newfoundland labrador hydro
a nalcor energy company

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March 17, 2017

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: An Application by Newfoundland and Labrador Hydro (Hydro) pursuant to Subsection 41(3) of the Act for the approval of the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and level 2 condition assessments of the synchronous condensers, at the Wabush Terminal Station

Please find enclosed the original and 9 copies of the above-noted Application, plus supporting affidavit, project proposal, and draft order.

On August 5, 2016, Hydro applied to the Board of Commissioners of Public Utilities (the Board) for approval to acquire the Wabush Terminal Station. This application was approved by the Board in Order No. P.U. 32(2016). It was identified within the application that many of the assets in the Wabush Terminal Station are nearing the end of their useful lives and will require refurbishment or replacement in coming years.

Inspections of the Wabush Terminal Station have indicated that immediate work is required to maintain reliable operation of the station. This work includes the replacement of a 46 kilovolt (kV) circuit breaker, the replacement of insulators, the replacement of synchronous condensers shaft seals and resistance rings, and the completion of Level 2 condition assessments of the synchronous condensers.

To address immediate risks related to the reliable supply of electricity to customers from the Wabush Terminal Station, Hydro is seeking approval to proceed with the above noted work which is more particularly described in the attached Application and project description. The estimated capital cost of this project $2,912,500 and it is scheduled for completion by October 2018. The two year schedule is required in order to initiate procurement of the long-lead insulators in 2017, which will not be available for installation until 2018.

Should you have any questions, please contact the undersigned.

Yours truly,

Newfoundland & Labrador Hydro

Tracey L. Pennell
Senior Counsel, Regulatory

TLP/bs
c: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Sheryl Nisenbaum – Praxair Canada Inc.
Dennis Browne, Q.C. – Consumer Advocate
Thomas J. O'Reilly, Q.C. – Cox & Palmer
ecc: Larry Bartlett – Teck Resources Limited

IN THE MATTER OF the *Electrical Power Control Act,* RSNL 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, RSNL 1990, Chapter P-47 (the *Act*), and regulations thereunder;

AND IN THE MATTER OF an Application by Newfoundland and Labrador Hydro for approval of the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station pursuant to Subsection 41(3) of the *Act*.

TO: The Board of Commissioners of Public Utilities (the Board)

THE APPLICATION OF NEWFOUNDLAND AND LABRADOR HYDRO (Hydro) STATES THAT:

1. Hydro is a corporation continued and existing under the *Hydro Corporation Act, 2007*, is a public utility within the meaning of the *Act*, and is subject to the provisions of the *Electrical Power Control Act, 1994*.

2. On August 5, 2016, Hydro applied to the Board for approval to acquire the Wabush Terminal Station and associated lands and assets. This application was approved by the Board in Order No. P.U. 37(2016).

3. The Wabush Terminal Station includes eight 230:46 kV power transformers, three 230 kV air blast circuit breakers, twenty-two 46 kV oil circuit breakers, five 46 kV gas circuit breakers, two 46 kV capacitor banks, two synchronous condensers (SC1 and SC2), and

other station equipment including disconnect switches, instrument transformers, bus work, insulators, surge arresters, power cables, and protection and control equipment.

4. Many of the assets in the Wabush Terminal Station are nearing the end of their useful lives and will require refurbishment or replacement. Inspections of the Wabush Terminal Station have indicated that immediate work is required to maintain reliable operation of the station. This includes replacing circuit breaker 46-33, high voltage insulators, and synchronous condenser components that could fail and affect the reliable operation of the Wabush Terminal Station.

5. To address immediate risks related to the reliable supply of electricity to customers from the Wabush Terminal Station, Hydro is proposing to proceed with the following work at the Wabush Terminal Station:

   a. the replacement of one 46 kV circuit breaker, 46-33 and the completion of breaker and feeder protection upgrades for this circuit breaker;
   b. the replacement of thirty-six 46 kV post insulators, twenty-four 46 kV suspension insulators, and twenty-four 230 kV suspension insulators;
   c. purchase and replacement of shaft seals and resistance rings for SC1 and SC2; and
   d. the completion of Level 2 condition assessments of SC1 and SC2.

   The scope of work for this project is set out inthe engineering report attached to this Application.

6. The estimated capital cost of the project is $2,912,500 and it is expected to be completed in October 2018. The two year schedule is required in order to initiate procurement of the long-lead insulators in 2017, which will not be available for installation until 2018.

7. Hydro submits that the proposed capital expenditure related to the Wabush Terminal Station is necessary to ensure that Hydro can continue to provide service which is safe and adequate and just and reasonable as required by Section 37 of the *Act.*

8. Therefore, Hydro makes Application that the Board make an Order pursuant to section 41(3) of the *Act* approving the capital expenditure of approximately $2,912,500 for the replacement of a circuit breaker, insulators, and synchronous condenser shaft seals and resistance rings, and the completion of Level 2 condition assessments of the synchronous condensers at the Wabush Terminal Station, as more particularly described in this Application and in the attached project description and justification document.

DATED at St. John's in the Province of Newfoundland and Labrador this 17th day of March 2017.

Tracey L. Pennell
Counsel for the Applicant
Newfoundland and Labrador Hydro
500 Columbus Drive P.O. Box 12400
St. John's, NL A1B 4K7
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A REPORT TO
THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

	Electrical
	Mechanical
	Civil
	Protection & Control
	Transmission & Distribution
	Telecontrol
	System Planning

Assessment and Refurbishment

Wabush Terminal Station

March 17, 2017

newfoundland labrador hydro
a nalcor energy company

Executive Summary

In September 2016, Hydro acquired the Wabush Terminal Station from the Twin Falls Power Corporation (TwinCo).[1] Inspections of the Wabush Terminal Station have indicated that immediate work is required to maintain reliable operation of the station. This includes the replacement of a 46 kilovolt (kV) circuit breaker, the replacement of insulators, the replacement of synchronous condensers shaft seals and resistance rings, and the completion of a Level 2 condition assessment of the synchronous condensers.

This proposal is requesting the approval of a two-year supplemental project to complete the above noted work. Although not typical for a Supplemental Capital Budget Application, two years are required for the procurement of the long-lead insulators. Procurement will be initiated in 2017 with installation to occur in 2018.

The total estimated cost of this project is $2,912,500. The project will be completed by October, 2018.

[1] Order No. P.U. 37(2016).

Table of Contents

1.0 Introduction

On August 5, 2016, Newfoundland and Labrador Hydro (Hydro) applied to the Board of Commissioners of Public Utilities (the Board) for approval to acquire the Wabush Terminal Station (WABTS). On September 8, 2016, this application was approved (Order No. P.U. 37(2016)). In that application, Hydro noted that many assets in the Wabush Terminal Station are nearing the end of their useful lives and will require refurbishment or replacement, including the replacement of a 46 kilovolt (kV) circuit breaker, the replacement of insulators, and the replacement of synchronous condensers shaft seals and resistance rings. Hydro also noted that a Level 2 condition assessment of the synchronous condensers was required.

The breaker replacement needs to proceed this year as particular breaker operating scenarios, further detailed in section 3.2, could result in an overloaded breaker current transformer, which could result in a failure of the breaker. The insulators, which have a long lead delivery of six to eight months, are subject to cement growth failures and Hydro replaces such insulators as opportunities arise. The replacement insulators need to be ordered in 2017 to enable replacement during the available outage windows in the 2018 construction season. Due to a history of repairs to resistance rings in both synchronous condensers and the Original Equipment Manufacturer recommendation to install redesigned rings, Hydro believes that the existing rings should be replaced as soon as possible to ensure reliable operation of the synchronous condenser. As the condensers will be disassembled to install the rings, Hydro will avail of the situation to install new shaft seals to address oil leakage into windings (which could cause electrical insulation failure) and to complete level 2 assessments on each condenser.

2.0 Project Description

The scope of work for this project includes:

- Replacement of one 46 kV circuit breaker, 46-33, please see Appendix A for WABTS single line diagram, and the completion of breaker and feeder protection upgrades

for this circuit breaker;

- Replacement of thirty-six 46 kV post insulators, twenty-four 46 kV suspension insulators, twenty-four 230 kV suspension insulators;
- Level 2 condition assessments of two synchronous condensers, SC1 and SC2. This requires sections of the unit to be dismantled by a specialized team, which hold the original equipment manufacturer intellectual property for the asset; and
- Purchase and replacement of shaft seals and resistance rings for SC1 and SC2.

3.0 Justification

This project will replace the circuit breaker 46-33, high voltage insulators, and synchronous condenser components that could fail and affect the reliable operation of the Wabush Terminal Station.

3.1 Existing System

The Wabush Terminal Station was acquired by Hydro in September 2016. Prior to Hydro taking ownership of this station, it was operated and maintained by Churchill Falls (Labrador) Corporation (CF(L)Co). Some assets at this site date back to 1961 and have operated successfully since installation.

This station includes eight 230:46 kV power transformers, three 230 kV air blast circuit breakers, twenty-two 46 kV oil circuit breakers, five 46 kV gas breakers, two 46 kV capacitor banks, two synchronous condensers (SC1 and SC2), and other station equipment including disconnect switches, instrument transformers, bus work, insulators, surge arresters, power cables, and protection and control equipment.

3.2 Operating Experience

The Wabush Terminal Station has operated successfully since 1963 while owned by TwinCo and operated by CF(L)Co; however, investigation by Hydro, upon purchase of the station, has identified the following issues with the terminal station:

a) 46 kV Circuit Breaker 46-33:

Normally, there are two circuit breakers, 46-32 and 46-33, providing electricity to the 50 MVA distribution load. With both breakers in service, the load is exceeding the 16 MVA rating of the metering current transformer by approximately fifteen percent. If breaker 43-32 was unavailable at peak load, breaker 46-33 would be significantly overloaded. In either scenario, the operation can result in incorrect metering and relaying, causing possible failure of the current transformers and circuit breaker.

The overloaded current transformers are internal to the 1961 oil filled circuit breaker. The circuit breaker and bushings are suspected to contain PCB's in excess of 50 mg/kg. PCB equipment containing greater than 50 mg/kg is required under federal legislation to be removed by 2025. The replacement of this breaker will ensure this deadline is met and will also be in line with Hydro's philosophy to have all oil filled circuit breakers replaced by 2025.

b) Insulator Replacements:

Initial inspections by Hydro have identified a number of 230 kV and 46 kV insulators which are of an older design prone to cement growth. Cement growth is a common problem in the utility industry that results from cracks forming in the cement and water migrating into the cracks. Through freeze and thaw cycles, pressure is placed upon the porcelain resulting in cracking and eventual insulator failure. The failure of these insulators will result in outages to customers.

c) SC1 and SC2 Resistance Rings:

Resistance rings are a component of the damper winding system on synchronous condensers that are required for the machine to be self-starting and react to electrical and mechanical forces placed on the unit. Damper windings are placed in the rotor poles of the unit and shorted together via a resistance ring on each end of

the rotor. In 2015, Voith Hydro (Voith) reported that "Annual inspections continue to reveal issues with both the [collector end] CE and NCE [non-collector end] resistance rings on both SC1 & SC2. Numerous repairs have been performed over the years and most recently one set of resistance rings were replaced. This year's inspections revealed cracks at the damper ring on the SC2 NCR side. The ring was repaired and the same procedure as during the 2014 repair was used."[2]

In 2016, Voith recommended for both SC1 and SC2, "replacing the resistance rings on both SC1 and SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit."[3]

Hydro believes the current condition of the resistance rings poses a risk to the reliable operation of the condenser machine and therefore should be replaced to ensure Hydro can continue to provide reliable service to its customers.

d) SC1 and SC2 Shaft Seals:

Shaft seals in a synchronous condenser prevent oil within the lubrication systems from contaminating other parts of the unit. In 2015, Voith stated that, "Recent annual inspections suggest the seals located in the bearing housings should be replaced and a new seal arrangement designed and installed on the motor end covers preventing oil mist and vapors from bearing sump being drawn along the rotor shaft extension and into the stator / motor frame." [4] This oil mist and vapor contamination can compromise the insulation of the stator, leading to possible equipment failure.

e) Assessments of Synchronous Condensers SC1 and SC2:

[2] Please see Appendix B, *Voith 2015 SC1 and SC2 Annual Inspection Report and Recommendations*, Page 6.
[3] Please see Appendix C, *Voith SC1 Annual Minor Inspection 2016*, Page 19and Appendix D, *Voith SC2 Annual Minor Inspection 2016*, Page 17.
[4] Please see Appendix B, *Voith 2015 SC1 and SC2 Annual Inspection Report and Recommendations, Page 8.*

Prior to Hydro taking over ownership of the Wabush Terminals Station assets, minor assessments have been completed every year and major assessments (Level 2) have been completed every 3 years. These Level 2 assessments require the units to be partially dismantled to complete electrical testing, inspection of bearings, resistance rings, stator, and rotor. A major assessment requires the rotor to be pulled from the unit for a more thorough inspection. These activities on synchronous condensers are required to identify equipment, environmental, and safety deficiencies.

As resistance ring replacements are required on both SC1 and SC2, both rotors will have to be pulled from the units. Given this, a major (Level 2) condition assessment will be conducted on both synchronous condensers as part of this project.

3.2.1 Reliability Performance

The Wabush Terminal Station has operated reliably in the past; however, there are concerns about future reliability as outlined earlier in this report.

3.2.2 Legislative or Regulatory Requirements

There are no legislative or regulatory requirement issues related to the justification of this project.

3.2.3 Safety Performance

There are no past safety performance issues related to the justification of this project.

3.2.4 Environmental Performance

There is no past environmental performance issue related to the justification of this project.

3.2.5 Industry Experience

There is no industry experience related to the justification of this project.

3.2.6 Vendor Recommendations

Vendor recommendations from Voith's past synchronous condenser inspections in Wabush Terminal Station were discussed in section 3.2 and form the basis for replacing resistance rings and shaft seals. Appendix B, C, and D contain the Voith reports for 2015 and 2016.

3.2.7 Maintenance or Support Arrangements

Maintenance on the equipment within the terminal station will be performed by a combination of Hydro personnel and contractors. For maintenance on the synchronous condensers CF(L)Co. has previously utilized Voith to complete this work.

3.2.8 Maintenance History

The five-year history for Wabush Terminal Station's preventative and corrective maintenance is shown in Table 1.

Table 1: Five-Year Maintenance History

Year	Preventive Maintenance ($000)	Corrective Maintenance ($000)	Total Maintenance ($000)
2016	182	940	1122
2015	451	727	1178
2014	466	972	1438
2013	695	338	1033
2012	67	658	725

3.2.9 Historical Information

There is no historical information related to the justification of this project.

3.2.10 Anticipated Useful Life

The following useful life information is applicable:

- The anticipated useful life of a circuit breaker is 55 years.
- The anticipated useful life of an insulator is 30 years.

- The anticipated useful life of a synchronous condenser is 65 years.

3.3 Forecast Customer Growth

There is no forecasted customer growth related to the justification of this project.

3.4 Development of Alternatives

There are no other viable alternatives to this project. The status quo is not an option as the risk to reliability will increase with continued operation.

3.5 Evaluation of Alternatives

3.5.1 Energy Efficiency Benefits

There is no energy efficiency benefit related to the justification of this project.

3.5.2 Economic Analysis

As there are no viable alternatives, economic analysis was not undertaken

4.0 Conclusion

In September 2016, Hydro acquired the Wabush Terminal Station. Initial review by Hydro indicates that immediate work is required in order to maintain reliable operation of this station. This work, included in this proposed Supplemental Capital Budget Application, includes the replacement of a 46 kV circuit breaker, high voltage insulators, shaft seals and resistance rings on the synchronous condensers, as well as Level 2 condition assessments on the synchronous condensers.

4.1 Budget Estimate

The budget estimate for this project is shown in Table 2.

Table 2: Project Budget Estimate

Project Cost:*($ x1,000)*	**2017**	**2018**	**Beyond**	**Total**
Material Supply	22.9	50.0	0.0	72.9
Labour	451.9	204.2	0.0	656.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	1,406.0	0.0	0.0	1,406.0
Other Direct Costs	173.6	0.0	0.0	173.6
Interest and Escalation	120.1	22.3	0.0	142.4
Contingency	410.9	50.8	0.0	461.7
TOTAL	**2,585.3**	**327.3**	**0.0**	**2,912.5**

4.2 Project Schedule

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity		**Start Date**	**End Date**
Planning	Scope, schedule, cost, risk, quality and communication planning	March 2017	April 2017
Design	Detailed P&C, Electrical and Civil designs; Develop work packages	April 2017	May 2017
Procurement	Tender for materials; Develop proposal for consultant assessment	May 2017	June 2017
Construction 1	Breaker Replacement; Insulator Replacement, Protection Upgrades; Synchronous Condenser work; Completion of Assessment	May 2017	Oct 2017
Commissioning 1	Commissioning of new equipment	Sept 2017	Oct 2017
Construction 2	Insulator Replacements	July 2018	Sept 2018
Closeout	Project Closeout	Sept 2018	Oct 2018

APPENDIX A

Wabush Terminal Station Single Line Diagram

CHURCHILL FALLS
WABUSH
L2303
L2404
L4G
L3G
SHUNT REACTOR
X1
S.C. 3
SS 3
SST3
15-3
15-2
15-1
BUS 150
T13
S.C. 1
S.C. 2
4000/310
EXCITER XFMR
EX101
EXCITER XFMR
EX201
T11EX1
T12EX2
PT 1
PT1B1
FUT
2B1
TO NORMAND SUBSTATION SEE NOTE No. 1
A05
CHANTAL
FERMONT
T1B21 (N.O.)
(65E)
FUT1
T1
46/34kV
L1T1 N / O
B02
NMD 34500
B03
B01
TO FERMONT
L469
4L4
3L3
230-4
230-3
4B1
3B1
BUS 1
B1B2
A
230-2
230kV BUS B2
QUEBEC
LABRADOR
23L23
L23G
24L24
L24G
T1B1
T1G
T2B1
T2G
T3B1
T3G
T4B1
T4G
4-1
12-1a
12-1b
4-2
12-2a
12-2b
T5B1
T5G
T6B1
T6G
T7B2
T7G
T8B2
T8G
T1
T2
T3
T4
T11
T12
BUS 17
T5
T6
T7
T8
469-1 N / C
WA33-D3 N / O
WA33-D4 N / C
WA33-D2 N / C
(SEE DWG. 419-1)
WALSH'S RIVER SUB
230-23
230-24
46-1
46-8
SF6
46-2
46-3
46-4
46-12
46-14
46-15
46-13
46-5
46-6
SF6
46-7
23B25
24B25
1B12
8B12
2B12
3B14
4B15
12B13
14B11
15B15
13B15
5B15
6B16
7B16
BUS 11
BUS 14
BUS 13
BUS 16
B25
B25B26
(PIPE) B11B14
(PIPE) B11B12
(PIPE) B12B13
(PIPE) B13B14
(PIPE) B15B16
19
PT 1
PT 2
PT-20
11B14
11B15
46-11
BUS 12
BUS 15
HARRY LAKE 2.5 MW
TS9WA33-1 N / O
22B25
21B26
230-22
M
230-21
22B24
21B23
21B11
22B12
23B12
16B12
24B12
25B13
27B14
17B15
28B15
29B15
30B15
32B15
33B15
34B15
35B15
36B15
38B16
46-21
46-22
46-23
46-16
46-24
46-25
46-27
46-17
46-28
46-29
46-30
46-32
46-33
46-34
46-35
46-36
46-38
21-1
22-1
23-1
SS1
16-1
24-1
G
XL
CAP-1
27-1
SS2
17-1
28-1
29-1
30-1
32-1
33-1
34-1
35-1
36-1
CAP-2
VANIER SUB
TS11WA33-2 N / O
TS11-D12 N / C
TOWNSITE SWITCHING SUB
WA32WA33-D2 N / O
WA33WA36-D1 N / O
WA36-D4 N / C
WA32-D3 N / C
WA32-D2 N / C
WA32WA33-1 N / O
TS11WA33-1 N / O
L33
WABUSH No. 1
WABUSH No. 2
WABUSH TOWN 13MW
LAB. CITY TOWN
TOWNSITE SWITCHING SUB
I.O.C. 1
I.O.C. 2
I.O.C. 3
SS1
I.O.C. 4
I.O.C. 5(a)
SS2
I.O.C. 5(b)
I.O.C. 6
I.O.C. 7
CONTINUED ON PLATE 13

NOTES :

1. FOR DETAIL SEE H.Q. DWG 50300-31013B
2. ◄— M —► MANUAL TRANSFER SCHEME CLOSE THE "OPEN" BREAKER TO TRANSFER
3. FOR FURTHER INFORMATION, PLEASE SEE DWG. 413-1.

DATE	NO.	REVISIONS OR ISSUES	DRAWN	CHECKED	APPROVED
11 JULY '16	19	ADDED B11B12, B11B14, B12B13, B13B14 & B15B16	PHC	CRW	CRW
3 NOV. '15	18	GENERAL REVISIONS IN CHANTAL BLOCK	PHC	K.D.	
8 JULY '14	17	GENERAL REVISIONS	PHC		
22 MAR. '12	16	ADDED PT-20	PHC		
14 APR. '10	15	GENERAL REVISIONS	PHC		
5 NOV. '09	14	GENERAL REVISIONS	PHC	CW	PT
7 NOV. '07	13	GENERAL REVISIONS	PHC	MD	
15 SEPT. '04	12	GENERAL REVISIONS	PHC		
25 JUNE '99	11	T7, T8 & S.C. 3 ADDED	KH		
24 OCT. '97	10	GENERAL REVISION	KH		

CHURCHILL FALLS
(LABRADOR) CORPORATION LIMITED

CHURCHILL FALLS POWER PROJECT - LABRADOR

CHURCHILL - WABUSH - FERMONT INTERCONNECTION SINGLE LINE DIAGRAM

SCALE
CONSULTANTS REFERENCE

DRAWING NUMBER
551 OSK 036

REV. 19

DRAWING NO. 551 OSK 036
REV. 19

APPENDIX B

Voith 2015 SC1 and SC2 Annual Inspection Report and Recommendations

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
	Revision -

Synchronous Condenser Inspection Report and Recommendations

Rev.	Page	Description	Created by	Approved by	Date

Executing OU	Created by		Checked by		Approved by		Issue Date
VHMS	Greg Rozik		Sigmar Dau		Sigmar Dau		2015-10-14

VOITH

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
	Revision -

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Executing OU	Created by		Checked by		Approved by		Issue Date
VHMS	Greg Rozik		Sigmar Dau		Sigmar Dau		2015-10-14

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
	Revision -

1 Technical Data

1. Kva - 60000
2. Volts - 13800
3. Amps - 2510
4. Rpm - 900
5. Serial – 1-1S1650

Executing OU	Created by		Checked by		Approved by		Issue Date
VHMS	Greg Rozik		Sigmar Dau		Sigmar Dau		2015-10-14

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
	Revision -

2 Stator Windings

1. General Observations:

Annual inspections of the stator windings have revealed light contamination of some oil and dust on the end turns and coil extensions. Stator windings are cleaned and tested for insulation resistance to ground. This year minor corona was observed and repairs were performed on the end turns based on Voith instruction #2-01671627 and inspected post repair. All blocking at the coil extensions is intact with no signs of movement. The coil slot wedges in the iron were inspected and no indication of movement or degradation was found. The stator iron which supports the windings is in good condition, as are the iron end packs showing no indication of looseness or movement.

The hand taped insulation on the main leads to the buss along with the buss for the lightning arrestors was replaced with insulating boots, typically common practice for voltages of this range, not to mention much more efficient than having to hand tape each time for inspection purposes.

2. Recommendations:

The air intake louvers need to be looked at so they open, close and seal at the appropriate required times. It is important to maintain constant temperatures and humidity throughout the stator/iron construction throughout the external seasonal changes. The terminal station itself needs to be kept clean and organized. Continued air leakage was noted, which will hinder the attempts to control ambient temperature and humidity within the building.

The stator windings should be tested and inspected annually so that the winding insulation system can be accurately trended. The Doble and insulation resistance tests should be performed at the next maintenance down turn to help to accurately predict reliability and schedule required maintenance. A Doble test of the stator winding should be performed every three to five years and insulation resistance to ground every year.

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
	Revision -

3 Lightning Arrestors

1. General Observations:

Subsequent annual inspection of the LA's includes disconnecting, inspection and cleaning. The insulation resistance to ground is also measured. Typically the units test well and no further work is required at this time.

Executing OU	Created by		Checked by		Approved by		Issue Date
VHMS	Greg Rozik		Sigmar Dau		Sigmar Dau		2015-10-14

Insulating boots were installed to eliminate the requirement to remove and hand tape each time.

4 Rotating Field Poles

1. General Observations:

Each inspection involves a visual inspection, insulation resistance to ground and voltage drop test. Typically, we find the turn insulation and collars to be in good condition. The insulation resistance to ground is within required specification. The voltage drop test indicates there are no shorted turns.

2. Recommendations:

As alluded to previously, maintaining constant temperature and humidity level in this building is critical. Issues with the terminal buildings louvers and heaters need to be addressed.

5 Damper Winding (resistance ring)

1. General Observations:

Annual inspections continue to reveal issues with both the CE and NCE resistance rings on both SC1 & SC2. Numerous repairs have been performed over the years and most recently one set of resistance rings were replaced. This year inspections revealed cracks at the damper ring on the SC2 NCR side. The ring was repaired and the same procedure as during the 2014 repair was used. A major failure of the resistance ring while not to be considered catastrophic, would result in electrical imbalances in the damper winding circuitry. Typical lead time for a replacement is lengthy - in the order of 16 – 20 weeks.

Aside from the indications in the resistance rings themselves the damper bars all look to be tight in the pole faces. The steel mechanical connection ring appears to be in good condition and has not suffered any noticeable defects failures and is suitable for continued service at this time

2. Recommendations:

Voith propose replacing both sets of resistance rings on both SC1 & SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.

Nalcor Energy - Churchill Falls (Labrador) Wabush Terminal Station	
SC1 and SC2 Annual Inspection Report	PDM 2-01731078
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6 Stator iron/rotor pole air gap

1. General Observations:

Typically we have found the stator air gap clearances and resulting concentricity to be within the required specifications and there are no recommendations at this time.

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7 Shaft

1. General Observations:

Annual inspections have found the rotor shaft is in good condition with very minor scratches in the region of CE and NCE bearing journals. Shaft journals were inspected and polished as acceptable for continued service.

8 Shaft clearance seals

1. General Observations:

Recent annual inspections suggest the seals located in the bearing housings should be replaced and a new seal arrangement designed and installed on the motor end covers preventing oil mist and vapors from bearing sump being drawn along the rotor shaft extension and into the stator / motor frame.

9 Field pole circuit ring

1. **General Observations:**

The circuit ring and bus connection between the pole windings are mounted at each end of the rotor core and are routinely inspected. The insulators and buss were cleaned and all insulating hardware replaced as required.

10 Brush rigging

1. General Observations:

Annual inspections and maintenance includes the removal, cleaning and/or replacing and re-installing of carbons into the brush holder mechanism. The tubing insulation on the support rods are inspected and replaced with new G10 insulating material as required.

The brush holders are cleaned and inspected on an annual basis. The constant pressure springs are inspected and replaced as required.

11 Collector rings

1. General Observations:

Annual inspection of the collector rings includes routine cleaning, inspection and electrical testing of the insulation resistance as measured in the same circuitry as when the rotating field poles were tested.

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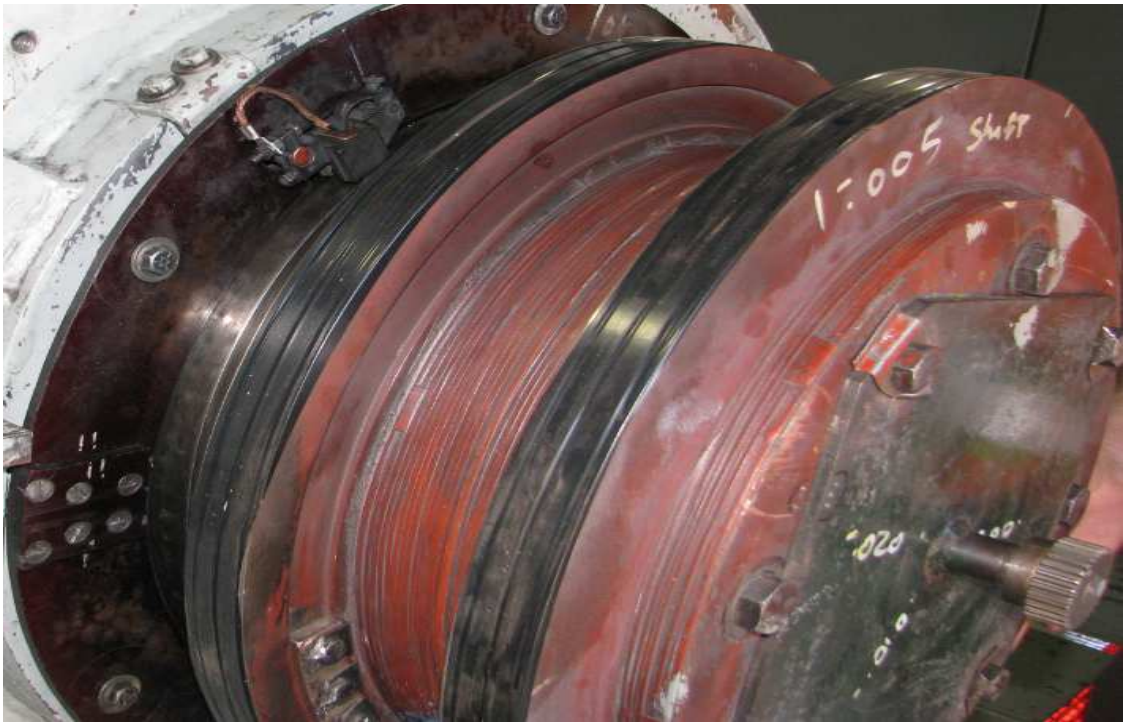
The collector rings are typically found to be in acceptable condition, with no excessive wear or out of round condition found. During this year's inspection of the SC1 collector ring, a cracked insulating washer for the connection bolt on the collector ring was replaced.



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12 Grounding brush

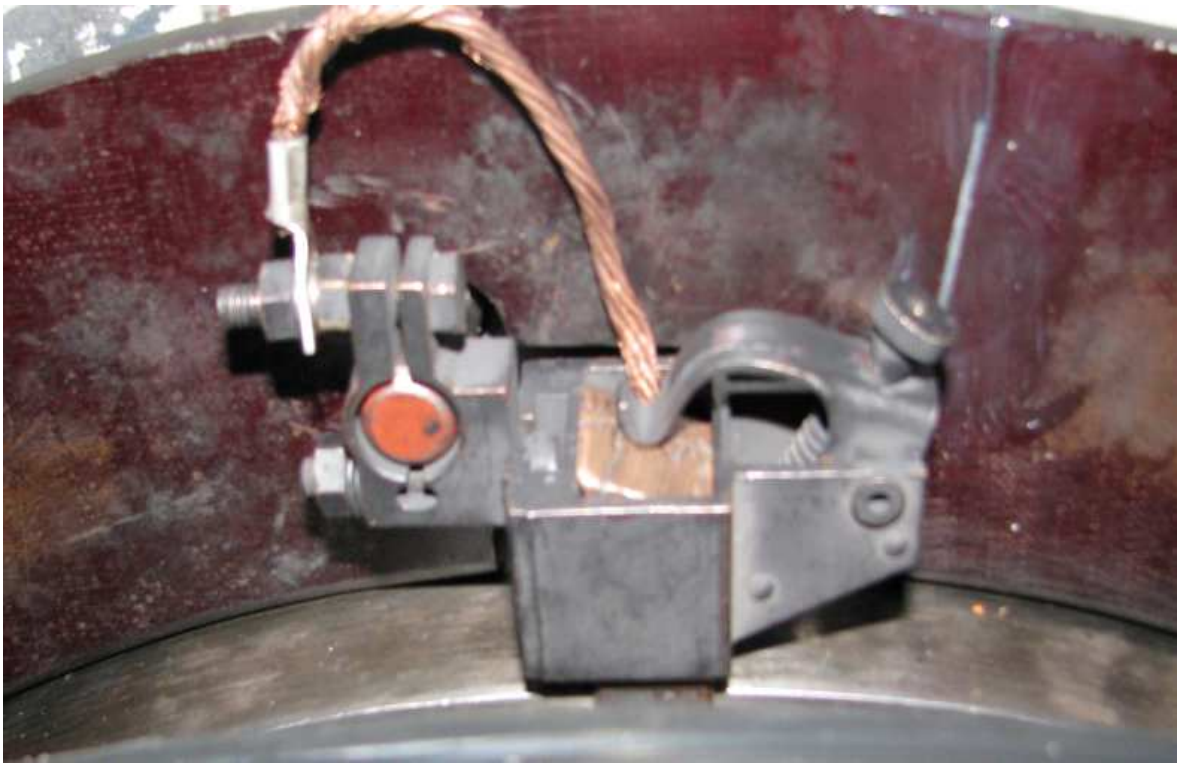
1. General Observations:

During the annual inspection, the grounding brush and holder are removed for cleaning and inspection.

Grounding brushes are typically replaced annually to ensure cylindrical shaft contact and cleanliness. However, during this year's inspection the brushes were found in acceptable condition and the same set was installed.

2. **Recommendations:**

Keep a set of spear brushes for each machine ready for annual inspection.



13 Blowers

1. General Observations:

Annual inspections involve cleaning and inspection for damage and/or cracks which could lead to a sudden major failure.

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14 Bearings and pedestals

1. General Observations:

Annual inspection of the journal bearings includes removal of the bearing pedestal top cover, inspection of the oil for Babbitt contamination and testing the integrity of the insulation system. Bearing pedestals are cleaned and the insulation resistance was measured.

The results of the pedestal oil inspection indicated Babbitt contamination and further examination of the journal bearing was required.

The top half of the bearing was removed. Visual inspection showed that the oil pickup ring had punch marks that were protruding and cut into the oil ring Babbitt guides. This problem was present in all four journal bearings.

The sharp burrs on the oil rings were deburred and the marks at the Babbitt guides on the bearing were cleaned.

2. Recommendations:

New sets of oil pickup rings should be installed. New bearing seal arrangement is recommended.

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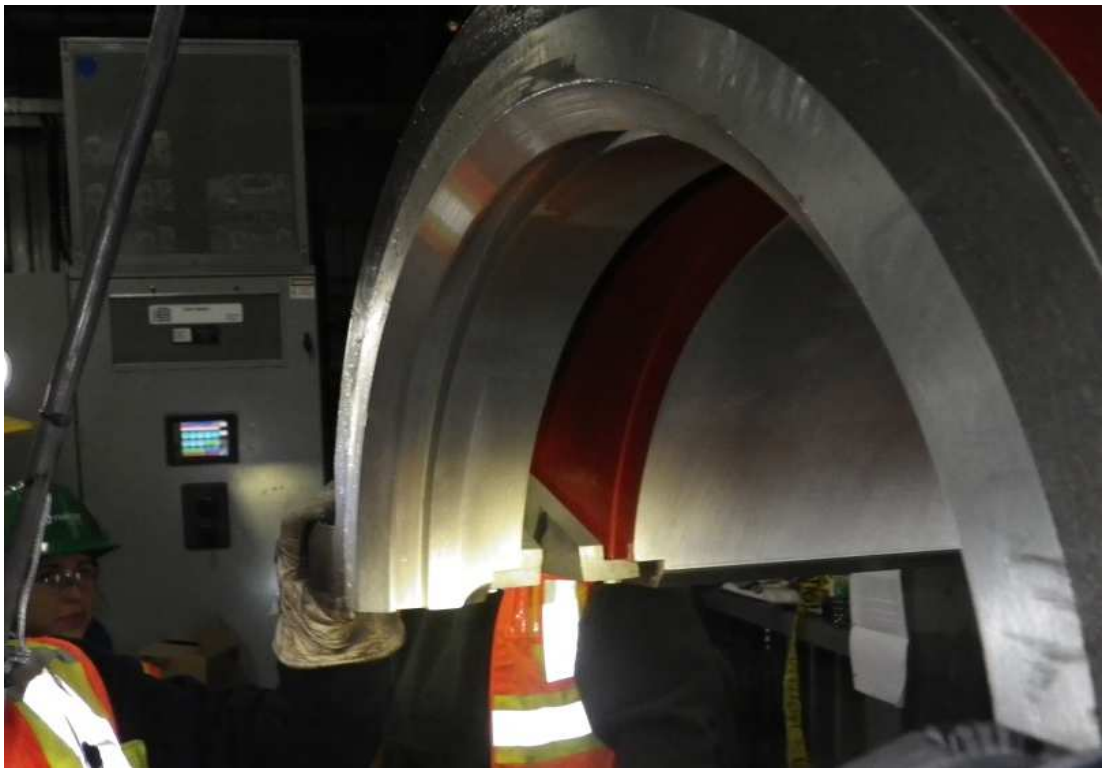

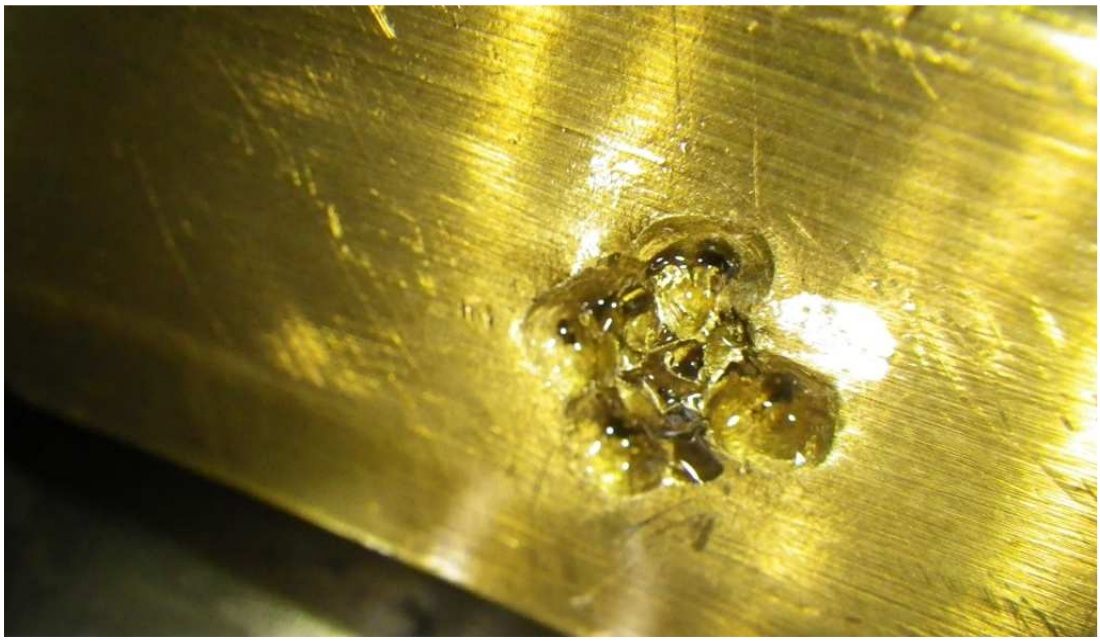

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15 Thrust bearing

1. General Observations:

Inspections revealed the thrust bearing to be in good condition, however the unit has been noted to trip out on a temperature alarm should the electrical magnetic center of the rotor be out of specification.

2. Recommendations:

The thrust bearing temperature should be monitored closely on start-up of the unit, further adjustments may be necessary to locate the electrical magnetic center if a temperature spike is noted. All Belleville washers should be replaced on the thrust bearing adjuster.

16 Oil, Holding Tanks, Filters and Pumps

1. General Observations:

Annual inspections and concern regarding oil cleanliness have found it necessary to pump the oil from the three holding tanks. The holding tanks were cleaned. The filters were replaced with new units. The oil was filtered upon draining and refilling of the reservoirs. It was determined that sourcing replacement parts and servicing of the original HPU units could be potentially troublesome and it was recommended that the existing HPU units be replaced with new. Two new HPU units were designed built and delivered to the Wabush terminal station.

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2. Recommendations:

Installation and commissioning of the new unit should be completed during the next year outage.

17 Shaft High-Lift System

1. General Observations:

The high lift supplies an oil film between the bearings bore and shaft journal prior to rotating the shaft.

For both SC1 and SC2 high lift systems were tested with positive results.

For SC1: CRE & NCRE : .009” @ 1000 psi

For SC2: CRE: .009” @ 1000 psi; NCRE: .007” @ 1305 psi

For both machines these systems were tested again during the start-up, and in both cases tune-up of pressure relieve valves were needed.

2. Recommendations:

During the inspection of the units the bearing lube system and high lift system should be checked together to make sure the systems are working properly. Spare parts should be considered a mandatory inventory item.

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18 Air Filters

1. General Observations:

Routine maintenance and monitoring should be practiced in conjunction with Preventative Maintenance Program.

During this year inspection, air filters were checked and cleaned. The same set of filters was installed. The customer is concerned about proper air flow in the SC1 and SC2. Currently the Voith AMB team is investigating the use of different filters which may be more suitable for the application.

2. Recommendations:

Spare air filters should be considered a mandatory inventory item.

19 Vibration Testing

1. General Observations:

Annual inspections have employed the use of a Schenck Vibroport 30 Universal Vibration Measuring Instrument c/w VS-080 magnetic base velocity pickups positioned horizontally on the bearing pedestal caps.

Vibration displacement levels at fundamental frequencies were found to be consistently within the permissible tolerance for Group III machines as per ISO 10816-1:1995 (supersedes VDI2056) Criteria for Assessing Mechanical Vibration of Machines.

20 Speed Switch

1. General Observations:

The RPM displayed on the screen has been noted to be inaccurate. The relay and speed switch require calibration for correct read out display on the panel and interface with the PLC. Additionally, Voith Automation group is recommending modification to the speed detection scheme to include dual equipment and circuitry to protect the equipment in the event of a component failure. Additionally, the wiring from the speed switch to the C620 contact should be replaced including the installation of a capacitor to the wiring scheme logic.

21 Lifting Beam, Rollers

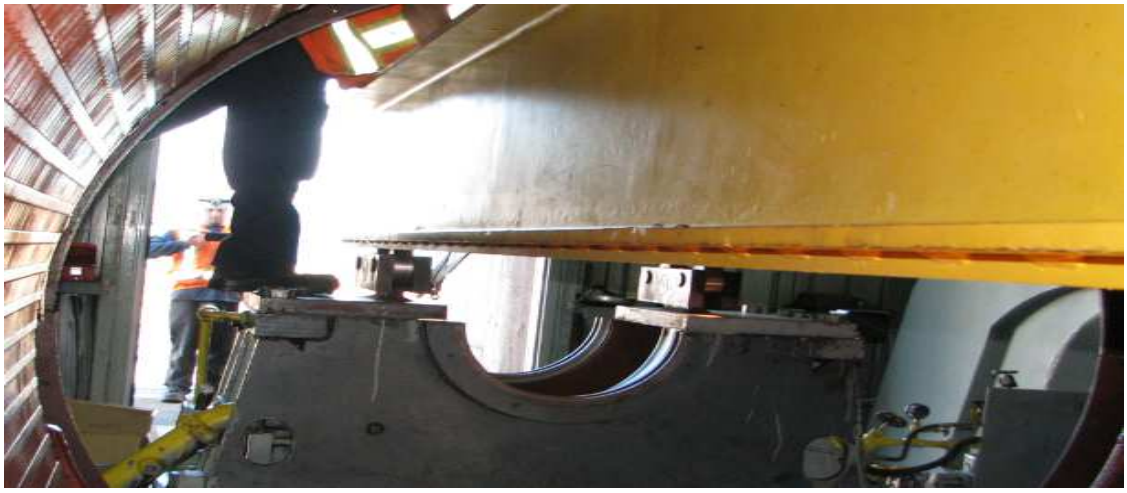
1. General Observations:

The tools and equipment supplied by the OEM to facilitate the rotor removal have been stored outdoors, resulting in corrosion. Visual cracks were observed in the lifting beam welds and were

repaired during the 2015 outage to facilitate rotor removal. It is recommended that the lifting beam and essential accessories be stored indoors. The shaft extension beam was sent out and certified following repairs. NDE certifications/documentation of repairs requires proper maintenance.

2. Recommendations:

The shaft extension beam should be sandblasted inspected and certified. When certified, beam should be painted and stored indoor. Also the hardware for the U-clamp should be inspected for damage and replaced if needed. It has also been recommended that stop blocks be installed on the lifting beam support pedestal to prevent the possibility of the beam extending beyond pedestal assembly.



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22 Summary of Recommendations

1	Stator Winding	Maintain constant temperature & humidity throughout the seasonal changes. Repair the air intake louvers. The stator winding should be tested and inspected annually.
2	Rotating Field Pols	Maintain constant temperature & humidity throughout the seasonal changes. Issues with the terminal buildings louvers and heaters need to be addressed.
3	Damper Winding (resistance ring)	Replace both sets of resistance rings on both SC1 & SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.
4	Ground Brush	Keep a set of spear brushes for each machine ready for annual inspection.
5	Bearings and Pedestals	New sets of oil pickup ring should be installed. New bearing seal arrangement is recommended.
6	Thrust Bearing	Replace all Belleville washers on the thrust bearing. Closely monitor thrust bearing temperature during the start-up of the unit.
7	Hydraulic Power Unit	The new unit should be installed.
8	Shaft High-Lift System	During the inspection all hydraulic systems should be tested together to assure that they work properly.
9	Air Filters	New air filters should be installed. Spare air filters should be considered a mandatory inventory item.
10	Lifting Beam	The shaft extension beam should be sandblasted, inspected and certified. When certified, beam should be painted and stored indoor. Also the hardware for the U-clamp should be inspected for damage and replaced if needed.
11	End Bells	Add lifting lugs where missing. Replace all end bell hardware. Add two location bolts to each end bell to keep proper alignment. Consider repainting.
12	100 ton jacks	Replace the two mechanical 100 ton jacks. They were both overextended and damaged (operator error).
13	Locking Tabs	All Locking Tabs should be replaced during the outage; it is not a good practice to reuse locking tabs twice. It is recommend that a spare set of locking tabs should be ordered for the blowers and slip-ring assembly and the resistant rings.

APPENDIX C

Voith SC1 Annual Minor Inspection 2016

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1 Unit Data

1.1 Nameplate Information

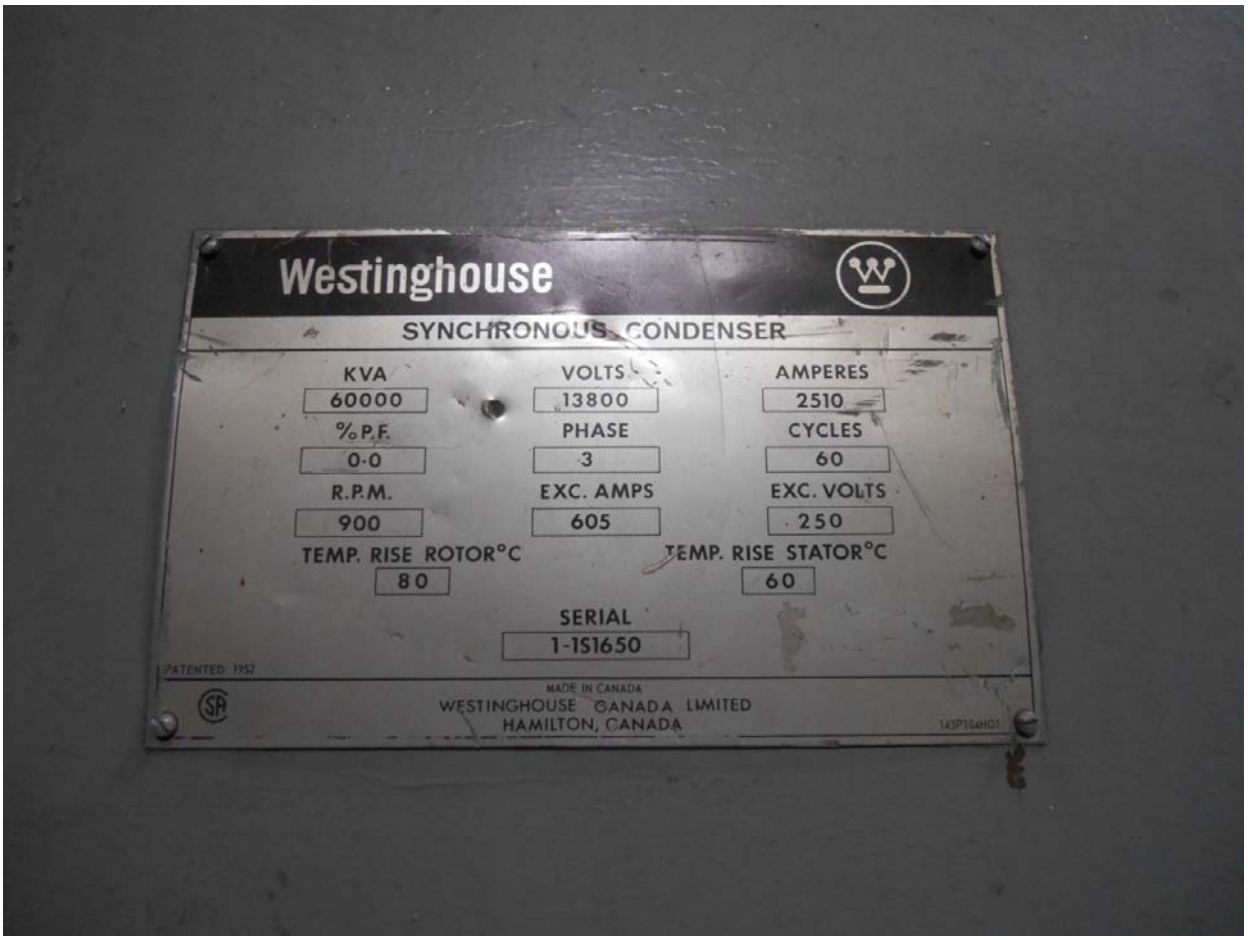

Fig. 1: Westinghouse 60MVA Syncronous Condenser

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2 Inspection Summary

2.1 Outage Overview

Nalcor Energy held an annual outage at the Wabush Terminal Station located near Labrador City, Labrador. The two synchronous condensers were scheduled for a minor inspection, starting with unit SC1. Jeff Slade was the lead representative from Nalcor. Wade Whiteway and Jeremy Stagg were the local operations staff for the site, providing daily permits, toolbox talks and testing permits as required throughout the outage.

Voith Hydro performed the inspection, with Paul Kay as the Technical Advisor, supported by craft labour from Labrador Rewind. The team arrived on site June 7, 2016 to begin the inspection with a planned 6 day/week x 10hr/day schedule.

There were no significant findings during the inspection of this unit, with the exception of an existing weld repair that initially appeared to be a crack in the Non-Collector End resistance ring. Closer investigation of this area revealed the overlap of the weld visually was intact and no further action was required. All related information is documented in the body of this report.

Unit SC1 was returned to service on the afternoon of June 18, 2016.

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2.2 Unit Condition Overview

Unit SC1 is in serviceable condition, with no findings that would curtail its operation within normal parameters. Internally, the Stator winding end turns and Rotor poles are covered in a light film of oil and dirt. This does not affect unit performance significantly but does affect the insulation integrity over the life of the unit.

Fig. 2: Overview of Non-Collector End - Light Dirt on Stator Winding End Turns and Rotor Poles

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Externally, this unit is covered in a thin layer of oil, dirt, and small metal shavings in some areas. This is particularly prevalent on the bearing pedestals, which resulted in a 0 Ohm Megger reading on both pedestals until a thorough cleaning was performed around the pedestals and piping.

Fig. 3: Collector End Bearing Pedestal - Oil film and metal shavings accumulated on isolation pad

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Fig. 4: The oil film appears to be a result of small leaks in the external oil piping. There are a number of oil absorbing pads placed on the outside of the bearing pedestal and around the unit.

A thorough cleaning of the unit was carried out prior to the unit being returned to service. Before the next major inspection, a plan should be put in place to correct the minor oil leaks.

Overall the unit is in good condition.

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3 Unit Inspection Results

3.1 Stator Windings

3.1.1 General Observations

Annual inspections of the stator windings have revealed light contamination of some oil and dust on the end turns and coil extensions. All blocking at the coil extensions is intact with no signs of movement.

Fig. 5: Stator end turn and coil extension condition

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Fig. 6: Stator end turn and coil extension condition

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3.1.2 Megger and PI Results

Stator windings are tested annually for insulation resistance to ground via 10 minute Megger/PI at 5000VDC.

The test results can degrade over the course of the unit outage due to accumulation of moisture within the windings. In order to mitigate moisture accumulation, the louvres are manually closed and the outside is covered with plastic.

This frame is installed after shutdown and lockout of the unit to reduce the moisture accumulation in the stator windings. The frame does not fully cover the louvres and should be re-made for a better fit with heavier gauge poly-plastic.

Fig. 7: Stator Louver protected with plastic to reduce moisture in the windings

A test was completed shortly after unit shutdown and then again prior to units startup to document the change.

Test Date	Megger at 1 min	Megger at 10 min	Calculated PI
2016-06-10	965	5850	6.06
2016-06-17	2320	8150	3.51

Table 1: Stator 5000VDC Megger/PI Test Results (values are in Mega-Ohms)

The test results are acceptable, with a minimum PI of 2 required for startup.

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3.1.3 Recommendations

The stator windings should be tested and inspected annually so that the winding insulation system can be accurately trended. In previous reports, a Doble and insulation resistance tests had been recommended for the next major inspection. In discussion with Voith's engineering team, a controlled overvoltage test would be a more effective means of assesing the condition of the unit stator insulation. This test is recommended for the next major inspection interval.

When the unit is offline for extended periods of time, the louvres should be kept closed to reduce the humidity within the unit. If necessary, supplemental heating should be introduced by means of a Salamander or Frost Fighter

3.2 Rotating Field Poles

3.2.1 General Observations

Annual inspection involves a visual inspection, insulation resistance to ground and voltage drop test. A thorough visual inspection of the rotor was completed. The ends of the rotor poles are covered in a light film of dirt. The fan blades all appear to be in good condition with no signs of damage. All V-Blocks were inspected by means of a hand-held inspection scope with no issues noted.

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Fig. 8: Collector End - View of rotor poles and fan

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Fig. 9: Non-Collector End - View of rotor poles and fan

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3.2.2 Electrical Testing

3.2.2.1 Megger Test

A megger test was performed on the rotor at 500VDC for 1 minute.

The final reading was **710 Mega-Ohms**, which is well above the acceptable minimum of 15 Mega-Ohms.

3.2.2.2 Rotor Pole-Drop test

A rotor pole drop test was performed using the site 240VAC supply and measuring the voltage drop across all 8 poles.

Measured supply Voltage: 228.7VAC
Measured supply Current: 0.4A

Pole Number	Measured Voltage Drop
1	28.7
2	29.0
3	29.0
4	28.8
5	28.4
6	28.2
7	28.2
8	28.3
Total	228.6VAC

Table 2: Rotor Pole-Drop Results

The voltage drops across each pole are similar and vary < 10% between readings.

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3.2.3 Mechanical Inspections

3.2.3.1 Rotor Air-Gap

The air-gap between each rotor poles and stator core is measured to ensure the rotor is well centered. The design gap is 0.775" and the acceptable variance is +/- 10% of the average value recorded.

Pole Number	Collector End	Non-Collector End
1	0.685"	0.685"
2	0.690"	0.687"
3	0.700"	0.735"
4	0.687"	0.720"
5	0.683"	0.720"
6	0.688"	0.688"
7	0.678"	0.680"
8	0.685"	0.684"
Average	0.687"	0.699"
Average + 10%	0.755"	0.769"
Average – 10%	0.618"	0.629"

Table 3: Rotor Air Gap Measurements

There will be slight variance due to the final resting location of the shaft. These values are consistent with previous year's results.

3.2.3.2 Resistance Ring Concentricity Checks

The distance from the resistance (damper) ring circumference to the shaft is measured in a minimum of 4 locations to ensure it remains concentric to the shaft.

Location	Collector End	Non-Collector End
1 - Top	20.865"	20.885"
2 - Bottom	20.850"	20.880"
3 – Left (looking at unit)	20.860"	20.865"
4 – Right (looking at unit)	20.855"	20.878"

Table 4: Resistance Ring Concentricity

There will be slight variance due to the final resting location of the shaft. These values are consistent with previous year's results.

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3.2.4 Recommendations

Continue with annual electrical testing and mechanical inspections at the next scheduled interval.

3.3 Damper Winding (Resistance Ring)

3.3.1 General Observations

A thorough visual inspection of the Damper Windings was completed. No issues were noted on the collector end damper winding, although there was some minor paint loss around the circumference and an accumulation of light dirt.

Fig. 10: Inspecting the back side of the damper winding with a mirror

On the Non-Collector end, an indication was noted that lined up with Pole No. 5. Initially, it appeared to be a crack that was propagating inward from the face of the ring. Upon further investigation by removal of the outer paint, it was revealed the area had been repaired previously, and the overlap of the weld is intact. No further action was necessary.

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The indication presented as propagating approximately 2.5cm inward on the inside of the damper winding and 1/2 the width of the face.

Fig. 11: NCRE Damper winding - Visual indication at Pole 5

This is a photo of the outer circumference of the damper winding. It appears this area may have been repaired previously.

Fig. 12: NCRE Damper winding - Outer circumference at Pole 5

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The paint was removed in this area to reveal the existing weld repair. The 'crack' is actually the overlap of the weld, and appears visually to be intact.

Fig. 13: NCRE Damper winding - Paint removed to investigate the area.

Second photo of the area using a mirror to show more of the weld repair.

Fig. 14: NCRE Damper winding - Existing weld repair is intact

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3.3.2 Recommendations

Voith recommends replacing the resistance rings on both SC1 and SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.

3.4 Brush Rigging, Collector Rings and Ground Brush

3.4.1 General observations

Annual inspections and maintenance includes the removal, cleaning and/or replacing and re-installing of carbons into the brush holder mechanism. The collector rings are inspected for burnishing and evidence of any physical damage. The ground brush is inspected for general condition and wear

During this inspection, no brushes required replacement and the spring tension on all retainers was around 3.5 lbs.

The collector rings appear to be in good condition. No issues were noted.

The ground brush assembly was cleaned and found to be in good condition. The brush should be replaced at the next inspection interval.

The brush rigging assembly is in good condition. All brushes appear to be in good condition and spring tension on the retainers is an average of 3.5lbs which is sufficient for proper brush pressure. The minimum spring pressure is 3lbs.

Fig. 15: Brush Rigging assembly

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The collector rings are in good condition with no evidence of burnishing or physical damage. The bore copper studs are tight.

Fig. 16: Collector Rings

The ground brush assembly is in good condition and the brush itself does not require replacement at this time. The brush will likely need to be replaced at the next inspection interval.

Fig. 17: Ground Brush Assembly

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3.4.2 Recommendations

Collector brushes should be kept in stock on site in the event that any require replacement

The last ground brush was used on SC2 and replacements should be ordered. Part number is – DWG 714A257 Item #1. The ground brush will likely require replacement at the next inspection interval.

3.5 Speed Probe

3.5.1 General Observations

The speed probe gap is measured before the brush rigging guards are removed and re-checked on reassembly of the guards to ensure the same gap is left. This is to ensure a proper signal to the PLC. The As Found gap was measured at 0.044" with the hi-lift system off and was verified to be the same value on reassembly.

Speed probe measurement was found to be 0.044" before removal of the guards.

Fig. 18: Speed probe gap

3.5.2 Recommendations

Voith recommends modification to the speed detection scheme to include dual equipment and circuitry to protect the equipment in the event of a component failure.

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3.6 Bearings and Pedestals

3.6.1 General Observations

Annual inspection of the journal bearings includes removal of the bearing pedestal top cover, inspection of the oil in the pedestal sump for any signs of babbitt contamination and testing the integrity of the pedestal insulation system. Bearing pedestals are cleaned and the insulation resistance is measured.

The bearing pedestals were drained to allow visual inspection of the bottom of the pedestal sumps. On SC1, it takes an extremely long time for the pedestals to drain; over 24 hours. There was no evidence of babbitt in either sump.

The bearing top halves were removed to inspect the oil rings and journal for any damage. During this inspection, no damage was noted. There are some light scratches on the journal surfaces. The punch marks on the oil rings have no raised spots that could create rubbing or wear as was found during the 2015 inspection.

The pedestals have an accumulation of oil, dirt and in the case of the collector end pedestal, fine metal shavings. The source of the shavings is not known. It took an extensive amount of cleaning of each pedestal in order to achieve an adequate pedestal insulation reading.

Final readings for the pedestal insulation were 35.6 Mega-Ohms on the Non-Collector End and 37 Mega-Ohms on the Collector End.

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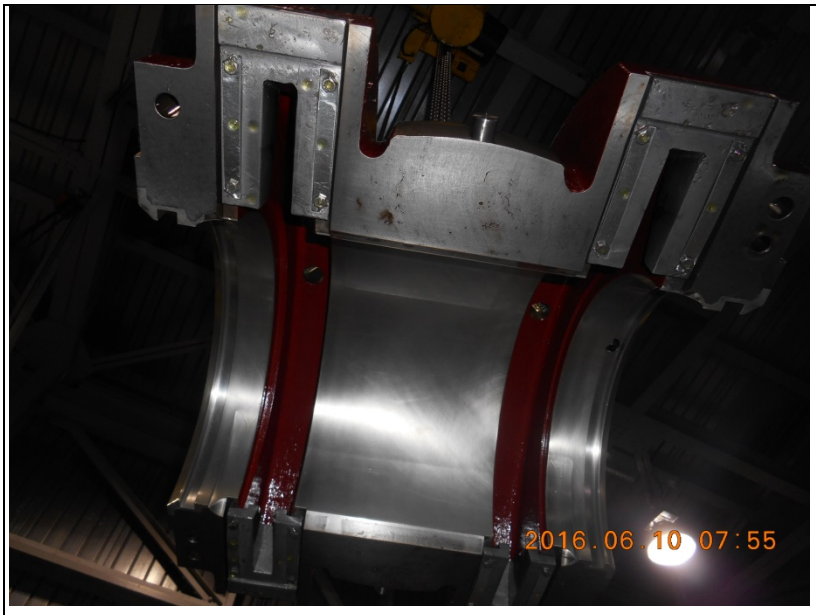
NCRE Bearing upper half removed. The journal is in good condition with only light scratches observed. The oil rings are in serviceable condition, with no raised spots on the punch marks as was found during the 2015 inspections

Fig. 19: NCRE Journal and Oil Rings



The NCRE bearing upper half is clean with no issues noted.

Fig. 20: NCRE Upper half bearing

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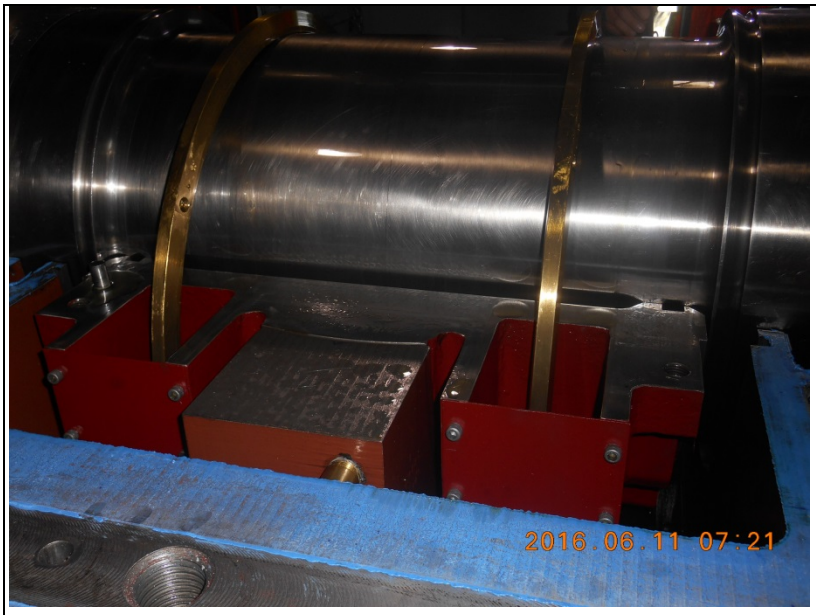
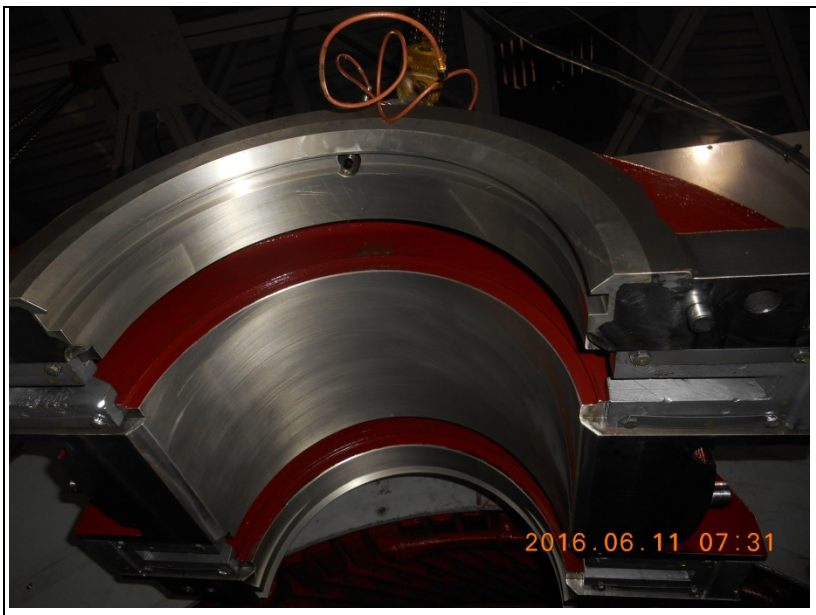


The CRE journal was found to be in good condition with only light surface scratches. The punch marks on the oil rings are flush with no high-spots.

Fig. 21: CRE Journal and Oil Rings



The CRE upper half bearing was found to be in good condition. There are some light scratches on the outboard side of the bearing surface.

Fig. 22: CRE bearing upper half

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3.6.2 Recommendations

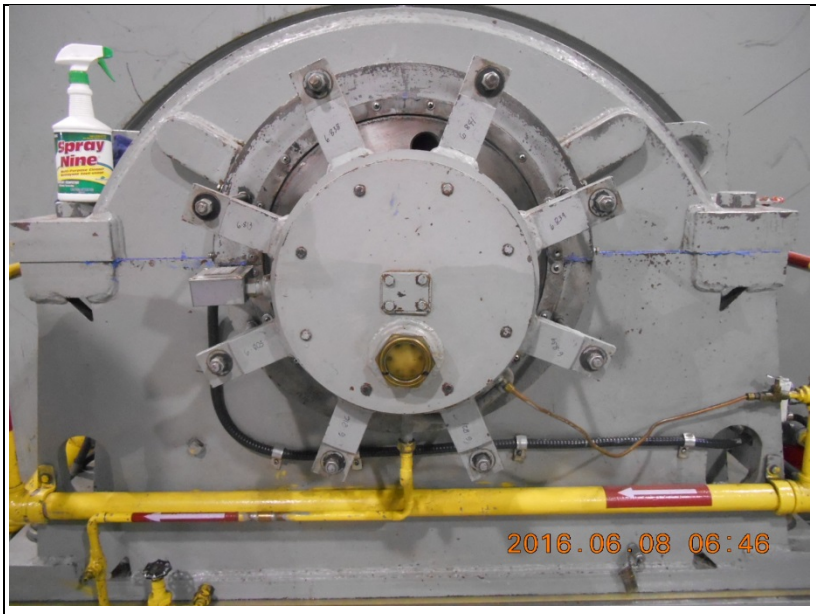
It takes an extremely long time for the bearing pedestals to drain on this unit. This may be due to a plugged screen at the bottom of the pedestals, or blockage of the ½" drain lines. During the next inspection, the pedestals should be completely emptied to allow for the drain lines to be removed and inspected. Air should be blown back into the drain to check for blockage of the screen at the bottom of the pedestal.

Removal and installation of the oil pickup rings creates wear at the joints and the need for additional peening to retain the screws. New rings should be ordered for replacement at the next major inspection interval.

3.7 Thrust Bearing

3.7.1 General Observations

The thrust bearing appears to be in good condition. No high temperature issues were noted since the last inspection. Before removing the NCRE pedestal cover, the As Found measurements were taken of the offset between the cover and the thrust housing to ensure it was reassembled to the same location.



The As Found offsets between the pedestal face and the bearing housing are taken before removing the cover. These were recorded on the face of the bearing housing as can be seen in this photo.
CW from 11 o'clock (Pos 1)

1 – 6.838"
2 – 6.841"
3 – 6.839"
4 – 6.839"
5 – 6.821"
6 – 6.816"
7 – 6.825"
8 – 6.819"

Fig. 23: Thrust Bearing offset measurements

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3.8 Hi-Lift System

3.8.1 General Observations

The shaft hi-lift system is operated and the lift measured using dial gauges to ensure it is working properly before and after the inspection. Filters are changed at both the CRE and NCRE pedestals.

Final lift measurements were 0.008” on the Collector End and 0.010” on the Non-Collector End. Oil pressure was 1000psi.

3.9 Oil, Holding Tanks, Filters, Oil Coolers and Pumps

3.9.1 General Observations

Historical concern regarding oil cleanliness has led to the practice of pumping the oil from the three holding tanks. The holding tanks were cleaned and filters were replaced with new units. The oil was filtered upon draining and refilling of the reservoirs.

The oil system is visually inspected for leaks. There are numerous minor leaks in the oil system piping, particularly at some Victaulic couplings on the 3” drain lines from the sumps back to the reservoirs.

The oil coolers appear to be in good condition. A few of the cooling fins are bent but this would have a negligible effect on cooling efficiency. There is a light film of oil and dirt on both coolers

3.9.2 Recommendations

Leaks found on any of the Victaulic couplings should be fixed at the next inspection interval. The coupling grommets or full assemblies can be purchased locally in Wabush.

Replacement suction filters should be on site for the next inspection interval. Currently there are no filters on site. The filter is Donaldson P/N **P169018**

Nalcor should take regular oil samples for analysis to track the condition over time.

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The covers of the reservoirs are removed after the oil is pumped out. The bottom of each one is manually cleaned and the suction filters are changed.

Fig. 24: Oil Resevoir cleanliness

The oil coolers appear to be in good condition. Some fins are bent. Both coolers have a film of oil and dirt.

Fig. 25: Oil Cooler Condition - Typical

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3.10 Air Filters

3.10.1 General Observations

The air filters on this unit appear to have been changed recently, although the site did not have the specific date or timeframe. Visual inspection concluded they are in good condition and no further action is required.

3.10.2 Recommendations

Continue to monitor the condition of the air filters and replace them as required.

The air filter media is clean and does not require changing at this time

Fig. 26: Air filters

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3.11 Additional Outage Scope

3.11.1 Lifting Lugs

Additional lifting lugs were welded to the end-bells of this unit so that each one had two (2) lugs to aid in safe lifting and removal during inspection. A total of four (4) lugs were installed. The lugs were supplied by Voith and manufactured to the original specification per OEM drawing #5-D-1845 item #2.

Voith has provided Nalcor with a letter certifying the installed lugs for their intended use.

The lugs were manufactured to the original design of this unit OEM drawing #5-D-1845 item #2. They are welded in place with a 1/2" fillet around the circumference of the lug.

Fig. 27: New lifting lug installed

3.11.2 Additional Guards

Nalcor requested additional guards be fabricated for the unit to block fully the Thrust Bearing area on the Non-Collector End and to cover the speed probe area of the Collector End. Measurements were taken by Carol Lake Metal Works but they could not be fabricated in time to be installed on this unit before it returned to service. The guards will be installed at a later date.

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3.12 Vibration Data

3.12.1 Pre-Shutdown Data

Baseline vibration data was collected prior to unit shutdown.

NCE

Fig. 28: Baseline Data NCRE

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CE

Fig. 29: Baseline Data CRE

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3.12.2 Post Inspection Data

Post inspection vibration data was collected after the unit was returned to service

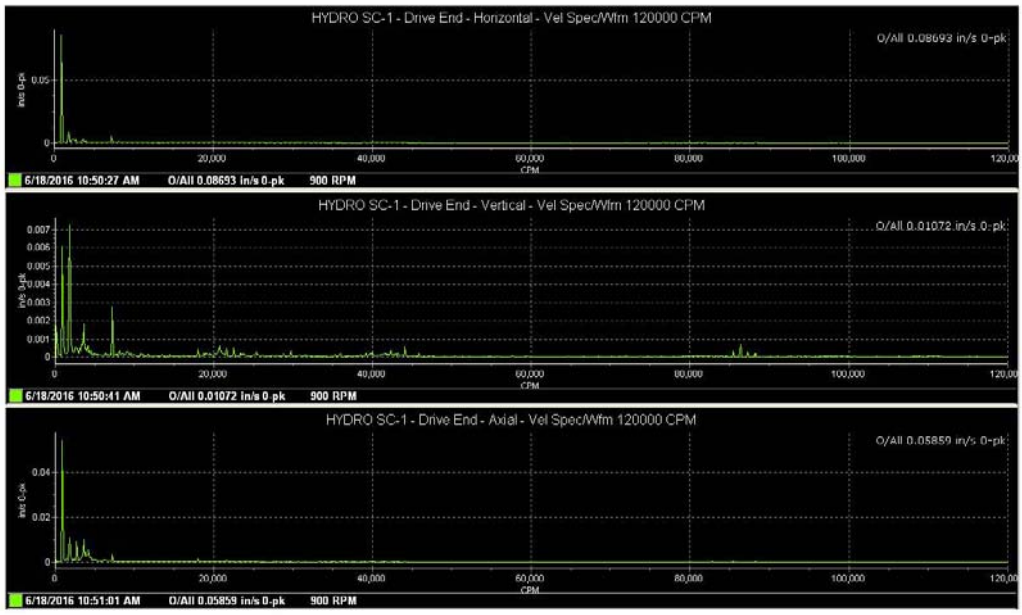

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Fig. 30: Post Inspection Vibration Data CRE

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NCE

Fig. 31: Post Inspection Vibration Data NCRE

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4 Recommendation Summary and Additional Recommendations

Item	Component	Recommendation
1	Stator Winding	The stator windings should be tested and inspected annually so that the winding insulation system can be accurately trended. In previous reports, a Doble and insulation resistance tests had been recommended for the next major inspection. In discussion with Voith's engineering team, a controlled overvoltage test would be a more effective means of assesing the condition of the unit stator insulation. This test is recommended for the next major inspection interval. When the unit is offline for extended periods of time, the louvres should be kept closed to reduce the humidity within the unit. If necessary, supplemental heating should be introduced by means of a Salamander or Frost Fighter
2	Rotor Field Poles	Continue with annual electrical testing and mechanical inspections at the next scheduled interval.
3	Damper Windings	Voith recommends replacing the resistance rings on both SC1 and SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.
4	Brush Rigging, Collector Rings and Ground Brush	Collector brushes should be kept in stock on site in the event that any require replacement The last ground brush was used on SC2 and replacements should be ordered. Part number is – DWG 714A257 Item #1. The ground brush will likely require replacement at the next inspection interval
5	Speed Probe	Voith recommends modification to the speed detection scheme to include dual equipment and circuitry to protect the equipment in the event of a component failure.
6	Bearings and Pedestals	It takes an extremely long time for the bearing pedestals to drain on this unit. This may be due to a plugged screen at the bottom of the pedestals, or blockage of the ½" drain lines. During the next inspection, the pedestals should be completely emptied to allow for the drain lines to be removed and inspected. Air should be blown back into the drain to check for blockage of the screen at the bottom of the pedestal.

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		Removal and installation of the oil pickup rings creates wear at the joints and the need for additional peening to retain the screws. New rings should be ordered for replacement at the next major inspection interval.
7	Oil, Holding Tanks, Filters, Oil Coolers and Pumps	Leaks found on any of the Victaulic couplings should be fixed at the next inspection interval. The coupling grommets or full assemblies can be purchased locally in Wabush. Replacement suction filters should be on site for the next inspection interval. Currently there are no filters on site. The filter is Donaldson P/N **P169018** Nalcor should take regular oil samples for analysis to track the condition over time
8	Air Filters	Continue to monitor the condition of the air filters and replace them as required
9	End Bell Hardware	The bolting hardware supporting the end-bells is mixed sizing around the flange and some threads are stripped. At the next major inspection interval, all holes should be drilled and tapped to the same size and new hardware purchased
10	Ceiling anchor points for chainfalls	The ceiling anchor points should be inspected and certified prior to the next inspection interval
11	Building Crane	The center rotating piece of the building crane should be locked in position with four structural grade bolts. Currently there is only one bolt in place and one pin to prevent rotation.
12	Lifting Beam	The shaft extension beam should be sandblasted, inspected and certified. When certified, beam should be painted and stored indoor. Also the hardware for the U-clamp should be inspected for damage and replaced if needed.
13	Locking tabs	New locking tabs for the shroud bolts should be on site for the next inspection interval.
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Table 5: Summary of Recommendations

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APPENDIX D

Voith SC2 Annual Minor Inspection 2016

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1 Unit Data

1.1 Nameplate Information

Fig. 1: Westinghouse 60MVA Syncronous Condenser

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2 Inspection Summary

2.1 Outage Overview

Nalcor Energy held an annual outage at the Wabush Terminal Station located near Labrador City, Labrador. The two synchronous condensers were scheduled for a minor inspection, starting with unit SC1. Jeff Slade was the lead representative from Nalcor. Wade Whiteway and Jeremy Stagg were the local operations staff for the site, providing daily permits, toolbox talks and testing permits as required throughout the outage.

Voith Hydro performed the inspection, with Paul Kay as the Technical Advisor, supported by craft labour from Labrador Rewind. The team arrived on site June 7, 2016 to begin the inspection with a planned 6 day/week x 10hr/day schedule. Unit SC2 inspections started on June 21, 2016.

There were no significant findings during the inspection of this unit. The Collector End bearing was replaced due to damage found on the outboard side if the bearing which resulted in babbitt accumulated in the bottom of the bearing pedestal sump. The unit had been operating within normal parameters and the bottom surface of the bearing did not have any evidence of abnormal wear. It is believed this damage may have occurred following startup during the 2015 inspection.

In addition to the minor inspection, unit SC2 oil skid was changed out with one of the new units purchased from Voith in 2014. Details of this work will be documented in a separate report.

Unit SC2 was returned to service on the afternoon of June 30, 2016.

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2.2 Unit Condition Overview

Unit SC2 is in serviceable condition, with no findings that would curtail its operation within normal parameters. Internally, the Stator winding end turns and Rotor poles are covered in a light film of oil and dirt. This does not affect unit performance significantly but does affect the insulation integrity over the life of the unit.

Fig. 2: Overview of Collector End - Light Dirt on Stator Winding End Turns and Rotor Poles

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Externally, this unit is covered in a thin layer of oil, dirt. Bearing pedestal megger results were near 0 Mega-Ohms and a thorough cleaning of the pedestals was needed to bring them to acceptable levels. In addition to the dirt and oil, the ½" Collector End pedestal drain line was making contact across the isolation pad, creating a shorted path to ground. The line was adjusted to eliminate the short.

There were a number of leaks in the Collector End 3" pedestal drain, which is constructed using sections of pipe and Victaulic couplings. Nalcor purchased new coupling assemblies and grommets that were installed during the outage.

The three couplings downstream of the first four seen in this photo were also replaced after the customer identified a second leak from this area.

Fig. 3: First section of Victaulic Couplings replaced (orange) to correct oil leaks

A thorough cleaning of the unit was carried out prior to the unit being returned to service. Before the next major inspection, a plan should be put in place to correct the minor oil leaks.

Overall the unit is in good condition.

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3 Unit Inspection Results

3.1 Stator Windings

3.1.1 General Observations

Annual inspections of the stator windings have revealed light contamination of some oil and dust on the end turns and coil extensions. All blocking at the coil extensions is intact with no signs of movement.

Fig. 4: Stator end turn and coil extension condition

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Fig. 5: Stator end turn and coil extension condition

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3.1.2 Megger and PI Results

Stator windings are tested annually for insulation resistance to ground via 10 minute Megger/PI at 5000VDC.

The test results can degrade over the course of the unit outage due to accumulation of moisture within the windings. In order to mitigate moisture accumulation, the louvres are manually closed and the outside is covered with plastic.

A test was completed shortly after unit shutdown and then again prior to units startup to document the change.

Test Date	Megger at 1 min	Megger at 10 min	Calculated PI
2016-06-23	1800	4560	2.53
2016-06-28	1660	3400	2.04

Table 1: Stator 5000VDC Megger/PI Test Results (values are in Mega-Ohms)

The results are above the minimum PI of 2.0 however they are marginal and decrease rapidly on this unit if there is high moisture content in the air. There was significant rainfall during this outage.

3.1.3 Recommendations

The stator windings should be tested and inspected annually so that the winding insulation system can be accurately trended. In previous reports, a Doble and insulation resistance tests had been recommended for the next major inspection. In discussion with Voith's engineering team, a controlled overvoltage test would be a more effective means of assesing the condition of the unit stator insulation. This test is recommended for the next major inspection interval.

When the unit is offline for extended periods of time, the louvres should be kept closed to reduce the humidity within the unit. If necessary, supplemental heating should be introduced by means of a Salamander or Frost Fighter.

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3.2 Rotating Field Poles

3.2.1 General Observations

Annual inspection involves a visual inspection, insulation resistance to ground and voltage drop test. A thorough visual inspection of the rotor was completed. The ends of the rotor poles are covered in a light film of dirt. The fan blades all appear to be in good condition with no signs of damage. All V-Blocks were inspected by means of a hand-held inspection scope with no issues noted.

Fig. 6: Collector End - View of rotor poles and fan

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Fig. 7: Non-Collector End - View of rotor poles and fan

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3.2.2 Electrical Testing

3.2.2.1 Megger Test

A megger test was performed on the rotor at 500VDC for 1 minute.

The final reading was **1290 Mega-Ohms**, which is well above the acceptable minimum of 15 Mega-Ohms.

3.2.2.2 Rotor Pole-Drop test

A rotor pole drop test was performed using the site 240VAC supply and measuring the voltage drop across all 8 poles.

Measured supply Voltage: 229VAC
Measured supply Current: 0.6A

Pole Number	Measured Voltage Drop
1	29
2	28.8
3	28.8
4	28.5
5	28.3
6	28.3
7	28.7
8	29.2
Total	229.6VAC

Table 2: Rotor Pole-Drop Results

The voltage drops across each pole are similar and vary < 10% between readings.

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3.2.3 Mechanical Inspections

3.2.3.1 Rotor Air-Gap

The air-gap between each rotor poles and stator core is measured to ensure the rotor is well centered. The design gap is 0.775" and the acceptable variance is +/- 10% of the average value recorded.

Pole Number	Collector End	Non-Collector End
1	0.780"	0.810"
2	0.778"	0.778"
3	0.776"	0.774"
4	0.771"	0.770"
5	0.770"	0.770"
6	0.772"	0.772"
7	0.778"	0.778"
8	0.782"	0.780"
Average	0.776"	0.779"
Average + 10%	0.853"	0.857"
Average – 10%	0.698"	0.701"

Table 3: Rotor Air Gap Measurements

There will be slight variance due to the final resting location of the shaft. These values are consistent with previous year's results.

3.2.3.2 Resistance Ring Concentricity Checks

The distance from the resistance (damper) ring circumference to the shaft is measured in a minimum of 4 locations to ensure it remains concentric to the shaft.

Location	Collector End	Non-Collector End
1 - Top	20.816"	20.850"
2 - Bottom	20.835"	20.840"
3 – Left (looking at unit)	20.820"	20.855"
4 – Right (looking at unit)	20.845"	20.845"

Table 4: Resistance Ring Concentricity

There will be slight variance due to the final resting location of the shaft. These values are consistent with previous year's results.

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3.2.4 Recommendations

Continue with annual electrical testing and mechanical inspections at the next scheduled interval.

3.3 Damper Winding (Resistance Ring)

3.3.1 General Observations

A thorough visual inspection of the Damper Windings was completed. No issues were noted on the collector end damper winding and no issues were noted on the Non-Collector end as well.

Fig. 8: View of Collector End Damper Winding

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Fig. 9: CRE Damper Winding

Fig. 10: NCRE Damper winding -

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Fig. 11: NCRE Damper winding -.

3.3.2 Recommendations

Voith recommends replacing the resistance rings on both SC1 and SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.

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3.4 Brush Rigging, Collector Rings and Ground Brush

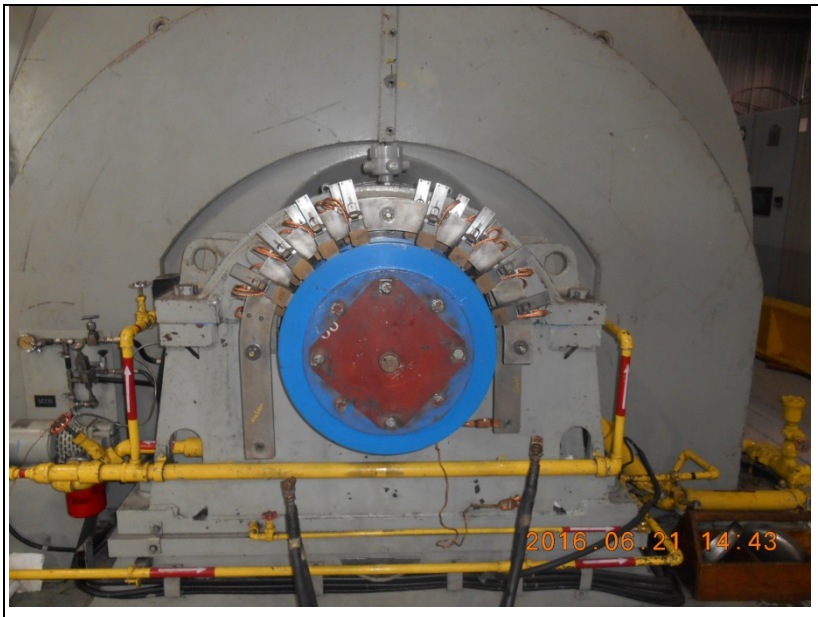
3.4.1 General observations

Annual inspections and maintenance includes the removal, cleaning and/or replacing and re-installing of carbons into the brush holder mechanism. The collector rings are inspected for burnishing and evidence of any physical damage. The ground brush is inspected for general condition and wear

During this inspection, no brushes required replacement and the spring tension on all retainers was around 3.5 lbs.

The collector rings appear to be in good condition. No issues were noted.

The ground brush assembly was cleaned and found to be in good condition. The brush itself is in poor condition and will need to be replaced.



The brush rigging assembly is in good condition. All brushes appear to be in good condition and spring tension on the retainers is an average of 3.5lbs which is sufficient for proper brush pressure. The minimum spring pressure is 3lbs.

Fig. 12: Brush Rigging assembly

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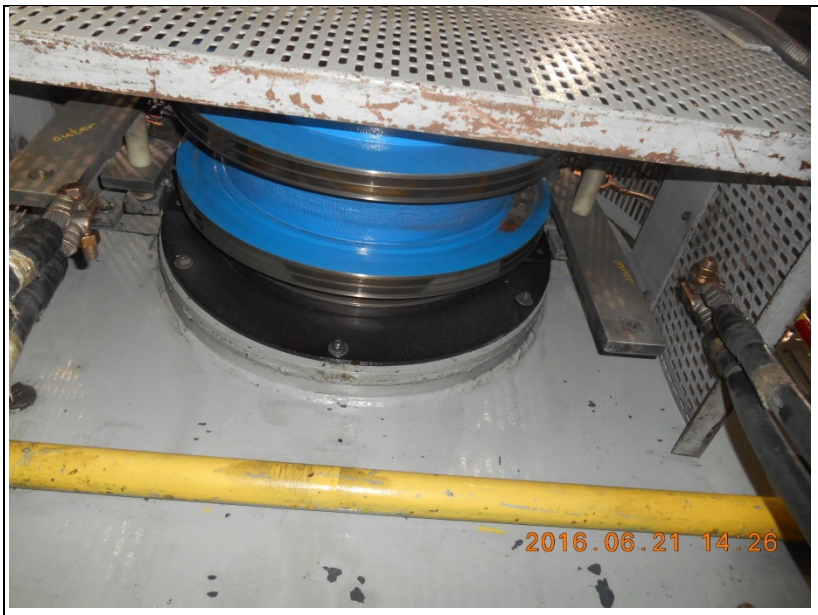

Fig. 13: Collector Rings

The collector rings are in good condition with no evidence of burnishing or physical damage. The bore copper studs are tight.

Fig. 14: Ground Brush – Requires replacement

The ground brush assembly is in good condition. The brush itself requires replacement at this time. A new brush was taken from stock.

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3.4.2 Recommendations

Collector brushes should be kept in stock on site in the event that any require replacement

The last ground brush was used on SC2 and replacements should be ordered. Part number is – DWG 714A257 Item #1.

3.5 Speed Probe

3.5.1 General Observations

The speed probe gap is measured before the brush rigging guards are removed and re-checked on reassembly of the guards to ensure the same gap is left. This is to ensure a proper signal to the PLC. The As Found gap was measured at 0.030” with the hi-lift system off and was verified to be the same value on reassembly. There was a concern about having to readjust the probe when the guard was reinstalled, and so the measurements were taken with the hi-lift system running. The rotor was turned 180 degrees to take a second measurement.

Speed probe measurement was found to be 0.030" before removal of the guards. With the hi-lift system running, the gap measures .021” in the same position and .028” when the shaft was manually rotated 180 degrees.

Fig. 15: Speed probe gap

3.5.2 Recommendations

Voith recommends modification to the speed detection scheme to include dual equipment and circuitry to protect the equipment in the event of a component failure.

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3.6 Bearings and Pedestals

3.6.1 General Observations

Annual inspection of the journal bearings includes removal of the bearing pedestal top cover, inspection of the oil in the pedestal sump for any signs of babbitt contamination and testing the integrity of the pedestal insulation system. Bearing pedestals are cleaned and the insulation resistance is measured.

The bearing pedestals were drained to allow visual inspection of the bottom of the pedestal sumps. On SC2, it takes approximately 2 hours for the pedestals to drain.

The bearing top halves were removed to inspect the oil rings and journal for any damage. During this inspection, no damage was noted on the Non-Collector End. However, there was a light mark around the circumference of the journal toward the outboard side. This appears to be the speed probe that is mounted in the upper half bearing. The jam nut was found loose and the probe could rotate freely. As this probe is not tied into the PLC, it was backed out to the point where it no longer touched the shaft and the jam nut was re-tightened.

The speed probe was found to be loose and had turned to the point it was making contact with the shaft. It was backed out and the jam nut re-tightened.

Fig. 16: NCRE Speed probe.

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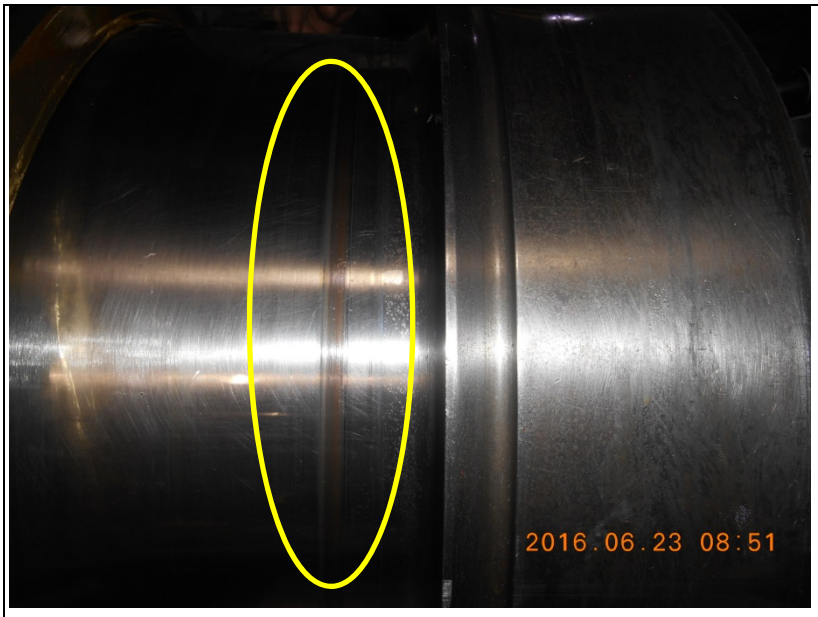
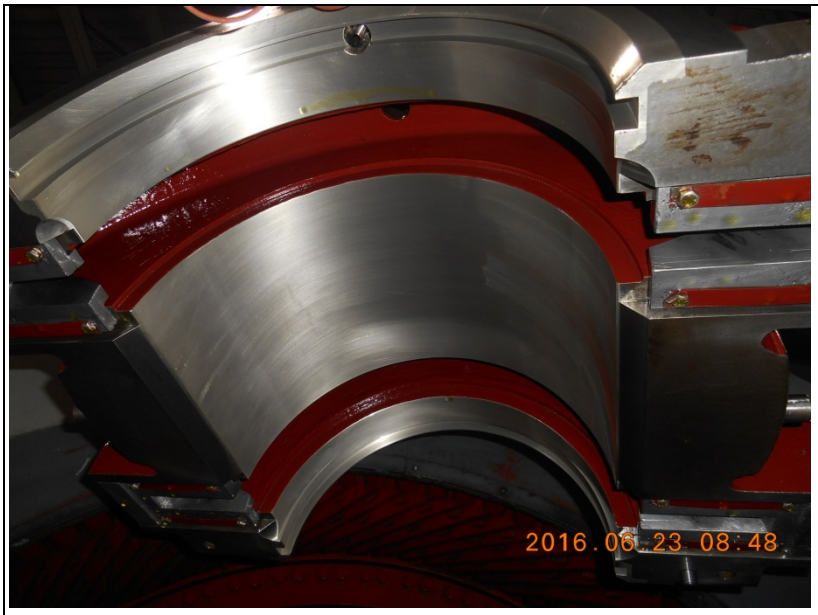


The mark in the center of this photo is the result of the speed probe making contact with the shaft. No damage occurred.

Fig. 17: NCRE – Mark on the shaft from speed probe.



The NCRE bearing upper half is clean with no issues noted.

Fig. 18: NCRE Upper half bearing

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The NCRE journal was found to be in good condition with only light surface scratches. The punch marks on the oil rings are flush with no high-spots.

Fig. 19: NCRE Journal and Oil Rings

The NCRE oil rings appear worn with rub marks noted around the circumference. Removal and installation of the rings required additional peening to retain the connecting screws.

Fig. 20: CRE bearing upper half

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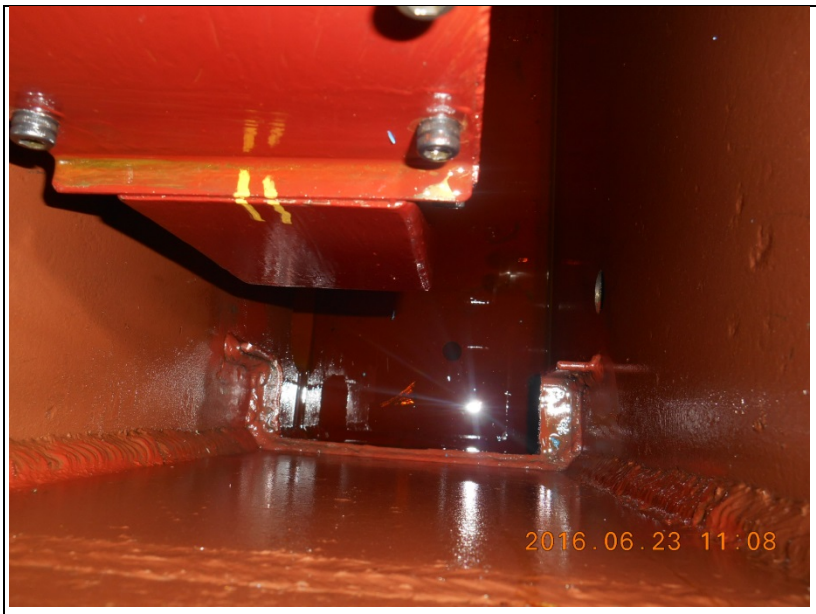
Babbitt was found in the sump of the Collector End bearing pedestal. The source of the babbitt was the outboard axial end face of the bearing, which appears to have been contacted by the adjacent shoulder of the shaft.

The decision was made to change the bearing with the spare that was on site.

The shaft was lifted 0.010” as measured by a dial gauge in order to roll out the lower half of the bearing. When the new lower half was installed, the gauge returned to 0.001”

Prior to the new bearing being installed, dimensional measurements were taken to determine the overall clearance. **Measurements indicated the clearance of the replacement bearing would be 0.018”**



Babbitt found in the bottom of the collector end bearing pedestal sump

Fig. 21: CRE Bearing Pedestal - Babbit

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Total quantity of babbitt found in the sump, buside a quarter for comparison

Fig. 22: Total babbitt from the bearing pedestal sump

Source of the babbitt where the shaft vertical face has made contact with the bearing.

Fig. 23: Bearing damage found on outboard side

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Photo of the damage to the outboard face of the lower half bearing

Fig. 24: CRE bearing lower half removed.

Replacement bearing removed from the shipping crate.

Fig. 25: CRE Replacement bearing

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3.6.2 Recommendations

Re-inspect the bearings at the next scheduled inspection interval.

Removal and installation of the oil pickup rings creates wear at the joints and the need for additional peening to retain the screws. New rings should be ordered for replacement at the next major inspection interval.

3.7 Thrust Bearing

3.7.1 General Observations

The thrust bearing appears to be in good condition. No high temperature issues were noted since the last inspection. Before removing the NCRE pedestal cover, the As Found measurements were taken of the offset between the cover and the thrust housing to ensure it was reassembled to the same location.

The As Found offsets between the pedestal face and the bearing housing are taken before removing the cover. These were recorded on the face of the bearing housing as can be seen in this photo.
CW from 11 o'clock (Pos 1)
1 – 6.802"
2 – 6.800"
3 – 6.799"
4 – 6.793"
5 – 6.801"
6 – 6.801"
7 – 6.803"
8 – 6.801"

Fig. 26: Thrust Bearing offset measurements

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3.8 Hi-Lift System

3.8.1 General Observations

The shaft hi-lift system is operated and the lift measured using dial gauges to ensure it is working properly before and after the inspection. Filters are changed at both the CRE and NCRE pedestals. For SC2, the new oil skid was being installed concurrently with the inspection, and so the hi-lift was only checked after this was completed.

Final lift measurements were 0.009” on the Collector End and 0.010” on the Non-Collector End. Oil pressure was 1000psi.

3.9 Oil, Holding Tanks, Filters, Oil Coolers and Pumps

3.9.1 General Observations

The replacement of the oil skid will be documented in a separate report.

The oil system is visually inspected for leaks. There are numerous minor leaks in the oil system piping, particularly at some Victaulic couplings on the 3” drain lines from the sumps back to the reservoirs. A total of seven (7) couplings were replaced at the collector end on this drain line.

The oil coolers appear to be in good condition. A few of the cooling fins are bent but this would have a negligible effect on cooling efficiency. There is a light film of oil and dirt on both coolers

3.9.2 Recommendations

Leaks found on any of the Victaulic couplings should be fixed at the next inspection interval. The coupling grommets or full assemblies can be purchased locally in Wabush.

Nalcor should take regular oil samples for analysis to track the condition over time.

Fig. 27:

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The oil coolers appear to be in good condition. Some fins are bent. Both coolers have a film of oil and dirt.

Fig. 28: Oil Cooler Condition - Typical

3.10 Air Filters

3.10.1 General Observations

The air filters on this unit were at the point where replacement was required. Visually, they in were poor condition. The site pulled new filters from stock and all were changed during this inspection.

3.10.2 Recommendations

Continue to monitor the condition of the air filters and replace them as required.

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The air filter media is plugged and requires changing during this inspection

Fig. 29: Air filters

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3.11 Additional Outage Scope

3.11.1 Lifting Lugs

Additional lifting lugs were welded to the end-bells of this unit so that each one had two (2) lugs to aid in safe lifting and removal during inspection. Only one (1) lug was installed on a NCRE End Bell for this unit. The lugs were supplied by Voith and manufactured to the original specification per OEM drawing #5-D-1845 item #2.

Voith has provided Nalcor with a letter certifying the installed lugs for their intended use.

Fig. 30: New lifting lug installed on SC2 NCRE End-Bell

The lugs were manufactured to the original design of this unit OEM drawing #5-D-1845 item #2. They are welded in place with a 1/2" fillet around the circumference of the lug.

3.11.2 Additional Guards

Nalcor requested additional guards be fabricated for the unit to block fully the Thrust Bearing area on the Non-Collector End and to cover the speed probe area of the Collector End. Measurements were taken by Carol Lake Metal Works and installed during this outage.

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The guard in this photo extends the coverage of the existing guard around the thrust bearing.

Fig. 31: SC2 NCRE Thrust End - New guard installed

The new guard installed on the collector end covers the speed probe and toothed wheel.

Fig. 32: CRE Guard/Cover installed

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3.12 Vibration Data

3.12.1 Pre-Shutdown Data

Baseline vibration data was collected prior to unit shutdown.

NCE

Fig. 33: Baseline Data NCRE

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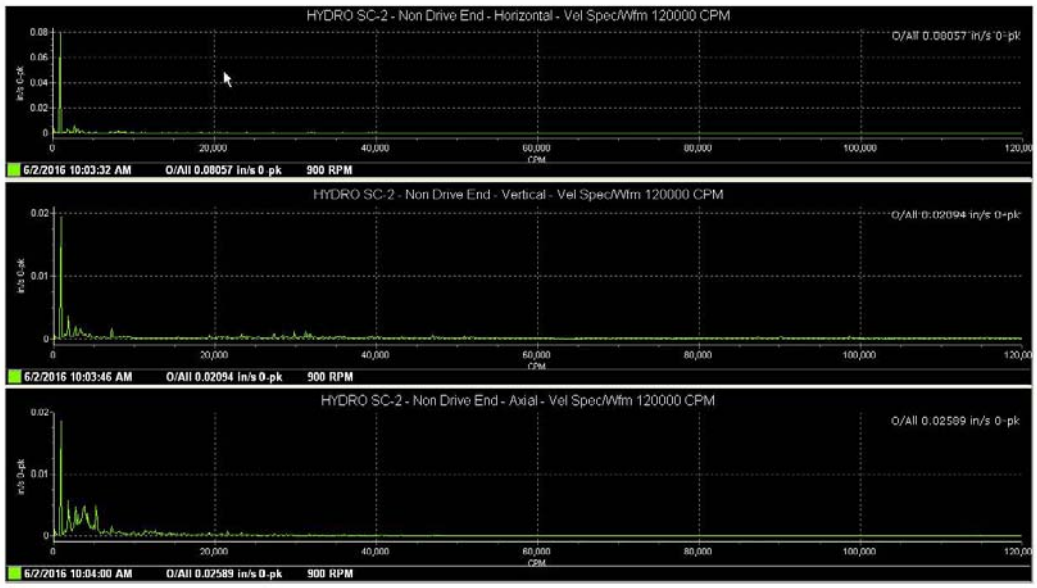

CE

Fig. 34: Baseline Data CRE

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3.12.2 Post Inspection Data

Post inspection vibration data was collected after the unit was returned to service

CE

Fig. 35: Post Inspection Vibration Data CRE

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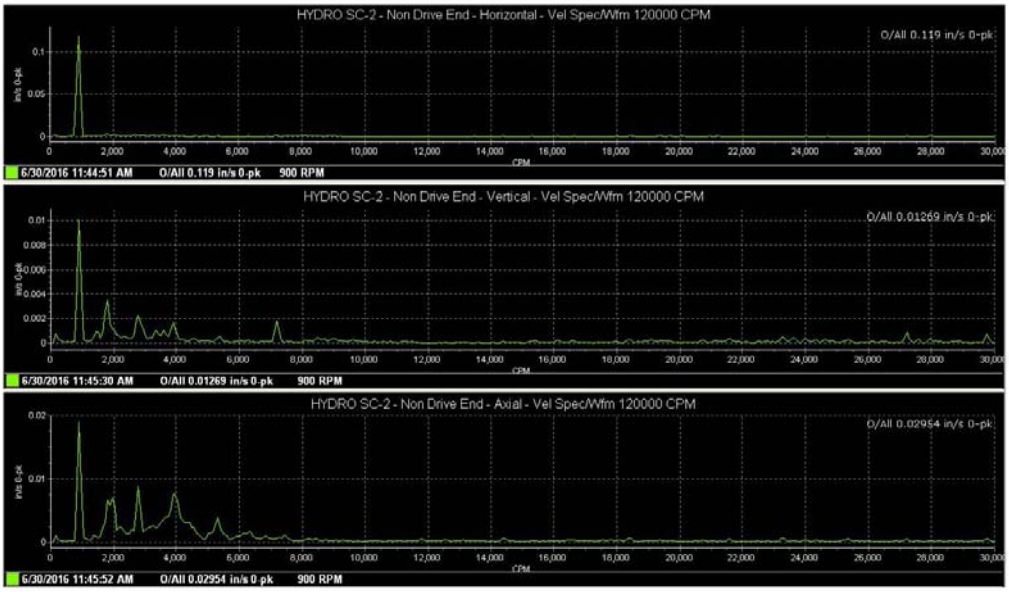

NCE

Fig. 36: Post Inspection Vibration Data NCRE

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4 Recommendation Summary and Additional Recommendations

Item	Component	Recommendation
1	Stator Winding	The stator windings should be tested and inspected annually so that the winding insulation system can be accurately trended. In previous reports, a Doble and insulation resistance tests had been recommended for the next major inspection. In discussion with Voith's engineering team, a controlled overvoltage test would be a more effective means of assesing the condition of the unit stator insulation. This test is recommended for the next major inspection interval. When the unit is offline for extended periods of time, the louvres should be kept closed to reduce the humidity within the unit. If necessary, supplemental heating should be introduced by means of a Salamander or Frost Fighter
2	Rotor Field Poles	Continue with annual electrical testing and mechanical inspections at the next scheduled interval.
3	Damper Windings	Voith recommends replacing the resistance rings on both SC1 and SC2 with a centrifugally cast design one piece ring given the high centrifugal forces and the mass and speed on the unit.
4	Brush Rigging, Collector Rings and Ground Brush	Collector brushes should be kept in stock on site in the event that any require replacement The last ground brush was used on SC2 and replacements should be ordered. Part number is – DWG 714A257 Item #1. The ground brush will likely require replacement at the next inspection interval
5	Speed Probe	Voith recommends modification to the speed detection scheme to include dual equipment and circuitry to protect the equipment in the event of a component failure.
6	Bearings and Pedestals	Removal and installation of the oil pickup rings creates wear at the joints and the need for additional peening to retain the screws. New rings should be ordered for replacement at the next major inspection interval.
7	Oil, Holding Tanks, Filters, Oil Coolers and Pumps	Leaks found on any of the Victaulic couplings should be fixed at the next inspection interval. The coupling grommets or full assemblies can be purchased locally in Wabush. Nalcor should take regular oil samples for analysis to track the condition over time

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8	Air Filters	Continue to monitor the condition of the air filters and replace them as required
9	End Bell Hardware	The bolting hardware supporting the end-bells is mixed sizing around the flange and some threads are stripped. At the next major inspection interval, all holes should be drilled and tapped to the same size and new hardware purchased
10	Ceiling anchor points for chainfalls	The ceiling anchor points should be inspected and certified prior to the next inspection interval
11	Building Crane	The center rotating piece of the building crane should be locked in position with four structural grade bolts. Currently there is only one bolt in place and one pin to prevent rotation.
12	Lifting Beam	The shaft extension beam should be sandblasted, inspected and certified. When certified, beam should be painted and stored indoor. Also the hardware for the U-clamp should be inspected for damage and replaced if needed.
13	Locking tabs	New locking tabs for the shroud bolts should be on site for the next inspection interval.
14		
15		

Table 5: Summary of Recommendations

Executing OU	Created by		Checked by		Approved by		Issue Date
VHMS	Name	Signature	Name	Signature	Name	Signature	2016-07-13
	Paul Kay	PK					

N THE MATTER OF the *Electrical Power Control Act,* RSNL 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, RSNL 1990, Chapter P-47 (the *Act*), and regulations thereunder;

AND IN THE MATTER OF an Application by Newfoundland and Labrador Hydro for approval of the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station pursuant to Subsection 41(3) of the *Act*.

AFFIDAVIT

I, Kyle B. Tucker, Professional Engineer, of St. John's in the Province of Newfoundland and Labrador, make oath and say as follows:

1. I am the Manager of Regulatory Engineering of Newfoundland and Labrador Hydro, the Applicant named in the attached Application.

2. I have read and understand the foregoing Application.

3. I have personal knowledge of the facts contained therein, except where otherwise indicated, and they are true to the best of my knowledge, information and belief.

SWORN at St. John's in the Province of Newfoundland and Labrador this 17th day of March, 2017, before me:)

Barrister – Newfoundland and Labrador

Kyle B. Tucker, M. Eng., P. Eng.

(DRAFT ORDER)
NEWFOUNDLAND AND LABRADOR
BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

AN ORDER OF THE BOARD

NO. P.U. __(2017)

IN THE MATTER OF the *Electrical Power Control Act*, RSNL 1994, Chapter E-5.1 (the *EPCA*) and the *Public Utilities Act*, RSNL 1990, Chapter P-47 (the *Act*), and regulations thereunder;

AND IN THE MATTER OF an Application by Newfoundland and Labrador Hydro for approval of the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station pursuant to Subsection 41(3) of the Act.

WHEREAS Newfoundland and Labrador Hydro (Hydro) is a corporation continued and existing under the *Hydro Corporation Act, 2007,* is a public utility within the meaning of the *Act*, and is subject to the provisions of the *Electrical Power Control Act*, 1994; and

WHEREAS Section 41(3) of the *Act* requires that a public utility not proceed with the construction, purchase or lease of improvements or additions to its property where:

a) the cost of construction or purchase is in excess of $50,000; or

b) the cost of the lease is in excess of $5,000 in a year of the lease,

without prior approval of the Board; and

WHEREAS in Order No. P.U. 45(2016) the Board approved Hydro's 2017 Capital Budget in the amount of $271,265,600; and

WHEREAS in Order No. P.U. 5(2017) the Board approved supplementary 2017 capital

expenditures in the amount of $3,045,000 to construct a distribution feeder at the Bottom Waters Terminal Station; and

WHEREAS on Order No. P.U. 7(2017) the Board approved supplemental 2017 capital expenditures in the amount of $3,168,944 for: (i) the sublease of two 230 kV transmission lines that run from Churchill Falls to the Twin Falls generating plant site; (ii) the sublease of two 230 kV transmission lines that run from the Twin Falls generating plant site to the Wabush Terminal Station; (iii) the lease of electrical equipment situated in the Churchill Falls Switchyard; and (iv) the purchase of spare parts and inventory associated with the Wabush Terminal Station, the Churchill Falls Switchyard and the transmission lines to acquire two 230 kV transmission lines serving Labrador West; and

WHEREAS on March 13, 2017, Hydro applied to the Board for approval to proceed with the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station; and

WHEREAS the capital cost of the project is estimated to be $2,912,500; and

WHEREAS the Board is satisfied that the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station are reasonable to allow Hydro to provide service and facilities which are reasonably safe and adequate and just and reasonable.

IT IS THEREFORE ORDERED THAT:

1. The proposed capital expenditure for the replacement of a circuit breaker, insulators, synchronous condenser shaft seals and resistance rings, and related condition assessments, at the Wabush Terminal Station at an estimated capital cost of $2,912,500 is approved.

2. Hydro shall pay all expenses of the Board arising from this Application.

DATED at St. John's, Newfoundland and Labrador, this day of , 2017.

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