PROTOTYPE
FACULTY OF ENGINEERING AND APPLIED SCIENCE
Journal of Undergraduate Engineering Research and Scholarship

*PT-13: Coastal and Ocean Engineering ENGI.8751 Undergraduate Student Forum*
*Faculty of Engineering and Applied Science, Memorial University, St. john's, NL, Canada MARCH, 2013*

*Paper Code. (PT-13 - Halley)*

# Exxon Valdez Incident

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## ABSTRACT

The Exxon Valdez was an oil tanker owned by the ExxonMobil Shipping Company, which gained its infamy after running aground in Prince William Sound spilling more than 11 million galleons (approximately 258,000 barrels) of crude oil [1]. It is currently operating under the name Oriental Nicety, and is owned by Hong Kong Bloom Shipping Ltd. In the early hours of March 24th, 1989 the vessel struck Bligh Reef in Prince William Sound, Alaska. The oil impacted over 1,100 miles of non-continuous coastline, making the Exxon Valdez the largest oil spill in U.S. history [2]. Exxon and the U.S. Coast Guard began a massive cleanup effort that included over 11,000 personnel, 1,400 vessels, and 85 aircrafts [2]. The spill affected one of the nations most vulnerable ecosystems, which included a national forest, four national wildlife refuges, five state parks, 3 national parks, four state critical habitat areas, and a state game sanctuary. Total toll on marine wildlife included approximately 300 harbour seals, 2,800 sea otters, and between 250,000 and 500,000 seabirds [3]. The remote location, the large spill size, and the character of the oil spill tested spill preparedness and response capabilities. Government and industry response plans proved to be completely insufficient to maintain an oil spill of this magnitude. Initial industry response to get equipment on site was exceptionally slow, and once deployed the equipment could not cope with the scale of the oil spill. In the aftermath of the incident, Exxon Mobil undertook substantial operational reforms and implemented an extremely thorough operational management system to prevent future incidents.

This report will explore the Exxon Valdez incident, environmental losses, economic losses, loss prevention measures, and the impact on design codes, practices and regulations.

## 1 INTRODUCTION

At the time of the incident, the Exxon Valdez was an American registered tank ship owned and operated by Exxon Mobil Shipping Company. The vessel was a typical modern tanker of all welded steel construction. The Valdez was the first of two Alaska-class tank ships built for Exxon Mobil

Shipping Company by National Steel and Shipbuilding Company, based in San Diego. The Valdez was designed and built to meet the standards of the International Convention for the Prevention of Pollution from Ships of 1978. The Valdez was certified by the U.S. Coast Guard for the transportation of crude oil and combustible liquids Grade B or lower. The Vessel measures 300 meters long, 51 meters wide, and 26 meters in depth, weighing 30,000 tons empty, and powered by a 23.60 Mega Watt (MW) diesel engine [4]. The vessel is capable of transporting 1.48 million barrels (200,000 tons) at a maximum loaded draft of 64.5 feet. The particulars can be seen below.

Table 1 Exxon Valdez Vessel Particulars [4]

| | |
|---|---|
| **Class** | VLCC Oil Tanker |
| **Type** | ABS:A1, Ore Carrier, AMS, ACCU, GRAB 25 |
| **Tonnage** | 209,836 (Deadweight Tonnage) |
| **Displacement** | 211,469 (Tons) |
| **Length** | 300 (meters) |
| **Beam** | 51 (meters) |
| **Draft** | 20 (meters) |
| **Deck Clearance** | 7.183 - 7.442 (meters) |
| **Installed Power** | 31,650 BHP (23.60 MW) |
| **Propulsion** | Eight Cylinder, Reversible, Slow-Speed Sulzer Marine Diesel Engine |
| **Speed** | 30.10 (km/h) / 16.25 (Knots) |
| **Capacity** | 1.48 Million Barrels of Crude Oil |
| **Crew** | 21 |

## 1.1 Exxon Valdez Incident

On the evening of March 23rd, 1989 the Exxon Valdez departed the Alyeska marine terminal in Valdez, Alaska. The vessel was under the control of its captain, Joseph Hazelwood, the guidance of an Alaskan state pilot, and monitored by the U.S. Coast Guard Vessel Traffic Service (VTS). The VTS is responsible for monitoring moving vessels via radar from Valdez and Potato Point. The vessel was sailing for Los Angeles / Long Beach and was transporting 53,094,510 gallons of crude oil. The captain of the Valdez informed VTS that the pilot had departed, and the ship would likely vacate the outbound traffic lane and cross the separation zone into the inbound traffic lane in order to avoid ice. The next call to VTS stated that the vessel was reducing its speed to 12 knots to navigate its way through some ice, and that VTS would be further advised after the ice was cleared [5]. The Exxon Valdez ran aground on Bligh Reef, Prince William Sound four minutes after midnight on March 24th, 1989. At this time, the vessel was operating at a draft of 56 feet, and the charted depth where grounding occurred was 30 feet at low tide [5]. The severity of the damage to the Valdez is attributed to both the ships momentum and the rocky bottom of the Prince William Sound. Damage surveys showed that eight of the eleven cargo tanks were torn open, extending the length of the vessel [5]. There was also three salt-water ballast tanks critically damaged, resulting in a total of eleven cargo tanks on the center and starboard side of the vessel. The colossal damage to the Valdez resulted in a loss of 10.1 million galleons of cargo within five hours [5]. At this time, about 80 percent of the vessels cargo remained on board as it came to rest in a very unstable position [5]. The Valdez was in danger of capsizing due to its unstable position, as a result both oil spill response and the removal of the remaining oil on board the vessel became of the upmost importance.

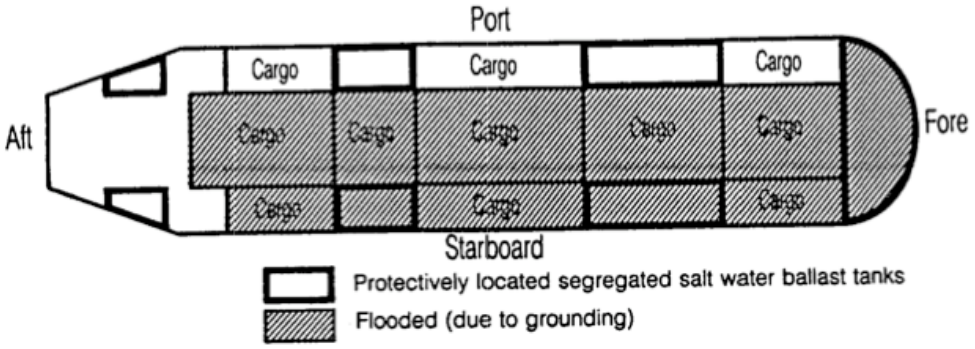


Figure 1: Schematic of Damaged Tanks [5]

### 1.2 Causes of the Incident

There have been multiple factors identified that contributed to the Exxon Valdez incident. The ExxonMobil Shipping Company failed to provide a sufficiently rested crew for the Exxon Valdez on March 23rd, 1989. The National Transportation Safety Board (NTSB) found that this was a widespread issue throughout the industry and provoked a safety recommendation for both Exxon and the entire industry. The Captain, Joseph Hazelwood, was confirmed to be asleep when the ship grounded on the Bligh reef. As a result the third mate was at the helm, and he failed to properly maneuver the vessel. Another contributing factor was that Exxon failed to properly uphold the Raytheon Collision Avoidance System (RAYCAS) radar. If functional, the RAYCAS would have indicated to the third mate that a collision was imminent by detecting the radar reflector placed near the Bligh Reef, for the purpose of keeping ships on course via radar. It was discovered that the tankers RAYCAS radar was left inoperable and disabled for more than a year before the incident. Further investigation into the Exxon Valdez accident led to more possible contributing factors. The crew on March 24th, 1989 was approximately half the size of the crew present in 1977, working 12-14 hour shifts. This relates to Exxon's failure to provide a sufficiently capable and rested crew. It was confirmed that U.S. Coast Guard inspections were not performed on the vessel before it left Valdez, and the crew size was reduced. Another problem associated with the accident was the lacking of an effective pilot and escort service.

## 2 ENVIRONMENTAL LOSSES

There were no human losses as a result of the Exxon Valdez incident, but the same cannot be said for environmental and economic losses. The severity of oil spill effects on the environment can vary greatly, depending on the conditions of the spill. These conditions include the type and amount of oil involved in the spill, the geographic location, seasonal timing, the forms of habitat affected, sensitivity of the affected organisms life stage, and the sufficiency of response. Most of the conditions present during the Exxon Valdez spill were amplified compared to spills in the past, resulting in very harsh effects on the environment. The Valdez spill occurred in a high latitude area in a semi-enclosed body of water at the beginning of spring. The 10.1 million gallons spilled from the Valdez wreckage was known to have spilled over 1,100 miles on non-continuous coastline and 350 miles of shoreline in the Prince William Sound alone [2]. The immediate effects were most noticeable on marine birds and sea otters. The bird population of the Prince William Sound Area was very diverse and plentiful in 1989.

The Fish and Wildlife Service counted more than 91,000 in the Prince William Sound immediately after the spill [3]. Twenty-three species of marine mammals live in the Prince William Sound or the Gulf of Alaska. Included are humpback whales, killer whales, various porpoises, dolphins, harbor seals, sea lions, and sea otters. Of these mammals, the sea otter is the most sensitive to spilled oil. A sea otter is dependent on its fur for insulation, so they can potentially die of hypothermia or stress when it comes in contact with oil. Immediate effects of the Valdez oil spill included the deaths of approximately 250,000 to as many as 500,000 sea birds, and 2,800 sea otters [3]. Other environmental losses included approximately 12 river otters, 300 harbor seals, 247 bald eagles, 22 orcas, and billions of salmon and herring eggs [3]. In years to come, overall reductions in population were seen in various ocean animals. Cleanup efforts washed away much of the visible damage of the Valdez oil spill within the first year, but the environmental impacts are still being felt. In years since the accident, scientists have noticed higher death rates among sea otters and other affected species, along with stunted growth among other species. The spill destroyed billions of salmon and herring eggs, adversely affecting the food chain in the Prince William Sound and the Gulf of Alaska. Twenty years later, those fisheries are still unrecovered.

## 3 ECONOMIC LOSSES

Sections of the Clean Water Act (CWA) authorize the president and state officials to act on behalf of the public as representatives for national resources seeking retribution from Exxon Mobil for costs of restoring and rehabilitating the affected environmental areas. The parties affected by the spill were the State of Alaska, the U.S. Departments of Agriculture, Commerce, and the Interior. Representatives from these agencies worked closely together to develop a strategy for assessing the short and long-term effects of the spill on their resources, the consequential economic damage, and the feasible cost of restitution. As a result, Exxon has spent over $4.3 billion in compensatory payments, site cleanup, settlements and fines [6]. Exxon voluntarily reimbursed 11,000 Alaskans and businesses within a year of the spill [6]. The department of Energy (DOE) increased its monitoring of fuel prices immediately after the Exxon Valdez spill. Within three weeks of the spill, gas prices had rose temporarily. Los Angeles gas prices rose by about 50 cents as a result of the spill, to $1.18 per gallon at their peak on March 31$^{st}$ [5]. On a national level, unleaded gasoline prices increased on average about 10 cents per gallon on both the wholesale and retails levels [5]. The fisheries for salmon, herring, crab, shrimp rockfish, and sablefish were closed as a result of the Valdez spill. The herring and salmon species have never fully recovered, meaning the commercial fishing industry that depends on these species hasn't either. These closings and restrictions also harmed the areas fish processing industry. The industry employed an average of 3000–4000 people annually. As a direct result of the spill, the tourism industry immediately lost 26,000 employees and close to $2.4 billion in sales [3]. By 2003, the tourism industry had recovered noticeably but it remained damaged as people still regarded the area as contaminated. Native villages such as Tatitlek and Chenega, which are located on the coast of the Prince William Sound, depend on the local birds, fish and plants as primary sources of food. The survival of their traditional ways depends on the survival of their local economy, which is dependent on the local wildlife.

Twenty-two years have passed since the Valdez oil spill and nearly twenty acres of the Prince William Sound coastline are still contaminated with oil remnants. Two species are extinct, ten species haven't reasonably recovered, and the fate of five species is unknown. Until all affected species recover from the colossal oil spill, the economy that is contingent upon them cannot fully recover.

## 4 ROLE OF RISK CONTROL STRATEGIES

At the time of the Exxon Valdez accident there were five contingency plans in place, including the National Contingency Plan (NCP) and the site-specific plans relating to the Prince William Sound [5]. All of these plans were designed to coordinate a highly effective government and industry response, except the Alyeska Plan underestimated the magnitude of the Valdez oil spill. The State approved Alyeska Plan was the primary plan for the purposes of direct spill containment involving oil from the Trans-Alaska Pipeline in the Valdez/Prince William Sound area [5]. However, the Exxon plan stated that the Exxon Shipping Company be responsible for spill containment and cleanup related to spills in U.S. waters from Exxon vessels. The issue was that these plans did not refer to one another or establish a response command hierarchy in the event of a spill in the Prince William Sound area. Lack of coordination between the Alyeska Plan and the Exxon Plan caused confusion in structuring a response to the Valdez oil spill. Alyeska did not provide timely information to the state of Alaska when Exxon assumed responsibility for the response. Furthermore, Alyeska did not carry out its responsibilities to guide the spill response in a manner that guaranteed a quick response with the availability of acceptable and necessary equipment. Alyeska was not prepared to respond to the Valdez oil spill. There was a lack of personnel skilled in oil response because the planners did not anticipate the manpower required to respond to a very large, and widespread spill. As a result, valuable time was used to train inexperienced workers. Making matters worse, some personnel and government representatives did not fully understand the National Response Team / Regional Response Team structure, reducing the efficiency of on-scene operations. The fundamental response strategy is outlined in the Alyeska Plan, however direction to help the responders implement this strategy was not acceptable for the magnitude of the Exxon Valdez spill. For example, the Alyeska plan identifies the delicate habitats and pegs them in order of response importance. In addition, the plan calculates the amount of diversion booming required to protect the habitats. The problem is that the Alyeska plan does not outline the manpower or equipment needed to deploy the booming. This resulted in an unknown amount of equipment stored at the Valdez terminal and elsewhere in the State of Alaska. Many of the plans mention the difficulty of planning for, and responding to spills in remote areas, but they do not explain detailed actions to address the problem. It is evident that the Alaskan Regional Response Teams and the Alaskan State plans did not consider the necessary manpower, equipment and logistics between different response plans, for a spill of this size.

## 5 LOSS PREVENTION MEASURES

The Exxon Valdez failed to appropriately maintain its RAYCAS radar, which if functional would have indicated to the third mate that the Bligh Reef posed a threat to the vessel, by detecting the radar reflector which was placed near the reef. The RAYCAS radar was left damaged and disabled for over a year before the incident, and Exxon Management was aware of this. If the radar was fully functional and being used at the time of the incident, the third mate would have been aware of the impending risk and could have easily avoided the Bligh Reef. The ExxonMobil Shipping Company should have ensured that a well-rested and sufficiently sized crew was provided for Valdez. If the crew was well rested before the Valdez left the Alyeska Marine Terminal, this accident could have potentially been avoided. Furthermore, the crew size on March 24$^{th}$, 1989 was half that of the crew size in 1977, and crewmember were working 12-14 hours shifts. This is another issue that the Exxon organization could have evaded. As mentioned earlier, the NTSB found that this issue was widespread throughout the industry, encouraging a safety reform for both Exxon and the entire industry. The oil industry had promised to install state of the art iceberg monitoring equipment. If this equipment were in place, the Valdez would have never had to cross the separation zone and enter the inbound traffic lane in order to

avoid icebergs thought to be in the area. An iceberg monitoring system was essential at the time of Valdez incident. The Exxon Shipping Company should have taken a proactive stance toward accident prevention. It is unacceptable to leave the primary radar system broken and disabled for over a year. This issue should have been dealt with as soon as it was encountered. Also, providing a revitalized crew is essential for efficient operation of a vessel such as the Valdez. A vessel inspection should have been completed before departing the Alyeska Terminal, noting the broken RAYCAS radar and the insufficient number of crewmembers.

## 6 IMPACT ON DESIGN CODES, PRACTICES AND REGULATIONS

The Valdez incident was one of the lowest points in ExxonMobil's history, however they took immediate responsibility for the incident, spending over $4.3 billion in cleanup costs, compensatory payments, and fines [6]. Prior to the incident, ExxonMobil undertook some operational reforms and implemented an upgraded operational management system to prevent future accidents. This new system was deployed globally, and no subsequent similar accidents have occurred. In the aftermath of the incident, ExxonMobil intensified its commitment to protect the environment, its employees, and communities worldwide. As a result of the incident, ExxonMobil has done the following to progress oil-spill prevention:

- Modified tanker routes
- Strengthened drug and alcohol testing programs
- Limited safety sensitive positions to employees with no history of substance abuse
- Implemented more extensive periodic assessment of ExxonMobil vessels
- Intensified training programs for vessel captains and pilots
- Introduced new technology to improve vessel navigation and ensure the reliability of oil containment systems [6]

ExxonMobil has also enhanced their oil-spill response capability by doing the following:

- ExxonMobil is a founding member of every major oil-spill response center worldwide
- There are over 1,000 ExxonMobil employees involved in spill response teams worldwide
- Hold frequent oil-spill response drills at ExxonMobil locations worldwide
- Developed and applied new spill-detecting technology [6]

The Exxon Valdez incident prompted both state and federal governments to alter the laws regarding oil-pollution considerably. Between April 1989 and May 1990 the state legislature pasted twelve new laws dealing with spill prevention, response, and supervision. Among the most intensified laws passed was law to boost the state's oil and hazardous response fund to $50 million, fifty times what the fund had contained at the time of the incident [7]. The state legislature also directed a total re-write of the state's oil prevention, response, and contingency planning regulations. A new government division was also formed directed towards oil and hazardous material spill issues; the Department of Environmental Conservation (DEC). Changes at the federal level came about with the Oil Pollution Act of 1990. The federal act raised the liability limits, implemented new spill prevention measures, and created a new response fund.

## 7 HUMAN FACTORS

The Valdez incident could have been avoided if the ExxonMobil Shipping Company had taken a proactive stance toward accident prevention, and vessel maintenance. As mentioned earlier, the RAYCAS radar onboard the Valdez was left damaged and disabled for over a year before the accident. Exxon management was aware of this and didn't interfere to properly repair the damaged radar system. If in use the night of the Valdez incident, the third mate at the helm of the vessel would have detected the Bligh Reef and would have easily avoided it. It has also been confirmed that the captain of the Valdez, Joseph Hazelwood, was asleep at the time of the incident, leaving the third mate in command of the vessel. Providing a well before the vessel left the Alyeska Marine Terminal this could have been avoided.

## 8 CONCLUSION

The Exxon Valdez oil spill was the largest in U.S. history, until the Deepwater Horizon spill occurred in 2010. The Valdez spill prompted both state and federal governments to alter laws concerning oil and hazardous substance pollution. ExxonMobil also undertook significant operational reforms following the Valdez incident, implementing an ungraded operational management system to avoid future accidents. The system has been deployed globally, and no similar accidents have occurred in the 22 years since the Valdez accident. The accident could have been easily avoided if the ExxonMobil Shipping Company had taken a proactive stance towards accident prevention. Repairing and enabling the RAYCAS radar, and providing a well-rested and sufficiently sized crew should have been top priorities by the ExxonMobil Shipping Company.

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