ONTARIO POWER GENERATION

Report

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CONTRACTING STRATEGY FOR FUEL HANDLING - DEFUELLING

Contracting Strategy For Fuel Handling - Defuelling

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CONTRACTING STRATEGY FOR FUEL HANDLING - DEFUELLING

Revision Summary

Revision Number	Date	Comments
R000	2012-10-02	Initial issue.

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1.0 EXECUTIVE SUMMARY

The Darlington Refurbishment ("**DR**") Program Commercial Strategy identifies a need to establish separate contracting strategies for each of the major projects under the DR Program (each a "**Contracting Strategy**"). This document sets out the Contracting Strategy for the defuelling portion of the Fuel Handling ("**FH**") Project. This Contracting Strategy is based on the business drivers and commercial principles set out in the DR Program Commercial Strategy.

After considering bundling and unbundling work packaging options, the FH team (the "**Team**") determined that the preferred approach for the FH Project (the "**Project**") is to bundle the contracts by scope of work:[1]

a) Defuelling of the reactors ("**Defuelling Work**") prior to retube and feeder replacement ("**RFR**") [~$25M]; and
b) Refurbishment of the FH equipment ("**Refurbishment Work**") [~$170M].[2]

Unbundling the Project work by scope allows DR to:

- source and move forward with critical path defuelling work while preparations for scoping and sourcing for the refurbishment work continue in parallel;
- mitigate risks associated with a non-integrated approach to the Defuelling Work (i.e., engineering, procurement, and technical support during execution); and
- maximize competitive sourcing potential for the overall Project (up to ~$170M).

This Contracting Strategy, therefore, recommends the following sourcing approaches for the Defuelling Work:

a) ***Plan A***: Engage in discussions with GE-Hitachi Nuclear Energy Canada Inc. ("**GHNEC**") (the Original Equipment Manufacturer ("**OEM**") of the FH equipment) for the engineering, supply of hardware, and technical support for the Defuelling Work. Provided that negotiations result in an acceptable agreement with GHNEC, approval to single source the Defuelling Work will be required. This option ensures the lowest risk to the overall DR Program schedule and the lowest technical risk due to equipment and design integration issues. The field execution of the Defuelling Work will be performed by OPG FH Operations personnel with GHNEC providing technical support.

b) ***Plan B***: Competitively procure the Defuelling Work. The composition of the competitive field for this work may include Candu Energy Inc. ("**CEI**", formerly AECL), Extended Services Master Services Agreement ("**ESMSA**") vendors, and/or other vendors. This may require engaging GHNEC as a subcontractor for some of the activities.

This Contracting Strategy deals with the Defuelling Work only. The Contracting Strategy for the Refurbishment Work is found in NK38-REP-09701-10130.

[1] Rationale for bundling by scope as the preferred alternative is set out in Appendix B.

[2] Refurbishment Work is refurbishment of Fuel Handling equipment installed on individual units, common equipment installed on East and West Fuelling Facilities Areas, and equipment in the Central Service Area. The work includes pre-refurbishment work, refurbishment work and post-refurbishment work.

2.0 INTRODUCTION

2.1 Background Information

The objective of the Defuelling Work is to remove all the irradiated fuel from the reactor core (as each unit starts its refurbishment outage) in order to allow the downstream DR activities, including RFR, to be executed.

2.2 Pre-Refurbishment

OPG engaged GHNEC to provide preliminary engineering (design and engineering), including pre-refurbishment engineering projects (studies, modification outlines and scoping determinations). This preliminary engineering work was awarded to GHNEC in April 2011 under an existing purchase order ("**PO**") (PO No. 205047), which was created under the terms of the existing FH Services Agreement with GHNEC. In 2012, OPG has spent $2.2M under this PO for preliminary engineering for both the Defuelling Work and the Refurbishment Work. The work related to the Defuelling Work is expected to be complete in Q4 2012.

2.3 Defuelling Work

The Defuelling Work consists of defuelling of the four (4) reactors for subsequent RFR activities. The contract for Defuelling Work includes design engineering, manufacturing procurement, and commissioning of all the components and equipment, followed by technical and operational support during the actual defuelling activities. The actual defuelling activities will be provided by OPG.

The Defuelling Work is required prior to starting major reactor refurbishment work, including RFR work for all units. The Defuelling Work will be a critical path activity and needs to be completed in the shortest practical timeframe.

As part of the pre-refurbishment work, GHNEC was engaged to complete a study (NK38-REP-35000-10004) to determine the most effective method to defuel the reactor core in order to perform the RFR work. "Flow Defuel" is the method that is being recommended to execute the Defuelling Work. Flow Defuel uses the flow of the Primary Heat Transfer ("**PHT**") system to push the fuel into the downstream fuelling machine assisted by Flow Restricting Outlet Bundles ("**FROBS**") and other components in the FH system. In the case where Flow Defuel is not able to defuel a channel, dummy fuel bundles will be used to displace the irradiated fuel into a fuelling machine.

Details of the scope of work for the Defuelling Work can be found in NK38-SOW-35000-10002. Based on the current schedule, OPG needs to execute an agreement or agreements for the Defuelling Work by early Q2 2013 to meet the DR Program milestones.

3.0 PROJECT OBJECTIVES

The key objective of the DR Program is to extend the life of the plant for 30 years. DR activities must be focused on ensuring reliability and improving performance and maintainability. Investments in refurbishment must deliver value for money and be aimed at improving reliability while lowering production costs.

In addition to the objectives for the DR Program, specific objectives were identified for the Defuelling Work. These include:

(a) Eliminate any nuclear and safety related risk related to defuelling;

(b) Defuel the reactor within the allotted schedule to allow downstream refurbishment work to commence;

(c) Seamlessly integrate defuelling activities with existing FH activities to minimize disruption to the fuelling of running units;

(d) Maintain or enhance the reliability of the FH equipment and system to meet performance objectives post-refurbishment, particularly Forced Loss Rate ("**FLR**");

(e) Ensure compatibility of parts with existing FH equipment;

(f) Ensure compliance with the technical and quality assurance requirements;

(g) Minimize impact on Operations and Maintenance staff; and,

(h) Complete the Defuelling Work within the approved funding limits.

A Kepner-Tregoe ("**KT**") analysis was performed for the Defuelling Work. The results are attached in Appendix D and include additional commercial objectives for the contracting strategy.

3.1 Purpose

The purpose of this document is to set out the overall Contracting Strategy proposed for delivery of the Defuelling Work under the DR Program. This document will:

- Identify the contracting alternatives suitable for the Defuelling Work;
- Document evaluation considerations; and
- Recommend a Contracting Strategy (includes strategy around sourcing and pricing models).

3.2 Development Process

The Team was initially established in February 2011 with support provided as required by Faithful+Gould Inc. and OPG's Law Division. A smaller working group was established which included Project Management, Refurb Supply Chain and Commercial Strategy (now Nuclear Commercial Development). The Team then identified and analyzed potential options around work packaging, contracting approaches/models and pricing options.

As the scope of work became understood, the decision was made in August 2012 to focus on the Defuelling Work ahead of the Refurbishment Work because the two scopes of work are mutually independent and are driven by different DR project execution timelines.

3.3 Stakeholder Identification

A list of stakeholder groups is listed below.

- Darlington Refurbishment Execution (Sorin Marinescu, David Train)
- Darlington Refurbishment Engineering (Catalin Butoi)
- Darlington Station Engineering (Jai Sanasi)
- Darlington Refurbishment Supply Chain (Gary Paterson, Mike Vacariu, Shirley McTeer, Andy Nelson)
- Darlington Refurbishment Commercial Strategy/Nuclear Commercial Development (Nancy Woodward, Kent Scherm, Pam Hendrix)
- Darlington Operations and Maintenance (Frank Guglielmi)
- Darlington Refurbishment Planning and Controls (Sunil Ingle)
- Darlington Refurbishment Program level Cross Functional Sourcing Team ("**CFST**") members (Law: Evguenia Prokopieva, Matt Thorpe; Treasury; Tax; Risk Services; Controllership)
- Refurbishment Program Executive Team ("**RPET**")
- Previous supporting members (Steve Ilott, Omair Naeem, John Cho, Silviu Stancu)

Each of the stakeholders identified was either on the Team or was consulted by the Team because of his or her role within the DR Program.

4.0 CONTRACTING CONSIDERATIONS

In developing the Contracting Strategy for the Defuelling Work, OPG must consider how the work will be executed and contracted in order to ensure the achievement of OPG's core business objectives and values of: safety, including nuclear safety, accountability, fairness, transparency and value creation.

(a) Defuelling Risks

Defuelling is a highly operations-oriented critical path work activity which will have significant impact on the entire DR Program. No refurbishment activities can be undertaken until the reactor is defueled.

(i) OPG has never defueled an entire reactor on critical path with the final goal of restarting the unit;

(ii) If the reactor cannot be partially or completely defueled by flow defuel method (the recommended method per previous studies), OPG will use dummy fuel bundles to push irradiated fuel out of the channel (as approved in an Engineering Decision Meeting ("**EDM**") ref.: NK38-REP-01000-0435734);

(iii) It is possible that varying lengths of dummy fuel bundles may be required due to channel creep and sag. The design of the dummy fuel bundle is critical because the dummy fuel bundles must mimic the dimensions of real fuel bundles in the existing fuelling machines ("**FM**") and be strong enough to safely push irradiated fuel out of the channel;

(iv) The dummy fuel bundles and FROBS must also be designed to enable them to be crushed and properly disposed of as part of the RFR work.

While it is expected that there will be some iterations during commissioning with the FROBs flow hole size and dummy fuel bundle lengths, problems during defuelling such as: dummy fuel bundles interference in the FMs, FROBS or fuel carriers fail to meet the requirements for defuelling, etc. may impact on nuclear safety and will very likely result in delays to the RFR work and the entire DR critical path schedule.

(b) Business Drivers:

(i) There is a preference for minimal number of parties to be accountable for the delivery of the Defuelling Work. A single point of accountability for the execution of the Defuelling Work is preferred to ensure proper oversight coordination, integration and flexibility of implementation.

(ii) Cost and schedule related considerations:

- Completion of the full scope of work[3] within the approved and released original budget for the Defuelling Work.
- Completion of the full scope of work within the original schedule.

(c) Commercial Principles

The Guiding Commercial Principles from the DR Commercial Strategy were considered in developing and evaluating the contracting options. A list of the principles considered is contained in Appendix A. A review of the applicability of these principles will be performed prior to negotiations and design of the contracts.

4.1 Vendor/Marketplace Capabilities, Restrictions

Key capabilities and restrictions in the vendor marketplace have been assessed for the Defuelling Work. Labour required to defuel the reactor (i.e., field execution for defuelling) will be performed by OPG operators and PWU maintenance staff. This is due to licensing and regulatory constraints – the unit is considered operational with fuel in the reactor and therefore must be operated (and therefore defueled) by trained staff of the license holder (OPG).

Four potential suppliers, CEI, GHNEC, Promation and Numet were identified as potentially capable of performing design and engineering work, designing and manufacturing FROBS, dummy fuel bundles and fuel carriers, performing software changes and any other modifications required for the Defuelling Work. All of these suppliers are on OPG's Approved Supplier List ("**ASL**"). The required details of the QA requirements are included in the Scope of Work document: NK38-SOW-35000-10002.

4.1.1 GE-Hitachi Nuclear Energy Canada Inc. (GHNEC)

GHNEC is the OEM of the Darlington FH system and the original design agency responsible for FH under the Design Agency Interface Agreement ("**DAIA**"). GHNEC is in the ASL and has provided services to OPG for a period of 30 years plus. Over this period, OPG has awarded numerous POs to GHNEC. The majority of the POs were for Darlington FH systems and very few for Pickering FH systems.

GHNEC maintains in-house design expertise to manage and modify the FH hardware, software and controls and to maintain FH specialized equipment including the test facility. GHNEC provides configuration management, systems engineering, as well as material and troubleshooting support. All source documents are maintained by GHNEC. OPG does have some in-house capability to develop software and hardware changes; however, there is still a link back to GHNEC to update and maintain the source documents and to maintain the test facility.

[3] Full scope of work in this context means all work approved by the Scope Review Board.

GHNEC could engineer, design and manufacture FROBS, fuel carriers and dummy fuel bundles. They could also lead and execute the required scope of work including: the analysis required to integrate the defuelling equipment with the existing equipment; the software changes which mitigates the risks of incompatibility; adapting the existing equipment for any mitigation strategies that arise (i.e. grappling in a sagging channel) and provide advice for the entire FH system during the actual defuelling activities conducted by OPG.

4.1.2 Candu Energy Inc. (CEI)

Although CEI (formerly AECL) is the designer of the Pickering, Gentilly and Pt. Lepreau FH systems, and has experience in fuel handling in general, [redacted] CEI has subcontracted to GHNEC for engineering and manufacturing of FH systems of some CANDU plants outside Canada (China, Korea). CEI has potential capability to design FROBS, fuel bundles and fuel carriers.

CEI would need to get access to source documentation (from GHNEC) and then take the time to become knowledgeable in trolley-based fuelling. CEI could provide hardware changes but any software changes would have to be validated by GHNEC. [redacted]

CEI is on the ASL and has provided services to OPG for a period of 30 years plus. Over this period, OPG has awarded numerous POs to CEI. However, the majority of CEI's OPG FH experience is with Pickering systems.

4.1.3 Promation and Numet

The Team determined that having experience and a proven track record in FH systems design is critical to providing the Defuelling Work. [redacted]

Promation (Promation Nuclear Ltd.) is on the ASL (since 2011) and OPG has awarded very few POs. Numet (former Rolls-Royce Civil Nuclear Canada Ltd.) is on the ASL and OPG has awarded relatively very few POs. None of these POs have been with FH systems.

4.2 Contracting Alternatives Analysis

4.2.1 Bundling of Work

The Team looked at each of the FH work packages and identified potential options for bundling of the work and contracting models. These included, (i) bundling all the work together, (ii) bundling by type of work, and (iii) bundling by scope of work. Full details of the options considered can be found in Appendix B.

4.2.2 Contracting Models

Various contracting models were considered in developing and evaluating the contracting options. A list of the pros and cons of all the contracting models considered is contained in Appendix C. None of the contracting models fit the Defuelling Work which includes buying a piece (or pieces) of engineered equipment and some related technical support services.

4.2.3 Work Packaging and Vendor Fit

The Defuelling Work includes:

(a) Engineering work that could be provided by CEI or GHNEC;

(b) Design and supply of dummy fuel bundles, fuel carriers and FROBS that could be provided by CEI, GHNEC, Numet or Promation; and

(c) Software changes which must be provided by GHNEC due to their source code knowledge and highest level of understanding of the impact of code changes on FH operations.

While the design and manufacture of the dummy fuel bundles, fuel carriers and FROBS could be procured on a competitive basis (CEI, GHNEC, Numet, or Promation (for design and manufacture)):

- GHNEC is the only supplier with trolley mounted FH system design and engineering experience and has a proven track record;
- GHNEC has been retained by OPG for over 30 years as the Design Agency for Darlington's FH system and has unique knowledge and expertise;
- GHNEC has experience with similar flow defuelling of reactors, having completed the *defuelling* work for Bruce Power LP;
- GHNEC is in the best position to advise OPG on defuelling the reactor. As the designer and manufacturer of fuel bundles and FH components, GHNEC has unique knowledge of the FH system that can be expected to minimize the risks during the design and manufacture of the FROBS, dummy fuel bundles and fuel carriers; and
- In the event design changes or modifications are required to the FROBS, dummy fuel bundles or fuel carriers during defuelling, GHNEC as the designer and manufacturer of the FH system is in the best position to ensure that the required changes or modifications are compatible with the existing system and to integrate the changes or modifications to the station FH systems and/or software required.

Due to the Defuelling Work being the first project executed on critical path, the entire DR schedule is at risk if a vendor with an untested and unproven track record and no previous knowledge of trolley based FH systems is awarded the contract.

The scope of the Defuelling Work has been prepared based on GHNEC providing the engineering studies and preliminary scoping engineering support. Additional work will be required in order to procure the work on a competitive basis.

4.3 Decision Options and Constraints

Initial development of this Contracting Strategy focused largely on contracting the entire FH scope (Defuelling Work and Refurbishment Work) to GHNEC or to GHNEC with a partner (for the Refurbishment Work). In the event that negotiations were not successful in that scenario, an alternative plan was developed which sought to minimize the scope that was required to be performed by GHNEC. This alternative which limits the scope that was to be sourced to GHNEC (i.e. the Defuelling Work), was preferred by both the Team and management, and it is the recommended approach.

The probability of success of the Defuelling Work is maximized with participation from GHNEC because GHNEC is the designer of the FH equipment and OPG does not have the internal design capability to perform the engineering work for FH. Provided that negotiations result in an acceptable agreement with GHNEC, approval to single source the Defuelling Work will be required.

How the Defuelling Work negotiations progress with GHNEC may shape GHNEC's involvement in the Refurbishment Work.

5.0 RECOMMENDED CONTRACTING STRATEGY

This Contracting Strategy recommends the following sourcing approach for the Defuelling Work:

(a) ***Plan A (preferred):*** Engage in discussions with GHNEC for the engineering, supply of hardware, and technical support for the Defuelling Work. Provided that negotiations result in an acceptable agreement with GHNEC, approval to single source the Defuelling Work will be required. This option ensures the lowest risk to the overall DR Program schedule and the lowest technical risk due to equipment integration issues. The field execution of the Defuelling Work will be performed by OPG FH Operations personnel with GHNEC providing technical support.

(b) ***Plan B:*** Engage in a competitive process with CEI, ESMSA, and/or other vendors. Plan B may result in better commercial terms (i.e. risk acceptance); however, engaging in a competitive process will require the scope of work to be re-written and will require additional planning activities. A competitive process may negatively impact on the overall cost of the Defuelling Work and schedule, and the benefits of a competitive process will likely be outweighed by the additional risk exposure. It may be difficult, given GHNEC's historical involvement with Darlington FH activities, to reasonably run a fair competitive process. As the Defuelling Work is the critical path activity prior to starting all major reactor refurbishment work, including RFR work, the entire DR schedule is hinged on the success of the Defuelling Work of each unit. Further development of Plan B will be undertaken in parallel with Plan A activities.

NOTE: The Negotiations Plan for the Defuelling Work can be found in NK38-PLAN-09701-10099.

6.0 CHOICE OF PRICING MODEL

Description	Unit 2	Unit 1	Unit 3	Unit 4	Comments
Engineering	Fixed Price				Detailed engineering is for all four units
Procurement	Fixed Price + Fixed Unit Price	Firm Price + Firm Unit Price	Firm Price + Firm Unit Price	Firm Price + Firm Unit Price	Procurement will include component manufacturing and delivery
Technical Support	Cost reimbursable + fixed fee	Cost reimbursable + fixed fee	Cost reimbursable + fixed fee	Cost reimbursable + fixed fee	Ongoing engineering support when defuelling performed by OPG personnel

7.0 INTERFACE OR INTEGRATION ISSUES WITH OTHER CONTRACTING STRATEGIES/ MAJOR CONTRACTS FOR THE DARLINGTON REFURBISHMENT WORK

At this point in time, the following interface or integration issues have been identified:

(a) Defuelling Work must be completed upstream of RFR; and

(b) Defuelling and Refurbishment Work will have some interface with resources and equipment supporting the running units.

This area will be continually assessed as the definition phase progresses further for all other DR Projects including the FH Project.

8.0 KEY RISKS AND PROPOSED MITIGATION

Key risks and proposed mitigation are contained in the Risk Register.

Commercial risks for Plan A include:

- [redacted]
- [redacted]
- [redacted] By establishing negotiations timelines as found in the Negotiations Plan (ref.: NK38-PLAN-09701-10099), a finite amount of time is allocated for negotiations to be completed. If negotiations are not complete within the allocated timeline, OPG will move forward with Plan B.

Key risks associated with Plan B were included in the KT analysis (Appendix D), and identified several that were assessed as having both a high probability, and a high consequence level. These included:

- Vendor not fully understanding the Defuelling Work's scope;
- Significant increase of interfaces introducing the need for additional OPG oversight; and
- Increased risk of integration issues having high negative impact in the Defuelling Work.

The above risks were identified with the alternative competitive sourcing options, and would be mitigated if the Defuelling Work is single sourced to GHNEC.

9.0 SUCCESS CRITERIA/PERFORMANCE INDICATORS

The key success criterion is successful negotiations with GHNEC for the Defuelling Work as outlined in the Negotiations Plan (ref.: NK38-PLAN-09701-10099).

Other critical success factors include:

(a) Meet Regulatory Requirements: meet all required standards for safety, environmental compliance and the CNSC/other applicable quality standards

(b) Maintain OPG Control: OPG has ultimate accountability for delivering the DR Program as the Program Manager

(c) Minimize Impact on Existing Units: minimize disruption to operating units where safety of the units is involved and where production is potentially disrupted

(d) Achievable Schedule and Budget: Schedule and budget are to be realistic and achievable. Cost recovery and financing methods must be in place.

(e) Demonstrate Success: Demonstrate to the public and shareholder that the Program is a success. The RPET have defined success through the following program critical success factors:

(i) Sustain current plant performance and support, where feasible, initiatives to achieve top decile performance post refurbishment;

(ii) Program implemented on budget, on schedule (measured against release quality estimate baseline); and

(iii) Return plant and people back to Darlington.

10.0 IMPLEMENTATION PLAN

Details of the Implementation Plan can be found in the Darlington Refurbishment Fuel Handling – Defuelling Project Negotiations Plan (ref.: NK38-PLAN-09701-10099).

Appendix A: Commercial Principles

Principle	Comments
Early Communication with OPG Stakeholders	There were open and active discussions with senior management and other important stakeholders (e.g. Law, DR Program Level CFST etc.) to make them aware of the Defuelling Work and obtain their input on the Team's recommended Contracting Strategy.
Early Engagement for Market Due Diligence	The Team drew from review of past & present FH projects and commercial agreements, OPG ASL database, OPEX around FH work primarily within Darlington, and the Team's knowledge base to gather market intelligence for FH work.
Competition	The Team's approach was that competition is the preferred method of procurement and benefits of competition must be considered. The option of sourcing via competition was incorporated in packaging the scope of work, the analysis of the contracting approach and the overall sourcing strategy.
Acceptance by Marketplace	A review of the marketplace for vendors experienced in FH system work, specifically, trolley-based FH system work as found at Darlington & Bruce was completed and reviewed by the Team.
Compliance with Applicable Internal Policies and Procedures	The Team's view is that the proposed Contracting Strategy complies with the requirements in applicable OPG's internal policies and procedures.
Scope Definition and Work Packaging	The strategy development considers optimal bundling of the scope of work taking into account acceptable risk thresholds associated with integration activities.
Timing of Contract Award	Consideration for cost and schedule when deciding the contract award timing, in particular for the Defuelling Work. Timing of engaging any third party will be decided in the context of OPG's and DR's objectives and priorities. Consideration is also given to pre-refurbishment work and long lead items.

Principle	Comments
Risk Sharing vs. Risk Premium	The objectives and key risk areas associated with the Defuelling Work were identified from analysis of the available options. These were considered to determine the best Contracting Strategy to achieve the DR and the Defuelling Work's objectives and post-refurbishment goals within acceptable risk thresholds taking into account inherent risks around transparency and value for money.
Working Approach/Philosophy between OPG and Vendors	Partnership approaches with appropriate monitoring and oversight by OPG was considered. 'Open book' contracts will be pursued to permit OPG to have a good understanding of the vendor's cost structure. OPG will leverage vendor capabilities and execution methodologies and work together to cooperatively resolve issues.
Use of OPG Knowledgebase	The Team gathered OPG OPEX for FH work from contracting and commercial perspectives through review of past projects and discussion with knowledgeable stakeholders across OPG.
Linkages to Other DR Strategies	OPG will avoid developing internal skills that will not be required post-refurbishment. Internal OPG resources will provide project oversight during planning and execution of the FH work to ensure effective integration with other DR strategies. Where required due to licensing and/or regulatory issues, internal OPG staff will be utilized.

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Appendix B: Bundling of Work

Option 1	Bundle All Work Together	The first option considered was bundling of all of the FH work (Defuelling and Refurbishment). Bundling all the work together and contracting with one vendor including GHNEC using an EPC model is the least complicated approach for procuring the work and is an approach consistent with many of the business drivers and commercial principles (i.e. minimizing the number of parties being accountable for Project delivery, mitigating risks on long-lead items, reducing the number of interfaces, and taking advantage of vendor capabilities). Based on the vendor/marketplace capabilities, bundling of all the work together would require contracting of all the work to GHNEC. Given that some of the work can be done by others, this option does not appear to be the best option. Bundling of all of the work together could negatively impact on OPG's ability to manage cost, integrate with the DR work schedule and OPG's ability to demonstrate value for money.
Option 2	Unbundle the Work by Type of Work	The second option considered was a complete unbundling of all of the FH work. This option would allow each of the CCA work packages to be dealt with individually or broken down by type of work (i.e. engineering, procurement and construction or labour and materials). Labour and materials could be further broken down and bundled based on the type of labour (i.e. design, inspection, construction, etc.) or type of material (i.e. original equipment manufacturer). Unbundling of the work allows for each work package to be carefully assessed and opportunities identified to procure from competitive sources. While this approach may enable competition for some materials and may reduce the price of some items, managing multiple work packages, suppliers and contracts would be time consuming and require additional resources. This approach is not consistent with the DR Program philosophy, business drivers and guiding commercial principles. The risks associated with this approach have the potential to significantly outweigh any potential cost savings (i.e. compatibility issues between hardware and software). The impact on schedule could be significant. Configuration management risk and corresponding level of effort needed to mitigate this risk usually increases with the number of suppliers. It may also be difficult to achieve the schedule, integrate work provided by multiple suppliers, and seamlessly plan and execute the work.
Option 3	Bundle by Scope of Work	The third option considered was bundling the work by scope as follows: • Defuelling Work • Refurbishment Work The Defuelling Work is by nature a completely separate type of work than the Refurbishment Work and therefore it doesn't make sense to bundle the scopes together. In effect, until the reactor has been defueled, the unit is still considered to be operational. Specifically: • The timing of the work and contract award is different for Defuelling Work and Refurbishment Work. Defuelling Work must be done long before the Refurbishment Work is done. • Defuelling Work is critical path and risks associated with Defuelling Work are very different from the risks in the Refurbishment (see section 4.0(a)). The commercial terms will need to mitigate (as much as commercially possible) these risks. • The potential suppliers for the Defuelling Work are different from the potential suppliers for the Refurbishment Work. The potential suppliers for the Defuelling Work (noted in section 4.1) are designers, engineering services and manufacturers of defuelling components including FH components. The potential suppliers for the Refurbishment Work will include contractors who will install FH components into the FH system. Bundling by scope of work would allow OPG to source to the most appropriate vendor and better ensures alignment between vendor/marketplace capabilities and the work that needs to be done. It is a better option than bundling of all work together because it enables OPG to select the best sourcing option for each of the work scopes. Bundling by scope is less complicated than complete unbundling and the approach is consistent with many of the business drivers and commercial principles (i.e., minimizing the number of parties being accountable for Project delivery, mitigating risks related to schedule, reducing the number of interfaces, and taking advantage of vendor capabilities). Bundling by scope of work and alignment of scope with vendor capability will positively impact on OPG's ability to manage the work. Given that and utilize competitive bidding which enables OPG to demonstrate value for money.

B.1.0 DEFUELLING WORK

For the Defuelling Work, in order to ensure integration, the Team determined that bundling the engineering, supply of hardware, and technical support together would reduce the schedule and technical risk due to equipment and design integration issues. Due to licensing requirements, the field execution of the Defuelling Work can only be performed by OPG FH Operations personnel. Unbundling of the Defuelling Work and competitive bidding would introduce risks (These other risks are contained in section 4.2.3 of this Contracting Strategy and the KT Analysis contained in Appendix D).

Appendix C: Contracting Models

Contracting Model	Description	Pros	Cons
Self Perform	The Self Perform model would mean that OPG would perform all of engineering, procurement, and construction activities for the Project. This option was briefly examined with the Team identifying the following pros and cons.	• Possibly cheaper (only if resources could be dedicated – see cons); • More control overall; • Schedule management totally in OPG's control; • Easier control of inage and pre-refurb outage scope if required.	• Limited resources / resources not available [eng/supply/trades]; • No infrastructure to support this approach; • Lack of FH engineering expertise internally; • Limited trades staff; • Not in alignment with OPG's strategic direction; • Time required to hire additional resources, train, etc., would cause delays; • OPG retains all risk.
Design, Bid, Build (DBB)[4]	Historically the way OPG has done business, the DBB model has OPG contract with separate entities to provide the design and to install. Procurement can be handled by a contracted party or by OPG supply chain.	• Less OPG resources than self perform; • OPG has more influence & can ensure OPG convention (i.e., historically this is the OPG way of doing things); • OPG can maintain input & control through reviews & design acceptance.	• Separate contracts require increased OPG resources to oversee and manage; • Extends schedule by requiring engineering to be complete prior to procurement & construction (unless procurement done at risk); • Process tends to be serial with limited ability to compress timelines; • Responsibilities are split; • Increased risk on OPG to manage interfaces i.e., finger pointing between design & build; • Increased difficulty in maintaining schedule & cost control; • Not in alignment with OPG's strategic direction.
Engineer, Procure, Construct (EPC)[5]	The EPC model would have OPG contracting with a single entity to provide the design, procure the material, and installation (and/or field technical support in the field as may the case with Defuel). It requires careful up-front development of specifications to ensure the EPC supplier has the required information.	• Fewest OPG resources required to oversee and manage (single interface, single contract); • Maximizes risk transfer to supplier (see cons for cost aspect); • Single accountability for contract, schedule, design, procurement, construction; • Potential cost savings due to better rates negotiated with supplier getting a larger overall piece of the overall program; • Seen as best opportunity at achieving schedule and cost targets when managed correctly; • In alignment with OPG's strategic direction.	• Difficult for OPG culture to 'let go' & lack of OPG experience managing EPC; • Transfer of risk to supplier can drive up cost to OPG; • Requires complete and accurate specifications to be produced by OPG up front; • OPG may have reduced ability to select subcontractors; • Larger overall impact if supplier under-performs.

[4] Note: Design, Bid, Build is not a relevant contracting model for the Defuelling Work as we are essentially buying a piece (or pieces) of engineered equipment and some related technical support services.
[5] Note: EPC is not a relevant contracting model for the Defuelling Work as we are essentially buying a piece (or pieces) of engineered equipment and some related technical support services

Appendix D: Kepner-Tregoe Analysis

Decision Analysis Worksheet Report

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FH Defuelling Strategy

Decision Analysis Background

As part of Darlington Refurbishment there are two major fuel handling projects. The first is the defueling of the reactors and the second is the rehabilitation and upgrade of the fuel handling system. This analysis is specific to the defueling phase of the refurbishment work. GE Hitachi currently acts as the OEM for Darlington fuel handling systems. A decision needs to be made as to the best option for OPG regarding the provision of engineering products (software, drawings and documentation) and procurement of hardware associated with the defueling project. It should be noted that execution of the field work will be performed by OPG operators so a full EPC contract cannot be considered for this case however technical field support for execution will be required.

Decision Analysis Team

Name	Company	Team Member Role	Team Member Expertise
neill allen	KT		
Hendrix, Pam			
Nelson, Andrew			
Scherm, Kent			
Marinescu, Sorin			
Vacariu, Mike			
Woodward, Nancy			
Diening, Jos			

Decision Statement

Select the best contract sourcing strategy for the provision of engineering (design) products, hardware procurement and field execution technical support for the defueling project.

Decision Analysis Worksheet Report

FH Defuelling Strategy

Objectives and Measures

Objectives	Measures	Classification
Meet OPG's current policy for procurement.	Satisfy OPG governance as concurred by Supply Chain management.	Must
Products and deliverables must meet quality requirements	As captured in the technical specifications or functional requirements certain CSA standards must be met. CSA N 286-05 for the design QA program.	Must
Minimize potential for changes to existing system. (OPG desire to maintain optimal configuation among all fuel handling systems.)	Demonstrated understanding of Darlington type fuel handling systems	Want
Vendor company must be sustainable financially	As assessed by Supply Chain	Want
Have knowledgable resources retained throughout the project	Evaluation of company technical capability.	Want
Minimize risk to project execution.	By evaluating the integrated capability of providing an integrated solution to the product and any mitigation plan. (Teams evaluation of the vendor overall capability relative to quality, schedule, cost, experience and technical expertise.)	Want
Demonstrate open, fair, transparent process for selection of suppliers	Auditable documentation trail	Want
Minimize the number of interfaces in the design/procure process	Number of hand-offs of deliverables.	Want
Meet existing Refurbishment milestones	As defined in current PIMS critical path.	Want
Minimize risk to nuclear safety	Demonstrated quality of previous deliverables and resources.	Want
Maximize value for money to OPG.	Cost element of value for money definition.	Want
Minimize the required OPG resources.	OPG resources involved across all departments	Want
Transfer of risk to vendors.	Clarity on vendor accountabilities and assumed risk.	Want
Allows OPG to maintain oversight.	Ability to monitor the vendors quality program and project task completion.	Want

Decision Analysis Worksheet Report

FH Defuelling Strategy

Weight of Want Objectives

Want Objectives	Measures	Weights
Minimize risk to nuclear safety	Demonstrated quality of previous deliverables and resources.	10
Minimize risk to project execution.	By evaluating the integrated capability of providing an integrated solution to the product and any mitigation plan. (Teams evaluation of the vendor overall capability relative to quality, schedule, cost, experience and technical expertise.)	9
Minimize potential for changes to existing system. (OPG desire to maintain optimal configuation among all fuel handling systems.)	Demonstrated understanding of Darlington type fuel handling systems	9
Have knowledgable resources retained throughout the project	Evaluation of company technical capability.	8
Maximize value for money to OPG.	Cost element of value for money definition.	7
Meet existing Refurbishment milestones	As defined in current PIMS critical path.	7
Demonstrate open, fair, transparent process for selection of suppliers	Auditable documentation trail	6
Minimize the number of interfaces in the design/procure process	Number of hand-offs of deliverables.	5
Vendor company must be sustainable financially	As assessed by Supply Chain	5
Allows OPG to maintain oversight.	Ability to monitor the vendors quality program and project task completion.	4
Minimize the required OPG resources.	OPG resources involved across all departments	4
Transfer of risk to vendors.	Clarity on vendor accountabilities and assumed risk.	3

Alternatives

Bundled defuelling scope, single sourced to OEM

Bundled defuelling scope competitively bid

Unbundled defuelling scope with mixed procurement via single source and competitive bid elements

Decision Analysis Worksheet Report

FH Defuelling Strategy

Alternatives Screened through Must Objectives

Must Objective and Measure	Bundled defuelling scope, single sourced to OEM		Bundled defuelling scope competitively bid		Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	
	Supporting Data	Go/No Go	Supporting Data	Go/No Go	Supporting Data	Go/No Go
Products and deliverables must meet quality requirements As captured in the technical specifications or functional requirements certain CSA standards must be met. CSA N 286-05 for the design QA program.	OEM is on the ASL	Go	All vendors must be on ASL	Go	All vendors will be on or capable of meeting ASL requirements	Go
Meet OPG's current policy for procurement. Satisfy OPG governance as concurred by Supply Chain management.	Yes, with appropriate justification and approval	Go	Yes	Go	Yes	Go

Decision Analysis Worksheet Report

FH Defuelling Strategy

Alternatives Scored Against Want Objectives

Objective: Minimize risk to nuclear safety

Measure: Demonstrated quality of previous deliverables and resources.

Weight: 10

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	OPEX from many previous projects	10
Bundled defuelling scope competitively bid	New approach, some companies have more knowledge/experience in some areas of the scope but not all areas	5
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Allows OPG to tailor the best suppliers but introduces some integration risk	7

Objective: Minimize risk to project execution.

Measure: By evaluating the integrated capability of providing an integrated solution to the product and any mitigation plan. (Teams evaluation of the vendor overall capability relative to quality, schedule, cost, experience and technical expertise.)

Weight: 9

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Minimises integration risk	10
Bundled defuelling scope competitively bid	Minimises integration risk but less experience and more potential re-work.	7
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Introduces intregration risk but allows for best supplier for some elements. OPG would have to provide more technical and project management integration	4

Decision Analysis Worksheet Report

FH Defuelling Strategy

Minimize potential for changes to existing system. (OPG desire to maintain optimal configuation among all fuel handling systems.)

Demonstrated understanding of Darlington type fuel handling systems

9

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Greatest understanding	10
Bundled defuelling scope competitively bid	Reduced understanding, some learning curve.	8
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Same as above	8

Objective: Have knowledgable resources retained throughout the project

Measure: Evaluation of company technical capability.

Weight: 8

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Currently available, supporting continued operation of other units.	10
Bundled defuelling scope competitively bid	Would be assessed as having knowledge for award of contract but depth and sustainability may be questionable	7
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Better assurance for each element but not necessarily for project management and integration.	5

Objective: Maximize value for money to OPG.

Measure: Cost element of value for money definition.

Weight: 7

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Most likely most expensive	5
Bundled defuelling scope competitively bid	Most likely least expensive	10

Decision Analysis Worksheet Report

FH Defuelling Strategy

Objective: Maximize value for money to OPG.

Measure: Cost element of value for money definition.

Weight: 7

Alternative	Supporting Data	Score
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	In between as it may incur additional costs for oversight and additional project management	8

Objective: Meet existing Refurbishment milestones

Measure: As defined in current PIMS critical path.

Weight: 7

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	most likely	10
Bundled defuelling scope competitively bid	somewhat at risk	7
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	most risk due to the porcesses involved	5

Objective: Demonstrate open, fair, transparent process for selection of suppliers

Measure: Auditable documentation trail

Weight: 6

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Least transparent (note all will have supporting documentation)	5
Bundled defuelling scope competitively bid	Most transparent	10
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	In between	8

Decision Analysis Worksheet Report

FH Defuelling Strategy

Objective:	Measure:	Weight:
Minimize the number of interfaces in the design/procure process	Number of hand-offs of deliverables.	5

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Least	10
Bundled defuelling scope competitively bid	Middle (some OEM/OPG interfaces are required)	8
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Most	3

Objective:	Measure:	Weight:
Vendor company must be sustainable financially	As assessed by Supply Chain	5

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Part of a bigger suite of projects to OEM	10
Bundled defuelling scope competitively bid	We would have to evaluate this so some small risk	8
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Similar to item 2	8

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Decision Analysis Worksheet Report

FH Defuelling Strategy

Objective: Allows OPG to maintain oversight.

Measure: Ability to monitor the vendors quality program and project task completion.

Weight: 4

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Requires least amount of oversight, existing OPG process in place (Important for permanent plant)	10
Bundled defuelling scope competitively bid	Requires more oversight	8
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Requires most oversight	6

Objective: Minimize the required OPG resources.

Measure: OPG resources involved across all departments

Weight: 4

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Least	10
Bundled defuelling scope competitively bid	More	8
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Most, supply chain, engineering and project management.	5

Objective: Transfer of risk to vendors.

Measure: Clarity on vendor accountabilities and assumed risk.

Weight: 3

Alternative	Supporting Data	Score
Bundled defuelling scope, single sourced to OEM	Difficult starting position	8

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Decision Analysis Worksheet Report

FH Defuelling Strategy

Objective:	Measure:	Weight:
Transfer of risk to vendors.	Clarity on vendor accountabilities and assumed risk.	3

Alternative	Supporting Data	Score
Bundled defuelling scope competitively bid	Risk transfer can be part of negotiation	10
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	Some risk transfer but introduces integration risk back to OPG	7

Total Weighted Scores for Alternatives

Alternative	Total Weighted Score
Bundled defuelling scope, single sourced to OEM	699
Bundled defuelling scope competitively bid	594
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	477

Decision Analysis Worksheet Report

FH Defuelling Strategy

Making the Decision

Tentative Choice	Total Score	Best Choice?	Risks	P	Adverse Consequences	S
Bundled defuelling scope, single sourced to OEM	699	☐	Operations require support for emerging issues reducing project priority at the OEM	H	Some schedule delay.	L
			If negotiation over commercial terms are not successful	M+	Cost increase, schedule delay.	M
			Less opportunity for innovation or rigourous cost challenge	M	Cost increase missed opportunity for schedule improvement	L
			If GE Peterborough plant is closed	L	Delay project.	H
Bundled defuelling scope competitively bid	594	☐	If the new vendor does not fully understand scope of projects	H	Schedule, cost impacts	H
			If the vendor requires a steep learning curve to understand interfaces	H	Schedule, cost impacts.	M
			If new vendor does not have staff with field experience then support during the execution phase will be limited.	H	Schedule impact.	M
			If new vendor then commercial contract will take time to negotiate	M	Schedule impact and potential exception claims throughout project	L
			If not OEM then a relationship will need to be established.	M	Cost increase to OEM sourced elements	L

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Decision Analysis Worksheet Report

FH Defuelling Strategy

Tentative Choice	Total Score	Best Choice?	Risks	P	Adverse Consequences	S
Unbundled defuelling scope with mixed procurement via single source and competitive bid elements	477	☐	Significant increase of interfaces introduces need for a lot of OPG oversight	H	Technical and schedule problems	H
			Introduces threat of integration mistakes	H	Technical, cost schedule problems	H
			Accumulated effect of multiple delays by each player	M	Technical, cost, schedule problems	M