MV Grand Manan Adventure

Independent Review of the Reliability of the Main Propulsion Machinery

Prepared by: Shawn Marshall – Director of Marine Operations – GNL
In consultation with: Max Harvey – Assistant Deputy Minister Marine Services – GNL
Stephen Mulrooney – Director of Fleet Renewal – GNL

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Introduction

At the request of the Department of Transportation & Infrastructure, Government of New Brunswick, the Marine Services Division of the Department of Transportation & Works, Government of Newfoundland & Labrador, performed an independent review of the design, build, operation, and reliability of the MV Grand Manan Adventure, specifically focusing on the failures that have plagued the main propulsion machinery onboard the vessel since it first entered service in July 2011. The mandate of the technical review is to specifically address the following questions:

1. Were the performance criteria laid out in the design & build contract appropriate for the type of vessel and service?

2. Did the propulsion machinery supplied by Eastern Shipbuilding Group Inc. meet the performance criteria found in the contract and were they consistent with industry standards at the time of the build?

3. Are the operating procedures of Coastal Transport Ltd. compatible with the design of the vessel and its machinery?

4. Are the operational, maintenance, and / or repair procedures of Coastal Transport Ltd. having an impact on the reliability of the vessel?

The MV Grand Manan Adventure is an 86 meter RO-RO type passenger ferry designed and built by Eastern Shipbuilding Group Inc. at their shipyard located in Panama City, Florida. The vessel's design utilizes two EMD 710 series 12 cylinder 2-stroke medium speed marine diesel engines that produce a total of 6000bhp. The engines drive two Berg controllable pitch propellers guided by high lift rudders. Auxiliaries include three Caterpillar C-18 500KW diesel generator sets, two 600KW shaft generators, and two athwart ship tunnel bow thrusters.

Since entering service in 2011, both main engines have experienced multiple catastrophic failures that have taken the vessel out of service. The details of the failures are as follows:

Port Main Engine

- July 2013 – Main Engine turbocharger clutch failed during operation.
- June 2014 – Cast lubricating oil line in turbocharger failed during operation.
- August 2014 – Cylinder #6, cylinder liner failed during operation.
- March 2015 – Cylinder # 3, cylinder head failure during operation.
- April 2015 – Cylinder #4, exhaust valve failure during operation.

- July 2015 – Cylinder #8, exhaust valve failure during operation.
- August 2015 – Cast lubricating oil line in turbocharger failed during operation.

Starboard Main Engine

- March 2014 – Cast lubricating oil line in turbocharger failed during operation.
- April 2014 – Turbocharger gear train failure during operation.
- June 2015 – Jacket water cooling pipe to cylinder #6 failed during operation.

This report shall discuss the relevant data contained in the various documents received from both the operator and the owner and conclude with recommendations, based on that data, in an attempt to improve the reliability of the main propulsion machinery. The relevant data was obtained from document review and interviews including, but not limited to:

- Engine room log book entries from July 2011 – August 2015.
- Detailed design documentation including the contract with the shipbuilder and the electrical load analysis.
- Detailed test and trial documentation including fuel and sea trial data.
- Various failure reports provided by the operator.
- OEM service reports.
- OEM service bulletins.
- Maintenance reports.
- Work order history.
- Data collected during onsite attendance.
- Statements from the operator including crew and shore personnel.
- Statements from the owner’s representatives including relevant consultants.
- Various email correspondence between the operator and OEM authorized representatives.

Methodology

The study began with a review of the design & build contract between the Department of Transportation & Infrastructure and Eastern Shipbuilding Group Inc. with specific attention paid to the decision making process surrounding the selection of the EMD 710 series marine diesel engines as the main propulsion machinery for the MV Grand Manan Adventure, and the engine’s suitability for this specific application. Following the review of the design criteria, research then focused on the reported failures affecting the main propulsion machinery.

As the MV Grand Manan Adventure appeared to have operated relatively problem and symptomatic free from its entry into service in July 2011 until the first recorded failure of a turbocharger in July 2013, the initial approach was to review the relevant engine room log book data and service conditions prior to July 2013 and compare the findings with the engine room log book data, service conditions, and service reports just prior to and subsequent to the July 2013 failure in an attempt to identify any significant changes in operation or abnormalities that could point to the cause of the various failures.

To obtain an accurate history of the main engines and their operating condition, a review of the maintenance records and maintenance history was also performed to identify any irregularities or variances from the manufacturer's recommendations that may have attributed to the various main engine failures.

Upon completion of a review of the relevant operating data, site visits were conducted onboard the vessel, as well as visits to the offices of Coastal Transport Ltd., and the Department of Transportation & Infrastructure. The purpose of these site visits was to interview the stakeholders and view the operation of the affected machinery first hand in order to verify thedata contained in the engine room log book. In addition, the operating practices and conditions of the vessel were observed in a relatively calm sea state.

Following the site visits, an in-depth review of all of the relevant data including log book entries, service reports, witness statements, OEM design data, and data collected from the onsite visits was completed.

Findings

A review of the design & build contract uncovered no notable issues in regards to the performance criteria or the main propulsion machinery requirements. While the contract could have been more detailed and prescriptive in requirements, it did represent a reasonable standard of performance given the nature of the service.

The EMD 710 series marine diesel engines appear to have adequately met the performance requirements of the contract. Interviews with key Department of Transportation & Infrastructure staff members indicate the engine selection process appeared to be based solely on a recommendation from the shipbuilder, Eastern Shipbuilding Group Inc., whose recommendation appeared to be influenced mainly on lead times associated with the delivery of new marine diesel engines at the time of the build in addition to a pre-established relationship between the shipbuilder and the engine manufacturer; which is not uncommon in the shipbuilding industry.

A look at the maintenance records, and maintenance history provided by both the operator and the owner, in comparison to the manufacturer's recommendations, did not identify any variances or irregularities. There was no evidence to support a finding that poor maintenance practices had contributed to the failures.

The maintenance records provided by the owner were in the form of an annual report received from the operator as per the existing agreement. The report simply indicates what major tasks were completed as well as containing a print out from the operator's maintenance management program. Aside from this report there is little to no oversight from the owner when it comes to maintenance, vessel operation, or major repairs.

Upon review of the relevant data associated with the failures, beginning in July 2013, there appear to be several influencing factors that may have attributed to the various failures. The data, as well as statements from the operators, indicate that from the vessel's entry into service in July 2011 up until the initial turbocharger failure in July 2013, the vessel had been operating in constant speed mode at 900 RPM not only while in transit but also while secured at the dock during loading and unloading operations. As a result there were several periods of approximately 30 minutes (the length of time between arrival and departure) throughout the day, in which the main engines were running at 900 RPM with little to no load on them.

The result of this "no-load operation" was that the turbocharger clutch assembly was likely engaged for extended periods of time reducing its life expectancy. EMD released a service advisory in October 2010 advising against this very practice. As a result of the failure, the operator changed the practice of remaining at 900 RPM while secured to the dock and began reducing the main engines to idle speed when not in transit. Since that change in procedure, there has been no other reported failure of this nature; this supports the recommendations and findings of the service bulletin issued by EMD in 2010.

The vessel underwent a scheduled refit during the autumn of 2013. At that time the operators elected to set up and employ a "combinator mode" on the vessel which would match propeller pitch settings with a predetermined engine speed to try and maintain a balanced load on the main machinery. Prior to this "combinator mode", the vessel had only been set up to operate in "constant speed mode" which would maintain the engine speed at a constant 900 RPM no matter what the propeller pitch demand was; this mode is normally intended to utilize shaft generators in supplying electrical power to the vessel which require a constant RPM in order to provide reliable power.

Following the commencement of the "combinator mode", various crew members, including one Master, indicated that there was a noticeable vibration present at main engine speeds below 900 RPM. The failures that occurred subsequent to the turbocharger clutch failure of July 2013 all appear to be that of a nature that suggests a possible vibration issue. During the site visit, it was observed that a slight vibration could be felt adjacent to the port main engine. Iin addition, when the vessel was put in “combinator mode”, a vibration was evident throughout the vessel.

Upon review of the engine room log book data, it is apparent that there is a difference in how the vessel is operated. Masters have discretion on the mode and had different mode preferences for operation. There appeared to be a pattern in which the vessel was operated for an extended period in “constant speed mode” and then changed to operate for an extended period in “combinator mode”. There was an extended period prior to each failure in which the vessel was operated in “combinator mode”.

Given the fact that the vessel operated for the first 2 years of its life in “constant speed mode” with no major reported issues, combined with the witness statements and observations made during the site visit, it is reasonable to suggest that the vibration caused while operating in “combinator mode” is a major contributing factor to the subsequent failures and is detrimental to the reliability of the main propulsion machinery.

During the site visit it was observed that there was a substantial imbalance between the port and starboard main engines. Review of the operating pressures and temperatures, as well as the fuel demand and consumption, indicated that the starboard engine appeared to be “carrying more load”, for the same amount of pitch on the propellers, than the port engine. This in itself may prove detrimental to the reliability of the vessel if allowed to exist for an extended period of operation.

Although fuel consumption was not part of the original scope of this review, it was presented as an issue on numerous occasions by the owner’s representatives. It goes without saying that running the engines and vessel at a slower speed will reduce the fuel consumption, however evidence has demonstrated that the reliability of this particular vessel is reduced as long as the main engines are run at speeds below 900 RPM with the current arrangement.

Conclusion

The EMD 710 marine diesel engines met the requirements of the design and build contract, therefore an argument to replace these engines is not supported.

Evidence indicates that there is no inherent problem with the existing main propulsion machinery, nor does there appear to be any link between the various failures and the maintenance practices of the operator. However it is apparent that there is a direct link between the failures and the manner in which the vessel is being operated. Vibration levels found during certain modes of operation appear to be substantial enough to cause recurring issues with the main engines.

Recommendations

Immediate

it is recommended that the vessel, given its current configuration, operate in “constant speed mode” as opposed to “combinator mode”. The main engines should be reduced to “idle speed” or shut down while in port. The evidence shows that vibrations occurring while in “combinator mode” have been harmful to the machinery, prolonged operation in this mode will likely cause further issues and reduced reliability. The “combinator mode” should not be used on this service in the current configuration.

It is recommended that the owners request the operators to employ a Vibration Analysis Technician to perform an in depth vibration analysis on the main propulsion machinery to identify and correct any vibration related issues.

Short Term (Within one year)

It is recommended that the owner requests the operator to task OEM service representatives for EMD and the Berg propeller systems to balance out the loading on the main engines and calibrate the load management system onboard. In order for this to be done properly, manufacturers’ representatives for both systems should be onsite at the same time. This should allow return to “combinator mode” operation which would reduce fuel consumption.

It is recommended that the owner request the operator to enroll in a routine vibration analysis program, once any existing vibration issues are corrected, to maintain the condition of the machinery plant. This will help improve the reliability of the vessel, and move towards a “preventative maintenance” routine as opposed to a “reactive maintenance” routine.

It is recommended that maintenance records should be forwarded to, and reviewed by, the owner no less than “quarterly” to ensure compliance with the OEM maintenance schedules.

It is recommended that the owner have a representative attend the vessel no less than “quarterly” to witness and review vessel operation. Had this been practiced prior to this report, the pattern that emerged in regard to the change in operating modes may had been discovered earlier, resulting in less “downtime”.

Medium Term (By end of scheduled refit)

It is recommended that the owner consider adding a technical and operational capability within its organization to oversee and monitor the contractor and the operation. This due diligence will promote greater, and earlier, operational and technical insight into the service. A more informed and involved owner, when it comes to the operation, maintenance practices, and repair procedures onboard their vessel, will promote increased reliability and sustainability of the service.

It is recommended that the current switchboard configuration be modified to permit the shaft generators to provide electrical service for the entire vessel. The current electrical supply system consists of three diesel auxiliaries and two shaft driven generators. The shaft generators are currently only utilized for supplying power to the bow thrusters while maneuvering. The remainder of the vessel's electricity is supplied by operating two of the diesel driven Caterpillar generators. If incorporated into the power management system, the shaft generators could provide the bulk of the electrical requirements with the diesel auxiliaries supplementing the power on an as needed basis. This would drastically reduce the fuel being consumed by the diesel auxiliaries as well as provide a load for the main engines while the vessel is secured to the dock. Any main engine not being utilized to provide power to the vessel should be reduced to idle, or ideally, shut down, between crossings.

Appendices

Appendix 1

Letter from Deputy Minister Sadie Perron (GNB) Convening the Technical Evaluation of the MV Grand Manan Adventure

New Nouveau Brunswick

Memo
Note

Transportation and Infrastructure/Transports et Infrastructure
P.O. Box/C.P. 6000
Fredericton, NB E3B 5H1

Date :	June 26, 2015
To/Dest. :	Stakeholders
From/Exp. :	Sadie Perron, Deputy Minister
Copies :	David Cogswell, Executive Director, Operations Division Nancy Lynch, Director, Planning and Strategic Development
Subject/objet :	TECVAL

This memo is to advise and direct that a technical evaluation (TecVal) be conducted regarding the Grand Manan Adventure (GMA) engineering issues which have impacted service delivery. It follows from a number of discussions between the Government of New Brunswick/Department of Transportation and Infrastructure (GNB/DTI) and various stakeholders and the Government of Newfoundland and Labrador/Transportation and Works (GNL/TW) regarding support for an independent 3rd party look into the technical issues experienced by the GMA.

GNL/TW has offered a team of three senior Marine personnel to conduct the TecVal. There have been some preliminary discussions as well as a round table meeting on Fri Jun 19, 2015 in St. George with major stakeholders - Minister Melanson and Minister Doucet, senior DTI leadership, senior Coastal Transport (CT) leadership including the senior Captain of GMA, and senior Village of Grand Manan (VGM) leadership.

During this discussion, two principal objectives were outlined- improved communication channels and a long term solution to the GMA engineering issues. This meeting, in setting the way ahead for the TecVal, was very positive and there was consensus on the approach methodology to be taken. It was highlighted by the Ministers and stakeholders alike, that for success in finding solutions, frank and full exchanges were needed. The introduction of outreach and improved communication channels is in progress with more to follow as a separate initiative.

To ensure the TecVal activities and expectations are aligned for all stakeholders, some direction and guidance to the GNL team and stakeholders are detailed below:

ISSUE

Loss of confidence in the GMA engine reliability to maintain schedule due to repeated breakdowns and out of service periods on an essential and busy marine link for Grand Manan Island.

BACKGROUND

GMA was delivered as new build vessel designed to serve the Village of Grand Manan Island in 2011. It was to bring long term capacity and reliability to a key provincial ferry route. Since that time, there has been a number of unexpected breakdowns and repeat failures of machinery. This has resulted in out of service periods, lost trips and delayed service as well as passenger and traffic disruption to residents, tourists, and commercial users who depend on the reliability of the service. As well, it has introduced considerable additional and unforecast costs to operate the service.

There are a range of stakeholder insights and perspectives on the causes of the breakdowns and potential solutions. An independent 3rd party review is considered the best option to consolidate the views of stakeholders and to conduct their own inquiry into the technical issues in exploring the cause and potential solutions.

GNL TECVAL TEAM

GNL has access to additional technical expertise support from it shore staff and fleet personnel. The GNL TecVal team will consist of:

- GNB Lead: Max Harvey – Assistant Deputy Minister, Marine Services
- Principal Contact: Shawn Marshall - Director of Operations
- Stephen Mulrooney - Director of Fleet Renewal

TECVAL MANDATE

The New Brunswick Department of Transportation & Infrastructure (NBDTI) is requesting an independent 3rd party review of the GMA's performance criteria and operation procedures to determine what options are available to reduce the down time and number of missed trips for this ferry service. Following are the main areas to be reviewed:

- Review of the performance criteria established by the Province for the GMA vessel design and engine requirements to determine if they were appropriate for the type of vessel required;
- Review of the engines supplied by Eastern Shipbuilding to see if they meet the standards for industry and the performance criteria specified in the Agreement;
- Review of the operational requirements in the Operations Agreement with CT to determine if they are compatible with the engines supplied and vessel design;
- Review of the operation, maintenance and repair procedures of CT to determine if they may be impacting the performance of the vessel.

KEY STAKEHOLDER GROUPS/CONTACTS

Noted below are the primary stakeholder groups and contact information. They are the primary contacts for the TecVal teams and direct liaison is authorized. It is recognized that stakeholders will have a number of secondary stakeholders - internal team, shipbuilders and equipment providers, designers, suppliers, consultants and other personnel - who will have information, insights, and documentation which will be helpful to the TecVal team. The TecVal team will follow up with primary stakeholders to request that these personnel be identified, contact information provided, and the type of information and connection to the TecVal themes of inquiry. Prior to contacting these individuals, the TecVal team will request that the primary stakeholder contact the individual and assist in arranging an interview or visit as appropriate.

- GNB Convening Authority: Sadie Perron, Deputy Minister, Transportation and Infrastructure, is the authority for the mandate. She will liaise with GNL as required.
- GNB Lead: Sadie Perron, Deputy Minister and David Cogswell, Executive Director, Operations Division - Principal Contact: Nancy Lynch nancy.lynch@gnb.ca Phone: 21(1)
- GNB/Design Consultants: E.Y.E Marine Consultants
- CT: Gregg Ryder – Service policies, vessel operations, schedule, records
- VGM: Mayor 21(1) (residents and ferry users)
- VGM: Harbour Authority (wharf operations)
- VGM: Fishing Leadership (wharf users)

PROCESS GUIDANCE

- Reporting: GNL will make their report to GNB via the DM DTI. GNB is responsible for all communications regarding this mandate.
- Documentation: All documentation to be submitted to Nancy Lynch for submission to GNL TecVal Team
- Access: GNL has direct liaison authority with stakeholders noted above and those identified by the stakeholders in the course of the TecVal
- GNL Approach: Impartial, honest and frank discussions – common cause to resolve issues. Stakeholders as separate groups
- GNL Stakeholder Visits: GNL team will make arrangements with stakeholders to conduct discussions via phone, email, and on site visits.
- GNL TecVal: Areas of Inquiry – Cause, Fix, Fix Validation, Service Strategy

TIMELINES

Noted below are draft timelines for the GMA TecVal. They will be updated as required.

- Prior to Jun 19 - Pre Meeting consultations
- May/Jun – GNL review and discussions
- Fri Jun 19 – Stakeholders Meeting – St. George
- By Fri Jul 3 – Documentation collection completed
- Jul-Aug – Stakeholder consultations
- Mon Aug 24 – Consultations completed
- By end of September – Final report to GNB

This TecVal is an important activity in determining the technical way ahead for the GMA and the ongoing service for Grand Manan Island. The support and partnership of all is much appreciated.

Sincerely,

Sadie Perron
Deputy Minister

Appendix 2

Sample Engine Room Log Book Entries Including "Constant Speed Mode" Operation & "Combinator Mode" Operation

Grand Manan Adventure, F-32

From: Grand Manan. NB

Day: 15 Month: May Year: 2015

#1 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts

#2 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts
1500	444	84	28	13/85	492	48	25.7	478	240	150
1800	432	85	36	13/85	492	50	25.7	478	250	165
1800	440	85	34	13/81.0	492	50	25.7	475	270	170

#3 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts
1800	456	81	38	11/68	496	44	25.7	478	250	165
1800	440	82	46	13/70	500	48	25.7	480	250	160
1801	460	82	44	13/71.4	500	48	25.7	480	280	180

Fuel Bunkering	
Amount at Start	
Start Time	
Stop Time	
Amount at Stop	
Quantity Received (m³)	

Bunkers + Day Tanks at 07:00 Hours =	150 m³
Todays Fuel Consumption (m³)	
Previous Total Fuel	150
plus Fuel Received	
minus Total Fuel at Finished with Engines	137
Days Consumption =	13m³
Fuel Monitor at Finished with Engines (litres)	N/A

Shore Power	
Volts	Amps
465	210
455	300
460	290
460	260

Potable Water	
07:00 Hours	39.1
Finished with Engines	36.5

Berg System	
A	B
—	

Tank	Dip
Dirty Oil	5414
Dirty Bilge	3817
Hydraulic Oil	2111
Lube Oil #1	893
Lube Oil #2	771
Gear Oil	1380

Water Tight Doors Tested:	OK
Start Up Procedures Completed:	

Remarks:

Gens #2 and 3 online @ 05:50
ME Top Deck inspection carried out - all ok - 21(1)

O.W.S started @ 1740 S/D @ 1845
O.W.S Started - 1940 - OWS S/D 2045 (3817 — 623)
Gen #2 S/D 2249 Shore Power on 2251 Gen #3 S/D 2253

Chief Engineer: 21(1)

To: Blacks Harbour, NB

Coastal Transport Limited

Main Engines

PME Time	RPM	Lube Oil In	Lube Oil Diff	Lube Oil TC	Lube Oil Temp	Start Air Bar	Fuel Oil - Bar In	Fuel Oil - Bar Filter	Jacket Water In	Jacket Water Out	Jacket Water Temp	A/C Bar	Air Inlet	Air Box Bar	Air Box Temp	M.B. #	High Temp	M.B. #	Low Temp	Soak Back Bar
0843	903	8	11	5	76	11	9	8	5	2	74	4	16	2	47	2	97	1	88	5
1241	904	8	10	5	76	11	9	8	4	2	74	4	17	2	47	2	97	1	89	5
2004	902	8	10	5	76	11	9	8	4	1	74	4	20	2	47	2	97	1	88	5

SME Time	RPM	Lube Oil In	Lube Oil Diff	Lube Oil TC	Lube Oil Temp	Start Air Bar	Fuel Oil - Bar In	Fuel Oil - Bar Filter	Jacket Water In	Jacket Water Out	Jacket Water Temp	A/C Bar	Air Inlet	Air Box Bar	Air Box Temp	M.B. #	High Temp	M.B. #	Low Temp	Soak Back Bar
0845	902	8	48	5	76	11	10	8	5	2	74	4	14	2	50	3	99	4	84	5
1242	903	7	50	5	76	11	10	8	5	2	74	4	18	2	51	3	100	4	84	5
2009	904	7	54	5	76	11	10	8	5	2	24	4	20	2	51	3	100	4	84	5

Port Shaft Gen Temps. Brng.	U	V	W	Port Shaft & CPP Pitch	RPM	Load	Thrust Temp	Journal Temp
37	62	60	61	93	275	73	64	44
37	67	68	66	94	274	70	67	48
41	70	68	70	94	273	60	67	50

Stbd Shaft Gen Temps. Brng.	U	V	W	Stbd Shaft & CPP Pitch	RPM	Load	Thrust Temp	Journal Temp
35	57	58	56	94	275	66	56	46
41	64	67	63	94	273	61	58	52
44	67	70	68	93	275	67	58	54

Machinery Oil Make Up

Main Engines	
Gear Boxes	
Ship's Service Genrs.	
Emergency Generator	
Steering Gear	
MacGregor Hydraulics	

Port Main Engine Exhaust

Cyl #	High	Cyl #	Low
8	517	12	455
8	510	12	454
~~8~~	~~504~~		~~442~~
8	504	12	442

Stbd Main Engine Exhaust

Cyl #	High	Cyl #	Low
8	574	6	477
8	577	6	480
~~8~~	~~584~~	~~6~~	~~488~~
8	584	6	488

Machinery Hours

Port Main Engine Hours	19130
Stbd Main Engine Hours	19140
#1 Generator Hours	19863
#1 Generator Litres of Fuel of Fuel Consumed	
#2 Generator Hours	16202
#2 Generator Litres of Fuel of Fuel Consumed	
#3 Generator Hours	17535
#3 Generator Litres of Fuel of Fuel Consumed	
Emergency Generator Hours	
Emergency Generator Litres of Fuel of Fuel Consumed	
#1 MacGregor Pump Hours	2898
#2 MacGregor Pump Hours	3365

Port Gearbox

Water Temperature	Press	Oil Temp
118	2.1	66
119	2.0	68
17		
120	2.0	68

Stbd Gearbox

Water Temperature	Press	Oil Temp
86	2.1	66
87	2.1	67
89	2.1	66

Run Times

M/E Start	Clutch In	Constant Speed	Shaft Generator	Stand By	Finished With Engines	Shutdown Complete
0714	0720	0728	0728	0729	2245	2248

Departure and Arrival Times

Depart	0733	Arrive	0857	Depart	0935	Arrive	~~1133~~
Depart	1133	Arrive	1258	Depart	1331	Arrive	1453
Depart	1534	Arrive	1701	Depart	1732	Arrive	1858
Depart	1930	Arrive	2055	Depart	2105	Arrive	2233
Depart		Arrive		Depart		Arrive	

Grand Manan Adventure, F-32

From: Grand Manan, NB

Day: 16 **Month:** May **Year:** 2015

#1 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts
1800	444	83	38	9/63	448	45	25.6	473	195	145
1800	440	82	32	10/68	444	44	25.5	473	260	180
1800	428	84	48	12/73	436	52	25.5	473	240	180
1800	440	83	40	11/69.4	448	45	25.6	475	200	140

#2 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts

#3 Ship's Service Generator										
RPM	Oil (kPa)	Jacket Temp.	Boost (kPa)	Manifold Temp	FO (kPa)	FO Cons (L/H)	Batt. Volts	Volts	Amps	Kilowatts
1801	452	82	34	11/63	496	~~25~~ 44	25.7	478	240	140
1801	448	81	30	11/67	492	42	25.7	478	300	175
1801	436	83	48	12/68	496	51	25.7	478	280	170
1801	452	83	40	11/69.8	496	46	25.7	480	250	140

Fuel Bunkering	
Amount at Start	93
Start Time	0904
Stop Time	0930
Amount at Stop	117 m^3
Quantity Received (m³)	25.057

Fuel Ticket # 25.057

Bunkers + Day Tanks at 07:00 Hours = 137 m³

Todays Fuel Consumption (m³)	
Previous Total Fuel	137
plus Fuel Received	25
minus Total Fuel at Finished with Engines	148
Days Consumption =	14
Fuel Monitor at Finished with Engines (litres)	N/A

Shore Power	
Volts	Amps
460	230
465	210
460	220
460	210

Potable Water	
07:00 Hours	36.1
Finished with Engines	31.8

Berg System	
A	B
✓	

Tank	Dip
Dirty Oil	5441
Dirty Bilge	893
Hydraulic Oil	2111
Lube Oil #1	893
Lube Oil #2	721
Gear Oil	1380

Water Tight Doors Tested:	OK
Start Up Procedures Completed:	

Remarks:

Gens #1 and 3 online @ 05:00 due to Scheduled Power Outage on Shore
Main Engine Top Deck Inspection Carried out - All OK 21(1)
Fire + Boat Drill - 1345

Gen #3 S/D 2300 Shore Power on 2302 Gen #1 S/D 2304

Chief Engineer: 21(1)

To: Blacks Harbour, NB

Coastal Transport Limited

Main Engines

PME Time	RPM	Lube Oil In	Lube Oil Diff	Lube Oil TC	Lube Oil Temp	Start Air Bar	Fuel Oil - Bar In	Fuel Oil - Bar Filter	Jacket Water In	Jacket Water Out	Jacket Water Temp	A/C Bar	Air Inlet	Air Box Bar	Air Box Temp	M.B. #	High Temp	M.B. #	Low Temp	Soak Back Bar
0838	904	8	10	5	76	11	9	8	4	2	74	4	16	2	47	2	97	1	88	5
1231	847	8	10	5	74	11	9	8	4	1	74	4	17	2	46	2	95	1	87	4
1617	846	8	9	5	74	11	9	8	4	1	74	4	18	2	46	2	95	1	87	5
2001	847	8	11	5	74	11	9	8	4	1	74	4	17	2	46	2	95	1	87	4

SME Time	RPM	Lube Oil In	Lube Oil Diff	Lube Oil TC	Lube Oil Temp	Start Air Bar	Fuel Oil - Bar In	Fuel Oil - Bar Filter	Jacket Water In	Jacket Water Out	Jacket Water Temp	A/C Bar	Air Inlet	Air Box Bar	Air Box Temp	M.B. #	High Temp	M.B. #	Low Temp	Soak Back Bar
0840	902	8	51	5	76	11	10	8	5	2	74	4	14	2	50	3	99	4	84	5
1233	846	7	52	5	74	11	9	8	4	1	74	4	18	2	49	3	97	4	83	5
1618	849	7	54	5	74	11	9	8	4	1	74	4	19	2	49	3	97	4	83	5
2005	848	7	55	5	74	11	9	8	4	1	74	4	18	2	49	3	97	4	83	5

Port Shaft Gen Temps. Brng.	U	V	W	Port Shaft & CPP Pitch	RPM	Load	Thrust Temp	Journal Temp
36	61	60	60	94	274	68	65	44
37	68	66	66	100	257	68	67	46
39	68	66	67	100	258	67	67	46
38	69	68	67	100	257	63	67	47

Stbd Shaft Gen Temps. Brng.	U	V	W	Stbd Shaft & CPP Pitch	RPM	Load	Thrust Temp	Journal Temp
38	57	60	57	94	276	62	56	48
41	65	69	65	100	257	63	57	51
43	66	68	66	100	258	64	58	51
42	67	71	67	100	257	68	58	52

Machinery Oil Make Up	
Main Engines	
Gear Boxes	
Ship's Service Genrs.	
Emergency Generator	
Steering Gear	
MacGregor Hydraulics	

Port Main Engine Exhaust Cyl #	High	Cyl #	Low
8	504	12	444
1	526	12	466
1	536	12	471
1	528	12	465

Stbd Main Engine Exhaust Cyl #	High	Cyl #	Low
8	570	6	476
8	562	6	477
8	565	6	476
8	565	6	474

Port Gearbox Water Temperature	Press	Oil Temp
118	2.0	67
119	2.0	68
120	2.0	66
120	2.0	68

Stbd Gearbox Water Temperature	Press	Oil Temp
86	2.1	65
86	2.1	65
87	2.1	67
87	2.1	65

Machinery Hours	
Port Main Engine Hours	19146
Stbd Main Engine Hours	19156
#1 Generator Hours	19881
#1 Generator Litres of Fuel of Fuel Consumed	
#2 Generator Hours	16202
#2 Generator Litres of Fuel of Fuel Consumed	
#3 Generator Hours	17553
#3 Generator Litres of Fuel of Fuel Consumed	
Emergency Generator Hours	
Emergency Generator Litres of Fuel Consumed	
#1 MacGregor Pump Hours	2898
#2 MacGregor Pump Hours	3370

Run Times						
M/E Start	Clutch In	Constant Speed	Shaft Generator	Stand By	Finished With Engines	Shutdown Complete
0714	0720	0728	0728	0729	2256	2259

Departure and Arrival Times							
Depart	0733	Arrive	0859	Depart	0932	Arrive	1056
Depart	1133	Arrive	1257	Depart	1331	Arrive	1456
Depart	1533	Arrive	1700	Depart	1731	Arrive	1854
Depart	1918	Arrive	2046	Depart	2101	Arrive	2243
Depart		Arrive		Depart		Arrive	

Appendix 3

EMD Service Advisory – Light Load Conditions

SERVICE ADVISORY - 710 Light Load Operation and Inspection

Components Affected:

12, 16, and 20 cylinder Model 710 Turbocharged Engines in Generator Service or Synchronous Operation

Purpose:

To reiterate the consequences of light load operation and provide an inspection guideline for turbocharger gear trains that have been subjected to excessive high driving torque

Background:

EMD engines, like other internal combustion engines, operate most efficiently when producing the power for which they were designed. Under normal operating conditions load can vary based on environmental conditions and equipment demands. Power Plant Load Management systems can and should be designed to minimize the number of engines on line at any time in order to maximize load, optimize fuel economy, and minimize any issues related to light load. The rapid response of the EMD two-cycle engine allows for fewer engines to be on line at any time to meet transient power requirements*.

Under typical drilling operations EMD engines provide durable and reliable performance for operators.

Recent failures of EMD turbochargers with relatively low operating hours have identified a potential problem which we believe to be attributed to extremely light load operation during the construction and testing phases of equipment. The practice of using main engines for hotel power during construction in the shipyards has been identified as a leading contributor to early wear of drive gears and turbocharger failures.

Shipyard practices of running engines for hotel power during construction of the vessel/drilling unit should be avoided.

As a general rule load management systems for Model 710 turbocharged engines running at 750 or 900 RPM should not be less than 30% of the full load rating for optimum life. There is no minimum load restriction for operation at lower engine speeds.

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*** EMD is available to assist in optimizing power plant load management systems with our two cycle engines.**

Under typical operating conditions it is normal for high driving torque to be transmitted through the turbo gear train for a short time. As the engine load is applied, the power needed to mechanically drive the turbo is proportionally decreased on the gear train by the turbine. The turbine uses exhaust gas energy to decrease the gear train load. At approximately 70% of full rated load, the exhaust energy is sufficient to drive the turbocharger rotating assembly without any gear train assist. At this operating condition, the overrunning clutch allows the turbo to speed up and run independent of the gear train: the gears continue to turn at their corresponding speed ratio to engine RPM without transmitting torque.

If engines are operated for extended periods at full speed with light loads, turbo gear train wear is accelerated. At loads of 30% and above there is no significant wear on the drive gears and EMD expects full turbocharger life. At loads below 30% wear rates gradually increase, however operating the engines during construction where loads could easily be below 10% load for sustained periods of time the wear rates could reduce the life of the drive gears to 3000 hours of operation.

EMD engines operated at full speed and less than 20% load can experience oil accumulation in the exhaust system. Engines equipped with Low Lube Oil power assemblies or engines that carry a US EPA Tier 2 certification will experience less accumulation. The exhaust system can be cleaned out by operating the engines at 70% load or more for at least 30 minutes. This should be performed after 8 hours of idling or 100 hours of continuous operation at synchronous speed with less than 20% load.

Recommended Action:

1. Change any operational activities that allow engines to operate at light loads for extended periods of time such as construction.
2. If it is suspected that engines have already been operated under very lightly loaded conditions, it is

recommended that an inspection of the gears be made to insure the gears have not worn to a point
where a failure would ensue. The following can be indicators of early stage turbocharger gear train
failure due to light engine loading:

• Noise generated from worn involute turbo spur gears will be louder than a turbo with unworn gears

• Visual wear on Turbo Spur Gears

Inspection Procedure:

Recent inspections of turbochargers have shown that the turbo spur gears are failing as a result of high turbocharger gear train loads. The gears at risk are the carrier drive, idler, and turbo drive gear, see
figure 1 below.

Figure 1-Turbocharger Gear Train

Inspect these 3 gears

1. Ensure that the engine is not running and the appropriate lock outs are in place
2. Remove the aux gen cover plate on the RB side of the turbocharger as depicted in figure 2 below.

Figure 2

3. Use the exposed opening as an access point for viewing the gears as shown in figure 3 below.

Figure 3

The following can be indicators of early stage turbocharger gear train failure due to light engine loading:

• Visual wear on Turbo Spur Gears (Turbo Drive Gear, Turbo Idler Gear, Carrier Drive Gears) See Figures 6 & 7 on page 6

• Loose, broken, or missing Oil Lube Jumper Bolts

Remove
Aux Gen
Cover Plate
Aux Gen

Cover Plate
Removed

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Due to space limitation, you may only be able to view of the turbo drive gear, idler gear, and the jumper
bolts (Reference Figures 4 & 5 below).

Figure 4

Figure 5

Turbo Drive
Gear
Turbo Idler
Gear
Oil Lube
Jumper Bolts

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4. Inspect at the surface of the gear flanks (called involute). On the involute check for signs of pitting/scoring/scuffing. (Reference Figure 6 & 7 below)

Figure 6

Figure 7

5. Replace the aux gen cover plate on the RB side of the turbocharger.
6. If light loading damage is confirmed as outlined in this document it is recommended that the engines not be operated to avoid more serious failures that can damage the entire gear train. Contact your licensed EMD distributor for resolution.

Pitting above the
pitch line area
accompanied by
scuffing near the tip
Pitting on the pitch
line on one side of
the gear face farther
away from the
impeller
Pitting above the
pitch line area
accompanied by
scuffing near the
root
Scuffing near the

root (dedendum)
Scuffing at the tip
SA#: 10-026
REVISION: Original
REVISION DATE:
ISSUE DATE: 6/25/10
AUTHOR: 21(1)
Customer Engineering • Electro-Motive Diesel, Inc. • 9301 W. 55th Street • LaGrange, IL 60525

SERVICE ADVISORY - 710 Light Load Operation and Inspection

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(For EMD Office Use Only)

Approvals (Required):

Approval Needed Y N	Approver	Approved Y N	Approved By	Date
	CES/CEM		21(1)	6/25/10
	Warranty			
	Marketing			

Service Advisory – General Classification (Select All that Apply):
GENERAL INFORMATION: This document is being issued to provide general information to the Customer Care Field Organization.
REQUEST FOR FIELD SUPPORT: This document is being issued to request Customer Care Field resources for the purpose of information/data collection in support of a current field issue investigation.
PRELIMINARY: This document is being issued to provide notable preliminary findings with regard to a current field issue. It will be followed by the issuance of an appropriate revision, or revisions, as the investigation progresses through closure, or more information becomes available.
FINAL: This document is being issued to provide final findings and recommendations on the proper handling of a current field issue. This document is intended to provide official closure of the subject field issue.

Appendix 4

Main Engine Failure History Report as Supplied by the Operator

MV Grand Manan Adventure - Main Engine Failures

Main Engine	Date of Failure	Total Engine Hours	Remarks
Port	22/Jul/2013	10,424	Turbocharger Over-running Clutch failed due to Light Load Operation
Stbd	03/Mar/2014	13,391	Cracked Cast Lube Oil Line to Turbo Planetary Gear - Turbocharger Failed
Stbd	04/Apr/2014	13,732	Turbo Idler Gear tore out of Dowel Plate damaging Camshaft Counterweights - Turbocharger replaced & Camshaft Counterweights replaced
Port	21/Jun/2014	14,504	Cracked Cast Lube Oil Line to Turbo Planetary Gear - Turbocharger Failed + Gear Train destroyed
Port	09/Aug/2014	15,150	Cracked Liner - #6 Cylinder, Inboard Bank. Replaced #6 Power Pack
Port	25/Mar/2015	18,417	Cracked Head-#3 Cylinder, Inboard Bank. Replaced #3 & #9 Power Packs (Blade & Fork). New Style Turbo Clutch fitted & Turbocharger replaced on Warranty due to pieces missing from Diffuser
Port	07/Apr/2015	18,555	Dropped Exhaust Valve-#4 Cylinder, Inboard Bank. Replaced #4 Power Pack (Blade)
Stbd	02/Jun/2015	19,400	Water leaking into #6 Cylinder. Power Pack replaced. Source of leak confirmed to be crack in way of water jumper.
Port	05/Jul/2015	19,908	Failed exhaust valve-#8 Cylinder, Outboard Bank. Replaced Cylinder Head
Port	08/Aug/2015	20,419	Turbocharger Cast Lube Oil Line to Planetary Gear came adrift - Turbocharger Failed. UTEX Turbocharger installed.

Notes:

1): Due to exhaust valve failures on the Port Main Engine (manifested by apparent cracked liners), Cylinder Heads No.1, 2, 5, 7, 10, 11 & 12 replaced with new Heads on August 10, 2015 at 20,419 Hours. Heads on No. 3, 4, 6, 8 & 9 Cylinders nor replaced due to Power Packs on Cylinders being recently replaced.