Prevention Bulletin 09-01

DEPARTMENT OF ECOLOGY State of Washington

Spill Prevention, Preparedness, & Response Program February 2009

The DEFENDER

OVERVIEW

On Wednesday, March 29, 2006, at about 1400, the fishing vessel DEFENDER's First Engineer noted oil coming up from below the surface of the water on the ship's starboard side. The DEFENDER had its starboard side against a pier at a former shipyard in Seattle, Washington while conducting an internal transfer of diesel oil. The ship's out-of-service starboard main engine day tank, known to be fractured, was unintentionally filled during the transfer. As a result, about 48 gallons of diesel oil was spilled to waters of Washington State.

Figure 1 - Fishing vessel DEFENDER at a former shipyard site on March 29, 2006.

WHY THIS MATTERS

This bulletin was prepared to share lessons learned with industry and the interested public. Prevention recommendations are also made to prevent similar occurrences. Sharing lessons learned is important if Washington State is to achieve its "zero spills" goal. See page 7 of this bulletin for the list of lessons learned and prevention recommendations.

The DEFENDER's operator was offered the opportunity to provide comments.

WEBSITE INFORMATION

http://www.ecy.wa.gov/programs/spills/spills.html

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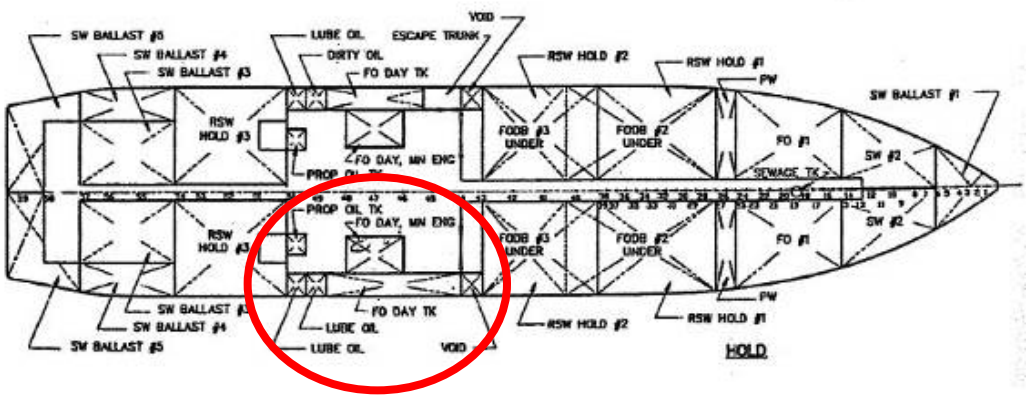

DEFENDER's tanks.

FACTUAL INFORMATION

Vessel Information

General Characteristics

The DEFENDER was built in 1974 and converted to a fishing vessel in 1993. It was approximately 194 feet (59 meters) in length. The vessel's gross tonnage was 1,412.

The DEFENDER had no classification society associated with it. The ship was originally built in Slidell, Louisiana as an offshore supply vessel ('mud boat'). It was converted to a fishing vessel at a Seattle shipyard in 1993.

Diesel Oil Day Tank Arrangement

The DEFENDER had four day tanks for fuel (diesel) that were supplied from storage tanks via a fuel purifier. Two day tanks were located outboard of the engine space near the turn of the bilges. Two smaller day tanks were located inboard of the larger day tanks under the main engines. Access to the smaller day tanks required removal of an engine room deck plate (Figure 2). The smaller "main engine day tanks" had a capacity of 1,350 gallons.

The starboard main engine day tank had cracked. Attempts were made to weld a steel plate over the crack to seal it, but the crack grew past the margins of the plates. Neither of two added steel plates adequately sealed the leak. A year to eighteen months before the spill, the starboard main engine day tank was taken out of service. It was reported to have contained only water after that.

The removal of the starboard main engine day tank from service was incomplete. A manual gate valve that would have securely isolated the tank from the fuel oil system was not closed. Instead, isolation of the tank depended entirely on the status of a single valve controlled by a solenoid (a type of electronic switch).

Normally the main engine day tanks overflowed to the larger day tanks. In the case, the starboard main engine day tank overflow line was plugged by the Chief Engineer with an arrangement used to pressurize the tank with compressed air (Figure 10). The tank's vent valve was tied closed.

Figure 2 - Access to the starboard main engine day tank just aft of the starboard main engine.

Purifier (Centrifuge) Piping Arrangement

The controls for the purifier aboard the DEFENDER included two three-way switches that controlled solenoid-actuated valves. These switches determined which tanks fuel was drawn for purification and those to which fuel was directed after purification (Figure 3).

Figure 3 – Control panel for the fuel oil purifier aboard DEFENDER taken March 29, 2006. Note the (upper) switch is in 'normal' position but that the top green light (at left) for the larger day tanks is off. [Photo courtesy USCG]

The lower switch was normally set to draw fuel from the fuel oil storage tanks, but could also be set to draw from the fuel oil day tanks. The upper switch was normally set to pump fuel to the larger fuel oil day tanks, but could also be set to pump to the smaller main engine fuel oil day tanks. Both switches also had an automatic setting.

Lights on the purifier controller box indicated the position of the switches for positions other than automatic. As seen in Figure 3, the top green light indicating valve positions set to pump oil to the larger day tanks was not operational on the day of the spill.

A copy of the purifier system diagram was obtained from aboard the ship. The two solenoid-activated valves were shown on the diagram. The pipe from the purifier to the main engine day tanks connected to the main engine day tanks via a T-fitting downstream of the solenoid valve. Two manual gate valves shown on the diagram were located beyond the T-fitting just before the main engine day tanks.

The starboard main engine day tank manual valve was inspected about a month after the spill. It was found to be closed and in working order (Figure 4). One of the engineers involved in the transfer that resulted in the spill indicated that the valve was only closed after the spill.

Figure 4 - Photo showing the location of the starboard main engine day tank manual isolation valve.

Hull Fracture

Ecology investigators visited the DEFENDER in dry-dock at Seattle, Washington, to examine the hull fracture in the starboard main engine day tank. They found the hull plate containing the fracture was already cut from the hull plating and new steel tack-welded in place. The removed section of steel plate was retained by the shipyard and shown to Ecology investigators. Figures 5 through 9 show the DEFENDER in dry-dock, the location of the fracture, the in-progress repair, and the fracture in the steel plate cut from the hull.

Figure 5 - DEFENDER in dry-dock on May 12, 2006. Light on starboard side under the hull shows location of the fracture and repair.

Figure 6. Looking inboard from starboard side at the replacement steel patch that has been tack-welded into place where the fracture had been cut out.

Figure 7 - View of damage location looking forward on the starboard side.

Figure 8 - Retained portion of hull plating.

Figure 9 - Close-up of the portion of steel cut from the hull showing the location of a two to three inch fracture through the shell plating and a doubled-up plate used as an attempted repair.

The shipyard master indicated that he found a series of indentations parallel to the keel running fore and aft at the same distance outboard from the keel as the fracture. The shipyard master noted the fore and aft steel stiffeners on the inside of the deformed shell plating were also bent. He believed the dry-dock blocks that were meant mainly to steady the ship had instead improperly borne significant weight during a past shipyard period. That error caused the bending of the shell plating and steel stiffeners. Combined with vibration from the main engines, the deformed plating and stiffeners resulted in the fracture of the hull and the failed repairs.

ENVIRONMENT

When the spill occurred, the ship was moored at a former shipyard site on the south side of the Lake Washington Ship Canal in Seattle, Washington.

Weather at the time of the spill was partly cloudy to overcast with light winds. The air temperature was reported as 50 degrees F.

ANALYSIS

Unplanned Filling of the Starboard Main Engine Day Tank

The starboard main engine day tank was immediately suspected as the source of the spill as it was known to be cracked. The crew opened the starboard main engine day tank to the ship's bilge, allowing the tank's contents to spill into the bilge. They reported that their initial assumption was that the tank content was mainly water. However, upon inspection they discovered the tank remained about half full of diesel, indicating the tank had been completely full of diesel. This occurred despite the fact the Chief Engineer had isolated and pressurized the tank.

Figure 10. Top of the main engine day tank vent pipe in engine room, starboard side, showing fittings used for injecting compressed air into the tank.

Following the spill it was noted that the upper switch on the purifier panel was not in its normal position. Instead of being set to pump to the larger day tanks, it was set to the smaller main engine day tanks.

The explanation initially given for the purifier panel switch being miss-set was that someone must have bumped it. Further inquiry indicated that the Chief Engineer had changed the switch position to silence a humming or buzzing sound coming from the controller box electronics.

After the Chief Engineer had changed the switch position, the First Engineer initiated a transfer from the starboard day tank to the port day tank using the purifier. The First Engineer assumed the upper switch would be in its normal position for pumping oil to the larger day tanks and did not check it. He failed to notice the light on the controller panel indicating that oil would be pumped to the smaller main engine day tanks. The starboard main engine day tank filled until the pressure of the water external to the hull was overcome. Diesel was forced from the tank through the facture and into the water.

Maintenance of the Starboard Main Engine Day Tank

A repair of the fracture in the starboard main engine day tank was attempted twice, but the repair efforts were ineffective. It was up to the vessel's operator to inspect and ensure the adequacy of the repairs and maintenance of the starboard main engine day tank in an out-of-service status.

The tank was taken out of service for fuel, and it was initially reported that all piping connections were closed. But the starboard main engine day tank manual isolation valve, which could have been used to securely isolate the tank, was not closed. The result was a marginal isolation of the tank as long as the purifier controller panel's upper switch was set to the larger day tank position.

Internal Oil Transfer Procedures

The DEFENDER had oil transfer procedures (OTP) that were posted on a bulletin board in the ship's mess deck (kitchen/dining area). The OTP were the standard minimum U.S. Coast Guard-required variety, but were posted with another document titled 'Company Policy.' The Master indicated that the policy was in effect.

The policy contained several procedures aimed at spill prevention. Those particularly relevant to the spill of March 29th included:

- *INSPECT any system before putting it into operation.*
- *BE SURE all valves are closed and opened for transfers as required, and that this be performed in the correct sequence.*

The First Engineer, who started the purifier transfer of March 29th, said he did not check the status of the purifier controller switch to ensure the solenoid valves were correctly positioned.

The First Engineer also said there were no specific instructions for setting up and conducting an internal oil transfer aboard the DEFENDER.

Causal Information

Based on the information gathered, the immediate cause of the spill was the failure to ensure that the transfer system was properly aligned to deliver fuel oil to the intended tank prior to initiating the transfer. Factors contributing to the spill included:

- The closing of the starboard main engine day tank overflow and vent. These actions prevented the starboard main engine day tank from overflowing into the larger starboard day tank. This caused pressurization of the tank, forcing diesel from the tank against the pressure of the surrounding water.
- Failure to ensure a secure out-of-service status for the starboard main engine day tank, through a failure to close the tank's manual isolation valve.
- Inadequate communication between the Chief and First Engineers regarding the internal transfer.
- Inadequate internal transfer procedures that did not include specific guidance for conducting an internal transfer using the purifier.
- An improper dry docking that resulted in damage to the ship's hull.

Lessons Learned

- Out of service equipment should be securely isolated to avoid inadvertent use.
- The potential effects of equipment modifications, even temporary modifications, need to be carefully considered when planning for operations that use that modified equipment.
- The correct alignment of the fuel oil system is critical to a safe fuel transfer and should be carefully checked before starting every transfer.
- Persons conducting a fuel transfer operation need to communicate clearly and effectively regarding the readiness of the vessel for the transfer.

Prevention Recommendations

<u>To vessel owners and operators:</u>

- Adopt procedures for internal transfers of oil that are comprehensive, and are understood and used by crew members.
- Develop a checklist for internal transfer procedures and post them in a location readily accessible for use.
- Post, or make readily available, a comprehensive and updated line diagram of the ship's oil transfer system for use by those involved in oil transfers.
- Ensure that persons-in-charge complete a transfer plan and comply with federal and state regulations prior to transferring oil.
- Implement a lock-out/tag-out program for ship's systems that are out of service. Ensure lock-out/tag-out procedures include a comprehensive review of each system to determine that it is isolated and not a danger to ship's personnel or the environment.

MORE PREVENTION BULLETINS

PB 08-02 – The CATHERINE QUIGG (ECY 08-08-007)
PB 08-01 The ALLEGIANCE (ECY 08-08-001)
PB 07-01 The SEA SYNERGY (ECY 07-08-009)
PB 06-01 The PACIFIC EXPLORER (ECY 06-08-018)
PB 06-02 The NOHO HELE (ECY 06-08-037)
PB 05-01 The TAI SHAN HAI (ECY 05-08-004)
PB 03-01 The OVERSEAS WASHINGTON (ECY 03-08-001)
PB 01-02 The ARCO TEXAS (ECY 01-08-006)
PB 01-01 The SUPER RUBIN (ECY 01-08-002)
PB 99-02 The MONCHEGORSK (ECY 99-261)
PB 99-01 The ANADYR (ECY 99-250)
PB 98-01 The ARCADIA (ECY 98-253)
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PB 96-01 The KEYSTONE CANYON
PB 95-02 The VERBIER
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Washington Dept. of Ecology
Spills Program - Prevention Section
PO Box 47600
Olympia, WA 98504-7600
Phone: 360-407-7455
Fax: 360-407-7288 or
1-800-664-9184
http://www.ecy.wa.gov/programs/spills/spills.html