WASHINGTON STATE
Office *of* Marine Safety

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PREVENTION BULLETIN 95-01

The DONA V

[1] OMS is now part of the Washington State Department of Ecology's Spill Prevention, Preparedness, and Response Program

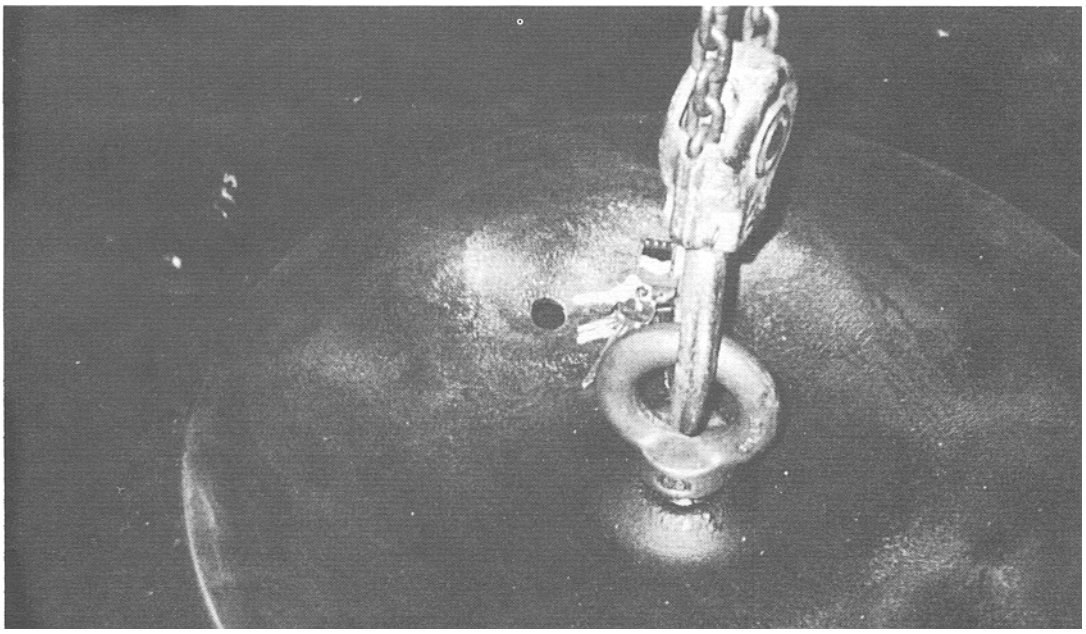
OVERVIEW

On October 11, 1994, at about 0410 hours, the DONA V, a Liberian-flagged bulk cargo vessel, was forced to shutdown her main diesel engine because of a mechanical failure. The vessel was completing an 18-day trip from China to Tacoma, Washington, and was to load bulk grain.

When the Captain stopped the engine, the DONA V was approximately 2880 yards northeast of Foulweather Bluff in Admiralty Inlet, Washington, in the inbound vessel traffic lane. The vessel then drifted in a southeasterly direction at approximately one-half nautical mile per hour (1/2 knot).

The U.S. Coast Guard Vessel Traffic Center was in constant communication with the vessel and assisted in ordering a tug to tow the vessel. The Coast Guard made several marine broadcasts to advise other traffic of the location and condition of the vessel. The DONA V drifted across the vessel traffic lanes and anchored near Double Bluff point at 0603 hours on the easterly edge of the outbound lane to await her tow.

At approximately 0700 hours the WEDELL FOSS reached the DONA V and began connecting her towing equipment. The WEDELL FOSS towed the DONA V to the Smith Cove West anchorage in Elliott Bay, Washington. The vessel arrived at the anchorage without incident at approximately 1030 hours.



-- Probable cause shown above, a hole in the number two piston crown. --

PROBABLE CAUSE

The Office of Marine Safety determines that the probable cause of the main engine casualty on the DONA V was a hole in the piston crown of number two piston. The oil-cooled piston crown probably failed because of improper maintenance. It is likely that the number two piston crown had not been removed or cleaned for many years, allowing the accumulation of oil sludge on the crown's cooling surfaces. The loss of lube oil pressure caused the main engine to be shut down to avoid further damage to the engine.

SAFETY ISSUES

Safety issues discussed in this report are:

- The importance of preventive maintenance to oil-cooled piston crowns;
- The adequacy and availability of engine manufacturer's preventative maintenance information to shipboard personnel; and
- Shipboard inspection policy of piston crowns.

VESSEL INFORMATION

General Characteristics of the DONA V

Length:	183.5 meters	Gross Tons:	20,122
Breadth:	26.61 meters	Net Tons:	11,342
Depth:	15.02 meters	Horsepower:	10,800

The main engine was made by Mitsubishi and is model number 6UEC 60/150 H. The engine is a uniflow, turbo-charged, 2 stroke, single acting, cross-head type design. This particular engine has two injectors for each cylinder. Vessel records indicate that the main engine had a total of 61,359 operating hours since put into service.

POST ACCIDENT VESSEL EXAMINATION

An Office of Marine Safety inspector and investigator boarded the DONA V at the TEMCO Grain Terminal in Tacoma on October 15, 1994, to obtain detailed information about the main engine casualty and to inspect the vessel. The OMS investigators found that the engineers on watch responded quickly and appropriately once the low lube oil and high exhaust gas temperature alarms were observed.

The alarms sounded when the number two piston crown failed. The piston crown failure allowed the lube oil that was being used to cool the piston crown to enter the combustion chamber above the piston. The lube oil readily burned causing a high exhaust gas temperature. The engineer on watch had to shut down the main engine to prevent further damage from the loss of lube oil pressure.

LESSONS LEARNED

Inspection Policies, Procedures, and Responsibilities

- Check Piston Crowns During Piston Overhaul

  During the investigation the chief engineer was asked to explain the procedures used to inspect pistons and piston crowns. He stated it is company policy that pistons are inspected during routine piston overhauls every 7,000 to 8,000 hours of operation.

  A piston overhaul begins with the cleaning and inspection of all the exposed surfaces of the piston, including the piston crown. Usually the inspection of the piston does not include the use of a dye-test to check for cracks on the piston crown. Only if the chief engineer observes an anomaly on the surface of the piston crown will the crown be dye-tested.

  It is neither the chief engineer's, nor the company's policy to routinely remove the piston crown from the piston body for examination, testing, or cleaning during a piston overhaul. If the piston crown is not removed during the overhaul period, it is not possible to ascertain the amount of carbon that may have built up on the oil side of the piston crown. Carbon build-up on the oil side of the piston crowns reduces heat transfer and can lead to thermal corrosion and failure of the piston crown.

  From the information collected during the investigation, it is probable that the piston crown had not been removed from the piston body for many years, allowing carbon to accumulate and adhere to the cooling surface of the piston crown. It is presumed that the collected carbon considerably reduced the effects of the cooling oil, causing the piston crown to crack.

Human Factor Issues

- Lack of Information/Complacency

  During the course of the investigation, the chief engineer stated that he was not aware of any engine manufacturer's preventative maintenance procedures for the piston crown. The chief engineer reviewed the vessel's engine manuals during the investigation and could not find any requirements to gauge the surface of piston crowns or any guidance on when to replace piston crowns.

  Based upon experience, the chief engineer believed that piston crown failures are routine casualties. The chief engineer had experienced two or three other piston crown failures during his sailing career and he also discussed these casualties with other engineers. In his opinion, piston crown failures could not be prevented.

Management Policy Issues

- Time Spent in Port

  The chief engineer stated that main engine maintenance was difficult to schedule because of the vessel's short stays in port (a grain ship can now load in 18 to 30 hours making engine maintenance difficult to accomplish). The chief engineer indicated that he had to maintain the vessel's machinery within the scheduled port times to load cargo. He did not feel comfortable in requesting additional port time to perform routine maintenance of machinery. This dilemma is an indication of maritime industry culture. In some instances, vessel operators are emphasizing vessel schedules at the expense of maintenance and safety.

Vessel Hardware Issues

- Engine Manufacturers' Preventive Measures

  Mitsubishi has documented that thermal corrosion will cause the piston crown to fail if carbon is allowed to build-up and adhere to the cooling surface side of the piston crown.

  Mitsubishi has developed procedures to improve the performance of the piston crown. The procedures will prevent thermal corrosion and wear on the flame side of the piston crown.

  Mitsubishi has published a recommended inspection and cleaning schedule to prevent thermal corrosion of piston crowns.

  Mitsubishi has also developed a process to address flame impingement and corrosion to the surfaces of the flame side of piston crowns, by building up the crown surface with a special steel alloy. The steel alloy can be applied to new pistons and pistons in service. In addition, a jet-cooling system has been developed by Mitsubishi to enhance the cooling of the piston crown.

  Mitsubishi's maintenance procedures demonstrate a commitment to improving engine operations and educating the maritime industry to reduce engine failures.

The DONA V

RECOMMENDATIONS

As a result of its investigation of this incident, the Office of Marine Safety makes the following safety recommendations:

To the Owners of the DONA V -

- Develop and adopt an engine maintenance program that includes the regular inspection of the oil side of piston crowns.
- Disseminate to vessel engineering personnel the engine manufacturers' preventative maintenance measures.
- Implement an accelerated schedule on the DONA V to inspect the oil side of all piston crowns to obtain baseline data on carbon accumulation.
- Provide sufficient time in port to enable the scheduling of main engine and other vessel maintenance.

To the Classification Society -

- Adopt procedures that include the regular inspection of the oil side of piston crowns.
- Provide preventative maintenance information to vessel personnel.
- Consider conducting studies or documenting trends of specific types of vessel casualties, so that information may be provided to vessel owners and used to prevent future casualties.

To Office of Marine Safety -

- Issue a Safety Advisory Bulletin to address the preventive measures for piston crown failures.
- Advise OMS inspectors to review and discuss the maintenance programs for oil cooled piston crowns with vessel personnel.
- Correspond with the owners/operators of the DONA V to explain the measures available to prevent the thermal corrosion of piston crowns. Request that owners/operators adopt the engine manufacturer's preventative measures to improve the performance of piston crowns.