PRODUCTION FORECAST AND METHODOLOGY – HYDROELECTRIC

1.0 PURPOSE

The purpose of this evidence is to provide a description of the methodology used to derive the hydroelectric production forecasts for 2005 - 2009, as well as to present an overview of outage planning for the regulated hydroelectric facilities.

2.0 HYDROELECTRIC PRODUCTION FORECAST

2.1 Methodology - General

The hydroelectric production forecast is impacted by water availability. OPG seeks to optimize the use of available water while meeting safety, legal, environmental, and operational requirements as discussed in Ex. A1-T4-S2. The availability of water is affected by meteorological conditions, with precipitation and evaporation of particular importance. The forecast methodology accounts for operational strategies that attempt to maximize use of available water and minimize spill (unutilized water flow).

Computer models are used to derive the production forecasts for the regulated hydroelectric sites. These models use forecast monthly water flows, generating unit efficiency ratings, and planned outage information to convert forecast water availability into forecast energy production.

2.1.1 Niagara River Flow and Energy Forecast

Forecast water levels and outflows for Lake Huron, Lake St. Clair, and Lake Erie are derived by OPG using the Hydrological Response Model for the Great Lakes, developed by the Great Lakes Environmental Research Laboratory. An updated model (advanced hydrologic prediction service) has been developed by Great Lakes Environmental Research Laboratory for the Niagara River and is being tested by OPG for future use.

Input parameters to the current model include:

- "Starting" elevations for Lakes Huron, St. Clair, and Erie based on current month end elevation estimates.
- Default median values for hydrological parameters based on historic data, antecedent conditions, and forecast data from Environment Canada and the U.S. National Oceanic and Atmospheric Administration. These parameters include basin precipitation, runoff, and lake evaporation for Lakes Michigan, Huron, St. Clair, and Erie, flows for the St. Mary's River (Lake Superior outflow), Chicago Diversion, and Welland Canal, and factors to account for the impact of ice retardation on the flow in the St. Clair, Detroit, and Niagara Rivers.

The model produces monthly average water level and outflow forecasts for Lakes Huron, St. Clair, and Erie. The Lake Erie water level and outflow forecast produced by the model is compared with the six-month advance forecast produced by Environment Canada as a consistency check.

Minor adjustments are applied to the forecast monthly Lake Erie outflows, as produced by the Great Lakes Environmental Research Laboratory model, to determine the Grass Island Pool inflow forecast. The Grass Island Pool is the section of the Niagara River immediately above the Falls. Water used by OPG for power production at Niagara is diverted from the river in this area. These adjustments account for seasonal variations in local inflow, and flow reductions due to ice or weed retardation effects. The Grass Island Pool inflow forecast is compared with that produced by the New York Power Authority as a consistency check. Because of the increasing uncertainty associated with predicting natural systems beyond a six month period, forecasts for periods beyond two years assume that water availability trends back towards historic monthly medians. This assumption reflects historical trends.

In addition to the forecast monthly Grass Island Pool inflows, flows diverted to the DeCew Falls stations, seasonal restrictions for the Beck waterways, and unit availability for the Sir Adam Beck plants (Sir Adam Beck I, Sir Adam Beck II, and Sir Adam Beck Pump Generating Station) are used in the forecasting of the energy production for the Sir Adam Beck plants in the Niagara Utilization Model – Monthly. Other factors that may be adjusted in the Niagara forecasting application, if necessary, include Lake Ontario water levels, Grass Island Pool leakage level and operating patterns, pump generating station operating patterns, New York Power Authority's diversion and discharge capacities, and the Sir Adam Beck 25 cycle system load and frequency changer limits. These adjustments are based on comparisons of model results with actual values, and are used to improve forecast accuracy.

The Niagara energy forecasting model uses the generating unit efficiency ratings to calculate monthly energy production for the Sir Adam Beck units based on the forecast flows and unit outage information determined above. Based on an assessment of historical performance, the calculated production forecast values are modified to account for losses attributed primarily to automatic generation control, condense-mode operations, and excess base-load generation.

Potential water transactions with New York Power Authority are also computed in the forecasting application, with adjustments applied based on assessment of historical performance with respect to transactions (see Ex. G1-T1-S1 for a discussion of water transactions). However, water transactions with respect to the use of OPG's share of water by New York Power Authority are not included in the production forecast for the regulated hydroelectric facilities.

Under an agreement between OPG and FortisOntario Inc., energy is returned to FortisOntario (formerly Canadian Niagara Power) as compensation for the utilization at the Sir Adam Beck stations of the FortisOntario Niagara water entitlement. The returned energy attributed to FortisOntario is equivalent to over 650 GWh annually, and is included as part of the total Niagara energy forecast. It is separately shown in the tables within this exhibit.

2.1.2 DeCew Falls Diversion Flow and Energy Forecast

The DeCew Falls stations use water diverted from Lake Erie through the Welland Canal to produce electricity. Forecasts of diversion through the Welland Canal are prepared based on actual historical diversion flows, forecast Lake Erie water levels, outages planned for the DeCew plants, scheduled rowing regatta events (OPG voluntarily reduces generation to provide appropriate conditions for major events), and St Lawrence Seaway Management Corporation navigation needs and plans for canal maintenance.

Energy production forecasts for DeCew Falls I and II are made using a spreadsheet application known as Rivmonth. It uses forecast monthly DeCew Falls diversion flow, DeCew Falls unit availability information based on planned outages, and generating unit efficiency ratings to calculate the combined monthly energy production for the DeCew Falls stations.

2.1.3 <u>St. Lawrence River Flow and Saunders Energy Forecast</u>

Lake Ontario and the St. Lawrence River outflows and levels are regulated by the International St. Lawrence River Board of Control. The International St. Lawrence River Board of Control has established plans to provide for artificial control of the outflows and levels of Lake Ontario to satisfy the various interests that were identified at the time of the plans development. Each of these “plans” involves a model that determines the regulated Lake Ontario outflow and level. The initial plan for the regulation of the levels and outflows of Lake Ontario (Plan 1958-A) was implemented in April 1960. Following further studies and several years of operating experience, a second plan was developed in 1963. While this plan, Regulation Plan 1958-D, continues in use today, it is under review by the International Joint Commission, and could be modified or replaced by a new model to better reflect the interests of the multiple users of the water. The International St. Lawrence River Board of Control has the authority to deviate from the approved plan under specific conditions.

As a consistency check, the forecast monthly flow and Lake Ontario levels from Plan 1958-D model are compared with values produced by each of Environment Canada (Great Lakes – St. Lawrence Regulation Office) and New York Power Authority. They are then used as input to the Rivmonth energy production model for up to the first six months of the forecast period. Where knowledge of International St. Lawrence River Board of Control plans and strategies that will result in deviations from plan is available, adjustments are applied to reflect this information. Thereafter, the forecast monthly flows are estimated to be consistent with flow trends predicted by the Niagara River forecast. The R.H. Saunders generating unit efficiency ratings and outage schedule are also incorporated in the Rivmonth model.

3.0 OUTAGE PLANNING

Outage planning for OPG's hydroelectric generating stations is based on a streamlined reliability centred maintenance philosophy as described in Ex. A1-T4-S2.

Outages are generally planned to conduct:

- Major overhaul, rehabilitation or upgrade work.
- Preventative maintenance.
- Condition based maintenance.
- Inspection and testing.

The normal cyclical patterns of river flow within a year are considered when scheduling outages in order to minimize the "spilling" of water.

At the Niagara Plant Group, a consistent base maintenance program (utilizing streamlined reliability centred maintenance principles) is used except for major overhauls or upgrades. A major unit rehabilitation/upgrade program at the Sir Adam Beck II plant was started in 1996 and completed in 2005. At Sir Adam Beck I, nine of the ten generating units are currently available for service (seven units at 60 cycle, two units at 25 cycle, and one currently deregistered 25 cycle unit). OPG plans to undertake major rehabilitation on three units during the current business plan period. This will impact unit availability. It has been assumed that the two 25 cycle units will no longer be in-service after April 2009. The six pump/generating units at Sir Adam Beck Pump Generating Station were rehabilitated within the past ten years and the units have become more reliable. However, to ensure a reasonable level of reliability, more frequent corrective maintenance is required on these reversible pump generators than on conventional units because of the complexity of these generating units compared to conventional hydroelectric units and the increased wear and tear associated with frequent stopping and starting associated with its storage and peaking role for the power system.

A major mechanical rehabilitation program has also been completed at DeCew Falls II. Rehabilitation of the first and second units were completed in 2006 and 2007, respectively. There are currently no major rehabilitation programs planned for DeCew Falls I.

There are no major overhauls or upgrades planned for R.H. Saunders Generating Station during the test period. All units were upgraded in the 1990's with new, more efficient equipment which added 118 MW to the original station capacity. In addition, slots were cut between each of the units using a special diamond wire technique, to mitigate the effects of concrete "growth" caused by a phenomenon known as alkali-aggregate reaction. Alkali-aggregate reaction is a chemical reaction between the cement and certain types of aggregate within the concrete resulting in "growth" of the concrete structure.

The outage plan for R.H. Saunders is fairly consistent from year to year. Maintenance outages are scheduled on four units each year, thereby completing inspections and maintenance on each of the 16 units over a four year period. Outages requiring more than two units to be out-of-service simultaneously (e.g., transformer bank outages and black start tests), are typically of short duration (less than three days) and normally scheduled during the fall when St. Lawrence river flows are typically at their lowest. In general, outages do not impact production at R.H. Saunders.

4.0 REGULATED HYDROELECTRIC PRODUCTION FORECAST 2005-2009

The regulated hydroelectric production forecast for the period 2005 to 2009 is presented in E1-T1-S1 Table 1.