# OPG

# EB-2013-0321

# Board Staff Compendium

# Panel 4

# Memorandum of Agreement

**BETWEEN**

**Her Majesty the Crown In Right of Ontario (the "Shareholder")**

**And**

**Ontario Power Generation ("OPG")**

## Purpose

This document serves as the basis of agreement between Ontario Power Generation Inc. ("**OPG**") and its sole Shareholder, Her Majesty the Queen in Right of the Province of Ontario as represented by the Minister of Energy (the "**Shareholder**") on mandate, governance, performance, and communications. This agreement is intended to promote a positive and co-operative working relationship between OPG and the Shareholder.

OPG will operate as a commercial enterprise with an independent Board of Directors, which will at all times exercise its fiduciary responsibility and a duty of care to act in the best interests of OPG.

## A. Mandate

1. OPG's core mandate is electricity generation. It will operate its existing nuclear, hydroelectric, and fossil generating assets as efficiently and cost-effectively as possible, within the legislative and regulatory framework of the Province of Ontario and the Government of Canada, in particular, the Canadian Nuclear Safety Commission. OPG will operate these assets in a manner that mitigates the Province's financial and operational risk.

2. OPG's key nuclear objective will be the reduction of the risk exposure to the Province arising from its investment in nuclear generating stations in general and, in particular, the refurbishment of older units. OPG will continue to operate with a high degree of vigilance with respect to nuclear safety.

3. OPG will seek continuous improvement in its nuclear generation business and internal services. OPG will benchmark its performance in these areas against CANDU nuclear plants worldwide as well as against the top quartile of private and publicly- owned nuclear electricity generators in North America. OPG's top operational priority will be to improve the operation of its existing nuclear fleet.

4. With respect to investment in new generation capacity, OPG's priority will be hydro- electric generation capacity. OPG will seek to expand, develop and/or improve its hydro- electric generation capacity. This will include expansion and redevelopment on its existing sites as well as the pursuit of new projects where feasible. These investments will be taken by OPG through partnerships or on its own, as appropriate.

5. OPG will not pursue investment in non-hydro-electric renewable generation projects unless specifically directed to do so by the Shareholder.

6. OPG will continue to operate its fossil fleet, including coal plants, according to normal commercial principles taking into account the Government's coal replacement policy and recognizing the role that fossil plants play in the Ontario electricity market, until government regulation and/or unanimous shareholder declarations require the closure of coal stations.

7. OPG will operate in Ontario in accordance with the highest corporate standards, including but not limited to the areas of corporate governance, social responsibility and corporate citizenship.

8. OPG will operate in Ontario in accordance with the highest corporate standards for environmental stewardship taking into account the Government's coal replacement policy.

## B Governance Framework

The governance relationship between OPG and the Shareholder is anchored on the following:

1. OPG will maintain a high level of accountability and transparency:

   - OPG is an *Ontario Business Corporations Act* ("OBCA") company and is subject to all of the governance requirements associated with the OBCA.
   - OPG is also subject to the *Freedom of Information and Protection of Privacy Act*, the *Public Sector Salary Disclosure Act* and the *Auditor General Act*.
   - OPG's regulated assets will be subject to public review and assessment by the Ontario Energy Board.
   - OPG will annually appear before a committee of the Legislature which will review OPG's financial and operational performance.

2. The Shareholder may at times direct OPG to undertake special initiatives. Such directives will be communicated as written declarations by way of a Unanimous Shareholder Agreement or Declaration in accordance with Section 108 of the OBCA, and be made public within a reasonable timeframe.

## C. Generation Performance and Investment Plans

1. OPG will annually establish 3 –5 year performance targets based on operating and financial results as well as major project execution. Key measures are to be agreed upon with the Shareholder and the Minister of Finance. These performance targets will be benchmarked against the

performance of the top quartile of electricity generating companies in North America.

2. Benchmarking will need to take account of key specific operational and technology factors including the operation of CANDU reactors worldwide, the role that OPG's coal plants play in the Ontario electricity market with respect to load following, and the Government of Ontario's coal replacement policy.

3. OPG will annually prepare a 3 – 5 year investment plan for new projects.

4. Once approved by OPG's Board of Directors, OPG's annual performance targets and investment plan will be submitted to the Shareholder and the Minister of Finance for concurrence.

## D. Financial Framework

1. As an OBCA corporation with a commercial mandate, OPG will operate on a financially sustainable basis and maintain the value of its assets for its shareholder, the Province of Ontario.

2. As a transition to a sustainable financial model, any significant new generation project approved by the OPG Board of Directors and agreed to by the Shareholder may receive financial support from the Province of Ontario, if and as appropriate.

## E. Communication and Reporting

1. OPG and the Shareholder will ensure timely reports and information on major developments and issues that may materially impact the business of OPG or the interests of the Shareholder. Such reporting from OPG should be on an immediate or, at minimum, an expedited basis where an urgent material human safety or system reliability matter arises.

2. OPG will ensure the Minister of Finance receives timely reports and information on multi-year and annual plans and major developments that may have a material impact on the financial performance of OPG or the Shareholder.

3. The OPG Board of Directors and the Minister of Energy will meet on a quarterly basis to enhance mutual understanding of interrelated strategic matters.

4. OPG's Chair, President and Chief Executive Officer and the Minister of Energy will meet on a regular basis, approximately nine times per year.

5. OPG's Chair, President and Chief Executive Officer and the Minister of Finance will meet on an as needed basis.

6. OPG's senior management and senior officials of the Ministry of Energy and the Ministry of Finance will meet on a regular and as needed basis to discuss ongoing issues and clarify expectations or to address emergent issues.

7. OPG will provide officials in the Ministry of Energy and the Ministry of Finance with multi-year and annual business planning information, quarterly and monthly financial reports and briefings on OPG's operational and financial performance against plan.

8. In all other respects, OPG will communicate with government ministries and agencies in a manner typical for an Ontario corporation of its size and scope.

## F. Review of this Agreement

This agreement will be reviewed and updated as required.

Dated: the 17th day of August, 2005

| | |
|---|---|
| On Behalf of OPG: | On Behalf of the Shareholder: |
| Original signed by: | Original signed by: |
| Jake Epp<br>Chairman<br>Board of Directors | Her Majesty the Queen in Right of the Province of Ontario as represented by the Minister of Energy, Dwight Duncan |

exceeded the value of the electricity generated and asked the Board to withhold payments for any facility that raises the cost of power for consumers.

AMPCO argued that over the 2005 to 2007 period, the average cost of Pickering A power was double the Hourly Ontario Energy Price and the nuclear payment amount received by OPG under O. Reg. 53/05. AMPCO concluded that even with the forecasted cost of 8.1 cent/kWh (AMPCO's calculation) in the test period, the prudence of continued operation of Pickering A remains a concern. AMPCO argued that OPG should be required to file a long-term assessment of the viability of Pickering A in the next rates application. SEC also argued that OPG should be directed to file a plan which demonstrates that Pickering A and Pickering B can operate at costs similar to other generators.

OPG responded that the Board's role in this application is to review the costs of Pickering A, and based on these costs, set reasonable payment amounts. OPG argued that the Board should not, and cannot, decide the ultimate viability of Pickering A, as this is beyond the scope of Section 78.1 of the *OEB Act*.

Regarding the AMPCO and SEC submissions that OPG's costs are excessive given the benchmarking results, OPG responded that the intervenors used selective data and disregarded technical differences regarding Pickering A and Pickering B. OPG also argued that AMPCO's assertion that OPG was resistant to benchmarking was unsupported. OPG maintained that it is committed to benchmarking and is in full compliance with the requirements in the MOA.

OPG also noted that it expects Pickering A and B's performance to improve substantially in the future and submitted that Darlington will continue to perform as well as it has in the past. Most of the intervenors countered that the forecasted results for 2008 and 2009 are unduly optimistic and the Board should discount these projections.

OPG also questioned the arguments by a number of intervenors that the Navigant Study supports the conclusion that 2006 staffing levels were 12% higher than benchmark. OPG claimed that the Navigant Study cannot be used to test the level and reasonableness of OPG's labour cost because the Navigant Study is not representative of staffing levels in the test period.

The Board does not believe it is sufficient for OPG to simply discount the benchmarking studies on the basis of data quality. The studies are all based on standard measures used by the nuclear industry throughout the United States and Canada. While caution should be exercised when reviewing such data, the Board is satisfied that the studies provide meaningful insights into OPG's operations. Moreover, even if there are frailties in the data, the differentials remain striking, particularly with respect to Pickering A. The reason why the MOA emphasized benchmarking was because such studies can and do shine a light on inefficiencies and lack of productivity improvement.

While OPG criticizes the data, the Board notes that few steps have been taken to improve the quality of studies. The Board also notes that benchmarking studies were not filed as a matter of course but rather were reluctantly produced during the course of cross-examination.

Moreover, the Board was surprised that OPG has not followed up with the suggested Phases 2, 3 and 4 of the benchmarking analysis suggested by Navigant. While the benchmarking is critical to the Board (and it would seem to the shareholder), it appears that OPG has done little since the completion of the Navigant Study. The Navigant Study was delivered two years ago on September 15, 2006. There appear to be no benchmarking studies underway. And OPG has not decided what benchmarking evidence, if any, it will present at the next rates case.

Navigant completed Phase I of its study in 2006. Phase 2 as described at page 9 of the Navigant Report was to set OPG's strategy and performance targets. Specifically, Phase 2 was to address the question "what level of cost and operational performance improvement is justified". Phase 3 was to develop and execute an implementation plan. Specifically, Phase 3 was to address the questions "what specific initiatives and actions are needed to achieve identified performance improvement targets".

The questions Navigant suggested should be addressed in the second and third phases of the study are important questions. They are directly responsive to paragraph A.3 of the MOA.[14]

[14] "OPG will seek continuous improvement in its nuclear generation business and internal services. OPG will benchmark its performance in these areas against CANDU nuclear plants worldwide as well as against the top quartile of private and publicly-owned nuclear electricity generators in North America. OPG's top operational priority will be to improve the operation of its existing nuclear fleet."

The Board directs OPG to produce further benchmarking studies in its next application that specifically address the questions raised in the proposed Phase 2 and Phase 3 of the Navigant Report. Whether these studies are performed by Navigant or another firm is a matter to be determined by the applicant.

The production costs of the Pickering A station are a particular concern. In the past, a major reason for the high PUEC for Pickering A has been the extent of unplanned outages and the resulting low capacity utilization. OPG has forecast significantly higher capacity factors for Pickering A in 2008 and 2009. But, as Chart 2-1 illustrates, even at those higher production levels, the PUEC for Pickering will still remain well above the PUEC for Pickering B, will be significantly higher than the PUEC of the Darlington station, and will stay well above the PUEC achieved by the Bruce station over the period 2005 to 2007. Thus, poor capacity factors are not the whole reason for a high PUEC at Pickering A.

The Board estimated the PUEC for Pickering A assuming it were able to reach the forecast capacity factors of the Pickering B station in 2008 and 2009. Even if Pickering A were able to increase its planned capacity factors by that much (from 79% in 2008 and 81% in 2009 to 86% in both years), the Board estimates that the PUEC of Pickering A would only fall to around $70 per MWh, a level that is still much higher than the next highest cost station in Chart 2-1. In the Board's view, this indicates an issue with the overall level of production costs at Pickering A.

Under these circumstances, the Board believes that a reasonable action is to disallow 10% of the Base OM&A costs of Pickering A. This represents a test period disallowance of $14.9 million in 2008 and $20.1 million in 2009. Even with those amounts removed from the revenue requirement, the amount of the operating costs of Pickering A will still remain well above those of other nuclear plants.

The Board will have an opportunity to reexamine this issue when the benchmarking studies are updated in the next proceeding. At that time the Board will examine any improvement or deterioration in production unit energy costs compared to other utilities, and the reasons for those changes.

Aside from this adjustment, the Board will allow the OM&A forecast by OPG. The Board understands the concern of the intervenors regarding the level of costs, but believes it is important to examine underlying cost drivers. A number of the planned expenditures are

## 5.0 MAJOR OPERATOR SUMMARY

### Purpose

This section supplements the Executive Summary, providing more detailed comparison of the major operators of nuclear plants for three key metrics: WANO NPI, Unit Capacity Factor (UCF) and Total Generating Costs (TGC). Operator level summary results are the average (mean) of the results across all plants managed by the given operator. These comparisons provide additional context but all of the detail data in the previous sections provide the more complete picture of plant by plant performance. WANO NPI and UCF are calculated as the mean of all unit performance for a specific operator. TGC is the mean of plant level data because costs are not allocated to specific units within EUCG.

A table of plants and their operators for WANO NPI and for UCF is provided in Table 10 of the appendix and for TGC see Table 11 in the appendix.

### WANO NPI Analysis

The WANO NPI results for the operators in 2008 are illustrated in the graph below. WANO method four was used for these calculations.

MR. SEQUEIRA: Well, the comparators used at OPG are divided into the four cornerstone areas that OPG uses, both for internal management, but that is very consistent with the balance scorecard approach to strategic planning, which we would have recommended had there not been those cornerstones in place.

MR. MILLAR: The phase 1 report benchmarks OPG against comparators for 19 metrics; is that correct?

MR. SEQUEIRA: It is.

MR. MILLAR: And you identify three of those metrics as being key metrics; is that correct? I am referring to page -- I believe it is 140 of your report. I don't know if it is in my materials, but perhaps if I can jog your memory, you speak of the WANO Nuclear Performance Index, the total generating cost per megawatt-hour and unit capability factor.

MR. SEQUEIRA: We have haven't used the... Wait a minute.

MR. MILLAR: When I say page 140, I am referring to the "140" at the top of the page as opposed to the bottom.

MR. SEQUEIRA: We haven't been using the term, because we also have key improvement areas, as well, but those are the three I would say highest-level aggregators of overall performance for an operator.

MR. MILLAR: Okay, thank you for that. Can you tell me a little bit about each of those? What is the WANO Nuclear Performance Index?

MR. SEQUEIRA: Well, WANO is World Association of

Nuclear Operators. It is an international association very similar to what is in place in North America as INPO.

It represents the industry, but in terms of what we have done here, they also produce a nuclear performance index, which is the NPI. That, in turn, is a roll-up of ten indicators, all of which are focussed on operational excellence in what the industry is doing.

What WANO does is collects that information for all of the operators that are members of WANO, and then reports it on a consistent basis over time.

MR. MILLAR: Okay. Thank you. What about total generating costs per megawatt-hour? Can you describe what that is?

MR. SEQUEIRA: Total generating cost is -- follows another source of benchmarking information. In this course, it is EUCG, which is Electric Utility Cost Group. This is a group of utilities started some time ago, realizing that there was a need for cost benchmarks within the industry, but every individual company had different definitions of costs and different sub-breakdowns, so they came up with an overall functional process model for costs, and established that as an industry standard and then have been collecting cost data from members consistently since then.

MR. MILLAR: And just to be clear, perhaps it is self-explanatory, but it says total generating cost. That would include all costs for generation?

MR. SEQUEIRA: That is the all-in cost, the highest

cost measure.

MR. MILLAR: So including fuel costs and...

MR. SEQUEIRA: Including fuel and capital, as well.

MR. MILLAR: The works?

MR. SEQUEIRA: Yes.

MR. MILLAR: Thank you. Finally, the unit capability factor, what is that?

MR. SEQUEIRA: That is a measure of the plants' actual output over a period of time. So it is generation.

MR. MILLAR: And is that expressed as a percentage, or how...

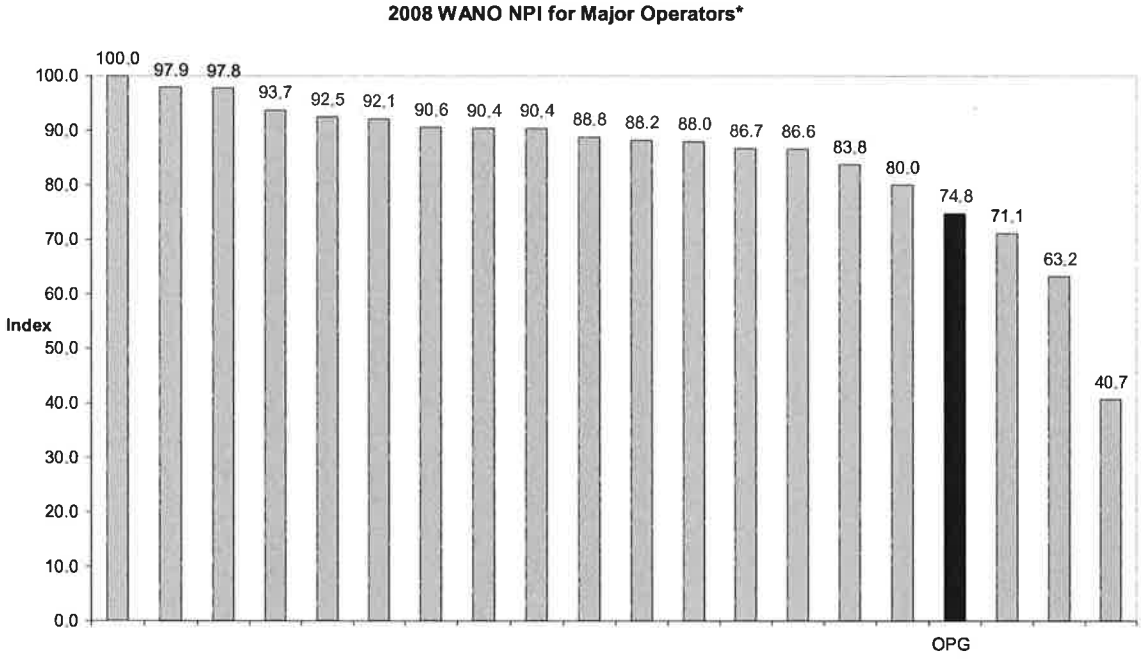
MR. LEAVITT: It is expressed as a percentage. The definition for unit capability factor is given in Exhibit F5, tab 1, schedule 1, page 152, and that is the nomenclature at the top of the page.

MR. MILLAR: Okay. Thank you.

Mr. Sequeira, you may have already answered this but you said that these are the -- I called them the three key metrics and you might have described them somewhat differently. Why are those either the three most important metrics or three of the most important metrics?

MR. SEQUEIRA: Well, primarily because they're roll-ups. The NPI, for example, is a roll-up of 10 very critical operating indicators. The total cost is a roll-up of all-in cost. And the capability factor, especially, as you will notice, often benchmark is used the denominator in the calculations.

And so that determines just how much power has been




*See Table 10 in the appendix for listing of operators and plants
**OPG unit values averaging to a WANO NPI of 74.8 in 2008 shown below:

| Unit | 2008 WANO NPI |
|---|---|
| Darlington 1 | 88.64 |
| Darlington 2 | 98.90 |
| Darlington 3 | 100.00 |
| Darlington 4 | 95.13 |
| Pickering A1 | 62.74 |
| Pickering A4 | 58.95 |
| Pickering B5 | 67.37 |
| Pickering B6 | 64.31 |
| Pickering B7 | 55.57 |
| Pickering B8 | 56.45 |

In 2008, led all the operators in this data set with an NPI of 100. OPG ranked 17th, with an NPI of 74.8. Darlington performed significantly better overall than Pickering A and Pickering B, achieving best quartile for most of the review period. Refer to Section 3 for further information.

The NPI rankings of the major operators from 2006 to 2008 are listed in Table 5.

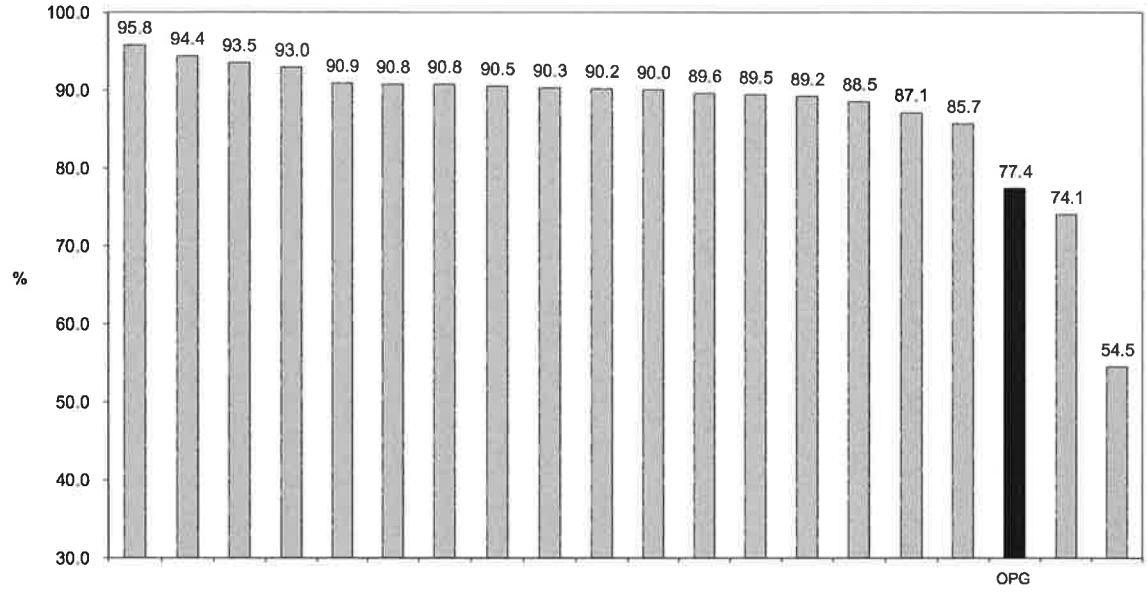
## Unit Capability Factor (UCF) Analysis

Unit Capability Factor is the ratio of available energy generation over a give time period to the reference energy generation of the same time period. Reference energy generation is the energy that could be produced if the unit were operating continuously at full power under normal conditions. Since nuclear generation plants are large fixed assets, the extent to which these assets generate reliable power is the key to both their operating and financial performance. For this reason, we examine this NPI indicator more closely below.

A comparison of UCF values for major nuclear operators is presented in the graph below. UCF is expressed as a two-year average. OPG achieved a two-year average unit capacity factor of 77.4% and ranked 18 out of 20 major operators in the WANO data set.

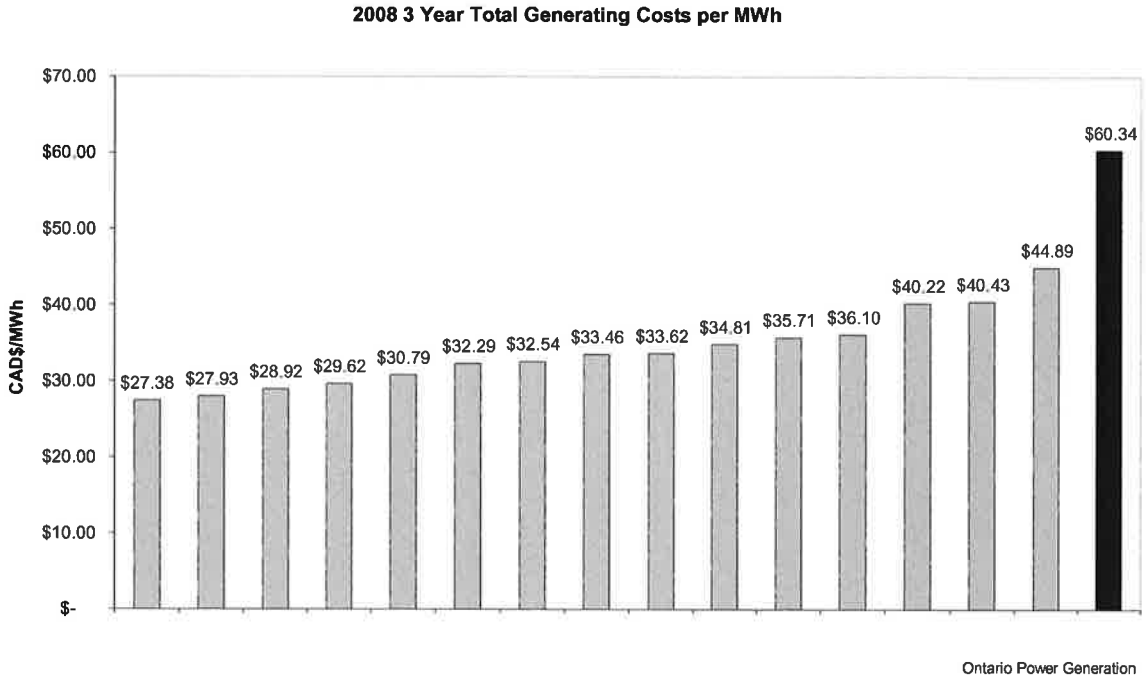
The range of values reported for these operators, however, varies greatly.

**2008 2 Year Unit Capability Factor Ranking for Major Operators***




*OPG unit values averaging to a 2 Year UCF in 2008 of 77.4 shown below:

| Unit | 2008 2-Year UCF |
|---|---|
| Darlington 1 | 89.50 |
| Darlington 2 | 91.12 |
| Darlington 3 | 97.35 |
| Darlington 4 | 89.97 |
| Pickering A1 | 50.65 |
| Pickering A4 | 62.55 |
| Pickering B5 | 74.20 |
| Pickering B6 | 83.73 |
| Pickering B7 | 58.22 |
| Pickering B8 | 76.54 |




*OPG plant values averaging to 3 Year TGC of $60.34/MWh shown below:

| Unit | 2008 3 Year TGC |
|---|---|
| Darlington | $30.08/MWh |
| Pickering A | $92.27/MWh |
| Pickering B | $58.68/MWh |

**Table 8: Three-Year Total Generating Costs per MWh Rankings**

| | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|
| | 1 | 1 | 1 | 1 |
| | 4 | 4 | 2 | 2 |
| | 6 | 5 | 3 | 3 |
| | 3 | 2 | 4 | 4 |
| | 2 | 3 | 5 | 5 |
| | 15 | 14 | 11 | 6 |
| | 13 | 7 | 6 | 7 |
| | 5 | 6 | 7 | 8 |
| | 8 | 8 | 8 | 9 |
| | 9 | 11 | 10 | 10 |
| | 10 | 10 | 9 | 11 |
| | 11 | 9 | 12 | 12 |
| | 7 | 12 | 13 | 13 |
| | 12 | 13 | 14 | 14 |
| | 14 | 15 | 15 | 15 |
| Ontario Power Generation | 16 | 16 | 16 | 16 |

# Nuclear: Ontario Power Generation Nuclear Benchmarking Reports

| Report Name: Ontario Power Nuclear Benchmarking Report (2009 through 2012) | | | |
|---|---|---|---|
| **Study Author** | Scott Madden | **Benchmark Types** | Efficiency |
| **Area of Study** | Nuclear | **Date Published** | July of each year 2009-2012 |
| **Survey Period** | 2009 to 2012 | | |

| | |
|---|---|
| **Appropriateness of Methodology** | **Objective**<br>• There is a clear objective, which is to present a comparison of OPG's Nuclear performance to that of nuclear industry peer groups both in Canada and worldwide<br>• The report was prepared as part of OPG's commitment to "performance informed" business management<br>• The results are used during business planning to drive a top-down target setting process with business improvement as the objective<br><br>**Data Collection Method**<br>• The data collection is from WANO and EUCG which are reliable and consistent sources<br>**Peer Group**<br>• Peer group includes WANO members which included CANDU Owners Group members and uses the most appropriate peers in each section<br>• No less than 13 and up to 48 peers were used in different sections including peers from INPO<br><br>**Constraints or Limitations**<br>• The report highlights areas where adjustments or information was missing in certain areas<br><br>*The approach and methodology are appropriate for the purpose of the report which was to collect data and compare against industry benchmark performance.* |

turn to some pages that are not in the booklet. So just for everyone's reference, I believe you can find the full copies of those reports at Exhibit 5, tab 1, schedule 1, and Exhibit 5, tab 1, schedule 2. So you may wish to have those ready, just in case.

I will start with some questions I think for you, Mr. Sequeira. These relate to the phase 1 and phase 2 report. So just by way of some background, there are two reports, is that correct, phase 1 and phase 2?

MR. SEQUEIRA: That is correct.

MR. MILLAR: And phase 1, the phase 1 report focusses on benchmarking OPG to a number of comparators; is that correct?

MR. SEQUEIRA: That is.

MR. MILLAR: And the phase 2 report included your observations and recommendations for improvement; is that right?

MR. SEQUEIRA: Yes, it is.

MR. MILLAR: Okay, thank you. And, again, some very high-level stuff. What the phase 2 report recommends at the highest level is that OPG adopt a gap-based business planning approach; is that correct?

MR. SEQUEIRA: It is.

MR. MILLAR: Can you tell me what that is?

MR. SEQUEIRA: Essentially, that is a process of what we would refer to as top-down business planning based on closing gaps to known performance measures versus a more traditional business planning approach, which is used by

both governments and utilities, largely, prior to the 2000s.

In the bottom-up business planning process, business units are asked to develop their business plans for whatever the planning horizon is. Those typically are then assembled based on what was done in the past, plus modifications. They are rolled up to a company level, typically at that point adjusted against some sort of financial cap or reality check, and then pushed back down to the business units.

And so we refer to it as a bottom-up/top-down business planning process.

The gap-based business planning process is a top-down/bottom-up, which means that the fundamental question is different. Instead of asking the business units, What can we do next year, the question becomes, What must we do next year?

It starts with where are we ourselves; then how do we compare to others? Is there a performance gap? If there is, what is a reasonable time frame or level of aggressiveness for closing the gap, and then targets are set at the top and communicated to the business units, and the business units are requested to define ways to close the gap or improve performance or whatever the target is.

MR. MILLAR: And when you say "gap", I assume it is obviously a gap from where you are and where you want to be. I understand you divide the comparators into quartiles; is that correct?

discussed at Ex. D2-2-1. The Darlington New Nuclear Project will continue in the planning and preparation phase as discussed at Ex. F2-8-1.

OPG Nuclear's 2013 - 2015 Business Plan is provided in Attachment 2.

## 3.0 NUCLEAR BUSINESS PLANNING AND BENCHMARKING

### 3.1 Gap-Based Business Planning Process

OPG Nuclear's business planning is undertaken annually as part of and consistent with the overall OPG business planning process (Ex. A2-2-1). The business planning process is focused on establishing strategic and performance targets for nuclear, in alignment with OPG's objectives, and identifying the initiatives and resources required to achieve these targets.

Since 2009, OPG nuclear has used a gap-based business planning process which consists of the following steps:

- **Benchmarking:** Using selected industry performance metrics, establish the current status of OPG nuclear relative to its peers.
- **Target Setting:** Implementing a "top-down" approach to set operational, financial and generation performance targets that will move OPG nuclear closer to top quartile industry performance over the business planning period.
- **Closing the Gap:** By reference to OPG Nuclear's four cornerstone values of Safety, Reliability, Human Performance and Value for Money, developing various initiatives to close the performance gaps between current and targeted results.
- **Resource Planning:** Preparing an OPG Nuclear business plan (i.e., the development of cost, staff and investment plans) that is based on the "top-down" targets and incorporates initiatives necessary to achieve targeted results.

### 3.2 Gap-Based Business Planning – Benchmarking

The 2012 Nuclear Benchmark Report benchmarks OPG's performance against industry peers based on 2011 data and uses 20 indicators aligned with the cornerstone values of Safety, Reliability, and Value for Money and Human Performance (see Attachment 1). The

# Appendix E – Final Business Planning Targets Established for 2014

The tables below present the final operational and financial planning targets agreed to by the OPG Nuclear Executive Committee (NEC) for inclusion in the 2010-2014 Business Plan. **Bold** type is used to indicate the maximum NPI point threshold established by WANO. These thresholds represent guidance as to what is considered superior industry performance.

## Safety Cornerstone Targets

| Metric | Site / Business Unit | 2009 Projection | 2014 | NA PWR/PHWR | | CANDU | |
|---|---|---|---|---|---|---|---|
| | | | | Best Quartile | Median | Best Quartile | Median |
| **Tier 1** | | | | | | | |
| All Injury Rate | Darlington | 1.3 | 1.2 | n/a | n/a | [redacted] | [redacted] |
| | Pickering A | 1.3 | 1.2 | n/a | n/a | [redacted] | [redacted] |
| | Pickering B | 1.3 | 1.2 | n/a | n/a | [redacted] | [redacted] |
| | IM&CS | 2.36 | 1.2 | | | | |
| Collective Radiation Exposure* (man-rem) | Darlington | 84.66 | ***66*** | 50.70 | 66.00 | 62.15 | 81.84 |
| | Pickering A | 129.53 | 125 | 50.70 | 66.00 | 62.15 | 81.84 |
| | Pickering B | 86.04 | 82 | 50.70 | 66.00 | 62.15 | 81.84 |
| Fuel Reliability* (microcuries per gram) | Darlington | ***0.00050*** | ***0.00050*** | 0.000001 | 0.000012 | 0.000001 | 0.000165 |
| | Pickering A | 0.00280 | ***0.00050*** | 0.000001 | 0.000012 | 0.000001 | 0.000165 |
| | Pickering B | 0.00120 | ***0.00050*** | 0.000001 | 0.000012 | 0.000001 | 0.000165 |
| Environmental Index (%) | Darlington | 85 | 80 | n/a | n/a | n/a | n/a |
| | Pickering A | 80 | 80 | n/a | n/a | n/a | n/a |
| | Pickering B | 80 | 80 | n/a | n/a | n/a | n/a |
| Accident Severity Rate | Darlington | 2.81 | 3.30 | n/a | n/a | n/a | n/a |
| | Pickering A | 4.18 | 3.30 | n/a | n/a | n/a | n/a |
| | Pickering B | 2.41 | 3.30 | n/a | n/a | n/a | n/a |
| | NP&T | 3.34 | 3.30 | n/a | n/a | n/a | n/a |
| | E&M | 2.30 | 3.30 | n/a | n/a | n/a | n/a |
| | PINO | 2.84 | 3.30 | n/a | n/a | n/a | n/a |
| | NSC | 2.42 | 3.30 | n/a | n/a | n/a | n/a |
| | IM&CS | 2.36 | 3.30 | n/a | n/a | n/a | n/a |
| | NWM | 7.34 | 3.30 | n/a | n/a | n/a | n/a |

**Summary of Nuclear Benchmarking Reports**

| | a | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|---|
| Darlington | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 Actual | 2014 "Scott Madden" | 2015 |
| WANO NPI (Index) | 95.67 | 95.10 | 94.10 | 92.80 | 96.30 | | 99.10 | 96.10 |
| 2-Year Unit Capability Factor (%) | 91.99 | 90.20 | 89.40 | 89.60 | 92.00 | 82.90 | 93.30 | 86.30 |
| 3-Year Total Generating Costs ($/New MWh) | 30.08 | 32.77 | 33.55 | 33.05 | 31.67 | | 36.75 | 42.78 |
| | | | | | | | | |
| Pickering A | | | | | | | | |
| WANO NPI (Index) | 60.84 | 61.10 | 47.40 | | | | 70.90 | |
| 2-Year Unit Capability Factor (%) | 56.60 | 68.00 | 63.30 | | | | 84.30 | |
| 3-Year Total Generating Costs ($/New MWh) | 92.27 | 95.41 | 90.21 | | | | 70.81 | |
| Pickering B | | | | | | | | |
| WANO NPI (Index) | 60.93 | 70.20 | 72.60 | | | | 81.30 | |
| 2-Year Unit Capability Factor (%) | 73.17 | 77.70 | 80.20 | | | | 81.00 | |
| 3-Year Total Generating Costs ($/New MWh) | 58.68 | 54.64 | 54.79 | | | | 64.80 | |
| Pickering | | | | | | | | |
| WANO NPI (Index) | | | | 66.10 | 64.70 | | | 74.20 |
| 2-Year Unit Capability Factor (%) | | | | 72.50 | 75.62 | 73.70 | | 82.10 |
| 3-Year Total Generating Costs ($/New MWh) | | | | 65.86 | 67.16 | | | 60.25 |

Sources
Column a - EB-2010-0008 Exh F5-1-1 page 12 (Scott Madden Phase 1)
Column b - EB-2010-0008 Undertaking J3.5 Attachment 1 page 4
Column c - Exh L-6.4-SEC-92
Column d - Exh F2-1-1 Attachment 1 page 3
Column e - Exh L-6.4-SEC-92
Column f - Exh L-2.1-ED-3 Attachment 1, 2013 Audited Financials (Note: 2013 UCF, not 2-year UCF)
Column g - EB-2010-0008 Exh F2-1-1 Attachment 1 (Annual Targets agreed based on Scott Madden for inclusion in 2010-2014 Business Plan)
Column h - Exh F2-1-1 Attachment 2 (2013-2015 Nuclear Business Plan)

| | |
|---|---|
| | Q1 |
| | Q2 |
| | Q3 |
| | Q4 |

| OPG Nuclear | 2008 | 2011 |
|---|---|---|
| WANO NPI (Index) | 17th out of 20 | 24th out of 27 |
| 2-Year Unit Capability Factor (%) | 18th out of 20 | 25th out of 28 |
| 3-Year Total Generating Costs ($/New MWh) | 16th out of 16 | 12th out of 14 |

2008 Data



**Table 2: Plant Level Performance Summary**

| Metric | Best Quartile* | Median* | Pickering A | Pickering B | Darlington |
|---|---|---|---|---|---|
| **Safety** | | | | | |
| All Injury Rate | | | 0.73 ⇧ | 0.96 ⇧ | 1.04 ⇧ |
| 2-Year Industrial Safety Accident Rate | 0.05 | 0.09 | 0.14 ⇩ | 0.07 ⇧ | 0.04 ⇧ |
| 2-Year Collective Radiation Exposure (man-rem per unit) | 62.15 | 81.84 | 44.2 ⇧ | 95.81 ⇧ | 72.83 ⇧ |
| Airborne Tritium (TBq) Emissions per Unit | 48.0 | 101.0 | 101.0 ⇧ | 50.7 ⇧ | 40.0 ⇩ |
| Fuel Reliability (microcuries per gram) | 0.000001 | 0.000165 | 0.00059 ⇧ | 0.00159 ⇩ | 0.00025 ⇧ |
| 2-Year Reactor Trip Rate (# per 7,000 hrs) | 0.00 | 0.33 | 1.22 ⇩ | 0.26 ⇔ | 0.00 ⇔ |
| 3-Year Auxiliary Feedwater System Unavailability | 0.0014 | 0.0020 | 0.0119 ⇧ | 0.0040 ⇧ | 0.0017 ⇧ |
| 3-Year Emergency AC Power Unavailability | 0.0024 | 0.0076 | 0.0081 ⇩ | 0.0091 ⇧ | 0.0020 ⇔ |
| 3-Year High Pressure Safety Injection Unavailability | 0.0001 | 0.0037 | 0.0012 ⇧ | 0.0001 ⇧ | 0.0001 ⇧ |
| **Reliability** | | | | | |
| WANO NPI (Index) | 96.19 | 62.46 | 60.84 ⇧ | 60.93 ⇔ | 95.67 ⇔ |
| 2-Year Forced Loss Rate (%) | 0.68 | 3.79 | 37.90 ⇩ | 18.19 ⇩ | 0.93 ⇧ |
| 2-Year Unit Capability Factor (%) | 90.97 | 84.31 | 56.6 ⇩ | 73.17 ⇔ | 91.99 ⇔ |
| 2-Year Chemistry Performance Indicator (Index) | 1.00 | 1.01 | 1.13 ⇧ | 1.25 ⇩ | 1.00 ⇔ |
| 1-Year Online Elective Maintenance (work orders/unit) | 218 | 278 | 425 ⇧ | 695 ⇧ | 311 ⇧ |
| 1-Year Online Corrective Maintenance (work orders/unit) | 4 | 7 | 14 ⇧ | 28 ⇧ | 11 ⇧ |
| **Value for Money** | | | | | |
| 3-Year Total Generating Costs per MWh ($/Net MWh) | 28.66 | 32.31 | 92.27 ⇧ | 58.68 ⇔ | 30.08 ⇔ |
| 3-Year Non-Fuel Operating Costs per MWh ($/Net MWh) | 18.06 | 21.28 | 82.62 ⇧ | 50.95 ⇔ | 25.10 ⇔ |
| 3-Year Fuel Costs per MWh ($/Net MWh) | 5.02 | 5.37 | 2.64 ⇔ | 2.68 ⇔ | 2.62 ⇔ |
| 3-Year Capital Costs per MW DER | 32.79 | 46.22 | 32.07 ⇩ | 32.44 ⇧ | 18.79 ⇔ |

*Panel used for WANO quartile and median data was All COG CANDU

⇧ = overall upward trend during reporting period

⇩ = overall declining trend during reporting period

⇔ = consistent performance during the reporting period

Green = best quartile performance/max NPI points achieved if applicable
White = 2nd quartile performance
Yellow = 3rd quartile performance
Red = lowest quartile performance

## Benchmarking Results – Operator Summary

Operator level summary results for a specific metric are the average (mean) of the results across all plants managed by the given nuclear operator, providing a comprehensive overview of a nuclear operator's financial and operating performance. While the operator level summary results presented in Section 5.0 include a calculation for Unit Capability Factor (UCF) as well as WANO Nuclear Performance Index (WANO NPI) and Total Generating Costs per MWh, this executive summary only addresses WANO NPI and Total Generating Costs per MWh. This is because UCF is a subcomponent of WANO NPI. Full details of the operator summary results can be found in Section 5.0.

Filed: 2010-10-27
EB-2010-0008
J3.5
Attachment 1

# Table 2: Plant Level Performance Summary

## 2009 Benchmarking Results

| Metric | NPI Max | 2009 Actuals | | | | |
|---|---|---|---|---|---|---|
| | | Best Quartile | Median | Pickering A | Pickering B | Darlington |
| **Safety** | | | | | | |
| All Injury Rate (#/200k hours worked) | | [redacted] | [redacted] | 1.11 | 0.64 | 0.75 |
| 2-Year Industrial Safety Accident Rate (#/200k hours worked) | 0.20 | 0.03 | 0.07 | 0.21 ⇩ | 0.11 | 0.06 |
| 2-Year Collective Radiation Exposure (man-rem per unit) | 80.00 | 67.78 | 93.58 | 78.01 | 93.10 ⇧ | 61.44 ⇧ |
| Airborne Tritium Emissions (Curies) per Unit[2] | | 1,878 | 3,784 | 7,073 ⇩ | 1,626 ⇧ | 1,081 |
| Fuel Reliability (microcuries per gram) | 0.000500 | 0.000001 | 0.000041 | 0.000041 ⇧ | 0.000056 ⇧ | 0.000247 |
| 2-Year Reactor Trip Rate (# per 7,000 hours) | 0.50 | 0.00 | 0.21 | 0.74 | 0.27 | 0.09 |
| 3-Year Auxiliary Feedwater System Unavailability (#) | 0.0200 | 0.0002 | 0.0036 | 0.0063 | 0.0043 | 0.0000 |
| 3-Year Emergency AC Power Unavailability (#) | 0.0250 | 0.0021 | 0.0093 | 0.0106 | 0.0107 | 0.0059 |
| 3-Year High Pressure Safety Injection Unavailability (#) | 0.0200 | 0.0000 | 0.0006 | 0.0011 | 0.0001 | 0.0001 |
| **Reliability** | | | | | | |
| WANO NPI (Index) | | 92.6 | 70.8 | 61.1 | 70.2 | 95.1 ⇧ |
| 2-Year Forced Loss Rate (%) | 1.00 | 0.42 | 1.98 | 26.65 | 14.63 | 1.13 ⇩ |
| 2-Year Unit Capability Factor (%) | 92.0 | 91.2 | 85.2 | 68.0 | 77.7 ⇧ | 90.2 ⇩ |
| 2-Year Chemistry Performance Indicator (Index) | 1.01 | 1.00 | 1.04 | 1.09 ⇧ | 1.31 | 1.01 |
| 1-Year Online Elective Maintenance (work orders per unit) | | 201 | 245 | 364 | 644 | 286 |
| 1-Year Online Corrective Maintenance (work orders per unit) | | 2 | 5 | 14 | 24 | 12 |
| **Value for Money** | | | | | | |
| 3-Year Total Generating Costs per MWh ($ per Net MWh) | | 30.68 | 35.77 | 95.41 | 54.64 | 32.77 |
| 3-Year Non-Fuel Operating Costs per MWh ($ per Net MWh) | | 18.50 | 21.94 | 82.70 | 48.37 | 26.94 |
| 3-Year Fuel Costs per MWh ($ per Net MWh) | | 5.35 | 5.83 | 3.24 | 3.13 | 3.11 |
| 3-Year Capital Costs per MW DER (k$ per MW) | | 38.02 | 50.14 | 48.26 ⇩ | 20.81 | 21.19 |
| **Human Performance** | | | | | | |
| Human Performance Error Rate (# per ISAR hours) | | 0.00758 | 0.01332 | 0.01579 | 0.01052 | 0.00710 |

Notes

1. No median benchmark available.
2. 2009 benchmark data unavailable. 2008 used for benchmark and results.

Green = maximum NPI points achieved or best quartile performance

White = 2nd quartile performance

Yellow = 3rd quartile performance

Red = worst quartile performance

⇩ Declining Benchmark Quartile Performance vs. 2008

⇧ Improving Benchmark Quartile Performance vs. 2008

## Comparison of 2010 OPG Nuclear Performance to Industry Benchmarks

| Metric | NPI Max | 2010 Actuals | | | | |
|---|---|---|---|---|---|---|
| | | Best Quartile | Median | Pickering A | Pickering B | Darlington |
| **Safety** | | | | | | |
| All Injury Rate (#/200k hours worked) | | 0.88 | N/A[1] | 0.77 | 0.60 | 0.74 |
| Rolling Average Industrial Safety Accident Rate (#/200k hours worked) | 0.20 | 0.05 | 0.10 | 0.14 ⇧ | 0.07 | 0.09 |
| Rolling Average Collective Radiation Exposure (Person-rem per unit) | 80.00 | 68.64 | 96.73 | 138.30 ⇩ | 93.00 | 71.55 |
| Airborne Tritium Emissions (Curies) per Unit[2] | | 2,041 | 3,784 | 3,790 ⇧ | 1,053 | 869 |
| Fuel Reliability (microcuries per gram) | 0.000500 | 0.000001 | 0.000036 | 0.003460 ⇩ | 0.000205 | 0.000241 |
| 2-Year Reactor Trip Rate (# per 7,000 hours) | 0.50 | 0.06 | 0.22 | 0.77 | 0.24 | 0.12 |
| 3-Year Auxiliary Feedwater System Unavailability (#) | 0.0200 | 0.0000 | 0.0006 | 0.0003 | 0.0000 | 0.0000 |
| 3-Year Emergency AC Power Unavailability (#) | 0.0250 | 0.0008 | 0.0077 | 0.0088 | 0.0125 | 0.0087 |
| 3-Year High Pressure Safety Injection Unavailability (#) | 0.0200 | 0.0000 | 0.0005 | 0.0010 | 0.0000 | 0.0031 |
| **Reliability** | | | | | | |
| WANO NPI (Index) | | 86.7 | 77.4 | 47.7 ⇩ | 72.6 | 94.1 |
| Rolling Average Forced Loss Rate (%) | 1.00 | 1.40 | 3.35 | 22.52 | 5.06 | 1.84 |
| Rolling Average Unit Capability Factor (%) | 92.0 | 91.7 | 83.7 | 63.3 | 80.2 | 89.4 |
| Rolling Average Chemistry Performance Indicator (Index) | 1.01 | 1.00 | 1.02 | 1.24 ⇩ | 1.09 ⇧ | 1.03 ⇩ |
| 1-Year Online Elective Maintenance (work orders per unit)[3] | | 213 | 261 | 333 ⇧ | 544 | 281 |
| 1-Year Online Corrective Maintenance (work orders per unit)[3] | | 2 | 4 | 14 | 29 | 9 |
| **Value for Money** | | | | | | |
| 3-Year Total Generating Costs per MWh ($ per Net MWh) | | 32.54 | 38.53 | 90.21 | 54.79 | 33.55 |
| 3-Year Non-Fuel Operating Costs per MWh ($ per Net MWh) | | 19.00 | 23.13 | 75.51 | 48.49 | 27.09 |
| 3-Year Fuel Costs per MWh ($ per Net MWh) | | 5.92 | 6.37 | 3.70 | 3.70 | 3.71 |
| 3-Year Capital Costs per MW DER (k$ per MW) | | 46.30 | 62.80 | 62.80 | 17.41 | 21.28 |
| **Human Performance** | | | | | | |
| 18-Month Human Performance Error Rate (# per 10k ISAR hours) | | 0.00700 | 0.01000 | 0.01150 | 0.00920 | 0.00700 |

Notes

1. No median benchmark available.
2. 2008 data is used for non-OPG CANDU plants because 2010 data is unavailable at the time of benchmarking.
3. Last backlog benchmark in 2010 was as of June 1, 2010.

Green = maximum NPI points achieved or best quartile performance

White = 2nd quartile performance

Yellow = 3rd quartile performance

Red = worst quartile performance

⇩ Declining Benchmark Quartile Performance vs. 2009

⇧ Improving Benchmark Quartile Performance vs. 2009

All data provided by the peer groups (WANO, INPO, CEA, EUCG) is confidential. A redacted version of this report, which removes individual plant and unit names, is available from Nuclear Finance – Business Planning should there be a requirement to publically release this report.

## Benchmarking Results – Plant Level Summary

Table 2 provides a summary of OPG Nuclear's performance compared to benchmark results.

**Table 2: Plant Level Performance Summary**

| Metric | NPI Max | 2011 Actuals | | | |
|---|---|---|---|---|---|
| | | Best Quartile | Median | Pickering | Darlington |
| **Safety** | | | | | |
| All Injury Rate (#/200k hours worked) | | | | 0.31 | 0.18 |
| Rolling Average Industrial Safety Accident Rate (#/200k hours worked) | 0.20 | 0.00 | 0.06 | 0.04 | 0.09 |
| Rolling Average Collective Radiation Exposure (Person-rem per unit) | 80.00 | 59.90 | 110.07 | 110.07 ⇧ | 71.12 |
| Airborne Tritium Emissions (Curies) per Unit[1] | | 969 | 3,366 | 2,565 | 969 |
| Fuel Reliability Index (microcuries per gram) | 0.000500 | 0.000015 | 0.000154 | 0.000175 ⇧ | 0.031133 ⇩ |
| 2-Year Reactor Trip Rate (# per 7,000 hours) | 0.50 | 0.00 | 0.10 | 0.60 ⇩ | 0.21 |
| 3-Year Auxiliary Feedwater System Unavailability (#) | 0.0200 | 0.0000 | 0.0026 | 0.0044 | 0.0000 |
| 3-Year Emergency AC Power Unavailability (#) | 0.0250 | 0.0005 | 0.0067 | 0.0107 | 0.0067 |
| 3-Year High Pressure Safety Injection Unavailability (#) | 0.0200 | 0.0000 | 0.0001 | 0.0001 | 0.0000 |
| **Reliability** | | | | | |
| WANO NPI (Index) | | 91.4 | 84.6 | 66.1 | 92.8 |
| Rolling Average Forced Loss Rate (%) | 1.00 | 1.14 | 1.90 | 10.34 | 1.80 |
| Rolling Average Unit Capability Factor (%) | 92.0 | 90.5 | 85.6 | 72.5 | 89.6 |
| Rolling Average Chemistry Performance Indicator (Index) | 1.01 | 1.00 | 1.01 | 1.10 | 1.03 |
| 1-Year On-line Deficient Maintenance Backlog (work orders per unit)[2] | | 260 | 378 | 301 | 266 |
| 1-Year On-line Corrective Maintenance Backlog (work orders per unit)[2] | | 33 | 52 | 160 | 121 |
| **Value for Money** | | | | | |
| 3-Year Total Generating Cost per MWh ($ per Net MWh) | | 34.21 | 41.28 | 65.86 | 33.05 ⇧ |
| 3-Year Non-Fuel Operating Cost per MWh ($ per Net MWh) | | 20.78 | 24.40 | 56.54 | 26.42 |
| 3-Year Fuel Cost per MWh ($ per Net MWh) | | 6.50 | 7.20 | 4.27 | 4.24 |
| 3-Year Capital Cost per MW DER (k$ per MW) | | 48.39 | 72.19 | 32.54 | 18.54 |
| **Human Performance** | | | | | |
| 18-Month Human Performance Error Rate (# per 10k ISAR hours) | | 0.00500 | 0.00700 | 0.00669 ⇧ | 0.00567 ⇩ |

Notes

1. 2010 data is used because 2011 results were unavailable at the time of benchmarking.
2. INPO set a new standard for classifying work order backlogs with the issuance of AP-928 Work Management Process Description, revision 3, in June 2010.

New metrics have been implemented industry-wide to ensure more effective and accurate comparisons between utilities. Data collected is as of September 2011.

Green = maximum NPI points achieved or best quartile performance
White = 2nd quartile performance
Yellow = 3rd quartile performance
Red = worst quartile performance

⇩ Declining Benchmark Quartile Performance vs. 2010
⇧ Improving Benchmark Quartile Performance vs. 2010

## Comparison of 2012 OPG Nuclear Performance to Industry Benchmarks

| Metric | NPI Max | 2012 Actuals | | | |
|---|---|---|---|---|---|
| | | Best Quartile | Median | Pickering | Darlington |
| **Safety** | | | | | |
| All Injury Rate (#/200k hours worked) | | 1.01 | N/A[1] | 0.33 | 0.34 |
| Rolling Average Industrial Safety Accident Rate (#/200k hours worked) | 0.20 | 0.00 | 0.03 | 0.03 | 0.10 |
| Rolling Average Collective Radiation Exposure (Person-rem per unit) | 80.00 | 40.50 | 83.32 | 124.06 ⇩ | 58.55 |
| Airborne Tritium Emissions (Curies) per Unit[2] | | 1,196 | 2,577 | 2,491 | 973 |
| Fuel Reliability Index (microcuries per gram) | 0.000500 | 0.000001 | 0.000048 | 0.000129 | 0.000194 ⇧ |
| 2-Year Reactor Trip Rate (# per 7,000 hours) | 0.50 | 0.000 | 0.104 | 0.517 ⇧ | 0.208 |
| 3-Year Auxiliary Feedwater System Unavailability (#) | 0.0200 | 0.0000 | 0.0003 | 0.0116 | 0.0000 |
| 3-Year Emergency AC Power Unavailability (#) | 0.0250 | 0.0005 | 0.0026 | 0.0037 | 0.0000 |
| 3-Year High Pressure Safety Injection Unavailability (#) | 0.0200 | 0.00000 | 0.00006 | 0.0001 | 0.0000 |
| **Reliability** | | | | | |
| WANO NPI (Index) | | 98.3 | 89.1 | 64.7 | 96.3 ⇩ |
| Rolling Average Forced Loss Rate (%) | 1.00 | 0.65 | 1.03 | 9.23 | 2.02 ⇩ |
| Rolling Average Unit Capability Factor (%) | 92.0 | 93.78 | 92.08 | 75.62 | 92.0 ⇧ |
| Rolling Average Chemistry Performance Indicator (Index) | 1.01 | 1.00 | 1.01 | 1.10 | 1.03 |
| 1-Year On-line Deficient Maintenance Backlog (work orders per unit) | | 222 | 313 | 232 | 203 ⇧ |
| 1-Year On-line Corrective Maintenance Backlog (work orders per unit) | | 8 | 28 | 118 | 66 |
| **Value for Money** | | | | | |
| 3-Year Total Generating Cost per MWh ($ per Net MWh) | | 36.30 | 43.40 | 67.16 | 31.67 |
| 3-Year Non-Fuel Operating Cost per MWh ($ per Net MWh) | | 21.76 | 24.65 | 57.21 | 24.76 |
| 3-Year Fuel Cost per MWh ($ per Net MWh) | | 7.24 | 8.03 | 5.00 | 4.69 |
| 3-Year Capital Cost per MW DER (k$ per MW) | | 52.46 | 70.96 | 31.84 | 17.66 |
| **Human Performance** | | | | | |
| 18-Month Human Performance Error Rate (# per 10k ISAR hours) | | 0.00400 | 0.00700 | 0.00800 ⇩ | 0.00760 ⇩ |

Notes

1. No median benchmark available.
2. 2011 data is used because 2012 results were unavailable at the time of benchmarking.

New metrics have been implemented industry-wide to ensure more effective and accurate comparisons between utilities. Data collected is as of December 3

Green = maximum NPI points achieved or best quartile performance

White = 2nd quartile performance

Yellow = 3rd quartile performance

Red = worst quartile performance

⇩ Declining Benchmark Quartile Performance vs. 2011

⇧ Improving Benchmark Quartile Performance vs. 2011

## FINANCIAL AND OPERATIONAL HIGHLIGHTS

| *(millions of dollars – except where noted)* | **2013** | **2012** |
|---|---|---|
| *Earnings* | | |
| Revenue | **4,863** | 4,732 |
| Fuel expense | **708** | 755 |
| Gross margin | **4,155** | 3,977 |
| Operations, maintenance and administration | **2,747** | 2,648 |
| Depreciation and amortization | **963** | 664 |
| Accretion on fixed asset removal and nuclear waste management liabilities | **756** | 725 |
| Nuclear Funds (earnings) – a reduction to expense | **(628)** | (651) |
| Other net expenses | **65** | 40 |
| Income before interest and income taxes | **252** | 551 |
| Net interest expense | **86** | 117 |
| Income tax expense | **31** | 67 |
| Net income | **135** | 367 |
| *Income (loss) before interest and income taxes* | | |
| Generating segments | **301** | 562 |
| Nuclear Waste Management segment | **(122)** | (68) |
| Other segment | **73** | 57 |
| Total income before interest and income taxes | **252** | 551 |
| *Cash flow* | | |
| Cash flow provided by operating activities | **1,174** | 876 |
| *Electricity generation (TWh)* | | |
| Regulated – Nuclear Generation | **44.7** | 49.0 |
| Regulated – Hydroelectric | **18.9** | 18.5 |
| Unregulated – Hydroelectric | **13.9** | 12.1 |
| Unregulated – Thermal | **2.8** | 4.1 |
| Total electricity generation | **80.3** | 83.7 |
| *Average sales prices and average revenue (¢/kWh)* | | |
| Regulated – Nuclear Generation [1] | **5.7** | 5.5 |
| Regulated – Hydroelectric [1] | **4.0** | 3.5 |
| Unregulated – Hydroelectric [1] | **2.8** | 2.4 |
| Unregulated – Thermal [1] | **2.7** | 2.6 |
| Average revenue for OPG [2] | **5.7** | 5.2 |
| Average revenue for all electricity generators, excluding OPG [3] | **9.9** | 8.6 |
| *Nuclear unit capability factor (per cent)* | | |
| Darlington Nuclear GS | **82.9** | 93.2 |
| Pickering Nuclear GS | **73.7** | 77.8 |
| *Availability (per cent)* | | |
| Regulated – Hydroelectric | **90.8** | 91.4 |
| Unregulated – Hydroelectric | **91.8** | 91.1 |
| *Start Guarantee rate (per cent)* | | |
| Unregulated – Thermal | **98.0** | 97.5 |
| *Return on equity (per cent)* [4] | **1.5** | 4.2 |
| *Funds from operations interest coverage (times)* [4] | **2.8** | 2.2 |

[1] Average sales prices are computed as net generation sales or spot market prices divided by net generation volume.

[2] Average revenue for OPG is comprised of regulated revenues, market based revenues, and other energy revenues primarily from cost recovery agreements, and revenue from hydroelectric Energy Supply Agreements.

[3] Revenues for other electricity generators are calculated as the sum of hourly Ontario demand multiplied by the hourly Ontario electricity price (HOEP) plus total global adjustment payments, plus the sum of hourly net exports multiplied by the HOEP, less OPG's generation revenue.

[4] "Funds from operations interest coverage" and "Return on equity" are non-GAAP financial measures and do not have any standardized meaning prescribed by US GAAP. Additional information about these measures is provided in OPG's Management's Discussion and Analysis for the year ended Dec. 31, 2013, under the heading, *Supplementary Non-GAAP Financial Measures.*

ONTARIO POWER GENERATION

# 5 Year Performance Plan

## 2008

| Metric | Pickering A | Pickering B | Darlington |
|---|---|---|---|
| **Safety** | | | |
| All Injury Rate | 0.73 | 0.96 | 1.04 |
| 2-Year Industrial Safety Accident Rate | 0.14 | 0.07 | 0.04 |
| 2-Year Collective Radiation Exposure (man-rem per unit) | 44.2 | 95.81 | 72.83 |
| Airborne Tritium (TBq) Emissions per Unit | 101.0 | 50.7 | 40.0 |
| Fuel Reliability (microcuries per gram) | 0.00059 | 0.00159 | 0.00025 |
| 2-Year Reactor Trip Rate (# per 7,000 hrs) | 1.22 | 0.26 | 0.00 |
| 3-Year Auxiliary Feedwater System Unavailability | 0.0119 | 0.0040 | 0.0017 |
| 3-Year Emergency AC Power Unavailability | 0.0081 | 0.0091 | 0.0020 |
| 3-Year High Pressure Safety Injection Unavailability | 0.0012 | 0.0001 | 0.0091 |
| **Reliability** | | | |
| WANO NPI (Index) | 60.84 | 60.93 | 95.67 |
| 2-Year Forced Loss Rate (%) | 37.90 | 18.19 | 0.93 |
| 2-Year Unit Capability Factor (%) | 66.6 | 73.17 | 91.99 |
| 2-Year Chemistry Performance Indicator (Index) | 1.13 | 1.25 | 1.00 |
| 1-Year Online Elective Maintenance (work orders/unit) | 425 | 695 | 313 |
| 1-Year Online Corrective Maintenance (work orders/unit) | 14 | 28 | 8 |
| **Value for Money** | | | |
| 3-Year Total Generating Costs per MWh ($/Net MWh) | 92.27 | 58.66 | 30.08 |
| 3-Year Non-Fuel Operating Costs per MWh ($/Net MWh) | 82.62 | 50.95 | 25.10 |
| 3-Year Fuel Costs per MWh ($/Net MWh) | 2.64 | 2.68 | 2.62 |
| 3-Year Capital Costs per MW DER**($/MW) | 32.07 | 32.44 | 18.79 |

- Continue to lead industry in overall conventional and nuclear safety performance.
- Increase fuel reliability.
- Strengthen equipment reliability and human performance to reduce reactor trips.
- Focus on work order readiness, reducing backlogs, improving maintenance effectiveness, and work management.
- Reduce base and outage operating costs to improve fleet-wide total generating costs per MWh. Darlington becomes industry leader in costs. Pickering A and B narrow gaps.

## 2014

| Pickering A | Pickering B | Darlington |
|---|---|---|
| **Safety** | | |
| 1.2 | 1.2 | 1.2 |
| 0.15 | 0.15 | 0.15 |
| 125 | 82 | 66 |
| 81.1 | 36.5 | 27.0 |
| 0.0005 | 0.0005 | 0.0005 |
| 0.50 | 0.50 | 0.50 |
| 0.0200 | 0.0200 | 0.0200 |
| 0.0250 | 0.0250 | 0.0250 |
| 0.0200 | 0.0200 | 0.0200 |
| **Reliability** | | |
| 70.9 | 81.3 | 99.1 |
| 4.00 | 4.00 | 1.25 |
| 84.3 | 81 | 93.3 |
| 1.04 | 1.04 | 1.01 |
| 278 | 300 | 214 |
| 9 | 15 | 4 |
| **Value for Money** | | |
| 70.81 | 64.80 | 36.75 |
| 60.07 | 52.47 | 28.82 |
| 6.01 | 7.45 | 5.43 |
| 34.73 | 34.67 | 20.37 |

2014 WANO indicator targets are set to provide maximum NPI points only. 2014 Cost Targets are above 2008 due to expected cost escalation of Median and Best Quartile Costs per EUCG panel historical trend. 2010-2014 values represent annual targets. Actuals will be calculated based on rolling average definitions.

# Nuclear Operations – 3 Year Performance Targets

## 2011

| Metric | 2011 Actuals (Rolling Average) Pickering | Darlington | 2015 Target Guidelines (Annual) Pickering | Darlington |
|---|---|---|---|---|
| **Safety** | | | | |
| All Injury Rate (#/200k hours worked) | 0.31 | 0.18 | 0.89 | 0.89 |
| Industrial Safety Accident Rate (#/200k hours worked) | 0.04 | 0.09 | 0.15 | 0.15 |
| Collective Radiation Exposure (Person-rem per unit) | 110.07 ⇧ | 71.12 | 98.71 | 73.80 |
| Airborne Tritium Emissions (Curies) per Unit | 2,565 | 969 | 1,800 | 1,000 |
| Fuel Reliability Index (microcuries per gram) | 0.000175 ⇧ | 0.001133 ⇩ | 0.000500 | 0.000500 |
| Reactor Trip Rate (# per 7,000 hours) | 0.60 ⇩ | 0.21 | 0.50 | 0.50 |
| Auxiliary Feedwater System Unavailability (#) | 0.0044 | 0.0000 | 0.0200 | 0.0200 |
| Emergency AC Power Unavailability (#) | 0.0107 | 0.0067 | 0.0250 | 0.0250 |
| High Pressure Safety Injection Unavailability (#) | 0.0001 | 0.0000 | 0.0200 | 0.0200 |
| **Reliability** | | | | |
| WANO NPI (Index) | 66.1 | 92.8 | 74.2 | 96.1 |
| Forced Loss Rate (%) | 10.34 | 1.80 | 5.50 | 1.00 |
| Unit Capability Factor (%) | 72.5 | 89.6 | 82.1 | 86.3 |
| Chemistry Performance Indicator (Index) | 1.10 | 1.03 | 1.04 | 1.01 |
| On-line Deficient Maintenance Backlog (work orders per unit) | 301 | 266 | < 197 | 180 |
| On-line Corrective Maintenance Backlog (work orders per unit) | 160 | 121 | 78 | 25 |
| **Value for Money** | | | | |
| Total Generating Cost per MWh ($ per Net MWh)[1] | 65.86 | 33.05 ⇧ | 60.25 | 42.78 |
| Non-Fuel Operating Cost per MWh ($ per Net MWh)[1] | 56.54 | 26.42 | 53.34 | 32.82 |
| Fuel Cost per MWh ($ per Net MWh)[1] | 4.27 | 4.24 | 5.93 | 5.28 |
| Capital Cost per MW DER (k$ per MW)[1, 2] | 32.54 | 18.54 | 6.98 | 34.82 |
| **Human Performance** | | | | |
| Human Performance Error Rate (# per 10k ISAR hours) | 0.007 ⇧ | 0.006 ⇩ | 0.004 | 0.004 |

## 2015

- Continue to lead industry in overall conventional and nuclear safety performance, with top quartile performance from both stations. Plan in place at Darlington to address fuel defects.
- Focus on work order readiness, reducing backlogs, improving maintenance effectiveness, and work management to improve reliability of the units. Execute the approved Nuclear Fleet Initiatives.
- Pickering continue to benefit from organizational efficiencies through Pickering site amalgamation and implementation of value for money initiatives. Continue focusing on value for money and outage cost reductions at Darlington.
- Darlington's 2015 TGC/MWh and NFOC/MWh are higher as a result of the planned VBO/SCO.
- Minimize the number of event free day resets through improved use of event free tools, oversight, and dynamic learning activities.

[1]TGC/MWh and NFOC/MWh targets exclude OPEB, Pension, and Corporate Asset Service Fees to align with industry standards.
[2]DER - Design Electrical Rating.

⇩ Declining Benchmark Quartile Performance vs. 2010
⇧ Improving Benchmark Quartile Performance vs. 2010

Green = max NPI points achieved (if applicable) or best quartile performance
White = 2nd quartile performance
Yellow = 3rd quartile performance
Red = worst quartile performance

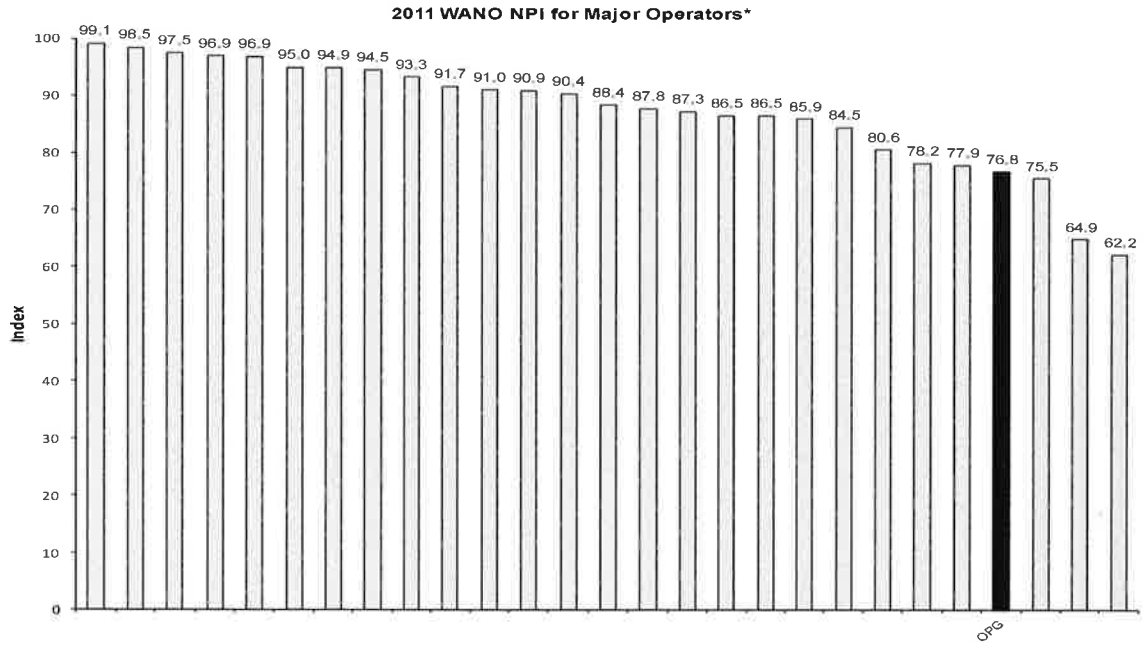
## 6.0 MAJOR OPERATOR SUMMARY

### Purpose

This section supplements the Executive Summary, providing more detailed comparison of the major operators of nuclear plants for three key metrics: WANO Nuclear Performance Index, Unit Capability Factor (UCF) and Total Generating Cost (TGC) per MWh. Although the benchmarking study has been primarily focused on operational performance comparison to COG CANDUs, this section of the report contemplates the larger industry by capturing OPG Nuclear's performance against North American PWR and PHWR operators in addition to the International CANDU panel. Operator level summary results are the average (mean) of the results across all plants managed by the given operator. These comparisons provide additional context, but the detailed data in the previous sections provide a more complete picture of plant by plant performance. The WANO NPI and UCF are calculated as the mean of all unit performance for a specific operator. The TGC per MWh is the mean of plant level data because costs are not allocated to specific units within the EUCG industry panel.

### WANO Nuclear Performance Index (NPI) Analysis

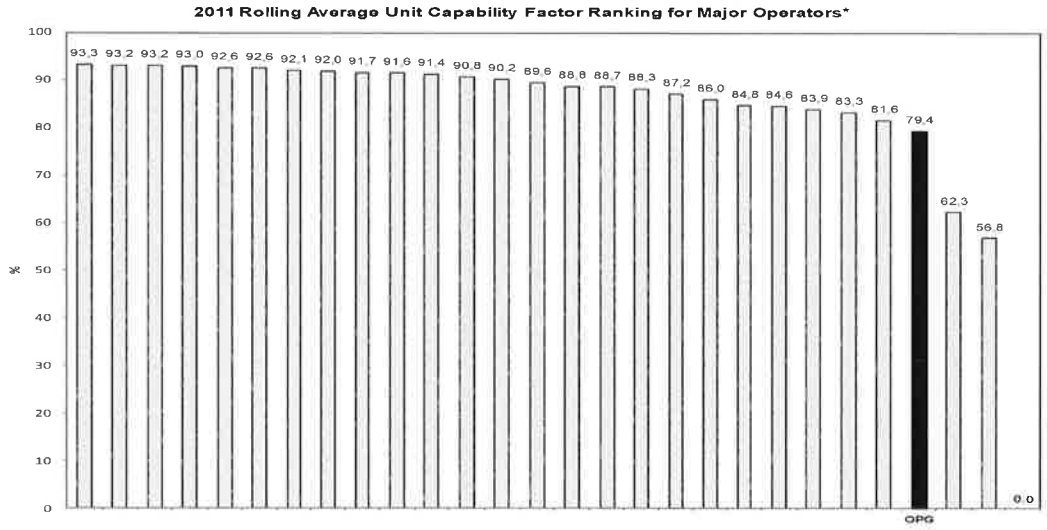
The WANO NPI results for the operators in 2011 are illustrated in the graph below. OPG's performance ranking has improved from 25th in 2008 to 24th in 2011 as shown in Table 3.



## Unit Capability Factor (UCF) Analysis

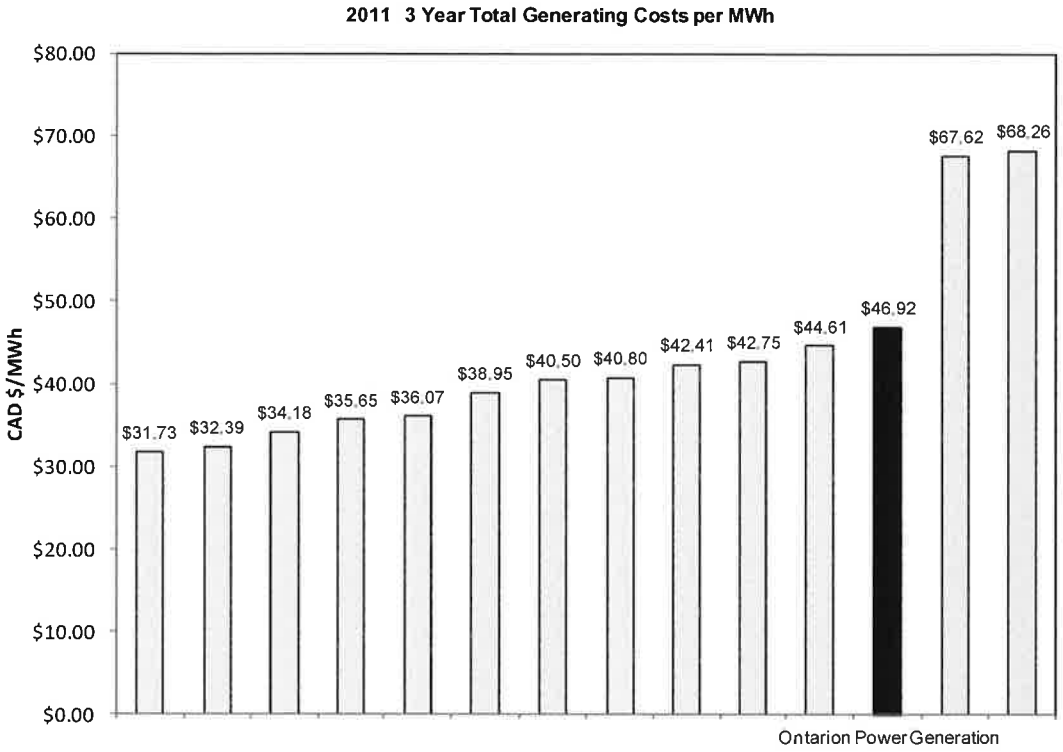
Unit Capability Factor is the ratio of available energy generation over a given time period to the reference energy generation of the same time period. Reference energy generation is the energy that could be produced if the unit were operating continuously at full power under normal conditions. Since nuclear generation plants are large fixed assets, the extent to which these assets generate reliable power is the key to both their operating and financial performance. For this reason, this NPI indicator has been examined more closely below.

A comparison of UCF values for major nuclear operators is presented in the graph below. UCF is expressed as a two-year average for all operators except for OPG which includes a three-year average for the Darlington station and a two-year average for Pickering. OPG achieved a rolling average unit capability factor of 79.4% and ranked 25 out of 28 operators in the WANO data set. The list and ranking of operators have been updated to reflect industry developments.




*OPG unit values averaging to a rolling average UCF of 79.4% in 2011 are shown below:

| Unit | 2011 Rolling Average UCF |
|---|---|
| Pickering 1 | 67.6 |
| Pickering 4 | 62.7 |
| Pickering 5 | 64.8 |
| Pickering 6 | 78.8 |
| Pickering 7 | 81.2 |
| Pickering 8 | 80.1 |
| Darlington 1 | 89.8 |
| Darlington 2 | 90.0 |
| Darlington 3 | 90.8 |
| Darlington 4 | 87.8 |




*OPG plant values of 3-year rolling average TGC per MWh are shown below:

| Plant | 2011 3-Year TGC |
|---|---|
| Pickering | $65.86/MWh |
| Darlington | $33.05/MWh |

**Table 5: Three-Year Total Generating Cost per MWh Rankings**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| | 9 | 6 | 5 | 3 | 1 |
| | 3 | 2 | 1 | 1 | 2 |
| | 1 | 1 | 2 | 2 | 3 |
| | 2 | 3 | 3 | 4 | 4 |
| | 4 | 4 | 4 | 5 | 5 |
| | 6 | 5 | 6 | 6 | 6 |
| | 8 | 11 | 11 | 9 | 7 |
| | 7 | 10 | 10 | 10 | 8 |
| | 11 | 8 | 7 | 7 | 9 |
| | 5 | 7 | 9 | 8 | 10 |
| | 10 | 9 | 8 | 11 | 11 |
| Ontario Power Generation | 14 | 14 | 12 | 12 | 12 |
| | 13 | 13 | 14 | 14 | 13 |
| | 12 | 12 | 13 | 13 | 14 |

support systems focused only on habitability of those structures. This distinction may vary among stations.

**Value for Money Definitions**

The following definition summaries are taken from the *January 2006 EUCG Nuclear Committee Nuclear Database Instructions*.

**Capital Costs ($)**
All costs associated with improvements and modifications made during the reporting year. These costs should include design and installation costs in addition to equipment costs. Other miscellaneous capital additions such as facilities, computer equipment, moveable equipment, and vehicles should also be included. These costs should be fully burdened with indirect costs. Exclude AFUDC.

**Fuel** ($)
The total cost associated with a load of fuel in the reactor which is burned up in a given year.

**Generation (Gigawatt Hours)**
Per NRC monthly operating report definition for net electrical energy: The gross electrical output of the unit measured at the output terminals of the turbine-generator minus the normal station service loads during the gross hours of the reporting period, expressed in Gigawatt hours (GWh). Negative quantities should not be used.

**Design Electrical Rating (DER)**
Per Energy Information Administration, the definition for design electrical rating: The nominal net electrical output of a unit, specified by the utility and used for plant design.

**Operating Costs ($)**
The data provided should reflect the full cost for operating and maintaining the nuclear plant. This should include all costs from the senior nuclear corporate officer down. These costs should reflect the share of payroll taxes & benefits and corporate administrative & general costs applicable to the nuclear plant. Costs that would be applicable if the plant were considered a business unit should be included.

**Total Generating Costs ($)**
The sum of total operating costs and capital costs as above.

**Total Operating Costs ($)**
The sum of operating costs and fuel costs as above.

Note: Capital costs, fuel costs, operating costs and total generating costs are divided by net generation as above to obtain per MWh results. Non-fuel operating costs and capital costs are also divided by MW DER to obtain MW results.

certified/designed to produce when constructed. The value would change if a power uprate was completed. After a power uprate, the value should be the certified or design value resulting from the uprate.

**Operating Costs ($)**
The operating cost is to identify all relevant costs to operate and maintain the nuclear operations in that company. It includes the cost of labour, materials, purchased services and other costs, including administration and general.

**Total Generating Costs ($)**
The sum of total operating costs and capital costs as above.

**Total Operating Costs ($)**
The sum of operating costs and fuel costs as above.

Note: Capital costs, fuel costs, operating costs and total generating costs are divided by net generation as above to obtain per MWh results. Capital costs are also divided by MW DER to obtain MW results.

**Human Performance Definitions**

The following definition summary is taken from the Institute of Nuclear Power Operations (INPO) database.

**Human Performance Error Rate (# per ISAR Hours)**
The Human Performance Error Rate metric represents the number of site level human performance events in an 18-month period per 10,000 hours worked (ISAR hours). The formula used is:

[# of S-EFDRs (in the last 18 months)] x [10,000 hours] / [total Industrial Safety Accident Rate (ISAR) hours (in the last 18 months)]

Fleet results are calculated with the same formula, using the total hours worked and total number of events of the three stations. Site event free day reset criteria was developed in 2004 to align with criteria established by the STARS Alliance (Strategic Team and Resource Alliance) which was used through to the end of 2010. This criterion was similar to but not identical to the criterion set out by INPO in publication INPO 08-004, Human Performance Key Performance Indicators. U.S. utilities were to align with this criterion in order to establish an effective benchmark process. This was done with some exceptions. In the same publication, INPO defined the Human Performance Error Rate metric. INPO piloted this metric throughout 2009 and 2010.

INPO defines an event to occur as a result of the following:

An initiating action (error) by an individual or group of individuals (event resulting from an active error) or an initiating action (not an error) by an individual or group of individuals during an activity conducted as planned (event resulting from a flawed defense or latent organizational

filing shows, relative to various peer groups, that our compensation levels for our represented staff are higher than certain measures of those peer group compensation levels.

MR. SHEPHERD: Just -- we are going to ask more about benchmarking in the other panels, of course, but can you tell me, have you changed -- in the last two or three years, have you changed your policies with respect to how you benchmark costs or whether you benchmark costs?

MR. BARRETT: I wouldn't necessarily say we have a policy. There is individual benchmarking analyses that are done that you would be familiar with. Like, there is the Scott Madden methodology that we employ in our nuclear organization, and that methodology has been consistently applied since we started that approach, with a few minor adjustments.

MR. SHEPHERD: What I am really trying to get at here is I see the KPMG report has a list of benchmarking studies going back to 2002/'3, like that, and you have in one of your interrogatory -- or your undertaking responses, JT2.14 -- which I think is in the material somewhere, although I can't find it offhand -- you have a list of benchmarking studies since 2010?

MR. BARRETT: A list of major benchmarking studies, yes.

MR. SHEPHERD: And it appears to me -- and tell me whether this is a fair conclusion -- that -- this is -- JT2.14 is at page 9 of our materials. That in recent

Numbers may not add due to rounding.



Table 3
Nuclear Staff Summary - Regular and Non-Regular (FTEs)

| Line No. | Group | 2010 Actual | 2011 Actual | 2012 Actual | 2013 Budget | 2014 Plan | 2015 Plan |
|---|---|---|---|---|---|---|---|
| | | (a) | (b) | (c) | (d) | (e) | (f) |
| | | | | | | | |
| | **NUCLEAR OPERATIONS:** | | | | | | |
| 1 | **Regular Staff** | 7,612.4 | 7,404.9 | 7,165.4 | 6,113.6 | 5,938.4 | 5,815.3 |
| 2 | **Less: Business Transformation Transfers to Corporate** | | | (1,064.7) | | | |
| 3 | **Total Regular Staff** | 7,612.4 | 7,404.9 | 6,100.7 | 6,113.6 | 5,938.4 | 5,815.3 |
| 4 | **Non-Regular Staff** | 680.1 | 583.7 | 436.0 | 434.2 | 377.2 | 428.6 |
| 5 | **Subtotal Nuclear Operations** | 8,292.5 | 7,988.6 | 6,536.7 | 6,547.8 | 6,315.6 | 6,243.9 |
| | | | | | | | |
| | **DARLINGTON REFURBISHMENT AND NEW NUCLEAR:**[1] | | | | | | |
| 6 | **Regular Staff** | 143.3 | 208.1 | 210.9 | 258.5 | 264.1 | 276.0 |
| 7 | **Non-Regular Staff** | 9.6 | 18.4 | 14.2 | 0.9 | 0.0 | 0.0 |
| 8 | **Subtotal Nuclear Generation Development** | 152.9 | 226.5 | 225.1 | 259.4 | 264.1 | 276.0 |
| | | | | | | | |
| 9 | **Total Nuclear** | 8,445.4 | 8,215.1 | 6,761.8 | 6,807.2 | 6,579.7 | 6,519.9 |

Notes:

1 All forecast New Build FTE's in 2014 (21 FTE's) and 2015 (21 FTE's) have been excluded for reasons discussed in Ex. F2-8-1.

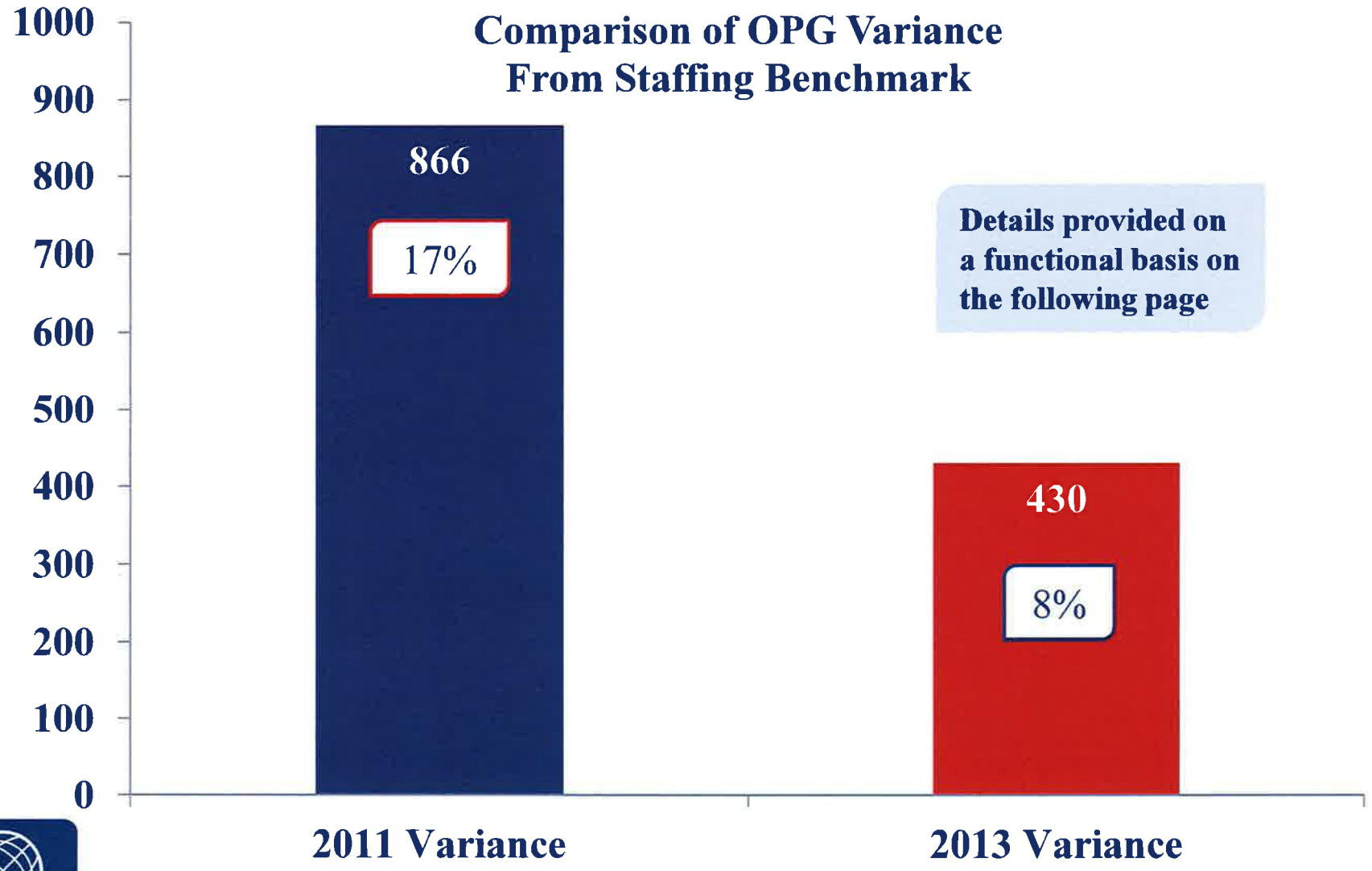
- 188 FTEs of OPG corporate staff that provide direct corporate support to OPG Nuclear (such as Finance and Human Resources); and,
- 382 FTEs of baseline contractors (i.e., contractors engaged in power, steady state activities including work activities related to the execution of the project portfolio).

Goodnight established an industry staffing benchmark of 5,090 FTEs. The comparator group was 16 large (greater than 800 MW) 2-unit PWRs stations operating in the United States. Goodnight selected PWRs over BWRs because in its opinion, CANDU plants are more similar to PWRs in that there are steam generators with similar primary and secondary loops. Goodnight chose larger capacity PWR stations because these later model designs are more complex than earlier versions, and therefore in Goodnight's opinion, would make for a more appropriate comparator with CANDU stations. However, in deriving the 5,090 industry staff benchmark, Goodnight made adjustments for CANDU versus PWR technology/design/regulatory differences as well as differences in work week hours (35 versus 40 hours).

The main conclusions of the initial Goodnight Nuclear Staffing Study were:

- As of July 2011, OPG Nuclear is above the comparable benchmark by 866 employees or approximately 17 per cent;
- Goodnight observed that OPG's use of overtime was not unusual relative to the U.S. PWR comparator group. Average base overtime use at OPG was 7 per cent in 2010 and 6 per cent in 2011, which compared favourably with U.S plants at 5 per cent-6 per cent (Ex. F5-1-1 page 20).
- OPG's 2012 - 2014 Nuclear Business Plan is directionally correct, reducing staff to within 343 FTEs of the benchmark, or 6.7 per cent, by 2014;
- OPG should target nuclear staff reductions in appropriate functions, as the Goodnight benchmark analysis indicates plant staffing is already below benchmark for certain functions (e.g. plant and technical engineering).

# The Gap Between OPG & The Benchmark Is 436 FTEs Smaller In 2013 Than It Was In 2011






GOODNIGHT CONSULTING

Nuclear OM&A

| $million | 2010 Actual | 2011 Actual | 2012 Acutal | 2013 Actual | 2014 Plan | 2015 Plan |
|---|---|---|---|---|---|---|
| Base | 1181.4 | 1249.1 | 1102.6 | 1127.7 | 1151.1 | 1154.0 |
| Project | 142.7 | 111.6 | 111.5 | 105.7 | 113.9 | 106.4 |
| Outage | 278.2 | 215.0 | 214.3 | 277.5 | 262.7 | 330.7 |
| SubTotal Operations | 1602.3 | 1575.7 | 1428.4 | 1510.9 | 1527.7 | 1591.1 |
| Darlington Refurbishment | 3.2 | 2.6 | 2.8 | 6.3 | 19.6 | 18.2 |
| Darlington New Nuclear | 23.2 | 15.7 | 24.7 | 25.6 | 0.0 | 0.0 |
| Corporate Costs | 226.5 | 233.1 | 408.4 | 428.3 | 433.9 | 417.4 |
| Centrally Held Costs | 161.6 | 267.1 | 342.7 | 409.9 | 418.2 | 419.8 |
| Asset Service Fee | 24.5 | 22.1 | 23.0 | 22.7 | 23.3 | 26.8 |
| SubTotal Other | 439.0 | 540.6 | 801.6 | 892.8 | 895.0 | 882.2 |
| **Total OM&A** | **2041.3** | **2116.3** | **2230.0** | **2403.7** | **2422.7** | **2473.3** |
| Exhibit N1 Update | | | | | **2491.8** | **2531.3** |
| Exhibit N2 Update | | | | | **2401.4** | **2419.8** |

Sources: Exh L-1-Staff-2 Table 19, Exh N2-1-1

Nuclear Staffing and Compensation

| | 2010 Actual | 2011 Actual | 2012 Acutal | 2013 Actual | 2014 Plan | 2015 Plan |
|---|---|---|---|---|---|---|
| Headcount | | | | | | |
| Nuclear Ops & Projects | 8,246 | 7,901 | 6,556 | 6,362 | 6,329 | 6,210 |
| DRP and New Nuclear | 153 | 241 | 227 | 198 | 266 | 276 |
| Nuclear Corporate Support | 871 | 857 | 1,941 | 1,883 | 1,759 | 1,683 |
| Total (Reg and Non Reg) | 9,270 | 8,999 | 8,724 | 8,443 | 8,354 | 8,169 |
| DRP, New Nuc, Corp Supp | 176 | 283 | 290 | 276 | 367 | 378 |
| FTE | | | | | | |
| Nuclear Ops & Projects | 8,292.5 | 7,988.6 | 6,536.7 | 6,353.6 | 6,315.6 | 6,243.9 |
| DRP and New Nuclear | 152.9 | 226.5 | 225.1 | 200.6 | 564.1 | 276.0 |
| Nuclear Corporate Support | 875.0 | 876.1 | 2,037.2 | 1,910.6 | 1,790.6 | 1,714.1 |
| Total (Reg and Non Reg) | 9,320.4 | 9,091.2 | 8,799.0 | 8,464.8 | 8,670.3 | 8,234.0 |
| DRP, New Nuc, Corp Supp | 178.3 | 268.6 | 290.7 | 280.2 | 368.1 | 380.4 |
| Compensation $million | | | | 2013 Plan | | |
| Nuclear Ops & Projects | 1,274.6 | 1,281.5 | 1,135.7 | 1,202.3 | 1,143.6 | 1,163.9 |
| DRP and New Nuclear | 23.1 | 36.3 | 37.6 | 40.3 | 52.2 | 55.2 |
| Nuclear Corporate Support | 122.4 | 129.1 | 268.2 | 291.7 | 290.1 | 280.5 |
| Total (Reg and Non Reg) | 1,420.1 | 1,446.9 | 1,441.5 | 1,534.3 | 1,485.9 | 1,499.6 |

**Chart 7**

**Darlington NGS Plan over Plan Changes**

| Darlington NGS | | 2014 | 2015 | Total Variance |
|---|---|---|---|---|
| Generation - TWH | 2014-2016 Nuclear Business Plan | 28.1 | 24.7 | |
| | 2013-2015 Nuclear Business Plan | 28.4 | 26.1 | |
| | **Variance ( BP2014-16 vs 2013-2015)** | -0.2 | -1.4 | **-1.6** |
| FLR % | 2014-2016 Nuclear Business Plan | 1.3 | 1.0 | |
| | 2013-2015 Nuclear Business Plan | 1.3 | 1.0 | |
| | **Variance ( BP2014-16 vs 2013-2015)** | 0.0 | 0.0 | **0.0** |
| Planned Outage Days | 2014-2016 Nuclear Business Plan | 81.4 | 245.6 | |
| | 2013-2015 Nuclear Business Plan | 77.1 | 188.0 | |
| | **Variance ( BP2014-16 vs 2013-2015)** | 4.3 | 57.6 | **61.9** |

Numbers may not add due to rounding

This is due to:

- A reduction of 0.28 TWh to reflect the expectation of higher lake water temperatures than assumed in the 2013 - 2015 Business Plan. Higher lake water temperatures lower generation output due to reduced condenser efficiency.
- A 61.9 day increase in planned outage days. The reassessment identified a need for 39 additional planned outage days due to the vacuum building outage ("VBO") scope being of greater complexity than previously undertaken by OPG and because the VBO outage scope includes life extension activities which have not been part of prior Darlington VBO's. The greater scope includes a 100 per cent increase in electrical equipment maintenance, significant emergency service water ("ESW") piping replacement, a 50 per cent increase in emergency coolant injection ("ECI") valve replacement and the first time implementation of pressure relief valve ("PRV") maintenance.

Planned outages are highly complex and a VBO is one of the most complex and intricate maintenance outages undertaken. As noted in Ex. E2-1-1, p. 6, the 2015 VBO eliminates the need for the 2021 VBO, reducing the complexity and resource demands during the Darlington Refurbishment Project. It is therefore critical that all of the outage scope in the 2015 VBO be completed as there is no opportunity to defer this work. The 2015 VBO will

**PWU Interrogatory #010**

**Ref:**
(a): Exh N1-1-1, Pages 14, line 29-page 15, line 8:

> The Darlington production forecast for 2014 and 2015 in the 2014-2016 Business Plan has a 1.6 TWh reduction in generation compared to the 2013 -2015 Business Plan.
>
> This is due to:
> - A reduction of 0.28 TWh to reflect the expectation of higher lake water temperatures than assumed in the 2013 -2015 Business Plan. Higher lake water temperatures lower generation output due to reduced condenser efficiency.
> - A 61.9 day increase in planned outage days...

**Issue Number:** 5.5
**Issue:** Is the proposed nuclear production forecast appropriate?

***Interrogatory***

a) Please confirm if the 61.9 day increase in planned outage days is responsible for a 1.32 TWh reduction in production forecast -the balance of the 1.6 TWh reduction after taking into account the 0.28 TWh reduction attributable to the expectation of higher water temperature?

b) If question a)is confirmed, please also confirm if, of the 1.32TWh reduction due to the 61.9 day increase in planned outage days, 0.83TWh is attributable to the Vacuum Building Outage ("VBO") and 0.49TWh is attributable to increased allowances for Darlington planned outages by 22 days?

***Response***

a) Yes, the 61.9 planned outage day increase for Darlington is responsible for a 1.32 TWh reduction in the production forecast. Losses due to lake water temperature account for a 0.28 TWh reduction.

b) Yes. 22.9 days (0.49 TWh) are attributed to Darlington planned outages (Unit 1 outage in 2014 and Unit 3 outage in 2015) and 39.0 days (0.83 TWh) are attributed to the Darlington VBO/SCO.

Witness Panel: Nuclear Business Planning, OM&A, Benchmarking

## Board Staff Interrogatory #67

**Ref:** Exh N1-1-1 pages 15-23

**Issue Number:** 5.5
**Issue:** Is the proposed nuclear production forecast appropriate?

***Interrogatory***

Planned outage days for Darlington are increased by a total of 61.9 days, with 93% (57.6 days) of the outage occurring in 2015. 39 additional planned outage days are added because of an increase in the vacuum building outage ("VBO") scope.

a) What factors were involved in changing the planning for VBO outages from the 2013-2015 Business Plan to the current plan?
b) In Exh E2-1-1, page 6, OPG states that it is seeking regulatory approval (presumably from the CNSC) to eliminate the station containment outages going forward and that this strategy of moving forward the VBO to 2015 is part of that regulatory plan.
    i. How critical is CNSC approval to the outage plans?
    ii. When will OPG know if they are successful with this strategy?
    iii. If regulatory approval is not obtained, what is OPG's plan to accommodate this scenario?
c) On page 15, the evidence contains the following statement: "....the 2015 VBO eliminates the need for the 2021 VBO, reducing the complexity and resource demands during the Darlington Refurbishment Project." To support this statement, did OPG prepare any analysis of the cost and benefits of moving the VBO forward to 2015?

***Response***

a) Please see the response to Ex. 05.5-17 SEC-074.

b)

i. CNSC approval is required to change the frequency of the SCO as the requirement for the SCO is documented in the Darlington License Condition Handbook/Darlington Power Operating License.

ii. During the SCO that has been combined with the VBO, OPG will complete the required testing to demonstrate future SCO's are not required. It is anticipated that the results will support OPG's request to the CNSC to eliminate the need for any future SCO outages.

iii. Darlington submitted a request to the CNSC for approval to eliminate the 2021 SCO. If regulatory approval is not obtained, OPG will perform additional inspections or analysis to confirm to the CNSC that future SCO's are not required.

Witness Panel: Nuclear Business Planning, OM&A, Benchmarking

c) A high level summary was prepared which established a positive payback to implementing a 12 year VBO/SCO cycle for the life of the plant compared to a 12 year VBO/6 year SCO cycle. Also, eliminating the VBO/SCO in 2021 will have a benefit when Darlington is scheduled to have two units in refurbishment by reducing complexity and resource demands.

Witness Panel: Nuclear Business Planning, OM&A, Benchmarking

## Value for Money Cornerstone Targets

| Metric | Site / Business Unit | 2009 Projection | 2014 | Projected 2014 Values | |
|---|---|---|---|---|---|
| | | | | Best Quartile | Median |
| **Tier 1** | | | | | |
| OM&A Base & Outage ($MM) | Darlington | 403.20 | 444.80 | n/a | n/a |
| | Pickering A | 260.30 | 272.86 | n/a | n/a |
| | Pickering B | 352.70 | 399.90 | n/a | n/a |
| | NP&T | 240.50 | 257.33 | n/a | n/a |
| | E&M | 81.00 | 77.76 | n/a | n/a |
| | PINO | 9.60 | 10.56 | n/a | n/a |
| | NSC | 71.90 | 73.91 | n/a | n/a |
| | IM&CS | 41.50 | 43.10 | n/a | n/a |
| | NWM | 4.60 | 4.39 | n/a | n/a |
| Non-Fuel Operating Cost per MWh ($/MWh) | Darlington | 30.13 | 28.82 | 25.53 | 29.08 |
| | Pickering A | 74.88 | 60.07 | 25.53 | 29.08 |
| | Pickering B | 46.01 | 52.47 | 25.53 | 29.08 |
| Total Generating Cost per MWh** ($/MWh) | Darlington | 36.48 | 36.75 | 33.98 | 37.90 |
| | Pickering A | 84.47 | 70.81 | 33.98 | 37.90 |
| | Pickering B | 54.17 | 64.80 | 33.98 | 37.90 |
| **Metric** | **Site / Business Unit** | **2009 Projection** | **2014** | **NA PWR/PHWR** | |
| | | | | **Best Quartile** | **Median** |
| **Tier 2** | | | | | |
| Nuclear Projects Available for Service (#) | Darlington | 32 | 100% | n/a | n/a |
| | Pickering A | 8 | 100% | n/a | n/a |
| | Pickering B | 18 | 100% | n/a | n/a |
| | NP&T | 7 | 100% | n/a | n/a |

NOTE: OM&A Base and Outage ($MM) excludes approximately $11.6M in OM&A cost associated with the Office of the CNO.

Nuclear Production

| TWh | 2010 Actual | 2011 Actual | 2012 Actual | 2013 Actual | 2014 Plan | 2015 Plan |
|---|---|---|---|---|---|---|
| Darlington | 26.5 | 29.0 | 28.3 | 25.1 | 28.4 | 26.1 |
| Pickering | 19.2 | 19.7 | 20.7 | 19.6 | 21.3 | 21.9 |
| **Total** | **45.7** | **48.7** | **49.0** | **44.7** | **49.7** | **48.0** |
| Exhibit N1 Update | | | | | 49.0 | 46.1 |
| Exhibit N2 Update | | | | | 48.5 | 46.1 |

Sources: Exh L-1-Staff-2 Attachment 1 Table 14, Exh N2-1-1

*See Table 7 in the Appendix for listing of operators and plants.
**OPG unit values averaging to a WANO NPI of 76.8 in 2011 are shown below:

| Unit | 2011 WANO NPI |
|---|---|
| Pickering 1 | 45.0 |
| Pickering 4 | 60.5 |
| Pickering 5 | 66.6 |
| Pickering 6 | 79.4 |
| Pickering 7 | 83.2 |
| Pickering 8 | 61.7 |
| Darlington 1 | 94.9 |
| Darlington 2 | 95.8 |
| Darlington 3 | 98.2 |
| Darlington 4 | 82.3 |

OPG ranked 24th, with an NPI of 76.8. Darlington performed significantly better overall than Pickering, achieving best quartile against the CANDU panel in 2011. Refer to Section 3 for further information.

The NPI rankings of the major operators from 2008 to 2011 are listed in Table 3. The list and ranking of operators have been updated to reflect industry developments.

**Table 3: Average WANO NPI Rankings**

| Operator | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| | 6 | 12 | 2 | 1 |
| | 11 | 20 | 12 | 2 |
| | 7 | 17 | 16 | 3 |
| | 2 | 1 | 1 | 4 |
| | 21 | 21 | 10 | 5 |
| | 22 | 14 | 6 | 6 |
| | 3 | 5 | 7 | 7 |
| | 10 | 6 | 3 | 8 |
| | 24 | 24 | 22 | 9 |
| | 1 | 9 | 14 | 10 |
| | 14 | 18 | 15 | 11 |
| | 5 | 4 | 5 | 12 |
| | 9 | 11 | 4 | 13 |
| | 19 | 15 | 18 | 14 |
| | 13 | 22 | 19 | 15 |
| | 16 | 16 | 17 | 16 |
| | 17 | 7 | 8 | 17 |
| | 18 | 2 | 11 | 18 |
| | 4 | 3 | 13 | 19 |
| | 8 | 10 | 9 | 20 |
| | 20 | 13 | 20 | 21 |
| | 15 | 19 | 25 | 22 |
| | 26 | 25 | 21 | 23 |
| Ontario Power Generation (OPG) | 25 | 23 | 23 | 24 |
| | 23 | 26 | 27 | 25 |
| | 27 | 27 | 26 | 26 |
| | 12 | 8 | 24 | 27 |
| | 28 | 28 | 28 | N/A* |

* N/A: Not applicable due to multi-year refurbishment at the generating station.

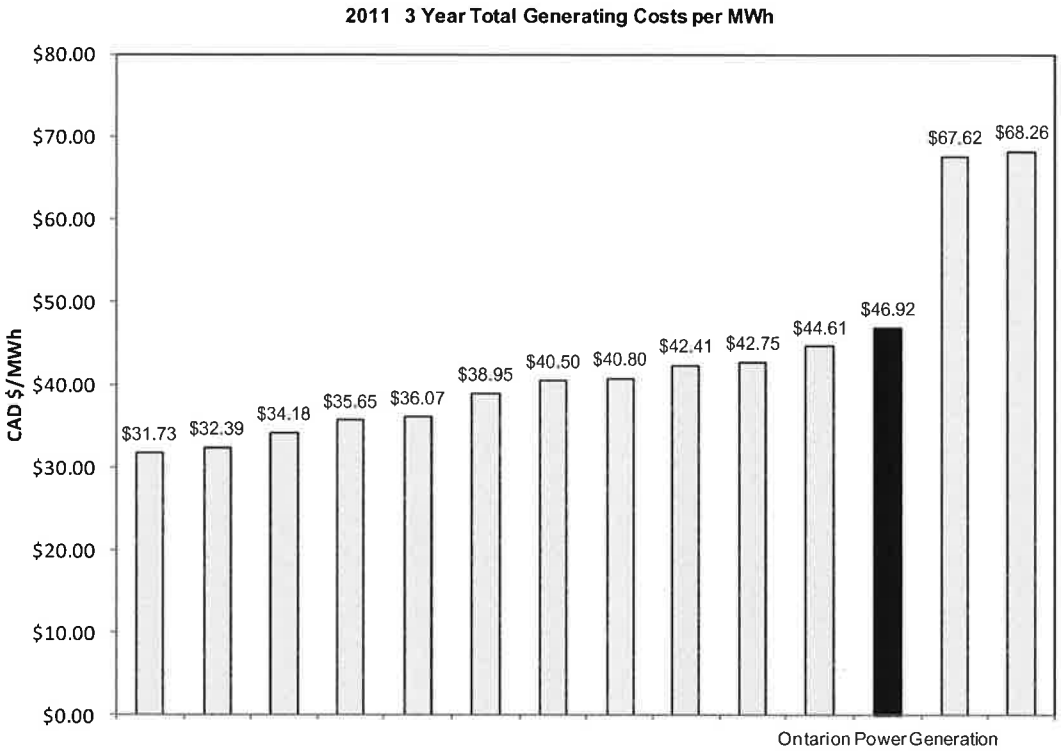
Rankings for the major operators for UCF over the past five years are provided in Table 4 below. OPG's performance has gradually improved from 27th in 2007 to 25th at the end of 2011.

**Table 4: Rolling Average Unit Capability Factor Rankings**

| Operator | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| | 8 | 13 | 20 | 20 | 1 |
| | 5 | 2 | 3 | 4 | 2 |
| | 6 | 1 | 1 | 2 | 3 |
| | 4 | 5 | 2 | 1 | 4 |
| | 14 | 9 | 16 | 9 | 5 |
| | 9 | 8 | 23 | 15 | 6 |
| | 16 | 18 | 5 | 6 | 7 |
| | 11 | 6 | 6 | 8 | 8 |
| | 19 | 19 | 11 | 5 | 9 |
| | 22 | 17 | 22 | 7 | 10 |
| | 18 | 7 | 13 | 12 | 11 |
| | 3 | 16 | 9 | 3 | 12 |
| | 15 | 12 | 8 | 13 | 13 |
| | 28 | 25 | 19 | 17 | 14 |
| | 1 | 3 | 4 | 11 | 15 |
| | 20 | 22 | 27 | 27 | 16 |
| | 21 | 23 | 18 | 19 | 17 |
| | 17 | 4 | 10 | 18 | 18 |
| | 13 | 21 | 7 | 14 | 19 |
| | 24 | 20 | 12 | 21 | 20 |
| | 7 | 15 | 17 | 10 | 21 |
| | 10 | 11 | 15 | 22 | 22 |
| | 26 | 24 | 24 | 24 | 23 |
| | 2 | 10 | 21 | 16 | 24 |
| Ontario Power Generation (OPG) | 27 | 26 | 25 | 23 | [illegible] |
| | 25 | 27 | 26 | 26 | 26 |
| | 12 | 14 | 14 | 25 | 27 |
| | 23 | 28 | 28 | 28 | 28 |

## Total Generating Cost/MWh Analysis

The 3-year total generating cost results for the major operators in 2011 are displayed in the graph below. Total generating costs are defined as total operating costs plus capital costs of all plants that the operator operates in 2009-2011. This value is divided by the total net generation of all plants that the operator operates for the same period and is provided as a three-year average. OPG ranked 12th, with a 3-year total generation cost of $46.92 per MWh.




*OPG plant values of 3-year rolling average TGC per MWh are shown below:

| Plant | 2011 3-Year TGC |
|---|---|
| Pickering | $65.86/MWh |
| Darlington | $33.05/MWh |

**Table 5: Three-Year Total Generating Cost per MWh Rankings**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| | 9 | 6 | 5 | 3 | 1 |
| | 3 | 2 | 1 | 1 | 2 |
| | 1 | 1 | 2 | 2 | 3 |
| | 2 | 3 | 3 | 4 | 4 |
| | 4 | 4 | 4 | 5 | 5 |
| | 6 | 5 | 6 | 6 | 6 |
| | 8 | 11 | 11 | 9 | 7 |
| | 7 | 10 | 10 | 10 | 8 |
| | 11 | 8 | 7 | 7 | 9 |
| | 5 | 7 | 9 | 8 | 10 |
| | 10 | 9 | 8 | 11 | 11 |
| Ontario Power Generation | 14 | 14 | 12 | 12 | 12 |
| | 13 | 13 | 14 | 14 | 13 |
| | 12 | 12 | 13 | 13 | 14 |

3. Assign a single point of accountability for reporting OPG data to EUCG, WANO and other outside organizations. This will help improve data quality and consistency of presentation.

### 4.2 Target Setting

The next step in gap-based business planning is to use the results of the benchmarking effort to establish meaningful targets that will help drive future performance. This step was completed by OPG during June and July 2009.

| Target Setting | |
|---|---|
| **Observations** | **Conclusions** |
| ▪ OPG used the 2009 Benchmarking Report to educate managers and raise performance expectations<br>▪ OPG conducted two formal target setting workshops and established desired performance levels for the year 2014 across common performance metrics<br>▪ Specific 2014 targets were set for each site and support unit<br>▪ The process of setting top-down performance targets based upon where OPG wants to be by 2014 represented a significant departure from past OPGN business planning practices. Adopting this practice represented a major cultural change within the organization at multiple levels<br>▪ The targets were agreed to by all of the site and support unit executives and were distributed to the site and support unit business managers for adoption in their 2010-2014 five-year business plan | ▪ OPG executive leadership demonstrated a firm commitment to top-down business planning throughout the planning process<br>▪ While the targets set for 2014 will not achieve "best quartile" performance in all performance categories for all sites, they represent a significant improvement over current performance<br>▪ In our opinion, the targets established by OPG management are fair and reasonable given OPGN's baseline position<br>▪ Without downplaying the success achieved during the current planning cycle, we believe that opportunities remain for continuous improvement beyond the current business planning horizon |

*Related Recommendations:*

1. When the OPG Nuclear Benchmarking Report is updated in 2010, analyze the new benchmarks and use them to establish operational and financial performance targets for 2015.

2. Through a process of continuous improvement, continue closing the gap to "best quartile" industry performance for all metrics and at all sites as additional years are added to the rolling five-year plan.