

HYDROELECTRIC INCENTIVE MECHANISM AND SURPLUS BASELOAD GENERATION

1.0 PURPOSE

This evidence describes OPG's proposed treatment of Surplus Baseload Generation ("SBG") during the test period and explains OPG's proposed Enhanced Hydroelectric Incentive Mechanism ("eHIM").

2.0 OVERVIEW

OPG's operation of the Sir Adam Beck Pump Generating Station ("PGS") under the Hydroelectric Incentive Mechanism ("HIM") reduces SBG spill to the maximum extent possible and provides a consumer benefit through reduced consumer costs. In order to address an unintended interaction between HIM and the SBG Variance Account, a modification to the HIM, or enhanced HIM ("eHIM"), is proposed. Compared to the alternatives considered, eHIM is the best choice and is proposed for both the existing regulated and the newly regulated hydroelectric facilities.

The evidence is organized as follows:

- Section 3.0 addresses the methodology for determining entries in the SBG Variance Account;
- Section 4.0 addresses the usage of the Pump Generating Station (PGS) during periods of SBG;
- Section 5.0 addresses the proposed enhanced incentive payment mechanism;
- Section 6.0 addresses the proposed payment mechanism for the test period;
- Attachment 1 presents a review of the proposed eHIM prepared by Cliff Hamal of Navigant Economics.

3.0 METHODOLOGY FOR DETERMINING ENTRIES INTO THE SBG VARIANCE ACCOUNT

3.1 Overview

In EB-2010-0008, the OEB established the Hydroelectric Surplus Baseload Generation Variance Account to capture the financial impacts of forgone production at OPG's hydroelectric facilities due to SBG spill. Entries in the account are calculated by multiplying the foregone production volume due to SBG spill (in MWh) by the approved regulated hydroelectric payment amount, net of the avoided Gross Revenue Charge (GRC) costs. OPG is seeking to clear the 2013 year end forecasted balance in the SBG Variance Account (See Ex. H1-1-1).

SBG spill occurs at Sir Adam Beck (SAB), and at other regulated hydroelectric facilities, including many that are newly regulated. OPG is proposing to extend the SBG Variance Account to include the newly regulated hydroelectric facilities with modeled production forecasts(See Ex. E1-1-1, Appendix 1).

OPG has determined that the present structure of the hydroelectric incentive mechanism results in unintended payments to OPG when SBG spill occurs. As a result, and based on the analysis described in Section 5.2, OPG is proposing changes in the operation of the SBG Variance Account, effective January 1, 2014, as an integral component of eHIM. The proposed changes to the account are described in Section 6.1

3.2 Determination of SBG Spill

In its Decision with Reasons in EB-2010-0008, the OEB suggested that OPG approach the IESO for assistance in the calculation of SBG spill. In 2011, OPG approached the IESO for this assistance and was advised by the IESO that it does not have a reporting framework to identify SBG production losses and was therefore unable to assist OPG. As a result, OPG developed its own methodology for calculating the foregone production associated with SBG spill.

Hydroelectric production planning is based upon the objective of achieving total utilization of the available water or ("stream flow"). However, several market, operational and production capability constraints, described below, inhibit the complete utilization of the available stream flow. As a result, spill occurs.

There are several components of spill which are due to circumstances other than SBG for which volumes are calculated:

- water conveyance constraints (e.g., SAB GS tunnel capacity constraints);
- production capability constraints (e.g., unit outages; operating regulatory requirements etc.);
- market constraints (i.e., IESO dispatch constraints: market or transmission system); and
- contractual obligations (e.g., AGC).

Therefore, to calculate the foregone production due to SBG spill, OPG starts with the total volume of spill and subtracts the volume of spill due to these four components. The remaining spill volume is identified as potential SBG spill. From this potential spill volume, OPG excludes spill that occurs when the Ontario market price is above the level of the Gross Revenue Charge ("GRC"). The volume of spill remaining after this adjustment is the foregone production due to SBG and is used in calculating entries into the SBG Variance Account. These volumes have been calculated to be 76.5 GWh for March through December 2011 and 116.9 GWh for 2012. SBG spill volume for 2013 is projected to be 178.0 GWh.

When SBG occurs, it has the effect of significantly depressing market prices. Therefore, SBG conditions are deemed to be present when the prevailing market price falls below a price threshold representing the marginal cost of generation for OPG's regulated hydroelectric facilities. This threshold is based on a plant's Gross Revenue Charge (GRC) which represents the minimum offer price for generation that would allow OPG to cover its cost of GRC on its production.

In practice, there is some minor variability around the SBG price threshold used at some of the hydroelectric facilities. This is because OPG needs to create small differences between the generation offers from its various units to achieve an orderly dispatch and meet operational requirements at its hydroelectric facilities.

4.0 USE OF SAB PGS DURING SBG CONDITIONS

4.1 Overview

In its Decision with Reasons in EB-2010-0008, the OEB indicated that it expects OPG to use the SAB Pump Generating Station (“PGS”) to the maximum extent possible to mitigate the cost to ratepayers in the SBG Variance Account. OPG operates the PGS taking into consideration market price signals, the availability of the PGS, the capacity of the PGS reservoir, and hydrological limitations. By following market price signals for PGS deployment, OPG is able to minimize SBG spill to mitigate the cost to ratepayers of entries into the SBG Variance Account and substantially reduce consumer costs, as described in Section 5.1.

Table 1 shows the extent to which PGS pump was used to reduce SBG spill at SAB.

Table 1: PGS usage and SBG spill March 1, 2011 to July 31, 2013		
	Number of hours	Percentage hours
Total SBG spill hours	2,604	100%
<u>During SBG hours only:</u>		
Hours where PGS was pumping	1,556	60%
<u>Hours where PGS was not pumping</u>		
Due to constraints	883	34%
Missed opportunities	165	6%

1 During the period March 1, 2011 to July 31, 2013, there were 2,604 hours when SBG spill
2 occurred at SAB. Of these hours, OPG operated the PGS in 1,556 hours or 60 per cent of
3 the total SBG spill hours.

4
5 There was no PGS pump operation in the remaining 1,048 hours or 40 per cent of the total
6 SBG spill hours. Of these 1,048 hours, the PGS was not pumping for 883 hours (34 per cent
7 of the total SBG hours) due to constraints such as: insufficient available pumping capacity;
8 insufficient storage in the reservoir; uneconomic off to on-peak price differentials; and
9 prevailing hydrological conditions.

10
11 There was no PGS pump operation in 165 hours, or 6 per cent of the time, where there were
12 no constraints that would have prevented pumping. These few hours represent missed
13 opportunities: periods where the PGS was available and could have been deployed to
14 mitigate SBG spill but was not. Use of the PGS is based on anticipated on-peak prices
15 several hours in the future and as a result, misreading future on-peak prices can cause such
16 missed opportunities. Given the dynamic nature of pricing in the Ontario market, missing just
17 6 per cent of the SBG spill hours represents very good performance by OPG and is evidence
18 that OPG is maximizing the use of the PGS to mitigate the impact of SBG.

19 20 **5.0 THE HYDROELECTRIC INCENTIVE MECHANISM**

21 In EB-2010-0008 Payment Amounts Order, the OEB established the HIM Variance Account
22 to record 50 per cent of HIM net revenues above \$10M for the period March through
23 December, 2011 and \$14M for calendar year 2012 as a credit to ratepayers. In EB-2012-
24 0002 Payment Amounts Order, the OEB set the threshold for 2013 at \$13M. Between March
25 1, 2011 and December 31, 2011 actual HIM net revenue was \$12.9M. For 2012 actual HIM
26 net revenue was \$15.8M. Projected HIM net revenue for 2013 is \$8.7M. Resulting entries
27 into the HIM Variance Account are discussed in ex. H1-1-1.

28
29 In the Board's Decision with reasons for EB-2010-0008 (p.148), OPG was directed to revisit
30 the structure of the Hydroelectric Incentive Mechanism ("HIM"). OPG was also directed to
31 provide a more comprehensive analysis of the benefits of the HIM for ratepayers, an analysis

1 of the interaction between HIM and SBG, and an assessment of potential alternative
2 approaches within the context of expected conditions in the contracted and traded markets.
3

4 **5.1 Consumer Benefits of the HIM**

5 The purpose of the HIM is to provide OPG with an incentive to operate its regulated
6 hydroelectric facilities in a way that benefits consumers. Presently, this takes the form of
7 payments to OPG to incent it to time-shift generation from periods of low market price to
8 periods of high market price. This, in turn, provides a benefit by reducing customer costs.

9 OPG's assessment of consumer benefits from the HIM concluded that economic time-shifting
10 its regulated hydroelectric substantially reduces consumer costs. OPG's findings are based
11 on analysis that accounts for the market effects by time shifting: the displacement by
12 hydroelectric production of more expensive generation (i.e., on-peak gas); increases in GRC
13 payments for additional on-peak generation at the regulated hydroelectric facilities; and
14 higher exporter payments¹ made to the IESO for off-peak exports that result in reduced
15 incremental costs to ratepayers.
16

17 Table 2 shows OPG's forecast of changes in ratepayer costs arising from the three factors
18 above for the test period. Negative values represent an *increase* in customer costs while
19 positive values represent a *reduction* in customer costs. These figures represent 'all-in'
20 customer costs including changes in Global Adjustment payments.
21

¹ Sales of exports in the off-peak are typically made from contracted generation sources with contract prices that are independent of market prices. These volumes are effectively "take or pay". The consumer benefit arises from increasing the off-peak price for export sales so as to generate additional revenues that, in turn, reduce Global Adjustment payments by consumers.

Table 2: Forecast Change in Customer Costs Arising from Economic Time-shifting		
Customer cost Changes in M\$	2014	2015
Reduction in payments to gas-fired generators	30	27
Increased GRC costs	(16)	(15)
Increase in export revenues	22	24
Total reduction in customer costs	36	36

As shown in Table 2, economic time-shifting, even when the impacts of the Global Adjustment are included, reduces ratepayers' costs as cheaper hydroelectric generation displaces more costly gas-fired generation. Additionally, increased amounts paid to the IESO for export sales also reduce ratepayers' costs.

5.2 Interaction between HIM and SBG

The incentive component of HIM is calculated as the sum of all hourly differences between the actual hourly production and the monthly average production priced at the prevailing market price (i.e. Hourly Ontario Energy Price or "HOEP") for a given month. When the hourly output is greater than the monthly average, OPG is credited for that incremental energy at HOEP. Conversely, when the hourly output is less than the monthly average, HIM is reduced for that decremental energy at HOEP.

Since the total hourly production in excess of the monthly average is equal to that below the monthly average, HIM is positive only when the production in excess of the monthly average has a higher market value than the production below the monthly average.

SBG conditions that result in production curtailments typically occur in low priced, off peak periods. When SBG spill is avoided through PGS deployment or time shifting the stored water is shifted to a higher value time period and incentive payments are appropriately

awarded. While the monthly average production is unchanged, the incentive payments are based on the quantity of energy moved at a value that represents the market price differential.

When SBG spill cannot be avoided, because the water cannot be time-shifted or stored, it is irrevocably lost. As a result, the monthly average production falls. The SBG spill, which lowers the monthly average production, is compensated for by an entry in the SBG Variance Account. However, the resulting production profile, reduced by the SBG spill volume also generates incentive payments under the HIM. This is an unintended consequence of interaction between the HIM and SBG Variance Account.

These two points may be best illustrated by the example shown in Table 3.

Table 3: Example of the Interaction Between SBG and the HIM (assuming 100 MW of Water Available for Use in Each Hour)							
	Case 1: Spill avoided			Case 2: Spill not avoided			
Period	Output MW	Spill MW	HIM \$	Output MW	Spill MW	HIM \$	HOEP \$/MWh
1	50	0	-\$500	50	50	-\$250	10
2	50	0	-\$500	50	50	-\$250	10
3	50	0	-\$500	50	50	-\$250	10
4	50	0	-\$500	50	50	-\$250	10
5	50	0	-\$500	50	50	-\$250	10
6	150	0	\$1,000	100	0	\$500	20
7	150	0	\$1,000	100	0	\$500	20
8	150	0	\$1,000	100	0	\$500	20
9	150	0	\$1,000	100	0	\$500	20
10	150	0	\$1,000	100	0	\$500	20
Total	1,000		\$2,500	750		\$1,250	

In this example, SBG conditions are present in the low-valued periods 1 through 5. In Case 1, spill is avoided through time-shifting the energy from the low-priced periods 1 through 5 to the higher valued periods 6 through 10. As a result, an incentive payment totaling \$2,500 is generated. In Case 2, the SBG conditions result in spill in periods 1 through 5. Since spill

occurs, no energy can be time-shifted to the higher-valued periods 6 through 10. Nonetheless, an incentive payment of \$1,250 is still generated as the SBG spill gives rise to the appearance of time-shifting.

In Case 1, as there is no SBG spill, there is no entry into the SBG Variance Account. In Case 2 however, the SBG-related spill in periods 1 through 5 gives rise to an entry into the SBG Variance Account. The SBG Variance Account entry in Case 2 is appropriate as the overall production in Case 2 is 250 MW lower than Case 1.

As the intent of the HIM is to reward time-shifting, the HIM payment in Case 1 is appropriate as time-shifting occurred. However, in Case 2, the HIM payment is unintended as no time-shifting occurred.

In order to eliminate this unintended consequence, OPG is proposing an enhanced Hydroelectric Incentive Mechanism ("eHIM") that eliminates the potential for incentive payments that produce no value for ratepayers. This alternative is described in greater detail in Section 6.

5.3 Alternative Incentive Mechanisms

Three alternatives to the current HIM incentive mechanism were assessed by OPG and reviewed by Mr. Cliff Hamal of Navigant Economics: the enhanced Hydroelectric Incentive Mechanism ("eHIM"); a modified version of the Hydroelectric Baseload Forecast ("eHBF") mechanism (used during the 2005 – 2008 period); and an Incentive Mechanism (IM) based on a fixed market price exposure.

The eHIM is essentially identical to the existing HIM payment mechanism and SBG Variance Account with the addition of an adjustment to the incentive mechanism to remove the effects of SBG. Under the proposed adjustment, all induced incentive revenues arising from SBG-related spill would be removed from the SBG Variance Account (as discussed in Section 5.2). OPG proposes to adopt eHIM for the test period. Further implementation information is found in Section 6.

1 The eHBF modifies the Hydroelectric Baseload Forecast ("HBF") mechanism used from June
2 2005 to November 2008. The HBF incentive payment was based on a quantity of generation
3 in excess of a predetermined volume of electricity that was priced at HOEP. The
4 predetermined volume of electricity was an unchanging amount for all hours. Under the
5 eHBF, the predetermined quantity of electricity would vary hourly commensurate with
6 seasonal and daily variations in available flows. Therefore, the volume of generation exposed
7 to market prices is more uniform across all hours. As a result, the quantity of electricity that
8 could be time-shifted would earn incentive revenues at the prevailing market rate.

9
10 The incentive mechanism (IM) based on a fixed market price exposure is similar to some
11 current electricity supply contracts in the Ontario market. This mechanism is conceptually the
12 simplest of all alternatives since the incentive payment is a fixed percentage (i.e., five per
13 cent for the purpose of this analysis) of actual output that is paid at HOEP.

14
15 Each alternative facilitates economic time-shifting decisions on the basis of prevailing market
16 prices. For the purpose of this assessment, the use of generation facilities under each
17 alternative, for any given set of market prices, is assumed to be the same.

18
19 Along with HIM, each alternative was assessed and evaluated on the basis of the *correlation*
20 between the annual volume of water time-shifted and the amount of incentive revenue
21 generated. An appropriately designed incentive mechanism would have a strong positive
22 correlation between the amount of time-shifting and the level of incentive revenues.

23 Additionally, the volatility of each alternative was analyzed. As incentive revenues are funded
24 by ratepayers based on a portion of the ratepayer savings achieved through time-shifting, an
25 incentive payment that exhibits low volatility ensures an appropriate balance between
26 ratepayer value and the incentive revenues provided to OPG. An incentive scheme that
27 exhibits a high volatility could result in incentive revenues that exceed the ratepayer cost
28 savings.

29
30 With respect to the correlation between the amount of time-shifting and the amount of
31 incentive revenues, all payment mechanisms except for IM, exhibit some degree of positive

correlation. The strongest correlations are found in the HIM and eHIM approaches followed by the eHBF mechanism. With respect to the degree of volatility in the incentive revenues, all payment mechanisms, except for eHBF exhibit approximately the same degree of volatility. The volatility in the HIM, eHIM and IM are similar but the volatility in incentive revenues under the eHBF scheme is much, much higher.

This assessment of the payment mechanisms is summarized in Table 4.

Table 4: Assessment of Alternative Payment Mechanisms		
Alternative	Correlation between incentive payout and amount of time shifting (High is preferable)	Volatility in incentive payout (Low is preferable)
HIM	High	Low
eHIM	High	Low
eHBF	High	High
IM	Low	Low

Based on this assessment, the HIM and eHIM are preferable to both the eHBF, due to much lower volatility in incentive payouts, and the IM due to better correlation between the amount of the incentive payout and the amount of time-shifting. Owing to its better ability to deal with SBG spill, OPG proposes the eHIM be used over the test period. This is discussed in Section 6 and supported in the accompanying testimony of Cliff Hamal of Navigant Economics (E1-2-1, Attachment 1).

6.0 PROPOSED NEW INCENTIVE MECHANISM

6.1 Design of Incentive Payments and SBG Variance Account

As a result of the assessment shown in Section 5.3 and the supporting testimony of Cliff Hamal of Navigant Economics (E1-2-1, Attachment 1), OPG proposes adopting the eHIM for the existing regulated hydroelectric facilities and the newly regulated hydroelectric facilities

listed in Ex. E1-1-1, Appendix 1. The eHIM is identical to the existing HIM and SBG Variance Account except that under the eHIM the entries in the SBG Variance Account would be adjusted to remove incentive revenues arising from SBG spill. The enhanced mechanism provides greater transparency and fairness while continuing to provide the correct market drivers to incent OPG's plant operations in a way that directly benefits ratepayers.

6.2 Incentive Revenue Sharing and Implementation

OPG proposes an adjustment to the eHIM net revenue to maintain the 50/50 sharing of net incentive revenues established in EB-2010-0008. The adjustment quantity is known as the 'X-factor'.

The proposed eHIM formula, consisting of HIM and SBG variance account adjustments combined with the revenue sharing mechanism is:

$$\text{Monthly IESO Payment}^2 = \text{Regulated payment} + \\ + \text{Incentive payment}$$

where

$$\text{Regulated Payment} = (MW_{\text{avg}} \times \text{Regulated rate} \times \text{No of hours in month})$$

$$\text{Incentive Payment} = \text{'X factor'} \times \sum [(MW_i - MW_{\text{avg}}) \times \text{HOEP}_i]$$

² OPG notes that many of the newly regulated hydroelectric stations are not connected directly to the IESO-controlled grid but are instead embedded at the distribution level. As the IESO does not currently have access to production data for these stations for settlement purposes, OPG will work with the IESO and the distributor to develop a settlement solution to enable implementation of this proposal.

Monthly SBG Variance	= Spill compensation
Account Entry	
	+ Incentive payment adjustment
where	
Spill Compensation	= $MW_{SBGavg} \times (\text{Regulated rate} - \text{GRC}) \times \text{No of hours in month}$
Incentive Payment Adjustment	= 'X factor' $\times \sum [(MW_{SBGi} - MW_{SBGavg}) \times HOEP_i]$

The 'X factor' appearing in the Incentive Payment and Incentive Payment Adjustment formulae is established such that the net incentive retained by OPG is equal to one-half the customer cost reduction shown in Table 2. In this manner the benefits arising from time-shifting of energy are shared equally between the customer and OPG as shown in Table 5 below.

Table 5: Expected Payments and Adjustments		
M\$	2014	2015
'X' factor	35%	31%
Incentive payment	27	30
Incentive payment adjustment	(9)	(12)
eHIM	18	18

Furthermore, OPG proposes to eliminate the revenue requirement adjustment, that no offset attributed to incentive revenue be applied to the revenue requirement based on an expectation of future incentive revenues. The generation of incentive payments for OPG, and the attendant value delivered to the customer, occur simultaneously. As a result, there is no difference in the timing between the customer cost savings and OPG's incentive payments. As a result, there is no need for a revenue requirement offset.

- 1 Given these proposed changes described above, the need for a HIM Variance Account is
- 2 eliminated. (Refer Exhibit H1-1-1).
- 3
- 4 Under the proposed eHIM, OPG anticipates incentive payments totaling \$27M in 2014 and
- 5 \$30M in 2015. Furthermore, OPG anticipates incentive payment adjustments in the SBG
- 6 Variance Account of (\$14M) and (\$19M) in 2014 and 2015 respectively (See Ex. H1-1-1).

LIST OF ATTACHMENTS

1

2

3 Attachment 1: Testimony of Cliff Hamal, Review of Proposed Hydroelectric Incentive
4 Mechanism.