Facilities Study Report

IR-670

98 MW Kmtnuk Wind
Colchester County, NS

Prepared by
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October 23, 2023

Facilities Study Report

IR-670 - Kmtnuk Wind

EXECUTIVE SUMMARY

This project (IR#670 – Kmtnuk Wind) provides for the establishment of a 230 kV system interconnection to Nova Scotia Power Inc (NSPI) transmission line L-7005 for a 98MW Wind Generation Facility in Colchester County, Nova Scotia.

The Point of Interconnection (POI) is at the 230kV bus node of a new 230kV three-breaker ring substation (102N-Chisholm Road) located approximately 6.5 kms from 67N-Onslow substation (between existing line structures L7005-031 and L7005-032). The Point of Change of Ownership (PCO) is at the new 230kV line (L-7028) terminal structure at the Kmtnuk Wind Interconnection Facility substation 103N. The POI and PCO are further clarified in the Interconnection Overview Drawing provided in Appendix B.

The new 230kV system interconnection substation has been assigned NSPI system number 102N – Chisholm Road. The interconnection substation at Kmtnuk Wind facility has been assigned system number 103N – Kmtnuk Wind, and the new transmission line between the interconnection substation 102N and Kmtnuk Wind substation 103N has been assigned system number L-7028.

The scope of work associated with this interconnection will consist of a line tap arrangement to NSPI transmission line L-7005, a three-breaker ring interconnection substation at 102N-Chisholm Road, a new 8km 230kV transmission line (L-7028) from the interconnection substation 102N to the Kmtnuk Wind facility (103N), modifications to existing remote protection and remedial action schemes (RAS) and the provision of redundant telecommunications systems.

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 interconnection substation and the Interconnection Customer's Facility substation both meet the Bulk Power System criteria and shall be designed with redundant and physically separated protection, control, and communications.

The following scope of work has been identified as meeting the defined criteria for 'Stand Alone' upgrades as per section 2.10:

- The interconnection substation (102N-Chisholm Road) including land acquisition, site preparation, access road, foundations, site grounding, primary equipment, control building, protection and control panels, and all associated devices except for the telecommunications equipment and the microwave radio tower.
- The transmission line L-7028 from 102N-Chisholm Road to 103N-Kmtnuk Wind substation including easement acquisition, access routes, all structures, conductors, shield wires, insulators, and foundations, the optical fibre shield wire, line terminations at both substations, and all potential railway, highway, and water crossings.
- All elements of the Kmtnuk Wind Interconnection Facility substation 103N except for provision of the revenue meter, the required L-7028 protection and control equipment, the remote terminal unit (RTU), and the telecommunications equipment required at 103N-Kmtnuk Wind substation.

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

- The 230kV transmission line tap at 102N-Chisholm Road to L-7005
- The relocation of a segment of L-5040 at 102N-Chisholm Road Substation
- The remote protection modifications at 3C-Port Hastings and 67N-Onslow
- The modifications to existing Remedial Actions Schemes (RAS).

- Telecommunications equipment supply and installation at 102N-Chisholm Road Substation.
- The revenue meter, L-7028 protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 103N-Kmtnuk Wind substation.

L-7005 shares a transmission line corridor with L-8003, L-6503 and L-5040. Outages to these lines impose limitations on Cape Breton export energy flows and potential customer interruptions. These constraints will require NSPI System Operator actions to minimize risks and maintain system stability and reliability. All system outages required to complete the interconnection work shall require advanced planning and coordination with the NS System Operator.

The Revenue Class 230kV voltage and current transformers required for revenue metering shall 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 (103N) control building for the L-7028 line protection equipment, the Remote Terminal Unit (RTU) and the communications equipment.

The total estimated cost to construct the required Network Upgrades and Transmission Provider's Interconnection Facilities is **$22,869,031**. Of this amount, the estimated cost to construct the *'Stand-Alone'* Network Upgrades and *'Stand-Alone'* Transmission Provider's Interconnection Facilities is **$19,412,220** and the estimated cost to construct the *'Non-Stand-Alone'* Network Upgrades and *'Non-Stand-Alone'* Transmission Provider's Interconnection Facilities is **$3,456,811.** 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).

The Interconnection Customer's targeted commercial operation date is December 2025, with first-power available July 2025. Based on the current supply chain issues and quoted delivery timelines for high voltage primary equipment, the Interconnection Customer's targeted in-service date is not able to be met. An estimated in-service date of Q3, 2026 has been provided based on an executed GIA in Q4, 2023. An overall preliminary project schedule is provided in Appendix G.

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.

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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-IR670-SIS-Part1-R1
By Hung Huynh, P.Eng.
Dated July 26, 2023

The SIS describes the facilities and modifications required to the Nova Scotia transmission system to add a 98 MW Wind Generating Facility at Kmtnuk interconnected to NSPI's 230kV transmission line L-7005. 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 substation will be labeled 102N-Chisholm Road and Interconnection Customer's facility substation will be labeled 103N-Kmtnuk Wind. The new 230kV transmission line from 102N-Chisholm Road to 103N-Kmtnuk Wind will be labeled L-7028. The section of the existing 230kV line from 102N-Chisholm Road to 3C-Port Hastings will be renamed L-7027.

Ownership of the infrastructure associated with 103N-Kmtnuk Wind substation is based on the Point of Change of Ownership at L-7028 line dead-end structure at 103N-Kmtnuk Wind substation (refer to the Interconnection Overview Diagram in Appendix B). NSPI, as the transmission provider, will own the new interconnection substation (102N-Chisholm Road) and the new 230 kV line L-7028 from the 102N-Chisholm Road substation to the dead-end structure located within customer's substation 103N.

All communication systems infrastructure between NSPI's 102N-Chisholm Road substation and the new Kmtnuk Wind facility required for control and monitoring will be owned by NSPI. This includes the fibre and microwave radio communications equipment, protection equipment, and the Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU) located at Kmtnuk Wind substation 103N.

NSPI will also own the revenue metering equipment located in the interconnection substation

103N-Kmtnuk Wind.

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 **$22,869,031**. Of this amount, the estimated cost to construct the *'Stand-Alone'* Network Upgrades and *'Stand-Alone'* Transmission Provider's Interconnection Facilities is **$19,412,220** and the estimated cost to construct the *'Non-Stand-Alone'* Network Upgrades and *'Non-Stand-Alone'* Transmission Provider's Interconnection Facilities is **$3,456,811.** 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 they 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, 2025, with first-power available July, 2025.

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.

Based on the current supply chain issues and quoted delivery timelines for high voltage primary equipment, the Interconnection Customer's targeted in-service date is not able to be met. An estimated in-service date of Q3, 2026 has been provided based on an executed GIA in Q4, 2023.

2.0 SCOPE OF WORK

2.1 Interconnection Overview

An interconnection overview diagram of the 98MW Kmtnuk Wind interconnection is provided in Appendix B. The Point of Interconnection (POI) is at the 230kV bus node of the new 230kV three-breaker ring substation (102N-Chisholm Road) located approximately 11.8 kms from 3C-Port Hastings substation (between existing line structures L7005-696 and L7005-697). The Point of Change of Ownership (PCO) is at the new 230kV line (L-7028) terminal structure at the Kmtnuk Wind Interconnection Facility substation 103N.

2.2 Line Tap on Transmission Line L-7005

A conceptual design plan for the line tap to L-7005 has been provided in Appendix D. Modifications are anticipated as detailed design is finalized. The overall design concept entails relocating a section of 69kV line L-5040 and placing the substation dead-ends for L-7005 and L-7027 on the same center line as the existing L-7005. The 230kV rigid bus for the L-7028 terminal will be extended within the substation fenced area to pass under the existing 345kV line L-8003. No modifications to the 345kV structures are anticipated. A new 230kV dead-end structure is anticipated to be required on L-7005 approach to the substation.

An outage will be required on L-7005 to facilitate installation of the line taps to the 102N Substation. An outage to L-5040 will also be required to relocate a section of the line. Outages to L-7005 and L-5040 will need to be approved by the System Operator and coordinated with any planned outages to minimize any system impacts.

Estimated costs associated with the line tap on L-7005 including termination at the 102N Substation and the relocation of L-5040 are included in the Non-Stand-Alone Network Upgrade cost estimate.

2.2.1 Relocation of a Section of L-5040

A section of L-5040 requires relocation to accommodate the new interconnection substation 102N-Chisholm Road and the line taps to L-7005 (see Overall Plan provided in Appendix D).

2.3 Transmission Interconnection Substation: 102N-Chisholm Road

The developmental one line for 102N-Chisholm Road substation is provided in Appendix C. The developmental plan view for 102N-Chisholm Road substation is provided in Appendix E. In summary, the transmission scope of work includes a 230kV three-breaker ring bus substation with three 230kV line terminals including all associated protection and control, tele-communications, and site development. The Interconnection Customer shall provide NSPI with deeded ownership, and developed road access to, the land associated with the substation site.

The interconnection substation meets the NPCC Bulk Power System criteria and shall be designed with redundant and physically separated protection, control, and communications.

2.3.1 Substation Site Development / Civil Works / Structures / Site Access

2.3.1.1 General Requirements

The following are the general requirements for NSPI substation civil design and construction:

- Topological survey is to be performed prior to design.
- Geotechnical investigation and soil resistivity testing is to be performed prior to design.
- Site Access
  - Access driveways must be designed with adequate width such that all equipment, deliveries, and general maintenance vehicles are able to access substation site.
  - Ditching along access roads are to be provided to ensure access is dry and stable.
  - Culverts are to be used where any drainage cuts across access route.
- Erosion/Sediment Control
  - Check dams/silt fences shall be installed to intercept runoff from any ditches and dewatering activities.
  - Substation finished grade shall be chosen such that surface water drains away from the site.
  - All exposed banks and/or erodible soil shall be temporarily stabilized by suitable means (hydroseed, straw, hay, or sodding).
- Environmental
  - A 30m wide buffer zone shall bracket all watercourses (if applicable).
  - Work inside this zone requires approval through the Dept. of Environment.
- Clearing/Stripping
  - Seasonal clearing must ensure nesting season is avoided and no habitat is destroyed.
  - Stripping shall consist of the removal and disposal of all surface vegetation, chipped or mulched brush, topsoil, trees, brush, tree stumps, roots, and any deleterious other material.
  - All greenfield sites are to be stripped at a minimum depth of 300mm.
- Excavation
  - All excavation practices must adhere to NSPI specification SS –10.7 - Earthworks.
  - Slopes resulting from rock cuts shall normally be 1 horizontal to 1 vertical. Slopes shall be cleaned and trimmed of all disturbed and loose material and left in a neat condition.
  - Following excavation on the site, the ground surface shall be graded and compacted to 95% Standard Proctor Density where it is 900 mm or more from subgrade and to the 100% Standard Proctor Density within the top 900 mm from subgrade.
- Backfill
  - All backfill practices must adhere to NSPI spec SS –10.7 - Earthworks
  - No native material shall be used as fill unless specified by design engineer.
  - Standard Type 1, and 2 gravels used for backfill shall conform to the Nova Scotia Department of Transportation and Public Works Standard Specification.
- Foundations
  - Bearing capacity design shall use maximum allowable bearing pressure of 75 kPa for support structures and 120 kPa for dead end structures.
  - Foundation design shall assume unsubmerged conditions.
  - Concrete must adhere to NSPI concrete spec SS –10.7 - Concrete Cast-in-Place with minimum 28-day compressive strength of 30 MPa.

- Fencing
  - Chain link fencing must adhere to NSPI concrete spec SS –10 - Chain-link Fencing – Supply and Install.
- Structural Steel – Design, Fabrication and Welding
  - Steel design and fabrication shall follow SE-12 Steel Substation Structures – Fabricate & Supply.
  - Materials shall be new and of high commercial quality conforming to the requirements of CSA G40.20 and G40.21, unless noted otherwise.
- Land and access allocated for the interconnection substation shall have deeded ownership provided to NSPI.

2.3.1.2 102N-Chisholm Road Site Specific

All cable trenches and conduits shall be installed with full separation of the 'A' and 'B' protection and control systems.

Concrete foundations and steel support structures will be installed for:

- 3 – 230kV tubular dead-ends
- 7 – 230kV high rigid bus supports
- 7 – 230kV low rigid bus supports
- 7 – 230kV disconnect supports
- 3 – 230V three phase potential transformer supports
- 2 – 132kV-120/240V single phase station service voltage transformer support
- 3 – 230kV three phase surge arrester supports

Concrete foundations (only) will be installed for:

- 3 – 230kV dead tank circuit breakers
- 1 – control building foundation
- 1 – self-supporting microwave radio tower foundation for 20m tower

2.3.2 Substation Grounding

A grounding grid system shall be installed for a design 3-phase fault level of 10,000MVA and meet NSPI's substation grounding specification SD-2. A ground grid design to any fault level lower than 10,000MVA shall require NSPI approval.

The minimum acceptable size of conductor shall be 2/0 stranded copper. An equivalent copper-weld conductor should be used for above ground applications.

All structures, fencing, and equipment shall be grounded as per NSPI standards.

2.3.3 Primary Equipment and Layout

A developmental substation layout for 102N is provided in Appendix E. All equipment shall conform with Nova Scotia Power standard equipment specifications.

2.3.3.1 Circuit Breakers 102N-701, 102N-702, and 102N-703

- 230kV, 2000A, 900kV BIL, 2 cycle, 31.5kA mom., SF6 dead-tank circuit breaker with independent pole operation.
- Complete with two sets (each side) of 2000/16/8/6-5A multi-ratio bushing current transformers.
- As per NSPI Standard Circuit Breaker Specification SE-14.

2.3.3.2 230kV Disconnects (102N-701A, 701B, 702A, 702B, 703A, 704B, and 728)

- 230kV, 2000A, 900kV BIL, 63kA mom., complete with 125Vdc motor operator.
- Line disconnects 102N-703A, 102N-702B and 102N-728 will also include an integral key interlocked ground switch.
- As per NSPI Standard Specification SE-8 (Outdoor Air Switches) and SE-10 (Air Switch Motor Operators).

2.3.3.3 230kV Voltage Transformers (P7005, P7027, and P7028)

- 2000/1200:1:1 with two 115/69V secondaries, 3000VA, 0.3 WXYZ, 900kV BIL
- As per NSPI Standard Specification SE-4

2.3.3.4 230kV Station Service Voltage Transformer (ST71 and ST72)

- 138kV – 120/240V single phase voltage transformer with KVA rating sized for full AC station service load

2.3.3.5 230kV Line Terminal Surge Arresters

- Station Type, Metal Oxide, 192kV rated, 152kV MCOV
- As per NSPI Standard Specification SE-20.

2.3.4 Protection and Control

At 102N, line protection on all three terminals will consist of redundant "A" and "B" protection schemes, with physical separation of panels and cabling between protection schemes, per Northeast Power Coordinating Council's (NPCC) Directory 4 criteria. The design shall be presented to NPCC Task Force on System Protection (TFSP) for approval and comment, prior to construction.

2.3.4.1 Line Protection

- The A scheme line protection relays shall be SEL-411L, using the 87L line current differential element for high-speed tripping and step distance elements for backup tripping.
- The B scheme line protection relays shall be GE L90, using the 87L line current differential element for high-speed tripping and step distance elements for backup tripping.
- The line protection shall accommodate single pole tripping and reclosing.

2.3.4.2 Breaker Failure

- Redundant A and B breaker failure protection shall be provided.

- The A scheme breaker failure protection shall be provided by an SEL-451 bay control relay for each breaker, which shall also provide reclosing and synchronizing for the breaker.
- The B scheme breaker failure protection may be provided by the GE L90 line relays.
- Breaker Failure Initiate (BFI) must not be latched in the design. Breaker failure timer shall only run for (Trip active) AND (Breaker 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-7005 and L-7024 shall be required for associated line breaker failures.
- Note: Breaker Failure protection is referred to as Breaker Backup (BBU) in NSPI documentation. A re-trip is referred to as "Early Trip."

2.3.4.3 Reclosing and Synchronizing

- Reclosing shall be initiated in the SEL-451 relays by both the A and B protection schemes.
- The reclosing mode shall be Single Pole Auto Reclose (SPAR), Delayed 3 phase Auto Reclose (DAR) or both SPAR/DAR.
- The reclosing function shall have a single OFF/ON control for each breaker, regardless of the reclosing mode selected.
- Automatic synchronizing/sync check shall be provided by the SEL-451 bay control relays.
- Manual synchronizing shall also be provided.

2.3.4.4 DC Supply for Protection

Two redundant 125V DC battery banks along with battery chargers shall supply the DC protection and control systems. The batteries and chargers will be sized as part of the detailed design to fully accommodate all DC loads under simultaneous operation.

- Both A and B 125 Vdc batteries shall have the capacity to supply the entire substation. These will be designated 102N-D41 for the A battery and disconnect switch, and 102N-D42 for the B battery and disconnect switch.
- The two batteries shall be physically separated, preferably in separate battery rooms.
- DC distribution panels for the A and B systems shall not be located beside each other.
- Manual transfer capability shall be provided between the A and B dc systems to permit offline battery maintenance, however there shall be two normally open switches or breakers in this transfer path.

2.3.4.5 Station Control and Communications

- Station control, Remote Terminal Unit (RTU), and Sequence of Events Recording (SER) functions to be provided by a non-redundant SEL Axion system, including SEL-RTAC and SEL-3350 HMI computer, keyboard/trackpad tray and touch screen. These functions are collectively referred to as the Substation Automation system (SAS).
- Communication to Supervisory Control and Data Acquisition (SCADA) master will use DNP3 protocol over a serial channel.
- Network connections between different panels shall be via fiber optic cable. Network connections within a panel may be copper cabling (Cat 5e or Cat 6).
- Sequence of Events Recording (SER) and Fault Recording (FR) shall meet the requirements of NERC Reliability standard PRC-002 and NPCC Directory 11.

- A non-redundant SEL-2488 satellite clock shall be provided.
- A time signal shall be distributed to each measuring relay using either PTP (IEEE 1588-2008 or later) or IRIG-B time code over 50 ohm coaxial cable, taking care to maintain galvanic isolation between A and B side equipment.
- Each protective relay shall assert an alarm to the SAS in the event of a loss of satellite clock signal.
- Ethernet switches shall be capable of supporting PTP with the C37.238-2017 power system profile.
- Local substation operation, including tagging functions, shall normally be from the HMI computer/Substation Automation System (SAS).
- In the event of a failure of the SAS, local manual operation of the breakers shall be available from inside the control building.
- Redundant communications paths shall be provided for 102N tele-protection channels.
- Redundant communication paths shall be provided for 103N tele-protection channels.
- Remote engineering access shall be provided via an NSPI-supplied firewall to be installed in either an NSPI telecom panel or the SAS panel.

2.3.4.6 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
   - A Battery(s) Volts Low
   - B Battery(s) Volts Low
   - A Battery Charger(s) Failed
   - B Battery Charger(s) Failed
   - A Protection and Control Relay/DC Failed
   - B Protection and Control Relay/DC Failed
   - A Protection AC Potential Failed
   - B Protection AC Potential Failed
   - Breaker Trip Circuit #1 Failed
   - Breaker Trip Circuit #2 Failed
   - Line L-7005 A Tele-protection Channels Failed
   - Line L-7005 B Tele-protection Channels Failed
   - Line L-7028 A Tele-protection Channels Failed
   - Line L-7028 B Tele-protection Channels Failed
   - Line L-7028 A Tele-protection Channels Failed
   - Line L-7028 B 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
   - A DC Supply(s) Grounded
   - B DC Supply(s) Grounded
   - Breaker 701 Monitor Trouble
   - Breaker 702 Monitor Trouble

- Breaker 703 Monitor Trouble
- Relay Time Sync Failed

3. A Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-7005 #1 Transfer Trip From 67N Received
   - Line L-7028 #1 Transfer Trip From 3C Received
   - Line L-7028 #1 Transfer Trip From 103N Received
4. B Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-7005 #2 Transfer Trip From 67N Received
   - Line L-7028 #2 Transfer Trip From 3C Received
   - Line L-7028 #2 Transfer Trip From 103N Received
5. Line L-7005 A Protection Operated (SER only)
6. Line L-7005 B Protection Operated (SER only)
7. Line L-7028 A Protection Operated (SER only)
8. Line L-7028 B Protection Operated (SER only)
9. Line L-7028 A Protection Operated (SER only)
10. Line L-7028 B Protection Operated (SER only)
11. Sync Freq Limit Exceeded (Scada) initiated by following SER point:
    - Synchronizing Frequency Limit Exceeded
12. Sync Volt Limit Exceeded (Scada) initiated by following SER point:
    - Synchronizing Voltage Limit Exceeded
13. Sync Phase Angle Limit Exceeded (Scada) initiated by following SER point:
    - Synchronizing Phase Angle Limit Exceeded
14. Local Control (Scada) initiated by following SER point:
    - Station Control Local
15. Breaker 701 Closed
16. Breaker 702 Closed
17. Breaker 703 Closed
18. Breaker 701 Urgent (Scada) initiated by following SER points:
    - Breaker 701 SF6 Density Low
    - Breaker 701 Motor Overload*
    - Breaker 701 Trip Circuit #1 Failed
    - Breaker 701 Trip Circuit #2 Failed
19. Breaker 702 Urgent (Scada) initiated by following SER points:
    - Breaker 702 SF6 Density Low
    - Breaker 702 Motor Overload*
    - Breaker 702 Trip Circuit #1 Failed
    - Breaker 702 Trip Circuit #2 Failed
20. Breaker 703 Urgent (Scada) initiated by following SER points:
    - Breaker 703 SF6 Density Low
    - Breaker 703 Motor Overload*
    - Breaker 703 Trip Circuit #1 Failed
    - Breaker 703 Trip Circuit #2 Failed
21. Breaker 701 Control Lockout (Scada) initiated by following SER point:
    - Breaker 701 SF6 Control Blocked
22. Breaker 702 Control Lockout (Scada) initiated by following SER point:
    - Breaker 702 SF6 Control Blocked
23. Breaker 703 Control Lockout (Scada) initiated by following SER point:
    - Breaker 703 SF6 Control Blocked
24. Breaker 701 Auto-reclose Off (Scada) initiated by following SER point:
    - Breaker 701 Auto-reclose Off
25. Breaker 702 Auto-reclose Off (Scada) initiated by following SER point:

- Breaker 702 Auto-reclose Off

26. Breaker 703 Auto-reclose Off (Scada) initiated by following SER point:
    - Breaker 703 Auto-reclose Off
27. Breaker Backup Lockout (Scada) initiated by following SER points:
    - Breaker 701 BBU Lockout Operated
    - Breaker 702 BBU Lockout Operated
    - Breaker 703 BBU Lockout Operated
28. Breaker 701 BBU Initiated & Early Trip Operated (SER) only
29. Breaker 702 BBU Initiated & Early Trip Operated (SER) only
30. Breaker 703 BBU Initiated & Early Trip Operated (SER) only
31. Substation Entry
32. MOD 701A Closed
33. MOD 701B Closed
34. MOD 702A Closed
35. MOD 702B Closed
36. MOD 703A Closed
37. MOD 703B Closed

*Note: These alarms may differ depending on the manufacturer of the breakers purchased.

2.3.4.7 General

- Specific part numbers for IEDs and equipment remain to be determined.
- A single line protection panel may include two relays for two lines, or a line relay and a bay control relay if this makes economic use of panel space.
- If IEC 67050 is used for protection functions, the network design shall meet NPCC Directory 4 criteria.
- If serial connections are used for communication between relays and/or the SAS, serial fiber shall be used between A and B systems. Ie. If the SAS is supplied from the A battery, serial connection to B IEDs shall be over fiber.

2.3.5 Control Building

A control building to house the redundant and physically separated protection and control panels, physically separated dual path tele-communications equipment, redundant and physically separated batteries and chargers, and physically separated primary and back-up station service supplies is required. The final size of the control building shall be determined during detailed design. A marshalling box shall be provided in the control building to interface all control cabling from external equipment.

The full extent of Remedial Action Scheme (RAS) modifications will not be determined until detailed design. Additional space shall be available in the control building at 102N-Chisholm Road to accommodate a single non-redundant RAS panel in case one is determined to be required.

2.4 New 230kV Transmission L-7028

2.4.1 Basis of Design

The 230kV transmission line (L-7028) from the interconnection substation 102N-Chisholm Road to 103N-Kmtnuk substation shall be 230kV wood pole gulf-port construction as per NSPI standard design. The total length of line is approximately 8 kms. The primary conductor shall be 1113 ACSR Beaumont with a thermal rating of 100 deg C. Two overhead shield wires will be installed, one with embedded fibres for telecommunications. Alternative design with steel pole construction would also be acceptable, subject to NSPI's review and approval, providing all basis of design criteria is met.

A Basis of Design document for transmission line L-7028 is provided in Appendix J.

The Interconnection Customer is required to provide NSPI with easement and access rights for the transmission line right of way and is responsible for obtaining all necessary construction permits.

2.4.2 Environmental

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

2.5 Remedial Action Scheme (RAS) Modifications

NSPI utilize special protection schemes or Remedial Action Schemes (RAS) to manage system power flow conditions.

- Modifications will be required to the Group 3 RAS logic at the 3C-Port Hastings and 67N-Onslow substations (to be determined during detailed design).
- At a minimum, breaker statuses and protection trips from 102N-Chisholm Road will be sent via high-speed tele-protection channels to the RAS panels at 3C-Port Hastings and 67N-Onslow substations, to be incorporated into the RAS panel logic there.
- The full extent of Remedial Action Scheme (RAS) modifications will not be determined until detailed design. Additional space shall be available in the control building at 102N-Chisholm Road to accommodate a single non-redundant RAS panel in case one is determined to be required.
- All additions and/or modifications to RAS are subject to Northeast Power Coordinating Council (NPCC) approval.

Estimated costs associated with the RAS modifications are included in the Non-Stand-Alone Network Upgrade cost estimate.

2.6 Terminal Station: 103N-Kmtnuk Wind

2.6.1 Terminal Station One-Line

A Basic One Line diagram of the Interconnection Customer's substation 103N-Kmtnuk Wind substation, as provided by the Interconnection Customer, is included in Appendix I.

2.6.2 Protection and Control at 103N–Kmtnuk

At 103N, 230 kV protection will consist of redundant "A" and "B" protection schemes, with physical separation of panels and cabling between protection schemes, per Northeast Power Coordinating Council's (NPCC) Directory 4 criteria. The design shall be presented to the NPCC Task Force on System Protection (TFSP) for approval and comment, prior to construction.

2.6.3 Protection and Control Assets at 103N–Kmtnuk

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.

NSPI will require space and access for an RTU, A and B communication panels plus two line current differential protection panels. The space allocated for the redundant "A" and "B" protection schemes shall adhere to the physical separation of panels and cabling requirements, as per Northeast Power Coordinating Council's (NPCC) Directory 4 criteria.

Estimated costs associated with these protection, control, and communication assets are included in the Non-Stand-Alone Network Upgrade cost estimate.

2.6.3.1 230 kV Line Protection

- The A 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 B scheme line protection relay shall be GE L90, using the 87L line current differential element for high-speed tripping and step distance elements for backup tripping.
- The line protection may accommodate single pole tripping and reclosing.

2.6.3.2 Breaker Failure

- Redundant A and B breaker failure protection shall be provided for the 230 kV circuit breaker(s).
- Breaker Failure Initiate (BFI) must not be latched in the design. Breaker failure timer shall only run for (Trip active) AND (Breaker current above minimum pickup). The trip input to the BFI logic shall not be subject to a minimum trip duration.
- Transfer tripping via NSPI-supplied redundant A and B high speed tele-protection channels to the remote end of line L-7028 shall be required for breaker failure.

2.6.3.3 Reclosing and Synchronizing

- If included in the design, automatic reclosing may be initiated by either the A or B line protection schemes.
- The reclosing mode may be Single Pole Auto Reclose (SPAR), Delayed 3 phase Auto Reclose (DAR) or both SPAR/DAR.
- The reclosing function shall have a single OFF/ON control for each breaker, regardless of the reclosing mode selected.
- Automatic synchronizing/sync check shall be provided.
- Automatic reclosing, if enabled, shall only occur with a live line/dead bus condition.

2.6.3.4 DC Supply for Protection

Two redundant 125V DC battery banks along with battery chargers shall supply the DC protection and control systems. The batteries and chargers will be sized as part of the detailed design to fully accommodate all DC loads under simultaneous operation.

- Both A and B 125 Vdc batteries shall have the capacity to supply the entire substation.
- The two batteries shall be physically separated, preferably in separate battery rooms.
- DC distribution panels for the A and B systems shall not be located beside each other.
    - NSPI panels located at 103N-Kmtnuk Wind shall be supplied by dedicated dc circuits from the dc distribution panels.
- Manual transfer capability shall be provided between the A and B dc systems to permit offline battery maintenance, however there shall be two normally open switches or breakers in this transfer path.

2.6.3.5 Station Control and Communications

- Communication to Supervisory Control and Data Acquisition (SCADA) master will use DNP3 protocol over a serial channel.
- Communication between the substation RTU and the wind farm control system will use DNP3 protocol over a serial channel.
- Communication between the substation RTU and the Substation Automation System (SAS) will use DNP3 protocol over a serial channel.
- Sequence of Events Recording (SER) and Fault Recording (FR) functions shall be included in the station design.
- SER and FR functions shall meet the requirements of NERC Reliability standard PRC-002 and NPCC Directory 11.
- A non-redundant satellite clock shall be provided.
- A time signal shall be distributed to each measuring relay using either Precision Time Protocol (PTP) (IEEE 1588-2008 or later) or IRIG-B time code over 50 ohm coaxial cable, taking care to maintain galvanic isolation between A and B side equipment.
- Each protective relay shall assert an alarm to the SER in the event of a loss of satellite clock signal.
- If PTP is used, then Ethernet switches shall be capable of supporting PTP with the C37.238-2017 power system profile.
- In the event of a failure of the Substation Automation System (SAS), local manual operation of the breakers shall be available from inside the control building.

- Redundant communication paths shall be provided for 103N A and B tele-protection channels.

2.6.3.6 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
   - A Battery(s) Volts Low
   - B Battery(s) Volts Low
   - A Battery Charger(s) Failed
   - B Battery Charger(s) Failed
   - A Protection and Control Relay/DC Failed
   - B Protection and Control Relay/DC Failed
   - A Protection AC Potential Failed
   - B Protection AC Potential Failed
   - Breaker Trip Circuit #1 Failed
   - Breaker Trip Circuit #2 Failed
   - Line L-7028 A Tele-protection Channels Failed
   - Line L-7028 B 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
   - A DC Supply(s) Grounded
   - B DC Supply(s) Grounded
   - Relay Time Sync Failed
3. A Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-7028 #1 Transfer Trip From 102N Received
4. B Transfer Trip Received (Scada) initiated by following SER points:
   - Line L-7028 #2 Transfer Trip From 102N Received
5. Line L-7028 A Protection Operated (SER only)
6. Line L-7028 B Protection Operated (SER only)
7. Local Control (Scada) initiated by following SER point:
   - Station Control Local
8. Breaker 7xx Closed
9. Breaker 7xx Urgent (Scada) initiated by following SER points:
   - Breaker 7xx SF6 Density Low
   - Breaker 7xx Motor Overload*
10. Breaker 7xx Control Lockout (Scada) initiated by following SER point:
    - Breaker 7xx SF6 Control Blocked
11. Breaker 7xx Auto-reclose Off (Scada) initiated by following SER point:
    - Breaker 7xx Auto-reclose Off
12. Breaker Backup Lockout (Scada) initiated by following SER points:
    - Breaker 7xx BBU Lockout Operated
13. Breaker 7xx BBU Initiated & Early Trip Operated (SER) only

14. Substation Entry

*Note: These alarms may differ depending on the manufacturer of the breakers purchased.

2.6.4 Station Service

The Interconnection Customer shall provide dedicated 120V AC and 125V DC circuits from Interconnection Customer's substation building AC distribution and DC distribution panels to supply the NSPI owned protection and control panels.

2.6.5 Revenue Metering

Revenue metering shall be installed at 103N as detailed in section 2.8. The Interconnection Customer will supply the 230kV revenue class current and voltage transformers, supporting structures, test switch, and meter base. The supply and installation of revenue metering equipment is considered part of the Interconnection Customers' Terminal Station and are not included in the cost estimates in this Facilities Study.

2.6.6 Canadian Electrical Code

The customer owned substation 103N-Kmtnuk Wind shall be designed and constructed to comply with Canadian Electrical Code requirements.

2.7 Remote Terminal Protection Modifications

The A and B line protection relays for L-7027 at 3C-Port Hastings and L-7005 at 67N-Onslow will be replaced to match the relays to be installed at 102N-Chisholm Road. Estimated costs associated with these protection modifications are included in the Non-Stand-Alone Network Upgrade cost estimate.

2.8 Revenue Metering

A 230kV revenue metering system, owned by NSPI, shall be installed at the Interconnection Customer's substation (103N).

230kV 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 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.

2.9 Tele-Communications

The 102N-Chisholm Road substation and the 103N-Kmtnuk Wind substation are both classified as bulk power and require fully redundant communication paths.

The redundant telecommunications paths for both the 102N-Chisholm Road substation and the 103N-Kmtnuk substation will be installed as per the following:

Dual Communications Paths to 102N-Chisholm Road
Path A: Optical Fibre: Tap into existing fibre on L-8003
Path B: Microwave radio: Chisholm Road to NSPI Onslow Radio

Dual Communications Paths to 103N-Kmtnuk Wind
Path A: Optical Fibre (L-7028): Chisholm Road to Kmtnuk Wind
Path B: Microwave radio: Nuttby Radio to Kmtnuk Wind

A 20m self-supporting tower will be required at 102N-Chisholm Road Substation. This tower will accommodate the microwave radio antennae for the Path B system from Chisholm Road to Onslow Radio.

A 20m self-supporting tower will be required at 103N-Kmtnuk Wind substation to accommodate the microwave radio antennae for the Path B system from Kmtnuk to Nuttby Radio. Both radio towers will be enclosed in a separate fenced area near the 102N and 103N substations.

The new transmission line L-7028 from 102N to 103N will be constructed with an Optical Ground Wire (OPGW) in one of the two shield wires. This will provide the communications Path A from 102N to 103N.

The costs to install the OPGW in the new L-7028 transmission line are included in the transmission line estimate (Stand-Alone TPIF). The estimated costs for the telecommunication assets for 103N-Kmtnuk Wind Substation are included in the Non-Stand-Alone TPIF cost estimate. The estimated costs associated with the telecommunication assets at 102N-Chisholm are included in the Non-Stand-Alone Network Upgrade cost estimate.

2.10 Stand Alone Upgrades 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.*

The Kmtnuk Wind transmission interconnection includes both Network Upgrades and Transmission Provider Interconnection Facilities. Should the Interconnection Customer decide to exercise their 'Option to Build', NSPI have defined the upgrades in terms of what would be considered stand-alone facilities and may be constructed without affecting day-to-day operations of the Transmission System.

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

The following scope of work meets the defined criteria for 'Stand Alone' Network Upgrades or Stand-Alone TPIF:

- Stand-Alone Network Upgrade:
  - The interconnection substation (102N-Chisholm Road) including land acquisition, site preparation, access road, foundations, site grounding, primary equipment, control building, protection and control panels, and all associated devices except for the telecommunications equipment and the microwave radio tower.
- Stand-Alone TPIF
  - The transmission line L-7028 from 102N-Chisholm Road to 103N-Kmtnuk Wind substation including easement acquisition, access routes, all structures, conductors, shield wires, insulators, and foundations, the optical fibre shield wire, line terminations at both substations, and all potential railway, highway, and water crossings.

The cost estimate for the 'Stand-Alone' Network Upgrades and 'Stand-Alone' Transmission Provider Interconnection Facilities is the total of the estimate provided for L-7028 transmission line and the estimate provided for 102N-Chisholm Road substation (see Section 6.0).

2.10.2 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 230kV transmission line tap and termination to existing L-7005 at 102N-Chisholm Road Substation
  - The relocation of a segment of L-5040 at 102N-Chisholm Road Substation
  - The remote protection modifications at 3C-Port Hastings and 67N-Onslow
  - The modifications to existing Remedial Actions Schemes (RAS).
  - Telecommunications equipment supply and installation at 102N-Chisholm Road and 103N-Kmtnuk Substations including the fibre connection to L-8003.

- Non-Stand-Alone TPIF
  - The revenue meter, NSPI's L-7028 protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 103N-Kmtnuk Wind substation.

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

The cost estimate for the 'Non-Stand-Alone' Network Upgrades and 'Non-Stand-Alone' TPIF have been broken out as separate cost estimates (see Section 6.0).

3.0 PERMITS, APPROVALS, AND STANDARDS

The Interconnection Customer is responsible to obtain all permits and approvals required to construct the interconnection substation at 102N-Chisholm Road and the new transmission line L-7028 from 102N-Chisholm Road substation to 103N-Kmtnuk Wind substation.

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.

Where applicable, all NPCC bulk power standards must be met.

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).

Interconnection Customer's responsibility for design, procurement, and construction scope of work shall be limited to Stand-Alone Upgrades as identified in Section 2.10 of this report.

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 2025.

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 to meeting the proposed commercial operation date.

Facilities Study Complete	Q4, 2023
Generation Interconnection Agreement Executed	Q4, 2023
Detailed Design Start – L-7005 Line Tap	Q2, 2024
Detailed Design Start – Substation 102N (Chisholm Road)	Q1, 2024
Detailed Design Start – L-7028	Q2, 2024
Procurement of Long Lead Items Start	Q1, 2024
102N Site Prep Complete, Access Road Complete	Q2, 2025
L-7028 Right of Way Tree Clearing Complete	Q1, 2025
102N Substation Construction Start	Q2, 2025
L-7028 Construction Start	Q2, 2025
Receipt of Long Lead Substation Primary Equipment	**Q1, 2026**
102N Substation Complete	Q3, 2026
L-7005 Line Tap Complete (Actual timing to coordinate with earliest line outage available opportunity)	Q3, 2026
Remote Terminal Protection and RAS Modifications Complete	Q2, 2026
Targeted First Power Available (per Interconnection Customer)	July, 2025
Estimated Earliest First Power Available (per NSPI)	**Q3, 2026**
Targeted Commercial Operation (per Interconnection Customer)	December, 2025
Estimated Earliest Commercial Operation Date (per NSPI)	**Q3, 2026**

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.

A contingency of 10% has been included in the estimates to account for 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.

For this Facilities Study the cost estimates have been broken out into four blocks:

1. Network Upgrade: Stand-Alone Interconnection Substation 102N-Chisholm Road
2. Network Upgrades – Non-Stand-Alone
3. TPIF: Stand-Alone: Transmission Line L-7028
4. TPIF – Non-Stand-Alone

Cost Estimate Summary:

Upgrade Component	Cost Estimate
Network Upgrades – Stand Alone	
Interconnection Substation – 102N Chisholm Road	$9,678,709
Network Upgrades – Non-Stand-Alone	
230kV line tap to existing L-7005 at 102N-Chisholm Road Substation; remote protection modifications at 3C-Port Hastings; modifications to existing Remedial Actions Schemes (RAS); telecommunications equipment supply and installation at 102N-Chisholm Road Substation.	$2,109,511
Network Upgrade Sub-Total	**$11,788,220**
TPIF - Stand-Alone	
Transmission Line L-7028 (8 kms)	$9,733,511
TPIF - Non-Stand-Alone	
The revenue meter, NSPI's L-7028 protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 103N-Kmtnuk Wind substation.	$1,347,300
TPIF Sub-Total	**$11,080,811**
Total	**$22,869,031**
Sub-Total (Stand-Alone)	$19,412,220
Sub-Total (Non-Stand-Alone)	$3,456,811

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.

L-7005 shares a transmission line corridor with L-8003, L-6503 and L-5040. Outages to these lines impose limitations on Cape Breton export energy flows and potential customer interruptions. These constraints will require NSPI System Operator actions to minimize risks and maintain system stability and reliability. 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 as well as NPCC bulk power system facility requirements.

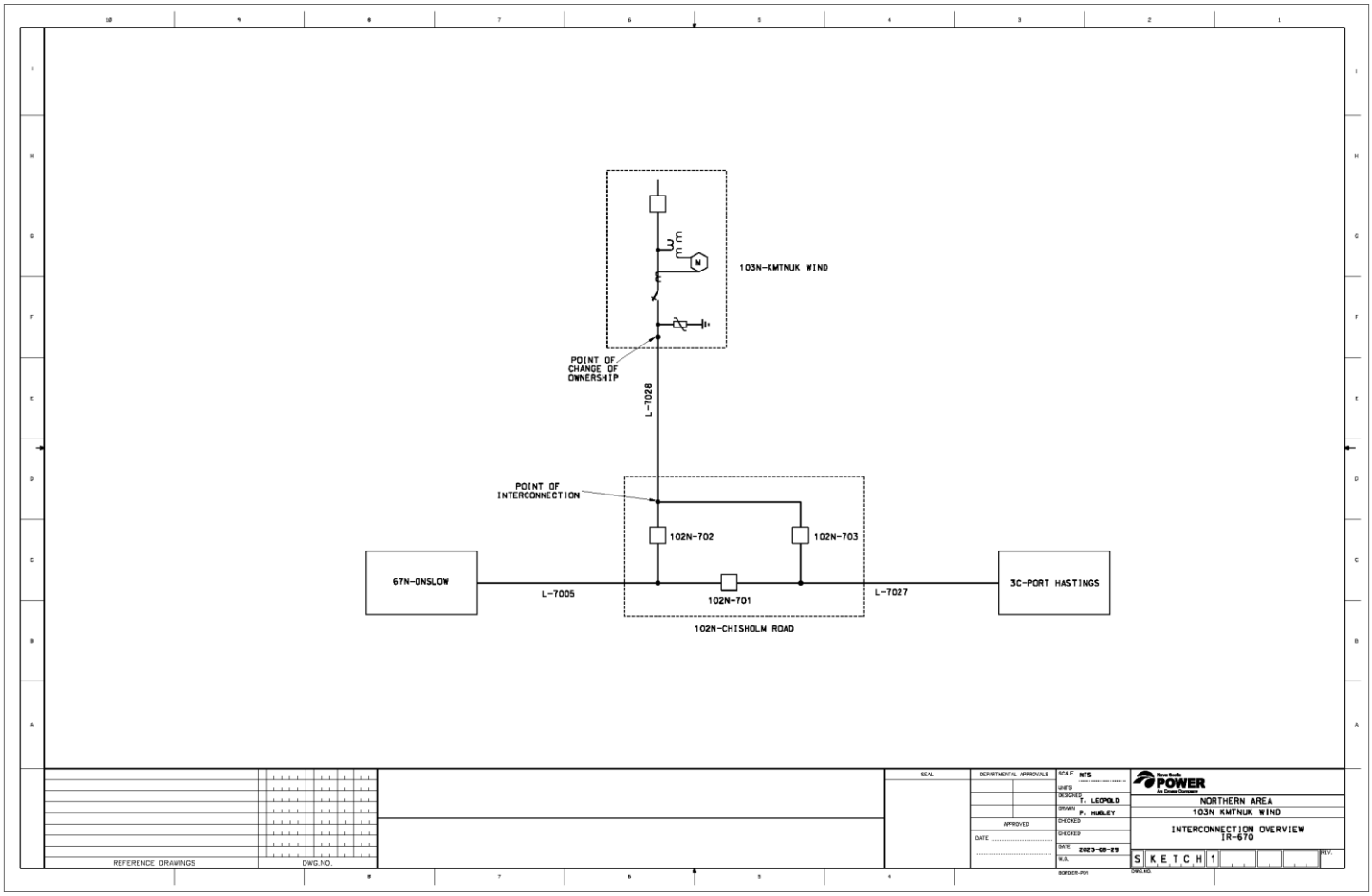
Appendices

APPENDIX A – INTERCONNECTION FACILITIES STUDY AGREEMENT
APPENDIX B – INTERCONNECTION OVERVIEW
APPENDIX C – INTERCONNECTION SUBSTATION DEVELOPMENTAL ONE LINE
APPENDIX D – INTERCONNECTION SUBSTATION DEVELOPMENTAL OVERALL PLAN
APPENDIX E – INTERCONNECTION SUBSTATION DEVELOPMENTAL PLAN VIEW
APPENDIX F – COST ESTIMATE DETAILS
APPENDIX G – PRELIMINARY PROJECT SCHEDULE
APPENDIX H – REVENUE METERING
APPENDIX I – 103N-KMTNUK TERMINAL STATION ONE LINE
APPENDIX J – TRANSMISSION LINE (L-7028) BASIS OF DESIGN
APPENDIX K – PROPOSED TRANSMISSION LINE ROUTING FOR L-7028
APPENDIX L – MINUTES OF FACILITIES STUDY REVIEW MEETING

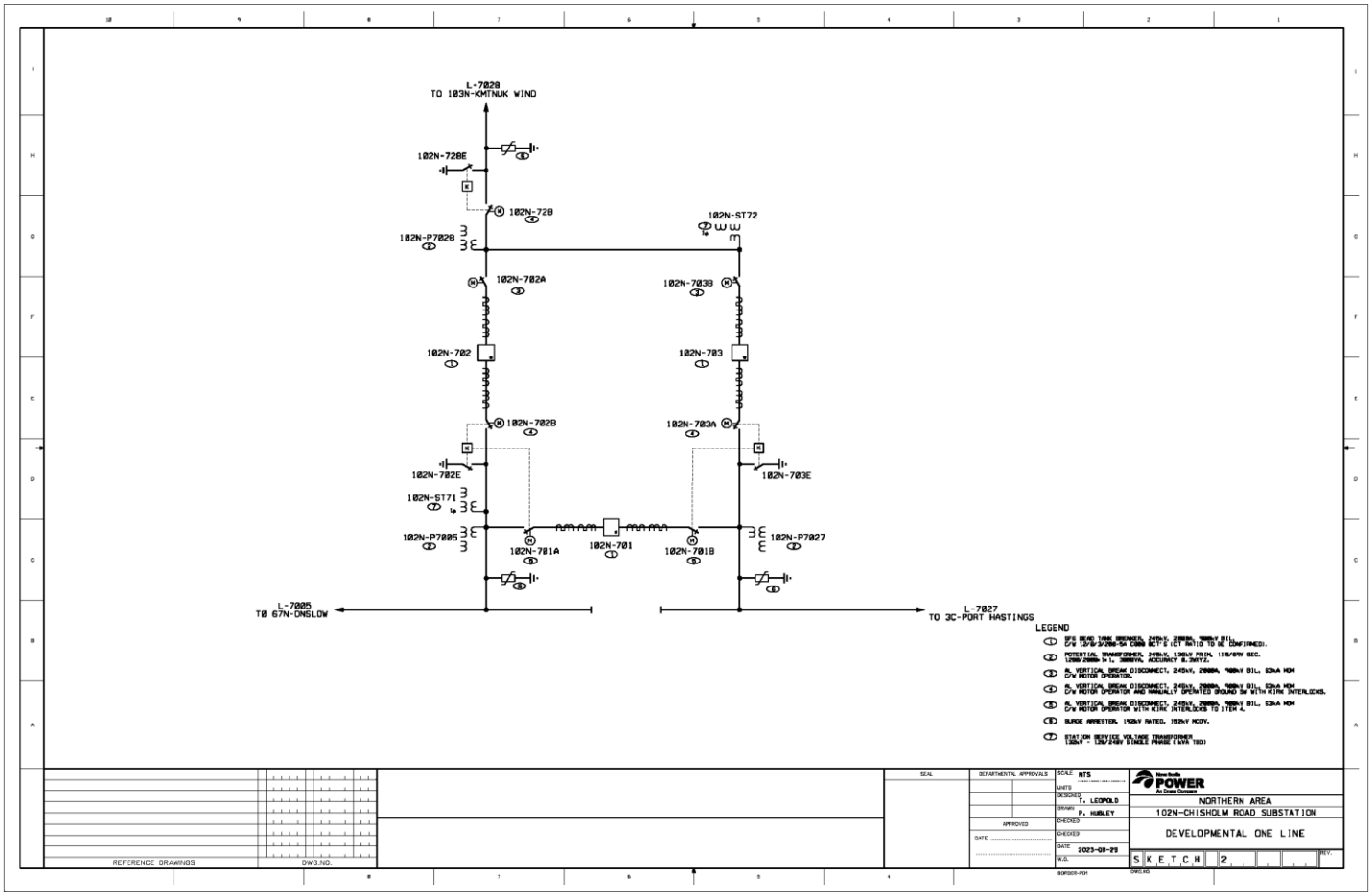
Appendix A – Interconnection Facilities Study Agreement

(Attachment 1)

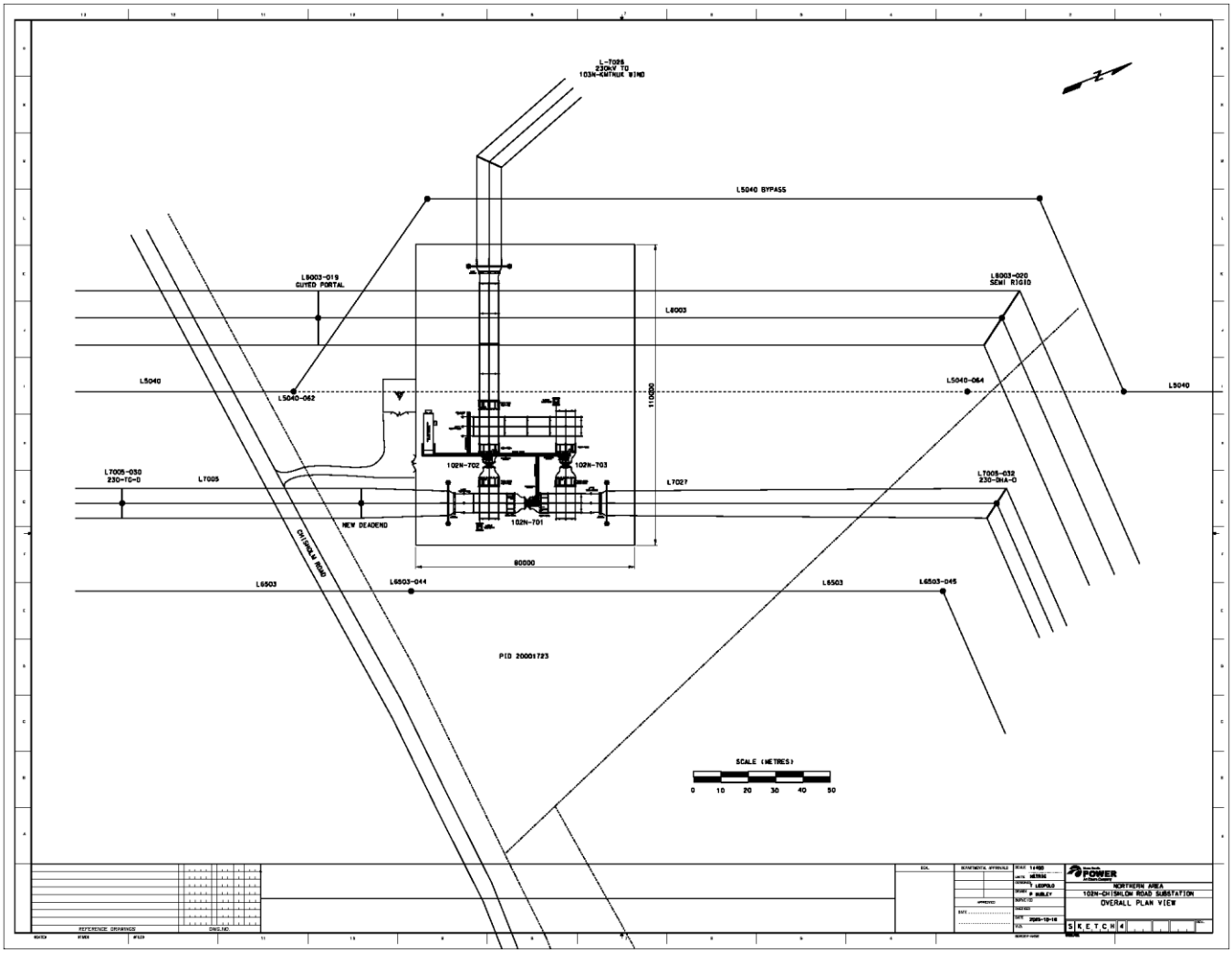
Appendix B – Interconnection Overview



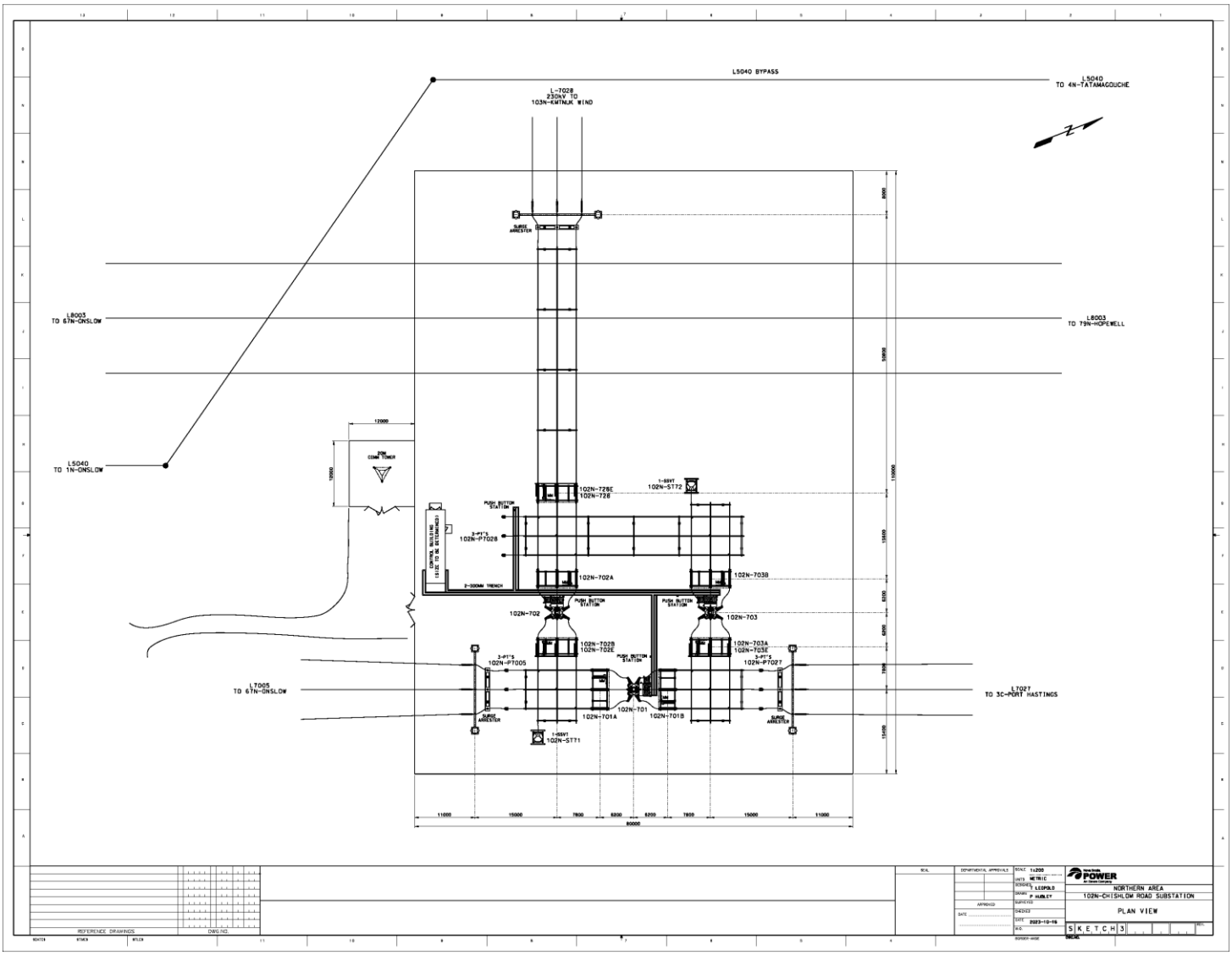
Appendix C – Interconnection Substation Developmental One Line



Appendix D – Interconnection Substation Developmental Overall Plan



APPENDIX E – INTERCONNECTION SUBSTATION DEVELOPMENTAL PLAN VIEW



Appendix F – Cost Estimate Details

'Stand-Alone' Upgrades:

Stand-Alone Network Upgrade: New Substation – 102N Chisholm Road

IR 670 Kmtnuk Wind FAC Interconnection Substation - 102N											
		Project Number:									
		Cost Centre:		900							
		Labour		Material	Expenses			Contracts	Consulting	Totals	
Activity	Accounts -->	535050	535200	531400	530950	533410	533400	531550	532500		
003	Buildings, Structures and Grounds	0	0	552,500	0	0	0	3,046,600		3,599,100	
022	Electrical Control Equipment	0	0	1,517,200	0	0	0	120,000		1,637,200	
043	Substation Devices	20,627	0	1,644,500	0	0	0	227,000		1,892,127	
085	Design (i.e. Engineering)	70,119		0	1,110		2,500	0	358,000	431,729	
086	Commissioning	174,088	0	0	0	1,500	0	0		175,588	
087	Field Supervision and Operations	16,390	0	0	29,850		0	160,000		206,240	
	Sub-Total	**281,223**	**0**	**3,714,200**	**30,960**	**1,500**	**2,500**	**3,553,600**	**358,000**	**7,941,983**	
085	Contingency	28,122	0	371,420	3,096	150	250	355,360	35,800	794,198	
	Sub-Total	**309,346**	**0**	**4,085,620**	**34,056**	**1,650**	**2,750**	**3,908,960**	**393,800**	8,736,182	
005	Vehicle Allocation (Labour & Eng'g)				112,744					112,744	
005	Construction Overhead (Labour)							204,097		204,097	
005	Construction Overhead (Contracts)							625,686		625,686	
	Sub-Total				**112,744**			**829,783**		942,528	
	Totals	**309,346**	**0**	**4,085,620**	**146,800**	**1,650**	**2,750**	**4,738,743**	**393,800**	**9,678,709**	

Stand-Alone TPIF: New Line L-7028

IR 670 Kmtnuk Wind Facilities Study - Transmission Line L-7028											
		Project Number:									
		Cost Centre:		900							
		Labour		Material	Expenses			Contracts	Consulting	Totals	
Activity	Accounts -->	535050	535200	531400	530950	533410	533400	531550	532500		
035	Wood Poles	5,018	0	2,800,000	0	0	0	4,400,000		7,205,018	
085	Design (i.e. Engineering)	41,558		0	1,480		1,000	0	400,000	444,038	
087	Field Supervision and Operations	5,463	0	0	3,700		10,000	100,000		119,163	
088	Survey and Mapping	2,578		0	0		0	260,000	0	262,578	
	Sub-Total	**54,618**	**0**	**2,800,000**	**5,180**	**0**	**11,000**	**4,760,000**	**400,000**	**8,030,798**	
085	Contingency	5,462	0	280,000	518	0	1,100	476,000	40,000	803,080	
	Sub-Total	**60,080**	**0**	**3,080,000**	**5,698**	**0**	**12,100**	**5,236,000**	**440,000**	8,833,878	
005	Vehicle Allocation (Labour & Eng'g)				21,897					21,897	
005	Construction Overhead (Labour)							39,639		39,639	
005	Construction Overhead (Contracts)							838,099		838,099	
	Sub-Total				**21,897**			**877,737**		899,634	
	Total	**60,080**	**0**	**3,080,000**	**27,595**	**0**	**12,100**	**6,113,737**	**440,000**	**9,733,511**	

'Non-Stand-Alone' Upgrades:

Non-Stand-Alone Network Upgrades

- The 230kV transmission line tap to existing L-7005 at 102N-Chisholm Road Substation
- The relocation of a segment of L-5040 at 102N-Chisholm Road Substation
- The remote protection modifications at 3C-Port Hastings and 67N-Onslow
- The modifications to existing Remedial Actions Schemes (RAS).
- Telecommunications equipment supply and installation at 102N-Chisholm Road Substation.

IR 670 Kmtnuk Wind FAC - Non-Stand-Alone Network Upgrades										
		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	20,627	5,157	140,000	0	0	0	0		165,783
035	Wood Poles	5,018	0	125,000	0	0	0	375,000		505,018
061	Telephone Equipment (/ Comm Equip.)	21,658	8,251	286,000	0	0	0	210,000		525,908
085	Design (i.e. Engineering)	141,114		1,000	740		500	0	170,000	313,354
086	Commissioning	20,627	0	0	3,000	0	0	0		23,627
087	Field Supervision and Operations	13,658	0	0	2,220		1,500	30,000		47,378
088	Survey and Mapping	0		0	0		0	0	10,000	10,000
	Sub-Total	**222,701**	**13,407**	**552,000**	**5,960**	**0**	**2,000**	**615,000**	**180,000**	**1,591,068**
085	Contingency	22,270	1,341	55,200	596	0	200	61,500	18,000	159,107
	Sub-Total	**244,971**	**14,748**	**607,200**	**6,556**	**0**	**2,200**	**676,500**	**198,000**	1,750,175
005	Vehicle Allocation (Labour & Eng'g)				89,282					89,282
005	Construction Overhead (Labour)							161,624		161,624
005	Construction Overhead (Contracts)							108,284		108,284
	Sub-Total				**89,282**			**269,908**		359,190
	Total	**244,971**	**14,748**	**607,200**	**95,838**	**0**	**2,200**	**946,408**	**198,000**	**2,109,365**

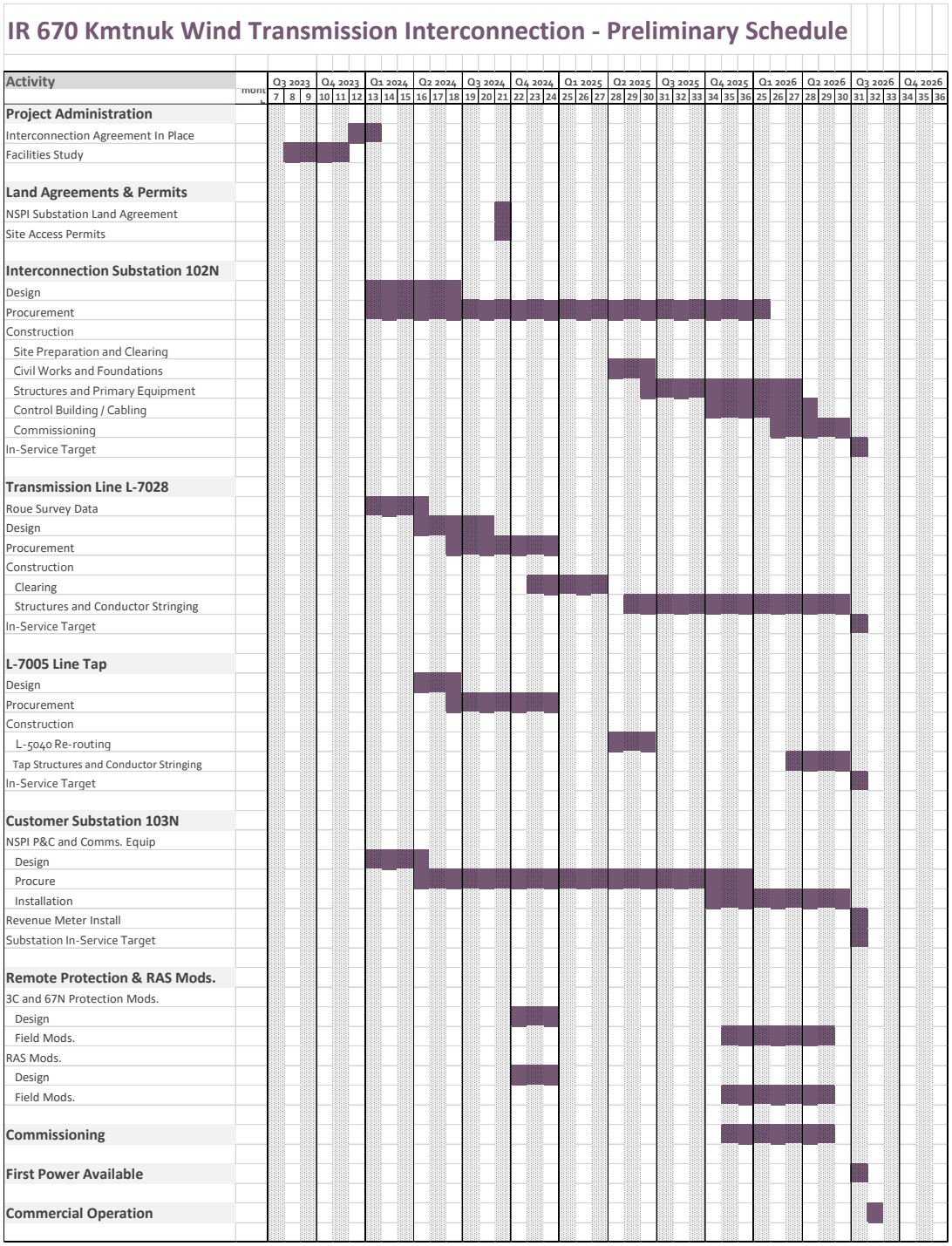
Non-Stand-Alone TPIF

- The revenue meter, NSPI's L-7028 protection and control equipment, remote terminal unit (RTU), and telecommunications equipment required at 103N-Kmtnuk Wind substation.

IR 670 Kmtnuk Wind FAC - Non-Stand-Alone TPIF										
		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	51,566	5,157	210,000	0	0	0	0		266,723
061	Telephone Equipment (/ Comm Equip.)	15,470	6,188	236,000	0	0	0	270,000		527,658
085	Design (i.e. Engineering)	82,889		1,000	740		500	0	60,000	145,129
086	Commissioning	20,627	0	0	3,000	0	0	0		23,627
087	Field Supervision and Operations	5,463	0	0	2,220		1,500	25,000		34,183
	Sub-Total	**176,015**	**11,345**	**447,000**	**5,960**	**0**	**2,000**	**295,000**	**60,000**	**997,319**
085	Contingency	17,601	1,134	44,700	596	0	200	29,500	6,000	99,732
	Sub-Total	**193,616**	**12,479**	**491,700**	**6,556**	**0**	**2,200**	**324,500**	**66,000**	1,097,051
005	Vehicle Allocation (Labour & Eng'g)				70,566					70,566
005	Construction Overhead (Labour)							127,742		127,742
005	Construction Overhead (Contracts)							51,941		51,941
	Sub-Total				**70,566**			**179,683**		250,249
	Total	**193,616**	**12,479**	**491,700**	**77,122**	**0**	**2,200**	**504,183**	**66,000**	**1,347,300**

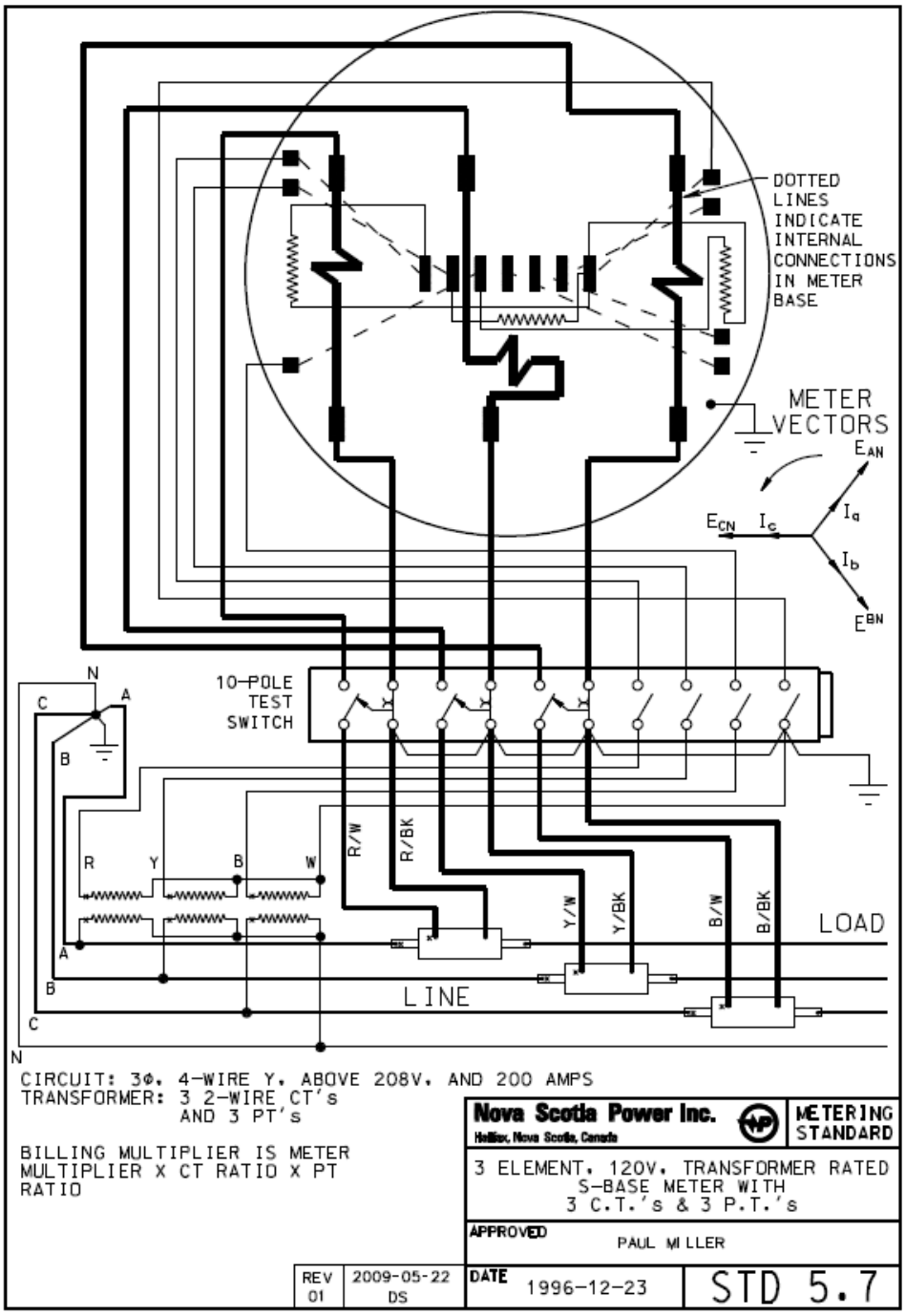
Appendix G – Preliminary Project Schedule

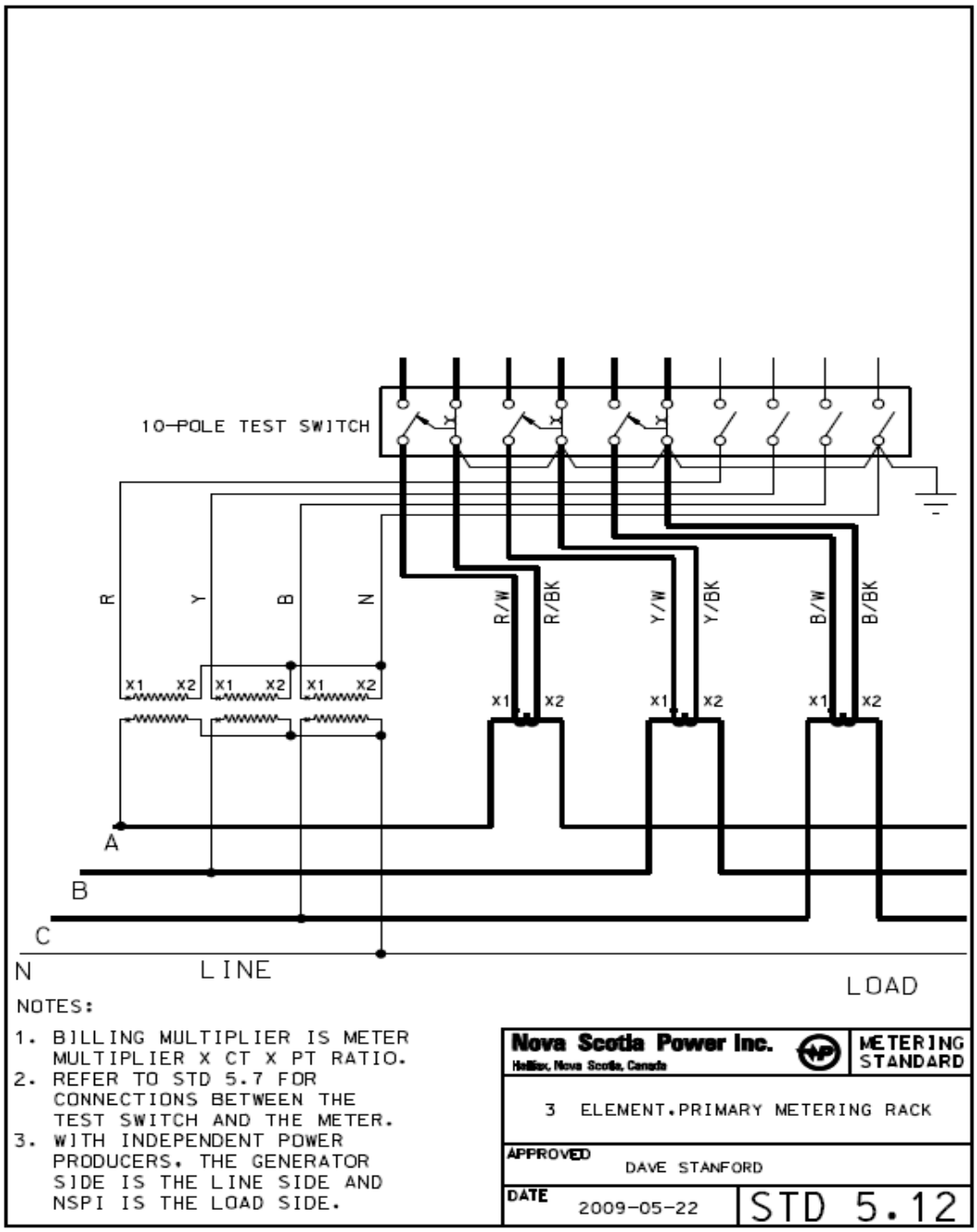
Note: Primary Equipment supply chain volatility may introduce significant and unpredictable procurement timelines to the overall project schedule.



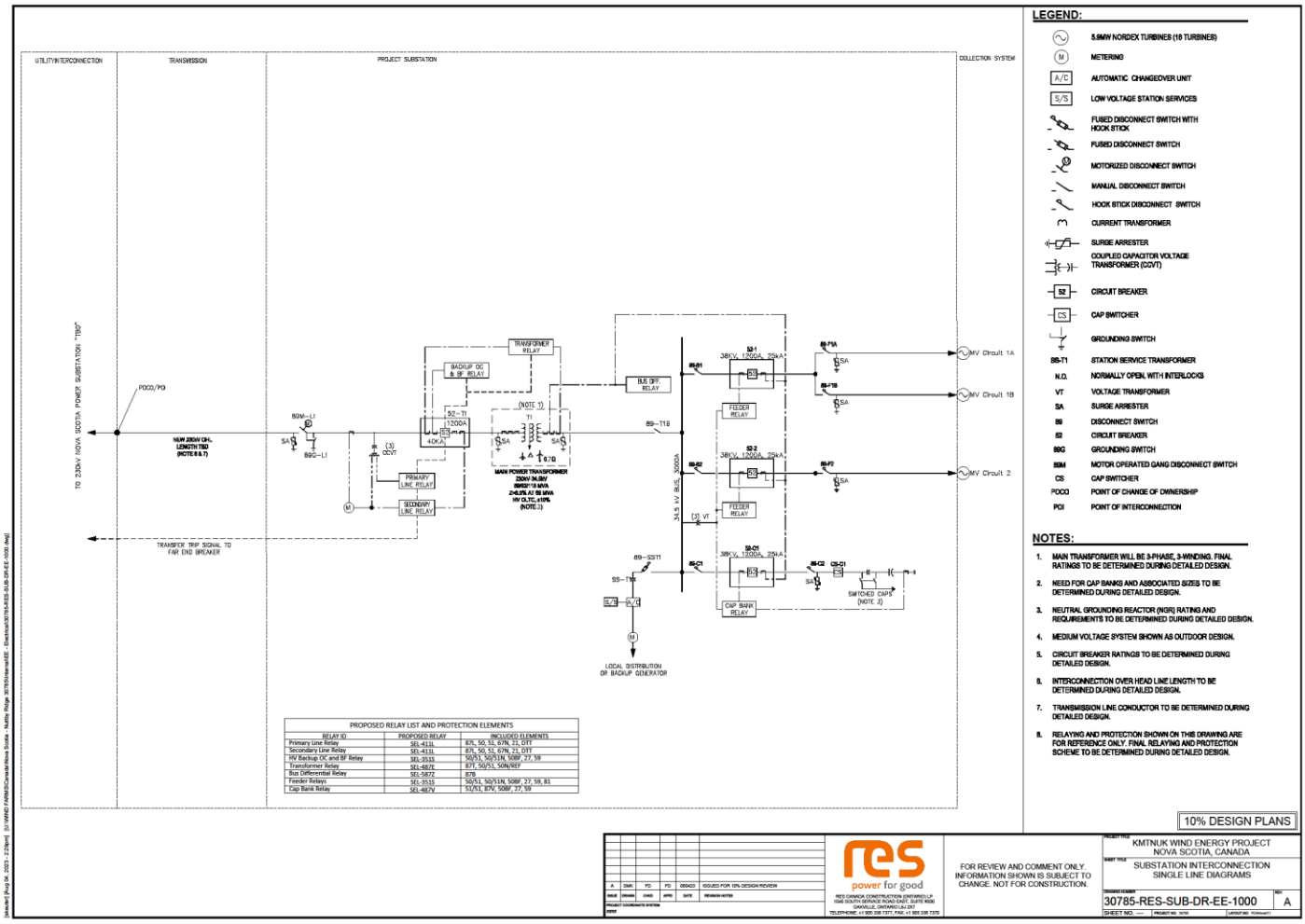
Appendix H – Revenue Metering

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

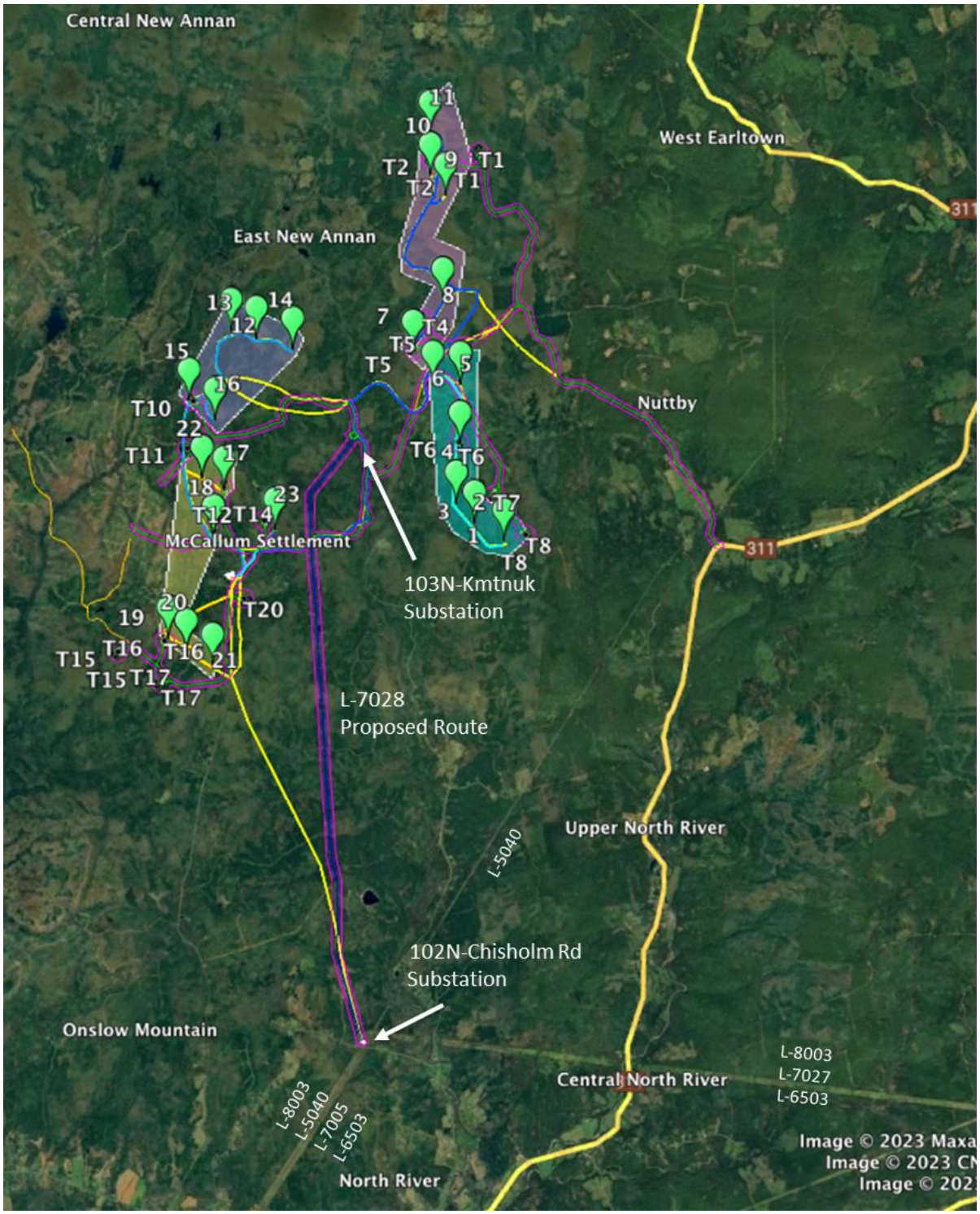
Appendix I – 103N-Kmtnuk Wind Terminal Station One Line



Appendix J – Transmission Line (L-7028) Basis of Design

(Attachment 2)

Appendix K - Proposed Transmission Line Routing for L-7028



Appendix L – Minutes of Facilities Study Review Meeting

Notes:

- Attendees:
- Introductions
- Review of questions provided by the Interconnection Customer (IC) on the draft Facilities Study (FAC):
  -
  -
- Next steps:
  -
  -