Operations Overview: Lower Mattagami River Project

MECC meeting, June 2011

# **Operation Overview Report**

Objective:

This report focuses on describing the existing and proposed Lower Mattagami Complex operating regime and OPG's methods to optimize the operation of the four generating stations.

Applies to EA Term and Condition 4:

EA Term and Condition 4 is intended to ensure that the operating regimen of the undertaking takes account of the need to maintain quality of aquatic habitat and the Department of Fisheries and Oceans' "No Net Loss Policy".

(a) OPG shall table a report, to MECC, describing the methods that it uses to optimize the present operating regimen of the Mattagami Complex, the power, energy, environmental, and other factors used in that optimization and the resulting operating regimen. That report shall serve as a reference point to monitor the effects of the undertaking.

# Hydrological Setting

The Mattagami River flows in a northerly direction a distance of approximately 418 km from its headwaters at Mesomikenda Lake to its confluence with the Moose River. Major tributaries of the Mattagami River include Groundhog River with a drainage area of 13,913 km<sup>2</sup>, and Kapuskasing River with a drainage area of 9111 km<sup>2</sup>. The Mattagami River drainage basin covers an area of 35,612 km<sup>2</sup>.



# **Station Characteristics**

Description		Little Long	Smoky Falls	Harmon	Kipling
In-service date	1963	1963	1931	1965	1966
Drainage area (km <sup>2</sup> )	36,310	36,310	36,480	36,500	36,510
Average annual flow (m <sup>3</sup> /s)	-	412	412	412	412
Maximum monthly flow (m <sup>3</sup> /s)	-	2865	2865	2865	2865
Minimum monthly flow (m <sup>3</sup> /s)	-	39	39	39	39
Absolute Maximum Operating Level	-	198.12	170.40	135.64	103.93
Maximum Operating Level <sup>1</sup>	-	198.12	170.30	135.10	103.02
Minimum Operating Level <sup>1</sup>	-	195.10	167.40	131.70	100.00
Absolute Minimum Operating Level	-	194.77	167.40	131.37	99.67
Gross operating head (m)	-	28.3	33.8	31.4	30.5
Drawdown range (m)	-	3.02	3.05	3.40	3.02
Surface area (ha)	-	7,600	530	300	130
Live storage (10 <sup>6</sup> m <sup>3</sup> )	-	161.9	6.7	6.9	3.2
Number of units	-	2	4	2	2
Unit size (MW)	-	69	13	71	77
Station capacity <sup>2</sup> (MW) (484 total)	-	138	52	142	154
Station discharge capacity, (m <sup>3</sup> /s)	-	583	186	527	598
Number of spillway sluices	8	2	10	2	2
Width (m)	12.2	12.2	8.4	12.2	12.2
Height (m)	9.2	9.2	9.2	9.2	9.2
Total capacity at FSL (m <sup>3</sup> /s) <sup>3</sup>	4870 <sup>5</sup>	1217 <sup>5</sup>	1182 <sup>6</sup>	1288	1217

#### Mattagami River System Water Management Plan (MRSWMP)

- The purpose of the MRSWMP is to provide certainty and clarity as to how waterpower facilities and associated control structures are operated.
- The MRSWMP examined a total of 10 hydroelectric stations and 8 storage dams on the Mattagami River and its tributaries (OPG owns 7 generating stations, 5 storage dams and 2 diversions).
- The approved MRSWMP regulates the management of in-stream flows and levels in the rivers and lakes that are affected by the operation of waterpower/water control structures.

## **Operational Overview**

OPG currently operates the Lower Mattagami Complex stations in a peaking mode (with the exception of the base loaded Smoky Falls GS) to optimize releases of water for power production in response to energy demand and changes in energy supply.

To achieve this, OPG operates the stations based on a number of factors which include:

- The availability of water (i.e., hydrologic conditions)
- Electricity demand (i.e., system electrical load requirements)
- Energy pricing (i.e., open market conditions)
- Operating constraints, based on the approved MRSWMP.

#### **Operational Overview con't**

- Smoky Falls GS has four generating units and is operated as a baseload station effectively 24 hour a day with a total rated flow capacity of 186 m<sup>3</sup>/s.
- Little Long, Harmon and Kipling each have two units with total rated flow capacities that range from 527 to 598 m<sup>3</sup>/s. These three stations are operated as peaking stations for various durations depending on available inflows.
- The different operating patterns require that Smoky Falls GS, Harmon GS and Kipling GS head pond water levels fluctuate daily.
- When river flows exceed the 583 m<sup>3</sup>/s maximum power flow of the Little Long GS, the Adam Creek Control Structure is used to spill Mattagami River flow into Adam Creek, which returns the flow into the Mattagami River approximately 17 km downstream of Kipling GS.



### **Operating Constraints**

- Facility constraints associated with the electrical, structural or hydraulic requirements of each storage/generating facility and legal/regulatory constraints established through Licenses of Occupation, Waterpower Lease Agreements or Land Use Permits.
- Environmental constraints constraints developed (MRSWMP) to mitigate environmental concerns associated with the regulation of levels and flows. Examples are minimum flow releases for maintenance of fish spawning habitat.
- Citizenship constraints constraints developed to benefit other users of the Mattagami River. One example is the Little Long Reservoir summer minimum head-pond level to enhance navigation.

## **Operating Objectives**

The hydroelectric stations in the Lower Mattagami Complex are considered "peaking" plants which typically operate 16 hours a day or less depending on inflow to the stations. Peaking generation is used to support "peak" load during the day when demand is at its highest and can also respond quickly to changes in supply from variable green energy sources such as solar or wind energy.



#### Lower Mattagami Complex Operations

Information and Operational Decision-Making Structure



## Proposed Lower Mattagami River Project

The Lower Mattagami River Project (LMRP) will consist of the following activities:

- Addition of a third turbine/generator unit at Little Long GS as well as upgrades to the existing two units to increase total station turbine capacity from 138 MW to 205 MW and the total station discharge capacity from 583 m<sup>3</sup>/s to approximately 860 m<sup>3</sup>/s.
- Addition of a third turbine/generator unit at Harmon GS as well as upgrades to the existing two units to increase total station capacity from 142 MW to 234 MW and the total station discharge capacity from 527 m<sup>3</sup>/s to approximately 860 m<sup>3</sup>/s.
- Addition of a third turbine/generator unit at Kipling GS to increase total station turbine capacity from 156 MW to 240 MW and the total station discharge capacity from 585 m<sup>3</sup>/s to 878 m<sup>3</sup>/s.
- Expansion of the Smoky Falls site, including construction of a new 3-unit powerhouse with an operating capacity of 270 MW and retirement of the existing 52-MW facility, thereby increasing the total station discharge capacity from 188 m<sup>3</sup>/s to 860 m<sup>3</sup>/s.

#### The LMRP will increase the total station capacity from the current 486 to 924 MW.

## **Proposed Operating Regime**

With the implementation of the LMRP:

- Water flows through the Lower Mattagami Complex facilities could be increased by approximately 277 m<sup>3</sup>/s.
- Operation of the (new) Smoky Falls GS would change from a baseload to a peaking operating regime.
- The Little Long, Harmon and Kipling GSs would continue to be operated as peaking facilities but more efficiently with the constraint at Smoky Falls removed.
- All four GSs could be operated in step, with each station discharging the same quantity of water and passing it to the next station downstream.
- During periods of high inflows the stations will, on average, be running at or near capacity, 7 days a week. During periods of lower inflows, all the generating stations will typically produce peak power during higher demand periods (e.g., weekdays) and allowed to fill up over the lower demand periods (e.g., weekends/evenings).
- The quantity of spill down Adam Creek is anticipated to be less than that currently experienced since the discharge capacities at the four GSs will increase by approximately 277 m<sup>3</sup>/s as a result of the LMR Project.

## **Adam Creek**

#### Pre-development vs. Post-development



## Proposed Operating Regime con't

Overall, the proposed LMRP would provide an optimized operating regimen, including greater operating flexibility which includes:

- increased flexibility through an ability to peak any combination of three units one, two or more times per day when required by the system.
- ability to schedule water more efficiently over a larger time step than one day (i.e., weekly), as opposed to the shorter duration limitations imposed by the Smoky Falls bottleneck.
- increased ability to meet energy emergencies and provide operating reserve to the system.
- Significant increase in support for future green energy supply initiatives such solar and wind.

## **Operating Constraints of the LMRP**

- Each station would continue to be operated within the established operating constraints in accordance with the approved operating plans prescribed by the MRSWMP.
- Maintain a daily average flow of 100 m<sup>3</sup>/s below Kipling GS based on the Terms and Conditions of the Provincial EA (If daily inflows are less than 100 m<sup>3</sup>/s, an amount equal to the average flow for that day through the Kipling plant).
- OPG proposes to maintain flows and levels downstream of Kipling by implementing a continuous shutdown limit of 19 hours, in combination with the average daily flow requirement.
- For Lake Sturgeon spawning protection, when water temperatures reach a minimum of 12 degrees centigrade, flows below Kipling will be equivalent to 1 unit continuous operations (approximately 240 m<sup>3</sup>/s) for 3 weeks.

#### Mattagami River Flows Downstream

The quantity of water available for use with the availability of an additional third unit will not change from existing conditions. The only potential change will be in the rate of change of drawdown.

While the drawdown would happen more quickly, recharge would also begin sooner minimizing exposure of shallow areas to effects of drying.

During low flow months, the Kipling GS units will be operated during the weekend to provide 100 m<sup>3</sup>/s daily average flows to maintain tailwater elevations.

In addition, a protection flow equivalent of a single unit continuous operation will be employed for 3 weeks to minimize the impacts of water level fluctuations during sensitive sturgeon spawning periods in the spring as inflows permit.

#### Summary of Proposed Operating Regime Changes

- Overall increase in flow through the Little Long, Smoky Falls, Harmon and Kipling stations during high flow periods such as spring freshet.
- Reduced fluctuations in the daily water levels in the Smoky Falls, Harmon and Kipling GS head ponds.
- Reduced spillage of water to Adam Creek and a shorter spill period.
- Increased water level fluctuations in the Mattagami River downstream from Kipling GS under certain conditions.
- Increased flows on weekends downstream from Kipling GS during lower flow periods due to requirement to pass a minimum of 100 m<sup>3</sup>/s daily average flow.
- Maintenance of flows and levels downstream of Kipling by implementing a continuous shutdown limit of 19 hours, in combination with the average daily flow requirement.
- Maintenance of flows below Kipling for Lake Sturgeon spawning protection by passing flows equivalent to 1 unit continuous operations (approximately 240 m<sup>3</sup>/s) for 3 weeks during Lake Sturgeon spawning period (while in-flows permit). These flows will be initiated when water temperatures reach a minimum of 12 degrees centigrade.