BUSINESS PLANNING AND BENCHMARKING - REGULATED HYDROELECTRIC

1.0 PURPOSE

This evidence presents the regulated hydroelectric business plan and benchmarking and provides a summary of the regulated hydroelectric operating costs.

2.0 OVERVIEW

A summary of the operating costs for 2010 - 2015 is presented in Ex. F1-1-1 Table 1 for the Niagara Plant Group and R.H. Saunders GS, and in Ex. F1-1-1 Table 2 for the newly regulated hydroelectric facilities.

Actual and planned regulated hydroelectric OM&A (Base and Project) expenditures increase by an average of 2.6 per cent /year over the 2010 to 2015 period. A large number of OPG's regulated hydroelectric facilities continue to benchmark well (i.e., top two quartiles) for safety, environmental performance, costs, reliability and availability.

Excluding extraordinary items described in Ex. F1-2-1, section 3 and the Business Transformation re-organization described in Ex. A4-1-1 and A1-4-2, section 4.1, increases in total OM&A are mostly due to labour cost escalation and additional maintenance and project work. The project work includes the start of several major unit overhauls and other structural rehabilitation projects (see Ex.F1-3-1).

The regulated hydroelectric forecasts for the test period are from OPG's 2013 - 2015 Business Plan. The business plan is discussed in section 3.0. Section 4.0 presents the regulated hydroelectric performance targets and section 5.0 presents the regulated hydroelectric benchmarking results.

3.0 REGULATED HYDROELECTRIC BUSINESS PLAN

The Hydro Thermal Operations ("HTO") Business Plan (which includes the regulated hydroelectric operations) is prepared annually as part of the corporate business planning and budgeting process described in Ex. A2-2-1. The HTO business planning process is focused on identifying the initiatives, programs, projects and resources required to achieve safety, environmental, operational, financial, and new development business objectives. The HTO business planning process is generally the same as that presented in EB-2010-0008, Ex. F1-1-1, and is described in Appendix A.

The 2013 - 2015 HTO Business Plan is provided in Attachment 1. Discussion of specific initiatives contained in the business plan and their impact on operational and financial performance can be found in the evidence on base OM&A (Ex. F1-2-1), project OM&A (Ex. F1-3-1), capital projects (Ex. D1-1-1), and the production forecast (Ex. E1-1-1).

OPG is in the midst of a Business Transformation ("BT") program in order to improve its cost structure, and to design a more efficient and effective organization.

The strategy and key initiatives for the regulated hydroelectric facilities in the 2013-2015 Business Plan in the areas of ongoing operations and investments in long-term energy supply are presented below.

<u>Ongoing Operations</u>

- Continue prudent and economic investment to sustain and improve the existing hydroelectric assets for the long term. These investments have been prioritized using a portfolio approach (described in Appendix A) with a focus on maintaining reliability, regulatory compliance, safety and structural integrity of the high value assets. Lower priority projects have been deferred to the post 2015 period.
- Focus on regulatory and sustaining work during planning period. Value enhancing projects are to be performed where prudent or deferred to the post 2015 period.
- Utilize a differentiated maintenance strategy (Streamlined Reliability Centred Maintenance) to target maintenance work at delivering high reliability at stations

with a high value to OPG. Availability of OPG's large hydroelectric stations is targeted to be in the top quartile of EUCG (formerly known as Electric Utility Cost Group) and CEA (Canadian Electrical Association) benchmarking.

- Improve safety performance and maintain excellent environmental performance.

Development Initiatives

- The Niagara Tunnel Project has been completed ahead of the approved schedule and approximately $100M lower than budget. The energy production at the existing Sir Adam Beck stations will increase by an average 1.5 TWh per year (see Ex. D1-2-1).
- Continue preparations for the Sir Adam Beck PGS reservoir rehabilitation project. This project, which is scheduled to start in 2016, is necessary to ensure the safety and the ongoing viability of the PGS station (see Ex. D1-1-2).
- Continue with the Ranney Falls Expansion project that will add up to 10 MW of capacity to the existing generating station (see Ex. D1-1-2).

4.0 HYDROELECTRIC KEY PERFORMANCE TARGETS

Hhydroelectric establishes performance targets to support its business objectives as part of the business planning process. Benchmarking, as discussed in section 5.0, is one tool used in target setting and Hydroelectric benchmarks its performance against these targets. Hydroelectric monitors and compares targets to actual data as the year progresses.The main hydroelectric performance targets are more fully described in Appendix B and consist of:

- Availability
- Equivalent Forced Outage Rate
- OM&A Unit Energy Cost
- Safety – All Injury Rate
- Environmental Performance

4.1 Performance Targets

4.1.1 Availability and Equivalent Forced Outage Rate ("EFOR") - History and Targets

Charts 1a and 1b show reliability targets and actual performance from 2010 - 2012 for each of OPG's large regulated hydroelectric stations (i.e., greater than 10MW), and the totals of all regulated stations grouped by large and small plants.

Overall, from 2010 through 2012, the availability of most of the large stations was on or better than target.

Chart 1a

Regulated Hydroelectric Facilities - History and Targets for Availability (%)

Station / Group Name	2010 Target	2010 Actual	2011 Target	2011 Actual	2012 Target	2012 Actual
DeCew Falls 2 GS	90.2	95.9	94.6	96.9	95.4	95.1
Sir Adam Beck 1 GS	79.3	82.8	83.5	84.2	80.5	78.2
Sir Adam Beck 2 GS	94.3	95.4	95.6	95.5	96.7	95.3
Sir Adam Beck Pump GS	82.3	95.8	79.8	78.4	80.6	92.6
R.H. Saunders GS	93.7	93.8	89.1	90.1	93.7	93.2
Niagara & Saunders	**89.9**	**92.8**	**89.4**	**89.7**	**90.9**	**91.4**
Abitibi Canyon GS	82.3	79.7	91.3	87.1	92.7	94.9
Lower Notch GS	94.8	85.4	94.0	94.2	81.8	81.0
Otter Rapids GS	93.3	95.2	93.3	92.3	93.3	94.2
Northeast PG	**88.6**	**86.4**	**92.5**	**90.3**	**90.9**	**92.2**
Aguasabon GS	95.5	94.0	92.1	94.5	93.4	91.8
Alexander GS	88.8	84.5	90.6	90.5	92.3	91.8
Cameron Falls GS	97.6	96.6	94.8	94.1	97.7	98.9
Caribou Falls GS	91.9	99.1	95.1	92.7	93.0	96.6
Kakabeka Falls GS	89.9	93.3	91.2	92.3	96.8	93.8
Manitou Falls GS	96.7	97.0	92.1	96.3	96.3	95.0
Pine Portage GS	92.2	97.2	97.3	97.2	86.8	88.5
Silver Falls GS	93.5	97.4	82.1	85.0	93.8	89.4
Whitedog GS	87.9	82.2	86.9	84.8	90.7	84.0
Northwest PG	**93.0**	**93.4**	**92.5**	**92.8**	**93.9**	**93.2**
Arnprior GS	85.4	97.0	82.1	77.8	76.6	74.3
Barrett Chute GS	82.8	96.2	80.3	85.5	83.5	79.1
Chats Falls GS	88.8	87.3	93.2	93.3	91.5	91.2
Chenaux GS	93.8	93.8	93.2	94.0	89.1	89.8
Des Joachims GS	92.3	91.3	91.7	92.0	91.9	92.0
Mountain Chute GS	67.4	56.8	59.8	67.4	70.3	70.5
Otto Holden GS	91.0	93.4	95.0	95.2	91.9	92.4
Stewartville GS	88.5	95.8	93.7	96.5	86.8	90.6
Ottawa St. Lawrence PG	**89.0**	**91.1**	**90.2**	**91.4**	**88.4**	**88.6**
Newly Reg. - large plants	**90.5**	**91.4**	**91.3**	**91.8**	**90.8**	**90.7**
CHPG - small plants			**87.7**	**87.9**	**89.8**	**87.6**

Notes:

- High availability factor is good.

Chart 1b

Regulated Hydroelectric Facilities - History and Targets for EFOR (%)

Station/ Group Name	2010 Target	2010 Actual	2011 Target	2011 Actual	2012 Target	2012 Actual
DeCew Falls 2 GS	2.6	0.2	1.0	0.1	0.8	2.8
Sir Adam Beck 1 GS	3.5	0.6	3.1	1.0	3.1	6.9
Sir Adam Beck 2 GS	0.2	0.2	0.2	0.4	0.3	0.4
Sir Adam Beck Pump GS	4.8	1.2	5.1	11.3	5.1	6.9
R.H. Saunders GS	0.4	0.2	0.4	0.4	0.4	0.0
Niagara & Saunders	**1.3**	**0.3**	**1.1**	**1.2**	**1.2**	**2.1**
Abitibi Canyon GS	2.7	3.9	3.3	1.4	3.4	1.4
Lower Notch GS	2.9	23.0	2.4	3.1	3.3	0.1
Otter Rapids GS	2.6	4.1	2.8	4.9	2.9	1.3
Northeast PG	**2.7**	**7.3**	**3.0**	**2.9**	**3.2**	**1.2**
Aguasabon GS	0.6	1.2	1.0	0.2	1.1	0.8
Alexander GS	0.5	0.1	0.4	0.5	0.3	0.1
Cameron Falls GS	1.0	0.6	0.7	0.9	0.7	0.4
Caribou Falls GS	0.6	0.0	0.5	0.1	0.5	0.1
Kakabeka Falls GS	1.8	3.0	1.7	0.5	1.7	1.3
Manitou Falls GS	0.7	0.5	0.5	1.0	0.5	0.5
Pine Portage GS	0.5	0.1	0.4	2.1	0.3	0.2
Silver Falls GS	0.4	1.0	0.3	0.6	0.3	1.5
Whitedog GS	0.8	1.8	0.5	1.8	0.5	10.3
Northwest PG	**1.0**	**0.8**	**1.0**	**0.9**	**1.0**	**1.3**
Arnprior GS	2.5	1.1	1.3	0.0	1.4	7.3
Barrett Chute GS	11.7	2.7	6.5	8.0	3.0	8.8
Chats Falls GS	3.1	0.8	1.5	0.7	1.2	1.4
Chenaux GS	1.4	0.2	0.7	0.0	0.6	0.1
Des Joachims GS	0.9	1.0	0.3	0.1	0.4	0.5
Mountain Chute GS	13.9	41.6	9.4	1.0	5.0	3.7
Otto Holden GS	0.9	0.3	0.4	0.3	0.4	0.4
Stewartville GS	5.8	6.3	2.5	0.9	3.0	2.5
Ottawa St. Lawrence PG	**2.6**	**2.5**	**3.5**	**0.8**	**2.4**	**1.2**
Newly Reg. - large plants	**1.9**	**2.4**	**2.4**	**1.1**	**1.8**	**1.3**
CHPG - small plants			**4.3**	**3.4**	**3.4**	**5.2**

Notes:

- Low EFOR is good.

As described in Appendix A, HTO uses a structured portfolio approach to the management of its generating stations. For OPG's larger hydroelectric plants, an average availability target of between 90 per cent and 94 per cent is considered acceptable over the business planning period. These targets are in excess of CEA and EUCG benchmarking averages. For the small plants under 10 MW, availability targets between 85 per cent and 90 per cent are considered acceptable depending on the capacity factor of the station.

Charts 2a and 2b show availability and EFOR targets for the 2013 - 2015 Business Plan period. Availability targets and actuals deviate from the long term targets described above due to planned outage programs, as well as forced outages which cannot be predicted. Overall, availability is expected to be between 90.8 per cent and 92.9 per cent for the regulated large plants and between 85 per cent and 90.5 per cent for the regulated small plants.

Chart 2a

Availability Targets (%)

Station / Group Name	2013 Target	2014 Target	2015 Target
DeCew Falls 2 GS	89.9	95.4	94.2
Sir Adam Beck 1 GS	89.3	84.9	84.9
Sir Adam Beck 2 GS	95.0	96.7	98.2
Sir Adam Beck Pump GS	73.6	79.0	76.2
R.H. Saunders GS	93.8	93.7	94.0
Niagara PG & Saunders GS	90.8	91.5	91.6
Northeast PG	90.3	87.4	87.9
Northwest PG	93.3	95.2	97.5
Ottawa St. Lawrence PG	90.9	92.2	86.3
Newly Regulated - large plants	92.0	92.9	92.2
Central Hydro PG - small plants	88.8	84.5	90.5

Chart 2b

EFOR Targets (%)

Station/ Group Name	2013 Target	2014 Target	2015 Target
DeCew Falls 2 GS	0.7	0.7	0.7
Sir Adam Beck 1 GS	3.3	3.3	3.4
Sir Adam Beck 2 GS	0.3	0.3	0.3
Sir Adam Beck Pump GS	6.7	6.7	6.8
R.H. Saunders GS	0.6	0.6	0.6
Niagara PG & Saunders GS	1.4	1.4	1.4
Northeast PG	3.8	3.8	3.8
Northwest PG	1.0	1.0	1.0
Ottawa St. Lawrence PG	1.4	1.4	1.4
Newly Regulated - large plants	1.6	1.6	1.6
Central Hydro PG - small plants	3.3	3.2	3.4

4.1.2 OM&A Unit Energy Cost - History and Targets

Chart 2c shows OM&A unit energy cost ("UEC") targets for 2010 – 2015 for the regulated hydroelectric stations. These targets are calculated using planned OM&A expenditures, divided by the energy forecast for each year**.** More details on the factors affecting unit energy costs are discussed in section 4.2 below.

Actual OM&A UEC performance for both Niagara and R.H. Saunders for 2010 and 2011, was better than target due to lower than planned OM&A spending. n 2012, performance was worse than target due to lower than expected water inflows and associated lower energy production. Future unit energy cost targets are expected to be higher than historical figures due to higher OM&A costs for both base and project work, combined with lower than historical inflows affecting production, partially offset by increased production due to the in-service of the Niagara Tunnel project.

Actual OM&A UEC performance for the newly regulated stations from 2010 to 2012, was worse than target due to lower than historical water inflows, station outages, and First

Nations settlement provisions and projects. Future unit energy cost targets are in line with historical figures as inflows are projected to increase to historical averages, while costs increase for both base and project OM&A.

Chart 2c

OM&A Unit Energy Cost Targets ($/MWh)

Plant Group	2010 Target	2010 Actual	2011 Target	2011 Actual	2012 Target	2012 Actual	2013 Target	2014 Target	2015 Target
Niagara PG	4.1	4.0	4.7	3.2	4.1	4.8	5.2	5.2	4.5
Saunders GS	2.3	2.4	2.6	2.4	2.8	2.4	3.4	3.5	3.8
Total - Niagara & Saunders	3.5	3.4	4.0	2.9	3.6	4.0	4.6	4.6	4.3
Ottawa St.Lawrence PG	7.6	8.7	8.5	7.5	8.2	8.8	8.1	8.2	10.0
Central Hydro PG	53.5	45.4	53.1	52.3	48.0	50.5	52.8	64.6	58.1
Northeast PG	12.5	20.9	9.4	11.9	10.9	12.0	11.3	12.8	12.0
Northwest PG	8.1	13.9	8.4	10.4	7.9	9.7	7.6	8.2	8.1
Total - Newly Regulated	10.6	14.0	10.5	11.1	10.4	11.3	10.4	11.1	11.7

Note: Above OM&A Unit Energy costs are consistent with OEB filing guidelines: SBG, NYPA water transactions, and related Gross Revenue Charge are excluded from the target levels. Northwest PG 2010 OM&A costs include a $11.3M First Nations settlement provision, and $9M of shoreline remediation projects for other First Nations.

4.1.3 Safety – All Injury Rate - History and Targets

The All Injury Rate (“AIR”) replaced the Accident Severity Rate (“ASR”) in 2012 as the key safety performance measure. Chart 2d shows the All Injury Rate actual performance and targets from 2010 - 2016. These targets are generally based on CEA benchmarking, as well as OPG’s overall targets. Combined (total Hydroelectric), the plant groups met the AIR targets in 2010 and 2012, but did not meet the target in 2011.

Chart 2d

All Injury Rate (number of medical treatment injuries /200,000 hours worked)

Plant Group	2010		2011		2012		2013-2016
	Target	Actual	Target	Actual	Target	Actual	Target
Niagara	2.50	0.96	1.54	0.00	1.66	1.01	1.56
Ottawa St. Lawrence (incl. Saunders)	2.50	1.30	1.54	2.52	1.66	1.28	1.56
Northeast	2.50	1.51	1.54	3.31	1.66	2.49	1.56
Northwest	2.50	5.78	1.54	1.60	1.66	1.65	1.56
Central Hydro	2.50	2.00	1.54	0.91	1.66	0.00	1.56
Hydro Total	2.50	1.98	1.54	1.78	1.66	1.40	1.56

Note: The above AIR statistics are Plant Group totals that include both regulated and unregulated stations.

4.1.4 Environmental Performance Index – History and Targets

Hydro Thermal Operations has a very good track record with regard to environmental performance. Environmental management systems have been in place since 2000 and have been registered under the International Organization of Standardization ("ISO") 14001. In 2009, the Niagara Plant Group was designated as an Environmental Leader by the Ontario Ministry of Environment ("MOE"). The Niagara Plant Group was the first in the electricity sector to receive this designation. The Niagara Plant Group and R.H Saunders have also been recognized by the Wildlife Habitat Council over the past several years for their various biodiversity programs.

The environmental performance index ("EPI") includes a variety of measures and deliverables, some that are specific targets (such as minimizing the number of spills and MOE infractions) and some that are environmental initiatives (such as compliance cost management, Endangered Species Act, etc.). The EPI target is 1.0. An EPI above 1.0 can only be achieved if the number of spills and infractions are less than target, and/or the number of energy efficiency initiatives is better than planned. For the Hydroelectric facilities, the actual EPI has been better than the target of 1.0 from 2010 - 2012. The EPI target for 2013 - 2015 continues to be 1.0.

5.0 REGULATED HYDROELECTRIC FACILITIES BENCHMARKING

Hydro Thermal Operations benchmarks reliability, cost and safety performance with comparable businesses to assess and understand the performance of its stations, as well as to identify and share best practices and opportunities for improvement. However, because of differing geography, the distribution of plants across the province, water conditions, as well as differences in regulatory regimes and station age, design, size, and infrastructure (dams, bridges, etc), absolute comparisons cannot be made between OPG's regulated hydroelectric station costs and those of other utilities.

Hydro Thermal Operations reviews benchmarking results and best practices annually as part of the business planning process and applies new practices and cost/efficiency improvements as appropriate.HTO also has participated in informal benchmarking activities with various utilities in the past to identify actions that ultimately may result in cost efficiencies, and operational and maintenance improvements. Examples of best practices that have been implemented include:

- Station automation,
- Use of a risk-based instead of a time-based maintenance approach (streamlined reliability-centred maintenance),
- Overtime reductions from 11 per cent of labour cost in 2001 to under 6 per cent in the 2010 – 2015 period (see Ex. F1-2-1),
- A transition to skill broadening in some locations (i.e., trades learn more than one discipline),
- Implementation of "lead plant" concept for some aspects of governance in order to minimize duplication of effort.

Hydro Thermal Operations uses three main sources for hydroelectric benchmarking:

- EUCG Inc. ("EUCG", formerly known as Electric Utility Cost Group)
- Navigant Consulting (GKS Hydro Benchmarking)
- Canadian Electrical Association ("CEA")

5.1 Availability and Equivalent Forced Outage Rate

Hydroelectric benchmarks reliability using Availability and Equivalent Forced Outage Rate ("EFOR") data from the EUCG and the CEA. The results of the 2009 - 2011 reliability benchmarking of the regulated hydroelectric facilities are presented in Charts 3a, 3b and 3c.

Hydro Thermal Operations has participated in the Generation Equipment Reliability Information System benchmarking programs carried out by EUCG and the CEA since the mid 1990s. EUCG benchmarking includes participation by Canadian and American utilities, including Manitoba Hydro, New Brunswick Power, Hydro-Quebec, Pacific Gas & Electric, U.S. Army Corps of Engineers, Tennessee Valley Authority, Seattle City and Light, and Bonneville Power Authority. For this benchmarking, the data are not aggregated, thus individual OPG plants can be compared to the individual plants in the entire group (i.e., "quartile" analysis can be done).

Fourteen Canadian utilities participate in the CEA reliability benchmarking, including Manitoba Hydro, BC Hydro, Newfoundland and Labrador Hydro, Nova Scotia Power, Saskatchewan Power, New Brunswick Power, Fortis, Capital Power, and others. The CEA benchmarking is done on an aggregate basis by utility. Aggregated results for OPG plants are compared to the aggregated results of the plants in the entire group of utilities.

OPG's small (i.e., less than 10 MW), run-of-the-river generating stations are excluded from benchmarking because they are self-dispatchable, connected to local distribution, and have no impact on the reliability of bulk electricity system. Collectively, these stations comprise approximately two per cent of OPG's total hydroelectric capacity and average annual energy production.

5.1.1 EUCG Availability and Reliability, Niagara Plant Group Stations and R.H. Saunders GS

Charts 3a and 3b present the EUCG quartile ranking for availability and reliability (as measured by EFOR) for the Niagara Plant Group stations and R.H. Saunders GS. Except as noted below, from 2009 - 2011, OPG's Niagara Plant Group stations and R.H. Saunders GS

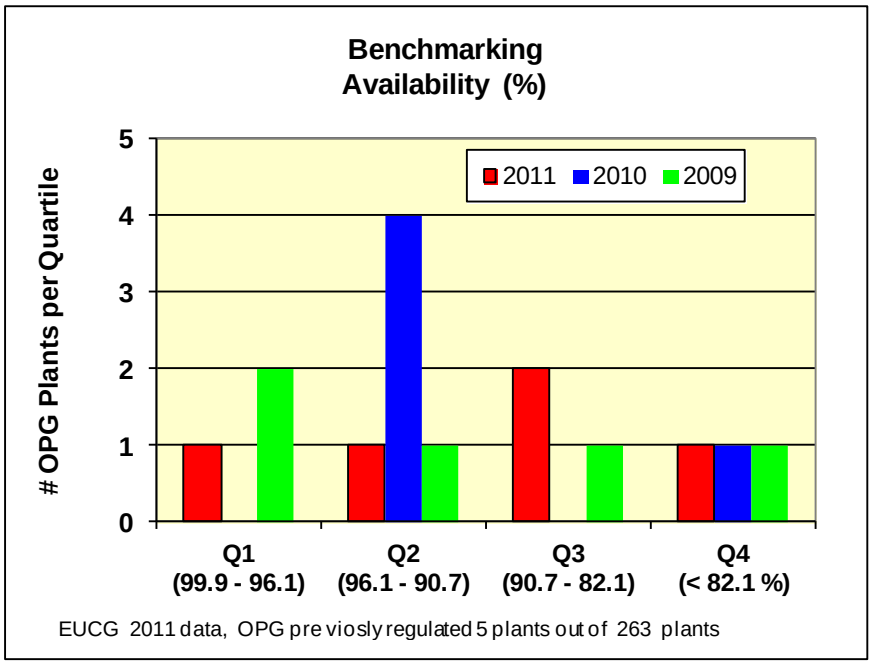
have performed better than the EUCG average benchmarks, ranking in the top two quartiles for availability and reliability.

As described in EB-2010-0008, the Sir Adam Beck Pump Generating Station ("PGS") is inherently less reliable, and therefore ranks lower than conventional hydroelectric generation. This is due to the PGS' older, technically complex, reversible pump turbine design, and its multi-faceted role in the electricity system (e.g., pumping, generating, automatic generation control, and water diversion control).

Performance at Sir Adam Beck I slipped below average into the third quartile due to the age and poor condition of the station's unrehabilitated units and long planned outages for the major unit rehabilitation/upgrade program. To date, work on Units 3, 7 and 9 has been completed. The availability and reliability of the station is expected to improve significantly after the remaining operating units have been rehabilitated and upgraded.

Chart 3a

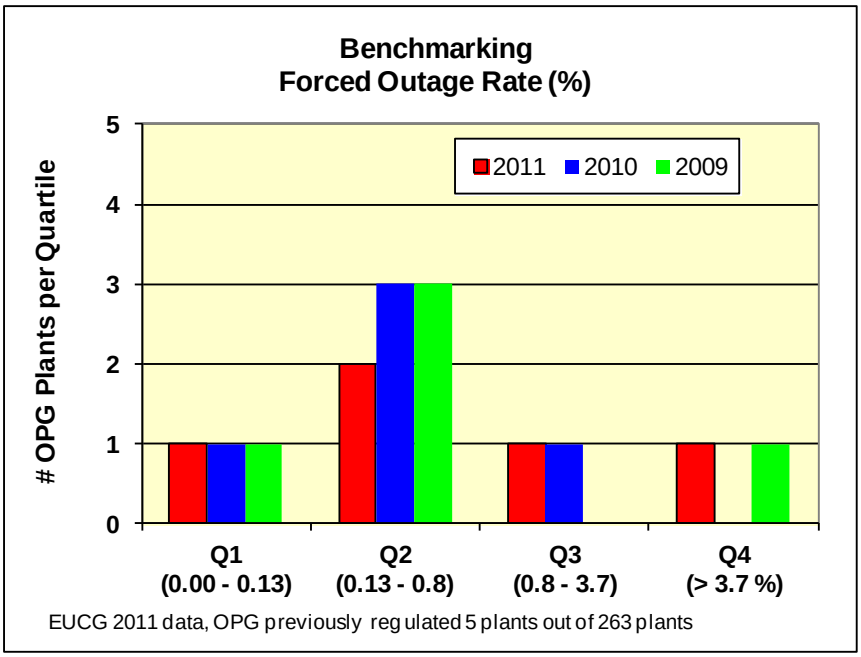
EUCG Availability Benchmarking – Niagara and Saunders



Note: 80% of Energy Production is in Q1/Q2 (3 year avg.)

Chart 3b

EUCG EFOR Benchmarking – Niagara and Saunders

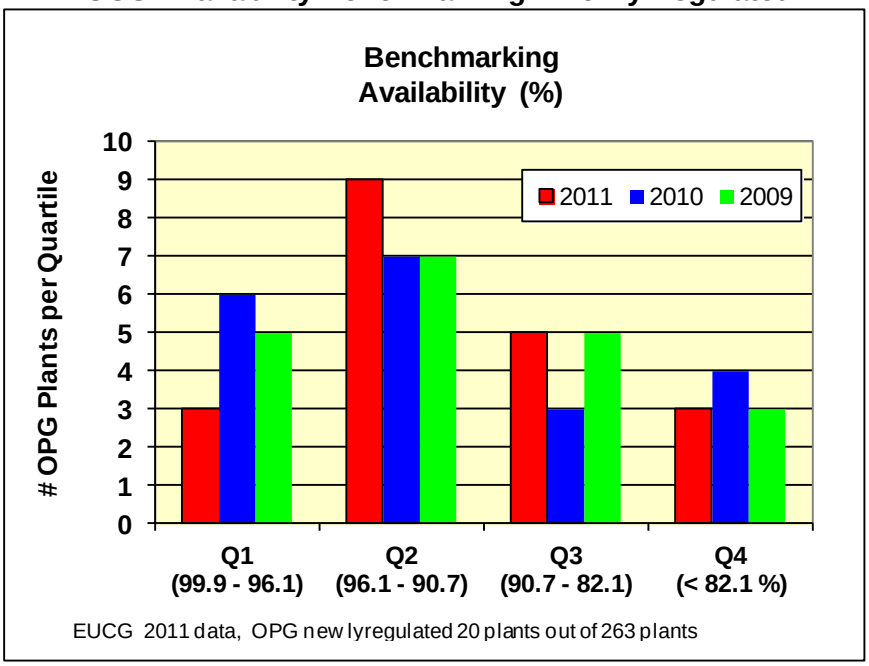


Note: 96% of Energy Production is in Q1/Q2 (3 year avg.)

5.1.2 EUCG Availability and Reliability, Newly Regulated Hydroelectric Stations

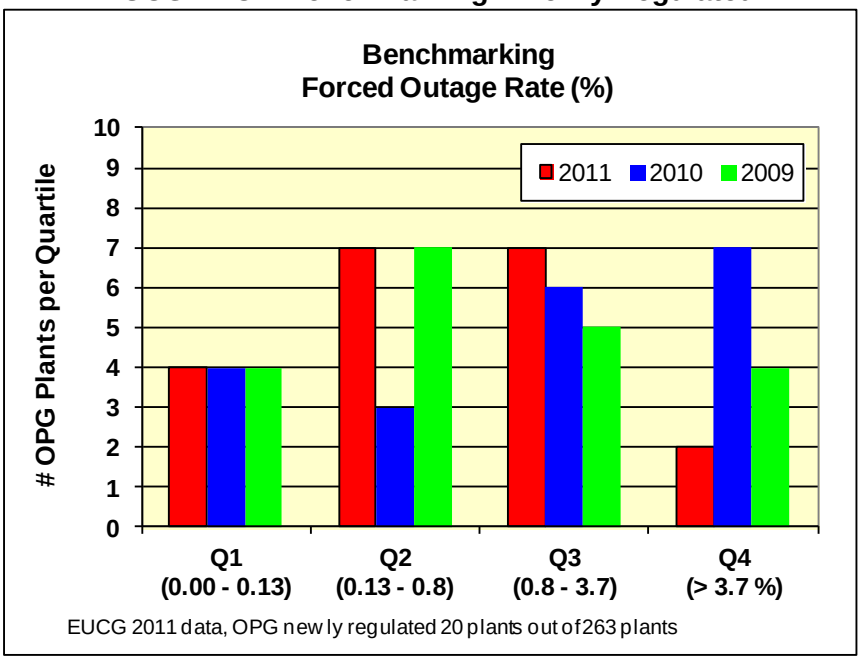
Charts 3c and 3d present the EUCG quartile ranking for availability and reliability (as measured by EFOR). From 2009 - 2011, most of OPG's newly regulated stations have performed better than the EUCG average benchmarks, ranking in the top two quartiles for availability and reliability.

Chart 3c
EUCG Availability Benchmarking – Newly Regulated



Note: 67% of Energy Production is in Q1/Q2 (3 year avg.)

Chart 3d
EUCG EFOR Benchmarking – Newly Regulated



Note: 67% of Energy Production is in Q1/Q2 (3 year avg.)

5.1.3 Canadian Electrical Association Availability and Reliability Benchmarks

Chart 3e presents aggregated CEA benchmarking data for availability and reliability ("EFOR"). Except where noted, the results demonstrate that the availability and reliability for the Niagara Plant Group and R.H. Saunders GS, and the newly regulated hydroelectric facilities are better than the CEA benchmarks. The main exceptions are in the Northeast Plant Group where:

- The 80 year old Abitibi Canyon GS experienced a full station outage in 2010 to rehabilitate/rebuild its deteriorated tailrace piers and to perform electrical upgrades.
- A failure of a generator winding at Lower Notch GS necessitated significant repairs and a 3 month outage.
- Outages at Otter Rapids GS for transformer and digital protections upgrades.

Chart 3e

CEA Reliability Benchmarking

Measure	Group Name	2009	2010	2011	2012
Equivalent Availability Factor (%)	**CEA (excluding OPG)**	91.1	89.7	87.1	88.2
	Niagara PG & Saunders GS	93.6	92.8	89.7	91.4
	Northeast PG	85.8	86.4	90.3	92.2
	Northwest PG	92.8	93.4	92.8	93.2
	Ottawa St.Lawrence PG	92.9	91.1	91.4	88.5
	OPG Newly Regulated	92.6	91.9	91.1	91.0
Equivalent Forced Outage Rate (%)	**CEA (excluding OPG)**	2.2	5.1	6.7	6.3
	Niagara PG & Saunders GS	1.0	0.3	1.2	2.1
	Northeast PG	5.7	7.3	2.9	1.2
	Northwest PG	0.8	0.8	0.9	1.3
	Ottawa St.Lawrence PG	1.7	2.5	0.7	1.2
	OPG Newly Regulated	1.5	1.6	1.1	1.6

Notes:
High Availability is good and low EFOR is good
Availability Factor and EFOR are unit-weighted
Composite measures based on: (1) CEA - 310 units; (2) Niagara & Saunders - 48 units; (3) OPG Newly Regulated - 100 units

5.2 OM&A Unit Energy Cost

Hydro Thermal Operations benchmarks OM&A cost performance at Niagara Plant Group and R.H. Saunders stations through participating in Navigant Consulting's Hydroelectric Generation Benchmarking Program. The Navigant benchmarking program includes a best practices and data review workshop held annually with participants. Hydro Thermal Operations also participates in EUCG's annual OM&A benchmarking program that includes all the large, newly regulated stations.

5.2.1 Navigant Unit Energy Cost Benchmarking

The Navigant Consulting Unit Energy Cost Benchmarking participants are comprised of Canadian and U.S. utilities and include BC Hydro, Nova Scotia Power, Great Lakes Power, TransAlta Utilities, Newfoundland and Labrador Hydro, the Tennessee Valley Authority, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, Southern California Edison, and Chelan County PUD. The hydroelectric stations in this group of utilities are diverse in size, type, location and age, and include a mix of run-of-the-river, peaking, and pumped storage stations.

Costs included in the Navigant Consulting unit energy cost benchmarking pertain to operations, plant maintenance, waterways and dams, and other maintenance, support (i.e., engineering, finance, corporate support), and public affairs and regulatory. Public affairs and regulatory costs include items such as water rentals and usage fees, gross revenue charge, major environmental costs such as fish/wildlife operations and studies, as well as special licensing fees (e.g., FERC re-licensing in the U.S.). The cost benchmarking data presented are for OM&A costs only, and excludes items such as project spending and regulatory costs.

The results of the Navigant Consulting OM&A unit energy cost benchmarking programs are summarized in Chart 4**.** The Navigant study results are segmented into various peer groupings. Cost drivers used to determine peer groupings include unit/station sizes, number of units, and age. The cost benchmarking results from 2009 - 2011 show that, collectively, the Niagara Plant Group and R.H. Saunders facilities are in the top quartile.

Chart 4

Navigant Consulting Hydroelectric Benchmarking Results (USD/MWh)

Station / Group Name	2009	2010	2011	Quartile	Peer Group (Navigant 2011 data)
DeCew Falls I	Not Available (outage all 2009)	Not Available (outage all 2010)	50.7 (Q4)	Q4: 23.4 to 86.5	37 micro plants (< 30 MW)
DeCew Falls II	3.3 (Q1)	3.0 (Q1)	3.1 (Q1)	Q1: 2.0 to 5.2	55 small plants (30 to 150 MW)
SAB I	6.5 (Q4)	8.0 (Q4)	9.1 (Q4)	Q4: 5.5 to 9.1	13 med-large plants (400 to 700 MW)
SAB II	1.7 (Q1)	1.96 (Q1)	2.0 (Q2)	Q2: 2.0 to 2.5	27 large plants (700 MW or more)
SAB PGS	65.2 (Q4)	90.1 (Q4)	128.2 (Q4)	Q4: 28.1 to 140.3	16 PGS plants
Saunders	2.2 (Q2)	2.65 (Q2/3)	2.4 (Q2)	Q2: 2.0 to 2.5	27 large plants (700 MW or more)
OPG plants (excl. PGS)	2.4 (Q1)	2.76 (Q1)	2.9 (Q1)	Q1: 0.6 to 3.9	186 plants
OPG plants (incl. PGS)	2.8 (Q1)	3.2 (Q1)	3.4 (Q1)	Q1: 0.6 to 4.0	210 plants

Notes:

- The above energy costs exclude: gross revenue charges, water rental fees, and capital and OM&A investment costs. Hydro common cost and corporate allocations are included
- Plant labour costs are normalized to US rates using Regional Wage Adjusters for skilled Trades.
- The costs are expressed in US dollars using International Monetary Fund report (International Financial Statistics). The following factors have been applied to 2009 = 0.85631, 2010 = 0.96562, 2011 = 1.01516
- In 2009 and 2010 DeCew Falls I was out of service. In these years, it is excluded form composite indices (OPG index)

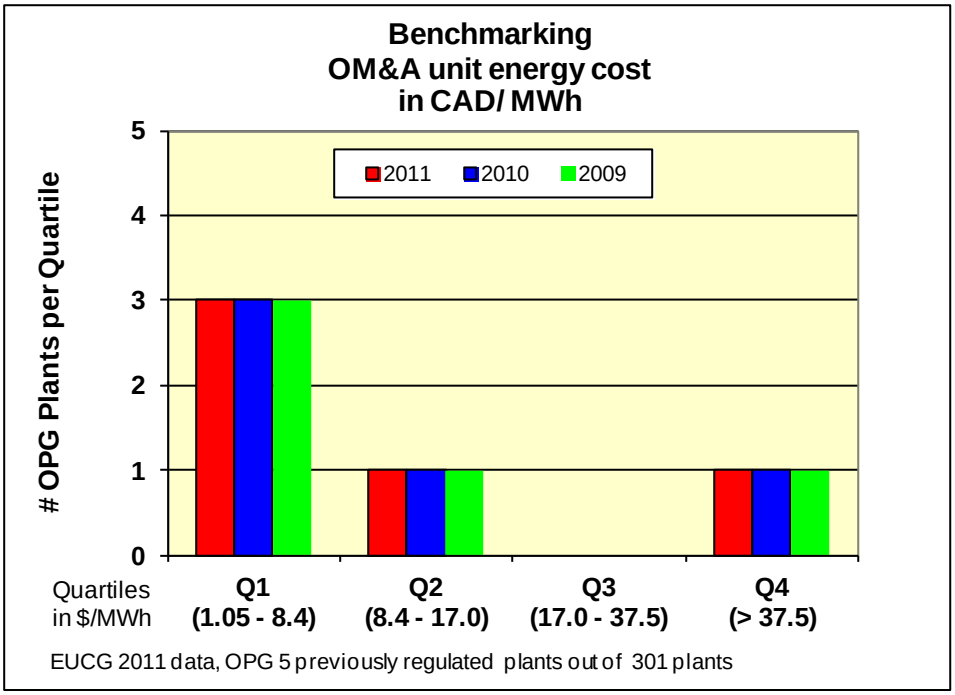
5.2.2 EUCG Unit Energy Cost Benchmarking

The results of the EUCG OM&A unit energy cost benchmarking programs are summarized in Chart 5a for the Niagara Plant Group and R.H. Saunders GS, and in Chart 5b for the newly regulated facilities. Participants in EUCG benchmarking are the same as those described for reliability benchmarking in section 4.0.

Chart 5a shows the EUCG quartile ranking for OM&A unit energy costs of the Niagara Plant Group stations and R.H. Saunders GS. These stations have generally been better than the EUCG average benchmarks over the 2009 - 2011 period. Over the three year period, an

average of 99 per cent of the energy production from these facilities has been ranked has ranked the top two quartiles.

Chart 5a
EUCG Unit Energy Cost Benchmarking Results - Niagara and Saunders

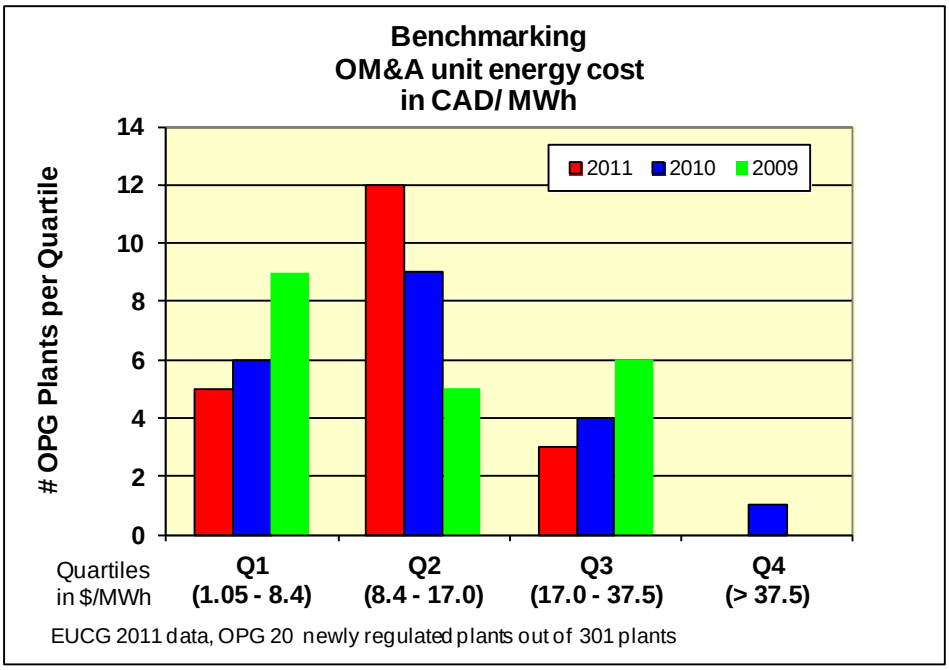


Notes:
99 per cent of Energy Production is in Q1/Q2 (3 year avg.)DeCew Falls I is not included in EUCG Cost Benchmarking Program because EUCG requires concurrent cost and reliability data.
DeCew I will be included starting with 2011 data submission.

Chart 5b shows the EUCG quartile ranking for OM&A unit energy costs of the newly regulated facilities. The newly regulated stations have also been generally better than the EUCG average benchmarks. Over the three year period, an average of 87 per cent of the energy production has ranked in the top two quartiles.

Chart 5b

EUCG Unit Energy Cost Benchmarking Results – Newly Regulated



Note: 87% of Energy Production is in Q1/Q2 (3 year avg.)

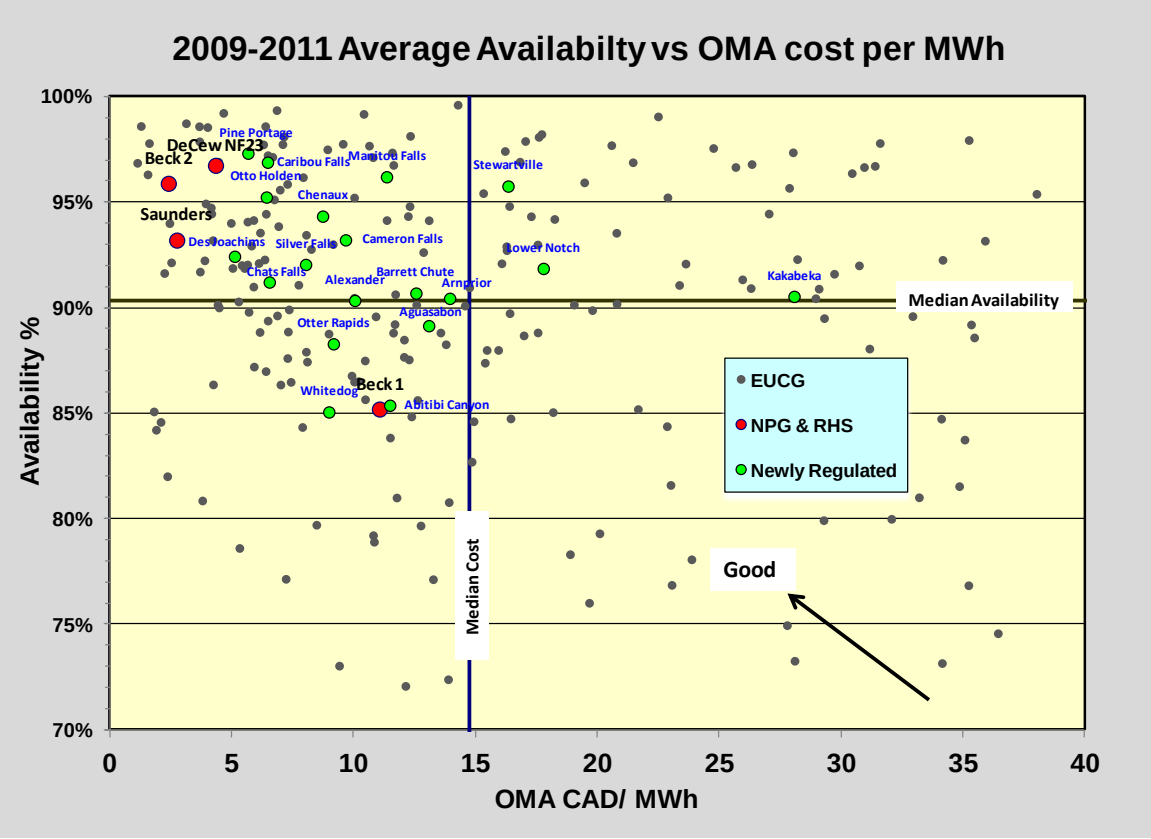
OM&A costs for OPG's regulated hydroelectric facilities are a function of their age, condition and specific circumstances relative to their peer group. Reliable operation is achieved by effective maintenance, but this tends to place upward pressure on OM&A costs. Benchmarking results are also affected by external factors such as water conditions. Based on OM&A unit energy cost benchmarks, OPG's regulated hydroelectric facilities are cost competitive, and have very good reliability, safety and environmental performance.

5.2.3 Combined Availability and Cost Benchmarking

Chart 6 compares OPG's large regulated plants to other facilities based on the combination of EUCG availability and OM&A unit energy cost benchmarks. Desired performance for a generating station is characterized by low unit energy costs with a low EFOR and high availability (i.e. upper left quadrant in the chart). As shown in Chart 6, a significant portion of OPG's large, regulated hydroelectric stations are in the upper left quadrant, with above average availability and below average OM&A costs.

Chart 6

OPG Availability and OM&A Unit Energy Costs



5.3 Safety (All Injury Rate)

OPG spends a significant amount of time and effort on training and awareness to ensure the safety of its employees. Safety performance is benchmarked through the CEA. The CEA collects safety performance data annually from its members who report their injury statistics based on the *CEA Standard for Recording and Measuring Occupational Injury Experience A-2*. The CEA now collects safety performance data from its members broken down into generation type (i.e., nuclear, fossil and hydroelectric).

In 2012, OPG's hydroelectric plant groups' combined AIR was 1.40 (number of medical treatment injuries per 200,000 hours worked), which ranks in the third quartile in CEA

benchmarking. On the other hand, the ASR was zero in 2012 (number of days lost due to injuries per 200,000 hours worked), which ranks in the first quartile in CEA benchmarking.

APPENDIX A

DESCRIPTION OF HYDRO THERMAL OPERATIONS BUSINESS PLANNING PROCESS

The Hydro Thermal Operations ("HTO") business planning process begins in early May of each year with internal reviews of the current planning framework, the confirmation and updating of business objectives and priorities, a review of business planning instructions from Finance, a review of the status of operational and performance plans and related capital and OM&A expenditures, a review of benchmarking "best practices" and comparisons, and the identification of emerging issues. Out of this process, strategic and performance objectives and guidelines for HTO are determined, prioritized and finalized.

OM&A and capital guidelines are established for each hydroelectric plant group, thermal plant and HTO central office group in May/June. A three-year time horizon for business planning (2013 - 2015) was used to focus efforts on near-term efficiency gains.

A business planning meeting is held at the end of May with production support management and finance stakeholders from each thermal plant, hydroelectric plant group, and central office groups, and certain corporate groups. The key business planning issues are also discussed at the monthly Hydro Thermal Operations Management Team meetings.

A preliminary HTO Business Plan is provided to the Senior Vice President ("SVP") HTO for review in late August. Redirection is provided to specific groups as required. A formal review meeting is subsequently held at each plant group location with the SVP - HTO and members of the HTO Management Team. The preliminary HTO Business Plan is then modified as required and submitted for review to the President and Chief Executive Officer ("CEO"), and the Chief Financial Officer ("CFO"). Changes are made per the direction of the CEO (if required) prior to its final submission to the OPG Board of Directors, as discussed at Ex A2-2-1.

The key approaches used to identify and prioritize investment and base work program requirements in support of regulated hydroelectric's objectives are described below.

Portfolio Approach to Investment Management

Hydro Thermal Operations uses a structured portfolio approach to identify and prioritize projects for its investment program. Annual engineering reviews and plant condition assessments (conducted on a cycle of approximately seven to ten years) are performed to determine short-term and long-term expenditure requirements to sustain or improve each facility, and ensure continued safe operation. These may be followed by the preparation of a facility life cycle plan. This planning approach is designed to identify necessary capital, operating and maintenance expenditures for each facility, and direct limited corporate funds at the facilities that can best maintain or enhance the value of the HTO business and OPG. The cornerstone of this approach is that safety, environmental, and other regulatory programs are of the highest priority. Chart 1 below shows the regulated generating stations by portfolio asset class along with their long-term availability and reliability targets.

Chart 1

Availability and EFOR Targets by Portfolio Asset Class (%)

Asset Class	Regulated Stations				Availability Factor	Equivalent Forced Outage Rate (EFOR)
Flagship	SAB I	SAB II	R.H. Saunders	Des Joachims	**94%**	**1.0%**
Workhorse	DeCew NF23 Pine Portage Silver Falls Abitibi Canyon	SAB PGS Lower Notch Caribou Falls Aguasabon	Otto Holden Chenaux Stewartville	Otter Rapids Mountain Chute Whitedog	**92.5%**	**2.5%**
Middle of the Pack	DeCew ND1 Cameron Falls	Chats Falls Arnprior	Alexander Barrett Chute	Manitou Falls Kakabeka Falls	**91%**	**4.5%**
Small Plants	Big Chute Big Eddy Frankford Auburn Hanna Chute South Falls	Ragged Rapids Sidney Crystal Falls Trethewey Falls Sills Island Lakefield	Matabitchuan Meyersberg Indian Chute Hagues Reach Merrickville	Ranney Falls Seymour Eugenia High Falls Stinson	**85% to 90%**	**5.0%**
Contenders (Small Plants)	Calabogie McVittie	Bingham Chute Nipissing	Elliott Chute	Coniston	**85%**	**7%**

Streamlined Reliability Centred Maintenance Process

Hydro Thermal Operations uses a process known as streamlined reliability centred maintenance to optimize the preventive maintenance program at its facilities. The streamlined reliability centred maintenance process provides a consistent method of identifying, scheduling and executing maintenance activities. The concept of streamlined reliability centred maintenance dictates that the type and frequency of preventive maintenance applied to an individual component is determined based on the nature and consequences of failure (i.e., balance of cost versus risk). By focusing maintenance and associated support resources appropriately, HTO has been able to accomplish more of its base work program (including additional regulatory requirements), while minimizing the need for additional resources.

APPENDIX B

DESCRIPTION OF HYDROELECTRIC KEY PERFORMANCE TARGETS

Availability

Availability is a measure of the reliability of a generating unit represented by the percentage of time the unit is capable of providing service, whether or not it is actually in-service, relative to the total hours for the period in question (typically 8,760 hours in a year).

Equivalent Forced Outage Rate

Equivalent Forced Outage Rate ("EFOR") is an index of the reliability of the generating unit measured by the ratio of time a generating unit is forced out-of-service, including equivalent forced deratings, compared to the sum of the forced outages and deratings plus the of amount of time the generating unit operates.

OM&A Unit Energy Cost

OM&A unit energy cost measures the cost effectiveness of the hydroelectric generating stations. It is defined as total hydroelectric OM&A expense, including allocated central support costs, divided by electricity generation. The gross revenue charge ("GRC") is excluded from this calculation because it is determined by provincial regulation and therefore not within the direct control of OPG.

Safety – All Injury Rate

Starting in 2012, in order to improve the focus on employee safety, OPG and the Hydro Thermal Operations Business Unit changed its key safety performance measure to the broader All Injury Rate ("AIR"), in place of the Accident Severity Rate ("ASR"). All Injury Rate is defined as the number of medical treatment injuries reported on the job divided by 200,000 hours worked, whereas the ASR is defined as the number of days lost by employees injured on the job divided by 200,000 hours worked. Both measures are used

by other electric utilities and are benchmarked by the Canadian Electrical Association ("CEA").

Environmental Performance

Hydro Thermal Operations uses an environmental performance index to measure the environmental performance of the regulated facilities. The environmental performance index consists of four main categories:

- Spills
- Regulatory compliance (e.g., regulatory infractions)
- Greenhouse and Acid Gas Emissions
- Other Environmental initiatives (e.g. support of Corporate EMS, compliance cost management, work on Endangered Species Act)

LIST OF ATTACHMENTS

Attachment 1: Hydro Thermal Operations 2013 - 2015 Business Plan

Note: Attachment 1 is marked “Confidential” because the original document contains confidential information. The redacted version provided as pre-filed evidence is not confidential.