

CI C0085185

4S-332 George St Rebuild and Reconfiguration

U&U

REDACTED

September 11, 2026





NSEB APPROVAL SHEET

Project Title: 4S-332 George St Rebuild and Reconfiguration

CI Number: C0085185

Date: September 11, 2026

Expenditure Profile			Type of Filing	
Year	Budget Amount	Project Estimate	☒	Capital Project Authorization
			☒	Unforeseen and Unbudgeted (U&U)
			☐	Planned & Advanced (P&A)
			☐	Subsequent Approval Item
2026		812,790	☐	Authorization to Overspend (ATO)
2026		(812,790)	☐	Scope Change
2027		1,625,580	☐	Final Cost (FIN)
2027		(1,625,580)		
Total	\$0	\$0		

COMMENTS

Submitted on behalf of NOVA SCOTIA POWER INCORPORATED

Authorized Signatory
Dave Pickles
Chief Operating Officer

DATE

September 11, 2026

Approved on behalf of NOVA SCOTIA ENERGY BOARD

DATE

CI Number: C0085185

Title: 4S-332 George St Rebuild and Reconfiguration

Start Date: 2026/10
In-Service Date: 2027/06
Final Cost Date: 2027/12
Function: Distribution
Forecast Amount: \$0

DESCRIPTION:

In order to accommodate the anticipated load growth and provision of a secondary supply from the Cape Breton Regional Hospital redevelopment, NS Power must undertake a rebuild and reconductoring of current infrastructure (at the customer's expense). This project includes rebuilding the existing double-circuit distribution line 4S-332/4S-321 along George St between Townsend St and Melody Ln in Sydney with poles that permit the required 8' of clearance between circuits, and reconductoring the circuit along Reservoir Road to the Cape Breton Regional Hospital from 2/0 ACSR to 336 ASC. The project includes installation of 83 poles, 8,085m of 336 ASC conductor, and 2,836m of 4/0 conductor.

The Cape Breton Regional Hospital will pay the actual costs incurred by NS Power. All work will be performed in accordance with NS Power standard practices.

Summary of Related CIs +/- 2 years:

Pursuant to Section 11.2 of the CEJC, related CIs for Distribution projects include "Work completed on the same asset class (Padmount transformers, Breakers, etc.) or in the same location (feeder, Transmission Line)."

- No other projects in 2024, 2025, 2026, 2027 or 2028

Depreciation Class: Distribution Plant – Overhead Conductors and Devices
 Distribution Plant - Poles, Towers and Fixtures
 Distribution Plant – Services
 Distribution Plant – Overhead Line Transformers
 Distribution Plant – Underground Conductors and Devices
 Distribution Plant – Street Lighting and Signal Systems - LED

Retirement Information:

- Categorization of Retirement: Accounting Policy 6420 - Retirement and Disposal of Capital Assets
- Percentage of Asset Pool: 0.03%

Estimated Life of the Asset: 30 years

JUSTIFICATION:

Justification Criteria: Distribution System

Sub Criteria: Pole Strength

Why do this project?

The Cape Breton Regional Hospital redevelopment project will increase the anticipated peak load served from 3.2 MVA to 6.9MVA. To accommodate this significant load growth and maintain reliable service to critical community infrastructure, the need for a second supply capable of carrying the full facility load under contingency conditions was identified. Replacing the existing poles is required to increase the available separation between the circuits to meet current construction standards and allow for maximum sag on circuit 4S-332 when carrying hospital load. The project increases local system capacity while supporting reliable service to customers served from the surrounding distribution network.

Why do this project now?

The Cape Breton Regional Hospital redevelopment project is progressing with the construction of the Cape Breton Cancer Centre, an Energy Centre, and a Clinical Services Building. The resulting anticipated increase in load and the need to maintain reliable service to critical customers under contingency conditions require this project to be completed before these new facilities are fully placed into service, which is currently expected before Q3 2027.

Why do this project this way?

Three alternative solutions were evaluated in a System Impact Study (please refer to Attachment 1). Rebuilding the double-circuit line and reconductoring the circuit along Reservoir Road was identified as the least-cost solution that meets capacity, reliability, and contingency requirements while minimizing the need for additional infrastructure investment.



1. Rebuild double-circuit distribution line 4S-332/4S-321 to provide clearance between circuits.
2. Reconduct to 336 ASC along Reservoir Rd.

Location: Distribution						Cost Support Reference	Completed Similar Projects (FP#s)
CI# : C0085185 Title: 4S-332 George St Rebuild and Reconfiguration Execution Year: 2026-2027							
Description	Unit	Quantity	Unit Estimate	Total Estimate			
Regular Labour							
Scoping	PD	38	\$ 403	\$ 15,250			
Engineering	PD	20	\$ 457	\$ 9,266			
Project Management	PD	239	\$ 391	\$ 93,627			
Planning	PD	247	\$ 411	\$ 101,489			
Sub-Total				\$ 219,632			
Materials							
Wood Poles	Lot	1	\$ 236,349	\$ 236,349			
O/H Conductor	Lot	1	\$ 71,030	\$ 71,030			
O/H Conductor Devices	Lot	1	\$ 3,862	\$ 3,862			
O/H Line Transformer	Lot	1	\$ 19,017	\$ 19,017			
Street Lights	Lot	1	\$ 176	\$ 176			
Services	Lot	1	\$ 446	\$ 446			
Sub-Total				\$ 330,880			
Contracts							
Land Rights	Lot	1	\$ 21,600	\$ 21,600			
Wood Poles	Lot	1	\$ 543,286	\$ 543,286			
Insulators	Lot	1	\$ 677	\$ 677			
O/H Conductor	Lot	1	\$ 730,809	\$ 730,809			
O/H Conductor Devices	Lot	1	\$ 15,245	\$ 15,245			
O/H Line Transformer	Lot	1	\$ 42,647	\$ 42,647			
Street Lights	Lot	1	\$ 25,362	\$ 25,362			
O/H Secondary Conductor (Services)	Lot	1	\$ 122,029	\$ 122,029			
Sub-Total				\$ 1,501,655			
Consulting							
Gr1 Construction - Railroad Crossing Assessment	Lot	1	\$ 30,000	\$ 30,000			
Sub-Total				\$ 30,000			
Royalty, Easement, Appraisal							
Easements	Lot	1	\$ 10,000	\$ 10,000			
Sub-Total				\$ 10,000			
Vehicle Overhead							
Vehicle Labour AO				\$ 70,673			
Sub-Total				\$ 70,673			
Administrative Overhead							
Labour AO				\$ 118,562			
Contractor AO				\$ 156,968			
Sub-Total				\$ 275,530			
SUB-TOTAL (no AO, AFUDC)				\$ 2,092,167			
Customer Contributions				\$ (2,438,370)			
TOTAL (AO, AFUDC included)				\$ -			
Original Cost					\$ 573,782		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.

Note 2: Small differences in totals are attributable to rounding.



Instructions: Select option in Column B.
Columns C through G will auto-populate.

Document No: XXX-XX-XXXX-XXXX

Project Cost Estimate Input Checklist and Maturity Matrix						
Transmission Line Infrastructure	Required fields:	Estimate Classification				
Project Name: 4S-332 George St Rebuild and Reconfiguration	Started or Preliminary	Class 5	Class 4	Class 3	Class 2	Class 1
Maturity Level of Project Definition Deliverables	Defined or Complete					
General Project Data						
A. Scope						
Project Scope of Work Description	Defined (D)	P	P	D	D	D
Site Infrastructure (Access, Construction Power, Camp, etc.)	Defined (D)	NR	P	D	D	D
B. Capacity						
Voltage (kV) and Circuits	Defined (D)	P	P	D	D	D
C. Project Location						
Not Applicable						
D. Requirements						
Codes and/or Standards	Defined (D)	NR	P	D	D	D
Environmental Monitoring	Defined (D)	NR	NR	P	P	D
E. Technology Selection						
Not Applicable						
F. Strategy						
Right-of-Way (ROW)	Defined (D)	P	P	D	D	D
Contracting/Sourcing	Defined (D)	NR	P	D	D	D
Escalation	Defined (D)	NR	P	D	D	D
G. Planning						
System/Grid Planning (including substation and interconnect locations)	Defined (D)	P	P	D	D	D
Logistics Plan	Preliminary (P)	P	P	P		
Integrated Project Plan	Defined (D)	NR	P	D	D	D
Project Code of Accounts	Defined (D)	NR	P	D	D	D
Project Schedule	Preliminary (P)	NR	P			
Regulatory Approval & Permitting	Preliminary (P)	NR	P			
Risk Register	Defined (D)	NR	P	D	D	D
Stakeholder Consultation/Engagement/Management Plan	Preliminary (P)	NR	P			
Work Breakdown Structure (WBS)	Defined (D)	NR	P	D	D	D
Start-up & Commissioning Plan	Preliminary (P)	NR	P	P/D		
H. Studies						
Routing Options	Defined (D)	P	P	D	D	D
Topography & Bathymetry	Not Applicable (NA)					
Environmental Impact/Sustainability Assessment	Not Applicable (NA)	NR				
Environment/Existing Conditions	Not Applicable (NA)	NR				
Meteorology and/or Oceanographic/Subsea	Not Applicable (NA)	NR				
Soils & Hydrology	Not Applicable (NA)	NR				
Technical Deliverables (Specifications and/or Drawings)						
Conductor, Insulator, Grounding, Joint Design (including protection for buried or subsea)	Complete (C)	S	P	C	C	C
Foundation/Structure (Tower) Design	Not Applicable (NA)					
Route Mapping/Survey	Preliminary (P)	S/P	P/C			
Design Specifications	Complete (C)	NR	S/P	C	C	C
Instrument List	Not Applicable (NA)	NR				
Construction Permits	Not Applicable (NA)	NR				
Geometric Layout, Alignment, Profile, Cross Section	Preliminary (P)	NR	S/P	P/C		
Land/ROW Title Negotiation	Started (S)	NR	S/P			
Civil/ Site/Structural/Architectural Discipline Drawings	Not Applicable (NA)	NR				
Crossings and Borings Designs and Drawings	Preliminary (P)	NR	S/P	P		
Demolition Plans and Drawings	Not Applicable (NA)	NR				
Erosion Control Plan & Drawings	Not Applicable (NA)	NR				
Foundation/Structure (Tower) Discipline Drawings	Not Applicable (NA)	NR				
Tower/Structure Location/Spotting	Not Applicable (NA)	NR				
Instrument Datasheets	Not Applicable (NA)	NR	NR/S			
Electrical Discipline Drawings	Not Applicable (NA)	NR	NR			
Instrumentation/Control System Discipline Drawings	Not Applicable (NA)	NR	NR			
Total # Deliverables for this Project		8	24	20	16	16
% Defined/Complete towards Class Estimate		100%	100%	80%	64%	64%

Comments:

This project is being filed as a Class 3 estimate. The defined deliverables for this project indicate that 80% of Class 3 deliverables are completed. A contingency value of 10% was selected to account for specific risks such as replacement of additional equipment. The contingency will also provide coverage for any traffic restrictions causing work to fall outside of typical working hours, additional rock breaking or hydro-excavation that is not foreseen, or any additional tree trimming required along the line.

Legend:

The maturity level is an approximation of the completion status of the deliverable. The completion is indicated by the following descriptors:

General Project Data:

- Not Required (NR): May not be required for all estimates of the specified class, but specific project estimates may require at least preliminary development.
- Preliminary (P): Project definition has begun and progressed to at least an intermediate level of completion. Review and approvals for its current status has occurred.
- Defined (D): Project definition is advanced, and reviews have been conducted. Development may be near completion with the exception of final approvals.

Technical Deliverables:

- Not Required (NR): Deliverable may not be required for all estimates of the specified class, but specific project estimates may require at least preliminary development.
- Started (S): Work on the deliverable has begun. Development is typically limited to sketches, rough outlines, or similar levels of early completion.
- Preliminary (P): Work on the deliverable is advanced. Interim, cross-functional reviews have usually been conducted. Development may be near completion except for final reviews and approvals.
- Complete (C): The deliverable has been reviewed and approved as appropriate.

Inclusions:

For the purposes of this document, the term *power transmission line infrastructure industries* is assumed to include greenfield or brownfield sites for overhead, buried and submarine transmission of electrical power in the infrastructure industries. High voltage is typically >100kV but may be less (e.g., 33 or 66kV) if long distance with light electrical loads. This excludes power supply and distribution scope within a process plant, mining facility, building complex or other facility site. It also excludes power generation facilities and substations. The defining deliverables of those excluded project scopes are covered in other RPs (e.g., 18R-97 for process plants [2]).

Power transmission is considered an element of the infrastructure industry. The Construction Industry Institute has provided a good definition of infrastructure in its Project Definition Rating Index for Infrastructure Projects as follows [3]:

“A capital project that provides transportation, transmission, distribution, collection or other capabilities supporting commerce or interaction of goods, services, or people. Infrastructure projects generally impact multiple jurisdictions, stakeholder groups and/or a wide area. They are characterized as projects with a primary purpose that is integral to the effective operation of a system. These collective capabilities provide a service that is made up of nodes and vectors into a grid or system.”

Using this definition, power transmission lines are a vector or linear scope element that connects substation or other facility nodes at its terminations. The substation nodes may be part of or associated with a generation, consuming or interconnection facility. As such, transmission projects are often executed as part of a program that also involves node project scope or facility operational changes (or at least considerations for integrated system commissioning and startup). As the definition states, a distinguishing feature of these projects is that they often traverse wide areas, cross country or subsea, which puts an emphasis on the definition of routing, land ownership and conditions, and establishing right-of-way (ROW). Associated scope definition challenges include defining stakeholder, permitting and regulatory requirements. Buried and submarine installations increase the focus on the protection philosophy and strategies affecting cable selection, armoring and joint considerations. While many distinguish power transmission (higher voltage, long distances) from power distribution (short distance, lower voltage connections to retail customers), the principles of estimating these elements are similar; i.e., the RP applies to both.

The main physical power transmission line scope elements are conductors and their support structures if installed overhead. Main installation elements include land clearing if over land (including forestry if applicable), foundation and structure erection and conductor stringing if overhead, or trenching, laying and horizontal boring if subsurface or subsea. Special scope elements are involved with crossings of water, road, rail and so on and at terminations. Because conductor (e.g., aluminum) and structure (e.g., steel) material costs are usually a significant cost element, these project estimates are particularly sensitive to escalation uncertainty. In general, the more developed the route, the more complex the installation will be. In urban areas, visual appeal and concern for safety and health can be major issues. Installation in remote location and/or difficult or environmentally sensitive terrain creates its own challenges. Subsea installation adds the need for bathymetry¹ and metocean² studies and specialized installation equipment and vessels. Before any installation work can begin in an area, stakeholder consultation must be advanced (sometimes requiring agreements with local populations with rights), and appropriate land and ROW must be acquired which creates unique scheduling as well as cost challenges.

For the purpose of estimate classification then, the main scope definition deliverables are associated with defining the power requirements (i.e., kV), the conductors and structure, and the routing. Conductors can vary widely in content (copper, aluminum, etc.) and insulation. Overhead structures may be wood, concrete, composite or steel in various configurations with various foundation designs including pilings, concrete and so on. The route's land or subsea characteristics and the nature of developments drive the need for special design features and execution strategies. Operability and maintainability considerations may also affect ROW and access design. Brownfield and revamp projects add their own concerns for interface with existing elements, crowded working conditions, etc. For each scope definition decision, stakeholder requirements need to be considered.

Power substation projects are usually associated with transmission projects. However, substations being equipment-centric and located on a facility site have physical and defining characteristics similar to process plant projects (e.g., reliance on one-line diagrams, plot plans, etc.).



System Impact Study Report 412-1120-IS138

Load Customer System Impact Study
6.9 MVA Cape Breton Regional Hospital Redevelopment
Cape Breton, NS

Revision		Date	Drafted By	Reviewed by	Approved By
0	Issued for Release	January 12, 2021	SG	JPC	JPC
1	Revised to clarify cost responsibility	March 8, 2021	SG/JPC	JPC	JPC
2	Cost updates	April 18, 2021	JPC	JPC	JPC
3	Revisions to Alternatives 2 & 3	January 31, 2022	JPC	BC	JPC

EXECUTIVE SUMMARY

This report presents the results of a Load Impact Study (LIS) for the 6.9MVA Cape Breton Redevelopment Project located in Sydney, Nova Scotia.

There are three alternatives included in this report for sourcing the 12.5 kV primary and secondary circuits to supply the Cape Breton Regional Hospital (CBRH). Note that network upgrades required to increase the capacity of the primary supply to enable it to pick up the entire CBRH load is the cost responsibility of NSPI. Costs for any subsequent upgrades required to provide a suitable secondary (back-up) supply are the responsibility of CBRH.

This report recommends that the primary and secondary supplies be interconnected to the NSPI Distribution System via circuits 111S-311 and 4S-332 respectively (Alternative 2). The following circuit modifications will be required:

Primary supply: 111S-311 reconfiguration:

1. Reconductor the .65 km section of 3ph 2/0 AASC on Terry Way to 336 ASC.
2. Reconductor the .2 km section of 3ph 2/0 AASC on Weatherbee Road to 336 ASC.
3. Extend 111S-311 to new customer cable termination pole on Weatherbee Road.
4. Add a new dead-end pole at the end of Mullers Lane and fully isolate (2 sets of in-line insulators), or remove, the span of 2/0 ACSR between it and switch D3A79819 off Terry Way. This removes the possibility of a single contingency impacting both the Primary (111S-311) and Secondary (4S-332) supplies to CBRH. These two circuits cannot dead-end on a common pole for that reason.

Secondary supply: 4S-332 reconfigurations:

5. Reconductor Reservoir Road to the CBRH cable termination from 2/0 ACSR to 336 ASC.
6. Close switch D3S22974 to Supply CBRH via 4S-332.
7. Replace the existing double circuit poles along George Street between Townsend Street and Melody Lane with poles that permit 8 feet of clearance between circuits 4S-321 (bottom) and 4S-332 (top).
8. Offload George Street north of Townsend Street from 4S-332 to 4S-322 by disconnecting the flying taps at the corner of George and Townsend Streets, and installing new flying taps at the corner of George and Falmouth Streets.
9. Offload Charlotte Street north of Townsend Street from 4S-332 to 4S-322 by opening switch OH709313-3 on Townsend Street and installing new flying taps at the corner of Charlotte and Falmouth Streets.

The estimated cost assigned to CBRH for provision of a secondary supply from 4S-Townsend Street to the hospital under Alternative 2 is \$1,226,500, not including taxes. Additional details are outlined in Section 8 of this report.

In addition to the work described above, a review of coordination will be required by Eastern Regional Engineering to ensure protective devices are sized and coordinated appropriately for the new feeder configurations.

Any change in the studied load and the plans submitted to the Electrical Inspection Authority must be identified by the Customer and a Materiality Study conducted to confirm the change is not Material (i.e. a lower load than studied may reduce the network upgrades needed by NSPI – reducing NSPI costs; an increased load may not be able to be supplied with the upgrades identified in this report). If the change is Material, the Distribution Load Impact Study must be revised to account for the actual load submitted by the Customer to the Electrical Inspection Authority. This could result in a significant impact to the In-Service Date.

With the exception of work fully funded by the Customer under an Engineering and Procurement Agreement, NSPI will not start investing in network upgrades or start any of the work required to supply the load until the Customer submits their plans to the Electrical Inspection Authority. Once the Customer submits their plans, NSPI can begin the processes for procurement, licenses/permits, and construction.

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1.0 SCOPE

This study was initiated by Eastern Regional Engineering and Key Accounts to investigate solutions to accommodate the redevelopment of the Cape Breton Regional Hospital and the associated increase in hospital load from 3.2 MVA to 6.9MVA. It includes provision of a second supply for the facility capable of supplying the full hospital load of 6.9MVA under contingency conditions following the loss of the main supply. The study focuses primarily on feeders out of the 111S-Prime Brook, 4S-Townsend Street, and 6S-Terrace Street substations in Sydney, Cape Breton, to provide the primary and secondary supplies to the hospital.

The study also includes analysis of circuit capacity and power quality associated with the relevant feeders out of 111S and 4S over a 15-year study period. Solutions were recommended to ensure sufficient feeder and substation capacity was available to meet the expected load growth.

2.0 EXISTING SYSTEM

2.1 Transmission

The 111S-Prime Brook substation is fed via the 138 kV line L6539 and is located between the 2S-Victoria Junction substation and the 3S-Gannon Road substation.

The 11S-Keltic Drive substation is fed from the 69 kV line L5576 from 3S-Gannon Road and from L5564 out of the 6S-Terrace Street substation.

The 4S-Townsend Street substation is fed from 69 kV lines L5560 and L5563 out of the 84S-V.G. distribution substation and the 2S-Victoria Junction substation respectively.

The 84S-V.G. distribution substation is fed from the 69 kV line L5560 out of the 2S-Victoria Junction substation. Figure 1 shows the simplified transmission system in the Sydney Area.

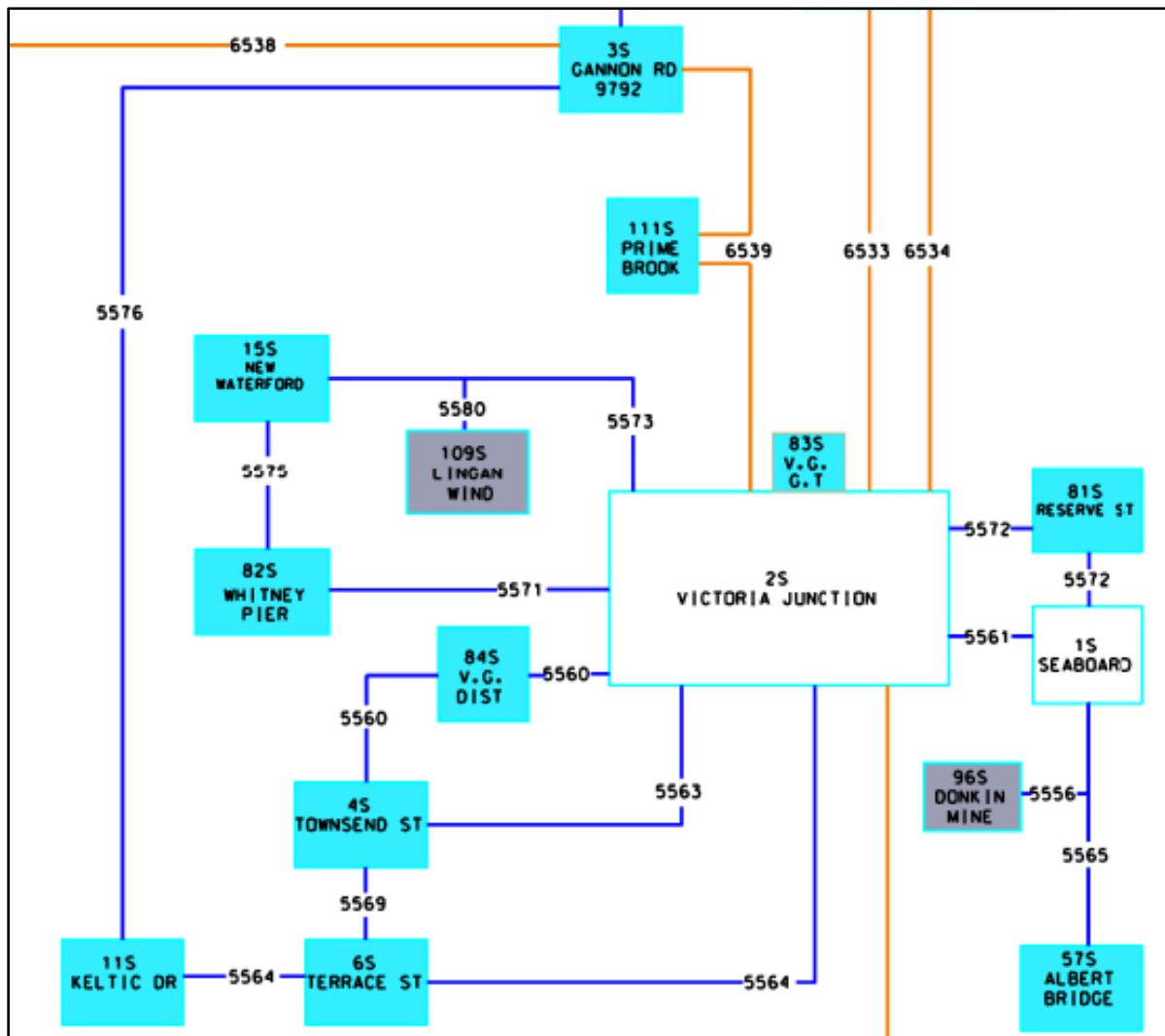


Figure 1: Simplified Sydney Area Transmission System

The ratings of the transmission (and sub-transmission) lines in the area key to this study are provided in Table 1 below:

Table 1: Sydney Area Transmission Line Ratings

Line Number	Location	Age	Summer (MVA)	Winter (MVA)
L-5560	2S-Victoria Jun. to 4S-Townsend	1949	41	60
L-5563	2S-Victoria Jun. to 4S-Townsend	1976	31	45
L-5564	6S-Terrace St. to 11S-Keltic Drive	1966	55	72
L-5576	3S-Gannon Rd. to 11S-Keltic Drive	1978	23	34
L-6539	3S Gannon Rd. to 2S Victoria Junction	1971	115	115

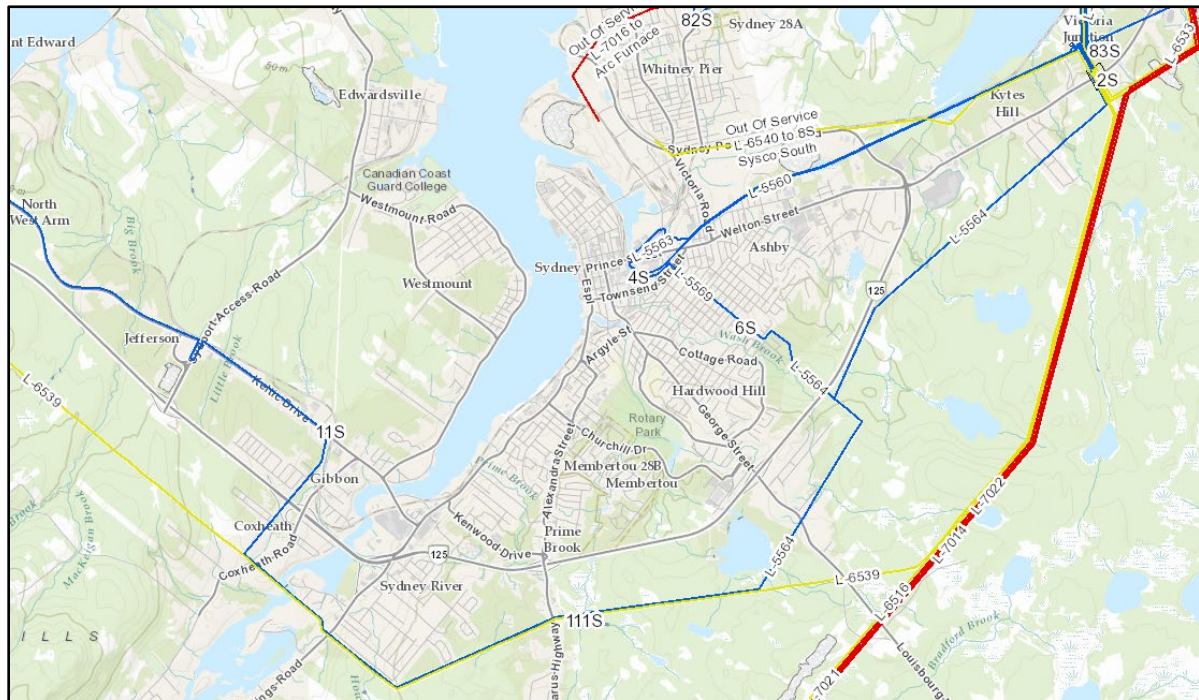


Figure 2: Sydney Area Transmission and Sub-Transmission

2.2 Distribution

The distribution system being investigated in this report includes 12.5 kV feeders supplied by the 111S-Prime Brook and 4S-Townsend Street substations as shown in Figure 3.

The 111S-Prime Brook substation supplies four 12.5 kV feeders which service customers in the Sydney River area, with feeders also extending south to Caribou Marsh and Front Lake, as well as southeast to Middle Lake. All four 12.5 kV feeders are supplied via transformer 111S-T61.

The 4S-Townsend substation supplies customers mainly in the Sydney and Sydney River area. The feeders run south to Hardwood Hill and east to Grand Lake Road. The 12.5 kV feeder circuits 4S-321, 4S-322, 4S-323 and 4S-324 are supplied via transformer 4S-T52 while the 12.5 kV feeder circuits 4S-331, 4S-332, 4S-333 and 4S-334 are supplied via transformer 4S-T53.

The report also considers circuits supplied via the 11S-Keltic Drive substation, which supplies two 12.5kV circuits and one 25kV circuit in the general area of the CBRH facility. In addition, the 6S-Terrace Street Substation is also reasonably close to the CBRH, but currently supplies circuits at the 4.2kV voltage level. Terrace Street circuits are being converted from 4.2kV to 12.5kV with the intention of retiring the substation. This creates an opportunity to re-use the substation with a new 12.5kV source, which could also provide a secondary supply to the CBRH.

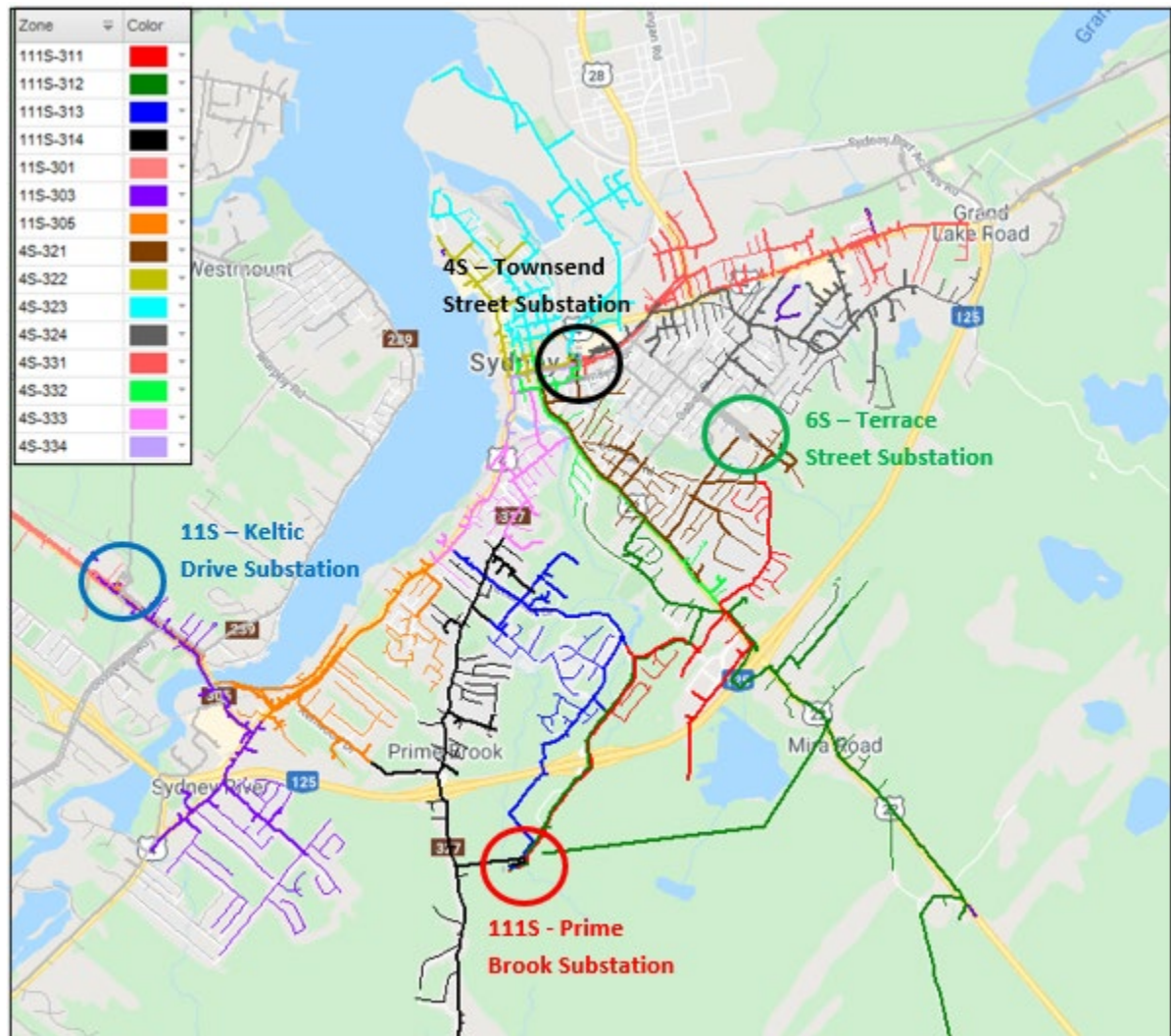


Figure 3: Sydney Area Distribution System

The one-line diagrams for 111S, 11S, 6S, and 4S are included in Appendix A of this report for reference. Table 2 and Table 3 provide additional information regarding the demand load and the substation transformers at 4S-Townsend Street and 111S-Prime Brook. Data on the 11S circuits was not included as these were determined to be unsuitable as a secondary supply point for the CBRH.

Table 2: Sydney Area Substation Feeders Overview

Substation	Feeder	Winter Peak		
111S-Prime Brook	111S-311	168A	3.6 MVA	13.4 MVA
	111S-312	107 A	2.3 MVA	
	111S-313	174 A	3.8 MVA	
	111S-314	173 A	3.7 MVA	
4S-Townsend Street	4S-321	200 A	4.3 MVA	20.0 MVA
	4S-322	210 A	4.5 MVA	
	4S-323	260 A	5.6 MVA	
	4S-324	259 A	5.6 MVA	
	4S-331	175 A	3.8 MVA	9.2 MVA
	4S-332	100 A	2.2 MVA	
	4S-333	130 A	2.8 MVA	
	4S-334	17 A	0.4 MVA	

Table 3: Sydney Area Distribution Substation Transformers

Substation	Transformer	Transformer Data				
		Manufacturer	kV	Rating (MVA)	Impedance	Age
111S-Prime Brook	111S-T61	WEG	138 – 13.2	15/20/25	8.00%	2018
4S-Townsend Street	4S-T52	Federal Pioneer	69 - 12.47	15/20//24.6	6.98%	1972
	4S-T53	Federal Pioneer	69 - 12.47	15/20//22.4	6.78%	1973

2.2.1 111S-Prime Brook

There is currently one transformer supplying the feeder circuits out of the 111S-Prime Brook substation. 111S-T61 is a 138 – 13.2 kV transformer unit rated for 15/20/25 MVA that supplies four 12.5 kV distribution circuits for customers in the Sydney area. The Cape Breton Regional hospital is currently supplied by 111S-311 on Reservoir Road.

Figure 4 shows the 111S substation and Appendix A contains a copy of the complete system one-line diagram for 111S. Qualitative descriptions of the two relevant feeders are located in Table 4.

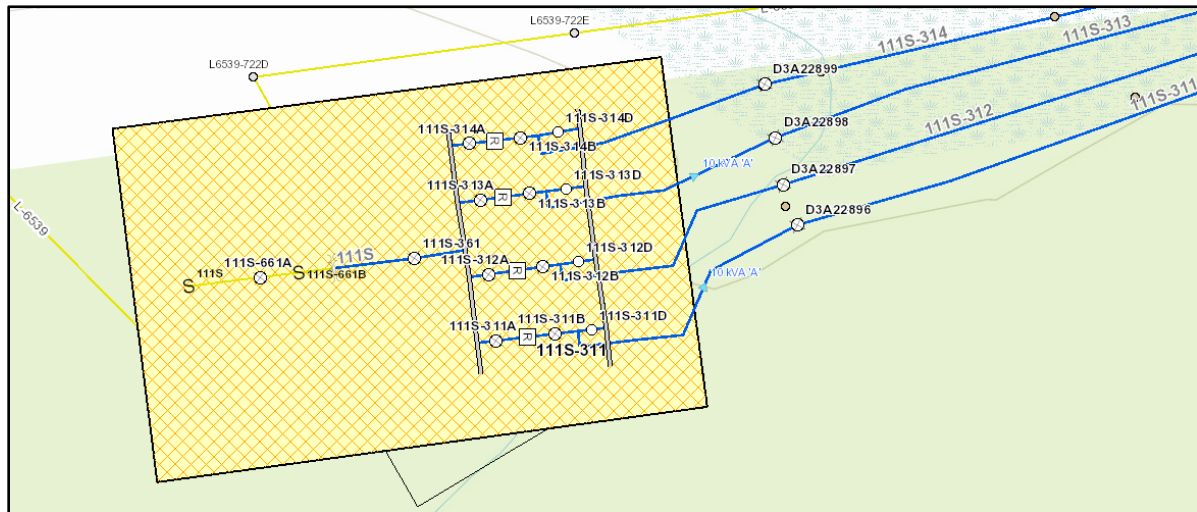


Figure 4: 111S Prime Brook Substation in OneGIS

Table 4: Relevant 111S-Prime Brook 12.5 kV Feeders

Feeder	Description
111S-311	Overhead feeder exits substation and runs northeast to Hardwood Hill and extends to the Cape Breton Regional Hospital. Tie-points with 111S-312, 111S-313, 4S-321 and 4S-332. No stepdown transformers, no voltage regulators, no downline reclosers.
111S-312	Overhead feeder exits substation and runs northeast to Hardwood Hill. Feeder also extends southeast of Harwood Hill to Mira Road and Middle Lake. Tie-points with 111S-311 and 4S-321. No stepdown transformers, no voltage regulators, one downline recloser.

2.2.2 4S-Townsend Street

There are currently two transformers supplying the distribution system out of 4S-Townsend Street. 4S-T52 is a 69 – 12.47 kV transformer rated 15/20//24.6 MVA that supplies four 12.47 kV distribution circuits for customers within Sydney, Hardwood Hill and Ashby. 4S-T53 is a 69 – 12.47 kV transformer rated for 15/20//22.4 MVA that supplies four 12.5 kV distribution circuits for customers within Sydney, Hardwood Hill and Ashby.

Figure 5 shows the 4S substation and Appendix A contains a copy of the complete system one-line diagram for 4S. A qualitative description of the relevant feeders is provided in Table 5.

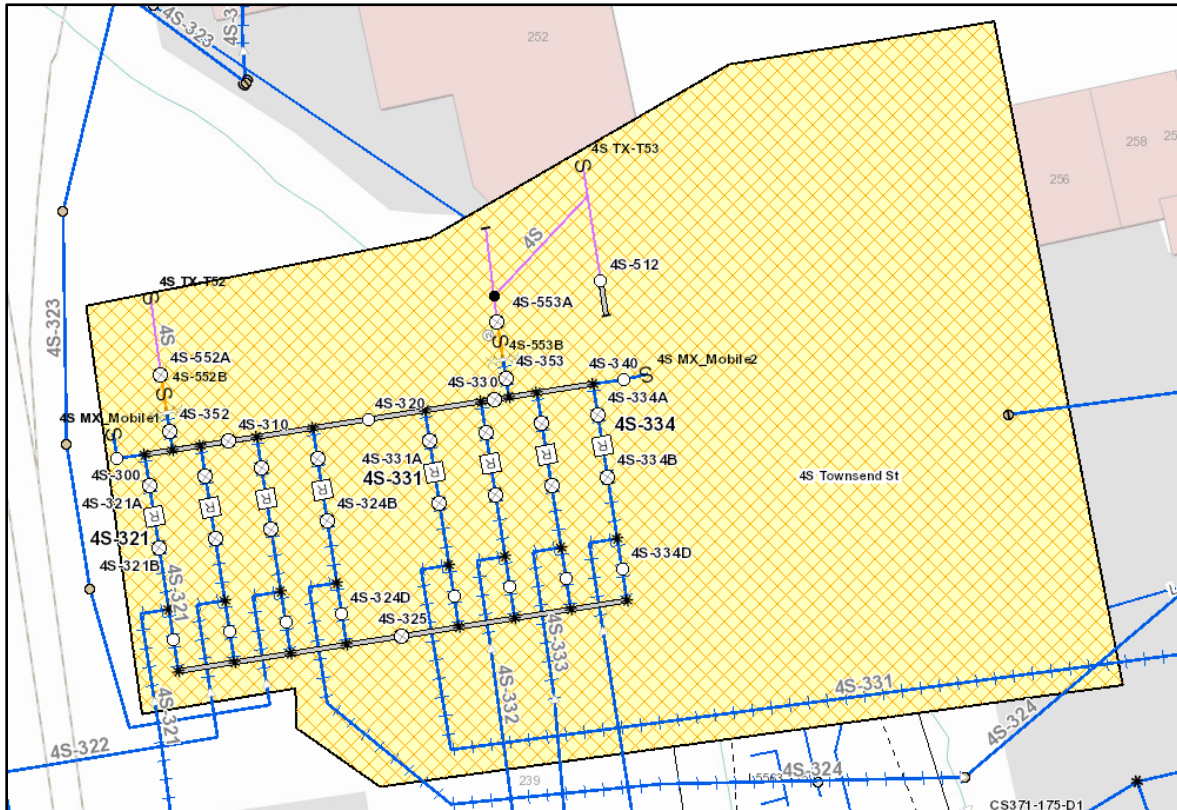


Figure 5: 4S Townsend Street Substation in OneGIS

Table 5: Relevant 4S-Townsend Street 12.5 kV Feeders

Feeder	Description
4S-321	Overhead feeder exits substation and runs southeast to Hardwood Hill. Tie points with 111S-311, 6S-223 and 6S-224. No stepdown transformers, no voltage regulators, no downline reclosers.
4S-332	Overhead feeder exits substation and runs southeast to Hardwood Hill. Tie points with 4S-333, 4S-334, 111S-313, 111S-314 and 11S-305. No stepdown transformers, no voltage regulators, no downline reclosers.

3.0 PROPOSED LOAD

An additional 3.7 MW of load will be added to the existing CBRH facility, raising the total hospital peak load to 6.9MVA. The Cape Breton Regional Hospital will require a primary source and a secondary source, both capable of supplying the entire facility load. The two supplies are to be sourced from different substations, providing a secure contingency supply. There are two substations in close proximity to the CBRH that can be utilized for this purpose: 111S-Prime Brook, or 4S-Townsend Street. A third site is also available at 6S-Terrace Street, but this site currently supplies feeders at 4.2kV and would require the addition of a new 69-12.5kV transformer prior being a viable supply point. Details of the proposed project are provided in Table 6.

Table 6: Proposed Cape Breton Regional Hospital Load

Cape Breton Regional Hospital Secondary Supply	
Site Location	1482 George St, Sydney, NS
3 Phase Supply	12.5 kV, 6.9 MW
Facility Voltage & Power Factor	600/347V, 208/120V, 0.90pf
Type of load	Mixed, lighting, HVAC, refrigeration, small power

This study is performed using the following assumptions:

1. The Load Customer is requesting an in-service date prior to Dec 31, 2022.
2. The power factor of the project is no less than 0.90.

The current supply to the CBRH is provided via feeder 111S-311 out of the 111S-Prime Brook Substation and is routed along Reservoir Road as shown in Figure 6.

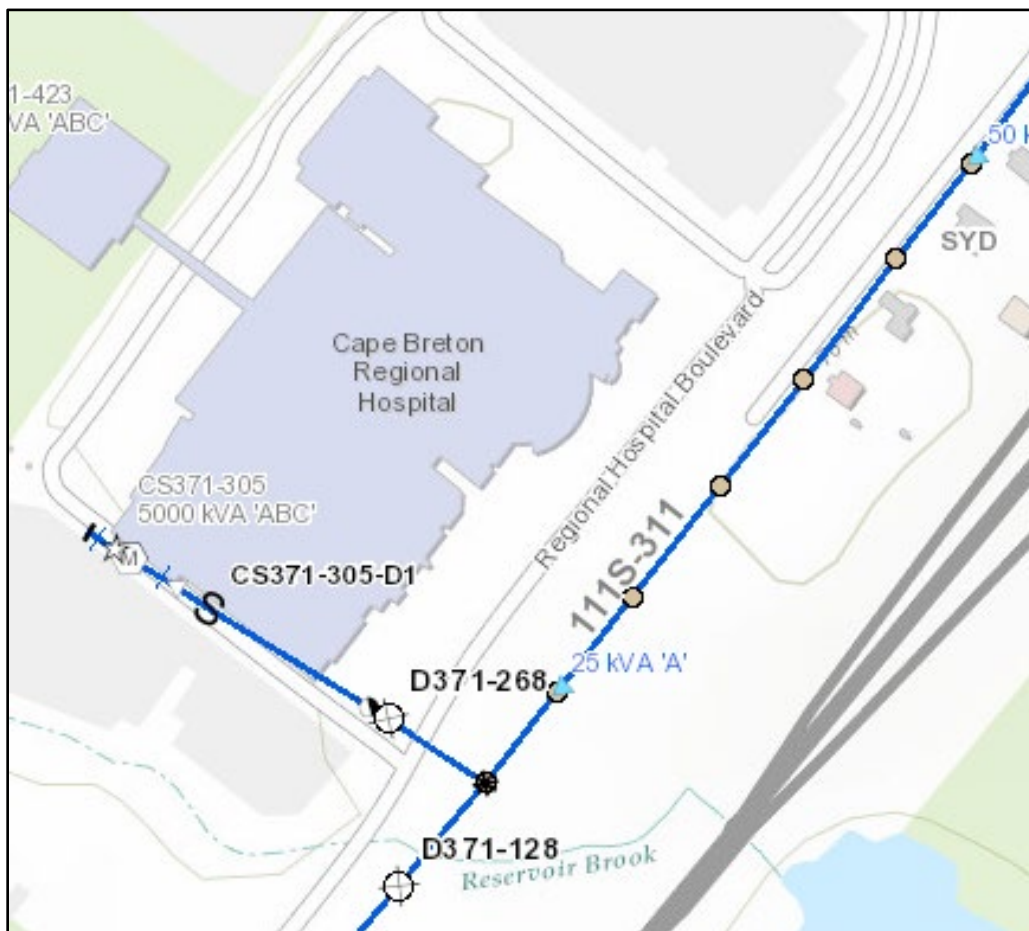


Figure 6: Cape Breton Regional Hospital Existing Supply

4.0 SYSTEM REQUIREMENTS

4.1 Electrical Inspection Act & Canadian Electrical Code Part I & II (CEC)

The installation must meet all applicable national, provincial and municipal electrical construction and safety codes, including, without limitation, the Electrical Installation and Inspection Act. Except as expressly permitted by law, all electrical equipment must have CSA or equivalent approval. Information Bulletins regarding Nova Scotia Power Electrical Permits (B-B1-002), and Customer Owned High Voltage Equipment (B-36-000), along with other bulletins can be found at: www.nspower.ca under “For My Home” and “For Your Business”, “Electrical Inspections”.

4.2 Configuration and Grounding

NS Power's primary Distribution System is a 3-phase, 4-wire multi-grounded common neutral system (“effectively grounded-wye”) operated at three typical voltage levels:

- 4,160 Volts line to line; 2,400 Volts line to ground (4 kV)
- 12,470 Volts line to line; 7,200 Volts line to ground (12 kV)
- 24,940 Volts line to line; 14,400 Volts line to ground (25 kV)

Distribution transformers, which step the primary voltage down to utilization voltages, are mainly single-phase units with primaries connected phase to ground. Three phase distribution transformers are normally configured grounded wye - grounded wye. This generally provides a single intentional ground path for short-circuit currents (one zero-sequence path) and has been utilized in the design of short-circuit protection applied to distribution feeder systems. NS Power’s standard secondary supply voltages are:

- 120/240 Volts 1-Phase
- 120/208 Volts Solidly Grounded Wye 3-Phase, 4-Wire
- 347/600 Volts Solidly Grounded Wye 3-Phase, 4-Wire

4.3 Voltage Standards

NS Power maintains voltage levels at all points on the Distribution Systems in compliance with “CSA CAN-3-C235-1983 (R2015) Preferred Voltage Levels for AC Systems, 0 to 50,000 Volts, Electric Power Transmission and Distribution”.

4.4 Phasing

Phasing is not standardized across NSPI’s Distribution Systems. Where necessary, the phase sequence and the direction of rotation must be coordinated with NS Power’s Distribution System.

4.5 Voltage Flicker, Dips and Unbalance

Voltage flicker and voltage dips refer to transient or periodic variations of voltage which cause objectionable lamp flicker and/or disturbances to connected equipment. Inrush current during starting of motors or generators typically causes a voltage dip whereas voltage flicker is a quasi-continuous variation of voltage that could be caused by arc-welder, arc-furnaces or variations in the real or reactive

power output of a generator. NS Power has established guidelines for the Distribution System regarding voltage dips and voltage flicker.

Although the Distribution System is a three-phase system, loads are connected phase to ground and much of the load is supplied from single-phase laterals. As a result, the load on the three-phase system is not perfectly balanced. The unbalanced load in turn causes a degree of voltage unbalance along the distribution feeder. During normal operation, NS Power's primary Distribution System has a phase-to-phase voltage unbalance which is normally less than 3%. In some rural locations the voltage unbalance can be higher.

4.6 Voltage and Current Distortion

NS Power has adopted "IEEE 519 – 2014 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems". This establishes harmonic distortion limits for the Distribution System. It provides the harmonic voltage distortion levels that can be expected on Distribution Systems.

4.7 Frequency

The power system in Nova Scotia is connected to the North American grid. As a result of this tie, the Nova Scotia system has tight frequency control which rarely varies more than 0.2 Hz from its 60 Hz nominal value.

On occasion, Nova Scotia and New Brunswick may become separated from this system and operate independently as an electrical island. The islanded condition may be very brief in duration or may last several weeks as maintenance to lines and substations are carried out. When NS Power's systems operate in an islanded state, the frequency may vary from 59.5 to 60.5 Hertz (Hz) during normal (uneventful) operation.

4.8 Fault Levels, Fault Clearing and Restoration

The maximum design fault level of the 12.5 kV system is 9000 A. The maximum design fault level of the 25 kV system is 8000 A. Actual fault levels will vary from substation to substation and will decrease with distance from the substation.

Short-circuits on distribution feeders are detected and cleared by the operation of protective devices such as reclosers and circuit breakers. These protective devices detect and interrupt the fault current and then reclose the circuit to restore service. If the short circuit remains (permanent fault) then the protective device again interrupts the circuit and again recloses. Reclosing is a common utility practice. This cycle may be repeated multiple times before the protective device opens and must be manually reclosed.

Short-circuit clearing times (fault initiation to interruption) typical of NS Power's Distribution Systems are less than 1.0 second, in some instances clearing times can be longer.

4.9 Power Factor

Per Regulation 4.7, NSPI requires that when charges are based on maximum demand measured in kilowatts, the customer shall maintain a power factor of not less than 90%.

4.10 Reliability

The Distribution System feeder circuits typically experience several outages per year due to exposure to human and natural factors. These outages may be brief or may extend to many hours. In addition to these forced outages, planned maintenance of the NS Power Distribution System may require that a supply feeder be removed from service for a period of time.

5.0 PROPOSED SOLUTIONS

In order to provide a suitable primary and secondary supply to CBRH, while avoiding circuit or transformer overloads and voltage criteria violations, the following alternatives are proposed:

5.1 Alternative 1: Primary supply via 111S-311; Secondary supply via 111S-312

Alternative 1 is provided for comparison purposes only as it does not meet the CBRH criteria for two separate substation sources. Circuit 111S-311 currently supplies CBRH via Reservoir Rd. Circuit 111S-312 is close to the CBRH Redevelopment Project site and can be easily extended to CBRH. Under normal operations, 50% of the CBRH load would be fed from each circuit, although either circuit must be capable of supplying the full CBRH load following loss of the other supply.

In order to facilitate this solution, the following upgrades/modifications would be required as shown in Figures 7 and 8:

Primary supply: 111S-311 reconfigurations:

1. Reconductor the 1km section of 3ph 2/0 AASC on Terry Way and Mullers Ln to 336 ASC.
2. Install a new normally open point on 111S-311 on George St between Rotary Dr and Edgar St.
3. Close switch D3A22974 to offload 111S-311 to 4S-332.
4. Reconductor the 0.73km section of 3ph 2/0 AASC of 111S-311 on Reservoir Rd to 336 ASC.

Secondary supply: 111S-312 reconfigurations:

5. Double circuit Terry Way between Ferguson Rd and Weatherbee Rd using 3 phase 336 ASC.
6. Open switch D3A22932 on Ferguson Dr to disconnect 111S-312 from downstream load.
7. Close switch D371-272 on Hillside St to pick up 111S-312 load from 4S-321.
8. Move the 4S-321 single phase tap at the Oxford St and Cottage Rd intersection from phase B to phase C.
9. Reconductor Weatherbee Rd to 3ph 336 ASC (200m), re-connect to 111S-312, and extend 150m to customer duct bank.

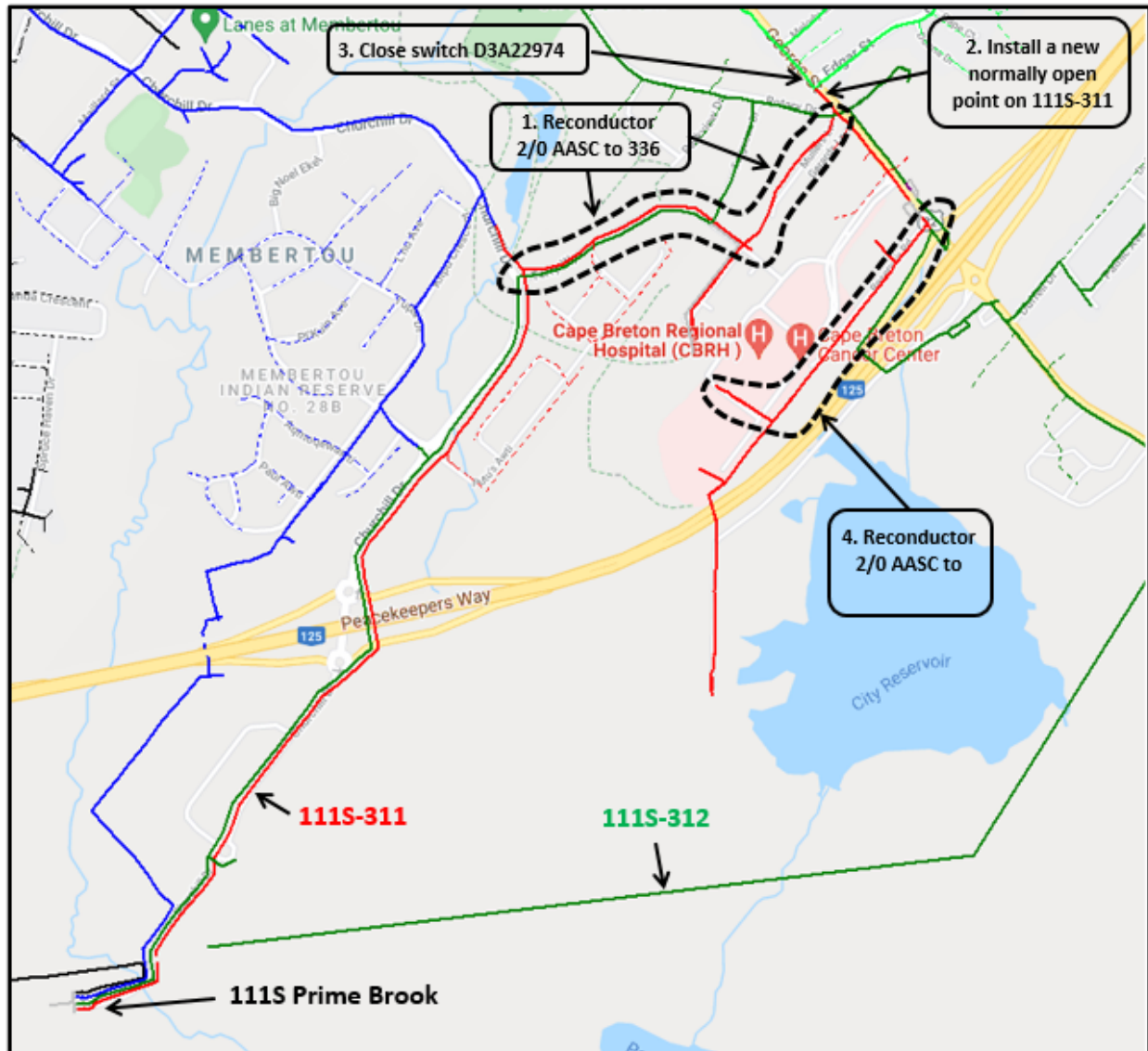


Figure 7: Required Modifications for Alternative 1 (1 of 2)

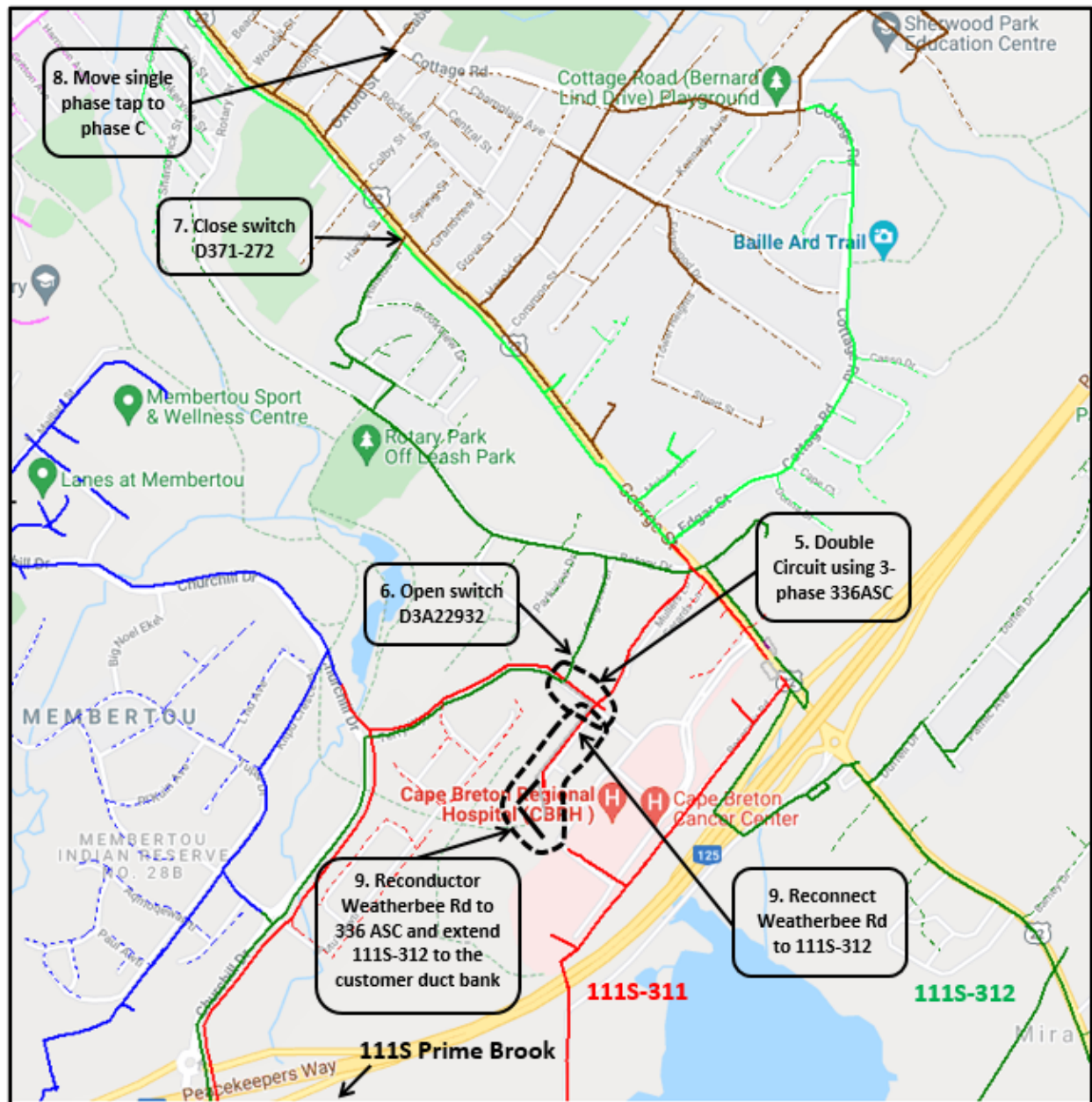


Figure 8: Required Modifications for Alternative 1 (2 of 2)

This solution requires limited capital investment. It is ideal from a transformer loading standpoint, as 111S-T61 is already supplying the hospital and therefore requires no additional capacity to supply it via another circuit. However, this solution is less reliable as the hospital secondary supply would not be fed from a different substation transformer than the primary supply, meaning an outage to 111S substation would remove both supplies to the hospital.

5.2 Alternative 2: Main supply via 111S-311 and Secondary supply via 4S-332

Feeder reconfigurations and circuit extensions can be completed to supply the Cape Breton Regional Hospital load from 111S-311 and 4S-332. Under normal operations, 50% of the CBRH load would be fed from each circuit, although either circuit must be capable of supplying the full CBRH load following loss of the other supply.

In order to facilitate this solution, the following upgrades/modifications would be required as shown in Figures 9 through 11:

Primary supply: 111S-311 reconfiguration:

1. Reconductor the .65km section of 3ph 2/0 AASC on Terry Way to 336 ASC.
2. Reconductor the .2km section of 3ph 2/0 AASC on Weatherbee Road to 336 ASC.
3. Extend 111S-311 to new customer cable termination pole.
4. Add a new dead-end pole at the end of Mullers Lane and fully isolate (2 sets of in-line insulators), or remove, the span of 2/0 ACSR between it and switch D3A79819 off Terry Way. This removes the possibility of a single contingency impacting both the Primary (111S-311) and Secondary (4S-332) supplies to CBRH. These two circuits cannot dead-end on a common pole for that reason.

Secondary supply: 4S-332 reconfigurations:

5. Reconductor Reservoir Road to the CBRH cable termination from 2/0 ACSR to 336 ASC.
6. Close switch D3S22974 to Supply CHRH via 4S-332.
7. Replace the existing double circuit poles along George street between Townsend Street and Melody Lane with poles that permit 8 feet of clearance between circuits 4S-321 (bottom) and 4S-332 (top).
8. Offload George St north of Townsend Street from 4S-332 to 4S-322 by disconnecting the flying taps at the corner of George and Townsend Streets, and installing new flying taps at the corner of George and Falmouth Streets.
9. Offload Charlotte Street north of Townsend Street from 4S-332 to 4S-322 by opening switch OH709313-3 on Townsend Street and installing new flying taps at the corner of Charlotte and Falmouth Streets.

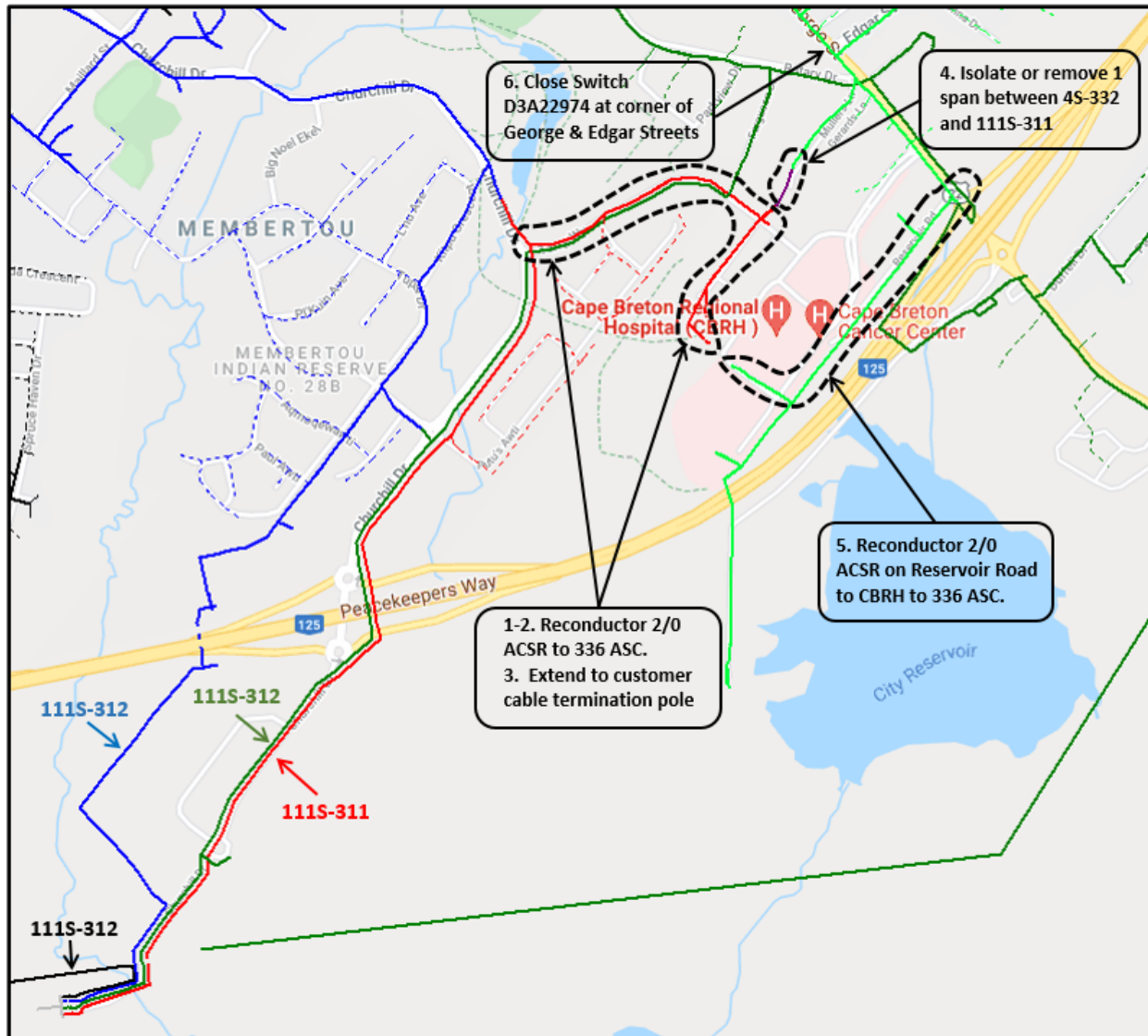


Figure 9: Required Modifications for Alternative 2 (1 of 3)

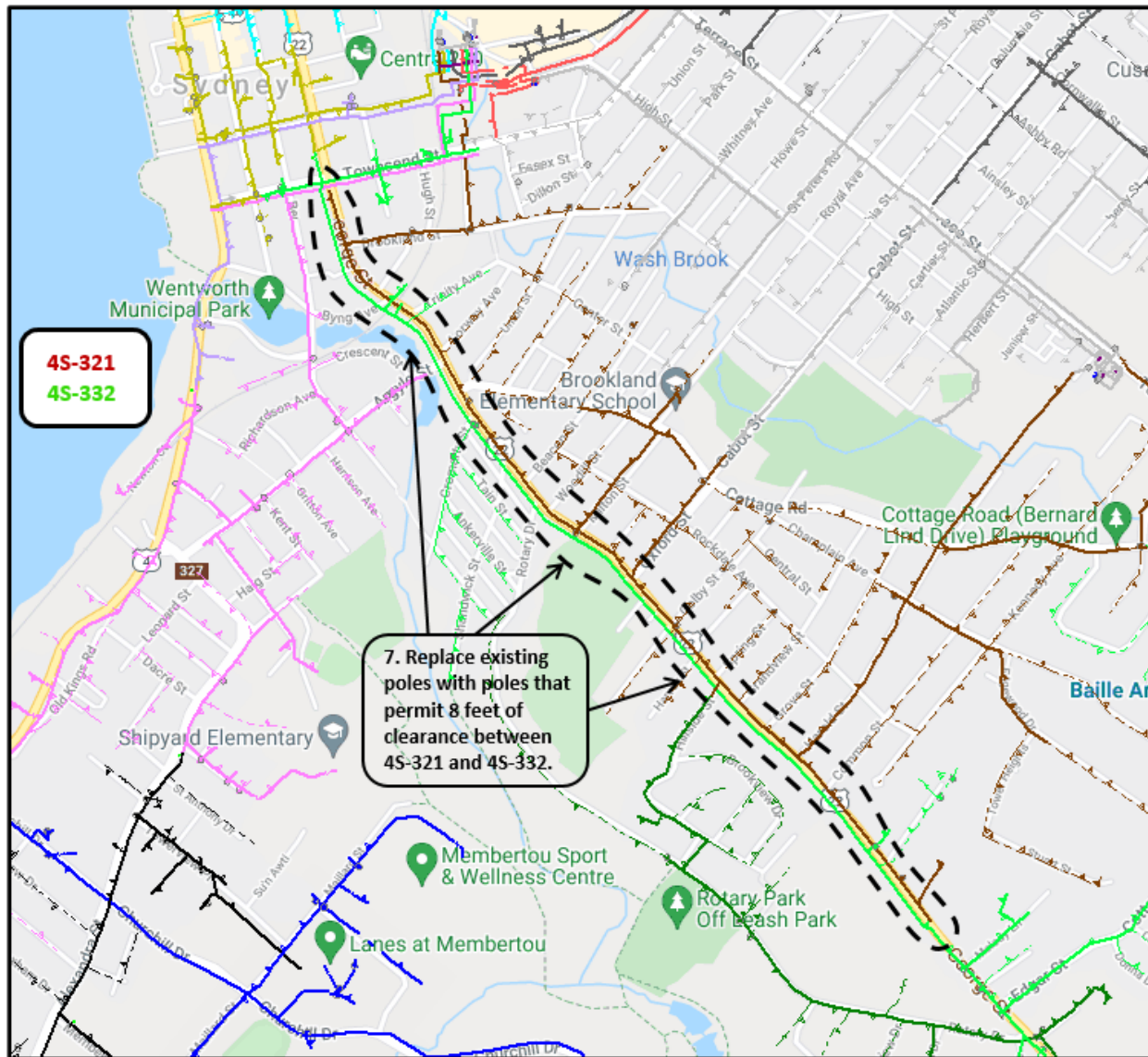


Figure 10: Required Modifications for Alternative 2 (2 of 3)

This solution requires substantial capital investment to replace existing double circuit poles on George Street, and to reconductoring 0.73km of line on Reservoir Road to 336 ASC to the Cape Breton Regional Hospital service point. However, it is the most direct circuit to the 4S substation with suitable conductor. Replacing the poles is required to increase separation between the top and bottom circuits to allow for sag on circuit 4S-332 when carrying the entire hospital load and to meet current construction standards.

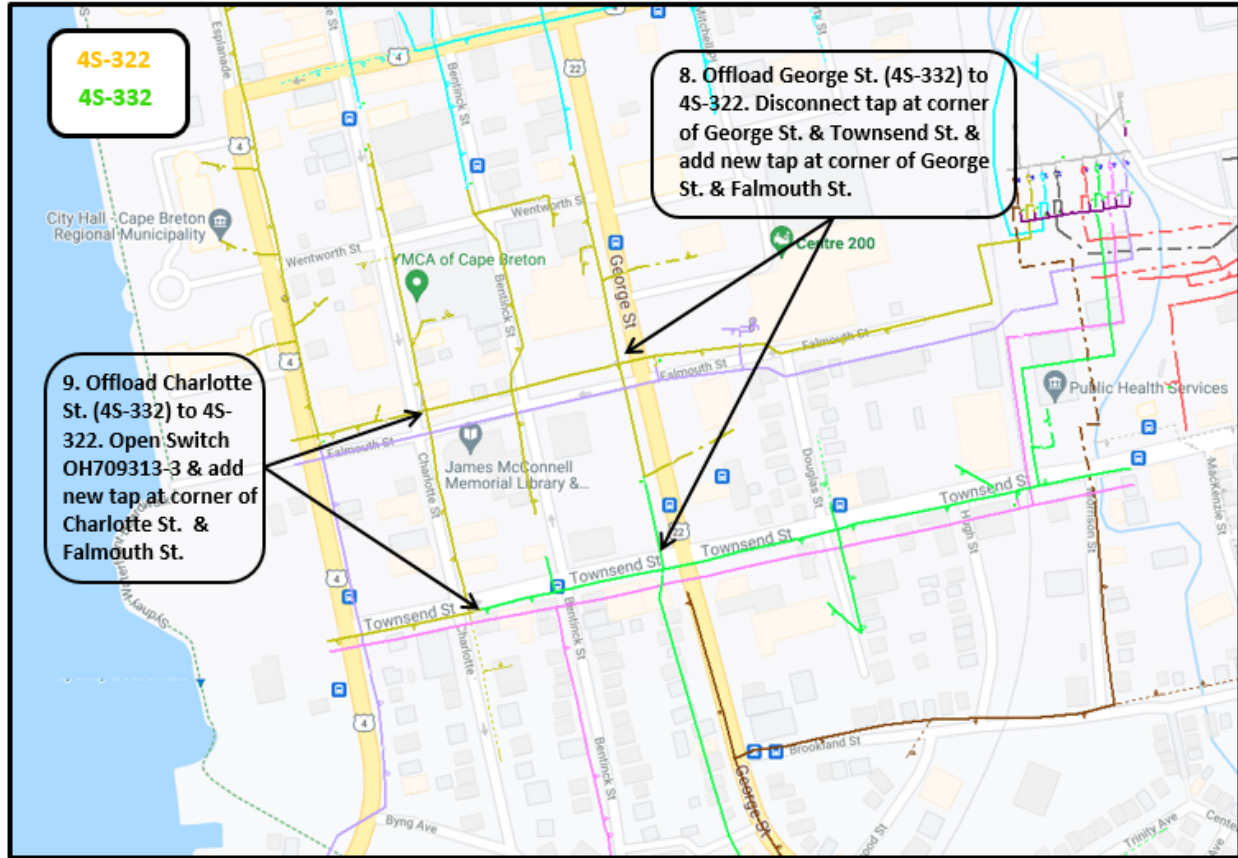


Figure 11: Required Modifications for Alternative 2 (3 of 3)

Table 7 shows the loads on circuits 4S-322, 4S-332, and 111S-311 following the above changes under normal CBRH load and full CBRH load conditions. Both 4S-332 and 111S-311 remain well under the maximum 325A criteria limit for normal CBRH load and remain well within the conductor rating of 336 ASC (560 amps) under contingency operation supplying the full CBRH load.

Table 7: Alternative 2 Feeder Loading

Alternative 2: Feeder Loading after Reconfiguration		
Feeder	Normal CBRH Load (A)	Full CBRH Load (A)
4S-322	260	260
4S-332	215	386
111S-311	170	338

5.3 Alternative 3: **Main supply via 111S-311 and Secondary supply via 6S-311**

In this alternative, circuit 111S-311 would continue to be the primary supply for the Cape Breton Regional Hospital, although some reconfiguration would be required to offload the circuit. The secondary supply would be provided via a new 12.5kV feeder out of the 6S-Terrace Street Substation (6S-311). Under normal operations, 50% of the CBRH load would be fed from each circuit, although either circuit must be capable of supplying the full CBRH load following loss of the other supply.

In order to facilitate this solution, the following upgrades/modifications would be required as shown in Figures 12 and 13:

Primary supply: 111S-311 reconfigurations:

1. Extend 111S-311 on Weatherbee Rd to the customer duct bank to supply the CBRH load.
2. Reconductor 0.85km of 2/0 AASC sections of 111S-311 along Terry Way and Weatherbee Rd to 336 ASC.
3. Install a new normally open point on 111S-311 on Muller Ln before the George St and Rotary Dr intersection.

Secondary supply: 6S-311 reconfigurations:

4. Refurbish the 6S Terrace St substation and install a 69-12.5 kV, 7.5/10/12.5 MVA transformer.
5. Construct a new feeder circuit exit out of 6S-Terrace Street to connect to the existing 12.5kV distribution system on Terrace St (currently 4S-321).
6. Open switch D3A23638 on Cottage Rd to disconnect 4S-321 from downstream load.
7. Close switch D3A23639 on Cottage Rd to pick up 111S-311 load from 6S-311.
8. Reconductor the 1.3km 2/0 ACSR section of 6S-311 on Cottage St and Edgar St to 336 ASC.
9. Reconductor the 2/0 AASC along Reservoir Rd between George St and the CBRH Service Point to 336 ASC.
10. Move the single phase tap at the Terrace St and Bristol Dr intersection from phase A to phase C.

This solution involves significant capital investment, as the 6S Terrace St substation will require refurbishment and the installation of a new 7.5/10/12.5 MVA transformer. On the other hand, it increases reliability as it allows for the hospital secondary supply to be fed from a different substation transformer at a different transmission voltage than the primary supply.

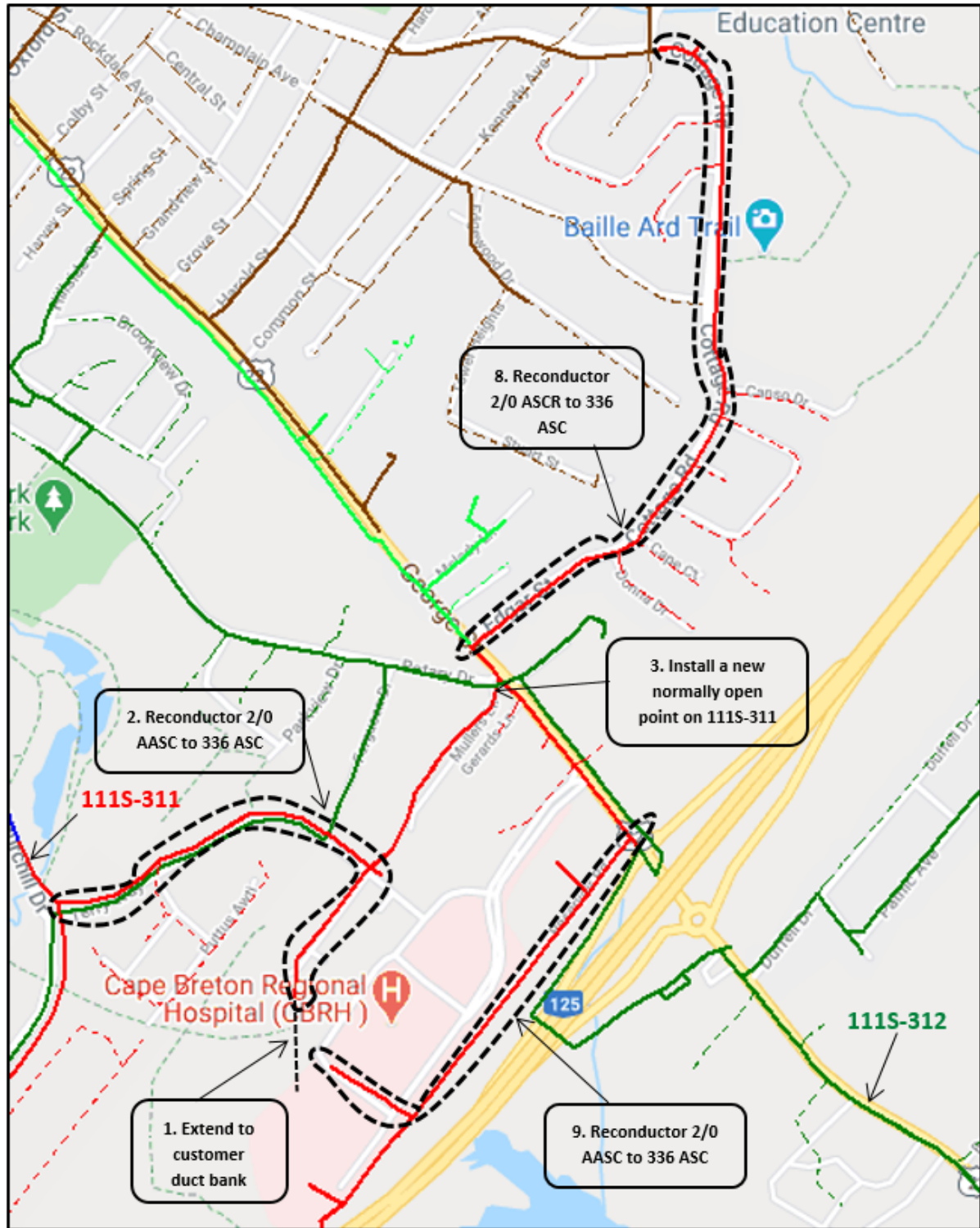


Figure 12: Required Modifications for Alternative 3 (1 of 2)

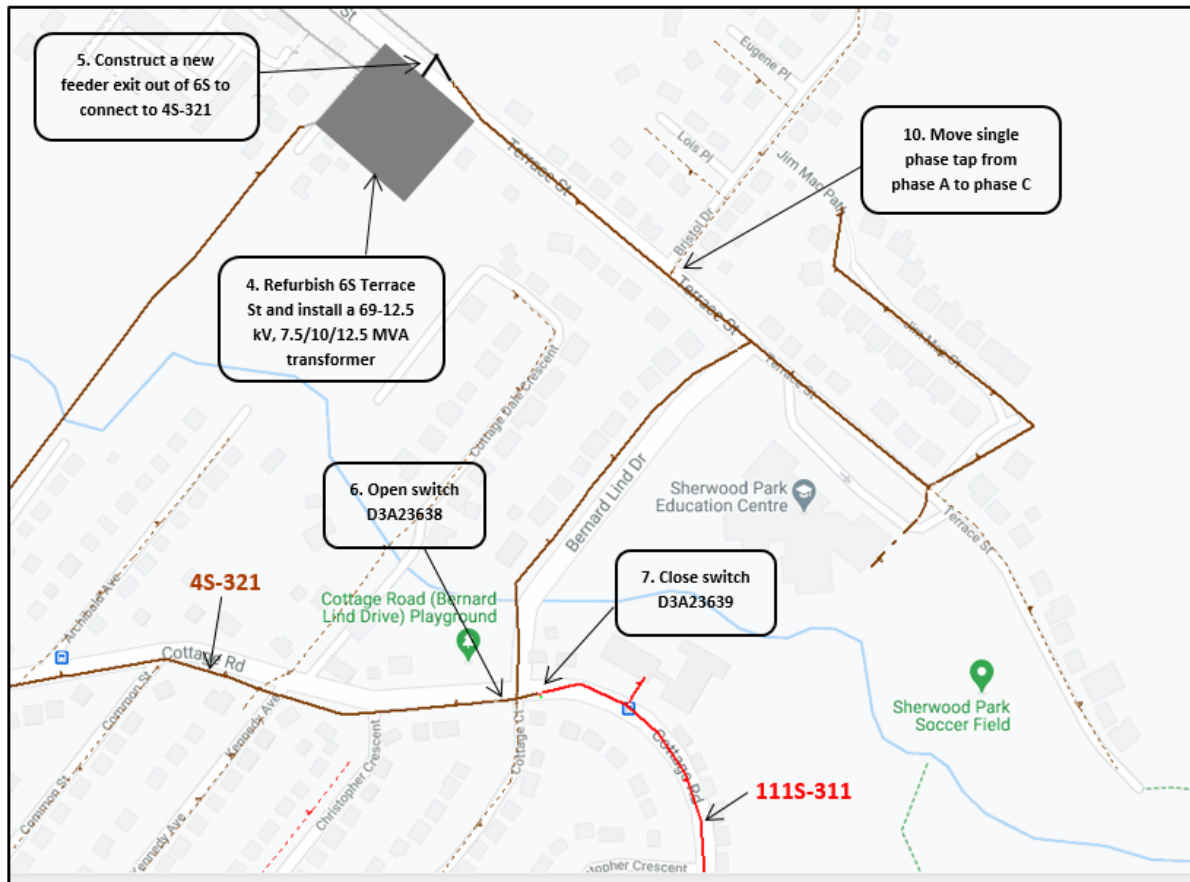


Figure 13: Required Modifications for Alternative 3 (2 of 2)

Table 8 shows the loads on circuits 6S-311 and 111S-311 following the above changes under normal CBRH load and full CBRH load conditions. Both circuits remain well under the maximum 325A criteria limit for normal CBRH load and remain well within the conductor rating of 336 ASC (560 amps) under contingency operation supplying the full CBRH load.

Table 8: Alternative 3 Feeder Loading

Alternative 2: Feeder Loading after Reconfiguration		
Feeder	Normal CBRH Load (A)	Full CBRH Load (A)
6S-311	199	380
111S-311	170	338

6.0 SYSTEM CONDITIONS

6.1 Transformer Loading

NSPI will load distribution load serving substation transformers to 110% of top nameplate rating (summer) and 133% (winter) based on normal cyclic daily loading, unless other limiting factors such as bushing rating or tap changer rating are more restrictive. System power transformers (i.e., 138-69kV) are limited to 100% of the 65°C manufacturer nameplate MVA for summer and 110% for winter under normal system conditions.

There are two existing sources of supply for the Cape Breton Regional Hospital: 111S-T61, and 4S-T53. Both of these supply points have been analyzed in this report.

6.1.1 111S-T61

Based on the available monthly load check data and PI data, the transformer 111S-T61 supplies a peak winter load of approximately 13.4 MVA and is not at risk of being overloaded within the study window (prior to 2035). The peak expected load in 2035 is 13.74 MVA. The top nameplate rating of the transformer 111S-T61 is 25 MVA, which allows an available capacity of approximately 33.25 MVA during periods of winter peak (133% of 25MVA rating).

6.1.2 4S-T53

Based on the available monthly load check data and PI data, the transformer 4S-T53 supplies a peak winter load of approximately 9.2 MVA and is not at risk of being overloaded within the study window (prior to 2035). The peak expected load in 2035 is 10 MVA. The top nameplate rating of the transformer 4S-T53 is 22.4 MVA, which allows an available capacity to approximately 30 MVA during periods of winter peak (133% of 22.4 MVA rating).

6.2 Feeder Loading

The fully loaded capacity of an NSPI 12.5 kV distribution feeder is presently the lower of the thermal capacity of the feeder circuit conductors, or 325 A (7 MVA). Under contingency operation, load on circuits can exceed the 325A normal operations limit but must remain well within the ratings of substation protection devices and overhead line.

As previously noted, feeder 111S-311 is currently supplying the Cape Breton Regional Hospital and can be extended to the new CBRH overhead to underground transition pole on Weatherbee Road. Either circuit 4S-322 or 6S-311 can be configured to supply the existing CBRH supply point on Reservoir Road. In either case, the 2/0 ACSR conductor on Reservoir Road must be replaced with 336 ASC conductor.

It is recognized that the Cape Breton Regional Hospital Load (6.9 MVA) will be split between the primary and secondary supplies in order to keep load on the NSPI 12.5 kV distribution feeders below the 325A feeder limit for normal operations.

6.2.1 Feeder 111S-311

Feeder 111S-311 experiences a typical winter peak loading of 168 A (3.6 MVA), which is well below the 325 A overload criterion. This feeder currently carries the Cape Breton Regional Hospital load. The main three phase line for 111S-311 consists of 336 ASC conductor and some 2/0 ACSR. To supply the full 6.9 MVA of hospital load, the sections of 2/0 AASC must be replaced with 336 ASC conductor.

6.2.2 Feeder 111S-312

Feeder 111S-312 experiences a typical winter peak loading of 105 A (2.3 MVA), which is well below the 325 A overload criterion. The circuit has capacity to offload other circuits and shares tie-points with 111S-311 and 4S-321. The main three phase line for 111S-312 consists of 336 ASC conductor which is capable of supplying the full hospital load.

6.2.3 Feeder 4S-321

Feeder 4S-321 experiences a typical winter peak loading of 200 A (4.3 MVA), which is well below the 325 A overload criterion. The circuit has capacity to offload other circuits and shares tie-points with 4S-332, 111S-311 and 111S-312. The main three phase line for 4S-321 utilizes 4/0 ACSR conductor and shares double circuit poles with 4S-332 along George Street. In order to utilize circuit 4S-321 as the secondary hospital supply, the 4/0 ACSR would need to be replaced with 336 ASC to ensure there was sufficient capacity to supply the full hospital load plus the existing residential load.

6.2.4 Feeder 4S-332

Feeder 4S-332 experiences a typical winter peak loading of 100 A (2.2 MVA), which is well below the 325 A overload criterion. The circuit has capacity to offload other circuits and shares tie-points with 111S-311, 4S-323, and 4S-321. The main three phase line for 4S-332 consists of 336 ASC conductor and shares double circuit poles with 4S-321 along George Street. In order to utilize 4S-332 as a secondary supply to the hospital, the vertical separation between 4S-332 (top circuit) and 4S-321 (bottom circuit) must be increased from 4 feet to 8 feet, requiring the replacement of all existing double circuit poles between Townsend Street and Melody lane along George Street.

6.3 Circuit Voltage

The Cymdist models of the distribution feeder circuits at 111S-Prime Brook, 4S-Townsend Street, and 6S-Terrace Street were modified to include the circuit switching and/or modifications needed to supply three-phase power to the hospital. The subsequent load flow analysis provided the following voltage profiles at the site with 50% of the hospital load present, and then with 100% of hospital load present on each feeder, for each of the alternatives studied. Under normal conditions, the primary and secondary supplies would each carry approximately half the total hospital load.

In each scenario, circuit voltages remained within CSA voltage limits during periods of normal CBRH supply (50% CBRH/circuit) and of contingency CBRH supply (100% of CBRH load on surviving circuit) as shown in Figures 14 through 25.

6.3.1 Voltage profiles after Alternative 1 modifications:

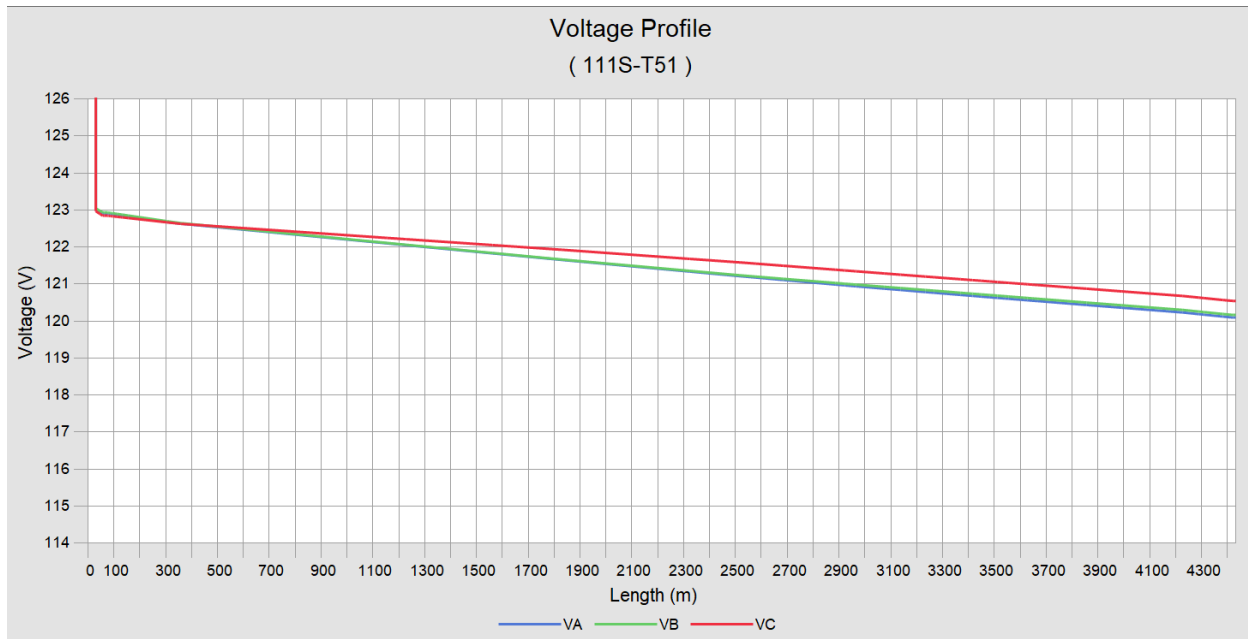


Figure 14: Alt. 1: Feeder circuit 111S-311; 50% CBRH peak load

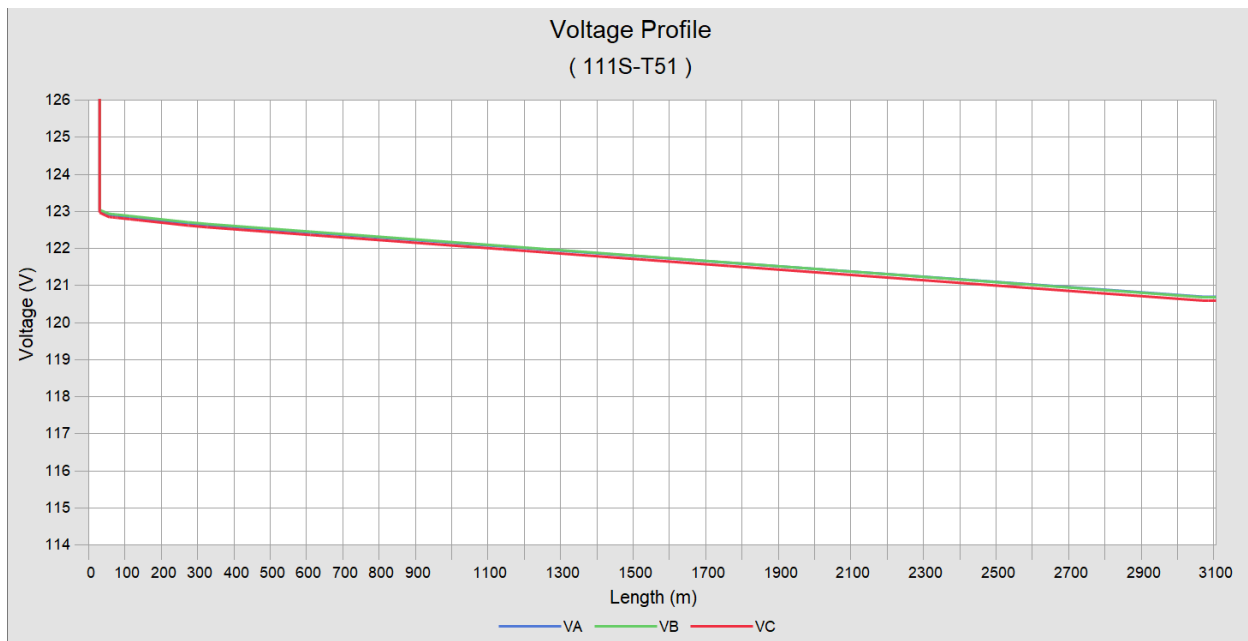


Figure 15: Alt. 1: Feeder circuit 111S-312; 50% CBRH peak load

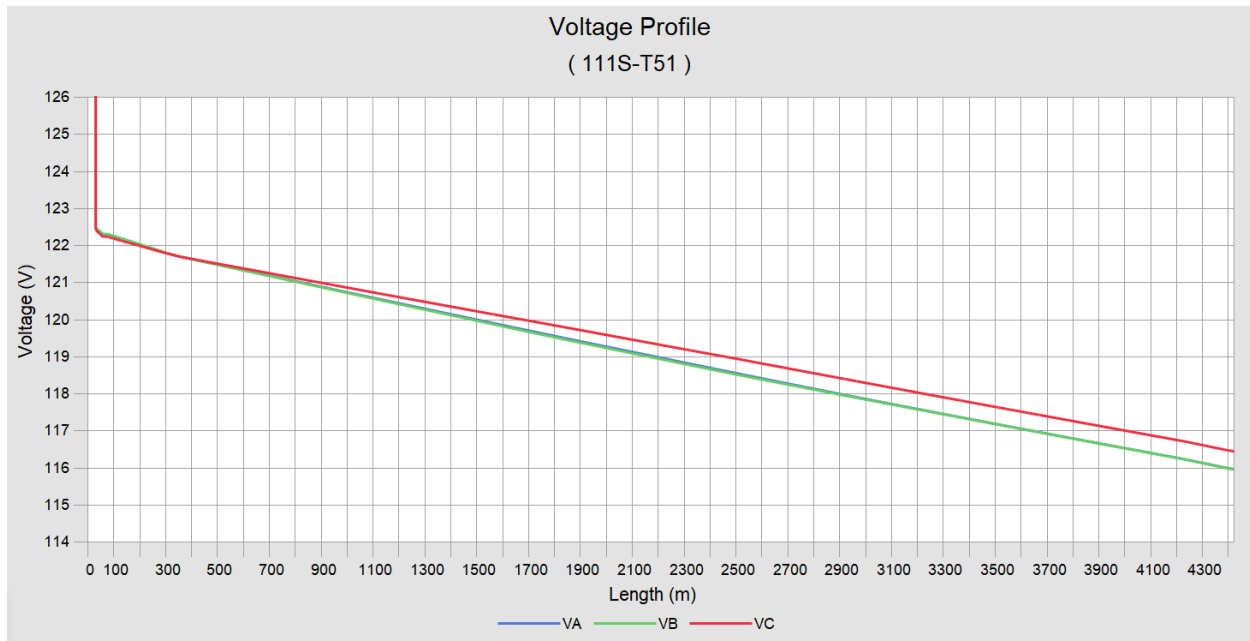


Figure 16: Alt. 1: Feeder circuit 111S-311; 100% CBRH peak load

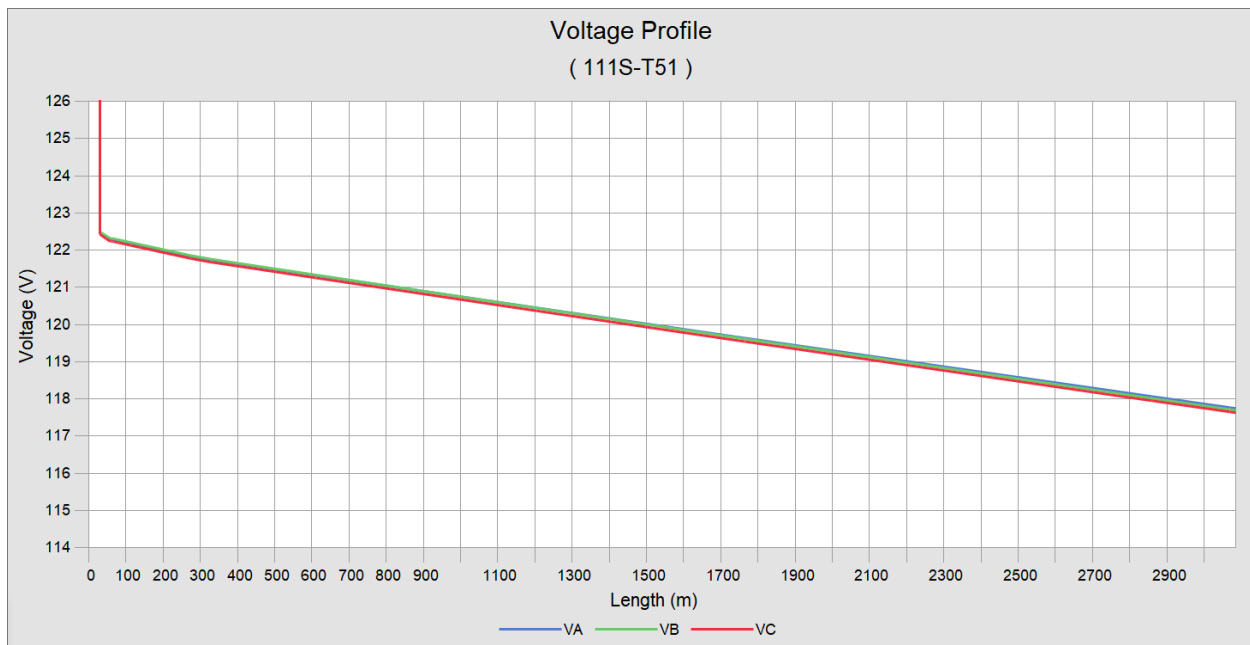


Figure 17: Alt. 1: Feeder circuit 111S-312; 100% CBRH peak load

6.3.2 Voltage profiles after Alternative 2 modifications:

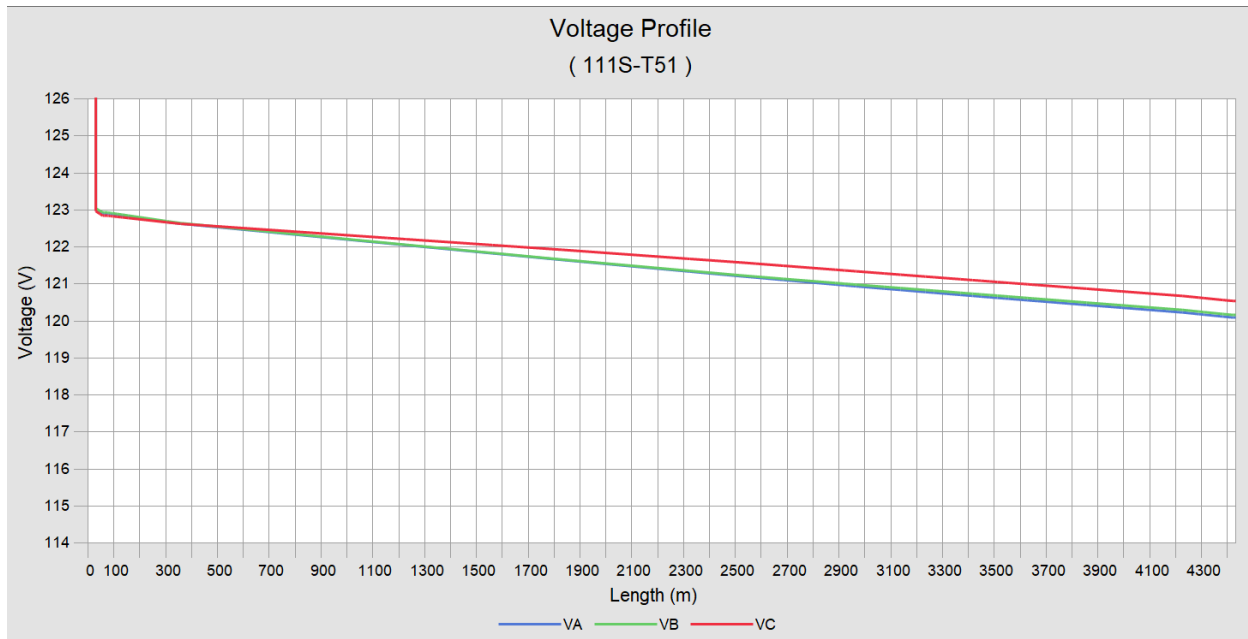


Figure 18: Alt. 2: Feeder circuit 111S-311; 50% CBRH peak load

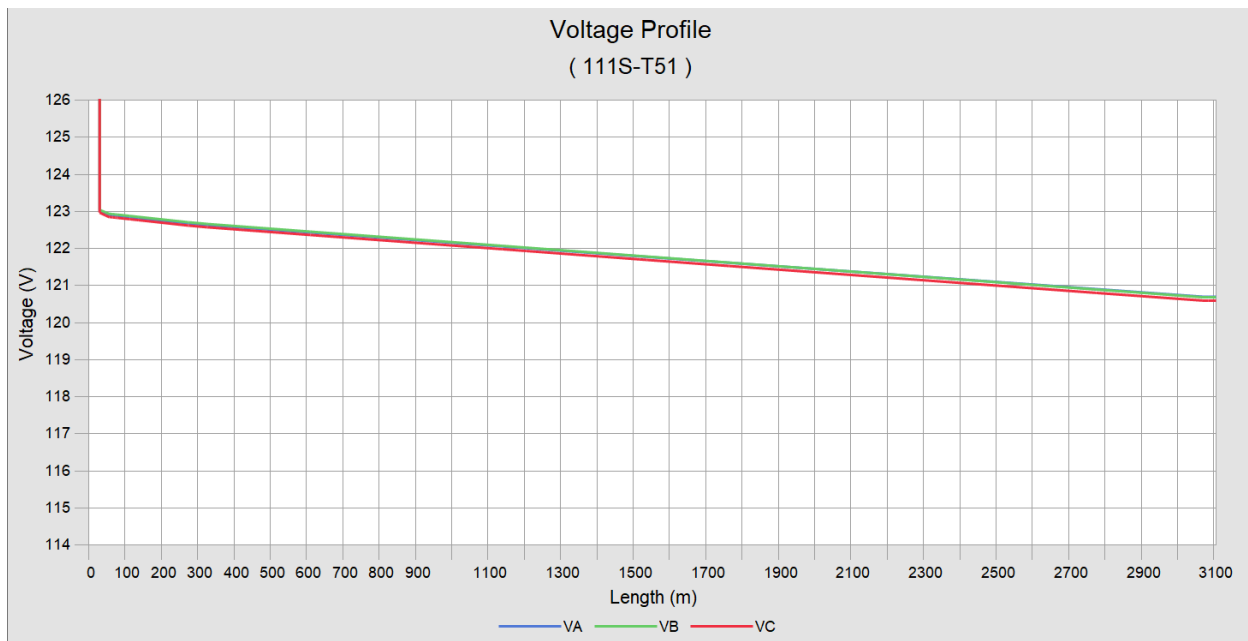


Figure 19: Alt. 2: Feeder circuit 4S-332; 50% CBRH peak load

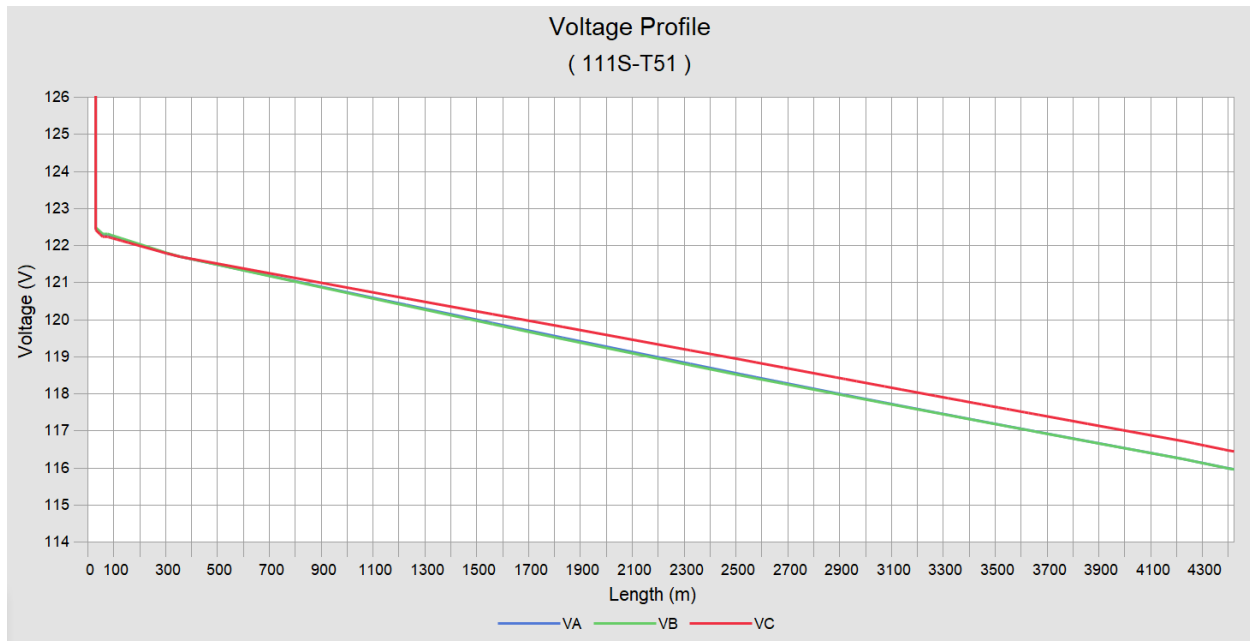


Figure 20: Alt. 2: Feeder circuit 111S-311; 100% CBRH peak load

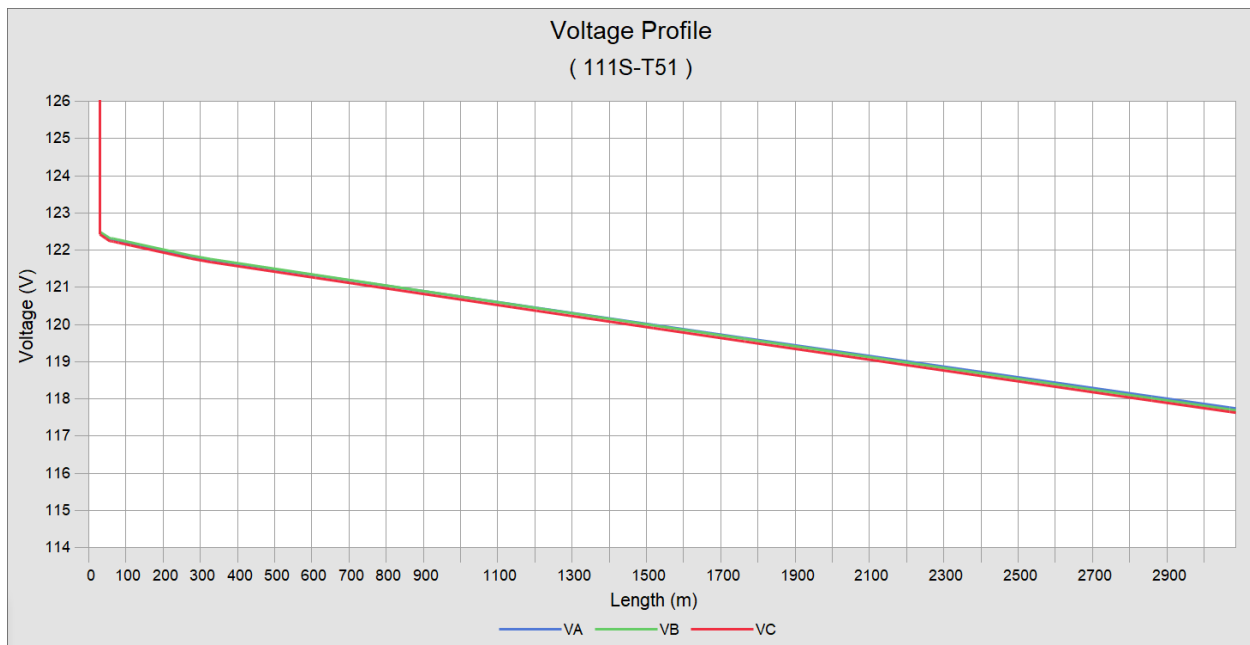


Figure 21: Alt. 2: Feeder circuit 4S-332; 100% CBRH peak load

6.3.3 Voltage profiles after Alternative 3 modifications:

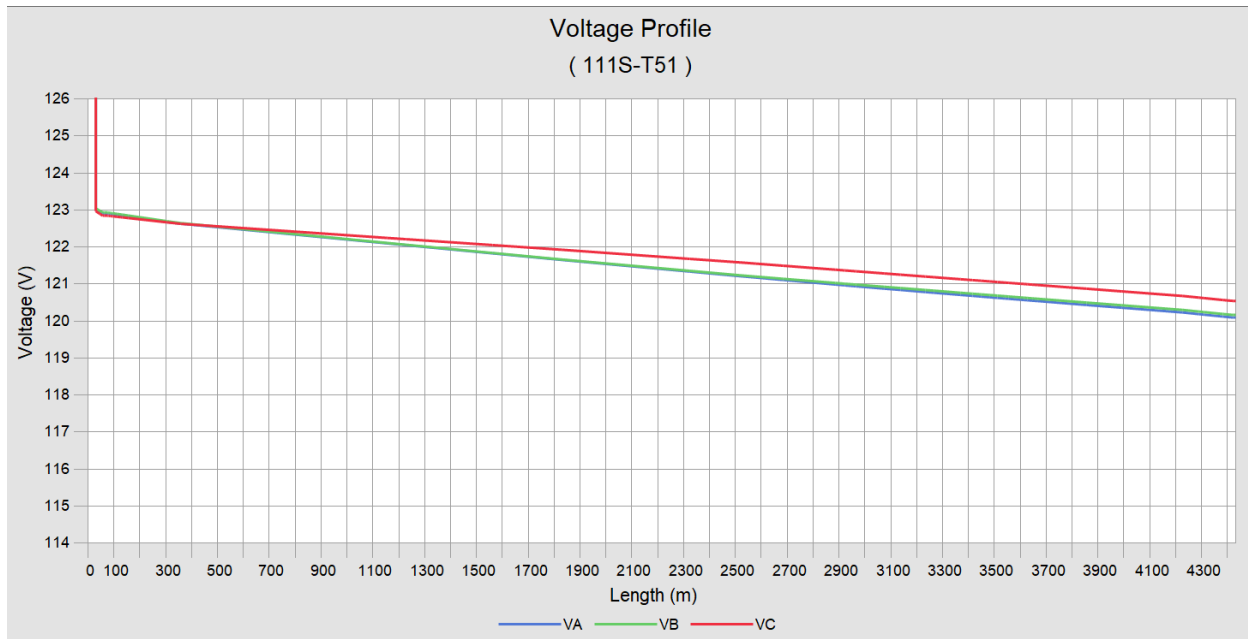


Figure 22: Alt. 3: Feeder circuit 111S-311; 50% CBRH peak load

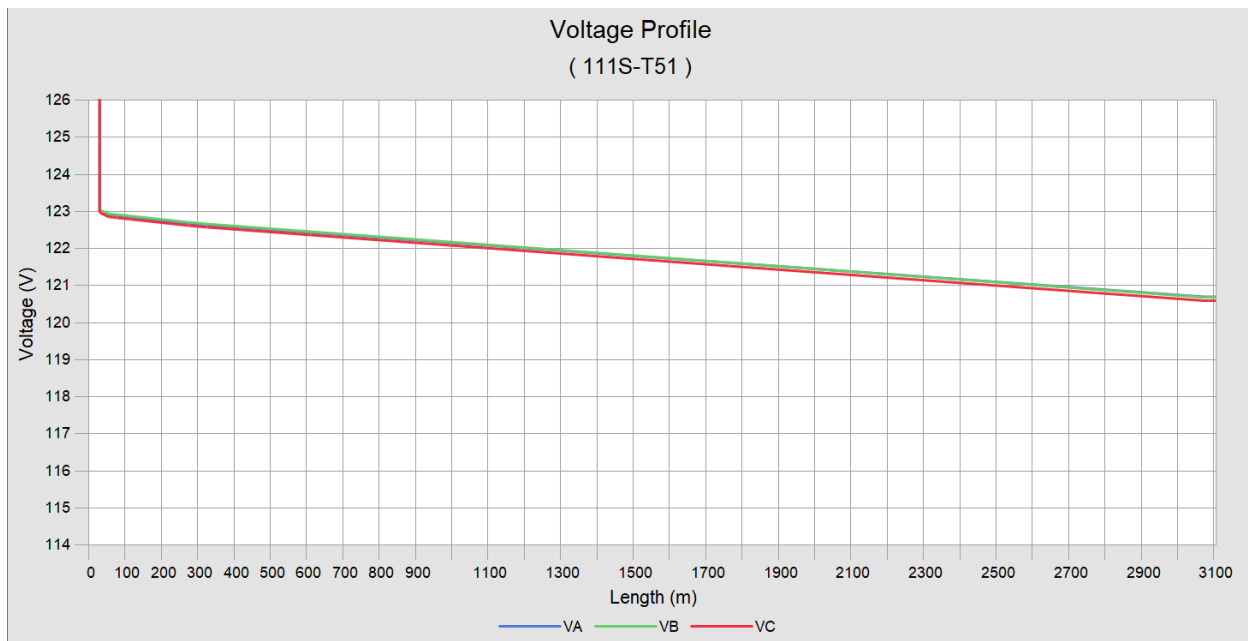


Figure 23: Alt. 3: Feeder circuit 6S-311; 50% CBRH peak load

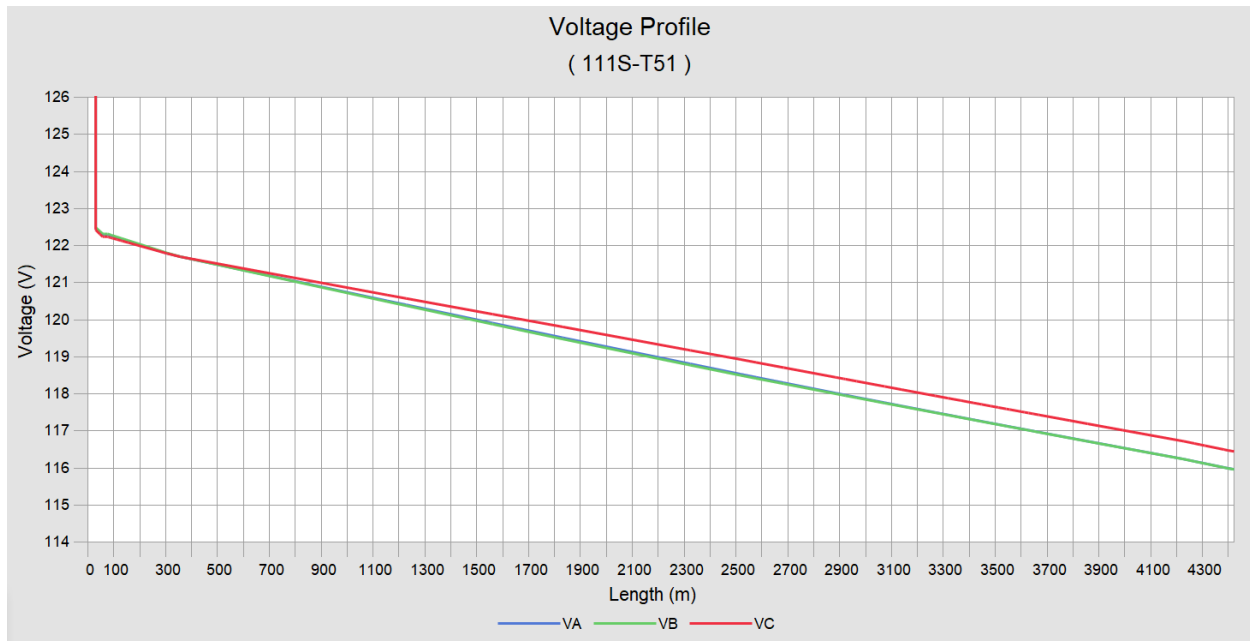


Figure 24: Alt. 3: Feeder circuit 111S-311; 100% CBRH peak load

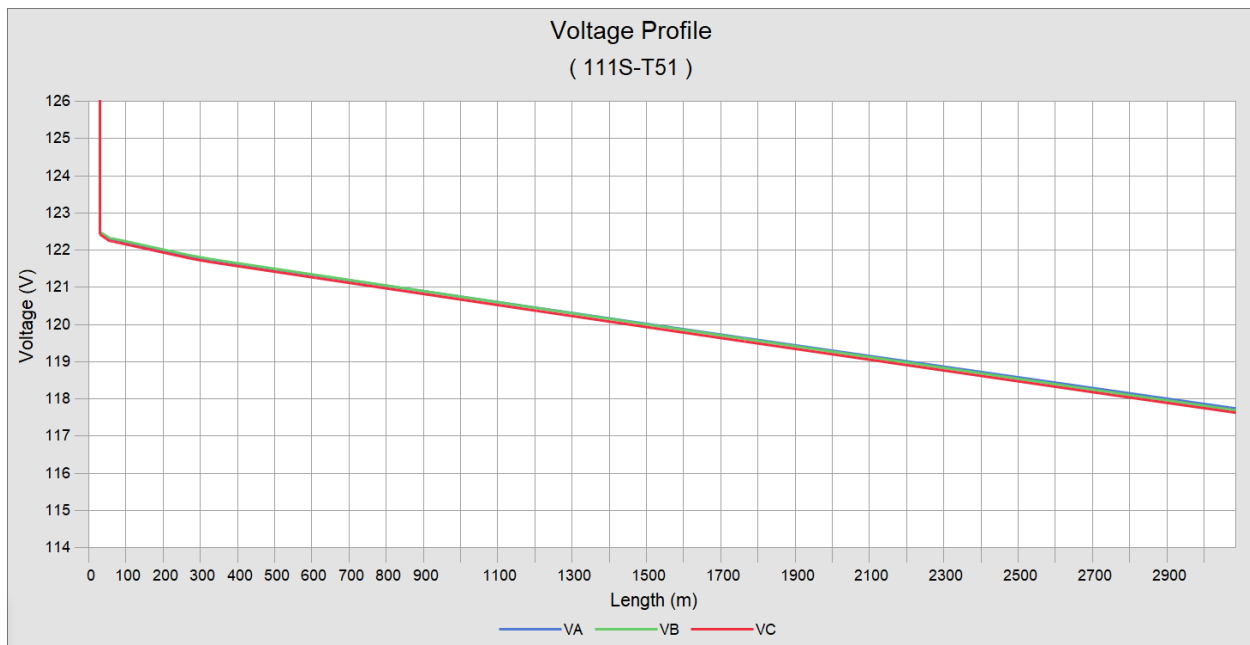


Figure 25: Alt. 3: Feeder circuit 6S-311; 100% CBRH peak load

6.4 Feeder Voltage Imbalance

The voltage imbalance at the Cape Breton Regional Hospital site is shown for the main and secondary supplies after the circuit modifications at peak load conditions in the tables below. This value will vary with the load on the circuit depending on time of day and season. Voltage imbalance is defined as the maximum deviation from the average phase-phase voltage divided by the average phase-phase voltage, and is typically < 3%.

Table 9: Alternative 1: Voltage Imbalance during Winter Peak Loading; 50% CBRH Load/Circuit

Supply Feeder	Voltage Imbalance at Cape Breton Regional Hospital			
	Phase Voltage	Voltage	Average	Imbalance
111S-311	Va	120.1	120.27	0.14%
	Vb	120.16		0.09%
	Vc	120.54		0.23%
111S-312	Va	120.7	120.66	0.03%
	Vb	120.69		0.02%
	Vc	120.6		0.05%

Table 10: Alternative 2: Voltage Imbalance during Winter Peak Loading; 50% CBRH Load/Circuit

Supply Feeder	Voltage Imbalance at Cape Breton Regional Hospital			
	Phase Voltage	Voltage	Average	Imbalance
111S-311	Va	120.43	120.50	0.06%
	Vb	120.44		0.05%
	Vc	120.63		0.11%
4S-332	Va	120.34	119.86	0.40%
	Vb	119.62		0.20%
	Vc	119.63		0.19%

Table 11: Alternative 3: Voltage Imbalance during Winter Peak Loading; 50% CBRH Load/Circuit

Supply Feeder	Voltage Imbalance at Cape Breton Regional Hospital			
	Phase Voltage	Voltage	Average	Imbalance
111S-311	Va	120.67	120.7	0.06%
	Vb	120.68		0.05%
	Vc	120.87		0.11%
6S-311	Va	122.07	122.1	0.05%
	Vb	122.21		0.07%
	Vc	122.11		0.02%

6.5 System Short Circuit Levels

The NSPI design criteria for maximum system fault capacity (three phase, symmetrical) is 195 MVA for the 12.5 kV distribution system (9000 A), and new equipment added to the 12.5 kV system must be designed to withstand fault levels of this magnitude.

Actual fault levels vary from substation to substation and decrease with distance from the substation. Tables 12-15 show the maximum expected 12.5 kV fault levels at the Cape Breton Regional Hospital site for both the main and secondary sources for each alternative.

Table 12: Alternative 1: Short Circuit Data

Supply Feeder	Maximum Short Circuit Level at Hospital Site			
	Fault	Amps	MVA	X/R Ratio
111S-311	LLL	3429	74	3.53
	LG	2078	45	2.36
111S-312	LLL	4644	100	3.72
	LG	2925	63	2.41

Table 13: Alternative 2: Short Circuit Data

Supply Feeder	Maximum Short Circuit Level at Hospital Site			
	Fault	Amps	MVA	X/R Ratio
111S-311	LLL	4478	97	2.38
	LG	2782	60	3.48
4S-332	LLL	2812	61	3.13
	LG	1894	41	3.79

Table 14: Alternative 3: Short Circuit Data

Supply Feeder	Maximum Short Circuit Level at Hospital Site			
	Fault	Amps	MVA	X/R Ratio
111S-311	LLL	4549	98	3.54
	LG	2818	61	2.40
6S-311	LLL	2452	53	4.07
	LG	1848	40	3.96

6.6 Power Factor

Should the customer utilize a Rate with a demand charge based on kW of Maximum Demand, the power factor of their load facility must be at least 90% per Regulation 4.7. NSPI's Rates and Regulations can be found on the www.nspower.ca website for reference. There is no requirement to improve Power Factor when utilizing a Rate based on kVA of Maximum Demand.

6.7 System Reliability

NSPI tracks the reliability of each distribution feeder in NS, including the number of Customer Interruptions (CI) and Customer Hours of Interruption (CHI). These are utilized to determine the CKAIFI and CKAIDI parameters, where CKAIFI is the Circuit Average Interruption Frequency Index, and CKAIDI refers to Circuit Average Interruption Duration Index.

The table below provides the previous five years of reliability data for circuits: 111S-311, 111S-312, 4S-321, and 4S-332. Note that the 111S circuits were commissioned in 2019 and so no data exists for those circuit prior to 2020.

Table 15: Feeder reliability data (five year historical)

Feeder	Year	All Events		Excluding Major and Extreme Event Days	
		CKAIDI	CKAIFI	CKAIDI	CKAIFI
111S-311	2020	0.05	0.05	0.05	0.05
	2021	0.04	0.02	0.04	0.02
111S-312	2020	0.08	0.07	0.08	0.07
	2021	0.05	0.02	0.05	0.02
4S-321	2016	38.08	5.36	1.17	1.30
	2017	1.43	0.14	0.10	0.30
	2018	0.35	2.74	0.29	0.28
	2019	16.87	2.13	2.29	1.10
	2020	1.27	0.53	1.27	0.53
	2021	1.30	0.59	1.30	0.59
4S-332	2016	17.85	1.41	0.21	0.41
	2017	0.97	0.93	0.97	0.93
	2018	0.35	0.19	0.31	0.19
	2019	0.23	0.04	0.15	0.04
	2020	1.38	2.00	1.38	2.00
	2021	2.27	0.43	2.27	0.43

CKAIFI provides the average interruption frequency per customer per year and CKAIDI provides the average cumulative hours of interruption per customer per year. For instance, in 2020, customers on 4S-332 were interrupted an average of 2.00 times for a cumulative duration of 1.38 hours (including days deemed as “major” and extreme” event days).

- CKAIFI = Sum of (Outage) Customer Interruptions / Total number of customers
- CKAIDI = Sum of (Outage) Customer Hours of Interruptions / Total number of customers
- Event Day = Significant, Major, and Extreme Event Days as defined by IEEE 2.5β methodology which considers cumulative outage hours in a defined period

7.0 COST & RIGHT OF WAY RESPONSIBILITY

In accordance with NSPI Regulation 2.6, a load customer is responsible for providing the following:

- a. A capital contribution for all line extension work in excess of 92m
 - i. If a line previously existed at the site and was removed < 5 years previously, a similar line extension would be provided at reduced cost to the customer
 - ii. Refunds are available each time a new customer is connected to the line extension within 10 years of the capital contribution (maximum refund of 90%) per Regulation 2.12.
- b. When building on the Customer's property, provision of a registered easement in NSPI's name
- c. When building on private property:
 - i. Provision of a suitable Right of Way registered in NSPI's name
 - ii. Suitable clearing of the ROW

Section 5.1 of the NSPI's Utility Service Requirements (May 2017) further clarifies the ROW requirements for line extensions as follows:

- a. The customer has overall responsibility for obtaining any easements or licenses.
- b. Where a service route as approved by the Supply Authority crosses private property the Customer shall be responsible for supplying and clearing the route.
- c. The Customer is responsible for any costs incurred by NSPI in acquiring easements or licenses where regulations do not allow the customer to obtain them on behalf of NSPI.

The Utility Service Requirements can be accessed on www.nspower.ca under Electrical Inspections.

3-phase Line extensions begin at the nearest suitable source of three phase supply. As such:

- a. Adding two phases to an existing 1-phase line: 2/3 of the associated costs are the customers responsibility and 1/3 are the responsibility of NSPI (network upgrades).
- b. Adding one phase to an existing 2-phase line: 1/3 of all associated costs are the customers responsibility and 2/3 are the responsibility of NSPI (network upgrades).
- c. 3-phase Line extension costs are the Customer's responsibility.
- d. Inclusion of existing line from other unsuitable sources that share a portion of the line extension route follow the same principle as items a and b.

The cost responsibilities identified above are associated with the design, purchase, and installation of equipment. Network Upgrades are the responsibility of NSPI, and NSPI will base the extents of Network Upgrades on the Load details provided in both the Load Impact Study Request and the Load Customer's Electrical Plan Submittal to the Inspection Department.

CBRH is required to provide a suitable, cleared Right of Way for the line extension along Weatherbee Road to their new cable termination pole.

8.0 ANALYSIS

As noted, there are three alternatives included in this report for sourcing the 12.5 kV primary and secondary circuits to supply the Cape Breton Regional Hospital. Network upgrades required to increase the capacity of the primary supply to enable it to pick up the entire CBRH load is the cost responsibility of NSPI. Costs for any subsequent upgrades required to provide a suitable secondary (back-up) supply are the responsibility of CBRH.

8.1 Cost Estimates for Modifications

The preliminary cost estimates for the circuit upgrades associated with a secondary supply to CBRH are included in the tables below. Note that the full actual cost of these modifications will be the responsibility of the Cape Breton Regional Hospital.

Alternative 1 Secondary Supply - 111S-312		
5	Double circuit Terry Way between Ferguson Rd and Weatherbee Rd	\$ 22,500
6-7	Open switch D3A22932 on Ferguson Dr and close switch D371-272 on Hillside St	\$ 1,000
8	Supply 1ph tap on 4S-321 at Oxford St and Cottage Rd intersection from phase C	\$ 250
9	Reconductor Weatherbee Rd (200m) and supply via 111S-312	\$ 30,000
10	Extend 111S-312 150m to customer duct bank	\$ 18,000
	Contingency (10%)	\$ 7,175
	Total	\$ 78,925

Table 16: Alternate 1 CBRH Upgrades Estimate

Alternative 2 Secondary Supply - 4S-332		
5	Reconductor 0.73km of 2/0 AASC on Reservoir Rd to 336 ASC to customer cable termination	\$ 109,500
6	Close switch DS322974	\$ 500
7	Replace existing poles along George St from Townsend St to Melody Ln	\$ 1,000,000
8	Offload George St 4S-332 to 4S-322 (Remove George/Townsend tap; add George/Falmouth tap	\$ 3,000
9	Offload Charlotte St 4S-332 to 4S-322 (Open Sw OH709313-3 & add taps at Charlotte/Falmouth)	\$ 2,000
	Contingency (10%)	\$ 111,500
	Total	\$ 1,226,500

Table 17: Alternative 2 CBRH Upgrades Estimate

Alternative 3 Secondary Supply - 6S-311		
4	Refurbish 6S substation & install a 69-12.5 kV, 7.5/10/12.5 MVA transformer: Includes refurbishment of structures and ground grid, environmental equipment, control equipment, station services, substation devices and transformer, underground conductors, telephone equipment, design and commissioning.	\$ 2,400,000
5	Construct new 6S feeder exit	\$ 50,000
6-7	Open switch D3A23638; Close switch D3A23639	\$ 1,000
8	Reconductor 1.3km of 2/0 ACSR on Cottage St and Edgar St to 336 ASC	\$ 195,000
9	Reconductor 0.73km 2/0 AASC along Reservoir Rd to the CBRH Service Point	\$ 109,500
10	Move 1ph tap at the Terrace St & Bristol Dr intersection from phase A to C	\$ 1,000
	Contingency (10%)	\$ 275,650
	Total	\$ 3,032,150

Table 18: Alternative 3 CBRH Upgrades Estimate

The least cost option for the CBRH is Alternative 1. However, in that option, both sources of supply originate from the 111S-prime Brook Substation, which is contrary to the stated objectives of CBRH. In addition, feeders 111S-311 and 111S-312 share common poles from the substation to the CBRH site, further impacting reliability.

Figure 26 shows an alternate route for 111S-312 that could be investigated at the customer's request. It disconnects the supply for 111S-312 on Churchill Drive and creates a new tap to the existing line that follows the L-5564 Right of Way to Route 22 to supply 111S-312 from that location. The reconfigurations required to 111S-312 for this option are as follows:

- Add a new line tap to 111S-312 1 structure from Switch D3A22925, to connect to existing 111S-312 line situated in the right of way for L-5564.
- Add a new open point on 111S-312 on Churchill Drive downstream of the new tap point.
- Open Switch D371-124 to disconnect Reservoir Rd from 111S-311
- Close Switch D3A18544 to supply Reservoir Rd from 111S-312
- Move Recloser R371-103 downstream of the Reservoir Road tap point on 111S-312 to provide sectionalizing of 111S-312 in the event of a fault downstream of the hospital tap.
- Reconductor the 700m of 2/0 ASC conductor on Reservoir Road with 336 ASC

In this scenario, 111S-311 would supply CBRH from the West side of the hospital, and 111S-312 would supply CBRH from the East side.

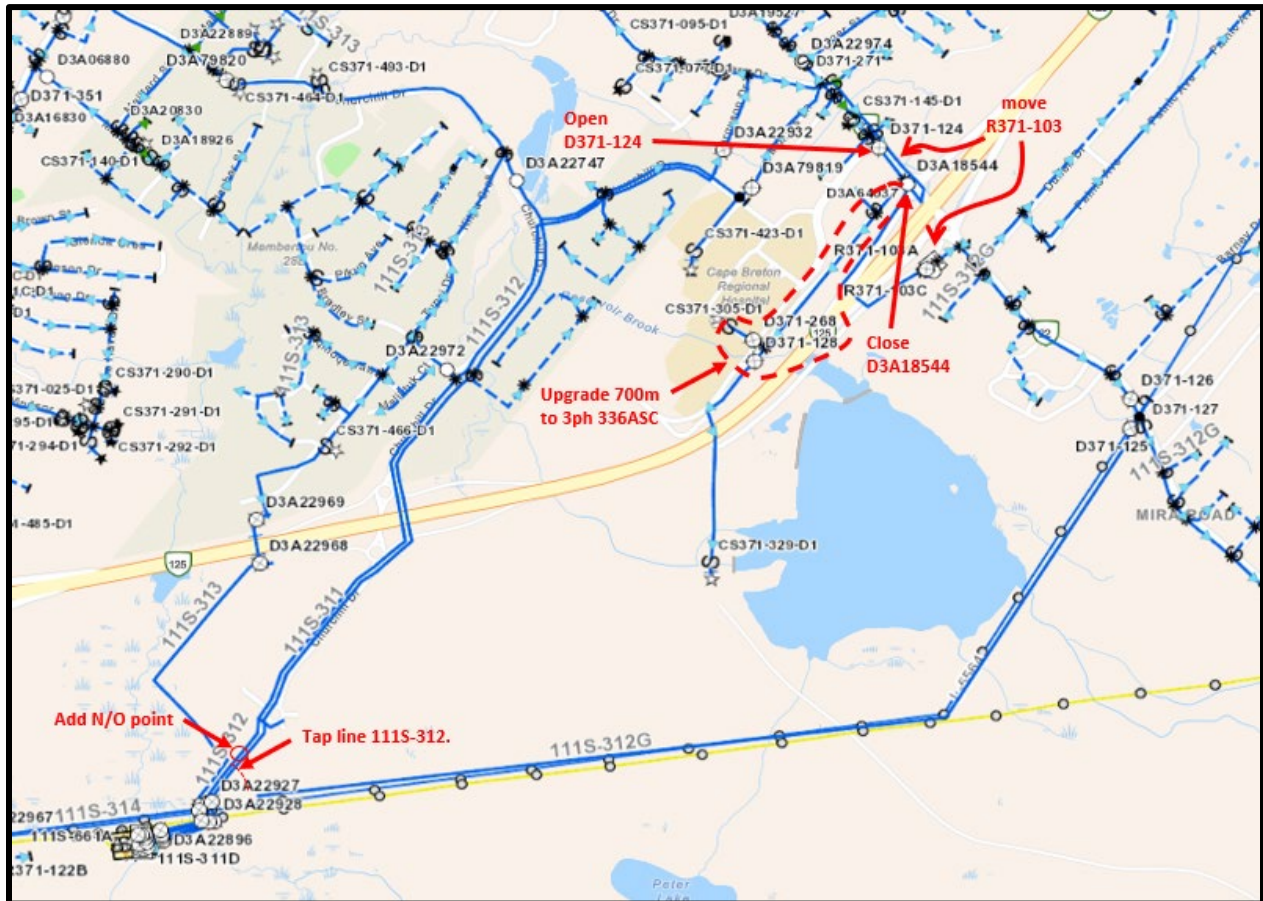


Figure 26: Alternate Route for 111S-312 in Alternative 1

However, as two separate substation sources are required, Alternative 2 is the 'least cost' solution that meets this requirement. Alternative 2 requires that the existing double circuit poles up George Street (4S-321 and 4S-322) be replaced to permit 8 foot vertical circuit separation.

The estimate provided for Alternative 3 assumes the installation of the transformer and a single circuit to supply the CBRH facility at 6S-Terrace Street. While the transformer will have capacity to supply a second circuit, there is no need for additional capacity within Sydney and therefore no grounds for cost sharing between NSPI and CBRH for the refurbishment of Substation 6S. If, at some point in the future, a second circuit was needed to supply NSPI customers, a pro-rated capital contribution refund for the shared portion the facilities would be provided to CBRH.

This report recommends Alternative 2 as the most reliable alternative for CBRH – with feeder circuit 111S-311 configured as the primary supply via Weatherbee Rd and feeder circuit 4S-332 configured as the secondary supply via 4S-Townsend Street.

9.0 CONCLUSIONS

This report presents the results of a Load Impact Study (LIS) for the 6.9MVA Cape Breton Redevelopment Project located in Sydney, Nova Scotia. After reviewing three alternatives, it is recommended that the primary and secondary supplies be interconnected to the NSPI Distribution System via circuits 111S-311 and 4S-332 respectively (Alternative 2). The following circuit modifications will be required:

Primary supply: 111S-311 reconfiguration:

1. Reconductor the .65 km section of 3ph 2/0 AASC on Terry Way to 336 ASC.
2. Reconductor the .2 km section of 3ph 2/0 AASC on Weatherbee Road to 336 ASC.
3. Extend 111S-311 to new customer cable termination pole on Weatherbee Road.
4. Add a new dead-end pole at the end of Mullers Lane and fully isolate (2 sets of in-line insulators), or remove, the span of 2/0 ACSR between it and switch D3A79819 off Terry Way. This removes the possibility of a single contingency impacting both the Primary (111S-311) and Secondary (4S-332) supplies to CBRH. These two circuits cannot dead-end on a common pole for that reason.

Secondary supply: 4S-332 reconfigurations:

5. Reconductor Reservoir Road to the CBRH cable termination from 2/0 ACSR to 336 ASC.
6. Close switch D3S22974 to Supply CBRH via 4S-332.
7. Replace the existing double circuit poles along George Street between Townsend Street and Melody Lane with poles that permit 8 feet of clearance between circuits 4S-321 (bottom) and 4S-332 (top).
8. Offload George Street north of Townsend Street from 4S-332 to 4S-322 by disconnecting the flying taps at the corner of George and Townsend Streets, and installing new flying taps at the corner of George and Falmouth Streets.
9. Offload Charlotte Street north of Townsend Street from 4S-332 to 4S-322 by opening switch OH709313-3 on Townsend Street and installing new flying taps at the corner of Charlotte and Falmouth Streets.

The estimated cost requirements for the substation refurbishment and circuit reconfiguration work are outlined in Section 8 of this report.

In addition to the work described above, a review of coordination will be required by Eastern Regional Engineering to ensure protective devices are sized and coordinated appropriately for the new feeder configurations.

This report recognizes the significant costs associated with provision of a suitable secondary supply if it is required to be provided from a separate substation. If primary and secondary supplies are acceptable from the same substation when routed in different distribution corridors, then the recommendation of this report would change to the amended Alternative 1 shown in Figure 26.

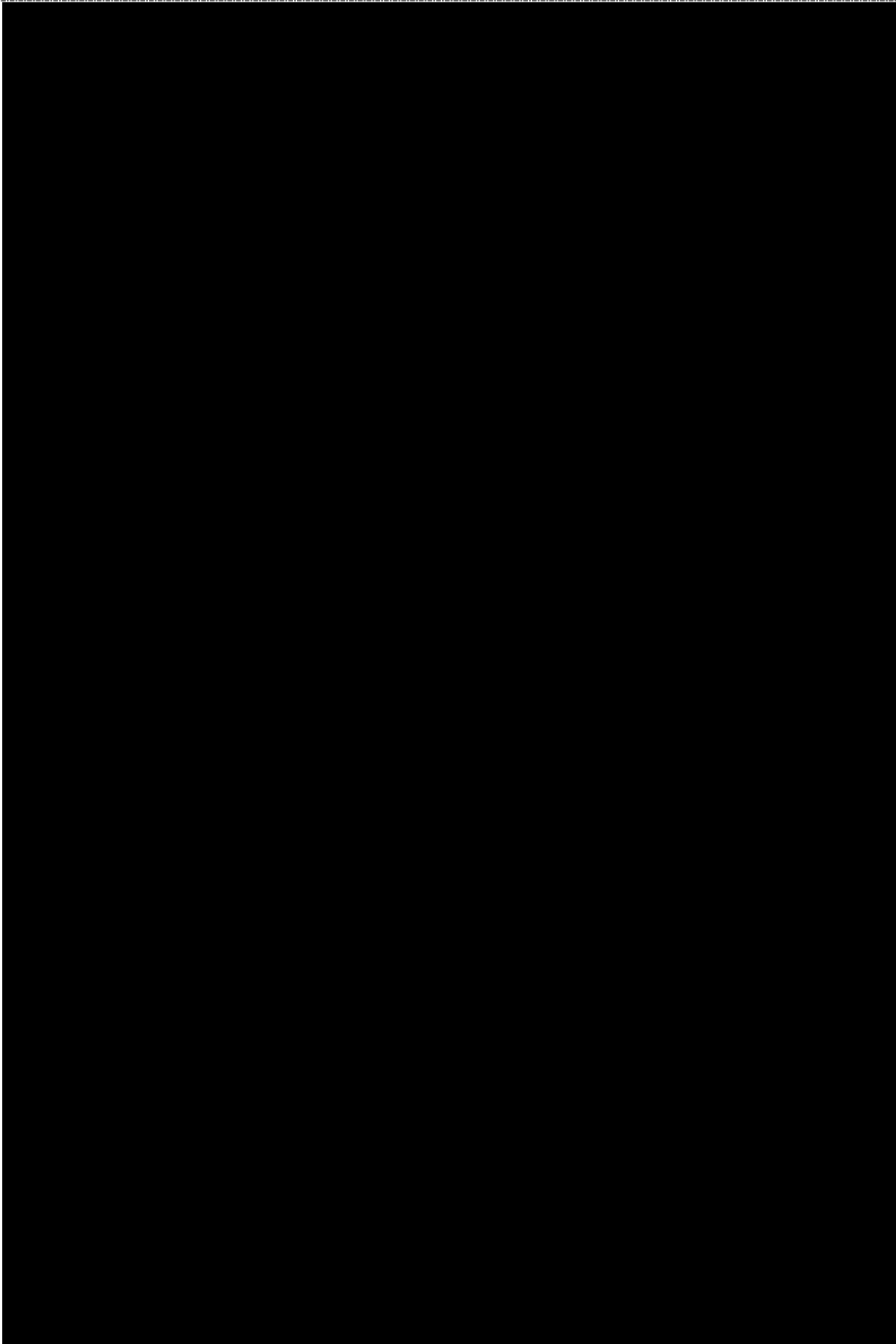
Any change in the studied load and the plans submitted to the Electrical Inspection Authority must be identified by the Customer and a Materiality Study conducted to confirm the change is not Material (i.e. a lower load than studied may reduce the network upgrades needed by NSPI – reducing NSPI costs; an increased load may not be able to be supplied with the upgrades identified in this report). If the change is Material, the Distribution Load Impact Study must be revised to account for the actual load submitted by the Customer to the Electrical Inspection Authority. This could result in a significant impact to the In-Service Date.

With the exception of work fully funded by the Customer under an Engineering and Procurement Agreement, NSPI will not start investing in network upgrades or start any of the work required to supply the load until the Customer submits their plans to the Electrical Inspection Authority. Once the Customer submits their plans, NSPI can begin the processes for procurement, licenses/permits, and construction.

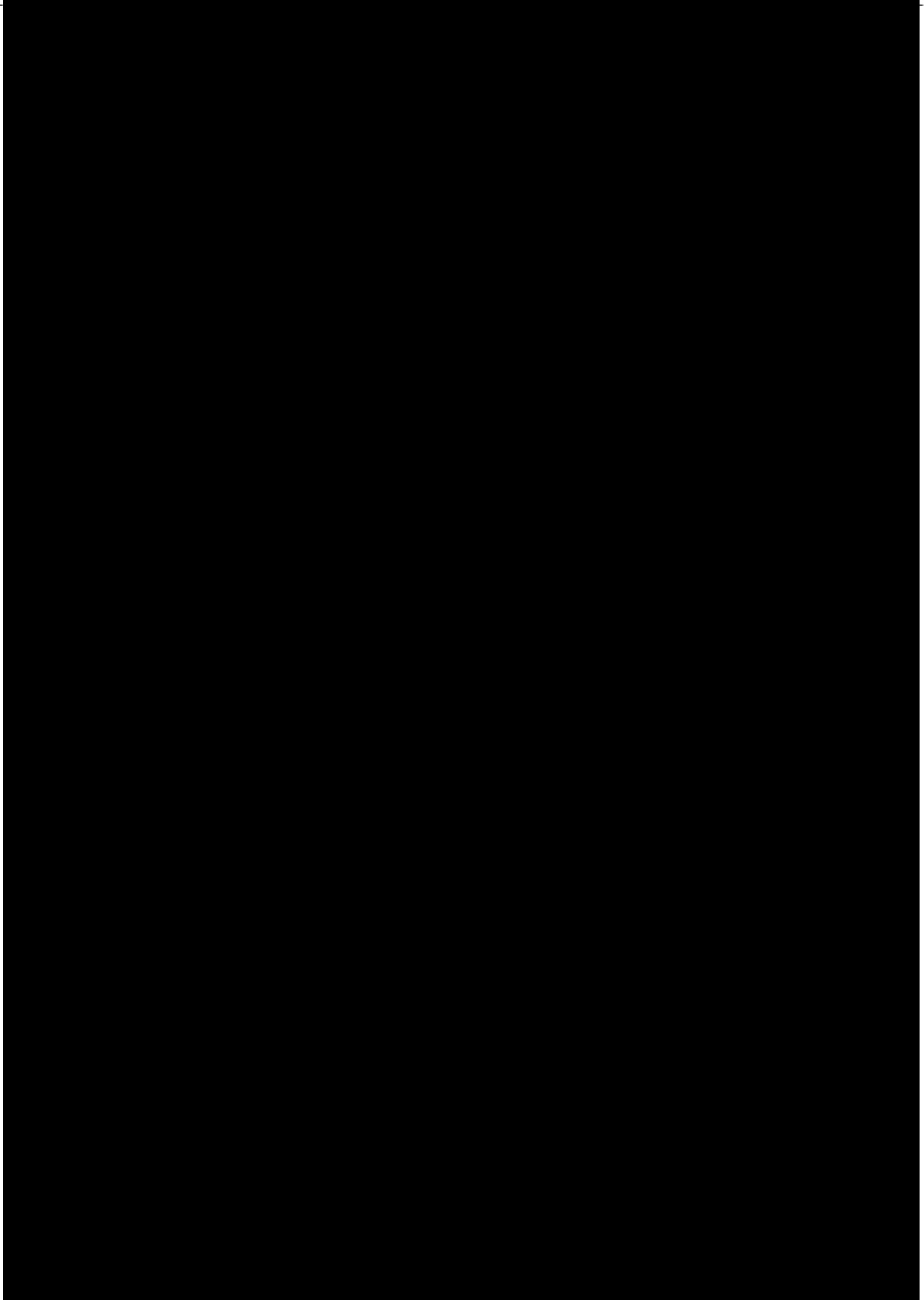
Appendix A

System Operating Diagrams

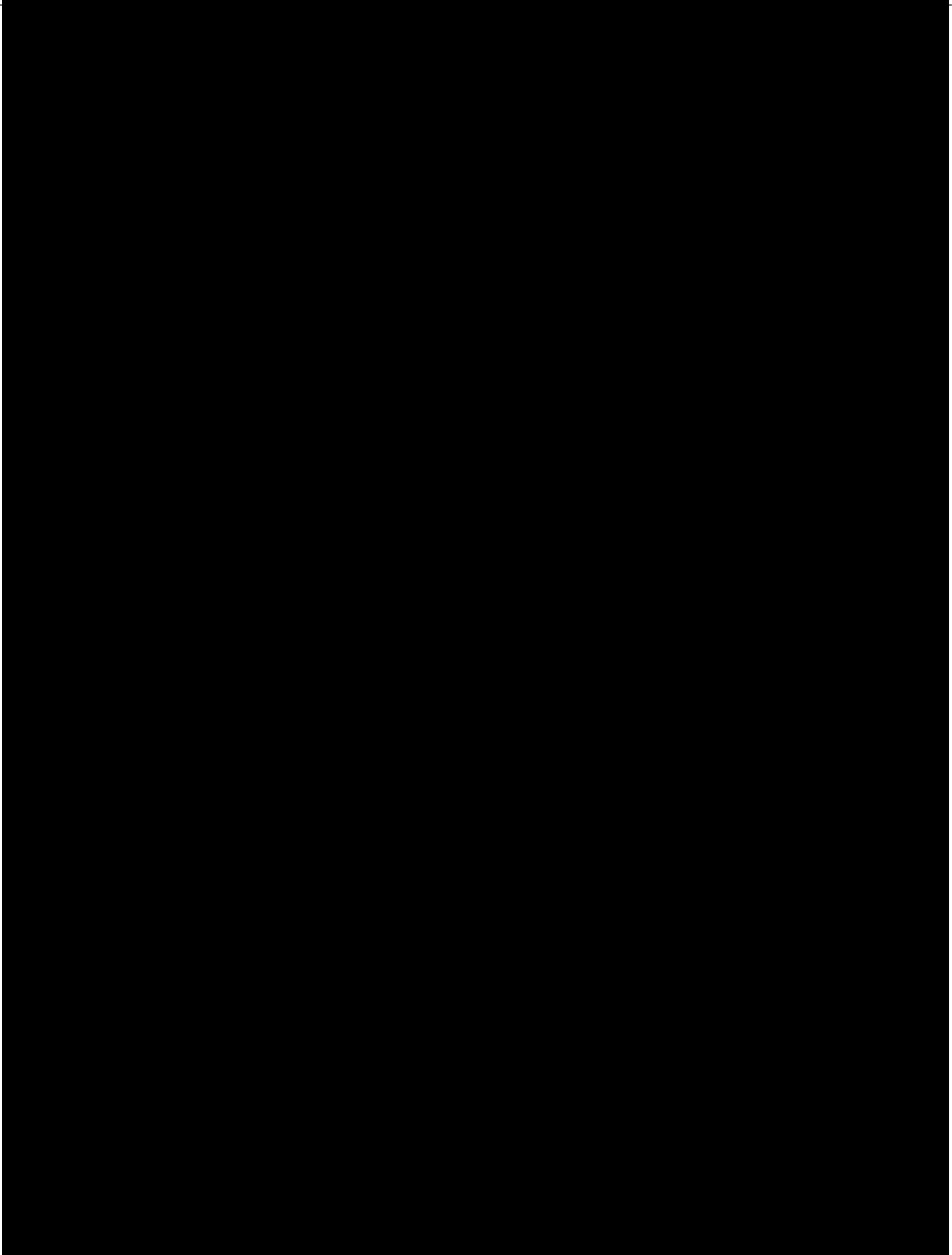
Appendix A – System Operating Diagrams



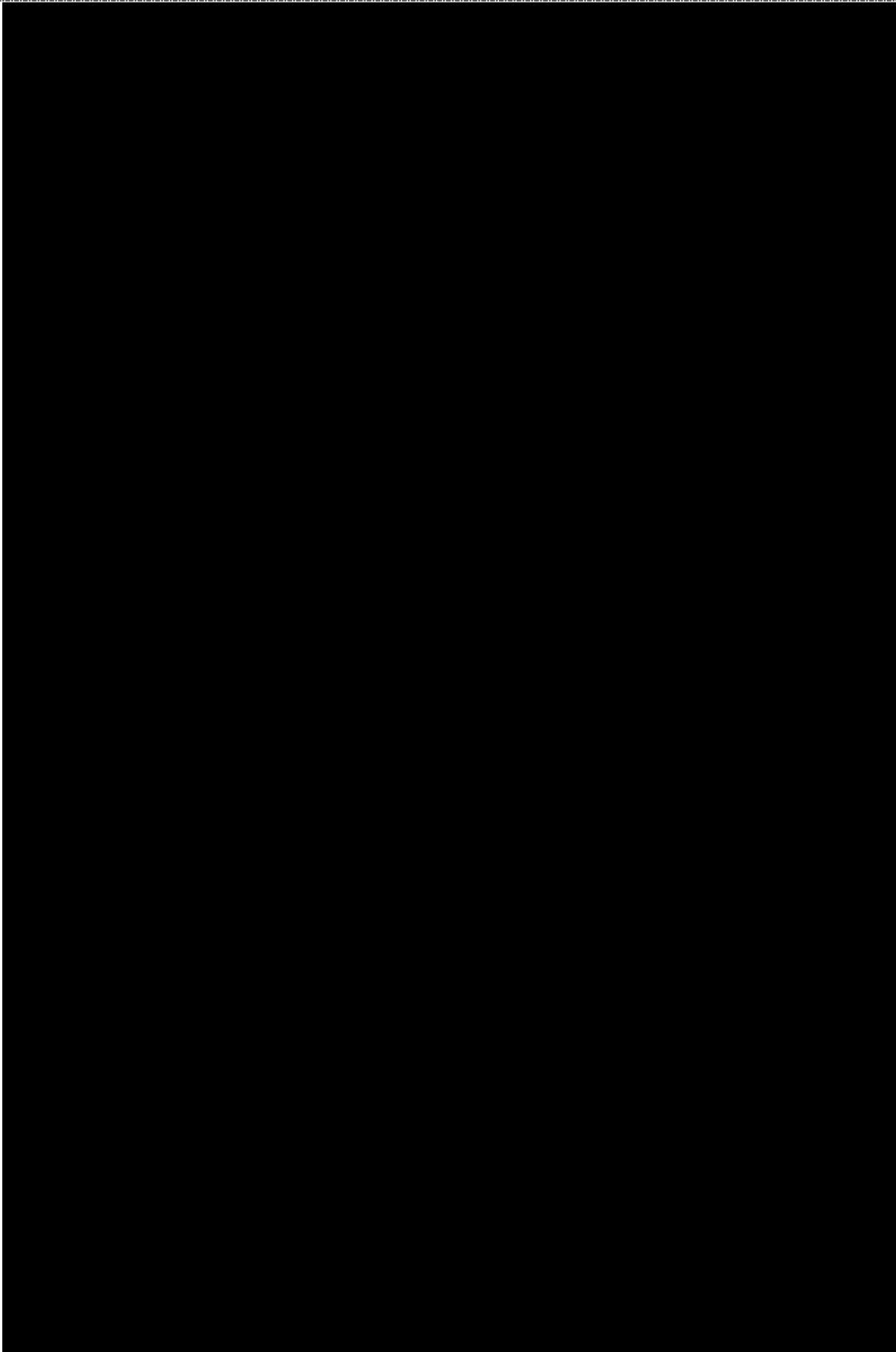
Appendix A – System Operating Diagrams



Appendix A – System Operating Diagrams



Appendix A – System Operating Diagrams



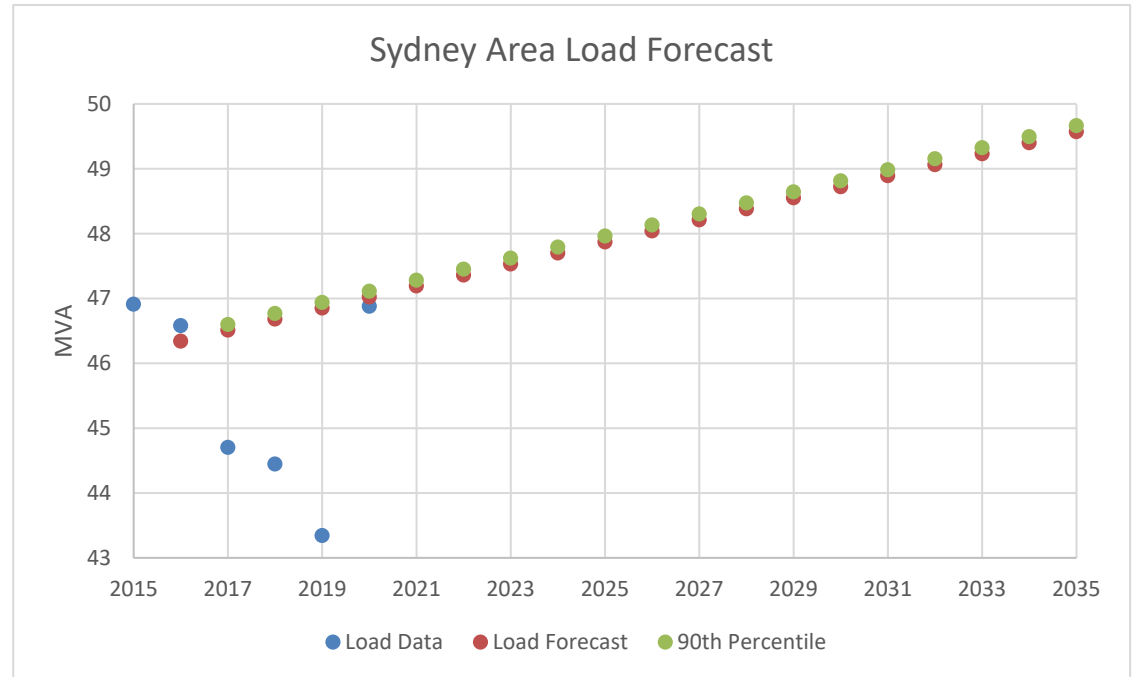
Appendix B

Load History and Forecasts

Appendix B – Load History and Forecasts

Year	Load Data	Load Forecast	Adjusted	90th Percentile
2015	46.91			
2016	46.58	46.34	0.005158	
2017	44.70	46.51	-0.03887	46.60
2018	44.44	46.68	-0.0479	46.77
2019	43.34	46.85	-0.07489	46.94
2020	46.88	47.02	-0.00304	47.11
2021		47.19		47.28
2022		47.36		47.45
2023		47.53		47.62
2024		47.7		47.79
2025		47.87		47.96
2026		48.04		48.13
2027		48.21		48.30
2028		48.38		48.47
2029		48.55		48.64
2030		48.72		48.81
2031		48.89		48.98
2032		49.06		49.15
2033		49.23		49.32
2034		49.4		49.49
2035		49.57		49.66

Load Growth 0.35%



Appendix C

Preliminary Assessment

Appendix C – Preliminary Assessment

Proposed 3.7 MW Distribution Connected Load at Sydney, NS: Preliminary Assessment						 Nova Scotia POWER An Emera Company	
Prep. By:		NSPI		7-Oct-20		Page 1 of 4	

Application Submitted By:		CBRH	
Load Customer General Location:		Sydney, NS	
Street Address & PID:		Regional Hospital Blvd Primary Supply	
Total Connected Load (MW):		3.7	Type: Commercial

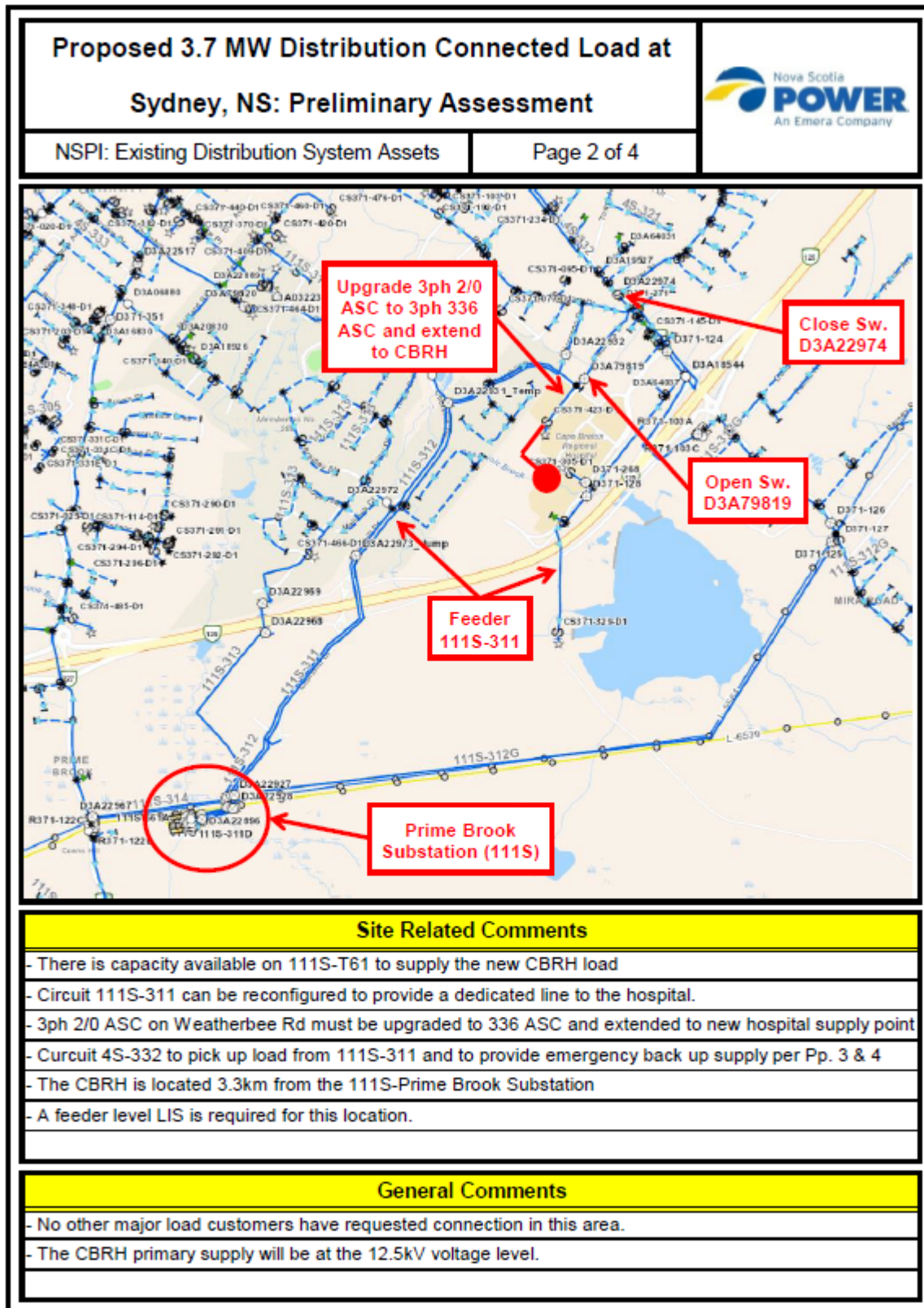
Supply Sub-station Data				Distribution System Data			
Sub-station Name	PRIME BROOK			Feeder Circuit ID	111S-311		
Sub-station ID	111S			Fixed kVAR on Cct	0		
Transformer ID	111S-T61			Upstream Regulators	0		
Transformer HV (kV)	138			Downstream Regulators	0		
Transformer LV (kV)	13.2			Upstream Xfmr kVA	0		
Transformer Rated MVA	15/20/25.0			Upstream Xfmr LV (kV)	0		

Supply Sub-station Load Data				Distribution Feeder Load Data			
Peak Xfmr MVA	9.0			Peak Feeder MVA	3.4		
Available Xfmr MVA	20.8			Available Feeder MVA	3.6		

Overhead Line Data for Sections between Sub-station & Load Customer Site													
Section	1	2	3	4	5	6	7	8	9	10	11	12	Total
Type	336 AL	2/0 AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	km
km (3Φ)	3.50	0.75	-	-	-	-	-	-	-	-	-	-	4.25
km (2Φ)	-	-	-	-	-	-	-	-	-	-	-	-	
km (1Φ)	-	-	-	-	-	-	-	-	-	-	-	-	
Extension	-	-	-	-	-	-	-	-	-	-	-	-	

Required Circuit Modifications				Order of Magnitude Cost Estimate *			
1 - 3 phase Line Upgrades (km)			0.00	\$0 - \$25000			
2 - 3 phase Line Upgrades (km)			0.00	\$25000 - \$75000			
3 phase Line Extensions (km)			0.00	\$75000 - \$150000			
Line Reconductoring (total km*ph)			0.00	X TBD			
Voltage Conversions (kVA Demand)			0	<i>* This estimate is non binding on NSPI. It does not include costs for ROW easements, clearing, flicker mitigation, power factor correction, etc... as determined by the SIS at later time.</i>			
Other Upgrades / Shared Line Costs			\$0				
Sub-station Upgrades			\$0				

Site Fault Data after Modifications				System Impact Study (SIS) Required?			
Fault	Short Cct	X/R	Phase	LIS is Not Required X LIS Required: Feeder Level LIS Required: Substation Level			
MVA	Ratio	Ratio	Angle				
54.5	14.7	2.57	68.7				



Proposed 6.9 MW Distribution Connected Load at Sydney, NS: Preliminary Assessment							
Prep. By:	NSPI	29-Sep-20	Page 3 of 4				
Application Submitted By:		CBRH					
Load Customer General Location:		Sydney, NS					
Street Address & PID:		Regional Hospital Blvd Backup Supply					
Total Connected Load (MW):		6.9	Type:	Commercial			

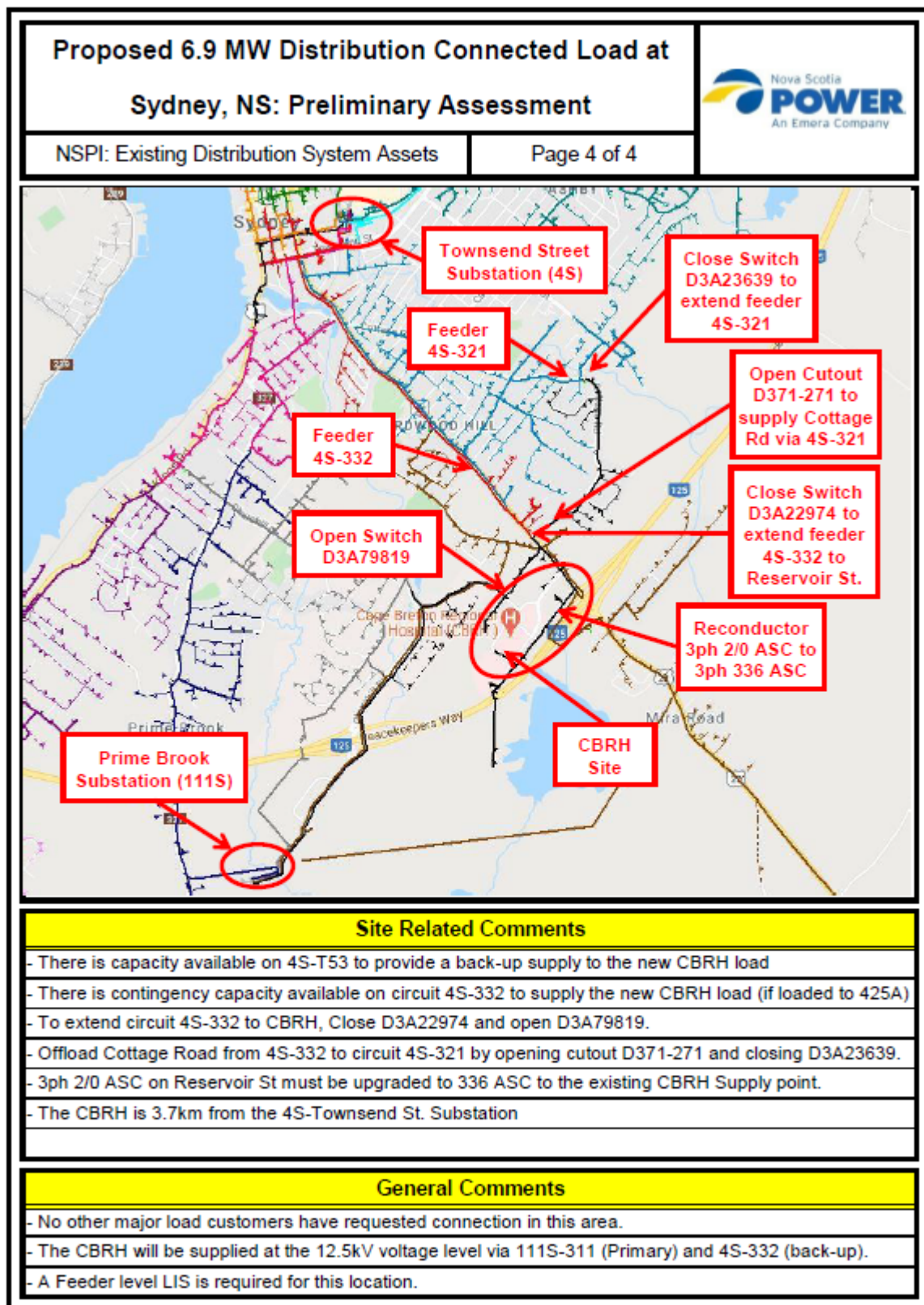
Supply Sub-station Data				Distribution System Data			
Sub-station Name	TOWNSEND STREET			Feeder Circuit ID	4S-332		
Sub-station ID	4S			Fixed kVAR on Cct	0		
Transformer ID	4S-T53			Upstream Regulators	0		
Transformer HV (kV)	69			Downstream Regulators	0		
Transformer LV (kV)	12.47			Upstream Xfmr kVA	0		
Transformer Rated MVA	15/20//22.4			Upstream Xfmr LV (kV)	0		

Supply Sub-station Load Data				Distribution Feeder Load Data			
Peak Xfmr MVA	9.0			Peak Feeder MVA	2.2		
Available Xfmr MVA	20.8			Available Feeder MVA	4.8		

Overhead Line Data for Sections between Sub-station & Load Customer Site													
Section	1	2	3	4	5	6	7	8	9	10	11	12	Total
Type	336 AL	2/0 AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	km
km (3Φ)	2.93	0.75	-	-	-	-	-	-	-	-	-	-	3.68
km (2Φ)	-	-	-	-	-	-	-	-	-	-	-	-	
km (1Φ)	-	-	-	-	-	-	-	-	-	-	-	-	
Extension	-	-	-	-	-	-	-	-	-	-	-	-	

Required Circuit Modifications		Order of Magnitude Cost Estimate *	
1 - 3 phase Line Upgrades (km)	0.00		\$0 - \$25000
2 - 3 phase Line Upgrades (km)	0.00		\$25000 - \$75000
3 phase Line Extensions (km)	0.00		\$75000 - \$150000
Line Reconductoring (total km*ph)	0.75	X	TBD
Voltage Conversions (kVA Demand)	0	<i>* This estimate is non binding on NSPI. It does not include costs for ROW easements, clearing, flicker mitigation, power factor correction, etc... as determined by the SIS at later time.</i>	
Other Upgrades / Shared Line Costs	\$0		
Sub-station Upgrades	\$0		

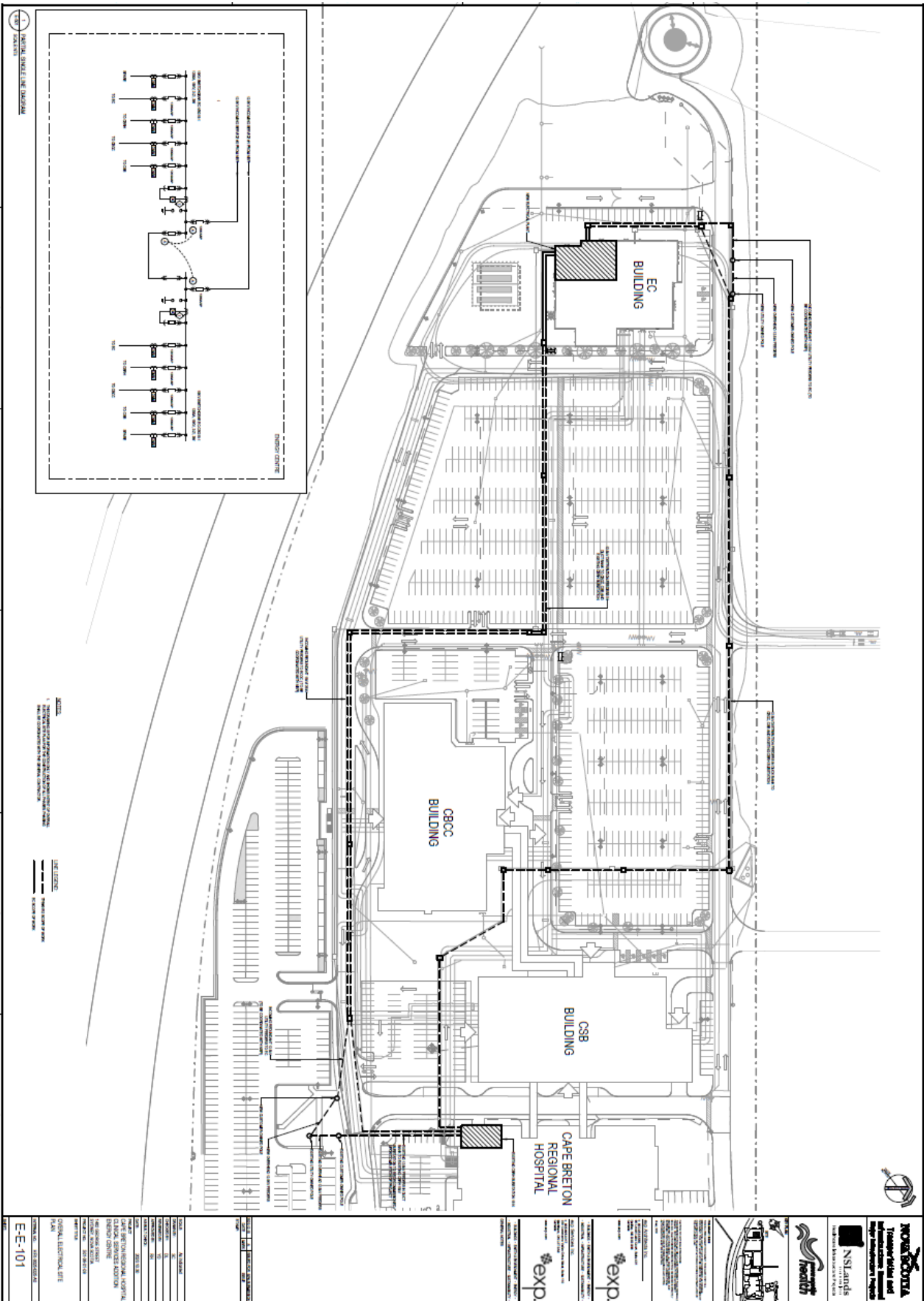
Site Fault Data after Modifications				System Impact Study (SIS) Required?	
Fault MVA	Short Cct Ratio	X/R Ratio	Phase Angle		LIS is Not Required
63.4	9.2	3.17	72.5	X	LIS Required: Feeder Level
					LIS Required: Substation Level



Appendix D

CBRH Redevelopment Project Site Plan

Appendix E – Substation Pictures



Appendix E

Substation Pictures

Appendix E – Substation Pictures

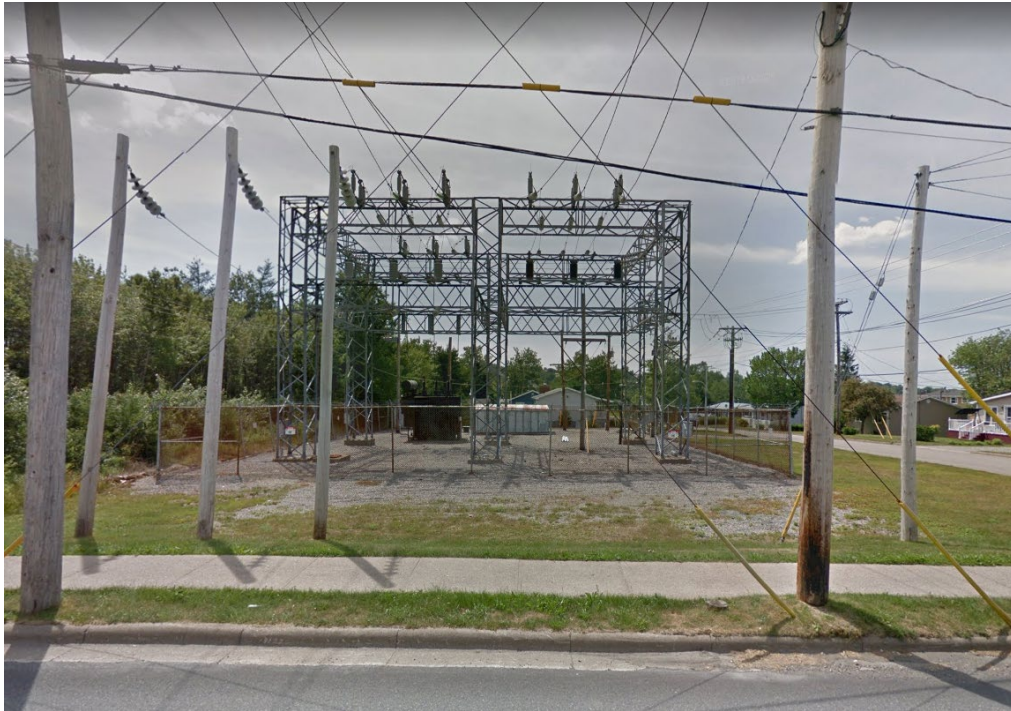


111S - Prime Brook (138kV – 12.5kV)

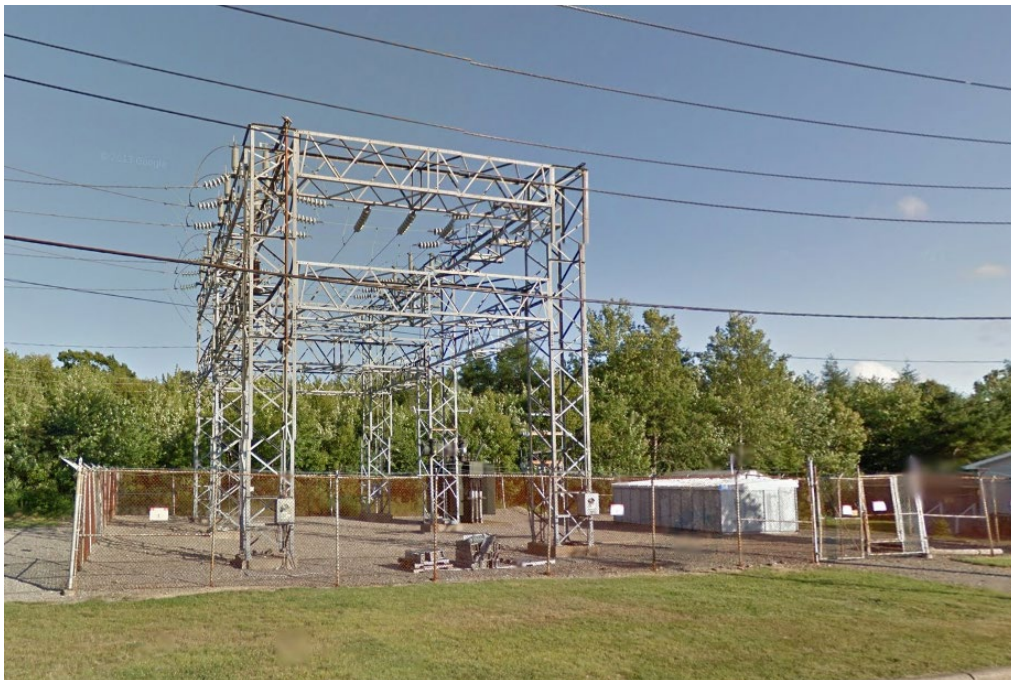


4S – Townsend Street (69kV – 12.5kV)

Appendix E – Substation Pictures



6S – Terrace Street (69kV – 4.2kV) – View 1



6S – Terrace Street (69kV – 4.2kV) – View 2