Interconnection Feasibility Study Report

[redacted]
30 MW Wind Generating Facility
Cheticamp/Grand Etang, NS

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Control Centre Operations
Nova Scotia Power Inc.

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1) Introduction:

[redacted] submitted an Interconnection Request to NSPI for a proposed 30 MW wind generation facility interconnected to the NSPI system on the 69kV line L-5579. [redacted] subsequently signed a Feasibility Study Agreement to study the connection of their proposed generation to the NSPI transmission system. This report is the result of that Study Agreement. The generation site would be located just east of the village of St. Joseph du Moine, Inverness County, on the 58C SW Margaree - 103C Cheticamp line. A one-line diagram of the 69kV system is shown in Appendix A, Figure 1. The proposed interconnections are shown in the basic system diagram in Appendix A, Figure 1.

2) Scope:

The Interconnection Feasibility Study report shall provide the following information:

i) preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection;

ii) preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection; and

iii) preliminary description and non-bonding estimated cost of facilities required to interconnect the Generating Facility to the Transmission System and to address the identified short circuit and power flow issues.

3) Assumptions:

The Point of Interconnection and configuration studied is as follows:

i) 30 MW wind farm comprised of 20 – 1.5 MW GE 1.5s wind turbines

ii) Connected to the 69 kV Line L-5579 via a 138/69-25 kV, 20/27/33 MVA, WYE/DELTA transformer

iii) Transformer Impedance assumed at 7% (on ONAN Base)

iv) Located a point just east of the village of St. Joseph du Moine, Inverness County, Nova Scotia.

4) Objective:

The objectives of the feasibility study are to identify the primary physical interconnection requirements. Specifically the short-circuit impacts on circuit breakers and any equipment overloads or voltage limits that may be exceeded. The feasibility study does produce a binding estimate of all costs and changes that may be required to interconnect the facility.

5) Short-circuit Duties

In this area short-circuit levels are low and circuit breaker duties should not be exceeded by this development although protective relay coordination may be impacted. We expect that adding directional protection will likely be required. To maintain service reliability to existing customers, following this development, some

relay additions and switches or switchgear changes may be required. Determination of any changes required to maintain existing levels of customer service and reliability, following this development and necessitated by this development, will be included in the system impact study (SIS)

6) Thermal Limits

The operating limit of the 69 kV line that is to be tapped is currently 24 MVA. This is limited by metering equipment at the 67C-Whycocomagh line terminal. Short-circuit protection on the line limits capacity to 29MVA. The thermal rating of the line is 51 and 67 MVA for summer and winter conditions respectively.

The proponents can expect that system protection changes will be required to facilitate this interconnection. Transfer trips to the [redacted] facility will be required from protections at Whycocomagh and possibly upstream 138kV substations. Communications and protection upgrades will be required to facilitate this development.

The 138/69 kV transformer capacity at 67C-Whycocomagh is not sufficient to cater to the full range of load that it will be subjected to following this development. Alternative remedial actions are to slightly reduce the [redacted] capacity, limit [redacted] at times of light area load or to upgrade the transformer. An assessment of these alternatives may be included in the SIS. At this time we will assume that applying capacity limitations to the [redacted] facility at times of light load will be acceptable to the project proponent. A determination of the extent of this limitation and the expected impact on [redacted]'s operation should be included in the SIS.

Thermal capacity of physical apparatus with the exception of the line terminal equipment and the transformer limitations stated above should not be significant. Protection issues will require careful assessment to minimize cost to [redacted] and maintain customer service reliability.

7) Voltage Control

The short-circuit level at the 69 kV tap or point-of-common coupling (PCC) is currently 85 MVA at NSPI maximum generating conditions. The conductor from S.W.Margaree (57C) substation is 336 MCM ACSR. The ratio of generating capacity to short-circuit level is 2.8 under maximum NSPI generating conditions. This ratio would not permit installation of conventional induction generators without additional fast acting voltage control devices. The SIS must verify, through correspondence with the vendor, that voltage variation and flicker will be within acceptable limits for the chosen technology and controls given the system characteristics.

Voltage variation from no load to full load across the 69 kV system will be about 2.5-3%. This is above acceptable limits. This coupled with the transformer limitations suggests that a total capacity of 25MW may be more viable. The proponent can expect to require centralized reactive power control and possibly have to provide automatic voltage regulation (AVR) controls. The voltage regulation equipment and control method employed will be determined by the SIS.

8) System Limitations

Additional generation at this location, at the east end of NSPI system, will displace other generation at times of high transfer or under contingency operation (NSPI equipment out of service). The extent of these limitations and the impact that they may have on the operation of this generating facility will be determined by the SIS.

The SIS will also investigate the facilities ability to stay on line through disturbances on the 138, 230 and 345 kV systems.

9) Expected Facilities Required for Interconnection:

i) Interconnection Substation (138/69-25kV)
ii) NSPI will require real-time monitoring of the interconnection substation
iii) Approx 10 km 138/69 kV transmission 336MCM ACSR (L5579 tap to [redacted])
iv) Protection upgrades at 67C
v) Metering upgrades at 67C
vi) Communication upgrades 67C
vii) Current Transformer – change ratio/metering
viii) Control and Communications as required

10) Magnitude of NSPI Interconnection Costs

i) Build 10 km 138 kV transmission	$2,400,000
ii) Install 2 switches at tap point on L5579	$100,000
iii) Protection/Metering Upgrades 67C	$100,000
iv) Communications Upgrades	$300,000
v) Contingency	$300,000
TOTAL:	$3,200,000

11) Additional Required Facilities Provided by [redacted]:

i) 138/69-25kV Substation (acceptable to NSPI)
ii) Protection (as required by NSPI)
iii) Real-Time Metering (as required by NSPI)
iv) Communications
v) Generation Controls (as required) by NSPI
vi) Transmission Right Of Way and Substation Lands

Appendix A: Basic System Diagram:

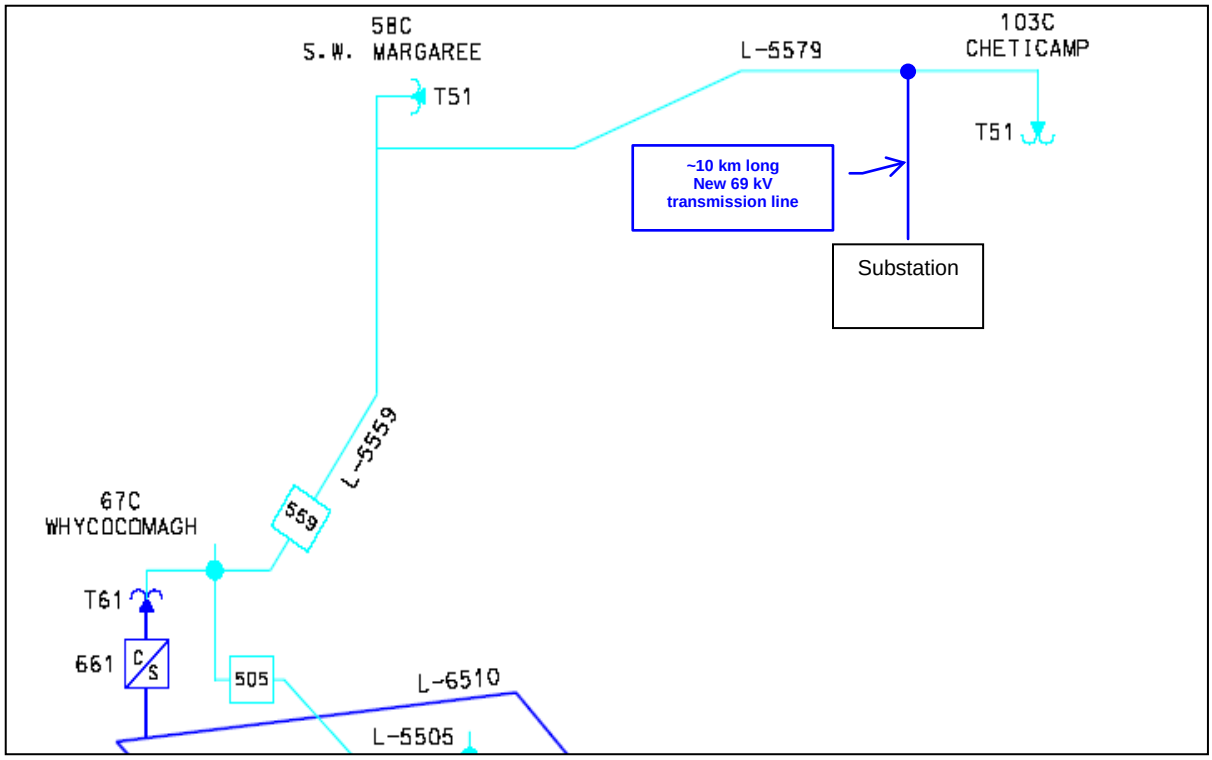

Figure 1 : Basic System Diagram

Control Centre Operations
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