

1 Q. Reference: *Gas Generator Engine Refurbishments Hardwoods and Stephenville*,
2 Page 8, line 5 to Page 9, line 10.

3

4 Please provide a copy of any inspection reports completed by the Alba Power
5 representative who was onsite at Hardwoods on February 18, 2016 and at
6 Stephenville on March 30, 2016.

7

8

9 A. Please see Attachment 1, Field Service Report for Removal of SN 202205,
10 Installation of Alba Lease SN 202040 and Attachment 2, Field Service Report for
11 Investigation of High Vibration Olympus SN: 202204.



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Field Service Report For Removal of Serial No: 202205 Installation of Alba Lease Serial No: 202040



Customer: Newfoundland Hydro Hardwoods

Date: 11th February 2016

Project Number: 5166

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Note:

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Introduction

Mr. Colin Smith arrived at the Newfoundland Hydro site in St. John's to remove Gas Turbine s/n:202205 and install Alba Lease Gas Turbine s/n:202040.

Date of works: Thursday 11th February 2016 – Thursday 18th February 2016.

Alba Power on site personnel: Mr. Colin Smith.

1 Daily Report

1.1 Thursday 11th February 2016

Colin arrived on site.

On arrival Gas Turbine serial number 202205 had already been removed from service and Gas Turbine serial number 202040 (Alba lease engine) had been installed. The lease gas turbine installation was inspected, along with the intake plenum. Onsite personnel replenished the lube oil system. A final walk round by Colin and confirmed the start process could begin in the morning.

1.2 Friday 12th February 2016

The alarm and trip parameter adjustments for Gas Turbine s/n 202040 were carried out before start-up.

These changes were made by Craig Warren (Controls Engineer NFH) to Alba Lease in Berth A;

N1 speed from 6800 to 6500 rpm

N2 speed from 8000 to 8200 rpm

EGT single Alarm 850 down to 720

EGT avg Alarm 771 down to 675

EGT Trip 771 down to 680

Peek curve 766 down to 670

At 16:30pm.

A start was attempted but unfortunately there was no light-off.

After two failed light-offs the fuel valve opening angle was changed from 7% to 8% and another light off attempted, but this also proved unsuccessful.

A pressure gauge was fitted to the primary line on the burner rail and a start-up initiated, this also was unsuccessful and the pressure at the gauge did not register.

The fuel valve angle was returned to 7%.

It was then decided to remove the NRV. This was found to be sticking open caused by a particle found emanating from the CCC valve. The CCC valve was replaced, and the NRV checked, found to be functioning satisfactorily, and then refitted.

Another start-up was initiated but again the gas turbine failed to light.

It was then noted that an extra pipe was installed at the fuel pumps to CCC valve connected by a tee piece, this pipe had been installed on the lease engine when installed on engine in B berth. This appeared to be back pressure to the valve.

A start-up was initiated and this time light off was achieved. The gas turbine was taken up to 5mw of load, but was shut down due to smoke from the unburnt fuel filling the berth.

1.3 Saturday 13th February 2016

Arrived on site 07.00am.

Colin carried a visual check of the gas turbine in berth before a start was initiated at 11:00am. Light off was achieved and data recorded up to 19mw limit as agreed for Alba Lease gas turbine. Mega Watt increments were as follows: 5mw, 7mw, 10mw, 12mw, 14mw, 16mw, 18mw and 19mws. See table.

1.4 Sunday 14th February 2016

Travelled to Stephenville via Deer lake arrive at 20.00pm.

1.5 Monday 15th February 2016

Arrived on site 06:00am.

Colin arrived on site and was given a tool box talk by the controls engineer, the maintenance engineer and the site operator who informed Colin of the issues concerning the failed light off on the Gas Turbine in berth B.

A pressure gauge was installed to main line burner at number 8 position and before and after on the gas turbine fuel pumps.

A gas turbine start was initiated but unfortunately it failed due to no pressure at the burners. Colin checked the Altair Valve was actuating correctly, it was found functioning satisfactorily. The Woodward Valve fuel shut off solenoid was checked and found not to be actuating. The cover was removed and the solenoid free-ed, and stroked a number of times to ensure it was functioning correctly. A start was initiated and light off

achieved. After several minutes the gas turbine was shut down and the pressure gauges removed.

Another start was initiated and Colin carried out a leak check which proved to be successful with no issues visible. The gas turbine was placed on a load of 5mw and returned to service.

Colin left site at 14:00pm.

1.6 Tuesday 16th February 2016

Colin travelled back to St Johns.

Colin arrived at site and found gas turbine s/n 202205 still outside in a wooden box. Due to weather conditions only the box lid was removed and partial removal of the damaged Combustion Casing. It was decided to stop work and arrange to get the gas turbine into the workshop for the next day.

1.7 Wednesday 17th February 2016

The gas turbine was lifted from the wooden box and moved to the workshop for investigation.

The heat shields, the combustion casings, and the damaged combustion chamber were removed. The gas turbine had sustained extensive damage to the turbine section and could not be repaired on site and would have to be shipped back to Alba Power for investigation and detail strip of the turbine section.

1.8 Thursday 18th February 2016

Arrived on site 06:00am.

Return to site to refit combustion casings, fuel pumps and get engine ready for shipping back to Alba.

1.9 Friday 19th February 2016

Colin travelled back to the U.K.

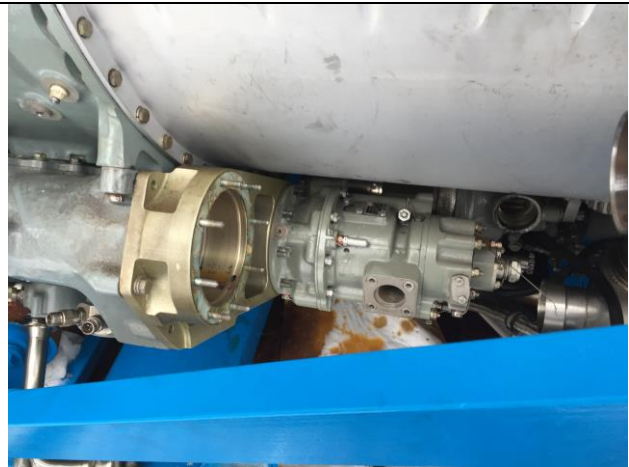
2 Data Collection Table

Date	13/02/2016						
Time	09.36	09.41	09.53	09.57	10.09	10.22	
Load MW	Idle	5	7	10	15	19	
MVAR	-	-	-	-	-	-	
Frequency	-						
N1 Speed	2181	4726	4957	5527	5708	5989	
N2 Speed	4871	6602	6775	7044	7375	7601	
PT Speed	2441	3600	3600	3600	3600	3600	
CDP (PSI)	16.9	70.1	79	90.6	108.4	122.3	
PTET	N/A	N/A	N/A	N/A	N/A	N/A	
Air intake DP Temp °C	-3.5	-6.1	-6.1	-5.9	-4.3	-4.1	
Fuel Gas Inlet Pressure	N/A	N/A	N/A	N/A	N/A	N/A	
Fuel Gas Skid Pressure	N/A	N/A	N/A	N/A	N/A	N/A	
PT Cooling Air Disc	N/A	N/A	N/A	N/A	N/A	N/A	
PT Front Bearing Temp °C	40.5	68.2	66.3	64.3	58.6	58.6	
PT Rear Bearing Temp °C	54.1	72.3	79.7	80.6	83.4	84	
EGT Temp Indication °C							
No 1	259	422	455	504	568	627	
No 2	273	426	460	510	587	643	
No 3	271	421	457	506	578	630	
No 4	279	445	479	523	589	640	
No 5	269	423	460	509	585	640	
No 6	257	416	447	492	561	607	
No 7	255	420	454	497	572	624	
No 8	254	421	456	504	580	632	
Temp spread	14	21	21	17	18	23	
Average Temp	264	424	458	505	577	630	
Vibs Gas Gen (in/s)	0.2	0.4	0.3	0.2	0.2	0.3	
Vibs PT (in/s)	0.1	0.3	0.2	0.2	0.2	0.2	

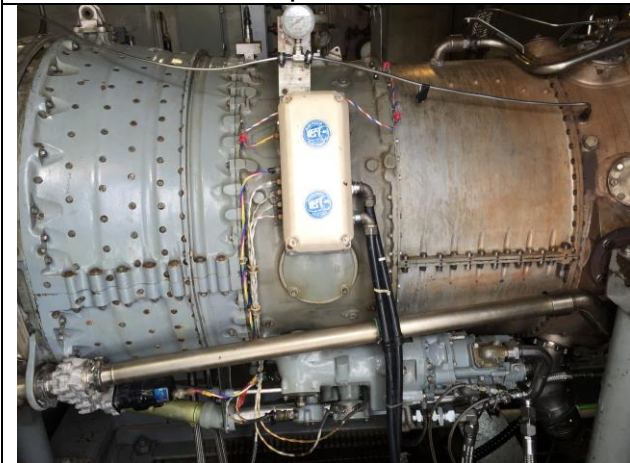
3 Images



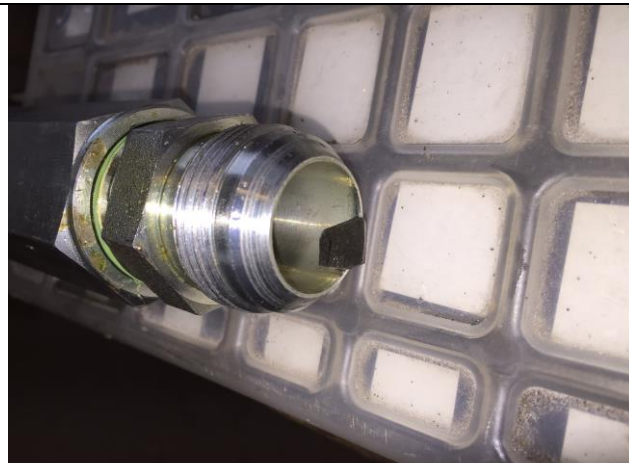
202205 removal of fuel pumps for Stephenville



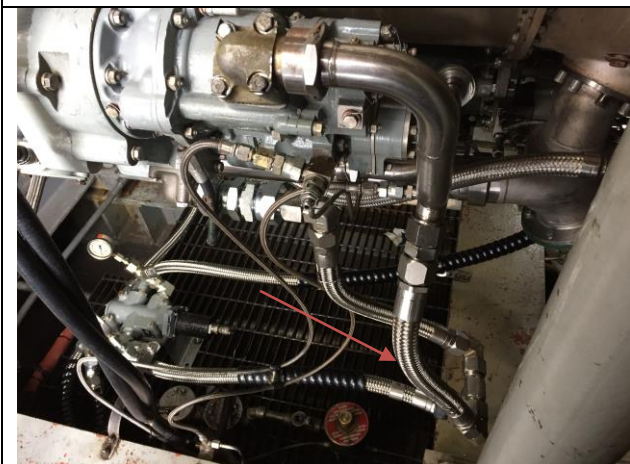
202205 removal of pumps



Installation of 202040



Part from CCC valve found inside NRV



202040 extra pipe removed and blanked



Gas Turbine 202040 installed

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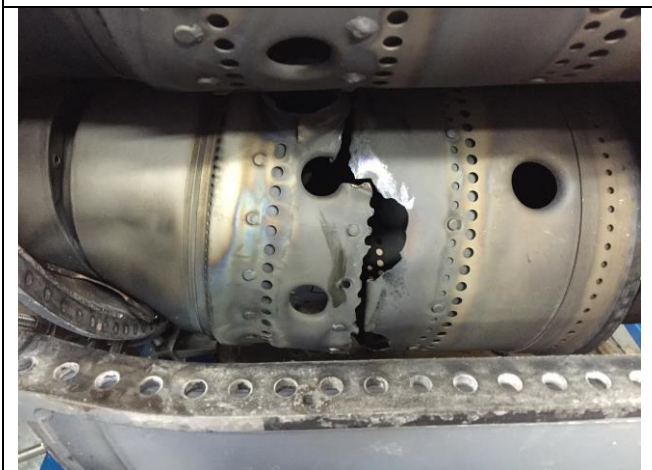
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Moving 202205 to workshop



Gas Turbine 202205 in workshop



Combustion can failure. Rivets missing



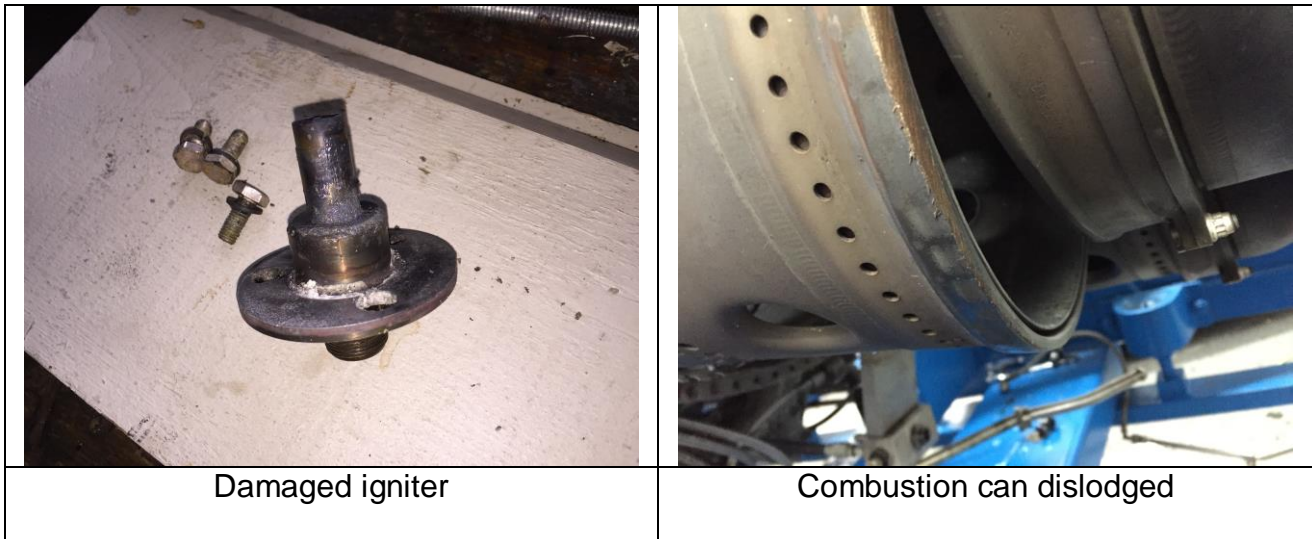
Turbine support housing holed & fretted



Pieces of combustion can in HP NGVs



Combustion can in two parts



4 Summary

Gas Turbine s/n: 202205 was successfully removed from berth.

The CCC valve was replaced and NRV removed, cleaned, function checked then re installed. Tee – piece connection blanked from LP fuel pump to CCC valve.
Alba lease Olympus Gas Turbine s/n: 202040 was installed and commissioned successfully in accordance with Alba Power Ltd procedures.

The Newfoundland Hydro Hardwoods site was restored to an operational capability of 30mw.

Fault finding at the Stephenville site uncovered a seized solenoid in the Woodward valve fuel shut off. This was stripped & repaired allowing berth 'B' to be returned to service.

5 Recommendations

Alba Power recommends that the Olympus Gas Turbine s/n 202040 should be inspected on a regular basis as per Alba Power recommendations.

Gas Turbine s/n 202205 failed to trip when the combustion casing failed and had to be manually shut down by site personnel at the main fuel valve.
Inspect function test of Alarm / Trip on Exhaust gas temperature thermocouples should be carried out.

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6 Customer acceptance

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9 Customer sign off sheet



Customer Acceptance Sign Off Sheet

ALBA Job No: 5166

Description of Works: Installation and commissioning of Olympus gas turbine

Site: Newfoundland Hydro, Hardwoods St Johns

Customer: Newfoundland Hydro

Designate: Olympus

Manufacture: Rolls Royce

Eng. Serial No: 202040

Having witnessed the installation and commissioning of Rolls Royce Olympus S/N 202040 gas turbine, I the under signed, am satisfied with the work carried out and that it complies with the works being completed within the boundaries of the contract.

Signed: *[Signature]*
Print: Robert Skanderson
Position: *Eng*
Date: 2016/02/14
For: Newfoundland Hydro

Signed: *[Signature]*
Print: COLIN SWIFT
Position: FIELD SERVICE TECH
Date: 14/2/16
For: Alba Power Ltd

Customer: Newfoundland Hydro
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Page 25
Date: 11/02/16

7 Report Compilation

On site personnel:	Colin Smith	Date:	11th Feb – 18 th Feb 2016
Report compiled by:	Colin Smith	Date:	24th February 2016
Reviewed by:	Bruce Proctor	Date:	25th February 2016



Field Service Report For Investigation of High Vibration Olympus Serial No: 202204



Customer: Newfoundland Hydro Stephenville

Date: 29th March 2016

Project Number: Alba 5269

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1 Introduction

Mr. Symon Hanna arrived at the Newfoundland Hydro site in Stephenville to investigate a high vibration trip and debris found on number 2 and 3 magnetic chip detector.

Date of works: Tuesday 29th March 2016 – Friday 1st April 2016.

Alba Power on site personnel: Mr. Symon Hanna.

2 Daily Report

2.1 Tuesday 29th March 2016

Symon checked in at Aberdeen airport and travelled to Deer Lake Newfoundland via London Heathrow and Toronto airports. Symon stayed overnight in Deer Lake.

2.2 Wednesday 30th March 2016

Symon travelled from Deer Lake to the Newfoundland Hydro Stephenville site. On arrival Symon was given a tailboard safety brief and the work scope of the job was discussed.

Both lube oil feed and return oil pipes were removed from the Olympus and the main oil tank. On removal of these pipes the oil contained fine black and metallic particles and also was discoloured with a burnt smell apparent.

The inlet oil strainer was removed and inspected for debris and found to be clean.

All magnetic chip detectors were removed and debris samples taken. All magnetic chip detector baskets were removed and debris samples were taken. There was severe bearing material debris in the green (Nos: 2 and 3) magnetic chip detector basket.

The air starter motor was removed and the HP rotor was rotated by hand. No abnormal noises or tightness was noted. The turning gear caps were removed from the fuel pump gear box and the LP rotor was attempted to be turned by hand. The LP rotor would not rotate.

The access was gained to the inlet plenum and the front of the LP rotor was inspected. On inspection a sizeable piece of debris was found between the LP rotor and the inlet casing stuck to the base of one of the first stage rotor blades. The LP rotor was rotated in an anti-clockwise direction and was tight to rotate. The LP rotor was then rotated in a clockwise direction and was very tight to turn with scraping noises noted.



2.3 Thursday 31st March 2016

Symon arrived on site and was given a tailboard safety brief before starting work.

All magnetic chip detector baskets were cleaned and replaced along with all corresponding magnetic chip detectors. All removed pipe-work was re-fitted along with the turning gear caps.

The oil used in the Olympus gas turbines was inspected and found to be in date in an adequate storage environment.

Symon left site and travelled to Dear Lake for his return flight to Aberdeen via Halifax and London Heathrow airports.

2.4 Friday 1st April 2016

Symon arrived back in Aberdeen.

3 Photographic Images

	
<p>No.1 (Blue) Bearing magnetic chip detector and basket.</p>	<p>No.2 and 3 (Green) Bearing magnetic chip detector basket showing excessive debris.</p>
	
<p>No. 4 and 5 (Aluminium) Bearing magnetic chip detector and basket</p>	<p>No. 7 (White) Bearing magnetic chip detector and basket showing several large pieces of debris.</p>

	
<p>No. 8 (Yellow) Bearing magnetic chip detector and basket.</p>	<p>Oil and debris drained from the removal of the No. 2 and 3 (Green) Bearings magnetic chip detector basket showing contaminated burnt oil and excessive debris.</p>
	
<p>Oil Tank scavenge filter showing large quantities of metallic debris.</p>	<p>Oil feed pipe from the oil tank to the Olympus showing contaminated and discoloured oil through excessive heat.</p>

	
<p>Oil scavenge pump filter removed. No signs of debris.</p>	<p>Mobil Jet 2 Oil tank showing that the oil is in date.</p>
	
<p>Fresh oil pumped from the oil drum used for the Olympus gas turbines showing its colour and cleanliness.</p>	<p>Piece of debris removed from between the LP compressor rotor and the intake casing.</p>



4 Summary

All oil filters and magnetic chip detectors have been examined and excessive amounts of debris found in the No. 2 and 3 (Green) magnetic chip detector basket. This debris appears to be bearing material.

The lubricating oil for the Olympus gas turbine appears to be burnt and as a result Gas Turbine s/n: 202204 has suffered front end LP rotor main line bearing failure. The reason behind the excessive heat within the oil system could be due to the heating element within the oil tank becoming too hot or the way in which the gas turbines are shut down and not having a cool down period of at least 5 minutes at LP idle speed of 2000rpm.

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5 Customer Acceptance

	Customer Acceptance Sign Off Sheet
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ALBA Job No: CO 5269

Description of Works:

Olympus vibration investigation

Site: Newfoundland Hydro Stephenville

Manufacture : Rolls Royce

Type: Olympus

I the under signed, am satisfied with the works carried out and that it complies with the works being completed within the boundaries of the contract.

Signed:



Print:

Equipment Engineer

Position:

Robert Shendera

Date:

30/03/2016

For: Newfoundland hydro Stephenville

Signed:



Print: S. HASINA

Position: LEAD FIELD SERVICE ENGINEER

Date: 30-03-2016

For: Alba Power Ltd



6 Report Compilation

On site personnel:	Symon Hanna	Date:	29 th March – 1 st April 2016
Report compiled by:	Symon Hanna	Date:	1 st April 2016
Reviewed by:	Alan Watson	Date:	1 st April 2016