Q. Please provide a single line diagram of the converter stations and the dc switchyards at the Strait of Belle Isle to show how the dc cables can be connected and re-connected as planned should a cable failure occur.

A. Please refer to the attached single line diagrams, which were developed by Alstom Grid as part of the bid review process. These single line diagrams are not to be used as an approved for construction design but rather used for illustrative purposes.

The Muskrat Falls Converter Station ac and dc details are shown on the following single line diagrams:

- Drawing TL004-13-301-0011 titled *Muskrat Falls Converter Station ac Protection Single Line Diagram* outlines the 315 kV ac details at the Muskrat Falls Converter Station. (PUB-NLH-246 Attachment 1)
- TL004-13-301-0031 titled *Muskrat Falls 315 kV dc Converter Station Single Line Diagram* outlines the 350 kV dc details at the Muskrat Falls Converter Station. (PUB-NLH-246 Attachment 2)

The Soldiers Pond converter station ac and dc details are shown on the following single line diagrams:

- Drawing TL004-13-301-0014 titled *Soldiers Pond Converter Station ac Protection Single Line Diagram* outlines the 230 kV ac details at the Soldiers Pond Converter Station. (PUB-NLH-246 Attachment 3)

- TL004-13-301-0034 titled *Soldiers Pond 315 kV dc Converter Station Single Line Diagram* outlines the 315 kV dc details at the Soldiers Pond Converter Station.[1] (PUB-NLH-246 Attachment 4)

The dc cable transition compound details including the high-speed switching arrangement for Shoal Cove and Forteau Point (Strait of Belle Isle) are shown on the following single line diagram:

- Drawing TL004-13-301-0012 titled *Forteau Point/Shoal Cove Converter Station Single Line Diagram* (PUB-NLH-246 Attachment 5)

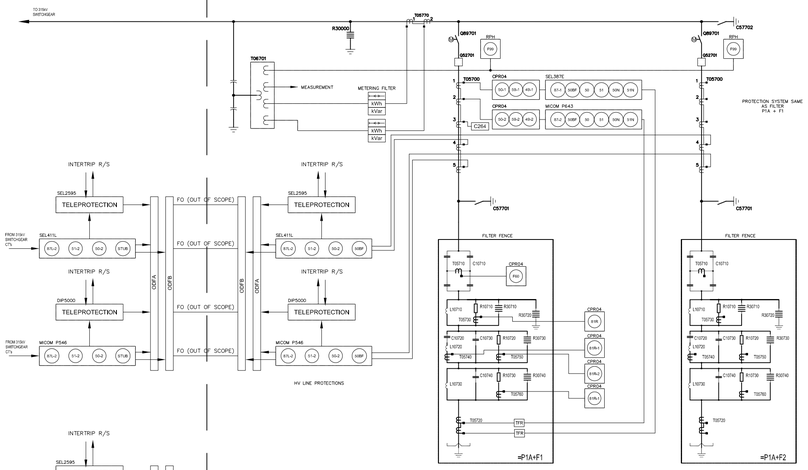
For illustrations of the cable switching sequence, please see Hydro's response to PUB-NLH-235.

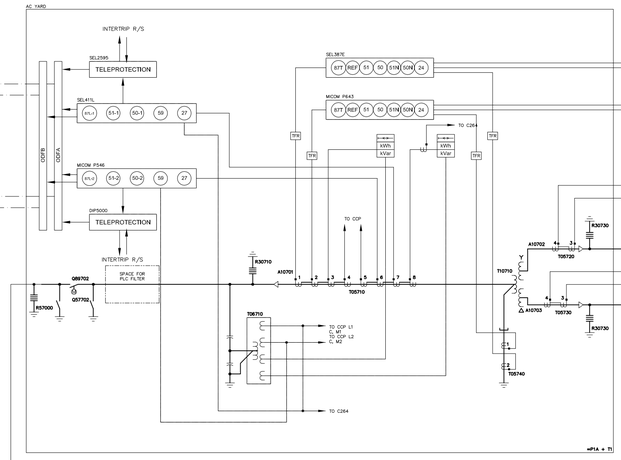
[1] The Soldiers Pond single line diagram is incorrectly labeled as 315 kV. The ac bus voltage at Soldiers Pond is 230 kV.

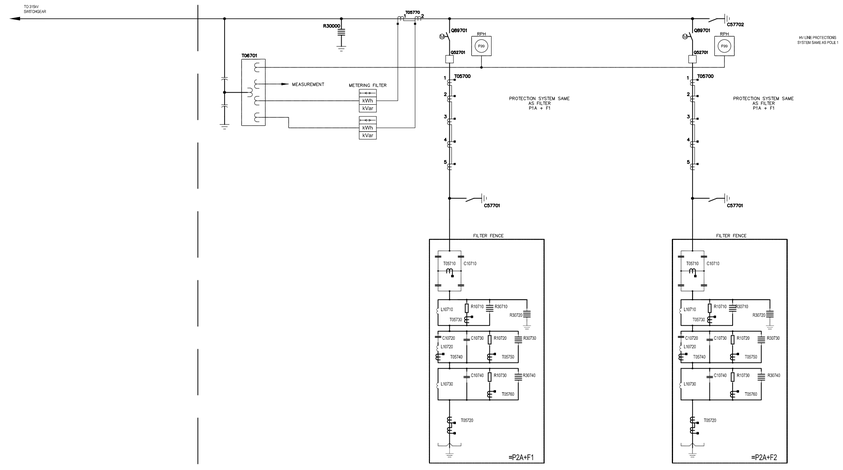
315kV
AC SUBSTATION
MUSKRAT FALLS

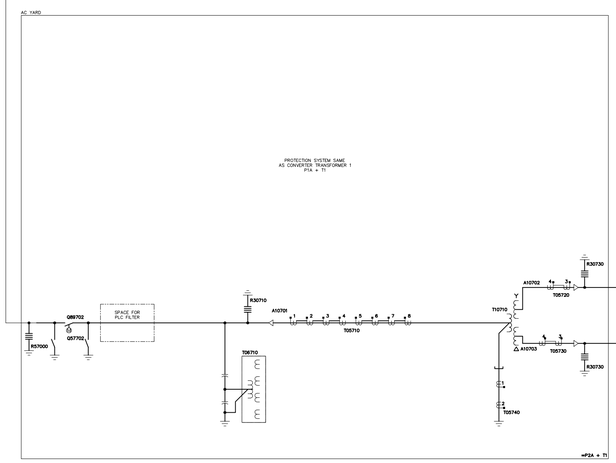
AC YARD 315kV

DC YARD 350kV
VALVE HALL









LEGEND:

- MOTORIZED DISCONNECT SWITCH, VERTICAL BREAK TYPE
- GROUND SWITCH
- 52 — CIRCUIT BREAKER
- CONVERTER TRANSFORMER
- CAPACITOR STACKS
- REACTOR COIL
- RESISTOR BOXES
- SURGE ARRESTER
- VOLTAGE TRANSFORMER
- CURRENT TRANSFORMER
- PLC — PLC FILTER
- ODF — OPTICAL DISTRIBUTION FRAME
- DDF — DIGITAL DISTRIBUTION FRAME
- CURRENT SIGNAL
- VOLTAGE SIGNAL
- CONNECTION FIBER OPTIC - DIGITAL
- PROTECTION RELAY
- TELEPROTECTION
- C264 — BUS CONTROL UNIT (BCU)
- TFR — FAULT RECORDER
- kWh / kVar — MEASUREMENT
- 24 — OVERFLUXING RELAY
- 27 — UNDERVOLTAGE RELAY
- 49 — OVERLOAD RELAY
- 50 BF — BREAKER FAILURE RELAY
- 50 ST — PHASE INSTANTANEOUS OVERCURRENT/ PHASE TIME OVERCURRENT PHASE RELAY
- 50N STN — NEUTRAL INSTANTANEOUS OVERCURRENT/ NEUTRAL TIME OVERCURRENT PHASE RELAY
- 59 — OVERVOLTAGE RELAY
- 60 — UNBALANCE RELAY
- 81R — FREQUENCY OVERCURRENT RELAY
- 87 — DIFFERENTIAL RELAY
- REF — RESTRICTED EARTH FAULT RELAY
- STUB — STUB RELAY

No	Reference	Document no

No	Date	Revision	Drawn	Ver.	App.
D	2013-11-29	Updated	S.P.	N.B.	J.F.D.
C	2013-10-29	Updated Bld technical clarification	S.P.	N.B.	J.F.D.
B	2013-10-15	AC FILTERS AND PLC FILTERS UPDATED	S.P.	J.F.D.	J.F.D.
A	2013-04-24	AUXILIARY CT QUANTITIES REVISED	S.P.	N.B.	N.B.

Stamp

ALSTOM GRID CANADA INC.
1400 Industrielle street
La Prairie, Québec, Canada
J5R 2E5
450-659-1399

NALCOR - LOWER CHURCHILL PROJECT

MUSKRAT FALLS 315kV

MUSKRAT FALLS CONVERTER STATION
AC PROTECTION
SINGLE LINE DIAGRAM

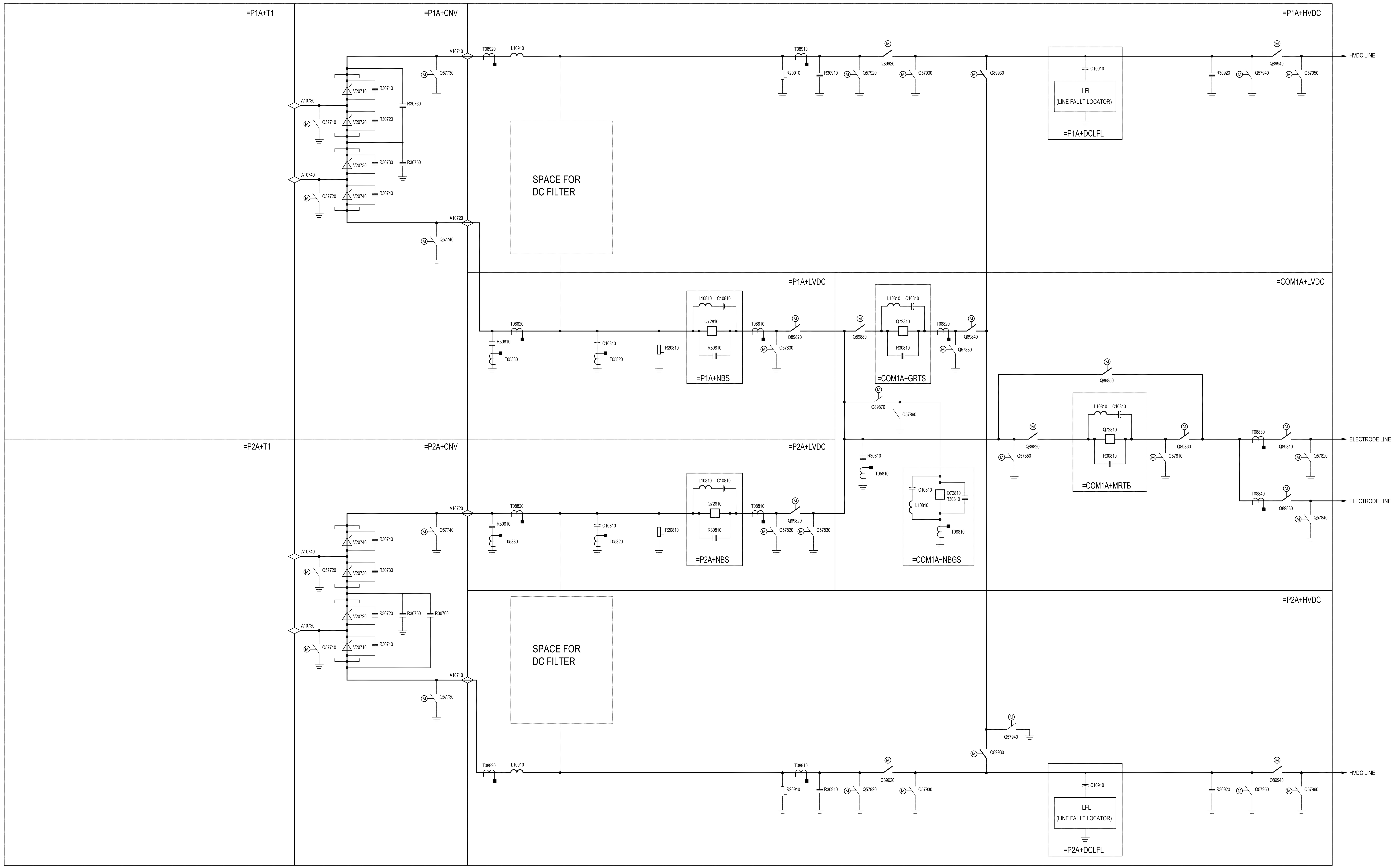
Drawn:	S. PROULX	Date: 2013-02-07	Ref. no:
Verified:	J.-F. DUBE	Date: 2013-02-07	Scale:
Approved:	A. KOJANIAN	Date: 2013-02-07	Dimensions in:

Drawing no.	Size	Rev.	Sheet no.	Total sheets
TL004-13-301-0011	D	A0	01	02	03

A0 (1189x841mm)

LEGEND:

- MOTORIZED DISCONNECT SWITCH, VERTICAL BREAK TYPE
- MOTORIZED GROUND SWITCH
- GROUND SWITCH
- CIRCUIT BREAKER
- CONVERTER TRANSFORMER
- VALVE
- CAPACITOR STACKS
- REACTOR COIL
- RESISTOR BOXES
- HIGH VOLTAGE DIVIDER
- SURGE ARRESTER
- VOLTAGE TRANSFORMER
- CURRENT TRANSFORMER



No	Reference	Document no

No	Date	Revision	Drawn	Ver.	App.
C	2013-11-29	UPDATED	S.P	J.F.D.	J.F.D.
B	2013-10-25	UPDATED	S.P	J.F.D.	J.F.D.
A	2013-10-15	UPDATED DC FILTER, DC SMOOTING REACTOR AND MRTB	S.P	J.F.D.	J.F.D.

Stamp

ALSTOM GRID

ALSTOM GRID CANADA INC.
1400 Industrielle street
La Prairie, Québec, Canada
J5R 2E5
450-659-1399

NALCOR - LOWER CHURCHILL PROJECT

MUSKRAT FALLS 315kV DC CONVERTER STATION
SINGLE LINE DIAGRAM

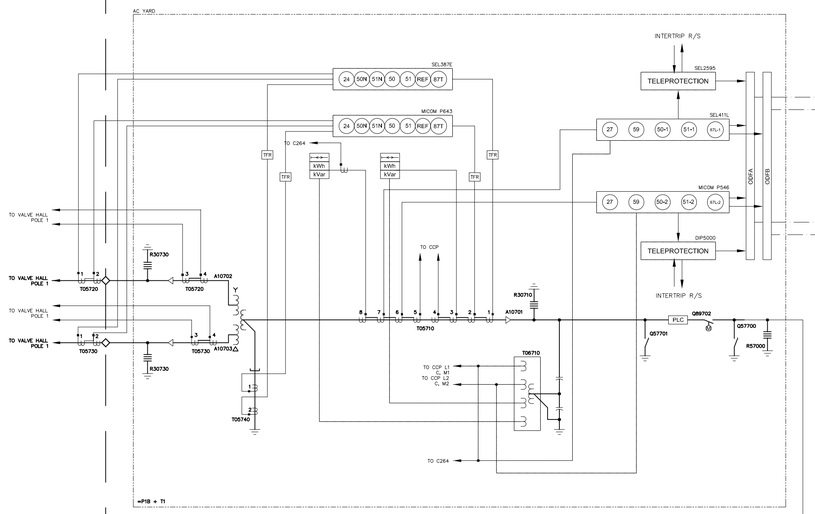
Drawn:	S. PROULX	Date:	2013-04-26	Ref. no:
Verified:	N. BERRAHAL	Date:	2013-04-26	Scale:
Approved:	N. BERRAHAL	Date:	2013-04-26	Dimensions in:

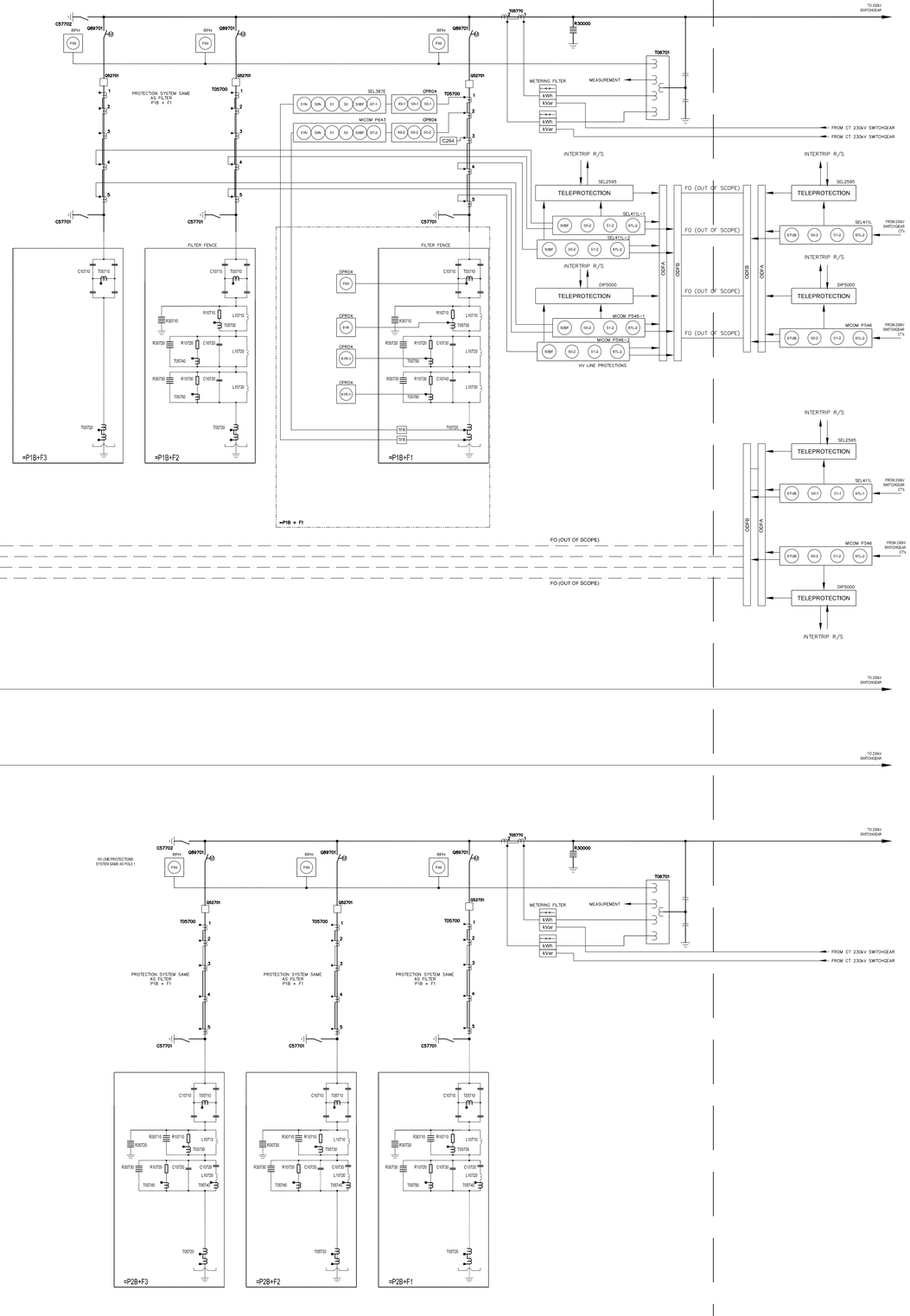
Drawing no	Rev	Size	Sheet	Next sheet	Last sheet
TL004-13-301-0031	C	A0	01	02	02

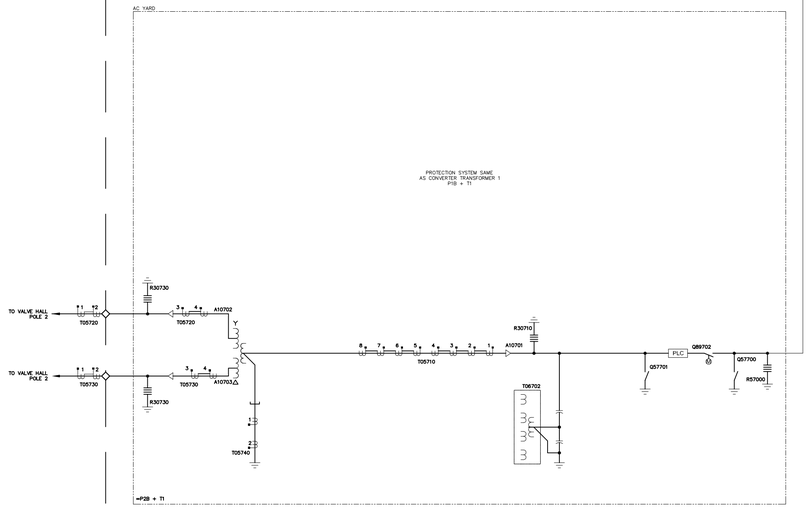
A0 (1189x841mm)

DC YARD 350kV
VALVE HALL

230kV
AC SUBSTATION
SOLDIER POND







LEGEND:

- MOTORIZED DISCONNECT SWITCH, VERTICAL BREAK TYPE
- GROUND SWITCH
- 52 — CIRCUIT BREAKER
- CONVERTER TRANSFORMER
- CAPACITOR STACKS
- REACTOR COIL
- RESISTOR BOXES
- SURGE ARRESTER
- VOLTAGE TRANSFORMER
- CURRENT TRANSFORMER
- PLC — PLC FILTER
- ODF — OPTICAL DISTRIBUTION FRAME
- DDF — DIGITAL DISTRIBUTION FRAME
- CURRENT SIGNAL
- VOLTAGE SIGNAL
- CONNECTION FIBER OPTIC - DIGITAL
- PROTECTION RELAY
- TELEPROTECTION — TELEPROTECTION
- C264 — BUS CONTROL UNIT (BCU)
- TFR — FAULT RECORDER
- kWh / kVar — MEASUREMENT
- 24 — OVERFLUXING RELAY
- 27 — UNDERVOLTAGE RELAY
- 49 — OVERLOAD RELAY
- 50 BFT — BREAKER FAILURE RELAY
- 50 ST — PHASE INSTANTANEOUS OVERCURRENT/ PHASE TIME OVERCURRENT PHASE RELAY
- 50N 51N — NEUTRAL INSTANTANEOUS OVERCURRENT/ NEUTRAL TIME OVERCURRENT PHASE RELAY
- 59 — OVERVOLTAGE RELAY
- 60 — UNBALANCE RELAY
- 81R — FREQUENCY OVERCURRENT RELAY
- 87 — DIFFERENTIAL RELAY
- REF — RESTRICTED EARTH FAULT RELAY
- STUB — STUB RELAY

No.	Reference	Document no

No	Date	Revision	Drawn	Ver.	App.
E	2013-12-17	AC FILTERS UPDATED	S.P.	N.B.	J.F.D.
D	2013-11-29	Updated	S.P.	N.B.	J.F.D.
C	2013-10-29	Updated Bill: technical clarification	S.P.	N.B.	J.F.D.
B	2013-10-15	AC FILTERS UPDATED	S.P.	J.F.D.	J.F.D.
A	2013-04-24	AUXILIARY CT QUANTITIES REVISED	S.P.	N.B.	N.B.

Stamp

ALSTOM GRID CANADA INC.
1400 Industrielle street
La Prairie, Québec, Canada
J5R 2E5
450-659-1399

NALCOR - LOWER CHURCHILL PROJECT

SOLDIERS POND 230kV

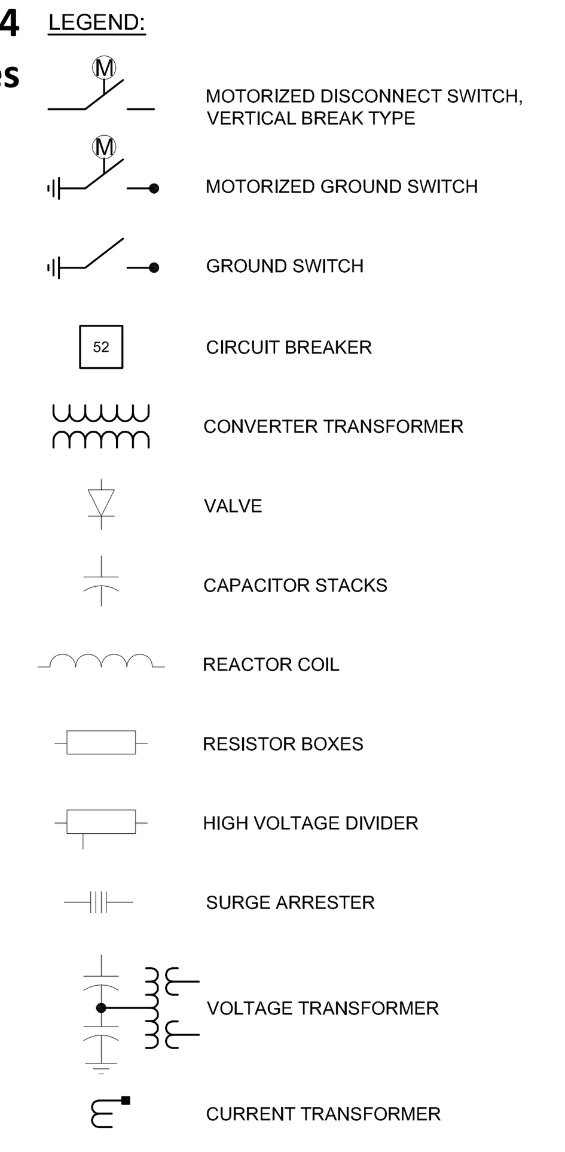
SOLDIERS POND CONVERTER STATION
AC PROTECTION
SINGLE LINE DIAGRAM

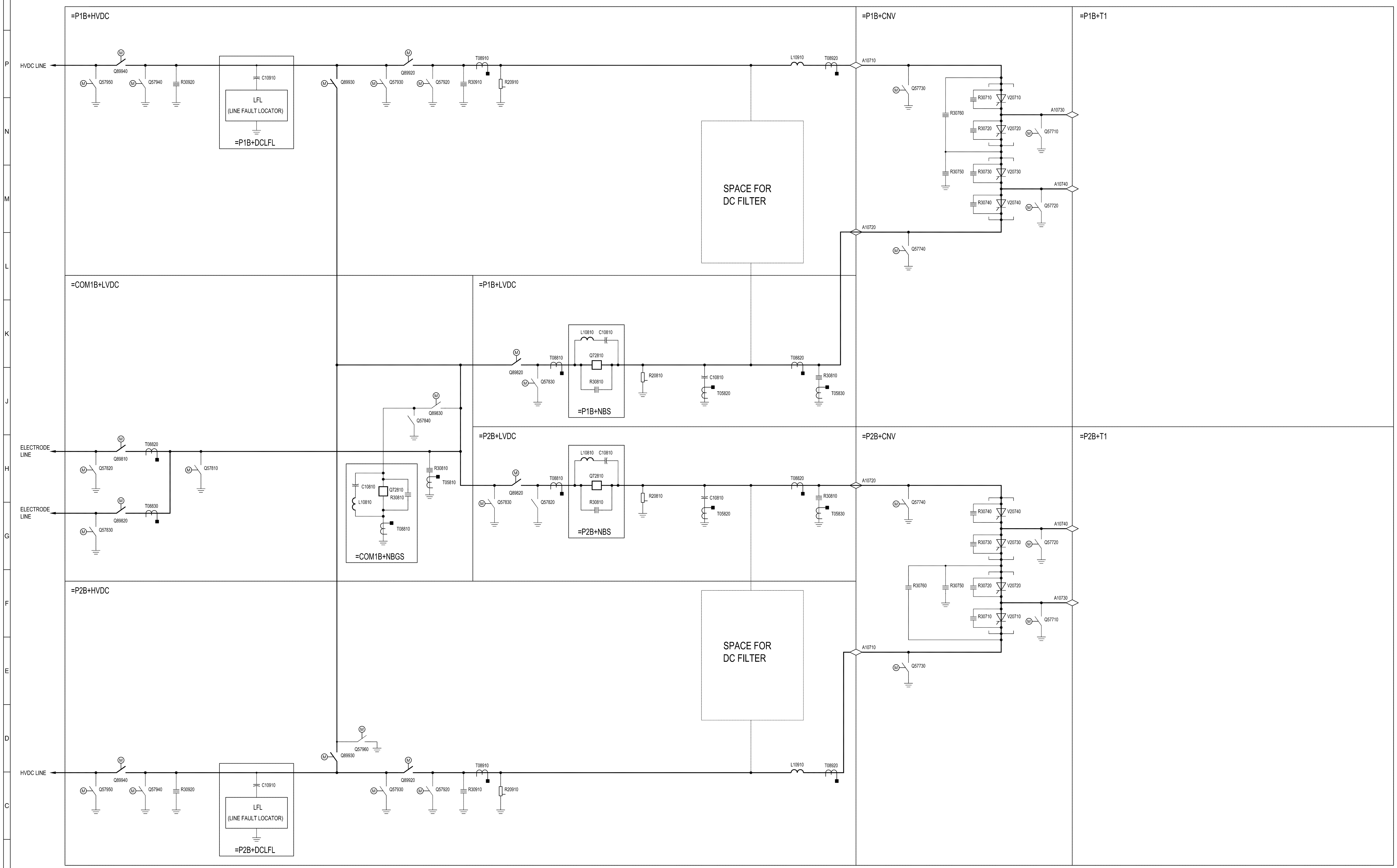
Drawn:	S. PROULX	Date: 2013-02-07	Ref. no:
Verified:	J.-F. DUBE	Date: 2013-02-07	Scale:
Approved:	A. KOJANIAN	Date: 2013-02-07	Dimensions in:

Document No. TL004-13-301-0014 | Rev. E | Size A0 | Sheet 01 | Total sheet 02 | Last sheet 03

A0 (1189x841mm)

LEGEND:





No	Reference	Document no

No	Date	Revision	Drawn	Ver.	App.
C	2013-11-29	UPDATED	S.P	J.F.D.	J.F.D.
B	2013-10-25	UPDATED	S.P	J.F.D.	J.F.D.
A	2013-10-15	UPDATED DC FILTER, DC SMOOTING REACTOR AND MRTB	S.P	J.F.D.	J.F.D.

Stamp

ALSTOM GRID

ALSTOM GRID CANADA INC.
1400 Industrielle street
La Prairie, Québec, Canada
J5R 2E5
450-659-1399

NALCOR - LOWER CHURCHILL PROJECT

SOLDIER POND 315kV DC CONVERTER STATION SINGLE LINE DIAGRAM

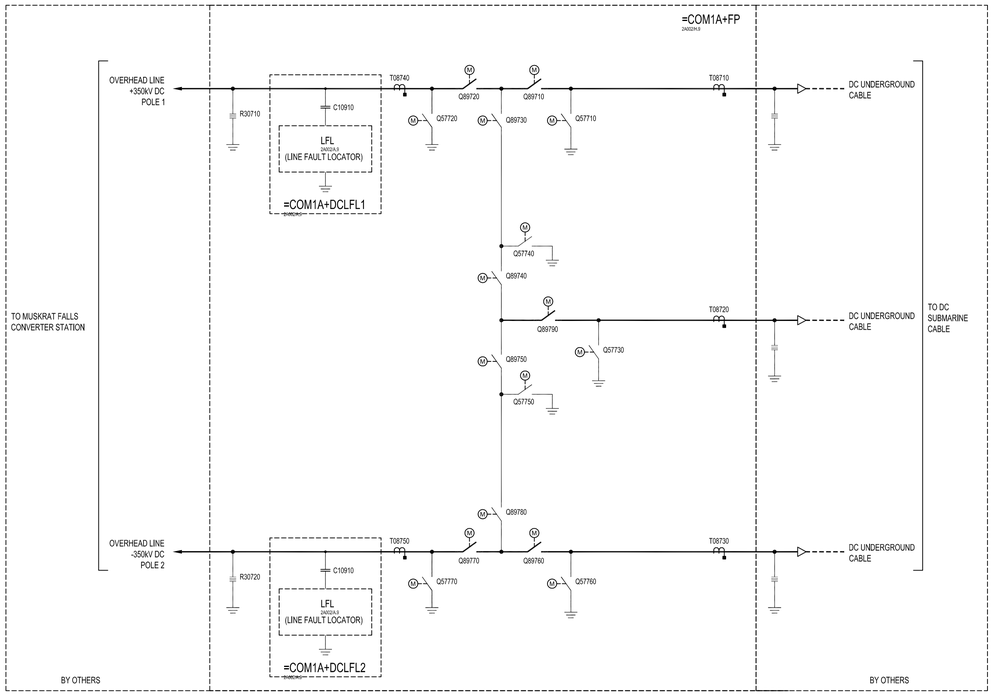
Drawn: S. PROULX	Date: 2013-04-26	Ref. no:	
Verified: N. BERRAHAL	Date: 2013-04-26	Scale:	
Approved: N. BERRAHAL	Date: 2013-04-26	Dimensions in:	

Drawing no	Rev	Size	Sheet	Next sheet	Last sheet
TL004-13-301-0034	C	A0	01	02	02

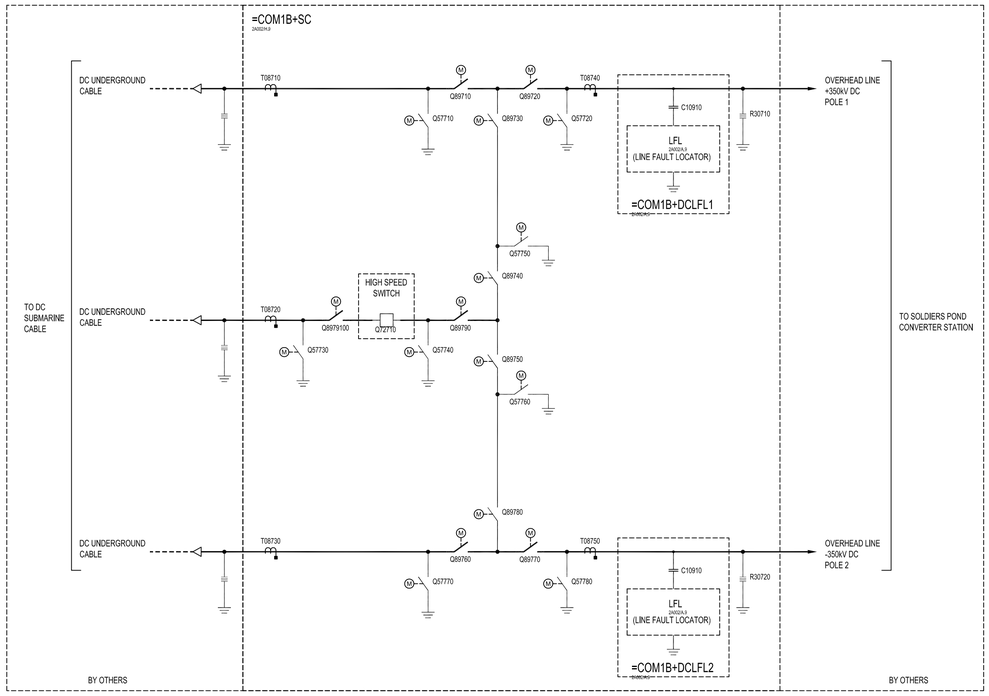
A0 (1189x841mm)

LEGEND:

- MOTORIZED DISCONNECT SWITCH, VERTICAL BREAK TYPE
- MOTORIZED GROUND SWITCH
- CIRCUIT BREAKER (52)
- CONVERTER TRANSFORMER
- VALVE
- CAPACITOR STACKS
- REACTOR COIL
- RESISTOR BOXES
- HIGH VOLTAGE DIVIDER
- SURGE ARRESTER
- VOLTAGE TRANSFORMER
- CURRENT TRANSFORMER



FORTEAU POINT



SHOAL COVE

No	Reference	Document no

No	Date	Revision	Drawn	Ver.	App.
B	2013-11-29	UPDATED	S.P	J.F.D.	J.F.D.
A	2013-10-25	UPDATED	S.P	J.F.D.	J.F.D.

Stamp

ALSTOM GRID CANADA INC.
1400 Industrielle street
La Prairie, Québec, Canada
J5R 2E5
450-659-1399

NALCOR - LOWER CHURCHILL PROJECT

FORTEAU POINT / SHOAL COVE

FORTEAU POINT / SHOAL COVE CONVERTER STATION
SINGLE LINE DIAGRAM

Drawn: S. PROULX	Date: 2013-02-07	Ref. no:	
Verified: J.-F. DUBE	Date: 2013-02-07	Scale:	
Approved: A. KOJAKIAN	Date: 2013-02-07	Dimensions in:	

Drawing no	Rev	Size	Sheet	Next sheet	Last sheet
TL004-13-301-0012	B	A1	01	-	01

A1 (841x594mm)