



# RALPH

## Automated Hydropower Dispatching

Hydro-Québec TransÉnergie ensures transmission grid reliability and generation/load balancing at all times. A team draws up an integrated schedule that is used to plan, for each hour of the day ahead, the output from the major reservoir generating stations according to energy needs, taking into account capacity limits on the main transmission corridors, equipment outages and interchanges with neighboring systems.

### *Supporting complex management*

With the integration of wind energy and the growth in exports, managing the generating fleet has become increasingly complex. The aim is to synchronize the availability of the required power and energy with transmission capabilities. RALPH makes it possible to simulate short-term dispatching of generation output. It presents a model of the transmission system for purposes of balancing generation and load. The application offers the possibility of configuring a multitude of parameters in order to apply specific generation strategies based on generating facility characteristics while staying within the constraints of the transmission system.

### *Characteristics of generating facilities*

RALPH uses a mathematical optimization approach to the dispatching of output from reservoir generating stations built on water systems. The application is based on an optimization model that takes into account the characteristics of the generating units in each power station (Hydro Unit Commitment). RALPH is destined to become a standard in the operation of a generating fleet over a 24-hour forecasting horizon.

Légende:		Groupes engagés des centrales																							
		Borne inf				Borne sup				Bornes inf & sup		Variation: sens inverse de la demande globale nette													
		Active	Violée	Active	Violée	Actives																			
Dem. glob. nette	Brissy	Lafrange_2	Lafrange_1	LG_4	LG_3	LG_2C	LG_2A	LG_1	Estmain_1	Estmain_1A	Sarcelle	Maic_5	Maic_SPA	Maic_3	Toulnisbuc	Maic_2	Maic_1	McComick	Outardes_4	Outardes_3	Outardes_2	Bersimis_1	Bersimis_2	Ste_Marguerite	
24h	10772	1	0	0	6	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1h	9956	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2h	9955	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3h	9659	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4h	9663	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5h	9658	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6h	10293	1	0	0	6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7h	12447	1	1	0	6	7	2	1	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8h	15626	1	0	4	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9h	16020	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10h	15889	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11h	16044	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12h	16162	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13h	15802	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14h	15932	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15h	15450	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16h	15427	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17h	15642	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18h	15962	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19h	15971	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20h	16835	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21h	16385	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22h	15102	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23h	14247	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24h	11119	1	0	0	6	7	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total de l'horizon</b>		<b>36</b>	<b>35</b>	<b>53</b>	<b>144</b>	<b>169</b>	<b>253</b>	<b>114</b>	<b>200</b>	<b>72</b>	<b>24</b>	<b>0</b>	<b>75</b>	<b>29</b>	<b>92</b>	<b>24</b>	<b>124</b>	<b>14</b>	<b>127</b>	<b>46</b>	<b>48</b>	<b>48</b>	<b>168</b>	<b>70</b>	<b>25</b>

Distribution of units in operation



Change in reservoir levels, along with end-of-day targets and hourly allowable minimum and maximum operating levels. The status of the generating units in the power stations at each reservoir is also shown so that dispatchers can see the sources of the variations in level.

### Main advantages

For each generating station, RALPH determines the units committed and their output for each hour of the day ahead. This approach makes it possible to

- > observe operating constraints
- > closely follow the generating strategy developed by Hydro-Québec Production
- > control efficiency deviations and unit startups and shutdowns

RALPH takes several parameters into account:

- > Availability of generating facilities (breakdowns, restrictions, etc.)
- > Reservoir filling rates (initial levels, operating levels, fluctuations in flow rates, etc.)
- > Transmission system status (losses, capacity limits, etc.)
- > Energy interchanges with neighboring systems

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