Shell Ship Quality Assurance - Safety Flash

Incident Type: Main Engine Start Failure
Additional: Failure after fuel changeover

What happened?

A number of incidents relating to Main engine failure within Regulated California Waters (24 nautical miles from California baseline) have been reported and one of these is analysed below for safety awareness. In this example, three incidents occurred on the same vessel within a period of 45 days when the main engine failed to start in the astern position. All three incidents occurred during routine manoeuvring tests in one of the Pilot station areas in California and prior to each event the vessel had changed over to distillate fuel with low sulphur content to comply with the California Air Resources Board (CARB) requirements.

Why it happened

After the first incident the ship staff's investigation revealed that the fault lied with the starting air distributor which was subsequently overhauled. After the repairs which were verified by class, the engine was started satisfactorily.

In the second incident, the root cause of the malfunction was evaluated to be the main engine starting system and air distributor valve. Although similar to the earlier malfunction, the root cause was different and as a precautionary measure the air distribution valve was renewed. On both occasions, the vessel sailed with no further malfunctions until returning to the California area.

In light of the repeat malfunctions, the operator arranged for the Engine manufacturer's service engineer and Control system maker's representative to board the vessel at the next opportunity in order to investigate the matter and also to verify the original diagnosis of the malfunctions. The technical superintendent was also sent to the vessel to carry out an in depth investigation.

After the third incident of main engine start failure, the maker's representative who had boarded the vessel just after the incident identified that the viscosity of the fuel at the pump inlet was below the maker's recommendation. Further testing revealed a lack of combustion of fuel oil in the Main Engine during the starting phase. It was also noted that during the changeover procedure the steam tracing isolating valves were kept open allowing steam to heat the fuel lines resulting in the reduced viscosity of the Marine Gas Oil (MGO). The viscosity of MGO supplied to the vessel was 1.9~2.0 cSt, marginally below the maker's recommendations for a value greater than 2.0 cSt, but had dropped due to the fast fuel change over and the heating of the fuel piping. At the time of the malfunction, the viscosity was found to be 1.5-1.6 cSt which resulted in reduced pressure being developed in the fuel pump, poor atomisation and hence lack of combustion in the cylinder.

Key Learnings

The previous investigations failed to properly identify and report the lack of combustion during the first two instances of main engine start malfunction, resulting in an incorrect diagnosis.

The established procedures for changing over to MGO were not properly followed as the changeover was done too quickly and the steam tracing lines were not isolated which resulted in high temperature of the fuel and a viscosity lower than recommended.

To build in some margin for safe and reliable operation, the maker recommends operators to test the engine's and external systems' sensitivity to low viscosity and it is always advisable to make start checks at regular intervals. However, as distillates of required minimum viscosity may not be available in all ports, it is an imperative necessity to perform start checks prior to entering high-risk

areas (e.g. ports and other congested areas). By such action, the individual low viscosity limit can be established for each engine. An outcome of the test might be that the specific engine requires a viscosity that cannot be maintained due to the influence from many factors such as worn fuel pumps. In this case the fuel pumps must be replaced and the start check repeated.

Further the guidance from this manufacturer is that the lowest viscosity suitable for most two-stroke diesel engines is 2.0 cSt at the engine inlet. It is to be noted that MGO with a minimum viscosity of 1.5 cSt at 40 deg C (ISO 8217) requires approximately 22 deg C to keep the limit to 2.0 cSt. The manufacturer further advice that maintaining the fuel oil temperature in the required range may require installing a cooler together with appropriate controls in the design of the modified fuel oil system.

For the lowest viscosity MGOs, the manufacturer advice that a cooler may not be sufficient and that in such cases it may be necessary to include in the design a so-called "Chiller" (along with appropriate controls), which removes heat through vapour-compression or an absorption refrigeration cycle.