MERCANTILE MARITIME SOLUTIONS PTE LTD
Company Reg. No. 201419851N

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CLIENT – APEEJAY SHIPPING LIMITED

VESSEL: APJ ANGAD 2

Mitsui MAN B&W 6S60MC (Mark VI)

MAIN ENGINE CONDITION SURVEY

PLACE – SINGAPORE

DATE FROM – 15/02/2018 TO - 16/02/2018

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SERVICE REPORT AND TIME SHEET

Customer	Apeejay Shipping Limited	Customer W/O No	
Location	Singapore	Equipment & Brand	
Vessel	APJ ANGAD 2	Model & Serial No	Mitsui 6S60MC
Service Request	Checked Fuel cam timing, Exhaust cam advance angle, Exhaust valve seal test, Fuel regulating linkage.		
Detail of Service			

1. Checked fuel cam timing unit No.1 and 3 (OK)

We have carried out fuel cam timing for unit No.1 and 3. The result was good in order, cam was intact condition, same as shop test setting date.

(mm)

Cyl No	1	2	3	4	5	6
Measurement on 15-Feb.2018	13.5	nil	13.9	nil	nil	nil
Shop test setting data	13.9	13.8	13.9	13.7	13.7	13.6

Remarks: Designed 13.5mm (+,- 0.5 mm)

2. Checked exhaust cam advance angle, unit No. 1 and 3 (OK)

We have carried out fuel cam timing for unit No.1 and 3. The result was good in order, cam was intact condition, same as shop test setting date.

(degree)

Cyl No	1	2	3	4	5	6
Measurement on 15-Feb.2018	-12.0	nil	-12.5	nil	nil	nil
Shop test setting data	-11.9	-11.5	-11.7	-11.6	-11.7	-11.6

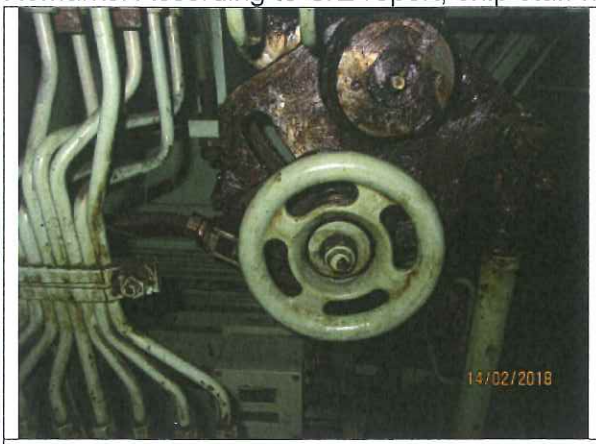
Remarks: Designed timing -12 (+,- 0.5 degree)

3. Exhaust valve spring air seal test (OK)

We have carried out seal test for exhaust valve spring air seal by means of shut-off the spring air inlet valve and found that the exhaust valve spindle remain closed position more than 1 Hr.
Acceptable at least 10 to 15 minute remain the valve closed position. That result is the exhaust valve spring air sealing rings are good conditions.
Remarks: Not recommend to overhaul the exhaust valve without O-ring and sealing rings of related spares.

4. Checked fuel regulating linkage with governor connection. (Defect)

We have checked fuel regulating linkage system and found that the Local and Remote select clutch (local stand) was loosen (locking device released) and big lost motion in between governor and fuel pump rack (index). That means the clutch was not engaged with governor properly.
When governor stop position (0) but showed fuel pump index 20/19/19/22/21/21.
Remarks: According to C/E report, ship staff had been carried out M/E local starting test on 8th Feb. 2018



Select clutch for Remote or Local control on Local control stand.

Released locking device and loose clutch (not tighten properly)

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5. Inspected to Scavenge air receiver (OK)

We have inspected scavenge air receiver, as a result of inspection all the flaps and non-return valves were intact condition.

Non-return valve on scavenge manifold (intact)

Carbone deposit on under cyl' liner (Acceptable)

6. Inspected to Gas receiver (Defect)

We have inspected gas receiver and found that partly broken the wire mesh in way of T/C gas inlet, might be the broken pieces of wire meshes go in to T/C and then it was made damage turbine blades and nozzle ring.

T/C gas inlet, mesh broken.

7. Inspected to piston ring and crown thru scavenge port. (OK)

We have checked piston ring, piston crown condition and measured clearance of piston top ring. As a result of inspection, all the piston rings are no broken, freely move, good surface.
Measured clearance for piston top ring and found all the rings are within acceptable clearance.

Vertical Clearance between top ring and groove. (mm) (Limit: 0.7mm)

Cyl No	1	2	3	4	5	6
Clearance	0.45	0.45	0.50	0.50	0.55	0.60

Remark: All clearances are acceptable

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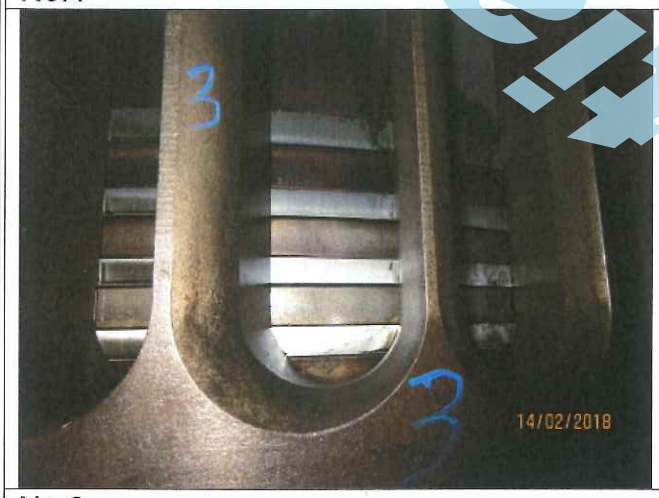
No.1

No.2



No.3

No.4

No.5

No.6

8. **Others (T/C overhaul, air cooler cleaning, economizer cleaning, fuel injection valve test)**

8-1. T/C overhaul (Defect)

After overhauled and found that damage parts as below.
Turbine blades, nozzle ring. (Dalwin Marine attending the repairs)

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T/C turbine blades (damaged)

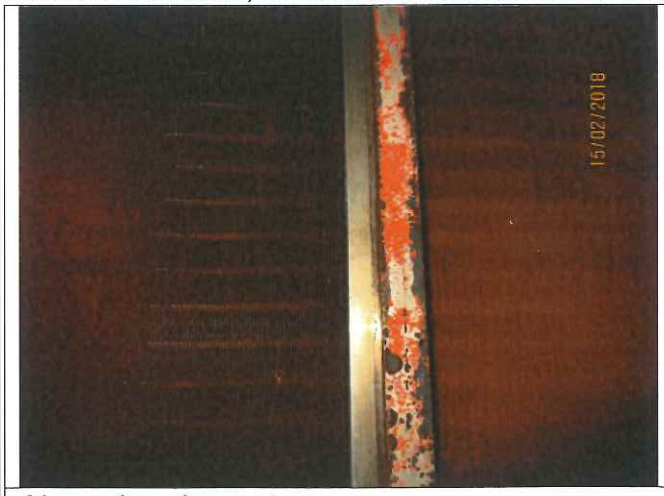
T/C Turbine blades damaged (Details)

Nozzle ring (damaged)

Nozzle ring (Details)

8-2. Air cooler cleaning. (OK)

Inspection of the air cooler element, the element was acceptable condition but not sure the internal condition, carried out chemical and water spray cleaning done.



Air cooler element

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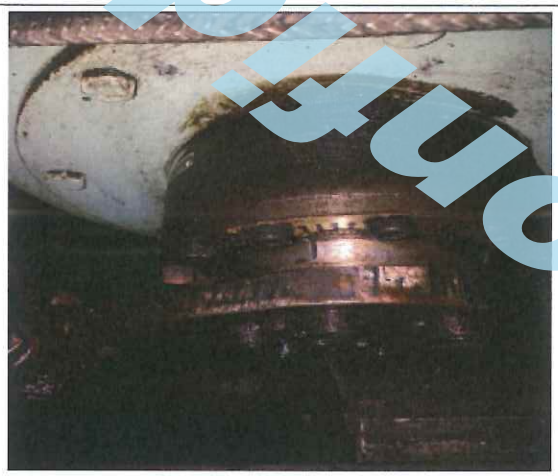
8-3. Economizer cleaning. (OK)

As the result of internal inspection, we found carbon deposit but still acceptable conditions.
carried out cleaning done.

Inside economizer (P-side)

Inside economizer (S-side)



Exhaust Valve Testing

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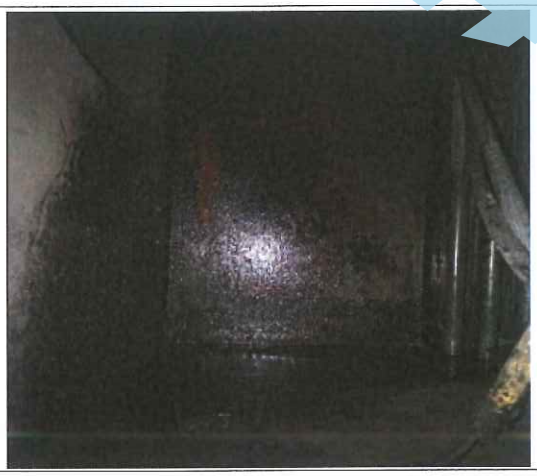
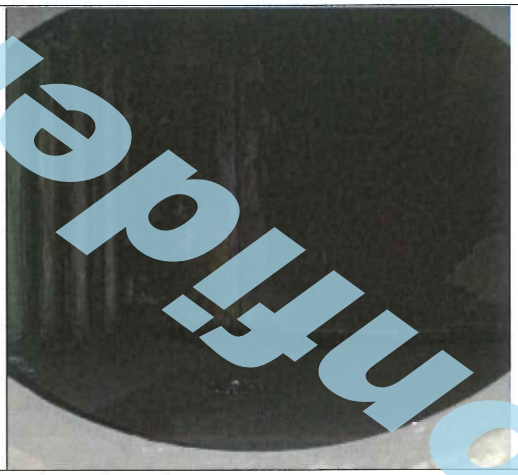
	Exhaust valve seat 
	Exhaust valve seat
	
Economizer cleaning	Air cooler cleaning
	
Economizer cleaning	

8-4. All units of fuel valve dismounted and pressure test and assembled in place. All found satisfactory

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9. Root cause analysis on turbocharger damage

Reference No.4 Checked fuel regulating linkage with governor connection. (Defect)

We have checked fuel regulating linkage system and found that the Local and Remote select clutch (local stand) was loosen (locking device released) and big lost motion in between governor and fuel pump rack (index). That means the clutch was not engaged with governor properly.
When governor stop position (0) but showed fuel pump index 20/19/19/22/21/21.
Remarks: According to C/E report, ship staff had been carried out M/E local starting test on 8th Feb. 2018

	
Select clutch for Remote or Local control on Local control stand.	Released locking device and loose clutch (not tighten properly)

Whilst we've already explored the root cause of turbocharger damage in our inspection report, how overheating and excessive exhaust gas temperatures can damage turbochargers, and the kind of damage they cause,

How temperature can damage your turbocharger -

1. Turbochargers work by using the kinetic energy of hot exhaust gases, and operate at incredibly high speeds (which generates heat in itself)

2. Whilst turbochargers are built to withstand the high temperatures generated during normal operation, if the temperature of the exhaust gases is too high, then it can cause catastrophic damage.

3. Typically, this damage is located around the turbocharger's turbine, cracking the housing, causing excessive erosion and corrosion, whilst causing collateral damage to other components.

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The causes of excessively high temperatures

Excessive exhaust gas and turbo temperatures have a number of different causes, including:

- Poor quality oil –
- Excessive oil temperatures –
- Improper performance remapping – in our case that over delivers fuel beyond the acceptable tolerances of the engine, reference point 4.
- Improper or poorly completed engine modifications – that over deliver fuel, or push the engine beyond its capabilities reference point 4.
- Poor maintenance/lack of servicing –

The symptoms of damage caused by excessive temperatures

The warning signs in our case associated with turbo damage are fairly similar, and include:

- Loss of power and performance/ imbalance fuel injection
- A smoky exhaust
- Abnormally loud whirring noises

Conditions as seen when TC opened up –

Root cause of the problem is excessive temperature or overheated exhaust gases:

- The turbine wheel has become eroded
- The turbine inlet wall is cracked
- There are spots of burnt oil on the turbine shaft
- The bearing housing oil drain cavity is blocked

Recommendation	1. Need to lub. oil fill in to spring air chamber for lubrication and smooth movement the exhaust valve open and close when reconditioning the exhaust valve. 2. When emergency stand operation, must confirm the changeover clutch selection position and secure the locking device properly. 3. Turbocharger overhaul to be done with the makers approved workshop
Material Supplied	As per owners confirmation order of turbocharger spares has been placed with the makers

End of Report