National Transportation Safety Board

Marine Accident Brief

Diesel Generator Failure aboard Offshore Supply Vessel *Red Dawn*

Accident type	Hull/machinery/equipment damage	**No.** DCA18FM009
Vessel name	*Red Dawn*	
Location	North Pacific Ocean, 375 miles south-southwest of Amchitka Island, Alaska 45°18.3' N, 177°01.0' E	
Date	December 13, 2017	
Time	1544 Alaska standard time (coordinated universal time − 9 hours)	
Injuries	None	
Property damage	$957,000 est.	
Environmental damage	None reported	
Weather	Cloudy skies, visibility 10 miles, winds south-southwest at 20 knots, seas southwest at 10–12 feet, air temperature 43°F, water temperature 41°F	
Waterway information	North Pacific Ocean, southwest of the Aleutian Islands.	

About 1544 local time on December 13, 2017, the offshore supply vessel *Red Dawn* was transiting through the North Pacific Ocean en route to resupply the radar station Sea-Based X-Band Radar (SBX-1). When the vessel was about 375 miles south-southwest of Amchitka Island, Alaska, its no. 2 main diesel engine suffered a mechanical failure that led to the ejection of components from the cylinder block, consequently destroying the engine.[1] No pollution or injuries to the 12 crewmembers and 33 passengers on board were reported. The estimated damage to the *Red Dawn* totaled $957,000.

***Red Dawn* under way before the accident.**

[1] Unless otherwise noted, all miles in this report are nautical miles.

Background

The *Red Dawn*, a 292-foot-long, 3,911-ton offshore supply vessel, was owned and operated by Hornbeck Offshore Services, LLC. The *Red Dawn* was the first of four vessels in the HOSMAX 300 class built for Hornbeck by Eastern Shipbuilding Group, Inc. in Panama City, Florida. The vessel was delivered in June 2013 and was powered by four Caterpillar 3516C, 16-cylinder, turbo-charged Tier III diesel generators (referred to as main diesel generators or MDGs). Each MDG was rated 1,825 kW at 1,800 rpm. The MDGs were located in two separate generator rooms (port and starboard) and supplied power for propulsion and ship services. The diesel-electric propulsion plant consisted of twin Schottel azimuthing stern Z-drives and two fixed-pitch propeller bow tunnel thrusters. The vessel's cruising speed was 10 knots.

Accident location, identified by a red triangle, 375 miles south-southwest of Amchitka Island, Alaska. (Background by National Geographic)

Accident Events

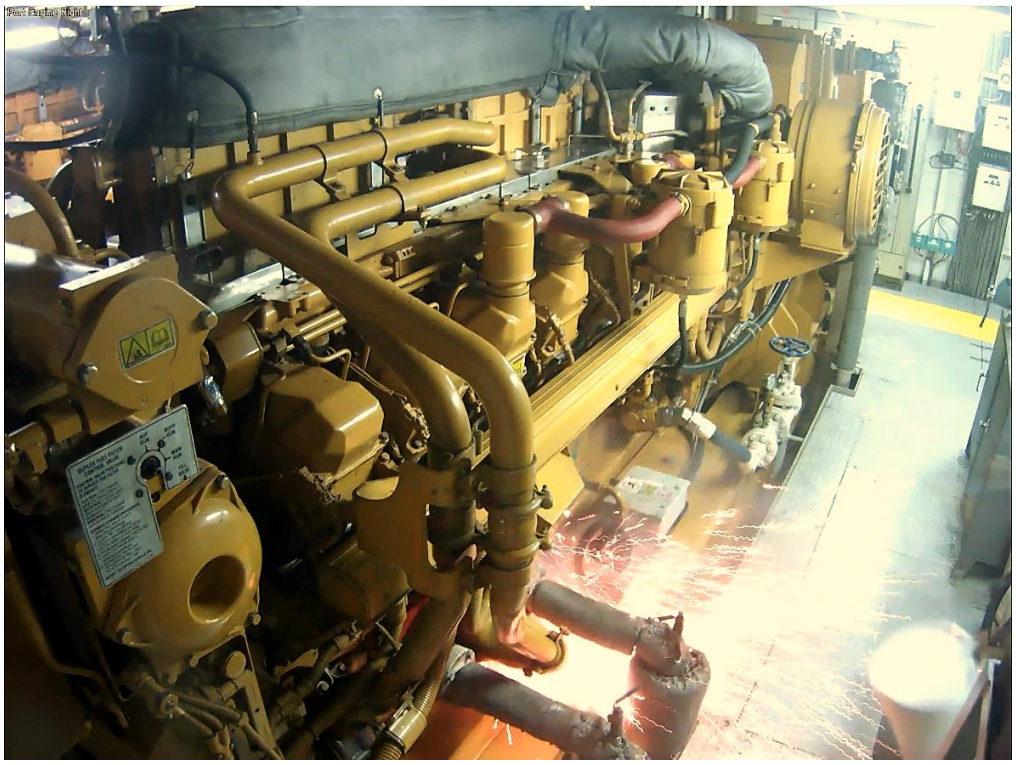
On the evening of December 9, the *Red Dawn* departed Dutch Harbor, Alaska, with a crew of 12 bound for the Sea-Based X-Band Radar (SBX-1) platform stationed in the North Pacific Ocean to replenish supplies and provisions. The *Red Dawn* also carried 33 additional persons (mariners, civilians, scientists, and contractors) scheduled for a crew change on board SBX-1. A 6-day transit to the platform was anticipated.

The captain and the chief engineer told investigators that the first 4 days were relatively uneventful, with moderate winds and seas as forecast. The captain said the vessel was making about 9 knots during the voyage, and the propulsion system was in bridge control-mode. He also said that when the vessel would surge into the waves (forward and aft linear motion imparted by

the sea conditions) and when the Z-drive propellers would come out of the water, the watchstanders occasionally needed to reduce the propulsion revolutions per minute (rpm), as both conditions activated audible alarms and warning displays. Surging into the waves activated "low power reserve margin" and propellers out of the water "propulsion motor overspeed."

During the *Red Dawn*'s transit, two of the four MDGs operated in parallel to power the propulsion and ship services, which was standard underway procedure. The integrated power management system was configured to automatically start the standby off-line MDGs sequentially when additional power was needed. It was also common practice to rotate the MDGs every 2 days to ensure operational readiness and to balance the service life and maintenance of the units. The chief engineer told investigators that the crew used MDG no. 3 sparingly on the accident voyage because of an exhaust manifold leak discovered during a previous voyage.

On the afternoon of December 13, MDGs nos. 1 and 4 were on line. The chief engineer and the assistant engineer had just returned to the port engine control room (ECR). Then, at 1539, MDG no. 4 experienced a high-exhaust-temperature alarm on cylinder no. 2. After a few minutes of troubleshooting the condition, the engineers planned to start MDG no. 2 and subsequently shut down MDG no. 4 to further evaluate the high-exhaust-temperature alarm. MDG no. 2 started and synchronized to the electrical bus as designed. However, when shutting down MDG no. 4, the engineers received a warning alarm indicating low lube oil pressure on MDG no. 2. Shortly thereafter, that alarm was followed by another alarm and shutdown of MDG no. 2 at 1544. Simultaneously, the engineers heard the automatic startup of MDG no. 3 and saw the engine automatically synchronize with the electrical bus. Meanwhile in the wheelhouse, the mate on watch and the captain heard an explosion and received a smoke alarm for the port generator room, which contained MDGs nos. 1 and 2. No one was in that space at the time of the incident.



Screenshot from closed-circuit television at the time of the failure, looking aft from the inboard side of MDG no. 2.

When the chief and the assistant engineers entered the port generator room to investigate, they discovered dense white haze/smoke but no sign of a fire. The smoke dissipated after about a minute and they noticed lube oil on the deck plates on the outboard side (right bank) of MDG no. 2. They also observed several internal fragments of MDG no. 2 lying on the deck in a puddle of lube oil on the inboard side (left bank).

The chief engineer returned to the port ECR, notified the captain, and continued to monitor the operating temperatures and pressures of the remaining online MDGs (1 and 3). The captain made notifications ashore while the chief engineer documented the damage and photographed the area. The vessel continued its voyage, with the crew assisting the engineering staff in cleaning up the lube oil and collecting the fragments in the port generator room.

Alcohol testing was performed on pertinent crewmembers; all results were negative. No postaccident toxicological testing for illegal drugs was conducted. The *Red Dawn* completed its voyage with no further incidents and returned to Dutch Harbor on the morning of December 21.

Other Information

While the *Red Dawn* was pierside in Dutch Harbor, investigators examined the vessel and reviewed available documentation, certificates, and records. A class surveyor, company technical representatives, and Caterpillar technicians also attended the *Red Dawn* in Dutch Harbor to document the incident.

Records showed that Caterpillar technicians conducted top-end overhauls on all four MDGs during a prior shipyard period in Portland, Oregon, about 3 weeks before the accident. It was the first top-end overhaul conducted on the engines, completed in accordance with the manufacturer's maintenance warranty contract. MDG no. 2 had about 17,415 running hours at the time of the overhaul and since then had accumulated another 220 hours before the incident occurred. After the overhaul, the vessel crew did not conduct any maintenance on the MDGs, nor were they required to do so.

Investigators and technical representatives conducted a forensic teardown of MDG no. 2 to document the condition of the engine's various components, develop a failure timeline, and record group observations. Below is a list of their observations:

- The engine was running at rated speed, began making noise, and stopped suddenly.
- Both sides of the cylinder block near the inspection covers had been impacted from a component inside the crankcase.
- The engine cylinder block was ventilated (breached) on both sides at the nos. 7 and 8 cylinders.
- The crankshaft's nos. 7 and 8 connecting rod journal was damaged.
- Cylinder no. 7's connecting rod was broken in half and lying on the engine room deck; both connecting rod caps were also lying on the deck.
- Cylinder no. 8's connecting rod was hanging outside of the left-bank side of the cylinder block.
- Cylinder no. 7's connecting rods, caps, bearing halves, and bolts were collected and analyzed. No abnormal conditions were present.

- Cylinder no. 8's connecting rods, caps, bearing halves, and bolts were also collected and analyzed. Three of the four connecting rod bolts sheared at the threaded end of the bolt. The fourth connecting rod bolt was bent at a 45-degree angle, but the threaded end was intact.
- Cylinder no. 8's crankshaft counterweight was lying in the bottom of the oil pan.
- The engine oil pan was cracked open along the right bank bottom side from the impact of the no. 8 crank counterweight.
- Borescope examination was conducted on cylinder heads nos. 6–9.
- The remaining cylinder heads were removed, photographed, and examined. All valves operated as designed and showed no signs of failure.
- The cylinder block was removed from the oil pan. Metal fragments were collected and analyzed. The material was consistent with the block and component damage to cylinder no. 8.
- Lube oil analysis reports indicated no abnormal findings. Wear metals, contaminants, and fluid properties were recorded as normal and within acceptable ranges.
- The main bearings were removed and examined. No abnormal conditions were recorded. No accelerated wear, heat, or wiping of the bearings were present.

Connecting rod, cap, bolts, and bearing halves of cylinder no. 8. (Photo by Coast Guard)

Based on the observations, the group developed an engine failure timeline, as follows:

- The engine was running at rated speed when the joint between cylinder no. 8's connecting rod and rod cap loosened. The connecting rod cap hinged open and detached from the crankshaft rod journal, impacting the cylinder block and causing massive damage to the engine.
- The connecting rods on cylinder nos. 7 and 8 disengaged from the crankshaft and collided with the rotating assembly. A series of high-energy collisions created secondary damage to the engine assembly.

Analysis

Based on the forensic analysis and teardown of MDG no. 2 and the appearance of cylinder no. 8's connection rod bolts and cap and bearing assembly, investigators determined that one of the four connecting rod bolts on cylinder no. 8 backed out of the internal thread of the connecting rod. Once this bolt backed out, the remaining three bolts became overloaded. It appeared that repetitive impact occurred as the connecting rod cap loosened, resulting in the remaining three bolts shearing off.

The two Caterpillar technicians who conducted the overhaul on MDG no. 2 the previous month stated that they followed company procedures and that they tightened the connecting rod bolts using a company-issued and calibrated torque wrench in accordance with the manufacturer's specifications. However, based on the findings of the circumstances pertaining to the rod assembly's failure, the bolts were likely under-torqued during the overhaul.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the mechanical failure on board offshore supply vessel *Red Dawn* was a connecting rod assembly on the no. 2 diesel engine that came loose and separated from the crankshaft due to improper tightening (torqueing) of the connecting rod bolts during the previous engine overhaul.

Vessel Particulars

Vessel	*Red Dawn*
Owner/operator	Hornbeck Offshore Services, LLC
Port of registry	New Orleans, Louisiana
Flag	United States
Type	Offshore supply vessel
Year built	2013
Official number (US)	1244590
IMO number	9647643
Construction	Steel
Length	292 ft (89 m)
Draft	19.91 ft (6.1 m)
Beam/width	64 ft (19.5 m)
Gross ITC tonnage	3,911 gross tons
Engine power, manufacturer	Four 2,447 hp (1825 kW) Caterpillar 3516C, V-16, 4-stroke water-cooled diesel engines
Persons on board	12 crewmembers, 33 passengers

For more details about this accident, visit www.ntsb.gov and search for NTSB accident ID DCA18FM009.

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NTSB investigators worked closely with our counterparts from Coast Guard Sector Anchorage and Marine Safety Detachment Dutch Harbor throughout this investigation.