NPCC 2017 Ontario Interim Review of Resource Adequacy

FOR THE PERIOD FROM 2018 TO 2020

APPROVED BY THE RCC ON DECEMBER 5, 2017

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Document Change History

Issue	Reason for Issue	Date
1.0	For submission to CP-8	September 20, 2017
2.0	For submission to TFCP	October 5, 2017

1 EXECUTIVE SUMMARY

The Independent Electricity System Operator (IESO) submits this assessment of resource adequacy for the Ontario Area in accordance with the Northeast Power Coordinating Council (NPCC) Regional Reliability Reference Directory #1, "Design and Operation of the Bulk Power System."

The 2017 Interim Review of Resource Adequacy covers the study period from 2018 through 2020 and identifies changes in assumptions from the 2015 Comprehensive Review, including changes to facilities and system conditions, generation resources' availability, demand forecast and the impact of these changes on the overall reliability of the Ontario electricity system.

The results presented in Table 1 conclude that Ontario will be able to meet the NPCC resource adequacy criterion that limits the loss of load expectation (LOLE) to no more than 0.1 days/year for all years within the study period (2018 to 2020) for both demand scenarios.

For the median demand growth scenario, the NPCC criterion is satisfied for all three forecast years with existing and planned resources. There is no need for rescheduling planned maintenance outages or invoking Emergency Operating Procedures (EOP) to meet the LOLE criterion.

For the high demand growth scenario, rescheduling planned maintenance outages would be needed to satisfy the NPCC criterion for 2018 and 2019 forecast years with existing and planned resources. For the 2020 forecast year, rescheduling planned maintenance outages and invoking limited EOP would be needed to meet the LOLE criterion. Alternatively, NPCC criterion for all three forecast years can be met by invoking EOP only.

Table 1 Annual LOLE Values - Median and High Demand Forecast

Scenario	Outages Rescheduled	Tie Benefits (MW)	EOP	LOLE [days/year]		
				2018	2019	2020
Median	No	0	No	0.069	0.020	0.006
High	No	0	No	0.106	0.111	0.150
	Yes	0	No	0.092	0.094	0.115
	Yes	0	Yes	-	-	0.076
	No	0	Yes	0.073	0.077	0.099

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2.1 List of Tables

2 INTRODUCTION

The 2017 Interim Review of Resource Adequacy for Ontario is submitted to NPCC to demonstrate compliance with the resource adequacy requirements of NPCC Regional Reliability Reference Directory #1, *"Design and Operation of the Bulk Power System."* This report was prepared by the Independent Electricity System Operator (IESO) in its role as the Planning Coordinator for Ontario.

The 2017 Interim Review of Resource Adequacy covers the study period from 2018 through 2020. This report describes changes in assumptions from the 2015 Comprehensive Review, including changes to facilities and system conditions, generation resources' availability, demand forecast and the impact of these changes on the overall reliability of the Ontario's electricity system.

The assessment is based on information available to the IESO as of June 2017.

3 CHANGES IN ASSUMPTION FROM 2015 COMPREHENSIVE REVIEW

3.1 Demand Forecast[1]

Table 2 compares the peak demand forecasts for the 2017 Interim Review with the 2015 Comprehensive Review under median and high demand growth scenarios for the overlapping years. Although point forecasts are presented for both the median and high demand growth scenarios, each scenario has an associated "uncertainty" distribution which recognizes the variability of demand due to weather volatility.

Table 2 Comparison of Demand Forecasts

Year	Normal Weather Summer Peak [MW]					
	Median Demand Growth			High Demand Growth		
	2015 Review	2017 Review	Difference between 2017 and 2015	2015 Review	2017 Review	Difference between 2017 and 2015
2018	22,790	22,381	-409	24,431	22,605	-1,826
2019	22,669	22,295	-374	24,936	23,187	-1,749
2020	22,522	22,209	-313	24,886	23,808	-1,078
Average Growth Rate (2018-2020)	-0.59%	-0.38%		2.89%	2.63%	

Ontario grid demand is shaped by two opposing sets of drivers: those that increase grid demand and those that act to reduce it. Economic expansion, population growth and increased penetration of electrically powered devices act to increase the need for grid-

[1] http://www.ieso.ca/-/media/files/ieso/document-library/planning-forecasts/18-month-outlook/18monthoutlook_2017sep.pdf?la=en

supplied electricity. Conservation programs, increasing embedded generation output and price incentives act to reduce the amount of grid-supplied electricity needed. The interplay of these drivers will shape both peak and energy demand over the course of the forecast period.

When comparing the demand forecasts in the 2015 Comprehensive Review and the 2017 Interim Review, the differences are attributable to two items:

- The opposing sets of drivers described in the previous paragraph. These factors have been updated in the 2017 Interim Review to reflect the most recent information available. Though none of the drivers have changed significantly, the aggregation of the many small changes lead to a shift in the total forecast demand.
- When 2016 actual historical demand data was included in the updated forecast for 2017 Interim Review, this resulted in resetting the starting point of the demand forecast thus having an impact on the ensuing demand levels. The resetting of the starting point resulted in both lower energy and peak demand compared to that of the 2015 Comprehensive Review forecast.

Drivers that increase grid demand and those that act to reduce it

Over the forecast horizon, the summer peaks are expected to decline under the median growth scenario. This is because downward pressure from price impacts, increased conservation savings and the growth in embedded generation output is likely to outstrip the underlying growth in demand from economic expansion and population growth. There are two other factors that causes demand to decline, these are:

- As embedded solar output increases the net result is that demand is lowered and the peak is pushed later in the day in summer.
- Also, pricing impacts further reduce peak demands as the Industrial Conservation Initiative (ICI) incents large users to reduce demand during peak conditions and time-of-use encourages shifting of load to non-peak periods. Effective January 2017, ICI eligibility has been expanded to include all electricity users with a monthly average peak demand of over 1 MW. In April 2017, the threshold was reduced to 500 kilowatts for manufacturers and greenhouses.

Despite all the changes incorporated into the updated forecast, the growth trajectories for the summer peaks remain very similar to those in the 2015 Comprehensive Review (negative growth for the median growth scenario and positive growth for the high growth scenario).

In the high growth scenario, the summer peaks are expected to grow over the forecast horizon as strong economic growth and population growth combined with increased electrification due to carbon reduction strategies spur electricity demand. The factors offsetting the growth – embedded generation, electricity prices and conservation – are not likely to be strong enough to offset the underlying growth.

3.2 Resource Forecast

Table 3 compares the capacity of supply resources at the time of the summer peak for the current 2017 Interim Review with the 2015 Comprehensive Review. This 2017 review assumes resource availability based on the latest available information for existing and planned resources. These values do not include generators that operate within local distribution company (LDC) service areas (embedded generation), except for those that participate in the IESO-administered markets.

Available resources are determined based on the following:

1) Historical median contribution of hydro resources during weekday peak demand hours;
2) Total capacity available from thermal units (nuclear, gas, oil and biofuel) after discounting for seasonal derating;
3) Historical median contribution of wind and solar resources during the peak demand hours; and
4) Projected effective capacity of the following demand-side resources: Demand Response (DR) / Capacity-Based Demand Response (CBDR) and Dispatchable Loads.

Table 3 shows how the available capacity of supply resources has changed compared to the 2015 Comprehensive Review. Reductions due to planned outages are not accounted for in this table. However, the effects of nuclear refurbishments are reflected as reduction in available capacity.

Table 3 Comparison of Available Resource Forecasts (MW)

Year	Summer Peak		
	2015 Review	2017 Review	Difference between 2017 and 2015
2018	27,757	27,831	74
2019	27,687	28,800	1,113
2020	28,560	28,031	-529

The differences in available resources between the 2017 Interim Review and the 2015 Comprehensive Review are primarily due to:

- A nuclear refurbishment outage that was previously expected to take place commencing in 2017 has been deferred, leading to increased resource availability in 2018 and 2019.
- Additionally, in 2018, increased nuclear capacity is offset by decrease in gas capacity due to renegotiated non-utility generator contracts and delayed in-service dates of future resources.

The remaining differences in resources are from small updates to hydroelectric, wind, solar and biofuel resource contributions.

Table 4 lists the major projects expected over the study period.

Table 4 Major Projects

Project Name	Fuel Type	Capacity (MW)
Belle River Wind	Wind	100
Napanee Generating Station	Gas	985
North Kent Wind 1	Wind	100
Amherst Island Wind	Wind	75

3.3 Transfer Capabilities and Fuel Supply

Northwestern Ontario is connected to the rest of the province by the 230 kV double-circuit East–West Tie. Local demand growth is forecasted as a result of an active mining sector in the region. However, existing transmission constraints may restrict the connection of additional generation in the area. To address these concerns, the addition of a 230 kV new double-circuit transmission line under the East-West Tie expansion project is planned. This expansion is primarily required to ensure reliability of supply to the northwest while accommodating the forecast load growth for the region. The IESO is currently assessing the need for this project, including whether the East-West Tie project continues to be the least cost solution for meeting the reliability needs in the region.

Considering Ontario's robust gas-pipeline infrastructure and history of coordinated gas-electric operations, it is not expected that Onatrio's gas generators will experience any material fuel supply constraints within the study period.

3.4 Emergency Operating Procedures

Emergency Operating Procedures (EOP) are used in the resource adequacy assessment if the existing and planned resources are not sufficient to meet the Loss of Load Expectation (LOLE) criterion. Table 5 summarizes the assumptions regarding the demand relief from EOP used when required in this study. For this study, all EOP are applied in one block.

Table 5 Emergency Operating Procedure Assumptions

EOP Measure	EOP Impact % of Demand
Public Appeals	1.0
No 30-minute OR (473 MW)	0*
No 10-minute OR (945 MW)	0*
Voltage Reductions	2.0
Aggregated Net Impact	**3.0**

* Although 30-minute and 10-minute Operating Reserve (OR) are included in this list of EOP, the analysis does not impose a requirement to provide for OR since only loss of load events are being considered. Therefore, the net benefit of applying EOP in the analysis excludes relaxation of OR requirements.

3.5 Forced Outage Rates

The IESO made two updates regarding forced outage rates in the 2017 Interim Review compared to the 2015 Comprehensive Review. First, the historical data has been updated as another two years of unit outage data became available. Second, the IESO has changed its methodology for calculating forced outage rates for these assessments. Instead of Equivalent Forced Outage Rates (EFOR), the IESO now uses Equivalent Forced Outage Rates on Demand (EFORd)[2]. While these updates have changed the weighted average values for the nuclear and gas/oil units, the net effect to the LOLE was not significant.

The resultant calculated EFORd based on the historical five-year generator performance record is shown in Table 6. For comparison purposes, Table 7 shows EFOR reported in the 2015 Comprehensive Review.

Table 6 Ontario's EFORd

Fuel Type	Weighted Average EFORd	Range of EFORd
Nuclear	5.69%	2.0 – 11.6%
Gas/Oil	9.1%	1.4 – 50%
Biofuel	2.6%	2.6%

Table 7 EFOR from 2015 Review

Fuel Type	Weighted Average EFOR	Range of EFOR
Nuclear	8.4%	3 - 20%
Gas/Oil	5.0%	1 - 50%
Biofuel	4.4%	4.4%

3.6 Firm Transactions: Purchase and Sale of Capacity

In November 2016, the IESO and Hydro-Québec (HQ) signed the *Electricity Trade Agreement* that extends to 2023 and includes three components: energy, capacity and cycling. This agreement was built on the *Seasonal Capacity Sharing Agreement* under which the two provinces agreed to exchange capacity during their respective peak periods. Under the electricity trade agreement:

[2] IESO applied this change in 2016 and this change was captured in 2016 NPCC Interim Review.

- Ontario will continue to supply Québec with 500 MW of capacity each winter from December to March until 2023;
- Québec will provide up to two terawatt hours of energy for seven years, until 2023. This energy will be targeted to displace greenhouse gas-emitting resources; and
- The IESO and HQ agreed to cycle surplus energy from Ontario to Québec so that it can be returned to displace future production from greenhouse gas-emitting resources.

Compared to the 2015 Comprehensive Review, in which 500 MW of capacity to Québec was modelled for winter of 2016/2017 and winter of 2017/18, Ontario is now obligated to provide this capacity each winter season up to 2023. Therefore, 500 MW of capacity to Québec was modelled for all winter seasons covered in this assessment. For this review, the capacity component of the seasonal capacity sharing agreement is modelled.

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4 RESOURCE ADEQUACY ASSESSMENT

The probabilistic resource adequacy assessment is performed using GE-MARS. The following inputs are used:

- Median and high demand growth forecast and load forecast uncertainty (LFU);
- Forecast of available resources and EOP;
- Planned outage schedules submitted by market participants;
- Equivalent Forced Outage Rates on Demand (EFORd) for thermal units derived using historical generator performance data; and
- Transmission limits of major interfaces connecting different zones.

The above inputs are described in greater detail in the 2015 Comprehensive Review as well as in the Methodology to Perform Long Term Assessments.

4.1 Assessment Results

The results for the median and high demand growth scenarios are presented in Table 8 and show that the NPCC LOLE criterion is satisfied for the forecasted scenarios.

For the median demand growth scenario, the NPCC criterion is satisfied for 2018, 2019 and 2020 with existing and planned resources. For all three forecast years under review, there is no need for rescheduling planned maintenance outages or invoking EOP to meet the LOLE criterion.

For the high demand growth scenario, rescheduling planned maintenance outages would be required to satisfy the NPCC criterion for 2018 and 2019 forecast years with existing and planned resources. For the 2020 forecast year, rescheduling planned maintenance outages and invoking limited EOP (Public Appeals only) would be required to meet the LOLE criterion. Alternatively, the NPCC criterion for all three forecast years can be met by invoking limited EOP only.

Table 8 Annual LOLE Values, Median and High Demand Forecast

Scenario	Outages Rescheduled	Tie Benefits (MW)	EOP	2018	2019	2020
Median	No	0	No	0.069	0.020	0.006
High	No	0	No	0.106	0.111	0.150
High	Yes	0	No	0.092	0.094	0.115
High	Yes	0	Yes*	-	-	0.076
High	No	0	Yes*	0.073	0.077	0.099

**Limited EOP were activated – Public Appeals only.*

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