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WASHINGTON STATE DEPARTMENT OF ECOLOGY

PREVENTION BULLETIN 06-01

The PACIFIC EXPLORER

This bulletin was prepared to share lessons learned with industry and interested public, and to make recommendations to prevent similar occurrences. The company operating the M/V PACIFIC EXPLORER at the time of the incident was invited to provide comment on this bulletin. They did provide comment.

OVERVIEW

On Friday, April 15, 2005 at about 2350[1], the tankerman aboard the tank barge 185-P2 was called by the crew of the car carrier PACIFIC EXPLORER to shut down the transfer of intermediate fuel oil (IFO) to the ship. The PACIFIC EXPLORER was starboard-side-to a berth on the Blair Waterway in Tacoma, Washington with the 185-P2 moored port-side-to its outboard side (see Figure 1). After shutting down the barge's pumps, the tankerman noted black oil spilling from two two-inch pipes on the PACIFIC EXPLORER's port side and into the Blair Waterway. About 20 gallons of IFO was spilled.

Figure 1. M/V PACIFIC EXPLORER alongside at the Blair Waterway with spill response crew at work. Note the tank barge 185-P2 moored along side.

VESSEL INFORMATION

General

The PACIFIC EXPLORER was a car carrier built in 1978 and sailing under the flag of the Marshall Islands. It was approximately 199 meters in length. The vessel's gross tonnage was 38,970.

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Figure 2. Fuel manifold at front bulkhead of the lower engine room of the PACIFIC EXPLORER [Note: The small piece of cloth tied to the valve handle was used to mark those valves being used during the transfer.]

Information provided by the operator of the PACIFIC EXPLORER indicated it was certified under the International Safety Management (ISM) Code and the ISO 9002 standard.

Fueling/Bunkering Arrangement and As-found Condition

The heavy fuel oil system aboard the PACIFIC EXPLORER consisted of five fuel oil storage tanks plus an overflow tank, a settling tank, and a service tank. The diesel oil system consisted of four storage tanks plus a settling tank and a service tank. Both systems were served by common piping leading from the transfer headers located on each side of the ship on one of the lower car decks. The fuel tanks were vented to fully enclosed containment located on the same car deck as the transfer headers and fuel sounding pipes (see Figures 4 & 5). On the forward engine room bulkhead was a fuel manifold (see Figure 2) along with a panel of fuel level monitoring gauges (reported by the Chief Engineer to be inoperative at the time of the spill) (see Figure 3).

The interior of the containment box around the fuel oil tank vents on the car deck could not be visually examined unless the bolted access ports were opened (see Figure 4). The No. 2 port fuel oil tank that overflowed had two vents: one located forward and one located aft (about one-half the hold length apart). Only the aft access port had been opened for the oil transfer operation, as access to the forward vent containment for the No. 2 port fuel oil tank was blocked by the cargo of passenger automobiles (see Figures 4 & 5).

Figure 3. Heavy fuel oil and diesel oil level gauging panel reported by the Chief Engineer to be inoperative at the time of the spill

Figure 4. No. 2 port fuel oil aft tank vent containment. Red circle highlights bolted access port for inspecting the interior of the containment box.

The vent containments on the No. 2 port fuel oil tank had two pipes that could be used to drain them. One drain pipe had a valve that led to a blank flange on the car deck, and the other had a valve that allowed the contents of the vent containment to flow overboard. The Tankerman-PIC of the delivering barge reported that oil flowed from two openings following the emergency shutdown of the transfer. Stenciling noted on the bulkhead above the overboard indicated that the overboard valves should be open when the ship was at sea (see Figure 4).

The interior of the No. 2 after port fuel oil vent containment was examined and the level of oil inside was photographed (see Figure 6). There was no staining to indicate that the level of the oil in the vent containment rose high enough to spill out though the containment access port.

According to the Chief Engineer, the overboard drain valves for the No. 2 port fuel oil tank vent containments were found open after the spill.

ENVIRONMENT

Figure 5. No. 2 port fuel oil forward tank vent containment. [Note passenger automobile blocking access.]

The PACIFIC EXPLORER was located at the Blair Terminal, Berth A on the Blair Waterway, Tacoma, Washington. The Blair Terminal handles roll-on/roll-off cargos and automobiles.

The weather on the evening of April 15, 2005 was overcast with increasing rain. Winds were estimated to be from the south at 10 knots.

Sunset was at 2000.

Thursday, April 14, 2005

1600 to 1630 A pre-bunker training session was conducted by the Chief Engineer of the PACIFIC EXPLORER.

Friday, April 15, 2005

2005 The PACIFIC EXPLORER was finished with engines (FWE) at Tacoma, Washington.

2030 The Tankerman-PIC assigned to the tank barge 185-P2 arrived at the Blair Terminal and waited for the PACIFIC EXPLORER to clear customs and immigration so he could board the tank barge 185-P2 via the ship.

2120 The Tankerman-PIC boarded the tank barge 185-P2.

2130 The Tankerman-PIC gauged the 185-P2 and the Third Engineer of the PACIFIC EXPLORER observed.

2240 The Declaration of Inspection was signed by the Chief Engineer and the Tankerman-PIC indicating an intended transfer of 1,220 metric tons of IFO 180. The oil transfer hose was passed from the 185-P2 to the PACIFIC EXPLORER. The ship's "Bunkering Reception Plan," signed by the Chief Engineer, First Engineer, and Tankerman-PIC indicated the ship was to receive:

- 980 cubic meters of IFO-180 into its No. 1 starboard fuel oil tank, and
- 343 cubic meters of IFO-180 into its No. 2 port fuel oil tank.

The transfer rate was to be 300 cubic meters per hour at a pressure of 3.0 kilograms per square centimeter.

2245 The oil transfer hose from the tank barge 185-P2 was connected to the PACIFIC EXPLORER.

2245/47 The tank barge 185-P2 began pumping fuel oil (IFO 180) to the PACIFIC EXPLORER.

2300 to 2310 The First Engineer opened the valve to the No. 1 starboard fuel oil tank about 2 turns.

2310 The Chief Engineer recorded an ullage of 9.25 meters in the No. 2 port fuel oil tank.

2315 The Chief Engineer recorded an ullage of 11.65 meters in the No. 1 starboard fuel oil tank.

2320 (estimated) The Tankerman-PIC got a request from the Chief Engineer to

Figure 6. View through No. 2 port fuel oil tank after vent containment viewing port. Note maximum level of oil was about 2.5 centimeters higher than when the photograph was taken.

increase the transfer pressure to 4.5 bar and he responded by increasing the r.p.m. of the barge's pumps to 1,750 to achieve a pressure at the barge's gauge of 75 to 80 p.s.i. (about 5 to 5.5 bar).

2325 The Chief Engineer recorded an ullage of 8.36 meters in the No. 2 port fuel oil tank (Note: He later stated that he thought the ullage he recorded may have been incorrect).

2340 (estimated) The Tankerman-PIC was told by someone from the ship to "slow down" the transfer rate and, in response, he decreased the tank barge pump speeds by about 400 r.p.m.

2350 According to the Tankerman-PIC, an emergency shutdown of the transfer was called by the ship and the Tankerman-PIC tripped the barge engines off line, stopping the cargo pumps.

According to the Chief Engineer, an ullage of 6.8 meters was taken on the No. 2 port fuel oil tank.

2355 According to the Chief Engineer, an emergency shutdown of the transfer was called by the ship.

Saturday, April 16, 2005

0000 The Tankerman-PIC notified his dispatcher of the emergency shutdown.

0005 The Tankerman-PIC notified his dispatcher of oil in the water.

0210 Ecology response personnel arrived on-scene.

0900 (estimated) Bunkering process was restarted with permission of USCG and Ecology.

1346 The re-started bunkering process was completed.

1400 Incident Command determined that response to the spill was complete and approved the start of demobilization of response equipment and personnel.

1555 The PACIFIC EXPLORER departed bound for New Westminster, British Columbia.

RECOLLECTION OF THE TANKERMAN-PIC

The Tankerman-PIC conducted sounding of the 185-P2 in the company of the PACIFIC EXPLORER's Third Engineer. A radio on VHF channel 69 was available for communication between the barge and the ship, though the Tankerman-PIC indicated that communication was face-to-face. For most of the transfer the Tankerman-PIC recalled there were two people at the point of transfer (the ship's port fuel header) whom he believed to be the Third Engineer and Electrician.

The Tankerman-PIC got a request to increase the delivery pressure to 4.5 bar (1 bar $\simeq$ 14.5 p.s.i) at about 30 minutes before the emergency shutdown (about 2320 or about 35 minutes after the start of the transfer). He increased the barge cargo pump speeds to their maximum r.p.m. (1,750 r.p.m.) to achieve a pressure at the barge pressure gauge of about 75 to 80 p.s.i. (about 5 to 5.5 bar). He began stripping the barge's No. 2 port tank but was also drawing oil from the barge's No. 3 port tank.

About 20 minutes later someone from the ship told the Tankerman-PIC to "slow down" the transfer rate by the ship and, in response, the Tankerman-PIC decreased the tank barge pump speeds by about 400 r.p.m.

At 2350 the Tankerman-PIC got a face-to-face request from what he believed was the Electrician (based on the label on his hard hat) for "slow slow" followed immediately by "stop stop." The Tankerman-PIC tripped the emergency shut-down switch on the barge, shutting down the barge generators; thereby removing power to the cargo pumps and the deck lights.

The Tankerman-PIC notified dispatch. He recalled that nothing about the transfer was unusual up to that point, that the ship's personnel seemed alert, and that he had experienced no problems in communicating with the ship's personnel.

The Tankerman-PIC recalled looking over the side maybe five to seven minutes after the emergency shutdown was called. He saw oil draining out of two holes of about two-inch (about 5 cm) diameter on the port side of the ship. He noted that the flow from the forward hole was heavier. He described the flow as maybe ½-inch in diameter which adhered to the ship's hull as it left the hole. He began to fashion plugs made of sorbents and to place the sorbents into the holes to stop the flow of oil. The Tankerman-PIC stated it took him 20 to 30 minutes to place the plugs in the holes.

RECOLLECTION OF THE CHIEF ENGINEER

The Chief Engineer recalled that the Third engineer was at the manifold (in the engine room), the First Engineer was in the engine room, and that he was on the No. 6 car deck (same deck as the fuel header and vent containments) looking at the No. 1 starboard tank when the spill occurred. The Chief Engineer said that there was one person sounding tanks and the transfer rate was "very fast."

According to the Chief Engineer, when the bunkering operation started all the IFO 180 fuel was going to the No. 2 port fuel oil tank. Then, between 2300 and 2310, the First Engineer opened the valve to the No. 1 starboard fuel oil tank maybe 2 turns (per the Third Engineer, the valves require about 6 turns to open fully). The Chief Engineer related that as they were nearing the end of filling the No. 2 port fuel oil tank, the Third Engineer called for the shut down of the transfer because there was too much pressure.

Following the spill, the Chief Engineer gravitated oil from the No. 2 port fuel oil tank to the No. 1 starboard fuel oil tank for about half an hour to lower the level in the No. 2 port tank. The Chief Engineer also indicated some oil (about 6 cubic meters) was transferred to the fuel oil settling tank.

The Chief Engineer investigated how the oil had gotten over the side and found that the overboard valves on the 2-inch overboard pipes from the No. 2 port fuel oil tank vent containment boxes had been left open. The Chief Engineer indicated it was the First Engineer's responsibility to close these valves prior to bunkering and that the Chief Engineer would normally then check that they were closed as part of his procedure. In this case he indicated that the vent containment access plates were open, but he did not check the tank vent containment overboard valves.

RECOLLECTION OF THE THIRD ENGINEER

The Third Engineer recalled that he was on duty and in charge of the compatibility analysis (fuel oil analysis).[2] He was in the engine room with the First Engineer at the manifold valves when the spill occurred. The No. 1 starboard fuel oil tank valve was open three turns and the No. 2 port fuel oil tank valve was open all the way. The Third Engineer observed a pressure of 3.5 kilograms/cm^2 (~3.5 bar) at the gauge at the fuel oil manifold in the engine room. The Third Engineer got a request to change tanks from the First Engineer. The Third Engineer opened the No. 1 starboard fuel oil tank valve all the way. He went to the No. 2 port fuel oil tank valve and began to close it. When the No. 2 port fuel oil tank valve was nearly completely closed, the pressure indicated on the gauge at the manifold in the engine room came up above 6 kilograms/cm^2 (~ 6 bar). Via radio, he requested the Electrician at the port fuel oil header (bunkering station) to reduce the pressure. He stopped closing the No. 2 port fuel oil tank valve, and then he called to shut down the transfer.

Transfer Rate

According to the ship's "Bunkering Reception Plan" signed by the Master, Chief Engineer, First Engineer, and Tankerman-PIC, the planned transfer rate was 300 cubic meters per hour at a pressure of 3.0 kilograms/cm^2. The length of the transfer was approximately 65 minutes (2245 to 2350). According to the tank barge delivery paperwork, the volume of IFO 180 transferred from the barge to the ship was about 3,207 (gross) barrels (or about 511 cubic meters). This resulted in an average transfer rate of about 2,960 (gross) barrels per hour (or about 472 cubic meters per hour). It therefore appears that the planned transfer rate was exceeded by as much as 57 percent.[3]

Tank Overfill

Following the emergency shut down and discovery of the spill, the Chief Engineer began gravitating oil from the No. 2 port fuel oil tank to the No. 1 starboard fuel oil tank in a process that lasted about one-half hour. He also transferred fuel oil (6.1 cubic meters) to the fuel oil settling tank. Soundings of the No. 2 port fuel oil tank were not taken before the post-shutdown internal transfer occurred, but it was assumed by the Chief Engineer that the No. 2 port fuel oil storage tank was too full.

Examination of the "Bunkering Reception Plan" indicated that the planned final sounding for the No. 2 port fuel oil tank was 4.82 meters (343.54 cubic meters or about 86-percent of tank capacity, uncorrected for trim). The post-spill sounding information indicated that the trim-corrected level in the No. 2 port fuel oil tank was 4.75 meters (336.41 cubic meters or about 84-percent of tank capacity). Adding back the 6.1 cubic meters that the Chief Engineer indicated was transferred to the fuel oil settling tank post-spill, indicates that the volume reached at least 342.51 cubic meters or about 86-percent of tank capacity. When the Chief Engineer's statement that he gravitated from the No. 2 port fuel oil tank to the No. 1 starboard fuel oil tank for approximately half an hour following the shut down is considered, it becomes apparent that the No.2 port fuel oil tank was filled beyond its planned final sounding (4.82 meters, 86-percent of capacity).

Crew Alertness/Work Hours

Work hour records were available for those with assignments for the bunkering operation except for the Chief Engineer. None of those for whom work hours were available exceeded the 15- in 24-hour or 36- in 72-hour limits contained in the Washington State's Procedures for Safe Bunkering (WAC 317-40).

The transfer began at about 2245, immediately after the ship cleared customs and immigration checks at the berth in Tacoma. This time of day falls within the typical time of reduced alertness for people who are not adapted to night work resulting from the circadian rhythm of the human body. The USCG Crew Alertness program refers to this period as the "Red Zone."[4]

Examination of the Chief Engineer's sounding notes indicated that he had transposed the columns for the No. 1 starboard and No. 2 port fuel oil tanks, and had ceased recording times alongside the tank soundings after 2325. In addition, the Chief Engineer was not regularly recording soundings for the No. 1 starboard fuel oil tank, though he indicated that the First Engineer had opened the valve to the tank between 2300 and 2310. Finally, the Chief Engineer overlooked completing a check to ensure the fuel oil tank vent containment overboard valves were closed prior to starting the transfer. Such actions could result from reduced alertness or fatigue.

The errors noted in the Chief Engineer's sounding notes, his departure from the bunkering plan (substantially exceeding the planned transfer rate), his failure to complete a routine pre-

transfer check, and the time of day were all potential indicators of reduced alertness on the part of the Chief Engineer.

Chief Engineer's Ship-specific Experience

According to the crew list the Chief Engineer joined the ship on March 30, 2005. He also stated that it was his first bunkering operation aboard the PACIFIC EXPLORER. Given that it was his first bunkering operation aboard the ship, his departure from the bunkering plan and his limited use of sounding notes must be questioned.

Status of Transfer Monitoring Equipment

The heavy fuel oil and diesel oil level gauging panel (see Figure 4) was reported by the Chief Engineer to be inoperative at the time of the spill. This reduction in monitoring capability heightened the responsibility of the Chief Engineer to closely monitor the tank levels, transfer rate, and transfer pressure by manual means in order to ensure a safe and spill-free transfer. Given the high transfer rate that occurred and the Chief Engineer's limited use of sounding notes in combination with this reduced monitoring capability, this additional responsibility was not met by the Chief Engineer.

CAUSAL INFORMATION

Based on the information gathered, the immediate cause of the spill was the failure of the First Engineer to close the No. 2 fuel oil tank vent containment valves, and the Chief Engineer's omission of a check of those valves prior to the start of bunkering, which allowed the small-volume tank overflow to progress to a spill. Factors contributing to the spill included:

· A loss of situational awareness on the part of the Chief Engineer with regard to the status of the No. 2 port fuel oil storage tank, that allowed the No. 2 port fuel oil tank to overfill; and,

· A high transfer rate that reduced the time available to detect and correct problems.

LESSONS LEARNED

· Maintaining situational awareness is critical during any maritime operation, whether underway or while conducting operations alongside. Situational awareness is particularly important for watchstanders and Persons-in-Charge.

· Bunker planning documents establish expectations for a transfer, including transfer rates. Departures from the plan during the bunkering process require a heightened standard of care by the Person-in-Charge authorizing the change to ensure that a spill does not occur as a result.

· Persons-in-Charge of bunkering operations should be aware of their work/rest hours, and should educate themselves regarding the potential effects of reduced alertness and fatigue on safety and performance. They should, if necessary, delay or alter plans for bunkering if they or crew members on their bunkering team have not had adequate rest.

· Regulations, company policy, plans, and checklists together set standards for safe bunkering. It is not enough to maintain copies of regulations, company policies, plans, and checklists; one must also comply with them to assure safe bunkering.

PREVENTION RECOMMENDATIONS

To ship owners and operators:

· Ensure your company's bunkering procedures and all federal and state regulations are understood and complied with by ships' crews.

· The receiving vessel's PIC must frequently calculate and record the rate of transfer based on the soundings. Recorded transfer rates should be retained in the bunkering file. The receiving

vessel's PIC should compare the calculated transfer rate to the planned rate and, if the transfer rate is higher than planned, should contact the delivering vessel or facility immediately to reduce it.

· Emphasize teamwork during bunkering training to help maintain situational awareness.

· Ensure that crew members that have assigned bunkering duties, including the Chief Engineer, are given sufficient time to get adequate rest prior to conducting bunkering operations, and that they understand the importance of adequate rest and the dangers of working while fatigued.

· Examine your procedures for transferring oil (internal and over-the-rail) to ensure that tank vent containment is checked prior to transfers.

· Ensure that work hour records are maintained up-to-date for all bunkering team members, including the Chief Engineer, and that they accurately reflect the hours actually worked and rest periods.

· Ensure your company policies and procedures place safety and environmental protection over commercial considerations in order of precedence.

· Emphasize the dangers of complacency during oil transfers to crews by publicizing lessons-learned from this spill throughout the company's fleet.

Since the PACIFIC EXPLORER oil spill, the vessel operator has:

1. *Determined that the crew of the ship undertook positive actions following the spill including:*

· *Proper notification of Washington State and the ship's cleanup contractor.*

· *Cooperation with federal and state authorities investigating the spill.*

2. *Undertaken the following prevention measures:*

· *Reviewed their bunkering and internal transfer procedures in light of the PACIFIC EXPLORER spill. The procedures were revised immediately based on Ecology findings and recommendations.*

· *Informed their fleet of the lessons learned from the PACIFIC EXPLORER spill.*

· *Began briefing on-coming officers regarding the company policies and procedures concerning environmental protection and oil transfers.*

· *Rented and distributed a "Good Bunkering Practice" digital video disk (DVD) to ships in their fleet.*

3. *Provided additional information for the preparation of this Prevention Bulletin.*

(Endnotes)
1 - All time stated in this report is local time (Pacific Daylight Time).
2 - The Third Engineer did not speak English and questions and answers were translated through the Master and Chief Engineer.
3 - Using the Chief Engineer's soundings of the ship's tanks the volume transferred was 487 cubic meters. If the start and stop times of the bunkering operation from the ship are used, the duration of the transfer was 68 minutes (2247 to 2355), and the average transfer rate was 430 cubic meters per hour or 43-percent greater than the planned transfer rate.
4 - "CREW ENDURANCE MANAGEMENT PRACTICES: A Guide for Maritime Operations." USCG R&D Center. January 2003.

More Prevention Bulletins

- ☐ PB 06-02: The NOHO HELE (WDOE #06-08-037)
- ☐ PB 06-03: The SEA SYNERGY (WDOE#06-08-038)
- ☐ PB 05-01: The TAI SHAN HAI (WDOE #05-08-004)
- ☐ PB 03-01: The OVERSEAS WASHINGTON (WDOE#03-08-001)
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- ☐ PB 01-01: The SUPER RUBIN (WDOE#01-08-002)
- ☐ PB 99-02: The MONCHEGORSK (WDOE#99-261)
- ☐ PB 99-01: The ANADYR (WDOE#99-250)
- ☐ PB 98-01: The ARCADIA (WDOE#98-253)
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