

Science You Can Use

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Dear Science: The Coast Guard has estimated the size of the oil pipeline leak off Long Beach, California on 2 October 2021 to be as small as about 30,000 gallons and as large as about 130,000 gallons. Why is there such a difference? -- Buck R.

Dear Buck: Platform Elly is an offshore oil and gas processing facility owned by Amplify Energy and operated by Beta Operating Company, LLC. It is not an oil well as such but processes the production of oil well platforms Ellen and Eureka. Elly is connected to the Long Beach port by an 8.6-mile, 16"-inside-diameter, 2"-thick steel pipe encased in concrete. The pipe rests on the ocean floor, about 100 feet below the surface. Based on US Government records, Elly's average oil production (which is the average oil flow through the pipe from Elly to the Long Beach port) has been about 9,000 gallons per hour since Elly became operational (about 40 years ago).

At 2:30 AM on October 2, 2021, a low-pressure alarm for the pipeline was recorded at Elly. The line wasn't shut down until 6:01 AM (about 3.5 hours after the alarm). Amplify Energy CEO Martyn Willsher has insisted that the company didn't know of the spill until the crew of a company inspection boat saw a sheen on the water near Elly at 8:09 AM on 2 October 2021. The company notified the Coast Guard of the spill at 9:07 AM. Subsequent underwater inspection revealed that about 4000 feet of the pipe had been displaced approximately 150 feet from its original position. The inspection found a 13" crack in the pipe. The spill has fouled several beaches and injured and killed wildlife.

Various eyewitnesses reported seeing an oil sheen near Elly on 1 October 2021 as much as 15 hours before the line was shut down.

Estimates of the size of the 2 October spill depend on several variables, including how much oil was in the pipe, what the flow (e.g., in gallons per hour) of oil through the pipe was, how long oil was pumped into the pipe after the rupture occurred, the pressure in the pipe at times after the rupture, and the size of the rupture in the pipe (it may have changed over time). As of 13 October 2021, there is still much we don't know about the value of these variables. Although neither the Coast Guard nor Amplify have published how they derived their estimate, we can hypothesize various scenarios, and some of these agree with the estimates the Coast Guard reported. Let's look at a few.

Scenario 1. Assume the pipeline was shut down the instant the leak began, and all the oil in the line leaked into the water through the crack within a few hours. The interior of the pipe approximates a cylinder, so if we know its radius (i.e., half of its diameter) and length, we can, using high-school math, closely estimate the size of the spill to be the static (no-flow) volume of the pipe. The pipe has a 16" inside diameter and is about 8.6 miles long. This "cylinder-approximation" calculation says that the pipe volume, and thus the spill volume, would be about 560,000 gallons.

Scenario 2. Assume all the oil pumped into the pipeline during the 3.5-hour period between the low-pressure alarm and the time the line was shut down escaped through the crack at approximately 9,000 gallons per hour. In this scenario, approximately (9,000 gallons per hour x 3.5 hours =) 32,000 gallons would leak into the ocean. This quantity is close to the lower estimate reported by the Coast Guard.

Scenario 3. Based on eyewitness accounts of the sheen on 1 October, assume that oil started leaking 15 hours before the pipeline was shut off, all the oil pumped into the line during that time escaped through the crack at approximately 9,000 gallons per hour, and no oil that was in the line prior to the start of the leak escaped. In this scenario, approximately (9,000 gallons per hour x 15 hours =) 135,000 gallons would leak into the ocean. This quantity is close to the larger estimate reported by the Coast Guard.

Scenario 4. Assume the crack in the pipe occurred 15 hours before the pipe was shut down, all the oil in the pipe at that time escaped, and oil continued to be pumped for 15 hours thereafter at 9,000 gallons per hour through the crack. In this scenario, the total size of the spill would be 560,000 gallons + 135,000 gallons = 695,000 gallons.

What caused the crack in the pipe, when it occurred, and how much oil escaped through the crack are (as of 13 October 2021) unknown. In any case, offshore production all but guarantees that oil spills will occasionally occur, some will be difficult to contain or even estimate, and a few will have catastrophic environmental and economic effects.

For more information, see U. S. Department of the Interior, Bureau of Safety and Environmental Enforcement, Beta Operating Company, LLC, <https://www.bsee.gov/stats-facts/ocs-regions/pacific/pacific-ocs-platforms/beta-operating-company-llc>.

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