7. Small offshore production spills

When we turn our attention to smaller offshore production spills, the 1971 and 1972 Coast Guard reports are undoubtedly the most complete source of data. In these two years, the Coast Guard reports some 5,700 offshore spills. The only other contender is the U.S. Geological Survey file on the EPA tape which contains only 800 offshore spills supposedly covering a wider period of time. Therefore, with respect to smaller offshore spills, we will confine our analysis to the Coast Guard data.

Unfortunately, the Coast Guard data suffers from the fact that the demarcation between transmission lines and platform and gathering net spills appears to be almost nonexistent as indicated by the shift from pipelines to offshore production facilities between 1971 and 1972 (see Table 1.3). This is most unfortunate, because it completely muddies our comparison of pipeline versus vessel for transport to shore as far as small spills are concerned.

There is very little one can do about this unless one is willing to assume that a find will not be landed by tanker and then one can lump together all of the offshore production spills in the Coast Guard data to make statements about all the small spills which will emanate from a development, irrespective of whether they are production facility spills or transmission line spills. This will be our approach. Needless to say, the ability to distinguish between gathering net spills and transmission line spills would be most welcome.

One may be able to do this from the raw Coast Guard reports. In any event, we strongly recommend that the Coast Guard system be modified so that these spills are distinguishable in the future.

With respect to these smaller offshore spills, we will make the same assumptions used earlier, including the assumption that the exposure variable in the Poisson process is volume of oil landed. At present, we have been unable to make a quantitative check on this assumption, as we did with tankers, since given the form the data is in, we have been unable to stratify the data in such a mahner as to generate a useful scatter diagram of spill against volume landed. To do so it would be necessary to, for example, discover in which lease block the spills occurred and compare those numbers with the production from that lease block.* Unfortunately, neither the spill location by lease nor the location by field is available from the Coast Guard file. This hypothesis and others (exposure parameter is number of wells, exposure parameter is number of platforms) certainly bear more investigation but for now, we will simply accept this as a working hypothesis and an obvious starting point for analysis.

The resulting densities on the number of spills for our sample for small, medium, and large fields, for field life, are shown in Figures 7.1, 7.2 and 7.3.

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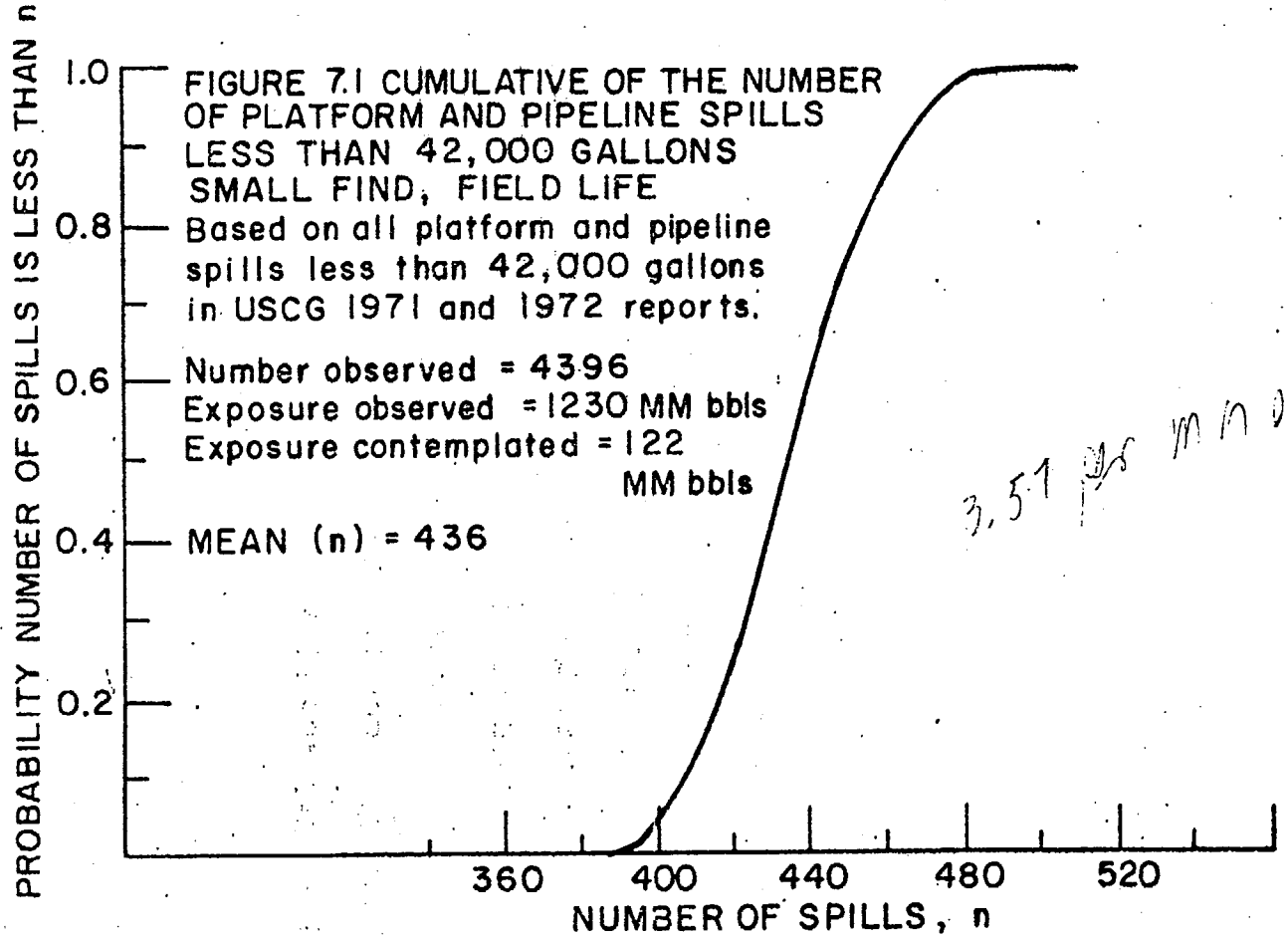
*The total production in 1972 and 1971 are too close together to generate a useful scatter diagram. However, the fact that total offshore spill incidences in 1971 and 1972 are about the same (Table 1.1) is consistent with the hypothesis.


PROBABILITY NUMBER OF SPILLS IS LESS THAN n
1.0
0.8
0.6
0.4
0.2
FIGURE 7.1 CUMULATIVE OF THE NUMBER OF PLATFORM AND PIPELINE SPILLS LESS THAN 42,000 GALLONS SMALL FIND, FIELD LIFE
Based on all platform and pipeline spills less than 42,000 gallons in USCG 1971 and 1972 reports.
Number observed = 4396
Exposure observed = 1230 MM bbls
Exposure contemplated = 122 MM bbls
MEAN (n) = 436
360
400
440
480
520
NUMBER OF SPILLS, n

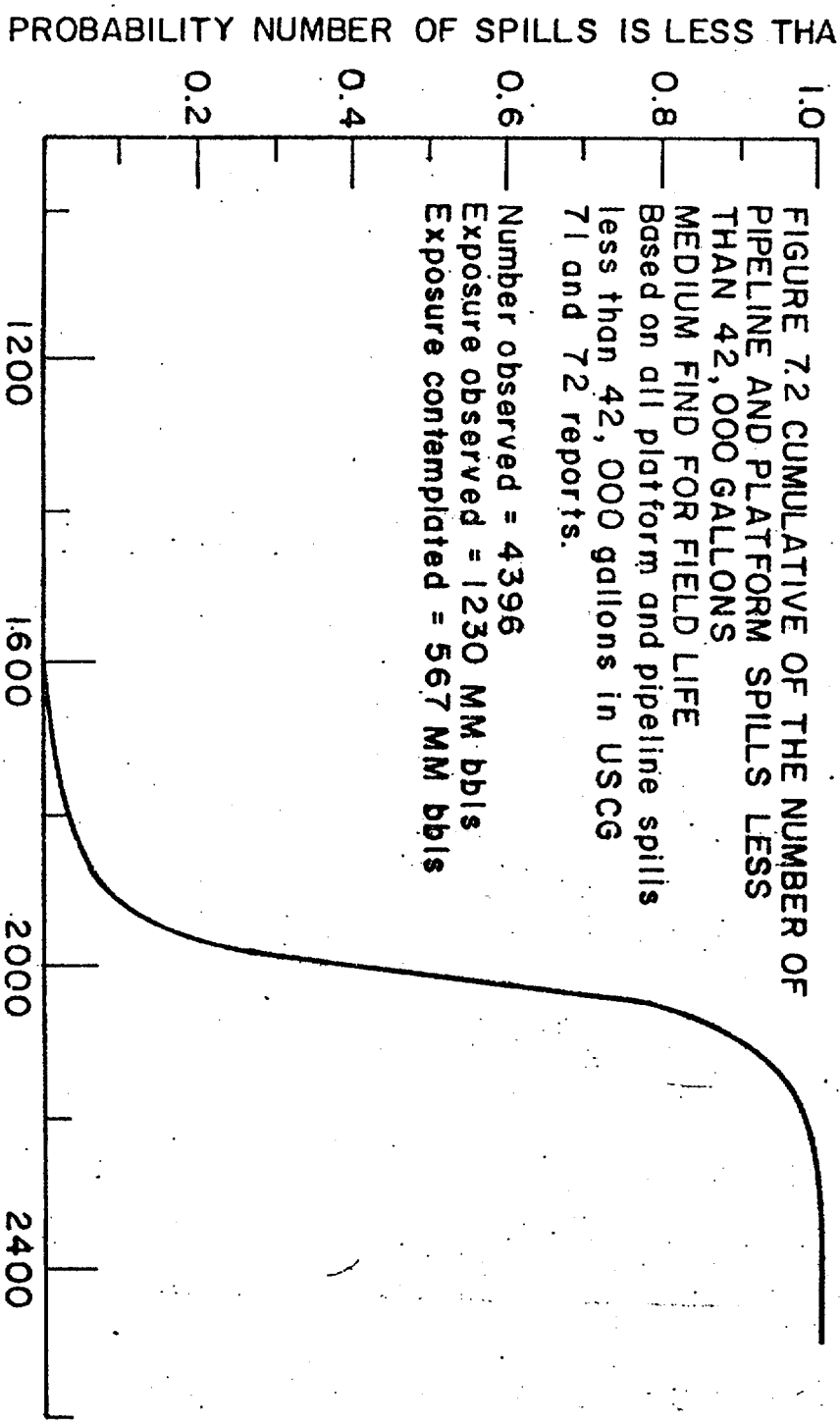
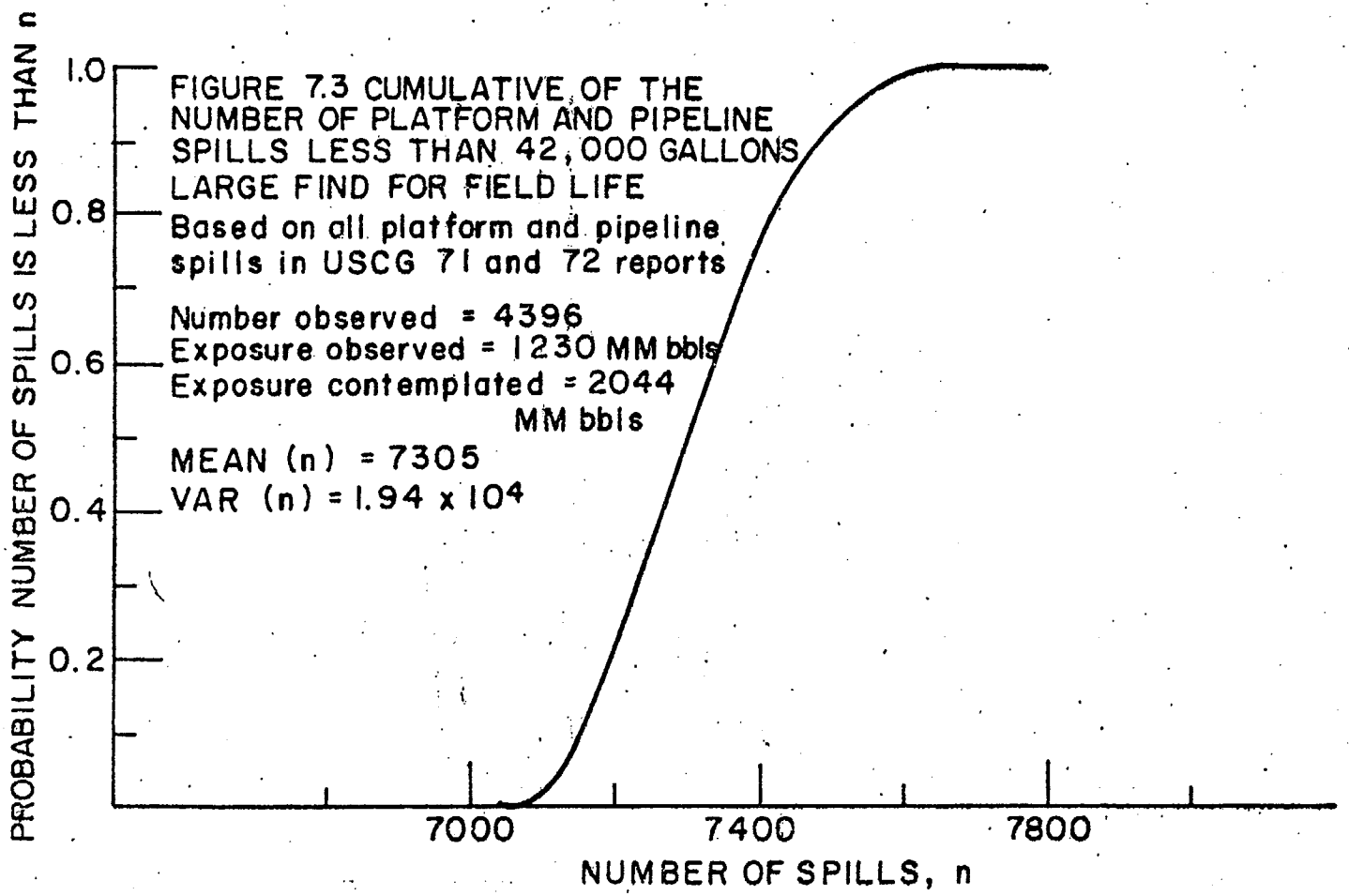


FIGURE 7.2 CUMULATIVE OF THE NUMBER OF PIPELINE AND PLATFORM SPILLS LESS THAN 42,000 GALLONS
MEDIUM FIND FOR FIELD LIFE
Based on all platform and pipeline spills less than 42,000 gallons in USCG 71 and 72 reports.

Number observed = 4396
Exposure observed = 1230 MM bbls
Exposure contemplated = 567 MM bbls


PROBABILITY NUMBER OF SPILLS IS LESS THAN n
1.0
0.8
0.6
0.4
0.2
FIGURE 7.3 CUMULATIVE OF THE NUMBER OF PLATFORM AND PIPELINE SPILLS LESS THAN 42,000 GALLONS LARGE FIND FOR FIELD LIFE
Based on all platform and pipeline spills in USCG 71 and 72 reports
Number observed = 4396
Exposure observed = 1230 MM bbls
Exposure contemplated = 2044 MM bbls
MEAN (n) = 7305
VAR (n) = 1.94 x 10⁴
7000
7400
7800
NUMBER OF SPILLS, n

These densities are reasonably tight. For example, according to the analysis, there is a very high probability that the number of small spills from our small find landed by pipeline will be between 1,900 and 2,300; and for our large find, we find that there is a high probability that the number of small spills will be between 7,100 and 7,600. Once again, these statements depend on our assumptions--principally that future developments will have the same spill incidence characteristics as past and that the proper exposure variable is volume handled and not, for example, number of platforms. Our Offshore Development Model indicates that future developments will be produced from a much smaller number of platforms per volume produced than has been past practice.

Most of these spills will be quite small, as is indicated by the cumulatives of the spill size densities for tower and pipeline spills less than 42,000 gallons based on the Coast Guard data (Figures 7.4 and 7.5). The means of the density of tower spills and pipeline spills greater than three miles offshore is about 100 gallons. In the Coast Guard data, the pipeline spills taking place less than three miles offshore are somewhat larger, perhaps reflecting the generally older facilities close to shore. Once again, these densities exhibit very high ratios of variances to means and thus are extremely skewed. The probability that an individual spill is less than the mean runs as high as .95. In other words, according to the analysis, over 90% of all these spills will be less than the mean in size.

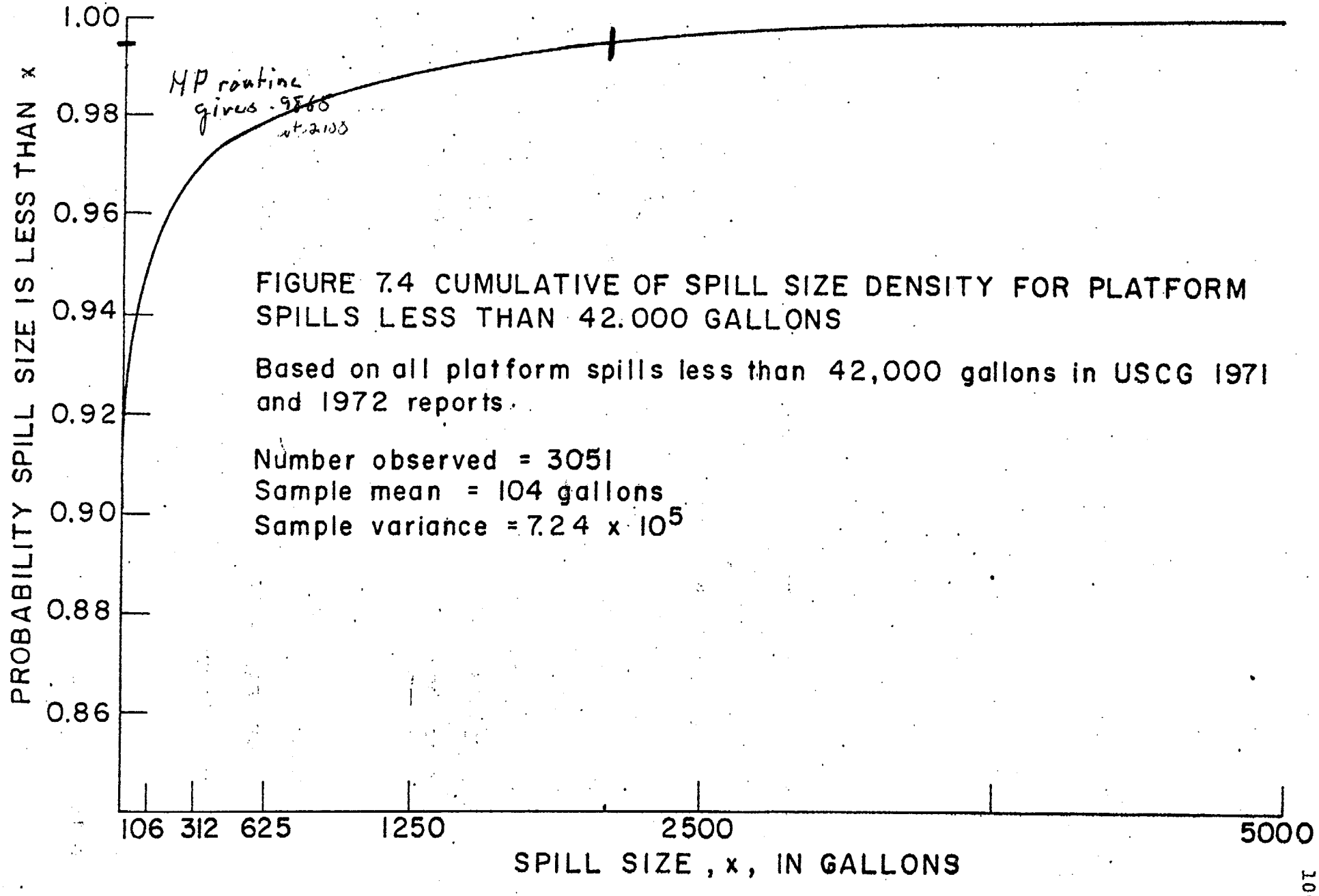


FIGURE 7.4 CUMULATIVE OF SPILL SIZE DENSITY FOR PLATFORM SPILLS LESS THAN 42.000 GALLONS

Based on all platform spills less than 42,000 gallons in USCG 1971 and 1972 reports.

Number observed = 3051
Sample mean = 104 gallons
Sample variance = 7.24×10^5

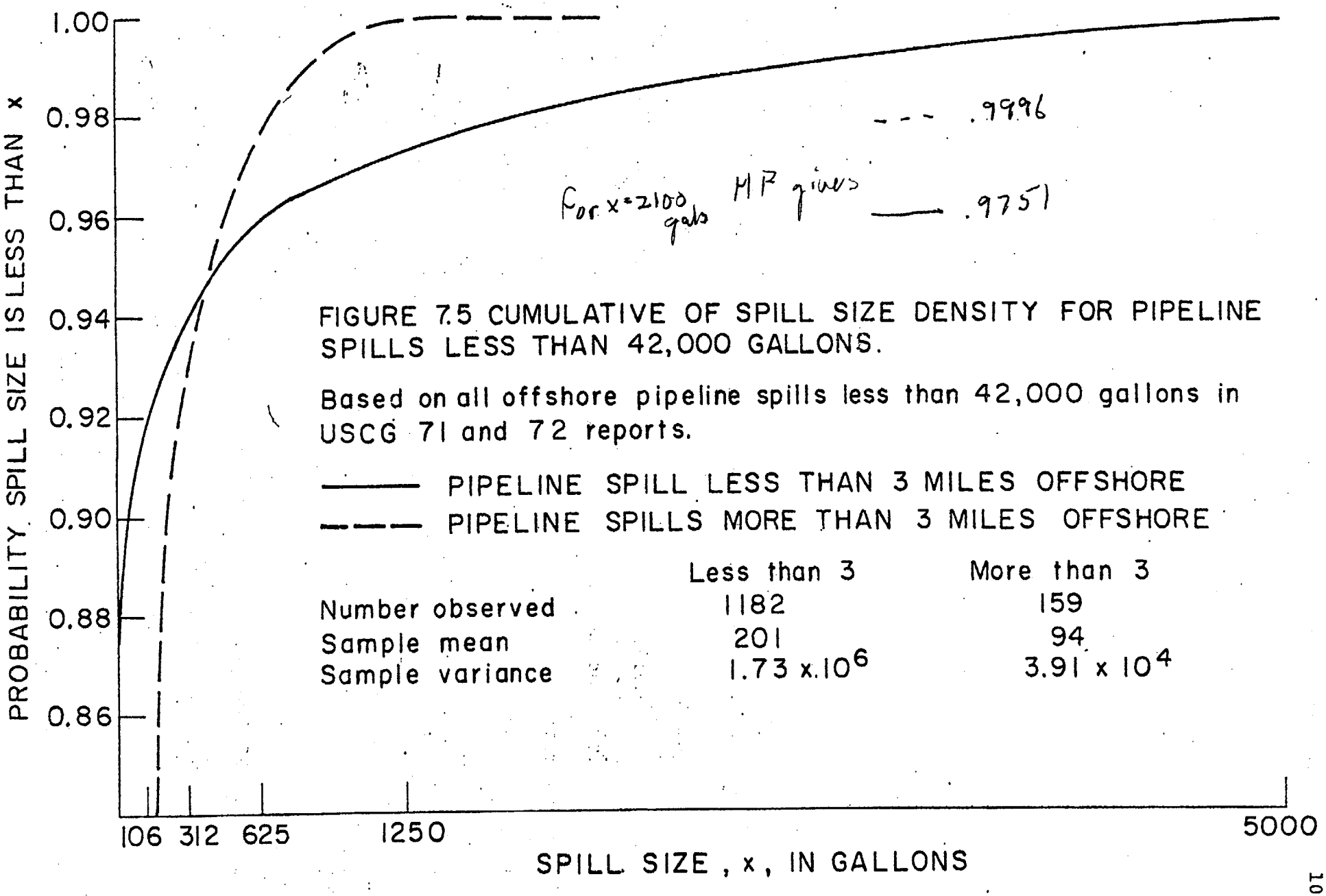


FIGURE 7.5 CUMULATIVE OF SPILL SIZE DENSITY FOR PIPELINE SPILLS LESS THAN 42,000 GALLONS.

Based on all offshore pipeline spills less than 42,000 gallons in USCG 71 and 72 reports.

——— PIPELINE SPILL LESS THAN 3 MILES OFFSHORE

– – – PIPELINE SPILLS MORE THAN 3 MILES OFFSHORE

	Less than 3	More than 3
Number observed	1182	159
Sample mean	201	94
Sample variance	1.73×10^6	3.91×10^4

7.1 Spill cause

Both the EPA and USCG tapes have been analyzed for the cause of spills from offshore production facilities. With respect to the EPA tape, the relevant data base was 1,019 spills, primarily from USGS files [1,3]. Only 9 of these spills were above 10,000 gallons. Therefore, this analysis speaks only to spills which are small by our definition. The sample of large spills is simply too small to do any meaningful statistical analysis of causes.

A cursory examination of large platform spills reveals that they have all been caused by some form of loss of well control. The earlier spills were associated with storm damage to platforms; the latter with drilling or workover operations. There is reason to believe that the surface-actuated down-hole valves presently being fitted will decrease the incidence or ameliorate the severity of at least some of these accidents. The surface-actuated, down-hole valve should have a considerably superior record to the storm choke due to the much larger pressure differential available for activation and the ease with which it can be tested. The marginal cost of these valves is about $5,000 per well, provided they are installed at the time the well is originally completed. However, the sample on large spills is too small and operational data on the down-hole valve not available to make any quantitative assessment of the improvement which would be obtained through use of these

devices. They will not affect the incidence of spills occurring during drilling or workover or spills due to loss of formation integrity such as Santa Barbara. Nonetheless, the surface-activated, down-hole valve appears to be the single most important technological improvement available with respect to large spills, if only because it may prove capable of restricting spillage to a single well in the case of a major accident.

With respect to small platform spills, both the USCG and the EPA analyses point to various forms of vessel overflows as the common cause of spillage, primarily in the separation system. Frequently cited sources of trouble are dump valves, high-level sensors, pressure relief valves, and rupture disks.* Fully one-third of all the platform spills listed in the EPA data are associated with separation. Overflow of sumps was another common platform culprit. The Coast Guard lists pump failure as a relatively common cause, but the EPA data claims pumps are rare offenders offshore. But in general, there is no striking pattern to the cause data. The frequencies appear to be roughly proportional to the amount of equipment represented by the subsystems. There doesn't appear to be any glaringly apparent weak link. Perhaps the best chance for improvement with respect to small platform spills lies with more comprehensive and somewhat larger drain and sump systems.

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*It's a little difficult to separate cause from symptom in the data. A dump valve or rupture disk may be the source of a spill because it's doing its job of relieving abnormal pressure caused by a failure elsewhere in the system and still be listed as the cause of a spill.

With respect to pipelines, 92% of all the offshore spills in the EPA data occurred on the platform; only 6% in the gathering-distribution system. As noted earlier, it is impossible to separate gathering net spills from platform spills in the Coast Guard data. Thus, on the basis of the EPA data, most of the small offshore spills are emanating from the platforms. However, despite this, pipeline leaks and ruptures are by far the single most common source of spillage listed in both the Coast Guard and EPA data. Presumably many of these "pipeline" leaks are from pipes on the platforms. This may be only because crude is commonly found in pipes. Nonetheless, if we broaden our view to include the onshore pipeline spillage listed in the EPA tapes, we find that pipeline corrosion is the most common cause of spillage, especially of the larger spills, for these generally older lines. It appears that inspection and regulation of corrosion control measures should be given high priority in OCS monitoring, especially as the lines become older.