ONTARIO POWER GENERATION

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# SPECIAL 2012 PROVINCIAL AUDIT PREPAREDNESS TEAM
# BRIEFING PAPER
# OPG AND EUCG CONFIDENTIAL AND PROTECTED

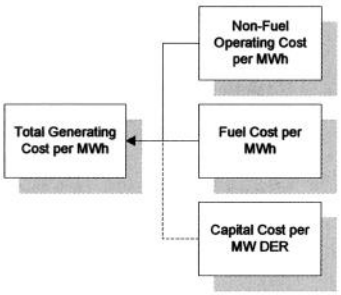
Evaluation Area: Nuclear Costs and Staffing Improvement Trends vs Benchmarks

Representative: Carla Carmichael, John Blazanin

## Nuclear Costs

Four "Value for Money" metrics are typically benchmarked. They are Total Generating Costs per MWh (TGC), Non-Fuel Operating Costs per MWh (NFC), Fuel Costs per MWh, and Capital Costs per MW DER. The metrics roll up as shown in the illustration below. Total Generating Cost is the sum of Non-Fuel Operating Cost, Fuel Cost, and Capital Cost. Given the differences between OPG and most North American plants with respect to both fuel costs and capital costs, the best overall financial comparison metric for OPG facilities is Total Generating Cost per MWh.

**Figure 1 - Summary Relationship of Value for Money Metrics**




### *Methodology and Sources of Data*

Cost data from the Electric Utility Cost Group (EUCG) is collected on a three-year rolling average for all financial metrics. All data is automatically converted to Canadian dollars. Effective January 2009 (but applied retroactively), EUCG automatically applies a purchasing power parity (PPP) factor to adjust for all values across national borders, to reflect currency exchange rate fluctuations and cross-border factors which may impact purchasing power of companies in different jurisdictions. Therefore, cost variation between plants is limited as much as possible to real differences and not advantages of utilizing one currency over another.

The benchmarking panel utilized for financial metrics is made up of all North American plants reporting to EUCG. Within that panel, there is only one other CANDU technology plant reporting, Bruce Power. Though some of the financial gaps in performance are likely associated with technology differences rather than comparable performance, the comparison is very useful. TGC and NFC are normalized by generation output (MWh) to allow a more accurate comparison across plants of different sizes and number of units.

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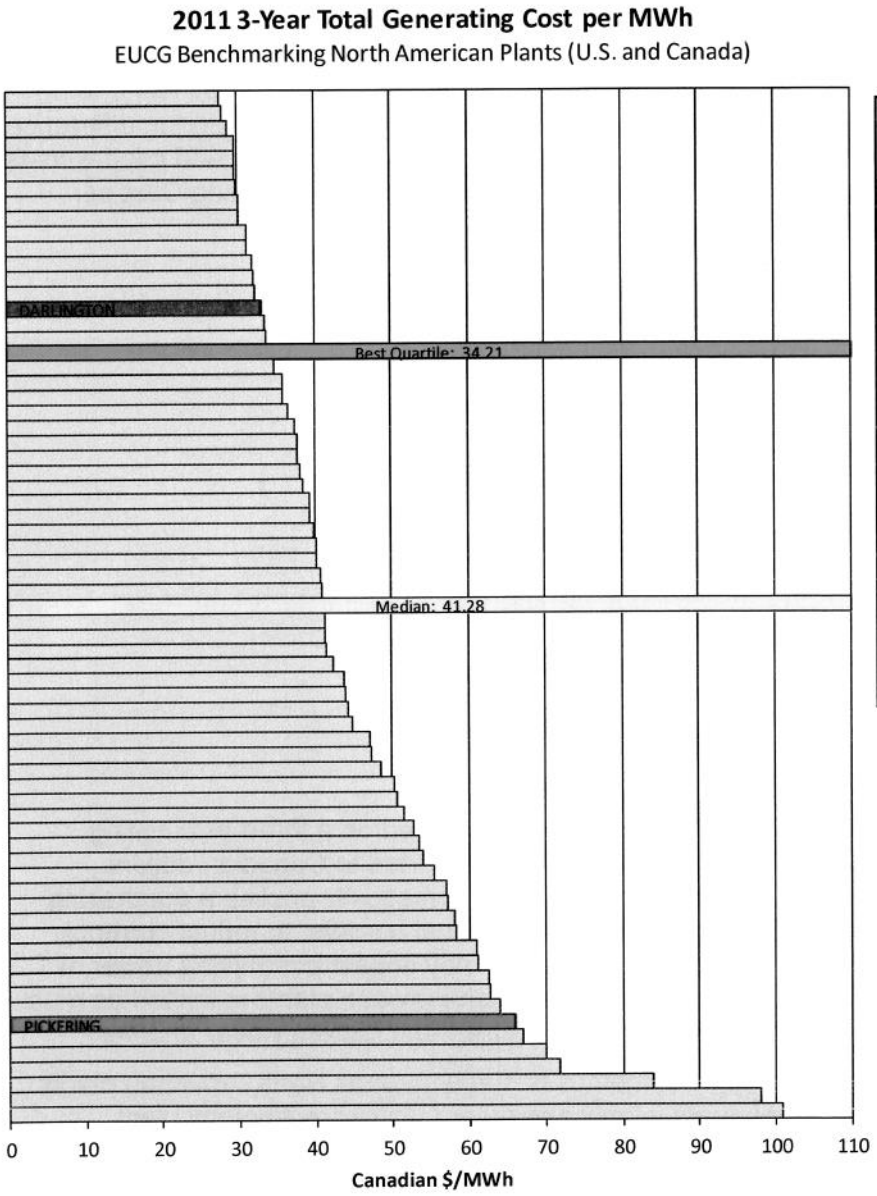
***Figure 2 - 2011 Total Generating Costs per MWh***




- The best quartile level for Total Generating Costs per MWh among North American EUCG participants was $34.21/MWh while the median level was $41.28/MWh.
- Pickering's Total Generating Costs was $65.86/MWh, significantly worse than the median of $41.28/MWh.
- Darlington was the only CANDU plant in the panel to achieve a Total Generating Cost per MWh ($33.05/MWh) better than the industry best quartile.

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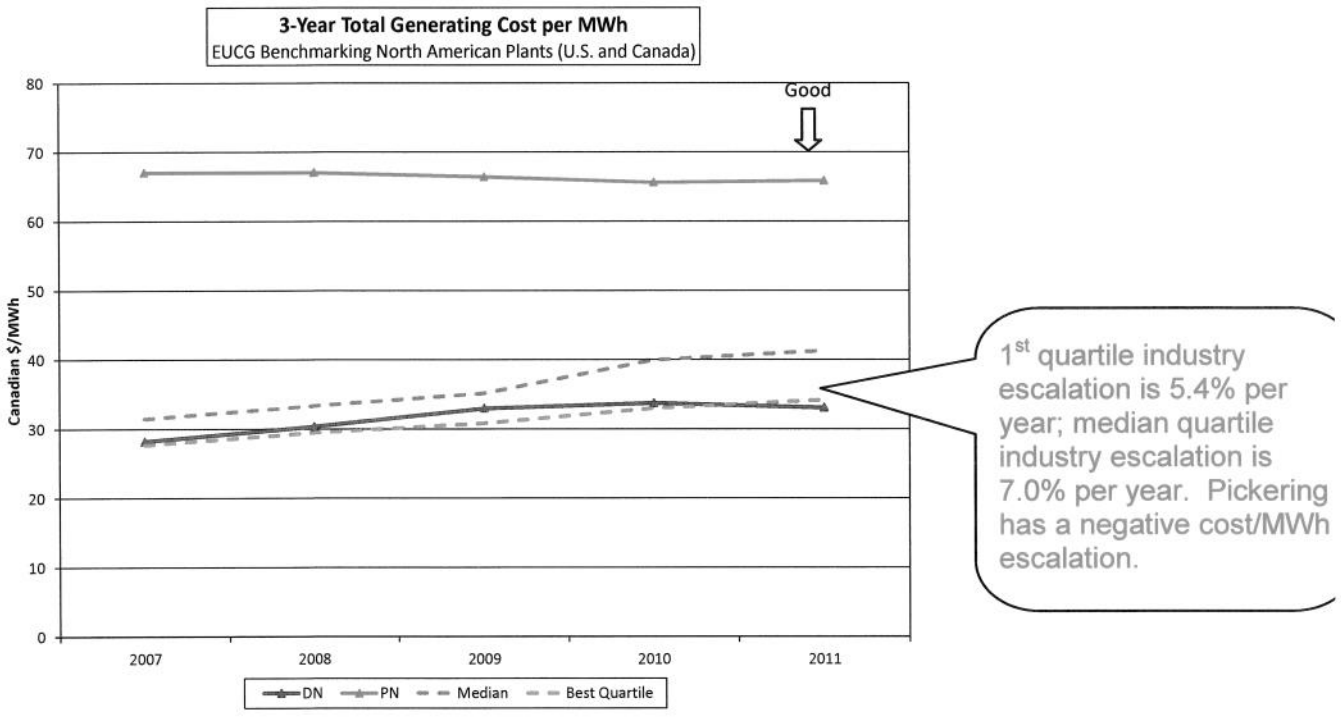
## ***Trends in Total Generating Costs***

- Both best quartile and median Total Generating Costs per MWh have increased since 2007. The best quartile cost rose by $6.50/MWh while the median cost rose by $9.82/MWh.
- Pickering's costs have consistently trended worse than median but have decreased in 2009 and 2010 with a slight increase in 2011. Over the 2007-2011 review period, Pickering had a negative escalation rate (improving cost trend) per year while the industry median quartile experienced a positive (unfavourable) cost trend per year.
- Darlington's costs trended upward over the review period with a slight decrease in 2011 over 2010. In 2011, Darlington achieved best quartile performance, an improvement over the review period. The growth in Darlington's TGC was $4.86/MWh during the 2007-2011 period, mostly due to higher base and outage operating, maintenance & administration costs partly offset by lower corporate allocations.

**Figure 3 - Trends in Total Generating Cost per MWh**



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***Factors Contributing to TGC Performance***

- For technological reasons, Fuel Costs per MWh are an advantage for all CANDU reactors (use of non-enriched uranium), and the OPG plants performed within the best quartile.
- Non-Fuel Operating Costs per MWh for all OPG plants yielded results worse than median for the most recent data point compared to the North American EUCG panel.
- Both Pickering and Darlington achieved lower Capital Costs per MW DER than the industry best quartile.

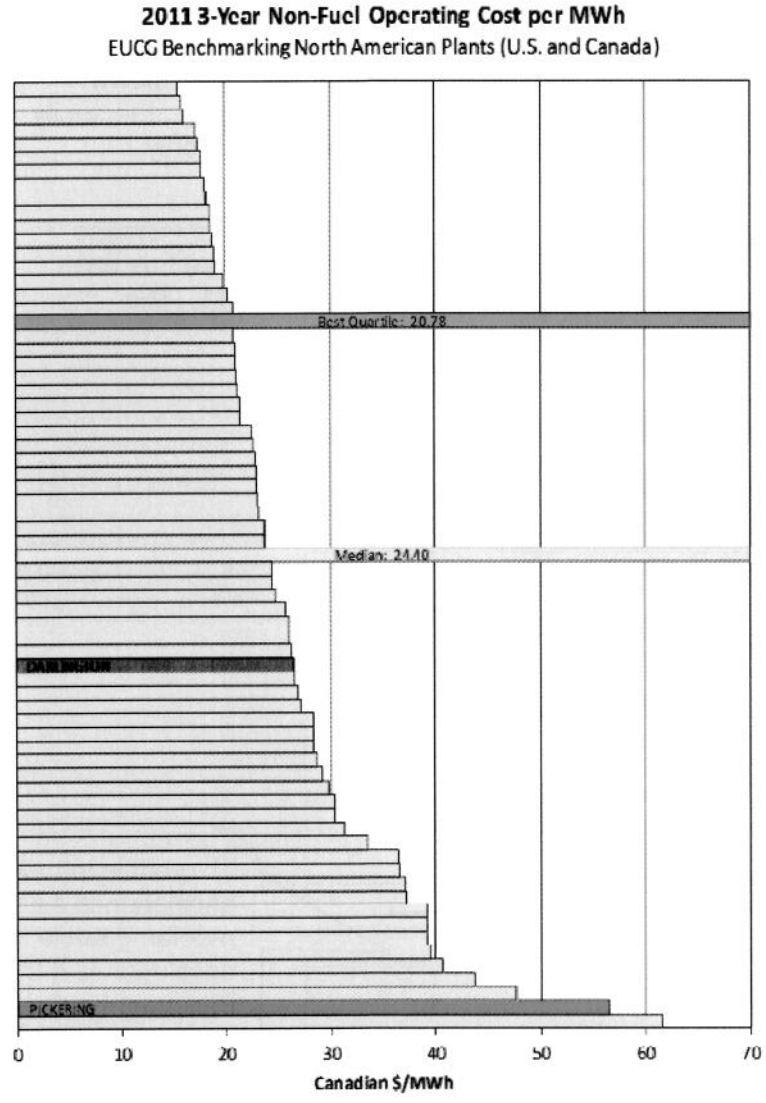
***Pickering TGC***

- The largest driver of cost per MWh for Pickering during the review period is a low capability factor; since costs are normalized to generation, forced outages and long planned outages increase the TGC.
- Station size also negatively impacts the cost per MWh for Pickering as it has relatively small units.
- The remaining large drivers of cost performance at Pickering include CANDU technology, impacting the number of staff required, corporate cost allocations, and a Vacuum Building Outage (VBO) during the review period (impacting generation).

***Darlington TGC***

- Darlington achieved performance within the industry best quartile in 2011 for Fuel Costs per MWh, Capital Costs per MW DER and Total Generating Costs per MWh though its Non-Fuel Operating Cost performance was worse than median.
- The largest drivers of performance gap for Darlington are CANDU technology, corporate allocations, potential controllable costs and a VBO in 2009.
- Due to strong electricity generation performance at Darlington, the capability factor has a positive impact on its Total Generating Cost per MWh.
- Station size provides an overall advantage for Darlington (due to 4 relatively large units).

***Figure 4 – 2011 Non-Fuel Operating Costs per MWh***




- Best quartile plants had Non-Fuel Operating costs better than $20.78/MWh and median plants were better than $24.40/MWh.
- Compared to North American EUCG plants, the Non-Fuel Operating Costs per MWh of all participating Canadian CANDU plants were significantly worse than median performance.
- Pickering's cost, at $56.54/MWh, was 35.76/MWh higher than best quartile and $32.14/MWh higher than the industry median.
- Darlington's costs, at $26.42/MWh, were $5.64/MWh higher than best quartile and $2.02/MWh higher than the median.

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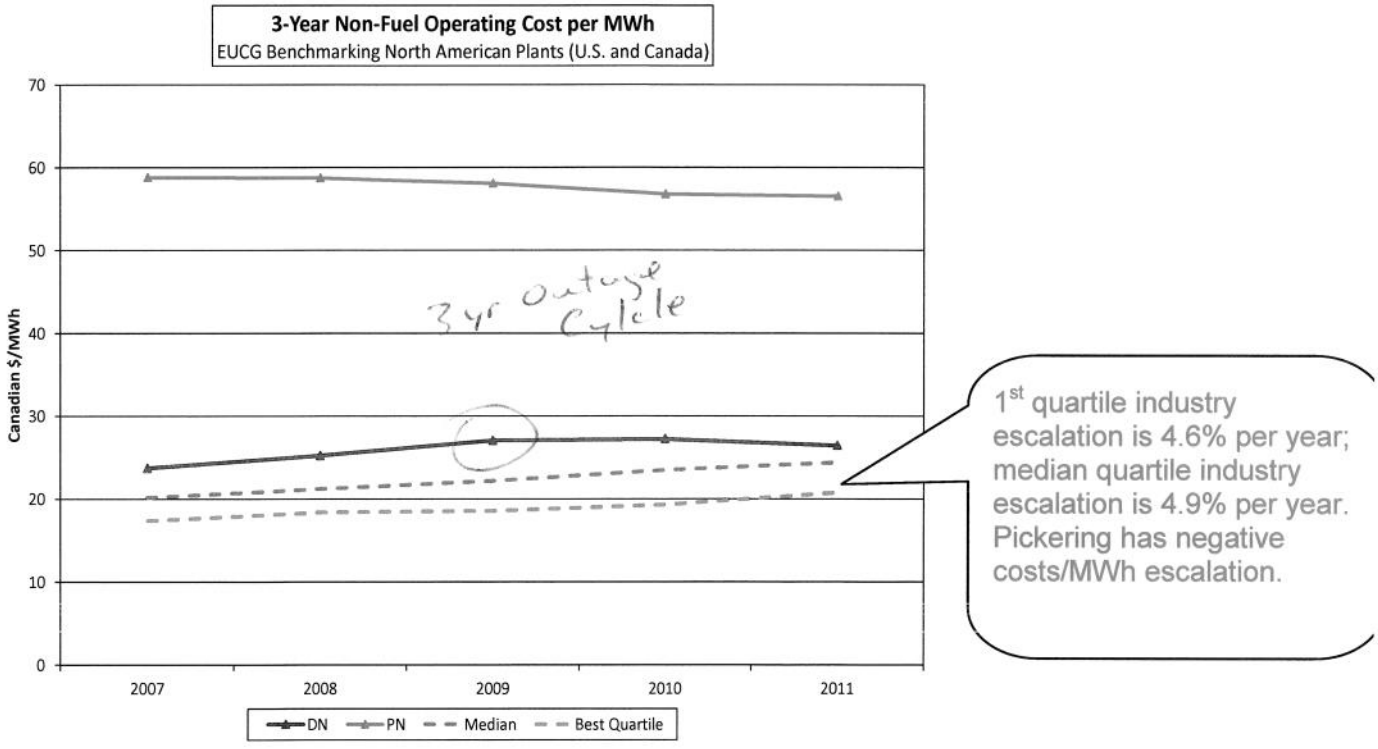
## ***Trends in Non-Fuel Operating Costs***

- Both best quartile and median levels increased over the review period with annual percentage increases between 1% and 8%.
- Pickering's Non-Fuel Operating Costs per MWh decreased steadily since 2007, slowly reducing the gap to industry best quartile performance during the review period. Electricity generation has improved steadily since 2007 while operating costs increased only moderately.
- The Darlington Non-Fuel Operating Cost per MWh trended upward at a rate of increase higher than that of the industry as a whole from 2007 to 2009, but this increase has been lower than the industry cost escalation for 2010 and in fact decreased in 2011. The decrease in 2011 is mostly due to lower corporate allocations.

***Figure 5 - Trends in Non-Fuel Operating Costs per MWh***



***Factors Contributing to NFC Performance***

- Non-Fuel Operating Cost per MWh is a big driver of OPG's financial performance. Removing OPG's advantage from lower fuel costs and capital costs reveals relatively poor financial performance at all OPG plants with respect to Non-Fuel Operating Cost per MWh. Overall, the biggest performance drivers are: capability factor, station size, CANDU technology, corporate cost allocations and potential controllable costs, all of which are further explained below:
    - The 'capability factor' driver is specifically related to the generation performance of the station in relation to the overall potential of the plant.
    - The 'station size' driver is the combined effect of number of units and size of units which can have a significant impact on plant cost performance.
    - The 'CANDU technology' driver relates specifically to the concept that CANDU technology results in some specific cost disadvantages related to the overall engineering and maintenance of the station. In addition, this factor is influenced by the fact that due to the fact that there are less CANDU plants worldwide, they have less well-developed user groups to share and adopt operating experience information than do user groups for BWR and PWR plants. OPG undertook a staffing study through a third-party consultant which concluded that technology, design and regulatory differences exist between CANDU and PWR reactor units and that such factors drive staffing differences. The study established that CANDU technology was a contributor to explaining higher staffing levels for CANDU versus PWR plants which also contributes to OPG's performance in Non-Fuel Operating Costs. The study found that labour for CANDU stations is approximately 20% higher than in benchmarked PWR stations. → staff levels
    - The 'corporate cost allocations' driver relates directly to the allocated corporate support costs charged to the nuclear group.
    - The 'potential controllable costs' driver relates to the remaining costs which are not attributable to other specific cost drivers – and is an area that OPG is focused on in its business planning to target areas for improvement.
    - The only additional contributing factor which appears in Non-Fuel Operating Cost is capitalization policy. The impact of differing capitalization policies is removed when looking at Total Generating Cost per MWh (i.e., the sum of Non-Fuel Operating cost, Fuel cost, and Capital cost).

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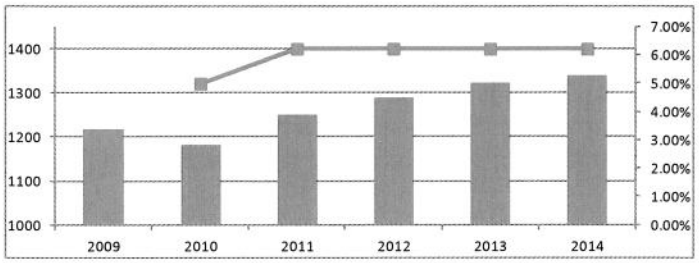
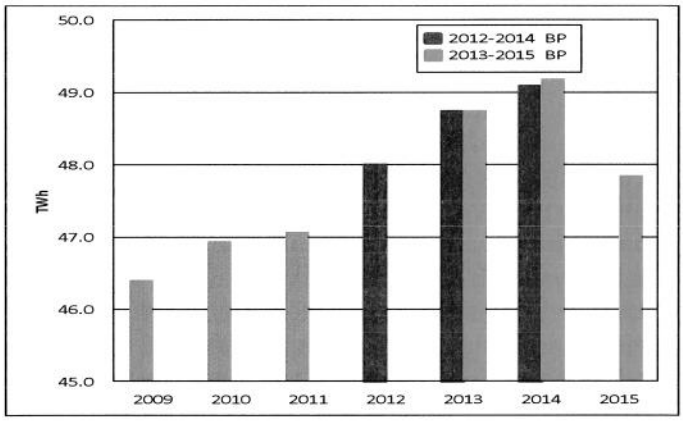
## Base OM&A Costs ($M) Trend

Labour Escalation ~3%



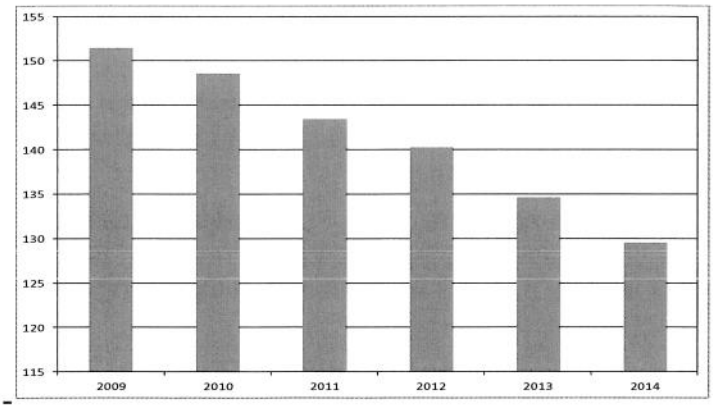

OPG Nuclear base OM&A costs increase by only 2% per year over the 2009-2014 period compared to the industry which has been escalating at levels between 5-6%. This achievement is the result of a continued focus on cost control and work prioritization.

## Generation Production Trend




Nuclear production is trending higher over the period 2009-2014 reflecting OPG initiatives to improve plant equipment reliability and reduce forced outages. The improving trend is evident where OPG's forecast nuclear production (3 year rolling average) in 2014 has increased by 5.8% compared to 2009. Nuclear generation is expected to decline in 2015 due to extended planned outage campaigns associated with Unit 7 Life Management (Pickering) and a combined VBO and moderator drain (Darlington).

## Nuclear Operations Regular Staff per TWh




As Nuclear staff levels reduce and production increases, the Staff/TWh rate is forecasted to reduce 14% by 2014. Since 2008, Staff/TWh has reduced by 5%.

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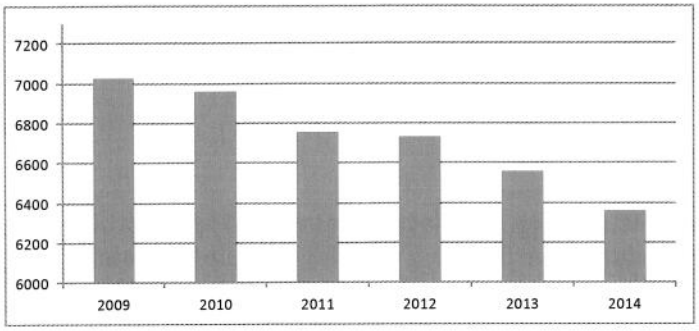
***Trend in Nuclear Operations Regular Staff Numbers***




**Nuclear Staff Levels vs. Benchmarking**

In its 2010 Decision, the Ontario Energy Board directed OPG to examine nuclear staffing levels as part of its benchmarking studies for the next rate hearing. The Nuclear Staff Benchmarking Study began in July 2011 following the retention of Goodnight Consulting, an external consultant with experience in nuclear industry staff benchmarking.

Goodnight identified a benchmarkable total of 5,956 OPG nuclear employees, of which 5,386 were OPG Nuclear staff, 188 were Corporate employees that provide direct nuclear support, and 382 were baseline contractors. An industry staffing benchmark of 5,090 was established, based on 16 large (greater than 800 MW) 2-unit PWR stations, adjusted for the 6-unit Pickering and 4-unit Darlington stations, a shorter Canadian work week (where applicable), and CANDU versus PWR design and regulatory differences.

The main conclusion of the Nuclear Staff Benchmarking Study was that OPG Nuclear is above the comparable benchmark by 866 employees or approximately 17%. It also concluded that OPG's 2012 - 2014 nuclear business plan is directionally correct, reducing staff to within 343 of the benchmark, or to 6.7% over the average benchmark, by 2014.

As the Nuclear Staff Benchmarking Study was completed in February 2012, the 2012-2014 Business Plan was not informed on the areas of excess and shortfall identified in the report. In addition, exploratory Business Transformation Strategy (BTS) design work proceeded throughout 2011 independent of the staff benchmarking study.

With the Nuclear Staff Benchmarking Study complete, it was appropriate in early 2012 to compare the direction of the Business Transformation with the conclusions of the report.

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In order to compare the proposed BTS organization with the benchmark data, BTS initial state and end state positions were mapped to the 40 Nuclear Staff Benchmarking Study functional areas byemployee. BTS out-of-scope functions were accommodated into the end state mapping with nochange from current staff numbers, and baseline contractors were assumed to remain constant for BTS in-scope areas. BTS reduction data from non-nuclear design teams was included where appropriate, e.g., Finance, People & Culture.

## Findings

The industry staffing benchmark of 5,090 represents average staff levels for the PWR peer group, with the top quartile benchmark at 4,474 and third quartile at 6,284. **The BTS end state nuclear organization, totalling 4,777 employees, is therefore lower than the average benchmark organization by 313 staff, between average and top quartile as shown in Figure 1.**

**Figure 1 - OPG Staff Levels vs. Industry Benchmark - Current and BTS End State**