

May 21, 2009

Niagara Tunnel Project**EXECUTIVE SUMMARY:**

The purpose of this submission is to seek the approval of the Board of Directors to complete the Niagara Tunnel Project under an amended Design Build Agreement with the current contractor, to increase the capital cost from \$0.985B to \$1.6B and to extend the schedule from June 2010 to December 2013.

The Niagara Tunnel Project has been delayed due primarily to difficulties encountered by the contractor, Strabag Inc. (Strabag) in excavating the tunnel through the Queenston shale formation. Following an unsuccessful attempt to resolve Strabag's claim for cost and schedule relief, the parties submitted the dispute to the Dispute Review Board (DRB), as provided in the Design Build Agreement between OPG and Strabag. Following receipt of the DRB's recommendations OPG and Strabag have negotiated a settlement to ensure the tunnel is completed both safely and expeditiously.

The financing for the project is arranged through the Ontario Electricity Financial Corporation (OEFC). The amended agreement increasing the facility limit of \$1B to \$1.6B will be executed following the OEFC's third quarter board meeting.

With a Levelized Unit Energy Cost of under 7 ¢/kWh and an equivalent Power Purchase Agreement price of less than 10 ¢/kWh, the Niagara Tunnel Project continues to remain attractive and economic relative to other generation alternatives.

Due diligence exercised by OPG prior to and during project execution will help ensure that OPG is well positioned to make the case to the OEB that the entire capital cost should form part of OPG's regulated rate base. However, given the significant cost over-runs associated with the project, the OEB will be likely to review the matter in detail and therefore regulatory risk remains.

RECOMMENDATION:

It is recommended that the Board of Directors approve:

1. the revised schedule and capital cost of the Niagara Tunnel Project,
2. the amendment and execution of the Design Build Agreement with Strabag Inc.,
3. the resolution attached as Appendix A, Approval of Cost and Schedule Variances of the Niagara Tunnel Project,
4. the additional project financing, and
5. the resolution attached as Appendix B, Amendment to the Niagara Tunnel Financing Agreement.

**Recommended By:
(original signed by)**

John Murphy
Executive Vice President, Hydro

(original signed by)

Pierre Charlebois
Executive Vice President &
Chief Operating Officer

**Approved for Submission to the Board of Directors:
(original signed by)**

Jim Hankinson
President & Chief Executive Officer

This Board memorandum was reviewed and approved for submission to the Board of Directors by the Major Projects Committee on May 8, 2009.

The Niagara Tunnel Project (NTP) has been delayed due primarily to difficulties encountered by the contractor, Strabag Inc. (Strabag) in excavating the tunnel through the Queenston shale formation. These difficulties have resulted in a significant delay to the projected completion of the tunnel, as well as a significant increase in the cost of the project. OPG and Strabag have negotiated a settlement to ensure the tunnel is completed both safely and expeditiously. This submission is structured as follows:

- I. Background
- II. Geological Studies
- III. Claim for Differing Subsurface Conditions
- IV. Settlement of Dispute
- V. Amended Design Build Agreement
- VI. Project Economics
- VII. Risk Assessment
- VIII. Financing
- IX. Communication Plan

- Appendices
 - A. Resolution – Approval of Cost and Schedule Variances
 - B. Resolution – Amendment to the Niagara Tunnel Financing Agreement
 - C. Milestone Schedule
 - D. Amended Design Build Agreement Summary of Key Terms
 - E. Major Risk Table

I. Background:

On July 28, 2005, OPG's Board of Directors approved the Execution Phase of the Niagara Tunnel Project (NTP). The approved budget and in service date were \$985 million and June 2010, respectively. This new water diversion tunnel will increase the amount of water flowing to existing turbines at the Sir Adam Beck (SAB) generating stations in Niagara Falls. This tunnel will also allow the SAB generating facilities to utilize available water more effectively and is expected to increase annual generation on average by about 1.6 TWh (14%).

The decision to proceed with the Execution Phase was taken after comprehensive geological studies, engaging an international tunnelling/mining consulting expert (Hatch Mott MacDonald) as OPG's Owner's Representative (OR), engaging Torys to provide legal oversight and advice and conducting an international competition to select a Design Build contractor (Strabag).

II. Geological Studies

A number of iterations of the NTP had been under study since the 1980's. Beginning in 1983, OPG began to assemble an extensive amount of geological data to support the study of various alternatives to increase generation at the Sir Adam Beck complex. The resulting data can be divided into four categories:

1. Geotechnical Data – 58 boreholes were drilled during the course of project development.
2. Definition of Buried St. Davids Gorge – Geophysical testing was conducted to determine the extent and depth of the buried St. Davids Gorge beneath which the tunnel had to pass.
3. Swelling of Queenston Shale – An extensive amount of laboratory testing was done to determine the swelling characteristics of the Queenston shale.
4. Feasibility of Rapid Mining in Queenston Shale – An exploratory adit and trial enlargement were excavated to assess the ability to use rapid mining techniques (Tunnel Boring Machine) in the Queenston shale.

From this data, the rock and rock mass characteristics, jointing and groundwater conditions of the rock were estimated which are the relevant parameters needed to assess the behaviour of the tunnel under excavation. The amount of data collected was significant and somewhat greater than would be typically collected for this type of project. OPG/Ontario Hydro engaged leading technical experts to conduct analysis and provide advice throughout the process. The experts included Acres, Golder Associates, professors from the University of Western Ontario and University of Toronto, Hatch Mott MacDonald and Hatch Acres.

From the above, a Geotechnical Baseline Report (GBR) was prepared and included in the Design Build Request For Proposal documents. Strabag refined the GBR to incorporate its planned means and methods. Finally, a GBR was negotiated by OPG and Strabag and included in the Design Build Agreement (DBA) with a fixed price of \$623M.

III. Claim for Differing Subsurface Conditions

Upon entering the Queenston shale formation in May 2007, Strabag encountered subsurface conditions that resulted in significantly slower than planned progress. Strabag alleged large block failures, insufficient stand-up time and excessive overbreak encountered were not consistent with the conditions described in the DBA. Strabag alleged these claims constituted a Differing Subsurface Condition (DSC), and as a result, it should be entitled to cost and schedule relief.

Following unsuccessful attempts to resolve the issue, the parties submitted the claim to the Dispute Review Board (DRB). The DRB is part of the dispute resolution process set out in the DBA and consists of three tunnelling experts who were regularly updated on project progress and issues. The claim was heard over four days in June 2008.

The DRB issued its non-binding recommendations in August 2008. The DRB ruled that the excessive overbreak encountered during the tunnel drive constituted a DSC.

“There is a DSC with respect to the excessive overbreak...Both Parties must accept responsibility for some portion of the additional cost, but at the same time the Contractor must have adequate incentives to complete the Work as soon as possible.”

IV. Settlement of Dispute

In April 2008, a Contract Litigation Oversight Committee (Oversight Committee) was established to provide OPG's CEO with advice independent from the project team on the contractual dispute. The committee consists of Donn Hanbidge (OPG CFO and Chair of committee), Barry Leon (Partner at Torys and expert in litigation and international arbitrations), John Hester (international tunnelling expert) and Norm Inkster (former Commissioner of the RCMP). The Oversight Committee has been kept abreast of the dispute and status of negotiations and has endorsed the strategy adopted by management to settle the dispute.

During October and November 2008, the parties negotiated a non-binding Principles of Agreement that would settle all claims up to November 30, 2008 and move to a Target Cost Contract for the remainder of the project with cost and schedule incentives and disincentives. The key tenets of the Principles of Agreement were as follows:

- Strabag claimed that it had incurred a loss of \$90M up to November 30, 2008. Under the Principles of Agreement, OPG would pay Strabag \$40M to settle all claims up to November 30, 2008, leaving Strabag with a loss of approximately \$50M.

- Should the \$90M loss not be substantiated, the agreement allows OPG to claw back the \$40M on a prorated basis.
- From December 1, 2008 onwards, Strabag could earn a \$10M fee upon completion of tunnelling, a \$10M fee upon Substantial Completion and maximum cost and schedule incentives of \$40M. Under this arrangement Strabag would incur a loss \$30M if cost and schedule performance are on target. Incentives and disincentives could result in a maximum profit of \$10M or a maximum loss of \$50M.

On November 19, 2008, OPG's Major Projects Committee reviewed the Principles of Agreement and endorsed management's plan to proceed to build upon the Principles of Agreement by negotiating a Term Sheet followed by an Amended Design Build Agreement with Strabag. On February 9, 2009, OPG and Strabag executed a non-binding Term Sheet that further elaborates on the Principles of Agreement.

Since then, the parties negotiated a Target Schedule of June 15, 2013 and a Target Cost of \$985M. Both of these targets were developed on an open book basis. The Target Schedule is premised on a horizontal realignment that reduces the tunnel length by approximately 200 metres as well as a vertical realignment to exit the Queenston shale and move to the upper formations where rock conditions are expected to improve. The primary drivers for the schedule extension are as follows:

- Based on Strabag's original baseline schedule, the average Tunnel Boring Machine (TBM) advance rate was expected to be 14.55 m per day over 715 days with TBM hole-through expected in August 2008. The TBM commenced boring the tunnel as planned on September 1, 2006, but the actual TBM progress rate to date has averaged only 4.07 m per day (27% of the planned rate). The primary reasons for the slower than planned TBM progress to date include:
 - o 0 to 800m – Delays associated with worker training, high groundwater inflow, cementitious ground-up rock clogging and damaging the TBM cutters, and difficulties installing full-ring rock support through the initial decline from the tunnel portal.
 - o 800m to 3900m – Excavating and supporting the overstressed Queenston shale formation, including the buried St. Davids gorge area, resulted in excessive crown overbreak, slow daily progress rates and required several TBM outages for modifications to the initial support area immediately behind the cutterhead.
- Permanent tunnel lining operations have been delayed by the slow TBM advance to date, such that invert concrete placement, planned to start in October 2007, did not begin until December 2008.
- The difficulties experienced in excavating the Queenston shale formation resulted in a decision to horizontally and vertically realign the tunnel path between 2974m and 9000m. This shortened the tunnel length by about 200m to 10.2 km and is expected to facilitate TBM advance rates to an average of 8.4m per day due to tunnelling in rock with higher strength and lower in-situ stress resulting in reduced crown overbreak and reduced initial rock support requirements. Nevertheless, these rates are still slower than the initial planned rate due largely to:
 - o More mixed face mining in the upper formations resulting in additional cutter wear and replacement and a reduction in the TBM penetration rate.

- o The higher alignment will bring the tunnel to within approximately 85m of the existing tunnels with a potential for increased water ingress resulting in reduced productivity.
- o The significant overbreak in the tunnel crown, which at times exceeded 4m, must be filled in to restore the tunnel to a circular profile prior to installing the concrete lining. Adding this fourth, concurrent operation adds significant complication and risk to the project logistics.

The primary activities to complete the project, along with their planned duration and daily progress rates are presented in Appendix C in both table form and in the form of a time-way schedule.

The parties are in the final stages of negotiating an Amended Design Build Agreement (ADBA) to reflect the Term Sheet and Principles of Agreement. A summary of the key terms of the ADBA are presented in the following section.

V. Amended Design Build Agreement:

OPG engaged Torys as external counsel in the negotiation and drafting of the ADBA. The key terms of the ADBA are summarized below. A more detailed description is provided in Appendix D.

Actual Cost: Strabag's Actual Cost being all amounts paid to Strabag prior to December 1, 2008 plus the accumulated Allowed Costs from December 1, 2008 will be used to calculate the applicable cost incentives and disincentives which apply to Strabag.

Allowed Costs: Strabag will be reimbursed for all costs it incurs to complete the project that are not specified to be Disallowed Costs in the ADBA.

Disallowed Costs: Strabag will not be reimbursed for certain costs that are specified to be disallowed. Disallowed Costs include costs arising from Strabag failing to meet a defined standard of care (negligence) or wilful misconduct, head office costs, interest costs, costs arising from breach of Applicable Law, certain insurance deductibles, costs for warranty work, costs of uncovering and recovering in certain cases, costs to correct or remove a defective part of the project and third party liability.

Overhead Recovery Fee: Strabag will be entitled to apply an overhead recovery fee of 5% to Allowed Costs from December 1, 2008 onwards.

Target Cost: \$985M (does not include the Overhead Recovery Fee noted above)

Baseline Adjustment Items: The Target Cost will be adjusted to reflect changes in costs for certain items. Baseline assumptions were included in the Target Cost calculation with the Target Cost to be adjusted up or down to reflect actual circumstances. For example, the Target Cost will be adjusted if the Construction Products Inflation Index differs from the baseline inflation assumption or if actual diesel fuel costs differ from the baseline assumptions.

Target Schedule: June 15, 2013

Interim Completion Fee: Strabag will be entitled to a \$10M fee upon completion of TBM mining activities.

Substantial Completion Fee: Strabag will be entitled to a \$10M fee upon achieving Substantial Completion.

Cost Performance Incentive/Disincentive: A Cost Performance Incentive/Disincentive will be calculated as 50% of the difference between Actual Costs and the Target Cost.

Schedule Performance Incentive/Disincentive: A Schedule Performance Incentive of \$200,000/day will apply for each day the Substantial Completion Date is prior to the Target Schedule Date. A Schedule Performance Disincentive of \$67,000/day will apply for each day the Substantial Completion Date is after the Target Schedule Date.

Maximum Incentive/Disincentive: The maximum aggregate Cost and Schedule Incentive will be \$40M. The maximum aggregate Cost and Schedule Disincentive will be \$20M.

Guaranteed Flow Amount Incentive/Disincentive: Consistent with the original DBA, an incentive or disincentive will be applied to the extent measured flow varies from the Guaranteed Flow Amount of 500 cubic metres per second.

Major Risk Events: Should a Major Risk Event occur the Target Cost and Schedule will be adjusted in the manner set out in the Major Risk Table. The Major Risk Events are as follows:

- Main bearing failure, except due to negligence
- Conveyor belt damage greater than 1 km, not due to negligence
- Gas concentration above Ontario Occupational Health and Safety Act limits
- Water ingress greater than 100 litres/second
- BTEX levels greater than threshold accepted by Ministry of the Environment
- Unexpected subsurface geotechnical conditions requiring a material change to means and methods or having a material impact on cost and schedule
- Measured crown overbreak depth and volume greater than baseline only if progress slower than planned
- Critical marine work at intake area affected by operational constraints at the International Niagara Control Works
- Unknown subcontractor claims
- Deductibles for certain insurable events

Warranties: Consistent with the original DBA, a one year warranty period will apply with the possibility of extension where rework is required to correct or replace any Defective part of the project.

Other Performance Guarantees: In addition to the schedule and cost incentives and disincentives introduced as part of the change to a Target Cost contract, performance guarantees continue to be required consistent with the original DBA. Hence there are incentives and disincentives applicable with respect to Strabag's commitment to the Guaranteed Flow Amount, and Strabag must maintain a parental indemnity, a Letter of Credit and a Maintenance Bond to secure its obligations and performance under the ADBA.

Occupational Health and Safety Act: Strabag will remain as the Constructor and OPG will retain Owner Only status.

Dispute Resolution: Disputes not settled at the project level will be brought to a Steering Committee consisting of one senior representative from each of OPG and Strabag. The Steering Committee may seek either advice or non-binding recommendations from an expert(s). As was the case in the original DBA, all unresolved disputes shall be finally settled by arbitration under the Rules of Arbitration of the International Chamber of Commerce (ICC) and only after Substantial Completion occurs; however, the Steering Committee members may mutually agree to submit a dispute to ICC arbitration before such time.

Default: Events of default remain largely unchanged from the original DBA although the breaches of covenants, representations and warranties are triggered by material breach only. Should OPG terminate the agreement as a result of an event of default, Strabag will be liable for all of OPG's incremental costs in completing the project (losses suffered from the default, correcting defective work and costs to finish) in excess of the Target Cost.

Liability Regime: Strabag is subject to an overall liability cap equal to the Target Cost (\$985M). There is no cap on Disallowed Costs.

OPG Caused Events and OPG Interference: The ADBA includes the concept that if OPG actions have an impact on cost or schedule, the Contractor will be entitled to an adjustment in the Target Cost and Contract Schedule. This is to deal with provisions in the ADBA that require Strabag to obtain OPG's consent such as a change or addition to Major Subcontractors or which impose obligations on OPG that may impact cost or schedule (e.g., OPG fails to provide sufficient lands).

VI. Project Economics

Total project costs are estimated to be \$1.6B which includes a contingency of \$164M, or approximately 17% of pre-contingency going forward project costs. The cost contingency was developed based on a quantitative assessment of 13 key risks as well as an additional 6 schedule uncertainty risks. The cost contingency is based on a 90% confidence level.

The estimated in-service date is December 31, 2013, including a 6.5 month schedule contingency beyond Target Schedule date of June 15, 2013. The schedule contingency was based on management judgement.

Project Cost Estimate (\$M) (including Contingency)	Original Approval (July 2005)	Superseding Release (May 2009)	Variance
OPG Project Management	4	6	2
Owner's Representative and Other Consultants	29	46	17
Environmental / Compensation	12	10	(2)
Tunnel Contract	724	1,182	458
Other Contracts / Costs	79	70	(9)
Interest	137	286	149
Total Project Capital	985	1,600	615

Key financial metrics utilized are:

- Levelized Unit Energy Cost (LUEC) represents the price required to cover all forecast costs, including a return on capital over the service life, escalates over time at the rate of inflation, and permits a consistent cost comparison between generation options with different service lives and cost flow characteristics. LUEC is expressed in current dollars and incorporates all forecast future costs.
- Equivalent Power Purchase Agreement (PPA) Price represents the price required if one were to bid the Project into the renewable RFP. It is similar to LUEC except only 20% of the PPA escalates at the Consumer Price Index.
- Revenue Requirement is a measure that represents the annual accounting cost of the Project including an allowed return on capital employed. Revenue Requirement generally declines over time as the rate base is depreciated.
- Equivalent PPA Price and Revenue Requirement are calculated in dollars of the year of the first full year of tunnel operation.
- These metrics are equivalent in present value terms over the life of the asset and reflect full recovery of costs including a return on the investment.

A summary of the financial analysis is as follows:

Financial Measure	Original Approval July 28, 2005 (\$985M; June 2010 In-Service)		Superseding Release May 21, 2009 (\$1.6B; Dec. 2013 In-Service)	
		in 2009 \$		in 2009 \$
LUEC (¢/kWh)	(2005\$) 4.8	5.2	(2009\$) 6.8	6.8
PPA (¢/kWh)	(2011\$) 6.7	6.7	(2014\$) 9.5	9.4
Revenue Requirements (¢/kWh)	(2011\$) 5.8	5.6	(2014\$) 8.7	7.9
Revenue Requirements Post GRC Holiday (¢/kWh)	(2021\$) 9.4	7.4	(2025\$) 13.0	9.5

The proposed Green Energy Act includes a “Feed-In-Tariff” (FIT) for hydroelectric projects under 50 MW of 12.9 ¢/kWh. This proposed program is comparable to the PPA measure noted in the above table except that the FIT contract is for 20 years instead of 50 years assumed in the PPA calculation.

Once the Niagara Tunnel is in service, the revenue requirement for OPG’s regulated hydroelectric assets is expected to increase from 4.0 ¢/kWh to 4.4 ¢/kWh (2014\$).

Based on the financial metrics presented above, the Niagara Tunnel Project continues to remain attractive and economic relative to other generation alternatives.

Once in-service, the NTP will form part of OPG’s regulated rate base. Under O.Reg 53/05 the OEB is required to ensure that OPG recovers the original project budget of \$985M approved by OPG’s Board and this amount will not be subject to a prudence review by the OEB. However, the incremental project costs above the original approval will be subject to a prudence test. Under the OEB’s prudence test, OPG’s actions are assumed to be prudent unless challenged on reasonable grounds. In assessing prudence, the OEB will consider what information was known or should have been known at the time key decisions were made and what third-party expert advice was sought to assist in decision making. Hindsight is not to be used in determining prudence. Given the extensive volume of studies conducted prior to project execution and the nature of independent advice sought throughout the process (leading international consultants, academia, Dispute Review Board, Contract Oversight Committee, etc.), OPG is well positioned to make the case that the entire capital cost should be recoverable. OPG will, of course, have to demonstrate ongoing diligence in project execution as part of its case for recoverability. However, given the significant cost over-runs associated with the project, the OEB will be likely to review the matter in detail and therefore regulatory risk remains.

VII. Risk Assessment

Prior to project execution, OPG, with the assistance of URS (a specialist consultant), conducted a comprehensive risk assessment (qualitative and quantitative) for design and construction of the Niagara Tunnel. Major project risks were identified through a series of workshops involving the project team and key stakeholders. During project execution, a Risk Register and associated Risk Management Plan have been maintained to manage residual risks. As required by the underwriters of the builder’s all risk insurance policy, OPG (OR) and Strabag developed and maintain a Combined Risk Register for management of the tunnel construction risks.

Beginning in March of this year, at the request of the project team, OPG's Risk Services Group facilitated the updating of the original risk registers using a widely accepted risk quantification methodology known as Monte Carlo simulation. A key step in this methodology involves the creation of input data that once gathered, is inserted into a software application. The input data was gathered through five separate facilitated workshops involving OPG project team and OR representatives who were asked to provide individual estimates of the both the likelihood and the impact of 13 key risks that they had previously identified. These risks included the Major Risk Events delineated in the ADBA and described in Section V. to this memo. In addition, six schedule uncertainty risks (TBM mining, invert concreting, infill shotcreting, arch concreting, contact grouting and pre-stress grouting) were similarly assessed. Once the software tool has the required data, various estimates of possible cost and schedule outcomes at various levels of confidence are generated.

This methodology concluded that a cost contingency of \$164 million would likely be sufficient to cover the costs at a 90% confidence level in the event that all 13 identified risks and six schedule uncertainty risks occurred as expected.

The estimated in-service date is December 31, 2013, including a 6.5 month schedule contingency beyond Target Schedule date of June 15, 2013. The schedule contingency was based on management judgement.

A Risk Register and associated Risk Management Plan will be maintained throughout project execution to manage residual risks.

Further details on individual risks are provided in the Major Risk Table presented in Appendix E.

VIII. Financing

The financing for the project was arranged through the OEFC with a facility limit of \$1B. The process to amend the existing loan agreement will be as follows:

1. OPG Board to approve a financing resolution for the revised project amount (Appendix B).
2. Minister of Finance will likely be required to provide a directive to the OEFC Board to execute an amendment to the existing agreement for the revised project amount.
3. OEFC Board to approve a resolution to execute the amended financing agreement.

Preliminary discussions have taken place with the OEFC regarding an increase in the facility as well as a timing extension. However, staff have indicated that given their current priorities it would be difficult to expedite the "Minister directive" since OPG's Niagara Tunnel Project spend is currently well below the \$1B facility limit. OEFC currently plans to have the final amendment executed after its third quarter Board meeting in September 2009.

IX. Communication Plan

Management has developed a communication plan that will guide the public positioning of the revised cost and schedule of the NTP. The communication plan will focus on the following key messages:

- OPG's number one priority is to progress the project safely.
- The NTP is an ambitious project that employs the largest diameter (14.4m) hard rock Tunnel Boring Machine in the world.

- OPG carried out all the proper due diligence on rock conditions. OPG undertook extensive geological studies over many years and sought advice at key decision points from leading consultants, law firms and academia.
- Even with the extended cost and schedule, the NTP remains among the most economic new renewable energy projects available in Ontario and will continue to deliver benefits for almost a century.
- OPG has been open and transparent in communicating the difficulties with the project.

APPENDIX A

RESOLUTION OF THE BOARD OF DIRECTORS OF ONTARIO POWER GENERATION INC.

Re: Approval of Capital Cost and Schedule Variances for the Niagara Tunnel Project

WHEREAS:

- A.** The Board of Directors at its July 28, 2005 meeting approved Ontario Power Generation Inc. (the "Corporation"), subject to confirmation of financing provided from the Shareholder, spending up to a maximum of \$985,000,000 for construction of a 10 km long tunnel with the capability to divert an additional 500 m³/s of Niagara River water to the Sir Adam Beck hydroelectric complex and authorized the Corporation to enter into the terms and conditions of a Design Build Agreement with a value not to exceed \$630,000,000 for the Niagara Tunnel facility;
- B.** The Corporation entered into the Design Build Agreement dated August 18, 2005 between the Corporation and Strabag AG, which was subsequently assigned to Strabag Inc. ("Strabag"), for construction of the Niagara Tunnel facility for a fixed price and according to an agreed contract schedule (the "Original Agreement");
- C.** In 2007, a dispute arose between the parties with regard to the existence of differing subsurface conditions ("DSCs") and the contractor's ability to make a claim for relief from the resulting cost and schedule impacts under the Original Agreement (the "Claims");
- D.** After unsuccessful attempts to resolve the issues, the parties referred the Claims to the Dispute Review Board (the "DRB") to seek the DRB's recommendations as provided in the Original Agreement;
- E.** The DRB issued its recommendations on the Claims in August 2008, including the recommendation that the excessive overbreak constituted a DSC and that both Parties must accept responsibility for some portion of the additional cost, but at the same time the Contractor must have adequate incentives to complete the Work as soon as possible;
- F.** Following the DRB's recommendations, the Corporation and Strabag entered into discussions to settle all issues, claims and actions related to the DSC Claims submitted to the DRB and negotiated a Principles of Agreement dated November 11, 2008 in which the parties agreed to certain one-time settlement payments to cover Strabag's cost over-runs to November 30, 2008, and to convert the Original Agreement into an open book Target Cost contract for the remainder of the Work on the Niagara Tunnel facility; and
- G.** The Corporation and Strabag have negotiated a Target Cost of \$985,000,000 and a Target Schedule of June 15, 2013, and intend to enter into an Amended Design Build Agreement to amend the Original Agreement to reflect the terms and conditions of an open book Target Cost for the remainder of the Work, including the negotiated changes in the capital cost and schedule.

BE IT RESOLVED THAT:

1. The Board of Directors approve authorization to spend a maximum of \$1,600,000,000 for completion of the Niagara Tunnel facility project, as described in the Board Memorandum dated May 21, 2009.
2. OPG's President and Chief Executive Officer, or his delegate, together with one of: the Chief Financial Officer, the Chief Operating Officer, or the Executive Vice President, Hydro, is authorized to execute and deliver in the name of and on behalf of the Corporation and under its corporate seal or otherwise and agree on all terms and conditions as appropriate or necessary in connection with the Amended Design Build Agreement, with a target cost of \$985,000,000 subject to adjustment in accordance with the terms of the Amended Design Build Agreement, for the Niagara Tunnel facility. Such execution and delivery shall be conclusive evidence of the agreement of the Corporation to the terms and conditions contained therein.
3. OPG's President and Chief Executive Officer, or his delegate is authorized to execute and deliver in the name of and on behalf of the Corporation and under its corporate seal or otherwise all such instruments, agreements, notices, certificates and other documents and do all such acts and things as in the opinion of such persons may be necessary or desirable in connection with the Amended Design Build Agreement or the performance by the Corporation of its obligations under the Amended Design Build Agreement.

APPENDIX B

RESOLUTION OF THE BOARD OF DIRECTORS OF ONTARIO POWER GENERATION INC.

Re: Amendment to the Niagara Tunnel Financing Agreement

WHEREAS:

- A. The Board of Directors at its July 28, 2005 meeting, approved Ontario Power Generation Inc. (the "Corporation") spending up to CAD \$985,000,000 (nine hundred and eighty five million dollars) with respect to the construction of a third tunnel to the Sir Adam Beck generating stations at Niagara Falls, Ontario (the "Project"), subject to OPG arranging satisfactory financing;
- B. The Corporation entered into a Credit Facility Agreement dated September 21, 2005 (the "2005 Credit Facility Agreement") between the Corporation and Ontario Electricity Financial Corporation ("OEFC") pursuant to which the Corporation may borrow up to CAD \$1,000,000,000 (one billion dollars) to finance the Project;
- C. The Board of Directors at its November 10, 2005 meeting, the Board of Directors ratified and approved the execution and delivery of the 2005 Credit Facility Agreement;
- D. The Project has advanced slower than originally planned and a dispute arose between the Corporation and the contractor (Strabag Inc.) with regard to the existence of differing subsurface conditions. When the dispute could not be resolved it was submitted to the Dispute Review Board (DRB) under the contract between the Corporation and the Contractor (the "Contract") for the Project. Following receipt of the DRB's recommendations, the Corporation and the contractor have negotiated a change in the Contract to a target cost contract which is expected to impact both the completion schedule and increase the Project cost estimate to \$1,600,000,000; and
- E. To finance the revised Project, the Corporation proposes to enter into an amended 2005 Credit Facility Agreement with the OEFC, pursuant to which OPG may borrow up to \$1,600,000,000 in respect of the Project.

BE IT RESOLVED THAT:

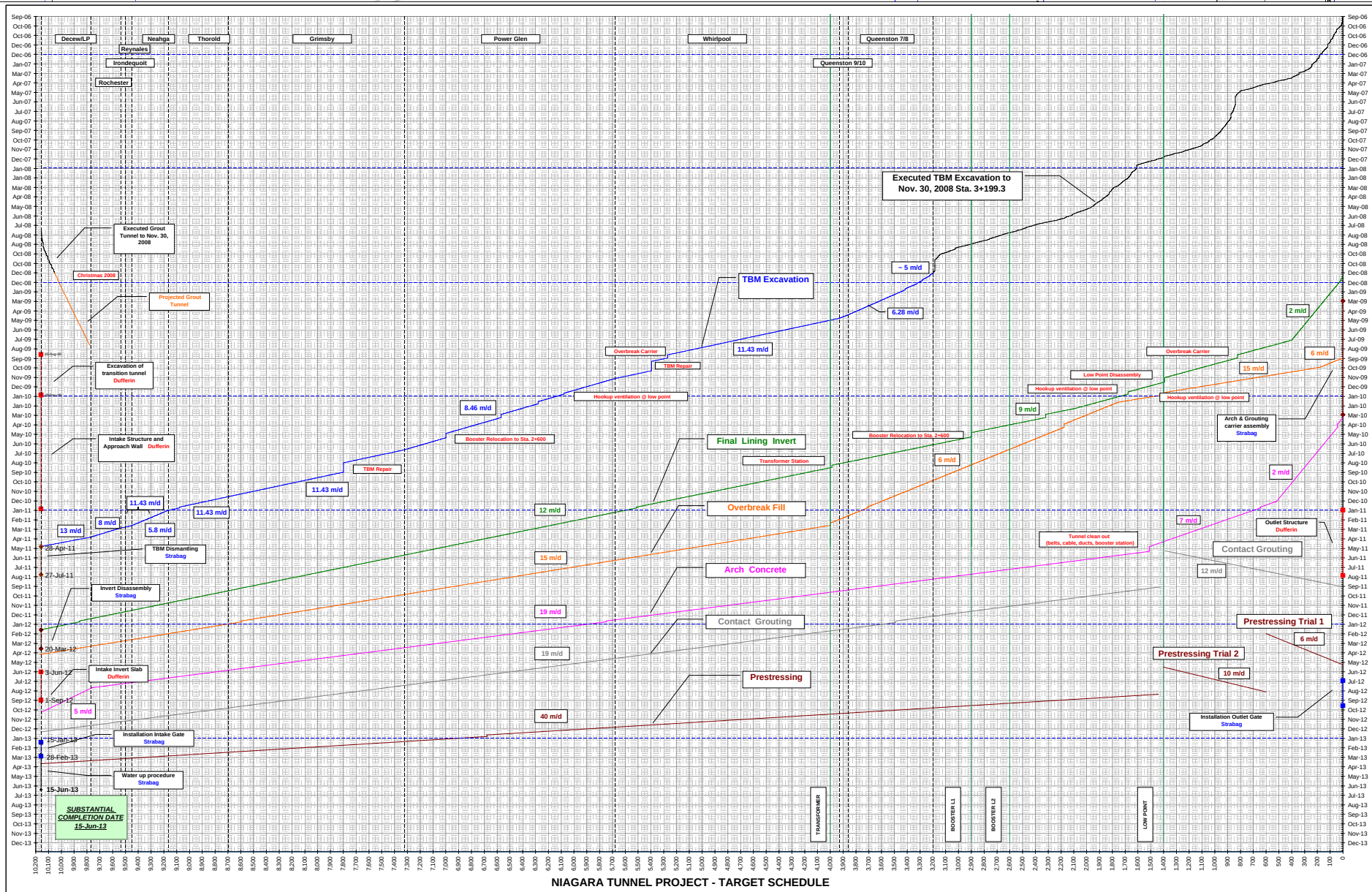
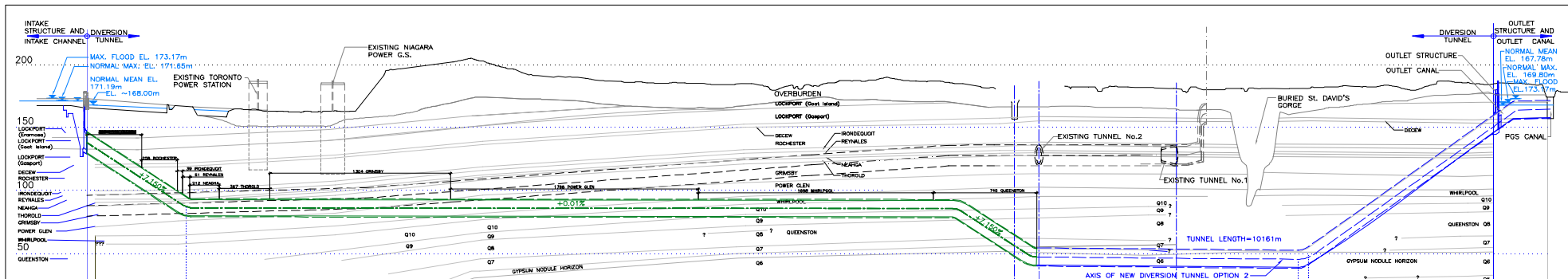
- 1. The Corporation is authorized to enter into either an amendment to, or a renewal and restatement of, 2005 Credit Facility Agreement (the 2005 Credit Facility Agreement as so amended, or renewed and restated hereafter known as the "Credit Facility Agreement") between the Corporation and Ontario Electricity Financial Corporation pursuant to which the Corporation may borrow an amount not to exceed CAD \$1,600,000,000 (one billion six hundred million dollars) to finance the completion of the Project.
- 2. Any two of the officers of the Corporation, including at least one of the Chief Financial Officer or the Vice President, Treasurer, are hereby authorized to execute and deliver the Credit Facility Agreement in the name and on behalf of OPG and under its corporate seal or otherwise and such execution and delivery shall be conclusive evidence of the agreement of OPG to the terms and conditions contained therein.

3. Any two directors or officers of the Corporation, or their delegates, are hereby authorized to execute and deliver all such borrowing notices, designations and instruments and to do all such other acts and things, including executing and delivering notes, as may, in the opinion of such persons, be necessary or desirable to give effect to the Credit Facility Agreement and to implement the intent of this resolution.
4. From time to time any two of the officers of the Corporation, including at least one of the Chief Financial Officer or Vice President, Treasurer, are authorized to execute and deliver such amendments to, renewals or restatements of the Credit Facility Agreement as the persons signing the same may approve, such approval to be conclusively evidenced by their signatures, provided in all cases that the amount of the Credit Facility Agreement shall not exceed CAD \$1,600,000,000.

APPENDIX C MILESTONE SCHEDULE

Activity	Start Date	End Date	Duration (days)	Avg Rate (m/day)
Award DBA	18-Aug-05	18-Aug-05	0	n/a
TBM Supply & Assembly	01-Sep-05	01-Sep-06	365	n/a
TBM to 3,619m	01-Sep-06	02-Mar-09	913	4.0
TBM - 3,619m to Intake	03-Mar-09	28-Apr-11	786	8.4
Invert Concrete	15-Dec-08	20-Jan-12	1,131	9.0
Overbreak Infill	01-Sep-09	08-Apr-12	950	10.7
Arch Concrete	11-Mar-10	11-Oct-12	945	10.8
Liner Contact Grouting	11-May-11	12-Dec-12	581	17.6
Liner Pre-Stress Grouting	01-Feb-12	24-Mar-13	417	24.5
Complete Intake Structure	28-Dec-09	28-Dec-10	365	n/a
Complete Outlet Structure	01-Jan-11	30-Jul-11	210	n/a
Install Intake Gates	23-Feb-13	28-Feb-13	5	n/a
Install Outlet Gates	01-Jul-12	19-Sep-12	80	n/a
Fill Outlet Canal & Tunnel	26-Mar-13	31-Mar-13	5	n/a
Remove Intake Cofferdam	01-Mar-13	14-Jun-13	105	n/a
Remove Outlet Rock Plug	01-Apr-13	14-Jun-13	74	n/a
Tunnel In-Service Date	15-Jun-13	15-Jun-13	0	n/a

Note: the Target Schedule was based on actual progress to March 2, 2009 (3,619m).



NIAGARA TUNNEL PROJECT - TARGET SCHEDULE

APPENDIX D

AMENDED DESIGN BUILD AGREEMENT

SUMMARY OF KEY TERMS

The following is a summary of amendments and additions to the material terms and conditions of the Amended Design Build Agreement for the Niagara Tunnel Project (the “ADBA”).

I. EXECUTIVE SUMMARY

The Original Design Build Agreement (the “DBA”) was used as the base for the ADBA. It has remained unchanged for the most part except for changes necessary to give effect to the conversion to a Target Cost contract. Under the Target Cost contract, OPG and the Contractor have agreed on a Target Cost and a Contract Schedule. The Contractor will be entitled to its costs to perform the Work and incentives will apply if the Contractor completes the Project for less than the Target Cost or before the scheduled Substantial Completion Date. Conversely, disincentives will apply if the costs exceed the Target Cost or completion is after the scheduled Substantial Completion Date.

II. DEFINITIONS (SECTION 1)

<i>Actual Cost</i>	Means the \$302 million for all amounts paid to the Contractor prior to December 1, 2008 plus the cumulative amount of Allowed Cost from the Effective Date and net of proceeds on the sale of assets and any insurance proceeds received by the Contractor.
<i>Allowed Costs</i>	Means costs incurred in the Work that are not Disallowed Costs, including the actual cost invoiced to the Contractor by Subcontractors.
<i>Contract Price</i>	Means the Actual Cost, plus or minus any incentives or disincentives, plus the Overhead Recovery Fee.
<i>Disallowed Costs</i>	Means costs not included in Allowed Costs, such as the costs arising from the Contractor's breach of the standard of care (negligence) or wilful misconduct of the Contractor, business development costs, costs to vacate liens, head office costs, income and withholding taxes, social events, senior staff, legal costs, costs arising from breach of applicable laws, costs of indemnities in favour of OPG, and third party liability.
<i>Overhead Recovery Fee</i>	Means 5% of Actual Costs incurred on or after the Effective Date (December 1, 2008).

III. CONTRACTOR'S OBLIGATIONS (SECTION 2)

The Contractor's obligations are essentially the same as under the original DBA except for the following material changes:

<i>Tunnel Facility Project Organization and Quality Assurance</i>	The Contractor will ensure that (i) a senior tunnel design engineer is present on Site on a continuous basis, as agreed by the Parties or when requested by OPG; and (ii) appropriate designer representatives are made available on-Site whenever requested by OPG. The Contractor will retain a full time third-party quality assurance manager, as an Allowed Cost.
<i>Fault Standard</i>	The costs arising from a stop work order or a Hazardous Condition are now Allowed Costs and there is an adjustment to the Target Cost and Contract Schedule except where the underlying circumstances are attributable to the negligence or wilful misconduct of the Contractor (in which event the costs are Disallowed Costs and there is no adjustment). Similarly, the Contractor's indemnities to OPG for safety and environmental violations are limited to circumstances attributable to the Contractor's negligence or wilful misconduct.

OPG Interference	Where the Contractor is required to obtain OPG's consent to take an action, the ADBA provides that, where OPG's actions have an impact on cost or schedule, the Contractor is entitled to an adjustment to the Target Cost and/or Contract Schedule. These events are: (1) OPG objects to a change or addition to Major Subcontractors; (2) OPG objects to a work approval for foreign nationals; (3) OPG objects to the Contractor accessing an area outside the Site; and (4) OPG objects to a supplier of Goods.
Major Subcontractors and Suppliers of Goods/Lands	The Contractor will advise OPG in advance of any proposed changes or additions to Major Subcontractors (defined as a Subcontractor where the value of all contracts with such Subcontractor exceeds \$100,000 in the aggregate) and of the names of any proposed suppliers of Goods for requirements greater than \$100,000 and OPG may object. OPG's prior written approval is required for the Contractor to acquire any interest in land with an acquisition cost greater than \$100,000.
Indemnity for Subcontractors	OPG is seeking an indemnity to cover claims that may arise as a result of Subcontractors performing work under unsigned contracts.
Release	In consideration of the receipt from OPG of a one-time payment for cost overruns incurred prior to the Effective Date, the Contractor releases and forever discharges each member of the OPG Group from any and all actions arising prior to the Effective Date.
Cooperation	The Contractor will co-operate with OPG to minimize Actual Costs, monitor construction risks, disclose information, provide records to OPG, and co-operate with OPG's inspections and audits of the Contractor and Major Subcontractors.
Audit Rights	OPG will be entitled, at its expense, to audit records and to have access to the Contractor's facilities or any Major Subcontractors from which Work is performed in order to verify charges and compliance with the ADBA.

IV. SECURITY DOCUMENTS AND INSURANCE (SECTION 4)

Required Insurance	OPG to procure builder's all risk insurance (now to an aggregate value of Target Cost, plus the Interim Completion Fee, plus the Substantial Completion Fee, plus the Overhead Recovery Fee).
Insurance Deductibles	The Contractor will pay all deductibles as a Disallowed Cost, except for deductibles under the builder's all risk insurance, where claims for the TBM or Underground Works are treated as a Major Risk Event (thereby adjusting the Target Cost) and are an Allowed Cost. For all other claims under the builder's all risk policy, the Actual Cost and Target Cost will be adjusted by 50% of the \$250,000 deductible and the remaining 50% will be a Disallowed Cost in the event of a claim.

V. CHANGES IN WORK (SECTION 5)

Changes requested by OPG	OPG may make changes at any time by issuing a Project Change Directive. For Project Change Directives, the Contractor is entitled to an adjustment in Target Cost and/or Contract Schedule.
Changes requested by the Contractor	No changes are permitted without OPG's prior written consent in a Project Change Directive.
Changes in Applicable Laws	OPG will be responsible for the effect on cost and time of such a change.
Insurable Events	If an event covered by the builders' all risk insurance policy occurs which directly impacts the Substantial Completion Date, OPG will issue a Project Change Directive indicating the extent of a change in the Target Cost and/or the Contract Schedule.
Force Majeure Events	If a Force Majeure event occurs, the Contractor will not be responsible for any delay in the Contract Schedule and the Contract Schedule and Target Cost may be amended to reflect the delay and any increased costs.
Major Risk Events	If a Major Risk Event occurs, the Target Cost and/or Contract Schedule will be adjusted on the basis set out in an Appendix (Major Risk Table).

Target Cost Baseline Items	Changes to the Target Cost Baseline Items (the assumptions that the Target Cost was based on) will result in an adjustment to the Target Cost.
OPG Caused Events	Where a delay is caused by OPG, the Contractor will be entitled to an adjustment in the Contract Schedule and/or Target Cost.

VI. PAYMENT OF CONTRACT PRICE (SECTION 7)

Application for Payment	OPG will make monthly payments based on estimated costs for the next month. OPG shall pay the Contractor the purchase price of capital assets and inventory when the Contractor is invoiced by the supplier of the assets.
Advance Payment	OPG will make a one-time advance payment of \$3,500,000 to provide the Contractor with an interest neutral position throughout the life of the ADBA and this amount shall be credited to OPG against either the final payment to the Contractor or payment of the Substantial Completion Fee.
One-Time Adjustment	OPG will pay the Contractor a one-time adjustment for Actual Costs incurred from December 1, 2008 to the date of the execution of the ADBA.

VII. PERFORMANCE INCENTIVES (SECTION 8)

Calculation of Disincentive for Delay	The Contractor will pay OPG \$67,000 for each complete day that the actual date of Substantial Completion falls after the date for Substantial Completion set out in the Contract Schedule.
Incentive for Early Substantial Completion	OPG will pay the Contractor \$200,000 for each complete day that the actual date of Substantial Completion falls before the date for Substantial Completion set out in the Contract Schedule.
Cost Performance Disincentive	If Actual Costs exceed the Target Cost, the Contractor will pay OPG an amount equal to 50% of the difference between Actual Cost and the Target Cost.
Cost Performance Incentive	If Actual Costs are less than the Target Cost, the Contractor will receive an amount equal to 50% of the difference between Actual Cost and the Target Cost.
Incentives and Disincentives Related to Guaranteed Flow Amount	Unchanged from DBA.
Maximum Disincentive/Incentive	Total amount of disincentives payable by the Contractor shall not exceed \$20,000,000 and the total amount of incentives received by the Contractor shall not exceed \$40,000,000.
Completion Fees	Strabag is entitled to a \$10,000,000 Interim Completion Fee payable, on the TBM Completion Date provided progress on the tunnel lining is in accordance with the Contract Schedule, or on achieving Substantial Completion otherwise. Strabag is also entitled to an additional \$10,000,000 Substantial Completion Fee payable upon achieving Substantial Completion.

VIII. ACCEPTANCE OF TUNNEL FACILITY PROJECT AND CORRECTION OF DEFECTS (SECTION 9)

Warranty	Costs for warranty work will be Disallowed Costs, except for an administration fee for warranty work to be paid by OPG in the final month of the ADBA. The administration fee will be \$100,000 per year of Warranty Period existing on the date of Substantial Completion (pro-rated for partial years). Rework recommences the warranty and OPG will pay a one-time \$50,000 administrative fee.
Indemnity	The Contractor will now only indemnify OPG from losses arising in respect of the Work where such Losses are attributable a breach of the ADBA by the Contractor; or by the negligence or wilful misconduct of the Contractor. (Under DBA, the Contractor indemnified OPG for all losses arising out of an action or omission of the Contractor.)

<i>Correction or Removal of Defective Parts</i>	If Defective Work is discovered by OPG, all correction costs are Disallowed Costs. If Defective Work is discovered by the Contractor and brought to the attention of OPG, the correction costs are Allowed Costs. Correction costs attributable to the negligence or wilful misconduct of the Contractor or any error or omission of the Contractor are Disallowed Costs.
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IX. DEFAULT (SECTION 10)

<i>Events of Default</i>	Event of default for breach of covenant/representation and warranty to be triggered on material breach only. Previously, any breach was an event of default.
<i>OPG Termination and OPG's Recourse</i>	Contractor will be liable for costs in excess of the Target Cost to entirely finish the Work, costs to correct defective Work and all other losses suffered in respect of the event of default.
<i>Limitation of Liability</i>	Subject to certain exceptions (no longer including breaches of environmental laws and correction or removal of defective parts of the Project since they are considered Disallowed Costs now), the Contractor's liability is limited to the greater of the Target Cost and the insurance recoverable. There is no limitation on Disallowed Costs.
<i>OPG's Liability</i>	OPG's maximum liability for breach of ADBA will not exceed the Contract Price. Note: <i>This remains the subject of negotiation and may change to Target Cost</i>

X. DISPUTE RESOLUTION (SECTION 11)

<i>Disputes</i>	Parties will establish a Steering Committee for informal resolution of disputes. Unless the Steering Committee otherwise agrees, unresolved Disputes will be held in abeyance until the earlier of Substantial Completion or termination of the ADBA.
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XI. SUSPENSION OF WORK AND TERMINATION (SECTION 13)

<i>Suspension of Work</i>	If OPG suspends Work, OPG will pay Contractor reasonable extra direct damages arising from the suspension and the Target Cost and Contract Schedule will be equitably adjusted unless the suspension results from default, negligence or wilful act or omission of Contractor.
<i>Termination for Convenience</i>	OPG may terminate any unprovided Work without being liable to Contractor for consequential damages, losses, economic losses, etc. On termination of the contract for convenience OPG will pay Contractor the Interim Completion Fee irrespective of the date of termination, and the Substantial Completion Fee if as of the date of termination, Strabag is projected to be less than 12 months late. OPG will also be required to pay Strabag incentives as follows: ▪ if OPG terminates prior to Jan 1, 2012, and cancels the Project (i.e. does not restart it with a different contractor within 5 years), no incentives are payable to Strabag; ▪ if OPG terminates after Jan 1, 2012, and Strabag is on or ahead of the Target Cost and/or Contract Schedule, OPG will pay Strabag incentives calculated based on how much Strabag is ahead of the Contract Schedule or better than Target Cost at time of termination (for eg. if Strabag is ahead of Contract Schedule by 20 days at the time of termination it would be entitled to 20 days X \$200,000=\$4,000,000)

APPENDIX E
MAJOR RISK TABLE

Appendix E - Niagara Tunnel Project Major Risks Table

Risk #	Risk	Objectives	Cause of Risk	Mitigation	Remediation/Plan B	Assumptions	Milestones	Comments
1	TBM Main Bearing Failure delays project completion and increases project costs	On time and on budget	Main bearing failure, damaged seals, dirt in hydraulics, rock conditions, and poor maintenance.	1. L10 life with sufficient safety factor; 2. Selection of a TBM with a proven design; 3. Contingency planning; 4. Bi-weekly oil sampling; 5. Careful adjustment of thrust with mixed face; 6. Regular inspections by remote camera; and 7. Secure bearing and bring bearing closer to site (Ohio possibly).	Replace TBM main bearing.	Spare bearing exists. <u>Burn Rate:</u> Contractor - \$240,000/day OPG & Hatch - \$20,000/day Interest - \$160,000/day Total - \$420,000/day	Risk expires at the end of tunnel mining April 2011 (i.e. TBM @ CH 10,170 m).	If bearing is not available, then the delay is 18 months to manufacture the bearing. Consider shipping delays due to winter weather. P5 is best case scenario where lining work has not started yet and so less delay. Cost of bearing is 1.5 million euros. L10 (15,000 hours) based on operating/drilling time, so even though the project duration lengthened. 6,000 hours actual expected drilling time. Financial impact does not include labour costs. Labour included in schedule delay costs.
2	Main Conveyor Failure delays project completion and increases project costs (10 km belt failure)	On time and on budget	Rock conditions, steel or rock slicing the belt, poor maintenance and poor operating practices/ monitoring.	1. Metal detection; 2. Contingency planning; 3. Keep critical spare parts and belts on site; 4. Video monitoring cameras on conveyor belt; 5. Increased visual monitoring; 6. Conveyor structural (rollers) inspection.	Replace the conveyor belt.	10 km conveyor belt failure (5 km of tunnel). Belt readily available to install is P5 scenario. <u>Burn Rate:</u> Contractor - \$240,000/day OPG/Hatch - \$20,000/day Interest - \$160,000/day Total - \$420,000/day	Risk expires at the end of tunnel mining April 2011 (i.e. TBM @ CH 10,170 m).	Financial impact does not include labour costs. Labour included in schedule delay costs.
3	Inundation or flooding of tunnel from intake	On time, on budget and safety	Cofferdam breach	1. Cofferdam height designed for 50 year return. 2. Design checks by contractor. 3. Review by OR. 4. Close contact and cooperation with INCW operators. 5. Monitoring system to check phreatic surfaces within cofferdam cells. 6. Leakage monitoring of cofferdam. 7. Seasonal inspection, as well as translational and tilting movements of the cells throughout the entire period when the cofferdam is dewatered and reviewed by cofferdam designer (Isherwood). 8. Ensure valve is locked out and cannot be operated. 9. Maintenance plan for extended life.	Dewater, restore all equipment, repair/replace cofferdam cells.	Worst case: everything floods. Flood TBM, invert carrier, and arch carrier. 8 weeks to repair cofferdam, 4 months to dewater (need to procure pumps and deliver). P5 - everything survived. P95 - replace concrete, repair damaged carrier. Assume no loss of life. <u>Burn Rate:</u> Contractor - \$200,000/day OPG/Hatch - \$20,000/day Interest - \$200,000/day Total - \$420,000/day Financial impact does not include labour. Assume minimal cost to repair cofferdam. P5 - Insurance covers equipment and materials repair.	Starts upon completion of tunnel mining (i.e. April 2011) until gates at intake are in place (i.e. March 2013).	Original contractual removal date is September 2009.
4	Critical work impeded by winter restrictions	On time, on budget, and safety	Ice conditions preventing marine activity.	Plan the work to minimize the amount of marine activity required.		Worst case: cofferdam removal occurs during winter months. Cofferdam removal is currently scheduled during winter 2013. <u>Burn Rate:</u> Contractor - \$200,000/day OPG/Hatch - \$15,000/day Interest - \$210,000/day Total - \$425,000	Starts December 2012 and ends mid-April 2013 (end of winter conditions).	
5	Tunnel collapse	On time, on budget, safety and quality	Liner overstress, support failure, engineering error/omission, rock conditions and water ingress.	1. Independent design reviews by Contractor and OR. 2. Geotechnical presence on site (full time). 3. Regular interfacing with designer. 4. Design/adjustments as required during construction. 5. Tunnel instrumentation and monitoring of rock support. 6. Clearly defined support for the whole range of expected ground conditions. 7. Material testing (rock dowels, shotcrete). 8. Monitoring, Convergence monitoring for cracks 9. Regular review of convergence measurements by designer/ Experienced supervision/ Design of TBM minimizes unsupported length of tunnel/ On-site presence of tunnel designer (ILF) from June 2009 onwards.	Repair and restore tunnel.	Localized collapse of tunnel (of 10 - 20 m) that damages major equipment (i.e. TBM, invert forms, conveyor, ventilation etc). Insurable event with \$1,000,000 deductible. Worst case: collapse of temporary liner, since permanent liner collapse would lead to more localized collapse. P5 is minor localized damage etc. <u>Burn Rate:</u> Contractor - \$240,000/day OPG/Hatch - \$20,000/day Interest - \$200,000/day Total - \$460,000/day Insurance deductible for P5.	Risk expires October 2012 (i.e. arch lining completion).	Emergency evacuation plan in place

Appendix E - Niagara Tunnel Project Major Risks Table

Risk #	Risk	Objectives	Cause of Risk	Mitigation	Remediation/Plan B	Assumptions	Milestones	Comments
6	Community Impact Agreement renegotiation	On budget and corporate reputation	Increased project duration leads to additional impact on Niagara community infrastructure	1. Effective negotiation strategy and communication with stakeholders. 2. Ensure continued compliance with terms of Community Impact Agreement (CIA).		Project end date of June 2013.	Expires June 2013 (Completion of project)	Existing money in the CIA fund and can be used instead of additional funds. This item should be moved to base estimate.
7	Unanticipated problems removing equipment	On time and on budget	Access and spatial constraints, logistics, etc.	Proper planning (including staging of equipment (e.g. cranes, cutting equipment).		Craning and spatial constraints for TBM and arch carrier are the biggest/most complex pieces of equipment to remove from tunnel, therefore more prone to unanticipated problems. Assume arch lining operation and grouting operation interference. Critical path, if arch carrier catches up with TBM. <u>Burn Rate:</u> Contractor - \$240,000/day OPG/Hatch - \$20,000/day Interest - \$200,000/day Total - \$460,000/day Does not adjust the target cost or target schedule, but does affect actual schedule.	Risk commences May 2011 and expires March 2013 (i.e. scheduled removal of all equipment from tunnel).	Is there a crane big enough with the reach needed to remove the main bearing?
8	Delays in providing outage for rock plug removal	On time and on budget	Inability to provide outage when contractor requires it	1. Early engagement of Independent Electricity System Operator (IESO) to understand consequence of rock plug outage and improve chance of getting outage when it is needed. Communicate request for flexibility to IESO. 2. Communicate outage changes to IESO as soon as possible.		Source of outage delay comes from IESO. Note: IESO needs 18 months notice and NTP can only provide approximately 6 months notice of when they think rock plug removal would be required. Spring or fall might be easier to get an outage from IESO since there could be less demand, however system status could be a factor (e.g. nuclear station vacuum building outages). <u>Burn Rate:</u> Contractor - \$200,000/day OPG/Hatch - \$10,000/day Interest - \$210,000/day Total - \$420,000/day Assume bonus for 200,000/day for Contractor.	According to schedule April 2013 to June 2013 (i.e. Water-up procedure).	Dewatering structure in canal to be removed because it reduces flow. Outage only applies to Sir Adam Beck Pump Generating Station (SAB PGS).
9	Delayed tunnel mining due to health and safety hazards	Safety, on time and on budget	Falling rock conditions, silica, methane, hydrogen sulphide, carbon monoxide and oxygen concentration.	1. Design ventilation and dust abatement systems. 2. Implementation of ventilation and dust abatement systems (e.g. foam in cutterhead, water mist sprays). 3. Regular operation of ventilation system and optimization/maintenance of dust abatement system. 4. Wearing of personal protective equipment (PPE).	Respirators (full face masks). Worker training.	High Silica concentration is worst case. Assume hazard is identified before major event through monitoring of conditions. Use of full faced respirator due to high silica in Whirlpool Sandstone is not included in scheduled labour progress. <u>Burn Rate:</u> Contractor - \$240,000/day OPG/Hatch - \$20,000/day Interest - \$120,000/day Total - \$380,000/day Does not include any health claims after project completion. 50/50 effect of schedule delay to critical path.	According to schedule April 2009 to January 2010. TBM mining in Whirlpool formation to Power Glen 2 formation).	

Appendix E - Niagara Tunnel Project Major Risks Table

Risk #	Risk	Objectives	Cause of Risk	Mitigation	Remediation/Plan B	Assumptions	Milestones	Comments
10	Prototype overbreak infill operation prolongs schedule	On time, on budget, safety and quality	Prototype operation for arch infill and initial setup delays (i.e. procurement & delivery of equipment).	1. 3 months of planned float in the schedule. 2. Planned learning curve via slow initial progress rate. 3. Properly designed system.	Timely modifications to improve the efficiency of the infill operation.	Critical path. Scheduled advance rate is based on expected average shotcrete delivery and discharge rate (i.e. site shotcrete limitations). 3 month float in schedule. 3 km length for infill operation. <u>Burn Rate:</u> Contractor - \$200,000/day OPG/Hatch - \$20,000/day Interest - \$200,000/day Total - \$420,000/day Based on 24/7 operation, 2 production shifts.		Some flavour of concurrent activities, could cause double counting. 7 months until it becomes critical path. 3 months float at the end (i.e. conditioning work, not infill activities). In worst case, then 2 months impact on critical path. Delivery & procurement could be 2 months delay. Delay in critical path due to late delivery of carrier (delays start date). Financial impact is slower progress in Queenston Shale.
11	Concurrent activities delay progress	On time, on budget	Logistics of concurrent activities.	1. Proper planning of logistics in the tunnel. 2. Adequate passing bays in the tunnel. 3. Traffic control system. 4. Ensure TBM mining is on schedule. 5. Ensure arch infill carrier is launched on schedule.		Worst case: shutdown arch lining activities because of too many concurrent activities. Assume that it does not occur at the end. <u>Burn Rate:</u> Contractor - \$240,000/day OPG/Hatch - \$20,000/day Interest - \$160,000/day Total - \$420,000/day	Risk expires in April 2011 (i.e. when TBM mining complete).	Short window where TBM and arch infill activities occur concurrently. Impact of TBM mining rate affects this risk.
12	Nonconformance and/or noncompliance is identified and requires rework	Quality, on time, and on budget	Contractor performance leads to inadequate design and construction quality, inadequate quality control and assurance.	1. OPG full-time presence during construction. 2. Structured submittal and stringent design review process by Hatch and Strabag. 3. Monitoring of construction works against plan (Hatch and Strabag). 4. Review formal non-compliance process of Contractor QC reports regularly 5. Full time quality assurance manager built into contract.		Worst case: re-pouring of concrete, tearing out localized areas of liner and membrane (i.e. aggregate of 25 m) because of substandard concrete/thickness, etc. Concrete placement at \$40,000 per m and removal at \$20,000 per m. Assumes all nonconformances/noncompliances are detected. Quality concerns discovered during operation are outside the scope of this analysis. Assume no schedule delay so no burn rate.	March 2010 (i.e. arch lining commences) to October 2012 (i.e. arch lining completion).	Adjust target if structure is removed and no problem is found.
13	Contract management problems increases project costs	On budget, on time, quality aspects	Unanticipated claims, inadequate Design Build Agreement contract, successful subcontractor claims, inadequate owner involvement during contract execution, frivolous claims	1. Revision and use of project execution plan (PEP) and detailed project procedures. 2. Periodic review and update of PEP. 3. OPG conducting intermittent audits. 4. Well defined contract language around disallowed costs. Adequate contract language to clearly define contractor's obligations. 5. Adequate and proactive Owner oversight.		Worst Case: unexpected ground conditions (e.g. sidewalls spalling affecting gripper efficiency). Frequency and magnitude of occurrence captured in P95. Assume no schedule delay so no burn rate.	Risk expires one year after project completion (i.e. 1 year limitation on claims).	Target date extended due to claims.
14	Lower than planned TBM progress in each rock strata due to overbreak above baseline	On time and on budget	Rock conditions	1. Reviewed historical TBM progress in different strata and incorporated into schedule. 2. Set target rates for anticipated overbreak. 3. Engagement of field engineer to optimize solutions for dealing with rock conditions.		No contingency in TBM mining schedule. Schedule includes planned maintenance and historical unplanned outages. Estimates includes slower than anticipated progress due to rock conditions, unanticipated cutter destruction and unanticipated machine issues. <u>Burn Rate:</u> Contractor - \$240,000/day OPG - \$20,000/day Interest - \$160,000/day Total - \$420,000/day Assume exceeding overbreak calculations already built into schedule.	Risk expires after TBM mining (i.e. scheduled April 2011).	
15	Adverse impact to existing structures	Impact to OPG, on budget, on time	Effects of tunneling near existing tunnels and structures			Worst case is damaging the tunnel. \$500 million/year to repair tunnel. Lost revenue for one tunnel \$300k/day. Dewatering time is 365 days.		

Appendix E - Niagara Tunnel Project Major Risks Table

Risk #	Risk	Objectives	Cause of Risk	Mitigation	Remediation/Plan B	Assumptions	Milestones	Comments
16	OPG Abandons Project	Reputation, Costs, Impact to OPG	Shareholder does not approve financing, OPG chooses not to proceed with project					The quantitative analysis is based on the expectation that the Niagara Tunnel Project is completed under a new Design Build Agreement with Strabag. It is recommended that this risk and its financial impact be considered as an alternative in the superseding business case.
17	Cost Recovery Uncertainty	Impact to OPG	Non prudent costs associated with the project are incurred					This is not an execution phase project risk. It is recommended that the financial impact of this risk be included in the operating revenue of the superseding business case NPV calculations.
18	Tunnel does not meet 90 year life or does not meet substantial performance requirements	Quality, on time, and on budget	Contractor performance leads to inadequate design and construction quality, inadequate QC and assurance					This is not an execution phase project risk. It is recommended that the financial impact of this risk be included in the operating revenue of the superseding business case NPV calculations.
19	Contractor defaults on its obligations	On time, on budget, impact on OPG	Potential of significant loss					The quantitative analysis is based on the expectation that the Niagara Tunnel Project is completed under a new Design Build Agreement with Strabag. The approach taken by the project team is to consider the consequences of this risk should it occur through another superseding business case.