August 2012

ONTARIO POWER GENERATION

ONTARIO POWER GENERATION NUCLEAR

2012 Nuclear Benchmarking Report

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Nuclear Finance - Business Planning and Performance Reporting

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1.0 EXECUTIVE SUMMARY

Background

This report presents a comparison of Ontario Power Generation (OPG) Nuclear's performance to that of nuclear industry peer groups both in Canada and worldwide. The report was prepared as part of OPG's commitment to "performance informed" business management. The results of this report are used during business planning to drive a top-down target setting process with business improvement as the objective.

Benchmarking involves three key steps: (a) identifying key performance metrics to be benchmarked, (b) identifying the most appropriate industry peer groups for comparison, and (c) preparing supporting analyses and charts. OPG personnel responsible for specific performance metrics assisted in the development of the supporting analyses by providing insight into the factors contributing to current OPG operational performance.

Performance Indicators

Good performance indicators for benchmarking are defined as metrics with standard definitions, reliable data sources, and utilization across a good portion of the industry. Good indicators allow for benchmarking to be repeated year after year in order to track performance and improvement. Additionally, when selecting an appropriate and relevant set of metrics, a balanced approach covering all key areas of the business is essential. As such, 20 key performance indicators have been selected for comparison to provide a balanced view of performance and for which consistent, comparable data is available. These indicators are listed in Table 1 and are divided into four categories aligned with OPG Nuclear's four cornerstone values: safety, reliability, value for money and human performance.

Consistent with OPG's strategy to continuously pursue efficiency improvements, the Pickering A and Pickering B nuclear generating stations were amalgamated into one Pickering site (6 units) in 2011 to realize efficiencies and financial benefits associated with one unified station. The charts and supporting analyses contained in this report reflect the amalgamation of the Pickering A and Pickering B stations and retroactive changes have been applied where needed to capture performance of one Pickering station.

There was a change in the maintenance backlog metrics this year to reflect the new industry standard documented in AP-928 Work Management Practices at INPO. The new standard sets a more consistent foundation for classification of backlogs such that comparisons between utilities are more meaningful. This report has been updated accordingly.

Industry Peer Groups

Peer groups were selected based on performance indicators widely utilized within the nuclear industry. Overall, six different peer groups were used as illustrated in Table 1 and panel members are detailed in Section 7.0, Tables 7, 8, 9, 10 and 11.

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Table 1: Industry Peer Groups

	COG CANDUs (WANO)	All North American PWR and PHWRs (WANO)	INPO AP-928 Workgroup	INPO	CEA	EUCG North American Plants (U.S. and Canada)
Safety						
All Injury Rate					X	
Rolling Average Industrial Safety Accident Rate*		X				
Rolling Average Collective Radiation Exposure*	X					
Airborne Tritium Emissions per Unit	X					
Fuel Reliability Index*	X					
2-Year Reactor Trip Rate*	X					
3-Year Auxiliary Feedwater System Unavailability*	X					
3-Year Emergency AC Power Unavailability*	X					
3-Year High Pressure Safety Injection Unavailability*	X					
Reliability						
WANO NPI	X					
Rolling Average Forced Loss Rate*	X					
Rolling Average Unit Capability Factor*	X					
Rolling Average Chemistry Performance Indicator*	X					
1-Year On-line Deficient Maintenance Backlog			X			
1-Year On-line Corrective Maintenance Backlog			X			
Value for Money						
3-Year Total Generating Cost / MWh						X
3-Year Non-Fuel Operating Cost (OM&A) / MWh						X
3-Year Fuel Cost (OM&A) / MWh						X
3-Year Capital Cost / MW DER						X
Human Performance						
Human Performance Error Rate				X		

* Sub-indicator of WANO NPI

Data provided by the World Association of Nuclear Operators (WANO) is the primary source of benchmarking data for operational performance indicators. Eleven out of twenty benchmarking metrics have been compared to the COG CANDU panel. All WANO performance indicators are measured at the unit level as well as at the plant level except for Industrial Safety Accident Rate and the Emergency AC Power Unavailability.

For a few of the specialized operating metrics, different peer groups were used since WANO data was not available. For comparing maintenance backlogs, the peer group consists of all plants participating in the Institute of Nuclear Power Operations (INPO) AP-928 workgroup. For All Injury Rate comparison, the Canadian Electricity Association (CEA) panel was used.

For financial performance comparisons, data compiled by the Electric Utility Cost Group (EUCG) was used. EUCG is a nuclear industry operating group and the recognized source for cost benchmark information. EUCG cost indicators are available at the plant level only and compared on a net megawatt hour generated basis (to be referred to as MWh subsequently) and a per megawatt (MW) design electrical rating (DER) basis. The only CANDU operators reporting data to EUCG in 2011 were OPG and Bruce Power which is not a sufficiently large panel to provide a basis for comparison. Should more CANDU operators choose to join EUCG in the future, comparisons to a CANDU specific panel will be reconsidered.

For human performance comparisons, data is obtained from INPO.

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

		2011 Actuals			
Metric	**NPI Max**	**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 ⇧	0.001133 ⇩
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

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Since achievement of full WANO Nuclear Performance Index (NPI) points is recognized within the industry as a measure of desirable performance, performance gaps are assessed against full WANO NPI points in addition to median and best quartile performance. Green shaded boxes indicate that maximum WANO NPI points were achieved or that performance is at or better than the best quartile threshold, white shaded boxes indicate that performance is between the best quartile and median thresholds, yellow shaded boxes indicate that performance is between the median and worst quartile thresholds, and red shaded boxes indicate that performance is worse than the worst quartile threshold.

Table 2 also identifies, by Nuclear cornerstone, where there has been either improving or declining benchmarking quartile performance relative to 2010. For Safety, overall, OPG's nuclear generating stations continue to demonstrate strong performance. Pickering was able to achieve notable year over year improvements in its benchmark quartile ranking relative to 2010 results for the Collective Radiation Exposure, Fuel Reliability Index and Human Performance Error Rate. However, the Pickering station experienced a decline in quartile performance for Reactor Trip Rate. Darlington achieved maximum NPI points or best quartile performance for all but one metric under the Safety cornerstone, the Fuel Reliability Index, which showed a decline in benchmark quartile performance from 2010.

For Reliability, Pickering remained in the 4th quartile in 2011 when compared to other CANDU plants for the WANO Nuclear Performance Index, the Forced Loss Rate and Chemistry Performance Indicator and marginal performance (3rd quartile) for the Unit Capability Factor. As the strongest OPG performer for WANO NPI, Darlington achieved best quartile performance in four of the last six years. Year over year quartile rankings were also maintained for Forced Loss Rate (median), Unit Capability Factor (median) and Chemistry Performance Indicator (3rd quartile) at Darlington in 2011. Since the industry standard for backlog metrics has recently changed, historical data is not available to assess year over year industry benchmark quartile progress from 2010 to 2011. Such comparison will be possible in future years when enough information is accumulated through the AP-928 INPO panel using the new standard. Continued fourth quartile station performance, for some metrics under the Reliability cornerstone, represents a key focus area for further improvement for the business.

Under the Value for Money cornerstone, Pickering maintained fourth quartile performance in its Total Generating Cost per MWh and Non-Fuel Operating Cost per MWh. This is due to longer planned outage durations needed to extend the life of the Pickering station in order to ensure a reliable supply of electricity during the refurbishment of the Darlington plant. In addition, lower capability factors, due to forced outages and forced extensions to planned outages at the Pickering station, have resulted in lower electricity production and additional costs which had an unfavourable impact on the station's Total Generating Cost per MWh and Non-Fuel Operating Cost per MWh. On the other hand, Pickering sustained best quartile performance in Fuel Cost per MWh and Capital Cost per MW DER. The relatively small size of Pickering's generating units also had an unfavourable impact on the station's cost per MWh. Darlington's Total Generating Cost per MWh improved from median to best quartile performance in 2011. Marginal (3rd quartile) performance in Non-Fuel Operating Cost per MWh was offset by excellent performance in Fuel Cost per MWh and Capital Cost per MW DER at Darlington in 2011.

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In the area of Human Performance, Pickering improved performance from third quartile in 2010 to second quartile at the end of 2011 for the Human Performance Error Rate. However, the Darlington station experienced a decline in quartile performance in 2011, moving from best quartile to second quartile.

Report Structure

Sections 2.0 to 5.0 of the report are structured to focus on the four OPG Nuclear cornerstone areas, with detailed comparisons at the plant, and where applicable, unit level. Each indicator is displayed graphically from best to worst (in bar chart format) for the most recent year in which data is available. Zero values are excluded from all calculations except where zero is a valid result. Missing data was input by averaging the prior and subsequent year where possible. If this was not possible, the average of the two most recent years was used.

Next, the historical trend was graphed (in line chart format) using data for the last few years (depending upon availability and metric). Each graph also includes median and best quartile results, and for some WANO operating metrics, the graph also shows the values required to achieve full WANO NPI points.

Following the graphical representation, performance observations were documented as well as insights into the key factors driving performance at OPG's nuclear generating stations.

Section 6.0 of the report is designed to provide an operator level summary across a few high-level metrics. The operator level analysis looks at fleet operators across North America, utilizing a simple average of the results (mean) from each of their units/plants. Operations related results were averaged at the unit level and cost related results were averaged at the plant level. The list and ranking of operators, for the nuclear performance index and unit capability factor, have been restated to reflect industry developments.

Section 7.0 provides an appendix of supporting information, including common acronyms, definitions, panel composition details and a WANO NPI plant level performance summary of OPG stations against the North American panel.

2.0 SAFETY

Methodology and Sources of Data

The majority of safety metrics were calculated using data from WANO. Data labelled as invalid by WANO was excluded from all calculations. Indicator values of zero are not plotted or included in calculations except in cases where zero is a valid result. Complete data for the 2004-2011 period was obtained and averages are as provided by WANO.

The All Injury Rate was calculated using data from the Canadian Electricity Association (CEA). Median information and individual company information was not available for this metric; therefore only trend and best quartile information is presented. The peer group for this metric is limited to Group I members of CEA (Section 7.0, Table 10).

Airborne Tritium Emissions per unit data was collected from the CANDU Owners Group (COG) for 2005 to 2010 as displayed in the historical trend line chart. Industry data for 2011 was unavailable at the time of benchmarking. The peer group for this metric is all CANDUs which are members of COG. The bar chart associated with this metric displays graphically plant performance from best to worst using 2010 data (most recent benchmark data).

Discussion

Nine metrics are included in this benchmarking report to reflect safety performance, including seven of the ten metrics which comprise the WANO Nuclear Performance Index: Industrial Safety Accident Rate, Collective Radiation Exposure, Fuel Reliability, Unplanned Automatic Reactor Trips, Auxiliary Feedwater Safety System, Emergency AC Power Safety System and High Pressure Safety Injection. The remaining WANO NPI metrics are included in Section 3.0 under the Reliability cornerstone. In addition to the WANO sub-indicators listed above, the CEA All Injury Rate and the COG Airborne Tritium Emissions per unit are included in this section of the report.

Overall, OPG Nuclear’s performance in the WANO NPI safety measures is strong, achieving full NPI points for many of the metrics. Pickering achieved industry best quartile performance for the All Injury Rate and maximum WANO NPI points for five other metrics under the Safety cornerstone, second quartile performance for two indicators and worst quartile performance for one metric, the Reactor Trip Rate. Darlington achieved best quartile performance for four metrics and maximum WANO NPI points for four other measures but reached worst quartile performance for the Fuel Reliability Index.

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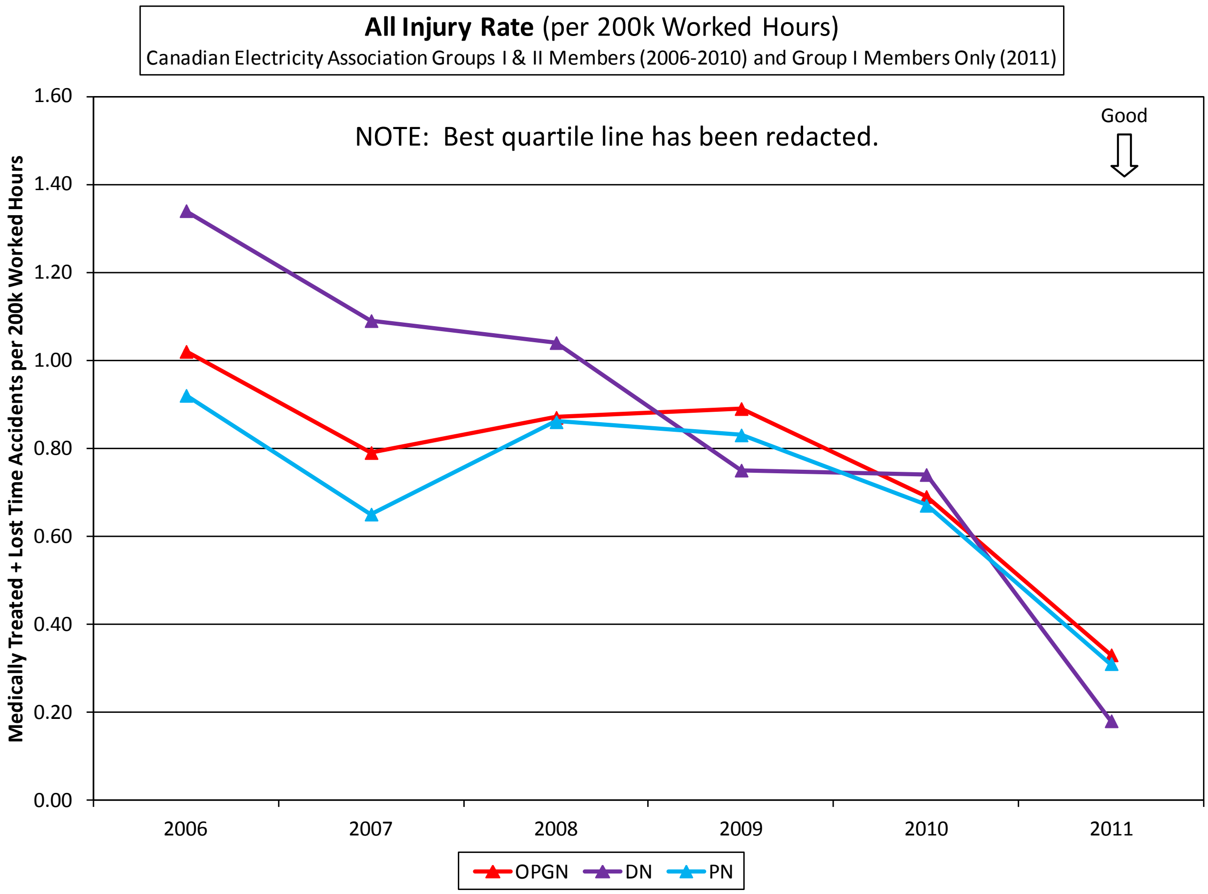
All Injury Rate



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Observations – All Injury Rate (AIR)

2011 (Annual Rate)

- The metric is more inclusive than the Industrial Safety Accident Rate (ISAR) as it incorporates medically treated injuries.
- OPG Nuclear had its best annual All Injury Rate (AIR) safety performance of the review period in 2011.
- The benchmark panel for this metric includes transmission and distribution personnel which may have an elevated risk level.
- In 2011, OPG started benchmarking its performance against the Canadian Electricity Association (CEA) Group I top quartile as the comparator versus CEA Groups I and II (combined) which has been used in past years. Groups I and II consist of 24 utilities with greater than 300 employees including eight provincial utilities with more than 2,300 employees (Group I) and 16 smaller utilities with 300-2,300 employees (Group II). CEA Group I, which consists of larger, multi-business utilities, is a better comparator for OPG than smaller CEA Group II utilities. Group II utilities typically manage one type of business with a much smaller number of employees resulting in a lower risk profile. Beginning in 2012, the CEA benchmarking groupings have been changed to separate and re-align Groups I and II. Group I now consists of 13 organizations with greater than 1,500 employees which provides a more representative benchmarking group for OPG and the 2011 CEA industry best quartile threshold was derived using this new grouping.

Trend

- The best quartile results for the 2006-2010 review period are derived using the CEA Groups I and II (combined) panels. The 2011 top quartile results are based on Group I utilities as described in the previous section of this analysis.
- While the best quartile has improved steadily over the review period, both OPG plants are performing better than best quartile for All Injury Rate (AIR) and have been since 2005.
- OPG Nuclear has continuously shown improvement in the number of medically treated and lost time accidents since 2005, but particularly so from 2010 to 2011. The AIR was reduced by more than 50% year over year, producing the best annual All Injury Rate ever recorded by OPG.
- A company-wide commitment to safety excellence has enabled OPG to achieve the best workplace safety performance in its history. The All Injury Rate results for 2011 were better than in 2010 and the lowest ever recorded at OPG, significantly better than the Canadian Electricity Association top quartile performance benchmark.
- Darlington Nuclear received an excellent safety and performance evaluation from the World Association of Nuclear Operators. This international review recognizes Darlington as one of the best performing nuclear stations in the world.

Factors Contributing to Performance

- OPG has a very robust safety reporting culture and formal safety management systems for all injuries, including minor, repetitive and chronic injuries, which exceed other utilities in the benchmarking panel.
- OPG focuses on proactive reporting of safety hazards, to address potential causes of injuries before minor injuries even occur, which contributes to and reinforces injury prevention.
- OPG scrutinizes safety performance trends, and develops programs and initiatives to address common injuries and causal factors, such as musculoskeletal disorders, continuously reducing the frequency of these types of injuries and lost time accidents.

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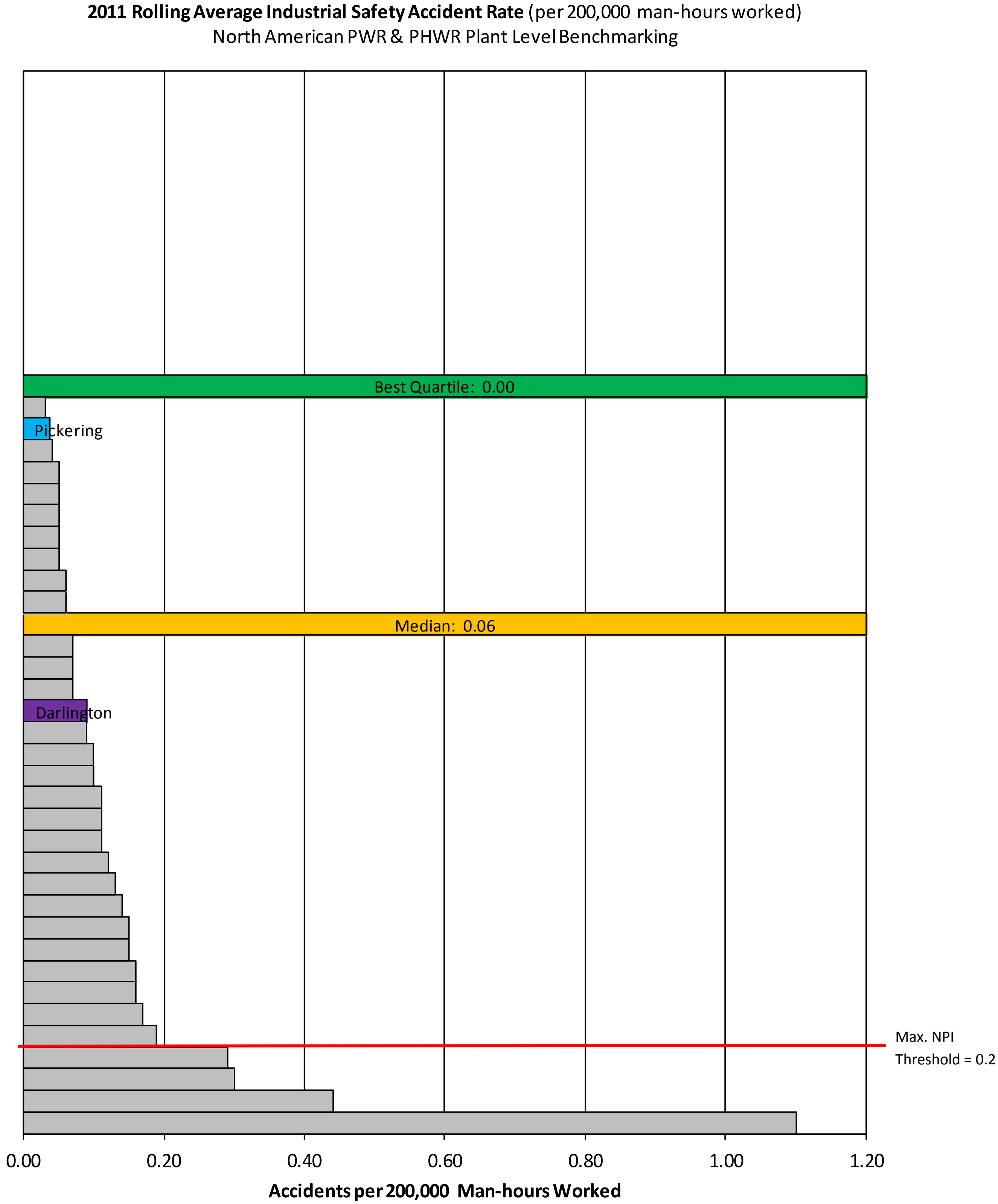
Rolling Average Industrial Safety Accident Rate



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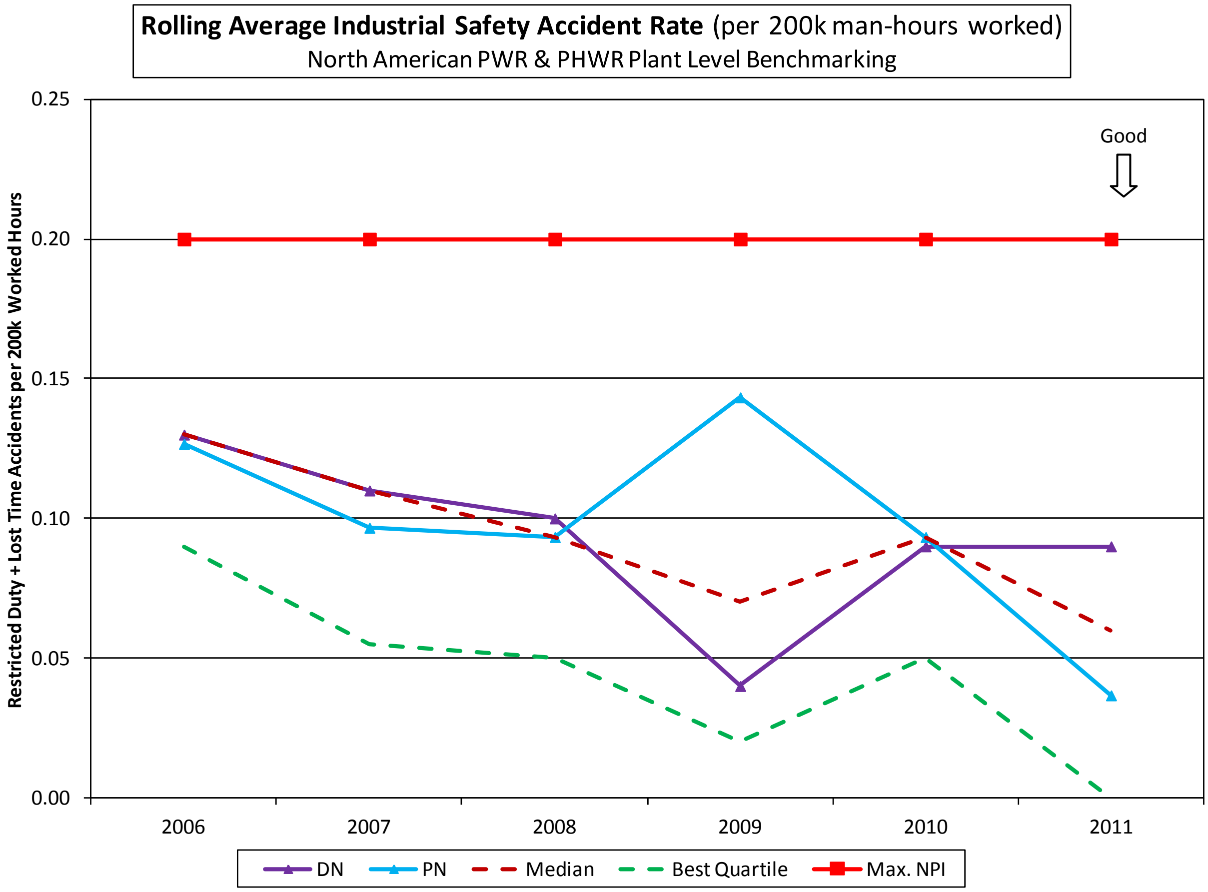

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Observations – Rolling Average Industrial Safety Accident Rate (ISAR)

2011 (Rolling Average)

- For reporting the Industrial Safety Accident Rate (ISAR), a 2-year rolling average was used for all panel members with the exception of the Darlington station which follows a 3-year outage cycle. This is consistent with the World Association of Nuclear Operators (WANO) Nuclear Performance Index (NPI) reporting guidelines.
- Best quartile for 2011 was 0.00 (i.e., zero ISAR events), significantly improving from 2010 (0.05) and slightly better than the 2009 best quartile of 0.02.
- Pickering recorded its best annual ISAR ever in 2011, achieving second quartile performance on a rolling average basis.
- The annual ISAR performance of Darlington (0.09) in 2011 is consistent with its 3-year rolling average performance in 2010.
- Both Pickering and Darlington achieved maximum NPI points for the ISAR in 2011.

Trend

- The overall OPG Nuclear fleet performance improved in 2011, with significant year over year progress, on a rolling average basis, at Pickering (0.09 to 0.04).
- Darlington showed a strong improving trend over the first four years of the review period, but increased in 2010 and sustained that level of performance in 2011 (0.09).
- The best quartile has shown an improving trend over the last 5 years, with a significant drop to 0.00 in 2011, equivalent to zero lost time and restricted duty injuries for the year.

Factors Contributing to Performance

- ISAR is a measure of “permanent utility personnel” and does not include contractors. As many of the utilities in the benchmarking panel utilize contractors to a greater extent than OPG for higher risk work activities (e.g., outages), this can overstate the gap between OPG’s ISAR and the reported industry benchmark quartiles.
- Lost time and restricted duty injuries to non-station staff (support staff) who “reside at the station” are counted against the station’s ISAR performance (WANO defined indicator). Injuries to these types of personnel impacted performance at both stations in 2011.
- OPG continues to monitor performance trends in the area of conventional safety and implements action plans to support continuous improvement.

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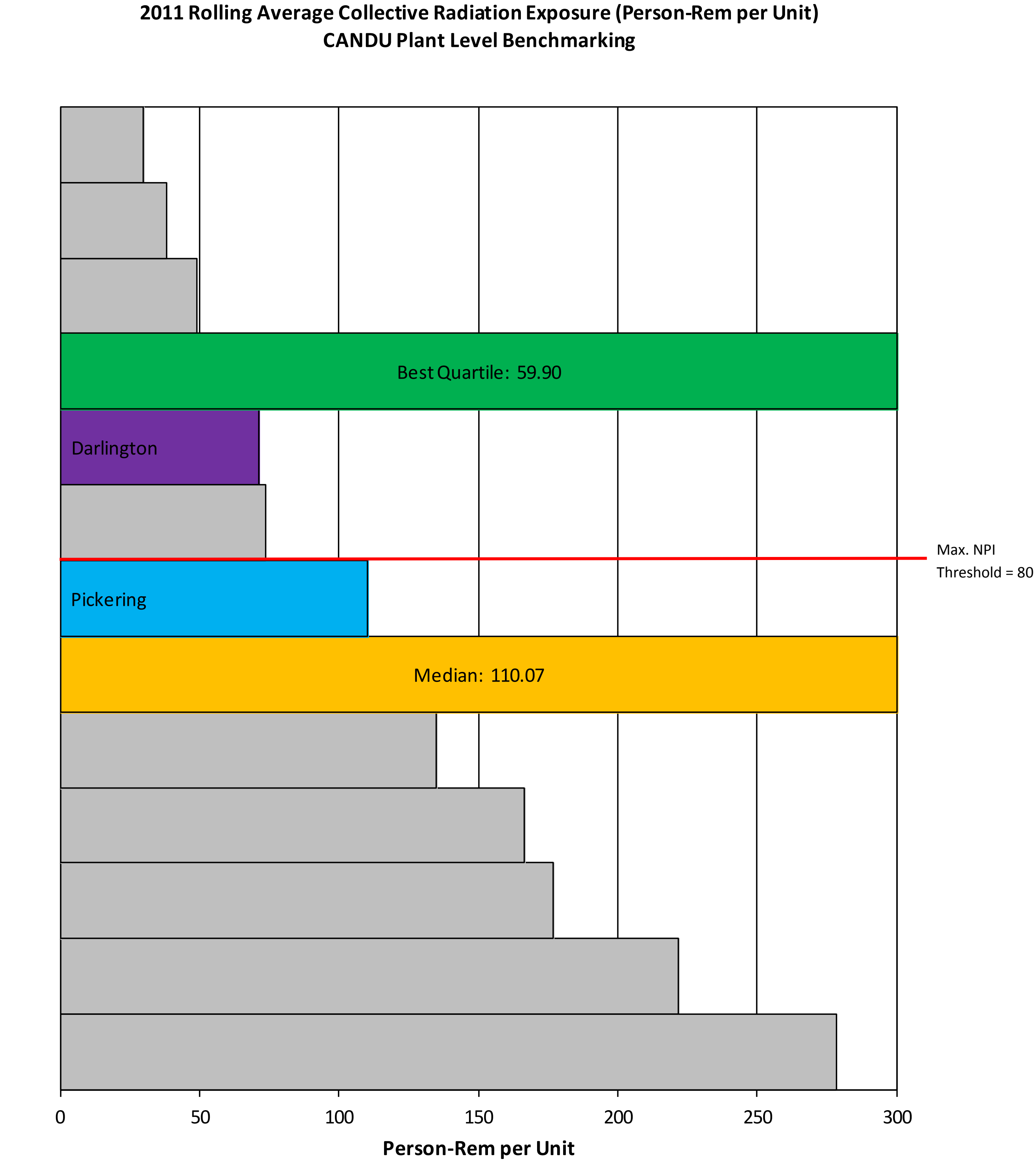
Rolling Average Collective Radiation Exposure



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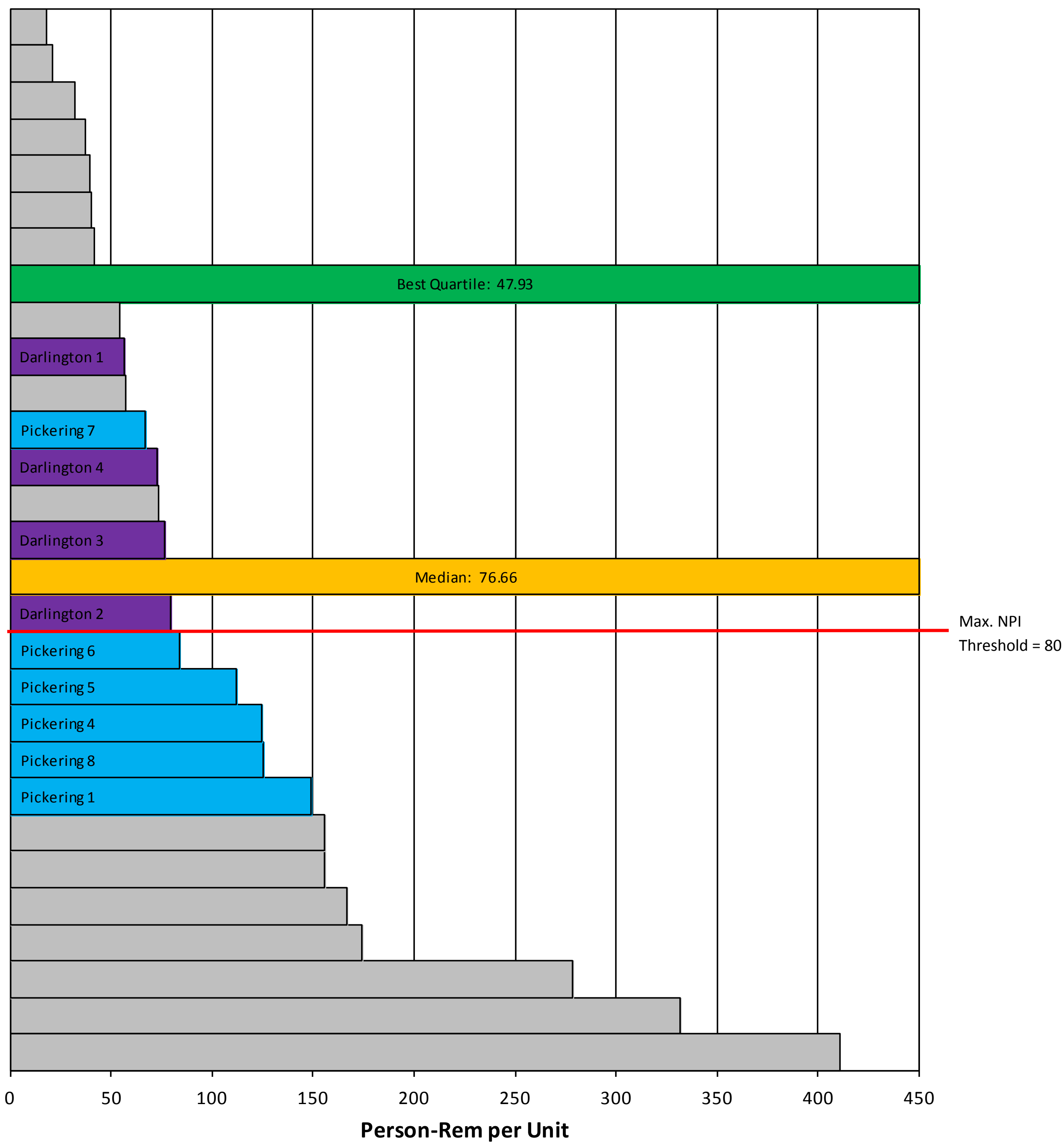
2011 Rolling Average Collective Radiation Exposure (Person-Rem per Unit)
CANDU Unit Level Benchmarking



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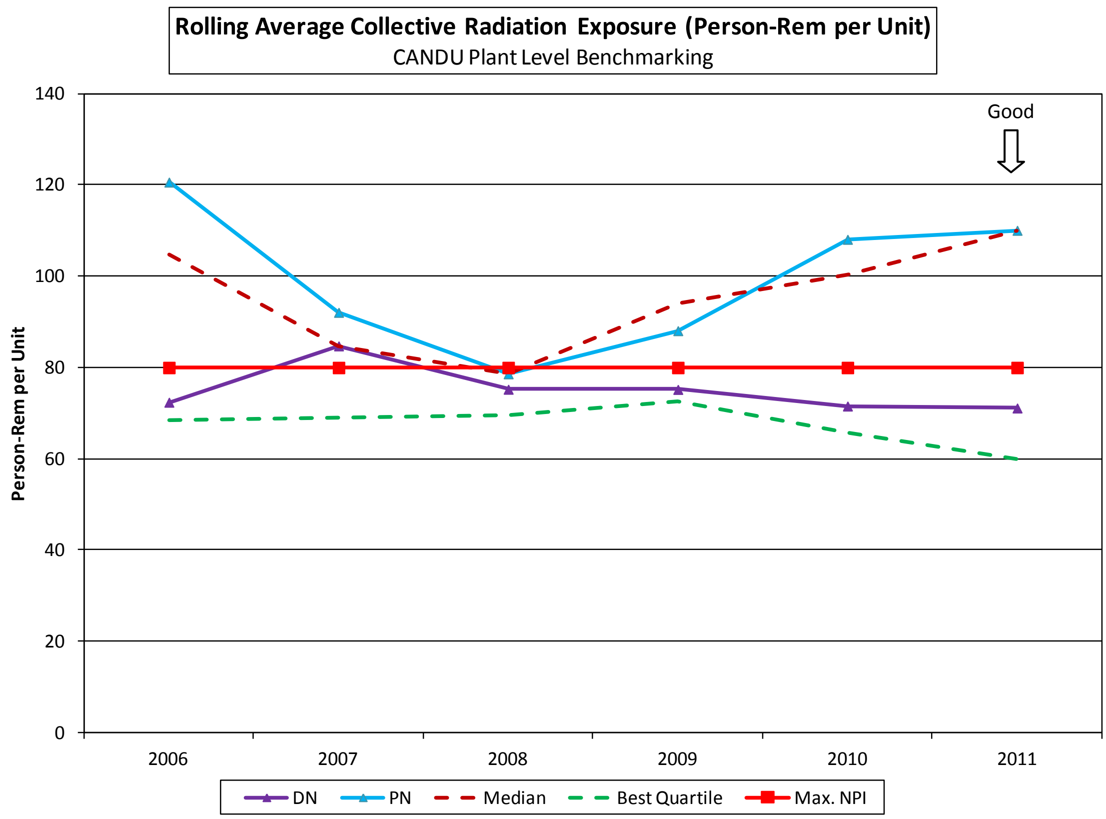

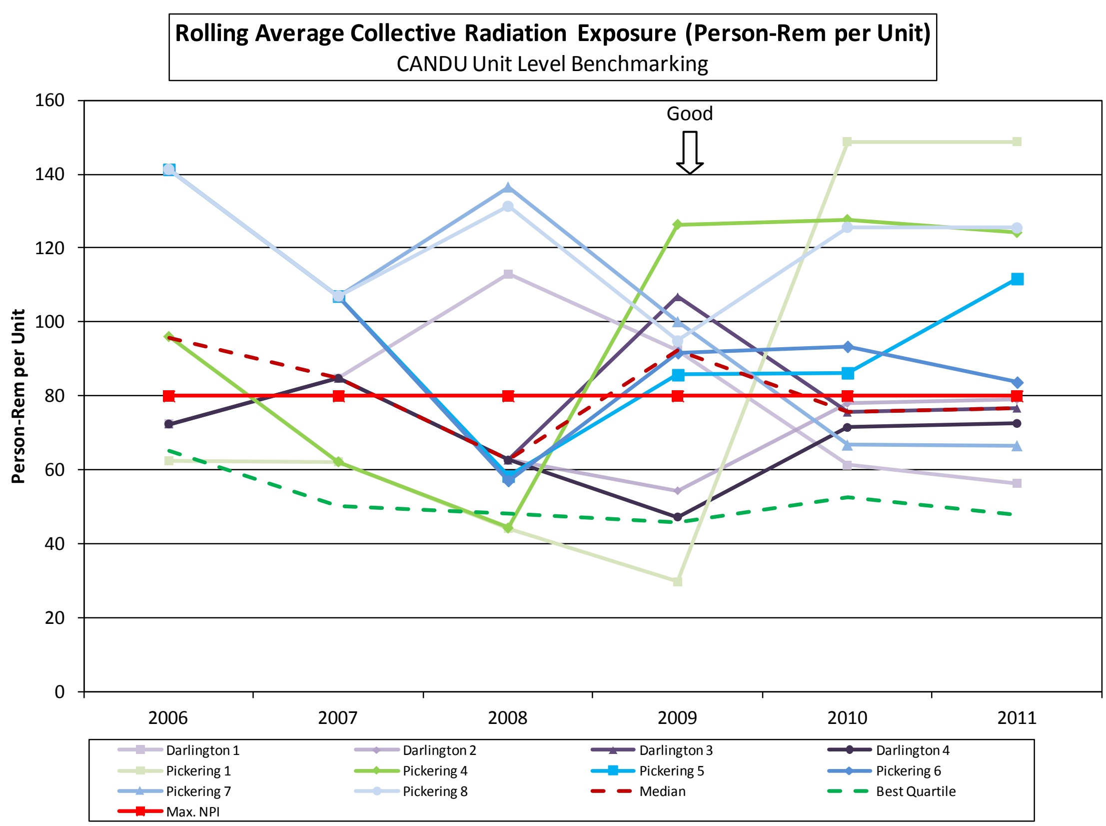

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Observations – Rolling Average Collective Radiation Exposure (CANDU)

- Collective Radiation Exposure (CRE) is an industry composite indicator encompassing external and internal collective Whole Body (WB) radiation dose. The industry recognized yardstick for measuring CANDU reactor CRE performance is the World Association of Nuclear Operators' method for assigning points for the calculation of the Nuclear Performance Index (NPI); full NPI points (10) at <80 person-rem per unit and zero points at >140 person-rem per unit.
- The industry uses a two or three year rolling average (based on the site outage cycle) to define the CRE performance for a given year. Darlington follows a 3-year outage cycle and Pickering and other panel members are on a 2-year outage cycle. The following factors play a significant role in the CANDU reactors' CRE performance: planned outage scope and duration, forced outage rate, reactor face and Primary Heat Transport (PHT) components external fields, tritiated ambient air in accessible and access controlled areas, effectiveness of mitigated measures and initiatives being implemented to reduce identified sources of radiological hazards, and human performance during execution of radiological tasks.

2011 (Rolling Average)

- The Pickering plant level rolling average performance was at the median of 110.07 person-rem per unit in 2011. Planned outage scope and forced outages contributed to this level of plant and unit performance at Pickering in 2011.
- Darlington performance was better than median (110.07 person-rem per unit) at the plant level. Darlington Units 1, 3 and 4 performed better than median (76.66 person-rem per unit) and Unit 2 was worse than the median.

Trend

- Best quartile and median CRE at both the plant and unit level have remained relatively flat during the last six years.
- Pickering achieved median performance in three of the last six years of the review period.
- Darlington plant and unit performance improved slightly with post-outage reviews indicating that, with the exception of scaffolding work, dose for all major work activities was at or better than target. Internal dose contribution as a percentage of the collective radiation exposure averaged 6.5 % in the last two years. This is considered good performance per CANDU guideline of <15% of the CRE.

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Factors Contributing to Performance

- The following list represents common practices that demonstrate continuous improvement and help maintain good CRE performance for CANDU type reactors:
    - Reactor face shielding to reduce dose rate
    - Use of full size vault platforms to improve workflow
    - Teledosimetry
    - Detritiation
    - Use of munter driers to enhance existing measures to minimize ambient airborne tritium levels
    - Optimization of fuelling machine purification using ion exchange with annual resin replacement and sub-micron filters
    - Sub-Micron filtration in the PHT system
    - Use of As Low As Reasonably Achievable mentors to improve human performance during execution of radiological tasks
- OPG Nuclear fleet-wide and site-specific initiatives have been implemented to incorporate the industry best practices noted above.
- Fleet initiatives include reducing the CRE during reactor face work through the optimization of reactor face shielding using a combination of alternatives appropriate for the tasks being performed and optimization of fuelling machine filtration at the sites to minimize cobalt-59 injection into the core and build-up of cobalt-60, the major source term for external exposure.
- Specific site initiatives are described below.

Pickering

- Use 0.1 micron PHT bleed filters to remove fine particulate from the PHT system.
- Use 0.1 micron Fuel Handling (FH) filters to remove particulate from FH system pipework and minimize cobalt-59 entering the PHT system.
- Use of overhead feeder cabinet shielding canopy and reactor face shielding.
- Use of munters vapour recovery system during outages.

Darlington

- The extensive use of shielding such as overhead shielding canopies and reactor face shielding resulted in 11 person-rem of dose savings during the first planned outage at Darlington in 2011.
- The use of a feeder ice plug jacket and remote installation/removal tooling resulted in 2.8 person-rem of dose savings.
- Dose savings were also increased by keeping the vault tritium in air concentrations low, through reliable use of munters vapour recovery dryer units during outages.
- Significant dose savings were realized due to improved planning and execution of scaffold builds and teardowns.

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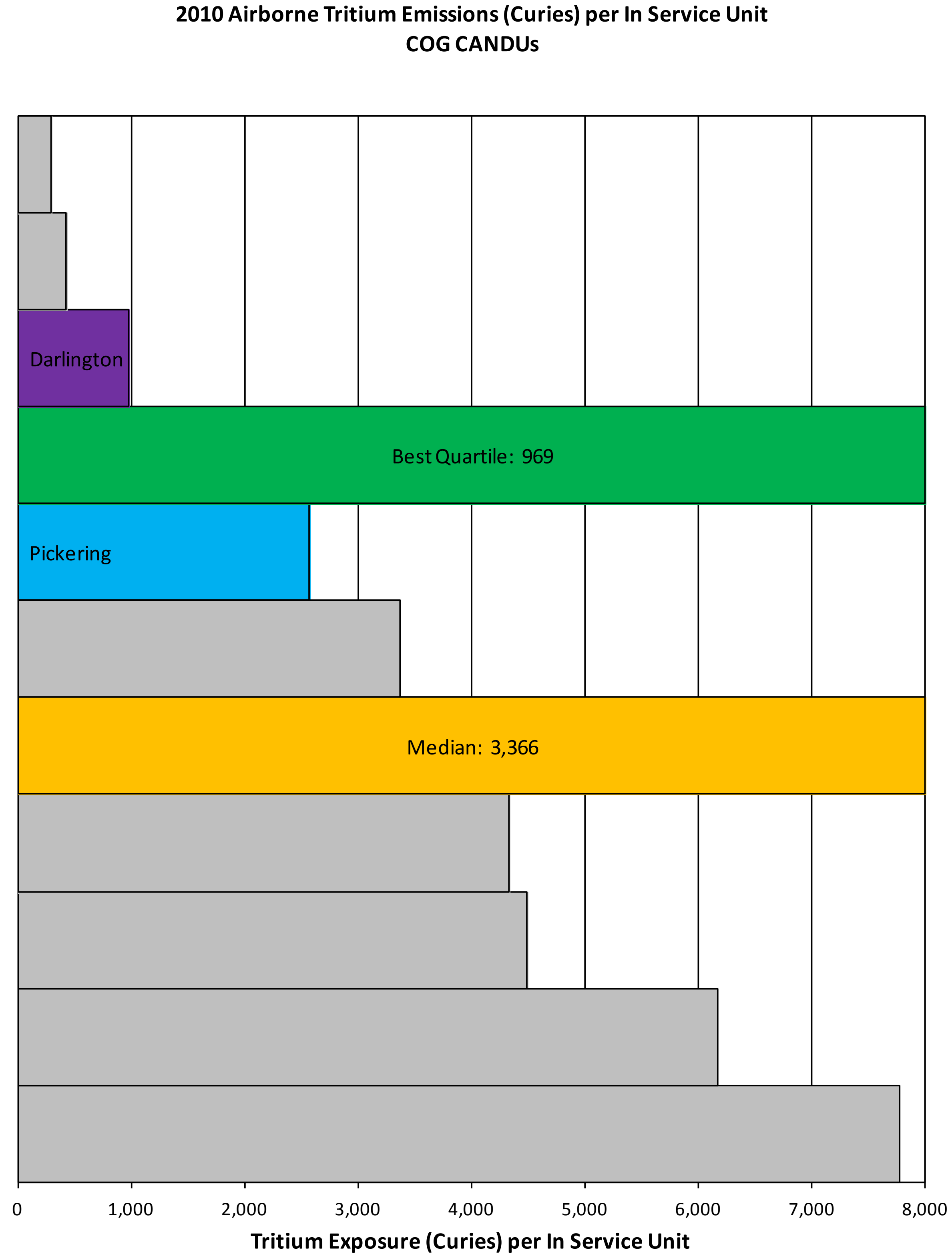
Airborne Tritium Emissions per In Service Unit



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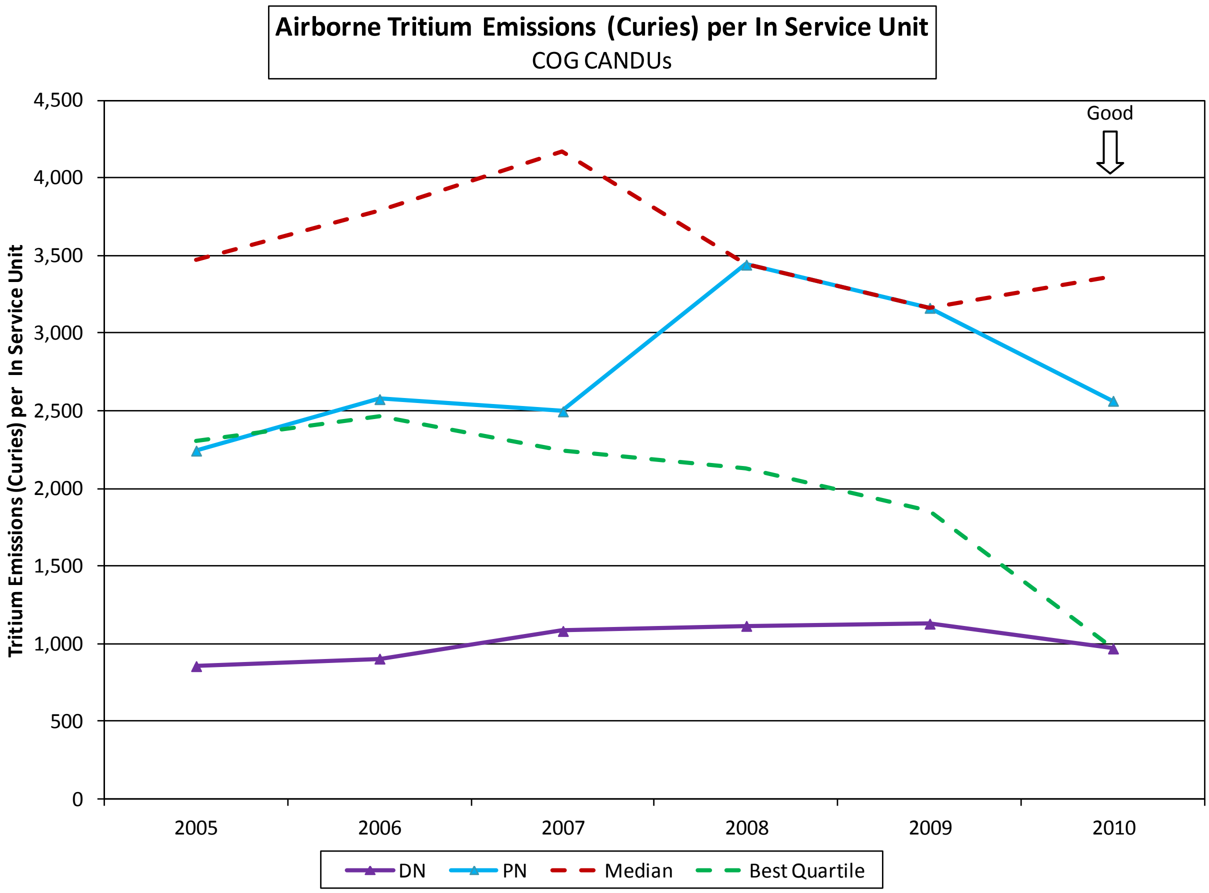

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Observations – Airborne Tritium Emissions (Curies) per Unit

2010 (Annual Value)

- Industry data for 2011 was unavailable at the time of benchmarking. The 2010 preliminary industry results collected from the CANDU Owners Group are included in this report as the most up to date figures available for benchmarking performance.
- Tritium emissions from each facility are compared per in service reactor unit to allow consideration of decreased emissions resulting from generating units undergoing major refurbishment work campaigns.
- Curies per in service unit at top quartile CANDU plants was 969 or lower.
- Darlington performed in the best quartile.
- Pickering performed better than the median threshold of 3,366 curies per in service unit.

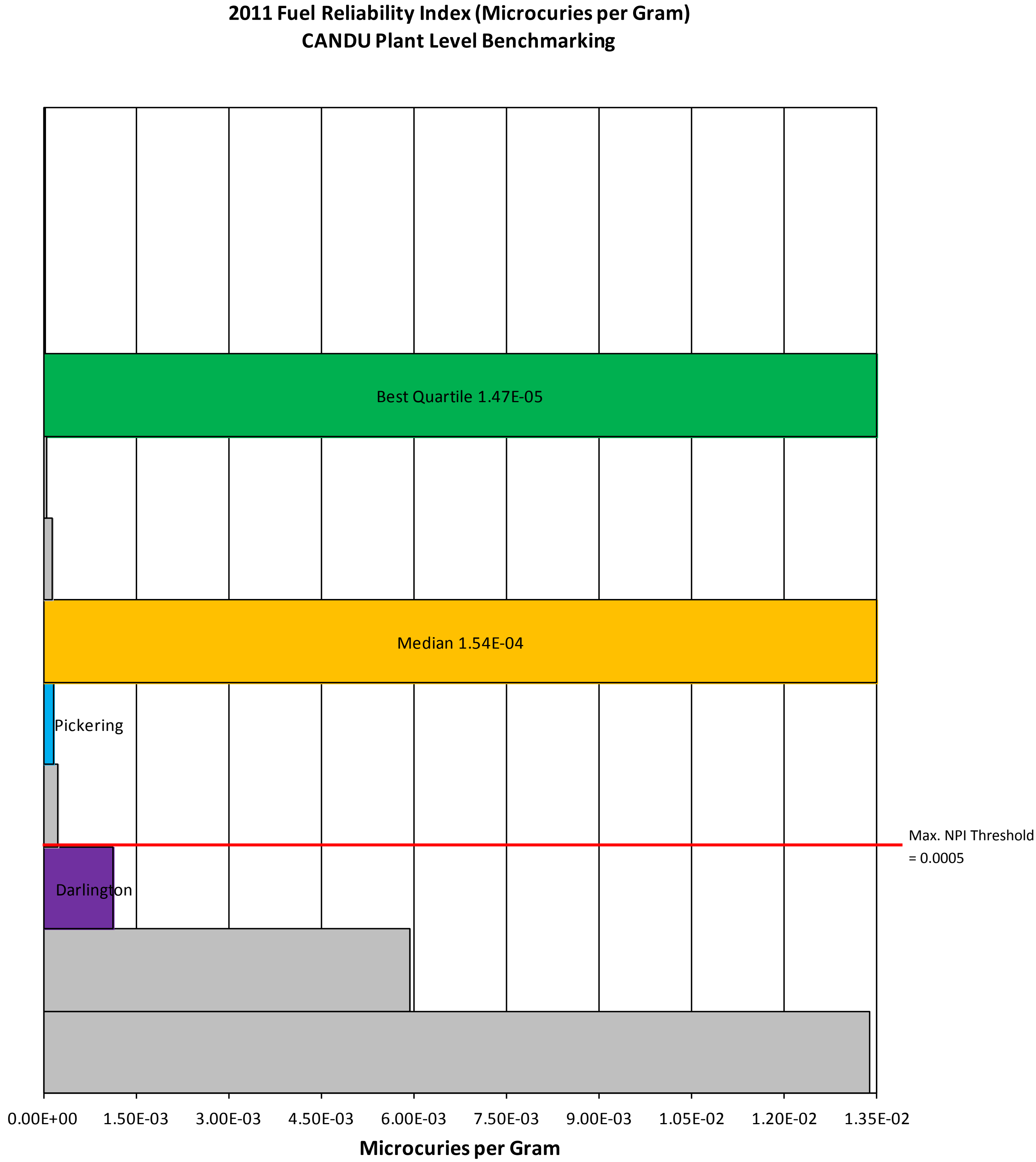
Trend

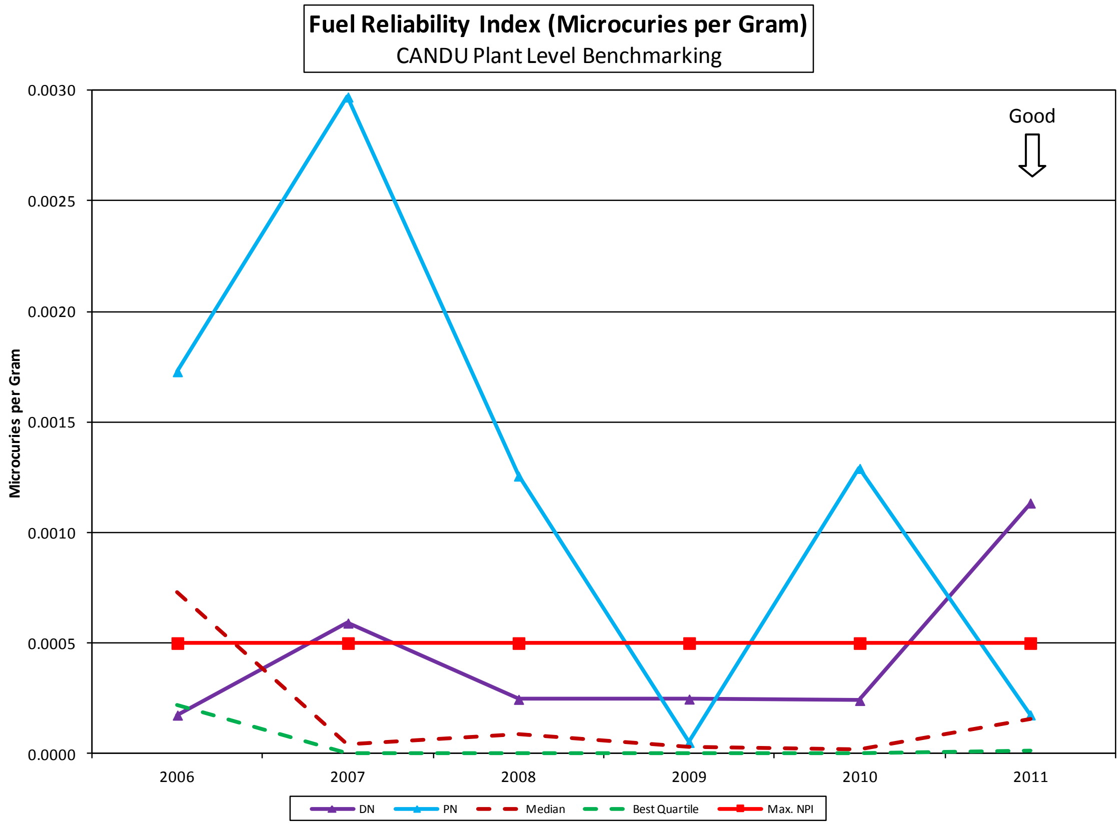
- Ongoing focus on dryer performance, leak management and source term reduction has helped Darlington sustain its strong performance over the review period and enabled the Pickering station to consistently improve its performance since 2008.
- The industry trend line graph shows that best quartile performance has improved considerably in 2010 with gradual improvement since 2006. The large change observed in 2010 is due to a significant decrease in emissions from one of the CANDU plants upon placing the unit reactor into refurbishment.

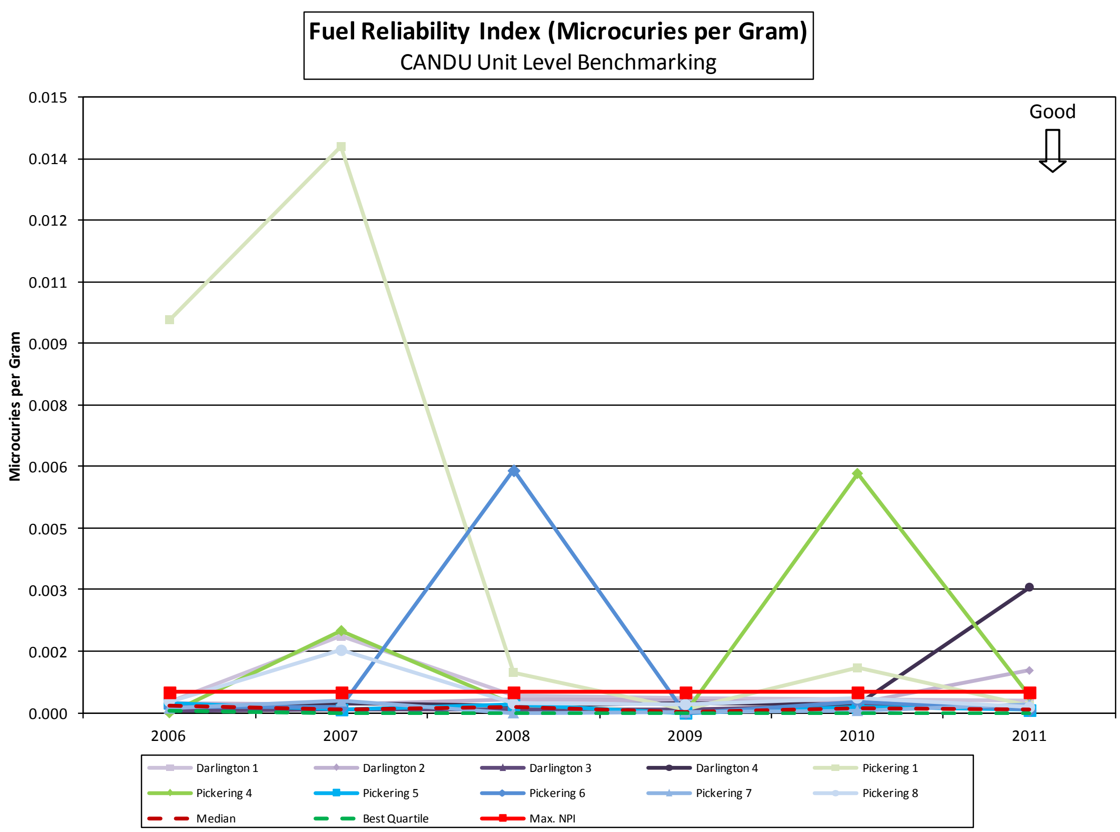
Factors Contributing to Performance

- Facilities with access to a tritium removal facility (e.g., Darlington and Pickering) fare better in this measure, having the benefit of a reduced source term.
- OPG is pursuing consistently executing moderator swaps, thereby taking full advantage of access to detritiation capabilities in order to improve Pickering's performance and allow Darlington to sustain best quartile performance.
- Implementation of tritium airborne leak-searching requirements and increased focus on tritium reduction in the tritium removal facility organization at the Darlington site, combined with the execution of the tritium reduction plan at Pickering, have helped both generating stations improve performance in 2010.

Fuel Reliability Index




Fuel Reliability Index (Microcuries per Gram)
CANDU Plant Level Benchmarking
Good
Microcuries per Gram
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
2006
2007
2008
2009
2010
2011
DN
PN
Median
Best Quartile
Max. NPI


Fuel Reliability Index (Microcuries per Gram)
CANDU Unit Level Benchmarking
Good
Microcuries per Gram
0.015
0.014
0.012
0.011
0.009
0.008
0.006
0.005
0.003
0.002
0.000
2006
2007
2008
2009
2010
2011
Darlington 1
Darlington 2
Darlington 3
Darlington 4
Pickering 1
Pickering 4
Pickering 5
Pickering 6
Pickering 7
Pickering 8
Median
Best Quartile
Max. NPI

Observations – Fuel Reliability Index (CANDU) (FRI)

2011 (Most Recent Operating Quarter)

- Fuel reliability at best quartile CANDU plants was 0.000015 and 0.000001 at the plant and unit level respectively, and median performance was 0.000154 and 0.000069 at the plant and unit level respectively.
- Pickering overall plant performance was slightly worse than median, albeit that two of the six units performing better than the median. Fuel defects were present in Units 1 and 4, and suspected in Unit 8, resulting in the fuel reliability index (FRI) being worse than median during the last operating quarter.
- Darlington plant performance was worse than median for the last operating quarter. This is a result of units 1, 2, and 4 experiencing fuel defects during the most recent operating quarter.

Trend

- Both the industry best quartile and median FRI at both the plant and unit levels have been consistently low over the past 5 years, with a slightly downward (i.e., improving) trend.
- Pickering plant FRI performance has improved over the past 5 years. The 2009-2011 values are significantly lower than the 2006-2008 FRI values, which were all well above the median threshold. This was largely due to the performance of Pickering Unit 1 which experienced high FRI values in 2006-2008 due to fuel defects which have now been removed.
- Darlington plant FRI performance, while relatively unchanged from 2008 to 2010, experienced an upward trend in 2011 due to a series of fuel defects occurring that year. Despite these fuel defects, the increase in FRI was relatively small as a result of rapid detection and removal of the defects.

Factors Contributing to Performance

- Improving fuel reliability continues to be a focus area at both Pickering and Darlington stations. Corrective actions are taken for each fuel defect, to locate, defuel, and examine the cause of the defect as quickly as possible. To the extent practicable, each defected fuel bundle, when discharged from the core, is examined to determine the reason for failure. Inspections are performed on-site, and if inconclusive, are shipped for more extensive examinations off-site. Several initiatives were undertaken to improve fuel integrity through improving foreign material exclusion from the heat transport system, fuel management, and defect detection and removal strategies.

Darlington has experienced an increase in fuel defects in the last 9 months of 2011. Removal of these defects has been very rapid, and the FRI has been affected minimally. Two teams have been assembled to identify areas for improvement in manufacturing practices and foreign material exclusion. These teams focus on identifying and correcting any deficiencies in these two areas, even before the causes of these defects have been identified.

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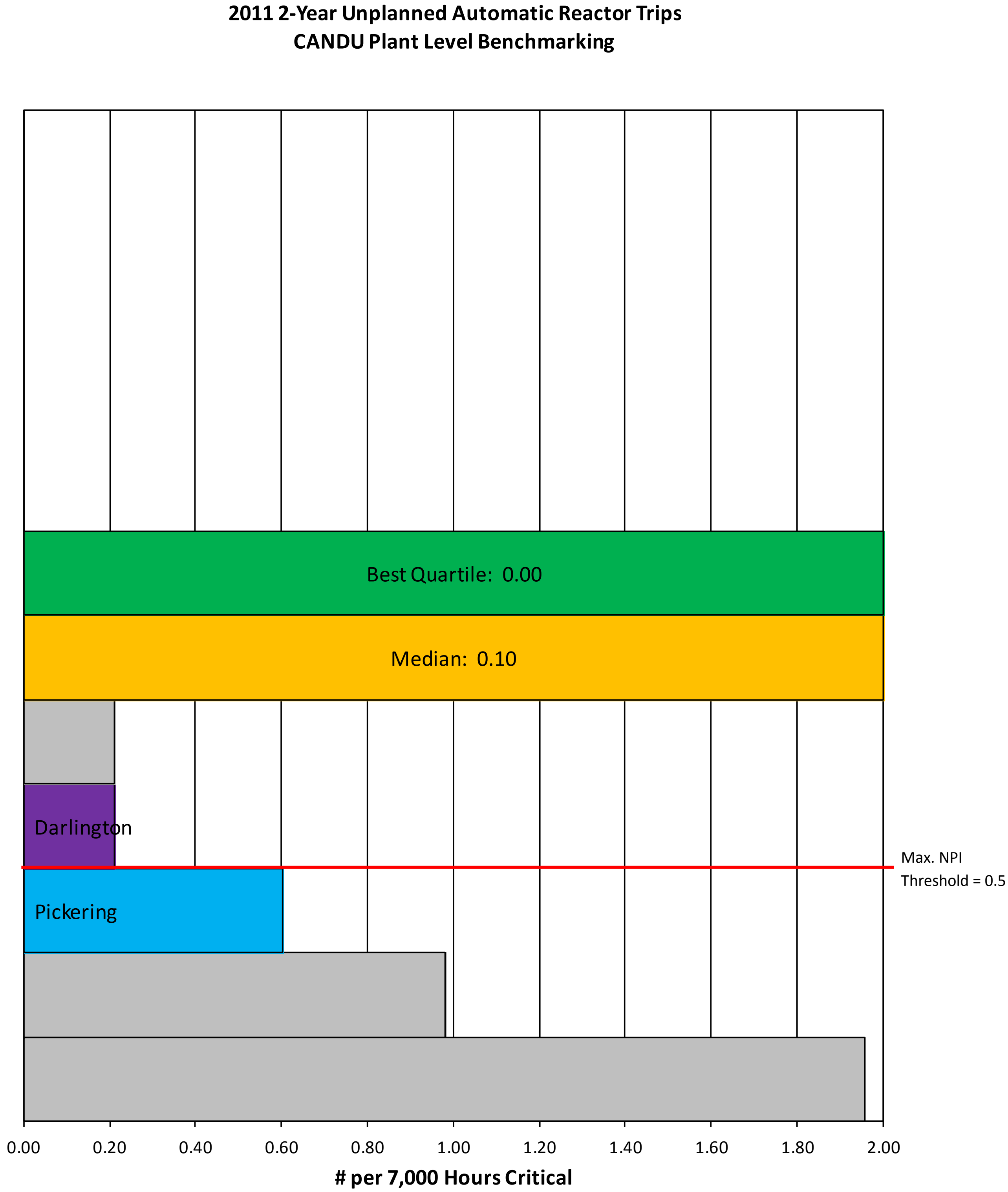
2-Year Unplanned Automatic Reactor Trips



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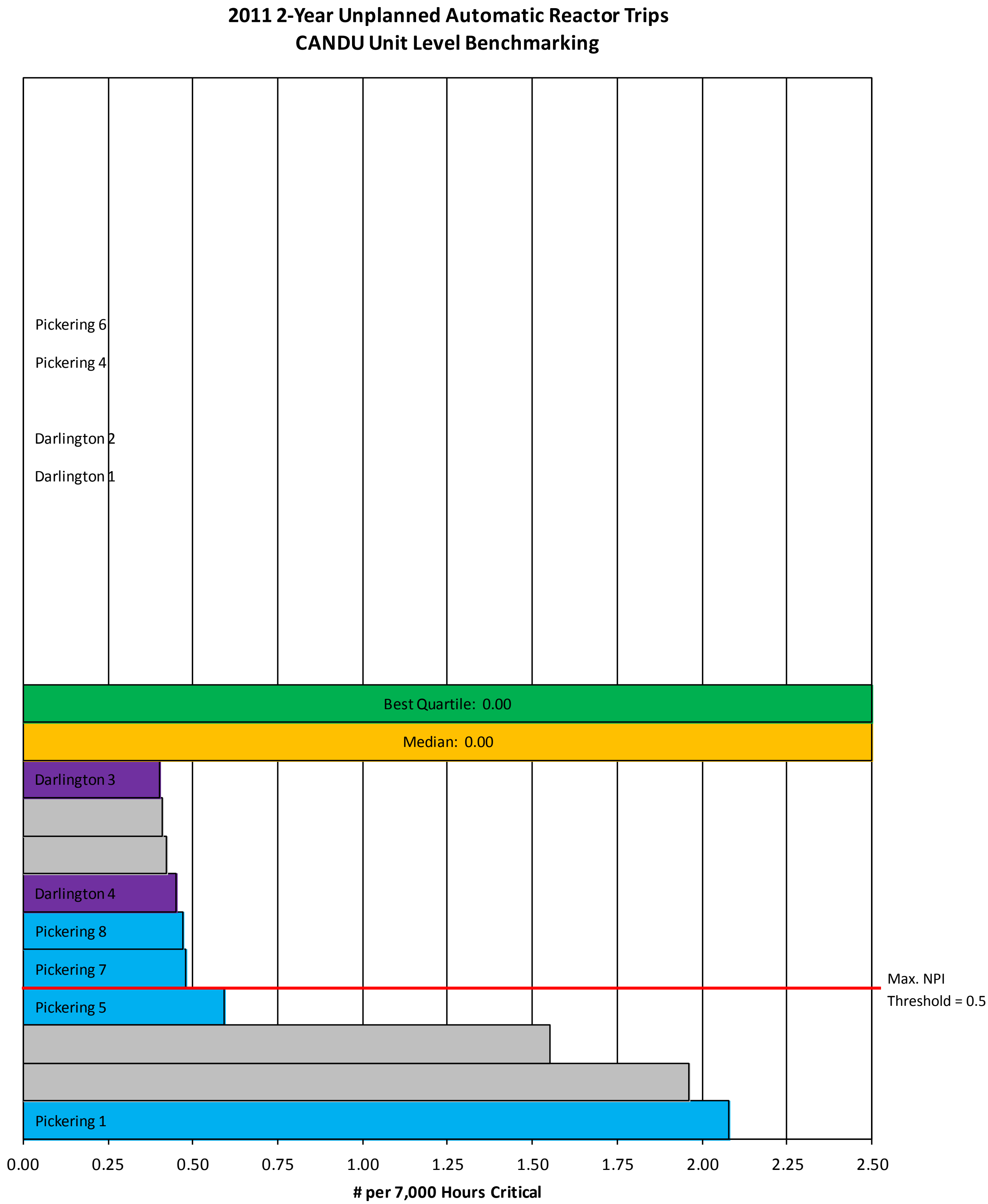
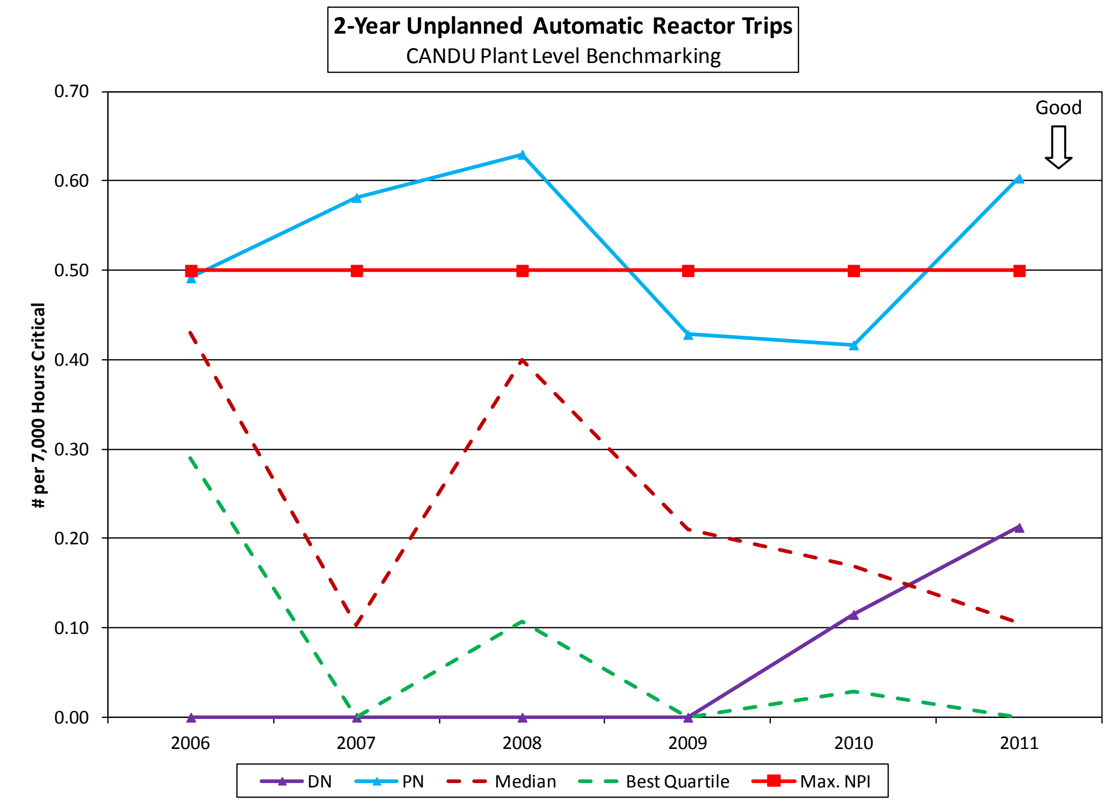
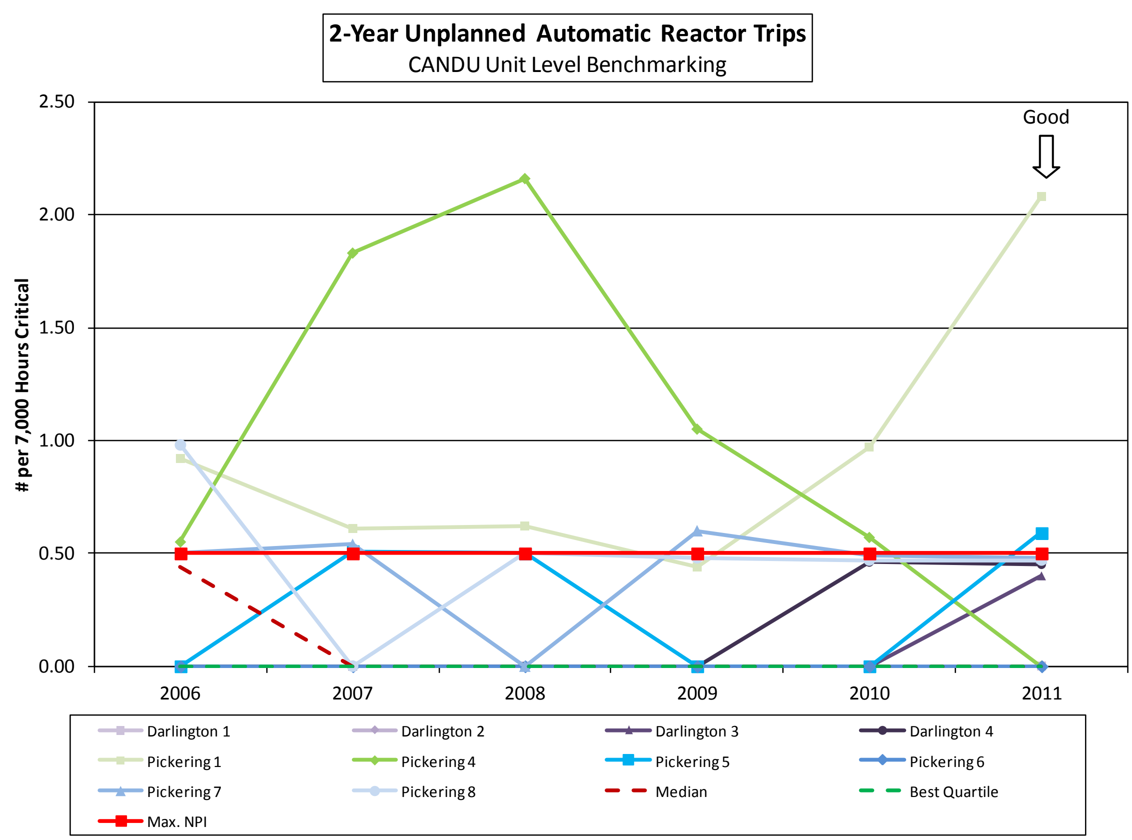



2-Year Unplanned Automatic Reactor Trips
CANDU Plant Level Benchmarking
Good
per 7,000 Hours Critical
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
2006
2007
2008
2009
2010
2011
DN
PN
Median
Best Quartile
Max. NPI


2-Year Unplanned Automatic Reactor Trips
CANDU Unit Level Benchmarking
Good
per 7,000 Hours Critical
2.50
2.00
1.50
1.00
0.50
0.00
2006
2007
2008
2009
2010
2011
Darlington 1
Darlington 2
Darlington 3
Darlington 4
Pickering 1
Pickering 4
Pickering 5
Pickering 6
Pickering 7
Pickering 8
Median
Best Quartile
Max. NPI

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Observations – 2-Year Unplanned Automatic Reactor Trips (CANDU)

2011 (2-Year Rolling Average)

- The 2-year rolling average unplanned automatic reactor trip rate best quartile for CANDU plants was zero with a median of 0.10. For individual CANDU units, the best quartile and median values for unplanned reactor trip rate was zero.
- At the plant level, Pickering Nuclear achieved a trip rate of 0.60 in 2011, performing worse than the third quartile benchmark of 0.51. On an individual unit basis, Units 4 and 6, with trip rates of zero, performed within the best quartile of zero. Pickering Unit 1, with a trip rate of 2.08, was the worst performing generating unit of the benchmarking panel and was significantly worse than the third quartile of 0.44. Units 7 and 8, with trip rates of 0.48 and 0.47 respectively, performed slightly worse than the third quartile in 2011.
- Pickering Units 1 and 4 received 5 out of 10 World Association of Nuclear Operators (WANO) nuclear performance index (NPI) points for unplanned automatic reactor trips as of the fourth quarter of 2011. Pickering Units 5 to 8 received an average of 9.8 out of 10 WANO NPI points for unplanned automatic reactor trips at the end of 2011.
- Darlington Nuclear achieved a plant level trip rate of 0.21 in 2011, performing worse than the median of 0.10 but better than the third quartile threshold of 0.51. On an individual unit basis, Units 1 and 2, with trip rates of zero, performed within the best quartile, which is zero. Unit 3, with a trip rate of 0.40, performed worse than median, but better than the third quartile threshold of 0.44. Unit 4 achieved a trip rate of 0.45, performing slightly worse than the third quartile.
- Darlington Nuclear received 10 out of 10 WANO NPI points for unplanned automatic reactor trips at the end of 2011.

Trend

- The unplanned automatic reactor trip rate best quartile and median of CANDU plants improved from 2010 to 2011. On an individual unit basis, the industry best quartile and median has remained strong at zero since 2007.
- The performance of the Pickering station has fluctuated over the 2006-2011 review period, achieving 0.49 trips in 2006, 0.63 trips in 2008 and ending the period with 0.60 trips in 2011. On an individual unit basis, Unit 4 showed improved performance from 2010 and had no annual automatic reactor trip events in 2010 and 2011. Unit 1 performance worsened from 2010 and the unit had two annual automatic reactor trip events in both 2010 and 2011. Unit 5 performance also worsened from 2010 to 2011 and the unit had one automatic reactor trip event in 2011. Unit 6 has consistently performed at zero trips since 2006. Unit 7 showed improvement in its reactor trip rate performance in 2011 from 2010. Unit 8 performance was consistent with 2010 and had no annual automatic reactor trip events in 2011.
- Darlington station performance worsened from 2010 to 2011. On an individual unit basis, Units 1 and 2 have consistently performed at zero trips since 2006. Unit 3 performance worsened from 2010 to 2011 and the unit had one annual automatic reactor trip event in 2011. Unit 4 showed slight improvement in performance from 2010, with no annual automatic reactor trip events in 2011.

Factors Contributing to Performance

- Key performance drivers for this metric include: general equipment reliability, material condition and human performance.

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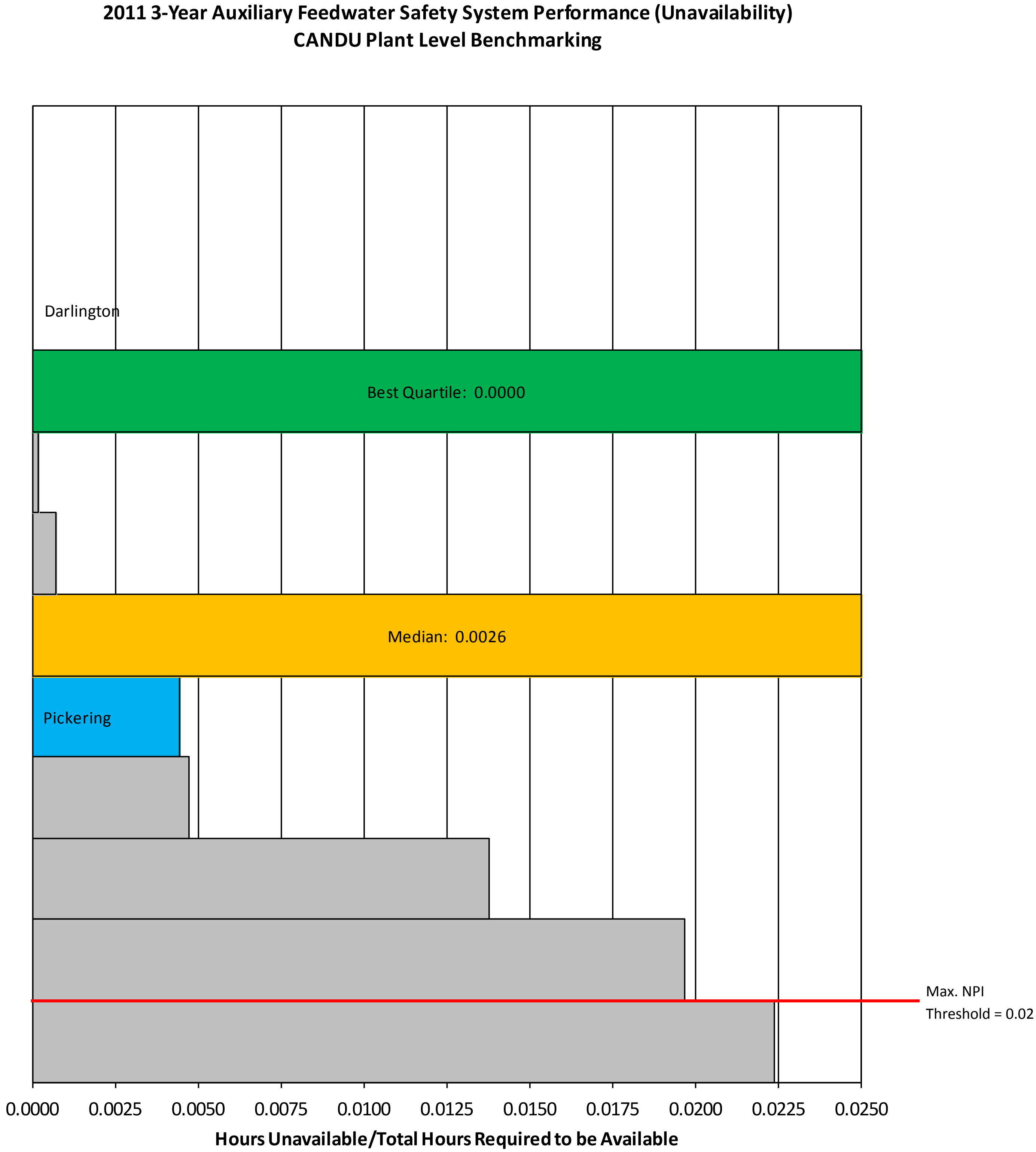
3-Year Auxiliary Feedwater Safety System Unavailability



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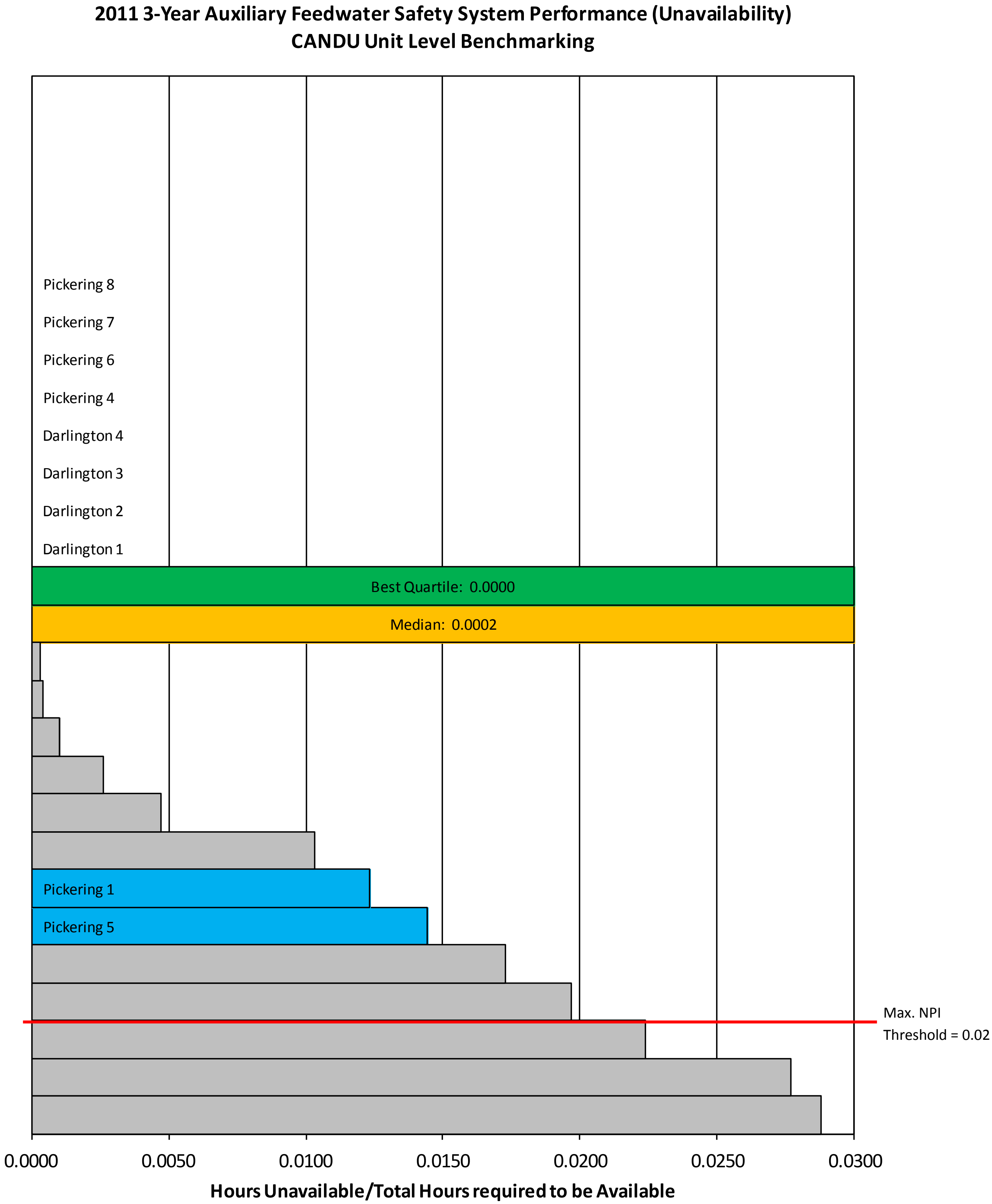
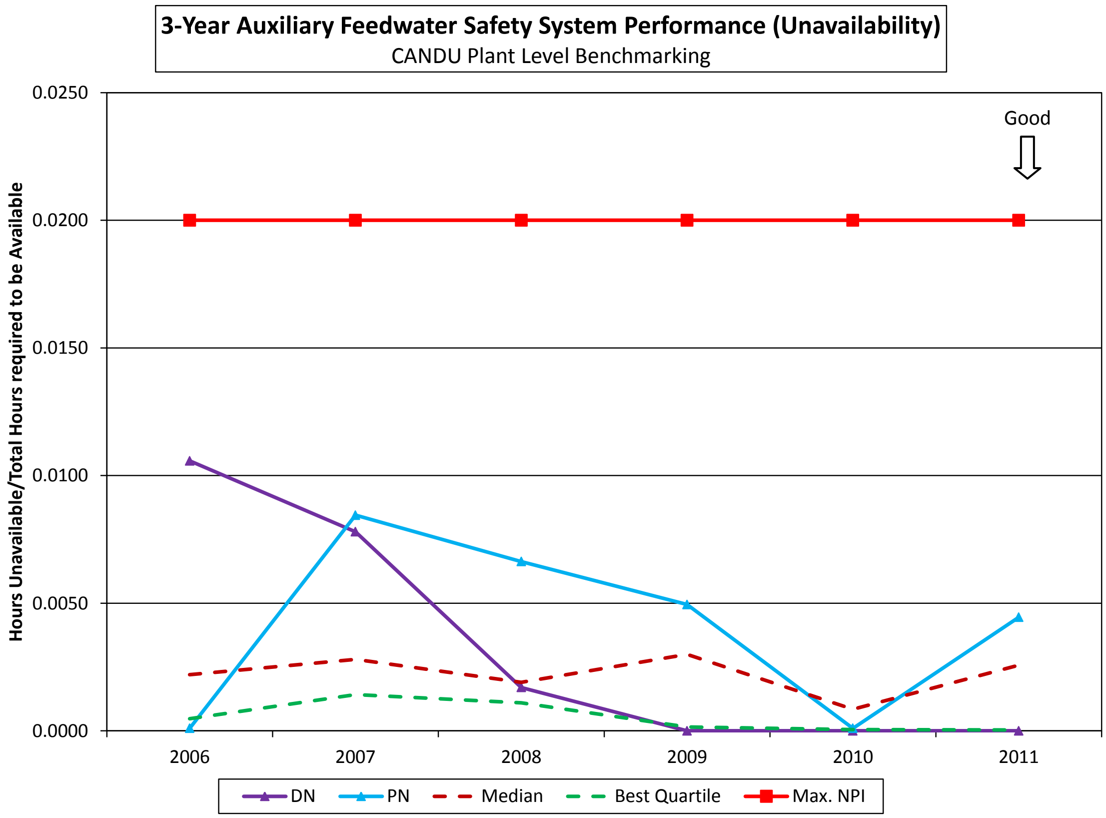
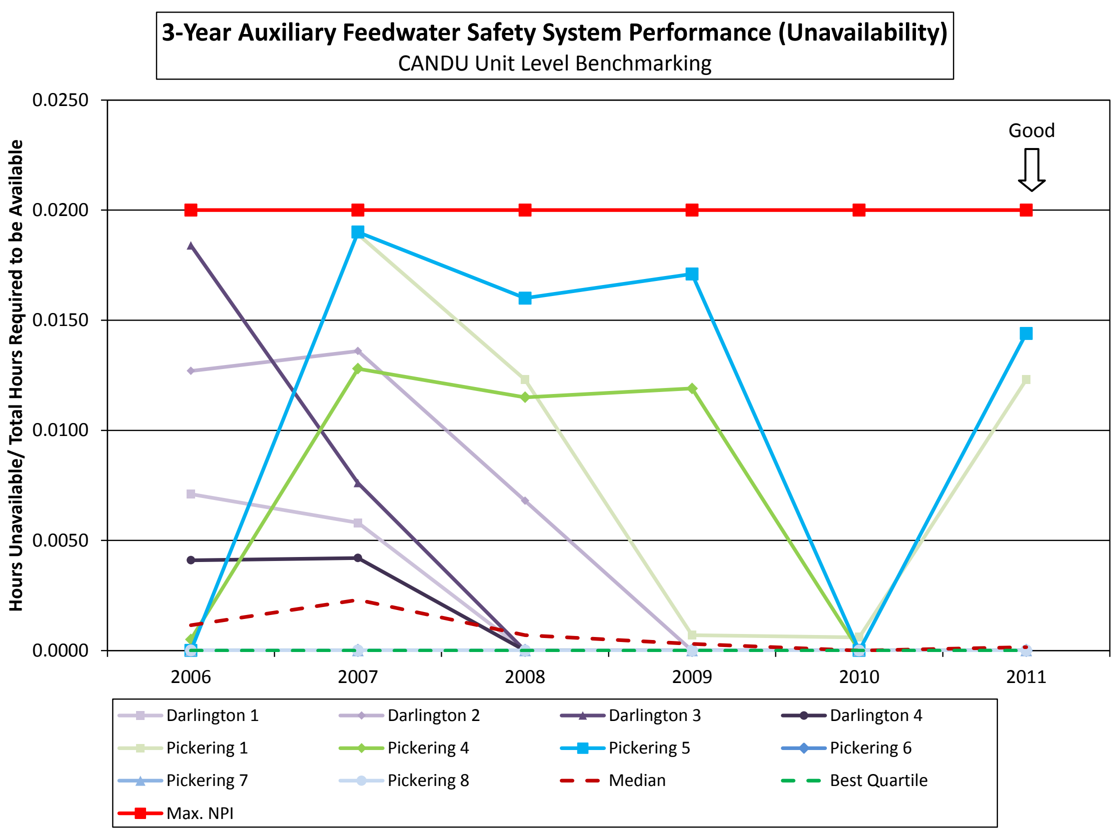



3-Year Auxiliary Feedwater Safety System Performance (Unavailability)
CANDU Plant Level Benchmarking
Hours Unavailable/Total Hours required to be Available
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
2006
2007
2008
2009
2010
2011
Good
DN
PN
Median
Best Quartile
Max. NPI


3-Year Auxiliary Feedwater Safety System Performance (Unavailability)
CANDU Unit Level Benchmarking
Hours Unavailable/ Total Hours Required to be Available
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
2006
2007
2008
2009
2010
2011
Good
Darlington 1
Darlington 2
Darlington 3
Darlington 4
Pickering 1
Pickering 4
Pickering 5
Pickering 6
Pickering 7
Pickering 8
Median
Best Quartile
Max. NPI

Observations – 3-Year Auxiliary Feedwater System (CANDU)

2011 (3-Year Rolling Average)

- Auxiliary feedwater (AFW) safety system performance at best quartile CANDU plants was zero with a median of 0.0026. For individual CANDU units, the best quartile was zero with a median of 0.0002.
- Pickering Nuclear station performance (0.0044) was worse than median but better than third quartile in 2011. On an individual unit basis, Units 4, 6, 7 and 8 had zero unavailability in 2011 (best quartile performance) and Units 1 and 5 performed worse than the median with an unavailability of 0.0123 and 0.0144 respectively.
- Darlington Nuclear achieved best quartile performance of zero unavailability at both the station and unit levels in 2011.
- Both OPG stations obtained full WANO NPI points at the end of 2011.

Trend

- The 3-year auxiliary feedwater unavailability best quartile of CANDU plants improved to zero unavailability in 2011 but the median value was slightly worse than in 2010. On an individual unit basis, best quartile performance value was zero consistent with performance observed in the past five years. The plant level industry median value was slightly worse than in 2010.
- Pickering station performance in 2011 was worse than 2010. On an individual unit basis, the performance of Units 1 and 5 worsened from 2010 to 2011. Unit 4 achieved an unavailability of zero similar to 2010. Units 6, 7 and 8 consistently maintained zero unavailability (best quartile performance) over the last five years.
- Darlington performance has steadily improved since 2006, decreasing from an average station unavailability of 0.0106 in 2006 to sustaining zero unavailability for the last three years of the review period. All Darlington units achieved zero unavailability since 2009.

Factors Contributing to Performance

- Key performance drivers for this metric include: general equipment reliability, material condition, and human performance.
- Pickering Unit 1 saw a decline in performance in 2011 due to a failed close Auxiliary Feedwater System pump control valve. This valve was subsequently replaced with a new and improved design.
- Pickering Unit 5 performance declined in 2011 due to the unavailability of pump 5 caused by a mechanical seal leakage. Bearing housing seals were replaced in 2011 and the pump returned to service.

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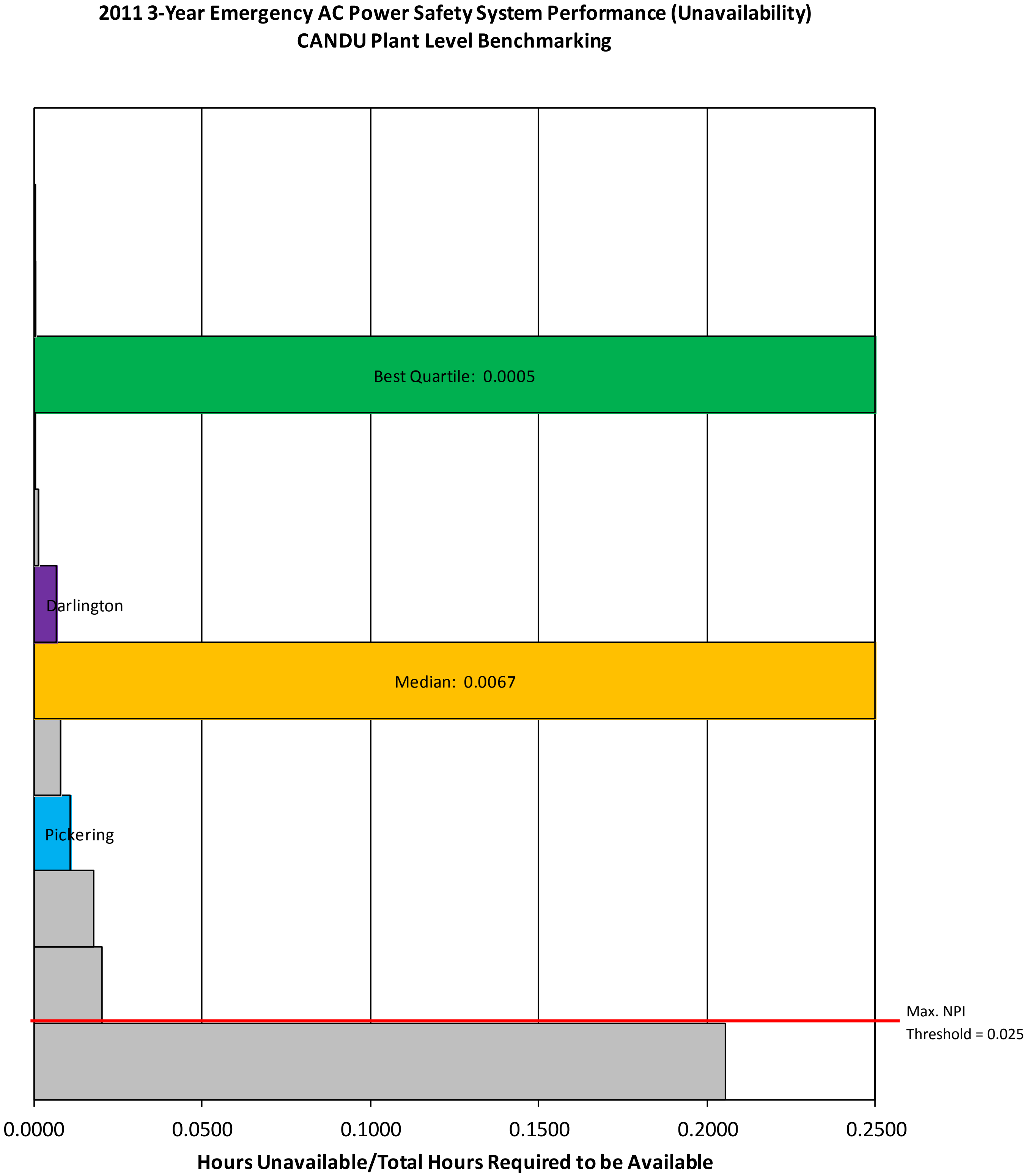
3-Year Emergency AC Power Safety Unavailability



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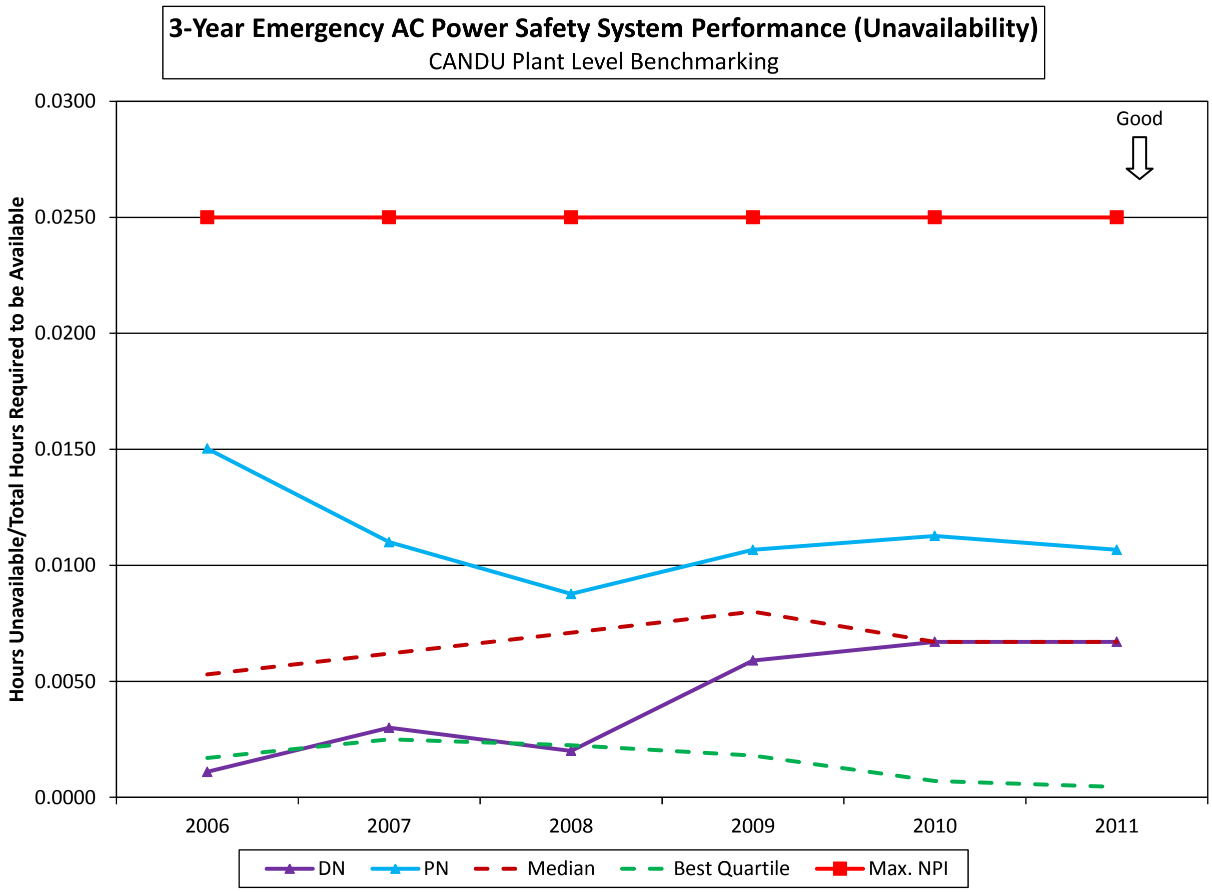

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Observations – 3-Year Emergency AC Power Safety System (CANDU)

2011 (3-Year Rolling Average)

- 3-Year Emergency AC Power Safety System performance at best quartile CANDU plants was 0.0005. The industry median value was 0.0067.
- Pickering performed worse than median but better than the third quartile threshold in 2011, earning 10 out of 10 WANO NPI points at the end of 2011.
- Darlington achieved median performance and earned 10 out of 10 WANO NPI points at the end of 2011.

Trend

- The 3-year Emergency AC Power Safety System unavailability industry best quartile of CANDU plants has steadily improved since 2007, reaching its lowest point of the review period in 2011 (0.0005). The industry median value in 2011 has remained the same as 2010.
- The performance of Pickering improved from 2006 to 2008, worsening in 2009 and 2010 before showing a favourable improvement in 2011.
- Darlington station performance in 2011 was similar to 2010 but showed an unfavourable trend in the 3-year rolling average from 2008 to 2010. Darlington achieved an annual unavailability of zero in 2011.

Factors Contributing to Performance

- Key performance drivers for this metric include: general equipment reliability, material condition, and human performance.

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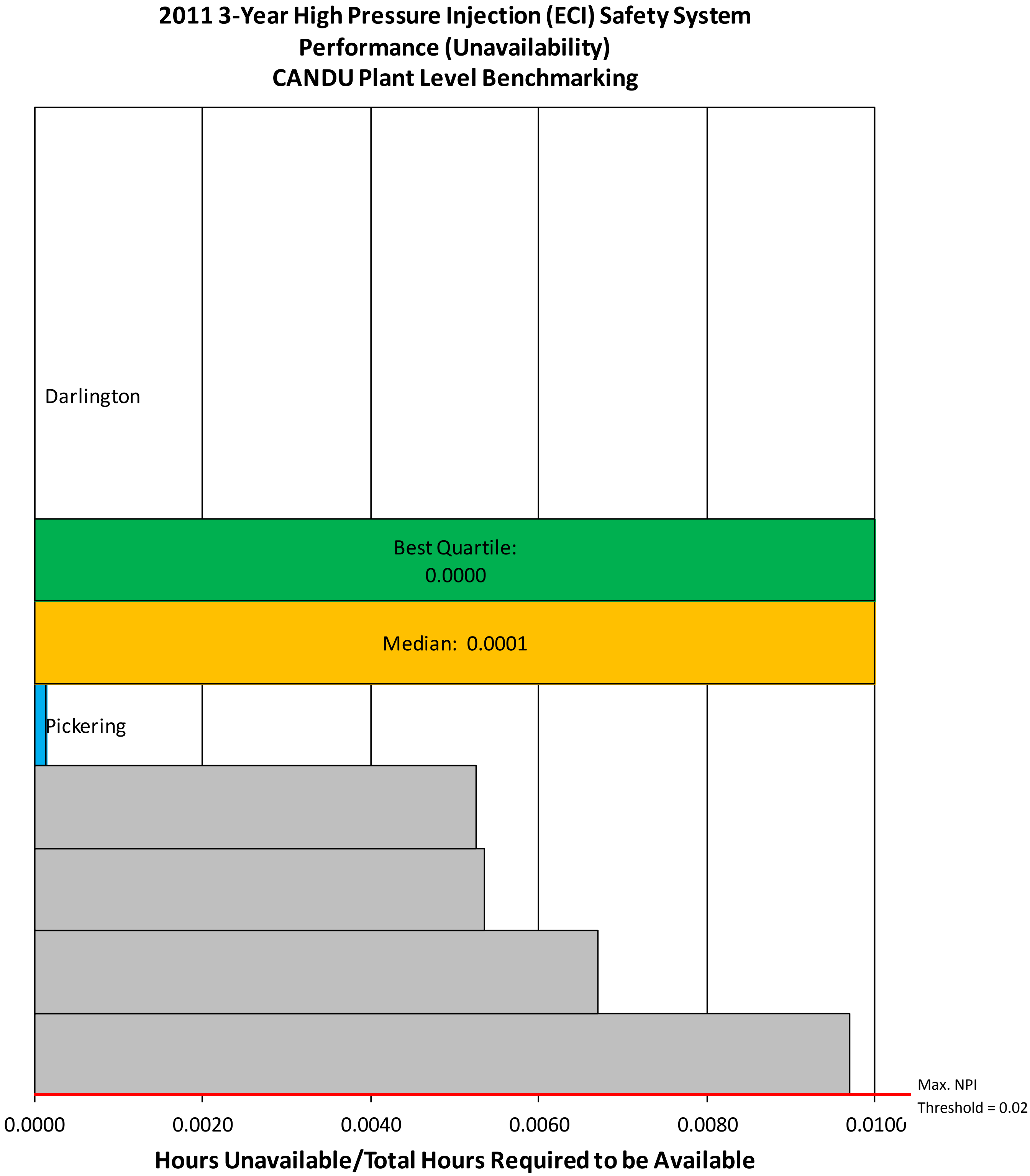
3-Year High Pressure Safety Injection



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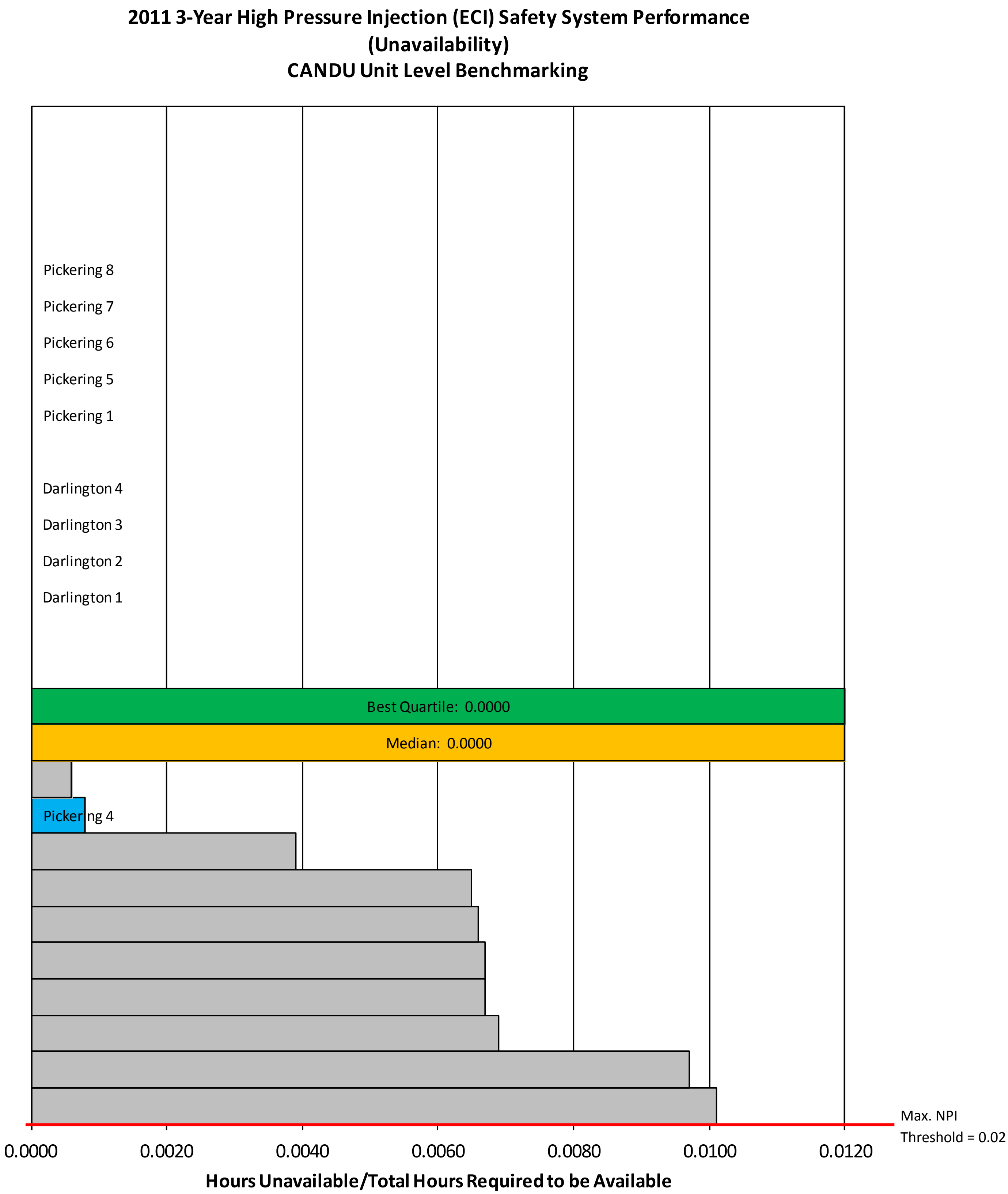

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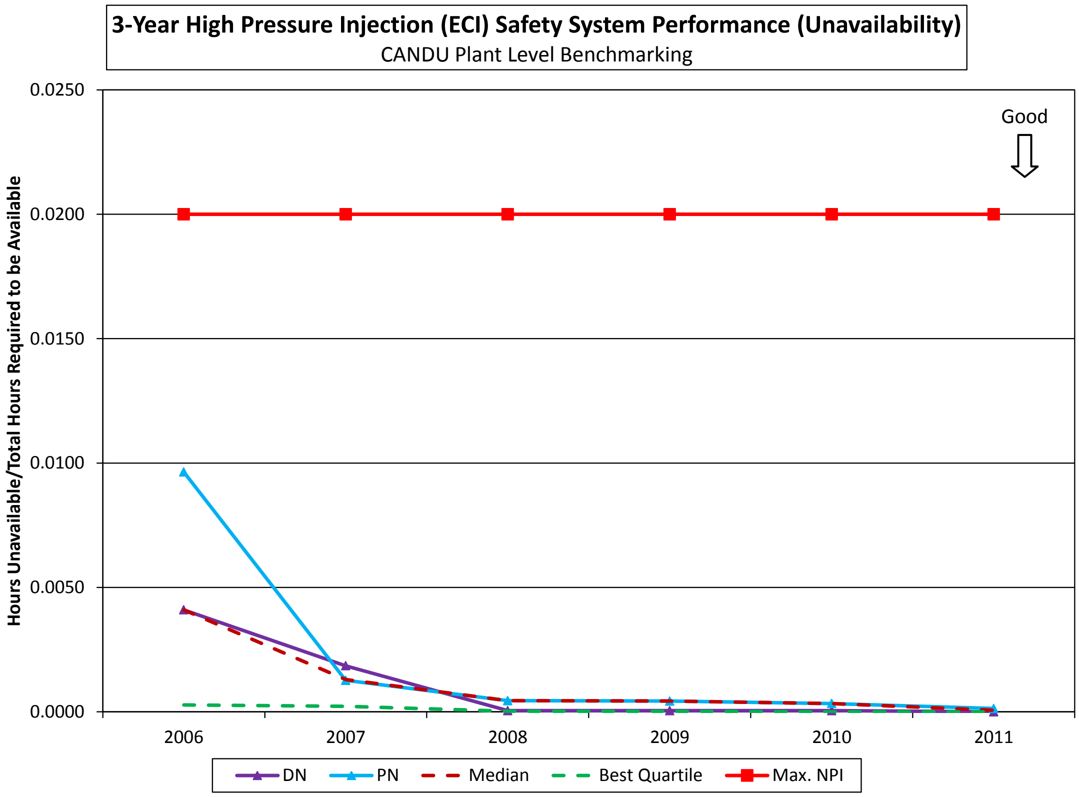

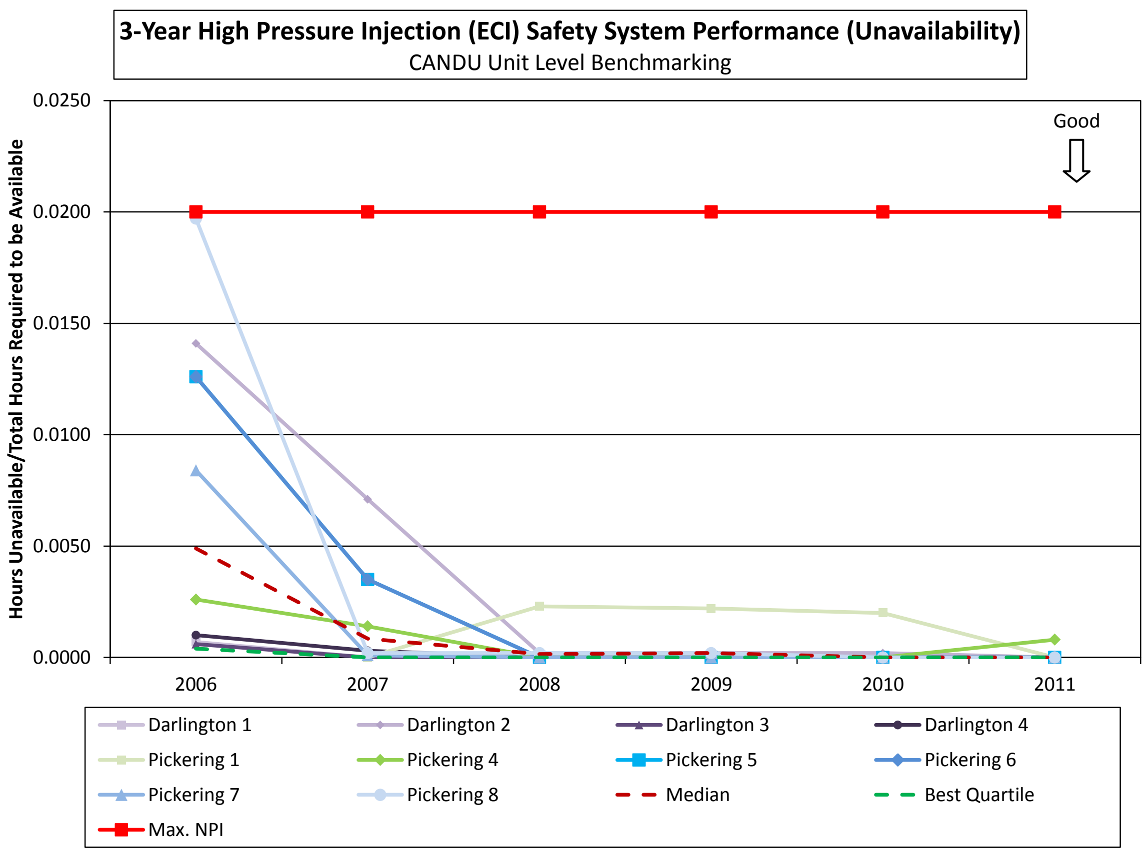

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Observations – 3-Year High Pressure Safety Injection Unavailability (CANDU)

2011 (3-Year Rolling Average)

- The 3-year High Pressure Safety Injection Unavailability performance at best quartile CANDU plants was zero at both the plant and unit level. The industry median value was 0.0001 at the plant level and zero at the unit level.
- Pickering station performance was at median value and earned full WANO NPI points at the end of 2011. On an individual unit basis, Units 1, 5, 6, 7 and 8 achieved best quartile performance (zero unavailability) in 2011. Unit 4 performed worse than the median but better than the industry third quartile threshold.
- Darlington plant performance was at the best quartile of zero in 2011, earning full WANO NPI points. On an individual unit basis, all Darlington units also achieved best quartile performance (zero unavailability) in 2011.

Trend

- The 3-Year High Pressure Safety Injection unavailability best quartile performance of CANDU plants has been at zero since 2008. The industry median value has improved from 0.0041 in 2006 to 0.0001 in 2011. At the unit level, best quartile performance was zero consistent with performance observed since 2007. The median value remained at zero from 2010.
- The plant performance of Pickering Nuclear has consistently improved over the past 5 years down from a high of 0.0096 in 2006 to 0.0001 in 2011. On an individual unit basis, Unit 1 has consistently improved over the past three years down from 0.0023 in 2008 to zero unavailability in 2011. Unit 4 performance worsened from 2010 to 2011. Units 5 and 7 have been at the best quartile of zero since 2008. Units 6 and 8 remained at best quartile since 2010.
- Darlington performance has been consistently strong in the past five years and achieved the best quartile of zero unavailability in 2011. On an individual unit basis, Units 1 and 3 have been at the best quartile of zero since 2007. Darlington Unit 4 has been at the best quartile of zero since 2008. Unit 2 has been consistently strong over the last three years and achieved the best quartile of zero in 2011.

Factors Contributing to Performance

- Key performance drivers for this metric include: general equipment reliability, material condition, and human performance.
- Pickering Unit 4 performance declined in 2011 due to a pump seal failure.

3.0 RELIABILITY

Methodology and Sources of Data

The majority of reliability metrics were calculated using the data from WANO. Any data labelled as invalid by WANO was excluded from all calculations. Indicator values of zero are not plotted or included in calculations except in cases where zero is a valid result. Complete data for the 2004-2011 period was obtained and averages are as provided by WANO.

The two backlog metrics, deficient and corrective maintenance, are also included within this section and the data comes from an industry sponsored INPO AP-928 subcommittee rather than from a more formal third-party source. Data points benchmarked are a single point in time, not a rolling average. All of the data is self-reported. Industry backlog benchmark standards changed with Revision 3 of AP-928 Work Management Practices at INPO in June of 2010. The new standard created an alignment between engineering criticality coding and backlog classification that allows improved focus on the more critical outstanding work. This standard also sets a more consistent foundation for classification of backlogs such that comparisons between utilities will be more meaningful. All OPG stations converted to the new standard on January 24, 2011. The latest 2011 industry backlog benchmark data was collected on September 30. The results and supporting analysis associated with the backlog metrics reflect this industry development.

Discussion

The primary metric within the reliability section is the WANO NPI. The WANO NPI is an operational performance indicator comprised of 10 metrics, three of which are analyzed in this section: Forced Loss Rate, Unit Capability Factor, and Chemistry Performance Indicator. The remainder of the WANO NPI components are analyzed in the safety section (Section 2.0).

For WANO NPI, Darlington performed very well achieving best quartile performance against CANDU plants in 2011. In addition, Darlington maintained median performance for three metrics, third quartile performance for one indicator and fourth quartile performance for the On-line Corrective Maintenance Backlog metric. The Pickering station needs to improve performance significantly to achieve industry best quartile for the NPI. The metrics with the poorest performance at the Pickering station are the Forced Loss Rate, Chemistry Performance Indicator and On-line Corrective Maintenance Backlog which were in the fourth quartile in 2011.

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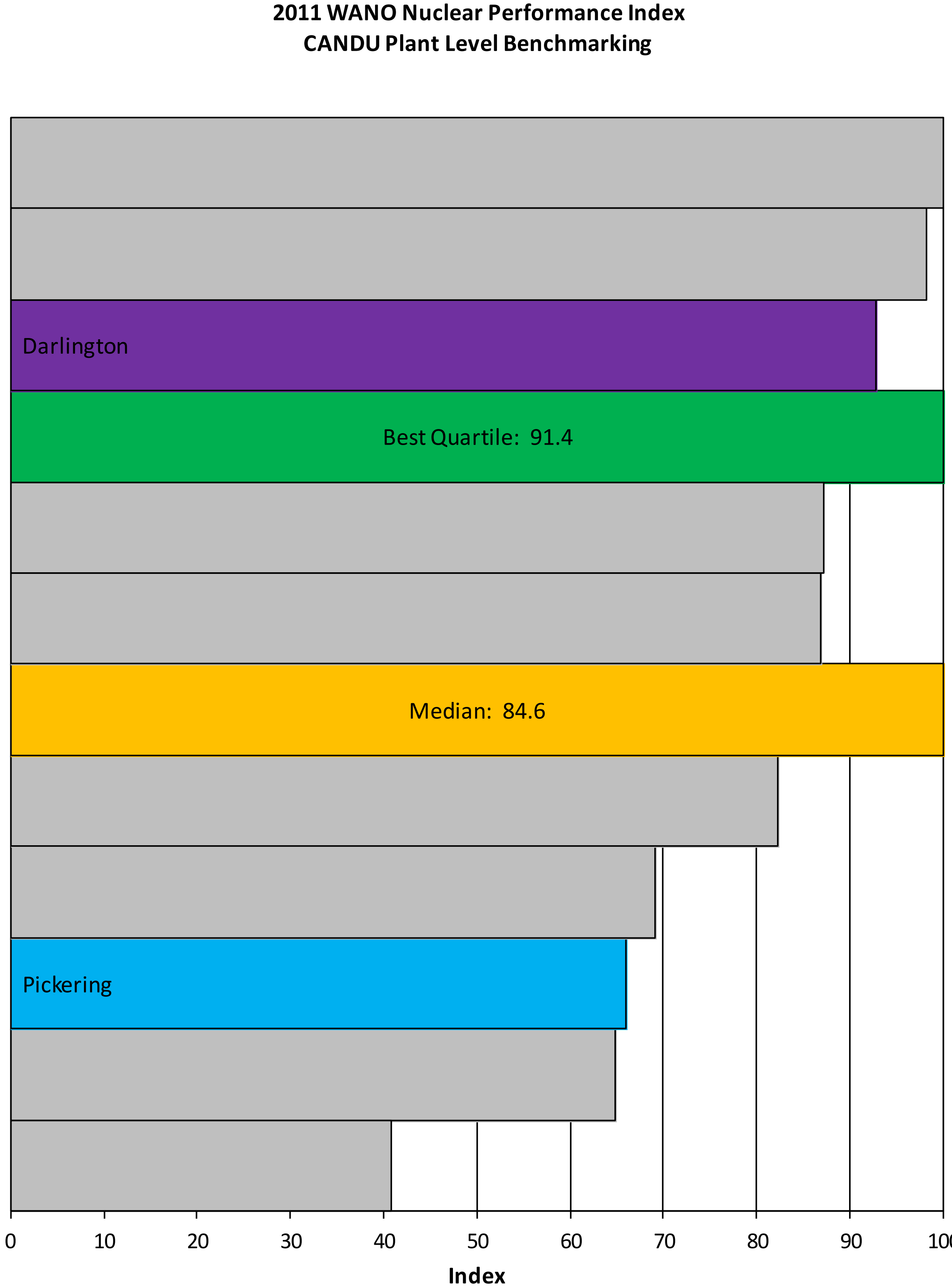
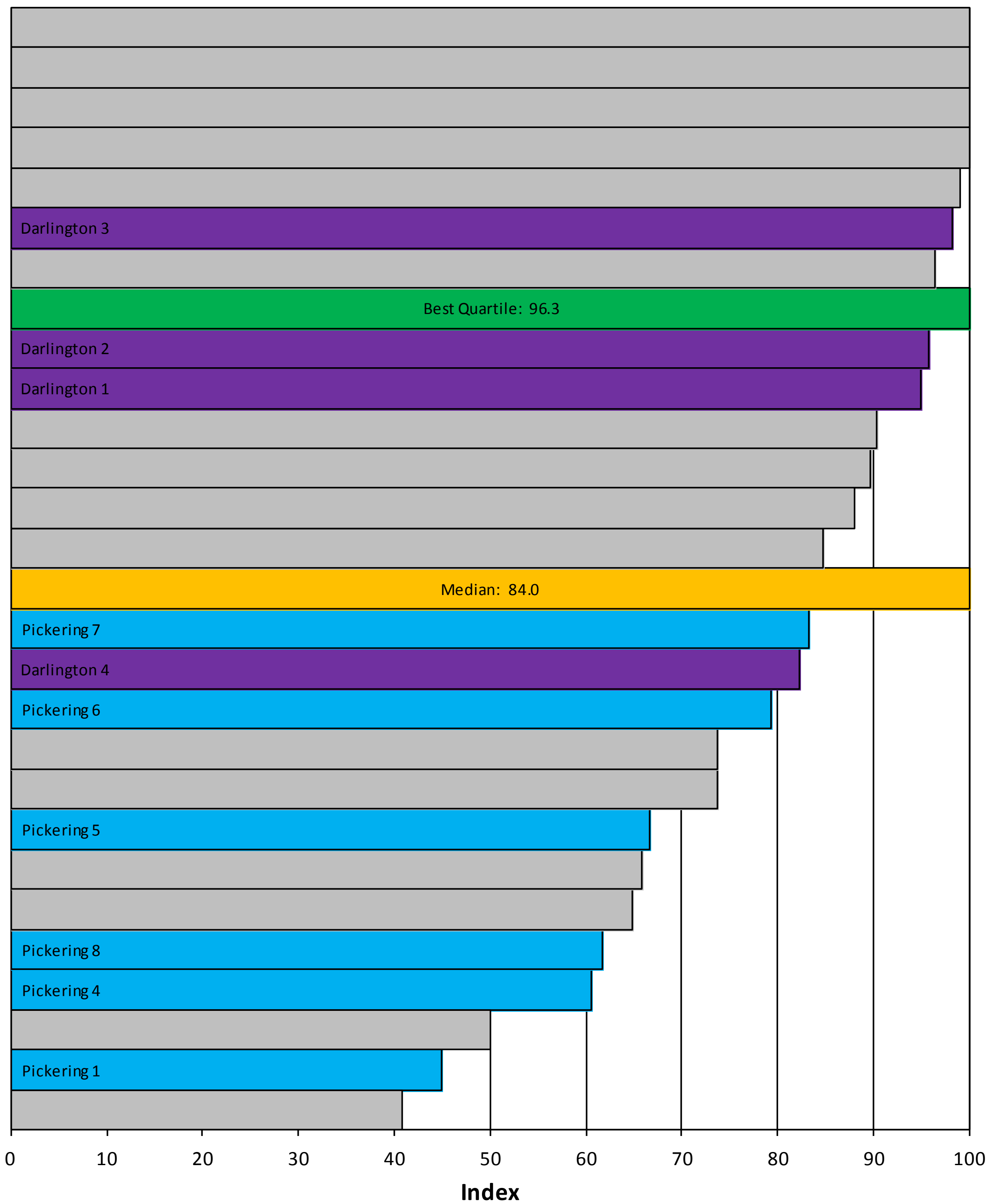
WANO Nuclear Performance Index



2011 WANO Nuclear Performance Index
CANDU Unit Level Benchmarking



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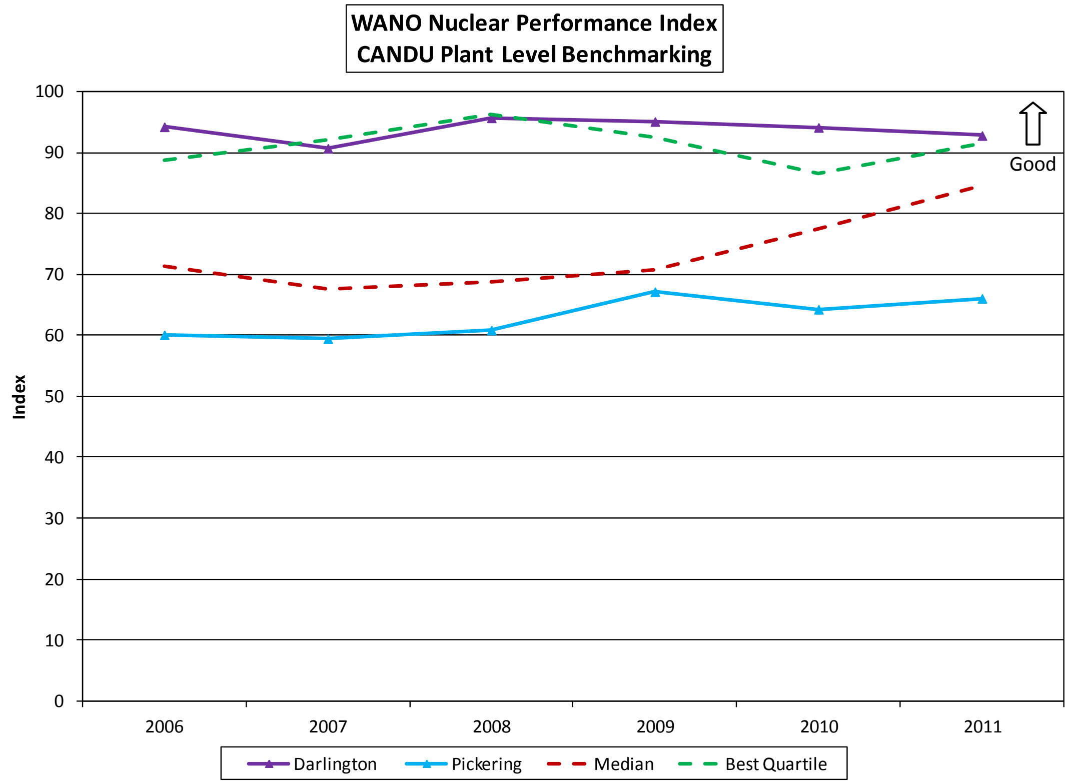

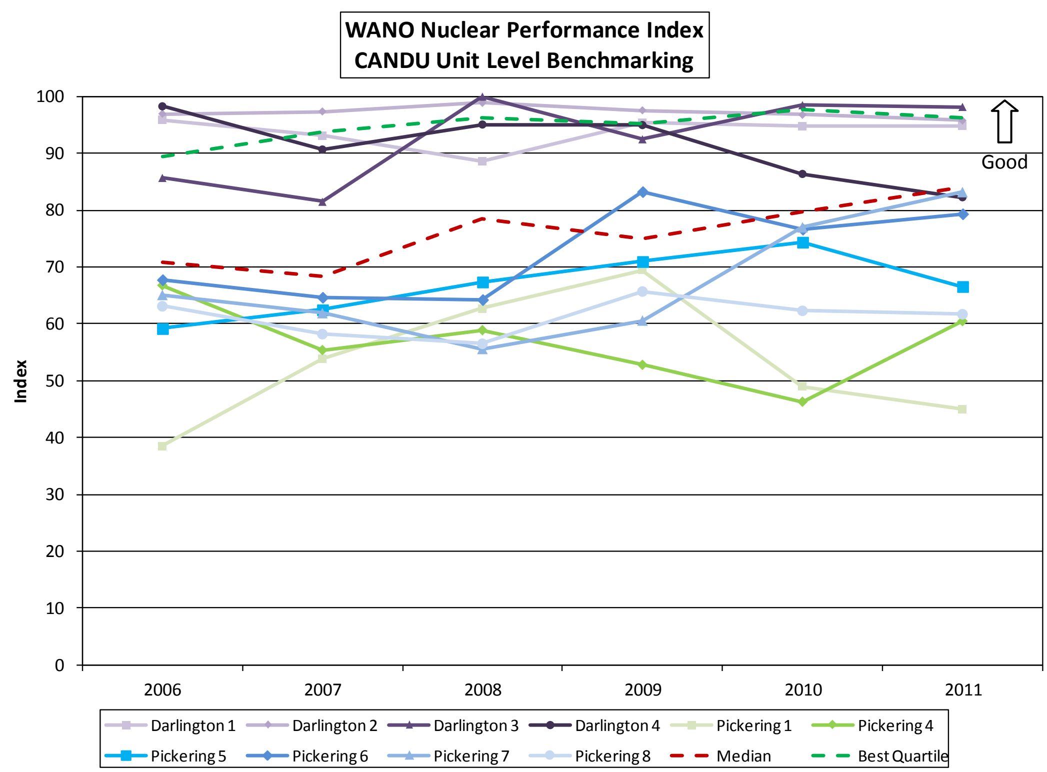

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Observations – WANO Nuclear Performance Index (NPI) (CANDU)

2011

- The 2011 best quartile of the CANDU plant comparison panel for WANO NPI is 91.4, representing an increase of 4.7 points above the 2010 best quartile. Since the performance of the top quartile plants has remained relatively stable, this increase is attributable to a smaller gap in performance between the top quartile and median.
- The median of the CANDU plant comparison panel rose 7.2 points from last year to 84.6 in 2011, indicating that the performers in the lower quartiles are performing better.
- Pickering's station performance remained below median in 2011.
- Darlington continued to demonstrate strong performance, maintaining best quartile in 2011.

Trend

- The best quartile of the CANDU plant comparison panel, which had shown an upward trend from 2006 to 2008, declined in 2009 and 2010. This trend reversed in 2011 with the best quartile threshold rising back to above 90%.
- The median value of the CANDU plant comparison panel has continued to rise from 2007 to 2011, indicating that the stations in the lower quartiles are performing better.
- Pickering has performed below median over the review period.
- Pickering showed improvement from 2007 to 2009, but this trend was reversed in 2010. More recently, stronger performance has resulted in improved results for 2011.
- As the strongest OPG performer, Darlington achieved best quartile performance over most of the review period.

Factors Contributing to Performance

- The WANO NPI is a composite index reflecting the weighted sum of the scores of 10 separate performance measures. A maximum score of 100 is possible. All of the sub-indicators in this index are reviewed separately in this benchmarking report.

Pickering

- For 2011, Pickering achieved maximum scores for 5 out of 10 NPI sub-indicators.
- For each of the key safety system related metrics, High Pressure Injection, Auxiliary Feedwater, and Emergency Alternating Current (AC) power, the station received 10 of 10 points.
- Pickering also achieved perfect scores for Industrial Safety Accident Rate (5 of 5) and Fuel Reliability Index (10 of 10).
- Pickering earned 8.2 of 10 points for Reactor Trip Rate.
- Pickering achieved 2.9 of 5 points for Chemistry Performance and 4.9 of 10 points for Collective Radiation Exposure.
- Due to challenges with forced outages and forced extensions to planned outages, Pickering received 0.3 of 15 points for Unit Capability Factor and 4.9 of 15 points for Forced Loss Rate.
- Pickering's WANO NPI performance was impacted by the execution of a station Vacuum Building Outage in 2010 and longer planned outage durations needed to extend the life of the station in order to ensure a reliable supply of electricity during the refurbishment of the Darlington plant.

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Factors Contributing to Performance (Cont'd)

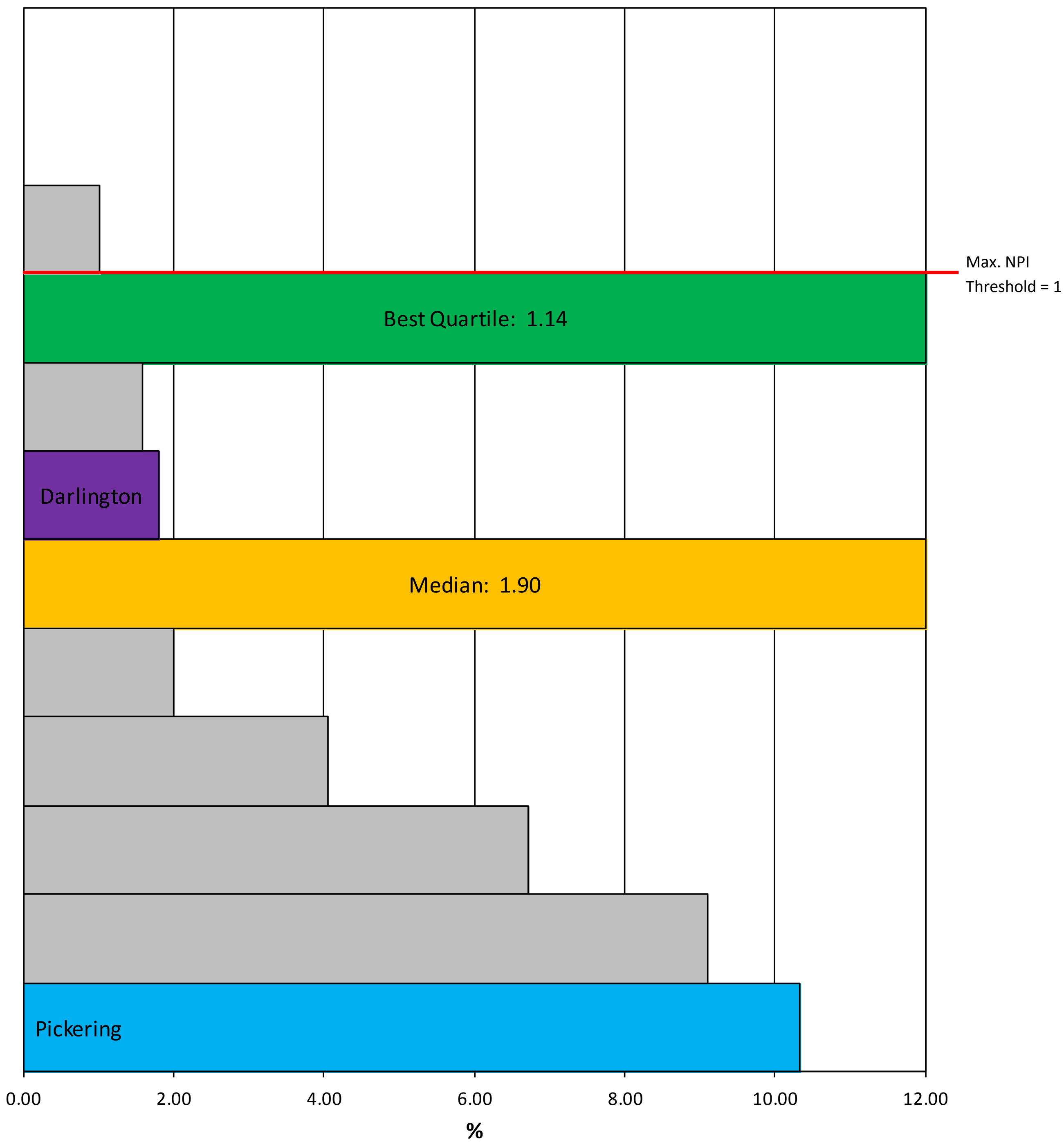
Darlington

- For 2011, Darlington achieved maximum scores for 6 out of 10 NPI sub-indicators.
- For each of the key safety system related metrics, High Pressure Injection, Auxiliary Feedwater, and Emergency Alternating Current (AC) power, Darlington received 10 of 10 points.
- Darlington also achieved perfect scores for Reactor Trip Rate (10 of 10), Collective Radiation Exposure (10 of 10) and Industrial Safety Accident Rate (5 of 5).
- Darlington earned 8.3 of 10 points for Fuel Reliability Index and 4.3 of 5 points for Chemistry Performance.
- Darlington achieved 12.0 out of 15 points for Unit Capability Factor, 13.2 out of 15 points for Forced Loss Rate due to the forced outages and forced extensions to planned outages. Darlington also continues to carry lower Unit Capability Factors in its rolling average from the execution of the station Vacuum Building Outage in 2009.

Please refer to Table 12 of the Appendix for an NPI plant level performance summary of OPG stations against the North American panel.

Rolling Average Forced Loss Rate

2011 Rolling Average Forced Loss Rate
CANDU Plant Level Benchmarking



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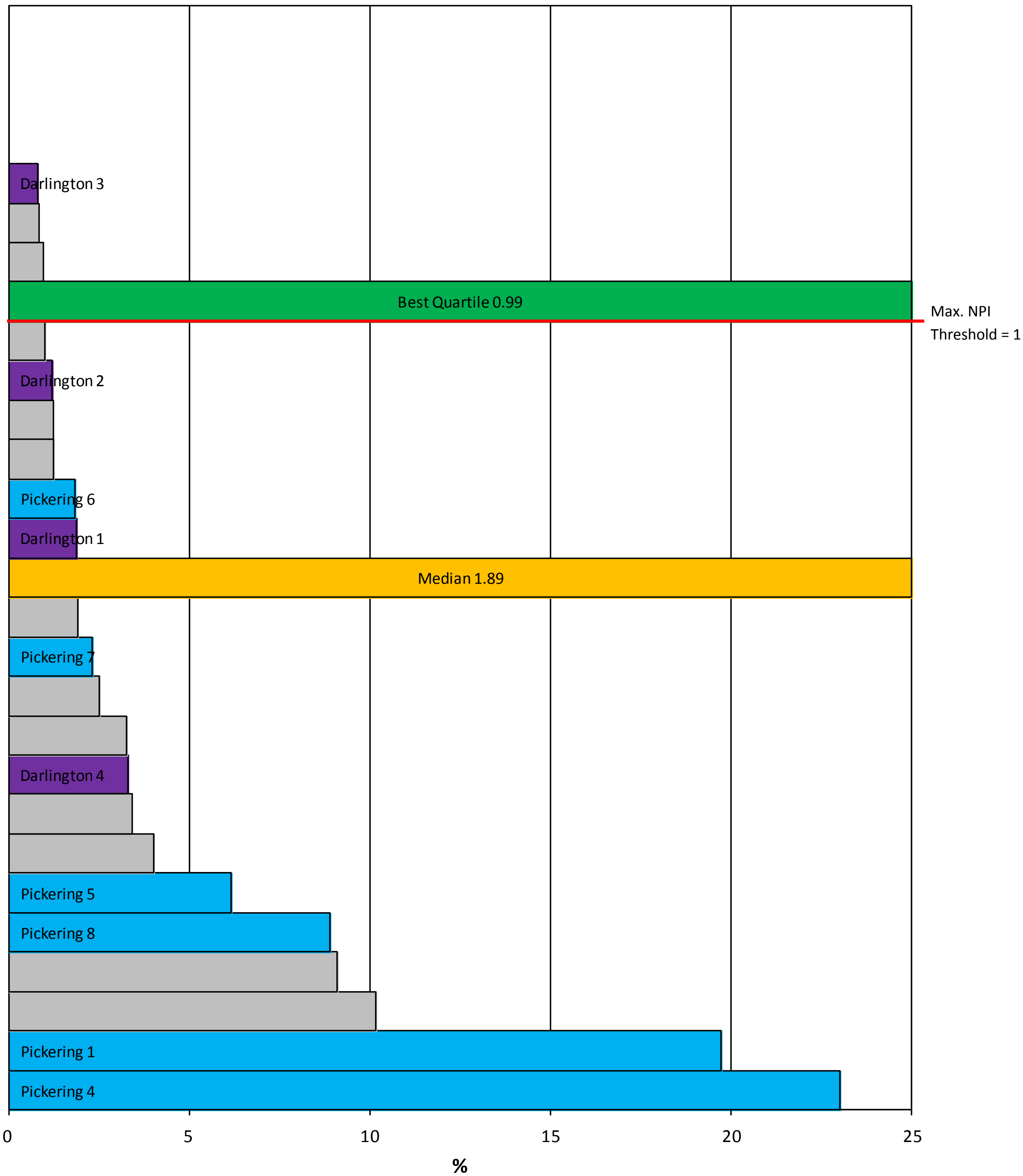
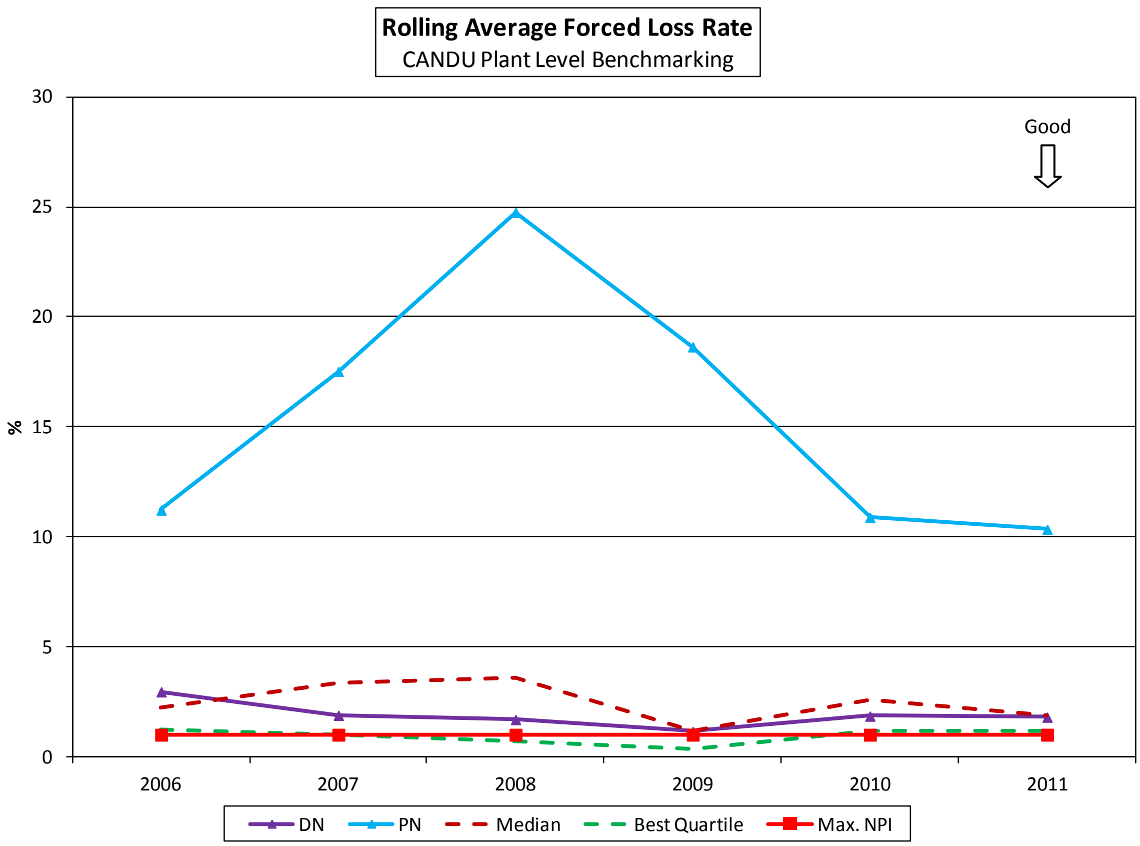
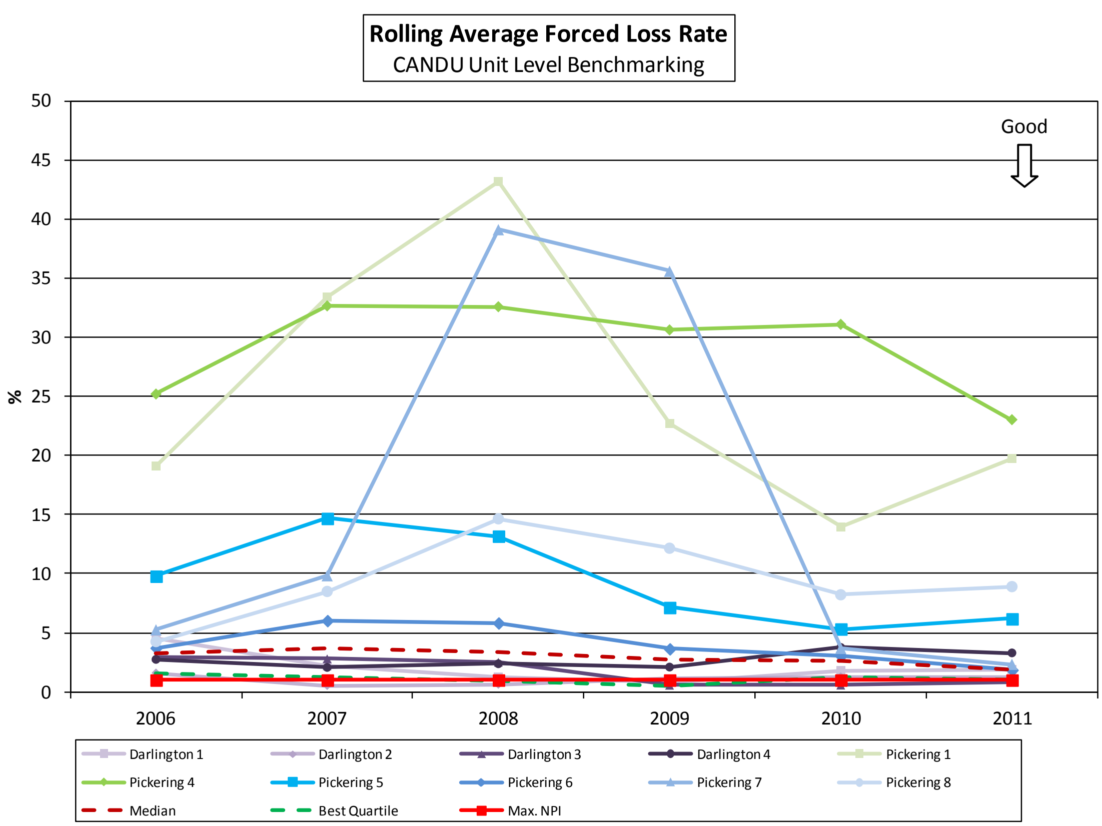
2011 Rolling Average Forced Loss Rate
CANDU Unit Level Benchmarking




Rolling Average Forced Loss Rate
CANDU Plant Level Benchmarking
Good
%
30
25
20
15
10
5
0
2006
2007
2008
2009
2010
2011
DN
PN
Median
Best Quartile
Max. NPI


Rolling Average Forced Loss Rate
CANDU Unit Level Benchmarking
Good
%
50
45
40
35
30
25
20
15
10
5
0
2006
2007
2008
2009
2010
2011
Darlington 1
Darlington 2
Darlington 3
Darlington 4
Pickering 1
Pickering 4
Pickering 5
Pickering 6
Pickering 7
Pickering 8
Median
Best Quartile
Max. NPI

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Observations – Rolling Average Forced Loss Rate (CANDU)

2011 (Rolling Average)

- Forced loss rate (FLR) best quartile performance for the CANDU panel was 1.14% at the plant level and 0.99% at the unit level. This represents a decrease of 0.04% at the plant level and 0.22% at the unit level over the rolling average FLR values reported for 2010.
- As a station, Darlington maintained its relative ranking in the CANDU panel by performing better than median but worse than best quartile.
- Darlington had one unit in the best quartile, two units better than median, and one unit below the median FLR threshold.
- The Darlington gap to best quartile was 0.66% against the CANDU panel in 2011.
- Pickering performance was worse than median at both the plant and unit level, with the exception of Unit 6, which performed better than median.
- The Pickering gap to best quartile was 9.2% against the CANDU panel in 2011.

Trend

- The industry best quartile and median improved slightly, during the review period, at both the unit and plant level.
- Darlington's overall performance improved from just worse than median performance at the start of the review period (2006) to between median and top quartile performance for the most recent time period (2011).
- Pickering station performance remains worse than median, but has improved from a high of 24.76% in 2008 to 10.34% in 2011.

Factors Contributing to Performance

- Top performing plants achieve low forced loss rates through effective implementation and integration of equipment reliability and human performance programs aligned with industry best practices.
- OPG Nuclear has established a structured cross-functional equipment reliability program based on top industry standards and supported by virtually every department in the organization. The implementation of the program involves focusing the workforce and processes on critical equipment across the fleet.
- OPG is currently working on reducing maintenance backlogs, optimizing the preventive maintenance program and obtaining spare parts for critical equipment.
- Darlington has established a fuel handling reliability project and developed new fuel bundles to prevent unit derating.
- Pickering has established short mid-cycle outages to complete critical maintenance activities to improve the reliability of the plant.

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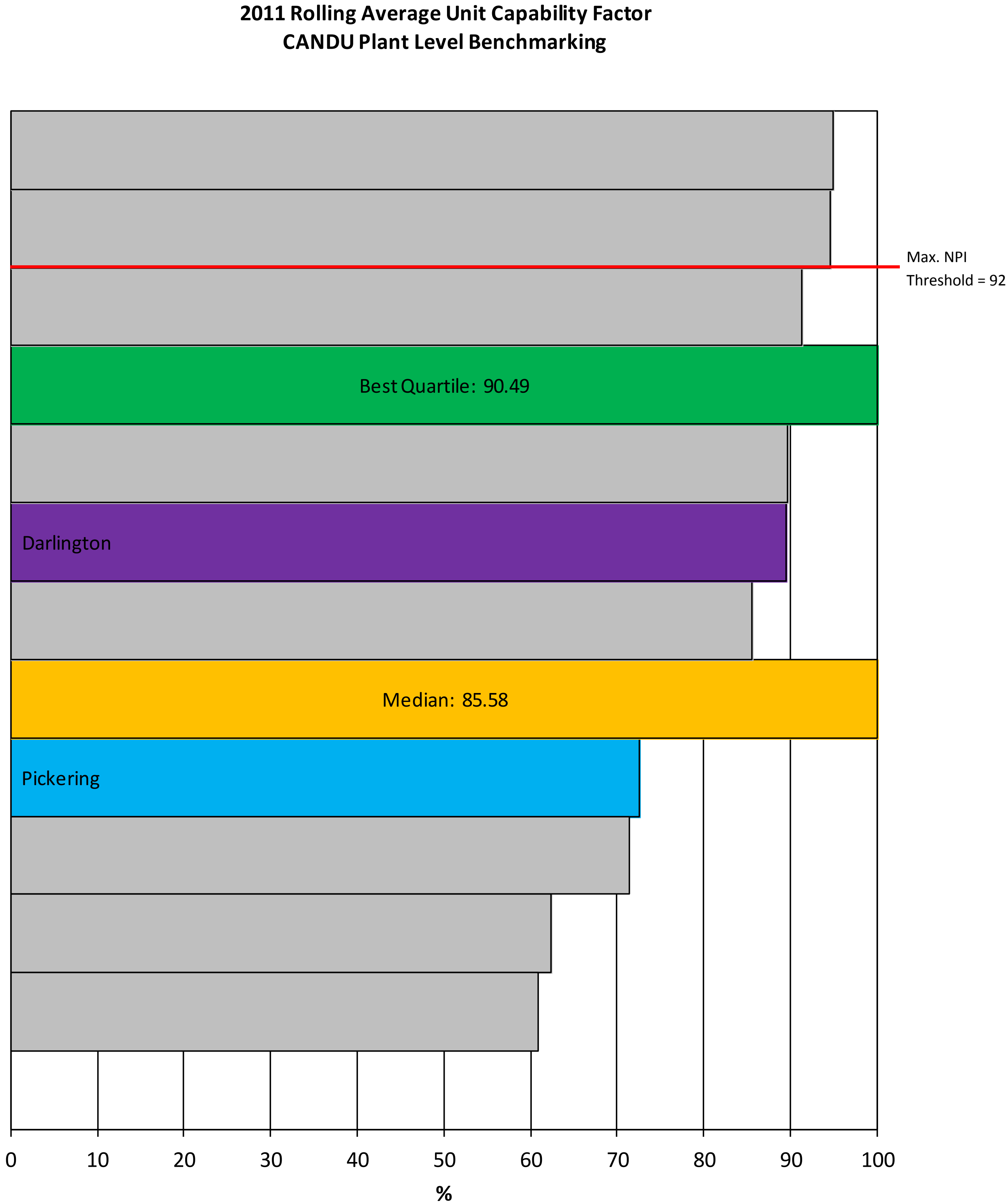
Rolling Average Unit Capability Factor



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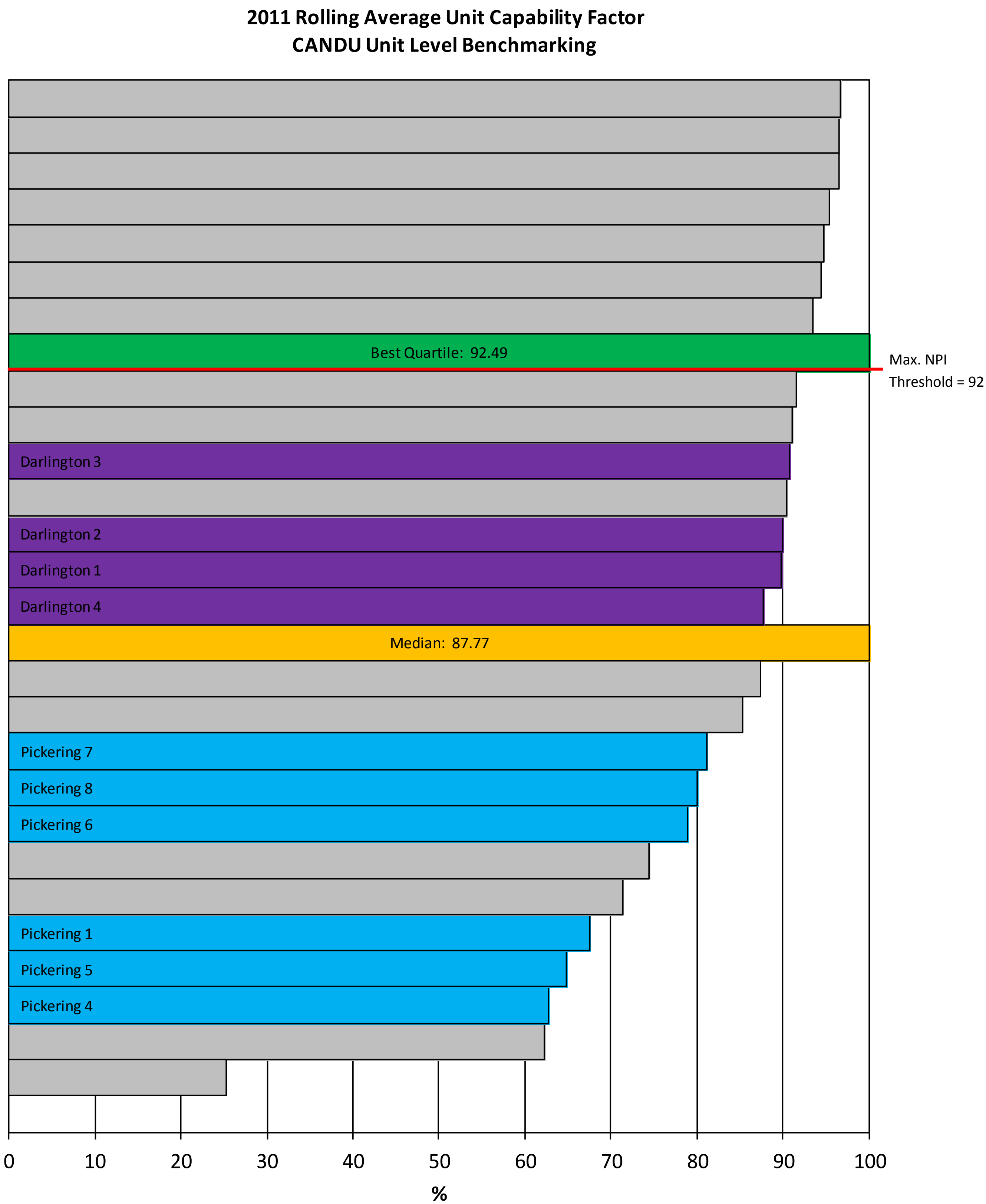
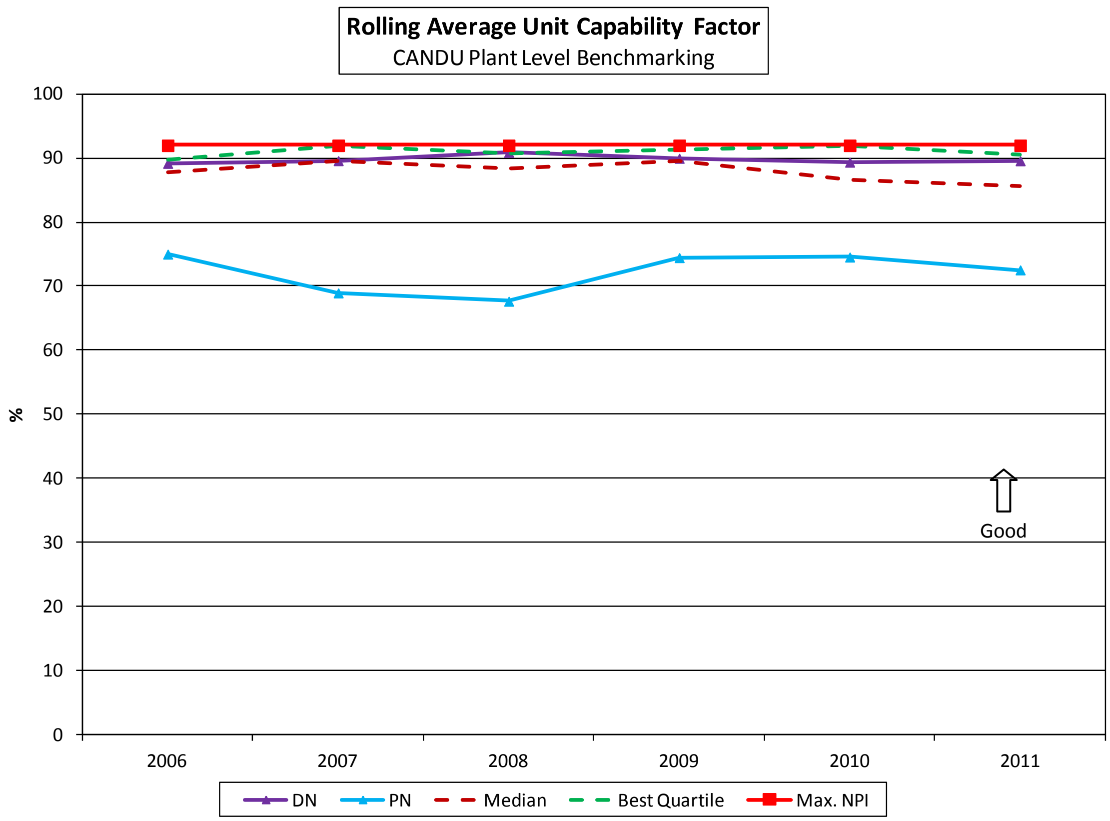
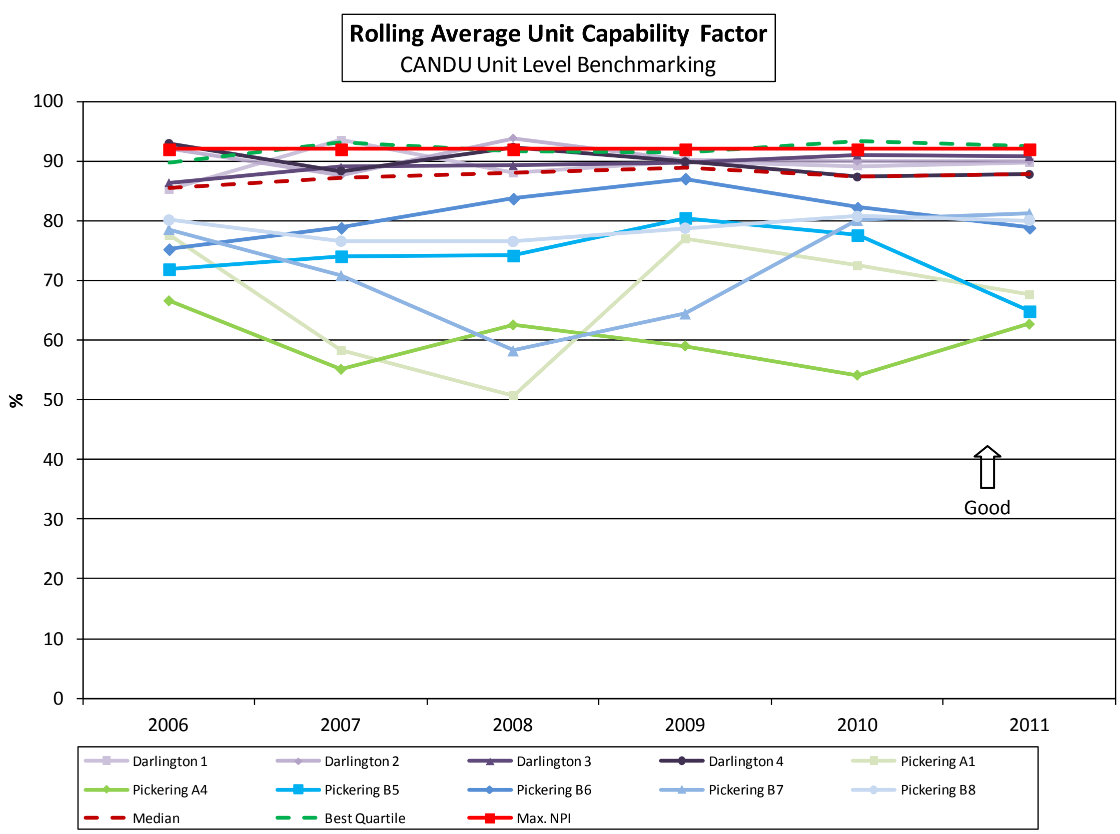



Rolling Average Unit Capability Factor
CANDU Plant Level Benchmarking
%
Good
2006
2007
2008
2009
2010
2011
DN
PN
Median
Best Quartile
Max. NPI


Rolling Average Unit Capability Factor
CANDU Unit Level Benchmarking
%
Good
2006
2007
2008
2009
2010
2011
Darlington 1
Darlington 2
Darlington 3
Darlington 4
Pickering A1
Pickering A4
Pickering B5
Pickering B6
Pickering B7
Pickering B8
Median
Best Quartile
Max. NPI

Observations – Rolling Average Unit Capability Factor (CANDU)

2011 (Rolling Average)

- Unit Capability Factor best quartile performance for the CANDU panel was 90.49% at the plant level and 92.49% at the unit level.
- Darlington performed below best quartile as a station with all units performing between median and best quartile at the unit level.
- Darlington's gap to best quartile performance in UCF was 0.91% for the rolling average period ending in 2011.
- Pickering performed below median at both the plant and unit level.
- Pickering's gap to best quartile performance in UCF was 17.95% for the rolling average period ending in 2011.

Trend

- Industry best quartile and median at the plant level has remained relatively flat over the review period, while there was a slight improvement at the unit level.
- Darlington's overall performance was better than median for the review period.
- Pickering station performance declined in 2007 and 2008 with no individual unit or plant average data points at median level for the review period. Although Pickering's UCF recovered significantly in 2009, that performance was not sustained in 2010 or 2011.

Factors Contributing to Performance

- Top performing plants achieve low forced loss rates through effective implementation and integration of equipment reliability and human performance programs aligned with industry best practices.
- OPG Nuclear has established a structured cross-functional equipment reliability program based on top industry standards and supported by virtually every department in the organization. The implementation of the program involves focusing the workforce and processes on critical equipment across the fleet.
- OPG is currently working on reducing maintenance backlogs, optimizing the preventive maintenance program and obtaining spare parts for critical equipment.
- Darlington has established a fuel handling reliability project and developed new fuel bundles to prevent unit derating.
- Pickering has established short mid-cycle outages to complete critical maintenance activities to improve the reliability of the plant.

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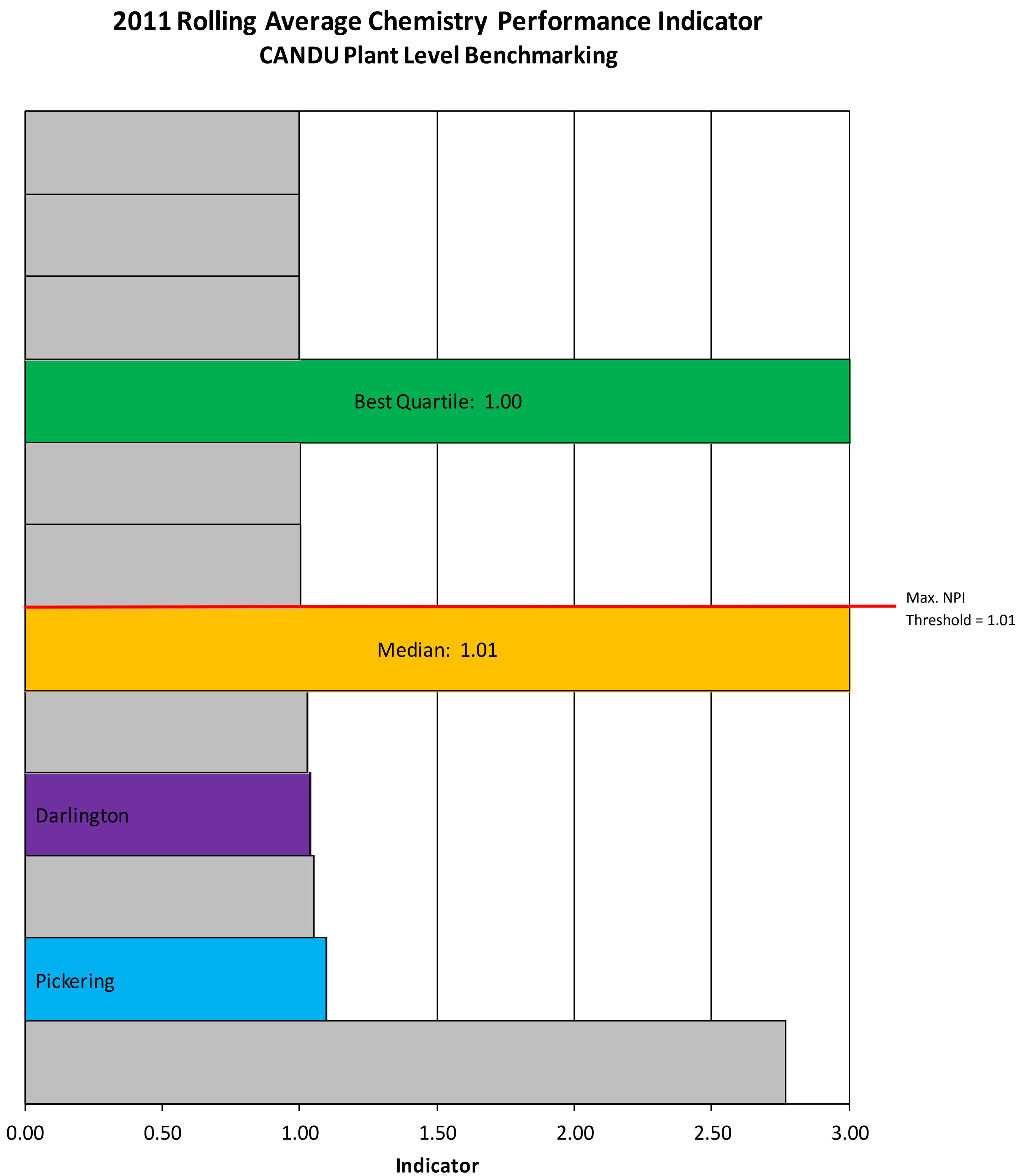
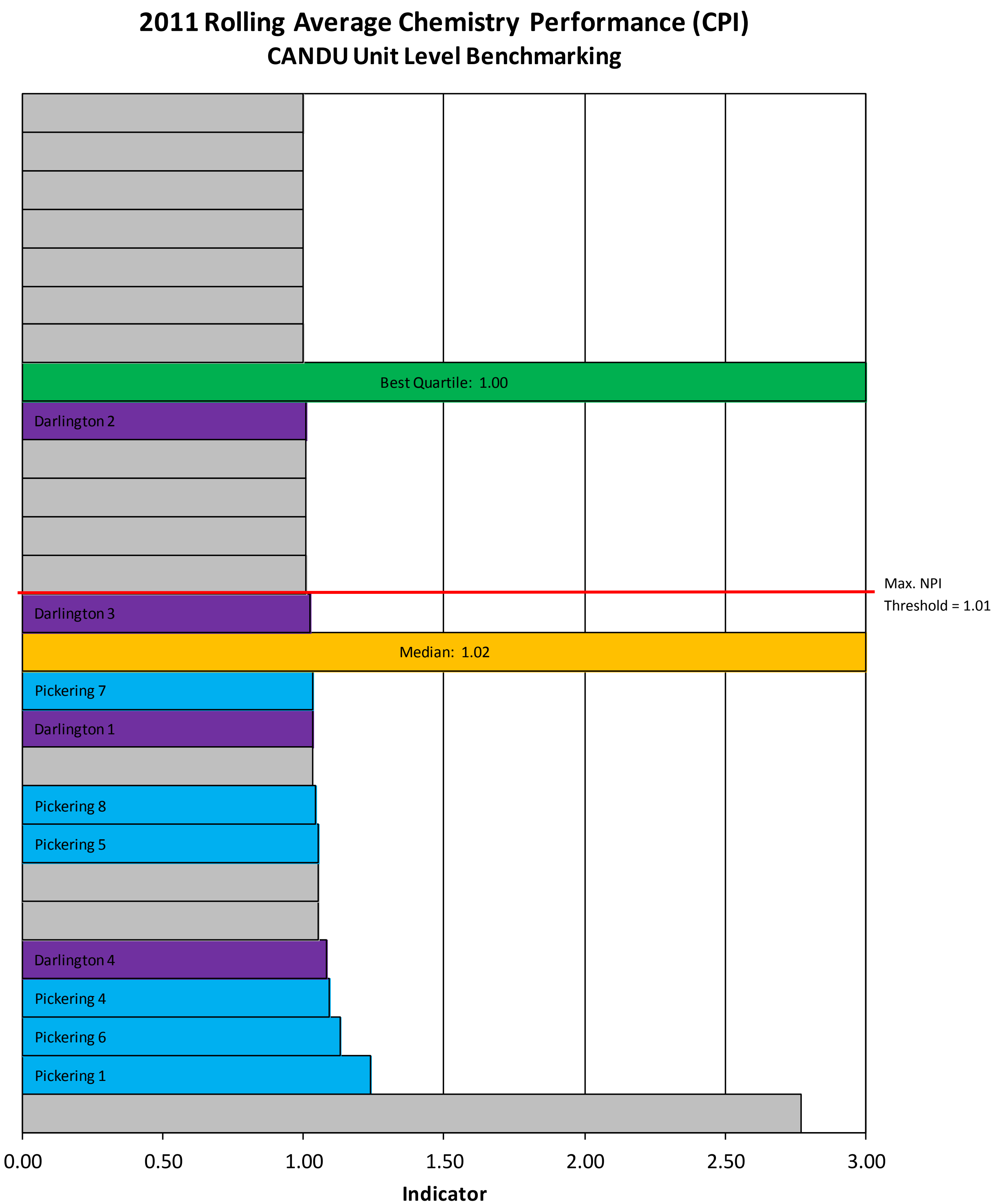
Rolling Average Chemistry Performance Indicator (CPI)




2011 Rolling Average Chemistry Performance (CPI)
CANDU Unit Level Benchmarking
Best Quartile: 1.00
Darlington 2
Max. NPI
Threshold = 1.01
Darlington 3
Median: 1.02
Pickering 7
Darlington 1
Pickering 8
Pickering 5
Darlington 4
Pickering 4
Pickering 6
Pickering 1
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Indicator

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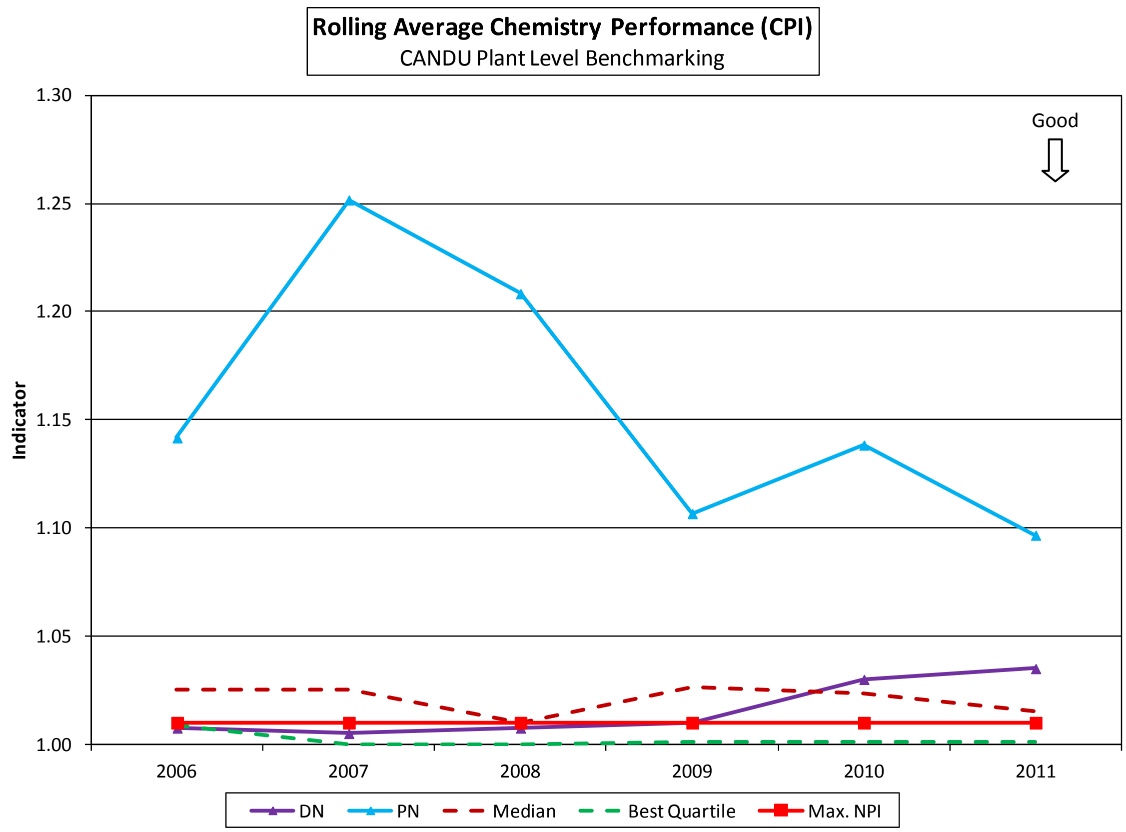

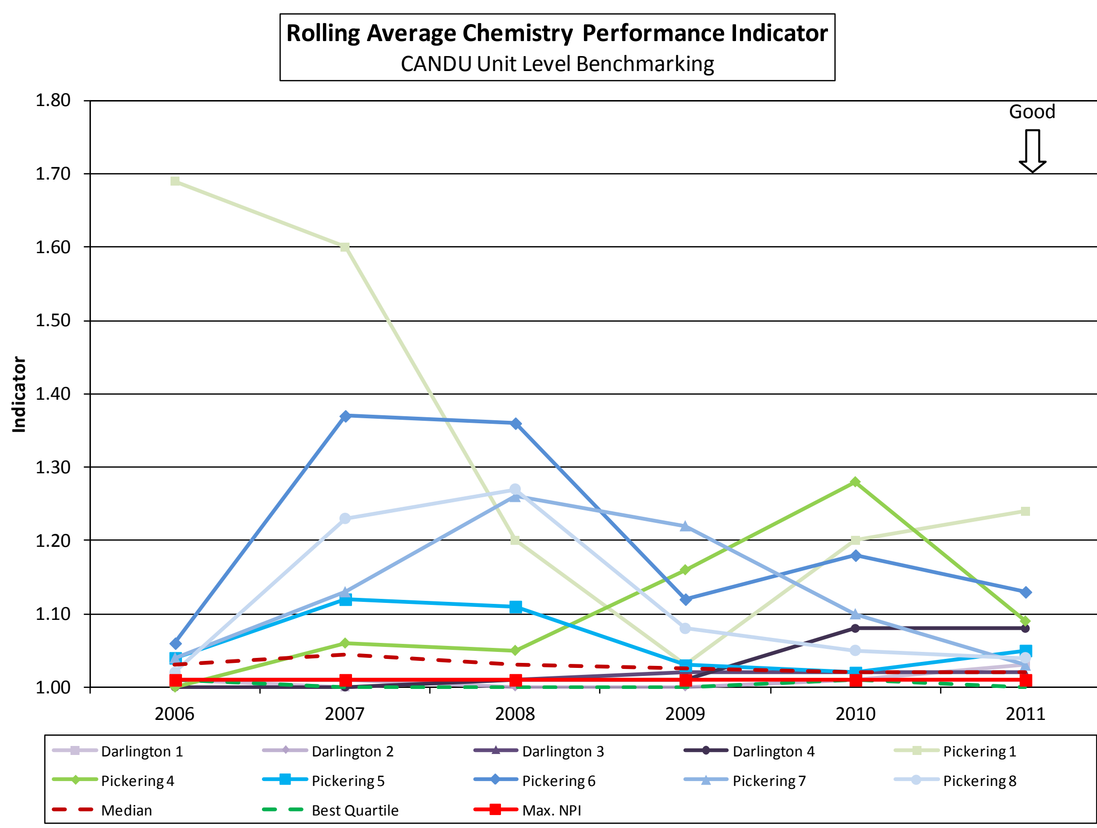

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Observations – Rolling Average Chemistry Performance Indicator (CANDU)

2011 (Rolling Average)

- The industry uses a two or three year rolling average (based on the site outage cycle) to define the chemistry performance indicator (CPI) values for a given year. The Darlington station follows a 3-year outage cycle and the Pickering station and other panel members are on a 2-year outage cycle.
- The CANDU plant and unit level medians are 1.01 and 1.02 respectively.
- The industry best quartile CPI of the CANDU panel was 1.00 at both the plant and unit level.
- Pickering plant and unit level performance were worse than the CANDU plant and unit level median CPIs of 1.01 and 1.02 respectively. Plant performance improved from 1.14 in 2010 to 1.10 in 2011. The performance of Units 1 and 5 declined from 2010 to 2011 while Pickering Units 4, 6, 7 and 8 showed year over year improvements during the same period. The CPI results were still impacted by the multiple unit start-ups immediately following the vacuum building outage (VBO) in 2010. Elevated boiler ion levels following the restart of Units 5 and 6 following planned outages, along with issues related to boiler blow downs, contributed to the elevated CPI.
- Darlington performed worse than median as a station with a CPI value of 1.03, which remained unchanged from 2010. One unit performed at the unit level median of 1.02, while another unit performed better than median and two units performed worse than median.

Trend

- Pickering's overall station performance continued to improve since 2006 but was severely impacted by the Water Treatment Plant resin excursion event in late 2006 which had an unfavourable impact on plant performance in 2007. Pickering results were also influenced by the post VBO start-ups in 2010. As a result, steady CPI improvements during the review period were temporarily reversed in 2007 (1.25) and 2010 (1.14) with overall performance trending in the right direction at the end of 2011.
- Since 2006, Darlington has shown consistent improvement in achieving the maximum WANO NPI points of five based on a CPI of 1.01 or below. Performance declined slightly in 2010 and 2011, with a plant CPI of 1.03 due to elevated feedwater iron transients following unit restarts and recovery from a unit transient.

Factors Contributing to Performance

- Best practices among top performing plants include the use of dispersants to reduce transport corrosion product build-up in steam generators, condenser inspection and, if necessary, cleaning to remove a source of corrosion product transport (i.e., the transport of iron and copper oxides during start-ups which contribute to an elevated CPI). These inspections/assessments have been performed at Pickering. Tasks are being added to maintenance activities related to Pickering condenser inspection to perform cleaning on all outages. Condenser inspection/clean-up is planned at Darlington. Darlington has a corrosion product transport reduction plan which includes start-up filtration, morpholine addition, dry lay-up and sampling improvements.

- Fleet-wide and station initiatives which helped the station and fleet improve performance include:
  - A morpholine injection trial at Darlington Unit 3 to reduce feedwater iron impacts on CPI.
  - Review of chemistry performance at morning plant meetings including administrative (pre-action) level violations.
  - Review of outage practices to reduce impacts of start-ups.
  - Participation in the CANDU Owners Group chemistry benchmarking project which concluded in 2011.

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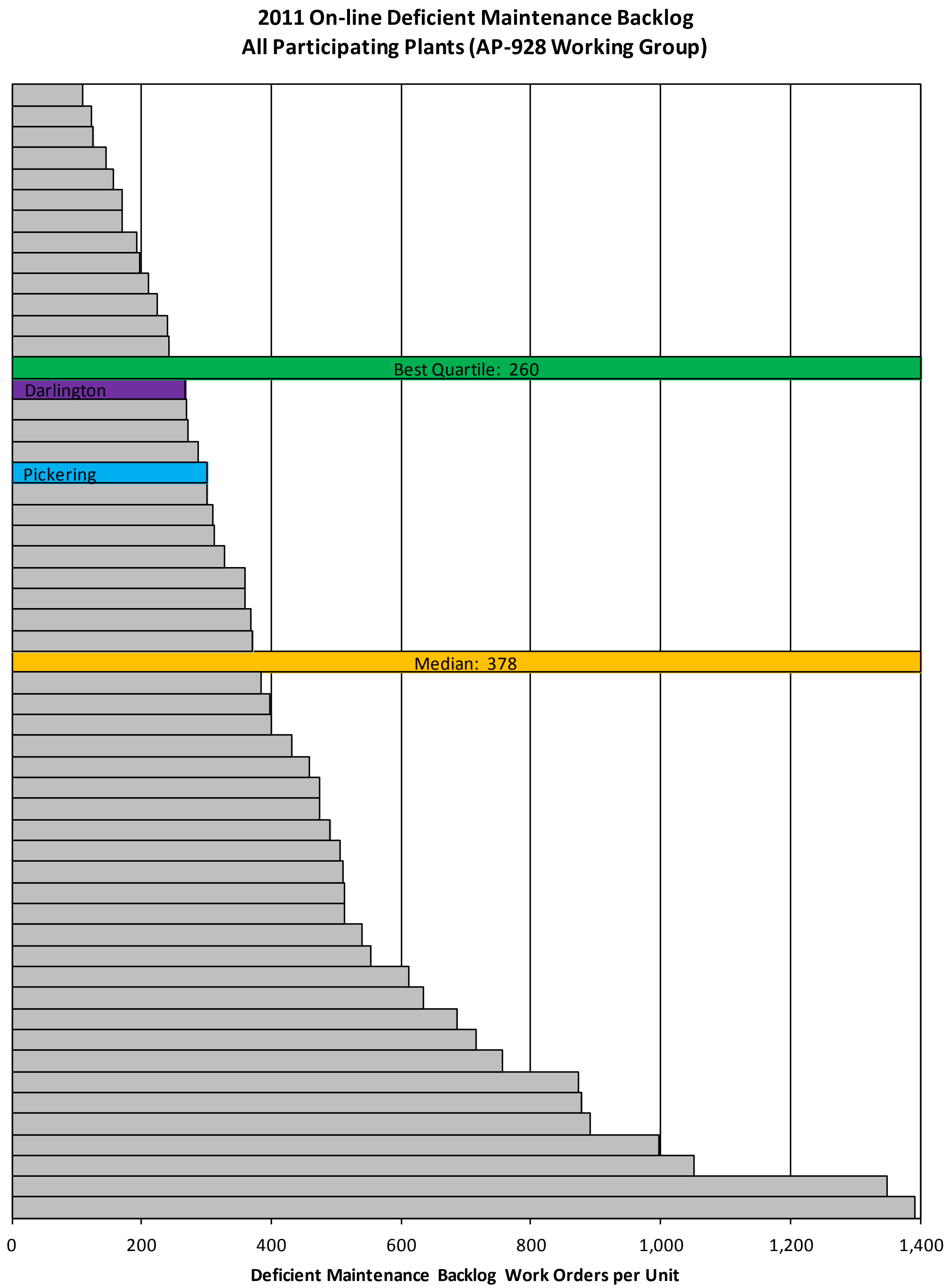
1-Year On-line Deficient Maintenance Backlog



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Observations – On-line Deficient Maintenance Backlog

2011

- The data in this panel is gathered by an independent industry peer group, the INPO AP-928 group. The last backlog benchmark was as of September 30, 2011 and this analysis utilizes that data.
- Industry backlog benchmark standards changed with Revision 3 of AP-928 Work Management Practices at INPO in June 2010. All OPG sites converted to the new standard on January 24, 2011. This review reflects the new standard.
- Using the new standard, the industry best quartile and median thresholds were 260 and 378 respectively for the panel.
- Both Pickering and Darlington stations are currently performing better than median.

Trend

- As described in the previous section, the 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. The new standard created an alignment between engineering criticality coding and backlog classification that allows improved focus on the more critical outstanding work. The new standard also sets a more consistent foundation for classification of backlogs such that comparisons between utilities will be more meaningful. Due to this recent development, a historical performance trend analysis may not be provided at this time.

Factors Contributing to Performance

- Key performance drivers for deficient and corrective backlog include:
  - Aging equipment and associated reliability
  - Getting work ready in a timely fashion and parts availability

Pickering

- Pickering is currently at 301 work orders per unit. A reduction of approximately 14% is required to achieve industry top quartile.
- A recovery plan is in place to reduce backlog levels to align with industry best quartile.

Darlington

- Darlington sits closest to best quartile at 266 work orders per unit. A 2% reduction in backlogs is required to bridge the gap to industry best quartile.
- With the introduction of the new AP-928 backlog classification, the work control group at Darlington has implemented a number of initiatives to prioritize and schedule the outstanding work.

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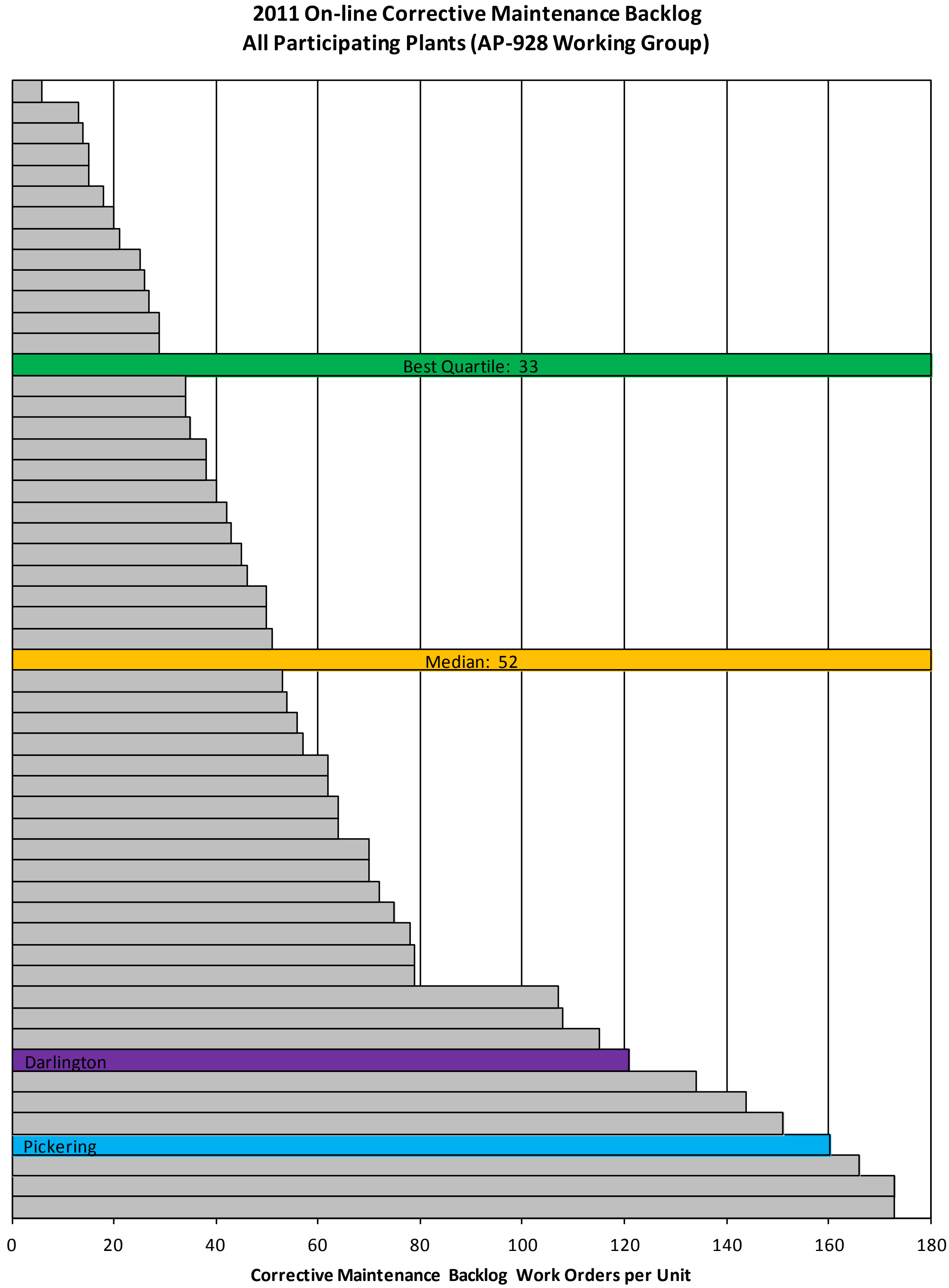
1-Year On-line Corrective Maintenance Backlog



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Attachment 1

Observations – On-line Corrective Maintenance Backlog

2011

- The data in this panel is gathered by an independent industry peer group, the INPO AP-928 group. The last backlog benchmark was as of September 30, 2011 and this analysis utilizes that data.
- Industry backlog benchmark standards changed with revision 3 of AP-928 Work Management Practices at INPO in June 2010. All OPG sites converted to the new standard on January 24, 2011. This review reflects the new standard.
- Using the new standard, the industry best quartile and median thresholds were 33 and 52 respectively for the panel.
- Both Pickering and Darlington stations are currently performing below the median.

Trend

- As described in the previous section, the 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. The new standard created an alignment between engineering criticality coding and backlog classification that allows improved focus on the more critical outstanding work. The new standard also sets a more consistent foundation for classification of backlogs such that comparisons between utilities will be more meaningful. Due to this recent development, a historical performance trend analysis may not be provided at this time.

Factors Contributing to Performance

- Key performance drivers for both corrective and deficient backlog include:
    - Aging equipment and associated reliability
    - Getting work ready in a timely fashion and parts availability

Pickering

- Pickering is currently at 160 work order per unit. A reduction of approximately 68% is required to attain median performance using the new benchmark standard.
- Pickering has implemented a number of initiatives to improve performance, including:
    - Using an on-line holds resolution team to support on-line schedule and holds removal
    - Having the Work Control Peer Team create a process for risk review of the oldest work orders to validate consequences

Darlington

- A reduction of approximately 57% is required to attain median performance using the new benchmark standard.
- To improve station performance, the Darlington Work Control department has implemented a number of initiatives to prioritize and schedule the outstanding work.

4.0 VALUE FOR MONEY

Methodology and Sources of Data

Cost indicators were retrieved from the Electric Utility Cost Group (EUCG) website. Data was collected for three-year rolling averages for all financial metrics covering the review period from 2007-2011. Zero values for cost indicators are excluded from all calculations. All data pulled from the EUCG website by OPG is automatically converted by EUCG to Canadian dollars. Therefore, all values included within this benchmarking report are in Canadian dollars.

Effective January 2009 (but applied retroactively to EUCG historical data), EUCG automatically applies a purchasing power parity (PPP) factor to adjust all values across national borders. The primary function of the PPP value is to adjust for currency exchange rate fluctuations but it will also take into account additional cross-border factors which may impact purchasing power of companies in different jurisdictions. As a result, cost variations between plants is limited, as much as possible, to real differences and not advantages of utilizing one currency over another.

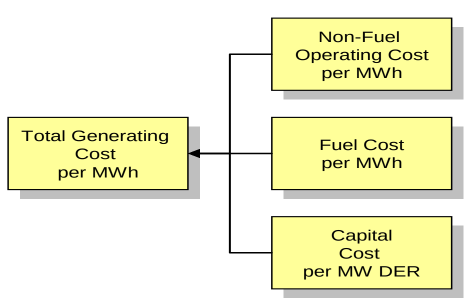
The benchmarking panel utilized for value for money metrics is made up of all North American plants reporting to EUCG. Within that panel, there is only one other CANDU technology plant reporting, Bruce Power. The remaining plants are Boiling Water Reactors or Pressurized Water Reactors. For that reason, some of the gaps in performance are likely associated with technology differences rather than comparable performance. However, some of a plant's performance is not directly tied to technology differences and can be compared across technologies, allowing this panel to be used for benchmarking purposes.

All metrics include cost information normalized by some factor (MWh or MW DER) to allow for more accurate comparison across plants of different sizes and numbers of units.

Discussion

Four "value for money" metrics are benchmarked in this report. They are total generating cost per MWh, non-fuel operating cost per MWh, fuel cost per MWh and capital cost per MW DER. The metrics themselves 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's nuclear generating stations and most North American plants with respect to both fuel costs and capital costs, the best overall financial comparison metric for OPG facilities is the total generating cost per MWh.

Diagram of Summary Relationship of Value for Money Metrics



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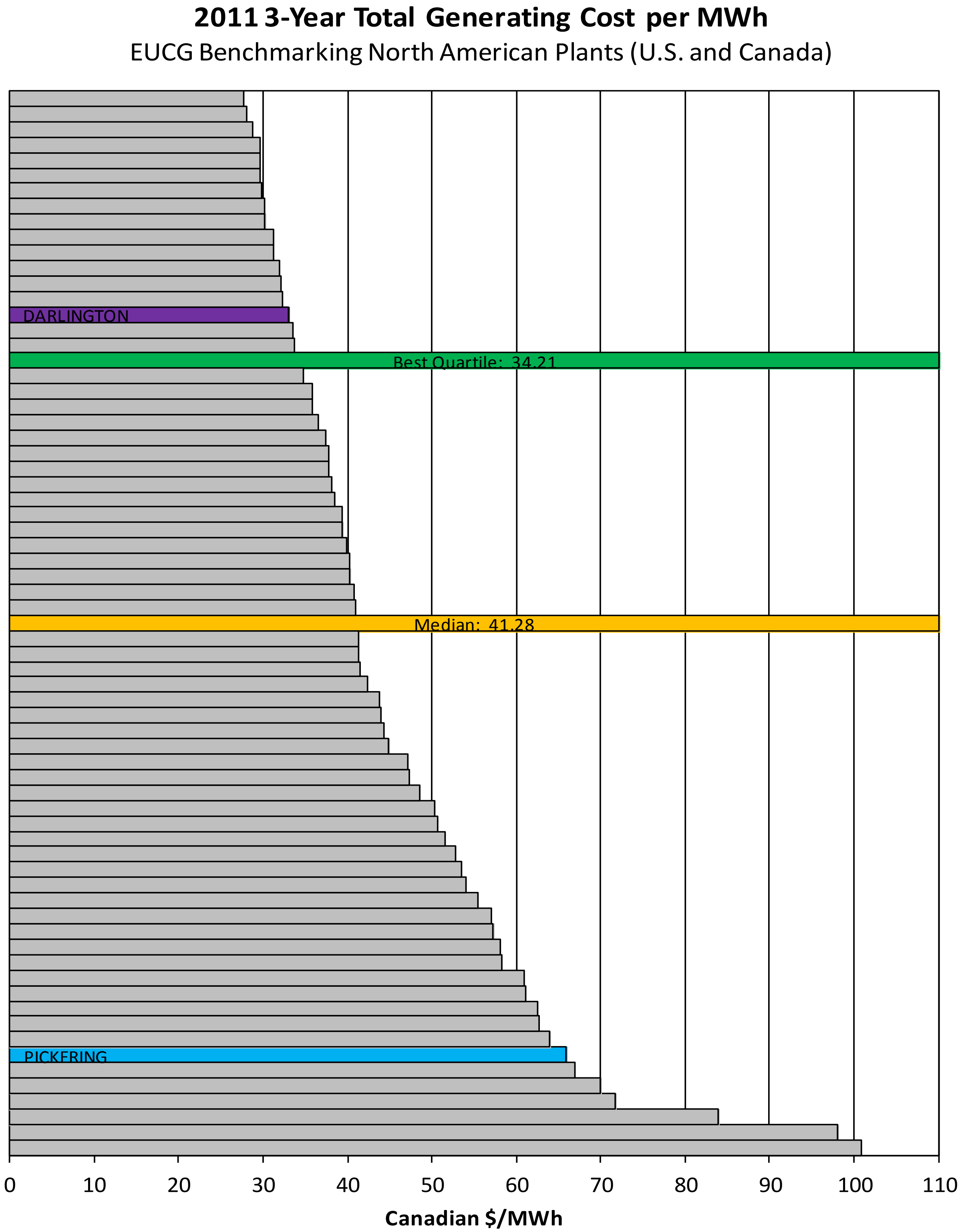
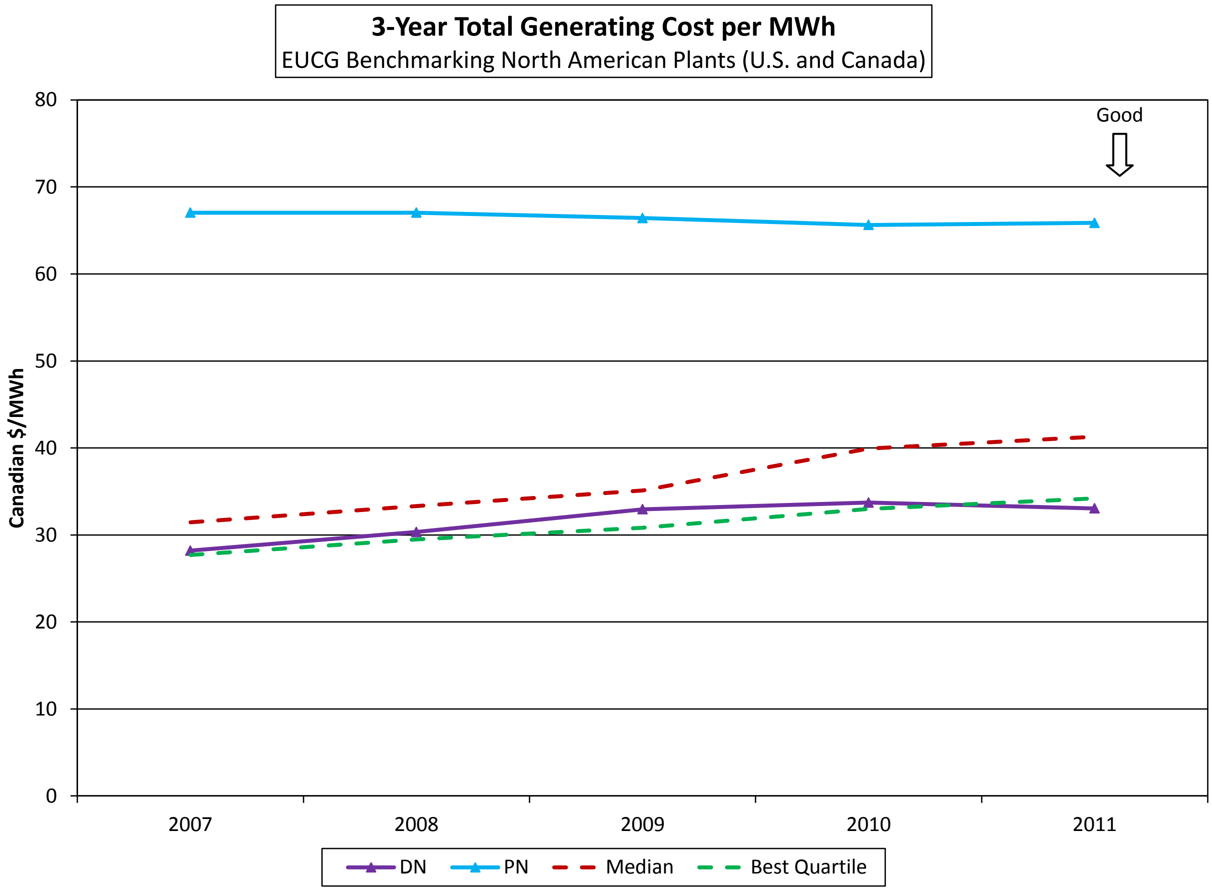
3-Year Total Generating Cost per MWh




3-Year Total Generating Cost per MWh
EUCG Benchmarking North American Plants (U.S. and Canada)
Canadian $/MWh
80
70
60
50
40
30
20
10
0
Good
2007
2008
2009
2010
2011
DN
PN
Median
Best Quartile

Observations – 3-Year Total Generating Cost per MWh (All North American Plants)

2011 (3-Year Rolling Average)

- The best quartile level for total generating cost per MWh (TGC/MWh) among North American EUCG participants was $34.21/MWh while the median level was $41.28/MWh.
- Darlington was the only CANDU plant in the panel to achieve a total generating cost per MWh in the best quartile ($33.05/MWh).
- Pickering had a TGC/MWh of $65.86/MWh, worse than the median of $41.28/MWh.

Trend

- Both best quartile and median total generating costs per MWh have increased over the 2007 to 2011 period. The industry best quartile cost rose by $6.50/MWh while the median cost rose by $9.82/MWh over the review period.
- 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/MWh 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.
- 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.

Factors Contributing to Performance

- Total generating cost per MWh is the sum of non-fuel operating cost per MWh, fuel cost per MWh and capital cost per MWh. The benchmark metric is capital cost per MW DER. To include capital cost impact in total generating cost, station capital costs are divided by net MWh produced – same as for fuel and non-fuel operating costs.
- For technological reasons, fuel cost per MWh is an advantage for all CANDUs and the OPG plants performed within the best quartile.
- Non-fuel operating cost per MWh, for all OPG plants, yielded results that are worse than median for the most recent data point compared to the North American EUCG panel.

Pickering

- Fuel cost per MWh and capital cost per MW DER were within the best quartile for Pickering while non-fuel operating cost per MWh performance was worse than the industry median.
- The overall largest driver of cost per MWh for Pickering during the review period is capability factor.
- Station size also negatively impacted cost per MWh for Pickering (primarily driven by relatively small units).
- The remaining large drivers of cost performance at Pickering include CANDU technology, corporate cost allocations, potential controllable costs and a Vacuum Building Outage during the review period.

Darlington

- As stated above, Darlington achieved performance within the industry best quartile in 2011 for fuel cost per MWh, capital cost per MW DER and total generating cost 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 and potential controllable costs.
- Due to strong electricity generation performance at Darlington, the capability factor had a positive impact on its total generating cost per MWh.
- Station size provides an overall advantage for Darlington (due to 4 relatively large units).

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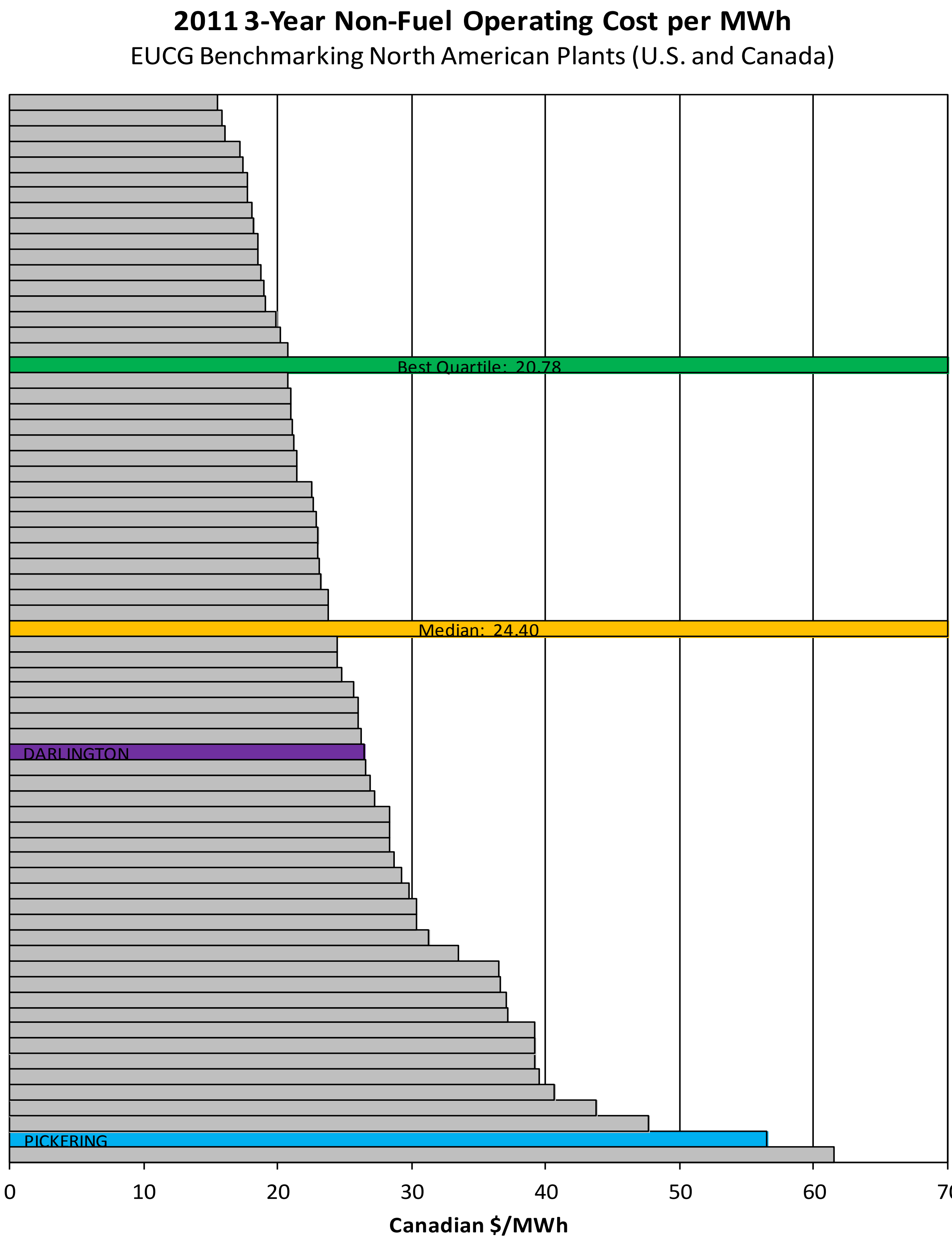
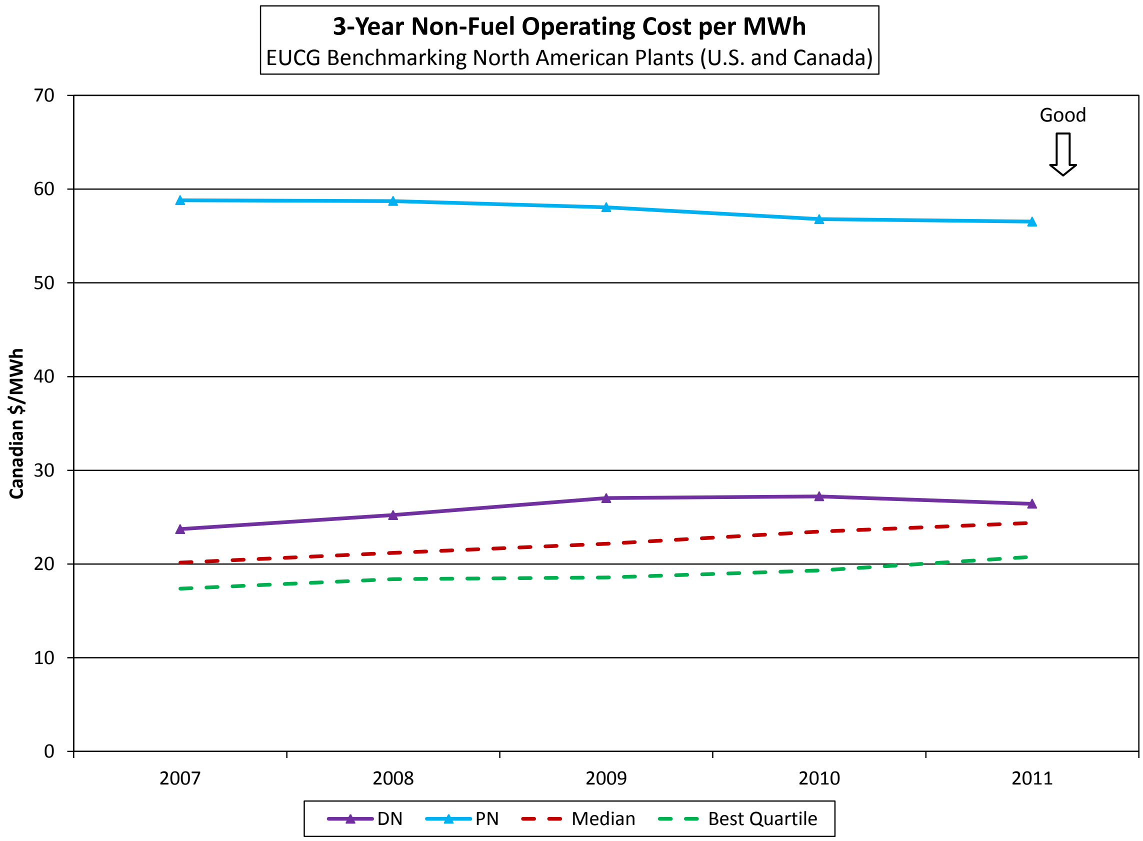
3-Year Non-Fuel Operating Cost per MWh





Observations – 3-Year Non-Fuel Operating Cost per MWh (All North American Plants)

2011 (3-Year Rolling Average)

- Best quartile plants had non-fuel operating costs equal to or better than \$20.78/MWh and median plants matched or bettered the \$24.40/MWh threshold.
- Compared to North American EUCG plants, the non-fuel operating costs per MWh (NFOC/MWh) of all participating Canadian CANDU plants were far worse than median performance.
- Darlington's cost, at \$26.42/MWh, was \$5.64/MWh higher than best quartile and \$2.02/MWh higher than the industry median at the end of 2011.
- Pickering's cost, at \$56.54/MWh, was \$35.76/MWh higher than best quartile and \$32.14/ MWh higher than the industry median.

Trend

- Both best quartile and median levels increased over the review period with annual percentage increases between 1% and 8% thus lowering the bar.
- 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 that of the industry for 2010 and in fact decreased in 2011. The decrease in 2011 is mostly due to lower corporate allocations.
- Pickering's non-fuel operating cost 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.

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Factors Contributing to 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 (results are discussed under the Reliability section of the report for the Rolling Average Unit Capability Factor metric).
  - 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.
  - 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).

- The major contributing factors to Pickering and Darlington performance for non-fuel operating cost per MWh were reviewed in the total generating cost per MWh section of the report.
- In order to continue to control costs while its generation portfolio is shrinking, OPG proactively initiated, in 2011, a corporate-wide Business Transformation initiative aimed at reducing labour costs and implementing a range of other efficiencies within its corporate and support functions (i.e., excluding operations and maintenance). Capitalizing on demographics to cost effectively manage the transition, several business transformation initiatives have been identified to deliver direct productivity savings and sustain them through cultural change.

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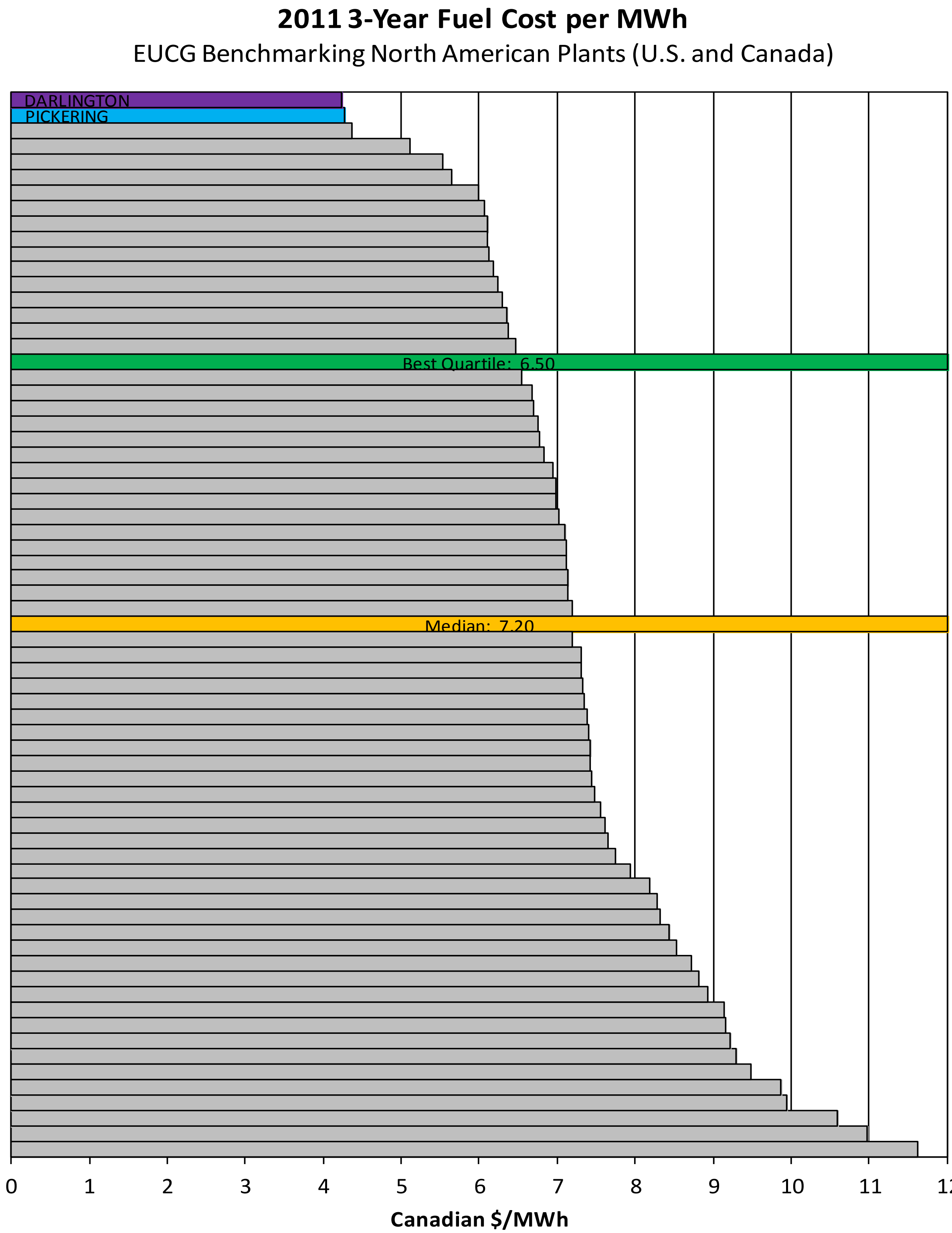
3-Year Fuel Cost per MWh



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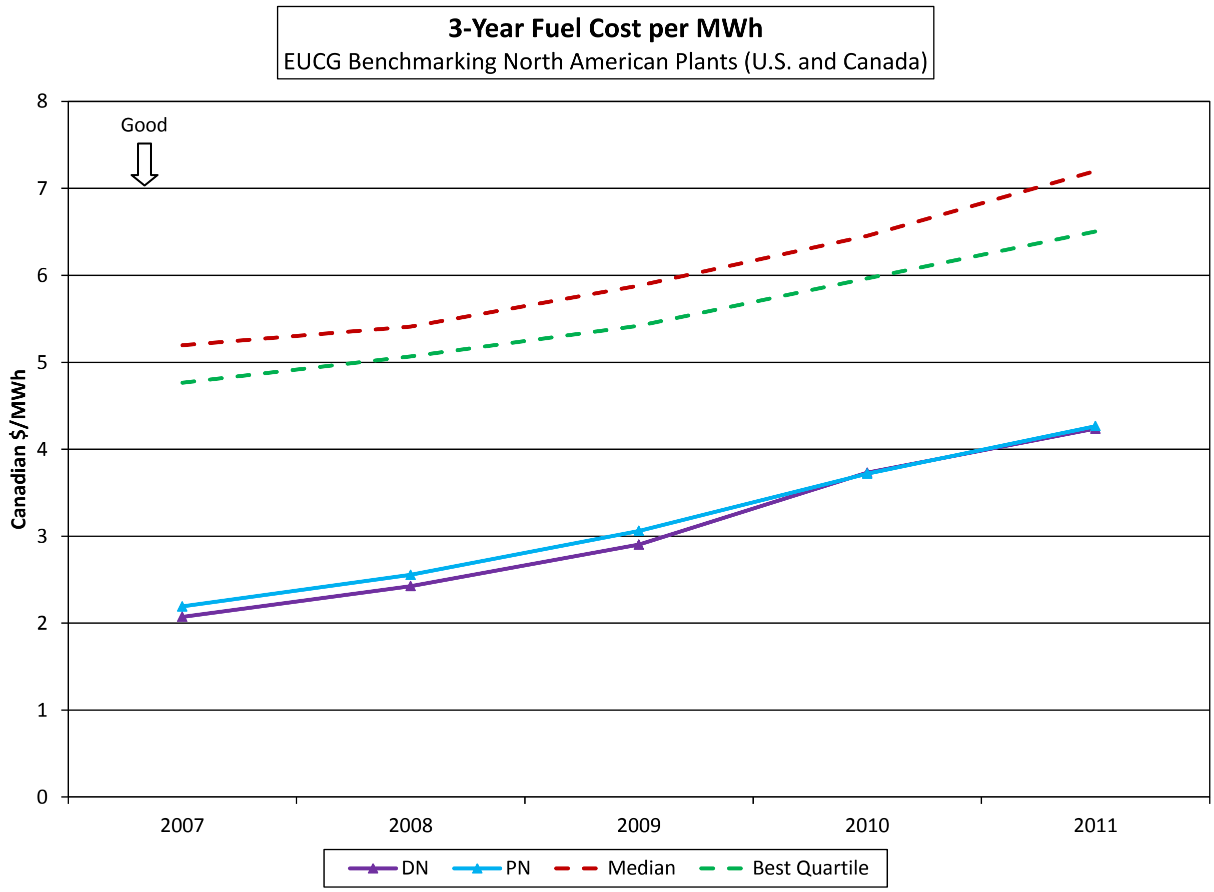

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Observations – 3-Year Fuel Cost per MWh (All North American Plants)

2011 (3-Year Rolling Average)

- The fuel cost per MWh of Canadian CANDU plants was $2.14/MWh to $2.26/MWh better than the best quartile threshold for the panel of North American EUCG plants.
- The three CANDU plants in the peer panel ranked as the three lowest fuel cost plants in the North American panel with Darlington being the lowest cost, followed by Pickering and then Bruce.

Trend

- The industry best quartile 3-year fuel cost per MWh has been rising since 2007 with the biggest increase shown in 2010.
- Since 2007, the fuel cost per MWh of all OPG plants increased with the biggest growth in 2010. The key drivers impacting not only OPG's unit fuel costs, but also the median and best quartile fuel costs are:
  - The impact of uranium market price increases
  - Escalation, generally at the rate of inflation, of conversion, enrichment and fuel manufacturing services costs
- To address the rising fuel costs, OPG is:
  - Reviewing the proportion of spot market priced quantities to take advantage of the current price differential between the sport market price and the long term contract price
  - Commissioning an external review of OPG's uranium procurement program to identify any areas for improvement
- Fuel costs per MWh, at the two OPG plants, have been converging and are currently essentially the same.

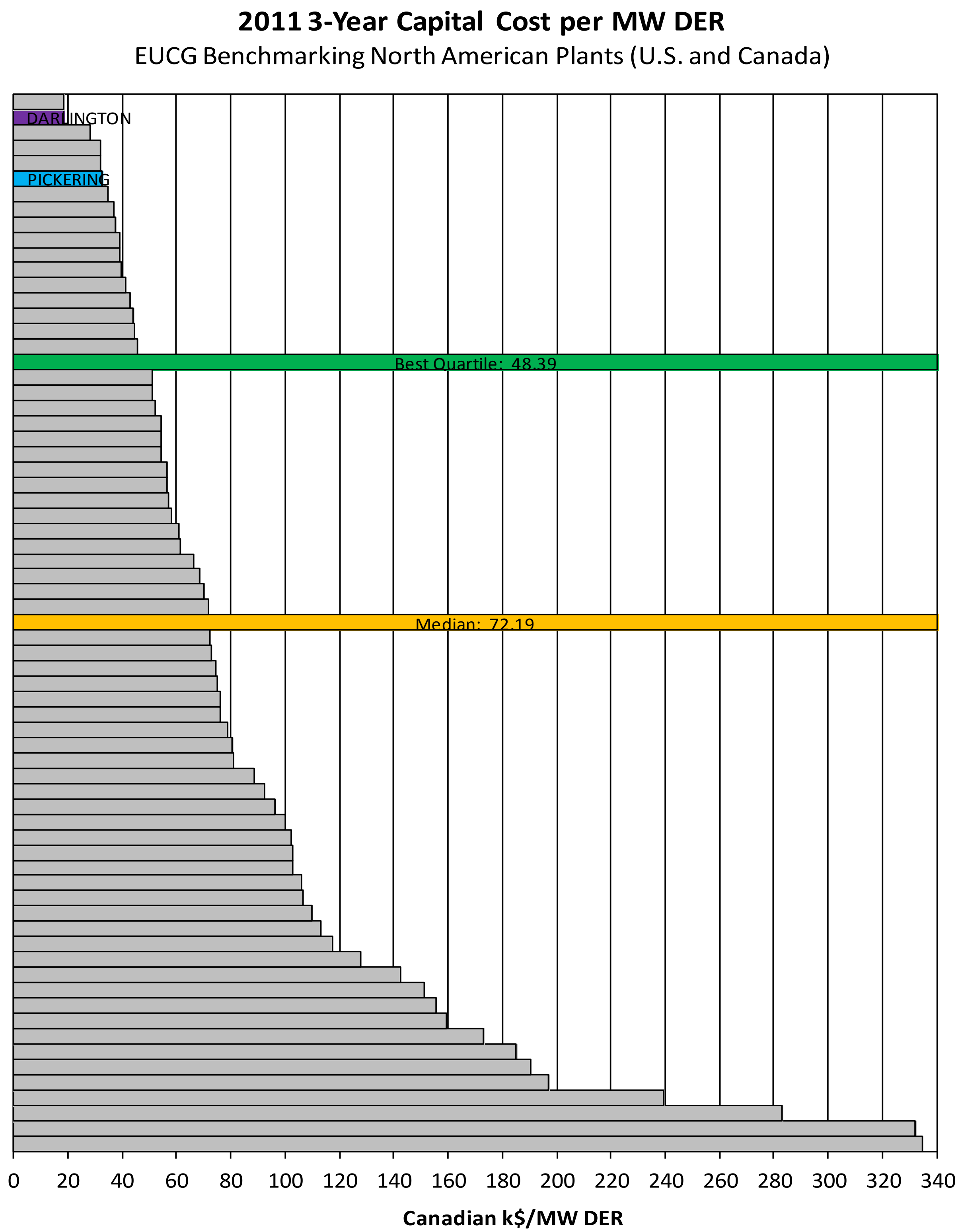
Factors Contributing to Performance

- Fuel cost, primarily driven by the technological differences in CANDU technology, are lower for OPG than for most North American BWR/PWR reactors. CANDU reactors do not require enriched uranium like BWRs and PWRs and, as a result, experience lower fuel costs.

The industry best quartile fuel cost performance noted above is due to three significant factors:

- <u>Uranium fuel costs</u>: Raw uranium is processed directly into uranium dioxide to make fuel pellets, without the cost and process complexity of enriching the fuel as required in light water reactors. The advantage due to fuel costs also includes transportation, handling and shipping costs.
- <u>Reactor core efficiency</u>: CANDU is the most efficient of all reactors in using uranium, requiring about 15% less uranium than a pressurized water reactor for each megawatt of electricity produced.
- <u>Fuel assembly manufacturing costs</u>: Manufacturing costs for light water reactor fuel assemblies are significantly higher than CANDU fuel bundles, due to physical design complexity and increased amount of materials.

3-Year Capital Cost per MW DER



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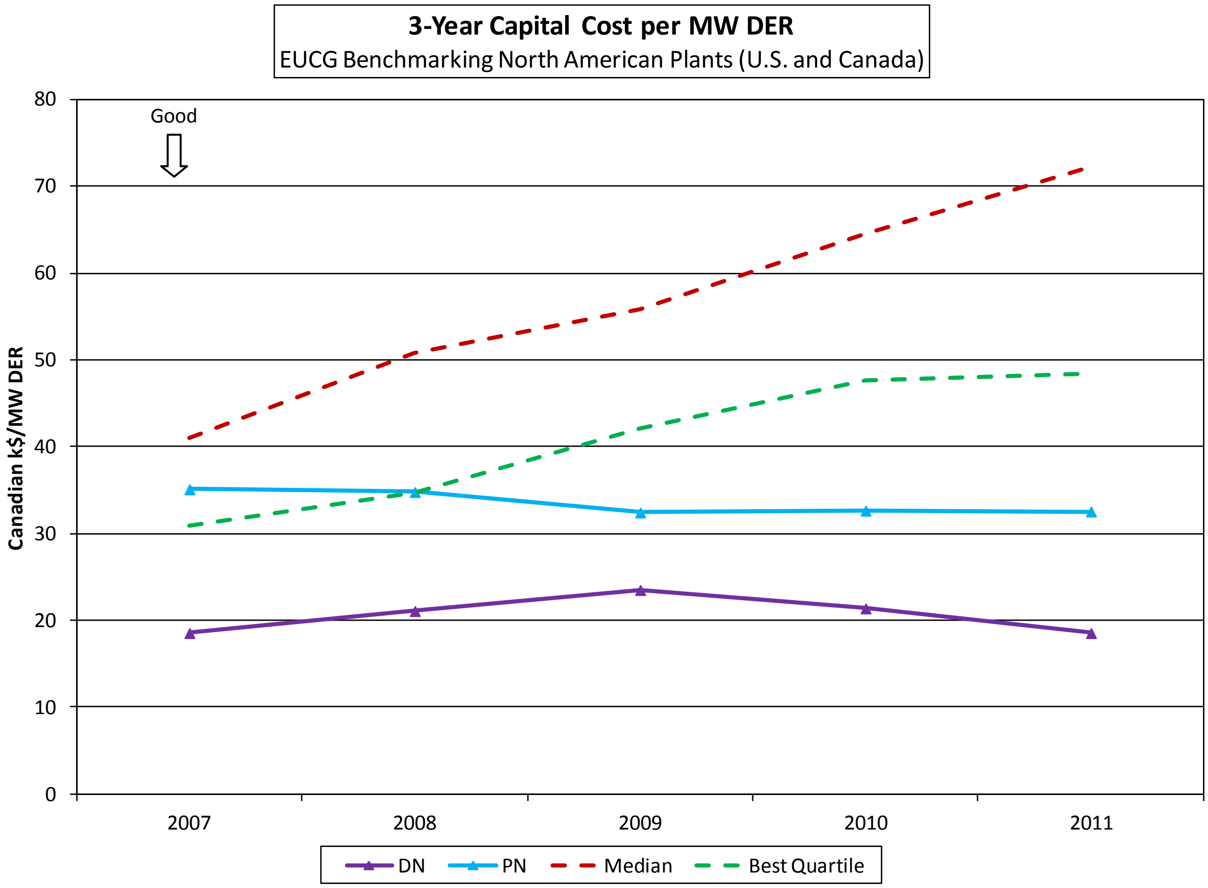

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Observations – 3-Year Capital Cost per MW DER (All North American)

2011 (3-Year Rolling Average)

- The best quartile threshold for capital costs per MW DER across the North American EUCG industry peer panel plants was $48.39/MW DER.
- Median cost for the panel was $72.19/MW DER.
- Both Pickering and Darlington had lower capital costs/MW DER than the best quartile.

Trend

- Best quartile capital costs per MW DER have increased since 2007 with the lowest increase in 2011. Increases in capital investments in the best quartile have been driven by investment in reliability and performance improvements as well as licence extensions and uprates. Investments in sustaining and regulatory projects levelled off in 2011 whereas investment in capital spares, while still small in comparison with other categories, has doubled in recent years.
- Median levels for capital costs per MW DER have been rising steadily since 2007 with the biggest increase in 2008. Consistent with refreshing an aging fleet, investments in reliability and performance improvements as well as replacement of aged and obsolete equipment has driven total capital spending. Regulatory spending, particularly on security, has levelled off in recent years, although this will likely see increased spending as plants respond to the Fukushima incident. Median investment in capital spares is less than a quarter of the first quartile average.
- Darlington's capital cost per MW DER increased moderately in 2008 and 2009 but has decreased to its 2007 level by 2011.
- Pickering's capital cost per MW DER decreased steadily since 2007 with the biggest decrease in 2009.
- When investments specific to the U.S. fleet are excluded (steam generator and reactor vessel head replacements, license extensions, dry spent fuel storage addition, etc.), Darlington and Pickering are still in the top quartile.

Factors Contributing to Performance

- One contributing factor for OPG appears to be the capitalization threshold. The minimum expenditure threshold for capitalization at OPG for generating assets is $200k per unit whereas the majority of the companies in the industry have adopted minimum capitalization thresholds that are significantly lower.
- A second contributing factor may be due in part to the application of the capitalization policy at OPG for purposes of classifying projects as capital or Operating, Maintenance and Administration costs. The policy requires that replacement of any asset consumed in significantly less than the originally determined service life is to be expensed to OM&A.
- Another factor would be the exclusion of Darlington capital refurbishment costs from OPG capital expenditures submissions to the Electric Utility Cost Group.

5.0 HUMAN PERFORMANCE

Methodology and Sources of Data

The Human Performance Error Rate metric has been selected to benchmark the performance of OPG's nuclear fleet against other INPO utilities in the area of Human Performance. This will ensure a continued focus on improving Human Performance by comparing OPG Nuclear stations to industry quartiles through the use of consistent and comparable data. Since this is a relatively new metric being piloted, only three years' worth of data was available through INPO when this report was produced.

Ontario Power Generation's association with INPO through WANO prevented its direct participation in this pilot. However, OPG commenced calculating this measure and INPO provided the company with data representing the aggregate results from U.S. utilities. OPG realigned its criterion to the INPO criterion effective January 2011.

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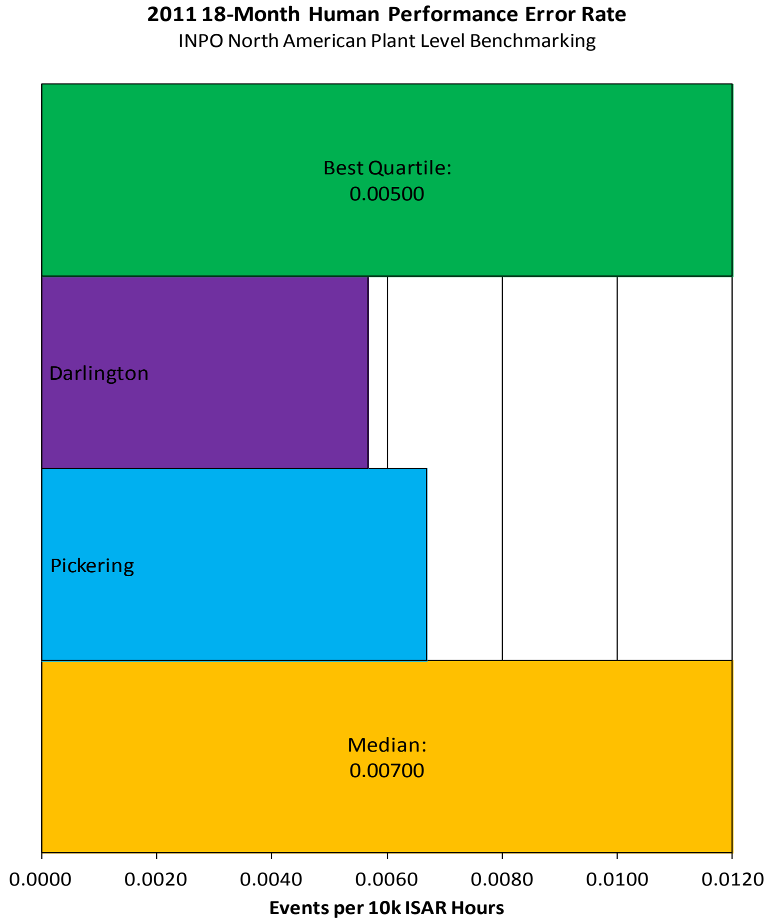
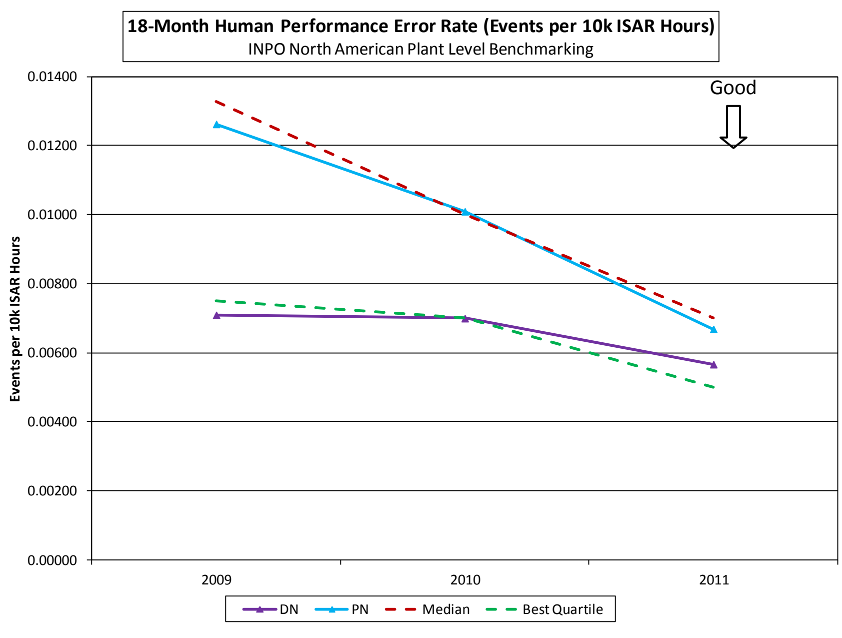
18-Month Human Performance Error Rate





Observations – 18-Month Human Performance Error Rate (INPO North American Plants)

2011 (18-Month Rolling Average)

- The 18-month Human Performance Error Rate (HPER) industry quartiles for all North American INPO plants were as follows at the end of 2011:
  - Best Quartile: ≤0.00500
  - Median: >0.00500 but ≤0.0070
  - Third Quartile: >0.00700 but ≤0.01200
  - Fourth Quartile: >0.01200
- Both Pickering and Darlington stations achieved median performance compared to the INPO peer group at the end of 2011.

Trend

- The industry top quartile and median benchmarks have both improved over the 2009-2011 review period.
- The industry has experienced some significant events as documented in the Significant Operating Experience Report (SOER) 10-2 (Engaged, Thinking Organizations) released by the Institute of Nuclear Power Operations in September of 2010.
- Pickering performance continues to improve, moving sharply towards industry top quartile.
- Darlington performance continues to be at or near industry top quartile.

Factors Contributing to Performance

OPG Nuclear's Human Performance strategy focuses on and reinforces the right behaviours during all phases of station operations and maintenance. It involves initiatives at the individual and leadership level and incorporates appropriate reviews of organizational processes and values.

This approach aligns with industry best practices.

Individual Behaviours

- OPG continues to train staff on the mastery of station fundamentals to establish a foundation for sound decisions and behaviours.
- OPG continues to train staff on Error Prevention techniques, "When, Why & How".

Leadership Behaviours

- OPG implemented a 5-year continuing training plan for Supervisory Effectiveness.
- Focused observations are used to improve leadership behaviours and have been essential to the success of the Human Performance program at Ontario Power Generation.

Organizational Processes and Values

- OPG has implemented Station Strategic Human Performance Improvement Plans.
- OPG has embraced the Accountability Model, with an approach where behaviours are coached in a manner that promotes discretionary efforts of organization members at all levels.
- OPG is focused on removing organizational barriers and facilitating time to allow leaders to spend more time coaching in the workplace.
- OPG joined the INPO Corporate Functional Area Managers Human Performance working group to ensure alignment with industry best practices and tools.
- SOER 10-2, Engaged Thinking Organizations, has been reviewed and recommendations have been incorporated into the Human Performance Program at OPG.

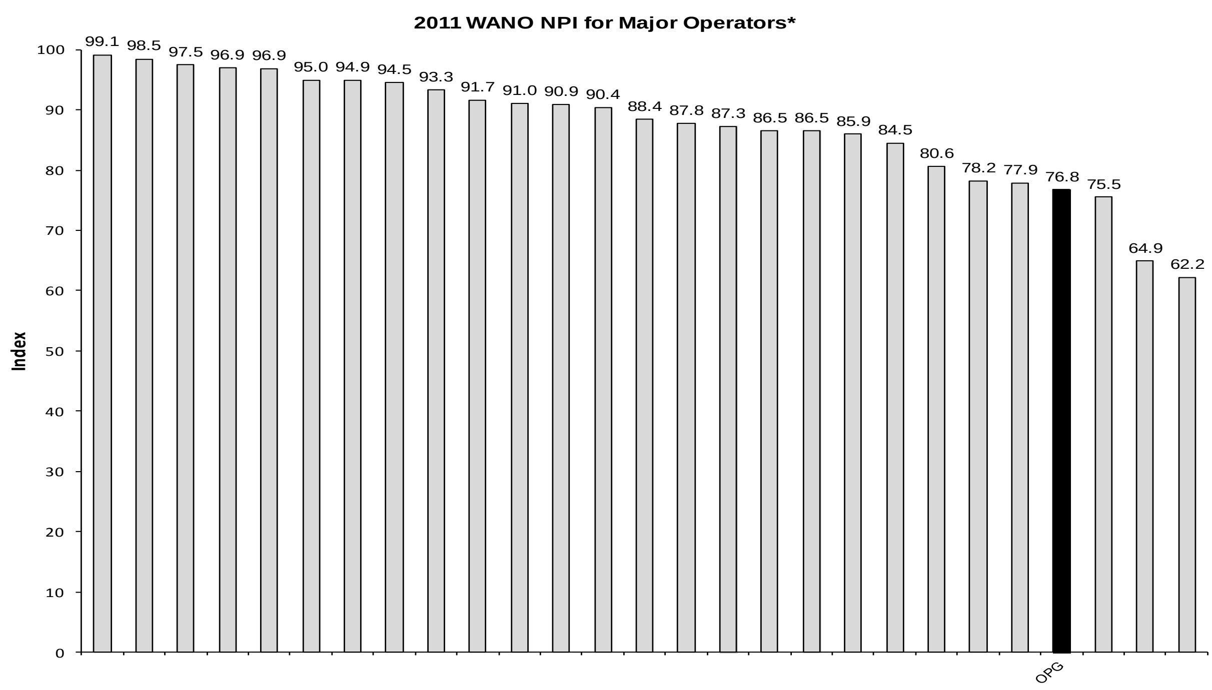
6.0 MAJOR OPERATOR SUMMARY

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.



*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.

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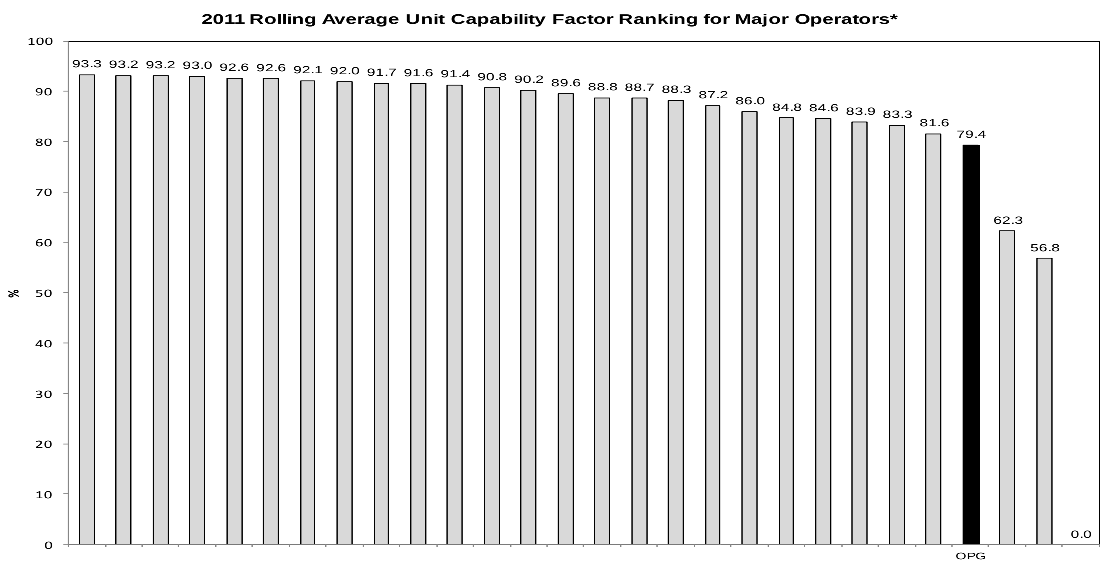
Unit Capability Factor (UCF) Analysis

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

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	25
	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.

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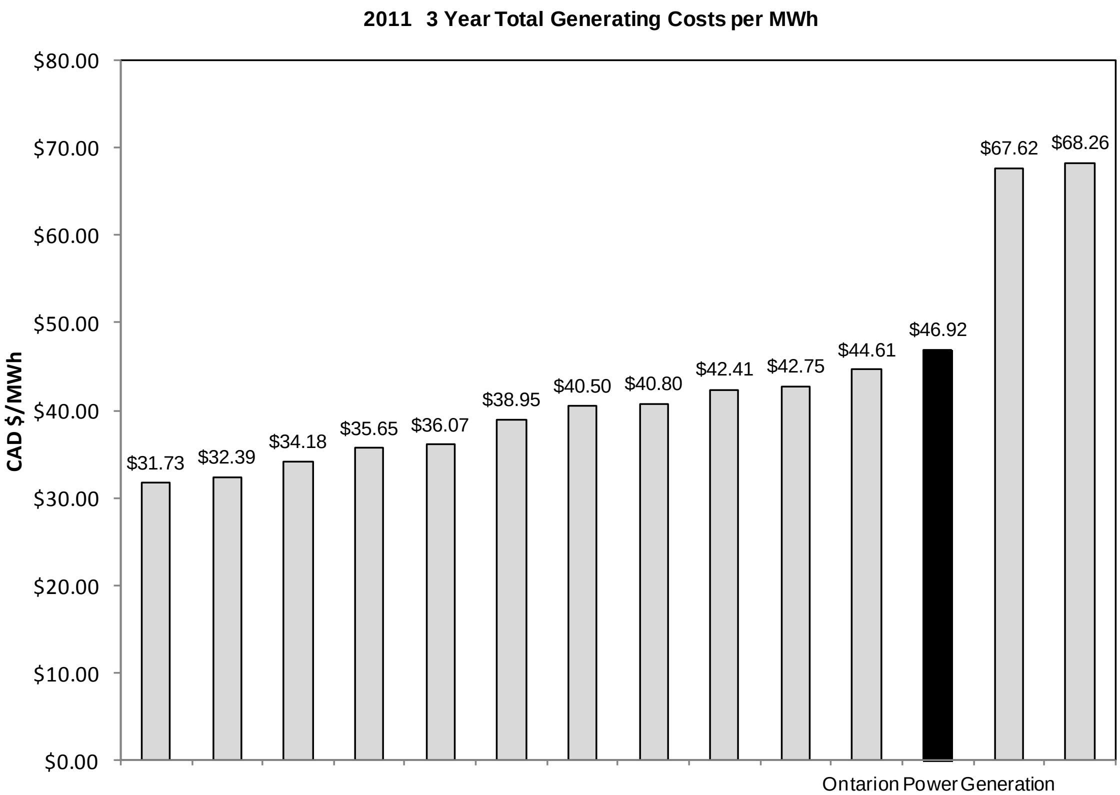

*OPG plant values of 3-year rolling average TGC per MWh are shown below:

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

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Total Generating Cost is comprised of: (a) Non-Fuel Operating Costs, plus (b) Fuel Costs, plus (c) Capital Costs. Table 6 below shows the relative contribution of these cost components to Total Generating Cost and compares OPG's costs to those of all EUCG operators. As stated in Section 4, OPG's advantages in Fuel Costs and Capital Costs is offset by relatively poor financial performance at all OPG facilities with respect to Non-Fuel Operating Cost. Low fuel costs are attributable to the use of CANDU technology while low capital costs may reflect OPG's policies regarding capitalization. Additionally, by reviewing individual plant results, Darlington performed by far the best overall, followed by Pickering.

Table 6: EUCG Indicator Results Summary (Operator Level)

EUCG Indicator Results Summary	OPG Average	EUCG Major Operators*		Units
		Median	Best Quartile	
Value for Money Performance				
3-Yr. Non-Fuel Operating Costs per MWh	$ 39.15	$ 23.94	$ 20.71	CAD $/MWh
3-Yr. Fuel Costs per MWh	$ 4.25	$ 7.01	$ 6.45	CAD $/MWh
3-Yr. Capital Costs per MWh	$ 3.52	$ 8.58	$ 6.44	CAD $/MWh
3-Yr. Total Generating Costs per MWh	$ 46.92	$ 39.53	$ 33.60	CAD $/MWh

*See Table 8 in the appendix for list of operators included.

Note: This summary contains the average of all plant results per operator.

7.0 APPENDIX

Acronyms

Acronym	Meaning
ALARA	As Low As Reasonably Achievable
BWR	Boiling Water Reactor
CANDU	Canada Deuterium Uranium (type of PHWR)
CEA	Canadian Electricity Association
COG	CANDU Owners Group
DER	Design Electrical Rating
EUCG	Electric Utility Cost Group
INPO	Institute of Nuclear Power Operators
OPG	Ontario Power Generation
PHWR	Pressurized Heavy Water Reactor
PWR	Pressurized Water Reactor
WANO	World Association of Nuclear Operators

Safety and Reliability Definitions

The following definitions are summaries extracted from industry peer group databases.

All Injury Rate is the average number of fatalities, total temporary disabilities, permanent total disability, permanent partial disabilities and medical attention injuries per 200,000 hours worked.

Industrial Safety Accident Rate is defined as the number of accidents for all utility personnel (permanently or temporarily) assigned to the station, that result in one or more days away from work (excluding the day of the accident) or one or more days of restricted work (excluding the day of the accident), or fatalities, per 200,000 man-hours worked. The selection of 200,000 man-hours worked or 1,000,000 man-hours worked for the indicator will be made by the country collecting the data, and international data will be displayed using both scales. Contractor personnel are not included for this indicator.

Collective Radiation Exposure, for purposes of this indicator, is the total external and internal whole body exposure determined by primary dosimeter (thermoluminescent dosimeter (TLD) or film badge), and internal exposure calculations. All measured exposure should be reported for station personnel, contractors, and those personnel visiting the site or station on official utility business.

Visitors, for purposes of this indicator, include only those monitored visitors who are visiting the site or station on official utility business.

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Airborne Tritium Emissions per Unit

Tritium emissions to air are one of the sites' leading components of dose to the public. By specific tracking of tritium emissions, the sites can maintain or reduce dose. Reducing OPG Nuclear's dose to the public demonstrates continuous improvement in operations.

Fuel Reliability Index is inferred from fission product activities present in the reactor coolant. Due to design differences, this indicator is calculated differently for different reactor types. The indicator is defined as the steady-state primary coolant iodine-131 activity (Becquerels/gram or Microcuries/gram), corrected for the tramp uranium contribution and power level, and normalized to a common purification rate.

Unplanned automatic reactor trips (SCRAMS) is defined as the number of unplanned automatic reactor trips (reactor protection system logic actuations) that occur per 7,000 hours of critical operation. The indicator is further defined as follows:

- Unplanned means that the trip was not an anticipated part of a planned test.
- Trip means the automatic shutdown of the reactor by a rapid insertion of negative reactivity (e.g., by control rods, liquid injection shutdown system, etc.) that is caused by actuation of the reactor protection system. The trip signal may have resulted from exceeding a setpoint or may have been spurious
- Automatic means that the initial signal that caused actuation of the reactor protection system logic was provided from one of the sensors' monitoring plant parameters and conditions, rather than the manual trip switches or, in certain cases described in the clarifying notes, manual turbine trip switches (or pushbuttons) provided in the main control room
- Critical means that, during the steady-state condition of the reactor prior to the trip, the effective multiplication factor (keff) was essentially equal to one.

The value of 7,000 hours is representative of the critical hours of operation during a year for most plants, and provides an indicator value that typically approximates the actual number of scrams occurring during the year.

The **safety system performance indicator** is defined for the many different types of nuclear reactors within the WANO membership. To facilitate better understanding of the indicator and applicable system scope for these different type reactors a separate section has been developed for each reactor type.

Also, because some members have chosen to report all data on a system train basis versus the "standard" overall system approach, special sections have also been developed for those reactor types where train reporting has been chosen. (The resulting indicator values resulting from these methods are essentially the same.)

Each section is written specifically for that reactor type and reporting method. If a member desires to understand how a different member is reporting or wishes to better understand that member's indicator, it should consult the applicable section.

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The safety systems monitored by this indicator are the following:

PHWRs

Although the PHWR safety philosophy considers other special safety systems to be paramount to public safety, the following PHWR safety and safety-related systems were chosen to be monitored in order to maintain a consistent international application of the safety system performance indicators:

- Auxiliary boiler feedwater system
- Emergency AC power
- High pressure emergency coolant injection system

These systems were selected for the safety system performance indicator based on their importance in preventing reactor core damage or extended plant outage. Not every risk important system is monitored. Rather, those that are generally important across the broad nuclear industry are included within the scope of this indicator. They include the principal systems needed for maintaining reactor coolant inventory following a loss of coolant, for decay heat removal following a reactor trip or loss of main feedwater, and for providing emergency AC power following a loss of plant off-site power. (Gas cooled reactors have an additional decay heat removal system instead of the coolant inventory maintenance system.)

Except as specifically stated in the definition and reporting guidance, no attempt is made to monitor or give credit in the indicator results for the presence of other systems at a given plant that add diversity to the mitigation or prevention of accidents. For example, no credit is given for additional power sources that add to the reliability of the electrical grid supplying a plant because the purpose of the indicator is to monitor the effectiveness of the plant's response once the grid is lost.

The **Nuclear Performance Index** Method 4 is an INPO sponsored performance measure, and is a weighted composite of ten WANO Performance Indicators related to safety and production performance reliability.

The NPI is used for trending nuclear station and unit performance, and comparing the results to the median or quartile values of a group of units, to give an indication of relative performance. The quarterly NPI has also been used to trend the performance and monitor the effectiveness of various improvement programs in achieving top quartile performance and allows nuclear facilities to benchmark their achievements against other nuclear plants worldwide.

The **Forced Loss Rate (FLR)** is defined as the ratio of all unplanned forced energy losses during a given period of time to the reference energy generation minus energy generation losses corresponding to planned outages and any unplanned outage extensions of planned outages, during the same period, expressed as a percentage.

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Unplanned energy losses are either unplanned forced energy losses (unplanned energy generation losses not resulting from an outage extension) or unplanned outage extension of planned outage energy losses.

Unplanned forced energy loss is energy that was not produced because of unplanned shutdowns or unplanned load reductions due to causes under plant management control when the unit is considered to be at the disposal of the grid dispatcher. Causes of forced energy losses are considered to be unplanned if they are not scheduled at least four weeks in advance. Causes considered to be under plant management control are further defined in the clarifying notes.

Unplanned outage extension energy loss is energy that was not produced because of an extension of a planned outage beyond the original planned end date due to originally scheduled work not being completed, or because newly scheduled work was added (planned and scheduled) to the outage less than four weeks before the scheduled end of the planned outage.

Planned energy losses are those corresponding to outages or power reductions which were planned and scheduled at least four weeks in advance (see clarifying notes for exceptions).

Reference energy generation is the energy that could be produced if the unit were operated continuously at full power under reference ambient conditions throughout the given period. Reference ambient conditions are environmental conditions representative of the annual mean (or typical) ambient conditions for the unit.

Unit Capability Factor is defined as the ratio of the available energy generation over a given time period to the reference energy generation over the same time period, expressed as a percentage. Both of these energy generation terms are determined relative to reference ambient conditions.

Available energy generation is the energy that could have been produced under reference ambient conditions considering only limitations within control of plant management, i.e., plant equipment and personnel performance, and work control.

Reference energy generation is the energy that could be produced if the unit were operated continuously at full power under reference ambient conditions.

Reference ambient conditions are environmental conditions representative of the annual mean (or typical) ambient conditions for the unit.

The **Chemistry Performance Indicator** compares the concentration of selected impurities and corrosion products to corresponding limiting values. Each parameter is divided by its limiting value, and the sum of these ratios is normalized to 1.0. For BWRs and most PWRs, these limiting values are the medians for each parameter, based on data collected in 1993, thereby reflecting recent actual performance levels. For other plants, they reflect challenging targets. If an impurity concentration is equal to or better than the limiting value, the limiting value is used as the concentration. This prevents increased concentrations of one parameter from being masked by better performance in another. As a result, if a plant is at or below the limiting value

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for all parameters, its indicator value would be 1.0, the lowest chemistry indicator value attainable under the indicator definition.

- PWRs with recirculating steam generators and VVERs
  - Steam generator blowdown chloride
  - Steam generator blowdown cation conductivity (only applicable to VVER and PWRs with I-800 steam generator tubes)
  - Steam generator blowdown sulfate
  - Steam generator blowdown sodium
  - Final feedwater iron
  - Final feedwater copper (not applicable to PWRs with I-800 steam generator tubes)
  - Condensate dissolved oxygen (only applicable to PWRs with I-800 steam generator tubes)
  - Steam generator molar ratio target range (by reporting the upper and lower range limits (as "from" and "to" values when using molar ratio control)
  - Steam generator actual molar ratio (if reporting molar ratio control data)

- PWRs with once through steam generators
  - Final feedwater chloride
  - Final feedwater sulfate
  - Final feedwater sodium
  - Final feedwater iron
  - Final feedwater copper

- Pressurized heavy water reactors (PHWRs)
  - *Inconel-600 or Monel tubes
    - Steam generator blowdown chloride
    - Steam generator blowdown sulfate
    - Steam generator blowdown sodium
    - Final feedwater iron
    - Final feedwater copper
    - Final feedwater dissolved oxygen

  - Incoloy-800 tubes
    - Steam generator blowdown chloride
    - Steam generator blowdown sulfate
    - Steam generator blowdown sodium
    - Final feedwater iron
    - Final feedwater dissolved oxygen

- PHWRs on molar ratio control
  - Steam generator blowdown chloride

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- Steam generator blowdown sulfate
- Final feedwater iron
- Final feedwater copper
- Feedwater dissolved oxygen
- Steam generator molar ratio target range (by reporting the upper and lower range limits (as "from" and "to" values)
- Steam generator actual molar ratio

Online Deficient Maintenance Backlog is the average number of active on-line maintenance work orders per operating unit classified as Corrective Critical (CC) or Corrective Non-Critical (CN) that can be worked on without requiring the unit shutdown. This metric identifies deficiencies or degradation of plant equipment components that need to be remedied, but which do not represent a loss of functionality of the component or system.

Online Corrective Maintenance Backlog is the average number of active on-line maintenance work orders per operating unit classified as Corrective Critical (CC) or Corrective Non-Critical (CN) that can be worked on without requiring the unit shutdown. This metric identifies deficiencies or degradation of components that need to be remedied, and represents a loss of functionality of a major component or system.

On-line maintenance is maintenance that will be performed with the main generator connected to the grid.

<u>Value for Money Definitions</u>

The following definition summaries are taken from the *January 2012 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, but exclude AFUDC (interest and depreciation).

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

Net Generation (Gigawatt Hours)
The gross electrical output of the unit measured at the output terminals of the turbine-generator minus the normal station service loads during the hours of the reporting period, expressed in Gigawatt hours (GWh). Negative quantities should not be used.

Design Electrical Rating (DER)
The nominal net electrical output of a unit, specified by the utility and used for plant design (DER net expressed in MWe). Design Electric Rating should be the value that the unit was

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

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weakness). They may be related to Nuclear Safety, Radiological Safety, Industrial Safety, Facility Operations or considered to be a Regulatory Event reportable to a regulator or governing agency. OPG Nuclear's criteria for defining station event free day resets have been developed based on INPO guidelines. However, the definition may differ slightly due to adaptation resulting from technological differences.

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Panels

Table 7: WANO Panel

Operator	Plant	Operator	Plant
AmerenUE	CALLAWAY	International CANDU	CERNAVODA
American Electric Power Co. Inc.	COOK		EMBALSE
Arizona Public Service Co.	PALO VERDE		QINSHAN 3
Bruce Power	BRUCE NUCLEAR A		WOLSONG A
	BRUCE NUCLEAR B		WOLSONG B
Constellation Energy Nuclear Group, LLC	CALVERT CLIFFS	Luminant Generation	COMANCHE PEAK
	GINNA	New Brunswick Power	POINT LEPREAU
Dominion Generation	KEWAUNEE	NextEra Energy Resources	POINT BEACH
	MILLSTONE		SEABROOK
	NORTH ANNA	Northern States Power Company	PRAIRIE ISLAND
	SURRY	Omaha Public Power District	FORT CALHOUN
Duke Power	CATAWBA	Ontario Power Generation (OPG)	DARLINGTON
	MCGUIRE		PICKERING
	OCONEE	Pacific Gas & Electric Co.	DIABLO CANYON
Entergy Nuclear	ARKANSAS NUCLEAR ONE	Progress Energy	CRYSTAL RIVER
	INDIAN POINT		HARRIS
	PALISADES		ROBINSON
	WATERFORD	Public Service Enterprise Group (PSEG) Nuclear, LLC	SALEM
Exelon Generation Co, LLC	BRAIDWOOD	South Carolina Electric & Gas Company (SCE&G)	SUMMER
	BYRON	Southern California Edison Co.	SAN ONOFRE
	THREE MILE ISLAND	Southern Nuclear Operating Co.	FARLEY
FirstEnergy Nuclear Operating Co.	BEAVER VALLEY		VOGTLE
	DAVIS-BESSE	STP Nuclear Operating Co.	SOUTH TEXAS
Florida Power & Light Co. (FPL)	ST. LUCIE	Tennessee Valley Authority (TVA)	SEQUOYAH
	TURKEY POINT		WATTS BAR
Hydro Quebec	GENTILLY	Wolf Creek Nuclear Operating Corp. (WNOC)	WOLF CREEK

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Table 8: EUCG Panel

Major Operator	Plant	Major Operator	Plant
Bruce	BRUCE	First Energy	BEAVER VALLEY
Constellation	CALVERT CLIFFS		DAVID-BESSE
	NINE MILES		PERRY
	R.E. GINNA	Ontario Power Generation (OPG)	DARLINGTON
Dominion Resources	KEWAUNEE		PICKERING
	MILLSTONE	Progress Energy	BRUNSWICK
	NORTH ANNA		CRYSTAL RIVER
	SURRY		HARRIS
Duke	CATAWBA		ROBINSON
	MCGUIRE	Public Service Enterprise Group (PSEG)	HOPE CREEK
	OCONEE		SALEM
Entergy	ARKANSAS ONE	Southern	FARLEY
	COOPER		HATCH
	FITZPATRICK		VOGTLE
	GRAND GULF	Tennessee Valley Authority (TVA)	BROWNS FERRY
	PALISADES		SEQUOYAH
	PILGRIM		WATTS BAR
	RIVER BEND	Xcel Energy	MONTICELLO
	VERMONT YANKEE		PRAIRIE ISLAND
	WATERFORD		
Exelon	BRAIDWOOD		
	BYRON		
	CLINTON		
	DRESDEN		
	LASALLE		
	LIMERICK		
	OYSTER CREEK		
	PEACH BOTTOM		
	QUAD CITIES		
	THREE MILE ISLAND		
FPL	ST LUCIE		
	TURKEY POINT		

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Table 9: COG CANDUs

Operator	Plant
Bruce Power	BRUCE NUCLEAR A BRUCE NUCLEAR B
China	QINSHAN 3
CNEA	EMBALSE
Hydro Quebec	GENTILLY
Korea	WOLSONG A WOLSONG B
NB Power	POINT LEPREAU
OPG	DARLINGTON PICKERING
Romania	CERNAVODA

Table 10: CEA Members

Companies
AltaLink
ATCO Electric
ATCO Power
BC Hydro
Brookfield Renewable Power
ENMAX
EPCOR
FortisAlberta
FortisBC
Horizon Utilities Corp
Hydro One
Hydro Ottawa
HydroQuebec Distribution
Hydro Quebec TransEnergie
Manitoba Hydro
New Brunswick Power
Newfoundland Power
Nova Scotia Power
OPG
SaskPower
The Hydro Group (Newfoundland)
Toronto Hydro
TransAlta

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Table 11: INPO Members for Human Performance Error Rate

Plant	
Grand Gulf	Ginna
Braidwood	Crystal River
Byron	Beaver Valley
Clinton	Perry
Dresden	Fort Calhoun
Limerick	Hope Creek
Comanche Peak	Davis-Besse
Catawba	Palo Verde
Quad Cities	Monticello
Diablo Canyon	Brunswick
Vermont Yankee	San Onofre
Calvert Cliffs	Columbia Gen
Pilgrim	Browns Ferry
Millstone	Robinson
McGuire	Summer
Cook	Callaway
Point Beach	Turkey Point
FitzPatrick	Kewaunee
Surry	Peach Bottom
Oconee	Wolf Creek (Sta)
LaSalle	Vogtle
Salem	Indian Point
ANO	Cooper
Hatch	Duane Arnold
Three Mile Island	Susquehanna
St. Lucie	Seabrook
Watts Bar	Sequoyah
Oyster Creek	Prairie Island
Nine Mile Point	Farley
North Anna	Palisades
Harris	River Bend
Waterford	South Texas
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Table 12: NPI Plant Level Performance Summary (North American Panel)

				2011 Actuals	
Indicator	**NPI Max**	**Median**	**Best Quartile**	**Pickering**	**Darlington**
Rolling Average Industrial Safety Accident Rate (#/200k hours worked)	0.20	0.06	0.00	0.04	0.09
Rolling Average Collective Radiation Exposure (person-rem per unit)	80.00	53.45	39.48	110.07	71.12
Fuel Reliability Index (microcuries per gram)	0.000500	0.000001	0.000001	0.000175	0.001133
2-Year Reactor Trip Rate (# per 7,000 hours)	0.50	0.41	0.00	0.60	0.21
3-Year Auxiliary Feedwater System Unavailability (#)	0.0200	0.0045	0.0028	0.0044	0.0000
3-Year Emergency AC Power Unavailability (#)	0.0250	0.0141	0.0093	0.0107	0.0067
3-Year High Pressure Safety Injection Unavailability (#)	0.0200	0.0038	0.0020	0.0001	0.0000
Rolling Average Forced Loss Rate (%)	1.00	1.77	1.07	10.34	1.80
Rolling Average Unit Capability Factor (%)	92.0	90.7	92.6	72.5	89.6
Rolling Average Chemistry Performance Indicator (Index)	1.01	1.01	1.01	1.10	1.03
WANO NPI (Index)	Not Applicable	88.8	96.9	66.1	92.8