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September 14, 2016  
Kirsten Walli  
Board Secretary  
Ontario Energy Board  
P.O. Box 2319  
2300 Yonge Street, 27th Floor  
Toronto ON M4P 1E4

Dear Ms. Walli:

**Re: Ontario Power Generation Inc. 2017-2021 Payment Amounts, EB-2016-0152**

Energy Probe Research Foundation (“Energy Probe”) plans to submit evidence in response to Ontario Power Generation’s (OPG) 2017-2021 Payment Amounts application. Our evidence will deal solely with the cost of the Darlington Refurbishment Project (DRP), which OPG is forecasting will cost \$12.8 billion to complete.

**The Experts:**

The evidence will be submitted by a team from Oxford Global Projects Ltd. (Oxford), which was established to present the latest academic thinking and research on megaprojects from around the globe. The group was founded in 2012 and has advised projects, companies and governments in a range of industries, including transport, energy, IT and health care.

The team will consist of two members, Prof. Bent Flyvbjerg and Alexander Budzier. A brief CV for the two members is attached.

**The Evidence:**

Oxford has looked at more than 6,000 projects of a wide range of sizes, industries and countries – including 180 nuclear energy projects. It has found that only 3 in 100 nuclear projects met their cost targets, with 85% of the projects exceeding their initial cost estimate by 10% or more. 9 out of 10 nuclear projects miss their schedule target by 10% or more.

The reason for these cost overruns and schedule delays is that those responsible for setting budgets and timelines do so on an “inside view”, meaning the projects and price tags are estimated by breaking down the constituent parts. By splitting a project into its constituent parts, planners and project managers systematically underestimate the needed cost, schedule and effort, while overestimating the achievable benefits.

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In contrast, Oxford's evidence will employ a technique known as Reference Class Forecasting (RCF), which takes an "outside view" in determining the final price tag of major infrastructure projects. RCF more accurately determines the budget, schedule and benefits of a megaproject.

RCF provides 5 key benefits:

- Greater transparency on the risk profile of the project and hard evidence to support and challenge expert judgments;
- Greater resource allocation through outside-in view, providing a better estimate on expected costs, benefits, and schedules;
- Allows managers to focus on the project itself rather than fighting for budget increases, scope reductions and contract re-negotiations;
- A decrease in planning uncertainty;
- Improvements in contracting by looking at hard evidence to estimate fair and realistic pricing, include pre-negotiated contingencies and realistic incentives in contracts.

### **RCF approach**

RCF was first conceived by Daniel Kahneman and Amos Tversky. In 2002, Kahneman received the Nobel Prize for this and other work. In 2004, Bent Flyvbjerg developed the method for its practical use in policy and project planning with a focus on transport infrastructure projects for the UK Department of Transport. RCF has since become the standard method to appraise large capital investment projects in the UK, Switzerland, Denmark, South Africa, Hong Kong and is endorsed in Australia, Norway, as well as by the American Planners Association and the Project Management Institute.

### **The RCF approach consists of three steps**

1. Compilation of the reference class
2. Analysis of risk exposure of the project in comparison to the reference class
3. Comparison of the inside-view forecast with the outside-view RCF

### **Compilation of the Reference Class**

The first step in a reference class forecast is the careful compilation of the reference class. The reference class needs to be as broad as possible, in order to not exclude valuable data points, while being as similar as necessary to the project that is being analysed.

The reference class is taken from Oxford's world-largest database of academic-quality project data.

### **Compare and Contrast the Estimates**

Oxford will then compare the inside-view price and schedule forecast with its RCF forecast. It will also provide recommendations on the following:

- What are the appropriate downside scenarios to stress test the affordability and economic viability of the project?
- What are the appropriate levels of cost and schedule contingencies that regulators and project managers should consider given the risk of the project?
- What steps can be taken to “de-risk” the project?
- What needs to be done to increase confidence that the project will be completed on time and on budget?
- How can the project prevent low-likelihood and high-impact risks?

### **Why the Evidence is Needed**

While the need for the DRP is laid out in legislation, the rates that ratepayers will be charged to cover the final cost are not. That decision rests solely with the OEB. If the financial and execution risk of the DRP is greater than OPG is forecasting in its application to the Board, then the rates the company is requesting are too low and, ultimately, downplay the real rate increases it will need from future ratepayers.

To date, the Board has only had OPG’s estimate – or estimates by consultants hired by OPG – for the DRP to use as a proxy for the rates needed to complete the project. Energy Probe believes that having another estimate – but more importantly, one that looks at the DRP through a different lens – will better assist the Board in setting rates that more accurately reflect the financial and economic risks the project entails.

To Energy Probe’s knowledge, this is the largest rate application that the Board has ever seen, with the DRP being the largest single line item in terms of capital spending in that application. Having an estimate from an outside organization on the overall cost of the DRP, particularly given what has occurred in previous nuclear refurbishments and other OPG projects, would assist the Board in ensuring the rates being set both keep the company whole and avoid billions of dollars in costs being pushed on to future ratepayers.

An additional estimate for the cost of the DRP will also allow the Board a better perspective on a number of other components of OPG’s application, such as:

- What level of rate smoothing is appropriate? If the final price tag of the DRP is higher than the company is currently forecasting, the risk of rate smoothing becomes even greater, as it kicks more costs to future ratepayers.
- What debt/equity ratio is important given the heightened financial risks of the DRP? If OPG is being too optimistic in its cost forecast for the DRP and contrary evidence shows that the final price tag may be higher, is OPG’s debt/equity ratio responsible?
- Is OPG’s estimate(s) for when assets will come into rate base reasonable given the risk of both cost and schedule overruns?
- Is OPG’s estimate – both in terms of final cost and scheduling – for the DRP prudent? Any prudence review entails the Board ensuring that the company took all of the necessary steps to avoid excess or unnecessary costs. Another estimate on the total cost of the DRP will provide the Board with more information on whether the company’s

forecasts on both costs and schedule are prudent when compared to other nuclear projects from around the world.

## **Costs**

Oxford has provided Energy Probe with a detailed breakdown of its costs to review the evidence, submit interrogatories, write the report, answer interrogatories and appear as a witness. Oxford is confident that its costs won't exceed its current estimates.

Oxford has offered to deliver the report and supporting activities at a fixed price of £28,000 (\$48,650 CAD).

The approximate breakdown of the work is as follows:

- 7.5 hours for overhead and planning;
- 90 hours for the creation of the reports;
- 23 hours for questioning interrogatories, incl. authors of previous reports;
- 7.5 hours for responses to interrogatories; and
- 15 hours for giving evidence as an witness, incl. preparation thereof..

Yours truly,

*Original signed by*

Brady Yauch,  
Consultant and Case Manager for Energy Probe



**Prof. Bent Flyvbjerg**  
**Mobile: +44 754 542 0572**  
**Email: flyvbjerg@oxfordglobalprojects.com**

Bent Flyvbjerg is the first BT Professor and Chair of Major Programme Management at Oxford University and the founding Director of Oxford University’s BT Centre for Major Programme Management.

Bent is a leading international expert within the field of programme management and planning, perhaps best known for his book *Megaprojects and risk – An anatomy of ambition*, widely considered as essential reading for project managers, sponsors and those involved in megaprojects. Bent is the most cited scholar in his field and his ideas on optimism bias (the tendency to take an overly positive view of planned actions), and strategic misrepresentation (deliberately misstating the likely outcomes of actions) have been incorporated into project evaluation techniques around the world. Bent continues to influence the development of project management both through his research and through teaching some of the leading programme managers of today and tomorrow.

**Current Position :** Chairman, Oxford Global Projects

**Qualifications**

Dr. Scient., higher doctorate in science, Aalborg University  
 Dr. Techn., higher doctorate in engineering, Aalborg University  
 Ph.D. in economic geography, University of Aarhus, University of California at Los Angeles

**Value to DfT**

- ✓ World-leading expert in megaproject management
- ✓ Eminent academic using innovative approaches to enhance project management capabilities of organisations
- ✓ De-risk projects and programmes and safeguard delivery
- ✓ De-bias forecasts and risk assessments through Reference Class Forecasting
- ✓ Enhance project leadership to ensure project success through world-leading programmatic

**Relevant Experience in Performing the Services**

**MTR Express Rail Link.** Estimated project cost HK\$85.3bn. Engaged as external experts to the Independent Board of MTR to review the risk of the project and assure the project cost and schedule estimates. Stress tested the project contracts against identified and unidentified risk and used top-down project analytics to quantitatively assess the cost and schedule risk of the project. The risk analytics and experts supported budget and contract negotiations.

**Reference Class Forecasts, HK Development Bureau.** Reference Class Forecasts for Highways Department, Drainage and Sewerage Department, Engineering Department. Engaged to build reference class forecasting databases and offer guidance on how to integrate reference class forecasts with existing environmental risk assessment for future projects.

**High Speed 2, United Kingdom, HS2 Ltd.** Estimated project cost GBP43bn. Engaged to establish the cost risk exposure of phase 1 and phase 2b of the project; identification of risk events and stress test of the project against risk events typical for high-speed rail projects. Risk analytics and experts supported highest level budget negotiations between HS2 Ltd, the UK Department for Transport and the UK Treasury.

**California High Speed Rail, United States, Government Accountability Office.** Planned value USD65bn. Advice on reference class forecast of cost and revenue risk exposure to assure the project’s business case.

**Finance Ministry, Danish Government, Denmark.** Planned value EUR 1.7bn. Advice on governance and procurement arrangements for infrastructure megaprojects, in particular the planned high-speed rail connection to Germany.

**Finance Ministry, Danish Government, Denmark.** Advice to professionalise project management profession for the Finance Ministry.

**Major Projects Authority, UK.** Support of the expert review led by Lord Browne into steps to improve project delivery in the UK. Adopted policy measures were the building of a profession and senior leadership development.



**Alexander Budzier**

**Mobile: +44 750 2107145**

**Email: alexander.budzier@oxfordglobalprojects.com**

Alexander Budzier is the Fellow in Management Practice at the University of Oxford's Saïd Business School. He is also the CEO of Oxford Global Projects Ltd, a specialist consultancy focussing on risk management in megaprojects.

At Oxford, he teaches on the MSc for Major Programme Management and the UK Government's Major Project Leadership Academy. His research focusses on complex transformational projects, programmes and portfolios. Alexander's research has been featured in, among others: Harvard Business Review, Financial Times, Forbes, BBC Radio 4, MIT Technology Review, ComputerWeekly, McKinsey Quarterly, InformationWeek, and BBC News.

**Current Position :** CEO, Oxford Global Projects

**Relevant Experience in Performing the Services**

**MTR Express Rail Link.** Estimated project cost HK\$85.3bn. Engaged as external experts to the Independent Board of MTR to review the risk of the project and assure the project cost and schedule estimates. Stress tested the project contracts against identified and unidentified risk and used top-down project analytics to quantitatively assess the cost and schedule risk of the project. The risk analytics and experts supported budget and contract negotiations.

**Reference Class Forecasts, HK Development Bureau.** Reference Class Forecasts for Highways Department, Drainage and Sewerage Department, Engineering Department. Engaged to build reference class forecasting databases and offer guidance on how to integrate reference class forecasts with existing environmental risk assessment for future projects.

**M+ West Kowloon Cultural District Authority.** Planned value HK\$8bn. Schedule risk assessment based on reference class of similar projects and identification of schedule risk exposure

**High Speed 2, United Kingdom, HS2 Ltd.** Estimated project cost GBP43bn. Engaged to establish the cost risk exposure of phase 1 and phase 2b of the project; identification of risk events and stress test of the project against risk events typical for high-speed rail projects. Risk analytics and experts supported highest level budget negotiations between HS2 Ltd, the UK Department for Transport and the UK Treasury.

**Qualifications**

2014 DPhil (PhD), University of Oxford

Project Management Professional (2009-2011)

**Midlands Mainline Upgrade, United Kingdom, Department for Transport.** Cost and schedule risks analysis for SOBC/OBC preparation; identification of risk events and stress test of the project against risk events typical for rail upgrade projects. Benchmark of current project capabilities against reference

## Value to DfT

- ✓ Understand the projects exposure to risk through world-class risk assessments
- ✓ Reduce the risk of high impact, rare events on the project through reducing project complexity
- ✓ De-risk strategic decisions through the use of reliable data
- ✓ Align the project through a singular focus on outcomes and benefits management
- ✓ Ensure that commercial strategies are aligned with risk exposure and incentives

class to guide risk mitigation strategies.

**Transport for London, United Kingdom, Transport for London.** Portfolio risk assessment. Cost risk assessment of 300+ contracts in the portfolio to establish the risk exposure with a view to change the procurement strategy from firm-fixed price contracts by default to partnership models.

**Fehmarn Belt, Denmark and Germany, confidential employer.** Planned value EUR 1.7bn. Schedule risk assessment of the project to establish scenarios with a view to identify long-term development of the different transport modes impacted by the project

**Hinkley Point C, United Kingdom, UK Nuclear Industry Council.** Planned value GBP19bn. Cost risk assessment to inform early outline business case planning of the project.