5. GENERAL STATISTICAL SUMMARY

In the course of performing this work, a number of data summaries were prepared to aid in analyzing the pipeline and tanker data. They serve to encapsulate some important features of the oil spillage problem as it exists today. It is appropriate, therefore, to conclude this report with a brief discussion of some of these results.

Table 5.1 aggregates all oil spill reports contained in the PIRS data by year. Notice the reasonable regularity in the number of spill incidents, either by volume range or in total, and the variability in the total volume spilled. Table 5.2 summarizes the spillage of oil from sources associated with the production, refining, transport, or storage of petroleum. Notice in particular the variability in total volume. Table 5.3 is a further disaggregation of 5.2. Again, as the number of samples decreases, the variability in the sum becomes larger and larger. Notice the large number and small volume of offshore production platforms and pipelines relative to the other spill sources. Despite the large number, however, the volume still jumps around mightily from year to year and we should not be too surprised to see a year in which one or two million gallons are spilled, assuming the process is a purely random one.

We have also examined the USCG's Office of Merchant Marine Safety worldwide tanker spill records for the period 1969-1973 and we have accumulated some worldwide tanker

TABLE 5.1

SPILLAGE OF OIL[a] IN THE U.S. FROM ALL SOURCES (USCG PIRS DATA)

Year	Total Volume (Gallons)	Total Number	Number on Volume Range (Gallons)			
			1-10	11-100	101-1000	> 1000
1973	15,300,389	9013	4510	2745	1227	531
1974	16,088,529	9925	4891	2797	1411	826
1975	20,397,541	8721	4454	2431	1222	614

[a]"Oil" being materials having a PIRS code in the range 1000-1099.

TABLE 5.2

SPILLAGE OF OIL IN THE U.S. FROM PETROLEUM INDUSTRY SOURCES

Year	Total Volume (Gallons)	Total Number	Number on Volume Range (Gallons)			
			1-10	11-100	101-1000	> 1000
1973	11,037,173	4715	2329	1399	796	301
1974	13,947,358	5527	2638	1454	866	569
1975	18,283,395	4388	2005	1161	921	301

TABLE 5

SPILLAGE STATISTICS FOR SELECTED SEGMENTS OF THE U.S. PETROLEUM INDUSTRY

	Total Volume (Gallons)	Total Number	Number in Volume Range (Gallons)			
			0-10	11-100	101-1000	> 1000
Tankers						
1973	3,157,848	692	232	262	155	43
1974	1,086,430	381	342	303	146	40
1975	7,758,102	587	248	211	91	37
Tank Barges						
1973	1,253,323	616	268	201	108	39
1974	2,336,328	751	329	265	116	41
1975	3,466,389	710	312	264	101	33
Refineries, Tank Farms (101+501+502)						
1973	1,623,033	667	243	221	119	84
1974	3,010,367	696	276	178	136	106
1975	693,801	673	237	204	146	86
Offshore Production Platforms and Pipelines (402+506)						
1973	951,857	2092	1347	537	173	35
1974	162,124	1937	1349	453	111	24
1975	127,867	1302	966	252	66	18

throughput figures as a means of scaling tanker transport activities during this five-year period. The figures are summarized in Tables 5.4 and 5.5.

Table 5.6 summarizes recent U.S. experience with large (> 1000 BBL) offshore transport pipeline spills. Table 5.7 develops throughput figures that are comparable with those used to describe tanker transport activities (Table 5.5).

Table 5.8 combines these figures in the sort of fashion we recommended against in Section 2. We have done this for a reason, however, because it not only illustrates the difficulty in making pipeline/tanker comparison, but it also has some data that supports portions of Section 4. The number of spills over 1000 barrels per barrel transported is noted here as being about 4 per thousand million barrels. The regression results of Figure 4.1 noted an oil spill incidence rate of about 7 spills per one hundred million barrels. This suggests about 4 spills out of 70 ought to be over a thousand barrels. An examination of the PIRS data reveals that about 1 tanker spill in 70 was of this size in the U.S. in 1973-1974. This seems to be quite a reasonable agreement between these two and independently acquired statistics.

The difficulty in the tanker/pipeline comparison is readily seen by the opposite conclusions we would draw if on the one hand we use number of big spills per ton mile as ir criterion, while on the other we use barrels spilled per barrels transported. Either criterion could be chosen

TABLE 5.4

SUMMARY OF OFFICE OF MERCHANT MARINE SAFETY (USCG) TANKER SPILLAGE DATA (1969-1973)

	STRUCTURAL FAILURE	GROUNDING	COLLISIONS & RAMMING	EXPLOSION & FIRE	OTHERS	TOTAL
All Spills over 10,000 tons	13 308,303	6 143,509	1 120,300	3 61,716	4 84,019	27 717,847
All Spills over 1,000 tons	19 336,074	31 212,532	27 181,633	15 98,350	4 84,019	96 912,612
All Spills over 125 tons	23 337,054	64 229,235	61 196,781	23 101,760	7 85,306	178 950,136
All Incidents in File	320 339,394	463 234,311	893 207,144	200 104,464	74 86,083	1950 953,446

TABLE 5.5

WORLDWIDE TRANSPORT OF CRUDE OIL AND OIL PRODUCTS BY SHIP 1969-1973[a]

Year	Ton-Mileage x 10^{-9}	Metric Tons x 10^{-6}	(Approximate) Barrels[b] x 10^{-6}
1969	5,613	1,080	7,560
1970	6,487	1,150	8,050
1971	7,454	1,315	9,205
1972	8,620	1,433	10,031
1973	9,770	1,585	11,095

[a]Source: Review 1973, Fearnley and Egers Chartering Co. Ltd., Radhusgt 27, Oslo 1, PO Box 355, Oslo, Norway, January 1974, Tables 1 and 2.

[b]7 barrels ∿ 1 metric ton.

TABLE 5.6

U. S. TRANSPORT PIPELINE SPILLS OVER 1000 BARRELS, 1967-1975[a]

Date (m-d-yr)	Location	Volume (BBLS)	Cause
10-15-67	W.D. 73	160639	Anchor Dragging
3-12-68	S.T. 123	6 000	Anchor Dragging
2-11-69	M.P. 299	7,532	Leak
5-12-73	W.D. 73	5,000	Leak/corrosion
8- 2-73	S.P. 60	1,000	Leak
4-17-74	E.I. 317	19,833	Anchor Dragging
9- 9-74	M.P. 73	2,213	Hurricane

[a]Source: U.S. Geological Survey, U.S. Coast Guard, and Office of Pipeline Safety and Operations, see also Stewart, 1975

and justified on quite reasonable grounds. Pipelines would prevail under the barrels handled criterion because of the ratio of the two comparable figures (144/9), in the bottom row of Table 5.8. Conversely, tankers would prevail if the criterion were chosen to be number of spills per ton-mile (i.e., 4.69×10^{-12} versus 128.2×10^{-12}) or barrels spilled per ton-mile (i.e., 175×10^{-9} versus 912×10^{-9}). If we examine the volume spilled per volume handled criterion we see that the value in the last row is composed of the product of the average spill size times the number of spills

TABLE 5.7

PRODUCTION OF CRUDE OIL IN STATE AND FEDERAL OCS WATERS[c]

Year	Barrels x 10^{-6}	(Approximate) Metric Tons[a] x 10^{-6}	Estimated Ton-Mileage[b] x 10^{-6}
1969	525.8	75.11	4765.8
1970	575.7	82.24	5474.5
1971	615.1	87.87	6240.4
1972	614.8	87.82	6174.2
1973	582.7	83.24	5926.7
1974	532.7	76.11	5418.7
1975	495.3	70.75	4740.5

[a] 1 metric ton ∿ 7 barrels.

[b] The ton-mileage was calculated by the formula:

Ton-miles = 10 x {state production in tons} +

100 x {federal OCS production in tons}

[c] Source: "Outer Continental Shelf Statistics," U.S. Geological Survey (DOI) Conservation Division, June 1976.

TABLE 5.8

SPILLAGE AND THROUGHPUT FOR TANKERS (WORLDWIDE) AND U.S. OFFSHORE TRANSPORT PIPELINES[a,b]

	Tankers (Worldwide) 1969-1973	Pipelines (U.S.) 1969-1975
Number of spills	178	5
Volume spilled (BBLS)	6.65×10^{6}	35.6×10^{3}
Ton-mileage	37.9×10^{12}	39.0×10^{9}
Barrels carried	45.9×10^{9}	3.94×10^{9}
Number/ton-mile	4.69×10^{-12}	128.2×10^{-12}
Volume (BBLS)/ton-mile	175×10^{-9}	912×10^{-9}
Number/barrel	3.87×10^{-9}	1.26×10^{-9}
Volume (BBLS)/barrel	144×10^{-6}	9.01×10^{-6} [c]

[a] Tanker spills include all spills over 125 tons ($\sim$ 900 BBL), pipeline spills include all spills over 1000 BBL.

[b] See Tables 5.5, 5.6, and 5.7 for a discussion of the techniques used to estimate these numbers and references to the original source material.

[c] Had the period been selected as 1967-1975, this figure would be 42×10^{-6}, another illustration of the variablity of the sums of such highly skewed random varialbles.

per barrel handled. In this case the average tanker spill is found to be 37,360 BBLS while the average pipeline spill is found to be 7,120 BBLS. The factor of 16 difference between the two modes is thus seen to be the product of the ratio of spill frequency per barrel handled, which is about 3 (i.e., 3.87/1.26), times the ratio of the average spill volume, which is slightly larger than 5. Because of the small number of samples in the pipeline data base, we must regard both ratios as highly uncertain. The same remarks would, of course, hold true in the ton-mile comparison.

If the reader is still not convinced of the high unreliability of such comparisons, let us note that the decision to use 1969 as the first year in both the pipeline and tanker calculations was one that was motivated both by the nonavailability of comprehensive tanker spill data prior to 1969 and a certain irrational love of symmetry. We might just as well have chosen 1967 as the first year in the pipeline calculation. Had we done so, the first two spills in Table 5.6 would have been included in the calculation and the spill rate in Barrels/Barrel would have soared to 42×10^{-6}.

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