Preliminary

Service Report

MAN PrimeServ

PRESIDENT EISENHOWER

APL Maritime Ltd.

PrimeServ Los Angeles

2 May 2021

1. General data

Vessel:	PRESIDENT EISENHOWER	IMO no	9295220
Engine type:	12K98MC-C	Run. hours:	93400
Engine builder:	HYUNDA	Engine no.:	AA2024
Newbuilding yard:	Hyundai Heavy Industries Co. Ltd. (HHI) Engine Customer Service Dep't	Hull no.:	1584
Job order no.:	D.2802111	Sea trial:	2005-09-30
Spare parts from MAN:		Spare order no.:	
Place:	Long Beach		
Visit by:	H. Due		
Period:	2021-04-30 – 2021-05-03		
Owner/manager:	APL Maritime Lte.		
Requested by, P/O no.:			
Reason:	Inspection of main engine due to engine room fire		

2. Summary and conclusion

Attended Vessel in order to inspect main engine due to engine room fire.

The fuel return pipe for the fuel valves on cylinder unit #5 was found pulled out/disconnected from the T-coupling (cutting ring fitting). The open/disconnected fuel return pipe was spraying gas oil onto the top of the cylinder cover and exhaust valve and the gas oil caught fire on the flange for the exhaust valve compensator/bellow.

Engine parts and components from top of the A frame and upwards were damaged by the fire in the area for cylinder unit #3, #4, #5, #6 and #7

3. Background – reason for attendance

Wednesday April 28, around 01:30, approx. eight hours after departure Long Beach, the crew got alarm for fire in engine room.
At first, it was believed to be the boiler that caught fire, but after some time it was discovered to be the top of the main engine, cylinder unit 4-5-6, that was on fire.
The main engine was stopped from the bridge, the quick closing valves for the engine fuel supply were activated and engine room ventilation was shut down.
As the fire was developing and spreading fast, it was decided to release the Engine Room CO2 Fire Extinguishing System.
The fire was ongoing for approx. 15-20 min.

4. Findings

Cylinder unit #5:

- The fuel return pipe for the fuel valves was found pulled out/disconnected from the T-coupling (cutting ring fitting).
- The open/disconnected fuel return pipe was spraying gas oil onto the top of the cylinder cover and exhaust valve and the gas oil caught fire on the flange for the exhaust valve compensator/bellow.
- Insulation for exhaust compensator/bellow flanges, for all cylinder units, was found insufficient and sheet metal not covering the flanges.
- As the fuel return from the high-pressure fuel pump is connected to the same pipe as the return pipe from the fuel valves, gas oil under pressure of 8 bars was led backwards in the return line feeding the fire, until the fuel supply was shut down.
- Steel protection hose for fuel valve high-pressure pipe on #5 fore and #6 centre pipe was found burst. The reason for the protective hoses bursting has to be investigated further.
- The main engine suffered damage by the fire within the area of cylinder unit #3 to #7, most severe for cylinder unit #4-#5-#6. Copper tubing was found sagging, brass fittings and aluminium parts had melted due to the heat from the fire, confirming temperatures of approx. 1000ºC (Melting point for brass = 930ºC, copper = 1083ºC)
- Engine instrumentation on top of the engine for unit 4-5-6 had disappeared in the heat of the fire, cabling for engine monitoring was melted or cable insulation was damaged.
- The fire extended down to the cam shaft deck as well where engine components and cabling was damaged by the fire.

The extension of the fire was from the cam shaft deck up to and through the grating at the deck above the main engine, reaching the boiler deck and further up through the casing.
The heat from the fire damaged/deformed the starboard rail for the engine room cranes as well.

5. Work carried out

Inspection of main engine was carried out and following was observed damaged for unit 4-5-6:

Engine top:

- Sheet metal and insulation on exhaust gas receiver.
- Sheet metal and insulation on exhaust valve compensator.
- Instrumentation had disappeared in the fire.
- Cabling on cam side and exhaust side for engine monitoring .
- Exhaust valve surfaces, internal parts likely suffered damage from the heat.
- Cylinder cover surfaces, internal parts likely suffered damage from the heat.
- Cooling water jacket for cylinder cover and cylinder liner.
- Starting air valve.
- Fuel valves.
- High-pressure fuel pipes.
- High-pressure fuel pump.
- Fuel rack regulating parts.
- VIT actuators.
- Reversing cylinders for fuel pump.
- Lifting cylinder for fuel pump roller guide and control device for same.
- Fuel pump roller guide bush/housing.
- Exhaust valve roller guide bush.
- Exhaust valve actuator.
- Exhaust valve high-pressure pipe.
- All copper tubing for control and safety air.

Aft side of cylinder unit #3 and fore side of cylinder unit #7 was found damaged in less degree than cylinder unit #4-5-6.

Turbocharger:

- Control panel for #2 turbo charger cut out including copper tubing and electrical wiring.
- Sheet metal and insulation for #2 turbocharger.
- Turbo charger #2 and #3 exposed to centre of fire and heat, no visual damage was found on the outside, but condition of the internal parts has to be verified.

Camshaft area:

- Emergency stand / engine side control station including instrumentation.
- Servo motor for engine governor.
- Alpha lubricators.
- Plastic covers for cam shaft.
- Underside of cam shaft housing.
- Cam side of cylinder frame.

No signs of fire inside the cam shaft housing was found.

Air cooler area:

- Insulation on scavenge air receiver between air cooler #2 and #3.
- Auxiliary blower #2.

Crank case area:

- Crank case for cylinder unit #5 was visually inspected, no signs of damage was found.
- No signs of engine damage was found at the lower engine deck.

Main engine auxiliary equipment:

- Electrical motors and electrical components may have suffered internal damage and/or fouling by hot smoke and fumes.

6. Conclusion

According to saved CCTV recordings, it was observed that the fuel leak started on top of cylinder cover #5 and was spraying fuel oil (gas oil) onto the exhaust valve compensator area where the gas oil it caught fire on the hot exposed compensator flange.
The leaking fuel return pipe was feeding the fire until the fuel supply to the main engine was cut off.

According to information from Engine Crew the mentioned return pipe for the fuel valves, on cylinder unit #5, was replaced during port stay in Long Beach prior to sea passage where the fire incident occurred.

The reason for the return pipe to get pulled out of the cutting ring fitting was likely due to incorrect assembly in way of insufficient tightening of the union nut or steel ferrule not mounted correctly, i.e. the pipe was not fully inserted through the steel ferrule at tightening.

The reason for bursting of the steel protection hose on #5 fore fuel oil high pressure pipe and #6 centre fuel oil high pressure pipe have to be investigated further when dismantling of engine parts are possible and allowed by the USCG. It is unknown if the steel hose burst due to heat exposure or excessive pressure in drain passage between the high pressure pipe and the steel protection hose.

As the fire was extinguished by releasing the CO_2 system, no hot surfaces of engine components were exposed to rapid cooling.

The main engine is designed with steel pipes of certain dimensions, outlined by Class Society, for oil systems in order to withstand fires of shorter duration. Class Society and Material Experts will decide if the affected steel piping has to be replaced.

All surfaces with temperatures above 220ºC has to be properly insulated.

7. Recommendations

Engine top:
Concerning cylinder unit #3, #4, #5, #6, #7 it is recommended to:

- Check alignment and calibration of cylinder frame. Check cylinder frame for heat cracks.
- Check engine alignment in way of crank shaft deflection and piano wire.
- Dismantle complete cylinder unit for overhaul, inspection and calibration of affected parts, i.e. exhaust valve, cylinder cover and cylinder liner.
- Replace sheet metal and insulation on exhaust gas receiver and exhaust gas compensators.
- Dismantle complete fuel pump with roller guide for overhaul, inspection and calibration of affected parts.
- Replace fuel valve high pressure pipes.
- Replace fuel pump VIT Control components, reversing cylinder and lifting gear.
- Check condition and alignment of fuel rack regulating shaft and locating bearings.
- Dismantle complete exhaust valve actuator with roller guide for overhaul, inspection and calibration of affected parts.
- Replace high pressure pipe for exhaust valve actuation.
- Material experts should determine the procedure for checking and/or replacing the engine steel parts and cast iron parts due to the extreme heat exposure.
- Replace engine monitoring instruments.
- Replace electrical cabling for engine instruments and engine monitoring. Cables located at top of cylinder frame in exhaust side. Cables for the entire engine has to be replaced as they run from the fore end of engine to the aft, passing the area where fire has damaged the cabling.
- Replace all copper tubing, pneumatic valves and pneumatic components for control and safety air.
- Likely replace all steel pipes and steel tubes due to extreme heat exposure. Material experts should determine this.
- Replace gaskets for piping systems.
- Sheet metal and insulation for all 12 exhaust valve compensators has to be rectified.
- Inspection and pressure test of all remaining fuel valve high pressure pipes.

Turbo charger:
It is recommended to:

- To dismantle and inspect turbocharger #2 and #3, at least.
- Replace control panel, cables, copper tubing and actuators for #2 turbo charger cut out device.

Cam shaft area, cylinder unit #3, #4, #5, #6:
It is recommended to:

- Check alignment of cam shaft housing and cylinder frame.
- Check cam shaft housing and cylinder frame for heat cracks.
- Replace covers for camshaft housing. All covers for entire engine cam shaft housing has to be replace by metal covers.
- Replace cabling for engine controls and engine monitoring. Cables for the entire engine has to be replaced as they run from the fore end of engine to the aft, passing the area where fire has damaged the cabling.
- Replace emergency stand instrumentation and pneumatic components.
- Replace governor servo motor and cabling.
- Replace Alpha Lubricator #3, #4, #5, #6 including cabling and pipe systems.

Air cooler area:
It is recommended to;

- Replace insulation on scavenge air receiver between air cooler #2 and #3.
- Overhaul auxiliary blower #2
- Replace power cables for auxiliary blower #2.
- Clean and inspect external/internal condition of oil mist detectors.

Main engine auxiliary equipment:
It is recommended to:

- Clean and inspect condition of electrical motors and electrical components that was exposed to hot smoke and fumes.

8. Enclosures

Photos components involved in starting the engine room fire, cylinder unit #5:

Return pipe for fuel valves disconnected/pulled out of fitting.

Return pipe for fuel valves disconnected/pulled out of fitting

Ferrule not mounted correctly. (Ferrule and union nut mounted on pipe for example of explanation)

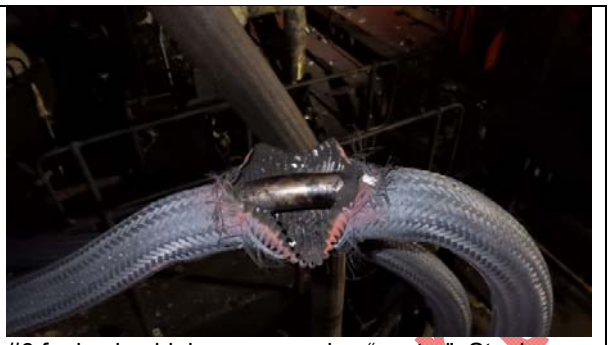
Pipe end pulled out of fitting

Fuel return pipe spraying on start air valve, exhaust gas receiver, exhaust valve compensator.

Exposed compensator flange where the fuel oil/gas oil caught fire.

Photos of engine parts affected and damaged by the engine room fire, cylinder unit #3, #4, #5, #6, #7.

#5 fuel valve high pressure pipe “fore”: Steel protective hose burst



#6 fuel valve high pressure pipe “centre”: Steel protective hose burst

Exhaust gas receiver sheet metal and insulation damaged

Exhaust gas receiver sheet metal and insulation damaged

Exhaust valve compensator sheet metal and insulation damaged

Exhaust valve compensator sheet metal and insulation damaged

Cylinder unit monitoring instruments missing/melted

Cylinder unit monitoring instruments intact

#5 cylinder unit: Exhaust valve, fuel valves, fuel valve high pressure pipes, starting air valve, cylinder cover. Condition unknown

High pressure fuel pump, shock absorber, roller guide bush/housing. Condition unknown

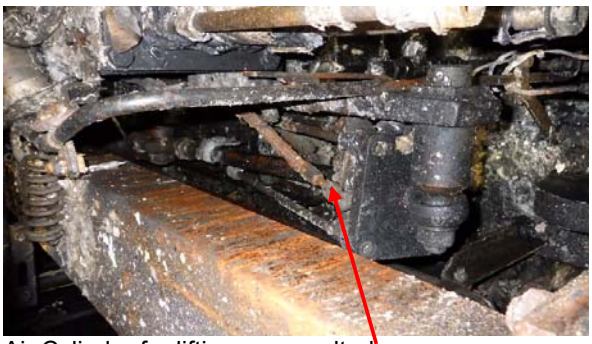
Fuel pump top cover with puncture valve.
Brass fitting, straight male coupling, for puncture valve copper tube missing (melted)

Fuel pump reversing cylinder and lifting gear cylinder (both aluminium) melted

VIT Cylinder melted, remaining laying on top of housing for reversing mechanism.
Device for lifting gear controlling melted.
Copper tubing for control air sagging, brass fittings (T-pieces and straight male couplings melted)

Device for lifting gear controlling melted.

VIT Cylinder melted, remaining laying on top of housing for reversing mechanism.



Air Cylinder for lifting gear melted

#6 Cylinder cover and cylinder liner. Condition unknown

#4, #5 cylinder cover, seen from exhaust side. Condition unknown

Fuel pump: Fuel supply pipe and insulation

Damaged copper tubing cylinder unit #7

Start air pipe for start air valve and start air header pipe exposed to extreme heat

Fuel rack lever and springs exposed to extreme heat

Cables and wiring on exhaust side damaged.

Cables and wiring on exhaust side damaged

Photos of affected components at turbo charger area:

Entire control panel for turbo charger cut out missing (melted)

Damaged copper tubing and electrical wiring for turbo charger cut out.

Damaged air cylinder and insulation for TCCO gas inlet. Turbocharger #2

Turbocharger #2: Damaged insulation for gas inlet.

#3 Turbocharger silencer, air inlet

Example of electrical motors exposed to hot smoke an fumes.

Air cooler area:

Damaged insulation for scavenge air receiver
Damaged insulation on power cables for aux. blower

Damaged insulation for scavenge air receiver between air cooler #2 and #3

Photos of affected components at cam shaft area, cylinder unit #3, #4, #5, #6:

#4, #5, #6 cam shaft housing

Alpha lubricator

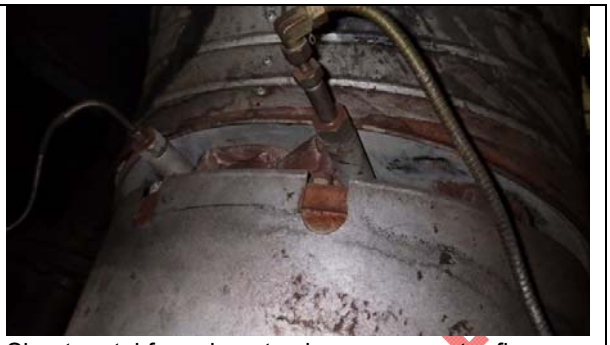
Damaged Emergency/Engine side stand and control panel instruments missing/melted

Engine governor servo motor, condition unknown

Damaged insulation on cables for engine control and monitoring.

Cylinder frame cam side and underside of cam shaft housing exposed to heat from the fire.
Damaged pipe insulation

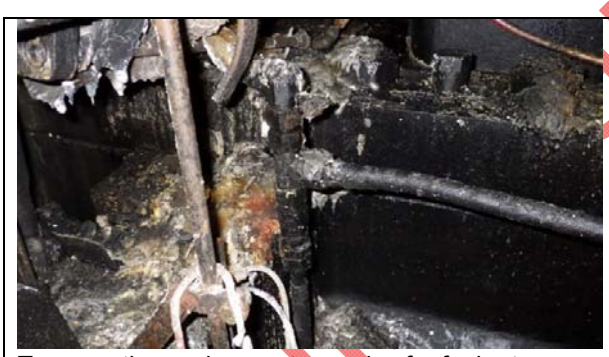
Sheet metal and insulation missing for exhaust valve compensator flange, exposing hot surface



Sheet metal for exhaust valve compensator flange not seated correctly, exposing hot surface

Return pipe for fuel valves correctly mounted with pipe hanger attached to cylinder cover.

Return pipe for fuel valves incorrectly mounted, pipe hanger missing.



T-connection and non return valve for fuel return pipes from fuel valves and fuel pump.

Deck above main engine and rail for engine room cranes damaged and deform due to extreme heat exposure

2021.05.02	HKD
Date	Signature