2008 QUÉBEC AREA

COMPREHENSIVE REVIEW

OF RESOURCE ADEQUACY

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A. Description of Resource Reliability Model

A.1.1 Load Model

A.1.1.1 Description of Load Model

GE MARS software uses a sequential Monte Carlo simulation to compute the reliability of a system comprised of a number of interconnected sub areas containing generation and load. The MARS model simulates the year repeatedly (multiple replications) to evaluate the impacts of a wide-range of possible random combinations of generator outages and load uncertainty. MARS employs an 8,760 hour chronological zonal load model. The load forecast currently used is based on demographic, economic and energy conditions, which are most likely to materialise.

A 1.1.2 Load Forecast Uncertainty

Load forecast uncertainty was determined by analysing Québec's internal load over the 1971 to 2006 period.

A 1.1.3 Loads of interconnected entities within the Area

The loads and resources of interconnected entities within the Area that are not members of the Area were not considered.

A 1.1.4 Demand Side Management

There are two interruptible load programs in Québec. Each program has it own customers.

Hydro-Québec Production's program cannot be called twice a day and not more than 100 hours per winter period. Therefore, a derate factor (30%) is applied to model operational constraints for planning purposes.

Hydro-Québec Distribution's program totals 722 MW for winter 2008/09 and 1 000 MW for the rest of the assessment period. Because conditions for this interruptible program are more flexible, a smaller reserve ratio (15%) is applied.

The 15% ratio was recently reassessed using a sequential Monte-Carlo model (FEPMC). The model allows a simulation of interruptible load dispatching according the specific program provisions. The results were presented to the CP-8 working group and to the TFCP Task Force of the NPCC.

A 1.2 Resource Unit Representation

A 1.2.1 Unit Ratings

A 1.2.1.1 Definitions

The capacity definitions used in the reliability evaluation are as follows:

- For hydroelectric generating stations of 50 MW and above

Dependable Maximum Net Generating Capability (DMNC) is defined as the net output a unit can sustain over a specified period modified for monthly limitations and reduced by the capacity required for station service or other auxiliaries. The DMNC must be sustainable for a minimum of two consecutive hours. The proper management of the reservoirs usually makes this capacity available on a daily basis. DMNC varies monthly.

- For hydroelectric generating stations less than 50 MW

These generating stations are the run-of-river plants. DMNC is based on historical generation.

- For thermal generating stations

DMNC is defined as the net output a unit can sustain over a two consecutive hour period. DMNC varies monthly subject to ambient temperature change.

A 1.2.1.2 Procedure for Verifying Ratings

The generating station ratings are based on annual maximum net output tests conducted between November and February of the following year. The procedure is in conformance with :

- NERC Reliability Standards TOP-002-00 and VAR-001-00;
- Criterion A-13, NPCC Verification of Generator Gross and Net Real Power Capability;
- Procedure C-07, NPCC Monitoring Procedures for the Guide for Rating Generating Capability.

A 1.2.2 Unit Unavailability Factors

A 1.2.2.1 Unavailability Factors Represented

Québec represents forced outage rates, planned outages, maintenances outages, and restrictions (hydraulic, electrical and mechanical) for each resource in the Resource Adequacy Assessment. To depict the states of the generating unit, an equivalent demand

forced outage rates (EFORd) is used. With the equivalent forced outage rates State Transition Rates for each unit of the generating station are determined.

A 1.2.2.2 Source of Unavailability Factors

- Forced Outage Rates

To depict the 4 states of the generating unit, an equivalent demand forced outage rates (EFORd) is used.
For existing Capacity resource, EFORd is determining for each specific Power Plant unit from the 5 year historical performance data (2003 to 2007).
The EFORd serves as an estimate of the transition rates in the studied period.

$$\text{EFORd} = \frac{Fr.FOH + Fp.(EFOH - FOH)}{SH + Fr.FOH}.$$

Where

$$\text{Fr} = \text{Full factor} = \frac{(1/r) + (1/T)}{(1/r) + (1/T) + (1/D)}$$

$$\text{Fp} = \frac{ServiceHours}{AvailableHours}$$

r = Average forced outage duration
T = Average reserve shut-down time between periods of need
D = Average in-service time per occasion of demand
FOH = Full Forced Outage Hours
EFOH = Equivalent full Forced Outage Hours i.e the number of hours a unit was involved in an outage expressed as equivalent hours of full forced outage at its maximum net dependable capability
SH = Service Hours

- Maintenance

A daily representation of a generator's scheduled outages is modeled for each unit, based on the 2008 schedules for planned outages.

Unit outage data is based on historical data for the years 2003-2007.

A 1.2.2.3 Maturity Considerations

Hydro units not having a complete 5-year historical data were given an outage rate equal to the historical average of hydraulic units in Québec.

A 1.2.2.4 Tabulation of Unavailability Factors

Table A-1 Equivalent Forced Outage Rates

Unit Type	Comprehensive Review 2005 FOR	2008 EFORd
Hydro Unit	1.1% to 1.8%	0.3% to 1.8%
Thermal Unit	4% to 9%	6.5% to 20.5%

Maintenance

2008 schedules for planned outages are used. The monthly volumes are comparable to historical volumes shown in the following table.

Table A.2 – Typical Maintenance for Power Station

Month	Maintenance Comprehensive Review 2005	2008
January	0.4%	0.2%
February	0.4%	0.7%
March	4.4%	0.9%
April	13.7%	7.8%
May	17.7%	16.9%
June	22.5%	21.2%
July	24.9%	18.6%
August	17.1%	19.5%
September	21.6%	15.7%
October	10.5%	10.1%
November	5.3%	5.1%
December	0.4%	0.4%

A 1.2.3 Purchase and Sale Representation

Purchases

Based on Hydro-Québec Distribution procurement policies, suppliers located outside the Québec Control Area must be treated on the same basis as local suppliers, as long as they provide an equivalent quality of service. Hydro-Québec Distribution calls for tenders are open to existing or new power units as well as to new demand response programs. All suppliers must provide a guarantee that the resources offered are not committed elsewhere.

The capacity purchases from other Control Areas and sales to other Control Areas are shown in Table A.2.

Table A.2

Firm Purchases and Firm Sales in MW

Firm Purchases	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
- New York CA	340				
- Maritimes CA	200	200	200		
Total Purchases	540	200	200	0	0

Firm Sales	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
- Maritimes CA	220				
- New England CA	329	329	329	329	268
- Ontario CA	154	154	154	154	154
- Québec CA	356	356	356	356	356
Total New Generation	1,059	839	839	839	778

Churchill Falls Corporation Limited (CFLC0)

The capacity purchases are represented according to the contracts between Hydro-Québec and CFLCo.

Québec has access to 4,930 MW during winter and from 2,900 to 4,200 MW during the rest of the year.