ONTARIO POWER GENERATION

OPG Confidential Commercially Sensitive	
Document Number: NK38-REP-09701-10024	Usage Classification: N/A
Sheet Number: N/A	Revision: R001

Title:
CONTRACTING STRATEGY FOR STEAM GENERATORS

© Ontario Power Generation Inc., 2013. This document has been produced and distributed for Ontario Power Generation Inc. purposes only. No part of this document may be reproduced, published, converted, or stored in any data retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise) without the prior written permission of Ontario Power Generation Inc.

Contracting Strategy For Steam Generators

NK38-REP-09701-10024-R001
2013-08-14

Order Number: N/A
Other Reference Number:

OPG Confidential Commercially Sensitive

Recommended by: Aug 29, 2013
Todd Josifovski — Date
Director, Steam Generator Project
Refurbishment Execution

Concurred by: Sep 4, 2013
Stephen Mills — Date
Vice President
Nuclear Commercial Development

Approved by: Sep 10, 2013
Dietmar Reiner — Date
Senior Vice President
Nuclear Refurbishment

Table of Contents

OPG Confidential Commercially Sensitive		
Document Number: NK38-REP-09701-10024		Usage Classification: N/A
Sheet Number: N/A	Revision Number: R001	Page: 3 of 25

Title:
CONTRACTING STRATEGY FOR STEAM GENERATORS

Revision Summary

Revision Number	Date	Comments
R000	2011-08-10	Initial Release
R001	2013-08-14	1. Clarifications on bundling recommendations. 2. Updated to new template revision. 3. Updated to reflect EOI developments and confirmation of contracting approach and timelines for RFP process.

OPG Confidential Commercially Sensitive		
Document Number: NK38-REP-09701-10024		Usage Classification: N/A
Sheet Number: N/A	Revision Number: R001	Page: 4 of 25

Title: CONTRACTING STRATEGY FOR STEAM GENERATORS

1.0 EXECUTIVE SUMMARY

The Darlington Refurbishment Program ('**DR**') Commercial Strategy identified a need to establish separate contracting strategies for each of the major projects under the DR Program. This strategy is a revision of the first Steam Generator ('**SG**') contracting strategy and incorporates the results of the Expression of Interest ('**EOI**') process and confirms OPG's decision to continue with its sourcing approach to solicit and evaluate Request for Proposals ('**RFP**') from selected contractors for the SG project ('**Project**').

The recommended contracting strategy is based on the business drivers and commercial principles set out in the DR Program Commercial Strategy and specific contracting considerations relevant to the SG Project.

The Darlington Nuclear Generating Station ('**DNGS**') SG refurbishment scope consists of various scopes of work:

(a) Primary Side Clean (PSC)

(b) Waterlancing, or Secondary Side Clean (SSC)

(c) Access Port Installation

(d) SG Inspections and Maintenance

(e) Divider Plate Leakage Measurements

(f) Lay-up

The SG team examined a number of work packaging options and, following an analysis that included evaluating advantages and disadvantages to each option, recommended pursuing a bundled approach for contracting purposes. Bundling the work in this manner will allow work to be efficiently scoped, planned, scheduled, and managed in accordance with the DR schedule, while maintaining a single point of accountability with the successful contractor.

The Engineer, Procure and Construct ('**EPC**') contract is deemed to be the appropriate contracting model given the nature of the SG refurbishment work. Within the framework of an EPC contract, various pricing models were also considered by the SG team. It is recommended that the pricing structure of the contract be primarily fixed/firm price for the major scopes of work except for the PSC execution work which will be cost reimbursable with an established target price given some of the uncertainties around the PSC work.

A competitive bidding process for the award of the SG scope is proposed. An EOI was issued to determine contractor interest and capability prior to issuing a RFP. The contract for the SG Project is planned to be awarded by the end of February 2014.

2.0 INTRODUCTION

2.1 Background Information

Major inspections and maintenance are required to be performed on the Darlington SG's. These inspection and maintenance activities will mitigate degradation risks, and the replacement and/or refurbishment of SG components will extend their life for an additional 25 to 30 years. The scope of work to complete these activities has been identified through the SG Life Cycle Management Plan ('**LCMP**') and will be planned and executed as a major Project under the DR Program.

The core scope of work for the SG Project was approved by the DR Scope Review Board in March 2011 under Darlington Scope Request ('**DSR**') Form TS0050: Darlington SG. The various scope of work documents and related SG refurbishment reports can be found in **Appendix A.** [redacted] The core scope of work can be summarized as follows:

a) PSC: This scope of work can be broadly described as mechanical cleaning of the inside of the tubes (inner diameter).

b) SSC: Waterlance each SG using a combination of high pressure intertube lancing and intertube/annulus flushing with visual inspections (i.e. cleaning outer diameter of tubes, tubesheet and possibly upper support plates).

c) Access Ports: Installation of access ports to allow additional incremental visual inspection of SG internals during and post refurbishment, ability to clean upper support plates through water lancing, future chemical cleaning opportunities, remote inspection of U bend region of tube bundle and foreign material removal.

d) Inspection and Maintenance: An augmented inspection and repairs scope for refurbishment has been established as per Life Cycle Management Plan (LCMP).

e) Primary Side Divider Plate Leakage Measurements: Measure leakage using Acoustic Leakage Inspection System (ALIS) and/or equivalent to compare measurements conducted in previous outages.

f) Lay-up work

In addition to the PSC and SSC scope of work, at OPG's option, OPG may request the successful contractor to perform the following optional scope and contingency work during the SG refurbishment:

- Optional Work: D1831 Waterlancing (combined with base Scope of Work Document) associated with the SSC Tubesheet Waterlancing base Work; and

- Contingency Work: PHT Pressure and Inventory Control – Miscellaneous Scope of Work associated with SSC Tubesheet Waterlancing base Work.

2.2 Objective and Scope

The key purpose of this document is to identify and capture the overall contracting strategy for the delivery of the Project scope of work. This document will:

- Identify the contracting alternatives suitable for the SG Project;
- Document evaluation considerations; and
- Recommend a contracting strategy (includes strategy around sourcing and pricing).

The initial version of the SG contracting strategy was issued in August 2011 as OPG was engaged in an EOI process to solicit contractor interest and assess their capability for the various scopes of work for the Project. This revised contracting strategy incorporates the results of the EOI and confirms OPG's path forward in terms of the contract model, pricing and contracting considerations.

2.3 Development Process

In late March 2011, a core Project Team ('**Team**') was established for the SG Project. The Team members included members from Engineering, Execution, Supply Chain, DR Planning & Control and Nuclear Contract Management (formerly known as Commercial Strategy and Nuclear Commercial Development). This core Team commenced the strategy development work by understanding the scope of work through the review of scope documents and analysis of relevant internal and external operating experience ('**OPEX**'). A summary of the OPEX captured on this project are included in **Appendix B**. The Team then identified and analyzed potential options around work packaging, contracting approaches and models to facilitate an overall contracting strategy for the work.

The Team included:

- Darlington Station Engineering: Components and Equipment (SG SPOC: Junaid Khan)
- DR SG Engineering (David Krupjuweit, Tahir Iqbal, Mario Pieries)
- DR SG Execution (Todd Josifovski, Pejman Asgaripour, Clare Robinson)
- DR SG Supply Chain (Peter Kukk)
- DR SG Commercial Strategy (Deepa Chatterjee, Kent Scherm)
- DR SG Planning and Controls (Sharyn Donnelly)

Other key stakeholders who reviewed the recommended contracting strategy, were involved with the development of the RFP package and the evaluation criteria included representatives from Law (Internal & External Counsel from Blake, Cassels & Graydon, LLP) and Corporate Investment Planning.

In June of 2011, OPG issued an EOI for the SG Project to identify contractors in the market place who could demonstrate their capacity to perform, in whole or in part, the scope of work that OPG requires to successfully complete the SG Project. Based on the results of the EOI, OPG issued an RFP on February 28, 2013 for the scope of work in the SG Project.

3.0 CONTRACTING CONSIDERATIONS

In developing the contracting strategy for the SG Project, the Project Team took into consideration the need to ensure OPG's business objectives and the DR Program and Project objectives were achieved while keeping with the Guiding Commercial Principles as outlined in the DR Program Commercial Strategy (NK38-REP-00150-10001).

The following business drivers were also considered in the evaluation of the contracting strategy:

(a) OPG's future business direction:

- Smaller fleet, reduced staff numbers, alternate labour and contracting strategies, different long-term inspection and maintenance strategy, different outage strategy (longer periods between subsequent outages, make others capable of supporting standard inspection and maintenance needs).
- OPG does not want to own any design and/or tools for specialized services and hence will not invest in design and/or tool development.

(b) Cost and schedule related considerations:

- Need for reliable Release Quality Estimate ('**RQE**');
- Completion of the contract within the original budget (against RQE);
- Completion of the scope of work within the original schedule (against RQE);
- No SG work is on the critical path. The SSC and access port installation will occur up front, following defueling activities and removal of SG heat sink requirements. PSC work will occur later in the execution timeline, in parallel with installation of new feeders in the vault by the RFR contractor, driven solely by space availability and dose rates in the

vault. Considerations should be given to have the PSC technology setup outside of the RFR vault space; and

- The team also recognizes that execution efficiencies can be gained and/or optimized by careful sequencing of the SG work from unit to unit.

(c) Long-lead considerations:

- PSC: In 2004, OPG used the AREVA NP Canada Ltd. ('**Areva**') (formerly known as Framatome ANP) PSC Process, called Sivablast. In 2009, OPG completed the qualification and effectiveness testing of Candu Energy Inc.'s ('**CEI**") CANDU clean process but did not execute any PSC utilizing that process. Both of these processes have been qualified by OPG. The optimization and design acceptance phase of PSC is currently estimated to take around one year. All of the balance work required to reach the "execution ready" phase (i.e., detailed engineering, design, fabrication, testing, site preparation and documentation) is also estimated to take another year, although this will vary with the type of technology and process used. A total lead time of 2 years is estimated for the PSC process if OPG uses either of the two existing technologies. For any new technology not qualified at DNGS, a longer lead time may be required.

(d) Quality considerations:

- The contractors are required to carry out all engineering, procurement and construction management activities under its approved Quality Assurance Program for Nuclear Activities which must meet the requirements of CSA Z299.1 and CSA N286-05, being the applicable elements for Design, Procurement and Construction and the applicable elements of N286.7 as a minimum, for the duration of the project; and

- OPG requires a simplified model for requalification of the PSC process. It may be noted two existing qualified processes are capable of effectively removing outer porous layer of magnetite from SG tube ID surface.

4.0 CONTRACTOR MARKETPLACE CAPABILITIES, RESTRICTIONS

In accordance with OPG's current knowledge of the marketplace, there are a limited number of potential contractors who can support the scope of work under consideration. These contractors include Candu Energy Inc. ('**CEI**'), Areva, Babcock & Wilcox Canada ('**B&W**') and Westinghouse. An EOI was provided to these four contractors on June 11, 2011 to determine interest and capability. OPG received three (3) responses to the EOI in August 2011 and the evaluation of all EOI submittals was completed during the same month. Upon receiving the submittals from the contractors, OPG made the following determination for the various scopes of work:

(a) PSC:

- [redacted]

(b) SSC:

- B&W had performed a total of six waterlancing campaigns in DNGS SGs between 1995 and 2003. [redacted]
- B&W has been performing waterlancing at the Pickering A and B SGs (Pickering work have also been historically awarded through a combination of competitive and single sourcing processes); and
- [redacted]

(c) Access Ports:

- All prospective contractors have the capability to perform this scope of work; and
- B&W is the Original Equipment Manufacturer (OEM) for the SGs. A formal request to B&W will be required in order to release the drawings and documents required to complete this modification by other contractors.

(d) Inspections and Maintenance:

- All prospective contractors have the capability to perform this scope of work. Historically, this work has been self-performed by OPG Inspection and Maintenance Services ('**IMS**'); and
- The execution of Inspection scope may be classified as optional scope of work.

(e) Primary Side Divider Plate Leakage Measurements:

- The only method used at OPG has been the ALIS technology, operated by Kinectrics who owns the Intellectual Property ('**IP**'). [redacted]

(f) Layup Work:

- All prospective contractors have the capability to perform this scope of work and as such, the work will be awarded to the contractor selected for the SG work.

Based on the information and assessment of available contractors for the scope of work, the Team decided that OPG would engage Areva and B&W/CEI (as a joint venture) to participate in the RFP on February 28th, 2013.

5.0 CONTRACTING ALTERNATIVES/ANALYSIS

5.1 Work Packaging

The Team considered two work packaging options for contracting purposes. Analysis of each of the options is as follows:

Option 1: Unbundle All Steam Generator Work Packages

The first option is to unbundle the scope of work for contracting purposes. The primary side work and secondary side work will be separated by approximately 19 months for each unit, with the separation much less between overlapping outages. Logically, the lowest level of feasible unbundling is to separate the scope into two packages based on the fundamental nature of the work, the location and the timing of the work:

- Primary Side Work Package
    - PSC
    - Divider Plate Leakage Measurements
    - Primary Side inspections and maintenance
    - Layup work
- Secondary Side Work Package
    - SSC (i.e.waterlancing)
    - Secondary Side inspections and maintenance
    - Layup work
    - Access Ports
    - Optional and Contingency work

This strategy would allow separate contractors to execute each of the bundles.

Benefits:

- Option open to utilize known and/or proven expertise and/or contractors for the different portions of the work;
- Allows OPG to use known technology and processes for the various pieces of the work, if supported by the sourcing approach (e.g., deployment of previously used Sivablast technology will require single sourcing the PSC work to Areva). This lowers the technical risks, as the use of new technologies/processes usually comes with "unknowns";
- Provides OPG additional leverage during negotiations and potentially more favourable contract terms and lower contract prices, when dealing with different contractors for different components of the work;
- Provides OPG with maximum information and transparency regarding each option and thus allows OPG to make an informed decision as to which option to proceed with; and
- Allows OPG to easily examine alternatives for a specific part of the SG project in subsequent units if desired results are not achieved from the first unit.

Risks:

- The SG Project requires a high level of integration and co-ordination for the various scope of work packages, particularly with overlapping outages and

hence it is important to minimize the number of contractor interfaces and have fewer (preferably one) point of accountability for Project execution.

- As all work packages will be performed on the same equipment, having multiple contractors will increase the integration and interface risk. OPG will need to manage the majority of this risk as the owner and general contractor;

- Splitting the work packages and allowing multiple contractors to work on one major component may lead to difficulty in assigning ownership to project planning, coordination between different work groups and/or execution risks and issues as they arise;

- There is a strong possibility that unbundling will enhance the level of effort required around project management (including scheduling integration and coordination);

- OPG may incur additional training costs as resources will not be shared between various sub-projects;

- Potential non-compliance with the requirements of the RFP (i.e. contractors may decide to pick and choose which bundle of work they will submit proposals on, in which case, OPG will not be able evaluate the proposals objectively ; and

- Additional internal cost to OPG for managing multiple contractors because there is no opportunity for resource sharing.

Option 2: Bundle All Steam Generator Work Packages

The second option of the SG Project Team is to bundle all scopes of work as one package for contracting purposes which includes all of the work associated with primary and secondary sides with the Optional and Contingency scope. OPG will request the contractor to submit their pricing breakdown for each scopes of work. The intended result of this approach is to ensure each contractor competitively prices the work for the PSC, SSC and Access Ports.

Benefits:

- The geographical location of the equipment on which the work will be performed (one equipment, one man-way) lends itself well to assigning one contractor point of accountability for full Project execution. This will limit hands-off and coordination risks;

- Integration and coordination risks are largely transferred to the contractor under a bundled approach. It is assessed that the contractor can be made largely accountable for generating a good quality RQE within the timeline required by OPG;

- This approach is assessed to facilitate a more "partnership type" working relationship with one contractor (i.e. high estimated contract value and the contractor having a stake at the outset of the process for overall project delivery will facilitate this relationship);

- Bundling increases the potential contract value, and hence increases the probability that contractors/ consortium of contractors will be willing and able to invest in development and qualification of tooling and processes. This willingness will be further enhanced if OPG considers building a longer term inspection and maintenance arrangement, given OPG's future business direction;

- There will be savings to OPG for training and in processing as one contractor can share resources among different projects;

- In the event of an evaluation of the contractor's proposals warrants an unbundling approach, OPG will have the option of unbundling the PSC and SSC work if schedule savings and value for money can be realized; and

- It increases chances of receiving comparable proposals of adequate quality and completeness for RFP evaluation purposes.

Risks:

- Bundling will not enable retaining any parts of the overall scope of work in-house with OPG, although OPG has current ability to plan and execute the Inspections and Maintenance and Primary Side Divider Plate Leakage Measurement work;

- Bundling may not enable utilization of existing and known technologies/ processes for PSC and SSC work as these technologies/processes usually vary from contractor to contractor;

- Some contractors may not be willing to assume all project scope, based on their core strengths and the technologies available to them;

- Concentrating all work packages with one contractor presents the risk that acceptable work performed on some sections of scope may be offset by less than expected quality on another (in terms of quality, schedule, or budget); and

- Concentrating all scope of work packages with one contractor may expose OPG to increased risk that an unforeseen commercial event (i.e., bankruptcy) could place undue risk on the DR execution.

5.2 Contracting Model

The following contracting models were examined:

Option 1: Self-Perform:

OPG in-house capability does not exist to self-perform the full scope of work for the SG project. There is capability to complete the SG Inspections via OPG IMS and sub-contract Primary Side Divider Plate Leakage Measurement to Kinectrics.

Benefits:

- Utilizing proven experience for the inspections and maintenance work; and
- Provides OPG the greatest flexibility to adjust the scope and schedule of the work, if retained in-house; OPG will have maximum control.

Risks:

- Not in alignment with OPG's future business direction to minimize resources; and
- This may lead to a situation where OPG staff and contractors need to work on the same equipment location at the same time, thereby making the integration and coordination of the work complex and difficult to manage.

Option 2: Traditional Design-Bid-Build ('DBB'):

Serial sequence of design and construction phases; procurement of materials usually commences with the construction phase; Owner/General Contractor (OPG at this point in time) contracts separately with designer and constructor and retains overall project management responsibility, including project oversight.

Benefits:

- Potential for lowest cost contracting option;
- May leverage the competitive bid process with an increased supply base (multiple and/or different contractors for each of the design and construction contracts);
- May also leverage contractor capabilities utilization (e.g. contractor's expertise in construction may be considered only as the pool for the construction work);
- May facilitate better control of the quality aspect (if Owner retains quality control and quality assurance functions); and

- May maximize the fixed price component of the work, if construction work is being bid to fully completed design specification.

Risks:

- Does not support minimizing interfaces and hand-offs (rather, maximizes numbers of interfaces and number of contracts) – potentially nullifies the benefits expected from bundling of the work for contracting purposes;
- Maximum schedule requirement, escalation costs greatest due to long schedule;
- Procurement approach may directly impact timely availability of long-lead items, or this approach may result in separate OPG procurement of long-lead items thereby creating another set of hand-offs;
- Design, development, and use of tools for work of this nature is usually approached through an integrated solution by the contractors in the market (i.e. it is difficult to separate detailed design/engineering, tool manufacturing and execution phases). There is limited ability to address constructability issues during design phase. In the DBB approach, the entire design risk is retained by OPG.
- Overall, as owner, OPG retains most control, OPG retains most risks (and hence may need to carry additional contingency beyond what is typical for DBB contract due to the volume of the work). Previous experience with DBB approach (not for this specific SOW, but in general) indicates there are often significant difficulties requiring the contractor to perform rework/warranty work because the contractor may try to blame OPG or other contractors for the problems or issues which may occur
- Not conducive of maintenance based work packages with no design component.

Option 3: Design-Build ('DB') or Engineer, Procure and Construct ('EPC'):

OPG to enter into one contract with an EPC contractor for overall project coordination, detailed design and engineering, procurement of equipment/components and execution.

Benefits:

- In alignment with OPG's preference for a limited number of accountable parties for project delivery (single point of accountability);
- Potential for the shortest schedule with concurrent E/P/C activities, and minimizes risks arising from multiple hand-offs and communication channels;

- Supports contractor capability development and early start of long-lead work;
- Greater up-front cost certainty;
- Risks around cost (and to some extent, schedule) can be largely transferred to contractor;
- May help to leverage contractor capabilities better (e.g. OPG may place more reliance on contractor to develop and deploy more efficient and optimum technologies and processes for executing the work);
- Streamlines Project organization and communication models; and
- Aligns with Construction Industry Institute's (CII's) Project Delivery and Contract Strategy ('**PDCS**') model (**Appendix C**).

Risks:

- Potentially higher cost because of risk transfer and contingencies carried by the contractor, although OPG will require correspondingly less contingency;
- Requirement for a much more detailed SOW and defined technical requirements early in the Project for turnover to the contractor
- Failure to properly prepare functional specifications or scope of work may leave OPG exposed to "extras" or change directives; and
- Rigorous effort by OPG is required in conducting audits on the contractor's QA program as OPG will heavily rely on the contractor's quality records prior to bringing the unit(s) back to service.

Option 4: Turnkey:

This was considered as a starting option but not further evaluated at this stage for the following reasons:

- The approach was not in alignment with the overall contracting approach for the DR Program (as OPG is the General Contractor, it does not make logical sense to have pieces under the Program set up as pure Turnkey); and
- A certain degree of OPG's involvement and oversight is essential for this type of work which is largely concentrated on inspection and maintenance.

6.0 RECOMMENDED CONTRACTING STRATEGY

Based responses from vendors who participated in the EOI identified in Section 4 and on the analysis completed in Section 5, it is recommended that the SG scopes of work

be bundled into one package for contracting purposes. This strategy provides the greatest opportunity for a successful project in terms of cost, schedule, and quality which demonstrates the least amount of risk to OPG. However, OPG will also ask prospective proponents to submit a breakdown on pricing for the individual scopes of work. The breakdown of pricing for the PSC, SSC and Access Ports in the RFP will provide OPG the maximum information and transparency in the key scope areas in order to evaluate the proposals. This will allow OPG to make an informed decision, and retain the option of unbundling if the potential value from unbundling outweighs the potential benefits that may be derived from bundling the work for execution purposes. Since Kinectrics has the IP for the ALIS technology to be used for the SG Primary Side Divider Plate Leakage Inspection, the contractor selected to complete the SG work will be expected to subcontract Kinectrics to execute the inspections.

An EPC contract will be pursued for the bid packages as it offers the most balanced approach that is in alignment with the preferred contracting model for the DR Program.

7.0 CHOICE OF PRICING MODEL

The project team performed the following analysis for the pricing models (including estimated Class 5 cost):

PSC [redacted]

For the PSC work, the definition phase (i.e., pre-execution) work that includes tooling, mock-up, and pre-execution engineering including Engineering Change Control ('**ECC**') integration will be done on a fixed price basis. This work can be defined in detail and the majority of this work will be performed at the contractor's facility.

The field execution portion of PSC will be cost reimbursable with a target price established, recognizing the fact that there is a lack of experience in performing this work at DNGS. Opportunities for efficiencies and adaptability may need to be explored.

SSC [redacted]

The scope of work for the SSC is best suited for the fixed/firm price model. This decision is based on OPEX, clearly defined base scope, and familiarity with the work from many successful previous outages. For any incremental scope (contingent on eddy current inspection data), consideration may be given to a fixed, firm, or cost reimbursable with fee adjustment pricing model, or deferred to subsequent outages (preferred).

Access Ports [redacted]

For Access Ports, tooling development, mock-up and ECC integration, this work will be fixed price. This work can be scoped out in detail and performed at the contractor's facility.

Access Port field execution will be firm price.

Inspection & Maintenance [redacted]

The Inspection and Maintenance work has been historically executed by OPG IMS, essentially on a cost reimbursable type of arrangement and will be the same for the contractor.

SG Primary Side Divider Plate Leakage Inspection [redacted]

This work will be awarded to the contractor on a firm price basis who will subcontract Kinectrics to execute the work

Layup Work [redacted]

Engineering will be Fixed Price for execution work.

8.0 PROCUREMENT PROCESS PREREQUISITES/CONSIDERATIONS

The procurement process is expected to follow OPG's standard competitive process as outlined in OPG-PROC-0058: Procurement Activities. The RFP will be issued to Areva and B&W/CEI at the end of February 2013 with a contract awarded by February 2014.

Key Dates planned in SG Procurement Timeline are as follows:

Issue RFP:	February 28, 2013
Receive Proposals:	June 3, 2013
Evaluations, Clarifications and Recommendation:	June 28, 2013
Negotiations Finalized:	August 30, 2013
Final Agreement/Signed Contract:	February 28, 2014

9.0 INTERFACE AND INTEGRATION WITH OTHER CONTRACTING STRATEGIES/MAJOR CONTRACTS FOR THE DARLINGTON REFURBISHMENT WORK

It is anticipated that the Project can be performed mostly in a stand-alone manner, due to the bundled approach of the SG scope or work packages and also the following:

- The islanding approach plans to create a "fence inside the fence" for the SG work;
- The SGs themselves are well suited to the geographically isolated work that takes place within their confines for both primary and secondary sides; and

- Primary and secondary side work may be able to proceed in parallel, given the different isolation boundaries and the physical separation of the worksites by the bellows containment structure. However, it is expected that the Secondary Side work will start immediately after defueling, and primary side work will be completed 19 months later during the Feedertube Installation window.

Further, there will be some overall Project interface issues that will require additional attention and mitigation by OPG and the successful contractor which can include the following:

- Coordination of PSC scheduling and execution activities with R&FR, in particular if the work is on critical path. (Note: The PSC window is expected to be off-critical path as provisions have been made in the equipment technical specifications that waste collection and process equipment are to be located outside the vault to avoid interference with RFR installation activities);

- SG work is to be performed after defueling activities, to avoid heat sink recall requirements for the fuelled reactor; and

- Layup activities and strategies for both the secondary side and primary side will need to be further developed to align with other plant work and Projects. Close coordination with the lay-up and services project will be required as the SG project will be laying-up the equipment and providing support for when SG's are not being worked on.

10.0 KEY RISKS AND PROPOSED MITIGATIONS

Bundling all of the scopes of work with one contractor presents the risk that acceptable work performed on some elements of the scope may be offset by less than expected quality on others (in terms of quality, schedule or costs). To mitigate this risk, consideration will need to given in building in contractual terms and conditions that provide OPG with the ability to defer elements of the work to subsequent unit outages during the DR execution.

Appendix A: : Bibliography

- OPG-PROC-0058; Procurement Activities
- NK38-REP-00150-10001; Darlington Refurbishment Program Commercial Strategy
- NK38-SOW-33110-10012; DARLINGTON REFURBISHMENT UNITS 1-4 SG SECONDARY SIDE TUBESHEET WATERLANCE
- NK38-SOW-33110-10014; SCOPE OF WORK DOCUMENT - DNGS UNITS 1-4 SGS PRIMARY SIDE CLEANING
- NK38-SOW-33110-10016; DARLINGTON REFURBISHMENT - UNITS 1-4 STEAM GENERATOR INSPECTION AND REPAIRS
- NK38-SOW-33110-10017; DARLINGTON REFURBISHMENT - UNITS 1-4 STEAM GENERATOR ACCESS PORT INSTALLATION
- NK38-REP-33000-10003 R002; Darlington Heat Transport Aging Report
- NK38-REP-33110-10031 R00; D411 Unit 1 Spring 2004 Outage Primary Side Clean (PSC) Lessons Learned Report
- NK38-REP-33110-0047600; Darlington Unit 4 Boiler Divider Plate Inspection using 'ALIS' Technique
- NK38-REP-33110-0000458; Darlington Unit 2 Boiler Divider Plate Inspection using 'ALIS' Technique
- D-LLD-33110-10013 R00; DNGS Unit 1 (D811) Steam Generator Waterlancing Lessons Learned
- D-LLD-33110-10016 R00; DNGS Unit 3 (D931) Steam Generator Waterlancing Lessons Learned
- D-LLD-33110-10020 R00; DNGS Unit 2 (D1021) Steam Generator Waterlancing Lessons Learned
- D-LLD-33110-10018 R00; D1041 Steam Generator Primary Side Open/Close and Secondary Side U-Bend Inspection Lessons Learned
- NK30-LLD-36340-00008 R00; P1072 Steam Generator Waterlancing – Lessons Learned Report

- NK30-LLD-36340-00007 R00; Unit 6 (P961) Steam Generator Waterlancing Lessons Learned Report
- Construction Industry Institute (CII) www.construction-institute.org; Owner's Tool for Project Delivery and Contract Strategy Selection (PDCS)
- NK38-REP-09701-10069-R000 Darlington Refurbishment SG EOI Evaluation Summary

Appendix B: Related External and Internal OPEX

Internal OPEX:

The SGs at Darlington and Pickering (A and B) sites are physically different and have different sludge issues. Hence, the SG Project team primarily collected and analysed OPG's internal OPEX on PSC and SSC from Darlington as noted below.

Primary Side Clean:

Darlington completed one PSC campaign to date in Unit 1 (Spring 2004 outage) using Sivablast technology. The contracted work included PSC equipment, mock-ups, effectiveness and qualification testing, waste handling, bungs and Foreign Material Exclusion (FME) barriers and field execution. [redacted]

The following key points have been summarized from review of a number of lessons learned reports from this work and are deemed important for planning and executing future PSC campaigns, and designing RFPs and agreements for this work:

- Recommended that future PSC carry out optimization of the process, specific to Darlington SG, and demonstrate effectiveness;
- Any future requalification of the PSC process should be done to a simplified approach that addresses solely the tube wall wear and provides the relation of wear with respect to the process operating parameters, instead of meeting an acceptance criterion; and
- [redacted]

Improvements to drying techniques of the SGs prior to PSC are recommended

Post Implementation Review Report of Qualification testing completed for the CANDUclean process (AECL) for Darlington steam generators in 2009 (reference D-PIR-33110-10004) also recommended:

- Any future requalification of the process should be done to a simplified approach that addresses solely the tube wall wear and provides the relation of wear with respect to the process operating parameters, instead of meeting an acceptance criterion.

OPG Confidential Commercially Sensitive		
Document Number: NK38-REP-09701-10024		Usage Classification: N/A
Sheet Number: N/A	Revision Number: R001	Page: 23 of 25

Title: CONTRACTING STRATEGY FOR STEAM GENERATORS

Appendix B (Continued)

Waterlancing:

As noted under Section 5.0 above, waterlancing at Darlington has been historically performed by both B&W (1995 to 2003) and Areva (2004 to present). The contractor has been responsible for design and registration, lance qualifications, lancing documentation, training of personnel and site execution.

The following key points have been summarized from review of a number of lessons learned reports for applying as lessons learned in future SSC campaigns:

- Recommended that future contracts include a performance cleanliness clause;
- Revisit the recommendation to lance tube sheets at current intervals based on lancing results from this and previous campaigns;
- Training requirements need to better defined and clearly stated in contract and Project Kick-off Meeting; and
- Refurbishment of the lancing tools was recommended prior to the next outage.

Access Port Installation:

In addition, the team also collected and analysed internal OPEX re: Access Ports installation at Pickering A. The key points noted from this review for future reference are:

- The contract was awarded through competitive bidding to B&W.
- [redacted]
- Most of the delays were due to OPG regarding non-conformances and changes requiring approval by OPG, including Design.
- Full mock-ups with training in plastic suits are suggested to resolve and reduce field issues. Special nozzle training for welders also suggested.
- Contingency planning around FME Prevention and foreign material recovery plan is also suggested as these caused problems during the past nozzle work.

- OPG needs to rely on contractor's expertise and may consider that contractor should handle the field change control items.

External OPEX:

The SG team also gathered relevant external OPEX. The SG SOW for Pt. Lepreau was very similar to the one planned for DR. The key points noted for future reference through discussion with Pt. Lepreau representative are as below:

- PLNGS had an existing co-op agreement with B&W and awarded their full SG Inspection and Maintenance work to B&W as OEM sole source. The PSC work was bundled with the R&FR work (added as an addendum to the R&FR work) and awarded to AECL. This was a unique situation for PLNGS. AECL already had lots of support personnel at site for the retube activities and PLNGS was able to utilize some of that support for the PSC work;

- A combination of fixed price and time and materials arrangements were utilized for the contracts;

- For the Inspection and Maintenance work, an inventory of PLNGS tooling was given to B&W during the planning stage and they were responsible for bringing any tooling above and beyond that. All specialized tooling was B&W's accountability. AECL was responsible for 100% of their tooling; and

- A combination of mock-ups at the contractors' facilities and PLNGS were utilized for the work.

Contractors were not accountable for compiling the final inspection reports for submission to the CNSC, although PLNGS often sent the post-inspection Results Assessment (prepared by B&W) to the CNSC as supplementary information to PLNGS' letter.

OPG Confidential Commercially Sensitive		
Document Number: NK38-REP-09701-10024	Usage Classification: N/A	
Sheet Number: N/A	Revision Number: R001	Page: 25 of 25

Title: **CONTRACTING STRATEGY FOR STEAM GENERATORS**

Appendix C: Project Delivery and Contract Strategy (PDCS) Contract Model Selection

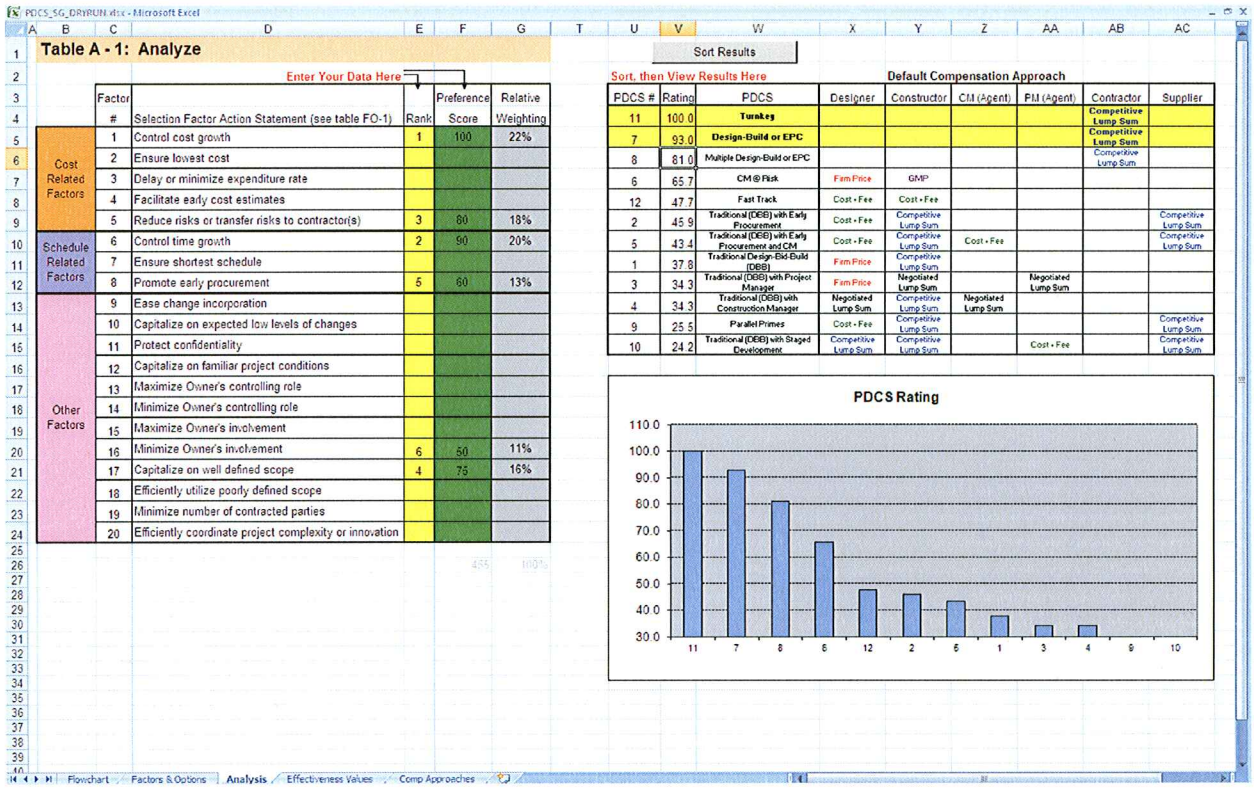

Table A - 1: Analyze

Enter Your Data Here

	Factor #	Selection Factor Action Statement (see table FO-1)	Rank	Preference Score	Relative Weighting
Cost Related Factors	1	Control cost growth	1	100	22%
	2	Ensure lowest cost			
	3	Delay or minimize expenditure rate			
	4	Facilitate early cost estimates			
	5	Reduce risks or transfer risks to contractor(s)	3	80	18%
Schedule Related Factors	6	Control time growth	2	90	20%
	7	Ensure shortest schedule			
	8	Promote early procurement	5	60	13%
Other Factors	9	Ease change incorporation			
	10	Capitalize on expected low levels of changes			
	11	Protect confidentiality			
	12	Capitalize on familiar project conditions			
	13	Maximize Owner's controlling role			
	14	Minimize Owner's controlling role			
	15	Maximize Owner's involvement			
	16	Minimize Owner's involvement	6	50	11%
	17	Capitalize on well defined scope	4	75	16%
	18	Efficiently utilize poorly defined scope			
	19	Minimize number of contracted parties			
	20	Efficiently coordinate project complexity or innovation			

Sort Results

Sort, then View Results Here

Default Compensation Approach

PDCS #	Rating	PDCS	Designer	Constructor	CM (Agent)	PM (Agent)	Contractor	Supplier
11	100.0	Turnkey					Competitive Lump Sum	
7	93.0	Design-Build or EPC					Competitive Lump Sum	
8	81.0	Multiple Design-Build or EPC					Competitive Lump Sum	
6	65.7	CM @ Risk	Firm Price	GMP				
12	47.7	Fast Track	Cost + Fee	Cost + Fee				
2	45.9	Traditional (DBB) with Early Procurement	Cost + Fee	Competitive Lump Sum				Competitive Lump Sum
5	43.4	Traditional (DBB) with Early Procurement and CM	Cost + Fee	Competitive Lump Sum	Cost + Fee			Competitive Lump Sum
1	37.8	Traditional Design-Bid-Build (DBB)	Firm Price	Competitive Lump Sum				
3	34.3	Traditional (DBB) with Project Manager	Firm Price	Negotiated Lump Sum		Negotiated Lump Sum		
4	34.3	Traditional (DBB) with Construction Manager	Negotiated Lump Sum	Competitive Lump Sum	Negotiated Lump Sum			
9	25.5	Parallel Primes	Cost + Fee	Competitive Lump Sum				Competitive Lump Sum
10	24.2	Traditional (DBB) with Staged Development	Competitive Lump Sum	Competitive Lump Sum		Cost + Fee		Competitive Lump Sum

PDCS Rating

Flowchart | Factors & Options | Analysis | Effectiveness Values | Comp Approaches