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1 **8 Determination and Description of Development Plans**

2

3 **8.0 Chapter Overview**

4 This chapter explains the strategies and components of the various development plans that
5 Manitoba Hydro has chosen to evaluate in this submission.

6

7 Development plans are formulated using the resource options selected in **Chapter 7 –**
8 **Screening of Manitoba Resource Options** and consider economic, financial, environmental, and
9 socio-economic/provincial characteristics. All development plans must be able to meet
10 Manitoba Hydro’s expected domestic load and existing firm export commitments which are
11 described in **Chapter 4 – The Need for New Resources**. Further to this requirement, plans are
12 determined in consideration of various strategic business opportunities and, in subsequent
13 chapters, are comparatively evaluated to identify the optimal plan for Manitobans. For
14 example, the development plans with a new transmission interconnection incorporate
15 opportunities to serve export market customers and increase U.S. transmission interconnection
16 capability. Alternatively, a development plan that provides the opportunity to minimize capital
17 investment uses natural gas-based generation resources sufficient to meet only Manitoba
18 Hydro’s expected domestic load and existing firm export commitments.

19

20 The Preferred Development Plan together with the alternative development plans defined in
21 this chapter provide the basis for all further evaluation in this submission.

22

23 **8.1 Introduction**

24 *The Manitoba Hydro Act* and *The Sustainable Development Act* provide the context for the
25 formulation of Manitoba Hydro’s development plans. *The Manitoba Hydro Act* Section 2
26 mandates that Manitoba Hydro “provide for the continuance of a supply of power adequate for

1 the needs of the province, and to engage in and to promote economy and efficiency in the
2 development, generation, transmission, distribution, supply and end-use of power”. *The*
3 *Sustainable Development Act* Schedule A section 1(1) sets out the framework for sustainable
4 development which includes the principle that “economic decisions should adequately reflect
5 environmental, human health and social effects”.

6
7 The direction provided in these Acts is reflected in the determination of development plans and
8 their analysis through the consideration of economic, financial, environmental, and socio-
9 economic impacts as well as through multiple-account benefit-cost analysis.

10
11 As described in **Chapter 4 – The Need for New Resources**, the 2012 Load Forecast indicates that
12 new resources are required in the year 2022/23 to ensure Manitoba electricity users continue
13 to have adequate power for their future needs. The formulation of each development plan is
14 based on this need for new resources and the requirement to achieve a reliable and
15 dependable supply for the bulk power system in Manitoba through the application of Manitoba
16 Hydro’s Generation Planning Criteria. All development plans meet or exceed these criteria.

17
18 The plans must also provide sufficient dependable energy and winter peak capacity to meet the
19 projected requirements for the entire 35-year study period. Further to this requirement,
20 Manitoba Hydro formulates development plans that will incorporate opportunities such as
21 building new transmission interconnections, pursuing other renewable resources or pursuing
22 export sales for the overall benefit of Manitoba.

23
24
25

1 **8.2 Formulation of Development Plans**

2 **Chapter 7 – Screening of Manitoba Resource Options** identified the following resource options
3 to be used in the determination of development plans:

- 4 • demand-side management programs
- 5 • Keeyask Generating Station (G.S.)
- 6 • Conawapa Generating Station (G.S.)
- 7 • on-shore wind generation
- 8 • natural gas-fired generation
- 9 • imports.

10

11 For a description of the characteristics of the selected resource options see **Chapter 7 –**
12 **Screening of Manitoba Resource Options.**

13

14 Development plans are comprised of a sufficient number and size of resources to meet
15 requirements or address opportunities over a 35-year planning horizon. A long-term
16 perspective is required due to the long lead time and the long life of the resource options under
17 consideration.

18

19 **8.2.1 Resource Option Descriptions**

20 The differing characteristics of resource options are taken into consideration when formulating
21 development plans. Based on 2012 planning assumptions, the following resource options have
22 been considered.

23

24 **Keeyask Generating Station**

25 The earliest in-service date (ISD) by which Keeyask G.S. can be developed is 2019/20. Keeyask is
26 therefore an option to meet the persistent deficits in energy supply which begin in 2022/23

1 based on the 2012 Load Forecast. Plans that include Keeyask G.S. as the first resource in
2 2022/23 will satisfy Manitoba’s energy and capacity needs until 2029/30, at which time another
3 resource is required.

4 Also under consideration is the opportunity to advance Keeyask G.S. to 2019/20 to serve a 250
5 MW (megawatt) sale to Minnesota Power (MP) starting in 2020, which would facilitate the
6 construction of a new transmission interconnection to the U.S., as described in **Chapter 6 – The**
7 **Window of Opportunity.**

9 **Conawapa Generating Station**

10 The earliest ISD by which Conawapa G.S. can be developed—if it is developed together with
11 Keeyask G.S. is assumed to be 2025/26 in these analyses. If Keeyask G.S. does *not* precede
12 Conawapa G.S. then an additional year will be required to finalize the Conawapa aboriginal
13 community arrangement, resulting in 2026/27 as the earliest ISD for Conawapa G.S. In the
14 latter case, in order to meet Manitoba domestic load and firm export commitments starting in
15 2022/23, other supply options would be needed in advance of Conawapa G.S. Wind and natural
16 gas-fired turbines are the other resource options being considered for this purpose.

17
18 Also under consideration is the opportunity to advance Keeyask G.S. to 2019/20 and Conawapa
19 G.S. to 2025/26 to serve sales to both MP and Wisconsin Public Service (WPS) totaling 550 MW.
20 A new transmission interconnection with a transfer capability of 750 MW to the U.S. would be
21 facilitated by such sales, as described in **Chapter 6 – The Window of Opportunity.**

23 **Keeyask and Conawapa Generating Stations – Manitoba Transmission**

24 For those plans in which Keeyask G.S. and Conawapa G.S. are both constructed, it is expected
25 that transmission improvements will be required in the Manitoba Hydro system, once the final
26 few units of the second plant comes into service, to be able to transmit all the firm power to

1 southern Manitoba (see North-South Transmission System Upgrade project description in
2 **Chapter 2 – Manitoba Hydro’s Preferred Development Plan Facilities**). As the additional north-
3 south transmission would not be required for over 10 years, the final determination of the
4 design will be made nearer to that time.

6 **Wind Resources**

7 Wind generation is available as a long-term resource option and is considered for inclusion in
8 development plans on that basis. Wind generation is also considered as a short lead time
9 resource option (approximate three year lead time) in the event that, from an energy
10 perspective, the load grows at a higher rate than forecasted.

11
12 In its long-term resource planning evaluations, Manitoba Hydro considers a development plan
13 that combines wind generation with natural gas-fired generation; such a combination provides
14 the firm winter peak capacity component that wind generation alone does not provide.
15 Manitoba Hydro also includes wind generation as a resource option in the circumstance where
16 there would be significant delays or deferral of large hydro or if large hydro cannot be built due
17 to environmental or regulatory restrictions and when the supply requirement is for dependable
18 energy and not for capacity. For purposes of the Needs For and Alternatives To (NFAT)
19 evaluations, additional new wind generation is assumed to be owned by Manitoba Hydro.

21 **Natural Gas-Fired Resources**

22 Natural gas-fired generation can serve a variety of functions in development plans, including as:

- 23 • a low-capital cost resource option
- 24 • a bridging resource option to meet load requirements prior to construction of new large
25 hydro-electric generation

26

- 1 • a capacity support resource option for wind generation
- 2 • a short lead-time resource option.

3 **8.2.2 New U.S. Interconnection**

4 In addition to resource options, a major consideration in the formulation of development plans
5 is the opportunity to develop a new transmission interconnection to the U.S.¹

6
7 As identified in *Chapter 5 – The Manitoba Hydro System, Interconnections and Export*
8 *Markets*, a new U.S. interconnection would support Manitoba Hydro’s mandate to provide a
9 reliable and dependable supply of electricity and would increase import capability during times
10 of drought, peak demand and emergency situations. As well, additional export capability
11 expands Manitoba Hydro’s market access and provides an outlet for surplus power from the
12 Manitoba Hydro system.

13
14 Pursuant to the executed power agreement with MP for 250 MW of system power, a new
15 transmission interconnection with a minimum export capability of 250 MW is required as well
16 as an import capability of up to 250 MW (50 MW import capability has been assumed for NFAT
17 analysis purposes). In addition, Manitoba Hydro and WPS have a signed term sheet that
18 provides for a sale by Manitoba Hydro of up to 500 MW of system power of which 400 MW
19 would require the construction of a new transmission interconnection. An interconnection with
20 a transfer capability of more than 250 MW would be required to accommodate both a 250 MW
21 sale to MP and a sale greater than 100 MW to WPS.

22

¹ It should be noted that the transmission lines can be described by voltage size (kV) or by transfer capability (MW). As the focus of this chapter is the usage of interconnections, transfer capability in MWs will be used as the reference, i.e. 250 MW and 50 MW, associated with a 230 kV line, and 750 MW, associated with a 500 kV line.

1 For the purposes of NFAT analysis, it is assumed that a new interconnection to the U.S. can be
2 in-service for 2020/21. Two interconnection projects are considered in the analysis: a larger
3 interconnection with 750 MW of import and export capability, and a smaller interconnection
4 with 50 MW of import and 250 MW of export capability. Irrespective of its size, a new
5 interconnection will consist of two parts: a portion constructed in Manitoba and a portion
6 constructed in the U.S.

7
8 Manitoba Hydro is responsible for the cost and all phases of development of the
9 interconnection facilities in Manitoba; U.S. counterparties are responsible for all phases of
10 development of the U.S. portion of the interconnection projects. For development plans that
11 include a new 750 MW interconnection, the cost of the interconnection facilities in the U.S. is
12 assumed to be shared to varying degrees by U.S. counterparties and Manitoba Hydro. In order
13 to avoid becoming a majority owner in a U.S. transmission line, Manitoba Hydro will only enter
14 into an arrangement where it will not own more than 49% of the interconnection facilities in
15 the U.S. In return for investing in the U.S. portion of the transmission interconnection,
16 Manitoba Hydro will benefit by having the right to use and/or sell its proportionate share of the
17 U.S. transmission service associated with the new interconnection.

18

19 **8.2.3 Description of Development Plans**

20 Fifteen development plans have been identified and described in this section and are based on
21 three main groupings:

- 22 • plans with a U.S. interconnection with 750 MW of import and export capability – five
23 plans
- 24 • plans with a U.S. interconnection with 250 MW of export capability and 50 MW of
25 import capability – three plans
- 26 • plans that meet Manitoba Hydro’s domestic load and existing firm export commitments
27 starting in 2022/23 with no new U.S. interconnection – seven plans.

1
2 The specifics of the development plans identified in the next section have been incorporated
3 into the supply-demand tables which can be found in **Appendix 4.2 – Manitoba Hydro Supply**
4 **and Demand Tables**. The cost assumptions used in NFAT analysis can be found in **Appendix 9.3**
5 **– Economic Evaluation Documentation, Appendix 11.1 – Net Capital Expenditures** and in
6 **Chapter 2 – Manitoba Hydro’s Preferred Development Plan Facilities**. Table 8.1, found at the
7 end of this chapter, provides a listing of new resources by development plan and ISD. Table 8.2,
8 also found at the end of this chapter, identifies the sales agreements associated with each of
9 the development plans. Table 9.3, found in **Chapter 9 – Economic Evaluation – Reference**
10 **Scenario**, provides a summary of the 15 development plans, described in this section, listed in
11 order of lowest incremental capital investment.

12

13 **8.2.3.1 Plans with a U.S. Interconnection with 750MW of Import and Export Capability – Five** 14 **Plans**

15 There are five development plans identified which include a U.S. interconnection with 750 MW
16 of import and export capability. They are described as follows:

1 **Preferred Development Plan**

2

3 **K19/C25/750MW (WPS Sale & Inv²) – Keeyask 2019/20, Conawapa 2025/26, Natural Gas-**
4 **Fired Generation Starting in 2041/42, 750 MW Import/Export Interconnection 2020/21**

5 This development plan consists of the Keeyask G.S. with an ISD of 2019/20, the Conawapa G.S.
6 with an ISD of 2025/26, and a transmission interconnection to the U.S. with import and export
7 capability of 750 MW with an ISD of 2020/21. Both the 250 MW MP sale and the 300 MW WPS
8 sale described in *Appendix 6.1 - Summary of Terms and Conditions of Export Contracts* are
9 evaluated as part of this plan. The 250 MW MP sale will require 250 MW of new transmission
10 service and the 300 MW WPS sale will require 200 MW of new transmission service. To meet
11 these commitments, Manitoba Hydro must build new hydro-electric generation which, in this
12 plan, consists of the Keeyask G.S. and Conawapa G.S. developed by their earliest ISDs. Other
13 firm export sale commitments that would be served by this plan include the 108 MW and
14 subsequent 100 MW WPS sales and the 125 MW Northern States Power (NSP) sale; this
15 development plan is also one of two plans that could serve the 300 MW WPS sale.

16

17 According to this plan, it is assumed that Manitoba Hydro will be responsible for 40% of the
18 capital cost and ongoing operating costs associated with the U.S. portion of the 750 MW
19 interconnection facilities. In addition, Manitoba Hydro will be responsible for the entire cost of
20 the Manitoba portion of the new interconnection. The generation resources for this plan are
21 illustrated in Figure 8.1 and the sale agreements are summarized in Table 8.2.

² Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.

1 **K19/C25/750MW – Keeyask 2019/20, Conawapa 2025/26, Natural Gas-Fired Generation**
2 **Starting in 2041/42, 750 MW Import/Export Interconnection 2020/21**

3 This development plan consists of the same resources as those evaluated in the Preferred
4 Development Plan described above, includes the 250 MW MP sale, but does *not* include the
5 potential WPS sale agreements of up to 300 MW as described in **Chapter 6 – The Window of**
6 **Opportunity** Section 6.5.2. The signed 100 MW WPS sale is included as it is contingent on the
7 Keeyask G.S. and would be served using existing transmission service.

8
9 Since the potential agreements with WPS continue to be under discussion, this development
10 plan allows for comparison to the Preferred Development Plan should the potential sale to WPS
11 not materialize and should WPS not invest in the U.S. portion of the 750 MW interconnection
12 facilities.

13 For the purposes of NFAT evaluation, while Manitoba Hydro will not enter into an arrangement
14 in which it owns more than 49% of the proposed U.S. interconnection, a conservative
15 assumption has been used whereby Manitoba Hydro will be responsible for approximately two-
16 thirds of the capital and ongoing operating costs associated with the U.S. portion of the 750
17 MW interconnection facilities. In addition, Manitoba Hydro will be responsible for the entire
18 cost of the Manitoba portion of the new interconnection. The generation resources for this plan
19 are illustrated in Figure 8.1 and the sale agreements are summarized in Table 8.2.

1 **K19/Gas25/750MW (WPS Sale & Inv³) – Keeyask 2019/20, Natural Gas-Fired Generation**
2 **starting in 2025/26, 750 MW Import/Export Interconnection 2020/21**

3 Manitoba Hydro has identified an alternative plan which allows for the comparison of the
4 option of building natural gas-fired generation as an alternative to building Conawapa G.S. in
5 2025/26. This plan consists of the construction of Keeyask with an ISD of 2019/20, the addition
6 of natural gas-fired generation starting in 2025/26, and a 750 MW U.S. interconnection with an
7 ISD of 2020/21. For the export sales requiring new hydro generation, power from the Keeyask
8 G.S. has been determined to be sufficient to meet the MP and WPS contract requirements. The
9 generation resources for this plan are illustrated in Figure 8.1 and the sale agreements are
10 summarized in Table 8.2.

11

12 **K19/C31/750MW – Keeyask 2019/20, Imports, Conawapa 2031/32, Natural Gas-Fired**
13 **Generation Starting in 2041/42, 750 MW Import/Export Interconnection 2020/21**

14 This development plan enables the construction of a new U.S. interconnection with 750 MW of
15 import and export capability and is facilitated by the 250 MW MP sale; to meet the
16 commitments of this sale, Manitoba Hydro must build the Keeyask G.S. This plan specifically
17 does not include the commitments associated with the 300 MW WPS sale. The plan
18 accommodates, in this case, a six-year deferral of the Conawapa G.S. The additional import
19 capability provided by the new interconnection can be used to meet Manitoba domestic load
20 and firm export commitments until 2031/32. Under the plan, Conawapa G.S. is assumed to be
21 placed in-service in 2031/32 to meet load and firm export commitments; and the new
22 interconnection would provide an outlet for surplus power. Other firm export sale
23 commitments that would be served by this plan include the 100 MW WPS sale and the 125 MW
24 NSP sale.

25

³ Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.

1 For the purposes of NFAT analysis, while Manitoba Hydro will not enter into an arrangement in
2 which it owns more than 49% of the proposed U.S. interconnection, a conservative assumption
3 has been used where Manitoba Hydro will be responsible for approximately two-thirds of the
4 capital and ongoing operating costs associated with the U.S. portion of the 750 MW
5 interconnection facilities. In addition, Manitoba Hydro will be responsible for the entire cost of
6 the Manitoba portion of the new interconnection. The generation resources for this plan are
7 illustrated in Figure 8.1 and the sale agreements summarized in Table 8.2.

8

9 **K19/Gas31/750MW – Keeyask 2019/20, Imports, Natural Gas-Fired Generation starting in**
10 **2031/32, 750 MW Import/Export Interconnection 2020/21**

11 This development plan is the same as K19/C31/750 MW, described directly above, with the
12 exception of natural gas-fired generation starting in 2031/32 as an alternative to building
13 Conawapa G.S. for that date. This plan specifically does not include the commitments
14 associated with the 300 MW WPS sale. This plan allows for the comparison of the option of
15 building natural gas-fired generation as an alternative to building Conawapa G.S. starting in
16 2031/32. The generation resources for this plan are illustrated in Figure 8.1 and the sale
17 agreements are summarized in Table 8.2.

18 **8.2.3.2 Plans with a U.S Interconnection with 250MW of Export Capability and 50 MW of**
19 **Import Capability – Three Plans**

20 There are three development plans identified which include a U.S. interconnection with 50 MW
21 of import and 250 MW of export capability. Manitoba Hydro will be responsible for the capital
22 and on-going operating costs associated with the Canadian portion of the 250 MW
23 interconnection facilities. U.S. counterparties are responsible for all capital and operating costs
24 for the U.S. portion of the interconnection. The development plans are described as follows:

25

1 **K19/C25/250MW – Keeyask 2019/20, Conawapa in 2025/26, Natural Gas-Fired Generation**
2 **Starting in 2040/41, 250 MW Export/50 MW Import Interconnection 2020/21**

3 This plan enables the construction of a new U.S. interconnection with 250 MW of export and 50
4 MW of import capability and is facilitated by the 250 MW MP sale. To meet the commitments
5 of this sale, Manitoba Hydro must build the Keeyask G.S. As the earliest ISD for the Conawapa
6 G.S. is assumed to be 2025/26, a one-year on-peak import contract is included for planning
7 purposes in 2024/25 to meet domestic load and firm export commitments and Manitoba Hydro
8 Generation Planning Criteria. This import contract would not be required in plans where a 750
9 MW interconnection is assumed as the import capability of the larger line provides significantly
10 more off-peak import capability. Other firm export sale commitments that would be served by
11 this plan include the 100 MW WPS sale and the 125 MW NSP sale. The generation resources for
12 this plan are illustrated in Figure 8.1 and the sale agreements are outlined in Table 8.2.

13

14 **K19/Gas24/250MW – Keeyask 2019/20, Natural Gas-Fired Generation starting in 2024/25,**
15 **250 MW Export/50 MW Import Interconnection 2020/21**

16 This plan enables the construction of a new U.S. interconnection with 250 MW of export and 50
17 MW of import capability and is facilitated by the 250 MW MP sale. To meet the commitments
18 of this sale, Manitoba Hydro must build the Keeyask G.S. This plan allows for the comparison of
19 the option of building natural gas-fired generation starting as an alternative to building
20 Conawapa G.S. Natural gas-fired generation is required starting in 2024/25 to meet Manitoba
21 domestic load and firm export commitments which include the 100 MW WPS sale and the 125
22 MW NSP sale. The generation resources for this plan are illustrated in Figure 8.1 and the sale
23 agreements are outlined in Table 8.2.

24

1 **K19/C31/250MW – Keeyask 2019/20, Imports, Natural Gas-Fired Generation starting in**
2 **2024/25, Conawapa 2031/32, 250 MW Export/50 MW Import Interconnection 2020/21**

3 This plan allows for the comparison of a transmission interconnection with 750 MW of export
4 and import capability compared to a transmission interconnection with 250 MW of export and
5 50 MW of import capability. This development plan is facilitated by the 250 MW MP sale; to
6 meet the commitments of this sale, Manitoba Hydro must build the Keeyask G.S. The plan
7 accommodates a six-year deferral of the Conawapa G.S. which is placed in-service in 2031/32 to
8 meet load and firm export commitments. Without the significant additional import capability
9 provided by the 750 MW interconnection, 490 MW of natural gas-fired generation is used to
10 meet domestic load and firm export commitments to accommodate the six-year deferral of the
11 Conawapa G.S. Other firm export sale commitments that would be served by this plan include
12 the 100 MW WPS sale and the 125 MW NSP sale.

13

14 **8.2.3.3 Plans that Meet Manitoba Hydro’s Domestic Load and Firm Export Commitments**
15 **Starting in 2022/23 with No New U.S. Interconnection – Seven Plans**

16 This section describes development plans with new resource additions starting in 2022/23 in
17 order to meet Manitoba domestic load and firm export commitments. No opportunities for
18 new U.S. transmission interconnections or for new long-term export sales are contemplated in
19 these alternative development plans. The development plans in this section that include
20 Keeyask G.S. in 2022/23 will provide sufficient surplus energy to serve the 100 MW WPS sale.
21 The generation resources for this plan are illustrated in Figure 8.1 and the sale agreements are
22 summarized in Table 8.2.

23

24 **All Gas – Natural Gas-Fired Generation Starting in 2022/23**

25 This development plan represents the lowest-capital cost alternative available to Manitoba
26 Hydro. In this plan simple-cycle gas turbines (SCGTs) are installed as peaking resources until

1 demand for energy and capacity is sufficient to justify a more efficient but higher-capital cost
2 combined-cycle gas turbine (CCGT).

3

4 **Wind/Gas - Wind Generation Starting in 2022/23 Supported by Natural Gas-Fired Generation**
5 **Starting in 2025/26**

6 This development plan represents an alternative in which wind is the primary resource
7 supported by natural gas-fired generation. Wind generation is not assigned a winter peak
8 capacity value due to its intermittent nature and physical limitations; as such, it can only be
9 relied upon as an energy resource. Therefore, in this development plan wind generation is
10 developed to provide energy and SCGTs are used mainly as a capacity resource. For purposes of
11 the NFAT analysis, additional new wind generation is assumed to be owned by Manitoba Hydro.

12

13 **K22/Gas – Keeyask 2022/23, Natural Gas-Fired Generation Starting in 2029/30**

14 In order to meet Manitoba domestic load and firm export commitments, this development plan
15 assumes Keeyask G.S. is constructed in 2022/23 followed by a combination of combined-cycle
16 and simple-cycle natural gas-fired units starting in 2029/30. SCGTs would be installed as
17 peaking resources until demand for energy and capacity is sufficient to justify a more efficient
18 but higher-capital cost CCGT.

19 **K22/C29 – Keeyask 2022/23, Conawapa 2029/30, Natural Gas-Fired Generation Starting in**
20 **2040/41**

21 This development plan considers building both Keeyask G.S. and Conawapa G.S. to meet
22 Manitoba load and firm export commitments without a new U.S. interconnection. Natural gas-
23 fired generation is included as a low-capital cost resource to meet energy and capacity needs
24 starting in 2040/41. This development plan provides a basis to assess the value of a U.S.
25 interconnection when both Keeyask G.S. and Conawapa G.S. are constructed; the plan also

1 allows for the comparison of the option of building Conawapa G.S. in 2029/30 as an alternative
2 to building natural gas-fired generation at that time.

3

4 **SCGT/C26 – Simple Cycle Gas Turbines in 2022/23, Conawapa 2026/27, Natural Gas-Fired**
5 **Generation Starting in 2038/39**

6 This development plan assumes SCGTs are developed starting in 2022/23 followed by
7 Conawapa G.S. in 2026/27, the earliest ISD for Conawapa G.S. when it is not preceded by
8 Keeyask G.S. In this development plan, an SCGT represents the lowest-capital cost resource
9 option prior to the 2026/27 ISD of Conawapa G.S. Subsequent to Conawapa G.S., SCGTs are
10 included as a low-capital cost resource to meet energy and capacity needs with a starting date
11 of 2038/39.

12

13 **CCGT/C26 – Combined Cycle Gas Turbine in 2022/23, Conawapa 2026/27, Natural Gas-Fired**
14 **Generation Starting in 2039/40**

15 This development plan is similar to SCGT/C26, as described directly above, except that it
16 assumes a CCGT is developed starting in 2022/23 followed by Conawapa G.S. in 2026/27. This
17 plan allows for the comparison of the option of building a CCGT as an alternative to building a
18 SCGT in 2022/23 prior to the 2026/27 ISD of Conawapa G.S. Subsequent to Conawapa G.S.,
19 SCGTs are included as a low-capital cost resource to meet energy and capacity needs with a
20 starting date of 2039/40.

21

22 **Wind/C26 – Wind in 2022/23, Conawapa 2026/27, Natural Gas-Fired Generation Starting in**
23 **2036/37**

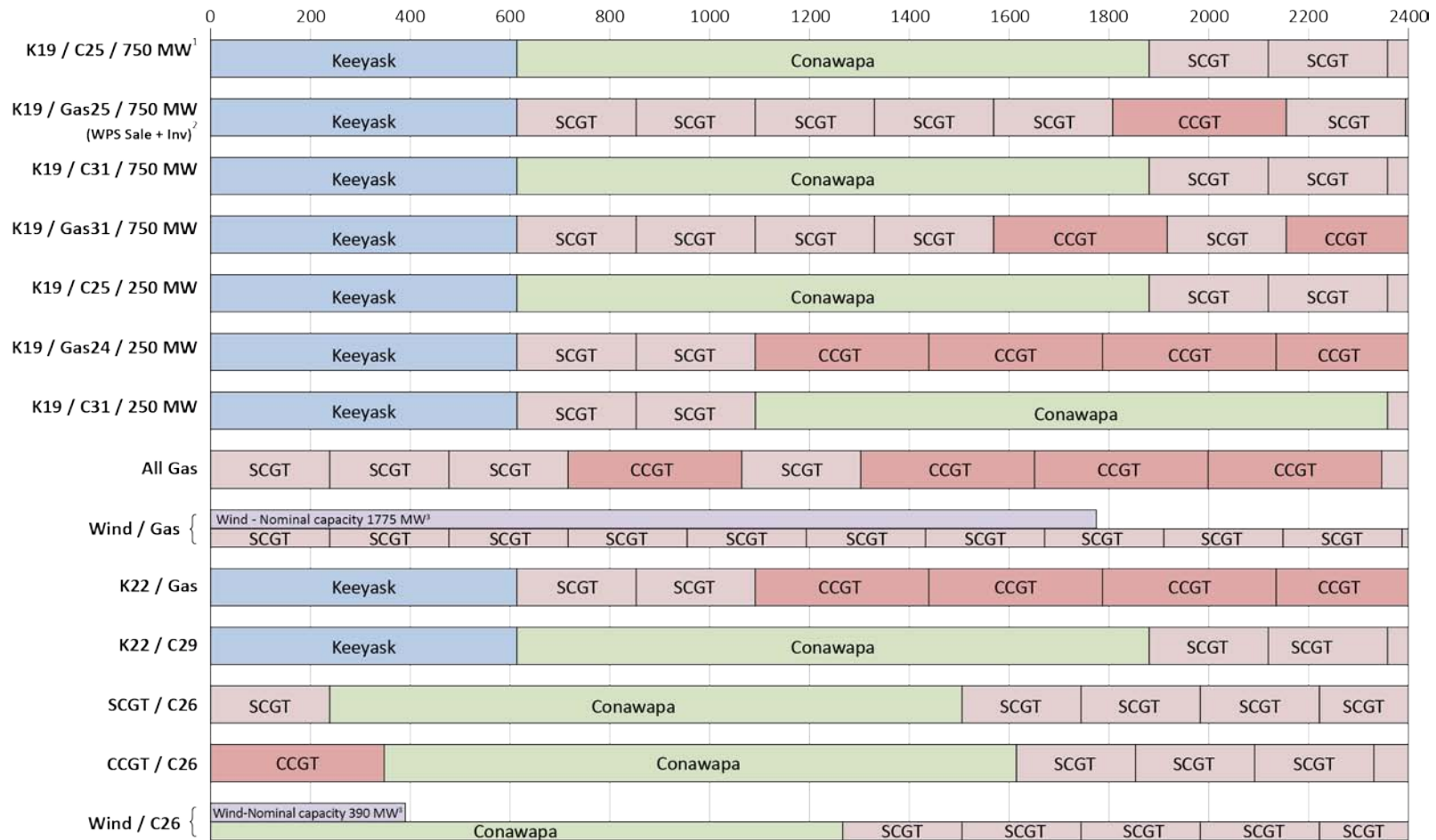
24 This development plan is similar to SCGT/C26 and CCGT/C26, as described directly above,
25 except it assumes wind generation is developed starting in 2022/23 followed by Conawapa G.S.
26 in 2026/27. This plan allows for the comparison of the option of building wind generation as an

1 alternative to building a natural gas-fired generation in 2022/23 prior to the 2026/27 ISD of
2 Conawapa G.S. Subsequent to Conawapa G.S., SCGTs are included as a low-capital cost resource
3 to meet energy and capacity needs with a starting date of 2036/37. For purposes of the NFAT
4 evaluation additional new wind generation is assumed to be owned by Manitoba Hydro.

5

6 Figure 8.1 provides an illustration of the quantity of winter peak capacity for each development
7 plan.

1 Figure 8.1 WINTER PEAK CAPACITY BY RESOURCE TYPE FOR EACH DEVELOPMENT PLAN FOR THE 35 YEAR PLANNING CYCLE



¹ K19 / C25 / 750 MW represents capacity resources for two plans; one with the proposed 300 MW WPS sale and investment and one without.

² Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.

³ Wind shown as nominal capacity since wind generation does not provide winter peak capacity.

2

1

2

Table 8.1 LISTING OF NEW RESOURCES BY DEVELOPMENT PLAN AND IN-SERVICE DATE

Development Plan	New Resources and Dates				New US Interconnection Capability
	Hydro	SCGT	CCGT	Wind	
K19/C25/750MW WPS Sale & Inv ⁴	2019 - Keeyask 2025 - Conawapa	2041 - 1 x 7FA 2044 - 1 x 7FA 2046 - 1 x 7FA	None	None	750 MW import/ 750 MW export
K19/C25/750MW no WPS (resources same as above)	2019 - Keeyask 2025 - Conawapa	2041 - 1 x 7FA 2044 - 1 x 7FA 2046 - 1 x 7FA	None	None	750 MW import/ 750 MW export
K19/Gas25/750MW WPS Sale & Inv ⁴	2019 - Keeyask	2025 - 1 x 7FA 2026 - 1 x 7FA 2028 - 1 x 7FA 2031 - 1 x 7 FA 2033 - 1 x 7 FA 2045 - 1 x 7 FA 2047 - 1 x LM6000	2042 - 1 x 7 FA	None	750 MW import/ 750 MW export
K19/C31/750MW	2019 - Keeyask 2031 - Conawapa	2041 - 1 x 7FA 2044 - 1 x 7FA 2046 - 1 x 7FA	None	None	750 MW import/ 750 MW export
K19/Gas31/750MW	2019 - Keeyask	2031 - 2 x 7FA 2032 - 1 x 7FA 2034 - 1 x 7FA 2043 - 1 x 7FA	2039 - 1 x 7 FA 2045 - 1 x 7 FA	None	750 MW import/ 750 MW export
K19/C25/250MW	2019 - Keeyask 2025 - Conawapa	2040 - 1 x 7FA 2044 - 1 x 7FA 2046 - 1 x 7FA	None	None	250 MW export / 50 MW import
K19/Gas24/250MW	2019 - Keeyask	2024 - 1 x 7FA 2029 - 1 x 7FA	2032 - 1 x 7 FA 2038 - 1 x 7 FA 2041 - 1 x 7 FA 2045 - 1 x 7 FA	None	250 MW export / 50 MW import
K19/C31/250MW	2019 - Keeyask 2031 - Conawapa	2024 - 1 x 7FA 2029 - 1 x 7FA 2046 - 1 x 7FA	None	None	250 MW export / 50 MW import

⁴ Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.

Development Plan	New Resources and Dates				New US Interconnection
	Hydro	SCGT	CCGT	Wind	
All Gas		2022 - 1 x 7FA 2025 - 1 x 7FA 2028 - 1 x 7FA 2034 - 1 x 7FA 2047 - 1 x LM6000	2031 - 1 x 7 FA 2037 - 1 x 7 FA 2040 - 1 x 7 FA 2044 - 1 x 7 FA	None	None
Wind/Gas		2025 - 2 x 7FA 2028 - 1 x 7FA 2031 - 1 x 7FA 2033 - 1 x 7FA 2036 - 1 x 7FA 2038 - 1 x 7FA 2040 - 1 x 7FA 2043 - 1 x 7FA 2045 - 1 x 7FA 2047 - 1 x LM6000	None	2022 - 2 x 65 MW 2023 - 2 x 65 MW 2024 - 2 x 65 MW 2027 - 1 x 65 MW 2028 - 1 x 65 MW 2029 - 1 x 65 MW 2030 - 1 x 65 MW 2031 - 1 x 65 MW 2032 - 1 x 65 MW 2033 - 1 x 65 MW 2034 - 1 x 65 MW 2035 - 1 x 65 MW 2036 - 1 x 65 MW 2037 - 1 x 65 MW 2038 - 1 x 65 MW 2039 - 1 x 65 MW 2040 - 1 x 65 MW 2041 - 1 x 65 MW 2042 - 1 x 65 MW 2043 - 1 x 65 MW 2044 - 1 x 65 MW 2045 - 1 x 65 MW 2046 - 1 x 65 MW 2047 - 1 x 65 MW	None
K22/Gas	2022 - Keeyask	2029 - 1 x 7FA 2032 - 1 x 7FA	2034 - 1 x 7 FA 2038 - 1 x 7 FA 2041 - 1 x 7 FA 2045 - 1 x 7 FA	None	None
K22/C29	2022 - Keeyask 2029 - Conawapa	2040 - 1 x 7FA 2044 - 1 x 7FA 2046 - 1 x 7FA	None	None	None

Development Plan	New Resources and Dates				New US Interconnection
	Hydro	SCGT	CCGT	Wind	
SCGT/C26	2026 - Conawapa	2022 - 1 x 7FA 2038 - 1 x 7FA 2041 - 1 x 7FA 2043 - 1 x 7FA 2045 - 1 x 7FA	None	None	None
CCGT/C26	2026 - Conawapa	2039 - 1 x 7FA 2042 - 1 x 7FA 2044 - 1 x 7FA 2047 - 1 x 7FA	2022 - 1 x 7FA	None	None
Wind/C26	2026 - Conawapa	2036 - 1 x 7FA 2038 - 1 x 7FA 2041 - 1 x 7FA 2043 - 1 x 7FA 2045 - 1 x 7FA	None	2 x 65 MW - 2022 2 x 65 MW - 2023 2 x 65 MW - 2024	None

1 Table 8.2 provides a summary of the sale agreements included in each development plan.

2 **Table 8.2 SALE AGREEMENTS ASSOCIATED WITH EACH DEVELOPMENT PLAN**

Development Plans	Sales Agreements					New US Interconnection Capability
	250 MW MP	300 MW WPS	108 MW WPS	100 MW WPS	125 MW NSP	
K19/C25/750MW WPS Sale & Inv⁵	June 2020 to May 2035	June 2026 to May 2036	June 2014 to May 2021	June 2021 to May 2027	May 2021 to Apr 2025	750 MW import/ 750 MW export
K19/C25/750MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	750 MW import/ 750 MW export
K19/Gas25/750MW WPS Sale & Inv⁵	June 2020 to May 2035	June 2026 to May 2036	June 2014 to May 2021	June 2021 to May 2027	May 2021 to Apr 2025	750 MW import/ 750 MW export
K19/C31/750MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	750 MW import/ 750 MW export
K19/Gas31/750MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	750 MW import/ 750 MW export
K19/C25/250MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	250 MW export/ 50 MW import
K19/Gas24/250MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	250 MW export/ 50 MW import
K19/C31/250MW	June 2020 to May 2035	No	No	June 2021 to May 2027	May 2021 to Apr 2025	250 MW export/ 50 MW import
All Gas	No	No	No	No	No	None
Wind/Gas	No	No	No	No	No	None
K22/Gas	No	No	No	June 2023 to May 2027	No	None
K22/C29	No	No	No	June 2023 to May 2027	No	None
SCGT/C26	No	No	No	No	No	None
CCGT/C26	No	No	No	No	No	None
Wind/C26	No	No	No	No	No	None

⁵ Inv refers to WPS investment in the U.S. portion of the 750 MW interconnection facilities.