Turbocharger explosion and engine room fire

During open-sea loaded passage, the main engine unit no. 6 piston, cooling oil high-outlet temperature alarm suddenly activated. The duty engineer gradually reduced the engine RPM and eventually stopped the engine (over a few minutes). Other engine parameters were checked for any abnormalities and found to be in order. However, some smoke was seen emanating from nos. 5 and 6 units' exhaust manifold. All of a sudden, the aft turbocharger exploded and debris flew all over the engine room. A fire started at the location and the engine room filled with thick black smoke. The emergency alarm was sounded and the engine room was promptly evacuated. Three crew members sustained serious burn injuries while escaping from it.

The engine room was then effectively sealed by closing all fire dampers and doors. Remote stops and quick closing valves were activated, which stopped all running machinery. Thereafter, the fixed CO2 flooding system was activated after confirmation that all crew were present at the muster point. The fire was effectively put out and, after a safe interval, entry was made as per SMS procedures. As a result of the fire, the main engine was rendered inoperative, even though the generators were restored.

All the units of main engine were opened up to investigate cause and assess internal damage. The crankcase and gear train were checked.

Root cause/contributory factors

1. Improper maintenance: Erosion and deterioration of the piston crown were not acted upon at the time of periodic overhauls and routine inspections;
2. Missing documents: A critically important technical bulletin issued by the makers specifically addressing piston crown damage, possible causes and maintenance procedures was not available on board;
3. Damaged piston crown: A burn hole of about 10 mm diameter was found in no. 6 piston crown and heavy erosion/ wastage/pitting was also evident elsewhere on the crown and skirt. Numbers 2, 3, 4 pistons also showed considerable but scattered erosion, but no burn hole had developed on them;
4. Unauthorised alterations: On all these four piston crowns, the recessed threaded sockets for lifting eye bolts had become so wasted that previous ship's staff had welded nuts over the sockets without recording the event or informing the management. Subsequent crews had failed to report this matter;
5. During every power stroke, exhaust gas entered the piston cooling oil system through the hole in no. 6 unit piston crown, causing overheating and contamination of the oil;
6. Similarly, during every exhaust stroke, the piston cooling oil from no. 6 unit found its way into the hot exhaust manifold;
7. Accumulated lube oil in the exhaust manifold reached auto-ignition temperature and this fire spread to the turbocharger and caused it to explode

Lessons learned

1. Routine inspections of engine parts and analysis of all oil samples must be performed as per maker's technical specifications. In case of abnormal results, prompt corrective steps must be implemented in consultation with management and makers.
2. If any unauthorised modification (welding of the nut in this case) is found on critical components, the matter must be referred to the management and makers.

3. It was found that those crew members who were familiar with escape routes suffered fewer injuries than those who were not. Engineers and ratings should be fully familiar with all exit doors of the engine room so that in an emergency, they can evacuate safely.
4. Injuries sustained were initially grossly underestimated by the officers on board and the casualties were repatriated five days after the incident.
5. An emergency escape breathing device (EEBD) containing normal air was used as first aid for a crew member suffering from smoke inhalation instead of the oxygen resuscitator that was available in the hospital.

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