Oil spill risks by the numbers

Posted 03/20/2019 by Christopher Dunagan

An EPA-funded study of oil spill risks in Puget Sound forms the basis of new legislation to regulate vessel traffic in the region. We break down some of the numbers from the study and look at where the risks may be greatest.

Oil barge, SEASPAN 827, in Fildalgo Bay with tug boat, Rosario. Photo: DanaStyber (CC BY-ND 2.0) https://flic.kr/p/f2SYAB

Worldwide and across the U.S., the number of oil spills from tank vessels and the average volume of each spill has declined dramatically over the past 10 years, according to reports from the International Tankers Owners Pollution Federation.

Coast Guard figures show that during 39 years from 1973 to 2011, tank ships spilled more oil in U.S. waters than tank barges — 67.9 million versus 45.2 million gallons respectively. But in the 20 years

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About this article

ARTICLE TYPE:
Magazine

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ORIGINALLY PUBLISHED:
March 2019

POSTED IN EOPS:
03/20/2019

TAGS:
Oil spills, Water quality, Killer whales

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from 1991 to 2011, tank barges spilled more oil than tank ships — 8.2 million versus 2.6 million gallons respectively.

Sound Area

Asked to look specifically at tank barge accidents in Washington and Oregon, the Washington State Department of Ecology reported on 45 tank barge accidents between 2008 and 2017. Of those, 26 resulted in oil spills totaling about 2,000 gallons. The agency found no trends over time.

Of the 26 spills, 23 occurred while the vessel was moored. Of the moving vessels, one was a grounding on the Columbia River, causing a sheen of oil; another was from a leaking generator fuel line, spilling about a gallon of oil; and one was a spill of about eight gallons from a cargo-transfer pipe.

Of the 19 non-spill accidents, six were groundings, six were collisions with a non-moving vessel, two were from broken towlines and one was from a partial loss of propulsion. Two others were listed as safety threats in which a tug towed a barge outside a traffic lane; one was a cracked outer hull on a double-hulled barge; and one was a loss of a generator on a tug towing a tank barge.

None of the 26 spill incidents could have been helped with a tug escort, Ecology officials concluded, but a tug escort might have reduced the potential of an oil spill in seven of the 19 non-spill incidents.

Traffic risk assessment

Modeling the risks of an oil spill involves recognizing the sequence of events that lead up to a collision or grounding, according to Johan Rene Van Dorp of George Washington University, co-author with Jason Merrick of Virginia Commonwealth University of the 2015 Vessel Traffic Risk Assessment (VTRA) report. An accident occurs only if a vessel is transiting through the water, comes into proximity with another vessel or shoreline, then something goes wrong. The probability of each step happening along the way — situation, incident, accident, oil spill — is calculated separately, based on standard operations, historical data and expert opinions.

The VTRA model differs from other oil-spill models by including the time of travel for each ship on the water, not just the total number of trips. Slower vessels may remain in a dangerous location longer, but they would create less damage during a collision. In model simulations, fewer oil-filled chambers in a tank vessel are ruptured when struck by a slower moving vessel — although the structure of the tank vessel and angle of collision are also important factors.

Oil tanker in Fidalgo Bay. Photo: DanaStyber (CC BY-NC-SA 2.0) https://flic.kr/p/R3HV87

Based on findings from the model, only 2 percent of all accidents with oil-laden vessels result in any oil spilled at all, noted Scott Ferguson, spill-prevention manager at Ecology.

Another important finding of the model was that limiting tankers to 125,000 deadweight tons, as established in a 1977 federal law, is still a good idea, he said. Some officials had argued that larger ships making fewer trips into Puget Sound would be a safer way to go, but the model showed that would not be the case.

Cargo ships and tank vessels were the main focus of the study because they can result in the greatest spills, but other vessels are included as possible contributors to accidents that could lead to spills. Cargo vessels account for about 16 percent of the time on the water, while tanker vessels account for about 8 percent, for a total of 24

percent. The other 76 percent include smaller vessels, 33 percent; ferries, 17 percent: tug and tows (except oil barges), 17 percent; and others, 9 percent.

Under existing conditions, the risk analysis divides potential oil spills into four categories:

Less than 264 gallons (1 cubic meter): About 98.2 percent of all potential oil spills fall into this category, with a 98.7 percent chance of having at least one of these spills per year. These smaller spills represent 0.5 percent of the total potential volume of oil spilled over time.

Between 264 and 264,000 gallons: About 1.8 percent of all potential oil spills fall into this category, with a 7.5 percent chance of at least one of these spills per year. These spills represent 45.3 percent of the total potential volume of oil spilled over time.

Between 264,000 and 660,000 gallons: About 0.01 percent of all potential oil spills fall into this category, with a 0.06 percent chance of one of these spills per year — or a 1.52 percent chance of one of these spills in 25 years. These spills represent 12.3 percent of the total potential volume of oil spilled over time.

More than 660,000 gallons: About 0.01 percent of all potential oil spills fall into this category, with a 0.05 percent chance of one of these spills per year — or a 1.24 percent chance of one of these spills in 25 years. These spills represent 42 percent of the total potential volume of oil spilled over time.

Slightly over 98 percent of all potential oil spills account for only 0.5 percent of the total oil spilled. These are considered the smallest oil spills, but the analysis also shows that the largest spills may not account for the greatest volume of oil spilled over time.

Van Dorp says the analysis is more useful in studying the greater risks of increased vessel traffic, rather than pinning a number on the probability of an oil spill under existing conditions. That's because the few large oil spills that have occurred over the past 25 years lead to uncertainty about their actual likelihood of occurrence.

Three future scenarios are considered, each with increased vessel traffic based on proposed terminal-expansion projects in the U.S. and Canada. A fourth scenario assumes all three projects move forward, resulting in a total addition of 1,600 vessels.

The Trans Mountain Pipeline expansion, for example, which is estimated to add 348 tankers, would increase the potential accident frequency by 11 percent and the potential oil loss by 21 percent without further mitigation safety measures, according to the analysis.

The full expansion of 1,600 vessels (403 tankers, 197 articulated tug boats, 632 bulk carriers and 368 container ships) would increase the potential accident frequency by 11 percent and the potential oil loss by 85 percent.

The study area of Puget Sound is divided into 15 separate waterway zones. The analysis shows that under current conditions the potential oil loss is greatest in Guemes Channel, Haro Strait/Boundary Pass, South Puget Sound and Rosario Strait. The full expansion of 1,600 vessels would more than triple the potential oil loss for Haro Strait/Boundary Pass and nearly double it for Guemes Channel.

After reviewing the what-if scenarios with various terminal expansions, the advisory committee assisting with model development identified nine potential risk-mitigation measures that could reduce the overall risk. The measures included changes in vessel-safety standards, adding new rescue tugs and requiring tug escorts for oil barges. The measures were then grouped into six mitigation scenarios.

The VTRA report showed how the six mitigation scenarios, alone or together, would reduce the risk of spills of various sizes. But even if all the mitigation measures were adopted and put into action, it is likely that potential oil-spill volume would still increase with major terminal expansions.

Under the full-build-out scenario, with an increase of 1,600 vessels, potential oil-spill volumes are likely to increase by 31 percent over current conditions, even with all the proposed mitigation measures in place. The advisory committee suggested looking for additional safety measures to avert the risk.

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