Facilities Study Report

IR-673
33.6 MW Wind Generating Facility
Benjamin's Mill

Prepared by
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September 12, 2023

EXECUTIVE SUMMARY

This project (IR#673 – Benjamin's Mill Wind) provides for the establishment of a 138 kV system interconnection to Nova Scotia Power Inc (NSPI) transmission line L-6054 for a 33.6MW Wind Generation Facility in Hants County, Nova Scotia.

The Point of Interconnection (POI) is on NSPI's 138kV transmission line L-6054 with the tap point approximately 4.1km from NSPI's substation 101V-MacDonald Pond between existing structures L-6054-273 and L-6054-274. The Interconnection Customer's substation (106V-Benjamin's Mill) will be located approximately 300m from the tap point on L-6054. The Point of Change of Ownership is the line tap dead-end structure in 106V-Benjamin's Mill substation. The POI and PCO are further clarified in the Interconnection Overview Drawing provided in Appendix B.

The new 138kV system interconnection substation has been assigned NSPI system number 106V – Benjamin's Mill.

The scope of work associated with this interconnection will consist of a line tap arrangement to NSPI transmission line L-6054 with a short tap to 106V-Benjamin's Mill substation, modifications to existing protection and control schemes at 43V-Canaan Road and 101V-MacDonald Pond, the addition of Supervisory Control and Data Acquisition (SCADA), revenue metering, and telecommunications at 106V-Benjamin's Mill and the thermal upgrade of sections of transmission lines L-6054 and L-6004 from 75 deg C to 100 deg C.

Part 2 of the SIS is still in progress and if any additional requirements are identified in the Part 2 Study, the FAC will be updated to reflect those additions as required.

All interconnection facilities must meet NSPI's Transmission System Interconnection Requirements (TSIR), version 1.1 dated February 25, 2021, as published on the NSPI OASIS site.

The protection and control additions will include a new NSPI panel at 106V-Benjamin's Mill with primary and secondary protection. Modifications to existing protection at 43V-Canaan Road and 101V-MacDonald Pond substations are required to add transfer trip circuits from both 43V-Canaan Road and 101V-MacDonald Pond to 106V-Benjamin's Mill. A preliminary list of the required SCADA points is provided in Appendix E.

NSPI will require space and unrestricted access in the Interconnection Customer's substation control building for the protection equipment at 106V, 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 Revenue Class 138kV voltage and current transformers required for revenue metering shall be supplied and installed by the Interconnection Customer as per NSPI specification.

There are no 'Stand-Alone' Network Upgrades or 'Stand-Alone' Transmission Provider Interconnection Facilities (TPIF) for this interconnection.

Non-stand-alone network upgrades and non-stand-alone TPIF include all other elements of the scope of work:

- Non-Stand-Alone Network Upgrades
  - The thermal upgrades of L-6054 and L-6004 transmission line sections
  - The remote protection modifications at 43V-Canaan Road and 101V-MacDonald Pond

substations.

- Non-Stand-Alone TPIF
  - The 138kV transmission line tap to L-6054 and the extension into 106V- Benjamin's Mill Substation
  - Telecommunications equipment supply and installation at 106V- Benjamin's Mill Substation.
  - The revenuemeter, NSPI protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 101V-Benjamin's Mill substation.

All system outages required to complete the interconnection work shall require advanced planning and coordination with the NS System Operator.

The total estimated cost to construct the required Network Upgrades and Transmission Provider's Interconnection Facilities is **$14,969,816**. There are no Stand-Alone Network Upgrades or Transmission Provider's Interconnection Facilities with this interconnection. The breakdown of the total estimated cost is $13,618,521 to construct the Network Upgrades and $1,351,295 for the TPIF. The detailed cost estimates are provided in Appendix F. All cost estimates exclude allowance for funds used during construction (AFUDC) or any escalations due to timing of project execution.

The customer will be responsible for paying NSPI for the actual costs associated with this project, be they higher or lower than the estimate provided herein, unless otherwise specified in the Generation Interconnection Agreement (GIA). As per Item 11.4 of the GIA, Network Upgrade costs are refundable to the Interconnection Customer pending Nova Scotia Utility and Review Board (NSUARB) approval.

The Interconnection Customer's targeted commercial operation date is December 13, 2024 with first-power available by September 13, 2024. An overall preliminary project schedule is provided in Appendix G.

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1.0 INTRODUCTION

This Facilities Study Report is based on the System Impact Study Report (SIS) as identified below:

System Impact Study Report (Part 1)
Report GIP-IR673-SIS-Part1-R0
By Hung Huynh, P.Eng.
Dated May 11, 2023

The SIS describes the facilities and modifications required to the Nova Scotia transmission system to add a 33.6 MW Wind Generating Facility at Benjamin's Mill, Hants County, interconnected to NSPI's 138kV transmission line L-6054. It also addresses short circuit, steady state, stability, power flow, and motor start analysis. It provides an overview of the scope of work to be completed and directions to this Facilities Study (FAC).

Part 2 of the SIS is still in progress and if any additional requirements are identified in the Part 2 Study, the FAC will be updated to reflect those additions as required.

The scope of work identified in the Facilities Study outlines the anticipated work requirements for a conceptual level of engineering and design. Detailed design may identify additional requirements or modifications that were not anticipated or captured during the preliminary design phase.

1.1 Project Ownership and Responsibilities

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

Following NSPI system naming standards, the new Interconnection Customer's facility substation will be labeled 106V-Benjamin's Mill.

Ownership of the infrastructure associated with 106V-Benjamin's Mill interconnection is based on the Point of Change of Ownership at the line tap dead-end structure in 106V-Benjamin's Mill substation (refer to the Interconnection Overview Diagram in Appendix B). NSPI (as the Transmission Provider) will own the 138 kV tap point on L-6054 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 existing Hemlock Hill Radio Site and the new Interconnection Customer's facility at 106V-Benjamin's Mill, required for control and monitoring of the facility, will be owned, supplied, and installed by NSPI. This includes the Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU), antenna and telecommunication equipment located at the Interconnection Customer's substation 106V-Benjamin's Mill.

NSPI will also own the revenue metering located in the Interconnection Customer's substation 106V-Benjamin's Mill.

All interconnection facilities must meet NSPI's Transmission System Interconnection Requirements (TSIR), version 1.1 dated February 25, 2021, as published on the NSPI OASIS site.

1.2 Estimated Cost

The total estimated cost to construct the required Network Upgrades and Transmission Provider's Interconnection Facilities is **$14,969,816**. There are no Stand-Alone Network Upgrades or Transmission Provider's Interconnection Facilities with this interconnection. The breakdown of the total estimated cost is $13,618,521 to construct the Network Upgrades and $1,351,295 for the TPIF. The detailed cost estimates are provided in Appendix F. *All cost estimates exclude allowance for funds used during construction (AFUDC) or any escalations due to timing of project execution.*

The cost estimates are based on the scope of work outlined in Section 2.0 of this Facilities Study Report. The cost estimate provided in Appendix F are estimates only based on 2023 budgetary dollars. The customer will be responsible for paying NSPI for the actual costs associated with this project, be it higher or lower than the estimate provided herein, unless otherwise specified in the Generation Interconnection Agreement (GIA).

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, or as per the terms of the GIA. As per Item 11.4 of the GIA, Network Upgrade costs are refundable to the Interconnection Customer pending Nova Scotia Utility and Review Board (NSUARB) approval.

1.3 Project Schedule

The estimated project duration includes all scope of work required for the transmission interconnection as outlined in Section 2.0.

The Interconnection Customer's targeted commercial operation date is December 13, 2024, with first-power available by September 13, 2024.

An outline of major project milestones is provided in Section 5.0 and a preliminary project schedule outlining the major components of this project is provided in Appendix G.

2.0 SCOPE OF WORK

The scope of this Facilities Study is limited to providing the necessary designs, equipment, labor, and services required to interconnect the new generating facility at Benjamin's Mill substation (106V) to NSPI's transmission system. The Benjamin's Mill substation will be direct-tapped, via an approximately 300m span, to NSPI transmission line L-6054. L-6054 extends between NSPI substations 101V-MacDonald Pond and 43V-Canaan Road.

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 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 Interconnection Overview

An interconnection overview diagram of the 33.6 MW Benjamin's Mill Wind interconnection is provided in Appendix B. The Point of Interconnection (POI) is at NSPI's 138kV transmission line L-6054 approximately 4.1 kms from 101V-MacDonald Pond (between existing line structures L6054-273 and L6054-274). The Point of Change of Ownership (PCO) is at the new 138kV line tap terminal structure at the Benjamin's Mill Interconnection Facility substation 106V (approximately 300m from the POI).

A Basic One Line diagram of the proposed 106V-Benjamin's Mill interconnection substation, as provided by the Interconnection Customer, is included in Appendix D.

2.2 L-6054 Transmission Line Tap

The new 106V-Benjamin's Mill substation will be direct tapped to NSPI transmission line L-6054 approximately 4.1 kms from 101V-MacDonald Pond and 21.1 kms from 43V-Canaan Road substations.

Based on the location of the Interconnection Customer's proposed substation, the line tap is anticipated to be approximately 300m from the substation's 138kV dead-end structure.

NSPI L-6054 existing tangent type structure #274 will be replaced with a wood pole line dead-end structure. A new wood pole dead-end structure will be installed in L-6054 between structure #274 and #273 to accommodate the line tap. The line tap will extend under the existing L-6054 and consist of two wood pole dead-end type structures; one just outside the new 106V substation and one located within the L-6054 right of way. The conductor for the line tap will be 556 ACSR Dove. The existing overhead shield wire on L-6054 will be extended into the 106V substation. (See Appendix C: L-6054 Line Tap Configuration).

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 for 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.

All land restrictions, environmental conditions, and construction activities shall comply with NSPI procedures, all existing laws and regulations and any environmental assessment requirements.

2.3 Thermal Upgrades: L-6004 and L-6054

Both transmission lines L-6054 and L-6004 are currently thermally rated for operation at 75 deg C. The L-6054 transmission line section from 43V-Canaan Road substation to the 106V- Point of Interconnection (approximately 21.1km) and the L-6004 transmission line section from 90H-Sackville substation to the Point of Interconnection for IR-671 (approximately 44.5km) require thermal upgrading to a conductor operating temperature of 100 deg C.

A lidar survey, to identify the existing line to ground clearances, is required for L-6054 and L-6004 to accurately determine the number of spans and the most effective remediation to upgrade the line sections to 100 deg C. Remediation techniques can include raising structures, adding structures, re-tensioning, and removing obstacles at ground level. The most cost-effective approach cannot be confirmed until the actual number of spans in violation of the 100 deg C clearance requirement and the level of additional clearance required is known.

At the time of this report, the Lidar surveys have been scheduled, but will not be complete until Q4, 2023. The scope of work and estimate for this Facilities Study have been based on existing field line inspection data to provide an indication of the estimated number of spans that may require remediation. The scope of work and cost estimate will need to be updated once the Lidar survey has been completed.

To prepare a high-level cost estimate in the absence of lidar data, the latest field inspection data was analyzed and all spans not currently having a minimum of 1.5m additional clearance from current line rating were assumed to require some form of remediation to achieve the 100 deg C thermal line rating. Based on NSPI average historical costs, an estimate of $60k per span was used to provide the thermal upgrade costs used in this FAC.

The total number of spans in L-6054 from the 43V-Canaan Road substation to the 106V Point of Interconnection is 113 spans. Based on review of field inspection reports only, it is estimated that approximately 40% of the total spans will require some level of remediation to achieve the 100 deg C operating temperature rating.

The total number of spans in L-6004 from the 90H-Sackville substation to the IR-671 Point of Interconnection is 239 spans. Based on review of field inspection reports only, it is estimated that approximately 55% of the total spans will require some level of remediation to achieve the 100 deg C operating temperature rating.

2.4 Customer's Interconnection Substation:106V-Benjamin's Mill

The layout and electrical design of the Interconnection Customer's substation shall be the responsibility of the Interconnection Customer. A preliminary one-line of the Interconnection Customer's substation, as provided by the Interconnection Customer, is included in Appendix D.

The substation will have a basic layout with the substation's transmission line terminating on a steel dead-end structure and connected to 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. A 138kV circuit switcher shall be provided by the Interconnection Customer for local and transfer trip protection. The substation will be metered on the 138 kV bus via a dedicated revenue metering system owned by NSPI. The power transformer (106V-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 two (2) 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 and shield wires to L-6054. The 138 kV dead-end structure will be located at the northeast end of the substation closest to L-6054.

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.

The customer owned substation 106V-Benjamin's Mill shall be designed and constructed to comply with Canadian Electrical Code requirements.

2.5 Protection and Control

Protection upgrades to line L-6054 are required at accommodate the addition of IR-673 Benjamin's Mill. NSPI will require space and unrestricted access in the Interconnection Customer's substation control building for the Remote Terminal Unit (RTU), two transmission line protection relays, and 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, install, and maintain the transmission line protection and control equipment.

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. The Interconnection Customer shall provide NSPI with the three phase inputs from the 138kV transformer current transformers and the 138kV bus potential transformers, access to the 138kV circuit switcher tripping circuit, and all required SCADA points as outlined in Appendix E.

2.5.1 Line Protection

At 106V-Benjamin's Mill, transmission line protection will consist of redundant primary and secondary protection schemes.

- The primary scheme line protection relay shall be SEL-411L, using the 87L line current differential element for high-speed tripping and step distance elements for backup tripping.
- The primary protection shall trip the circuit switcher via Trip Coil #1.
- The secondary scheme line protection relays shall be GE L90, using distance elements with a permissive signal (POTT scheme) for high-speed tripping to match the remote ends.
- The secondary protection shall trip the circuit switcher via Trip Coil #2.
- AC potentials for the primary and secondary protection schemes shall be supplied from separate secondary windings in the line Potential Transformers (PTs).
- AC currents for the primary and secondary protection schemes shall be supplied from separate Current Transformer (CT) cores.

2.5.2 Breaker Failure

- Breaker failure protection shall be provided for the 138 kV circuit switcher 106V-601.
- Breaker Failure Initiate (BFI) must not be latched in the design. Breaker failure timer shall only run for (Trip active) AND (transformer current above minimum pickup). The trip input to the BFI logic shall not be subject to a minimum trip duration.
- Transfer tripping via high-speed tele-protection channels to the remote ends of line L-6054 shall be required for a 138 kV circuit switcher failure.
- Transfer tripping of 106V-601 via high-speed tele-protection channels from the remote ends of L-6054 is required for remote line breaker failures and anti-islanding protection.
- Note: Breaker Failure protection is referred to as Breaker Backup (BBU) in NSPI documentation. A Re-trip is referred to as "Early Trip."

2.5.3 Reclosing and Synchronizing

- Line circuit switcher reclosing may be initiated by either the primary or secondary protection schemes.
- The reclosing function shall have a single OFF/ON control.
- The 138 kV circuit switcher shall be logically interlocked and only permitted to close under LIVE LINE/DEAD BUS conditions, including an open breaker or switch between the 138 kV line circuit switcher and the collector circuits.

2.5.4 DC Supply for Protection

The Interconnection Customer shall provide dedicated 125V DC circuits and conduits (if required) from Interconnection Customer's substation DC station service distribution panel to supply the NSPI owned protection and control panel.

Primary and secondary protection schemes shall be supplied by separate DC breakers from the DC distribution panel.

2.5.5 Station Control and Communications

- A central Sequence of Events Recording (SER) functionality shall be provided to assist operational investigations.
- If the IC design at 106V includes a non-redundant Substation Automation System (SAS), then this may also act as the substation RTU, reducing the NSPI panel space requirement.
- Communication to the Supervisory Control and Data Acquisition (SCADA) master will use DNP3 protocol over a serial channel.
- If a separate NSPI RTU is needed, communication between the substation RTU and the wind farm control system will use DNP3 protocol over a serial channel.
- If a separate NSPI RTU is needed, communication between the substation RTU and the SAS will use DNP3 protocol over a serial channel.
- A non-redundant satellite clock shall be provided.
- A time signal shall be distributed to each measuring relay using either Precision Time Protocol (IEEE 1588-2008 or later) or IRIG-B time code over 50 ohm coaxial cable.
- Each protective relay shall assert an alarm to the SER in the event of a loss of satellite clock signal.
- If PTP is used for time distribution, Ethernet switches used in the SAS shall be capable of supporting PTP with the C37.238-2017 power system profile.
- In the event of a failure of the SAS, local manual operation of the breakers shall be available from inside the control building.

2.5.6 Additional Protection

The Interconnection Customer shall include tank ground protection for both the interconnection transformer 106V-T61 and the line circuit switcher 106V-601 to distinguish between substation faults and line faults.

2.5.7 Station Alarms

The following substation alarms will be provided to the local Sequence of Events Recorder (SER) and SCADA (unless otherwise noted):

1. Urgent (SCADA) time delayed & initiated by following SER points:
   - Station Service Failed
   - Battery Volts Low
   - Battery Charger Failed
   - Protection AC Potential Failed
   - Breaker Trip Circuit #1 Failed
   - Breaker Trip Circuit #2 Failed
   - Line L-6054 Tele-protection Channels Failed
   - Fire Alarm Operated
   - Building High Temperature
   - Building Low Temperature
2. Non-Urgent (Scada) time delayed & initiated by following SER points:
   - Alternate Station Service Failed
   - Station Service Auto Transfer Operated
   - DC Supply(s) Grounded
   - Relay Time Sync Failed
3. #1 Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-6054 #1 Transfer Trip From 101V Received

- Line L-6054 #1 Transfer Trip From 43V Received

4. #2 Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-6054 #2 Transfer Trip From 101V Received
   - Line L-6054 #2 Transfer Trip From 43V Received
5. Line L-6054 Primary Protection Operated (SER only)
6. Line L-6054 Secondary Protection Operated (SER only)
7. Local Control (Scada) initiated by following SER point:
   - Circuit Switcher 601 Control Local
8. Circuit Switcher 601 Closed
9. Breaker 411 Closed
10. Breaker 412 Closed
11. Circuit Switcher 601 Urgent (Scada) initiated by following SER points:
    - Circuit Switcher 601 SF6 Density Low
    - Circuit Switcher 601 Motor Overload*
12. Circuit Switcher 601 Control Blocked (Scada) initiated by following SER point:
    - Circuit Switcher 601 SF6 Control Blocked
13. Circuit Switcher 601 Auto-reclose Off (Scada) initiated by following SER point:
    - Circuit Switcher 601 Auto-reclose Off
14. Breaker Backup Lockout (Scada) initiated by following SER points:
    - Circuit Switcher 601 BBU Lockout Operated
15. Circuit Switcher 601 BBU Initiated & Early Trip Operated (SER) only
16. Substation Entry
17. Protection/DC Fail (Scada) initiated by following SER points:
    – L-6054 Primary Protection Relay/DC Fail
    - L-6054 Secondary Protection Relay/DC Fail

* Note: These alarms may differ depending on the manufacturer of the circuit switcher/breakers purchased and additional SCADA alarms will be required related to the Wind Farm Control System.

2.6 Remote Terminal Protection Modifications

The primary line protection relays for L-6054 at 101V-MacDonald Pond and 43V-Canaan Road will be replaced to match the relays to be installed at 106V-Benjamin's Mill.

2.7 Supervisory Control and Data Acquisition / Remote Terminal Unit

The preliminary list of Supervisory Control and Data Acquisition (SCADA) points are listed in Appendix E with station alarms as outlined in section 2.5.6. Additional control and status points may be identified during final design.

The Remote Terminal Unit (RTU) will be installed in a common panel (as mentioned in section 2.5) 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.

2.8 Telecommunications

A radio link shall be installed from 106V-Benjamin's Mill to NSPI's existing Hemlock Hill Radio Site to provide a communications path for telecontrol and protection. A self-supporting communications tower will be installed within the Interconnection Customer's substation for the radio antenna. The tower location is to be determined during detailed design but should be as close to the Interconnection Customer's control building as possible. The existing microwave radio equipment between Newtonville Radio Site and Canaan Road substation will be upgraded to accommodate the additional installation at Benjamin's Mill. The communications equipment at 106V-Benjamin's Mill will be in a common panel (as mentioned in section 2.5) along with the protection equipment and RTU. NSPI will own, supply, and install the tower, radio antenna, and communications equipment.

2.9 Station Service

The Interconnection Customer shall provide a dedicated 120V AC circuit and dedicated 125V DC circuits in conduits (if required) from Interconnection Customer's substation AC and DC station service distribution panels to supply the NSPI owned protection and control panel.

2.10 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 shall be supplied and installed by the Interconnection Customer complete with supporting structures, test switch, and meter base as per Nova Scotia Power metering standard STD 5.12 (attached as Appendix H: Revenue Metering).

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

2.11 Scope of Work Categorization

In the event NSPI cannot meet the Interconnection Customer's schedule expectation or as agreed in the terms of the Generation Interconnection Agreement (GIA), the Interconnection Customer may take responsibility for design, procurement, and construction activities associated with NSPI owned assets.

These design, procurement, and construction activities are limited to upgrades deemed to be 'Transmission Providers Interconnection Facilities (TPIF)' or 'Stand Alone Network Upgrades',

defined as:

> *Transmission Provider's Interconnection Facilities shall mean all facilities and equipment owned, controlled, or operated by the Transmission Provider from the Point of Change of Ownership to the Point of Interconnection as identified in Appendix A to the Standard Generator Interconnection and Operating Agreement, including any modifications, additions or upgrades to such facilities and equipment.*
>
> *Stand Alone Network Upgrades shall be defined as Network Upgrades that the Interconnection Customer may construct without affecting day-to-day operations of the Transmission System during their construction.*

However, the Benjamin's Mill Wind transmission interconnection only includes 'Non-Stand-Alone' Network Upgrades and 'Non-Stand-Alone' TPIF. Since there are no Stand-Alone Network Upgrades or Stand-Alone TPIF the 'Option to Build' under the GIA is not applicable.

2.11.1 'Stand-Alone' Network Upgrades and Stand-Alone TPIF

There are no 'Stand-Alone' Network Upgrades or Stand-Alone TPIF for this interconnection.

2.11.2 Non-Stand-Alone Network Upgrades and Non-Stand-Alone TPIF

Non-stand-alone network upgrades include all other elements of the scope of work not identified as stand-alone upgrades:

- Non-Stand-Alone Network Upgrades
  - The thermal upgrades of L-6054 and L-6004 transmission line sections
  - The remote protection modifications at 43V-Canaan Road and 101V-MacDonald Pond substations.

- Non-Stand-Alone TPIF
  - The 138kV transmission line tap to L-6054 and the extension into 106V- Benjamin's Mill Substation
  - Telecommunications equipment supply and installation at 106V- Benjamin's Mill Substation.
  - The revenue meter, NSPI protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 101V-Benjamin's Mill substation.

Interfaces and commissioning activities requiring joint collaboration shall be identified during the detailed design phase and prior to construction.

3.0 PERMITS, APPROVALS, AND STANDARDS

The Interconnection Customer is responsible to obtain all permits and approvals required to construct the interconnection substation at 106V-Benjamin's Mill.

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, and other applicable CSA standards, 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 approval by Nova Scotia Power to ensure coordination of the Nova Scotia Power and Interconnection Customer's scopes of work.

4.0 DESIGN AND CONSTRUCTION

NSPI will be responsible for the design and engineering drawing production for all aspects of the scope of work from the Point of Interconnection to the Point of Change of Ownership unless otherwise specified and agreed in the Generation Interconnection Agreement (GIA). NSPI will also be responsible for the design of any other associated network upgrades or modifications identified in the Study Impact Study.

NSPI will be responsible for the procurement and construction of all aspects of the scope of work from the Point of Interconnection to the Point of Change of Ownership and any associated network upgrades unless otherwise specified in the Generation Interconnection Agreement (GIA).

The Interconnection Customer shall be responsible for the design, procurement, and construction of all facilities on the Interconnection Customer side of the Point of Change of Ownership.

The construction work associated with this interconnection will require planned outages to existing system components. Planned system outages must be coordinated with NSPI System Operations and will be restricted to opportunities when system reliability risks are acceptable.

5.0 SCHEDULE MILESTONES

The Interconnection Customer's targeted commercial operation date is December 2024.

A preliminary project schedule outlining major components is provided in Appendix G.

A series of milestone target dates (listed below) were assumed based on optimistic timelines for the purpose of drafting a schedule for this Facilities Study. The in-service dates provided in this schedule are based on achieving these milestones. Missing any of these milestones increases the risk of meeting the proposed commercial operation date.

Facilities Study Complete	September, 2023
Generation Interconnection Agreement Executed	Q4, 2023
Detailed Design Start – L-6054 Line Tap	Q1, 2024
Interconnection Customer Substation (106V) Construction Start	Q1,2024
Interconnection Customer Substation (106V) Construction Complete	September 2024
Interconnection Customer provides Easement and Cleared Right of Way for L-6054 Line Tap	Q2, 2024
L-6054 Line Tap Complete	September 2024
Remote Terminal Protection and Communications Complete	September 2024
First Power Available (106V)	September 13, 2024
L-6054 and L-6004 Thermal Upgrades Complete	November 2024 (See note)
Commercial Operation	December 13, 2024

Milestone Schedule Note: The thermal upgrades to L-6054 and L-6004 are required for IR-673 based on IR-671 being ahead of IR-673 in the Combined T/D Advanced Stage Interconnection Request Queue. However, the targeted commercial in-service date for IR-671 is February 28, 2026. Therefore, the thermal upgrades to L-6054 and L-6004 completion date could be later as long as it's prior to IR-671 in-service date. Generation limitations may be required during line outages for construction work.

6.0 COST ESTIMATE

The cost estimates have been produced using 2023 budgetary rates. They do not include allowance for funds during construction (AFUDC) or any escalations due to timing of project execution.

The cost estimates are based on the conceptual design outlined in this report and should be considered as a class 3 accuracy level (-20% / +30%).

The cost estimates include project overheads based on NSPI's typical internal capital administration overhead allocation process. Overhead allocations may vary depending on how the project is executed.

A contingency of 10% has been included in the estimates to account for any unforeseen scope changes or supply chain issues.

As per Item 11.4 of the GIA, Network Upgrade costs are refundable to the Interconnection Customer pending Nova Scotia Utility and Review Board (NSUARB) approval.

The cost estimate has been broken out into two blocks:

1. Transmission Provider Interconnection Facilities (all are Non-Stand-Alone)
2. Network Upgrades (all are Non-Stand-Alone)

Cost Estimate Summary:

Upgrade Component	Cost Estimate
Transmission Provider Interconnection Facilities (TPIF)	
Transmission Line tap to L-6054; NSPI's protection, control, and telecommunication equipment installed at 106V substation.	$1,351,295
Network Upgrades	
Thermal upgrades to L-6004 and L-6054 transmission line segments; Remote Protection Changes at 101V and 43V.	$13,618,521
Total	**$14,969,816**

A more detailed breakdown of each cost estimate is provided in Appendix F.

7.0 COMMISSIONING / OPERATIONS

NS Power reserves the right to inspect all Interconnection Facilities identified in this study prior to connection to the NS Power Transmission System to ensure the facility design and construction will not adversely affect the reliability of the Transmission System. All Interconnection Facilities are subject to NS Power's review and acceptance of all testing and commissioning requirements and results. Construction, switching, testing, and commissioning schedules that affect the reliable and stable operation of the Transmission System shall be coordinated with the Nova Scotia Power System Operator.

All system outages required to complete the interconnection work shall require advanced planning and coordination with the NS System Operator.

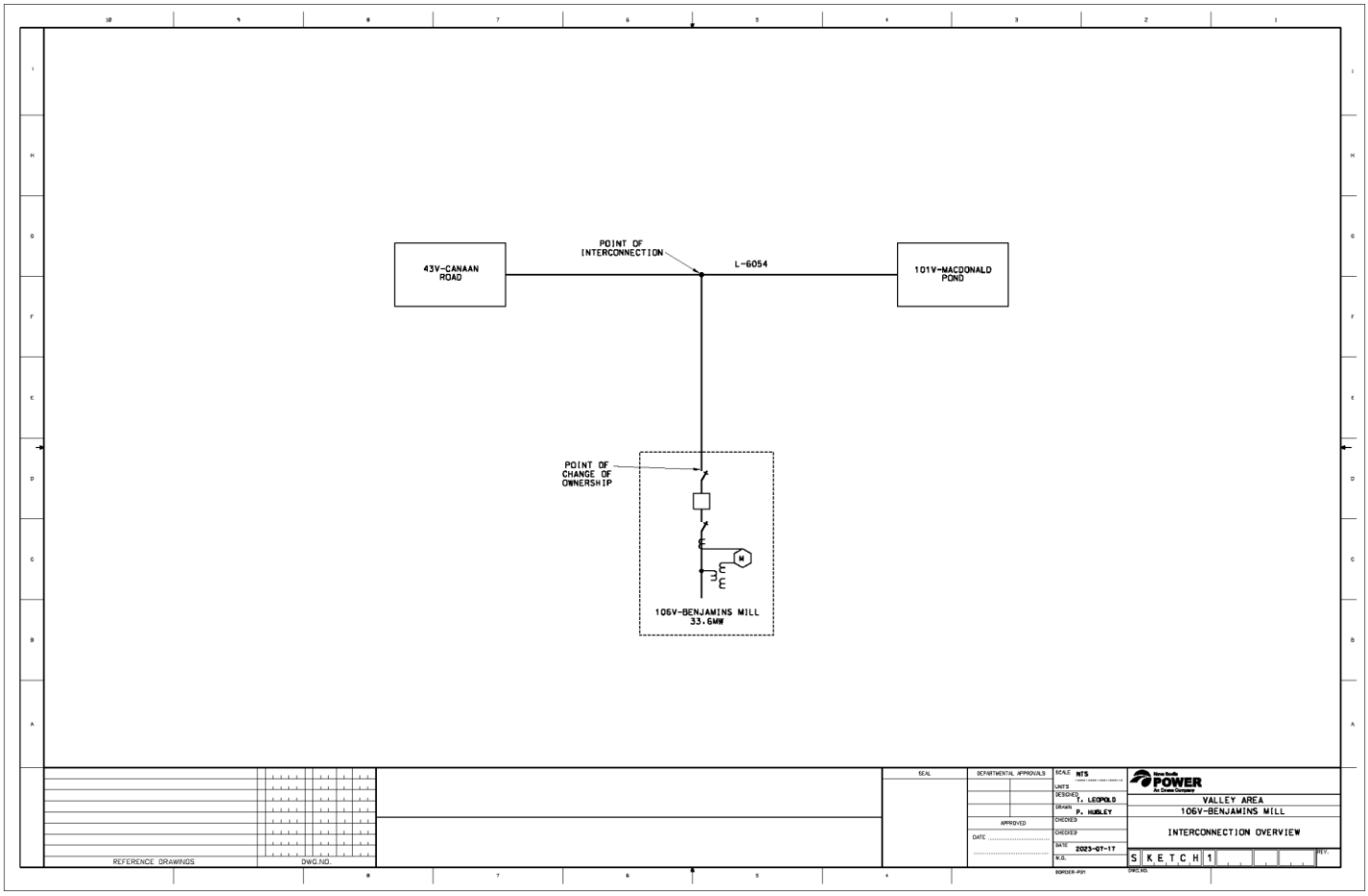
All interconnection facilities must meet NSPI's Transmission System Interconnection Requirements (TSIR), version 1.1 dated February 25, 2021, as published on the NSPI OASIS site.

Appendices

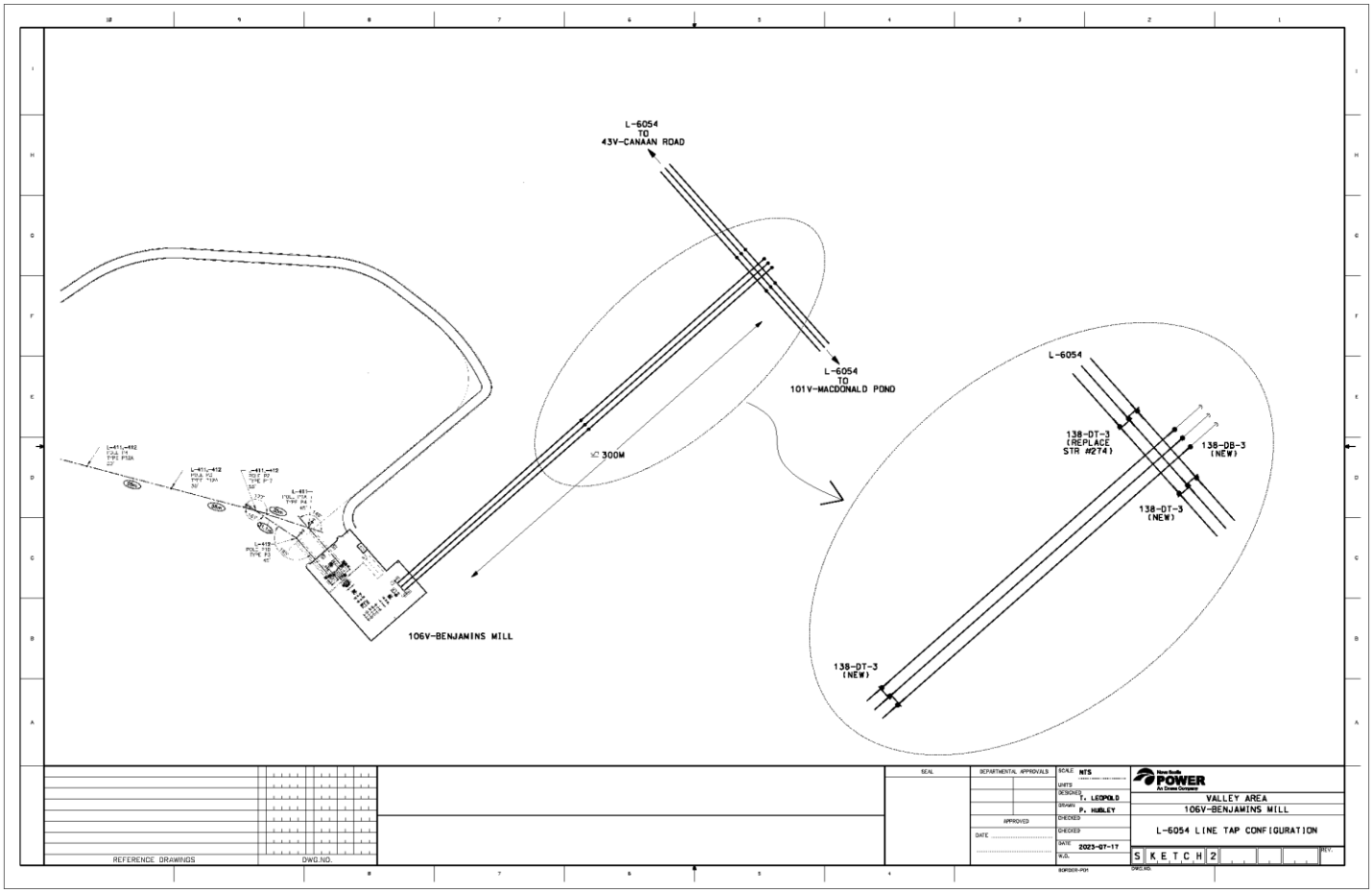
Appendix A – Interconnection Facilities Study Agreement

(Provided as Attachment 1)

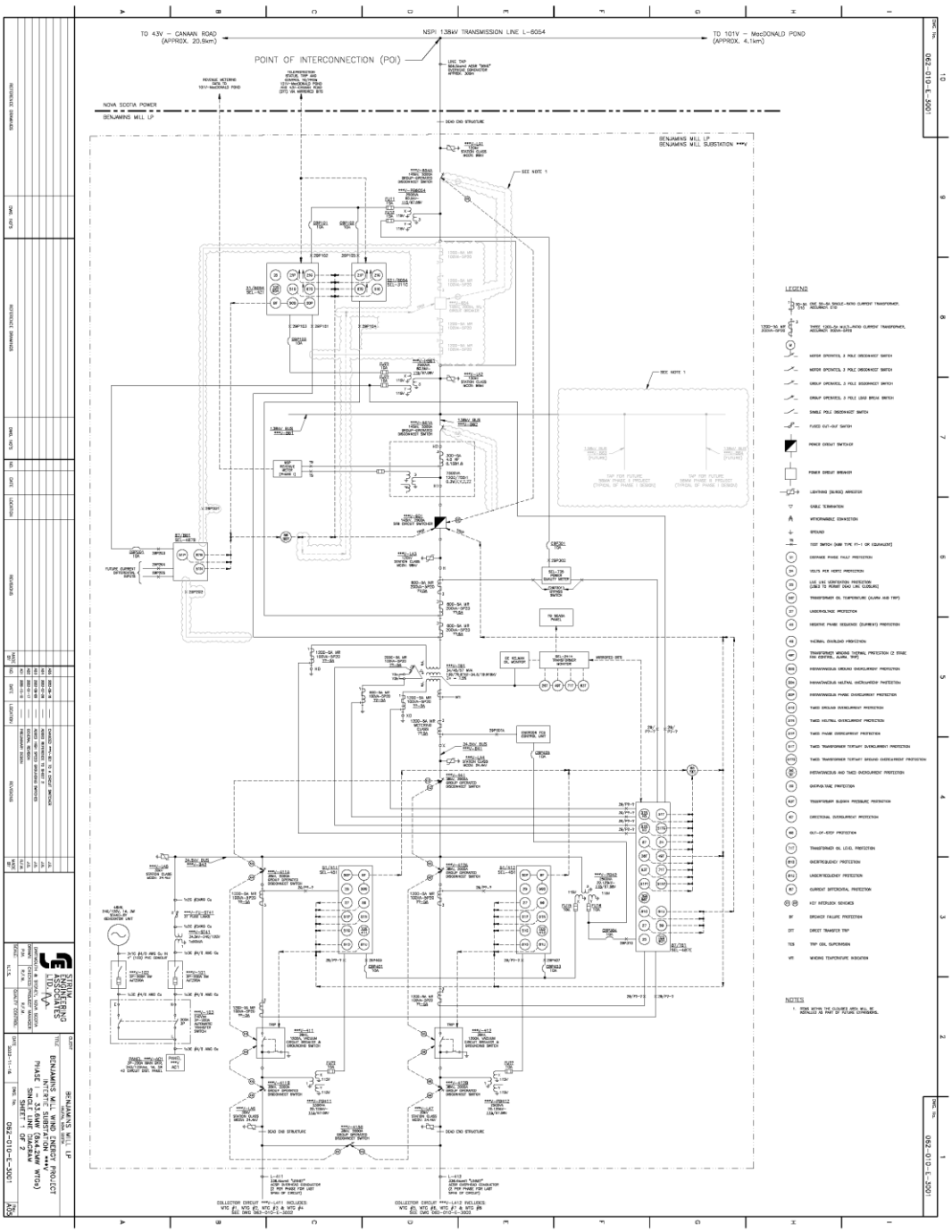
Appendix B – Interconnection Overview



Appendix C – L-6054 Line Tap Configuration



Appendix D – Interconnection Substation One Line (106V)



APPENDIX E – PRELIMINARY SCADA POINTS LIST

	106V - Benjamin's Mill SCADA Points	
Control	**Binary Outputs**	**Destination**
	PERMIT TO OPERATE DENIED	Comms to WFC
	PERMIT TO OPERATE 33%	Comms to WFC
	PERMIT TO OPERATE 66%	Comms to WFC
	PERMIT TO OPERATE FULL	Comms to WFC
	Control Circuit Switcher 106V-601	Hard-wired
	Analogue Outputs	
	Active Power Setpoint	Comms to WFC
	Voltage Setpoint	Comms to WFC
Status	**Binary Inputs**	**Source**
	Status of PERMIT TO OPERATE DENIED	Comms from WFC
	Status of PERMIT TO OPERATE 33%	Comms from WFC
	Status of PERMIT TO OPERATE 66%	Comms from WFC
	Status of PERMIT TO OPERATE FULL	Comms from WFC
	#1 Transfer Trip Received	Hard-wired
	#2 Transfer Trip Received	Hard-wired
	Status of circuit switcher 106V-601	Hard-wired
	Circuit Switcher 601 Control Blocked	Hard-wired
	Status of Collector Circuit Breaker 411	Hard-wired
	Status of Collector Circuit Breaker 412	Hard-wired
	Circuit Switcher 601 URGENT	Hard-wired
	LOCAL CONTROL (only for 106V-601)	Hard-wired
	Circuit Switcher 601 Auto-Reclose Off	Hard-wired
	Circuit Switcher 601 Breaker Back-up Lockout Operate	Hard-wired
	TELEPROTECTION URGENT	Comms from SEL relay
	ISLANDING INTERTRIP	Comms from SEL relay
	URGENT	Hard-wired
	NON-URGENT	Hard-wired
	SUBSTATION ENTRY (if NSPI have a separate room/entrance)	Hard-wired
	PROTECTION/DC FAIL	Hard-wired
Analogs	**Analog Inputs**	
	106V Net Watts	Comms from XFMR protection, or revenue meter
	106V Net Vars	Comms from XFMR protection, or revenue meter
	106V Volts	Comms from XFMR protection, or revenue meter
	Wind speed	Comms from WFC
	Wind direction	Comms from WFC
	Ambient Temperature	Comms from WFC
	Active Power Setpoint confirmation	Comms from WFC
	Expected Wind Output for AGC	Comms from WFC
By NSPI at Remote Sites		
Added at 43V-Canaan Road		
	Line L-6054 Transfer Trip From 106V Received	
Added at 101V-MacDonald Pond		
	Line L-6054 Transfer Trip From 106V Received	

Appendix F – Cost Estimate Details

Transmission Provider Interconnection Facilities:

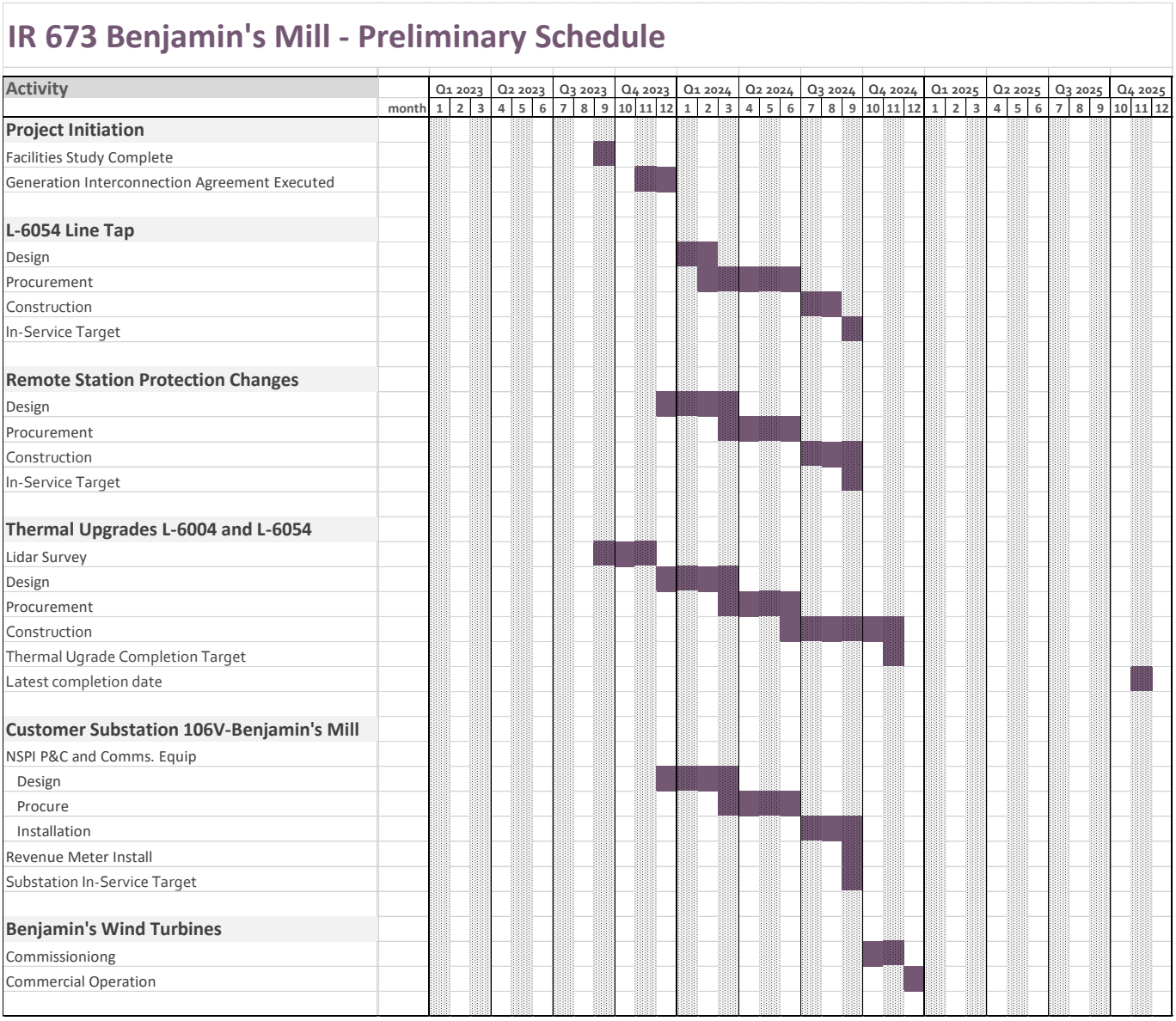
IR-673 Benjamin's Mill TPIF			CI Number:							
			Project Number:							
			Cost Centre:	900						
		Labour		Material	Expenses			Contracts	Consulting	Totals
Activity	Accounts -->	535050	535200	531400	530950	533410	533400	531550	532500	
022	Electrical Control Equipment	15,470	0	109,000	0	0	0	20,000		144,470
035	Wood Poles	0	0	85,000	0	0	0	300,000		385,000
061	Telephone Equipment (/ Comm Equip.)	16,501	4,125	213,000	450	0	500	100,000		334,577
085	Design (i.e. Engineering)	83,933		0	555		0	0	12,000	96,488
086	Commissioning	10,313	0	0	1,500	0	0	0		11,813
087	Field Supervision and Operations	10,927	0	0	0		0	28,000		38,927
088	Survey and Mapping	0		0	0		0	0	5,000	5,000
	Sub-Total	**137,144**	**4,125**	**407,000**	**2,505**	**0**	**500**	**448,000**	**17,000**	**1,016,274**
085	Contingency	13,714	413	40,700	251	0	50	44,800	1,700	101,627
	Sub-Total	**150,858**	**4,538**	**447,700**	**2,756**	**0**	**550**	**492,800**	**18,700**	**1,117,902**
005	Vehicle Allocation (Labour & Eng'g)				54,982					54,982
005	Construction Overhead (Labour)							99,532		99,532
005	Construction Overhead (Contracts)							78,880		78,880
	Totals	**150,858**	**4,538**	**447,700**	**57,737**	**0**	**550**	**671,212**	**18,700**	**1,351,295**

Network Upgrades:

IR-673 Benjamin's Mill Network Upgrades			CI Number:								
			Project Number:								
			Cost Centre:	900							
		Labour		Material	Expenses			Contracts	Consulting		Totals
Activity	Accounts -->	535050	535200	531400	530950	533410	533400	531550	532500		
022	Electrical Control Equipment	0	2,578	62,000	0	0	0	0			64,578
035	Wood Poles	0	0	2,647,500	0	0	0	7,942,500			10,590,000
085	Design (i.e. Engineering)	87,258		0	1,480		0	0	101,250		189,988
086	Commissioning	10,313	2,578	0	1,500	0	0	0			14,392
087	Field Supervision and Operations	5,463	0	0	40,550		0	80,000			126,013
088	Survey and Mapping	0		0	0		0	40,000	0		40,000
	Sub-Total (New Capital)	103,035	5,157	2,709,500	2,980	0	0	8,062,500	101,250		10,984,421
085	Contingency	10,303	516	270,950	298	0	0	806,250	10,125		1,098,442
	Sub-Total	**113,338**	**5,672**	**2,980,450**	**3,278**	**0**	**0**	**8,868,750**	**111,375**		**12,082,863**
005	Vehicle Allocation (Labour & Eng'g)				41,307						41,307
005	Construction Overhead (Labour)							74,777			74,777
005	Construction Overhead (Contracts)							1,419,573			1,419,573
	Totals	**113,338**	**5,672**	**2,980,450**	**44,585**	**0**	**0**	**10,363,100**	**111,375**		**13,618,521**

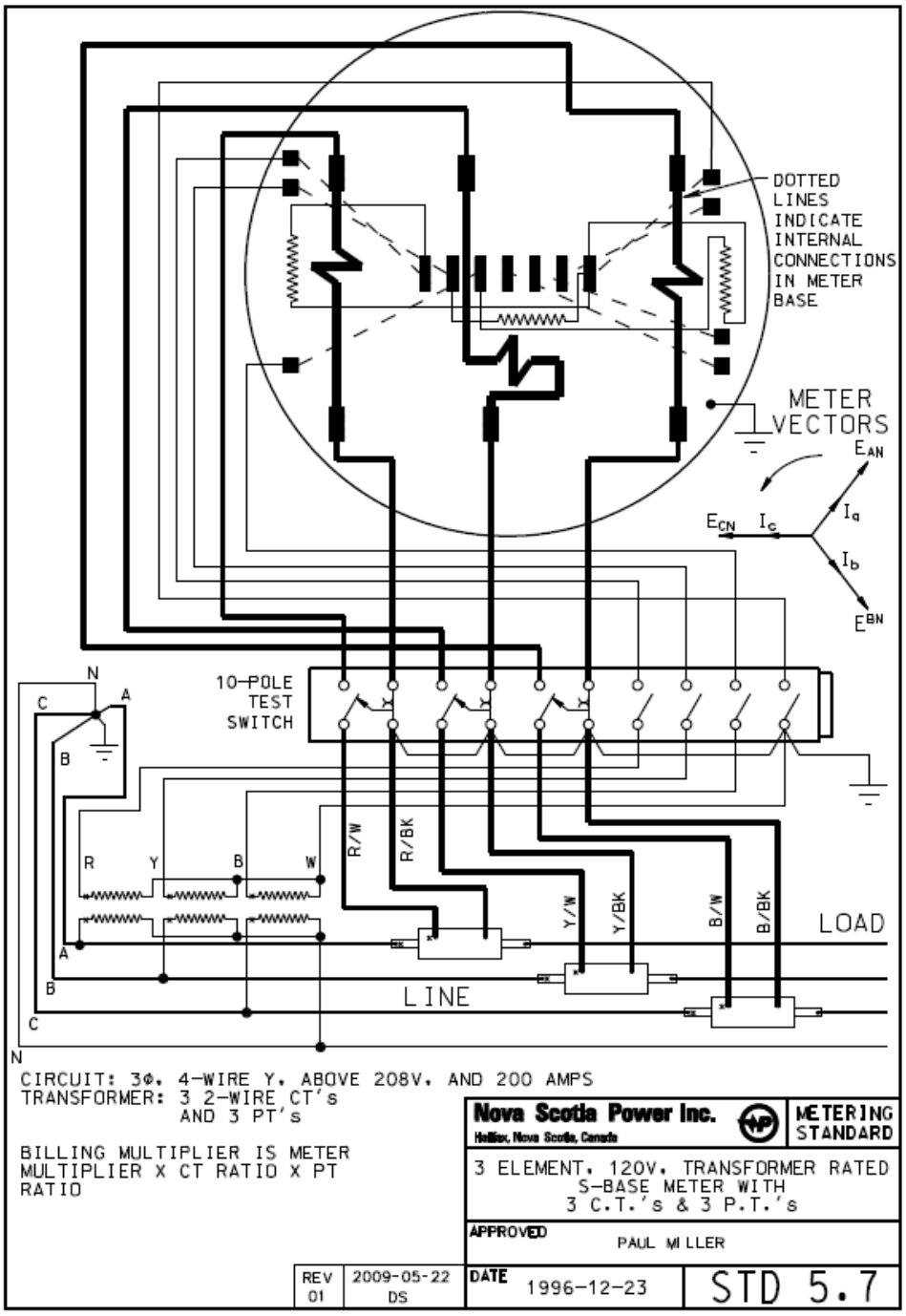
Appendix G – Preliminary Project Schedule

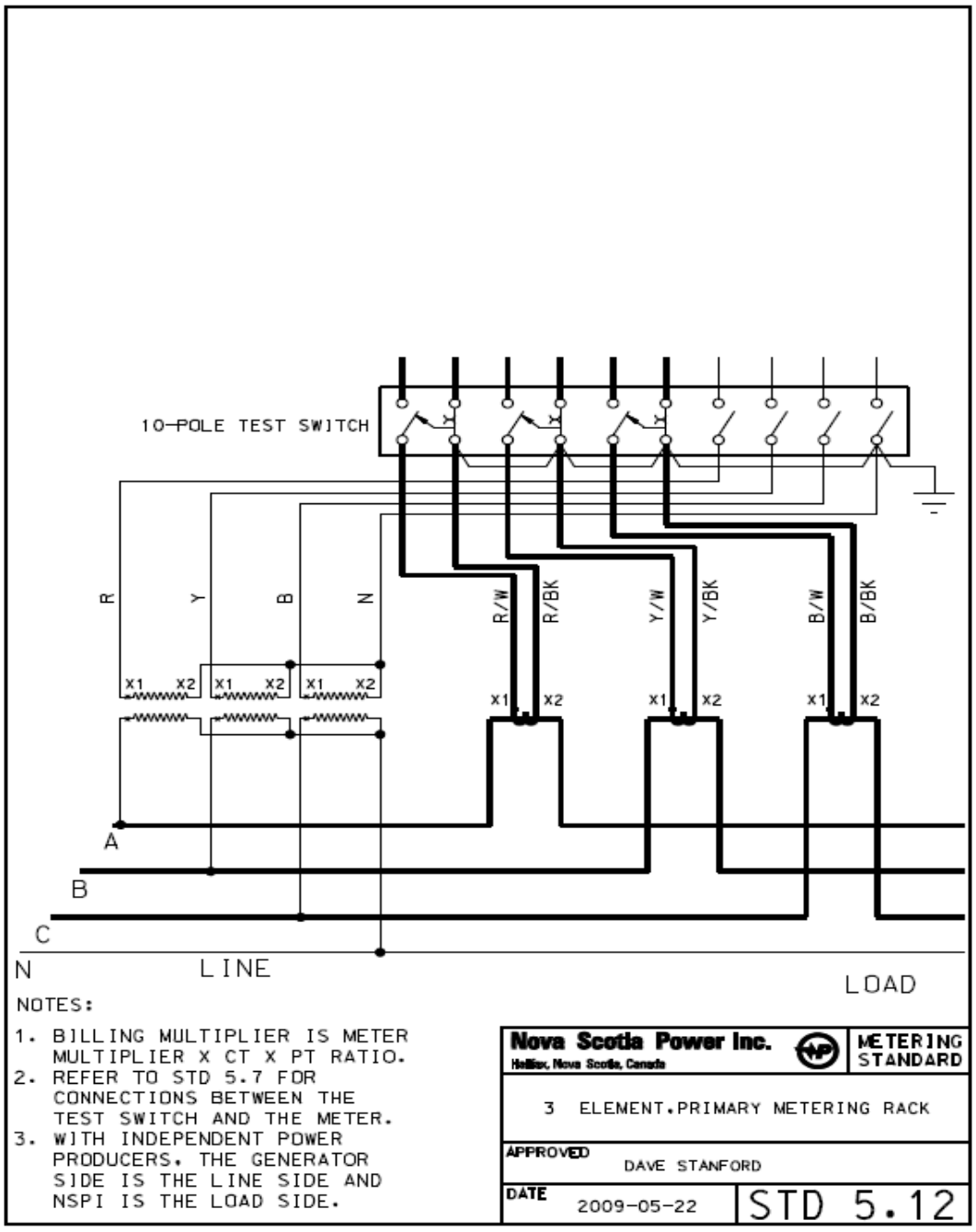
Note: Primary Equipment supply chain volatility may introduce significant and unpredictable procurement timelines to the overall project schedule.



Appendix H – Revenue Metering

NSPI Standards 5.7 and 5.12




10-POLE TEST SWITCH
R
Y
B
N
R/W
R/BK
Y/W
Y/BK
B/W
B/BK
X1
X2
A
B
C
N
LINE
LOAD
NOTES:
1. BILLING MULTIPLIER IS METER MULTIPLIER X CT X PT RATIO.
2. REFER TO STD 5.7 FOR CONNECTIONS BETWEEN THE TEST SWITCH AND THE METER.
3. WITH INDEPENDENT POWER PRODUCERS, THE GENERATOR SIDE IS THE LINE SIDE AND NSPI IS THE LOAD SIDE.
Nova Scotia Power Inc.
Halifax, Nova Scotia, Canada
METERING STANDARD
3 ELEMENT.PRIMARY METERING RACK
APPROVED
DAVE STANFORD
DATE
2009-05-22
STD 5.12

Appendix I – Minutes of Facilities Study Review Meeting (Date: October 04, 2023)

Notes:

- Attendees: Joe Purser, Timothy Leopold, Andrea Bradshaw, Rick McCarthy, Jamin Barett, Mohit Agarwal
- Notes
  IC is expecting Wind turbine by Next year in July.
  IC is expecting first power by Nov 2024 instead of sep 2024 due to delays in cicruit swicther coming in October 2024.
  Schedule in FAC study assumes that GIA will be signed in Q4 and any further delays on that will impact In-servcie date.
  IC allowed room in control building for RTU and other equipment but they are unsure of size. FAC report is not providing the size for that. Consultant thinks that this can be done with one panel but at most two panels.
  Question From IC:When IC proceed with the GIA what they need to put as security for the cost of TPIF.? the cost will be separated out in the GIA based on the design and procurement cost as separate from the construction cost and so there will be a a requirement for a deposit for the to start the design and procurement. And then there will be another deposit required for the construction aspects of it, and there'll be dates as applied to.
  Question from IC: Section 2.4 the last paragraph, or the last sentence for the second paragraph. That says each Generation Collector Circuit will have a grounding? We probably pulled it off in all one line just as a description of the scope of work.
  Question from IC:would we typically expect your protection relays? to be in the lineup with the client protection relays? our intent with this would be to try to put the the RTU, the communications and the protection relays all in one panel
  SIS Part 2 study is pending and required to complete the GIA.

  Next Steps: GIA as per Section 11 of GIP

- Review of questions provided by the Interconnection Customer (IC) on the draft Facilities Study (FAC):
- Our comments on the draft Facilities Study for Benjamin's Mill wind farm as follows;
- • The Network Upgrades and TPIF are listed as not being 'Stand Alone' what if any is the significance of 'Stand Alone' or non-stand alone?
  The GIA provides for construction options whereas the Interconnection Customer (IC) may opt to take responsibility for Stand-Alone Transmission Provider Interconnection Facilities (TPIF) and/or Stand-Alone Network Upgrades (NU). Stand-Alone upgrades being defined as upgrades that may be constructed without affecting day to day operations of the Transmission System. The purpose of defining these in the Facilities Study is to define and clarify what upgrades NSPI would deem Stand-Alone should the IC decide to exercise this option. In the case of IR-573 there are no 'Stand-Alone' TPIF or NU so the only significance is that the IC does not have the option to take construction responsibility for the TPIF or NU's for this project

- • Our comment in my email below still stands – we are progressing this project on the understanding that the costs associated with the Network Upgrades will not be included in the GIA.
  NSPI understand that commitment has been provided by the NSPI Executive that the Network Upgrade costs shall not be included in the GIA.
- • Easement for the RoW – is there a required standard form or template that NSPI require for property agreements?
  Yes. A copy of NSPI's standard land easement agreement has been provided under a separate attachment.

- • Discuss what NSPI requires of us for the line tap the study mentions that the site needs to be cleared.
  An approximate 300m section of tap line is required from the Point of Interconnection on L-6054 to the IC's substation. The IC is responsible to provide an easement (as noted above) to NSPI and the 30m easement must be cleared and accessible prior to NSPI starting construction. If there are any wetland constraints these need to be identified as soon as possible. For NSPI to terminate the tap line to the IC's substation, the substation dead-end structure must be in position.

- • Outages – do NSPI have any concerns about being able to schedule an outage for L6054 for the interconnection?
  NSPI do not currently have any concerns of being able to schedule outages to L-6054. This will require further review by the System Operator once the required outage windows are further defined.

- • Do NSPI have any concerns about the interconnection timeline?
  The proposed schedule does not include any float for any unforeseen delays. Any delays may put the schedule at risk. The schedule for the TPIF is achievable but will require close monitoring and coordination.
  The scope of work to complete the Thermal Upgrades required on L-6054 and L-6004 is still not fully understood and won't be determined until the Lidar survey is completed. This work will most likely not be fully completed until 2025.