

OGP

Risk Assessment Data Directory

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**Major
accidents**

International Association of Oil & Gas Producers



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Abbreviations:

API	American Petroleum Institute
BBL	Barrels
BLEVE	Boiling Liquid Expanding Vapour Explosion
DECC	Department of Energy and Climate Change
DNV	Det Norske Veritas
FPSO	Floating Production, Storage and Offloading Unit
FSU	Floating Storage Unit
GoM	Gulf of Mexico
ITOPF	International Tanker Owners Pollution Federation Limited
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MMS	(US) Minerals Management Services
OLF	The Norwegian Oil Industry Association
QRA	Quantitative Risk Assessment (sometimes Analysis)
SBM	Synthetic Based Mud
SFT	Statens forurensningstilsyn (Norwegian Pollution Control Authority)
US	United States (of America)
WOAD	World Offshore Accident Databank

1.0 Scope and Definitions

1.1 Application

This datasheet provides background historical information on major accidents in the onshore and offshore oil and gas production and process industries, to serve as background for QRA studies.

The focus of this datasheet is on presenting an overview the range of accident types and their relative frequency of occurrence, rather than on absolute frequencies. Attention is focused on major accidents, taken to be those that have resulted in significant numbers of fatalities, asset damage and/or environmental pollution. Frequencies have been estimated for several of the accident types most commonly addressed in QRAs in other datasheets of this set.

1.2 Definitions

- **Major Accident** An accident¹ resulting in at least one of:
 - Multiple fatalities
 - For Offshore units:
 - Total Loss or Severe Damage (as defined below)
 - For Onshore units:
 - Approximately USD 100M property damage
 - 1000 barrels of oil spilt

(Note: these definitions should not be treated as implying any equivalence between the stated levels of fatalities, loss and environ-mental damage.)
- **Total Loss** Total loss of the unit including constructive total loss from an insurance point of view, however the unit may be repaired and put into operation again (as per definition in WOAD [1]).
- **Severe Damage** Severe damage to one of more modules of the unit; large /medium damage to loadbearing structures; major damage to essential equipment (as per definition in WOAD [1]).

2.0 Summary of Recommended Data

The data presented in this section are set out as follows:

- Major offshore accidents (Section 2.1)
 - Major offshore accidents resulting in significant fatalities (Section 2.1.1)
 - Major offshore accidents resulting in total loss or severe damage (Section 2.1.2)
 - Major offshore accidents resulting in significant pollution (Section 2.1.3)
- Major onshore accidents (Section 2.2)
 - Major onshore accidents resulting in significant fatalities (Section 2.2.1)

¹ Road accidents are excluded from this database. They are addressed in the *Land Transport Risks* datasheet.

- **Major onshore accidents resulting in significant property damage (Section 2.2.2)**

Note that data on major onshore accidents resulting in significant pollution is not readily available to a standard comparable with that available for offshore accidents; hence no such data are presented.

2.1 Major offshore accidents

2.1.1 Major offshore accidents resulting in significant fatalities

The WOAD database [1] was searched for all accidents involving fatalities. The data cover the period 1970 to 2007, in which there were a total of 553 accidents resulting in a total of 2171 fatalities.

Table 2.1 lists all accidents resulting 10 or more fatalities along with the operating mode, the main event that caused the accident, the extent of damage involved, and the geographic area where the platform was operating.

Table 2.2 breaks down the numbers of fatal accidents and fatalities by the type of unit involved.

Table 2.3 provides a breakdown of fatalities by 5-year periods; the numbers of fatal accidents and fatalities are graphed in Figure 2.1.

Table 2.4 provides a breakdown of fatalities by geographical area.

Table 2.1 Top Offshore Incidents Listed in Decreasing Order of Fatalities Involved: Worldwide, 1970 – 2007 (mainly [1])

Accident Date (dd/mm/yyyy)	Installation/ Field¹	Type of Unit	Operation Mode	Damage	Event Sequence²	No. of Fatalities³	No. of Injuries	Geographical Area
06/07/1988	Piper Alpha	Jacket	Production	Total loss	Release → Explosion → Fire	167	60	Europe North Sea
27/03/1980	Alexander L Kielland	Semi- submersible	Accommodation	Total loss	Breakage or fatigue → List → Capsizing, overturn, toppling	123	NA	Europe North Sea
03/11/1989	Seacrest	Drill ship	Exploration drilling	Severe damage	Breakage or fatigue → Capsizing, overturn, toppling	91	0	Asia South
15/02/1982	Ocean Ranger	Semi- submersible	Exploration drilling	Total loss	Breakage or fatigue → Leakage into hull → List → Capsizing, overturn, toppling	84	0	America North East
25/10/1983	Glomar Java Sea	Drill ship	Drilling, unknown phase	Total loss	Breakage or fatigue → Leakage into hull → List → Capsizing, overturn, toppling → Loss of buoyancy or sinking	81	0	Asia East
25/11/1979	Bohai II	Jackup	Transfer, wet	Total loss	Breakage or fatigue → Leakage into hull → List → Capsizing, overturn, toppling	72	0	Asia East
06/11/1986	Brent field	Helicopter- Offshore duty	Other	Total loss	Breakage or fatigue → Helicopter accident → Loss of buoyancy or sinking	45	2	Europe North Sea
16/08/1984	Enchova Central	Jacket	Development Drilling	Significant damage	Blowout → Fire → Explosion	42	19	America South East
11/08/2003	Neelam field	Helicopter- Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	27	0	Asia South
15/10/1995	DLB 269	Barge (not drilling)	Transfer, wet	Severe damage	Leakage into hull → List → Capsizing, overturn, toppling → Loss of buoyancy or sinking	26	0	Gulf of Mexico, excl. US
02/10/1997	Caspian Sea	Helicopter- Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	23	1	Caspian/Black Sea

RADD – Major accidents

Accident Date (dd/mm/yyyy)	Installation/ Field¹	Type of Unit	Operation Mode	Damage	Event Sequence²	No. of Fatalities³	No. of Injuries	Geographical Area
15/08/1991	McDermott Lay Barge 29	Lay barge	Construct. work unit	Total loss	Leakage into hull → Capsizing, overturn, toppling → Loss of buoyancy or sinking	22	NA	Asia South
23/10/2007 ⁴	Usumacinta	Jackup	Drilling	Severe damage	Collision → Release → Fire	22 ⁴	NA	Gulf of Mexico, excl. US
02/10/1980	Ron Tappmeyer	Jackup	Exploration drilling	Minor damage	Blowout	19	19	Middle East
09/10/1974	Gemini	Jackup	Drilling, unknown phase	Severe damage	Breakage or fatigue → Capsizing, overturn, toppling → Loss of buoyancy or sinking	18	0	Middle East
26/06/1978	Statfjord field	Helicopter- Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	18	0	Europe North Sea
08/12/1977	South Marsh, 128A	Helicopter- Offshore duty	Other	Total loss	Collision → Helicopter accident → Loss of buoyancy or sinking	17	1	US Gulf of Mexico
		Jacket	Production	Minor damage	Collision (helicopter)	17 ⁵	1 ⁵	US Gulf of Mexico
13/10/1971	Western Offshore 2	Drill barge	Exploration drilling	Severe damage	Blowout → Explosion → Fire	16	0	America South West
03/06/1978	Zakum field	Helicopter- Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	15	0	Middle East
17/11/1982	NA	Helicopter- Offshore duty	Other	Total loss	Collision (helicopter)	15	0	Asia East
21/12/1987	Eugene Island, 190	Helicopter- Offshore duty	Other	Total loss	Collision → Fire	15	0	US Gulf of Mexico
		Jackup	Stacked	Minor damage	Helicopter accident	15 ²	0	US Gulf of Mexico
20/03/1980	off Macae, Brazil	Helicopter- Offshore duty	Other	Total loss	Breakage or fatigue → Helicopter accident → Loss of buoyancy or sinking	14	0	America South East
17/10/1985	Trintoc Atlas	Mobile unit (not drilling)	Construct. work unit	Severe damage	Release → Explosion	14	0	Centr.Amer.East, not GoM

RADD – Major accidents

Accident Date (dd/mm/yyyy)	Installation/ Field ¹	Type of Unit	Operation Mode	Damage	Event Sequence ²	No. of Fatalities ³	No. of Injuries	Geographical Area
15/04/1976	Ocean Express	Jackup	Mobilizing	Total loss	Towline failure/rupture → Capsizing, overturn, toppling	13	0	US Gulf of Mexico
13/08/1981	Leman field	Helicopter-Offshore duty	Other	Total loss	Helicopter accident	13	0	Europe North Sea
30/04/1982	Gulf of Thailand	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	13	0	Asia South
20/03/1983	B.O.S. 355	Barge (not drilling)	Construct. work unit	Severe damage	Explosion → Fire	13	32	Africa West
25/11/1990	Adriatic	Helicopter-Offshore duty	Other	Total loss	Breakage or fatigue → Helicopter accident	13	0	Europe South, Mediterr.
18/11/1998	Campeche S. field	Helicopter-Offshore duty	Other	Total loss	Collision → Loss of buoyancy or sinking	13	0	Gulf of Mexico, excl. US
23/11/1977	nr. Varhaug field	Helicopter-Offshore duty	Other	Total loss	Breakage or fatigue → Helicopter accident	12	0	Europe North Sea
08/09/1997	en route Norn field	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	12	0	Europe North Sea
02/10/1999	off Dharan, Saudi Arabia	Helicopter-Offshore duty	Other	Severe damage	Helicopter accident → Loss of buoyancy or sinking	12	8	Middle East
27/07/2005	Bombay High North	Jacket	Production	Severe damage	Collision → Release → Fire	12	0	Asia South
29/05/1972	SS, 201	Helicopter-Offshore duty	Other	Total loss	Helicopter accident	11	NA	US Gulf of Mexico
04/06/1980	Opobo, Nigeria	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	11	0	Africa West
20/05/1985	Tonkawa	Drill barge	Transfer, wet	Severe damage	List → Capsizing, overturn, toppling → Loss of buoyancy or sinking → Release	11	0	US Gulf of Mexico
03/10/1989	High Island Pipeline	Pipeline	Production	Significant damage	Collision → Release → Explosion → Fire	11	4	US Gulf of Mexico
14/03/1992	Cormorant field	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	11	1	Europe North Sea

RADD – Major accidents

Accident Date (dd/mm/yyyy)	Installation/ Field ¹	Type of Unit	Operation Mode	Damage	Event Sequence ²	No. of Fatalities ³	No. of Injuries	Geographical Area
25/03/1993 ⁶	Lake Maracaibo	NA	NA	Significant damage	Explosion & Fire	11	NA	America South East
15/03/2001	Petrobras P-36	Semi-submersible	Production	Total loss	Explosion → Fire → Capsizing, overturn, toppling → Loss of buoyancy or sinking → Release	11	0	America South East
16/07/2002	Leman field	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	11	0	Europe North Sea
24/03/2004	NA	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	11	0	US Gulf of Mexico
27/05/1982	nr. Natuna Island	Helicopter-Offshore duty	Other	Total loss	Helicopter accident → Loss of buoyancy or sinking	10	0	Asia South
04/11/1985	Concem	Barge (not drilling)	Construct. work unit	Total loss	Capsizing, overturn, toppling	10	0	Europe North Sea
31/07/1989	Avco 5	Barge (not drilling)	Transfer, wet	Total loss	Capsizing, overturn, toppling	10	0	US Gulf of Mexico
05/05/1989	Bohai Harbour	Helicopter-Offshore duty	Other	Total loss	Breakage or fatigue → Helicopter accident	10	0	Asia East
06/12/1990	nr. Matak	Helicopter-Offshore duty	Other	Total loss	Explosion → Helicopter accident → Loss of buoyancy or sinking	10	2	Asia South
18/01/1995	Ubit	Jacket	Repair work/ under repair	Severe damage	Explosion & Fire	10	23	Africa West

Notes

- 1: Installation given for installation accidents; field or location given for helicopter accidents
 - 2: Event sequence given as in WOAD [1] except 'Other' replaced by 'Helicopter accident' where applicable
 - 3: Fatalities and Injuries includes crew members and contract workers
 - 4: Source: [12]
 - 5: Fatalities and Injuries were only in helicopter
 - 6: Source: [8]
- NA = Not Available

**Table 2.2 Breakdown of Incidents and Fatalities by Type of Unit:
Worldwide, 1970 – 2007 [1]**

Type Of Unit	No. of units ¹	% of Total Units	No. of Fatal Incidents ²	% of Total No. of Fatal Incidents	Total No. of Fatalities ²	% of Total No. of Fatalities
Artificial Island	2	0.1	0	0.0	0	0.0
Barge (not drilling)	62	1.7	9	1.6	44	2.0
Concrete structure	31	0.9	8	1.4	19	0.9
Drill barge	141	3.9	15	2.7	70	3.2
Drill ship	110	3.0	47	8.5	236	10.9
Drilling tender	16	0.4	3	0.5	14	0.6
Flare	10	0.3	0	0.0	0	0.0
FPSO/FSU	22	0.6	4	0.7	8	0.4
Helicopter-Offshore duty	260	7.2	113	20.4	646	29.8
Jacket	1278	35.2	202	36.5	509	23.4
Jackup	720	19.8	66	11.9	233	10.7
Lay barge	22	0.6	4	0.7	29	1.3
Loading buoy	30	0.8	0	0.0	0	0.0
Mobile unit (not drilling)	18	0.5	6	1.1	21	1.0
Other	8	0.2	1	0.2	1	0.0
Other/Unkn. fixed structure	7	0.2	1	0.2	2	0.1
Pipeline	236	6.5	5	0.9	19	0.9
Platform rig	1	0.0	0	0.0	0	0.0
Semi-submersible	326	9.0	47	8.5	292	13.5
Ship, not drilling or production	26	0.7	12	2.2	17	0.8
Submersible	42	1.2	3	0.5	3	0.1
Subsea installation	22	0.6	0	0.0	0	0.0
Tension leg platform	13	0.4	2	0.4	2	0.1
Well support structure	229	6.3	5	0.9	6	0.3
Totals	3632	100.0	553	100.0	2171	100.0

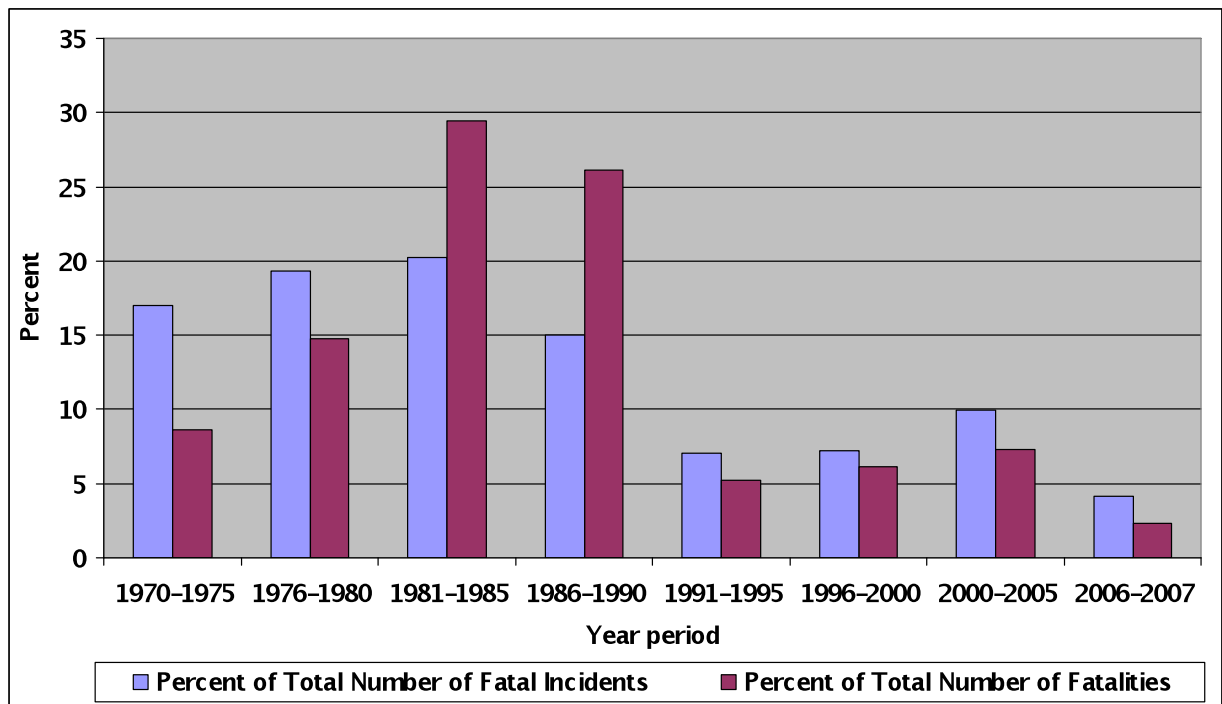
Notes

1. Since WOAD is an incident database only (i.e., it does not provide unit operating years), the numbers in this row represent the frequency of the unit in the incident database.
2. To avoid double counting of fatal accidents and fatalities, the number given is for the installation/ vessel/aircraft which suffered fatalities (e.g. helicopter hits offshore platform/installation/vessel, crew/passenger(s) in helicopter killed give number of fatalities and fatal accident is recorded on the helicopter)

Table 2.3 Breakdown of Fatalities by Year Period: Worldwide, 1970 – 2007 [1]

Year Period	No. of Fatal Incidents	% of Total No. of Fatal Incidents	No. of Fatalities	% of Total No. of Fatalities
1970-1975	94	17.0	188	8.7
1976-1980	107	19.3	320	14.7
1981-1985	112	20.3	639	29.4
1986-1990	83	15.0	568	26.2
1991-1995	39	7.1	114	5.3
1996-2000	40	7.2	134	6.2
2000-2005	55	9.9	158	7.3
2006-2007	23	4.2	50	2.3
Total	553	100.0	2171	100.0

Figure 2.1 Breakdown of Number of Fatalities and Number of Incidents by Year Period: Worldwide, 1970 – 2007



Note

1. This chart shows, for each period, the percentage of total incidents/fatalities in 1970-2007 that occurred during that period. (As the numbers of installations have varied during this time, they cannot be used to estimate per-installation incident frequencies or fatality rates.)
2. The period 2006-2007 represents only 2 years' data whereas the previous periods are 5 years.

Table 2.4 Breakdown of Fatalities by Geographical Area: Worldwide, 1970 – 2007 [1]

Geographical Area	No. of Fatal Incidents	% of Total No. of Fatal Incidents	No. of Fatalities	% of Total No. of Fatalities
US GoM	344	62.2	611	28.1
Europe N.S.	88	15.9	574	26.4
Asia + Australia	41	7.4	443	20.4
Other	80	14.5	543	25.0
Totals	553	100.0	2171	100.0

2.1.2 Major offshore accidents resulting in total loss or severe damage

Table 2.5 to Table 2.7 give the numbers of major accidents resulting in total loss by unit type, worldwide for the period 1970 to 2007, taken from WOAD [1], broken down further as follows:

- By Operation Mode: Table 2.5
- By Main Event: Table 2.6
- By Geographical Area: Table 2.7

Table 2.8 to Table 2.10 give the numbers of major accidents resulting in severe damage by unit type, worldwide for the period 1970 to 2007, taken from WOAD [1], broken down further as follows:

- By Operation Mode: Table 2.8
- By Main Event: Table 2.9
- By Geographical Area: Table 2.10

Table 2.5 Number of Total Losses by Type of Unit and Operation Mode: Worldwide, 1970 – 2007 [1]

Type of Unit	Operation mode (see below for key to codes)																			
	AB	AC	CP	C W	DM	DR	ID	LO	MO	OT	PR	RE	SC	SE	ST	TE	TR	UC	W O	Tota I
Artificial Island	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Barge (not drilling)	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	3	0	1	9
Concrete structure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Drill barge	0	0	2	0	0	9	0	0	1	0	0	0	0	0	0	0	1	0	2	15
Drill ship	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	4
Drilling tender	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		0	0	1
Flare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FPSO/FSU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopter-Offshore duty	0	0	0	0	0	0	0	0	0	145	0	0	0	0	0	0	0	0	0	145
Jacket	1	0	0	0	0	10	1	0	0	0	15	0	1	0	0	0	0	2	3	33
Jackup	0	0	0	3	0	30	1	0	9	1	1	0	1	3	1	0	27	0	4	81
Lay barge	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Loading buoy	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Mobile unit (not drilling)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	6
Other fixed structure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Semi-submersible	0	1	1	0	0	4	0	0	0	0	1	0	0	0	0	0	2	1	0	10
Ship, not drilling or production																				
Submersible	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2
Subsea installation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Well support structure	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Total	1	1	3	10		57	2	3	10	146	21	1	2	4	2		41	4	10	318

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Code	Operation Mode	Code	Operation Mode	Code	Operation Mode	Code	Operation Mode	Code	Operation Mode
AB	Abandonment of production	DM	Demobilizing	MO	Mobilizing	SC	Scrapped	TR	Transfer
AC	Accommodation	DR	Drilling	OT	Other	SE	Service	UC	Under construction
CP	Completion	ID	Idle	PR	Production	ST	Stacked	WO	Well workover
CW	Construction work	LO	Loading of liquids	RE	Repair work/under repair	TE	Testing		

Table 2.6 Number of Total Losses by Type of Unit and Main Event: Worldwide, 1970 – 2007 [1]

Type of Unit	Main event (see below for key to codes)																					
	AN	BL	CA	CL	CN	CR	EX	FA	FI	FO	GR	HE	LE	LI	LG	MA	OT	PO	ST	TO	WP	Total
Artificial Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Barge (not drilling)	0	0	5	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	9
Concrete structure	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Drill barge	0	0	4	0	0	0	0	0	8	2	1	0	0	0	0	0	0	0	0	0	0	15
Drill ship	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Drilling tender	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Flare																						
FPSO/FSU																						
Helicopter-Offshore duty	0	0	0	11	13	0	0	0	2	119	0	0	0	0	0	0	0	0	0	0	0	145
Jacket	0	1	6	5	0	0	0	0	16	1	0	0	0	1	1	0	0	0	2	0	0	33
Jackup	0	0	47	1	1	0	0	1	10	8	3	0	2	3	0	0	0	0	5	0	0	81
Lay barge	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Loading buoy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
Mobile unit (not drilling)	0	0	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	6
Other fixed structure																						
Pipeline	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Semi-submersible	0	0	4	0	0	0	0	0	3	2	1	0	0	0	0	0	0	0	0	0	0	10
Ship, not drilling or production																						
Submersible	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Subsea installation																						
Well support structure	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	3
Total	0	2	73	18	14	0	0	1	40	140	10	0	3	4	1	0	0	0	12	0	0	318

RADD – Major accidents

Code	Main Event	Code	Main Event	Code	Main Event	Code	Main Event	Code	Main Event
AN	Anchor/mooring failure	CR	Crane accident	GR	Grounding	MA	Machinery/propulsion failure	WP	Well problem, no blowout
BL	Blowout	EX	Explosion	HE	Helicopter accident	OT	Other		
CA	Capsizing, overturn, toppling	FA	Falling load / Dropped object	LE	Leakage into hull	PO	Out of position, adrift		
CL	Collision, not offshore units	FI	Fire	LG	Release of fluid or gas	ST	Breakage or fatigue		
CN	Collision, offshore units	FO	Loss of buoyancy or sinking	LI	List, uncontrolled inclination	TO	Towline failure/rupture		

Table 2.7 Number of Total Losses by Type of Unit and Geographical Area: Worldwide, 1970 – 2007 [1]

Type of unit	Geographical Area					
	US GoM	Europe N.S.	Asia	Australia	Other	Total
Artificial Island	0	0	0	0	1	1
Barge (not drilling)	4	1	1	2	1	9
Concrete structure	0	1	0	0	0	1
Drill barge	7	0	1	0	7	15
Drill ship	0	0	3	0	1	4
Drilling tender	0	0	0	0	1	1
Flare						
FPSO/FSU						
Helicopter-Offshore duty	52	28	29	4	32	145
Jacket	17	1	9	0	6	33
Jackup	36	4	18	1	22	81
Lay barge	0	0	1	0	1	2
Loading buoy	0	3	0	0	0	3
Mobile unit (not drilling)	4	1	0	0	1	6
Other fixed structure						
Pipeline	0	2	0	0	0	2
Semi-submersible	0	4	0	0	6	10
Ship, not drilling or production						
Submersible	2	0	0	0	0	2
Subsea installation						
Well support structure	3	0	0	0	0	3
Total	125	45	62	7	79	318

Table 2.8 Number of Accidents with Severe Damage by Type of Unit and Operation Mode: Worldwide, 1970 – 2007 [1]

Type of Unit	Operation mode (see below for key to codes)																			
	AB	AC	CP	C W	DM	DR	ID	LO	MO	OT	PR	RE	SC	SE	ST	TE	TR	UC	W O	Tota I
Artificial Island	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	6	0	0	11
Barge (not drilling)	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	3
Concrete structure	0	0	1	0	0	15	0	0	0	0	0	0	0	0	1	0	4	1	1	23
Drill barge	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	2	0	0	9
Drill ship	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Drilling tender																				
Flare																				
FPSO/FSU	0	0	0	0	0	0	0	0	0	55	0	0	0	0	0	0	0	0	0	55
Helicopter-Offshore duty	0	2	3	0	0	17	0	0	0	0	149	1	1	0	0	0	1	10	5	189
Jacket	0	1	0	6	4	44	3	0	23	3	1	1	0	2	1	1	32	1	4	127
Jackup	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Lay barge	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Loading buoy	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5
Mobile unit (not drilling)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other fixed structure	0	0	0	0	0	0	0	0	0	0	148	0	0	0	0	0	0	4	0	152
Pipeline	0	1	0	0	0	15	1	0	1	0	2	1	0	0	1	1	3	3	1	30
Semi-submersible	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Ship, not drilling or production	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	3
Submersible	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	1	0	4
Subsea installation	0	0	0	0	0	1	0	0	0	0	83	0	0	0	0	0	0	0	0	84
Well support structure	0	4	4	13	4	105	4	3	25	58	388	4	1	2	3	2	50	22	11	703
Total																				

RADD – Major accidents

Code	Operation Mode	Code	Operation Mode	Code	Operation Mode	Code	Operation Mode	Code	Operation Mode
AB	Abandonment of production	DM	Demobilizing	MO	Mobilizing	SC	Scrapped	TR	Transfer
AC	Accommodation	DR	Drilling	OT	Other	SE	Service	UC	Under construction
CP	Completion	ID	Idle	PR	Production	ST	Stacked	WO	Well workover
CW	Construction work	LO	Loading of liquids	RE	Repair work/under repair	TE	Testing		

Table 2.9 Number of Accidents with Severe Damage by Type of Unit and Main Event: Worldwide, 1970 – 2007 [1]

Type of Unit	Main event (see below for key to codes)																					
	AN	BL	CA	CL	CN	CR	EX	FA	FI	FO	GR	HE	LE	LI	LG	MA	OT	PO	ST	TO	WP	Total
Artificial Island																						
Barge (not drilling)	0	0	3	0	0	0	0	0	1	4	3	0	0	0	0	0	0	0	0	0	0	11
Concrete structure	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	3
Drill barge	0	0	5	0	0	0	0	0	11	4	1	0	0	0	0	0	0	0	2	0	0	23
Drill ship	0	1	1	2	0	0	0	2	0	0	1	0	0	0	0	0	0	0	2	0	0	9
Drilling tender	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	2
Flare																						
FPSO/FSU																						
Helicopter-Offshore duty	0	0	0	3	10	0	0	2	0	1	0	0	0	0	0	39	0	0	0	0	0	55
Jacket	0	1	79	18	6	0	5	3	44	9	0	0	0	2	3	0	0	0	19	0	0	189
Jackup	0	3	29	3	3	0	2	1	14	11	8	0	3	11	0	0	0	2	36	1	0	127
Lay barge	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Loading buoy	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3
Mobile unit (not drilling)	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	5
Other fixed structure	0	0	0	0	0	0		0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Pipeline	0	0	0	7	0	0	2	0	4	0	0	0	0	0	117	0	0	0	21	1	0	152
Semi-submersible	0	0	0	1	4	0		4	5	1	6	0	2	0	0	0	1	0	5	1	0	30
Ship, not drilling or production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Submersible	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	3
Subsea installation	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	4
Well support structure	0	1	69	8	0	0	0	1	1	1	0	0	0	1	1	0	0	0	1	0	0	84
Total	0	6	189	42	24	0	10	13	86	33	21	0	5	14	122	0	40	2	93	3	0	703

RADD – Major accidents

Code	Main Event	Code	Main Event	Code	Main Event	Code	Main Event	Code	Main Event
AN	Anchor/mooring failure	CR	Crane accident	GR	Grounding	MA	Machinery/propulsion failure	WP	Well problem, no blowout
BL	Blowout	EX	Explosion	HE	Helicopter accident	OT	Other		
CA	Capsizing, overturn, toppling	FA	Falling load / Dropped object	LE	Leakage into hull	PO	Out of position, adrift		
CL	Collision, not offshore units	FI	Fire	LG	Release of fluid or gas	ST	Breakage or fatigue		
CN	Collision, offshore units	FO	Loss of buoyancy or sinking	LI	List, uncontrolled inclination	TO	Towline failure/rupture		

Table 2.10 Number of Accidents with Severe Damage by Type of Unit and Geographical Area: Worldwide, 1970 – 2007 [1]

Type of unit	Geographical Area				
	US GoM	Europe N.S.	Asia + Australia	Other	Total
Barge (not drilling)	1	0	3	7	11
Concrete structure	1	2	0	0	3
Drill barge	13	0	4	6	23
Drill ship	0	1	5	3	9
Drilling tender	1	0	1	0	2
Helicopter-Offshore duty	32	12	6	5	55
Jacket	151	7	19	12	189
Jackup	60	5	39	23	127
Lay barge	0	0	0	1	1
Loading buoy	0	2	0	1	3
Mobile unit (not drilling)	2	0	0	3	5
Other fixed structure	0	0	0	1	1
Pipeline	133	9	6	4	152
Semi-submersible	10	14	3	3	30
Ship, not drilling or production	0	0	1	0	1
Submersible	3	0	0	0	3
Tension leg platform	4	0	0	0	4
Well support structure	82	1	0	1	84
Total	493	53	87	70	703

2.1.3 Major offshore accidents resulting in significant pollution

2.1.3.1 Spills from offshore E&P installations

Table 2.11 gives the numbers of blowouts resulting in pollution worldwide and for selected geographical areas, taken from SINTEF’s blowout database [6]. Categorisation of spill size is from this database. Table 2.12 gives the fractions of all blowouts that result in pollution, overall and by spill size category.

Table 2.11 Blowouts Resulting in Pollution, by Geographical Area, 1970 – 2007 [6]

Location	Total No. of Blowouts	Blowouts with Pollution				
		Large	Medium	Small	Unknown	Total
UK	30	0	0	0	0	0
Norway	34	1	0	1	1	3
D/DK/NL	2	0	0	0	0	0
North Sea*	66	1	0	1	1	3
US GoM	273	5	9	40	9	63
Worldwide	498	22	11	56	39	128

* Includes UK West of Shetland

Table 2.12 Fractions of Blowouts with Pollution, by Geographical Area, 1970 – 2007 [6]

Location	Fraction of Blowouts w. Pollution	Fraction of Blowouts with Defined Spill Size		
		Large	Medium	Small
UK	0	-	-	-
Norway	0.088	0.50	0.00	0.50
D/DK/NL	0	-	-	-
NS/WoS	0.045	0.50	0.00	0.50
US GoM	0.23	0.09	0.17	0.74
Worldwide	0.26	0.25	0.12	0.63

Table 2.13 gives details of large spills (defined here as > 1000 BBL) in the US Gulf of Mexico during 1970 – 2007, excluding those resulting from Hurricane Rita on 24/09/2005, which are given separately in Table 2.14 and Figure 2.2 shows the corresponding proportions of incidents and spill volumes by material spilt.

Table 2.13 Large Spills (> 1000 BBL) from Platforms in the US Gulf of Mexico, 1970 – 2007 [2]

Date	Spill Size (BBL)	Material	Operation
01/12/1970	53,000	Oil ¹	Completion/Workover
10/02/1970	30,000	Oil ¹	Production
17/04/1974	19,833	Oil	Pipeline
07/02/1988	15,576	Oil	Pipeline/Marine Vessel
24/01/1990	14,423	Condensate	Pipeline
09/01/1973	9,935	Oil	Production
29/09/1998	8,212	Oil	Pipeline
26/01/1973	7,000	Oil	Production
11/12/1981	5,100	Oil	Pipeline/Marine Vessel
24/09/2005 ²	5,066 ²	Condensate + Diesel	Production + Drilling
12/05/1973	5,000	Oil	Pipeline
06/05/1990	4,569	Oil	Pipeline
16/11/1994	4,533	Condensate	Pipeline
18/12/1976	4,000	Oil	Pipeline
11/09/1974	3,500	Oil	Pipeline
23/07/1999	3,200	Oil	Pipeline
01/03/2002	3,000	SBM ²	Drilling
21/01/2000	2,240	Oil	Pipeline
31/08/1992	2,000	Oil	Pipeline
23/11/1979	1,500	Diesel	Drilling/Marine Vessel
19/01/2000	1,440	SBM ³	Drilling
21/05/2003	1,421	SBM ³	Drilling
14/11/1980	1,456	Oil	Production
26/01/1998	1,211	Condensate	Pipeline/Marine Vessel
21/10/2007	1,061	SBM ³	Drilling
11/04/2004	1,034	SBM ³	Drilling
Totals			
Number	Spill Size (BBL)	Material	Average Spill Size (BBL)
16	174,621	Oil	10,914
1	1,500	Diesel	1,500
3	20,167	Condensate	6,722
5	7,956	SBM	1,591
25	204,244	All	8,170

¹ Blowout incident

² Hurricane Rita: total spill of 5,066 (BBL) comprised 3 spills as listed in Table 2.14

³ SBM = Synthetic Based Mud

Table 2.14 Detail of Spills Resulting from Hurricane Rita [2]

Date	Spill Size (BBL)	Material	Operation
24/09/2005	2,000	Condensate	Production
24/09/2005	1,572	Diesel	Drilling
24/09/2005	1,494	Diesel	Drilling
Total	5,066		

Figure 2.2 Proportions of Incidents and Spill Volumes by Material Spilt

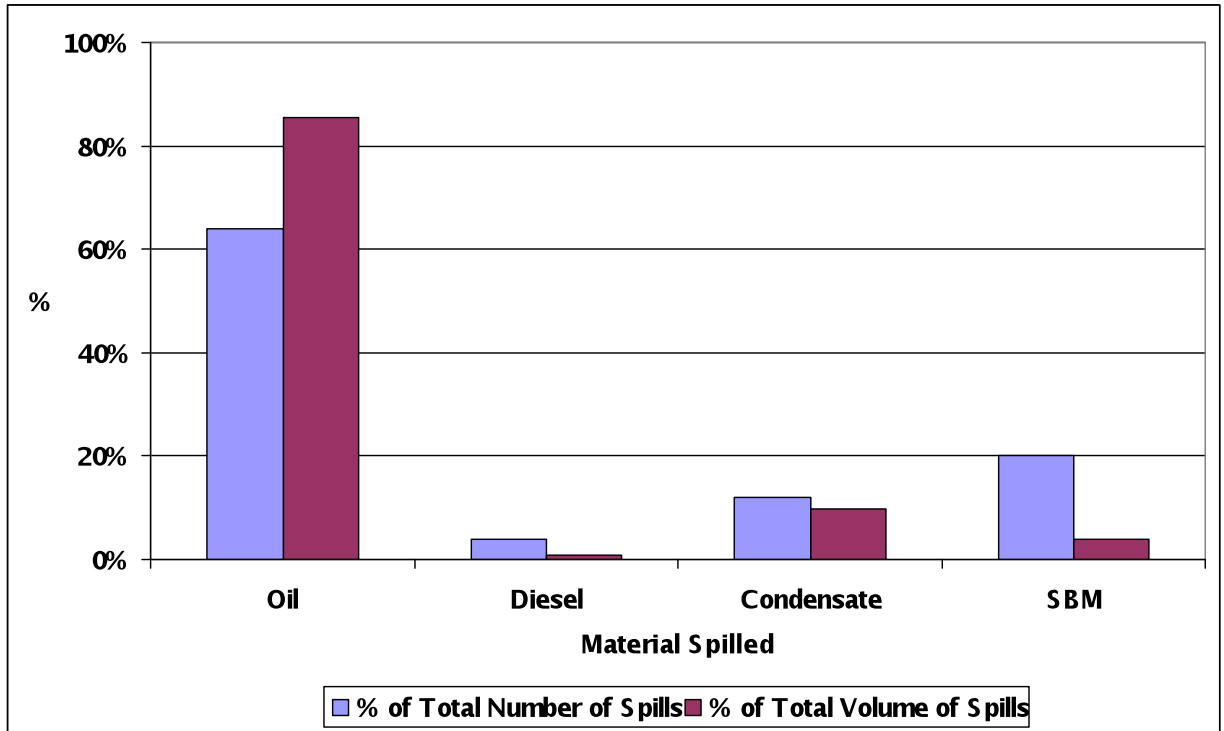


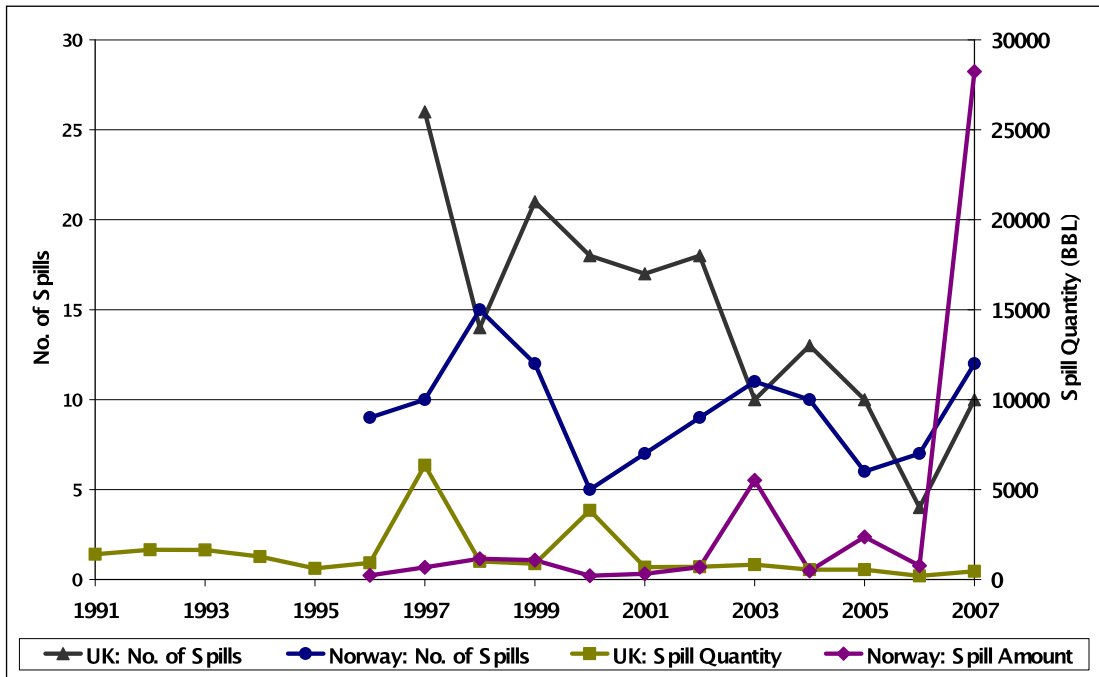
Table 2.15 and Figure 2.3 present data on all spills offshore UK and Norway by year.

Table 2.15 Spills by Year Offshore UK (1991 – 2007) [3] and Norway (1996 – 2007) [4]

Year	United Kingdom		Norway	
	Number of Spills	Spill Size (BBL)	Number of Spills	Spill Size (BBL)
1991	N/A	1,407	N/A	N/A
1992	N/A	1,649	N/A	N/A
1993	N/A	1,642	N/A	N/A
1994	N/A	1,275	N/A	N/A
1995	N/A	616	N/A	N/A
1996	N/A	931	9	227
1997	26	6,348	10	680
1998	14	1,004	15	1,158
1999	21	880	12	1,076
2000	18	3,841	5	214
2001	17	689	7	314
2002	18	704	9	686
2003	10	828	11	5,518
2004	13	550	10	483
2005	10	551	6	2,372
2006	4	195	7	768
2007	10	459	12	28,238*

* This includes a large oil spill from the Statfjord field caused by the rupture of a loading hose on the Offshore Loading System. An estimated 27,500 barrels of oil was pumped into the sea amounting to 99% of the total oil spilled in 2007. This is the second-largest spill in Norwegian petroleum history.

Figure 2.3 Spills by Year in UK (1991 – 2007) [3]and Norway (1996 – 2007) [4]



2.1.3.2 Tanker spills

Table 2.16 presents data on major tanker spills worldwide since 1970, comprising those of the ITOPF [5] “top 20” tanker spills during this period (only the *Torrey Canyon* incident of 1969 is thereby omitted from the ITOPF “top 20”) and other significant tanker spill incidents.

Table 2.16 Major Tanker Spills Worldwide 1970 – 2007 ([5] and others)

Date	Tanker	Spill Location	Spill Size (te)
19/07/1979	<i>Atlantic Empress</i>	Off Tobago, West Indies	287,000*
28/05/1991	<i>ABT Summer</i>	700 nautical miles off Angola	260,000
06/08/1983	<i>Castillo de Bellver</i>	Off Saldanha Bay, South Africa	252,000
16/03/1978	<i>Amoco Cadiz</i>	Brittany, France	223,000
11/04/1991	<i>Haven</i>	Genoa, Italy	144,000
10/11/1998	<i>Odyssey</i>	700 nautical miles off Nova Scotia, Canada	132,000
19/12/1972	<i>Sea Star</i>	Gulf of Oman	115,000
07/12/1971	<i>Texaco Denmark</i>	Belgium, North Sea	107,140
23/02/1980	<i>Irenes Serenade</i>	Navarino Bay, Greece	100,000
12/05/1976	<i>Urquiola</i>	La Coruna, Spain	100,000
23/02/1977	<i>Hawaiian Patriot</i>	300 nautical miles off Honolulu	95,000
15/11/1979	<i>Independenta</i>	Bosphorus, Turkey	95,000
29/01/1975	<i>Jakob Maersk</i>	Leixoes, Portugal	88,000
05/01/1993	<i>Braer</i>	Shetland Islands, UK	85,000
19/12/1989	<i>Khark 5</i>	120 nautical miles off Atlantic coast of Morocco	80,000
03/12/1992	<i>Aegean Sea</i>	La Coruna, Spain	74,000
15/02/1996	<i>Sea Empress</i>	Milford Haven, UK	72,000
17/04/1992	<i>Katina P</i>	Off Maputo, Mozambique	72,000
06/12/1985	<i>Nova</i>	Off Kharg Island, Gulf of Iran	70,000
13/11/2002	<i>Prestige</i>	Off Galicia, Spain	63,000
13/05/1975	<i>Epic Colocotronis</i>	USA, Caribbean Sea	61220
24/03/1999	<i>Exxon Valdez</i>	Prince William Sound, Alaska, USA	37,000
11/12/1999	<i>Erika</i>	Bay of Biscay, off Brittany Coast	20,000

* This comprised 2 separate spills of approximately 145,000 te on 19/07/1979 and 141,000 te on 02/08/1979 following repairs.

2.2 Major onshore accidents

2.2.1 Major onshore accidents resulting in significant fatalities

The MHIDAS database [13] was searched for all accidents involving fatalities. The data searched cover the period from 1970 onwards², in which period a total of 13,502 accidents involving dangerous substances resulting in a total of 21,785 fatalities are recorded.

Table 2.17 lists all accidents resulting 10 or more fatalities along with the material(s) involved, the source of the event, and event descriptors.

² Accidents up to the end of 2005 are covered by the database made available to DNV: see Section 4.2.

Table 2.17 Top Onshore Incidents Listed in Decreasing Order of Fatalities Involved: Worldwide, 1970 – 2005 (mainly [13])

Accident Date (dd/mm/yyyy)	Location	Material name	Source	Event (Note 1)	No. of Fatalities	No. of Injuries	Country	Notes
3/12/1984	Bhopal, Madhya Pradesh	Methyl Isocyanate	Process: Pressurised	Continuous Release; Fireball	>2000	>170,000	India	1
2/11/1994	Dronka	Aircraft Fuel	Storage: Atmospheric	Continuous Release; Fire	>580		Egypt	3
19/11/1984	San Juan Ixhuatepec, Mexico City	LPG	Storage: Pressurised Storage	BLEVE	>500	2500	Mexico	
23/12/2003	Gao Qiao, Chongqing	Natural Gas, Hydrogen Sulphide (Sour Gas)	Gas Well	Blowout; Continuous Release	243	4000-9000	China	
19/12/1982	Tacoa	Fuel Oil	Transfer: Atmospheric Storage	Explosion; Instantaneous Release	>153	500	Venezuela	
14/9/1997	Visakhapatnam, Andhra Pradesh	LPG, Kerosene, Petroleum Products, Crude Oil	Transfer: Pipework	Explosion; Fire	56	20	India	
24/1/1970	Semarang, Java	Kerosene	Storage: Pipework	Fire; Tank Fire	50		Indonesia	4
6/1/1998	Xingping, Shaanxi	Nitrogen	Process: Pipework	Explosion	50	100	China	
8/1/1979	Bantry Bay, Cork	Crude Oil	Transfer: Ship	Explosion; Fireball	50		Eire	5
24/3/1992	Dakar	Ammonia	Process	Explosion; Fire	41	403	Senegal	6
10/2/1973	Staten Island, New York	Natural Gas	Storage: Atmospheric	Confined Explosion; Fire	40	2	Usa	
30/3/1972	Duque De Caxias, Rio De Janeiro	LPG	Storage: Pressurised	BLEVE; Fire	39	51	Brazil	
17/8/1999	Korfez, Gulf Of Izmit	Crude Oil, Naphtha	Process	Fire; Continuous Release	37		Turkey	
9/11/1988	Bombay	Toluene, Benzene, Naphtha	Storage: Atmospheric	Fire; Explosion	35	16	India	
26/6/1971	Czechowice	Oil	Storage: Atmospheric	Explosion; Fire	33		Poland	
6/11/1990	Maharastra, Bombay	LPG	Process: Pipework	Continuous Release; Unconfined Explosion	<31	>30	India	
21/9/2001	Toulouse	Ammonium Nitrate, Ammonia, Chlorine	Storage: Atmospheric	Explosion	30	2500	France	
1/6/1974	Flixborough, Lincolnshire	Cyclohexane	Process: Pipework	Continuous Release; Unconfined Explosion	28	89	UK	
22/10/1988	Shanghai	LPG	Process	Unconfined Explosion; Fire	25	17	China	
20/10/1995	Colombo	Diesel, Kerosene, Crude Oil	Storage: Atmospheric	Explosion; Fire	<25		Sri Lanka	7
19/1/2004	Skikda	LNG	Process: Heat Exchangers	Fire	23	74	Algeria	
23/10/1989	Pasadena, Texas	Isobutane	Process: Reactor	Unconfined Explosion;	23	125	USA	

RADD – Major accidents

Accident Date (dd/mm/yyyy)	Location	Material name	Source	Event (Note 1)	No. of Fatalities	No. of Injuries	Country	Notes
				Fire				
??/1972	Weirton, West Virginia	Propane	Process	Confined Explosion	21	20	USA	8
9/12/1977	Cartagena	Ammonia	Process: Reactor	Explosion; Release	21	30	Colombia	
26/6/1996	Nr Tianjin	Chemicals (unspecified)	Process	Explosion	19	20	China	
23/3/1979	Beira, Sofala	Oil	Storage: Atmospheric	Tank Fire; Fire	19		Mozambique	9
13/7/1979	Taipei	Resin	Storage	Dense Phase Explosion; Fire	18	59	Taiwan	10
13/7/1973	Potchefstroom, Natal	Ammonia	Transfer: Pressurised Storage	Instantaneous Release; Dense Gas Cloud	18	65	South Africa	
5/7/1990	Channelview, Texas	Hydrocarbons	Waste: Atmospheric Storage	Explosion; Fireball	17	5	USA	
1/11/1986	Devnya,	Vinyl Chloride	Process: Pipework	Explosion; Fire	17	19	Bulgaria	
??/7/1984	Chicago, Illinois	Propane, Monoethanolamine	Process: Process Vessels	Instantaneous Release; Explosion	17	17	USA	
23/5/1984	Abbeystead, Lancashire	Methane	Process	Explosion	16	28	UK	11
13/8/1989	Qingdao,	Oil	Storage	Explosion; Tank Fire	16	86	China	
5/8/1993	Qingshuihe, Guangdong	Sulphur, Organophosphorus, Ammonium Nitrate, LPG	Warehouse	Explosion; Fire	>15	>160	China	12
23/3/2005	Texas City, Texas	Octanes	Process: Process Vessels	Explosion; Fire	15	>100	USA	
23/7/1984	Romeoville, Illinois	Propane	Process: Reactor	Unconfined Explosion; BLEVE	15		USA	
13/10/1974	,	Crude Oil	Transfer: Ship	Explosion; Fire	15	4	Sumatra	13
??/6/1974	Zaluzi,	Ethylene	Process	Explosion	14	79	Czechoslovakia	
25/8/1977	Cairo,	Butane	Process	Release	14	6	Egypt	14
7/11/1975	Beek,	Propylene	Process: Pipework	Dense Gas Cloud; Unconfined Explosion	14	107	Netherlands	
1/9/1992	Eleusis,	Crude Oil	Process: Pipework	Explosion; Fire	14	>30	Greece	
2/6/1979	Sajobabony,	Chemicals (unspecified)	Process	Explosion; Fire	13	6	Hungary	
4/10/1989	Yochon, Cholla Namdo	Chemicals	Process	Explosion; Fire	13	19	South Korea	15
18/3/1990	Tehran,	Gas	Storage	Explosion; Fire	13	>1	Iran	16
8/7/2002	Shenxian, Shandong Province	Ammonia	Process: Pipework	Continuous Release	13	11	China	
??/1976	Chalmette, Louisiana	Ethyl Benzene	Process: Process Vessels	Explosion; Fire	13		USA	
5/7/1973	Kingman, Arizona	Butane	Transfer: Rail Tanker	Continuous Release; BLEVE	13	95	USA	17
7/4/1974	Fort Miffin, Pennsylvania	Crude Oil	Transfer: Ship	Fire; Explosion	13	8	USA	18

RADD – Major accidents

Accident Date (dd/mm/yyyy)	Location	Material name	Source	Event (Note 1)	No. of Fatalities	No. of Injuries	Country	Notes
30/1/1989	Secunda, Transvaal	Oil	Process: Pipework	Explosion; Fire	12	8	South Africa	
25/3/1993	Maracaibo,	Natural Gas	Process	Explosion; Fire	11	>1	Venezuela	
26/5/1992	Haryana,	Ammonia	Process: Pipework	Release	11	9	India	
7/9/1992	Haryana,	Ammonia	Process: Pipework	Explosion	>11	9	India	
??/3/1984	, Lagos	Kerosene	Process	Explosion	10		Nigeria	
??/2/1979	Risa,	Petrol	Process	Confined Explosion; Fire	10		Germany	
22/6/1981	Rocklin, California	Gasoline	Storage: Atmospheric	Release	10		USA	

Notes

1. Events are presented as given in MHIDAS.
2. Fatalities/injuries estimated from various sources.
3. Military depot tanks struck by lightning and flaming fuel spread through flooded town.
4. Tank fire caused by theft from pipeline after torch ignited leak from pipeline.
5. Explosion on vessel during unloading.
6. Ammonia tank in peanut plant.
7. Bomb attack.
8. Coking works.
9. Guerilla attack.
10. Resin factory.
11. Water pumping station.
12. Warehouse fire spread to LPG tank.
13. Explosion on ship during loading.
14. Butane bottling factory
15. Unclear from description if plastics goods factory or acrylonitrile plant.
16. Underground gas storage facility.
17. Rail tanker BLEVE during unloading.
18. Explosion on ship - not clear from description if vessel was loading/unloading at time of incident.

2.2.2 Major onshore accidents resulting in significant property damage

Table 2.18 presents data on major onshore accidents in the hydrocarbon-chemical industry during 1970 to 2001 resulting in significant property damage as measured by the cost, taken from [6] (the most recent compilation of data). The loss amounts include property damage, debris removal and cleanup costs while the costs of business interruption, extra expense, employee injuries and fatalities, and liability claims are excluded.

These data do not include the Texas City disaster of 23/03/2005. The cost of this has been reported [9] as USD 305M; however, the basis of this sum may not be comparable to the values presented in Table 2.18, which are strictly property damage losses.

Table 2.18 Top Property Damage Losses in the Hydrocarbon-Chemical Industry, 1970 – 2001 [7],[8]

Date	Name of Unit	Type of Unit	Operating Mode	Main Event	Cost (10⁶ USD Actual)	Cost (10⁶ USD 2002)	Area
23/10/1989	High Density Polyethylene Reactor	Petrochem	Operating	Explosion	675	869	USA
21/09/2001	Ammonium Nitrate Storage Warehouse	Petrochem	Storage	Explosion	750	750	Europe
25/06/2000	Condensate Line	Refinery	Transfer	Explosion	412	433	Middle East
05/05/1988	Fluid Catalytic Cracking Unit	Refinery	Operating	Explosion	255	336	USA
09/11/1992	Fluid Catalytic Cracking Unit	Refinery	Operating	Explosion	260	318	Europe
25/12/1997	Air Separation Unit	Gas Processing	Operating	Explosion	275	294	Asia
14/11/1987	Butane Oxidation Reactor	Petrochem	Startup	Explosion	215	288	USA
23/07/1984	Monoethanolamine Absorber Column	Refinery	Operating	Explosion	191	275	USA
16/10/1992	Hydrodesulphurization Unit	Refinery	Startup	Explosion	161	196	Asia
01/06/1974	Cyclohexane Oxidation Reactor	Petrochem	Operating	Explosion	62	182	Europe
03/04/1977	Refrigerated Propane Storage	Gas Processing	Storage	Fire	76	179	Middle East
25/09/1998	Gas Processing Plant	Gas Processing	Operating	Explosion	160	171	Australia
26/07/1996	Cryogenic Unit	Gas Processing	Operating	Explosion	136	148	Central America
13/12/1994	Ammonium Nitrate Unit	Petrochem	Operating	Explosion	120	141	USA
01/09/1979	Ethanol Storage Tank/DWT Tanker	Refinery	Transfer	Explosion	68	138	USA
09/04/2001	Visbreaker Unit	Refinery	Maintenance	Fire	130	134	Central America
01/05/1991	Nitroparaffin Unit	Petrochem	Operating	Explosion	105	129	USA
23/04/2001	Coker Unit	Refinery	Operating	Fire	120	124	USA
30/05/1978	Alkylation Tank Farm	Refinery	Storage	Fire	55	120	USA
27/05/1994	Synthetic Rubber Reactor	Petrochem	Operating	Explosion	100	118	USA
15/04/1978	Gas Transmission Pipeline	Gas Processing	Transfer	Explosion	54	117	Middle East
05/12/1970	Hydrocracking Unit	Refinery	Operating	Explosion	27	114	USA

RADD – Major accidents

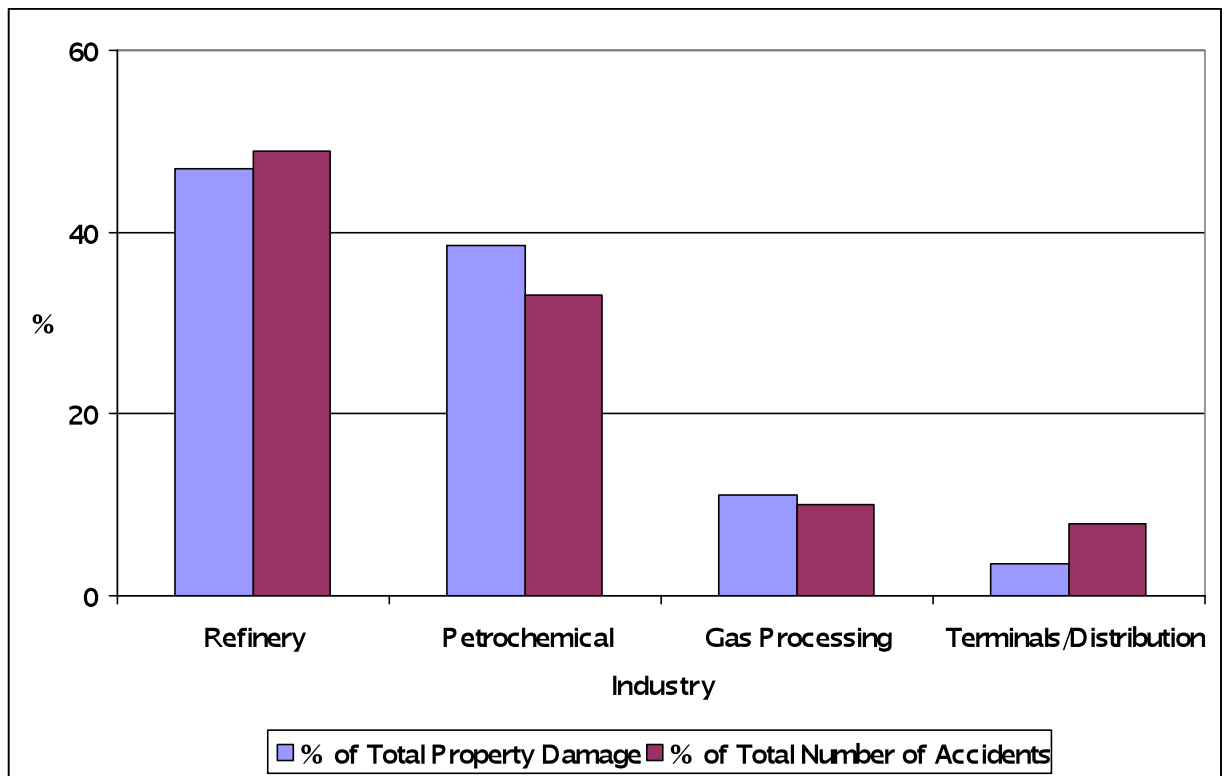
Date	Name of Unit	Type of Unit	Operating Mode	Main Event	Cost (10⁶ USD Actual)	Cost (10⁶ USD 2002)	Area
11/03/1991	Vinyl Chloride Plant	Petrochem	Operating	Explosion	91	112	Central America
10/04/1989	Hydrocracker Unit	Refinery	Shutdown	Fire	87	112	USA
21/10/1980	Polypropylene Reactor	Petrochem	Maintenance	Explosion	60	111	USA
16/05/2001	Polyacrylates Plant	Petrochem	Operating	Fire	109	109	Europe
15/08/1984	Fluid Bed Coking Unit	Refinery	Operating	Fire	76	109	Canada
22/06/1997	Olefins Unit	Petrochem	Operating	Explosion	100	108	USA
22/03/1987	Hydrocracking Unit	Refinery	Startup	Explosion	79	107	Europe
07/03/1989	Aldehyde Column	Petrochem	Operating	Explosion	77	99	Europe
12/03/1991	Ethylene Oxide Unit	Petrochem	Operating	Explosion	80	98	USA
08/10/1992	Hydrogen Processing Unit	Refinery	Operating	Explosion	73	96	USA
19/05/1985	Ethylene Plant	Petrochem	Operating	Fire	65	93	Europe

Table 2.19 presents a summary of the top 100 onshore incidents during 1972 – 2001 (i.e. over the 30 years preceding publication) [8]; Figure 2.4 presents this information graphically.

Table 2.19 Summary of Top 100 Major Onshore Incidents, 1972 – 2001 [8]

Industry	Total Loss (10 ⁶ USD 2002)	Percent of Total USD	No. (and %) of Incidents
Refining	4,958	47	49
Petrochemical	4,072	38.5	33
Gas Processing	1,170	11	10
Terminals/Distribution	363	3.5	8
Total	10,563	100	100

Figure 2.4 Breakdown of Top 100 Major Onshore Incidents by Type of Unit, 1972 – 2001 [8]



3.0 Guidance on use of data

3.1 General validity

The information presented in Section 2.0 is taken from data sources believed to be the most comprehensive available. Nevertheless, it cannot be taken to be complete for all worldwide locations, for the reasons set out in Section 4.0. It is intended to give an overview of the types of accident that have occurred and the types of unit involved, and to provide limited indications of relative likelihoods for different types of unit, operation mode, main event, variation over time, and geographical area. However, it should not be used by itself to estimate absolute frequencies as the corresponding exposure data are not given. Rather, as stated in Section 1.1, the information presented is background historical information on major accidents in the onshore and offshore oil and gas production and process industries, to serve as background information for QRA studies.

3.2 Uncertainties

Regarding the completeness of the information with respect to major offshore accidents, see Section 4.1.

For offshore tanker spills, various data sources have been cross-checked with the primary source, ITOPF statistics [5]: spill quantities do not always match and, in these cases, the ITOPF data have been taken as definitive.

4.0 Review of data sources

4.1 Major offshore accidents

The *Worldwide Offshore Accident Databank* (WOAD) project was launched in 1983 and at present [1] includes accident data from 1970 to 2007 inclusive. The database is maintained by DNV, which collects data on major offshore accidents from public sources worldwide. Although the database attempts to cover worldwide accidents, there are areas of the world for which limited information is available, e.g. countries with a fully state-owned offshore industry. For such areas only accidents to units owned by private, foreign operators is normally known.

Whereas WOAD provides good data on fatalities and damage levels, it has only limited data on pollution incidents, hence other, national, sources have been used to obtain the pollution incident data presented in Section 2.1.3 for the US Gulf of Mexico [2], offshore United Kingdom [3] and offshore Norway [3] (with supplementary data from [10]). SINTEF's blowout database [6] indicates whether pollution occurred and, where information was available, categories the pollution as "Small", "Medium", "Large", "Unknown", and "None"; however, it does not define these categories quantitatively. For the purposes of determining the fraction of blowouts resulting in pollution (Table 2.12), it has been assumed that some pollution resulted where the category is "Unknown".

Tanker accident data has been taken principally from ITOPF [5] with additional data from [11].

4.2 Major onshore accidents

The accident data presented in Table 2.17 are taken almost entirely from MHIDAS [13], one of the most authoritative databases of accidents in the onshore energy and process industries. Compilation of MHIDAS commenced in the 1980s, however information on selected accidents before that time were included as available.

Two editions of Marsh's (formerly Marsh & McLennan) regular publications of major onshore property damage incidents have been used, from 1995 [7] and 2003 [8]. These provide property damage values, both actual and on a common USD basis (1993 USD in [7]; 2002 USD in [8]; the 1993 values have been updated to 2002), as well as brief accident descriptions.

5.0 Recommended data sources for further information

The sources referenced in Section 4.0 may be consulted for additional information, especially:

WOAD [1] for offshore accidents in general, and in particular for accidents causing fewer than 10 fatalities (cf. Section 2.1.1, Table 2.1).

MMS [2] for offshore pollution accidents and other offshore accidents

OLF [4] for discharges and emissions offshore Norway

ITOPF [5] for tanker spills

SINTEF [6] for comprehensive data on blowouts (requires licence to download and access)

MHIDAS [13] for further information on major onshore incidents up to the end of 2005.

Marsh [7] for further information on major onshore property damage incidents

JLT [9] for insurance costs of losses in upstream, downstream and power generation and also losses from hurricanes Katrina, Rita and Wilma in 2005

MHIDAS is now maintained by AEA Technology, who should be contacted for further information (<http://www.aeat.co.uk/cms/locations-office/>). TNO's FACTS database contains information on more than 23,000 (industrial) accidents involving hazardous materials that have happened all over the world during the past 90 years. It is available online (<http://www.factsonline.nl/>) but requires a licence to obtain detailed information such as numbers of fatalities and injuries.

6.0 References

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