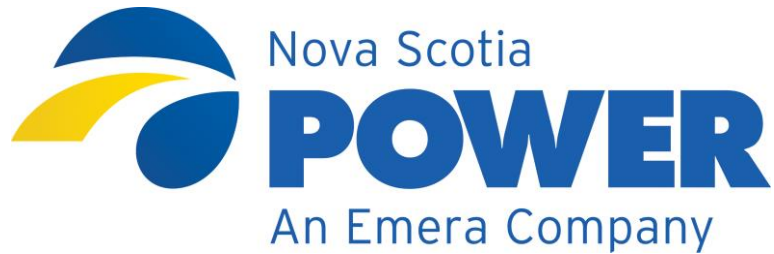


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# Facilities Study Report

IR 574 – 58.8 MW Wind Farm – Ellershouse III

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## **Facilities Study Report**

### **IR-574**

### **58.8 MW Ellershouse III**

Prepared by  
Tim Leopold, P.Eng.

August 6, 2021

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# Facilities Study Report

IR 574 – 58.8 MW Wind Farm – Ellershouse III

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## EXECUTIVE SUMMARY

This project provides for the establishment of a 138 kV system interconnection for a 58.8 MW wind generation facility (IR-574) located at Ellershouse, Hants County, Nova Scotia to Nova Scotia Power Inc (NSPI) 138kV transmission line L-6051.

The new system interconnection substation has been assigned NSPI system number 103V-Ellershouse III.

The Point of Interconnection and the Point of Change of Ownership between NSPI and the Interconnection Customer is indicated on the Basic One Line diagram provided in Appendix B.

The new system connection at 103V-Ellershouse III will consist of a single span line tap to NSPI 138kV transmission line L-6051. The tap point will be installed between L-6051 structures #132 and #133 located approximately 2 kms from NSPI's 17V - St. Croix Substation. A proposed configuration and location are indicated on the line tap and substation location drawing provided in Appendix C.

The new system connection will include modifications to the protection and control (P&C) schemes at 17V St. Croix and 120H Brushy Hill substations and the addition of protection relays, Supervisory Control and Data Acquisition (SCADA), revenue metering, and telecommunications at 103V-Ellershouse III.

The P&C modifications will include a new panel at 17V-St. Croix with new primary and secondary protection, modifications to Panel P19A at 120H-Brushy Hill to add a new relay, and the addition of transfer trip circuits from both 120H-Brushy Hill and 17V-St. Croix to 103V-Ellershouse III. A list of the required SCADA points is provided in Appendix G. The Revenue Class 138kV voltage and current transformers required for revenue metering will be supplied and installed by the Interconnection Customer as per NSPI specification.

NSPI will require space and unrestricted access in the Interconnection Customer's substation control building for the protection equipment at 103V, the Remote Terminal Unit (RTU) and the communications equipment. It is anticipated that this equipment can be housed in one single free-standing cabinet, but detailed design will be required before it can be confirmed if a second cabinet is required.

The total estimated cost to construct the 103V-Ellershouse III interconnection is **\$901,010**. The detailed cost estimates are provided in Appendix D.

The Interconnection Customer's proposed commercial operation date is December 2023. An overall estimated project schedule is provided in Appendix E.

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## 1.0 INTRODUCTION

This Facilities Study Report is based on the Standard Generation Interconnection Procedures and System Impact Study (SIS) and addendum as identified below:

System Impact Study Report  
Report GIP-IR574-SIS-R0  
By Peter Huynh, P.Eng.

Addendum to System Impact Study Report  
Report GIP-IR574-SIS-R1  
By Peter Huynh, P.Eng.

The SIS describes the facilities required to connect the generating facility to NSPI's transmission system. It also addresses short circuit, power factor, steady state and stability analysis, voltage flicker and power flow issues. It provides an overview of the scope of work to be completed and provides direction to this Facilities Study.

### 1.1 Project Ownership and Responsibilities

Ownership, maintenance, and other commercial operation arrangements will be covered separately in a future Generation Interconnection Agreement (GIA) between NSPI and the customer.

Ownership of the infrastructure associated with 103V-Ellershouse III generating substation is based on the Point of Change of Ownership shown on the Basic One Line diagram in Appendix B. NSPI (as the transmission provider) will own the 138 kV tap point on L-6051 between existing structures 132 and 133 as well as the single span of 138kV conductor up to the dead-end structure located within customer's substation.

All communication systems infrastructure between NSPI's St Croix Substation and the new generation interconnection facility 103V-Ellershouse III required for control and monitoring of the facility will be owned, supplied, and installed by NSPI. This includes the SCADA RTU, antenna and telecommunication equipment located at the generation interconnection substation 103V-Ellershouse III.

NSPI will also own the revenue metering located in the generation interconnection substation 103V-Ellershouse III.

### 1.2 Estimated Cost

The total estimated cost to construct the NSPI portion of the 103V Ellershouse III substation is **\$901,010**.

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The cost estimates are based on the scope of work outlined in Section 2.0 and 3.0 of this Facilities Study Report. The cost estimate details provided in Appendix D are estimates only. The customer will be responsible to pay NSPI for the entire incurred cost associated with this project, be it higher or lower than the estimate provided herein.

The cost estimate in this report is valid for one-hundred eighty (180) days.

The project cannot commence until the customer delivers to NSPI the balance of the cost estimate for the project in a form acceptable to NSPI, as per the GIA.

## 1.3 Schedule

The estimated project duration includes all scope of work required for the transmission interconnection with the Interconnection Customer's substation including all protection, transfer trips, communications, SCADA, and revenue metering.

The total project duration is based on the preliminary project schedule shown in Appendix E with a planned commercial operation date of December 2023. To meet this commercial operation date the schedule assumed all start of construction milestones are in place by the end of February, 2023.

## 2.0 SCOPE OF WORK BY NSPI

The scope of this Facilities Study is limited to providing the necessary designs, equipment, labor, and services required to interconnect the new generating facility to a new Ellershouse III substation (103V) to NSPI's transmission system. The Ellershouse III substation will be direct tapped, via a single span, to NSPI transmission line L-6051. L-6051 extends between NSPI substations 17V-St. Croix and 120H-Brushy Hill.

This report will cover the following:

- The Network Upgrades required by NSPI as the Transmission Provider (equipment installed on the NSPI side of the Point of Interconnection).
- The equipment required by NSPI at the Transmission Provider's Interconnection Facilities (equipment located between the Point of Interconnection and the Point of Change of Ownership and within the Interconnection Customer's Substation).

### 2.1 Basic One Line and Primary Equipment

A Basic One Line diagram of the proposed 103V-Ellershouse III interconnection substation is provided in Appendix B.

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*Please note the single line drawing provided by the Interconnection Customer indicates a 138kV line tap disconnect at the tap point. This switch is not required by NSPI and is not included in the scope of work covered under this Facilities Study.*

## **2.2 L-6051 Transmission Line Tap**

The new 103V-Ellershouse III substation will be direct tapped to NSPI transmission line L-6051 approximately 2 kms from 17V-St Croix and 25 kms from 120H-Brushy Hill substations.

Based on the location of the Interconnection Customer's proposed substation, the line tap is anticipated to be approximately 75m from the substation's 138kV dead-end structure.

NSPI L-6051 existing tangent type structure #132 will be replaced with a wood pole line dead-end structure. A new wood pole dead-end structure will be installed in L-6051 between structure #132 and #133 to accommodate the line tap. The line tap will extend under the existing L-6051 and consist of two wood pole dead-end type structures; one just outside the new 103V substation and one located within the right of way between L-6051 and L-6011. The conductor for the line tap will be 795 ACSR Drake and will be designed without overhead shield wire.

## **2.3 Protection and Control**

Protection upgrades to line L-6051 are required to accommodate the addition of IR-574. NSPI will require space and unrestricted access in the Interconnection Customer's substation control building for the Remote Terminal Unit (RTU), two SEL-2506 relays, one SEL-311L current differential relay, and the communications equipment. It is anticipated that this equipment can be housed in one single free-standing cabinet, but detailed design will be required before it can be confirmed if a second cabinet is required. NSPI will own, supply, and install the protection and control equipment.

At 17V-St. Croix substation the existing L-6051 line protection panel requires replacement with a new protection panel consisting of a SEL-311L current differential relay with distance backup for primary protection and a GE D30 step distance relay for secondary protection.

At 120H-Brushy Hill substation a new SEL 311L current differential relay will be added to the existing L-6051 line protection panel to replace the existing primary protection scheme relay.

At 103V-Ellershouse III, the new protection equipment required and owned by NSPI will include two SEL-2506 relays for the transfer trip circuits from 17V and 120H and a SEL-

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311L current differential relay with distance backup for primary protection. The RTU and communications equipment are intended to be housed in the same panel.

NSPI shall require the Interconnection Customer to supply three phase inputs from the 138kV breaker current transformers and the 138kV bus potential transformers. NSPI shall also require access to the 138kV breaker tripping circuit for line protection trip.

## **2.4 Supervisory Control and Data Acquisition / Remote Terminal Unit**

The required Supervisory Control and Data Acquisition (SCADA) points are listed in Appendix G.

The Remote Terminal Unit (RTU) will be installed in a common panel (as mentioned in section 2.3) along with the protection and communications equipment. The RTU will come with a 48V backup battery and charger. NSPI will own, supply, and install the RTU.

A 120V AC station service supply shall be supplied by the Interconnection Customer to supply the battery charger.

## **2.5 Communications**

A radio link shall be installed from 103V-Ellershouse III to 17V-St. Croix to provide a communications path for telecontrol and protection. An 18m pole will be installed within the Interconnection Customer's substation for the radio antenna. The pole location is to be determined during detailed design but should be as close to the Interconnection Customer's control building as possible. The communications equipment will be in a common panel (as mentioned in section 2.3) along with the protection equipment and RTU. NSPI will own, supply, and install the pole, radio antenna, and communications equipment.

## **2.6 Revenue Metering**

A 138kV revenue metering system, owned by NSPI, shall be installed at the Interconnection Customer's substation for remote interrogation of the revenue meters.

The 138kV revenue class current and voltage transformers will be supplied and installed by the Customer complete with supporting structures, test switch, and meter base as per Nova Scotia Power metering standard STD 5.12 (attached as Appendix F: Revenue Metering).

The revenue metering class potential and current transformers shall not be embedded in

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any other piece of equipment and shall be certified by Measurement Canada for three element metering. Nova Scotia Power shall provide the technical specifications for the required current and voltage transformers to the Interconnection Customer.

Nova Scotia Power will install the revenue meter at the Interconnection Customer's substation once the commissioning is complete and the system is ready for energization.

## **2.7 Station Service**

NSPI will require a dedicated 120V AC circuit from Interconnection Customer's substation building AC distribution panel to supply the NSPI owned protection and control panel.

## **3.0 SCOPE OF WORK BY CUSTOMER**

### **3.1 Basic One Line**

A Basic One Line diagram of the proposed customer's 103V Ellershouse III Interconnection Customer substation is provided in Appendix B. The only deviation to the proposed one line is that the line disconnect shown directly at the L-6051 tap point is not required.

### **3.2 Transmission Line Tap**

The Interconnection Customer is responsible for providing NSPI with an easement for the required right-of-way (ROW) for the transmission line tap. NSPI's standard for 138 kV ROW is 30 m (15 m on each side of the center phase in an H-Frame design). The easement grant should allow NSPI the right to construct, operate, maintain, and repair the transmission line.

The line tap ROW shall be cleared by the Interconnection Customer prior to construction of the line tap.

### **3.3 Generation Interconnection Substation**

The layout and electrical design of the Interconnection Customer's substation shall be the responsibility of the Interconnection Customer.

The substation will have a basic layout with the substation's transmission line entering



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the substation through a 138 kV group-operated disconnect switch used principally to isolate the substation from the transmission system and for maintenance and repairs on the transmission line. The substation will be metered on the 138 kV bus via a dedicated revenue metering system owned by NSPI. The power transformer (103V-T61) will be three phase and step-up the generator bus voltage from 34.5 kV to the 138kV system voltage. The low side of the transformer will consist of three (3) generation collector circuit bays and a substation station service supply. Each generation collector circuit will have a grounding transformer.

The substation will have one (1) 138 kV line terminal dead-end structure for terminating the line tap to L-6051. The 138 kV dead-end structure will be located at the northeast end of the substation.

The Interconnection Customer shall be responsible to supply and install the revenue metering system to Nova Scotia Power specifications as outlined in Section 2.6.

The Interconnection Customer shall provide the Protection and Instrumentation One Line and Substation Layout drawings to NSPI for review to ensure protection & control systems and physical line tap arrangements align with NSPI designs.

### **3.4 Protection and Control Access and Inputs**

The Interconnection Customer shall provide space and unrestricted access in the Interconnection Customer's substation control building for NSPI's protection, communications, and control equipment as detailed in section 2.3, 2.4, and 2.5. The Interconnection Customer shall provide NSPI with the three phase inputs from the 138kV breaker current transformers and the 138kV bus potential transformers, access to the 138kV breaker tripping circuit and all required SCADA points as outlined in Appendix G.

### **3.5 Station Service**

The Interconnection Customer shall include a dedicated 120V AC circuit from Interconnection Customer's substation building AC distribution panel to supply the NSPI owned protection and control panel.

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## 3.6 Permits, Approvals, and Standards

The Interconnection Customer is responsible to obtain all permits and approvals required to construct the interconnection substation at 103V-Ellershouse III.

The Nova Scotia Electrical Inspection Act requires that electrical work be performed under permit. Contractors must take out permits for work at voltage levels below and above 750V – including work on customer owned substations. Plans must be submitted for review and all equipment must be approved by a recognized certification authority (CSA, ULC, etc.).

The customer facilities are subject to the minimum requirements of the latest edition of the Canadian Electrical Code, CSA C22.1, for the purpose of electrical inspection. The cost associated with acquiring wiring permits and the associated electrical inspections are the responsibility of the customer. No equipment will be connected or energized without authorization of the electrical inspector.

The interconnection substation installation will be subject to the review and acceptance by Nova Scotia Power to ensure coordination of the Nova Scotia Power and Interconnection Customer’s scopes of work.

## 4.0 DESIGN

NSPI will be responsible for the engineering drawing production for all aspects of the scope of work described in Section 2.0 of this report. NSPI will also own, supply and install this equipment including:

- Transmission line modifications to L-6051 and the line tap to the Interconnection Customer’s Substation
- The telecommunications system design
- The SCADA RTU design
- The protection and control design associated with the modifications at 120H-Brushy Hill and 17V-St. Croix and the NSPI protection relays at 103V-St. Croix

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## 5.0 COMMISSIONING

At 17V-St. Croix and 120H-Brushy Hill substations, NSPI, as the transmission provider, will perform the commissioning of all protection and control, telecommunications, and SCADA modifications as outlined in section 2.0 of this report.

At 103V-Ellershouse III substation, the Interconnection Customer will perform the commissioning on all primary and secondary equipment including the revenue metering voltage and current transformers. The Interconnection Customer and NSPI will perform joint verification of the communications system and terminal equipment between the interconnection substation and NSPI's communication facilities.

Nova Scotia Power's Meter Services team will install and test the revenue metering.

Nova Scotia Power shall require review of:

- the insulation test results of the Customer's 138 kV circuit breaker and 138kV disconnect switch.
- the insulation tests of the revenue metering voltage and current transformers.
- the relay settings test results and injection test results associated with the interconnection protection.
- all secondary commissioning and trip test results for all interface protection, control and metering systems that interface to the Nova Scotia Power transmission system.

NSPI shall witness the final trip tests of all interface protection.

These reviews are required to ensure the interconnection substation is ready to be energized and accepted onto the transmission system.