EB-2016-0152

Ontario Energy Board

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Sch. B, as amended;

AND IN THE MATTER OF the Application by Ontario Power Generation Inc. For 2017-2021 Payment Amounts (the "Application"), EB-2016-0152.

Interrogatories of

Energy Probe Research Foundation for Exhibit M1 and M2

December 2, 2016

INTERROGATORIES ON EXHIBIT M1

M1-Interrogatory #1

Is it Schiff Hardin's opinion that the Board, at least in regards to the Darlington Refurbishment Project (DRP), is, in its review of this application, essentially conducting a prudency review of the project? If that's not that case, can you explain how the Board would proceed with a prudency review given Schiff Hardin's and OPG evidence that the company is in line with industry practices in terms of preparing for a megaproject?

M1-Interrogatory #2

Is it Schiff Hardin's opinion that OPG should be considered to have acted "prudently" in the Definition Phase of the DRP only?

M1-Interrogatory #3

Is Schiff Hardin aware of any other energy megaprojects in North America that were given legislative approval prior to an application before a regulatory body to approve rates and in-service additions related to that project?

M1-Interrogatory #4

Are you aware of any nuclear new-build/re-build/refurbishment projects in North America that have come in on time and on budget? If so, please provide the details.

M1-Interrogatory #5

Are you aware of any regulators in North America that have required a utility to implement higher rates than are stated in their rate application in effort to potentially limit future rate increases that will occur as a result of the cost overruns and schedule delays, which are endemic to megaprojects?

M1-Interrogatory #6

Given the cost overruns that Schiff Hardin admits are common on most megaprojects, are you aware of any other regulators that allowed a utility to employ a "rate smoothing" approach and push rate increases to future ratepayers? Does Schiff Hardin think that is a good policy, considering any cost overruns will also be pushed onto future ratepayers?

M1-Interrogatory #7

Reference: Exhibit M1, page 28

On page 28 of the report, Schiff Hardin states:

"If OPG fails to create and maintain staffing levels in accordance with the staffing plan, it could adversely impact OPG's ability to effectively manage the DRP."

Should the Board be concerned that OPG has struggled to ramp up its hiring in the run-up – and eventual transition – to the Execution Phase? In your opinion, if the Board were to initiate a prudency review of the project, would the company's struggle to hit its hiring targets work against it?

M1-Interrogatory #8

Reference: Exhibit M1, page 5-6

The report states: "A high-level review is an appropriate scope of review because Schiff is not able to independently verify the appropriateness, sufficiency, or correctness of the scope of the DRP, the DRP cost estimate, or the DRP schedule. Additionally, Schiff did not perform a compliance audit to determine whether OPG has adhered to their internal policies, procedures, guidelines or any applicable legal regulations."

a). Given the above comments, how can Schiff Hardin be confident in the estimates and planning for the DRP when it hasn't considered whether the company has even followed its own policies in terms of project management?

b). Has Schiff Hardin looked at OPG's previous projects to see how its project management has improved/declined for the DRP?

M1-Interrogatory #9

Reference: Exhibit M1, page 12

On page 12 you state: "Schiff does not have an opinion regarding the content or completeness of the risk registry or whether OPG's assessment of the likelihood or magnitude of all risks or any particular risk will prove to be accurate during the execution phase of the Program."

How can Schiff Hardin – or the OEB and OPG's shareholder – be confident that the company has acted prudently in terms of recognizing and planning for the risk associated with megaprojects if you haven't examined, in detail, the company's risk registry?

M1-Interrogatory #10

Reference: Exhibit M1, page 24

On page 24, you state: "Currently, OPG has only completed the detailed schedule for Unit 2. The detailed schedules for Units 1, 3, and 4 do not yet exist and OPG's evidence does not specify when these schedules are going to be created. Depending on the size of the project controls team for both OPG and the major contractors, it may be a challenge during the Execution Phase to

monitor, update and track the Unit 2 schedule while simultaneously developing the subsequent units' detailed schedules."

Is Schiff Hardin aware of other megaprojects that attempted to create detailed schedules for future parts of a project while attempting to complete one part of the project?

M1-Interrogatory #11

Reference: Exhibit M1. Page 37

On page 37 you state: "The owner accepts greater risk due to accepting coordination of construction work and responsibility for design. Conversely, comparatively less risk is typically transferred to the contractors than in a typical single EPC, fixed-price model."

Is OPG, in your opinion, assuming more risk (to its shareholders, ratepayers and so on) by pursuing a multi-prime approach rather than other contracting strategies?

INTERROGATORIES ON EXHIBIT M2

M2-Interrogatory #1

Reference: M2/11.1

The parties appear to agree that methods of statistical inference can be usefully applied in this case. For example, in its econometric cost analysis, the PEG report states:

> Results of the econometric work for the cost model are reported in Table 7. The table also reports the values of the *t* statistic that correspond to each parameter estimate. A parameter estimate is deemed statistically significant if the hypothesis that the true parameter value equals zero is rejected. This statistical test requires the selection of a critical value for the test statistic. (p.75)

Regarding its analysis of output quantity specification, the PEG report concludes that

> The estimated cost elasticities for the generation capacity and volume were 0.906 and 0.009, respectively. The parameter estimate for the volume variable was not statistically significant. (p.48)

Both PEG and LEI base their estimate of annual total factor productivity growth from samples of hydro generators over certain time periods. Figure 27 in LEI's expert report shows that the average TFP Index Growth for the years 2002-2003 to 2013-2014 was -1.01%. In response to Undertaking JT3.24 following the Technical Conference, LEI confirmed that the standard deviation of the annual TFP Growth rate in Figure 27 was 8.40% on a sample basis and 8.06% on a population basis.

Table 3 of the PEG report provides multifactor productivity ("MFP") growth rates for the years 1996-2014. For the 1996-2014 period, the mean annual MFP growth rate was 0.29% based on

capacity and -2.03% based on volume. PEG did not provide the standard deviation for either estimate.

Table 3 of the PEG report also shows that MFP growth for the period 2003-2014 averaged 0.05% per year based on capacity and -1.83% based on volume. Again, PEG did not provide the standard deviations.

a. On page 48 of the PEG report, PEG reports that the parameter estimate for the volume variable was not statistically significant. Is this, as it appears, a regression-analysis result? Please provide the full estimated regression equation, the statistics typically calculated for the purpose of hypothesis-testing in a regression analysis, and the summary statistics typically calculated for the purpose of assessing the variance accounted for by the exogenous variables and the unexplained variance.

b. Please confirm/disconfirm that with a standard deviation of 8.4% in LEI's sample, the population mean, if it lies within one standard deviation would lie between -9.41% and 7.39%

c. To make the above more precise, please confirm/disconfirm that it is conventional in statistical inference (relying on the Central Limit Theorem) to characterize the sample mean as a normally-distributed random variable. Please additionally confirm/disconfirm that on LEI's data, the population mean inferred therefrom lies between -9.41% and 7.39% with a probability of 2/3.

d. Please calculate and confirm/disconfirm that the standard deviations for PEG's MFP growth rates (i.e. capacity and volume) for the 1996-2014 period are 1.71% and 13.56% respectively.

e. Please calculate and confirm/disconfirm that the standard deviations for PEG's MFP growth rates (i.e. capacity and volume) for the 2003-2014 period are 0.74% and 15.62% respectively.

f. The large standard deviation in LEI's sample of 8.4% suggests that the true population mean growth rate may not be statistically different from zero. Please perform the conventional one-sample statistical test of significance on LEI's sample data in Figure 27 of its report. Please use a 2-tailed test and a 5% significance criterion. Show all calculations and state the conclusion that PEG arrives at, along with any qualifying remarks that PEG feels are important.

g. Are PEG's mean annual MFP estimates for capacity and for volume for 1996-2014 and for 2003-2014 statistically significant? Please perform a 2-tailed test using a 5% significance level as was requested in the previous question e. Please show all calculations needed to compute the relevant test statistic and state the conclusion that PEG arrives at, along with any qualifying remarks that PEG feels are important.

M2-Interrogatory #2

Reference: M2/11.1

In Chart 1 at p.2 of its response to Undertaking JT3.24, LEI provided the annual TFP growth rate that it had calculated for each of the 16 companies for each of the 12 years in its sample:

Year		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
OPG		-3.20%	5.90%	-5.30%	1.10%	-4.20%	11.10%	-1.70%	-16.70%	6.60%	-6.60%	6.10%	0.80%
AB Power		33.60%	-27.00%	0.40%	-37.40%	-82.80%	50.20%	97.00%	-51.40%	-12.00%	-19.20%	72.50%	-40.90%
AP Power		50.70%	-17.70%	-15.20%	-7.00%	-5.20%	-12.10%	19.60%	-6.40%	-3.30%	6.20%	13.80%	-33.30%
Ameren		-8.80%	30.40%	2.70%	-76.70%	46.80%	6.20%	2.60%	8.00%	-6.10%	-26.60%	21.00%	-23.70%
Avista		-14.80%	6.50%	-5.90%	12.40%	-11.30%	3.90%	-3.20%	-6.90%	24.30%	-9.60%	-14.20%	15.10%
Duke		21.50%	-26.70%	8.80%	-12.80%	-6.60%	4.70%	-1.30%	-2.90%	-10.80%	-6.30%	26.50%	-3.10%
GPA		50.70%	-35.70%	8.00%	-35.00%	-18.20%	-36.50%	110.30%	-22.20%	-13.40%	5.80%	65.10%	-38.10%
ID		1.70%	-2.90%	2.80%	39.40%	-40.40%	11.00%	16.30%	-10.00%	40.60%	-32.60%	-34.50%	9.40%
PacifiCorp		5.50%	-16.10%	-3.50%	36.50%	-21.70%	0.00%	-7.00%	8.30%	21.40%	-4.70%	-32.80%	20.40%
PG&E		10.30%	-7.40%	14.50%	17.80%	-61.00%	-0.30%	9.60%	16.10%	13.30%	-50.10%	-2.30%	-25.80%
Portland		-1.30%	3.30%	-9.40%	23.20%	-14.90%	0.10%	-1.10%	6.20%	7.70%	-9.80%	-14.90%	-4.90%
SCE&G		28.90%	-12.20%	12.20%	-26.50%	8.00%	-13.90%	-3.70%	0.80%	-13.40%	6.70%	2.50%	-28.40%
Seattle		-12.90%	-1.10%	-7.50%	19.10%	-4.20%	-4.20%	-6.90%	-2.90%	28.30%	-9.70%	-16.80%	17.10%
SEPA		50.20%	-10.80%	12.20%	-58.70%	-0.90%	-17.20%	28.40%	14.80%	-13.90%	-11.40%	34.60%	-5.70%
SoCal		14.20%	-13.20%	37.20%	-2.50%	-70.10%	2.10%	33.50%	11.30%	9.60%	-48.70%	-20.80%	-24.30%
VA		6.60%	-14.30%	-20.60%	9.50%	15.00%	-40.50%	30.30%	19.80%	-12.50%	48.10%	-38.90%	-1.70%

LEI's Chart 1 also provides the average TFP growth over the entire 2003-2014 period for each company in its sample, referred to as the AVG. For example, the Chart shows that OPG's AVG was -0.49%.

a. Please confirm/disconfirm that OPG's AVG over the 12-year sample period is -0.51% rather than -0.49% as shown in Chart 1. Could the difference simply be due to rounding error? Are there any other instances of such error in Chart 1?

b. Please confirm/disconfirm that the mean of the 16 company AVG's is -1.01% and that the sample standard deviation is 2.37% (using the sample-variance formula in LEI's response to Undertaking JT3.24.

c. P.15 of the PEG reports states: "The productivity growth rates of individual companies tend to be more volatile than the average productivity growth of a group of companies". The data from Chart 1 above appear to support this statement. The sample standard deviation of the company AVG's is 2.37% (subject to check). However, the range of standard deviations of the individual company AVG's is 7.50% (for OPG) to 54.02% (for AB Power). (PEG may wish to confirm this range.) What accounts for this difference in volatility?

d. The LEI data in Chart 1 can also be averaged over the 12 company TFP's for each of the 16 years. For example, it appears that the mean TFP growth rate over all 16 companies was 14.56% for 2003 and -8.69% for 2004. Please confirm/disconfirm that the mean of those 12 year-averages is also -1.01, and that the sample standard deviation is 10.77%.

e. Taking all the 12-company TFP data for each of 16 years together, please confirm that the total number of TFP growth rate observations is 192, that the mean is -1.01% and that the standard deviation is 26.40%.

f. Please briefly discuss the relationship(s) among the standard deviation for the total sample of 192 observations (26.4%), the standard deviation of the 16 observations of company AVG's (2.37%) and the standard deviation of the 12 observations of the year-averages (10.77%).

g. If there is a relationship among the respective variances (rather than the standard deviations), what is that relationship? For example, can it be concluded that the variability in annual TFP growth rates is partly due to inter-company differences, and partly due to differences between business conditions in different years, apparently leaving a very large portion of the total variability unexplained?

h. What, in PEG's view, are the policy implications of adopting LEI's estimate of -1.01% when so much of the variability in its sample is, apparently, unexplained?

i. As LEI had done, please provide PEG's estimates of annual productivity growth for each company in its sample and for each year in its sample.

M2-Interrogatory #3

Reference: M2/11.1

In its interrogatory #31 to LEI, Energy Probe provided data on negative MFP growth in the Canadian business sector and observed that:

> The CANSIM data tend to support LEI's conclusion of declining productivity growth in the study period used in its Updated Report. In the overlapping eight years, the CANSIM series has five negative growth years and the mean annual growth rate is -0.25%; the Updated Report (Figure 27) has 3 negative growth years and the mean annual growth rate is -0.54%.
> (Ex L/T11.1/Sch 6 EP-031/Page 2 of 4)

PEG's analysis of OPG MFP for the 2013-2014 period shows only one year (2014) of negative MFP growth.

At p.60 of the PEG report, PEG argues for a longer sample period because it "more effectively smooths the effects of volatility in the sample. On the other hand, a more recent sample reflects more recent business conditions, and the effects of the benchmark year adjustment are further in the past."

a. Casually speaking, is it PEG's view that a longer sample period is likely to include both "ups" and "downs" in business-cycle conditions which, in essence, average out to (or near to) zero over a sufficiently long sample period? And if so, does PEG believe that for a sufficiently long sample period, business-cycle conditions can appropriately be omitted from a study of the determinants of multifactor productivity growth for that period?

b. Correspondingly, is it PEG's view that if the sample period is too short, then these short-run business-cycle factors may be significant determinants of productivity growth in that period and should not be omitted?

c. In PEG's view, are there aspects of LEI's productivity-measurement approach that make its estimates more sensitive to general trends in the business-sector conditions than PEG's own estimates? If so, please identify and briefly discuss.

d. Table 4 (p.51) of the PEG report shows that output growth (based on capacity) declined markedly in the 2003-2014 period from the 1975-1995 period, in both the Common Sample and the Larger Sample. In PEG's view, why was hydro output growth so low in the more recent period compared to the earlier period?

M2-Interrogatory #4

Reference: M2/11.1

Footnote 21 of p.19 of PEG's report states:

> *Mention here of the stretch factor option is not meant to imply that a positive stretch factor is warranted in all cases*

a. Is a stretch factor added only or primarily for the purpose of sharing the financial benefits of performance improvements with customers, or are there other reasons why a stretch factor is added to the formula? If so, please indicate and discuss briefly.

b. Please briefly discuss the circumstances in which a positive stretch factor may not be warranted.

c. The PEG report discusses Efficiency Carryover Mechanism ("ECM") at p.66. Is the stretch factor an ECM? Do stretch factors and ESM's have different rationales?