Kitchener-Waterloo-Cambridge-Guelph IRRP

Appendix B: Needs Assessment

Table A-6: Peak Capacity Contribution Assumptions

Resource Type	Peak Capacity Contribution (% of installed capacity)
Biomass/Gas	98%
Hydro	71%
Solar	30%
Wind	14%

A.4 Planning Demand Forecast and Scenarios

A.4.1 Near- and Medium-Term Planning Forecast 2014-2023

Table A-7: Near- and Medium-Term Planning Forecast 2014-2023 – KWCG Region

Near-and Medium-Term Planning Forecast (MW)										
Municipalities	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Guelph & Rockwood	291	301	314	322	331	325	334	341	349	357
Waterloo, Wellesley, & Woolwich	308	316	326	335	349	361	364	371	376	384
Cambridge & North Dumfries	304	313	318	324	330	336	345	348	356	363
Kitchener & Wilmot	417	421	425	435	439	440	443	445	449	453
Wellington County & Blandford-Blenheim (Oxford County)	166	166	166	168	169	168	168	168	169	170
Total	1486	1517	1549	1584	1619	1629	1653	1673	1699	1727

PSS/E Base case and Bulk System Conditions

The KWCG transmission system was assessed using PSS/E Power System Simulation software. The PSS/E base case for the KWCG Region regional planning study was adapted from the 2015 base case that was produced by the IESO for the 2010 Northeast Power Coordinating Council ("NPCC") review.

The following bulk system conditions were assumed for purpose of the power flow simulation studies:

- All eight Bruce units and the new 500 kV double-circuit line between the Bruce Complex and Milton SS. All units at Darlington are assumed to be in-service, and all of the units at Pickering GS are assumed to be unavailable.
- Renewable generation in the Bruce and other parts of southwestern Ontario will have an impact on the bulk system flows into the KWCG Region. About 1,800 MW of wind output in the Bruce area and about 400 MW of renewable output from southwestern Ontario (Buchanan, Chatham and Sarnia).

Equipment Rating

For transmission facilities, continuous and limited time ratings based on an ambient temperature of 35°C for summer and a wind speed of 4 km/hour were respected.

Demand Forecast

The KWCG transmission system is assessed under the near- and medium-term planning forecast (2014-2023) and longer-term planning forecast scenarios (2024-2033), provided in Appendix A.4.

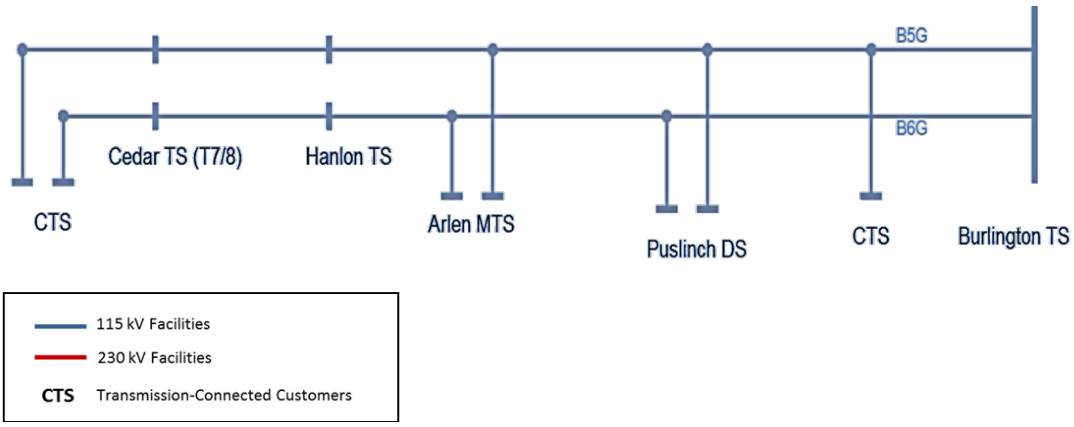
B.3 Load Meeting Capability (LMC) of the Existing KWCG Transmission System

Supply capacity describes the electricity system's ability to provide continuous supply to a local area. This is limited by the load meeting capability ("LMC"). The LMC of transmission or sub-system is defined the maximum demand that can be supplied on a transmission line or sub-system under applicable transmission and generation outage scenarios as prescribed by ORTAC.

B.3.1 South Central Guelph 115 kV Sub-system: LMC and Supply Capacity Needs

The South-Central Guelph 115 kV sub-system (B5/6G) is a double circuit 115 kV transmission line supplying Cedar TS (T7/8), Hanlon TS, Arlen MTS, Puslinch DS and two transmission-connected customers, as shown in Figure B-2.

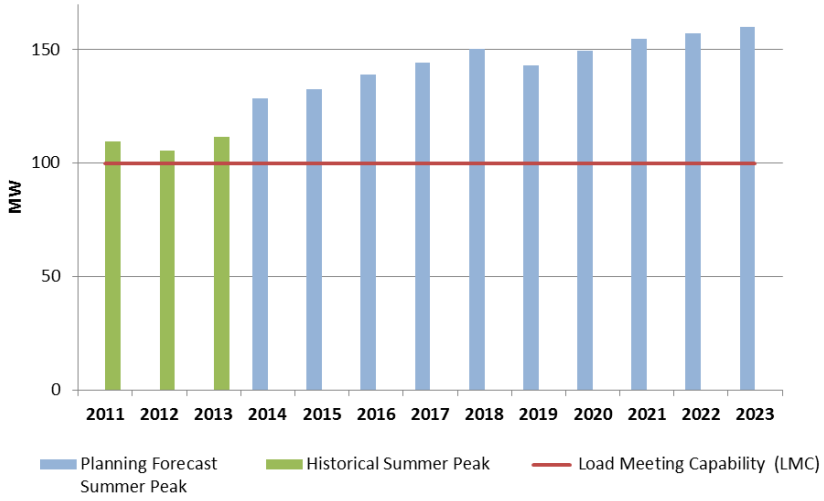
Figure B-2: South-Central Guelph 115 kV Sub-system



Based on the application of ORTAC criteria, this system has an LMC of 100 MW. This limit is based on the voltage limitations of the B5G circuit, assuming the B6G is out-of-service.

As shown in Figure B-3, the summer peak demand in the South-Central Guelph area has already exceeded the 100 MW LMC limit of the South-Central Guelph 115 kV system over the last couple of years. The existing South-Central Guelph 115 kV system does not meet the ORTAC supply capacity criteria.

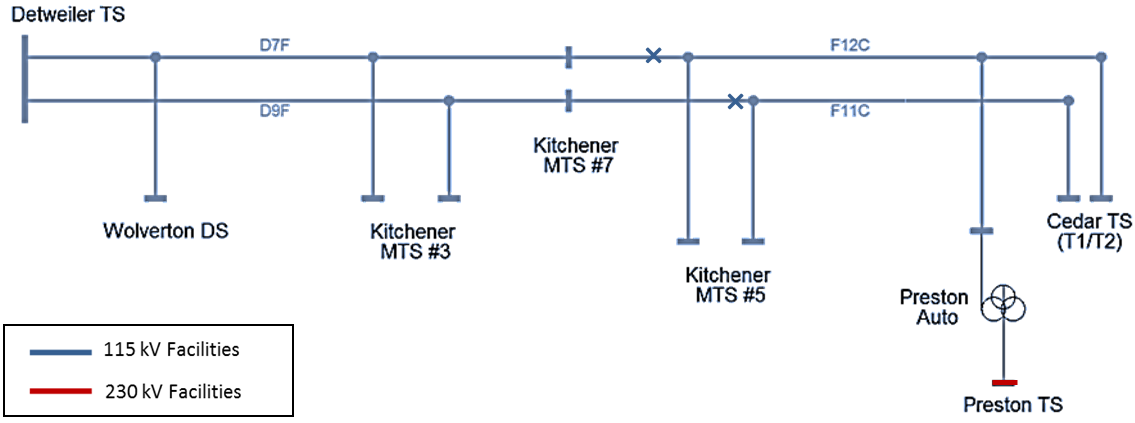
Figure B-3: Summer Peak Demand on South-Central Guelph 115 kV Sub-system



B.3.2 Kitchener-Guelph 115 kV Sub-system: LMC and Supply Capacity Needs

The Kitchener-Guelph 115 kV sub-system (D7/9F and F11/12C) is a double circuit 115 kV transmission line supplying Cedar TS (T1/T2), Kitchener MTS #5, Kitchener MTS #7, Kitchener MTS #3, and Wolverton DS, as shown in Figure B-4.

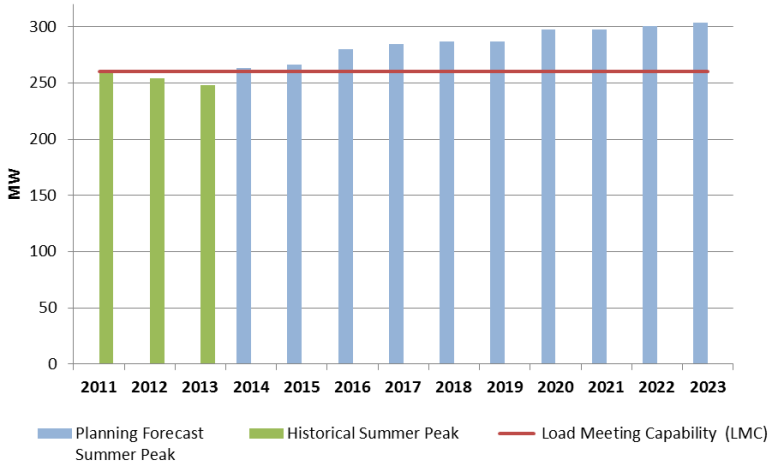
Figure B-4: Kitchener-Guelph 115 kV Sub-system



Based on the application of ORTAC criteria, this system has a LMC of 260 MW. This limit is based on the thermal overloading of the D7F circuit, assuming the D9F circuit is out-of-service.

As shown in Figure B-5, the summer peak demand in the Kitchener and Guelph area exceeded the 260 MW LMC limit of the Kitchener-Guelph 115 kV system in the summer of 2014. Given the forecast near- and medium-term summer peak demand growth, the existing Kitchener-Guelph 115 kV system does not meet the ORTAC supply capacity criteria.

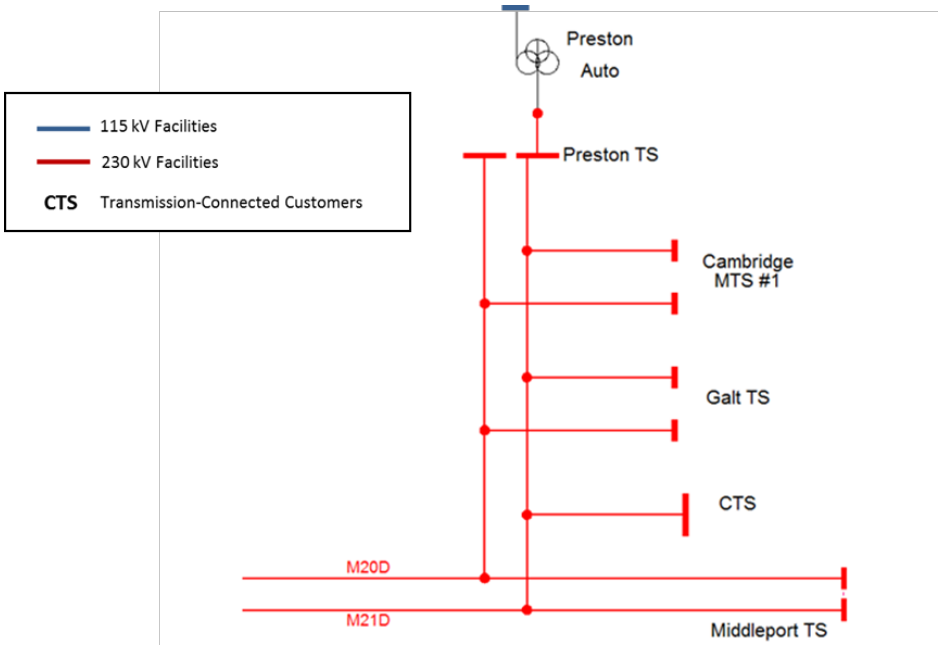
Figure B-5: Summer Peak Demand on Kitchener-Guelph 115 kV Sub-system



B.3.3 Cambridge 230 kV Sub-system: LMC and Supply Capacity Needs

The Cambridge 230 kV sub-system (M20/21D) is a double circuit 230 kV transmission line supplying Preston TS, Cambridge MTS #1, Galt TS and a transmission-connected customer, as shown in Figure B-6 below. Today, this 230 kV transmission is the main source of supply to customers in the Cambridge area.

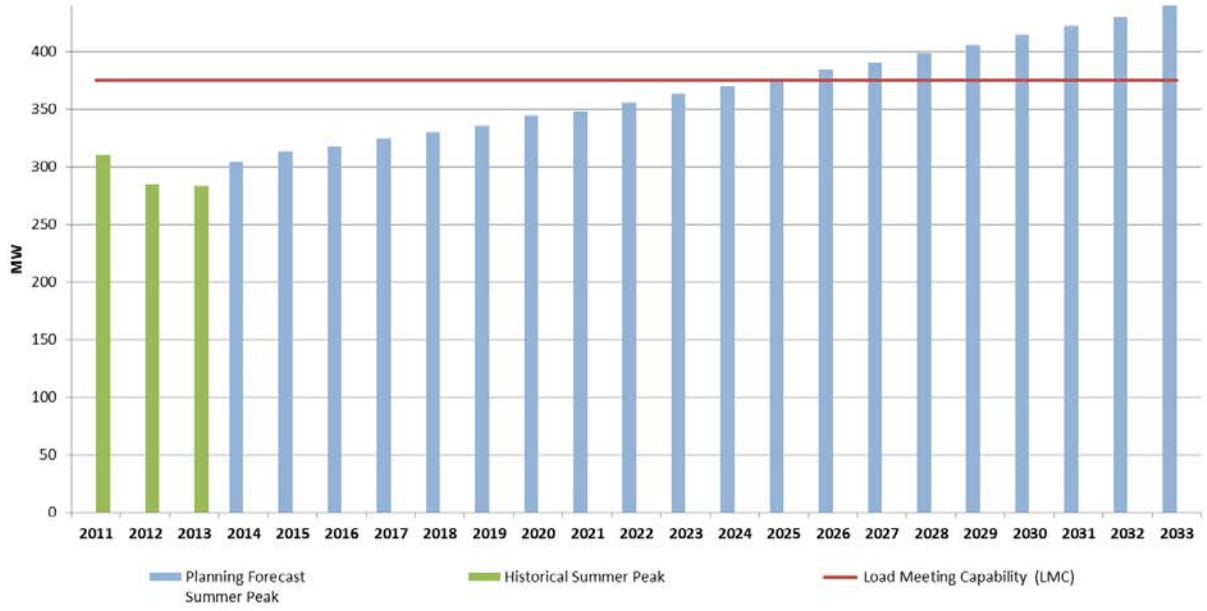
Figure B-6: Cambridge 230 kV Sub-system



Based on the application of ORTAC criteria, this system has a LMC of 375 MW. This limit is based on the thermal overloading of the M20D circuit, assuming the M21D circuit is out-of-service.

Under the high-growth scenario (Figure B-7), the summer peak demand on the Cambridge 230 kV sub-system will exceed the 375 MW LMC limit in the summer of 2026 and will not meet the ORTAC supply capacity criteria.

Figure B-7: Summer Peak Demand on Cambridge 230 kV Sub-system



Over the longer term, future electricity demand growth in Cambridge can be supplied on the Kitchener-Guelph 115 kV sub-system. Once the GATR project comes into service around 2016, there will be sufficient capacity on the Kitchener-Guelph 115 kV system to supply up to 100 MW of peak demand growth in the Cambridge area. Therefore, there are no supply capacity needs identified in the Cambridge area beyond 2023.

Kitchener-Waterloo-Cambridge-Guelph IRRP

Appendix C: Transmission Options to Improve Load Restoration on Cambridge-Kitchener 230 kV Sub-system

Appendix C: Transmission Options to Improve Load Restoration on Cambridge-Kitchener 230 kV Sub-system

Figure C-1: Options to Improve Restoration on Cambridge-Kitchener 230 kV Sub-system

Option	Options to Improve Restoration	Fault on Middleport X Detweiler - Restorable Load (Note 2)	Fault on Galt junction X Preston TS – Restorable Load (Note 2)	Cost (Note 3)	Cost/Load Restored
--	Cambridge-Kitchener 230 kV sub-system (After GATR comes in-service – Note 1)	100 MW (Cambridge & North Dumfries Hydro's load – Note 4)	100 MW (Cambridge & North Dumfries Hydro's load – Note 4)	0	$0/MW
1	230 kV in-line switches on M20/21D at **Preston Junction**	100 MW (Cambridge & North Dumfries Hydro's load – Note 4)	100 MW (Cambridge & North Dumfries Hydro's load – Note 4)	$6M	$60k/MW
2	230 kV in-line switches on M20/21D at **Galt Junction**	135 MW (Kitchener Wilmot Hydro's load) 400 MW (Cambridge & North Dumfries Hydro's load – Note 4)	135 MW (Kitchener Wilmot Hydro's load) 100 MW (Cambridge & North Dumfries Hydro's load – Note 4)	$6M	$11k/MW to $25k/MW
3	One 230 kV cap bank at Preston TS plus 230 kV in-line switches on M20/21D at **Preston Junction**	140 MW (Cambridge & North Dumfries Hydro's load – Note 4)	140 MW (Cambridge & North Dumfries Hydro's load – Note 4)	$11M	$79k/MW
4	2nd auto-transformer at Preston TS plus 230 kV in-line switches on M20/21D at **Preston Junction**	200 MW (Cambridge & North Dumfries Hydro's load – Note 4)	200 MW (Cambridge & North Dumfries Hydro's load – Note 4)	$21M	$105k/MW
5	2nd auto-transformer at Preston TS plus 230 kV in-line switches on M20/21D at Preston Junction plus two 230 kV cap banks at **Preston TS**	280 MW (Cambridge & North Dumfries Hydro's load – Note 4)	280 MW (Cambridge & North Dumfries Hydro's load – Note 4)	$31M	$111k/MW

Notes: (1) Prior to the installation of the GATR project, only 65 MW of electricity supply in Cambridge can be restored within 30 minutes through the existing auto-transformers at Preston TS. (2) Restorable load values are approximate values only as the actual amount of restorable load will depend on the prevailing system conditions and Operating/Control Centre protocols and priorities and are based on the KWCG IRRP planning forecast. (3) All prices are based on historical data: taxes extra, overhead extra, no escalation considered, no assumptions are made to feasibility or construction, no assumptions made as to space requirements, real estate and environmental cost extra. (4) Restoration of 230 kV connected load (Cambridge and North Dumfries Hydro's load) via the Preston TS auto-transformer may require operational measures on the 115 kV system to secure the transmission system to hand a subsequent contingency e.g., open low voltage bus-tie breakers/switches at 115 kV connected stations.