ONTARIO POWER GENERATION

Report

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CONTRACTING STRATEGY FOR TURBINE GENERATORS

Contracting Strategy For Turbine Generators

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N/A	R000	2 of 34

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Revision Summary

Revision Number	Date	Comments
R000	2012-08-31	Initial issue

Table of Contents

Page

1.0 EXECUTIVE SUMMARY 5

2.0 INTRODUCTION 6
2.1 Background Information 6
2.2 Objectives and Scope of Strategy 8
2.3 Development Process 8

3.0 STAKEHOLDER ANALYSIS 9

4.0 CONTRACTING CONSIDERATIONS 9

5.0 VENDOR/MARKETPLACE CAPABILITIES, RESTRICTIONS 10

6.0 CONTRACTING ALTERNATIVES ANALYSIS 12
6.1 Work Packaging for Contracting Purpose 12
6.2 Contracting Model 13
6.3 Sourcing Strategy 13

7.0 RECOMMENDED CONTRACTING STRATEGY 15

8.0 CHOICE OF PRICING MODEL 17

9.0 PROCUREMENT PROCESS PREREQUISITES/CONSIDERATIONS 18

10.0 INTERFACE OR INTEGRATION ISSUES WITH OTHER CONTRACTING STRATEGIES/MAJOR CONTRACTS FOR THE DARLINGTON REFURBISHMENT WORK 20

11.0 KEY RISKS AND PROPOSED MITIGATION 20

12.0 SUCCESS CRITERIA/KEY PERFORMANCE INDICATORS 21

13.0 IMPLEMENTATION PLAN 21

REFERENCES 22

Appendix A: Analysis of Work Packaging for Contracting Purpose 23

Appendix B: Contract Model Analysis 26

Appendix C: KT Analysis 28

Appendix D: Plan A – Initial Negotiations with OEM 32

Appendix E: Plan B – Competitive Sourcing 34

1.0 EXECUTIVE SUMMARY

The Darlington Refurbishment ("**DR**") Commercial Strategy identified a need to establish separate contracting strategies for each of the major projects under the DR Program. 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 Turbine Generator ("**TG**") Project ("**Project**").

The Darlington TG sets were custom designed and are unique to Darlington Nuclear Generating Station ("**DNGS**"). The Project under the DR Program is a combination of piecemeal retrofits, repairs of hardware, hydraulics and full controls upgrades. Successful planning and execution of this work will need a large amount of technical integration and accurate interfacing. The contracting strategy for the Project thereby recommends bundling the following work into one package for contracting purpose as the most preferred option:

- Turbine High Pressure, Low Pressure, and Auxiliaries repairs/replacements
- Generator Rotor, Stator, and Auxiliaries repairs/replacements
- Moisture Separator Reheater repairs/replacements
- Turbine Controls Upgrade
- Generator Controls Upgrade

Bundling the work in this manner allows work to be efficiently scoped, planned, scheduled, and managed in accordance with the DR Program schedule.

Having considered various contracting and sourcing models, the TG Project Team concluded the nature of the TG work will fit well into the procurement model for an Engineering, Procurement and Construction ("**EPC**") contract. The recommended approach is to negotiate acceptable contract terms with the Original Equipment Manufacturer ("**OEM**") as the primary option while in parallel continue to perform the preparatory work that would allow OPG to pursue, in whole or in part, a competitive bidding process as a backup option. This approach will allow OPG to minimize impact on the DR Program schedule, if OPG decides to cancel the negotiations with the OEM for any reason (including for reasons of not being able to achieve the negotiation objectives within a specified time frame) and continue pursuing other sourcing alternatives.

Various pricing models were considered by the Project Team. The recommended pricing models vary based on the nature of the work and have been determined based on operational knowledge/experience.

The approach recommended in this contracting strategy is expected to allow OPG to achieve the DR Program and Project objectives, as well as post-refurbishment goals within acceptable risk thresholds and value for money considerations.

2.0 INTRODUCTION

2.1 Background Information

The Project is one of the major projects within the DR Program. The goal of the Project is to complete a major overhaul and upgrade of the turbine generator sets and their control systems to extend the life of the equipment for an additional 25 to 30 years. Five separate and distinct phases have been identified, presented to the DR Scope Review Board ("**SRB**")[1] and approved at Project Gate 0 on May 5, 2011:

(a) Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure ("**HP**") and Low Pressure ("**LP**") turbine components and a number of turbine auxiliaries;

(b) Generator and Generator Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,

(c) Moisture Separator Reheater ("**MSR**"): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);

(d) Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control ("**STEC**") System, includes entire Turbine Supervisory System with modern design (digital system); and

(e) Generator Excitation Upgrade: replacement of the obsolete Generator Excitation system controls with modern design (digital system) and a set of additional Generator Excitation and Protection equipment to resolve obsolescence.

Based on the Class 5 estimates[2] developed in 2011 for the above work, the total estimated value for the Project is around $510 M, of which around [redacted] is the

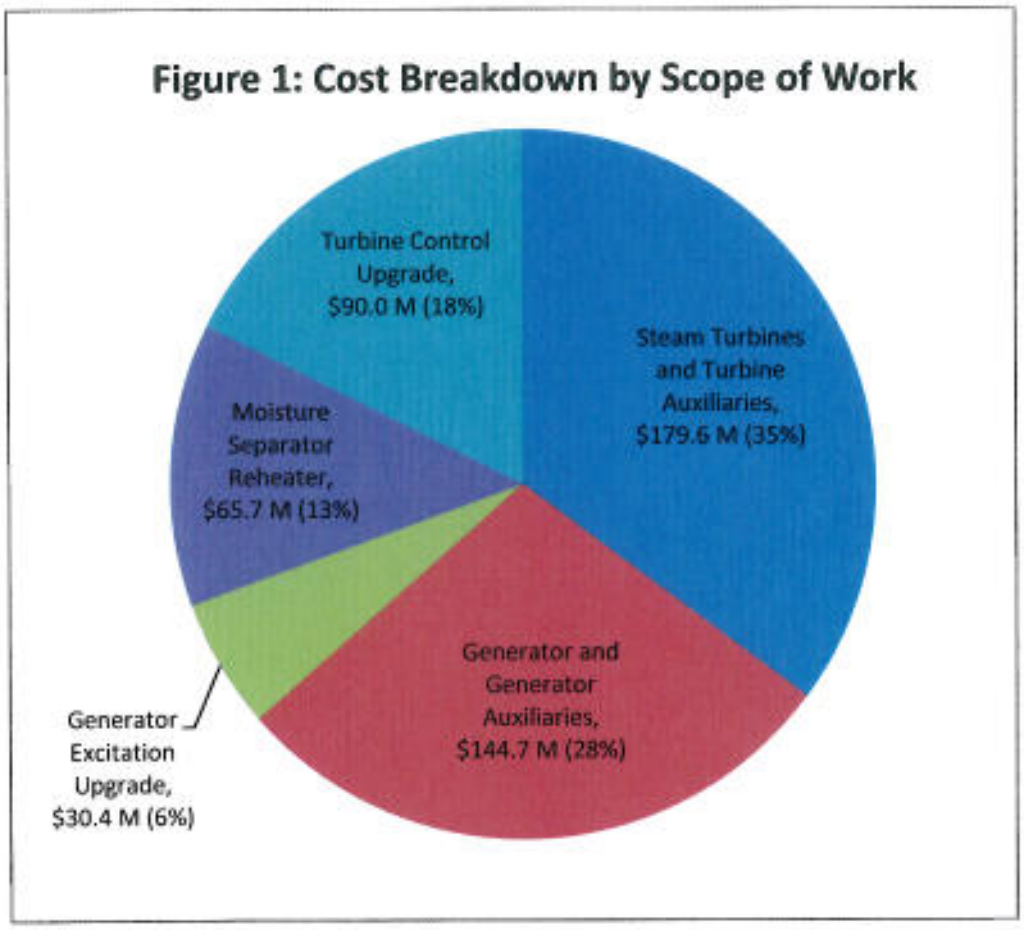
[1] *The purpose of the SRB is to:*
- *challenge the proposed refurbishment work scope to ensure work is necessary for the successful refurbishment of Darlington;*
- *align the scope with the objectives of maintaining/improving reliability and lowering production costs; and*
- *ensure investments in refurbishment deliver value for money.*

[2] *Cost Estimate Classification System from the Association for the Advancement of Cost Engineering (AACE) which maps the phases and stages of project cost estimating together with a generic maturity and quality matrix. The Project Class 5 estimates are based on current Darlington Scope Request (DSR) forms, prepared at the initial stages of project definition based on limited information.*

confirmed scope and [redacted] is classified as the contingency scope.[3] The contingency scope is the work that has been identified as "potentially required". A set of contingency items are listed for the Steam Turbine and Turbine Auxiliaries, Generator and Generator Auxiliaries and MSR phases. Once inspections and analyses are complete, recommendations will be made as to whether this scope of work is required.

Although some of the work can be done as part of Darlington's project portfolio for inspection and maintenance, the whole work is planned to be executed during the refurbishment outage for efficiency to minimize outage schedule. The breakdown of work sub-packages by estimated $ value (and % value) is presented below. These estimates may change over time as the project definition phase progresses and will be updated.

Figure 1: Cost Breakdown by Scope of Work



[3] *In addition to the above estimates, approximately $60 M of turbine related operations & maintenance ("OM&A") cyclical work (e.g. regular equipment maintenance activities, removal and installation of the HP casings, etc.) are also planned for execution during this Project.*

The Darlington TGs were originally designed, manufactured and installed by Brown Boveri Canada Inc. ("**BBC**"). BBC, the OEM has since undergone a number of changes as a business entity – BBC was bought out by Asea Brown Boveri ("**ABB**") and subsequently ABB's TG business segment was bought out by Alstom Power ("**Alstom**"). Currently, Alstom is the OEM on record and has been providing technical, engineering, maintenance and outage support services for the Darlington TG units. These TG sets are considered specialized products, unique in North America as they were custom designed specifically for Darlington.

2.2 Objectives and Scope of Strategy

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

(a) Identify the contracting alternatives suitable for the Project;

(b) Document evaluation considerations; and

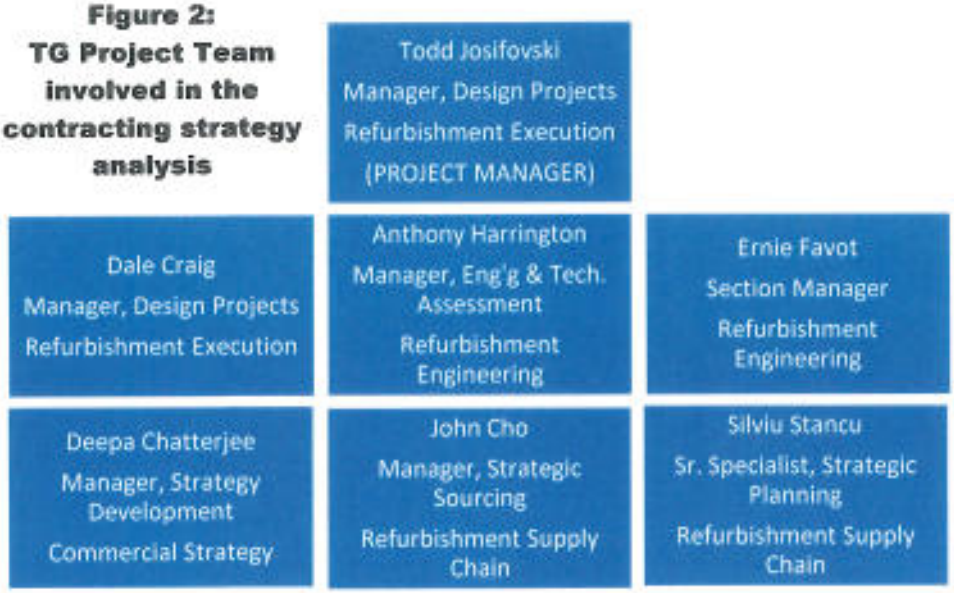
(c) Recommend a contracting strategy (including strategy around sourcing and pricing).

A Contracting Strategy Summary for Turbine Generators (NK38-REP-09701-10030-R000) was prepared to provide an overview and key drivers for the proposed contracting strategy. That document was reviewed and approved by the EVP, Nuclear Projects on March 9, 2012. As the Project Team progresses with the recommended path forward, this document was created to provide a more in-depth analysis of the main alternatives and key factors considered by the Project Team in the process of developing the proposed contracting strategy.

2.3 Development Process

The Project Team was established in early March 2011 with representation from Engineering, Execution, Supply Chain and Commercial Strategy (renamed Nuclear Commercial Development in June 2012). This core Project Team commenced the strategy development work through understanding the scope of work with the review and analyses of background information available from OPG's 2010 Darlington Steam Turbine Electronics Controls Project (DN STEC Upgrade Project 16-33973), relevant internal and external operating experience ("**OPEX**") and results from comprehensive Component Condition Assessments ("**CCA**"). The Project Team identified and analyzed potential options around work packaging, contracting approaches/models and pricing options. Inputs were also solicited from other key stakeholders within the company and external sources.

Figure 2:
TG Project Team involved in the contracting strategy analysis



3.0 STAKEHOLDER ANALYSIS

In addition to the Project Team engaged in strategy development, key stakeholders groups who provided input included representatives from Law (internal and external counsel from Blake, Cassels & Graydon, LLP), Finance, DR Planning & Control and Hydro Supply Chain. The recommended strategy was also communicated to the Chief Supply Officer ("**CSO**") and the following committees:

- DR Program Level Cross-Functional Sourcing Team ("**CFST**")
- Refurbishment Project Executive Team ("**RPET**")
- Nuclear Executive Committee ("**NEC**")
- Executive Advisory Committee ("**EAC**")
- Nuclear Oversight Committee ("**NOC**") of OPG's Board of Directors

4.0 CONTRACTING CONSIDERATIONS

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

The following business drivers have also been considered in evaluating the contracting strategy for this Project:

- Operational Reliability: TG units are critical components for nuclear generation. Any problem requiring an unexpected shutdown of the main turbine is likely to cause a significant unplanned outage, potentially resulting in millions of dollars of downtime costs. The DGNS have approximately 870,000 KWh of generation capacity per unit and costs associated with unplanned outages can amount to $1.25 M per day for one unit. Operational reliability is a critical consideration for this Project.

5.0 VENDOR/MARKETPLACE CAPABILITIES, RESTRICTIONS

Based on market intelligence, the Project Team identified the following vendors as capable of undertaking the whole or parts of the scope of work ("**SOW**"):

(a) Turbines, Generators, and Auxiliaries: Siemens, General Electric ("**GE**"), Alstom;

(b) Moisture Separator Reheaters: Siemens, GE, Alstom, Babcock & Wilcox; and

(c) Turbine, Generator and Excitation Controls (includes Excitation power component upgrades): Siemens, GE, Alstom, ABB. Invensys can only perform turbine and general controls.

The Project Team has also identified that some off-shore Japanese and Korean TG manufacturers such as Toshiba, and Mitsubishi who may be in a position to offer some alternative options for this work. However, additional OPEX will need to be sought out on their performance in similar projects. Additionally, it will be important to seek out information on these companies performance as a support organisation for longer term maintenance requirements. These companies will be considered in any competitive bidding options.

Based on the 2010 Vendor Assessment Report from the DN STEC Upgrade Project (NK38-REP-64100-10002-R000) which evaluated five vendors (GE, Siemens, ABB, Alstom, Invensys), each is identified as capable of supplying a functional turbine control system. While the general hardware and software architectures for all systems were very similar, the key variations between vendors existed in the types of redundancy, ability to interface with existing systems, Human Machine Interface ("**HMI**") offerings, installation and commissioning capabilities, hardware and software support periods, and simulator integration support.

Alstom, as the OEM has been providing technical support to OPG to address life cycle management issues and technical expertise during Darlington's planned outages for the last 15 years, working with the design basis of Darlington's TG set. In the TG industry, Alstom currently holds the dominant position in the nuclear generation refurbishment market winning more than half of the available world refurbishment market since 2004. Next to Alstom, Siemens and GE are second and third in terms of installed base of nuclear turbines globally[3]. Of these three vendors, only Siemens and Alstom have retrofitted equipment on other manufacturers' steam TG's. Most retrofits are performed by the OEM.[4]

Siemens is currently the OEM for OPG's turbine units at Pickering Nuclear Generating Station ("PNGS"), providing on-going maintenance and technical support. [redacted]

[3] *2011 industry data indicates Alstom has a market share of 30%, Siemens 23%, and GE 15%.*

[4] *Electric Power Research Institute (EPRI), 2010 Technical Report on Large Steam Turbine Component Retrofits and Replacements: Lessons Learned*

6.0 CONTRACTING ALTERNATIVES ANALYSIS

6.1 Work Packaging for Contracting Purpose

The Project Team considered the following two work packaging options for contracting purposes:

- Option 1: Unbundle the total SOW by scope (i.e. equipment/component or labour and materials) or type of work (i.e. Engineering, Procurement or Construction); and
- Option 2: Bundle all TG work as one package.

A summary of the analysis completed are included in Appendix A. Under Option 1, based on the nature of the vendor, the Project Team determined that the lowest level of unbundling technically feasible is to divide the Project by equipment/component into the five phases identified in Section 2.1. Although Option 1 provides the opportunity for OPG to increase the number of potential vendors to bid on the separate scope items with more leverage for OPG to obtain better contract terms and prices, it introduces substantial risks in several key areas which may prevent OPG from meeting the Project and DR objectives, increased technical and project management challenges. These include extensive in-house integration and monitoring efforts (i.e. coordination, scheduling, contract management, etc.), significant increase in equipment compatibility issues and overall inefficiencies with the lack of a single point of accountability.

The Project Team recommends proceeding with Option 2. Contracting all TG work as one package under Option 2 not only minimizes the work effort required for OPG, it provides greater confidence of seamless integration of equipment with overall vendor quality management and sharing of risks with the single point of accountability which will be essential given the expected regulatory scrutiny that the Project would likely be subject to.

Work packaging under Option 2 is also supported by industry research prepared by the DN STEC Upgrade Project team in 2010 (OPEX Report NK38-REP-64000-10001: DNGS Steam Turbine Controls Retrofit). The research, based on a review of a number of Electric Power Research Institute Reports and direct OPEX enquiries from eight utilities in Canada and the US, which completed similar controls retrofits stated: "The strategy during the planning stage of such a complex project should be to use the same vendor for turbine, generator, and electro hydraulic governor if possible to facilitate easy interface and reduce risks. If not, the interfaces have to be very well-defined and understood prior to design and implementation."

6.2 Contracting Model

To maintain alignment with the overall contracting framework that has been adopted for the DR Program, the Project Team examined the following contracting models for this Project:

- Option 1: Traditional Design-Bid-Build
- Option 2: Design-Build or EPC
- Option 3: Turnkey

Based on analysis of these contracting models as summarized in Appendix B, the Project Team recommends proceeding with Option 2. Under Option 2, an EPC contract would facilitate efficient scoping, planning, and execution, consistent with timing and scheduling considerations for the DR Program. This model minimizes the number of vendor interfaces and hand-offs while assigning a "single point of accountability" for Project execution. The other two options were not considered viable because of the extensive integration efforts required in this Project.

6.3 Sourcing Strategy

The next decision point is around the sourcing approach to be adopted for this Project. Other vendors have no design basis knowledge of the Darlington TG sets. A 2006 competitive process for replacement of the last state of turbine blades at Darlington did not yield a viable proposal from a non-OEM vendor due to limitations in critical/key machine boundary conditions only known to the OEM. The non-OEM vendor had to make significant assumptions and factor in a number of technical constraints. To consider non-OEM vendors, OPG would need to obtain Intellectual Property ("**IP**") rights from OEM Alstom to make the information available to the other vendors or the other vendors will need to either reverse engineer, or completely re-design the components in order to complete all the repairs, replacements and controls upgrades. The table below provides a summary provided by Faithful+Gould Inc. ("**F&G**"), an engineering consultant hired by OPG, in respect of the potential additional costs associated with obtaining the design basis information to facilitate a competitive sourcing strategy.

Figure 3: Additional Estimated Costs Associated with Obtaining Design Basis Information for Competition[5]	
Obtaining IP Rights for Design Basis information from OEM:	
• Restricted[6]	$22.9 M to $39.1 M
• Unrestricted (allows for manufacturing and sale of components)	$40.5 M to $62.1 M
Reverse Engineering[7]:	
• Additional work to allow Reverse Engineering	$11.7 M to $39.0 M (min. for 1 unit to max. for 4 units)
• Reverse Engineering – including Controls (vendor costs only, excludes OPG internal costs)	$14.6 M to $22.5 M

The report identified that although most components can now be reverse engineered, OEM specific work areas for the Turbine, Generator and Excitation Controls SOW include controls logic, hydraulics, and system integration where extensive work technical specification and engineering work with a high level of complexity is required. Empirical evidence in F&G's analysis suggests that success to first-time-right quality remains limited which may result in higher potential risks, additional costs and delays in the Project schedule. The Koeburg Nuclear Power Station is an example of a turbine reverse engineering activity which resulted in dependability problems; the unit was in service for ten months before the failure occurred and investigation identified shortcomings in the reverse engineering process and material receiving process.

[redacted]

[5] *F&G, OPG Darlington Refurbishment IP and Reverse Engineering Report (February 2012)*

[6] *Restricted IP Rights are limited to provision of outline Operating and Maintenance drawings showing general arrangements of equipment and exploded views but not material specifications, detailed clearances and technical specifications.*

[7] *Reverse Engineering describes the practice of determining material make-up and dimensions of an existing part and using that information to design and manufacture a replacement part.*

Based on the above cost estimates, a competitive sourcing strategy may add approximately 5% - 12% additional costs to the overall Project to obtain the necessary design basis information. There may also be additional increase in internal costs and efforts which have not been quantified. Given the value for money considerations and DR Program objective to minimize the impact on existing units, the Project Team decided that the best sourcing strategy is to initially approach Alstom with the full SOW and endeavour to negotiate appropriate contract terms, while in parallel embarking on preparatory activities respecting other sourcing alternatives. With this approach, if negotiations with Alstom are unsuccessful, OPG will be able to minimize impact on the Project schedule and continue pursuing other sourcing alternatives, including engaging other vendors in a competitive process.

7.0 RECOMMENDED CONTRACTING STRATEGY

Based on the Contracting Alternatives Analyses in Section 6.0, the Project Team recommends the following contracting strategy:

Plan A – Initial Negotiations with OEM

As an initial step, OPG will bundle the whole TG work into one package and engage OEM Alstom in negotiations for an EPC contract. As evidenced in the information provided in Section 6.0 above, this approach appears to be the most optimal approach that allows OPG to obtain value for money based on the lowest operational risk and lowest project cost. This approach also appears to best align with the DR program objectives of long-term reliability and maintainability of the equipment, with reliable performance and lower production costs. The basis of selection for the Plan A is also validated through in a facilitated workshop using the Kepner-Tregoe ("**KT**") Decision Analysis[8] tool as outlined in Appendix C. In summary:

- Bundling of the whole TG work into one package for contracting purposes offers the best opportunity for a successful project from cost, schedule, and quality perspectives given the high level of integration required between the various work phases for this Project. It is assessed qualitatively that the potential benefits from bundling will outweigh the potential cost savings that may be derived from piecemealing the work for contracting purposes. This approach is also recommended by industry OPEX.

- The Design-Build (EPC) contracting model offers the most balanced approach for the whole TG work with the best opportunity for a successful project from cost,

[8] *Kepner Tregoe Decision Analysis tool is a structured methodology for gathering information and prioritizing and evaluating it. It was developed by Charles H. Kepner and Benjamin B. Tregoe in the 1960s. This is a rational model that is well respected in business management circles. An important aspect of Kepner-Tregoe decision making is the assessment and prioritizing of risk.*

schedule, and quality perspectives with a single point of accountability and sharing of risks.

- Engaging the OEM as an Initial Step is a prudent decision from a value for money, Project and operational risks perspectives given the additional costs associated with obtaining the design basis information to facilitate competition, increased internal resource commitments and the potential equipment compatibility issues. Alstom as the OEM for OPG's TG sets at Darlington will have the ability to manufacture required parts in a reasonable time frame and OPG will be able to obtain spare parts with no extra-stocking or quality requalification requirements. Alstom has a good track record of field execution with OPG Nuclear and the nuclear industry, with significant experience in this type of work and presence in more than half of the world refurbishment market. The other two vendors under consideration for a bundled EPC contract should OPG engage in a competitive process would include GE and Siemens. GE has [redacted]

The negotiations strategy with Alstom will include a pre-defined set of negotiation objectives and key success factors, building on the key principles of accountability, transparency and value for money. This is outlined in the Darlington Refurbishment Turbine Generator Project Negotiations Plan (NK38-PLAN-09701-10096). OPG will maintain appropriate leverage in the negotiations with a defined timeline to complete negotiations and full disclosure of OPG's plans to engage in a competitive process if negotiations are unsuccessful.

In preparation for negotiations, the Project Team gathered available commercial OPEX for Alstom through discussions with internal OPG stakeholders across the organization that had past experience of negotiations and experience working with Alstom. Such stakeholder feedback provided the Project Team with an understanding of the key commercial terms that Alstom had provided or agreed to in previous competitive processes or single source purchases. OPG intends to negotiate a new agreement for the Project that will be comparable to an agreement successfully negotiated with Alstom in the past as a result of a competitive process and build in any lessons learnt from OPG's past experience with Alstom.

Negotiations are not a commitment to enter into an agreement. For OPG to engage Alstom in an EPC contract for the entire SOW, the proposed contract must achieve the pre-determined negotiation objectives including being commercially viable (i.e. value for money, transparency, appropriate allocation of risks, appropriate commercial terms, etc.). Should OPG contract the services of Alstom under Plan A, it would require a full single source justification in accordance with OPG-PROC-0058: Procurement Activities, and the appropriate levels of approvals mandated by OPG-STD-0017: Organizational Authority Register ("**OAR**"). The proposed timelines, key deliverables and due diligence associated with the proposed negotiation activities are outlined in Appendix D.

Plan B – Competitive Sourcing

The Plan B option involves OPG engaging in an alternate procurement process which involves competitive sourcing. This option will be invoked under the following possible scenarios in Plan A:

i. OPG is unsuccessful in achieving the desired negotiation objectives and goals;

ii. Either OPG or Alstom decides to cancel negotiations for any reason; or

iii. OPG's senior management does not approve the single source contract when negotiations are completed.

Under this plan, OPG will issue an Expression of Interest ("**EOI**") to potential vendors and will develop technical requirements/specifications for the Request for Proposals (**RFP**"). OPG plans to consider the available options in respect of procuring materials, equipment and services regarding the Project, and the intent of the EOI is to assist OPG to assess the market for such materials, equipment and services taking into consideration Project risks related to the scope, cost and schedule. OPG will use the information submitted by potential vendors in response to the EOI to prepare a proponents list and the RFP, review scope risk related to non-OEM vendors and determine if the OEM needs to be engaged for specific activities and/or supply of equipment on a selective single source basis. Vendors may express interest in the entire scope of the Project, or individual work scopes (i.e. any of the 5 scopes of work) that are suited to their experience, expertise or interest.

The Project Team will initiate activities associated with Plan B in parallel with Plan A. Work will continue to assess which equipment/component will require design basis or other information from OEM to unbundle the TG work to re-evaluate the SOW packaging for contracting purposes. These additional planning activities and adherence to the requirements in engaging in a transparent and fair competitive process in Plan B are expected to require 18 months of work effort. Details of the key deliverables and the TG Project schedule will be reassessed when Plan B is invoked to incorporate the timelines as outlined in Appendix E. Plan B is not expected to impact the critical path for the overall DR Program.

8.0 CHOICE OF PRICING MODEL

The Project Team recommends that the pricing models be different for the confirmed scope of the work [redacted] and the contingency scope of work [redacted]

For the confirmed scope, it is recommended that:

(a) The materials for the TG and Auxiliaries (including skids) and MSR to be done on a fixed price basis since the work will be essentially completed on the vendor's premises.

(b) If any interface engineering (e.g. Engineering Change Control ("**ECC**") type integration work) is required for the above work, then it should be managed through a cost reimbursable plus fixed-fee model. Another option may be to ask the vendor to provide a fixed price (based on the estimated work effort (in hours) × hourly labour rate) for the ECC integration work based on the various existing interface agreements that will be provided to the vendor.

(c) The inspection, analysis, and repair/overhaul work for TG and Auxiliaries at site to be based on a cost reimbursable, with a target price plus fixed fee model. The target price should be arrived at through an open book pricing approach.

(d) The engineering and supply portion of the Turbine Controls and Generator Excitation Upgrades to be done on a fixed price basis. The installation and testing work at site should be based on a cost reimbursable, with a target price plus fixed fee model. The target price should be arrived through an open book pricing approach.

(e) All types of commissioning support work to be priced on a cost reimbursable basis, as the level of uncertainty in scope is maximum for this portion of the work in the Project definition phase.

For the contingency scope of work, the Project Team recommends that any work accepted as confirmed scope from this bucket during Project execution should be package under fixed price and fixed schedule model. To achieve transparency and value for money, OPG should pursue an open-book contract with the vendor for full disclosure, cost transparency and build-in incentive/disincentive mechanisms around target costs to promote risk sharing. An open-book contract will allow OPG to work with the vendor to obtain visibility into each major cost item to reach a target price that reflects an appropriate risk profile for each party. This also provides OPG with an audit trail to mitigate regulatory risks associated with rate applications and the ability to retain information in planning future projects.

9.0 PROCUREMENT PROCESS PREREQUISITES/CONSIDERATIONS

The procurement process and negotiation strategy needs to effectively executed in order to obtain value for money and appropriate commercial terms. Approvals to enter into a contract will not be obtained unless value for money can be demonstrated.

The process includes the following stages:

- Stage I – Prepare for Negotiations
- Stage II – Conduct Negotiations
- Stage III – Complete the Commercial Agreement
- Stage IV – Obtain Approvals and Execute Agreement

Stage I - Prepare for Negotiations

The objective of Stage I is to prepare OPG to enter into negotiations with the OEM. At the end of this stage, OPG will be prepared to negotiate with Alstom and, in the event negotiations fail to achieve the desired objectives, to have a preliminary preparation/plan to initiate a competitive process. This stage will comprise of a number of activities largely executed in parallel.

Stage II - Conduct Negotiations

The objective of Stage II is to conduct the negotiations and arrive at a commercially acceptable agreement with appropriate commercial terms and pricing which meets technical requirements. The core activity will be the actual conduct of negotiations.

Stage III - Complete the Commercial Agreement

(Refer to Stage V if Stage II is unsuccessful)

On completion of successful negotiations, as measured against the negotiation objectives, the actual agreement will be completed and finalized. This stage will include OPG internal stakeholder reviews of the draft agreement to assess whether value for money has been obtained.

Stage IV - Obtain Approvals and Execute Agreement

OPG will prepare/complete required documents for review and approval in accordance with OPG-PROC-0058: Procurement Activities. The key documents will include:

- "Single Source Justification" Form
- "Major Contract Memorandum"
- "Recommendation for Submission to the Board of Directors Memorandum" (with supporting information)

Stage V - Subsequent Phase (if Stage II is unsuccessful)

If the negotiations do not succeed within the specified time frame, OPG will terminate the negotiations and pursue other procurement alternatives (i.e. re-package and issue RFP). An alternate procurement approach has the potential to considerably delay the Project schedule due to the associated engineering and technical requirements, and, as well, negatively impact multiple Project objectives identified earlier in this Report. The possible options and other positions that OPG may take, including off-ramps during negotiations, will be further developed and executed during this stage.

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

A bundled EPC approach to the TG work can be performed mostly in a stand-alone manner due to the following:

(a) The islanding approach plans to create a "fence inside the fence" for the TG machines;

(b) The areas can be easily geographically segregated; and

(c) Well defined termination points will be developed to define the limits of all the geographic segregation.

As the definition phase progresses further for all other DR Program projects, including for the Balance of Plant, integration issues will be reassessed.

11.0 KEY RISKS AND PROPOSED MITIGATION

Some of the key risks and proposed mitigation are:

(a) [redacted] In the event negotiations break off or become stalled, there is a significant risk to the TG Project in terms of schedule. The contract negotiations have to be carefully planned and managed. To focus the negotiation efforts, OPG has developed a Negotiation Plan (NK38-PLAN-09701-10096) which outlines the negotiation objectives in advance.

(b) [redacted] OPG has the final decision authority for scope and plans to implement a strict scope review and control process for deciding any additional scope inclusion from this group of work. OPG has knowledgeable people who can assess recommendations and determine work to be done prior to work proceeding.

(c) Engineering has confirmed that if the work goes to the OEM, it will only need functional specifications compared to the detailed technical specifications that will be required for a competitive scenario. Scope definition and technical requirements are expected to be further refined through discussions with Alstom under Plan A, which may reduce the incremental engineering work required if OPG has to engage in a competitive process under Plan B.

(d) Due to engineering and material lead times, the contract(s) need to be executed in early 2013 to meet an October 2016 start date for the Project. OPG will have to engage Alstom in active negotiations with a target date of completion that will

allow sufficient time for OPG to pursue a competitive process if negotiations are unsuccessful with Alstom to minimize the impact to the Project schedule. At this time, it is estimated that Plan B would require 15-18 months to accommodate the additional planning activities associated with reassessment of work packaging, technical engineering work and the competitive process. Depending on when Plan B is invoked, OPG may have to reassess the sequence of the DR Program project portfolio to delay the TG work to accommodate the additional efforts. The more the Project is delayed; the greater the impact on the level of scheduling contingency available for unexpected work for this Project. Also, OPG will have reduced leverage when negotiating a contract with other vendors given the time constraints.

(e) Under Plan B, successful proponents will be expected to work with the Alstom equipment. There is a risk that potential vendors may be unwilling to participate in the competitive process due to reluctance to work with a competitor or utilize a competitor's products OPG will consider leveraging any existing master agreements and will need to proactively manage the relationships with the vendors involved to mitigate this risk.

(f) Lack of project resources for the TG work to execute the contracting strategy – this lack of resources spans across Engineering (impacting preparation of specifications/SOW required for issuing RFP), and Execution. There is a high probability that this will have a direct impact on the contract award timeline.

12.0 SUCCESS CRITERIA/KEY PERFORMANCE INDICATORS

The following are the criteria of success for the proposed contracting strategy: (i) OPG successfully awards appropriate terms and for the SOW; (ii) the awarded terms and conditions incorporate OPG's core business values of accountability, transparency and value for money, taking into account the overall DR Program objectives to maintain OPG control, minimize impact on existing units, achievable schedule and budget and the appropriate allocation of risks as outlined in the DR Program Commercial Strategy (NK38-REP-00150-10001).

13.0 IMPLEMENTATION PLAN

The implementation plan has been incorporated into Section 9.0 of this document.

REFERENCES

[R-1] EPRI 2010 Technical Report, "Large Steam Turbine Component Retrofits and Replacements: Lessons Learned

[R-2] Project Charter: Steam Turbine Electronic Controls Upgrades dated July 10, 2008

[R-3] Project Charter: Main Generator Excitation Controls Replacement dated March 7, 2007

[R-4] Project Business Case Summary: Steam Turbine Electronic Controls Upgrades dated January 26, 2009

[R-5] TG Controls Upgrade: Overview of Level 1 logic/schedule dated September 9, 2010

[R-6] Draft Basis of Estimate: Turbine Generator Controls Upgrade dated March 2, 2010

[R-7] DNGS Turbine Generator Controls Upgrade Project Vendor Assessment Report dated January 27, 2010

[R-8] DNGS Steam Turbine Controls Retrofit OPEX Report dated December 7, 2009

[R-9] Turbine Generator Controls Upgrade Value Engineering Study Report dated March 26, 2010

[R-10] Darlington Scope Request Forms for Turbine Generator dated May 5, 2011-06-24

[R-11] White Paper – Turbine Generator Refurbishment Strategy dated April 7, 2011 (NK38-REP-09701-10017)

[R-12] White Paper – Refurbishment Island Strategy dated February 10, 2011 (NK38-REP-09701-10005)

[R-13] White Paper – Shutdown, Layup, Commissioning, and Startup Strategy dated March 11, 2011 (NK38-REP-09701-10015)

[R-14] Various internal meeting minutes and OPEX reports

[R-15] Turbine Generator Lessons Learned items and attachments from DR DOLLAR database

[R-16] Darlington Refurbishment Turbine Generator Project Negotiations Plan (NK38-PLAN-09701-10096)

[R-17] OPEX, COG Screened Events Database no. 41053, WANO MER ATL 07-297, "Generator Cooler Bellows Failure Causes Unit Turbine Trip", Koeburg, 2007-07-17.

Appendix A: Analysis of Work Packaging for Contracting Purpose

The Project Team considered two work packaging options in the TG Project for contracting purposes:

- **Option 1:** Unbundle the total SOW
- **Option 2:** Bundle all TG work as one package

Under Option 1, the scope of work can be unbundled by equipment/component, labour and materials, or type of work. Based on the nature of the vendor market, the Project Team determined that the lowest level of unbundling technically or practically feasible is to divide the Project by equipment/ component as per the five phases identified in Section 2.1.

- Separating by type of work for this SOW does not seem ultimately beneficial from a contracting perspective. For example, there are a number of vendors in the market able to do inspections but the majority of the inspections work can only be carried out during refurbishment (i.e. with machines dismantled). The cost/complexity of bringing in multiple vendors to work on the same equipment at the same time may outweigh the perceived benefit from the independence of accountabilities for the inspection vs. repair/replace parts of the SOW.

- Unbundling by labour and materials may introduce the option to award contracts to vendors with core expertise in the respective labour areas (e.g. firms specializing in design/engineering can be awarded that piece of work, firms expert in installation can be awarded that piece of work etc). This approach may also enable OPG to have flexibility in the materials procurement strategy e.g. conduct procurement directly from the OEM for the most critical components and explore the market for the best pricing and availability for other parts. However, the Project Team determined that this is not the most preferred option to unbundle the SOW as it would transfer a large burden of project management and scheduling risks to OPG.

Legend:	Increased risks to achieving objectives ⬆	Decreased risks to achieving objectives ⬇

Details of the analysis for the two work packaging options are outlined in the table below:

Project Objectives[9]	Option 1 Unbundle the total SOW by equipment/component	Option 2 Bundle all TG work as one package	Supporting Information
Minimize risks to project execution and scheduling:	⬆	⬇	Unbundling will result in increased risks in the following: • Unbundling may result in multiple contracts with different vendors, with many interfaces which will increase complexity around management of the overall TG Project. • Technical integration with different vendors for hardware and controls. • Compatibility for turbine-generator and excitation controls which interfaces with a large number of field devices, components within hydraulic system, and excitation power system. Configuration management and corresponding level of effort needed to mitigate this risk usually increases with increasing number of vendors for an equipment group like TG.
Maximize value for money	⬇	⬆	Bundling will result in fewer potential bidders with less opportunity to drive more competitive costs through rates and burdens whereas unbundling will introduce the opportunity for innovation, especially for Controls.
Minimize risk to ongoing operability after refurbishment	⬆	⬇	Unbundling will result in more interfaces, technical and process differences between vendors, increasing the risk of equipment compatibility and reliability issues. TG's are critical components for nuclear generation and unplanned outages can cost OPG up to $52 K in lost generation per hour.
Ensure accountabilities for deliverables is clear	⬆	⬇	Unbundling will increase the number of interfaces and integration issues with the lack of a single point of accountability. Under a bundled approach, the accountability for scheduling, integration and coordination are largely transferred to the vendor who can be held responsible for the overall deliverable.
Allows OPG to maintain oversight	⬆	⬇	Unbundling increases OPG's effort level in contract and project management to monitor vendor quality and compliance with multiple contracts, different quality programs, etc.

[9] *Results of the assessment highlighted if the option would result in an increased/decreased risk associated with the achievement of the desired objectives.*

Project Objectives[9]	Option 1 Unbundle the total SOW by equipment/component	Option 2 Bundle all TG work as one package	Supporting Information
Maximize transfer of risk to vendor	⬆	⬇	Unbundling may result in several contracts with potential EPC variations. Integration issues may also transfer additional risks back to OPG. Under the bundled approach, the vendor will be responsible for interface, integration, scheduling and coordination. As such, the vendor can be largely held accountable for the overall quality of the project deliverables. This is important given the expected increased regulatory scrutiny associated with the complexity of this Project.
Minimize changes to maintenance, training practices post refurbishment	⬆	⬇	Unbundling may result in multiple contracts with different vendors. There will be variations between the vendors in the integration and configuration of the TG components which may require increased training efforts and significant changes to maintenance and training practices post refurbishment
Minimize level of resources (staff) required by OPG	⬆	⬇	Unbundling increases OPG effort level in contract and project management to monitor vendor quality and compliance with multiple contracts, different quality programs, etc.

Recommended Work Packaging Approach: Based on the analysis, the Project Team concluded that the best approach for packaging the scope of work for contracting purposes is Option 2, to "Bundle all the TG work as one package".

Appendix B: Contract Model Analysis

	PROS	CONS
OPTION 1: Traditional Design-Bid-Build ➢ Serial sequence of design and construction phases ➢ Procurement begins with construction ➢ OPG contracts separately with designer and constructor; retains overall project management responsibility, including project oversight	▪ Ability to leverage the competitive bid process with an increased supply base for each phase of work ▪ Ability to leverage vendor capabilities (e.g. vendors expert in installation may be considered only as the pool for the installation work) ▪ Lower direct cost contracting option, with OPG responsible for the quality control and quality assurance functions	▪ It is difficult to separate detailed design/engineering and manufacturing phases because of large inherent design risk. There is limited ability to address constructability issues in the design. In this approach, the entire design risk is retained by OPG ▪ Does not support exploring the potential of long-term maintenance arrangements with any one vendor ▪ Maximizes numbers of interfaces and number of contracts which potentially nullifies the benefits expected from bundling of the work for contracting purposes ▪ Inability to have a reliable cost and schedule estimate upfront; maximum schedule requirement with potential escalation of costs due to long schedule ▪ Procurement approach may directly impact timely availability of long-lead items ▪ For the Controls upgrade part, detailed technical specifications instead of functional specifications will be required for establishing separate construction contracts ▪ As OPG retains most of the risks (i.e. quality, costs and schedule), additional contingency and resources must be put in place due to the complexity in the nature of the work when dealing with multiple vendors

	PROS	CONS
Option 2: Design-Build or EPC ➢ Overlapped sequence of design and construction phases ➢ Procurement begins during design ➢ OPG to enter into one contract with a contractor for overall project (i.e. coordination, detailed design and engineering, manufacture and supply or selection and procurement of equipment/components, installation, testing and commissioning or commissioning support)	▪ Shortest schedule because of concurrent design and construction activities ▪ Greater potential for up-front cost certainty ▪ Ability to transfer risks around cost (and to some extent, schedule) to contractor ▪ Provides maximum flexibility in terms of initiating procurement of long lead items in a timely manner ▪ Minimizes internal staffing requirements for monitoring and due diligence. ▪ Facilitates the quality management aspect with single point of accountability.	▪ Higher cost because of risk transfer and contingencies carried by the contractor ▪ Failure to properly prepare specifications may leave OPG exposed to increased costs associated with "extras" (e.g. engineering changes midstream). ▪ Level of OPG involvement in design must be clearly specified in details and managed accordingly.
Option 3: Turnkey ➢ Overlapped sequence of design and construction phases ➢ Procurement begins during design ➢ OPG provides performance specifications and the contractor has a wide discretion as to how to it can satisfy the requirements. There is no design review	This option was not analysed in detail because: ▪ As OPG is the General Contractor, it does not make logical sense to have pieces under the Program set up as Turnkey. ▪ Anticipated transition challenges as highlighted in OPEX Report NK38-REP-64000-10001 R000: Efforts by Operators to issue Turnkey contracts have resulted in significant problems for Controls Upgrade Projects (large risk of a "black box" transferred to OPG resulting in undesired learning curve events with significant economic losses). Experiences tend to support that involvement of in house staff from the start to finish side-by-side OEM/vendor was considered crucial to the success of the projects.	

Recommended Contracting Model: Based on the analysis, Option 2 – EPC Model is selected as the best approach for the TG Project.

Appendix C: KT Analysis

Decision Analysis Executive Summary Report

Select the best contracting option to implement (engineer, procure and construct) the Turbine Generator Refurbishment Project identified scope of work.

Decision Background

As part of the Refurbishment Project at Darlington there will be number of work packages prepared and executed to ensure that the turbine generator sets (TG) operate efficiently and effectively until end of life (additional 30 years). The original company is no longer servicing the industry but the original design basis information and associated intellectual property has passed through an intermediary company and is now resident with a single vendor which currently provides engineering and maintenance support to Darlington.

Decision Analysis Team

Name	Company	Team Member Role	Team Member Expertise
neill allen	KT	Facilitator	Commercial Strategy
Chatterjee, Deepa		Content expert	Commercial Strategy
Craig, Dale		Content expert	Engineering
Jouhovski, Todd		Owner	Project Manager
Woodward, Nancy		Content expert	Commercial Strategy
Nelson, Andrew		Content expert	Supply Chain
Soares, Silvia		Content expert	Supply Chain
Prokopetva, Evgenia		Content expert	Legal Issues
Charterson, Ron		Content expert	Ops and Maintenance
Allen, Neill		Facilitator	Commercial Strategy

Decision Statement

Select the best contracting option to implement (engineer, procure, construct) the identified scope of work for the Darlington turbine generator sets.

Must Objectives	Measures
Must not compromise current OPG policy for procurement	Meet OPG governance
Meet Technical Requirements	As per OPG approved technical specifications
Meet Quality Requirements	As per PO (tech specs plus source surveillance etc. to satisfy that vendor application of their Quality Program satisfies OPG requirements for permanent plant components. Vendor must be (or capable of qualifying) on OPG Approved Supplier List.

Decision Analysis Executive Summary Report

Select the best contracting option to implement (engineer, procure and construct) the Turbine Generator Refurbishment Project identified scope of work.

Want Objectives	Measures	Weights
Minimize risk to project execution and schedule(three phases of engineering, procurement and manufacturing and field execution and commissioning.)	Development of engineering requirements Duration of procurement process Complexity of execution phase Ability to integrate with other work	10
Maximize value for money (cost element)	Total cost for refurbishment to OPG (internal and external expenditures)	9
Make decision transparent	Demonstrate open and fair process	8
Minimize risk to ongoing operability after refurbishment	Vendor ability to minimize manage changes	7
Ensure accountability for deliverables is clear (risk element)	Minimize number of hand offs and interfaces	7
Enable contractor procurement	Remove any impediments from contractor process	6
Allows OPG to maintain oversight	By monitoring quality program, project task completion	5
Maximize transfer of risk to vendor	Clarity on EPC accountabilities	5
Maximize value for money (pre refurb outages impact for inspection by non OEM)	Pre refurbishment outage impact for additional inspections and preparations due to lack of access to original design information.	4
Minimize changes to maintenance, training practices post refurbishment.	Vendor ability to minimize manage changes.	4
Demonstrate open process for selection of vendors	Provides sufficient records, documents to support an audit.	3
Minimize future dependency on single sourcing	Develops alternative supply sources	3
Minimize level of resources (staff) required by OPG	Number of interface points in processes and deliverables	2

Alternatives Considered

Unbundled scope (5 packages), competitive bid process.
Bundled scope, sole source process (OEM).
Bundled scope, competitive bid process.
Unbundled scope, selective sole source and competitive processes.

Recommended (or Selected) Alternative

Bundled scope, sole source process (OEM).

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Decision Analysis Executive Summary Report

Select the best contracting option to implement (engineer, procure and construct) the Turbine Generator Refurbishment Project identified scope of work.

Risks Associated with the Recommended (or Selected) Alternative(s)

Alternative: **Bundled scope, sole source process (OEM).**

Risks (If...)	Probability	Adverse Consequences (Then...)	Seriousness
The single source vendor goes out of business	L	Delay to project while new procurement process is entered into. Possible higher costs.	H
OPG cannot negotiate an acceptable contract with vendor	L	Delays to award of contract and project schedule. Potential to have to repeat procurement process with new vendors. There would be some internal cost increases and potential project cost issues if work has to be expedited.	H
Risks (If...)	**Probability**	**Adverse Consequences (Then...)**	**Seriousness**
The vendor refuses to transfer intellectual property	H	Future maintenance and modification options are limited unless OPG future needs are captured in contract terms and conditions	M
We do not use a competitive bid process then there could be a challenge to OPG's contracting strategy by external stakeholders. (supply chain process challenged)	M	There could be delays to award of contract if process review requested.	M
The vendor increases the contingency scope (due to their influence over the entire project).	L	Schedule and cost increase above estimate	M
Risks (If...)	**Probability**	**Adverse Consequences (Then...)**	**Seriousness**
We do not use a competitive bid process then there could be a challenge to OPG's contracting strategy by external stakeholders. (cost recovery allowance challenged)	H	Rate approval and full cost recovery may be denied at a future date.	L
OPG's reputation for open and fair treatment of vendors is challenged	L	Increased scrutiny of OPG Supply Chain processes.	L

Decision Analysis Executive Summary Report

Select the best contracting option to implement (engineer, procure and construct) the Turbine Generator Refurbishment Project identified scope of work.

Actions and their Status

Best Choice Alternative: **Bundled scope, sole source process (OEM).**

Action	Who	By When	Status	Notes
Prepare recommendation cover letter to go with Contracting Strategy and ET analysis to executive team	Woodward, Nancy	2/29/12	In Progress	

Summary

Record Name

Select the best contracting option to implement (engineer, procure and construct) the Turbine Generator Refurbishment Project identified scope of work.

Knowledge Management Code

OPG

Record Created

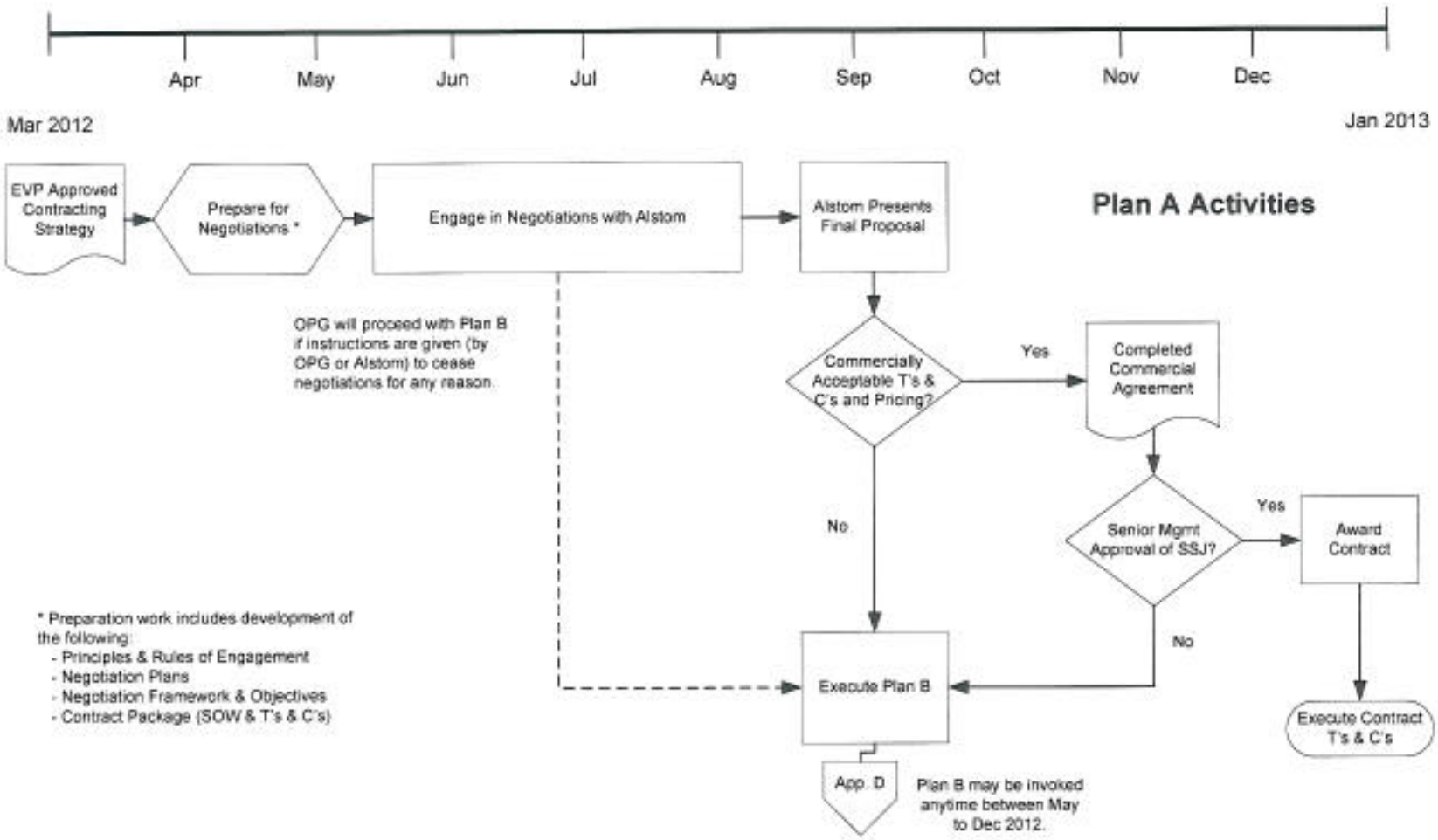
02/02/2012

Benefits

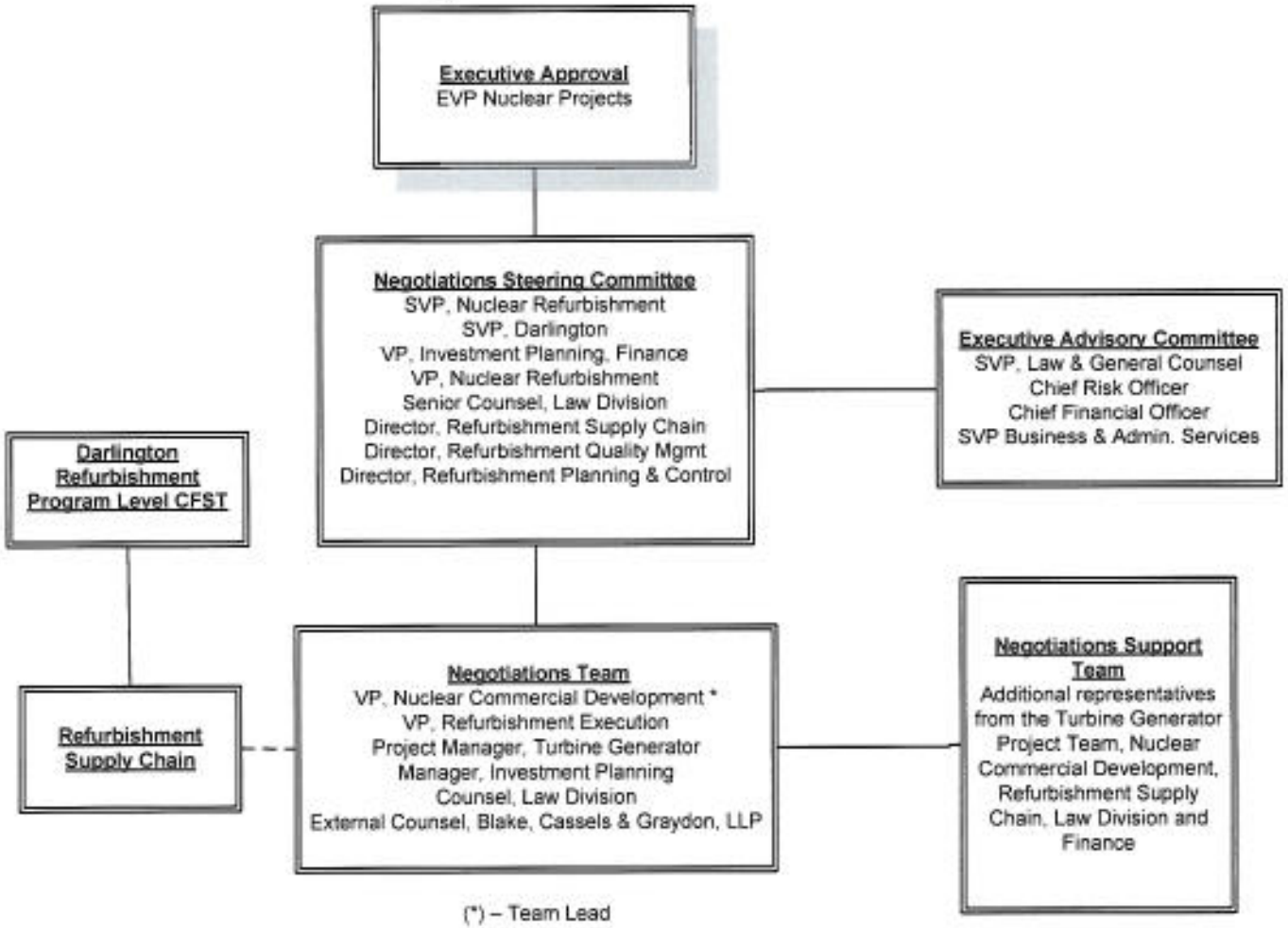
Lessons Learned

Closeout Notes

Appendix D: Plan A – Initial Negotiations with OEM

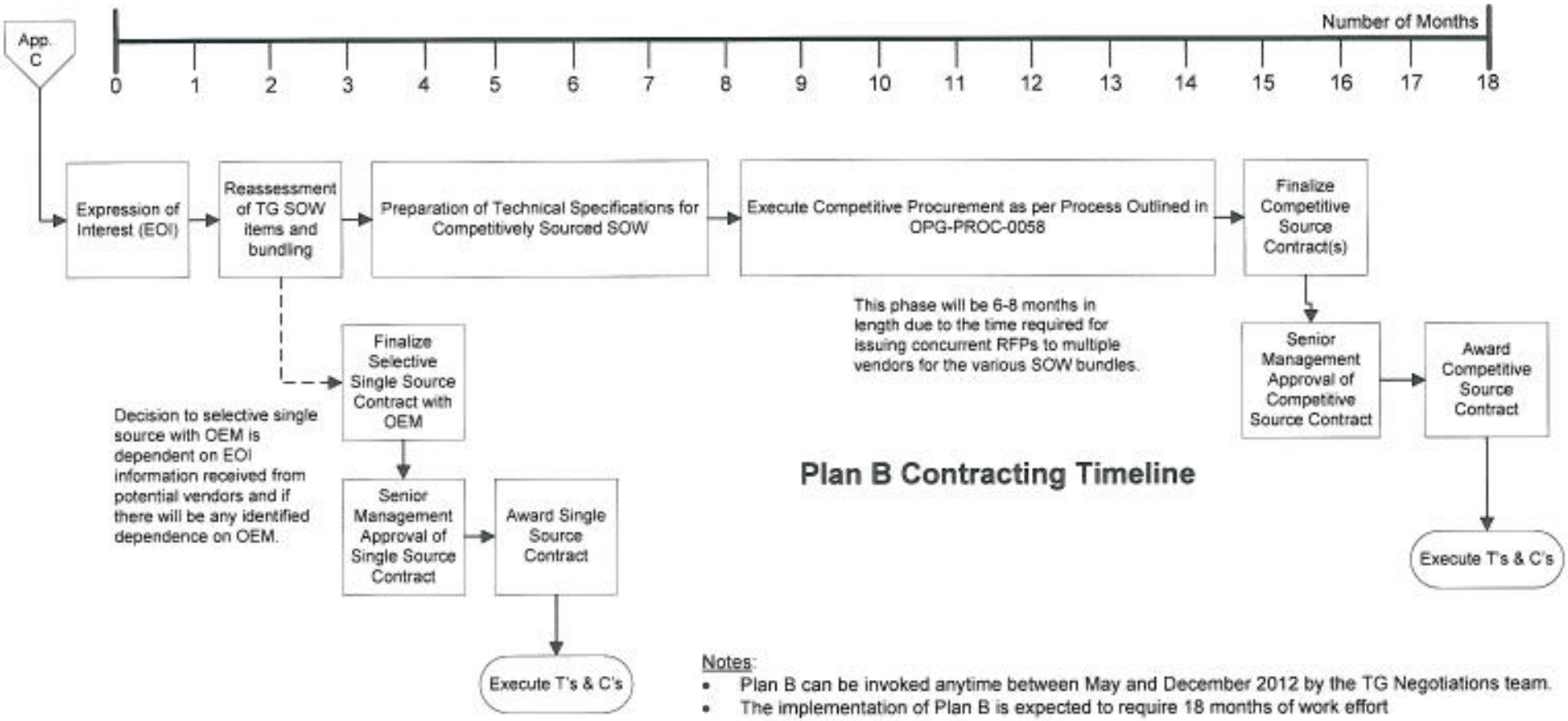


Plan A – Negotiation Team Structure



(*) – Team Lead

Appendix E: Plan B – Competitive Sourcing



Plan B Contracting Timeline

Notes:

- Plan B can be invoked anytime between May and December 2012 by the TG Negotiations team.
- The implementation of Plan B is expected to require 18 months of work effort