

1 Q. **Reference: Study, page 1**

2

3 Describe the remaining steps and timeline before the synchronous condenser SC-3 at the  
4 Wabush Terminal Station can be commissioned.

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7 A. Please refer to IOC-NLH-017, Attachment 1 for the “Wabush Terminal Station SC-3  
8 Operational Readiness Scope of Work” document and IOC-NLH-017, Attachment 2 for the  
9 schedule for remaining work. These documents were developed by Newfoundland and  
10 Labrador Hydro and sent to Iron Ore Company of Canada on February 22, 2019.

11

12 The scope document outlines all remaining steps.

13

14 The tentative schedule was developed to capture durations related to the scope of work.  
15 March 6, 2019 was selected as a start date for illustrative purposes. The start date will  
16 ultimately begin once all necessary agreements are in place between Newfoundland and  
17 Labrador Hydro and Iron Ore Company of Canada regarding cost recovery and scope of  
18 work. It is estimated that the project will take approximately two months to complete,  
19 provided all resources are available.



# WABUSH TERMINAL STATION SC-3 OPERATIONAL READINESS

Scope of Work  
Rev. 0

2/22/2019

This scope is meant to define the work required to bring SC-3 at the Wabush terminal Station (WAB) into operation. Since commissioning in 2014, the machine has been left idle with periodic maintenance being done by BBA. The intent is to conduct a selection of tests from the previous commissioning test sheets and omit any procedures that do not need to be repeated. After review of the previous commissioning documents, it has been noted that the machine is mechanically and electrically ready for service, however several tests must be conducted to confirm reliable operation.

**1) General Inspections**

Prior to any testing:

- General overall visual inspection of:

- (a) The unit, PTs and switch gear
- (b) All associate junction boxes, heaters, and cables

**2) SC-3 Machine Pony Motor and VFD , Lube System Test, Medium Voltage Cables**

Equipment: SC-3, Pony Motor, VFD and HV Cables

Document Number:

- 1) SC-3: 5141401-SM0001-77-ETS-4A04-R00
- 2) Pony Motor: 5141401-PE0010-77-ETS-4D01-R00
- 3) VFD: 5141401-PE0006-80-VSP-0006-R00
- 4) Lube System: 5141401-700001-75-ESP-0001-R00
- 5) MV Power Cable: 5141401-SM0001-77-ETS-4A05-R00

Since the machine has not been operated in four years, we require the commissioning testing be re-conducted on SC-3, Pony Motor, VFD and Cables running to the MV switch gear. For the machine this includes, but is not limited to, IR, PI, WR and motor test. The condenser shaft will also need to be rotated by hand prior to energization to ensure proper alignment. The Lube System also requires testing to confirm pump operation, current draw, pressures and flows. A sample of the lube oil will be taken and analyzed before testing begins. Since the medium voltage cables, running from SC-3 to the MV switch gear, have not been used since 2014 a megger test is required. All alarms associated with the machine and pony motor, both local and remote, will be verified at this time.

**3) Transformers**

Equipment: T13, SST3

Document Number:

- 1) T13: 5141401-700001-77-ETS-2A01-R00
- 2) T13 Doble: 5141401-ODOBLE-47-GSP-0004-R00
- 3) SST3: 5141401-PE0007-77-ETS-3B04

The Power Transformer (T13) and Station Service Transformer (SST3) will require testing again. This will include, but is not limited to, WR, IR and PI tests. A Doble test has also been recommended for T13. All transformer alarms, both local and remote, will also be verified at this time.

#### 4) **Switch Gear Test**

Equipment: Circuit Breakers 15-1,-2,-3, 46-14,-15 and 600 V Breakers

Document Number:

- 1) Breakers 15-1: 5141401-PE0002-77-ETS-3A03-R00 (Page 7)
- 2) Breakers 15-2: 5141401-PE0002-77-ETS-3A03-R00 (Page 19)
- 3) Breakers 15-3: 5141401-PE0002-77-ETS-3A03-R00 (Page 30)
- 4) Breaker 46-14: 5141401-PE0004-77-ETS-1B01-R00
- 5) Breaker 46-15: 5141401-PE0004-77-ETS-1B02-R00
- 6) 600 V Breakers: 5141401-PE0011-77-ETS-3C02-R00

Since the equipment has been idle, it would be prudent to test the breakers. This will confirm that they are operating properly and do not require any maintenance. The tests shall include, but are not limited to: functional verification, IR, contact resistance, contact synchronization, opening and closing time measurements and Capacitance/PF measurement. All alarms, both local and remote, will also be verified at this time. Where applicable the breakers will be operated from each tripping device, including hand, remote and relay operation. Note: Relay initiated trips will only be tested once from each device, the blocking switch can then be opened for the remainder testing.

#### 5) **Protective Relay Function Testing**

Equipment: 87B-SC3-SG-1, SC3-SG-1, 87T-SC3-SG-1, SC3-SG-1, P034, SC3-SG-2

Document Number:

- 1) 87B-SC3-SG-1 (SEC 2), SEL-787: 5141401-PE0002-77-ETS-3A04-R00
- 2) SC3-SG-1 (SEC 3), 15-2/SC-3, SEL-700G: 5141401-PE0002-77-ETS-3A05
- 3) 87T-SC3-SG-1 (SEC 2), T13, SEL-787: 5141401-PE0002-77-ETS-3A06-R00
- 4) SC3-SG-1 (SEC 1), 15-1/SST3, SEL-751A: 5141401-PE0002-77-ETS-3A07-R00
- 5) SC3-SG-1(SEC 3), 15-2/SC-3, SEL-751A: 5141401-PE0002-77-ETS-3A09-R00
- 6) SC3-SG-1 (SEC 4), 15-3/X1, SEL-751A: 5141401-PE0002-77-ETS-3A10-R00
- 7) P034, 46-14, SEL-351: 5141401-PE0009-77-ETS-1D04-R00
- 8) P034, 46-15, SEL-351: 5141401-PE0009-77-ETS-1D05-R00
- 9) P034, 46-15/46-14, SEL-551: 5141401-PE0009-77-ETS-1D06-R00
- 10) SC3-SG-2, CELL. 1B, CELL. 1D, CELL. 2C, CELL 2D: 5141401-PE0011-77-ETS-3C01-R00
- 11) SC3-SG-2, SST3, SEL-751: 5141401-PE0011-77-ETS-3C04-R00
- 12) SC3-SG-2, SST3, SE-300: 5141401-PE0011-77-ETS-3C05-R00

Since the relays have been idle, the functionality must be verified again. This will ensure proper operation in the case of a fault or system abnormality. This will include, but is not limited to, injection testing of the relay with appropriate testing device, functional verification of DC circuits, activation of any alarm/indication points, and operation of any associated auxiliary and lockout relays. The relay settings and coordination will also be reviewed by a senior P&C engineer and any necessary revisions will be made prior to testing. Note: Relay initiated breaker trips will only be tested once during breaker verification, the blocking switch can then be opened for the remainder of testing.

#### 6) **Battery Bank Discharge Test**

Equipment: Chargers 1, 2 and Battery Bank

Document Number: 5141401-PE0014-77-ETS-3D01

The battery bank is a self-contained system and has been left running with the chargers maintaining the voltage across the cells but no load on the system. A test was conducted in 2014 and several cells were replaced. However, since the system has not been used, a test is warranted. The battery bank is also approaching five years of service at which time the manufacture recommends a discharge test. This is to confirm we have suitable capacity to operate the 125VDC equipment in the case of a system outage.

#### 7) **Shunt Reactor X1 Tests**

Equipment: X1

Document Number:

- 1) Shunt Reactor: 5141401-PE0003-77-ETS-5A06-R00
- 2) MV Cable, SC3-P0203 to SC3-P0208: 5141401-PE0003-77-ETS-5A02-R00
- 3) MV Cable, SC3-P0233: 5141401-PE0003-77-ETS-5A03-R00
- 4) Shunt Reactor PT: 5141401-PE0003-77-ETS-5A05-R00

The shunt reactor X1 will also require testing before it is put back into service. This will include IR, WR, Reactor measurement and Capacitance/PF measurement. The Shunt Reactor PT must also be re-tested; this will include a ratio check, polarity measurement, WR and IR test. Since the MV cables have not been used since 2014 they will require a megger test. All alarms associated with the reactor, both local and remote, will also be verified at this time.

#### 8) **SC-3 First Run With Excitation and Vibration Monitoring System**

Equipment: SC-3

Document Number:

- 1) SC-3 First Run: 5141401-700001-77-ESP-0014-R00
- 2) SC-3 Vibration: 5141401-SM0001-78-ETS-4A01-R00
- 3) Pony Motor Vibration: 5141401-PE0010-78-ETS-4D01-R00

The test shall consist of a full run up of SC-3 with no load. This shall confirm satisfactory operation of the machine, Pony motor/VFD, exciter/AVR, protection and all ancillary systems (lube/HVAC) and that the machine will not cause any issues when connected to the system. During this test vibration measurements will be taken for both the machine and the starting motor and compared to previous test reports.

**9) SC-3 MVARs Ramping Up**

Equipment: SC-3

Document Number: 5141401-700001-77-ESP-0010-R02

This test shall consist of a full run up of SC-3 connected to the system via B15 with SC-2 off. This will confirm the machines ability to supply reactive power to the system.

**10) SC-3 Paralleled with SC-2**

Equipment: SC-3, SC-2

Document Number: 5141401-700001-77-ESP-0020-R01

This test shall consist of a full run up of SC-3 in parallel with SC-2 and connected to the system via B15. This will confirm the machines ability to act, as a slave unit, in unison with SC-2 and prove reliable operation of both SC-3 and SC-2 control sequences.

**11) SC-3 on Bus 1**

Equipment: SC-3

Document Number: NA

This test shall consist of a full run up of SC-3 connected to the system on B13 via B11 with SC-1 off. This will prove the machines ability to operate on B13. As there is no procedure in place portions of 5141401-700001-77-ESP-0010-R02 and 5141401-700001-77-ESP-0020-R01 can be adapted to facilitate this test. This test can also be used to analyze the SC-3 and SC-1 control sequences. WARNING: Due to fault current levels and breaker interrupting capability, SC-1 and SC-3 can only operate on the same bus long enough for switching to occur.

**12) Meter Polarity Deficiency**

Equipment: P-034 Meter

The polarity of the MVARs measurement on P-034 is still showing as inverted. At the time of testing the leads shall be reversed, so that the MVAR reading is positive when generating Vars and negative when absorbing. Any necessary checks and verifications must also be done at this time.

**13) Review of Standard Operating Procedures and Re-Energization Plan**

During the initial review process it was noted that some sections of the SOP’s associated with SC-3 must be reviewed for clarity and accuracy. Once they are reviewed any necessary revisions will be made. Also at this time an energization plan shall be developed and added to the SOPs.

**14) Churchill Falls Simulator Updates**

As part of the work to complete final integration of SC-3, simulator updates are required in Churchill Falls. Once updates are completed, testing and training can commence.

**15) Training**

Upon completion of SC-3 commissioning, training will be required for the various stakeholders. The training program is expected to be similar to that completed in 2014. I.e. 3 day course on SC-3 and any required training in Churchill Falls for the remote operation of the unit. We currently anticipate the following people to attend training in Labrador City:

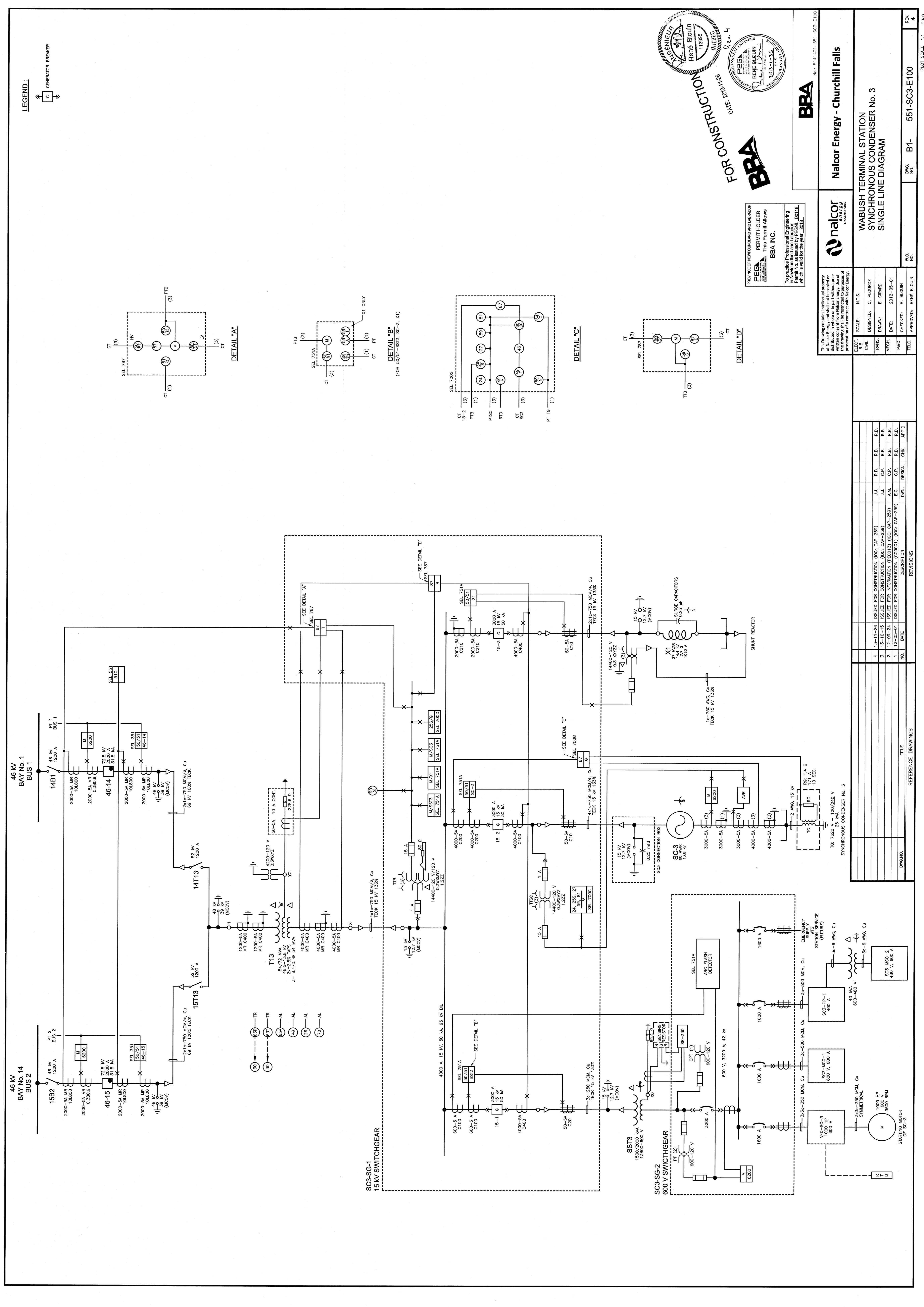
<b>Title</b>	<b>Personnel</b>
Station Operator – Wabush	2
Electrical Supervisor	1
Mechanical Supervisor	1
P&C Technologist	2
Work Execution Lead	1
Station Operator - Churchill Falls	3
Asset Specialist	1
Equipment Engineer	1
P&C Engineer	3
ECC operators	5
	<b>20</b>



**Summary of Test:**

ITEM	Document Number	Title
1	5141401-SM0001-77-ETS-4A04-R00	SC-3 SYNCHRONOUS CONDENSER TEST SHEET
2	5141401-PE0010-77-ETS-4D01-R00	600V PONY MOTOR TEST SHEET
3	5141401-PE0006-80-VSP-0006-R00	IOC VFD SC-3 START-UP SUMMARY REPORT
4	5141401-700001-75-ESP-0001-R00	METHOD STATEMENT FOR GENERATOR LUBE OIL SYSTEM COMMISSIONING
5	5141401-SM0001-77-ETS-4A05-R00	SC3-P0209 TO SC3-P0220 POWER CABLE TEST SHEET
6	5141401-700001-77-ETS-2A01-R00	T13 POWER TRANSFORMER AND INSTRUMENTATION VERIFICATION TEST SHEET
7	5141401-ODOBLE-47-GSP-0004-R00	SFRA TEST THREE-PHASE, THREE WINDINGS TRANSFORMERS
8	5141401-PE0007-77-ETS-3B04-R00	SST3 POWER TRANSFORMER TEST SHEET
9	5141401-PE0002-77-ETS-3A03-R00	SC3-SG-1 SWITCHGEAR TEST SHEET
10	5141401-PE0004-77-ETS-1B01-R00	CIRCUIT BREAKER 46-14 TEST SHEET
11	5141401-PE0004-77-ETS-1B02-R00	CIRCUIT BREAKER 46-15 TEST SHEET
12	5141401-PE0011-77-ETS-3C02-R00	SC3-SG-2 CELL 1B, 1D, 2B, 2C AND 2D SWITCHGEAR TEST SHEET
13	5141401-PE0002-77-ETS-3A04-R00	87B - SC3-SG-1 SEL-787 TEST SHEET
14	5141401-PE0002-77-ETS-3A05-R00	SC3-SG-1 (SECTION 3) SEL-700G PROTECTION RELAY TEST SHEET
15	5141401-PE0002-77-ETS-3A06-R00	87T - SC3-SG-1 SEL-787 TEST SHEET
16	5141401-PE0002-77-ETS-3A07-R00	SC3-SG-1 (SECTION 1) SEL-751A PROTECTION RELAY TEST SHEET
17	5141401-PE0002-77-ETS-3A09-R00	SC3-SG-1 (SECTION 3) SEL-751A PROTECTION RELAY TEST SHEET
18	5141401-PE0002-77-ETS-3A10-R00	SC3-SG-1 (SECTION 4) SEL-751A PROTECTION RELAY TEST SHEET

19	5141401-PE0009-77-ETS-1D04-R00	CIRCUIT BREAKER 46-14 SEL-351 PROTECTION RELAY TEST SHEET
20	5141401-PE0009-77-ETS-1D05-R00	CIRCUIT BREAKER 46-15 SEL-351 PROTECTION RELAY TEST SHEET
21	5141401-PE0009-77-ETS-1D06-R00	SEL-551 PROTECTION RELAY TEST SHEET
22	5141401-PE0011-77-ETS-3C01-R00	SC3-SG-2 CELL 1B, 1D, 2C AND 2D PROTECTION RELAY TEST SHEET
23	5141401-PE0011-77-ETS-3C04-R00	SC3-SG-2 SEL-751A ARC DETECTION RELAY TEST SHEET
24	5141401-PE0011-77-ETS-3C05-R00	SC3-SG-2 SE-330 PROTECTION RELAY TEST SHEET
25	5141401-PE0013-77-ETS-3D01-R00	BATTERY CHARGER AND ACCUMULATORS
26	5141401-PE0003-77-ETS-5A06-R00	SHUNT REACTOR AIR CORE REACTOR TEST SHEET
27	5141401-PE0003-77-ETS-5A02-R00	SC3-P0203 TO SC3-P0208 POWER CABLE TEST SHEET
28	5141401-PE0003-77-ETS-5A03-R00	SC3-P0233 POWER CABLE TEST SHEET
29	5141401-PE0003-77-ETS-5A05-R00	SHUNT REACTOR INDUCTIVE VOLTAGE TRANSFORMER TEST SHEET
30	5141401-700001-77-ESP-0014-R00	ENERGIZATION PROCEDURE FOR FIRST SC-3 RUN WITH EXCITATION
31	5141401-SM0001-78-ETS-4A01-R00	VIBRATION INSTRUMENTATION VERIFICATION SHEET
32	5141401-PE0010-78-ETS-4D01-R00	VIBRATION INSTRUMENTATION TEST SHEET
33	5141401-700001-77-ESP-0010-R02	PERFORMANCE PROCEDURE FOR SC-3 MVARs RAMPING UP
34	5141401-700001-77-ESP-0020-R01	PERFORMANCE PROCEDURE FOR SC-3 IN PARALLEL WITH SC-2
35	NA	PROCEDURE FOR SC-3 ON BUS 13



FOR CONSTRUCTION  
**BBA**  
 DATE: 2012-05-31

PROVINCE OF NEWFOUNDLAND AND LABRADOR  
**PEGA**  
 PERMIT HOLDER  
 This Permit Allows  
**BBA INC.**  
 To practice Professional Engineering  
 in Newfoundland and Labrador  
 under the authority of the PEAB  
 which is valid for 180 days, 2012.

**BBA** No. 5141401-051-002-E100

**Nalcor Energy - Churchill Falls**

**WABUSH TERMINAL STATION  
 SYNCHRONOUS CONDENSER No. 3  
 SINGLE LINE DIAGRAM**

PROJECT: N.T.S.  
 SCALE: N.T.S.  
 DESIGNED: C. FLAURIE  
 DRAWN: E. GIBBARD  
 CHECKED: R. BLOUIN  
 DATE: 2012-05-31  
 APPROVED: R. BLOUIN

NO.	DATE	DESCRIPTION	CHK.	APP'D.
1	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
2	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
3	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
4	13-11-26	ISSUED FOR CONSTRUCTION (OC- CAP-259)	J.J.	R.B.

NO.	DATE	DESCRIPTION	CHK.	APP'D.
1	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
2	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
3	12-08-07	ISSUED FOR CONSTRUCTION (000001) (OC- CAP-259)	E.G.	R.B.
4	13-11-26	ISSUED FOR CONSTRUCTION (OC- CAP-259)	J.J.	R.B.

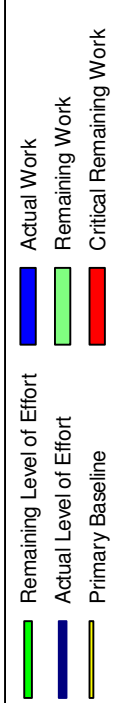


Printed 22-Feb-19

SC-3 Re-Commissioning (WAB-TS)

Data date: 14-Feb-19

Activity ID	Activity Name	Remaining Duration	% Complete	Budgeted Labor Units	Resource IDs	Start	Finish
<b>SC-3 Re-Commissioning (WAB-TS)</b>							
<b>Engineering</b>							
13321901-CN-271	Review Of Operating Procedures	49.0	0%	880		06-Mar-19	15-May-19
13321901-CN-228	Develop Commissioning Documents	16.0	0%	0		06-Mar-19	28-Mar-19
13321901-CN-278	Internal Review Of Commissioning Documents	8.0	0%	0		06-Mar-19	18-Mar-19
		10.0	0%	0		07-Mar-19	21-Mar-19
		5.0	0%	0		21-Mar-19	28-Mar-19
<b>Construction</b>							
		49.0	0%	880		06-Mar-19	15-May-19
<b>Site Work</b>							
		49.0	0%	880		06-Mar-19	15-May-19
<b>Deficiencies</b>							
13321901-CN-269	Address Other Open Deficiencies	2.0	0%	48	TRO-L-EMA, TRO-L-EMA, TRO-L-F	07-Mar-19	11-Mar-19
<b>General Inspection</b>							
13321901-CN-148	Visually Inspect PT's and Switchgear	32.0	0%	528		06-Mar-19	22-Apr-19
13321901-CN-178	Rotate Machine by Hand	0.5	0%	8	TRO-L-EMA, TRO-L-P&C	06-Mar-19	07-Mar-19
13321901-CN-218	Complete PM On Station Service Transformer	0.5	0%	8	TRO-L-EMA, TRO-L-EMA	07-Mar-19	07-Mar-19
13321901-CN-138	Check Breakers using Standard PM Check Sheet	1.0	0%	16	TRO-L-EMA, TRO-L-P&C	07-Mar-19	08-Mar-19
13321901-CN-128	Check Lube Oil System, Measure Operate Pressure and Flow Rates, Confir	10.0	0%	160	TRO-L-EMA, TRO-L-P&C	08-Mar-19	22-Mar-19
13321901-CN-108	Megger Stator and Rotor	1.0	0%	16	TRO-L-EMA, TRO-L-MMA	22-Mar-19	25-Mar-19
13321901-CN-118	Megger Starting Motor and Complete Routine Checks on Variable Speed Driv	3.0	0%	72	TRO-L-EMA, TRO-L-P&C, TRO-L-E	25-Mar-19	28-Mar-19
13321901-CN-208	MV Cables Between SC3 generator and the Switchgear - Meggar and High f	2.0	0%	48	TRO-L-P&C, TRO-L-EMA, TRO-L-E	28-Mar-19	01-Apr-19
13321901-CN-318	Shunt Reactor Test	1.0	0%	32	TRO-L-EMA, TRO-L-P&C	01-Apr-19	02-Apr-19
13321901-CN-168	Complete Relay Testing	2.0	0%	48	TRO-L-EMA, TRO-L-P&C, TRO-L-E	02-Apr-19	04-Apr-19
13321901-CN-258	Complete PM On 600 Volt Breakers (x5)	7.0	0%	56	TRO-L-P&C	04-Apr-19	15-Apr-19
13321901-CN-270	Address Battery Discharge Test	3.0	0%	48	TRO-L-EMA, TRO-L-P&C	15-Apr-19	18-Apr-19
<b>Spring Work</b>							
		1.0	0%	16	TRO-L-EMA, TRO-L-EMA	18-Apr-19	22-Apr-19
		9.0	0%	144		22-Apr-19	03-May-19
13321901-CN-268	Complete PM On 15 kV Breakers	3.0	0%	24	TRO-L-EMA, TRO-L-P&C	22-Apr-19	25-Apr-19
13321901-CN-248	Complete PM On 46KV Breakers (46-14 / 46-15)	3.0	0%	48	TRO-L-EMA, TRO-L-P&C	25-Apr-19	30-Apr-19
13321901-CN-158	Complete PM and Doble Test on Unit Transformer (T13)	3.0	0%	72	TRO-L-EMA, TRO-L-P&C, TRO-L-E	30-Apr-19	03-May-19
<b>Commissioning</b>							
13321901-CN-238	SC-3 Commissioning - Functionality (Complete Vibration Measurements)	5.0	0%	160		03-May-19	10-May-19
		5.0	0%	160	TRO-L-EMA, TRO-L-P&C	03-May-19	10-May-19
<b>Training</b>							
13321901-CN-298	Churchill Falls Simulator Updates	21.0	0%	0		15-Apr-19	15-May-19
13321901-CN-308	Training in Churchill Falls	5.0	0%	0		15-Apr-19	23-Apr-19
13321901-CN-288	On-Site Training (WAB-TS)	1.0	0%	0		10-May-19	13-May-19
		3.0	0%	0		10-May-19	15-May-19



TASK filter: (Untitled Filter)\_1.