OCS Study MMS 2008-025

FINAL TASK 3.1 REPORT

Alternative Oil Spill Occurrence Estimators and their Variability for the Alaskan OCS – Fault Tree Method UPDATE OF GOM OCS STATISTICS TO 2006

MMS Contract Number 1435-01-05-CT-39348

March 2008

By

Bercha International Inc.
Calgary, Alberta, Canada

U.S. Department of the Interior
Minerals Management Service
Alaska Outer Continental Shelf Region

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EXECUTIVE SUMMARY

A. Introduction

Historical data and their statistical analyses are used as a starting point for fault tree application to oil spill indicator quantification for the Alaskan OCS. In the initial fault tree analysis[1], data from the GOM OCS were analyzed for the period from 1972 to 1999. Subsequently, a more refined publication of the data characteristics by MMS[2] has made it possible to conduct a more thorough statistical analysis as well as an update of the data and its analysis to 2006. This report generally discusses and gives data summaries as well as detailed statistical results for the re-analysis of the data, including an update of the GOM OCS data for platform and pipeline spills, including an update to 2006. The work is covered by MMS contract number 1435-01-05-CT-39348, and it is the first update under Task 3, and accordingly, is considered to be Task 3.1.

B. Pipeline Spills

The pipeline spill statistics generated in this update are basic spill statistics. First, the number of spills by size occurring for each causal category is given. Next, spill causes by two principal spill size categories are given, and transformed to spill frequencies per kilometer-year by dividing the number of kilometer-years exposure. And finally, the spill frequency distribution for spills of different size categories, by pipe diameter is determined. Table 1 summarizes the spill occurrences by size for each of the principal causes. These causes are those that are reported in the MMS database[2]. Both the exact spill size in barrels and the spill size distribution by each of the spill size categories are given in Table 1.

Table 2 gives the pipeline hydrocarbon spill statistics by cause. These statistics are given as the probability of occurrence per kilometer-year of operating pipeline. Thus, for example, approximately 12.78 spills per 100,000 km-yrs in the small and medium size category are likely to occur. Of these, it is expected that approximately 1.1 per 100,000 km-yrs can be attributed to pipe corrosion.

Finally, Table 3 summarizes the pipeline hydrocarbon spill statistics by spill size and pipe diameter.

[1] Bercha International Inc., "Alternative Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas – Fault Tree Method", Volume II, **Appendix A – Historical Data**, OCS Study MMS 2002-047, Final Report to US Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, August 2002.
[2] MMS Website, www.mms.gov/incidents/spills.

Table 1
Pipeline Hydrocarbon Spill Summary by Spill Size

CAUSE CLASSIFICATION	NUMBER OF SPILLS	SPILL SIZE BBL																	NUMBER OF SPILLS					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	S	M	L	H	SM	LH
CORROSION	**4**																		**1**	**2**	**1**		**3**	**1**
External	1	80																	1				**1**	
Internal	3	100	5000	414																2	1		**2**	**1**
THIRD PARTY IMPACT	**18**																		**2**	**6**	**7**	**3**	**8**	**10**
Anchor Impact	12	19833	65	50	300	900	323	15576	2000	800	1211	2240	600						2	5	3	2	**7**	**5**
Jackup Rig or Spud Barge	1	3200																			1			**1**
Trawl/Fishing Net	5	4000	100	14423	4569	4533														1	3	1	**1**	**4**
OPERATION IMPACT	**4**																		**3**		**1**		**3**	**1**
Rig Anchoring	1	50																	1				**1**	
Work Boat Anchoring	3	50	5100	50															2		1		**2**	**1**
MECHANICAL	**2**																			**2**			**2**	
Connection Failure	1	135																		1			**1**	
Material Failure	1	210																		1			**1**	
NATURAL HAZARD	**20**																		**6**	**11**	**3**		**17**	**3**
Mud Slide	3	250	80	8212															1	1	1		**2**	**1**
Storm/ Hurricane	17	3500	671	126	200	260	250	1720	95	123	960	50	50	100	75	862	66	108	5	10	2		**15**	**2**
UNKNOWN	**2**	119	190																	**2**			**2**	
TOTALS	**50**																		**12**	**23**	**12**	**3**	**35**	**15**

Table 2
Pipeline Hydrocarbon Spill Statistics by Cause

CAUSE CLASSIFICATION	Small and Medium Spills 50-999 bbl				Large and Huge Spills >=1000 bbl			
	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [km-years]	FREQUENCY spill per 10^5km -year	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [km-years]	FREQUENCY spill per 10^5km -year
CORROSION	**8.57**	**3**		**1.0955**	**6.67**	**1**		**0.3652**
External	2.86	1		0.3652				
Internal	5.71	2		0.7303	6.67	1		0.3652
THIRD PARTY IMPACT	**22.86**	**8**		**2.9213**	**66.67**	**10**		**3.6517**
Anchor Impact	20.00	7		2.5562	33.33	5		1.8258
Jackup Rig or Spud Barge					6.67	1		0.3652
Trawl/Fishing Net	2.86	1		0.0365	26.67	4		1.4607
OPERATION IMPACT	**8.57**	**3**		**1.0955**	**6.67**	**1**		**0.3652**
Rig Anchoring	2.86	1		0.3652				
Work Boat Anchoring	5.71	2		0.7303	6.67	1		0.3652
MECHANICAL	**5.71**	**2**		**0.7303**				
Connection Failure	2.86	1	**273847**	0.3652			**273847**	
Material Failure	2.86	1		0.3652				
NATURAL HAZARD	**48.57**	**17**		**6.2078**	**20.00**	**3**		**1.0955**
Mud Slide	5.71	2		0.7303	6.67	1		0.3652
Storm/ Hurricane	42.86	15		5.4775	13.33	2		0.7303
ARCTIC								
Ice Gouging								
Strudel Scour								
Upheaval Buckling								
Thaw Settlement								
Other Arctic								
UNKNOWN	**5.71**	**2**		**0.7303**				
TOTALS	**100.00**	**35**		**12.7809**	**100.00**	**15**		**5.4775**

Table 3
Pipeline Hydrocarbon Spill Statistics by Spill Size and Pipe Diameter

GOM OCS Pipeline Spills, Categorized 1972-2006			Spill Statistics	Exposure	Frequency
			Number of Spills	km-years	spills per 10^5 km-years
By Pipe Diameter		<= 10"	30	187,984	15.9588
		> 10"	20	85,863	23.2929
By Spill Size		Small <100 bbl	12	273,847	4.3820
		Medium 100 - 999 bbl	23	273,847	8.3989
		Large 1000 - 9999 bbl	12	273,847	4.3820
		Huge >=10000 bbl	3	273,847	1.0955
By Diameter, By Spill Size	<=10"	Small <100 bbl	8	187,984	4.2557
		Medium 100 - 999 bbl	14	187,984	7.4474
		Large 1000 - 9999 bbl	7	187,984	3.7237
		Huge >=10000 bbl	1	187,984	0.5320
	> 10"	Small <100 bbl	4	85,863	4.6586
		Medium 100 - 999 bbl	9	85,863	10.4818
		Large 1000 - 9999 bbl	5	85,863	5.8232
		Huge >=10000 bbl	2	85,863	2.3293

C. Platform Spills

The primary platform spill statistical information required is the spill frequency distribution by different causes and spill sizes, and the spill rate per well year. Table 4 summarizes the spill size distribution among the principal reported causes. As can be seen, the major cause attributable to almost 50% of the spills – at 35 out of 74 spills – is equipment failure. However, although hurricanes have only caused a relatively small number of spills, their total spill volumes are the largest, giving the largest spill volume total. The largest single spill, however, is the tank failure which caused a spill of nearly 10,000 barrels.

The spill rate data, given per production well-year, is shown in Table 5, again, by causal distribution as well as two broad spill size categories of small and medium spills and large and huge spills. Here, it becomes immediately evident that the largest spill potential in terms of volume is attributable to hurricanes, which are responsible for roughly 43% of the large and huge spills.

Table 4
Summary of GOM OCS Platform Hydrocarbon Spills by Size and Cause

CAUSE CLASSIFICATION	NUMBER OF SPILLS	SPILL SIZE BBL														NUMBER OF SPILLS					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	S	M	L	H	SM	LH
EQUIPMENT FAILURE	**35**															**17**	**18**			**35**	
Process Equipment	14	130	50	104	60	95	107	50	643	60	50	400	75	125	127	7	7			**14**	
Transfer Hose	12	321	118	50	400	228	214	540	125	77	200	77	58			4	8			**12**	
Incorrect Operation	9	300	70	83	58	60	50	280	436	60						6	3			**9**	
HUMAN ERROR	**12**	239	95	120	286	100	64	600	170	200	262	429	60			**3**	**9**			**12**	
TANK FAILURE	**3**	9935	150	50												**1**	**1**	**1**		**2**	**1**
SHIP COLLISION	**6**	166	100	1500	320	95	119									**1**	**4**	**1**		**5**	**1**
WEATHER	**10**	7000	165	258	80	1456	66	89	105	100	105					**3**	**5**	**2**		**8**	**2**
HURRICANE	**6**	75	200	1536	954	3093	6897									**1**	**2**	**3**		**3**	**3**
OTHER	**2**	64	100													**1**	**1**			**2**	
TOTALS	**74**															**27**	**40**	**7**		**67**	**7**

Table 5
GOM OCS Platform Hydrocarbon Spill Statistics (1973-2006)

CAUSE CLASSIFICATION	Small and Medium Spills 50-999 bbl				Large and Huge Spills >=1000 bbl			
	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [well-years]	FREQUENCY spill per 10^4well-year	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [well-years]	FREQUENCY spill per 10^4well-year
EQUIPMENT FAILURE	**52.24**	**35**		**1.6434**				
- Process Equipment	20.90	14		0.6574				
- Transfer Hose	17.91	12		0.5635				
- Incorrect Operation	13.43	9		0.4226				
HUMAN ERROR	**17.91**	**12**		**0.5635**				
TANK FAILURE	**2.99**	**2**	**212971**	**0.0939**	**14.29**	**1**	**212971**	**0.0470**
SHIP COLLISION	**7.46**	**5**		**0.2348**	**14.29**	**1**		**0.0470**
WEATHER	**11.94**	**8**		**0.3756**	**28.57**	**2**		**0.0939**
HURRICANE	**4.48**	**3**		**0.1409**	**42.86**	**3**		**0.1409**
OTHER	**2.99**	**2**		**0.0939**				
TOTALS	**100.00**	**67**		**3.1460**	**100.00**	**7**		**0.3287**

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- Cheryl Anderson, MMS Spill Database Coordinator
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- Dr. Frank G. Bercha, Project Manager and Principal Engineer
- Milan Cerovšek, Reliability Engineering Specialist
- Edmund A. Yasinko, Offshore Pipeline Specialist
- Wesley Abel, Offshore Engineering Specialist
- Susan Charlton, Editorial and Word Processing Manager

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GLOSSARY OF TERMS AND ACRONYMS

Bbbl	**B**illion Barrels
CDF	**C**umulative **D**istribution **F**unction
Consequence	The direct effect of an accidental event.
GOM	**G**ulf **o**f **M**exico
Hazard	A condition with a potential to create risks such as accidental leakage of natural gas from a pressurized vessel.
KBpd	Thousand Barrels per day
LOF	**L**ife of **F**ield
MMbbl	Million Barrels
MMS	**M**inerals **M**anagement **S**ervice, Department of the Interior
Monte Carlo	A numerical method for evaluating algebraic combinations of statistical distributions.
OCS	**O**uter **C**ontinental **S**helf
QRA	**Q**uantitative **R**isk **A**ssessment
Risk	A compound measure of the probability and magnitude of adverse effect.
RLS	Release
SINTEF	The Foundation of Scientific and Industrial Research at the Norwegian Institute of Technology
Spill Frequency	The number of spills of a given spill size range per year. Usually expressed as spills per 1,000 years (and so indicated).
Spill Frequency per Barrel Produced	The number of spills of a given spill size range per barrel produced. Usually expressed as spills per billion barrels produced (and so indicated).
Spill Index	The product of spill frequency for a given spill size range and the mean spill size for that spill size range.
Spill Occurrence	Characterization of an oil spill as an annual frequency and associated spill size or spill size range.
Spill Occurrence Indicator	Any of the oil spill occurrence characteristics; namely, spill frequency, spill frequency per barrel produced, or spill index (defined above).
Spill Sizes	Small (S): 50 - 99 bbl Medium (M): 100 - 999 bbl Large (L): 1,000 - 9,999 bbl Huge (H): >=10,000 bbl Significant (SG): >=1,000 bbl

SECTION 1

INTRODUCTION

1.1 General Introduction

Historical data and their statistical analyses are used as a starting point for fault tree application to oil spill indicator quantification for the Alaskan OCS. In the initial fault tree analysis [1]*, data from the GOM OCS were analyzed for the period from 1972 to 1999. Subsequently, a more refined publication of the data characteristics by MMS [2] has made it possible to conduct a more thorough statistical analysis as well as an update of the data and its analysis to 2006. This report generally discusses and gives data summaries as well as detailed statistical results for the re-analysis of the data, including an update of the GOM OCS data for platform and pipeline spills, including an update to 2006. The work is covered by MMS contract number 1435-01-05-CT-39348, and it is the first update under Task 3, and accordingly, is considered to be Task 3.1.

1.2 Data Sources

The bulk of the data was obtained directly from the MMS website [2], and was generally collated and analyzed in a format similar to that of the earlier data analysis by Bercha International Inc. [1].

In addition to the data obtained directly from the MMS website, numerous clarifications and supplemental data was acquired through a meeting and a series of email discussions between Bercha investigators and MMS staff, between October 1 and 31, 2007.

1.3 Outline of Report

Following this brief introduction, Section 2 deals with the pipeline spill data and its analysis, while Section 3 deals with the platform spill data and its analysis.

* Numbers in square brackets refer to publications listed in "References" section of this report.

SECTION 2

PIPELINE SPILLS

2.1 Introduction on GOM OCS Pipeline Spills

Subsea pipelines in the Gulf of Mexico (GOM) Offshore Continental Shelf (OCS) hold roughly 13 thousand kilometers in 2006, representing an exposure of nearly 300,000 kilometer-years between 1972 and 2006.

Spill reporting for spills greater than 50 barrels has been carried out over this period. Although in the subsequent variability analysis to be reported elsewhere, continuous spill volume distributions will be utilized, spill size characterization is reported according to the following spill size categories:

- Small (S): 50 - 99 bbl
- Medium (M): 100 - 999 bbl
- Large (L): 1,000 - 9,999 bbl
- Huge (H): >= 10,000 bbl
- Significant (SG): >=1,000 bbl

In the balance of this section, all reported spills in the Alaskan GOM OCS are summarized; those containing hydrocarbons (crude oil, diesel, condensate) are extracted from these, and analyzed both by causal distribution and frequency distribution.

2.2 Pipeline Exposure

Table 2.1 summarizes the total length of GOM OCS subsea pipelines in operation between 1972 and 2006. In addition, it gives the total mile-years and kilometer-years and their distribution for pipelines of different nominal pipe size (NPS) – representing an approximate outside diameter. In the notes below Table 2.1, a comparison is made between the exposure data used in the previous report [1] (showing 187,183 km) and the current report (totaling 184,600 km) between 1972 and 1999. The figures in the main part of Table 2.1, of course, include lengths operating up to and including 2006.

2.3 All Pipeline Spills

Table 2.2 gives a summary of all pipeline liquid spills. As can be seen, not all of these are hydrocarbons, as some include methanol, ethylene glycol, and other liquids – although these other liquids are quite limited, and make only a small contribution. Nevertheless, all these spills have been shown in Table 2.2. It should be noted that minor updates on these spills were carried out through communications with MMS staff, October 19, 2007.

Table 2.1
GOM OCS Pipeline Exposure Data (1972-2006)

Miles of OCS OIL Pipeline Segments by Year and Size											
Year	**<=10" NPS**	**>10" NPS**	**Total**	**2"**	**3"**	**4"**	**5 - 6"**	**7 - 8"**	**9 - 10"**	**11 - 19"**	**20 - 36"**
1972	1301	439	1740	59	84	289	468	276	125	439	0
1973	1418	514	1932	60	88	299	499	320	152	510	4
1974	1514	535	2049	66	90	304	507	395	152	531	4
1975	1590	610	2200	67	94	310	524	443	152	606	4
1976	1700	751	2451	73	98	317	533	521	158	639	112
1977	1784	779	2563	74	101	345	556	550	158	646	133
1978	1963	855	2818	74	109	361	620	592	207	722	133
1979	2089	867	2956	74	112	389	639	647	228	734	133
1980	2221	899	3120	76	119	406	658	708	254	766	133
1981	2404	939	3343	79	120	450	755	746	254	806	133
1982	2535	976	3511	79	124	468	838	767	259	843	133
1983	2684	1019	3703	79	142	483	929	792	259	886	133
1984	2889	1036	3925	79	155	555	994	823	283	903	133
1985	3025	1038	4063	79	175	585	1036	862	288	905	133
1986	3100	1138	4238	79	184	600	1072	877	288	1005	133
1987	3210	1135	4345	79	192	634	1091	891	323	1002	133
1988	3276	1175	4451	85	217	666	1088	892	328	1042	133
1989	3339	1223	4562	86	241	689	1092	903	328	1090	133
1990	3513	1224	4737	93	243	751	1161	926	339	1091	133
1991	3624	1212	4836	94	267	790	1178	948	347	1079	133
1992	3764	1215	4979	94	280	809	1210	1023	348	1082	133
1993	3807	1223	5030	88	290	829	1227	1025	348	1090	133
1994	3944	1343	5287	81	300	858	1285	1070	350	1210	133
1995	4059	1477	5536	82	306	886	1325	1104	356	1271	206
1996	4218	1930	6148	81	318	912	1425	1126	356	1416	514
1997	4338	2095	6433	80	320	950	1463	1140	385	1573	522
1998	4470	2283	6753	80	308	992	1538	1160	392	1725	558
1999	4622	2374	6996	80	307	1008	1585	1226	416	1816	558
2000	4731	2516	7247	71	306	1032	1606	1259	457	1959	557
2001	4892	2574	7466	70	300	1079	1685	1291	467	1998	576
2002	4988	2663	7651	67	297	1076	1702	1380	466	2087	576
2003	4966	2876	7842	64	270	1035	1747	1388	462	2264	612
2004	5006	3510	8516	57	272	1027	1760	1408	482	2512	998
2005	4914	3455	8369	57	257	1013	1727	1392	468	2457	998
2006	4910	3455	8365	57	257	1013	1727	1389	467	2457	998
TOTAL mile-yrs	**116808**	**53353**	**170161**	**2643**	**7343**	**24210**	**39250**	**32260**	**11102**	**43162**	**10191**
TOTAL km-yrs	**187984**	**85863**	**273847**	**4253**	**11817**	**38962**	**63167**	**51917**	**17867**	**69463**	**16401**

Note: For calculation used 1 mile = 1.609344 km and rounded to full number

Current: 1972-1999			
	<=10"	**>10"**	**Total**
miles	82401	32304	114705
km	132612	51988	184600

Previous Report [1]: 1972-1999			
	<10"	**>=10"**	**Total**
km	105336	81847	187183

Table 2.2
GOM OCS Pipeline All Spill Data Summary

#	Year	Size bbl	NPS	Material	Cause	Water Depth (ft)	
1	1972	100	12	Crude Oil	Internal Corrosion	140	
2	1973	5000	16	Crude Oil	Corrosion	168	
3	1974	19833	14	Crude Oil	Anchor	240	
4	1974	65	12	Crude Oil	Anchor and Storm	246	
5	1974	3500	8	Crude Oil	Hurricane	141	
6	1976	414	18	Crude Oil	Anchor and Corr.	160	
7	1976	4000	10	Crude Oil	Shrimp Trawl	210	
8	1977	250	13	Crude Oil	Mud Slide	105	
9	1977	50	14	Crude Oil	Anchor	247	
10	1977	300	8	Crude Oil	Anchor	210	
11	1978	135	9	Crude Oil	Pipeline Clamp	177	
12	1978	900	9	Crude Oil	Anchor	103	
13	1979	50	8	Crude Oil	Anchor	300	
14	1980	100	8	Condensate	Trawler Net	137	
15	1981	80	4	Crude Oil	Ext Corr and Metal fatigue	54	
16	1981	5100	8	Crude Oil	Anchor	190	
17	1983	80	8	Crude Oil	Storm and mud slide	184	
18	1985	323	13	Crude Oil	Anchor	162	
19	1985	50	12	Crude Oil	Anchor	17	
20	1986	119	6	Crude Oil	Leak	27	
21	1986	210	8	Crude Oil	Anchor or construction	300	
22	1988	15576	14	Crude Oil	Human, Anchor and Judgment	75	
23	1990	14423	4	Condensate	Fish Net or Anchor tie-in	197	
24	1990	4569	8	Crude Oil	Pipeline Valve	230	
25	1992	190	12	Crude Oil	Leak	90	
26	1992	2000	20	Crude Oil	Hurricane	30	
27	1993	50	4	Crude Oil	Anchor	116	
28	1994	4533	4	Condensate	Trawler Net	197	
29	1997	71.4	1	Methanol	Leak	5292	
30	1998	800	14	Crude Oil	Anchor	150	
31	1998	1211	16	Condensate	Anchor	264	
32	1998	8212	10	Crude Oil	Hurricane	108	
33	1999	3200	12	Crude Oil	External Damage	133	
34	2000	2240	24	Crude Oil	External Damage - Anchor	435	
35	2003	83	4	Ethylene	Human Error	479	
36	2004	671	18	Crude Oil	Hurricane Ivan	200	
37	2004	126	6	Crude Oil	Hurricane Ivan	305	
38	2004	200	8	Crude Oil	Hurricane Ivan	244	
39	2004	260	8	Crude Oil	Hurricane Ivan	255	
40	2004	250	6	Crude Oil	Hurricane Ivan	255	
41	2004	1720	6	Crude Oil	Hurricane Ivan	479	
42	2004	95	8	Crude Oil	Hurricane Ivan	185	
43	2004	123	10	Crude Oil	Hurricane Ivan	300	
44	2004	4834	2	Methanol	Hurricane Ivan	1475	
45	2005	960	8	Crude Oil	Hurricane Katrina	1100	
46	2005	50	8	Crude Oil	Hurricane Katrina	340	
47	2005	50	8	Condensate	Hurricane Katrina	48	
48	2005	100	14	Condensate	Hurricane Rita	17	*
49	2005	75	4	Crude Oil	Hurricane Rita	180	
50	2005	862	8	Crude Oil	Hurricane Rita	141	
51	2005	66.5	12	Crude Oil	Hurricane Rita	152	
52	2005	108	6	Crude Oil	Hurricane Rita	210	
53	2006	600	14	Crude Oil	External Damage - Anchor	126	*

Notes:
All Data from MMS Web site(GOM Region), October 1, 2007
* = updated by Cheryl Anderson October 19, 2007

2.4 Pipeline Hydrocarbon Spills

Table 2.3 gives the same basic data, but only for hydrocarbon spills; that is, for crude oil and condensate spills from GOM OCS pipelines. The previous number of 53 spills, has now been reduced by 3 to 50 spills, showing a relatively insignificant contribution of the non-hydrocarbon spills. Table 2.3 is used as a basis of statistical analysis subsequently, and in the scenario simulations to be carried out in future studies. As can be seen, in addition to the year of occurrence, the reported spill size is given, the nominal pipeline size (NPS) in approximate inches, the spill material, and cause, as well as the water depth at which the spill occurs are all given.

2.5 Pipeline Spill Statistics

The pipeline spill statistics generated in this update are basic spill statistics. First, the number of spills by size occurring for each causal category is given. Next, spill causes by two principal spill size categories are given, and transformed to spill frequencies per kilometer-year by dividing the number of kilometer-years exposure. And finally, the spill frequency distribution for spills of different size categories, by pipe diameter is determined. Table 2.4 summarizes the spill occurrences by size for each of the principal causes. These causes are those that are reported in the MMS database [2]. Both the exact spill size in barrels and the spill size distribution by each of the spill size categories are given in Table 2.4.

Table 2.5 gives the pipeline hydrocarbon spill statistics by cause. These statistics are given as the probability of occurrence per kilometer-year of operating pipeline. Thus, for example, approximately 12.78 spills per 100,000 km-yrs in the small and medium size category are likely to occur. Of these, it is expected that approximately 1.1 per 100,000 km-yrs can be attributed to pipe corrosion.

Finally, Table 2.6 summarizes the pipeline hydrocarbon spill statistics by spill size and pipe diameter.

Table 2.3
GOM OCS Pipeline Hydrocarbon Spill Data Summary

#	Year	Size bbl	NPS	Material	Cause	Water Depth (ft)	
1	1972	100	12	Crude Oil	Internal Corrosion	140	
2	1973	5000	16	Crude Oil	Internal Corrosion	168	
3	1974	19833	14	Crude Oil	Anchor	240	
4	1974	65	12	Crude Oil	Anchor and Storm	246	
5	1974	3500	8	Crude Oil	Hurricane	141	
6	1976	414	18	Crude Oil	Anchor and Corr.	160	
7	1976	4000	10	Crude Oil	Shrimp Trawl	210	
8	1977	250	13	Crude Oil	Mud Slide	105	
9	1977	50	14	Crude Oil	Anchor	247	
10	1977	300	8	Crude Oil	Anchor	210	
11	1978	135	9	Crude Oil	Pipeline Clamp	177	
12	1978	900	9	Crude Oil	Anchor	103	
13	1979	50	8	Crude Oil	Anchor	300	
14	1980	100	8	Condensate	Trawler Net	137	
15	1981	80	4	Crude Oil	Ext Corr and Metal fatique	54	
16	1981	5100	8	Crude Oil	Anchor	190	
17	1983	80	8	Crude Oil	Storm and mud slide	184	
18	1985	323	13	Crude Oil	Anchor	162	
19	1985	50	12	Crude Oil	Anchor	17	
20	1986	119	6	Crude Oil	Leak	27	
21	1986	210	8	Crude Oil	Anchor or construction	300	
22	1988	15576	14	Crude Oil	Human, Anchor and Judgment	75	
23	1990	14423	4	Condensate	Fish Net or Anchor tie-in	197	
24	1990	4569	8	Crude Oil	Pipeline Valve	230	
25	1992	190	12	Crude Oil	Leak	90	
26	1992	2000	20	Crude Oil	Hurricane	30	
27	1993	50	4	Crude Oil	Anchor	116	
28	1994	4533	4	Condensate	Trawler Net	197	
29	1998	800	14	Crude Oil	Anchor	150	
30	1998	1211	16	Condensate	Anchor	264	
31	1998	8212	10	Crude Oil	Hurricane	108	
32	1999	3200	12	Crude Oil	External Damage	133	
33	2000	2240	24	Crude Oil	External Damage - Anchor	435	
34	2004	671	18	Crude Oil	Hurricane Ivan	200	
35	2004	126	6	Crude Oil	Hurricane Ivan	305	
36	2004	200	8	Crude Oil	Hurricane Ivan	244	
37	2004	260	8	Crude Oil	Hurricane Ivan	255	
38	2004	250	6	Crude Oil	Hurricane Ivan	255	
39	2004	1720	6	Crude Oil	Hurricane Ivan	479	
40	2004	95	8	Crude Oil	Hurricane Ivan	185	
41	2004	123	10	Crude Oil	Hurricane Ivan	300	
42	2005	960	8	Crude Oil	Hurricane Katrina	1100	
43	2005	50	8	Crude Oil	Hurricane Katrina	340	
44	2005	50	8	Condensate	Hurricane Katrina	48	
45	2005	100	14	Condensate	Hurricane Rita	17	*
46	2005	75	4	Crude Oil	Hurricane Rita	180	
47	2005	862	8	Crude Oil	Hurricane Rita	141	
48	2005	66.5	12	Crude Oil	Hurricane Rita	152	
49	2005	108	6	Crude Oil	Hurricane Rita	210	
50	2006	600	14	Crude Oil	External Damage - Anchor	126	*

Notes:
All Data from MMS Web site(GOM Region), October 1, 2007

* = updated by Cheryl Anderson October 19, 2007

<=10"	30
>10"	20

12	Small <100 bbl
23	Medium 100 - 999 bbl
12	Large 1000 - 9999 bbl
3	Huge >=10000 bbl

<=10"	8	Small <100 bbl
	14	Medium 100 - 999 bbl
	7	Large 1000 - 9999 bbl
	1	Huge >=10000 bbl
>10"	4	Small <100 bbl
	9	Medium 100 - 999 bbl
	5	Large 1000 - 9999 bbl
	2	Huge >=10000 bbl

Table 2.4
Pipeline Hydrocarbon Spill Summary by Spill Size

CAUSE CLASSIFICATION	NUMBER OF SPILLS	SPILL SIZE BBL																	NUMBER OF SPILLS					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	S	M	L	H	SM	LH
CORROSION	**4**																		**1**	**2**	**1**		**3**	**1**
External	1	80																	1				**1**	
Internal	3	100	5000	414																2	1		**2**	**1**
THIRD PARTY IMPACT	**18**																		**2**	**6**	**7**	**3**	**8**	**10**
Anchor Impact	12	19833	65	50	300	900	323	15576	2000	800	1211	2240	600						2	5	3	2	**7**	**5**
Jackup Rig or Spud Barge	1	3200																			1			**1**
Trawl/Fishing Net	5	4000	100	14423	4569	4533														1	3	1	**1**	**4**
OPERATION IMPACT	**4**																		**3**		**1**		**3**	**1**
Rig Anchoring	1	50																	1				**1**	
Work Boat Anchoring	3	50	5100	50															2		1		**2**	**1**
MECHANICAL	**2**																			**2**			**2**	
Connection Failure	1	135																		1			**1**	
Material Failure	1	210																		1			**1**	
NATURAL HAZARD	**20**																		**6**	**11**	**3**		**17**	**3**
Mud Slide	3	250	80	8212															1	1	1		**2**	**1**
Storm/ Hurricane	17	3500	671	126	200	260	250	1720	95	123	960	50	50	100	75	862	66	108	5	10	2		**15**	**2**
UNKNOWN	**2**	119	190																	**2**			**2**	
TOTALS	**50**																		**12**	**23**	**12**	**3**	**35**	**15**

Table 2.5
Pipeline Hydrocarbon Spill Statistics by Cause

CAUSE CLASSIFICATION	Small and Medium Spills 50-999 bbl				Large and Huge Spills >=1000 bbl			
	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [km-years]	FREQUENCY spill per 10^5km -year	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [km-years]	FREQUENCY spill per 10^5km -year
CORROSION	**8.57**	**3**		**1.0955**	**6.67**	**1**		**0.3652**
External	2.86	1		0.3652				
Internal	5.71	2		0.7303	6.67	1		0.3652
THIRD PARTY IMPACT	**22.86**	**8**		**2.9213**	**66.67**	**10**		**3.6517**
Anchor Impact	20.00	7		2.5562	33.33	5		1.8258
Jackup Rig or Spud Barge					6.67	1		0.3652
Trawl/Fishing Net	2.86	1		0.0365	26.67	4		1.4607
OPERATION IMPACT	**8.57**	**3**		**1.0955**	**6.67**	**1**		**0.3652**
Rig Anchoring	2.86	1		0.3652				
Work Boat Anchoring	5.71	2		0.7303	6.67	1		0.3652
MECHANICAL	**5.71**	**2**		**0.7303**				
Connection Failure	2.86	1	**273847**	0.3652			**273847**	
Material Failure	2.86	1		0.3652				
NATURAL HAZARD	**48.57**	**17**		**6.2078**	**20.00**	**3**		**1.0955**
Mud Slide	5.71	2		0.7303	6.67	1		0.3652
Storm/ Hurricane	42.86	15		5.4775	13.33	2		0.7303
ARCTIC								
Ice Gouging								
Strudel Scour								
Upheaval Buckling								
Thaw Settlement								
Other Arctic								
UNKNOWN	**5.71**	**2**		**0.7303**				
TOTALS	**100.00**	**35**		**12.7809**	**100.00**	**15**		**5.4775**

Table 2.6
Pipeline Hydrocarbon Spill Statistics by Spill Size and Pipe Diameter

GOM OCS Pipeline Spills, Categorized 1972-2006			Spill Statistics	Exposure	Frequency
			Number of Spills	km-years	spills per 10^5 km-years
By Pipe Diameter		<= 10"	30	187,984	15.9588
		> 10"	20	85,863	23.2929
By Spill Size		Small <100 bbl	12	273,847	4.3820
		Medium 100 - 999 bbl	23	273,847	8.3989
		Large 1000 - 9999 bbl	12	273,847	4.3820
		Huge >=10000 bbl	3	273,847	1.0955
By Diameter, By Spill Size	<=10"	Small <100 bbl	8	187,984	4.2557
		Medium 100 - 999 bbl	14	187,984	7.4474
		Large 1000 - 9999 bbl	7	187,984	3.7237
		Huge >=10000 bbl	1	187,984	0.5320
	> 10"	Small <100 bbl	4	85,863	4.6586
		Medium 100 - 999 bbl	9	85,863	10.4818
		Large 1000 - 9999 bbl	5	85,863	5.8232
		Huge >=10000 bbl	2	85,863	2.3293

SECTION 3

PLATFORM SPILLS

3.1 Introduction to Platform Spills

Generally, platform spills in the GOM OCS have been reported to occur due to equipment failure, human error, tank failure, ship collisions, and weather, including hurricanes. In the period from 1973 to 2006, approximately 200 platform spills have been reported, with roughly 74 spills of hydrocarbon fluids.

In the statistical analysis, the exposure factor utilized in the platform spill frequency computation is the number of active producing wells in any given time period. In the balance of this section, following a discussion of the exposure, all platform spills are summarized, followed by the platform hydrocarbon spill summaries, and the spill statistical analysis by both causal distribution and active well year.

3.2 Platform Exposure

The exposure factor utilized for the platforms is the number of active producing wells in any given time period. The definition of the number of active producing wells is "*the number of OCS GOM wells producing oil and/or condensate which reported production greater than 0 barrels in each year (or the relevant time period)*".

Table 3.1 summarizes the number of these active producing wells for each year between 1972 and 2006. The bar chart in Figure 3.1 simply illustrates these numbers of producing wells. A peak of roughly 7,000 producing wells in 1985, is followed by a gradual decline to the present number of approximately 4,800 producing wells in 2006.

3.3 All GOM OCS Platform Spills

All liquid spills reported from GOM OCS platforms between 1973 and 2006 are summarized in Table 3.2. As can be seen, numerous non-hydrocarbon spills such as zinc bromide, synthetic based muds, or methanol are included in this number of spills, which totals 190. As can be seen in the table, following the spill itemization number data given are the year of occurrence, the actual size in barrels, the material spilled, the reported cause, and the associated operation, as well as the water depth.

Table 3.1
Annual Number of Active Producing Wells in GOM OCS (1972-2006)

Year	Wells
1972	4276
1973	4512
1974	4545
1975	4603
1976	4763
1977	4981
1978	5228
1979	5510
1980	5713
1981	5969
1982	6343
1983	6493
1984	6762
1985	7034
1986	6986
1987	6950
1988	6948
1989	6942
1990	6973
1991	6974
1992	6825
1993	6764
1994	6757
1995	6653
1996	6716
1997	6666
1998	6472
1999	6341
2000	6313
2001	6432
2002	6188
2003	6014
2004	5936
2005	5572
2006	4817
Total	**212971**

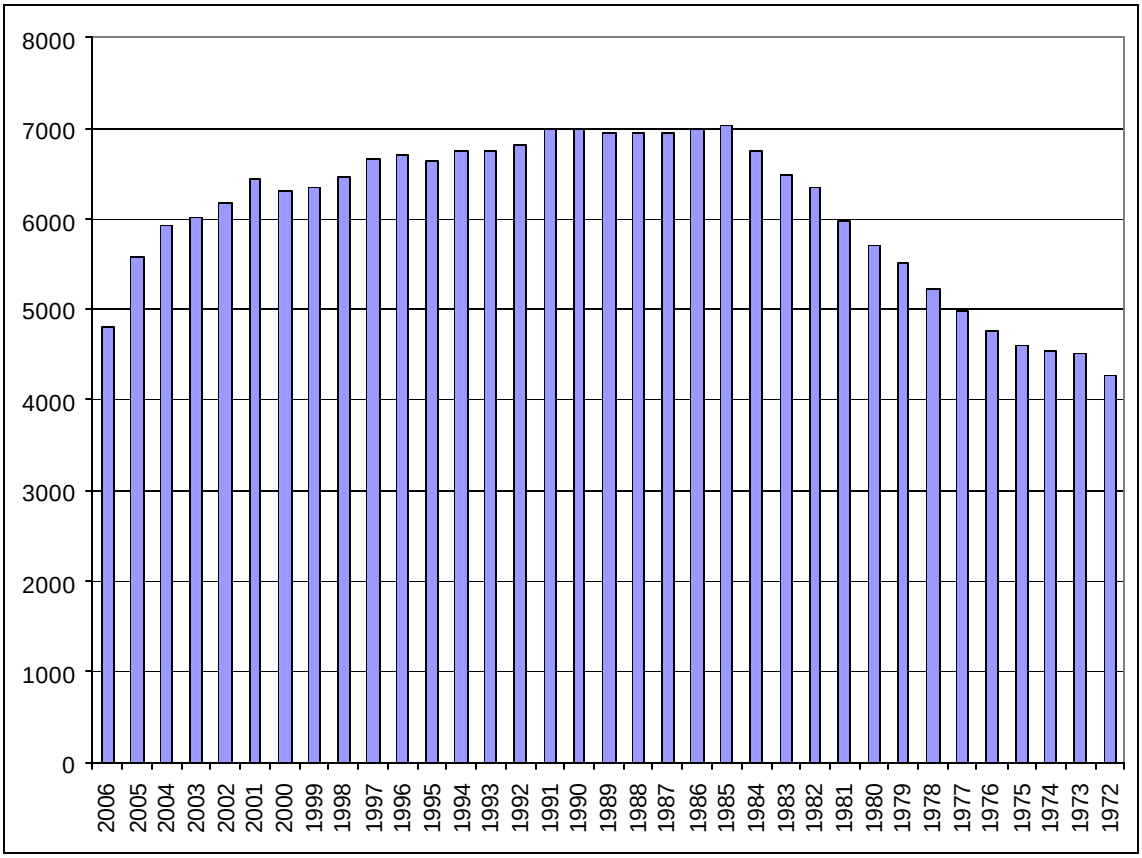

Figure 3.1
Annual Number of Active Producing Wells in GOM OCS (1972-2006) – Bar Chart Display

Table 3.2
Summary of All GOM OCS Platform Spills (1973-2006)

#	Year	Size bbl	Material	Cause	Operation	Water Depth ft
1	1973	9935	Crude Oil	Tank ruptured	Production	110
2	1973	7000	Crude Oil	Rough Seas	Production	61
3	1973	239	Diesel	Human error	Drilling and Motor Vessel	300
4	1973	95.2	Diesel	Human error	Drilling and Motor Vessel	103
5	1974	130	Crude Oil	Liquid Level Control	Production	60
6	1974	75	Crude Oil	Hurricane	Production	29
7	1974	50	Crude Oil	Liquid Level Control	Production	27
8	1974	120	Crude Oil	Human error	Production	140
9	1974	200	Crude Oil	Hurricane	Drilling, Compl., or Workover	30
10	1975	166	Diesel	Collision	Production and Motor Vessel	210
11	1975	100	Diesel	Collision	Drilling and Motor Vessel	200
12	1976	300	Diesel	Eq failure and Human Err	Drilling and Motor Vessel	127
13	1977	70	Diesel	Eq failure and Human Err	Drilling and Motor Vessel	55
14	1978	104	Crude Oil	Eq failure LACT	Production	105
15	1979	321	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	311
16	1979	165	Diesel	Weather related	Motor Vessel	228
17	1979	60	Crude Oil	Liquid Level Control	Production	210
18	1979	1500	Diesel	Collision -Hurricane	Drilling and Motor Vessel	280
19	1980	286	Diesel	Human error	Drilling	156
20	1980	258	Diesel	Weather related	Production and Motor Vessel	65
21	1980	95	Diesel	Excessive wear	Drilling	140
22	1980	150	Diesel	Tank ruptured	Motor Vessel	168
23	1980	80	Diesel	Weather related	Drilling and Motor Vessel	220
24	1980	83	Diesel	Eq failure and Human Err	Production	187
25	1980	1456	Crude Oil	Weather related	Production	60
26	1980	118	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	99
27	1981	58	Crude Oil	Eq failure, Human error	Production	54
28	1981	210	Mineral Oil	Tank ruptured	Drilling	49
29	1981	50	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	350
30	1981	64	Crude Oil	Not Indentified	Completion or Workover	340
31	1982	400	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	180
32	1982	228	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	394
33	1982	214.3	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	60
34	1983	540	Diesel	Eq failure Transfer hose	Drilling and Barge	43
35	1983	125	Crude Oil	Eq failure Transfer hose	Production	90
36	1983	77	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	48
37	1983	320.4	Diesel	Collision	Drilling and Motor Vessel	50
38	1983	200	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	65
39	1983	77	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	48
40	1983	95	Diesel	Collision	Drilling and Motor Vessel	78
41	1983	119	Diesel	Collision	Production and Motor Vessel	105
42	1984	50	Crude Oil	Tank ruptured	Production	94
43	1984	100	Diesel	Human error	Drilling and Motor Vessel	307
44	1985	107.1	Diesel	Eq failure Pipe Elbow	Drilling	130
45	1985	59.52	Diesel	Eq failure, Human error	Deactivation	50
46	1985	50	Crude Oil	Eq failure	Workover	196
47	1985	643	Diesel	Eq failure Flow meter	Drilling and Motor Vessel	3115
48	1985	50	Mineral Oil	Tank ruptured	Drilling	200
49	1985	66	Condensate	Weather related	Production	55
50	1985	58	Diesel	Eq failure Transfer hose	Drilling and Motor Vessel	103
51	1986	52	Hydraulic Fluid	Human error	Construction	750
52	1987	60	Crude Oil	Eq failure BOP	Drilling	126
53	1988	50	Crude Oil	Eq failure, Human error	Production	172
54	1988	64	Diesel	Human error	Drilling	200
55	1988	50	Crude Oil	Leak, Wellhead assembly	Production	140
56	1989	400	Crude Oil	Eq failure Liquid level	Production	112

Table 3.2 ~ *Continued* ~

#	Year	Size bbl	Material	Cause	Operation	Water Depth ft
57	1990	110	Zinc Bromide	Eq failure dump valve	Drilling	155
58	1991	280	Crude Oil	Eq failure, Human error	Production	50
59	1992	100	Condensate	Other, Inuff. Mud weight	Drilling	187
60	1994	62	Zinc Bromide	Eq failure Transfer hose	Fuel Transfer and Motor Vesel	240
61	1994	141	Zinc Bromide	Human error	Completion or Workover	113
62	1995	600	Condensate	Human error	Drilling and Motor Vessel	50
63	1995	75	Condensate	Eq failure	Production	116
64	1995	89	Diesel	Weather related	Drilling and Motor Vessel	430
65	1995	436	Condensate	Eq failure, Human error	Production	56
66	1996	104.8	Diesel	Weather related	Drilling and Motor Vessel	2096
67	1996	60	Zinc Bromide	Eq failure	Production	276
68	1996	61.9	Hydraulic Fluid	Eq failure	Construction	705
69	1997	80	Zinc Bromide	Human error	Completion	2096
70	1997	170	Condensate	Human error	Production	40
71	1998	1012	Zinc Bromide	Human error	Completion	1271
72	1998	100	Diesel	Weather related	Production	700
73	1998	85	Ethylene Glycol	Eq failure	Production	5292
74	1998	54.8	Paraffin Inhibitor	Poor design	Production	3214
75	1998	170	Zinc Bromide	Human error	Completion	1648
76	1998	88	Zinc Bromide	Human error	Completion	1648
77	1999	105.24	Diesel	Weather related	Production and Motor Vessel	392
78	1999	125	Condensate	Eq failure	Workover	463
79	1999	100	Synthetic Based Mud	Human error	Drilling	N/A
80	1999	360	Zinc Bromide	Human error	Workover and Motor Vessel	284
81	2000	1440	Synthetic Based Mud	Human error	Drilling	6327
82	2000	165.6	Synthetic Based Mud	Eq failure	Drilling	3290
83	2000	114	Synthetic Based Mud	Eq failure	Drilling	35
84	2000	200	Crude Oil	Human error	Drilling	2223
85	2000	573.6	Synthetic Based Mud	Human error	Drilling	2223
86	2000	60	Crude Oil	Eq failure, Human error	Production	172
87	2000	133.8	Synthetic Based Mud	Eq failure	Drilling	7500
88	2001	71.4	Synthetic Based Mud	Human error	Motor Vessel	1025
89	2001	122	Zinc Bromide	Eq failure	Drilling	1140
90	2001	127	Crude Oil	Eq failure	Production	243
91	2001	429	Zinc Bromide	Human error	Drilling	53
92	2001	332	Ethylene Glycol	Eq failure	Production	5292
93	2001	550	Synthetic Based Mud	Eq failure	Drilling	4479
94	2001	102	Synthetic Based Mud	Human error	Workover	184
95	2001	150	Synthetic Based Mud	Human error	Drilling and Motor Vessel	44
96	2001	270	Synthetic Based Mud	Human error	Motor Vessel	N/A
97	2002	51.5	Synthetic Based Mud	Operetional Discharge	Drilling	38
98	2002	267	Synthetic Based Mud	Eq failure	Drilling	3950
99	2002	1800	Synthetic Based Mud	Weather related	Drilling	8180
100	2002	350	Crude Oil	Hurricane	Production	50
101	2002	445.2	Diesel	Hurricane	Workover	37
102	2002	741	Diesel	Hurricane	Drilling	94
103	2002	327	Zinc Bromide	Hurricane	Rig Recovery	94
104	2002	156	Zinc Bromide	Human error	Completion	2400
105	2002	60	Synthetic Based Mud	Eq failure	Drilling	3338
106	2002	120	Synthetic Based Mud	Human error	Drilling	8334
107	2002	375.5	Synthetic Based Mud	Human error	Drilling	4060
108	2002	60	Synthetic Based Mud	Human error	Drilling	1023
109	2003	261.7	Diesel	Human error	Motor Vessel	165
110	2003	428.6	Diesel	Human error	Motor Vessel	146
111	2003	1421	Synthetic Based Mud	Weather related	Drilling	6040
112	2003	139	Synthetic Based Mud	Eq failure, Human error	Drilling	3643
113	2003	60	Diesel	Human error	Motor Vessel	N/A
114	2003	944	Synthetic Based Mud	Human error	Drilling	4400
115	2003	62.7	Synthetic Based Mud	Human error	Drilling	4484
116	2003	74	Synthetic Based Mud	Eq failure	Drilling	4400
117	2003	137.5	Synthetic Based Mud	Eq failure	Drilling	6040

Table 3.2 ~ *Continued* ~

#	Year	Size bbl	Material	Cause	Operation	Water Depth ft
118	2003	224	Synthetic Based Mud	Human error	Exploration	10
119	2003	123	Ethylene Glycol	Eq failure	Production	369
120	2004	95.7	Synthetic Based Mud	Human error	Drilling	3214
121	2004	1034	Synthetic Based Mud	Weather related	Drilling	4238
122	2004	184.8	Synthetic Based Mud	Eq failure, Human error	Drilling	5709
123	2004	202	Methanol	Eq failure	Production	2860
124	2004	52	Diesel	Hurricane Ivan	N/A	277
125	2004	55.3	Diesel	Hurricane Ivan	N/A	302
126	2004	133	Crude Oil	Hurricane Ivan	N/A	305
127	2004	102	Diesel	Hurricane Ivan	N/A	305
128	2004	77	Crude Oil	Hurricane Ivan	N/A	244
129	2004	21	Diesel	Hurricane Ivan	N/A	244
130	2004	27	Crude Oil	Hurricane Ivan	N/A	255
131	2004	21	Diesel	Hurricane Ivan	N/A	255
132	2004	410.2	Crude Oil	Hurricane Ivan	N/A	479
133	2004	55	Diesel	Hurricane Ivan	N/A	479
134	2004	537	Synthetic Based Mud	Human error	Drilling	4675
135	2004	75.9	Hydrate Inhibitor	Eq failure	Drilling	2861
136	2004	108	Synthetic Based Mud	Eq failure	Drilling	3338
137	2005	156	Synthetic Based Mud	Eq failure, Human error	Drilling	3341
138	2005	170	Synthetic Based Mud	Human error	Drilling	5785
139	2005	110	Synthetic Based Mud	Human error	Drilling	2945
140	2005	500	Calcium Bromide	Human error	Completion	2618
141	2005	426	Synthetic Based Mud	Weather related	Drilling	4400
142	2005	242	Crude Oil	Hurricane Katrina	N/A	83
143	2005	141	Crude Oil	Hurricane Katrina	N/A	86
144	2005	204.1	Crude Oil	Hurricane Katrina	N/A	91
145	2005	213.6	Crude Oil	Hurricane Katrina	N/A	88
146	2005	325	Crude Oil	Hurricane Katrina	N/A	1023
147	2005	380.2	Diesel	Hurricane Katrina	N/A	140
148	2005	106	Crude Oil	Hurricane Katrina	N/A	255
149		11.7	Diesel	Hurricane Katrina	N/A	255
150	2005	180	Crude Oil	Hurricane Katrina	N/A	340
151	2005	85	Crude Oil	Hurricane Katrina	N/A	340
152	2005	132	Crude Oil	Hurricane Katrina	N/A	216
153	2005	55	Crude Oil	Hurricane Katrina	N/A	240
154	2005	50	Crude Oil	Hurricane Katrina	N/A	116
155	2005	50	Crude Oil	Hurricane Katrina	N/A	137
156	2005	50	Crude Oil	Hurricane Katrina	N/A	128
157	2005	50	Crude Oil	Hurricane Katrina	N/A	137
158	2005	50	Crude Oil	Hurricane Katrina	N/A	117
159	2005	95.24	Crude Oil	Hurricane Katrina	N/A	140
160	2005	220	Calcium Chloride	Hurricane Katrina	N/A	172
161	2005	307	Crude Oil	Hurricane Katrina	N/A	153
162	2005	50	Crude Oil	Hurricane Katrina	N/A	223
163	2005	130	Condensate	Hurricane Katrina	N/A	228
164	2005	75	Crude Oil	Hurricane Katrina	N/A	285
165	2005	66.7	Aviation Fuel	Hurricane Rita	N/A	182
166	2005	582	Crude Oil	Hurricane Rita	N/A	230
167	2005	35.7	Diesel	Hurricane Rita	N/A	230
168	2005	44	Condensate	Hurricane Rita	N/A	204
169	2005	11.9	Diesel	Hurricane Rita	N/A	204
170	2005	2000	Condensate	Hurricane Rita	N/A	230
171	2005	150	Crude Oil	Hurricane Rita	N/A	254
172	2005	150	Condensate	Hurricane Rita	N/A	231
173	2005	12	Diesel	Hurricane Rita	N/A	231
174	2005	100.8	Crude Oil	Hurricane Rita	N/A	472
175	2005	536.4	Crude Oil	Hurricane Rita	N/A	2107
176	2005	1494	Diesel	Hurricane Rita	N/A	232
177	2005	1410.9	Diesel	Hurricane Rita	N/A	182
178	2005	53.4	Crude Oil	Hurricane Rita	N/A	230

Table 3.2 ~ *Continued* ~

#	Year	Size bbl	Material	Cause	Operation	Water Depth ft
179	2005	212	Synthetic Based Mud	Eq failure, Human error	Drilling	4304
180	2006	150	Synthetic Based Mud	Weather related	Drilling	6844
181	2006	62	Caustic Cleaner	Eq failure	Drilling	252
182	2006	107	Synthetic Based Mud	Human error	Drilling	6832
183	2006	125.6	Condensate	Hurricane Rita	Production	240
184	2006	294	Calcium Bromide	Human error	Completion	5636
185	2006	70	Synthetic Based Mud	Human error	Drilling	6926
186	2006	383	Synthetic Based Mud	Eq failure	Drilling	6037
187	2006	162.8	Synthetic Based Mud	Human error	Drilling	123
188	2006	142.8	Crude Oil	Hurricane Rita	Submerged Platform	230
189	2006	110.6	Crude Oil	Hurricane Katrina	Submerged Platform	88
190	2006	47.4	Crude Oil	Hurricane Rita	Submerged Platform	170

3.4 Platform Hydrocarbon Spills

Table 3.3 summarizes all of the platform hydrocarbon spills from among all spills associated with platforms between 1973 and 2006. It should be noted, that when the spills are attributable to an individual hurricane, such as Hurricane Katrina, spills in these hurricanes were counted as one single spill. However, the total spill volume was recorded and utilized as a basis for subsequent statistics. It can be seen from Table 3.3 that the total number of platform spills from 1973 to 2006 is 74, with sizes ranging between nearly 10,000 barrels and the threshold of reporting, 50 barrels.

3.5 Platform Spill Statistics

The primary platform spill statistical information required is the spill frequency distribution by different causes and spill sizes, and the spill rate per well year. Table 3.4 summarizes the spill size distribution among the principal reported causes. As can be seen, the major cause attributable to almost 50% of the spills – at 35 out of 74 spills – is equipment failure. However, although hurricanes have only caused a relatively small number of spills, their total spill volumes are the largest, giving the largest spill volume total. The largest single spill, however, is the tank failure which caused a spill of nearly 10,000 barrels.

The spill rate data, given per production well-year, is shown in Table 3.5, again, by causal distribution as well as two broad spill size categories of small and medium spills and large and huge spills. Here, it becomes immediately evident that the largest spill potential in terms of volume is attributable to hurricanes, which are responsible for roughly 43% of the large and huge spills.

Table 3.3
Summary of GOM OCS Platform Hydrocarbon Spills (1973-2006)

#	Year	Size bbl	Cause	Operation
1	1973	9935	Tank ruptured	Production
2	1973	7000	Rough Seas	Production
3	1973	239	Human error	Drilling and Motor Vessel
4	1973	95	Human error	Drilling and Motor Vessel
5	1974	130	Liquid Level Control	Production
6	1974	75	Hurricane	Production
7	1974	50	Liquid Level Control	Production
8	1974	120	Human error	Production
9	1974	200	Hurricane	Drilling, Compl., or Workover
10	1975	166	Collision	Production and Motor Vessel
11	1975	100	Collision	Drilling and Motor Vessel
12	1976	300	Eq failure and Human Err	Drilling and Motor Vessel
13	1977	70	Eq failure and Human Err	Drilling and Motor Vessel
14	1978	104	Eq failure LACT	Production
15	1979	321	Eq failure Transfer hose	Drilling and Motor Vessel
16	1979	165	Weather related	Motor Vessel
17	1979	60	Liquid Level Control	Production
18	1979	1500	Collision -Hurricane	Drilling and Motor Vessel
19	1980	286	Human error	Drilling
20	1980	258	Weather related	Production and Motor Vessel
21	1980	95	Excessive wear	Drilling
22	1980	150	Tank ruptured	Motor Vessel
23	1980	80	Weather related	Drilling and Motor Vessel
24	1980	83	Eq failure and Human Err	Production
25	1980	1456	Weather related	Production
26	1980	118	Eq failure Transfer hose	Drilling and Motor Vessel
27	1981	58	Eq failure, Human error	Production
28	1981	50	Eq failure Transfer hose	Drilling and Motor Vessel
29	1981	64	Not Identified	Completion or Workover
30	1982	400	Eq failure Transfer hose	Drilling and Motor Vessel
31	1982	228	Eq failure Transfer hose	Drilling and Motor Vessel
32	1982	214	Eq failure Transfer hose	Drilling and Motor Vessel
33	1983	540	Eq failure Transfer hose	Drilling and Barge
34	1983	125	Eq failure Transfer hose	Production
35	1983	77	Eq failure Transfer hose	Drilling and Motor Vessel
36	1983	320	Collision	Drilling and Motor Vessel
37	1983	200	Eq failure Transfer hose	Drilling and Motor Vessel
38	1983	77	Eq failure Transfer hose	Drilling and Motor Vessel
39	1983	95	Collision	Drilling and Motor Vessel
40	1983	119	Collision	Production and Motor Vessel
41	1984	50	Tank ruptured	Production
42	1984	100	Human error	Drilling and Motor Vessel
43	1985	107	Eq failure Pipe Elbow	Drilling
44	1985	60	Eq failure, Human error	Deactivation
45	1985	50	Eq failure	Workover
46	1985	643	Eq failure Flow meter	Drilling and Motor Vessel
47	1985	66	Weather related	Production
48	1985	58	Eq failure Transfer hose	Drilling and Motor Vessel
49	1987	60	Eq failure BOP	Drilling

Table 3.3 ~ *Continued* ~

#	Year	Size bbl	Cause	Operation
50	1988	50	Eq failure, Human error	Production
51	1988	64	Human error	Drilling
52	1988	50	Leak, Wellhead assembly	Production
53	1989	400	Eq failure Liquid level	Production
54	1991	280	Eq failure, Human error	Production
55	1992	100	Other, Inuff. Mud weight	Drilling
56	1995	600	Human error	Drilling and Motor Vessel
57	1995	75	Eq failure	Production
58	1995	89	Weather related	Drilling and Motor Vessel
59	1995	436	Eq failure, Human error	Production
60	1996	105	Weather related	Drilling and Motor Vessel
61	1997	170	Human error	Production
62	1998	100	Weather related	Production
63	1999	105	Weather related	Production and Motor Vessel
64	1999	125	Eq failure	Workover
65	2000	200	Human error	Drilling
66	2000	60	Eq failure, Human error	Production
67	2001	127	Eq failure	Production
68	2002	1536	Hurricane	N/A
69	2003	262	Human error	Motor Vessel
70	2003	429	Human error	Motor Vessel
71	2003	60	Human error	Motor Vessel
72	2004	954	Hurricane Ivan	N/A
73	2005	3093	Hurricane Katrina	N/A
74	2005	6897	Hurricane Rita	N/A

Only one spill (Crude Oil, Condensate, Diesel) counted per Hurricane

27	Small <100 bbl
40	Medium 100 - 999 bbl
7	Large 1000 - 9999 bbl
0	Huge >=10000 bbl

Table 3.4
Summary of GOM OCS Platform Hydrocarbon Spills by Size and Cause

CAUSE CLASSIFICATION	NUMBER OF SPILLS	SPILL SIZE BBL														NUMBER OF SPILLS					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	S	M	L	H	SM	LH
EQUIPMENT FAILURE	**35**															**17**	**18**			**35**	
Process Equipment	14	130	50	104	60	95	107	50	643	60	50	400	75	125	127	7	7			**14**	
Transfer Hose	12	321	118	50	400	228	214	540	125	77	200	77	58			4	8			**12**	
Incorrect Operation	9	300	70	83	58	60	50	280	436	60						6	3			**9**	
HUMAN ERROR	**12**	239	95	120	286	100	64	600	170	200	262	429	60			**3**	**9**			**12**	
TANK FAILURE	**3**	9935	150	50												**1**	**1**	**1**		**2**	**1**
SHIP COLLISION	**6**	166	100	1500	320	95	119									**1**	**4**	**1**		**5**	**1**
WEATHER	**10**	7000	165	258	80	1456	66	89	105	100	105					**3**	**5**	**2**		**8**	**2**
HURRICANE	**6**	75	200	1536	954	3093	6897									**1**	**2**	**3**		**3**	**3**
OTHER	**2**	64	100													**1**	**1**			**2**	
TOTALS	**74**															**27**	**40**	**7**		**67**	**7**

Table 3.5
GOM OCS Platform Hydrocarbon Spill Statistics (1973-2006)

CAUSE CLASSIFICATION	Small and Medium Spills 50-999 bbl				Large and Huge Spills >=1000 bbl			
	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [well-years]	FREQUENCY spill per 10^4well-year	HIST. DISTRIBUTION %	NUMBER OF SPILLS	EXPOSURE [well-years]	FREQUENCY spill per 10^4well-year
EQUIPMENT FAILURE	**52.24**	**35**		**1.6434**				
- Process Equipment	20.90	14		0.6574				
- Transfer Hose	17.91	12		0.5635				
- Incorrect Operation	13.43	9		0.4226				
HUMAN ERROR	**17.91**	**12**		**0.5635**				
TANK FAILURE	**2.99**	**2**	**212971**	**0.0939**	**14.29**	**1**	**212971**	**0.0470**
SHIP COLLISION	**7.46**	**5**		**0.2348**	**14.29**	**1**		**0.0470**
WEATHER	**11.94**	**8**		**0.3756**	**28.57**	**2**		**0.0939**
HURRICANE	**4.48**	**3**		**0.1409**	**42.86**	**3**		**0.1409**
OTHER	**2.99**	**2**		**0.0939**				
TOTALS	**100.00**	**67**		**3.1460**	**100.00**	**7**		**0.3287**

REFERENCES

1. Bercha International Inc., "Alternative Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas – Fault Tree Method", Volume II, **Appendix A – Historical Data**, OCS Study MMS 2002-047, Final Report to US Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, August 2002.
2. MMS Website, www.mms.gov/incidents/spills .

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.