



**ASSESSMENT OF COMMERCIAL STRATEGIES  
DEVELOPED FOR THE DARLINGTON REFURBISHMENT  
PROJECT'S TURBINE GENERATORS WORK PACKAGE**

**PREPARED FOR ONTARIO POWER GENERATION**

**SEPTEMBER 2013**

**TABLE OF CONTENTS**

<b>I.</b>	<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>II.</b>	<b>SUMMARY OF CONCLUSIONS.....</b>	<b>2</b>
<b>III.</b>	<b>STANDARD OF REVIEW .....</b>	<b>2</b>
<b>IV.</b>	<b>INFORMATION SOURCES.....</b>	<b>3</b>
<b>V.</b>	<b>GENERAL LIMITATIONS OF CONCENTRIC'S OPINION .....</b>	<b>3</b>
<b>VI.</b>	<b>TURBINE GENERATORS WORK PACKAGE COMMERCIAL STRATEGY.....</b>	<b>5</b>
<b>VII.</b>	<b>CONCENTRIC'S OBSERVATIONS AND RECOMMENDATIONS.....</b>	<b>10</b>
<b>VIII.</b>	<b>CONCLUSIONS .....</b>	<b>13</b>



## I. EXECUTIVE SUMMARY

On September 9, 2011, Tory's LLP retained Concentric Energy Advisors, Inc. ("Concentric") to review the commercial strategies and contracts developed and implemented for the refurbishment of four CANDU heavy water reactors at Ontario Power Generation, Inc.'s ("Ontario Power Generation's" or the "Company's") Darlington Nuclear Generating Station ("Darlington" or the "Plant").<sup>1</sup> The Darlington Refurbishment Project (the "Project") will include the removal and replacement of the reactor calandria tubes and pressure tubes from each reactor, the replacement of all feeders, the refurbishment of the existing fuel handling equipment, the refurbishment of the existing turbine generators (referred to herein as the "Turbine Generators work package"), and the refurbishment of the existing steam generators, among many other tasks. The plant modifications are currently planned to be made during overlapping 36-month outages for each of the four Darlington units between October 2016 and 2024.<sup>2</sup> However, the Company is currently conducting an evaluation of the business case for un-lapping the refurbishment execution of the first two units. Under this scenario, the first refurbishment outage would be conducted on Unit 2 between Fall 2016 and Fall 2019. The remaining outages will occur between Fall 2019 and Fall 2025 with approximately 17 to 19 months of overlap between each successive outage. The Company expects to reach a decision on whether to proceed with this revised Project calendar in November 2013.

Prior to commencing the execution phase work, Ontario Power Generation has committed to undertaking significant planning activities, which include working to develop and implement appropriate commercial strategies for the Project, to better prepare for a project of this magnitude. Concentric was engaged to review the Company's commercial strategies and how these strategies are being implemented. This report summarizes Concentric's review and opinion of the current Turbine Generators work package commercial strategy.

The Project is following a standard megaproject progression that includes the following phases: (1) project initiation; (2) definition; (3) execution; (4) commissioning; and (5) project closeout. In the project initiation phase, a project is evaluated for its initial feasibility based on relatively high-level information that is readily available. Should a project prove feasible during the project initiation phase, it will proceed into the definition phase. During the definition phase, the project team undertakes more detailed reviews of the project's anticipated scope, cost, and schedule to begin to define the activities that must be completed during the project, when those activities must be completed, and how much those activities are expected to cost. Concurrently, the project team begins to define the commercial strategies expected to be employed. Later during the definition phase, the project team is responsible for: (1) identifying, procuring and fabricating all long lead materials, components and tooling; (2) executing all of the necessary agreements to proceed with the major work packages; (3) completing the detailed scope and project schedule; and (4) developing a "release quality" cost and schedule estimate from which the project's performance can be measured. The release quality estimate and the integrated schedule available at the conclusion of the definition phase are more defined than prior iterations of the cost estimate and integrated schedule, yet both still contain uncertainty. Following the definition phase, a project enters the execution phase during which the actual plant modifications will take place. This stage is followed by the commissioning and project closeout phases.

---

<sup>1</sup> As used in this context, commercial strategies refers to the processes by which Ontario Power Generation will procure goods and services for the Darlington Refurbishment Project.

<sup>2</sup> As a practical matter, initial planning for the Project began in 2006 with the initiation of feasibility studies and plant technical assessments. Thus, from the Project's initiation to closeout, the Project will span nearly 20 years.



During these phases, the project team brings the project online and completes all of the recordkeeping associated with the project.

The initiation phase of the Project began in late 2007 with the preparation of a business case that evaluated, at a high level, the overall feasibility of completing the Project. In November 2009, the Project sought and received authorization from the Ontario Power Generation Board of Directors to proceed with the planning portion of the definition phase. In February 2010, the Ministry of Energy concurred with the Board of Directors' decision. To execute the work, Ontario Power Generation will retain multiple contractors for discrete portions of the Project work known as work packages. Consistent with this approach, Ontario Power Generation has proposed dividing the work into multiple major work packages, of which the Turbine Generators work package is one.

As part of that process, the Company is currently pursuing contracts with qualified vendors for two separate scopes of work related to the Turbine Generators work package. The first scope of work, for Engineering Services and Equipment Supply, has been negotiated on a single-source basis with Alstom, the Original Equipment Manufacturer ("OEM"). The remaining scope, which will primarily involve additional engineering and on-site construction, is being pursued through a bundled, reduced-scope Engineering Procurement and Construction ("EPC") arrangement sourced through a competitive process that began in May 2013. Throughout the balance of this phase of the Project, the Company and its vendors will complete planning and design for the Turbine Generators work packages, execute project agreements, and develop a release quality cost estimate, among many other activities.

## **II. SUMMARY OF CONCLUSIONS**

As discussed below, Concentric concluded that, based on activities that have taken place between late 2009 and August 1, 2013, the commercial strategy Ontario Power Generation is employing for the Turbine Generators work package is appropriate and reasonable and meets the regulatory standard of prudence.

Concentric's opinion is not without certain caveats and limitations, which are discussed in the sections that follow. Similarly, the basis for our opinions are described throughout the remainder of this document.

## **III. STANDARD OF REVIEW**

To conduct our review of the commercial strategy selected by Ontario Power Generation for the Turbine Generators work package, Concentric sought to answer three primary questions:

- 1) Is the commercial strategy selected by Ontario Power Generation for the Turbine Generators work package reasonable?
- 2) Is the Company executing that commercial strategy in a reasonable manner?
- 3) Do the selected commercial strategy and the execution of that strategy meet the regulatory standard of prudence?

To answer these questions, Concentric adopted a definition for the regulatory standard of prudence based on Concentric's work before state, provincial and federal energy regulators in both Canada and the United States. The definition utilized by Concentric is consistent with decisions rendered by the Ontario Superior Court of



Justice,<sup>3</sup> the Court of Appeal for Ontario,<sup>4</sup> the Ontario Energy Board,<sup>5</sup> and the U.S. Supreme Court,<sup>6</sup> among other jurisdictions. Specifically, Concentric defined the prudence standard as examining the range of actions that a reasonable manager would take given the facts or circumstances that were known or knowable at the time of the decision or action. That definition rejects the use of hindsight as a basis for determining the prudence of a decision or action. In addition, that definition relies on an evaluation of decisions or actions. Project costs are neither prudent nor imprudent; instead, costs are prudently or imprudently incurred as a consequence of the decisions and actions of management.

In this report, Concentric provides its assessment of the Company's development and execution of its commercial strategy for the Turbine Generators work package in the context of the above-described standard of prudence review. In particular, Concentric is providing its opinion on the prudence and reasonableness of Ontario Power Generation's decisions to:

- 1) Initially concentrate its efforts on a single-source EPC agreement with the Turbine Generator OEM for the full scope of work ("Plan A");
- 2) Transition to an alternative, "Plan B," contracting strategy; and
- 3) Concentrate its efforts on a bundled, reduced scope EPC-style arrangement with a single vendor through a competitive process, but with considerable involvement of the OEM in an "Engineering Services and Equipment Supply" arrangement.

These decisions are discussed in greater detail in the sections that follow.

#### **IV. INFORMATION SOURCES**

Our review and the development of our opinions relied on three primary information sources. First, Concentric submitted multiple rounds of data requests for information related to the Turbine Generators work package. Second, Concentric performed independent research on topics including lessons learned and the experiences of other CANDU operators performing similar projects, the Canadian nuclear safety regime, and industry trends and practices for other large nuclear refurbishment projects that included major modifications to turbine generators. Third, Concentric conducted in-person and telephone interviews with members of the Turbine Generator refurbishment project team.

#### **V. GENERAL LIMITATIONS OF CONCENTRIC'S OPINION**

The following are general limitations regarding the scope of our review:

---

<sup>3</sup> 2005 CanLII 4941 (Ont. Div. Ct.).

<sup>4</sup> Court of Appeal for Ontario Decision, Docket: C55602, C55641 and C55633, June 4, 2013.

<sup>5</sup> Decision with Reasons, RP-2001-0032, December 13, 2002. This Decision deals with Enbridge Gas Distribution Inc.'s (formerly Enbridge Consumers Gas or ECG) application for a Board Order approving rates for the 2002 Test Year.

<sup>6</sup> Separate, concurring opinion of Justice Louis Brandeis, *Missouri ex. Rel. Southwestern Bell Telephone Co. v. Public Service Commission*, 262 U.S. 276 (1923).



- First, our review is limited to Ontario Power Generation's actions and documents prepared between late 2009 and [August 1, 2013].<sup>7</sup> Concentric did not review Ontario Power Generation's actions related to the Project prior to or after that time period.
- Next, Concentric did not independently verify the appropriateness, sufficiency, or correctness of the project schedules, cost estimates, scope, or, from an engineering perspective, the division of responsibilities. However, Concentric was informed of the processes used to develop these items, and we reviewed assessments from outside experts that were engaged by the Company specifically to evaluate whether the Project and commercial terms with key vendors are consistent with similar projects throughout the industry.
- Concentric evaluated the division of responsibilities between the two key vendors at a high level, but is not providing an opinion on the appropriateness of the division of those responsibilities from an engineering perspective. We understand that the OEM will provide Engineering Services and Equipment Supply, and that the scope of work to be completed by a separate vendor under the EPC contract will include the original scope of work with equipment and technical oversight work removed.

Concentric's opinion does not consider whether this division of responsibilities is practicable from the perspective of vendors that may respond to the Request for Proposals ("RFP") for the construction-oriented balance of work. We do note, however, that the Company received multiple expressions of interest from potential third party vendors to work with the OEM on the Project.

- In addition, Concentric assumed Ontario Power Generation will retain adequately qualified personnel to complete the Project generally, and the Turbine Generators work package specifically. Those resources are critical to the success of the project, and may be sourced internally, hired directly, or engaged through contracts with third parties.
- Concentric did not perform a compliance audit to determine whether Ontario Power Generation and the Project were in compliance with Ontario Power Generation's internal policies, procedures, instructions and guidelines, or applicable provincial and federal regulations. Similarly, Concentric did not conduct a legal review of Ontario Power Generation's agreements or proposed agreements with any contractors. Notwithstanding that limitation, Concentric did review relevant Ontario Power Generation internal policies and procedures, and relevant provincial and federal laws and regulations when developing our opinion.
- Finally, Concentric's review is not an assessment of the Project's likelihood of success. Successful execution of the Project generally and the Turbine Generators work package specifically will require the efforts of many entities and individuals over many years, and the development and implementation of the Project's commercial strategies is only one contributor to project success.

---

<sup>7</sup> The beginning of the period Concentric reviewed is roughly concurrent with Ontario Power Generation's completion of the Economic Feasibility Assessment of Darlington Refurbishment dated November 13, 2009. However, portions of the operational experience material reviewed by Concentric were prepared prior to this time.



## VI. TURBINE GENERATORS WORK PACKAGE COMMERCIAL STRATEGY

### A. OVERVIEW

Ontario Power Generation's Turbine Generator project team was established in March 2011 and included representation from a broad array of groups within the Company, including Engineering, Execution, Supply Chain, and Contract Management. In addition, input for the Turbine Generator refurbishment work was gathered from Law (internal and external), Finance, Darlington Refurbishment Planning and Control, and the Hydro Supply Chain organization. The team's progress in developing a commercial strategy was communicated on a regular basis to the appropriate members of the Ontario Power Generation corporate and Refurbishment Project leadership teams.

As is documented in the Contracting Strategy for Turbine Generators, the Project team was focused on achieving an additional 25-30 years of operations at Darlington through a Turbine Generator refurbishment project that minimizes risks to the degree feasible while ensuring optimal value for money.

The Darlington Turbine Generator sets were custom designed and are unique to the Darlington site. The units were initially designed, manufactured, and installed by Brown Boveri Canada Inc. ("BBC"), which later became a subsidiary of Asea Brown Boveri ("ABB") following a merger between BBC's parent company and ABB in 1989. The turbine generator segment of ABB was subsequently purchased by Alstom in 2000, which, by virtue of its exclusive ownership of intellectual property ("IP") and design basis engineering, is considered the OEM for the Darlington turbine generator units. Alstom, or its antecedents, has provided engineering, ongoing maintenance, and outage support services on the units since the Plant was commissioned in the early 1990s.<sup>8</sup>

Refurbishment of the turbine generators involves a combination of retrofits, repairs of hardware and hydraulics, and a full control-system upgrade.<sup>9</sup> The project consists of five discreet components:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs and/or replacements of high pressure and low pressure turbine components and auxiliaries;
- Generator and Generator Auxiliaries: inspections, repairs, and /or replacements of generator components and generator auxiliaries;
- Moisture Separator Reheater: inspection, overhaul and/or replacements of Moisture Separator Reheater internals and auxiliaries;
- Turbine Controls Upgrade: Replacement of the analog Turbine Generator electronic control system with a new digital system; and
- Generator Excitation Upgrade: replacement of the Generator Excitor control system with a new digital system.

---

<sup>8</sup> Contracting Strategy for Turbine Generators, NK38-REP-09701-10021(R000). August 31, 2012, page 8.

<sup>9</sup> *Ibid.*, page 5. Concentric understands that for Unit 2 (*i.e.*, the first unit to undergo refurbishment) the Project is considering deferring replacement of the turbine generator digital controls upgrade until a later routine outage. This proposal is still under evaluation, but is expected to lower the risk on completing the first outage schedule and cost estimates by reducing the scope of the initial refurbishment outage and the new technology introductions during that first outage.





## B. INITIAL STRATEGY DEVELOPMENT

In Ontario Power Generation's evaluation of the experiences of other utilities throughout North America that have undertaken similar refurbishment projects, it became clear that there are several material advantages to maintaining the involvement of the OEM. In particular, the Company attempted to mitigate the risk of an extended outage or poor reliability of the turbine generator equipment. An event at the DC Cook Nuclear Generating Station ("DC Cook") in September 2008 is a specific example of this risk. In the DC Cook event, the plant's Unit 1 was manually tripped when the control room experienced simultaneous high vibration readings on all main turbine bearings. The ultimate damage from the event was extensive and led to a lengthy forced outage and what was at the time the highest insurance claim in the history of the US nuclear industry. The cause of the event was ultimately determined to be a design error in systems and components that were replaced by a non-OEM vendor during the refurbishment of the turbine generators. The Company also cited problems that arose at the Koeberg Nuclear Power Station, which operated for ten months prior to a failure that was the result of "shortcomings in the reverse engineering process and material receiving process."<sup>10</sup> Finally, Ontario Power Generation consulted Exelon Corporation ("Exelon"), which has extensive and recent experience with large retrofit, uprate, and refurbishment programs at its sites. The Company learned that Exelon considers it a best practice to engage the OEM for work on all major nuclear system components. In fact, Exelon recommended engaging a non-OEM only when conducting a full replacement of major components as opposed to retrofitting or refurbishment. Finally, in its analysis of industry experience, Ontario Power Generation learned that the recent turbine generator refurbishment work at the Point Lepreau Generating Station in New Brunswick was completed by the OEM.

In addition to concerns with safety and reliability, Ontario Power Generation was aware of the significant costs related to the IP rights and design basis engineering in the event that a non-OEM vendor were to be selected to complete the refurbishment.<sup>11</sup> The Company commissioned a study from Faithful & Gould, which concluded that obtaining restricted rights could cost from \$22.9 to \$39.1 million,<sup>12</sup> while reverse engineering the system specifications could cost from \$26.3 to \$61.5 million.<sup>13</sup> Intent on mitigating risk and cost to the Turbine Generator work, the Company elected to seek an agreement with Alstom, the OEM.

Ontario Power Generation initially considered unbundling the Turbine Generator refurbishment based on the scope or type of work. To assess the impact of different approaches on key project objectives and risk impacts, the Company commissioned a Kepner-Tregoe ("KT") analysis<sup>14</sup> of the following competing options for packaging the Turbine Generators scope of work:

<sup>10</sup> *Ibid*, page 14.

<sup>11</sup> It is unclear whether Ontario Power Generation or Alstom owns the IP rights and design basis engineering.

<sup>12</sup> Obtaining unrestricted rights, which would permit a party to manufacture and sell components, would raise the range to \$40.5 million to \$62.1 million.

<sup>13</sup> This figure includes both the additional cost to the Company to allow reverse engineering, which Faithful & Gould estimate would cost from \$11.7 million to \$39.0 million, and the reverse engineering itself, at a cost of \$14.6 million to \$22.5 million. Contracting Strategy for Turbine Generators, NK38-REP-09701-10021(R000). August 31, 2012, page 14.

<sup>14</sup> Kepner-Tregoe, Inc., is a management consulting firm that specializes in the processes of strategy development. The KT analysis conducted for the Turbine Generators work package consisted of identifying a wide array of objectives and classifying them into two broad categories of "want" and "need." Each contracting strategy was first assessed by whether it was compatible with each "need" objective. The strategies that achieved all *need* objectives





- Unbundled scope (5 packages), competitively bid;
- Bundled scope, single-source process (OEM);
- Bundled scope, competitively bid; and
- Unbundled scope, selective sole source and competitive processes

The analysis concluded that technical integration of components and work elements from multiple vendors creates technology, reliability, project management, and operational risks that do not justify the potential benefits of using multiple vendors with specific expertise. In addition, while unbundling may provide Ontario Power Generation flexibility with respect to sourcing and procurement, it would introduce a large administrative and project management burden on the Company, and would introduce additional schedule risk. The KT analysis concluded that a bundled scope of work using a sole-source agreement with the OEM resulted in the least risk while meeting each key project objective. Ontario Power Generation also conducted an analysis of benefits and risks of contracting approaches including traditional Design-Bid-Build, EPC, and Turnkey<sup>15</sup> delivery and determined that the EPC approach is most effective. While there is the potential that an EPC arrangement can be more costly because of the risk-transfer to the vendor, this model reduces interfaces, significantly lowering the technology and implementation risk. Interface risk arises when work products from multiple vendors are required to work seamlessly together in combinations that have not been thoroughly tested in operational settings. For instance, there would be significant risks involved with the installation of turbine generators from one vendor and digital turbine controls from an independent vendor. The EPC model mitigates this type of risk, while also removing significant implementation and project management risk from Ontario Power Generation by minimizing staff commitments from the Company. The EPC model also involves the shortest schedule because of concurrent design and construction activities and provides greater cost certainty for the project. Finally, an EPC arrangement provides a single point of accountability for quality issues.

The variety of analyses described above resulted in Ontario Power Generation electing to pursue a fully bundled, single-sourced EPC contract with Alstom, the OEM. As discussions between Ontario Power Generation and Alstom began to take place early in 2012, however, the Company recognized the possibility that negotiations with the OEM could fail to produce an agreement that achieves the Company's key contracting objectives. Ontario Power Generation began to prepare an alternative strategy, termed its "Plan B," in June 2012 while formal negotiations with Alstom were getting underway.

### C. DEVELOPMENT OF AN ALTERNATE STRATEGY ("PLAN B")

The Company considered three contracting approaches in the formation of its Plan B contracting strategy: (1) a bundled EPC-oriented model; (2) five unbundled scopes of work competitively bid separately; and (3)

---

(*e.g.*, "meet technical requirements") were then scored on the ability to achieve the "want" objectives (*e.g.*, "minimize level of resources (staff) required by Ontario Power Generation"), which were weighted by priority.

<sup>15</sup> Under a traditional Design-Bid-Build arrangement, design engineering and construction are handled sequentially. Ontario Power Generation would contract separately for design and construction, and would maintain overall project oversight and management responsibility. Under the EPC model, these roles and all associated risks are transferred to the contractor, and the design and construction phases may have significant overlaps. Under a turnkey contract, the Company would define performance specifications for the contractor, which would have wide latitude in determining the most effective means of meeting the specifications.



unbundling the scope of work into separate Engineering, Procurement, and Construction portions, each competitively bid. Throughout the development of the Plan B strategy, Ontario Power Generation remained focused on working closely with Alstom, with the OEM serving either in a subcontractor role or as part of a joint venture arrangement with an EPC vendor in order to “mitigate risks associated with reverse engineering and contracting with a non-OEM vendor.”<sup>16</sup>

The KT analysis commissioned during the assessment of the Company’s Plan A approach supported the conclusion that a bundled scope of work using an EPC contracting model was the optimal alternative. The Company’s decision to continue to seek involvement of the OEM was reinforced by the Faithful & Gould assessment of the costs of obtaining the Turbine Generator design basis engineering specifications. In addition, a Worley Parsons report from September 2012 validated the Project’s scope definition.

The KT analysis was prepared before the development of Ontario Power Generation’s Plan B strategy. As a consequence, it did not evaluate a contracting arrangement with significant involvement of the OEM through an Engineering Services and Equipment Supply contract. We have no reason to believe that a different approach would be selected if that option were to be compared to the alternatives, but we believe the Project should document the risks that are introduced by having two major contracts to complete the Turbine Generator scope of work. This recommendation is discussed later in this report.

#### **D. TRANSITION TO THE PLAN B COMMERCIAL STRATEGY**

Indications that Alstom did not fully understand Ontario Power Generation’s expectations with regard to the commitments required of an EPC vendor in the Canadian nuclear industry began to surface during the summer of 2012. Members of Ontario Power Generation’s Turbine Generator Negotiations Steering Committee had concerns with Alstom’s ability to satisfy the EPC Qualification process, and with requirements related to the Engineering Change Control process in particular. The team had multiple interactions with Alstom through late summer, including a series of meetings and conference calls to ensure that Ontario Power Generation and the vendor were aligned on the nature and terms and conditions of a nuclear EPC agreement. Negotiations with Alstom concluded on July 24, 2012, and a formal request for pricing was sent to Alstom on July 26, 2012.

The pricing structure the Company received in Alstom’s final bid in September 2012 was more than 50% higher than the indicative pricing Alstom had delivered during negotiations just two months earlier. In addition, Ontario Power Generation’s concerns that Alstom would be unable to satisfy requirements for EPC contractors in the Canadian nuclear industry remained. The Company noted that while Alstom had developed preliminary plans for engineering Quality Assurance (“QA”) programs during negotiations in the summer of 2012, there were strong indications that those QA plans would not be robust enough to execute the project, including supervision of construction trades in Ontario.<sup>17</sup> Additionally, Ontario Power Generation was not confident that Alstom could implement the plans on the schedule required to proceed with EPC contracting.

After evaluating Alstom’s proposal, Ontario Power Generation concluded that it would not be possible to negotiate a satisfactory agreement in terms of value for money, commercial terms, and an appropriate

---

<sup>16</sup> Turbine Generator Refurbishment Project Alternate Contracting Plan, NK38-PLAN-09701-10112 (R000). November 11, 2012.

<sup>17</sup> Meeting Notes – Turbine Generator Negotiations Steering Committee Meeting #4 (September 10, 2012).



allocation of risk. As a result, Ontario Power Generation decided to pivot from its focus on a bundled EPC contract with the Turbine Generator OEM to an alternate contracting strategy. While that decision had significant implications for the Project (the secondary approach is expected to add approximately 18 months to the non-critical-path elements of the Turbine Generator procurement process) the additional time was contemplated in developing the overall schedule for the Turbine Generator work package, and is not expected to affect the overall Project schedule. Concentric has concluded that Ontario Power Generation's recognition of deficiencies in Alstom's Quality Assurance programs was appropriate. Many other organizations in the North American nuclear industry have struggled to recognize similar problems, and have experienced significant problems related to project oversight and technology integration.<sup>18</sup>

## **E. EXECUTION OF THE COMPANY'S PLAN B STRATEGY**

Ontario Power Generation officially pivoted to the Plan B strategy in early October 2012. The Company issued a Request for Expressions of Interest in order to determine whether there was sufficient interest among qualified nuclear engineering and construction firms to bid for two potential types of work:

- 1) The remaining project work scope that would not be completed by Alstom through an Engineering Services and Supply Agreement; and
- 2) The full Turbine Generator refurbishment scope of work in the event that negotiations with Alstom for Engineering Services and Equipment Supply were unsuccessful.

In December 2012, Ontario Power Generation received positive indications from contractors interested in bidding on both approaches. Expecting that it would find sufficient interest in working closely with Alstom among potential vendors, and in order to minimize schedule impacts related to engineering and design of the turbine controls, in October 2013 Ontario Power Generation began to pursue a commercial arrangement with the OEM limited to Engineering Support and Equipment Supply. This approach was intended to alleviate the Company's concerns with Alstom's ability to meet the requirements of a nuclear EPC vendor while mitigating the cost, technology, and integration risks of moving forward on a project of this magnitude without the OEM. The Company and Alstom reached agreement on terms and conditions in December 2012, and pricing elements were put in place. Subsequently, by early March 2013, Ontario Power Generation's discussions with Alstom for the limited Engineering Support and Equipment Supply scope yielded a contract with several features that are favorable to the Company's interests and priorities.

The contract provides Ontario Power Generation with access to the OEM's IP resources for refurbishment and ongoing maintenance activities for the remaining life of the Plant. Furthermore, Ontario Power Generation obtained the authority to assign, in whole or in part, the contract or the Company's IP rights under a contract to the vendor selected to complete the balance of the Turbine Generator scope. This flexibility is expected to reduce administrative and Project Management responsibilities and transfer many vendor interface management risks from Ontario Power Generation to its EPC contractor. The contract also provides flexibility in redefining Project scope to accommodate Project economics.

---

<sup>18</sup> Southern California Edison was confronted with this challenge at the San Onofre Nuclear Generating Station, which has been closed permanently as a result of an engineering error with its recently-replaced steam generators. Xcel has faced similar circumstances with the feedwater pumps at its Monticello Nuclear Generation Plant.



The agreement with Alstom was formally executed in April 2013. Following the conclusion of negotiations with the OEM, Ontario Power Generation initiated plans for the construction-oriented EPC contract. The Company currently envisions three options for the form of this contract:

- 1) An EPC agreement with the OEM contract assigned to the EPC vendor;
- 2) A Joint Venture arrangement between the EPC contractor and Alstom; or
- 3) An EPC contract, with Ontario Power Generation managing the interface between the OEM and EPC-vendor.

Ontario Power Generation issued a formal RFP for this work to four companies<sup>19</sup> on May 31, 2013, with bids due on August 23, 2013. The Company plans to select a vendor and complete negotiation by the end of November 2013, and execute an EPC agreement for this work by January 31, 2014.

#### **F. CURRENTLY UNDER REVIEW: REVISION TO FIRST-UNIT EXECUTION PLANS**

In July 2013, the Company began to consider a departure from the initial project execution schedule. Under a revised approach, Ontario Power Generation would complete refurbishment of the first unit before initiating a schedule of overlapping construction on the remaining three units. This approach is intended to create an opportunity for the Company to collect, synthesize, and apply considerable operating experience to the refurbishment of the remaining units.

In addition to delaying the overlapping schedule of unit refurbishment, Ontario Power Generation is considering whether to defer the digital upgrade of turbine controls on the first unit, removing that scope of work from the Darlington Refurbishment Project. If this approach is approved by the Ontario Board of Directors, the Company would complete the controls upgrade for that unit during a scheduled refueling and maintenance outage after the conclusion of the remaining refurbishment work. A Board of Directors decision is expected in November 2013.

#### **VII. CONCENTRIC'S OBSERVATIONS AND RECOMMENDATIONS**

As stated above in the Summary of Conclusions, Concentric determined that the planning processes and activities completed by the Company between late 2009 and [August 1, 2013] were appropriate and reasonable, and meet the regulatory standard of prudence. In addition, we have made observations and identified opportunities for improvement that can strengthen the project management and supply chain functions going forward. Those observations and opportunities include:

1. Concentric agrees that a single-source agreement composed predominately of fixed, firm, and reimbursable pricing elements would allow Ontario Power Generation to obtain value for money in an arrangement that mitigates risk while achieving the long-term goals of enhanced reliability and maintainability of the Turbine Generators equipment. This was a reasonable and prudent initial strategy for the Turbine Generator scope of work.

---

<sup>19</sup> The RFP was distributed to Areva, AECON, and the two firms with which Ontario Power Generation has executed extended services master services agreement ("ESMSA") contracts for purposes of the Darlington Refurbishment Project. However, these two vendors, E.S. Fox and Black & McDonald, withdrew from the Turbine Generators EPC solicitation process in August 2013.



2. An Ontario Power Generation Internal Audit report from May 2012 made the recommendation that the Fuel Handling and Turbine Generators work package project teams clearly establish when justifications for single-source processes would be created and approved for significant portions of the two scopes of work. We agree with the audit's findings that there is a potential gap in the sequencing of supply-chain approvals, but stress that our concern is limited to the process for SSJ development and approval, not the basis for the SSJs themselves. Nothing Concentric observed in this regard has indicated imprudence on the part of Ontario Power Generation, nor did the process as implemented affect the outcome of the supply chain activities.

We believe that it is in the Project's best interest to achieve internal alignment on a single-source approach at the outset of the development of plans to negotiate with single-source vendors. This is particularly true for agreements that will develop over the course of several months or for contractual arrangements that will exceed \$10 million. This will ensure that the team is aligned on the strategic direction of the Project, and will mitigate the risk of committing significant resources to a procurement strategy that may not ultimately be approved by established Supply Chain procedures. It will also prevent unnecessary schedule extensions related to pursuing contracting strategies that are not ultimately approved. Recognizing that a structural solution may be too formal for what is an exceptionally dynamic process, we recommend that, at a minimum, clear lines of communication be established when new members of the Supply Chain organization are introduced to the Project, which will happen during a project of this scale and duration.

3. We recommend that Ontario Power Generation clearly document the risks introduced by executing an Engineering Services and Equipment Supply contract in advance of retaining an EPC vendor for the balance of work. Ontario Power Generation's selected contracting approach has minimized the number of interfaces and contracts, but still requires a collaborative arrangement between the OEM vendor and a yet-to-be-selected EPC contractor. Industry experience demonstrates that a successful interface between the OEM and the EPC vendor requires detailed scope definition, schedule coordination, and a clear division of responsibilities between the two.<sup>20</sup>

There is material risk that the relationship between the vendors will be strained as contingent scope is identified and other possible scenarios emerge. From discussions with the Company it is clear that these risks are understood, and that certain mitigation efforts have been undertaken, including the integration of requirements for collaboration with the OEM in the RFP materials distributed to potential EPC vendors. However, we believe these risks must be thoroughly documented, and that monitoring and mitigation plans must be developed.

---

<sup>20</sup> This risk has arisen recently with other mega-projects, notably in the ongoing construction of Finland's Olkiluoto Unit 3. The challenges encountered coordinating Siemens and FANP (Areva) are documented by the Finnish nuclear safety regulator. See: Stuk Nuclear Regulation, "Management of Safety Requirements in Subcontracting During the Olkiluoto 3 Nuclear Power Plant Construction Phase," Investigation Report 1/06, October 7, 2006 (page 51).





4. The Engineering Services and Equipment Supply contract that has been negotiated with Alstom contains many provisions that are advantageous to Ontario Power Generation, including warranty provisions that are superior to the industry standard 24-month warranty period, according to Ontario Power Generation's survey of industry experience with similar contracts. However, the contract with Alstom does not eliminate risk, and the Company should document and mitigate remaining risk to the degree possible. In particular, while the contract grants the Company authority and control over vendor-initiated change order requests, this does not eliminate the cost and schedule risk associated with scope disputes and resolution. Also, the warranty provisions of the contract do not eliminate the possibility the unit warranty period will expire before a given unit comes online. This possibility is certainly remote; it would require a four-year delay in the Project. However, Ontario Power Generation should be certain to document the risk and additional mitigating strategies.
5. Limited restrictions to Ontario Power Generation's IP rights to the control systems source code introduce a potential restriction to the Company's ability to fully assign the Engineering Services and Equipment Supply contract to the EPC vendor. Associated risk should be documented, and the Company should take steps to ensure that this limitation does not impede the EPC contractor's ability to complete its scope of work.
6. We note that Ontario Power Generation has documented the risk of contracting for equipment supply with a vendor (Alstom) reliant on an international supply chain network. The Company has documented its awareness of this risk and of concerns that have arisen with international manufacturing centers that are not currently expected to affect the Project. The risk has been mitigated through the material specifications contained in the scopes of work, quality program, and oversight plans.
7. Concentric believes that as Ontario Power Generation continues to develop its approach to the market for the EPC scope of the Turbine Generators work package, the Company should focus on assigning the Alstom contract to the EPC vendor rather than encouraging a joint venture structure. Industry experience, including the challenges that have surfaced at Olkiluoto Unit 3, as well as other projects,<sup>21</sup> indicates that a joint venture arrangement introduces material financial and interface risks.
8. Alstom has provided assurances that the Turbine Controls engineering will be complete within two years. This is an aggressive schedule and must be monitored and overseen by Ontario Power Generation. The Company has evaluated the schedule in detail and has

---

<sup>21</sup> Siemens and Areva were partners in a joint venture, Areva NP, to market nuclear services and equipment supply, including the construction of the new Olkiluoto Unit 3 in Finland. However, in 2009, Siemens exercised a put option to sell its one-third share of the joint venture to Areva, which is now the main contractor for the project. While Siemens has remained involved in the work as a subcontractor, the upheaval has had significant cost and schedule impacts on the construction of Unit 3. As with Joint Venture arrangements within other projects throughout the industry, problems at Olkiluoto involving ineffective communication between Joint Venture partners (Siemens and Areva), a lack of ultimate accountability for work execution, and a lack of authority to address changing circumstances have all contributed to schedule and cost challenges. See also footnote 15. Stuk Nuclear Regulation. "Management of Safety Requirements in Subcontracting During the Olkiluoto 3 Nuclear Power Plant Construction Phase." Investigation Report 1/06, October 7, 2006.



determined that it does not require a recovery plan or strategy at this time. Rather, schedule implications can be monitored and controlled through the risk register.

9. Concentric has not reviewed any analysis of the costs, benefits, and changes to Project or Turbine Generators work package risk that may result from a decision to change the sequencing of the Project so that the first two refurbishment outages no longer overlap. While there are benefits to focusing execution efforts on a single unit through commissioning, significant cost, efficiency, and vendor-related savings may be compromised. If the Ontario Power Generation Board of Directors chooses to un-lap the refurbishment of the first two units, Concentric would strongly advise the Turbine Generators project team to conduct a thorough assessment of the impact this change will have on the Company's relationship and contract with the Turbine Generators OEM, as well as the costs and risks of completing the remainder of the Project.
10. Concentric recognizes that execution risk would be diminished by the deferral of the Turbine Generator digital controls upgrade on the first unit to enter refurbishment outage (*i.e.*, Unit 2). However, if Ontario Power Generation chooses to defer the controls upgrade on Unit 2, we recommend that The Company undertake a risk-based review of the implications of removing that portion of work from the Darlington Refurbishment Project, and ensure that changes are reflected in the Turbine Generator work package's risk register, commercial strategy documentation, and in the overall Darlington Refurbishment Project execution plans.

## VIII. CONCLUSIONS

Concentric was retained to review Ontario Power Generation's development and implementation of its commercial strategies for the Project. At a cost of \$6 to \$10 billion in 2009 dollars, excluding inflation and interest, and a duration of more than 18 years from the start of planning to the conclusion of commissioning and project closeout activities, the Project is clearly a major undertaking for Ontario Power Generation, and it is subject to financial, economic, regulatory, political, and execution risks. While effective commercial strategies are necessary to assist the Company in mitigating these risks, no commercial strategy can fully eliminate them.

To conduct our review of the Project's commercial strategies, Concentric undertook a detailed process to determine whether the strategies selected by the Turbine Generators Project team are reasonable, whether the strategies were executed in a reasonable manner and whether Ontario Power Generation's actions related to the selection and execution of those strategies meet the regulatory prudence standard. Our opinion of these strategies relied on information provided by the Company in response to our data requests, in-person interviews, our independent research and Concentric's experience advising other megaproject sponsors. Our review confirms the reasonableness and prudence of Ontario Power Generation's selected procurement strategies.