Assessment of spill risk (hazard rate) for offshore crude oil production in U.S. Waters

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Overview

This paper draws on U.S. government agency data covering offshore crude production volumes, spill frequency, and spill size by year. The dataset includes both platform and pipeline spills. Where a hurricane (Hilda, Ivan, or Rita) caused spills across multiple offshore platforms simultaneously, the event is counted as a single spill incident. Data sources are cited at the end of this paper.

Our review of the historical offshore spill record — both quantitative and qualitative — finds a stable trend in the frequency of major spills (greater than 1,000 barrels). Based on 60 years of data, major spills have occurred roughly every 1.2 to 2.2 years, or once for every 0.7 to 1.7 billion barrels produced. Catastrophic spills, while less frequent, have also recurred throughout this period. Because the spill rate is tied directly to production volume, **if offshore production increases, the rate of major spill events can be expected to rise proportionally.**

Results

Number of spills (Figure 1) of greater than 1 barrel (bbl). Years 1971, 1972, 1973 and 2005 are outliers from an apparent down trend. There appears to be a baseline rate of spill incidents trending down punctuated by periodic surges in spill incidents.

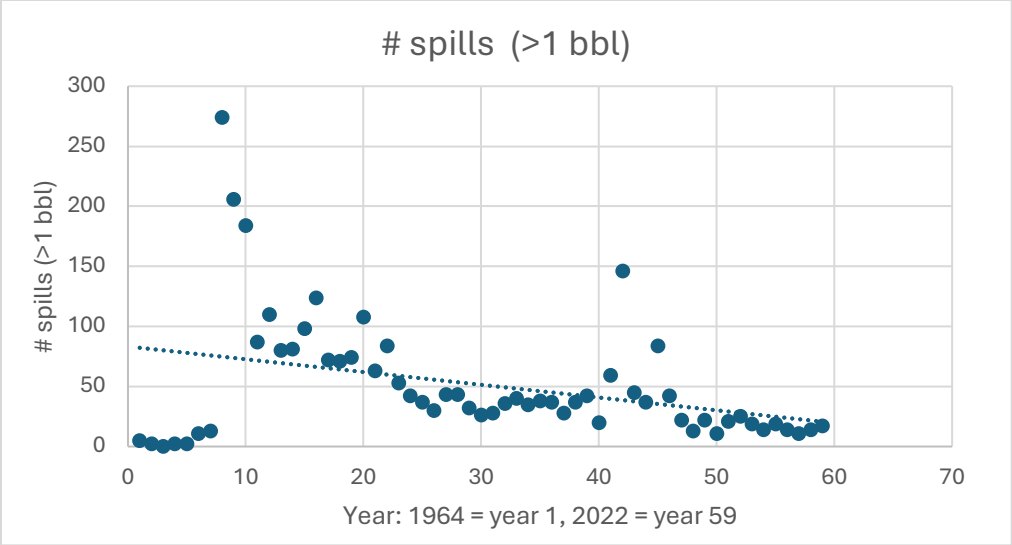

Figure 1: Spill incidents (> 1bbl)

The number of bbl spilled annually is shown (Figure 2). In those spills, 1967, 1969 & 1970 are outliers from an average ~4175 bbl annually. In the BOEM pdf document, reference 1, covering 1964-2013, the largest incidents, Taylor Energy (2004) and Deepwater Horizon (2010), were excluded. Again, there appears to be an overall average with occasional surges in annual spillage.

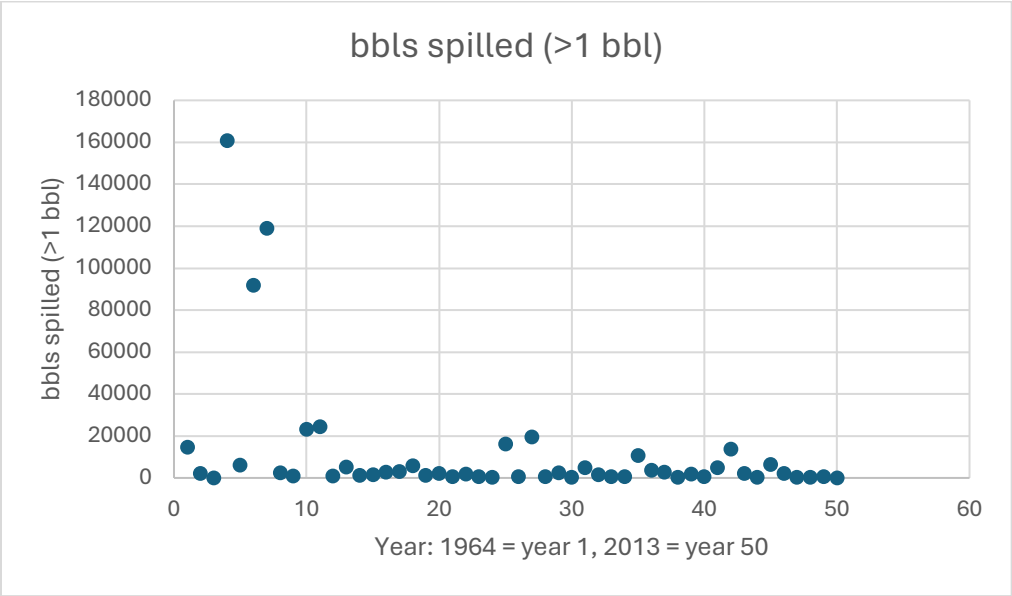

Figure 2: bbl spilled for spill incidents (> 1bbl)

Between 1964 and 2023, there were 38 major spill incidents (>1000 bbl), see Figure 3. We conclude that there is no apparent trend because even though the number of major spill incidents for 2004 (x=year 41, Taylor Energy) and year 2010 (x=year 47, DeepWater Horizon) were only counted once each, the cumulative spillage was millions of bbl. There were 38 major spills for 60 years (a hazard rate of 0.63 major spills/year); or, one major spill every 1.58 years. We calculated the 95% confidence interval or an average of 1.2 – 2.2 years between major spills. This rate reflects a stable relationship between production activity and spill risk: as long as offshore production continues at current levels, major spills can be expected at a similar frequency. Any expansion of production would shift that expectation upward proportionally.

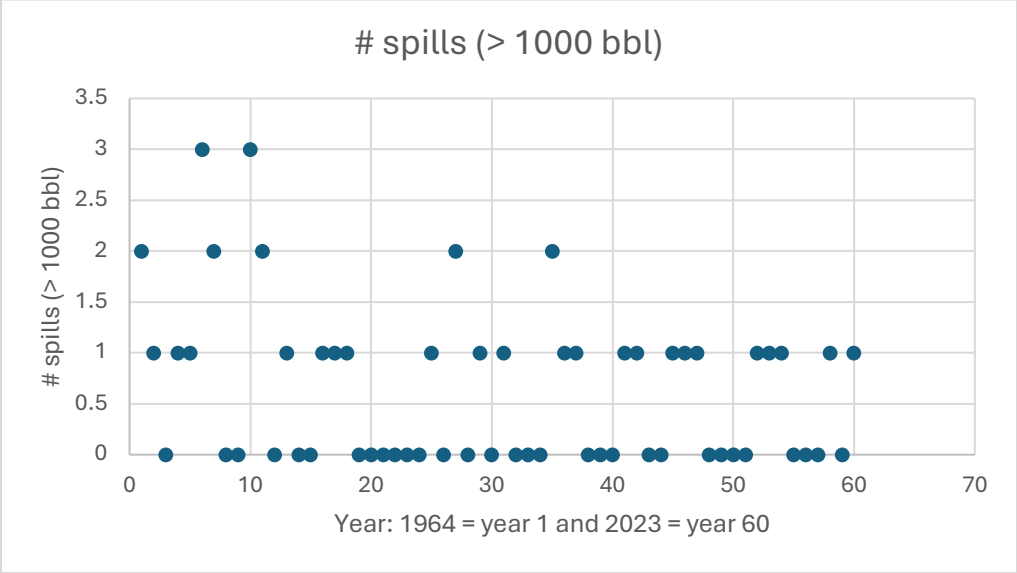

Figure 3: major spills (>1000 bbl) by year

Offshore production totals (the Gulf of Mexico and Pacific regions) for 1981-2025 were reviewed. The number of major spill incidents (> 1000 bbl) per MMbbl produced is shown in Figure 4. This appears to trend down, but the size of the large spills is not taken into account as there are some inaccuracies. Since 2004, the abandoned Taylor Energy platform (sunk in Hurricane Ivan) has spilled crude from some of the 28 well heads for more than 20 years. When the Deepwater Horizon disaster occurred in 2010, an oil slick near the Taylor spill site was observed. In 2019, an effort to contain the Taylor site netted some 25 bbl/day and is ongoing. The cumulative spillage from the abandoned Taylor site is not known but is thought to be on the order of a million bbl. Also, the Deepwater Horizon disaster of 2010 spilled some 4.3 million bbl. Again, the actual spillage is not known; thus, our conclusion is that the spill hazard continues and trend analysis is not appropriate. The

Taylor Energy site spilled oil for six years before it was discovered, raising serious concerns about how many other offshore spill sites may be leaking undetected.

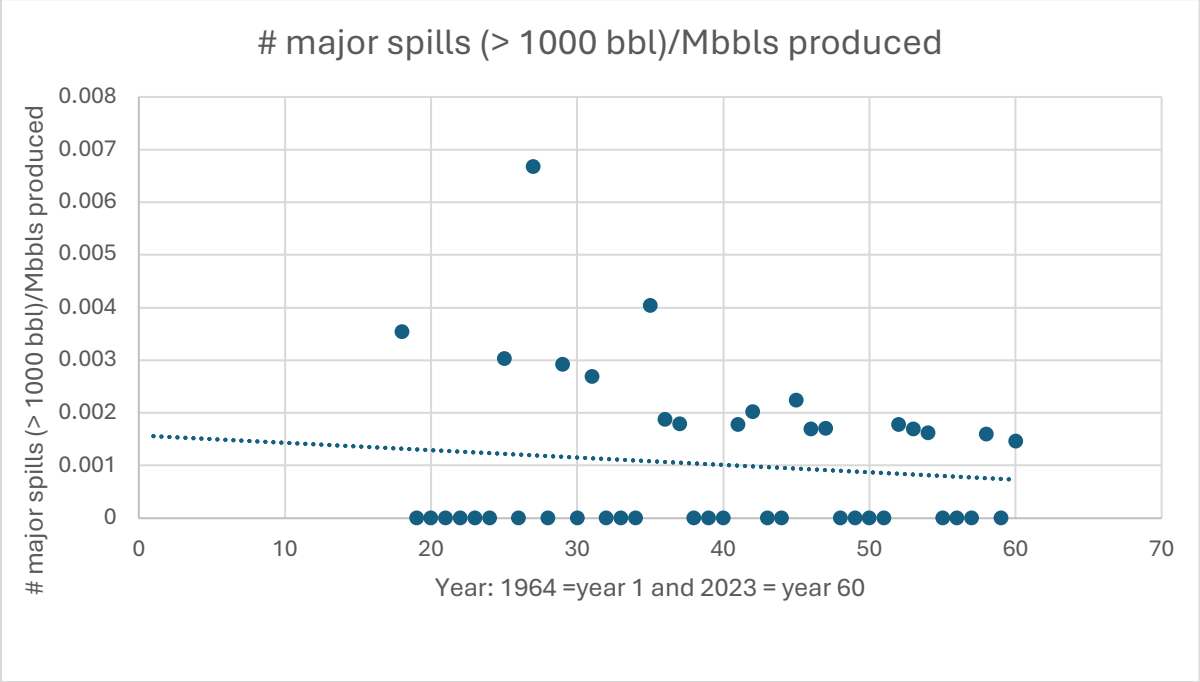

Figure 4: major spills (> 1000 bbl), 1981-2022, note that x=1 is year 1964 & x =60 is year 2023

An additional item we reviewed was the annual spillage/production ratio. In the 1981-2022 reported history, there were 20 reported major spills (> 1000 bbl) out of 21.44 billion bbl produced. That is a hazard rate of 0.93 major incidents for every billion bbl, which is one major spill for every 1.072 billion bbl produced. We split the history into two parts, 1981-2001 (10 incidents) and 2002-2022 (again 10 incidents) and tested (chi-square test) for trend. The result indicates that there is no significant trend. We calculated the 95% confidence interval on the average of 723 M bbl – 1.7 B bbl produced between major spills. This stable per-barrel hazard rate is the key finding: the data show no improvement in spill risk per unit of production over time, meaning that increases in offshore production volume can be expected to produce a proportional increase in major spill frequency.

Conclusion

Spill incidents, especially in the Gulf of Mexico, continue. Production in the Gulf is much greater than on the Pacific coast due to the existence on the Pacific coast of six national marine sanctuaries, local ordinances governing onshore facilities in place since the 1980's and early 1990s, strong coastal protections as a result of California's Coastal Act

(Proposition 20, 1972,) an annual moratorium on leasing imposed by Congress, and opposition from state Governors, environmental organizations, local governments and citizens. Those efforts were motivated by the catastrophic spill off the Santa Barbara coast in 1969. There are still very large catastrophic spills that plague coastal waters. Even though predictions are subject to variability, we can expect to see a large spill roughly every year and a half (+/-) and occasionally a catastrophic spill. Of course, this assumes that nothing has changed over the 60-year history. Major spill incidents are not a question of "if" but rather "when" and "how large". **Critically, because the spill hazard rate per barrel produced has remained constant, any increase in offshore production would be expected to increase the frequency of major spills proportionally.** Additionally, in the Gulf, hazards due to hurricanes remain.

While the number of reported oil spills has decreased, total spill volume has remained relatively flat, indicating that the average size of each spill is increasing.

The continuing occurrence of crude oil spill incidents effects coastal and ocean habitats and organisms, tourism, commercial and recreational fishing, ocean recreation, as well as the health of "clean-up" personnel (a study of the health of workers who cleaned up after the Deepwater Horizon disaster includes a follow-up 7 years later). As of the most recent Wikipedia page about DeepWater Horizon, BP has paid out $65B+ in compensation to satisfy claims made by various people and organizations. Note that on Friday, 13 March 2026, the Interior Department has approved another DeepWater Horizon type exploration platform in the Gulf. The newly approved BP platform will operate in 6,000 feet of water which is substantially deeper than that of the Deepwater Horizon.

Data sources

1. Spill summary, 1964-2013, offshore rigs & pipelines, in pdf format located at https://doibseedev.prod.acquia-sites.com/sites/bsee.gov/files/reports/oil-spill-response/all-spills-1964-2011.pdf

2. Spill summary, 2013-2023, on a webpage located at https://www.bsee.gov/stats-facts/offshore-incident-statistics

3. Offshore production for the Pacific and the Gulf, 1981-2025 located at these webpages
   https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFP3FM2&f=A

   https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFP5F2&f=A

4. 2016 Update of Occurrence Rates for Offshore Oil Spills, ABS Consulting, July 13 2016. Under contract to BOEM. Provides list of major spills, > 1000 bbl, 1964 – 2010. Available at https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research/1086aa.pdf

5. https://en.wikipedia.org/wiki/List_of_oil_spills, reviewed 7 March 2026. Provide additional major spills up to 2023.

Tim Haifley is a statistician. He holds an MS in Biostatistics from UCLA. He spent 40+ years in the Silicon Valley semiconductor industry. In his duties, Tim qualified semiconductor devices for operating in the harsh high temperature environment of the oil well down hole. He is a member of the American Statistical Association, a fellow of the Royal Statistical Society, a member of the Institute of Electrical and Electronics Engineers, and member of the American Society for Quality. He has published articles in peer reviewed journals including The IEEE Transactions on Reliability, The Proceedings of the Reliability, Availability and Maintainability Symposium, The Annual Meeting of the Automotive Electronics Council and the Annals of Clinical Psychiatry.

Katie Thompson is the Executive Director of Save Our Shores, an organization dedicated to protect and preserve the health of Monterey Bay and the central coast through education, advocacy, and outreach. She grew up in the Midwest, spending her free time on rivers and lakes, yet always had a love for the ocean. This passion drove her to study biology at Oberlin College then acquire a Master in Marine Affairs from the University of Washington. Katie joined Save Our Shores as Executive Director in 2024. Katie has worked in the marine conservation sector for a decade and has developed an expertise in community-based conservation strategies and nonprofit management. In previous roles at the Ocean Foundation and Stanford Center for Ocean Solutions, she focused on program management, international marine conservation strategies and research.

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