OPG
Mockup Building Permits Issued	15-Jun-2013	2	Finish no later than Date when Mock-up Building Permits Issued
Mockup Installation Starts at DEC	15-Jul-2013	2	Finish no later than Date when Mock-up Installation Starts at DEC, DEC made available by OPG
Mockup Shop Fabrication Complete	15-Jan-2014	2	Finish no later than Date when Mock-up Off DEC Site Fabrication Complete
Mockup Site Construction and Assembly Complete	15-Feb-2014	2	Finish no later than Date when Mock-up on DEC Site Construction and Assembly Complete
Mockup Substantial Completion	15-Mar-2014	5	Finish no later than Date when Mock-up Substantial Completion Declared
Mockup Building Permits Inspections Passed	15-Mar-2014	2	Finish no later than Date when Mock-up Building Permits Inspections Passed
Mockup Punchlist Completed	15-Mar-2014	2	Finish no later than Date when Mock-up Punchlist Completed and DEC Construction Island Returned to OPG
Mockup Final Design As Built Drawings Accepted by OPG	15-Apr-2014	2	Finish no later than Date when Mock-up Final 100% Design As Built Drawings Reviewed / Accepted / Accepted as Noted by OPG
Mockup Finalize DEC Modifications by OPG / Mockup Available for Use	15-May-2014	0	Finish no later than Date when Mock-up Final DEC Modifications by OPG / Mock-up Available for Use by RFR Contractor
3. Tooling	**Finish**	**% Fee**	**Milestone Definition**
Tooling Preliminary Design Review Complete	31-Aug-2013	2	Finish no later than Date when Tooling Preliminary COMS and Design Review Complete and Reviewed / Accepted / Accepted as Noted by OPG
Tooling Preliminary Engineering (Eng) Complete	15-Feb-2014	2	Finish no later than Date when Tooling Preliminary Engineering (Eng) Complete
Tooling Draft Procedures Issued	30-May-2014	1	Finish no later than Date when Tooling Draft Procedures have been Reviewed & Issued
Tooling Detailed Eng Complete	30-Jun-2014	1	Finish no later than Date when Tooling Detailed Eng Reviewed / Accepted / Accepted as Noted by OPG
Tooling Prototypes' Complete	30-Sep-2014	1.5	Finish no later than Date when Tooling Prototypes Fabricated and Demonstrated
Tooling Qualification Complete	31-Dec-2014	1	Finish no later than Date when Tooling Qualification Report Reviewed / Accepted / Accepted as Noted by OPG (Factory Acceptance)
Tooling Final Design Accepted by OPG	15-Jun-2015	1	Finish no later than Date when Tooling Final Design Reviewed / Accepted / Accepted as Noted by OPG
Tooling Commissioning and Mockup Integration Testing Complete	15-Jun-2015	2.5	Finish no later than Date when Tooling Commissioning and Mock-up Integration Testing Complete and Reviewed / Accepted / Accepted as Noted by OPG
Tooling Procedures Issued & Available for Service (AFS)	15-Aug-2015	1	Finish no later than Date when Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / Accepted as Noted by OPG
Waste Management & Volume Reduction Tooling Draft Procedures Issued	30-Nov-2014	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Draft Procedures have been reviewed and issued.
Waste Management & Volume Reduction Tooling Draft Detailed Engineering Complete	30-Jan-2015	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Detailed Engineering Reviewed / Accepted / Accepted as Noted by OPG
Waste Management & Volume Reduction Tooling Prototypes Complete	30-Nov-2015	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Prototypes Fabricated and Demonstrated
Waste Management & Volume Reduction Tooling Qualification Complete	30-Jan-2016	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Qualification Report Reviewed / Accepted / Accepted as Noted by OPG (Factory Acceptance)
Waste Management & Volume Reduction Tooling Final Design Accepted by OPG	28-Feb-2016	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Final Design Reviewed / Accepted / Accepted as Noted by OPG
Waste Management & Volume Reduction Tooling Commissioning Complete	15-Jun-2016	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Commissioning Report Reviewed / Accepted / Accepted as Noted by OPG
Waste Management & Volume Reduction Tooling Procedures Issued & Available for Service (AFS)	15-Jun-2016	0	Finish no later that Date when Waste Management & Volume Reduction Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / Accepted as Noted by OPG. NOTE: Commissioning may take place at facilities other than Retube Waste Processing Building.
End Fitting Transfer System Tool sets - Manufactured Complete / Delivered	10-Nov-2017	0	Finish no later than Date when End Fitting Transfer Tool sets are received at the Darlington Energy Complex (DEC)

4. Modifications (Mods) & Eng	Finish	% Fee	Milestone Definition
D1231 Unit 3 Outage - Walkdowns	15-Mar-2012	2	Finish no later than Date when D1231 Unit 3 Outage - Walkdown Plan Submitted
Definition Phase PMP Submitted	15-Jun-2012	1	Finish no later than Date when Definition Phase PMP Submitted
D1341 Unit 4 Outage - Walkdowns	15-Apr-2013	2	Finish no later than Date when D1341 Unit 4 Outage - Walkdown Report Submitted
Mods Scoped	15-Jun-2013	5	Finish no later than Date when All Mod Outline Packages Complete and Reviewed / Accepted / Accepted as Noted by OPG
D1321 Unit 2 Outage - Walkdowns	15-Nov-2013	2	Finish no later than Date when D1321 Unit 2 Outage - Walkdown Report Submitted
D1411 Unit 1 Outage - Walkdowns	15-May-2014	2	Finish no later than Date when D1411 Unit 1 Outage - Walkdown Report Submitted
Mods Preliminary Design Review & COMS Complete	15-Jul-2014	2	Finish no later than Date when Mods Preliminary Design Review & COMS Complete
Mods Final Design Review & COMS Complete	15-Mar-2015	3	Finish no later than Date when Mods Final Design Review & COMS Complete
Engineering Complete	15-Jun-2015	3	Finish no later than Date when all design packages Reviewed / Accepted / Accepted as Noted by OPG.
Mods Design Work Package Ready	15-Jun-2015	2	Finish no later than Date when Mods Design Work Packages Ready for use
Mods Materials On Site (Goods)	15-Apr-2016	1	Finish no later than Date when 1st Unit Mods Materials Available for Use Within One Week
5. RFR Owner-Specified Materials	**Finish**	**% Fee**	**Milestone Definition**
Materials Specifications Issued - Long Lead Materials	1-Sep-2012	3	Finish no later than Date when Materials Specifications Issued - Long Lead Materials from OPG
Materials Procurement Package Issued - Long Lead Materials	15-Aug-2013	3	Finish no later than Date when Materials Procurement Packages Issued - Long Lead Materials (> 24 months)
Materials 1st Unit Long-Lead Material Ordered	31-Oct-2013	3	Finish no later than Date when Materials 1st Unit Long-Lead Material Ordered (last PO issued)
Materials Specifications Issued - Non-Long-Lead Materials	15-Jan-2014	1	Finish no later than Date when Materials Specifications Issued - Non-Long-Lead Materials (< 24 months) from OPG
Materials Procurement Packages Issued - Non-Long-Lead Materials	15-Jun-2014	1	Finish no later than Date when Materials Procurement Packages Issued - Non-Long-Lead Materials (< 24 months)
Materials Owner-Specified Materials Ordered- Non-Long-Lead Materials	15-Sep-2015	2	Finish no later than Date when Materials Owner-Specified Materials Ordered- Non-Long-Lead Materials (last PO issued)
OSM Materials 1st Unit On Site	15-Sep-2017	0	Finish no later than Date when OSM Materials 1st Unit On Site (this does not influence Definition Phase Work Complete Milestone)
6. RQE	**Finish**	**% Fee**	**Milestone Definition**
Class 5 Estimate, Level 2 Schedule, Risk Reviews	1-Sep-2012	3	Finish no later than Date when Class 5 Estimate, Level 2 Schedule, Risk Reviews Reviewed / Accepted / Accepted as Noted by OPG
Class 4 Estimate, Level 3 Schedule, Risk Reviews	15-Jun-2013	3	Finish no later than Date when Class 4 Estimate, Level 3 Schedule, Risk Reviews Reviewed / Accepted / Accepted as Noted by OPG
Class 3 Estimate, Level 4 Schedule, Risk Reviews	15-Jun-2014	3	Finish no later than Date when Class 3 Estimate, Level 4 Schedule, Risk Reviews Reviewed / Accepted / Accepted as Noted by OPG
Class 2 Estimate, Level 5 Schedule, Risk Reviews	15-Jun-2015	3	Finish no later than Date when Class 2 Estimate, Level 5 Schedule, Risk Reviews Reviewed / Accepted / Accepted as Noted by OPG
7. Execution	**Finish**	**% Fee**	**Milestone Definition**
Definition Phase Work Complete	15-Jun-2016	3	Finish no later than Date when all Definition Phase Work Complete, other than 1) "Deferred Definition Phase Work" as described in section 21 of this Exhibit, 2) "Containment Isolations Valves Mods Material on Site (Goods)" as described in section 22 of this Exhibit, and 3) other Definition Phase Work with finish dates after 15-Jun 2016 as set out in this Exhibit.
8. Unit Containment Isolations	**Finish**	**% Fee**	**Milestone Definition**
Unit Contaiment Isolations Conceptual Design Report Completed (Including recommended option)	28-Feb-2013	0	Finish no later than Date when Reviewed/Reviewed as Noted by OPG
Bulkhead, Associated Isolations and Test Equipment Final Design Completed	15-Feb-2014	0	Finish no later than Date when Reviewed/Reviewed as Noted by OPG
Class 3 Estimate for Unit Containment Isolations Procurement & Fabrication	28-Feb-2014	0	Finish no later than Date when Reviewed/Reviewed as Noted by OPG
Calandrial Seal Final Design Completed	15-Sep-2014	0	Finish no later than Date when Reviewed/Reviewed as Noted by OPG
Bulkhead, Calandria Seal and Associated Isolations Duct Work Ready to Perform During Station Condition Outage (SCO).	4-Apr-2015	0	Finish no later than Date for Contractor to be ready to perform the duct Work during the 2015 SCO. The Contractor must perform all required planning and other activities for the SCO in accordance N-PROC-MA-0013 and the milestones set out therein.
Calandria Seal, Associated Isolations and First Bulkhead Tested & Available	15-Jun-2015	0	Finish no later than Date when first bulkhead set is tested and available for service
9. Retube Waste Processing Building (RWPB)	**Finish**	**% Fee**	**Milestone Definition**

RWPB Engineering (Design) Complete	15-Mar-2015	0	Finish no later than Date when all RWPB detailed design packages (Foundations, Building Shell, Interior Shielding, Bridge Cranes, HVAC, and Balance of Scope) Reviewed/Reviewed Noted by OPG
RWPB Final Procedures Issued	15-Feb-2016	0	Finish no later than Date when all RWPB operating procedures are Reviewed/Reviewed as Noted by OPG
RWPB Materials Ordered	15-Nov-2015	0	Finish no later than Date when last RWPB PO is issued by the Contractor with any PO hold points released.
RWPB Manufacturing Complete	15-Dec-2015	0	Finish no later than Date when Shop Fabrication of Foundations, Building Shell, Interior Shielding, Bridge Cranes, HVAC, and Balance of Scope is complete.
RWPB Installation/Commissioning Complete	15-Jun-2016	0	Finish no later than Date when RWPB construction of Foundations, Building Shell, Interior Shielding, Bridge Cranes, HVAC, and Balance of Scope is complete and commissioned.
10. PHT and Moderator Drying Tooling	**Finish**	**% Fee**	**Milestone Definition**
PHT and Moderator Drying Tooling Draft Procedures Issued	30-Nov-2014	1	Finish no later than Date when PHT and Moderator Drying Tooling Draft Procedures have been Reviewed & Issued
PHT and Moderator Drying Tooling Detailed Eng Complete	30-Nov-2014	1	Finish no later than Date when PHT and Moderator Drying Tooling Detailed Eng Reviewed / Accepted / Accepted as Noted by OPG
PHT and Moderator Drying Tooling Prototypes Complete	30-Mar-2015	1.5	Finish no later than Date when PHT and Moderator Drying Tooling Prototypes Fabricated and Demonstrated
PHT and Moderator Drying Tooling Qualification Complete	30-Jun-2015	1	Finish no later than Date when PHT and Moderator Drying Tooling Qualification Report Reviewed / Accepted / Accepted as Noted by OPG (Factory Acceptance)
PHT and Moderator Drying Tooling Final Design Accepted by OPG	31-Jul-2015	1	Finish no later than Date when PHT and Moderator Drying Tooling Final Design Reviewed / Accepted / Accepted as Noted by OPG
PHT and Moderator Drying Tooling Commissioning and Mockup Integration Testing Complete	30-Jun-2015	2.5	Finish no later than Date when PHT and Moderator Drying Tooling Commissioning and Mock-up Integration Testing Complete and Reviewed / Accepted / Accepted as Noted by OPG
PHT and Moderator Drying Tooling Procedures Issued & Available for Service (AFS)	15-Aug-2015	1	Finish no later than Date when PHT and Moderator Drying Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / Accepted as Noted by OPG
11. Bulk PHTS Vacuum Drying Modifications (Mods) & Eng	**Finish**	**% Fee**	**Milestone Definition**
Bulk PHTS Vacuum Drying MODS and Final Design Review & COMS Complete	15-Jun-2015	0	Finish no later than Date when Mods Final Design Review & COMS Complete.
Bulk PHTS Vacuum Drying Engineering Complete	15-Sep-2015	0	Finish no later than Date when all design packages Reviewed / Accepted / Accepted as Noted by OPG.
Bulk PHTS Vacuum Drying MODS Design Work Package Ready	15-Oct-2015	0	Finish no later than Date when Mods Design Work Packages ready for use.
12. Bulk PHTS Vacuum Drying Tool	**Finish**	**% Fee**	**Milestone Definition**
Bulk PHTS Vacuum Drying Tooling Final Design Accepted by OPG.	15-Oct-2015	0	Finish no later than Date when Tooling Final Design Reviewed / Accepted / Accepted as Noted by OPG
Bulk PHTS Vacuum Drying Tooling Commissioning and Mockup Integration Testing Complete.	15-Oct-2015	0	Finish no later than Date when Tooling Commissioning and Mock-up Integration Testing Complete and Reviewed / Accepted / Accepted as Noted by OPG
Bulk PHTS Vacuum Drying Tooling Procedures Issued & Available for Service (AFS)	15-Dec-2015	0	Finish no later than Date when Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / Accepted as Noted by OPG
13. In-Station Transfer Flask Route	**Finish**	**% Fee**	**Milestone Definition**
In-station Flask Transfer Route Final Design Review & COMS Complete (Rev 0)	29-Apr-16	0	Finish no later than Date when In-station Flask Transfer Route Final Design Review & COMS Complete
In-station Flask Transfer Route Engineering Complete DA/DOM Approval	15-Jul-16	0	Finish no later than Date when all design packages Reviewed / Accepted / Accepted as Noted by OPG.
In-Station Flask Transfer Route Goods On Site	15-Nov-16	0	Finish no later than when Goods on site and available for use.
14. Enhanced Material Handling Capabilities	**Finish**	**% Fee**	**Milestone Definition**
Enhanced Material Handling Capabilities - Tooling Procedures Issued & Available for Service (AFS)	15-Feb-16	0	Finish no later than Date when Enhanced Material Handling Capabilities -Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / accepted as Noted by OPG
15. Annulus Spacers Retrieval Tooling (ASRT)	**Finish**	**% Fee**	**Milestone Definition**
ASRT Tooling Detailed Engineering Complete	15-Jun-16	0	Finish no later than Date when Tooling Detailed Engineering Reviewed / Accepted / Accepted as Noted by OPG
ASRT Manufacture Complete / Delivered	15-Nov-16	0	Triggered when Tool is received at the Darlington Energy Centre (DEC)
ASRT Procedures Issued & Available for Service (AFS)	15-Mar-17	0	Finish no later than Date when Tooling Procedures Issued & Available for Service (AFS) Report Reviewed / Accepted / Accepted as Noted by OPG
16. Rehearsals at Darlington Energy Centre	**Finish**	**% Fee**	**Milestone Definition**
Detailed Rehearsal Plan and Schedule	1-Oct-2015	0	Finish no later than Date when Detailed Rehearsal Plan and Schedule for rehearsals activity to be performed at DEC Reviewed / Accepted / Accepted as Noted by OPG
Fuel Channel Inspection Series Rehearsals	31-May-2016	0	Finish no later than Date when Fuel Channel Inspection Series Rehearsals Complete
Feeder Removal Series Rehearsals Complete	31-May-2015	0	Finish no later than Date when Feeder Removal Series Rehearsals Complete
Feeder Installation Series Rehearsals Complete	31-May-2016	0	Finish no later than Date when Feeder Removal Series Rehearsals Complete

Fuel Channel Installation Series Rehearsals	31-May-2016	0	Finish no later than Date when Fuel Channel Installation Series Rehearsals Complete
Fuel Channel Removal Series Rehearsals	31-May-2016	0	Finish no later than Date when Fuel Channel Removal Series Rehearsals Complete
Lessons LearnedReport and Documentation Revisions	15-Jun-2016	0	Finish no later than Date when Lessons Learned Report and Documentation Revisions completed (including CWPs, training material, work instructions and operating manuals, Project Supply List, and Tooling Improvement List)
Execution Phase Schedule and Cost Estimate Revised	15-Jun-2016	0	Finish no later than Date when Execution Phase Schedule and Cost Estimate Reviewed / Accepted / Accepted as Noted by OPG
17. Tooling Management System	**Finish**	**% Fee**	**Milestone Definition**
TMS Hardware and Software Management Plan	31-Jan-2016	0	Finish no later than Date when TMS Hardware and Software Management Plan Reviewed / Accepted / Accepted as Noted by OPG
Scope of Work for Off-Site Tooling Shipping and Packaging	31-Jan-2016	0	Finish no later than Date when Scope of Work for Off-Site Tooling Shipping and Packaging Complete and Incorporated into TMS and Reviewed / Accepted / Accepted as Noted by OPG
Scope of Work for Off-Site Tooling Storage Facilities	31-Mar-2016	0	Finish no later than Date when Scope of Work for Off-Site Tooling Storage Facilities Complete and Incorporated into TMS and Reviewed / Accepted / Accepted as Noted by OPG
TMS System Hardware and Software Configured and Available for Data Input	30-Apr-2016	0	Finish no later than Date when TMS System Hardware and Software Configured and Available for Data Input Complete
Procedures for Scheduled and Preventative Tooling Maintenance	15-Jun-2016	0	Finish no later than Date when Procedures for Scheduled and Preventative Tooling Maintenance Complete and Reviewed / Accepted / Accepted as Noted by OPG
Tooling Readiness Program	15-Jun-2016	0	Finish no later than Date when Tooling Readiness Program Complete and Reviewed / Accepted / Accepted as Noted by OPG
Tooling-specific Material Management Plan	15-Jun-2016	0	Finish no later than Date when Tooling-specific Material Management Plan completed and data input into TMS and Reviewed / Accepted / Accepted as Noted by OPG
Revised CWP, Training Material, Work Instructions, and Operating Manuals	15-Jun-2016	0	Finish no later than Date whenRevised CWP, Training Material, Work Instructions, and Operating Manuals Reviewed / Accepted / Accepted as Noted by OPG
Execution Phase Schedule and Cost Estimate Revised	15-Jun-2016	0	Finish no later than Date when Execution Phase Schedule and Cost Estimate Reviewed / Accepted / Accepted as Noted by OPG
18. Upgrade to Lattice Tube Inspection Tool	**Finish**	**% Fee**	**Milestone Definition**
Automated CTSB Inspection - Mobilization	30-Nov-2015	0	Finish no later than Date when Automated CTSB Inspection Mobilization Complete.
Automated CTSB Inspection - Detailed Engineering Complete	30-Mar-2016	0	Finish no later than Date when Detailed Engineering package Reviewed / Accepted / Accepted as Noted by OPG
Automated CTSB Inspection - Prototype Complete	30-May-2016	0	Finish no later than Date when Prototype proof testing complete and Test Report accepted by Contractor
Automated CTSB Inspection - Feasibility Report Complete	30-Jun-2016	0	Finish no later than Date when Automated CTSB Inspection Feasibility Report Reviewed / Accepted / Accepted as Noted by OPG
19. East AGV Upgrade to Dual Flasks	**Finish**	**% Fee**	**Milestone Definition**
EAGV Upgrade to Dual Flasks - Mobilization	30-Nov-2015	0	Finish no later than Date when EAGV Upgrade to Dual Flasks Mobilization Complete.
EAGV Upgrade to Dual Flasks - Manufacturing Complete / Delivered	30-Sep-2016	0	Finish no later than Date when EAGV Upgrade to Dual Flasks manufacturing complete and Tool delivered to the Darlington Energy Centre.
EAGV Upgrade to Dual Flasks - Final Procedures Issued	20-Nov-2016	0	Finish no later than Date when EAGV Upgrade to Dual Flasks Final Procedures and Design Documentation Reviewed / Accepted / Accepted as Noted by OPG
20. Modifications to Sub-Assembly Insertion Fixtures	**Finish**	**% Fee**	**Milestone Definition**
Modifications to Sub-Assembly Insertion Fixtures - Mobilization	30-Nov-2015	0	Finish no later than Date when Modifications to Sub-Assembly Insertion Fixtures Mobilization Complete.
Modifications to Sub-Assembly Insertion Fixturess - Manufacturing Complete / Delivered	30-Sep-2016	0	Finish no later than Date when Modifications to Sub-Assembly Insertion Fixtures Manufacturing Complete and Tool Delivered to the Darlington Energy Centre.
Modifications to Sub-Assembly Insertion Fixtures - Final Procedures Issued	30-Dec-2016	0	Finish no later than Date when Modifications to Sub-Assembly Insertion Fixtures Final Procedures and Design Documentation Reviewed / Accepted / Accepted as Noted by OPG
21. Deferred Definition Phase Work	**Finish**	**% Fee**	**Milestone Definition**
Miscellaneous Definition Phase Work Complete	15-Aug-2016	0	Finish no later than Date when Miscellaneous Definition Phase Work Complete. Miscellaneous Definition Phase Work is listed in Attachment 1 to this Exhibit.
Deferred Mods Materials On Site (Goods)	15-Aug-2016	0	Finish no later than Date when Deferred Mods Materials (Goods) Available for use within one week. Deferred Mods Materials (Goods) are listed in Attachment 1 to this Exhibit.
Vault Cranes Mods Materials on Site (Goods)	8-Sep-2016	0	Finish no later than Date when Vault Cranes Mod. Materials 1st Unit (Goods) Available for use within one week. Vault Cranes Mods Materials are listed in Attachment 1 to this Exhibit.
Bulk PHTS Vacuum Drying Mods Materials On Site (Goods)	15-Oct-2016	0	Finish no later than Date when 1st Unit Bulk PHTS Vacuum Drying MODS Materials (Goods) Available for use within one week. Bulk PHTS Vacuum Drying Mods Materials are listed in Attachment 1 to this Exhibit.

Access Platform Trolley on Site (Goods)	14-Dec-2016	0	Finish no later than Date when Access Platform Trolley (Goods) Available for use within one week. Access Platform Trolley is listed in Attachment 1 to this Exhibit.
22. Containment Isolations Valves Mods Material on Site (Goods)	**Finish**	**% Fee**	**Milestone Definition**
Containment Isolations Valves Mods Material on Site (Goods)	30-Aug-2016	0	Finish no later than Date when Containment Isolations Valves Mods Material (Goods) Available for use within one week. Containment Isolations Valves are listed in Attachment 1 to this Exhibit.
23.Feeder Weld Head Aluminum Tracks	**Finish**	**% Fee**	**Milestone Definition**
Feeder Weld Head Aluminum Tracks - Manufacture Complete/Delivered	30-Apr-2016	0	Finish no later than date when Tool is received at the Darlington Energy Complex (DEC)
24.Modifications to SSDO Tools	**Finish**	**% Fee**	**Milestone Definition**
Modifications to SSDO Tools - Manufacture Complete/Delivered/Test Report Complete	25-Feb-2017	0	Finish no later than date when Modifications to SSDO Tools manufacturing complete, delivered to DEC, and Test Report Reviewed/Reviewed as Noted by OPG.
Modifications to SSDO Tools - Final Procedures Issued/RFS Report Completed/CWP Completed	22-Mar-2017	0	Finish no later than date Modification to SSDO Tools Final Procedures and RFS Report and CWP Completed Reviewed/Reviewed as Noted by OPG.
25.Waste Management & Volume Reduction Tooling Rehearsals	**Finish**	**% Fee**	**Milestone Definition**
Waste Management & Volume Reduction Tooling - Rehearsals at vendor's facility - Complete	23-Aug-2016	0	Finish no later than date when Waste Management & Volume Reduction Tooling - Series Rehearsals Complete
Waste Management & Volume Reduction Tooling - Series Rehearsals Lessons Learned Report	5-Sep-2016	0	Finish no later than date when Waste Management & Volume Reduction Tooling - Series Rehearsals Lessons Learned Report Reviewed, Reviewed as Noted by OPG
Waste Management & Volume Reduction Tooling Manufactured Complete/Delivered	28-Feb-2017	0	Finish no later than date when Waste Management & Volume Reduction Tooling is received at the Retube Waste Processing Building
Waste Management & Volume Reduction Tooling CWPs and training material	21-Oct-2016	0	Finish no later than date when Waste Management & Volume Reduction Tooling CWPs and training material Reviewed, Reviewed as Noted by OPG
26.Additional West Automated Guided Vehicle (WAGV)	**Finish**	**% Fee**	**Milestone Definition**
Additional West Automated Guided Vehicle (WAGV) - Manufacture Complete/Delivered	17-Mar-2017	0	Finish no later than date when Additional West Automated Guided Vehicle (WAGV) Manufacture Complete and Delivered to the DEC.
27.Expansion of VCS for Radiation Protection	**Finish**	**% Fee**	**Milestone Definition**
Update RCC Internals - Detailed Engineering Complete	31-Oct-2016	0	Finish no later than date when Detailed Engineering Complete and Reviewed/Accepted/Accepted as Noted by OPG
Update RCC Internals - Qualification Complete	24-Feb-2017	0	Finish no later than date when Qualification Complete and Reviewed/Accepted/Accepted as Noted by OPG
Update RCC Internals - Final Procedures Issued Complete/CWP Completed	10-Mar-2017	0	Finish no later than date when Final Procedures, PSL updated as required and CWP Complete and Reviewed/Accepted/Accepted as Noted by OPG
28.Supply of additional New Fuel Load tooling	**Finish**	**% Fee**	**Milestone Definition**
Additional New Fuel Load Tooling - Manufacture Complete / Delivered	30-Jun-2017	0	Finish no later than date when Additional New Fuel Load Tooling is received at the Darlington Energy Complex (DEC)
29.Supply of additional tooling for Double Bellows Inspection	**Finish**	**% Fee**	**Milestone Definition**
Additional tooling for Double Bellows Inspection - Manufacture Complete / Delivered	30-Jun-2017	0	Finish no later than date when Additional Bellows Inspection Tooling is received at the Darlington Energy Complex (DEC)
30.Upgrades to Annulus Spacers Retrieval Tooling (ASRT)	**Finish**	**% Fee**	**Milestone Definition**
Upgrades to ASRT - Manufacture Complete / Delivered	3-Nov-2017	0	Triggered when Tool is received at the Darlington Energy Center (DEC)
Upgrades to ASRT - Procedures Issued	17-Nov-2017	0	Finish no later than Date when Tooling OM, Definition CWP and Training updates (if required) Reviewed I Accepted /Accepted as Noted by OPG

1. Consumables and items with a limited shelf life will not be considered when determining if the Goods milestones have been met
2. The Clean Room and Calibration Shop will not be considered Definition Phase Work it will be considered Execution Phase Work.
3. Tooling for G08W will be considered contingency Tooling and although it is part of the Definition Phase Work, it will not attract Definition Phase schedule disincentives.
4. The Goods for the Bulk Head Shielding are Definition Phase Work. Laser cutting and fabrication of the Bulk Head Shielding Goods will be considered Execution Phase Work.
5. Rentals will be considered procured when a purchase order has been issued.
6. Contingency items tracked on the Contractors' weekly Goods Dashboard dated May 17, 2016 will be considered Execution Phase Work.
7. Project Change Directives numbered 19, 21 and greater will not attract Definition Phase schedule disincentives, although they will be subject to the Definition Phase cost incentive/disincentive regime.
   For clarity PCD 20 work is subject to the RWPB incentive/disincentive regime

Attachment D

Exhibit 3.1(b) – Execution Phase Milestone Schedule

See attached.

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
1st unit				
	Execution Phase Notice to Proceed	1-Jan-16	OPG Notice provided to contractor to commence Execution Phase.	0
	Execution Phase Schedule Integration	30-Jan-16	Execution Phase Schedule Management Plan and Project Controls Plan Reviewed/Reviewed as noted by OPG	0.75
	Detailed Execution Phase Target Schedule	28-Feb-16	Detailed Execution Phase Target Schedule Reviewed/Reviewed as noted by OPG	0
	Execution Phase Project Management Plans	30-Mar-16	Execution Phase Project Execution Plan, Quality Plan, Procurement Plan, Engineering Plan Reviewed/Reviewed as noted by OPG	0.75
	Outside Vault Pre-Reqs Readiness Complete	15-Aug-16	Contractor ready to commence outside of Vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.5
	Unit Breaker Open	15-Oct-16	Unit Shutdown Commence - OPG Notice that Unit Shutdown has started.	3
	Outside Vault Pre-Reqs Field work Complete	6-Feb-17	Outside Vault Pre-Reqs field work complete	1.5
	In Vault Pre-Reqs Readiness Complete	2-Mar-17	Contractor ready to commence in-vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.5
	Vault Turnover	1-May-17	OPG Notice of Vault Turnover issued to contractor. Items as per Scope of Work complete by OPG and documented in the Notice of Vault Turnover.	2
	Closeouts and OPEX Reports issued for Pre-Req before Vault Turnover	31-May-17	Comprehensive Work Package closeouts complete for Pre-Reqs before Vault Turnover	0.125
	In Vault Pre-Reqs field work Complete	19-Jul-17	RTP declared "in service" and available for use as an elevating device.	1
	Waste Tooling System Operational	15-Aug-17	Waste tooling system commissioning complete on site	2.5
	Feeder Removal Readiness complete	19-Aug-17	Contractor ready to commence feeder removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.125
	1st Unit OSM available	15-Sep-17	1st Unit related OSM available for shipment to site, OSM as per Exhibit 2.1 (SOW Appendix A)	2
	Closeouts and OPEX Reports issued for Pre-Req after Vault Turnover	17-Sep-17	Comprehensive Work Package closeouts complete for Pre-Reqs after Vault Turnover	0.125
	Feeder Removal field work Complete	7-Oct-17	Completion of field work for Feeder Removal	1
	Upper Feeder Install Readiness Complete	15-Oct-17	Contractor ready to commence Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Feeder Removal	7-Nov-17	Comprehensive Work Package closeouts complete for Feeder Removal	0.125
	End Fitting Removal Readiness complete	21-Nov-17	Contractor ready to commence End Fitting Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	End Fitting Removal Field Work Complete	21-Jan-18	Completion of field work for End Fitting Removal	1
	Calandria Tube Removal Readiness Complete	25-Mar-18	Contractor ready to commence Calandria Tube Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Face PT Removal	2-Apr-18	Comprehensive Work Package closeouts complete for Face PT removal	0.125
	Tubesheet Bore Cleaning and Inspection Readiness Complete	14-May-18	Contractor ready to commence Tubesheet Bore Cleaning and Inspection - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Calandria Tube Removal Field Work Complete	20-May-18	Completion of field work for Calandria Tube Removal	1
	Clean Room Commissioned for CT install complete	31-May-18	Clean room tooling commissioned and clean room ready for use for CT install.	0.125
	CT install trial Complete	3-Jun-18	First 5 Calandria tubes successfully installed.	0.5
	Closeouts and OPEX Reports issued for Face CT Removal	20-Jun-18	Comprehensive Work Package closeouts complete for Face CT removal	0.125
	CT Install Readiness Complete	25-Jun-18	Contractor ready to commence CT Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Tubesheet Bore Cleaning and Inspection Field Work Complete	10-Jul-18	Completion of field work for Tubesheet Bore Cleaning and Inspection	1
	Upper Feeder Install Field Work Complete	24-Aug-18	Completion of field work for Upper Feeder Install	1
	CT Install Field Work Complete	23-Oct-18	Completion of field work for CT Install	1

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	FC Install Readiness Complete	27-Oct-18	Contractor ready to commence FC Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Clean Room Commissioned for FC install Complete	15-Nov-18	Clean room tooling commissioned and clean room ready for use for FC install.	0.125
	Closeouts and OPEX Reports issued for CT Install	22-Nov-18	Comprehensive Work Package closeout complete for CT install	0.125
	Closeouts and OPEX Reports issued for Face Inspection Series	12-Dec-18	Comprehensive Work Package closeout complete for Face Inspection Series	0.125
	Lower Feeder Install Readiness Complete	7-Mar-19	Contractor ready to commence Lower Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	FC Install Field Work Complete	18-Mar-19	Completion of field work for FC Install	1
	Closeouts and OPEX Reports issued for FC Install	18-May-19	Comprehensive Work Package closeout complete for FC Install	0.125
	New Fuel Load Readiness Complete	11-Jun-19	Contractor ready to commence New Fuel Loading - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	Lower Feeder Install Field Work Complete	25-Jun-19	Completion of field work for Lower Feeder Install	0.5
	Post Req Readiness Complete	7-Jul-19	Contractor ready to commence Post Req Readiness - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	New Fuel Load Field Work Complete	9-Jul-19	Completion of field work for New Fuel Loading	0.5
	Closeouts and OPEX Reports issued for New Fuel Load	9-Aug-19	Comprehensive Work Package closeout complete for New Fuel Load	0.125
	Closeouts and OPEX Reports issued for Feeder Inspection and Install	24-Aug-19	Comprehensive Work Package closeout complete for Feeder Inspection and Install	0.125
	RA Bridge reinstalled	7-Sep-19	Completion of field work for RA bridge reinstallation (exclusive of commissioning)	0.25
	PHTS Hydrostatic Test Complete	6-Nov-19	PHT hydrostatic test complete and accepted by OPG and ANI	0.25
	Unit Mechanical Completion	13-Nov-19	Finish no later than date Unit Mechanical Completion occurs	2
	Closeouts and OPEX Reports issued for Post Reqs before AFS containment test	10-Dec-19	Comprehensive Work Package closeout complete for Post Reqs prior to AFS containment test	0.125
	Unit Available for Service	12-Dec-19	Certificate of AFS issued as per Scope of Work requirements	2
	Closeouts and OPEX Reports issued for Post Reqs after AFS containment test	13-Jan-20	Comprehensive Work Package closeout complete for Post Reqs after AFS containment test	0.125
	Unit Closeout Complete	10-Apr-20	Finish no later than Date Unit Closeout complete	0.25
	Project Supply List Revised	10-Apr-20	Project Supply List (PSL) Reviewed/Reviewed as noted by OPG	0.1
2nd Unit				0
	2nd Unit Goods available	15-Oct-19	2nd Unit related goods available on site, or available for shipment or release to site	1
	2nd Unit OSM available	15-Jul-19	2nd Unit related OSM available for shipment to site, OSM as per Exhibit 2.1 (SOW Appendix A)	2
	Outside Vault Pre-Reqs Readiness Complete	15-Aug-19	Contractor ready to commence outside of Vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Unit Breaker Open	15-Oct-19	Unit Shutdown Commence - OPG Notice that Unit Shutdown has started.	2
	Outside Vault Pre-Reqs Field work Complete	6-Feb-20	Outside Vault Pre-Reqs field work complete	0.5
	In Vault Pre-Reqs Readiness Complete	22-Mar-20	Contractor ready to commence in-vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete	0.25
	Vault Turnover	21-May-20	OPG Notice of Vault Turnover issued to contractor. Items as per Scope of Work complete by OPG and documented in the Notice of Vault Turnover.	2.5
	Closeouts and OPEX Reports issued for Pre-Req before Vault Turnover	20-Jun-20	Comprehensive Work Package closeouts complete for Pre-Reqs before Vault Turnover	0.125
	In Vault Pre-Reqs field work Complete	5-Aug-20	RTP declared "in service" and available for use as an elevating device.	0.5
	Feeder Removal Readiness complete	3-Sep-20	Contractor ready to commence feeder removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Closeouts and OPEX Reports issued for Pre-Req after Vault Turnover	4-Oct-20	Comprehensive Work Package closeouts complete for Pre-Reqs after Vault Turnover	0.125
	Feeder Removal field work Complete	20-Oct-20	Completion of field work for Feeder Removal	0.5

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	Upper Feeder Install Readiness Complete	15-Nov-20	Contractor ready to commence Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete	0.25
	Closeouts and OPEX Reports issued for Feeder Removal	20-Nov-20	Comprehensive Work Package closeouts complete for Feeder Removal	0.125
	End Fitting Removal Readiness complete	6-Dec-20	Contractor ready to commence End Fitting Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	End Fitting Removal Field Work Complete	31-Jan-21	Completion of field work for End Fitting Removal	0.5
	Calandria Tube Removal Readiness Complete	31-Mar-21	Contractor ready to commence Calandria Tube Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Face PT Removal	10-May-21	Comprehensive Work Package closeouts complete for Face PT removal	0.125
	Tubesheet Bore Cleaning and Inspection Readiness Complete	16-May-21	Contractor ready to commence Tubesheet Bore Cleaning and Inspection - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Calandria Tube Removal Field Work Complete	22-May-21	Completion of field work for Calandria Tube Removal	0.5
	CT Install Readiness Complete	22-Jun-21	Contractor ready to commence CT Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Face CT Removal	22-Jun-21	Comprehensive Work Package closeouts complete for Face CT removal	0.125
	Tubesheet Bore Cleaning and Inspection Field Work Complete	6-Jul-21	Completion of field work for Tubesheet Bore Cleaning and Inspection	0.5
	Clean Room Commissioned for CT install complete	8-Jul-21	Clean room tooling commissioned and clean room ready for use for CT install.	0.2
	Upper Feeder Install Field Work Complete	17-Aug-21	Completion of field work for Upper Feeder Install	1
	CT Install Field Work Complete	12-Oct-21	Completion of field work for CT Install	1
	FC Install Readiness Complete	18-Oct-21	Contractor ready to commence FC Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Clean Room Commissioned for FC install Complete	3-Nov-21	Clean room tooling commissioned and clean room ready for use for FC install.	0.1
	Closeouts and OPEX Reports issued for CT Install	11-Nov-21	Comprehensive Work Package closeout complete for CT install	0.125
	Closeouts and OPEX Reports issued for Face Inspection Series	2-Dec-21	Comprehensive Work Package closeout complete for Face Inspection Series	0.125
	Lower Feeder Install Readiness Complete	13-Feb-22	Contractor ready to commence Lower Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	FC Install Field Work Complete	25-Feb-22	Completion of field work for FC Install	1
	Closeouts and OPEX Reports issued for FC Install	27-Apr-22	Comprehensive Work Package closeout complete for FC Install	0.125
	New Fuel Load Readiness Complete	18-May-22	Contractor ready to commence New Fuel Loading - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.125
	Lower Feeder Install Field Work Complete	1-Jun-22	Completion of field work for Lower Feeder Install	0.5
	Post Req Readiness Complete	11-Jun-22	Contractor ready to commence Post Req Readiness - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	New Fuel Load Field Work Complete	14-Jun-22	Completion of field work for New Fuel Loading	0.25
	Closeouts and OPEX Reports issued for New Fuel Load	15-Jul-22	Comprehensive Work Package closeout complete for New Fuel Load	0.125
	Closeouts and OPEX Reports issued for Feeder Inspection and Install	31-Jul-22	Comprehensive Work Package closeout complete for Feeder Inspection and Install	0.125
	RA Bridge reinstalled	13-Aug-22	Completion of field work for RA bridge reinstallation (exclusive of commissioning)	0.25
	PHTS Hydrostatic Test Complete	11-Oct-22	PHT hydrostatic test complete and accepted by OPG and ANI	0.25
	Unit Mechanical Completion	18-Oct-22	Finish no later than date Unit Mechanical Completion occurs	2
	Closeouts and OPEX Reports issued for Post Reqs before AFS containment test	18-Nov-22	Comprehensive Work Package closeout complete for Post Reqs prior to AFS containment test	0.125
	Unit Available for Service	20-Nov-22	Certificate of AFS issued as per Scope of Work requirements	2

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	Closeouts and OPEX Reports issued for Post Reqs after AFS containment test	18-Dec-22	Comprehensive Work Package closeout complete for Post Reqs after AFS containment test	0.125
	Unit Closeout Complete	20-Mar-23	Finish no later than Date Unit Closeout complete	0.125
	Project Supply List Revised	20-Mar-23	Project Supply List (PSL) Reviewed/Reviewed as noted by OPG	0.1
3rd Unit				0
	3rd Unit Goods available	15-Dec-20	3rd Unit related goods available on site, or available for shipment or release to site (eg: PO placed for concrete, but not delivered)	0.25
	3rd Unit OSM available	15-Dec-20	3rd Unit related OSM available for shipment to site, OSM as per Exhibit 2.1 (SOW Appendix A)	0.25
	Outside Vault Pre-Reqs Readiness Complete	13-Jan-21	Contractor ready to commence outside of Vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Unit Breaker Open	15-Mar-21	Unit Shutdown Commence - OPG Notice that Unit Shutdown has started.	2
	Outside Vault Pre-Reqs Field work Complete	7-Jul-21	Outside Vault Pre-Reqs field work complete	0.5
	In Vault Pre-Reqs Readiness Complete	13-Aug-21	Contractor ready to commence in-vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Vault Turnover	12-Oct-21	OPG Notice of Vault Turnover issued to contractor. Items as per Scope of Work complete by OPG and documented in the Notice of Vault Turnover.	2.5
	Closeouts and OPEX Reports issued for Pre-Req before Vault Turnover	11-Nov-21	Comprehensive Work Package closeouts complete for Pre-Reqs before Vault Turnover	0.125
	In Vault Pre-Reqs field work Complete	26-Dec-21	RTP declared "in service" and available for use as an elevating device.	0.25
	Feeder Removal Readiness complete	23-Jan-22	Contractor ready to commence feeder removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Closeouts and OPEX Reports issued for Pre-Req after Vault Turnover	24-Feb-22	Comprehensive Work Package closeouts complete for Pre-Reqs after Vault Turnover	0.125
	Feeder Removal field work Complete	11-Mar-22	Completion of field work for Feeder Removal	0.5
	Upper Feeder Install Readiness Complete	11-Apr-22	Contractor ready to commence Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Feeder Removal	11-Apr-22	Comprehensive Work Package closeouts complete for Feeder Removal	0.125
	End Fitting Removal Readiness complete	25-Apr-22	Contractor ready to commence End Fitting Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	End Fitting Removal Field Work Complete	19-Jun-22	Completion of field work for End Fitting Removal	0.5
	Calandria Tube Removal Readiness Complete	17-Aug-22	Contractor ready to commence Calandria Tube Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Face PT Removal	25-Sep-22	Comprehensive Work Package closeouts complete for Face PT removal	0.125
	Tubesheet Bore Cleaning and Inspection Readiness Complete	1-Oct-22	Contractor ready to commence Tubesheet Bore Cleaning and Inspection - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Calandria Tube Removal Field Work Complete	8-Oct-22	Completion of field work for Calandria Tube Removal	0.5
	CT Install Readiness Complete	6-Nov-22	Contractor ready to commence CT Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25
	Closeouts and OPEX Reports issued for Face CT Removal	8-Nov-22	Comprehensive Work Package closeouts complete for Face CT removal	0.125
	Tubesheet Bore Cleaning and Inspection Field Work Complete	20-Nov-22	Completion of field work for Tubesheet Bore Cleaning and Inspection	0.5
	Clean Room Commissioned for CT install complete	23-Nov-22	Clean room tooling commissioned and clean room ready for use for CT install.	0.2
	Upper Feeder Install Field Work Complete	1-Jan-23	Completion of field work for Upper Feeder Install	0.75
	CT Install Field Work Complete	26-Feb-23	Completion of field work for CT Install	0.75
	FC Install Readiness Complete	3-Mar-23	Contractor ready to commence FC Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.25

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	Clean Room Commissioned for FC install Complete	20-Mar-23	Clean room tooling commissioned and clean room ready for use for FC install.	0.1
	Closeouts and OPEX Reports issued for CT Install	28-Mar-23	Comprehensive Work Package closeout complete for CT install	0.125
	Closeouts and OPEX Reports issued for Face Inspection Series	17-Apr-23	Comprehensive Work Package closeout complete for Face Inspection Series	0.125
	Lower Feeder Install Readiness Complete	28-Jun-23	Contractor ready to commence Lower Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	FC Install Field Work Complete	10-Jul-23	Completion of field work for FC Install	0.75
	Closeouts and OPEX Reports issued for FC Install	9-Sep-23	Comprehensive Work Package closeout complete for FC Install	0.125
	New Fuel Load Readiness Complete	26-Sep-23	Contractor ready to commence New Fuel Loading - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.125
	Lower Feeder Install Field Work Complete	10-Oct-23	Completion of field work for Lower Feeder Install	0.5
	Post Req Readiness Complete	19-Oct-23	Contractor ready to commence Post Req Readiness - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	New Fuel Load Field Work Complete	23-Oct-23	Completion of field work for New Fuel Loading	0.25
	Closeouts and OPEX Reports issued for New Fuel Load	23-Nov-23	Comprehensive Work Package closeout complete for New Fuel Load	0.125
	Closeouts and OPEX Reports issued for Feeder Inspection and Install	9-Dec-23	Comprehensive Work Package closeout complete for Feeder Inspection and Install	0.125
	RA Bridge reinstalled	20-Dec-23	Completion of field work for RA bridge reinstallation (exclusive of commissioning)	0.25
	PHTS Hydrostatic Test Complete	15-Feb-24	PHT hydrostatic test complete and accepted by OPG and ANI	0.25
	Unit Mechanical Completion	22-Feb-24	Finish no later than date Unit Mechanical Completion occurs	2
	Closeouts and OPEX Reports issued for Post Reqs before AFS containment test	16-Mar-24	Comprehensive Work Package closeout complete for Post Reqs prior to AFS containment test	0.125
	Unit Available for Service	26-Mar-24	Certificate of AFS issued as per Scope of Work requirements	2
	Closeouts and OPEX Reports issued for Post Reqs after AFS containment test	23-Apr-24	Comprehensive Work Package closeout complete for Post Reqs after AFS containment test	0.125
	Unit Closeout Complete	24-Jul-24	Finish no later than Date Unit Closeout complete	0.3
	Project Supply List Revised	24-Jul-24	Project Supply List (PSL) Reviewed/Reviewed as noted by OPG	0.1
4th Unit				0
	4th Unit Goods available	15-Jul-22	4th Unit related goods available on site, or available for shipment or release to site (eg: PO placed for concrete, but not delivered)	0.75
	4th Unit OSM available	15-Jul-22	4th Unit related OSM available for shipment to site, OSM as per Exhibit 2.1 (SOW Appendix A)	0.75
	Outside Vault Pre-Reqs Readiness Complete	15-Aug-22	Contractor ready to commence outside of Vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.5
	Unit Breaker Open	15-Oct-22	Unit Shutdown Commence - OPG Notice that Unit Shutdown has started.	1
	Outside Vault Pre-Reqs Field work Complete	6-Feb-23	Outside Vault Pre-Reqs field work complete	0.75
	In Vault Pre-Reqs Readiness Complete	16-Mar-23	Contractor ready to commence in-vault pre-requisite work - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.25
	Vault Turnover	15-May-23	OPG Notice of Vault Turnover issued to contractor. Items as per Scope of Work complete by OPG and documented in the Notice of Vault Turnover.	2.5
	Closeouts and OPEX Reports issued for Pre-Req before Vault Turnover	14-Jun-23	Comprehensive Work Package closeouts complete for Pre-Reqs before Vault Turnover	0.125
	In Vault Pre-Reqs field work Complete	28-Jul-23	RTP declared "in service" and available for use as an elevating device.	1
	Feeder Removal Readiness complete	25-Aug-23	Contractor ready to commence feeder removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG and training complete.	0.45
	Closeouts and OPEX Reports issued for Pre-Req after Vault Turnover	26-Sep-23	Comprehensive Work Package closeouts complete for Pre-Reqs after Vault Turnover	0.125
	Feeder Removal field work Complete	10-Oct-23	Completion of field work for Feeder Removal	1
	Upper Feeder Install Readiness Complete	18-Oct-23	Contractor ready to commence Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.75

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	Closeouts and OPEX Reports issued for Feeder Removal	10-Nov-23	Comprehensive Work Package closeouts complete for Feeder Removal	0.125
	End Fitting Removal Readiness complete	24-Nov-23	Contractor ready to commence End Fitting Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.5
	End Fitting Removal Field Work Complete	19-Jan-24	Completion of field work for End Fitting Removal	1
	Calandria Tube Removal Readiness Complete	17-Mar-24	Contractor ready to commence Calandria Tube Removal - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.3
	Closeouts and OPEX Reports issued for Face PT Removal	26-Apr-24	Comprehensive Work Package closeouts complete for Face PT removal	0.125
	Tubesheet Bore Cleaning and Inspection Readiness Complete	2-May-24	Contractor ready to commence Tubesheet Bore Cleaning and Inspection - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.3
	Calandria Tube Removal Field Work Complete	8-May-24	Completion of field work for Calandria Tube Removal	1
	CT Install Readiness Complete	6-Jun-24	Contractor ready to commence CT Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.125
	Closeouts and OPEX Reports issued for Face CT Removal	8-Jun-24	Comprehensive Work Package closeouts complete for Face CT removal	0.125
	Tubesheet Bore Cleaning and Inspection Field Work Complete	20-Jun-24	Completion of field work for Tubesheet Bore Cleaning and Inspection	0.5
	Clean Room Commissioned for CT install complete	23-Jun-24	Clean room tooling commissioned and clean room ready for use for CT install.	0.1
	Upper Feeder Install Field Work Complete	8-Aug-24	Completion of field work for Upper Feeder Install	0.5
	CT Install Field Work Complete	26-Sep-24	Completion of field work for CT Install	0.5
	FC Install Readiness Complete	1-Oct-24	Contractor ready to commence FC Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.125
	Clean Room Commissioned for FC install Complete	18-Oct-24	Clean room tooling commissioned and clean room ready for use for FC install.	0.125
	Closeouts and OPEX Reports issued for CT Install	26-Oct-24	Comprehensive Work Package closeout complete for CT install	0.125
	Closeouts and OPEX Reports issued for Face Inspection Series	15-Nov-24	Comprehensive Work Package closeout complete for Face Inspection Series	0.125
	Lower Feeder Install Readiness Complete	27-Jan-25	Contractor ready to commence Lower Feeder Install - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	FC Install Field Work Complete	7-Feb-25	Completion of field work for FC Install	0.25
	Closeouts and OPEX Reports issued for FC Install	9-Apr-25	Comprehensive Work Package closeout complete for FC Install	0.125
	New Fuel Load Readiness Complete	25-Apr-25	Contractor ready to commence New Fuel Loading - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	Lower Feeder Install Field Work Complete	9-May-25	Completion of field work for Lower Feeder Install	0.25
	Post Req Readiness Complete	19-May-25	Contractor ready to commence Post Req Readiness - Comprehensive Work Packages Reviewed/Reviewed as Noted by OPG, tooling ready and training complete.	0.1
	New Fuel Load Field Work Complete	23-May-25	Completion of field work for New Fuel Loading	0.125
	Closeouts and OPEX Reports issued for New Fuel Load	23-Jun-25	Comprehensive Work Package closeout complete for New Fuel Load	0.125
	Closeouts and OPEX Reports issued for Feeder Inspection and Install	8-Jul-25	Comprehensive Work Package closeout complete for Feeder Inspection and Install	0.125
	RA Bridge reinstalled	18-Jul-25	Completion of field work for RA bridge reinstallation (exclusive of commissioning)	0.125
	PHTS Hydrostatic Test Complete	14-Sep-25	PHT hydrostatic test complete and accepted by OPG and ANI	0.1
	Unit Mechanical Completion	21-Sep-25	Finish no later than date Unit Mechanical Completion occurs	2.25
	Closeouts and OPEX Reports issued for Post Reqs before AFS containment test	14-Oct-25	Comprehensive Work Package closeout complete for Post Reqs prior to AFS containment test	0.125
	Unit Available for Service	24-Oct-25	Certificate of AFS issued as per Scope of Work requirements	2
	Closeouts and OPEX Reports issued for Post Reqs after AFS containment test	21-Nov-25	Comprehensive Work Package closeout complete for Post Reqs after AFS containment test	0.1

Exhibit 3.1(b) Execution Phase Milestone Schedule

	Milestone	Completion Date	Requirements to Satisfy Milestone Completion	% Fixed Fee Paid
	Unit Closeout Complete	21-Feb-26	Finish no later than Date Unit Closeout complete	0.15
Common				
	Feeder Removal Series Rehearsals Complete	1-Sep-16	Finish no later than Date when Feeder Removal Series Rehearsals Complete	0
	Fuel Channel Removal Series Rehearsals Complete	18-Nov-16	Finish no later than Date when Feeder Removal Series Rehearsals Complete	0
	Fuel Channel Installation Series Rehearsals Complete	16-Dec-16	Finish no later than Date when Fuel Channel Installation Series Rehearsals Complete	0
	MEC Package Complete	23-Dec-16	Finish no later than Date OPG Master EC Packages remaining units issued to Contractor by OPG	0.75
	Owner Specified Materials Procurement Package Issued	31-Dec-16	Finish no later than Date when Owner Specified Materials Procurement Packages Issued for remaining units	0.5
	Feeder Installation Series Rehearsals Complete	20-Jan-17	Finish no later than Date when Feeder Installation Series Rehearsals Complete	0
	Lessons Learned Report and Documentation Revisions Completed	24-Feb-17	Finish no later than Date when the Lessons Learned Report is Reviewed, Reviewed as Noted by OPG	0
	Owner Specified Materials Ordered	28-Feb-17	Finish no later than Date when Owner Specified Materials Ordered for remaining units	0.5
	Non-Feeder Process Qualification Complete	22-Dec-17	Finish no later than Date when Process Qualification is completed and the Test Reports are reviewed I reviewed as noted by OPG	0
	Engineering Complete	7-Jan-19	Finish no later than Date when all design packages for remaining units Reviewed / Accepted / Accepted as Noted by OPG	0.5
	Final Mechanical Completion	24-Oct-25	Finish no later than Date Notice of Final Mechanical Completion occurs	0.25
	Temporary Site Infrastructure Removed	22-Aug-26	Finish no later than Date all temporary site infrastructure removed from site by Contractor	0.1
	Waste tooling system decommissioned	22-Aug-26	Finish no later than Date Waste Tooling System Decommissioned and Disposed	0.1
	Final Completion	21-Sep-26	Finish no later than Date Notice of Final Completion issued by OPG	0.5
	Project Close Out Report	20-Nov-26	Finish no later than Date Project close out report Reviewed / Accepted / Accepted as Noted by OPG	0.1

Attachment E

Exhibit 4.7 Economic Cost Adjustments

See attached.

Exhibit 4.7 – Economic Cost Adjustments

All costs forming part of the Execution Phase Target Cost will be designated by OPG and the Contractor as either (i) subject to economic cost adjustment (each, an "**Adjustable Cost**"), or (ii) not subject to economic cost adjustment.

As part of the initial development of the Execution Phase Target Cost in accordance with section 3.5 of this Agreement, OPG and the Contractor will allocate all Adjustable Costs to the specific calendar year(s) (each, a "**Contract Year**") in which such Adjustable Costs are anticipated to be incurred. In addition, if a Project Change Directive will result in the incurrence of additional Adjustable Costs, OPG and the Contractor will allocate such Adjustable Costs to the specific Contract Year(s) in which such Adjustable Costs are anticipated to be incurred. These allocations will not be adjusted to account for the actual date of incurrence of Adjustable Costs during the Execution Phase.

By the end of each Contract Year following the calendar year in which OPG and the Contractor agree to the Execution Phase Target Cost, OPG will determine the economic cost adjustment amount for the preceding Contract Year in accordance with formula set out below. The total economic cost adjustment amount for each Contract Year will be the aggregate of the economic cost adjustment amounts for each category of Adjustable Costs.

$$\text{economic cost adjustment amount for each category of Adjustable Costs for Contract Year} = \text{aggregate amount of Adjustable Costs in such category allocated to Contract Year} \times \frac{\text{Current Index Value} - \text{Base Index Value}}{\text{Base Index Value}}$$

Base Index Value

When OPG and the Contractor allocate Adjustable Costs to specific Contract Year(s), OPG and the Contractor will also link each Adjustable Cost item to the applicable index set out in the table below. The "**Base Index Value**" in the formula set out above refers to the value specified in the version of the index that is used by OPG and the Contractor to develop the initially-agreed Execution Phase Target Cost. (Unless otherwise agreed by OPG and the Contractor, the most recent version of each applicable index will be used for such purpose. Provisional indices will not be used.)

	Adjustable Cost Element	Applicable Index
1	Professional Services (non-union)	Statistics Canada; Survey of Employment, Payrolls and Hours (SEPH), fixed weighted index of average hourly earnings for all employees, by North American Industry Classification System (NAICS) (CANSIM Table 281-0039); geographic area of Ontario; North American Industry Classification System (NAICS) of Service producing industries (41-91N); annual average data
2	Professional Services (union)	Union Collective Agreements
3	Trade labour	Union Collective Agreements
4	SS&E (Small Tools and Consumables)	Statistics Canada; Consumer Price Index for the Province of Ontario
5	SS&E (Construction Equipment)	The weighted average of the increases/decreases in a basket of rates selected by OPG and the Contractor from Ontario Provincial Standards, OPSS 127 Schedule of Rental Rates for Construction Equipment, including model and specification reference. Such weighted average to be determined by OPG and the Contractor as part of the initial development of the Execution Phase Target Cost in accordance with section 3.5 of this Agreement.

In order to distinguish any change in the Execution Phase Target Cost arising from changes in the RFR Scope of Work from the change in the Execution Phase Target Cost that will arise from economic cost adjustments, the amount of each Adjustable Cost resulting from a Project Change Directive will be adjusted (using the indices referenced above) to the amount that would have been recorded for such Adjustable Cost item in the initial development of the Execution Phase Target Cost. Thereafter, the formula set out above will be applied to such adjusted value.

Current Index Value

The "**Current Index Value**" in the formula set out above refers to the value specified in the most recent version of the index that is available to OPG and the Contractor as of the date of calculation. (Provisional indices will not be used.)

Effect on Execution Phase Target Cost

The Execution Phase Target Cost will be adjusted annually by OPG and the Contractor to reflect the total amount of the economic cost adjustment calculated using the formula set out above. All such adjustments will be documented in a Project Change Directive.

Indexation of Execution Phase Fixed Fee

Except as provided below, the unpaid balance of the Execution Phase Fixed Fee will also be adjusted annually by OPG and the Contractor on the date on which the Execution Phase Target Cost is adjusted in accordance with this Exhibit 4.7. Such adjustment will be equal to the annual increase/decrease reported in the Consumer Price Index for the Province of Ontario published most recently by Statistics Canada. Such adjustment will operate prospectively to payments of the Execution Phase Fixed Fee made after the calculation date. Each such adjustment will be documented in a Project Change Directive.

Provided that, the foregoing adjustment will be made only to that portion of the unpaid balance of the Execution Phase Fixed Fee that is scheduled to be paid after the calculation date (i.e., no adjustment will be made on any portion of the Execution Phase Fixed Fee that has not been paid because the corresponding Execution Phase Work was not been completed on schedule.)

For certainty, such adjustment will not be restricted to the profit component of the Execution Phase Fixed Fee as contemplated by section 4.6 of this Agreement.

Firm Price Work

In the event that OPG engages the Contractor to perform Firm Price Work, then the methodology outlined in this Exhibit 4.7 for adjustment of the Execution Phase Target Cost will also be applied, with all necessary modifications, to the Firm Price for such Firm Price Work on each anniversary of the date on which OPG engages the Contractor to perform such Firm Price Work.

Illustrative Examples

1. Professional Services (Non-union)

Index Reference: Statistics Canada; Survey of Employment, Payrolls and Hours (SEPH), fixed weighted index of average hourly earnings for all employees, by North American Industry Classification System (NAICS) (CANSIM Table 281-0039); geographic area of Ontario; North American Industry Classification System (NAICS) of Service producing industries (41-91N); annual average data

Current Index Values:

Year	2012	2013	2014	2015 (Base Year)	2016
Index Value (Annual Average data)	135.5	138	139.6	143.6	146.0

To retrieve data for the Professional Services (Non-union) index follow these steps:

1. Access the Statistics Canada CANSIM Table 281-0039
2. Select the "Add/Remove data" tab and select the following variables to create the customized CANSIM table:
   a. Step 1 - Select the geographic area of "Ontario"
   b. Step 2 - Select the North American Industry Classification System of "Service producing industries [41-91N]"
   c. Step 3 - Select the time frame from January 2015 (the base year) to December of the year being escalated
   d. Step 4 - Select the Screen output format "HTML table, time as columns" and Series details "normal retrieval"
   e. Step 5 - Select "Apply" and a table with monthly data will open
3. Select the "Manipulate" tab and select the following three variables:
   a. Frequency of output data will be: "Annual (average)"
   b. When converting frequency by summing or averaging: "Use calendar year"
   c. Data table will contain: "Data as retrieved"
   d. Select "Apply" and the table will open.
4. Verify the data output for 2015 and 2016 match that shown in the Current Index Values table above to confirm the data has been retrieved correctly.

Illustrative Cost Flows (unescalated 2017$):

Contract Year	2015	2016	2017
Professional Services (Non-union) ($M)	$150.0	$200.0	$250.0

Example Base Year: 2015 (Execution Phase Target Cost agreement)

2016 Economic Cost Adjustment:

Base Index Value (2015) = 143.6

Current Index Value (2016) = *146.0*

Professional Services (Non-union) Cost in 2016 Contract Year = $200.0M

2016 Economic Cost Adjustment = $200.0M x (146.0-143.6)/143.6 = $3.3M

Illustrative Cost Flows after 2016 Adjustment:

Contract Year	2015	2016	2017
Professional Services (Non-union) ($M)	**$150**	$203.3	$250.0

2017 Economic Cost Adjustment:

Base Index Value (2015) = 143.6

Current Index Value (2017) = 147.0 *(not actual index data)*

Professional Services (Non-union) Cost in 2017 Contract Year = $250.0M

2017 Economic Cost Adjustment = $250.0M x (147.0-143.6)/143.6 = $5.9M

Illustrative Cost Flows after 2017 Adjustment:

Contract Year	2015	2016	2017
Professional Services (Non-union) ($M)	$150	$203.3	**$255.9**

2. Professional Services (Union)

To be calculated using the same methodology as the Trade Labour example below.

3. Trade Labour

Economic Cost Adjustment Reference: Various Union Collective Agreements

Description of Cost Adjustment Methodology:

After every Contract Year, the Trade Labour cost flows submitted by the Contractor in the basis for estimate will be recalculated to reflect wage rates stipulated by the various Union Collective Agreements during that Contract Year. The Trade Labour cost flows in the basis for estimate will be deducted from the adjusted cost flows to produce an incremental cost flow for each Trade Labour category. The sum of the incremental cost flows for each Trade Labour category will be the Economic Cost Adjustment for that particular Contract Year.

Illustrative Example:

Basis for Estimate EPSCA Boilermakers Cost Flow (Costs in 2007$):

		2008 Cost											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EPSCA	Boilermakers												
	Wage Rate ($/Hr)	58.23	58.23	58.23	58.23	58.23	58.23	58.23	58.23	58.23	58.23	58.23	58.23
	Hours	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717
	Cost ($000's)	100	100	100	100	100	100	100	100	100	100	100	100

Assuming a 3% wage rate increase came into effect on May 1, 2008, the adjusted cost flow would be:

		2008 Cost											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EPSCA	Boilermakers												
	Wage Rate ($/Hr)	58.23	58.23	58.23	58.23	59.98	59.98	59.98	59.98	59.98	59.98	59.98	59.98
	Hours	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717	1717
	Cost ($000's)	100	100	100	100	103	103	103	103	103	103	103	103

The incremental EPSCA Boilermakers cost flow for 2008 is $3,000 x 8 months (May-Dec.) = $24,000. This amount would be summed with the other Trade Labour wage adjustments for the 2008 Contract Year to produce the total Trade Labour Economic Cost Adjustment.

4. Small Tools and Consumables

Index Reference: Statistics Canada; Table 3260021 - Consumer Price Index (CPI), 2005 basket, annually (2002=100 unless specified); V41694217 Ontario; All-items

Current Index Values:

Year	Index
2007	110.8
2008	113.3
2009	113.7
2010	Not Avail.

If Trade Labour resources, and correspondingly, Small Tools and Consumables, are expected to fluctuate significantly from month to month during each Contract Year, OPG and the Contractor may wish to consider applying the monthly CPI values to calculate the Economic Cost Adjustment.

Illustrative Cost Flows (unescalated 2007$):

Contract Year	2008	2009	2010
Small Tools & Consumables (ST&C) ($M)	$100.0	$125.0	$150.0

Example Base Year: 2007 (Execution Phase Target Cost agreement signed)

<u>2008 Economic Cost Adjustment:</u>

Base Index Value (2007) = 110.8

Current Index Value (2008) = 113.3

ST&C Cost in 2008 Contract Year = $100.0M

2008 Economic Cost Adjustment = $100.0M x (113.3-110.8)/110.8 = $100.0M x 0.023 = $2.3M

Illustrative Cost Flows after 2008 Adjustment:

Contract Year	2008	2009	2010
Small Tools & Consumables (ST&C) ($M)	**$102.3**	$125.0	$150.0

2009 Economic Cost Adjustment:

Base Index Value (2007) = 110.8

Current Index Value (2009) = 113.7

ST&C Cost in 2009 Contract Year = $125.0M

2009 Economic Cost Adjustment = $125.0M x (113.7-110.8)/110.8 = $125.0M x 0.026 = $3.3M

Illustrative Cost Flows after 2009 Adjustment:

Contract Year	2008	2009	2010
Small Tools & Consumables (ST&C) ($M)	$102.3	**$128.3**	$150.0

2010 Economic Cost Adjustment:

To be calculated in 2011 once the 2010 index value is published by Statistics Canada.

5. Construction Equipment

Reference: Ontario Provincial Standard Specification (OPSS 127); Schedule of Rental Rates for Construction Equipment, Including Model and Specification Reference

Example Base Year: 2007 (Execution Phase Target Cost agreement signed)

Illustrative Construction Equipment Cost Flows:

Contract Year	2008	2009	2010
Construction Equipment ($M)	$200	$300	$400

Illustrative Basket of Rates Selected by OPG and the Contractor from the OPSS 127 Schedule:

Item	2007 Base Year			
	Rental Cost ($/Hr)	Estimated Usage (Hrs)	Rental Cost ($)	Basket Weighting (%)
Boom Truck (25,000 kg)	$174.55	300	$52,365	12.17%
Aerial Bucket Lift (20m)	$121.40	800	$97,120	22.56%
Dump Truck (Rigid Frame, 50,000kg)	$272.70	300	$81,810	19.01%
Scissor Lift (9m)	$26.75	1,000	$26,750	6.21%
Centrifugal Pump (100mm intake)	$3.70	2,000	$7,400	1.72%
Air Compressor (25m^3/min)	$94.25	1,200	$113,100	26.28%
DC Arc Welder (400A)	$25.95	2,000	$51,900	12.06%
Basket Total	$719.30		$430,445	100.00%

For this example, the basket weightings remain the same for all contract years, and are calculated using the Base Year rental costs and estimated equipment usages agreed upon between OPG and the Contractor prior to the first Contract Year. Alternatively, OPG and the Contractor could agree to establish estimated equipment usages for each individual Contract Year if the projected usage of these equipment items relative to the other basket items is expected to change. Using this alternative approach would cause the weightings of the equipment basket to vary year over year.

2008 Economic Cost Adjustment:

Item	2007 Base Year		2008 Contract Year		
	Rental Cost ($/Hr)	Basket Weighting (%)	Rental Cost ($/Hr)	Cost Increase/ Decrease (%)	Weighted Increase/ Decrease (%)
Boom Truck (25,000 kg)	$174.55	12.17%	$174.55	0.00%	0.00%
Aerial Bucket Lift (20m)	$121.40	22.56%	$121.40	0.00%	0.00%
Dump Truck (Rigid Frame, 50,000kg)	$272.70	19.01%	$272.70	0.00%	0.00%
Scissor Lift (9m)	$26.75	6.21%	$26.75	0.00%	0.00%
Centrifugal Pump (100mm intake)	$3.70	1.72%	$3.70	0.00%	0.00%
Air Compressor (25m^3/min)	$94.25	26.28%	$94.25	0.00%	0.00%
DC Arc Welder (400A)	$25.95	12.06%	$25.95	0.00%	0.00%
Basket Total	$719.30	100.00%	$719.30		**0.00%**

2008 Economic Cost Adjustment = $200.0M x 0.00% = $0.0M

2009 Economic Cost Adjustment:

Item	2007 Base Year		2009 Contract Year		
	Rental Cost ($/Hr)	Basket Weighting (%)	Rental Cost ($/Hr)	Cost Increase/ Decrease (%)	Weighted Increase/ Decrease (%)
Boom Truck (25,000 kg)	$174.55	12.17%	$174.55	0.00%	0.00%
Aerial Bucket Lift (20m)	$121.40	22.56%	$121.40	0.00%	0.00%
Dump Truck (Rigid Frame, 50,000kg)	$272.70	19.01%	$272.70	0.00%	0.00%
Scissor Lift (9m)	$26.75	6.21%	$26.75	0.00%	0.00%
Centrifugal Pump (100mm intake)	$3.70	1.72%	$4.75	28.4%	0.49%
Air Compressor (25m^3/min)	$94.25	26.28%	$94.25	0.00%	0.00%
DC Arc Welder (400A)	$25.95	12.06%	$25.95	0.00%	0.00%
Basket Total	$719.30	100.00%	$720.35		**0.49%**

2009 Economic Cost Adjustment = $300.0M x 0.49% = $1.5M

2010 Economic Cost Adjustment:

Item	2007 Base Year		2010 Contract Year		
	Rental Cost ($/Hr)	Basket Weighting (%)	Rental Cost ($/Hr)	Cost Increase/ Decrease (%)	Weighted Increase/ Decrease (%)
Boom Truck (25,000 kg)	$174.55	12.17%	$172.20	-1.35%	-0.16%
Aerial Bucket Lift (20m)	$121.40	22.56%	$119.60	-1.48%	-0.33%
Dump Truck (Rigid Frame, 50,000kg)	$272.70	19.01%	$268.85	-1.41%	-0.27%
Scissor Lift (9m)	$26.75	6.21%	$26.25	-1.87%	-0.12%
Centrifugal Pump (100mm intake)	$3.70	1.72%	$4.60	24.32%	0.42%
Air Compressor (25m^3/min)	$94.25	26.28%	$93.50	-0.80%	-0.21%
DC Arc Welder (400A)	$25.95	12.06%	$24.40	-5.97%	-0.72%
Basket Total	$719.30	100.00%	$709.40		**-1.39%**

2010 Economic Cost Adjustment = $400.0M x (-1.39%) = -$5.6M

Attachment F

Exhibit 6.1 – Pricing

See attached.

Exhibit 6.1 – Pricing

Section Ref.		($) / (%)
1.1(pp)	Definition Phase Fixed Fee (Including 1.1 (rrrrrrr.3) RWPB Fixed Fee) Definition Phase Fixed Fee excluding RWPB Fixed Fee $51,074,119 ***Add*** RWPB Fixed Fee $21,472,008 = **$72,546,127**	$72,546,127
1.1(tt)	Definition Phase SS&E Fixed Fee	$4,771,215
1.1(uu)	Definition Phase SS&E Target Cost	$27,741,650
1.1(ww)	Definition Phase Target Cost (Including 1.1 (uu) Definition Phase SS&E Target Cost) Definition Phase Target Cost excluding SS&E Target Cost excluding RWPB Target Cost $ 101,016,081 ***Add*** Definition Phase SS&E Target Cost $ 27,741,650 RWPB Target Cost $ 65,886,447 = **$ 194,644,178**	$194,644,178
1.1(ppp)	Execution Phase Fixed Fee	$482,001,937
1.1(ttt)	Execution Phase SS&E Fixed Fee	$12,103,675
1.1(uuu)	Execution Phase SS&E Target Cost	$68,128,307
1.1(www)	Execution Phase Target Cost	$1,594,807,128
1.1(xxxx)	Mock-Ups Fixed Price	$38,057,943
1.1(iiiiiii)	Tooling Fixed Price	$385,788,549
1.1 (rrrrrrr.3)	RWPB Fixed Fee	$21,472,008
1.1 (rrrrrrr.4)	RWPB Target Cost	$65,886,447

Section Ref.		($) / (%)
6.1(e)	Mark-up for Owner-Specified Materials	10.00%
6.1(f)	Mark-up for Goods	5.00%
6.1(g)	Profit Percentage for Commissioning Phase Reimbursable Work	11.10%
7.1(a)	Definition Phase Advance	$2,348,771
7.1(b)	Execution Phase Advance	To be updated in accordance with 7.1(b)
18.15	[redacted]	
Execution Phase Fixed Fee Worksheet		See attachment 1 to this Exhibit 6.1
Definition Phase Fixed Fee Worksheet		See attachment 2 to this Exhibit 6.1
RWPB Fixed Fee Worksheet		See attachment 3 to this Exhibit 6.1
[redacted]	[redacted] - Estimated Cost of OSM (excluding mark-up and net of all discounts, rebates and refunds)	$368,288,392
[redacted]	[redacted] - Estimated Cost of Goods (excluding mark-up and net of all discounts, rebates and refunds)	$33,052,300

Attachment G

Exhibit 7.1(b) – Tooling Milestone Payment Table

See attached.

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	Sub-Total	Cost Breakdown Engineered	Cost Breakdown Non-Engineered	Total	Condition of Tool(s) (New, Refurbished/Existing)
4.2	Removal Tools				$ 80,291,974	
4.2.1	Feeders Removal Tools				$ 6,409,506	
4.2.1.1	Reactor Face Insulation Tools	100%		$405,368	$ 405,368	New
4.2.1.1.1	Mobilization/Preliminary Design Start	10%			$ 40,537	
4.2.1.1.2	Preliminary Design Review Complete	10%			$ 40,537	
4.2.1.1.3	Materials/P.O.s Placed to Subs	10%			$ 40,537	
4.2.1.1.4	Detail Engineering Complete	5%			$ 20,268	
4.2.1.1.5	Prototype Complete	15%			$ 60,805	
4.2.1.1.6	Qualification Complete	10%			$ 40,537	
4.2.1.1.7	Manufacture Complete/Delivered	15%			$ 60,805	
4.2.1.1.8	Draft Procedures Issued	10%			$ 40,537	
4.2.1.1.9	Commissioning & Integration Test Complete	10%			$ 40,537	
4.2.1.1.10	Final Procedures Issued	5%			$ 20,268	
4.2.1.2	Feeder Cabinet Tools	100%		$1,052,601	$ 1,052,601	New
4.2.1.2.1	Mobilization/Preliminary Design Start	10%			$ 105,260	
4.2.1.2.2	Preliminary Design Review Complete	10%			$ 105,260	
4.2.1.2.3	Materials/P.O.s Placed to Subs	10%			$ 105,260	
4.2.1.2.4	Detail Engineering Complete	5%			$ 52,630	
4.2.1.2.5	Prototype Complete	15%			$ 157,890	
4.2.1.2.6	Qualification Complete	10%			$ 105,260	
4.2.1.2.7	Manufacture Complete/Delivered	15%			$ 157,890	
4.2.1.2.8	Draft Procedures Issued	10%			$ 105,260	
4.2.1.2.9	Commissioning & Integration Test Complete	10%			$ 105,260	
4.2.1.2.10	Final Procedures Issued	5%			$ 52,630	
4.2.1.3	Coupling Hardware Tools	100%	$2,569,736	$584,542	$ 3,154,278	New
4.2.1.3.1	Mobilization/Preliminary Design Start	10%			$ 315,428	
4.2.1.3.2	Preliminary Design Review Complete	15%			$ 473,142	
4.2.1.3.3	Materials/P.O.s Placed to Subs	10%			$ 315,428	
4.2.1.3.4	Detail Engineering Complete	5%			$ 157,714	
4.2.1.3.5	Prototype Complete	10%			$ 315,428	
4.2.1.3.6	Qualification Complete	10%			$ 315,428	
4.2.1.3.7	Manufacture Complete/Delivered	15%			$ 473,142	
4.2.1.3.8	Draft Procedures Issued	10%			$ 315,428	
4.2.1.3.9	Commissioning & Integration Test Complete	10%			$ 315,428	
4.2.1.3.10	Final Procedures Issued	5%			$ 157,714	
4.2.1.4	Feeder Pipes Tools	100%		$1,797,259	$ 1,797,259	New
4.2.1.4.1	Mobilization/Preliminary Design Start	10%			$ 179,726	
4.2.1.4.2	Preliminary Design Review Complete	15%			$ 269,589	
4.2.1.4.3	Materials/P.O.s Placed to Subs	10%			$ 179,726	
4.2.1.4.4	Detail Engineering Complete	5%			$ 89,863	
4.2.1.4.5	Prototype Complete	10%			$ 179,726	
4.2.1.4.6	Qualification Complete	10%			$ 179,726	
4.2.1.4.7	Manufacture Complete/Delivered	15%			$ 269,589	
4.2.1.4.8	Draft Procedures Issued	10%			$ 179,726	
4.2.1.4.9	Commissioning & Integration Test Complete	10%			$ 179,726	
4.2.1.4.10	Final Procedures Issued	5%			$ 89,863	
4.2.2	Fuel Channel Removal Tools				$ 73,882,468	
4.2.2.1	Position Assembly Tools	100%		$699,388	$ 699,388	New
4.2.2.1.1	Mobilization/Preliminary Design Start	10%			$ 69,939	
4.2.2.1.2	Preliminary Design Review Complete	10%			$ 69,939	
4.2.2.1.3	Materials/P.O.s Placed to Subs	10%			$ 69,939	
4.2.2.1.4	Detail Engineering Complete	5%			$ 34,969	
4.2.2.1.5	Prototype Complete	15%			$ 104,908	
4.2.2.1.6	Qualification Complete	10%			$ 69,939	
4.2.2.1.7	Manufacture Complete/Delivered	15%			$ 104,908	
4.2.2.1.8	Draft Procedures Issued	10%			$ 69,939	
4.2.2.1.9	Commissioning & Integration Test Complete	10%			$ 69,939	
4.2.2.1.10	Final Procedures Issued	5%			$ 34,969	

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	Subtotal	Cost Breakdown Engineered	Non-Engineered	Total	Cost Breakdown Tool(s) (New/Refurbish/Existing)
4.2.2.2	**Closure Plug Tools**	**100%**	$1,679,661		$ 1,679,661	New
4.2.2.2.1	Mobilization/Preliminary Design Start	10%			$ 167,966	
4.2.2.2.2	Preliminary Design Review Complete	10%			$ 167,966	
4.2.2.2.3	Materials/P.O.s Placed to Subs	10%			$ 167,966	
4.2.2.2.4	Detail Engineering Complete	5%			$ 83,983	
4.2.2.2.5	Prototype Complete	15%			$ 251,949	
4.2.2.2.6	Qualification Complete	10%			$ 167,966	
4.2.2.2.7	Manufacture Complete/Delivered	15%			$ 251,949	
4.2.2.2.8	Draft Procedures Issued	10%			$ 167,966	
4.2.2.2.9	Commissioning & Integration Test Complete	10%			$ 167,966	
4.2.2.2.10	Final Procedures Issued	5%			$ 83,983	
4.2.2.3	**Pressure Tube Tools**	**100%**	$16,155,028		$ 16,155,028	New
4.2.2.3.1	Mobilization/Preliminary Design Start	10%			$ 1,615,503	
4.2.2.3.2	Preliminary Design Review Complete	15%			$ 2,423,254	
4.2.2.3.3	Materials/P.O.s Placed to Subs	10%			$ 1,615,503	
4.2.2.3.4	Detail Engineering Complete	5%			$ 807,751	
4.2.2.3.5	Prototype Complete	10%			$ 1,615,503	
4.2.2.3.6	Qualification Complete	10%			$ 1,615,503	
4.2.2.3.7	Manufacture Complete/Delivered	15%			$ 2,423,254	
4.2.2.3.8	Draft Procedures Issued	10%			$ 1,615,503	
4.2.2.3.9	Commissioning & Integration Test Complete	10%			$ 1,615,503	
4.2.2.3.10	Final Procedures Issued	5%			$ 807,751	
4.2.2.4	**End Fitting Tools**	**100%**	$46,245,005		$ 46,245,005	New
4.2.2.4.1	Mobilization/Preliminary Design Start	10%			$ 4,624,500	
4.2.2.4.2	Preliminary Design Review Complete	15%			$ 6,936,751	
4.2.2.4.3	Materials/P.O.s Placed to Subs	10%			$ 4,624,500	
4.2.2.4.4	Detail Engineering Complete	5%			$ 2,312,250	
4.2.2.4.5	Prototype Complete	10%			$ 4,624,500	
4.2.2.4.6	Qualification Complete	10%			$ 4,624,500	
4.2.2.4.7	Manufacture Complete/Delivered	15%			$ 6,936,751	
4.2.2.4.8	Draft Procedures Issued	10%			$ 4,624,500	
4.2.2.4.9	Commissioning & Integration Test Complete	10%			$ 4,624,500	
4.2.2.4.10	Final Procedures Issued	5%			$ 2,312,250	
4.2.2.5	**Calandria Tube Inserts Tools**	**100%**	$5,419,267		$ 5,419,267	New
4.2.2.5.1	Mobilization/Preliminary Design Start	10%			$ 541,927	
4.2.2.5.2	Preliminary Design Review Complete	10%			$ 541,927	
4.2.2.5.3	Materials/P.O.s Placed to Subs	10%			$ 541,927	
4.2.2.5.4	Detail Engineering Complete	5%			$ 270,963	
4.2.2.5.5	Prototype Complete	15%			$ 812,890	
4.2.2.5.6	Qualification Complete	10%			$ 541,927	
4.2.2.5.7	Manufacture Complete/Delivered	15%			$ 812,890	
4.2.2.5.8	Draft Procedures Issued	10%			$ 541,927	
4.2.2.5.9	Commissioning & Integration Test Complete	10%			$ 541,927	
4.2.2.5.10	Final Procedures Issued	5%			$ 270,963	
4.2.2.6	**Calandria Tube Tools**	**100%**	$3,684,120		$ 3,684,120	New
4.2.2.6.1	Mobilization/Preliminary Design Start	10%			$ 368,412	
4.2.2.6.2	Preliminary Design Review Complete	10%			$ 368,412	
4.2.2.6.3	Materials/P.O.s Placed to Subs	10%			$ 368,412	
4.2.2.6.4	Detail Engineering Complete	5%			$ 184,206	
4.2.2.6.5	Prototype Complete	15%			$ 552,618	
4.2.2.6.6	Qualification Complete	10%			$ 368,412	
4.2.2.6.7	Manufacture Complete/Delivered	15%			$ 552,618	
4.2.2.6.8	Draft Procedures Issued	10%			$ 368,412	
4.2.2.6.9	Commissioning & Integration Test Complete	10%			$ 368,412	
4.2.2.6.10	Final Procedures Issued	5%			$ 184,206	

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	% of Total	Cost Breakdown Entitlement	Cost Breakdown Non-Entitlement	Total	Condition of Tool (% New/Refurbished/Existing)
4.3	Installation Tools				$ 61,479,294	
4.3.1	Calandria Tubes Install Tools	100%	$19,243,385		$ 19,243,385	New
4.3.1.1	Mobilization/Preliminary Design Start	10%			$ 1,924,338	
4.3.1.2	Preliminary Design Review Complete	15%			$ 2,886,508	
4.3.1.3	Materials/P.O.s Placed to Subs	10%			$ 1,924,338	
4.3.1.4	Detail Engineering Complete	5%			$ 962,169	
4.3.1.5	Prototype Complete	10%			$ 1,924,338	
4.3.1.6	Qualification Complete	10%			$ 1,924,338	
4.3.1.7	Manufacture Complete/Delivered	15%			$ 2,886,508	
4.3.1.8	Draft Procedures Issued	10%			$ 1,924,338	
4.3.1.9	Commissioning & Integration Test Complete	10%			$ 1,924,338	
4.3.1.10	Final Procedures Issued	5%			$ 962,169	
4.3.2	Fuel Channel and End Fitting Install Tools	100%	$13,211,062		$ 13,211,062	New
4.3.2.1	Mobilization/Preliminary Design Start	10%			$ 1,321,106	
4.3.2.2	Preliminary Design Review Complete	15%			$ 1,981,659	
4.3.2.3	Materials/P.O.s Placed to Subs	10%			$ 1,321,106	
4.3.2.4	Detail Engineering Complete	5%			$ 660,553	
4.3.2.5	Prototype Complete	10%			$ 1,321,106	
4.3.2.6	Qualification Complete	10%			$ 1,321,106	
4.3.2.7	Manufacture Complete/Delivered	15%			$ 1,981,659	
4.3.2.8	Draft Procedures Issued	10%			$ 1,321,106	
4.3.2.9	Commissioning & Integration Test Complete	10%			$ 1,321,106	
4.3.2.10	Final Procedures Issued	5%			$ 660,553	
4.3.3	Feeders Install Tools	100%	$29,024,847		$ 29,024,847	New
4.3.3.1	Mobilization/Preliminary Design Start	10%			$ 2,902,485	
4.3.3.2	Preliminary Design Review Complete	15%			$ 4,353,727	
4.3.3.3	Materials/P.O.s Placed to Subs	10%			$ 2,902,485	
4.3.3.4	Detail Engineering Complete	5%			$ 1,451,242	
4.3.3.5	Prototype Complete	10%			$ 2,902,485	
4.3.3.6	Qualification Complete	10%			$ 2,902,485	
4.3.3.7	Manufacture Complete/Delivered	15%			$ 4,353,727	
4.3.3.8	Draft Procedures Issued	10%			$ 2,902,485	
4.3.3.9	Commissioning & Integration Test Complete	10%			$ 2,902,485	
4.3.3.10	Final Procedures Issued	5%			$ 1,451,242	
4.3.4	Position Assembly Install Tools	100%	$0	$0	$ -	Included in 4.3.2
4.3.4.1	Mobilization/Preliminary Design Start	10%			$ -	
4.3.4.2	Preliminary Design Review Complete	10%			$ -	
4.3.4.3	Materials/P.O.s Placed to Subs	10%			$ -	
4.3.4.4	Detail Engineering Complete	5%			$ -	
4.3.4.5	Prototype Complete	15%			$ -	
4.3.4.6	Qualification Complete	10%			$ -	
4.3.4.7	Manufacture Complete/Delivered	15%			$ -	
4.3.4.8	Draft Procedures Issued	10%			$ -	
4.3.4.9	Commissioning & Integration Test Complete	10%			$ -	
4.3.4.10	Final Procedures Issued	5%			$ -	
4.4	Inspection and Repair Tools/Contingency Tools				$ 29,662,894	
4.4.1	Contingency - LISS Nozzle Replacement	100%	$365,269		$365,269	New
4.4.1.1	Mobilization/Preliminary Design Start	100%			$ 365,269	
4.4.1.2	Preliminary Design Review Complete	0%				
4.4.1.3	Materials/P.O.s Placed to Subs	0%				
4.4.1.4	Detail Engineering Complete	0%				
4.4.1.5	Prototype Complete	0%				
4.4.1.6	Qualification Complete	0%				
4.4.1.7	Manufacture Complete/Delivered	0%				
4.4.1.8	Draft Procedures Issued	0%				
4.4.1.9	Commissioning & Integration Test Complete	0%				
4.4.1.10	Final Procedures Issued	0%				

Exhibit 7.1(b) - Tooling Milestone Payment Table

Retube and Feeder Replacement

ONTARIOPOWER GENERATION

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	Support	Cost Breakdown Engineered	Non-Engineered	Total	Contribution to OIL (New/Refurbishment/Retrofit)
4.4.2	Contingency - Feeder Header Replacement	100%	$ 417,969		$ 417,969	New
4.4.2.1	Mobilization/Preliminary Design Start	100%			$ 417,969	
4.4.2.2	Preliminary Design Review Complete	0%				
4.4.2.3	Materials/P.O.s Placed to Subs	0%				
4.4.2.4	Detail Engineering Complete	0%				
4.4.2.5	Prototype Complete	0%				
4.4.2.6	Qualification Complete	0%				
4.4.2.7	Manufacture Complete/Delivered	0%				
4.4.2.8	Draft Procedures Issued	0%				
4.4.2.9	Commissioning & Integration Test Complete	0%				
4.4.2.10	Final Procedures Issued	0%				
4.4.3	Contingency - Bellows Replacement	100%	$382,305		$ 382,305	New
4.4.3.1	Mobilization/Preliminary Design Start	10%			$ 38,230	
4.4.3.2	Preliminary Design Review Complete	10%			$ 38,230	
4.4.3.3	Materials/P.O.s Placed to Subs	10%			$ 38,230	
4.4.3.4	Detail Engineering Complete	5%			$ 19,115	
4.4.3.5	Prototype Complete	15%			$ 57,346	
4.4.3.6	Qualification Complete	10%			$ 38,230	
4.4.3.7	Manufacture Complete/Delivered	15%			$ 57,346	
4.4.3.8	Draft Procedures Issued	10%			$ 38,230	
4.4.3.9	Commissioning & Integration Test Complete	10%			$ 38,230	
4.4.3.10	Final Procedures Issued	5%			$ 19,115	
4.4.4	Contingency - Other (Please Identify)	100%	$5,263,255		$ 5,263,255	New
4.4.4.1	Mobilization/Preliminary Design Start	10%			$ 526,325	
4.4.4.2	Preliminary Design Review Complete	10%			$ 526,325	
4.4.4.3	Materials/P.O.s Placed to Subs	10%			$ 526,325	
4.4.4.4	Detail Engineering Complete	5%			$ 263,163	
4.4.4.5	Prototype Complete	15%			$ 789,488	
4.4.4.6	Qualification Complete	10%			$ 526,325	
4.4.4.7	Manufacture Complete/Delivered	15%			$ 789,488	
4.4.4.8	Draft Procedures Issued	10%			$ 526,325	
4.4.4.9	Commissioning & Integration Test Complete	10%			$ 526,325	
4.4.4.10	Final Procedures Issued	5%			$ 263,163	
4.4.5	Inspection - Calandria Internals	100%	$3,627,979		$ 3,627,979	New
4.4.5.1	Mobilization/Preliminary Design Start	10%			$ 362,798	
4.4.5.2	Preliminary Design Review Complete	10%			$ 362,798	
4.4.5.3	Materials/P.O.s Placed to Subs	10%			$ 362,798	
4.4.5.4	Detail Engineering Complete	5%			$ 181,399	
4.4.5.5	Prototype Complete	15%			$ 544,197	
4.4.5.6	Qualification Complete	10%			$ 362,798	
4.4.5.7	Manufacture Complete/Delivered	15%			$ 544,197	
4.4.5.8	Draft Procedures Issued	10%			$ 362,798	
4.4.5.9	Commissioning & Integration Test Complete	10%			$ 362,798	
4.4.5.10	Final Procedures Issued	5%			$ 181,399	
4.4.6	Inspection - Calandria Tubesheet	100%	$9,921,380		$ 9,921,380	New
4.4.6.1	Mobilization/Preliminary Design Start	10%			$ 992,138	
4.4.6.2	Preliminary Design Review Complete	15%			$ 1,488,207	
4.4.6.3	Materials/P.O.s Placed to Subs	10%			$ 992,138	
4.4.6.4	Detail Engineering Complete	5%			$ 496,069	
4.4.6.5	Prototype Complete	10%			$ 992,138	
4.4.6.6	Qualification Complete	10%			$ 992,138	
4.4.6.7	Manufacture Complete/Delivered	15%			$ 1,488,207	
4.4.6.8	Draft Procedures Issued	10%			$ 992,138	
4.4.6.9	Commissioning & Integration Test Complete	10%			$ 992,138	
4.4.6.10	Final Procedures Issued	5%			$ 496,069	

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	% of Total	Cost Breakdown Engineered	Non Engineered	Total	Condition of Tool (New/Refurbished/Existing)
4.4.7	Inspection - Lattice Tube & Bellows	100%	$2,104,753		$ 2,104,753	New
4.4.7.1	Mobilization/Preliminary Design Start	10%			$ 210,475	
4.4.7.2	Preliminary Design Review Complete	10%			$ 210,475	
4.4.7.3	Materials/P.O.s Placed to Subs	10%			$ 210,475	
4.4.7.4	Detail Engineering Complete	5%			$ 105,238	
4.4.7.5	Prototype Complete	15%			$ 315,713	
4.4.7.6	Qualification Complete	10%			$ 210,475	
4.4.7.7	Manufacture Complete/Delivered	15%			$ 315,713	
4.4.7.8	Draft Procedures Issued	10%			$ 210,475	
4.4.7.9	Commissioning & Integration Test Complete	10%			$ 210,475	
4.4.7.10	Final Procedures Issued	5%			$ 105,238	
4.4.8	Inspection/Pre. - Feeder Nozzle	100%	$7,579,985		$ 7,579,985	New
4.4.8.1	Mobilization/Preliminary Design Start	10%			$ 757,999	
4.4.8.2	Preliminary Design Review Complete	10%			$ 757,999	
4.4.8.3	Materials/P.O.s Placed to Subs	10%			$ 757,999	
4.4.8.4	Detail Engineering Complete	5%			$ 378,999	
4.4.8.5	Prototype Complete	15%			$ 1,136,998	
4.4.8.6	Qualification Complete	10%			$ 757,999	
4.4.8.7	Manufacture Complete/Delivered	15%			$ 1,136,998	
4.4.8.8	Draft Procedures Issued	10%			$ 757,999	
4.4.8.9	Commissioning & Integration Test Complete	10%			$ 757,999	
4.4.8.10	Final Procedures Issued	5%			$ 378,999	
4.4.9	Inspection - Other (Please Identify)	100%	$0	$0	$ -	
4.4.9.1	Mobilization/Preliminary Design Start	10%			$ -	
4.4.9.2	Preliminary Design Review Complete	10%			$ -	
4.4.9.3	Materials/P.O.s Placed to Subs	10%			$ -	
4.4.9.4	Detail Engineering Complete	5%			$ -	
4.4.9.5	Prototype Complete	15%			$ -	
4.4.9.6	Qualification Complete	10%			$ -	
4.4.9.7	Manufacture Complete/Delivered	15%			$ -	
4.4.9.8	Draft Procedures Issued	10%			$ -	
4.4.9.9	Commissioning & Integration Test Complete	10%			$ -	
4.4.9.10	Final Procedures Issued	5%			$ -	
4.6	PHT Vacuum Drying System	100%	$7,061,021		$ 7,061,021	New
4.6.1	Mobilization/Preliminary Design Start	10%			$ 706,102	
4.6.2	Preliminary Design Review Complete	15%			$ 1,059,153	
4.6.3	Materials/P.O.s Placed to Subs	10%			$ 706,102	
4.6.4	Detail Engineering Complete	5%			$ 353,051	
4.6.5	Prototype Complete	10%			$ 706,102	
4.6.6	Qualification Complete	10%			$ 706,102	
4.6.7	Manufacture Complete/Delivered	15%			$ 1,059,153	
4.6.8	Draft Procedures Issued	10%			$ 706,102	
4.6.9	Commissioning & Integration Test Complete	10%			$ 706,102	
4.6.10	Final Procedures Issued	5%			$ 353,051	
4.7	Calandria/Moderator Vacuum Drying System	100%	$4,519,054		$ 4,519,054	New
4.7.1	Mobilization/Preliminary Design Start	10%			$ 451,905	
4.7.2	Preliminary Design Review Complete	15%			$ 677,858	
4.7.3	Materials/P.O.s Placed to Subs	10%			$ 451,905	
4.7.4	Detail Engineering Complete	5%			$ 225,953	
4.7.5	Prototype Complete	10%			$ 451,905	
4.7.6	Qualification Complete	10%			$ 451,905	
4.7.7	Manufacture Complete/Delivered	15%			$ 677,858	
4.7.8	Draft Procedures Issued	10%			$ 451,905	
4.7.9	Commissioning & Integration Test Complete	10%			$ 451,905	
4.7.10	Final Procedures Issued	5%			$ 225,953	

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CEO for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	% Split of E	Cost Breakdown Engineered	Non Engineered	Total E	Contribution Profile (New/Rework/Existing)
4.8	Waste Management & Volume Reduction Tooling	100%	$36,701,818		$36,701,818	New
4.8.1	Mobilization/Preliminary Design Start	10%			$ 3,670,182	
4.8.2	Preliminary Design Review Complete	15%			$ 5,505,273	
4.8.3	Materials/P.O.s Placed to Subs	10%			$ 3,670,182	
4.8.4	Detail Engineering Complete	5%			$ 1,835,091	
4.8.5	Prototype Complete	10%			$ 3,670,182	
4.8.6	Qualification Complete	10%			$ 3,670,182	
4.8.7	Manufacture Complete/Delivered	15%			$ 5,505,273	
4.8.8	Draft Procedures Issued	10%			$ 3,670,182	
4.8.9	Commissioning & Integration Test Complete	10%			$ 3,670,182	
4.8.10	Final Procedures Issued	5%			$ 1,835,091	
4.8.11	Waste Management & Volume Reduction Tooling Rework	100%	$1,920,976		$1,920,976	New
4.8.11	Waste Tooling Rework	100%			$ 1,920,976	
4.9	New Fuel Loading	100%	$5,524,474		$ 5,524,474	New
4.9.1	Mobilization/Preliminary Design Start	10%			$ 552,447	
4.9.2	Preliminary Design Review Complete	10%			$ 552,447	
4.9.3	Materials/P.O.s Placed to Subs	10%			$ 552,447	
4.9.4	Detail Engineering Complete	5%			$ 276,224	
4.9.5	Prototype Complete	15%			$ 828,671	
4.9.6	Qualification Complete	10%			$ 552,447	
4.9.7	Manufacture Complete/Delivered	15%			$ 828,671	
4.9.8	Draft Procedures Issued	10%			$ 552,447	
4.9.9	Commissioning & Integration Test Complete	10%			$ 552,447	
4.9.10	Final Procedures Issued	5%			$ 276,224	
4.10	Channel by Channel Draining	100%	$13,933,550		$ 13,933,550	New
4.10.1	Mobilization/Preliminary Design Start	10%			$ 1,393,355	
4.10.2	Preliminary Design Review Complete	15%			$ 2,090,033	
4.10.3	Materials/P.O.s Placed to Subs	10%			$ 1,393,355	
4.10.4	Detail Engineering Complete	5%			$ 696,678	
4.10.5	Prototype Complete	10%			$ 1,393,355	
4.10.6	Qualification Complete	10%			$ 1,393,355	
4.10.7	Manufacture Complete/Delivered	15%			$ 2,090,033	
4.10.8	Draft Procedures Issued	10%			$ 1,393,355	
4.10.9	Commissioning & Integration Test Complete	10%			$ 1,393,355	
4.10.10	Final Procedures Issued	5%			$ 696,678	
4.11	Tooling Letter of Credit	100%				

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	Subtotal	Cost Breakdown Engineering	Cost Breakdown Non-Engineering	Total	Condition of Tool (New/Refurbished/Existing)
5	Other Costs			$	144,693,492	
	[Proponent to Insert additional line items below if required]					
	Work Tables	100%	$14,122,043	$	14,122,043	New
	Mobilization/Preliminary Design Start	10%		$	1,412,204	
	Preliminary Design Review Complete	15%		$	2,118,306	
	Materials/P.O.s Placed to Subs	10%		$	1,412,204	
	Detail Engineering Complete	10%		$	1,412,204	
	Prototype Complete	10%		$	1,412,204	
	Qualification Complete	10%		$	1,412,204	
	Manufacture Complete/Delivered	10%		$	1,412,204	
	Draft Procedures Issued	10%		$	1,412,204	
	Commissioning & Integration Test Complete	10%		$	1,412,204	
	Final Procedures Issued	5%		$	706,102	
	Trolleys and Rails	100%	$12,028,859	$	12,028,859	New
	Mobilization/Preliminary Design Start	10%		$	1,202,886	
	Preliminary Design Review Complete	15%		$	1,804,329	
	Materials/P.O.s Placed to Subs	10%		$	1,202,886	
	Detail Engineering Complete	5%		$	601,443	
	Prototype Complete	10%		$	1,202,886	
	Qualification Complete	10%		$	1,202,886	
	Manufacture Complete/Delivered	15%		$	1,804,329	
	Draft Procedures Issued	10%		$	1,202,886	
	Commissioning & Integration Test Complete	10%		$	1,202,886	
	Final Procedures Issued	5%		$	601,443	
	Platform	100%	$57,085,310	$	57,085,310	New
	Mobilization/Preliminary Design Start	10%		$	5,708,531	
	Preliminary Design Review Complete	15%		$	8,562,796	
	Materials/P.O.s Placed to Subs	10%		$	5,708,531	
	Detail Engineering Complete	10%		$	5,708,531	
	Prototype Complete	10%		$	5,708,531	
	Qualification Complete	10%		$	5,708,531	
	Manufacture Complete/Delivered	10%		$	5,708,531	
	Draft Procedures Issued	10%		$	5,708,531	
	Commissioning & Integration Test Complete	10%		$	5,708,531	
	Final Procedures Issued	5%		$	2,854,265	
	RCC Internals	100%	$25,904,434	$	25,904,434	New
	Mobilization/Preliminary Design Start	10%		$	2,590,443	
	Preliminary Design Review Complete	15%		$	3,885,665	
	Materials/P.O.s Placed to Subs	10%		$	2,590,443	
	Detail Engineering Complete	5%		$	1,295,222	
	Prototype Complete	10%		$	2,590,443	
	Qualification Complete	10%		$	2,590,443	
	Manufacture Complete/Delivered	15%		$	3,885,665	
	Draft Procedures Issued	10%		$	2,590,443	
	Commissioning & Integration Test Complete	10%		$	2,590,443	
	Final Procedures Issued	5%		$	1,295,222	
	General Camera Tool Set	100%	$1,590,588	$	1,590,588	New
	Mobilization/Preliminary Design Start	10%		$	159,059	
	Preliminary Design Review Complete	10%		$	159,059	
	Materials/P.O.s Placed to Subs	10%		$	159,059	
	Detail Engineering Complete	5%		$	79,529	
	Prototype Complete	15%		$	238,588	
	Qualification Complete	10%		$	159,059	
	Manufacture Complete/Delivered	15%		$	238,588	
	Draft Procedures Issued	10%		$	159,059	
	Commissioning & Integration Test Complete	10%		$	159,059	
	Final Procedures Issued	5%		$	79,529	
	PHT and Moderator Dry Auxiliaries Tooling	100%	$3,002,786	$	3,002,786	New
	Calandria and Moderator Auxiliaries Drying Tooling Manufactured Complete/Delivered	69%		$	2,084,642	
	PHTS and Auxiliaries Vacuum Drying Tool Manufactured Complete/Delivered	31%		$	918,144	
	Annulus Spacer Retrieval Tooling (ASRT)	100%	$8,630,090	$	8,630,090	New
	ASRT Mobilization / Preliminary Design Start	30%		$	2,589,027	
	ASRT Flasks Materials / P.O.s Placed to Subs	25%		$	2,157,523	
	ASRT Detailed Engineering Complete	15%		$	1,294,513	
	ASRT Manufacture Complete / Delivered	30%		$	2,589,027	
	Bulk PHTS Vacuum Drying Tool	100%	$2,283,348	$	2,283,348	New

Exhibit 7.1(b) - Tooling Milestone Payment Table

Retube and Feeder Replacement

ONTARIOPOWER GENERATION

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	% Total	Cost Breakdown Engineering	Cost Breakdown Non Engineering	Total	Condition of Tool(s) (New/Refurbished/Existing)
	Bulk PHTS Vacuum Drying Tool Manufactured Compled / Delivered	100%		$	2,283,348	
	Enhanced Material Handling Capabilities Tooling	100%	$4,658,333	$	4,658,333	New
	Enhanced Material Handling Capabilities Tooling Mobilization	50%		$	2,329,167	
	Enhanced Material Handling Capabilities Tooling Manufactured Complete/Delivered	50%		$	2,329,166	
	Upgrade to Lattice Tube Inspection Tool	100%	$1,046,458	$	1,046,458	New
	Automated CTSB Inspection - Mobilization	10%		$	104,646	
	Automated CTSB Inspection - Materials / POs Placed to Subs	20%		$	209,292	
	Automated CTSB Inspection - Detailed Engineering Complete	25%		$	261,615	
	Automated CTSB Inspection - Prototype Complete	35%		$	366,260	
	Automated CTSB Inspection - Feasibility Report	10%		$	104,646	
	East AGV Upgrade to Dual Flasks	100%	$3,182,405	$	3,182,405	New
	East AGV Upgrade to Dual Flasks - Mobilization	10%		$	318,241	
	East AGV Upgrade to Dual Flasks - Materials / POs Placed to Subs	20%		$	636,481	
	East AGV Upgrade to Dual Flasks - Detailed Engineering Complete	25%		$	795,601	
	East AGV Upgrade to Dual Flasks - Manufacture Complete / Delivered Complete	35%		$	1,113,842	
	East AGV Upgrade to Dual Flasks -Final Procedures Issued	10%		$	318,241	
	Modifications to Sub-Assembly Insertion Fixtures	100%	$431,923		$431,923	New
	Modifications to Sub-Assembly Insertion Fixtures - Mobilization	10%		$	43,192	
	Modifications to Sub-Assembly Insertion Fixtures - Materials / POs Placed to Subs	20%		$	86,385	
	Modifications to Sub-Assembly Insertion Fixtures - Detailed Engineering Complete	25%		$	107,981	
	Modifications to Sub-Assembly Insertion Fixtures - Manufacture Complete / Delivered Complete	35%		$	151,173	
	Modifications to Sub-Assembly Insertion Fixtures - Final Procedures Issued	10%		$	43,192	
	Feeder Weld Head Aluminum Tracks	100%	$190,741		$190,741	New
	Feeder Weld Head Aluminum Tracks - Materials/PO's Placed to Subs	50%		$	95,370	
	Feeder Weld Head Aluminum Tracks - Manufacture Complete/Delivered	50%		$	95,371	
	Modifications to SSDO Tools	100%	$498,900		$498,900	New
	Modifications to SSDO Tools - Materials/PO's Placed to Subs	50%		$	249,450	
	Modifications to SSDO Tools - Manufacture Complete/Delivered/Available for Use/Test Report Complete	40%		$	199,560	
	Modifications to SSDO Tools - Final Procedures Issued/RFS Report/CWP Complete	10%		$	49,890	
	Additional West Automated Guided Vehicle (WAGV)	100%	$2,616,900		$2,616,900	New
	Additional West Automated Guided Vehicle (WAGV) - Materials/PO's Placed to Subs	50%		$	1,308,450	
	Additional West Automated Guided Vehicle (WAGV) - Manufacture Complete/Delivered	50%		$	1,308,450	
	Update RCC Internals	100%	$2,054,687		$2,054,687	New
	Update RCC Internals - Materials/PO's Placed to Subs	25%		$	513,672	
	Update RCC Internals - Detailed Engineering Complete	25%		$	513,672	
	Update RCC Internals - Qualification Complete	25%		$	513,672	
	Update RCC Internals - Final Procedures Issued and Manufacture Complete/Delivered	25%		$	513,672	
	Additional New Fuel Load Tooling	100%	$531,774		$531,774	New
	Additional New Fuel Load Tooling - Materials/PO's Placed to Subs	50%		$	265,887	

Exhibit 7.1(b) - Tooling Milestone Payment Table

ONTARIOPOWER GENERATION

Retube and Feeder Replacement

Fixed Price for Tooling

Element of Work	Definition
Mobilization/Preliminary Design Start	Triggered on CED for mobilization.
Preliminary Design Review Complete	Triggered when Preliminary Design COMS report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Materials/P.O.s Placed to Subs	Triggered when last PO for tool set is issued.
Detail Engineering Complete	Triggered when last Detailed Engineering package is assigned the comment "REVIEWED" or "REVIEWED AS NOTED".
Prototype Complete	Triggered at Prototype proof testing and acceptance of Test Report by SLN.
Qualification Complete	Triggered when Qualification Report is assigned the comment "REVIEWED" or "REVIEWED AS NOTED" by the Darlington Refurbishment Design Authority (DA).
Manufacture Complete/Delivered	Triggered when Tool is received at the Darlington Energy Center (DEC).
Draft Procedures Issued	Triggered when Draft procedures are submitted.
Commissioning & Integration Test Complete	Triggered by OPG PM and DA assigning the comment "REVIEWED" or "REVIEWED AS NOTED".
Final Procedures Issued	Triggered when procedures are assigned the comment "REVIEWED" or "REVIEWED AS NOTED".

Reference	Element of Work/Payment Milestone	Cost Breakdown Subtotal	Engineered	Non-Engineered	Total	Condition of Tool(s) (New, Refurbished/Existing)
	Additional New Fuel Load Tooling - Manufacture Complete/Delivered	50%		$	265,886	
	Additional Tooling for Double Bellows Inspection	100%	$1,316,214		$1,316,214	New
	Additional Tooling for Double Bellows Inspection - Materials/PO's Placed to Subs	50%		$	658,107	
	Additional Tooling for Double Bellows Inspection - Manufacture Complete/Delivered	50%		$	658,107	
	Supply of Fuel Channel and Calandria Process Qualification Tooling	100%	$100,000		$100,000	New
	Supply of Fuel Channel and Calandria Process Qualification Tooling - Materials/PO's Placed to Subs	50%		$	50,000	
	Supply of Fuel Channel and Calandria Process Qualification Tooling - Manufacture Complete/Delivered	50%		$	50,000	
	End Fitting Transfer System Tool sets	100%	$2,588,400		$2,588,400	New
	End Fitting Transfer System Tool sets - PO's Placed to Subs	50%		$	1,294,200	
	End Fitting Transfer System Tool sets - Manufactured Complete/Delivered	50%		$	1,294,200	
	Upgrades to Annulus Spacers Retrieval Tooling (ASRT)	100%	$829,300		$829,300	New
	Upgrades to ASRT - P.O.s Placed to Subs	50%		$	414,650	
	Upgrades to ASRT - Manufacture Complete / Delivered	40%		$	331,720	
	Upgrades to ASRT - Procedures Issued	10%		$	82,930	
	The Fixed Price for Tooling Is:			$	8,887,888,849	