

European downstream oil industry safety performance

Statistical summary of
reported incidents – 2016



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ABSTRACT

The twenty-third annual report on European downstream oil industry safety performance presents work-related personal injuries for the industry's own employees and contractors and process safety performance indicators. Information was received from 38 Concaawe Member Companies representing approximately 99% of the European refining capacity. In 2016, there were two fatalities in the industry. While this is the lowest number of annual fatalities since Concaawe began compiling industry records in 1993, we must consider this two too many. Lost Workday Injuries fell from 546 to 501, a drop of approximately 8%. The number of Tier 1 and 2 process safety releases continues to decline but the rate of decline per annum appears to be slowing (total count of 287 in 2015 down to 282 in 2016).

INTERNET

This report is available as an Adobe pdf file on the Concaawe safety publications website (<https://www.concaawe.eu/publications/concaawe-reports/>).

NOTE

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EXECUTIVE SUMMARY

For 2016, information was received from 38 Concaawe Member Companies, together accounting for 99% of the available refining capacity in the EU-28, Norway and Switzerland. The purpose of collecting this data is twofold.

- To provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their safety management systems, identify shortcomings, and take corrective actions.
- To demonstrate that the responsible management of safety in the downstream oil industry results in a low level of accidents despite the hazards intrinsic to its operations.

The aggregated 2016 results for Manufacturing, Marketing and the combined downstream industry are shown in the table below.

Table Aggregated 2016 results for all reporting companies

All reporting companies Sector	Manufacturing			Marketing			Both Sectors		
	OS	CT	AW	OS	CT	AW	OS	CT	AW
Work Force									
Hours worked Mh	112	171	283	153	123	275	265	293	558
Fatalities	0	2	2	0	0	0	0	2	2
FAR - FA/100Mh	0.0	1.2	0.7	0.0	0.0	0.0	0.0	0.7	0.4
LWI	139	113	252	143	106	249	282	219	501
Lost time through LWI - Days	4,725	4,119	8,844	3,266	3,095	6,361	7,991	7,214	15,205
LWIF - LWI/Mh	1.2	0.7	0.9	0.9	0.9	0.9	1.1	0.7	0.9
LWIS [*] - Lost days/LWI	34.5	42.5	37.5	24.6	37.3	29.4	29.6	39.6	33.6
AI	236	255	491	265	138	403	501	393	894
AIF - AI/Mh	2.1	1.5	1.8	1.7	1.1	1.5	1.9	1.4	1.6
Distance travelled - million km							252	579	831
RA							198	145	343
RAR ⁺ - RA/million km							0.8	0.2	0.4

* LWI severity is calculated for those LWI where lost days are reported

+ RAR is calculated for those RA where distance is reported

OS: Own staff; CT: Contractors; AW: All workers

There were 2 fatalities reported for 2016, both were contractors working in Manufacturing. This is the lowest annual number of fatalities in the industry since Concaawe began collating membership data in 1993.

Fatalities are a relatively rare occurrence in the downstream industry. Consequently, the membership study Lost Workday Injuries (LWI) to identify further opportunities for continuous safety performance improvement. A total of 501 LWIs were reported in 2016 (546 in 2015) and 492 of these were allocated to the agreed 12 causal categories within the membership company submissions. As in previous years, a relatively small number of causal factors, including 'slips and trips (same height)' and 'overexertion, strain' contribute to most LWIs reported.

In 2009, the Safety Management Group of Concaawe decided to expand the scope of industry wide safety performance indicators to address process safety, aligned to the reporting guidelines that were developed by the API [23, 24]. For 2016, 33 companies submitted Process Safety Event (PSE) data for the Manufacturing operations and 14 submitted Marketing PSE data. The 2016 PSE data represents 33 out of 37 (89%) of reporting companies in manufacturing and 93% of the total manufacturing exposure hours reported. The annual reduction on Tier 1 and 2 PSE events seen since 2011 appears to be slowing and may have plateaued.

1. INTRODUCTION TO 2016 REPORT

The collection and analysis of incident data is widely recognised by the hydrocarbon industry as an essential element of an effective safety management system.

Concaawe started compiling statistical data for the European downstream oil industry in 1993 and this is the twenty-third report on this topic (see references of past reports in the reference list [1-22]). This report covers data collected for 2016 as well as a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available. For 2016, information was received from 38 Concaawe Member Companies, together accounting for 99% of the available refining capacity in the EU-28, Norway and Switzerland. From the outset, most Concaawe member companies have participated so that the report has always represented a large portion of the industry and by 1995 the report represented ~93% of European refining capacity (somewhat less for distribution and retail). Over the years, the level of representation has fluctuated in line with the structural changes and mergers occurring in the industry.

The term “downstream” represents all activities of the Industry from receipt of crude oil to products sales, through refining, distribution, and retail. Not all companies operate in both the manufacturing and marketing areas and not all companies are able to supply all the requested data. All those who do, collect data separately for “Manufacturing” (i.e. refining) and “Marketing” (i.e. distribution, retail and “head office” staff) and this split has been applied in the report. The data is also split between company and contractor staff as contractor statistics are normally fully integrated in to the companies’ safety monitoring systems. Some companies do not record road accidents separately from other incidents. All companies record own staff injuries against the Manufacturing and/or Marketing categories but this is not always the case for lost days. Contractor data is in general, less complete than company staff data. Where data are not available directly, Members are requested to present the best estimate possible.

The purpose of collecting this data is twofold.

- To provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their safety management systems, identify shortcomings, and take corrective actions.
- To demonstrate that the responsible management of safety in the downstream oil industry results in a low level of accidents despite the hazards intrinsic to its operations.

Several key performance indicators have been adopted by most oil companies operating in Europe as well as by other industries. Although there are differences in the way member companies collect base data these common indicators allow for an objective comparison at the industry level. The differences in precise definitions used and in local interpretation of metrics means that direct comparison of data from individual companies could lead to erroneous conclusions. For this reason, Concaawe does not report individual company data but rather aggregates at the membership level.

In 2009 Concaawe began to compile Process Safety Performance Indicator (PSPI) data. These describe the number of Process Safety Events (PSE) expressed as unintended Loss of Primary Containment (LOPC). The 2016 data represents 89% of the manufacturing companies that reported (33 out of 37) and these companies in turn represent 93% of the reported exposure hours in manufacturing. The number of respondents was increasing each year up to 2012 but now seems to have plateaued. Efforts are underway to improve the completeness of data to further increase the benchmark reliability.

In 2014, the members decided to commence collecting additional information in relation to the nature of Marketing retail operations. Companies have been asked to describe their retail operations as either Company Owned Company Operated (COCO), Company Owned Dealer Operated (CODO), Dealer Owned Company Operated (DOCDO) or Dealer

Owned Dealer Operated (DODO). Concaawe would like to improve the report in the data coverage for retail and transport contractors. In the 2016 report, only 6 member companies provided data for Company Owned Dealer Operated (CODO) retail sites, which does not fully reflect the operating reality in the industry.

Table 1 summarises the number of submissions and illustrates some key aspects of the data supplied by the companies.

Table 1 Number of companies submitting data for 2016

Reporting details	2016					
No of companies	Manufacturing ^b			Marketing		
	Own staff	Contractors	All workers	Own staff	Contractors	All workers
Submission	37	37		23	18	
Including						
Lost days	31	30		12	13	
All injuries	34	34		14	14	
Road accidents ^a	9	3		10	11	
Distance travelled	13	5		16	11	
Process Safety ^c			33			14
Retail Operations						
COCO						10
CODO						6
DOCO						3
DODO						6

- a) Several Companies do not report their Road accidents separately and these incidents are included in their overall statistics.
- b) One reporting member reported no refining activities in 2015 so in total there were 38 company submissions.
- c) For the first time in 2016, it has been assumed that a zero recorded against Process Safety events for the Marketing Sector indicates that the company has not collected the data unless a history of collecting data has been previously recorded. Consequently, the Marketing Sector's contribution to Process Safety statistics has dropped from 17 in 2015 to 14.

2. 2016 PERSONAL SAFETY PERFORMANCE RESULTS

The aggregated 2016 results for Manufacturing, Marketing and the combined downstream industry are shown in **Table 2**. Data is normally reported to one decimal place in recognition of the underlying variability in the source data.

Table 2 Aggregated 2016 results for all reporting companies

All reporting companies	Manufacturing			Marketing			Both Sectors		
Sector	OS	CT	AW	OS	CT	AW	OS	CT	AW
Work Force									
Hours worked Mh	112	171	283	153	123	275	265	293	558
Fatalities	0	2	2	0	0	0	0	2	2
FAR - FA/100Mh	0.0	1.2	0.7	0.0	0.0	0.0	0.0	0.7	0.4
LWI	139	113	252	143	106	249	282	219	501
Lost time through LWI - Days	4,725	4,119	8,844	3,266	3,095	6,361	7,991	7,214	15,205
LWIF - LWI/Mh	1.2	0.7	0.9	0.9	0.9	0.9	1.1	0.7	0.9
LWIS - Lost days/LWI	34.5	42.5	37.5	24.6	37.3	29.4	29.6	39.6	33.6
AI	236	255	491	265	138	403	501	393	894
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Distance travelled - million km							252	579	831
RA							198	145	343
RAR* - RA/million km							0.8	0.2	0.4

* LWIS is calculated for those LWI where number of lost days are reported

* RAR is calculated for those RA where distance is reported

OS: Own staff; CT: Contractors; AW: All workers

2.1. 2016 FATALITIES

There were 2 fatalities reported for 2016 (from 7 fatalities in both 2015 and 2014) and both were contractors working in Manufacturing. This is the lowest recorded annual number of fatalities in the industry since Concaawe began collating membership data in 1993.

Fatalities are becoming a relatively rare occurrence in the downstream industry and as such the opportunity for learning is changing. Consequently, the membership also study Lost Workday Injuries (LWI) to identify further opportunities for continuous safety performance improvement.

2.2. 2016 LOST WORKDAY INJURIES

It has long been accepted that to achieve a sustainable zero-fatality safety performance a company must continually work to reduce lower level safety incidents (such as restricted workday injuries, medical treatment cases, first aid cases and near misses). Although lower level incidents such as slips and trips can result in relatively minor consequences, the actual root causes behind both minor and major incidents generally prove to be very similar.

The effective investigation on all incidents (near miss, minor and major) to obtain a full understanding of their root causes is therefore essential for the creation of a supportive safety culture and the fostering of the right organisational behaviours necessary to achieve zero incidents or accidents in operations.

The Concaawe membership now collectively submit causal information for Lost Workday Injuries. A total of 501 LWIs were reported in 2016 and 492 of these were allocated to the agreed 12 causal categories within the membership company submissions. See **Table 3** for a breakdown of LWI submissions.

Table 3 Causes of LWIs in 2016

LWI 2016					
Causes		Manufacturing	Marketing	Combined	Percentage
Road accident	Road accident	2	18	20	4.1%
Height/Falls	Falls from height	19	17	36	7.3%
	Staff hit by falling objects	10	5	15	3.0%
	Slips & trips (same height)	63	85	148	30.1%
Burn/ electrical	Explosion or burns	29	7	36	7.3%
	Exposure electrical	2	0	2	0.4%
Confined space	Confined Space	1	0	1	0.2%
Other causes	Assault or violent act	0	15	15	3.0%
	Water related, drowning	0	0	0	0%
	Cut, puncture, scrape	14	14	28	5.7%
	Struck by	17	24	41	8.3%
	Exposure, noise, chemical, biological, vibration	10	7	17	3.5%
	Caught in, under or between	22	8	30	6.1%
	Overexertion, strain	30	45	75	15.2%
	Pressure release	5	1	6	1.2%
	Other	19	3	22	4.5%
	Total	243	249	492	100%

Note: Not allocated 9 LWIs, Manufacturing.

As in previous years, a relatively small number of causal factors contribute to most LWIs reported. Slips and trips (same height) and Overexertion, strain account for 45.3% of all LWIs reported in 2016.

Table 4 repeats the same data with percentages shown for both Manufacturing and Marketing. A similar pattern repeats in both sectors with the same causal factors contributing to 38% of Manufacturing LWIs and 52% of Marketing LWIs. Slight differences between the sectors then emerge as Explosions, burns; Caught in, under or between; Falls from height; contribute 29% in Manufacturing. In Marketing, it is Struck by; Road accident; Fall from height that contribute 24%. Road accidents are a significant cause of LWI in Marketing operations.

Concentrating on the causes of these incidents offers the opportunity to address prevention of Lost Workday Injury across both sectors.

Table 4 Causes of LWIs in 2016 split Manufacturing vs. Marketing.

LWI 2016					
Causes		Manufacturing	Percentage	Marketing	Percentage
Road accident	Road accident	2	0.8%	18	7.2%
Height/Falls	Falls from height	19	7.8%	17	6.8%
	Staff hit by falling objects	10	4.1%	5	2.0%
	Slips & trips (same height)	63	25.9%	85	34.1%
Burn/ electrical	Explosion or burns	29	11.9%	7	2.8%
	Exposure electrical	2	0.8%	0	0%
Confined space	Confined Space	1	0.4%	0	0%
Other causes	Assault or violent act	0	0%	15	6.0%
	Water related, drowning	0	0%	0	0%
	Cut, puncture, scrape	14	5.8%	14	5.6%
	Struck by	17	7.0%	24	9.6%
	Exposure, noise, chemical, biological, vibration	10	4.1%	7	2.8%
	Caught in, under or between	22	9.1%	8	3.2%
	Overexertion, strain	30	12.3%	45	18.1%
	Pressure release	5	2.1%	1	0.4%
	Other	19	7.8%	3	1.2%
Total		243	100%	249	100%

Note: Not allocated 9 LWIs, Manufacturing.

Table 5 shows the Lost Workday Injury frequency statistics broken down in to quartiles. This demonstrates a wide range of variability in performance between the top performing members (Quartile 1 – Q1) and the bottom performing members (Quartile 4 – Q4). Further analysis of the data over many years shows that the variability is consistently between member companies and not within one or more member company’s year to year submissions. For the most part these differences do not change much over the years. This reflects genuine levels of performance achieved by different member companies. It is also influenced by differences in the way companies monitor and classify incidents and collect their data.

Table 5 2016 LWIF quartile distribution ranges and average values for each quartile range

LWIF	Quartiles														
	Manufacturing			Marketing			Total own staff			Total contractors			Total downstream		
	low	high	average	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	0.45	0.21	0.00	0.00	0.00	0.00	0.52	0.10	0.00	0.40	0.13	0.00	0.52	0.29
Q2	0.45	1.25	0.79	0.00	0.47	0.21	0.52	1.40	0.81	0.40	0.86	0.54	0.52	1.18	0.76
Q3	1.25	3.21	1.75	0.47	1.66	0.81	1.40	3.21	2.11	0.86	1.44	1.15	1.18	2.40	1.76
Q4	3.21	5.89	4.39	1.66	11.66	3.74	3.21	7.94	5.54	1.44	13.07	4.46	2.40	5.89	4.19

The quartile distribution ranges and average values for each quartile for the 2016 All Injury Frequency (AIF) are shown in **Table 6**. The average performance indicator figures for the industry conceal a wide range of individual values between reporting companies.

Table 6 2016 AIF quartile distribution ranges and average values for each quartile range

Quartiles															
AIF	Manufacturing			Marketing			Total own staff			Total contractors			Total downstream		
	low	high	average	low	high	average	low	high	average	low	high	average	low	high	average
Q1	0.00	1.33	0.82	0.00	0.00	0.00	0.00	0.76	0.41	0.00	0.89	0.36	0.00	1.07	0.76
Q2	1.33	2.06	1.70	0.00	0.70	0.40	0.76	1.97	1.51	0.89	1.75	1.34	1.07	2.01	1.45
Q3	2.06	4.73	3.37	0.70	2.87	1.36	1.97	5.59	3.22	1.75	4.05	2.53	2.01	4.40	3.26
Q4	4.73	14.08	7.86	2.87	25.25	9.57	5.59	17.31	9.45	4.05	21.79	8.52	4.40	14.08	8.14

2.3. PERFORMANCE TRENDS 2007 TO 2016

Performance indicators are particularly useful for identifying trends and patterns when considered over time. The historical trends for the European downstream oil industry over the past 10 years are summarised in this section. Ten years has been chosen as a period reasonably representative of actual operating conditions and practices in place within the industry. For a full historical perspective, back to 1993, additional data tables are provided in **Appendix 2**.

Table 7 Fatalities by sector 2007-2016

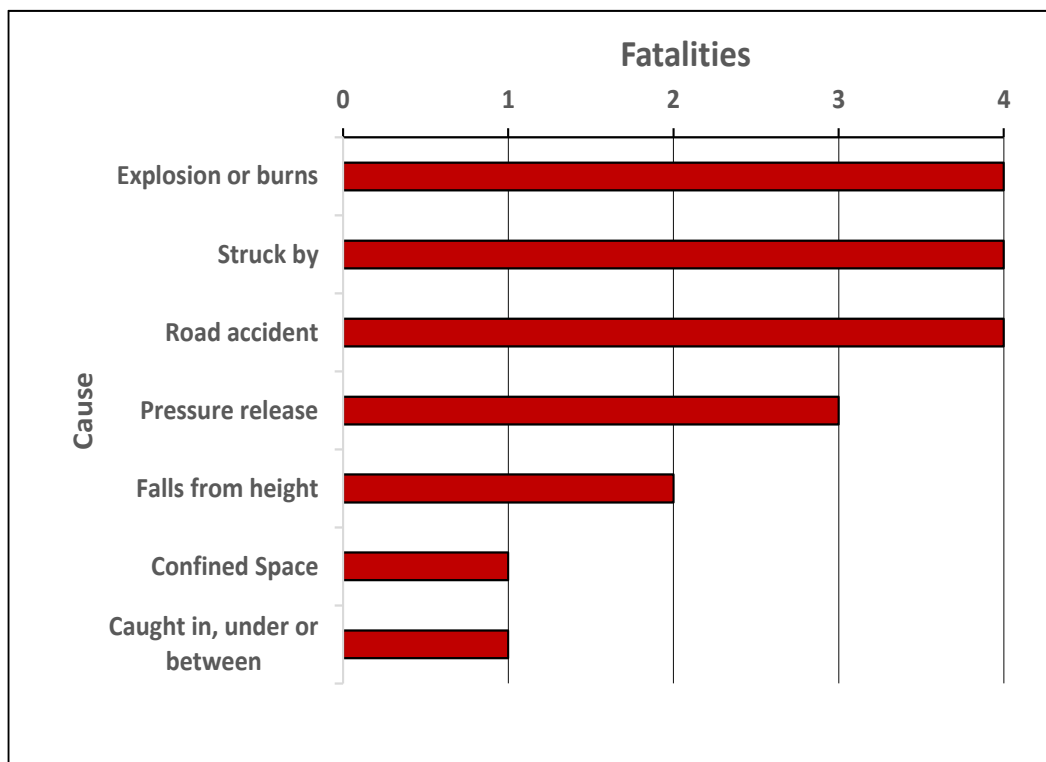
Fatalities over 10 years by sector			
Year	Manufacturing	Marketing	Total
2007	8	7	15
2008	5	6	11
2009	9	2	11
2010	11	3	14
2011	10	1	11
2012	4	6	10
2013	4	2	6
2014	6	1	7
2015	4	3	7
2016	2	0	2

Over the past 10 years there has been a steady reduction in the number of fatalities recorded in the European downstream oil industry with the improvement seen in both the Manufacturing and Marketing Sectors. This represents continuing improvement in the management of safety risks within the downstream oil industry.

In 2013, the membership agreed to adopt 16 cause categories to describe both fatalities and Lost Workday Injury (LWI) in an attempt to learn more from the actual incidents. These causal categories allow for better benchmarking and align with other industry organisations, particularly the IOGP that represents the upstream sector of the oil and gas industry. The Concaawe categorization of causes for fatalities and LWIs are further explained in **Appendix 1**.

Figure 1 summarizes the causes of all fatalities which were allocated a cause by the participating company in the period 2013 to 2016.

Figure 1 Number of fatalities by cause 2013-2016



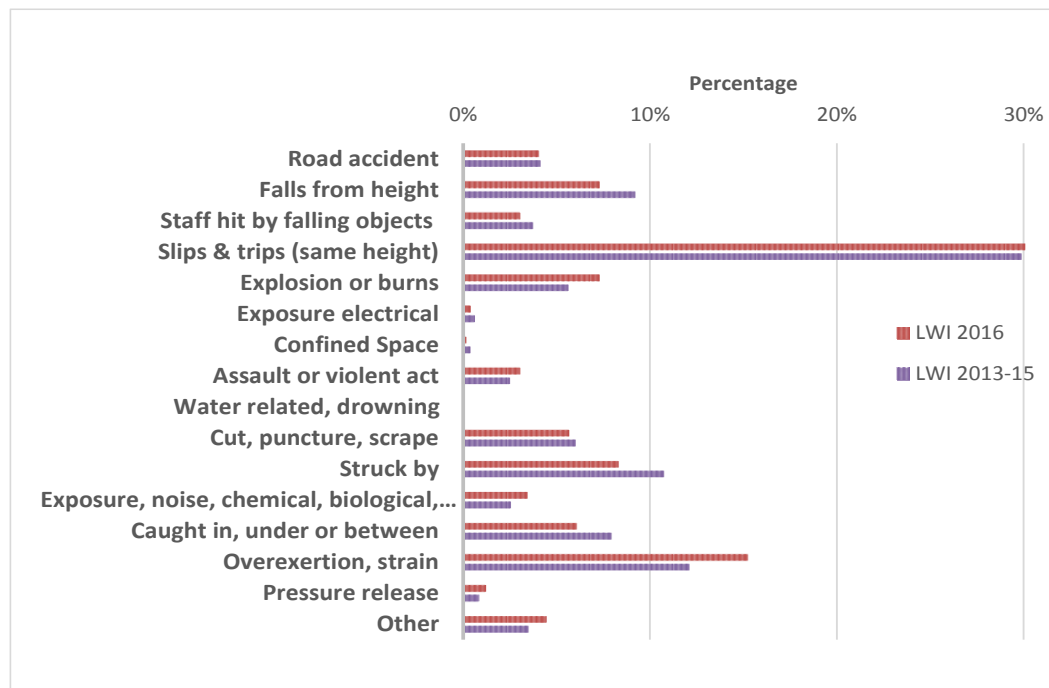
Since Concaawe moved to reporting fatalities against the same 16 causes as Lost Workday Injury in 2013, ‘explosions or burns’ (4 fatalities), ‘road accident’ (4 fatalities) and ‘struck by’ (4 fatalities) have been the largest contributors to fatalities in the industry. Together, the 3 causes account for nearly 55% of the fatalities experienced in the industry since 2013. Three fatalities in this period have not been allocated to a cause category.

Moving to new causal categories can make it more difficult to analyse data over longer periods of time. Until 2013 Concaawe compiled fatality data against broad causal categories that could change year to year. Expanding this to 16 provided for greater transparency of cause and better benchmarking, but risked losing information on longer term trends. However, by revisiting pre-2013 data a reasonably consistent pattern can be seen.

While road accidents are the largest single cause of fatalities 2007-16 (23%), they have declined as an overall percentage of all fatalities compared to 1997-2006 when they represented 46% of all fatalities. Falls from height account for 15% of fatalities over 2007-16 while Burn/electrical causes accounted for 15% of fatalities in the same period. Fire related causes also account for 15% of fatalities in the period 1997 to 2006. Concaawe data collected over 2008-16 describes 28% of fatalities as resulting from operations, maintenance and construction.

LWI causal data has only been available since 2013. A summary of the LWI results from 2013 to 2016 is shown in **Table A2-6 (Appendix 2)** and in **Figure 2**.

Figure 2 LWI causes in 2016 vs the period 2013-2016



Since Concaawe began collecting LWI data against the 16 causal categories in 2013 a pattern has been emerging in the data. As in fatalities, a limited number of causes contribute to most LWIs. In 2016, 74% of LWIs were caused by the following, Slips & Trips (same height) 30%, Overexertion, strain 15%, Struck by 8%, Explosion or burns 7%, Falls from height 7% and Caught in, under or between 6%. This pattern is broadly consistent year to year and similar across both Manufacturing and Marketing.

Figure 3 shows the historical evolution of the main performance indicators over the past 10 years. **Figures 4a** and **4b** show the FAR split for Manufacturing and Marketing and then again for company versus contract staff. The variability within this statistic is again demonstrated but it would seem to be clear for both Manufacturing and Marketing that contract road transport operations are the source of most incidents. Fatalities within company staff on the road are now a relatively rare occurrence. This is not surprising given the fact that most kilometres driven within the industry are by contracted operations.

Figure 3 Performance indicators 2007-2016 European downstream oil industry.

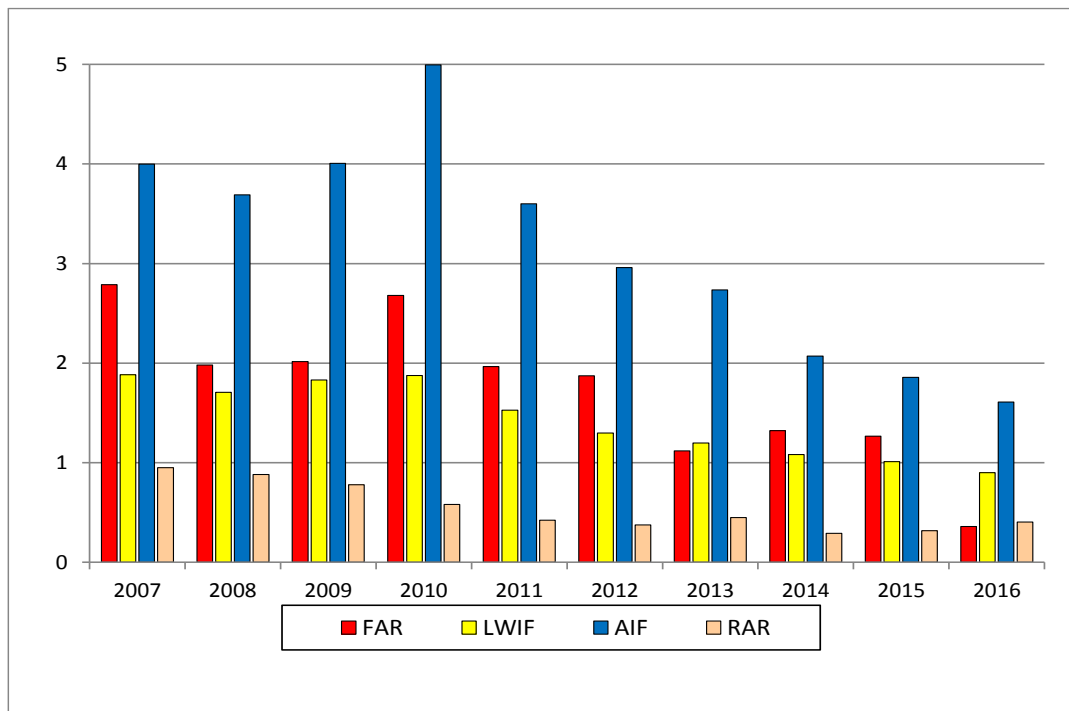


Figure 4a Fatal Accident Rate – Manufacturing 2007-2016

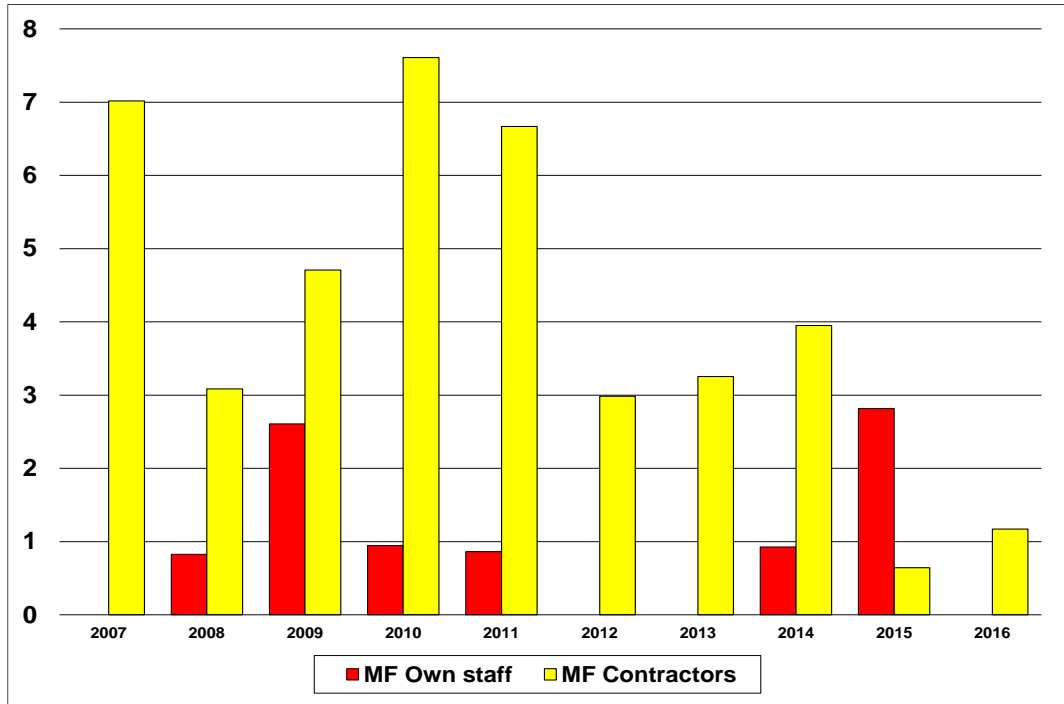
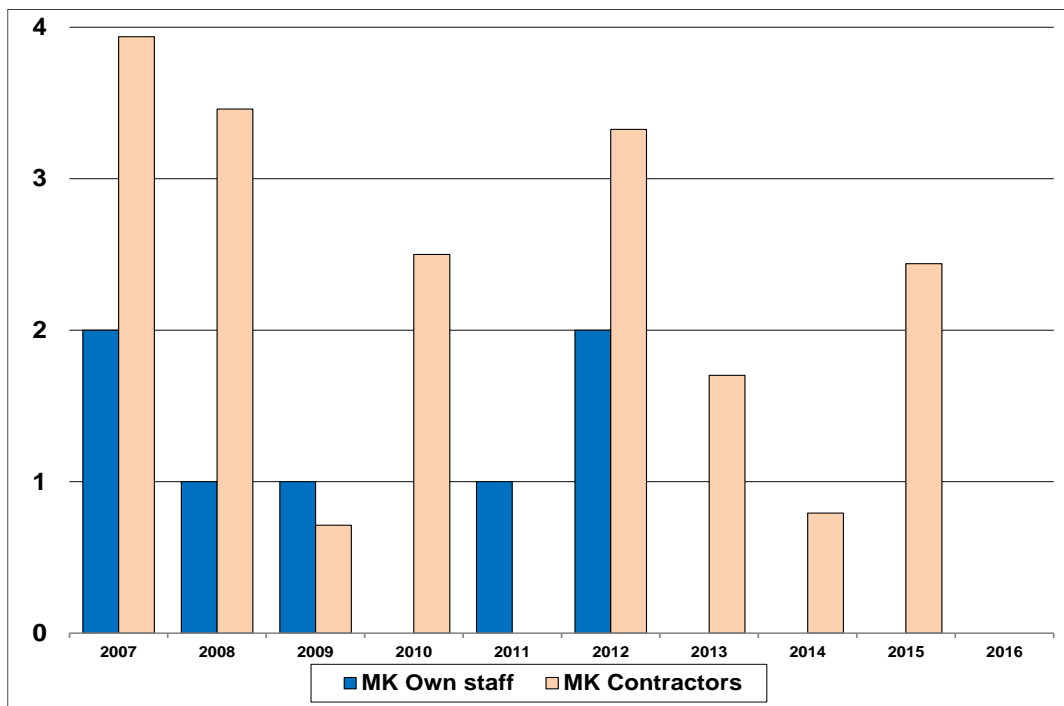


Figure 4b Fatal Accident Rate – Marketing 2007-2016



The LWIF of 0.9 (Manufacturing and Marketing combined) recorded for 2016 is the lowest value since the collection of this data commenced in 1993 and maintains the trend of less than 2.0 for the tenth consecutive year, the longest consistent period since Concaawe started to collect safety data. This indicator initially had greater reductions in Manufacturing than in Marketing, however, since 2006 figures for the 4 categories continue to remain very close. Contractor performance is now better than own staff performance as shown in **Figures 5a** and **5b**.

Figure 5a Lost Workday Injury Frequency – Manufacturing 2007-2016

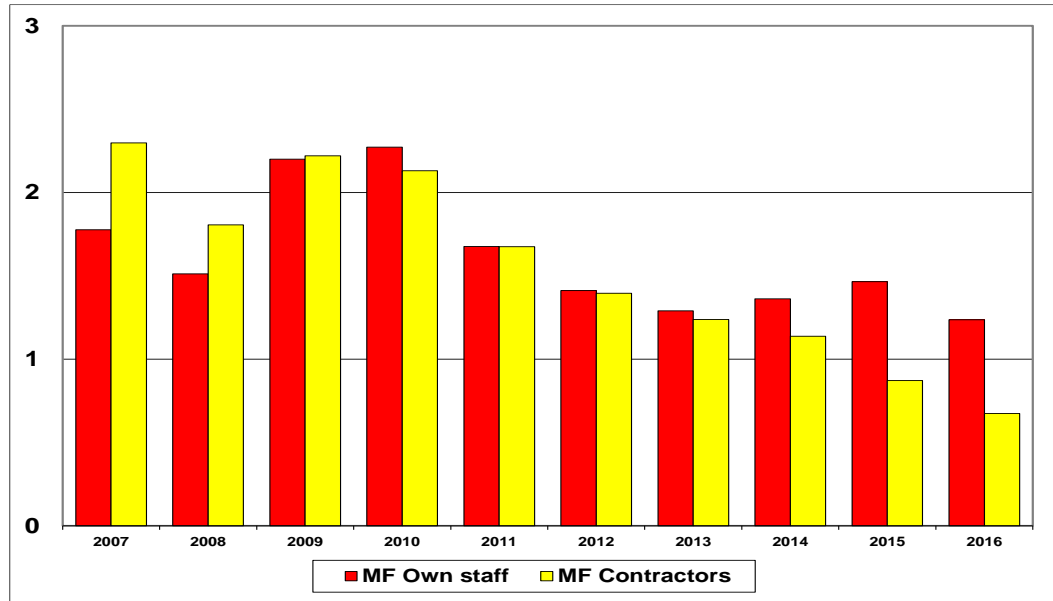
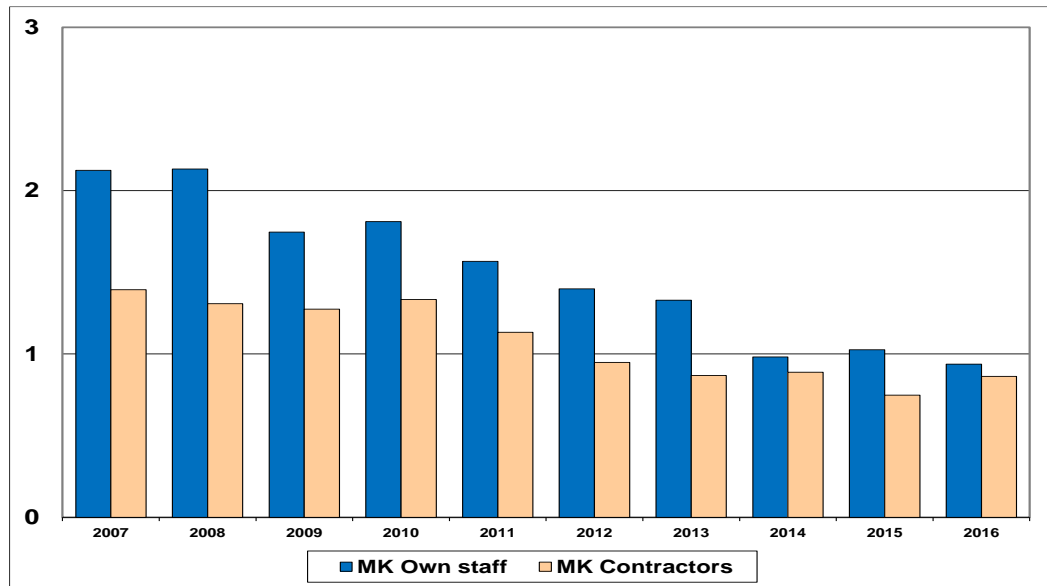


Figure 5b Lost Workday Injury Frequency – Marketing 2007-2016



Historical figures (see **Appendix 2**) suggest that AIF peaked around 1996-97 but this was considered at the time likely the result of improved reporting standards. Since then the trend has been slowly downward for both Manufacturing and Marketing. Again, contractor performance is now better than company staff. See **Figures 6a** and **6b**.

Figure 6a All Injury Frequency – Manufacturing 2007-2016

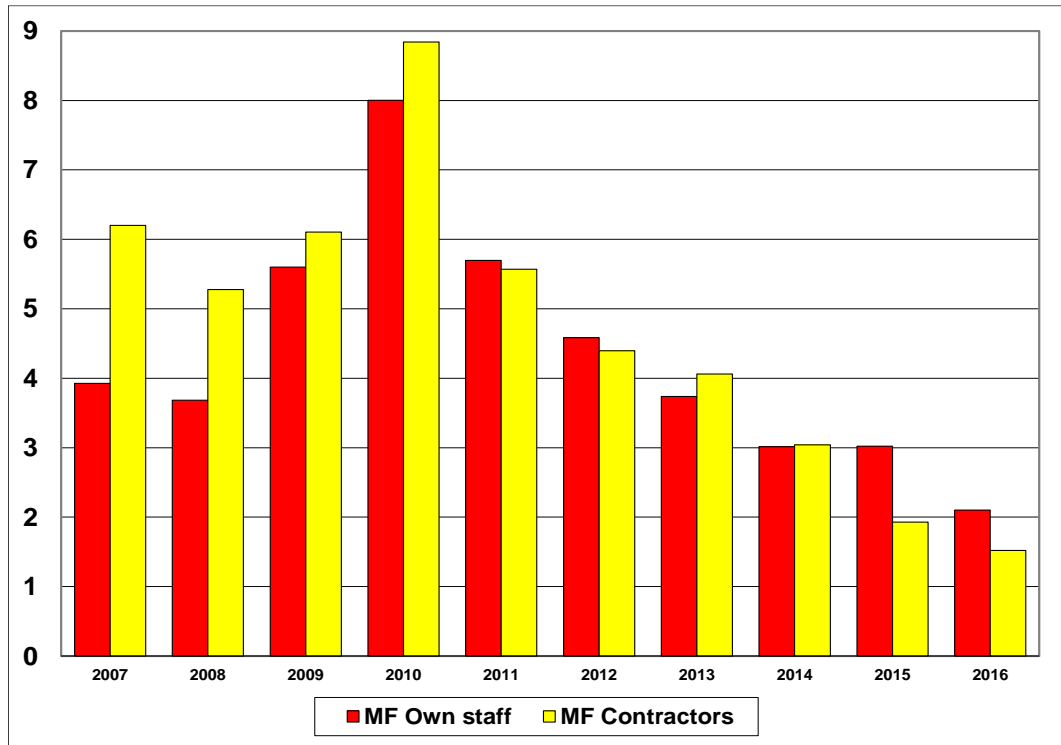
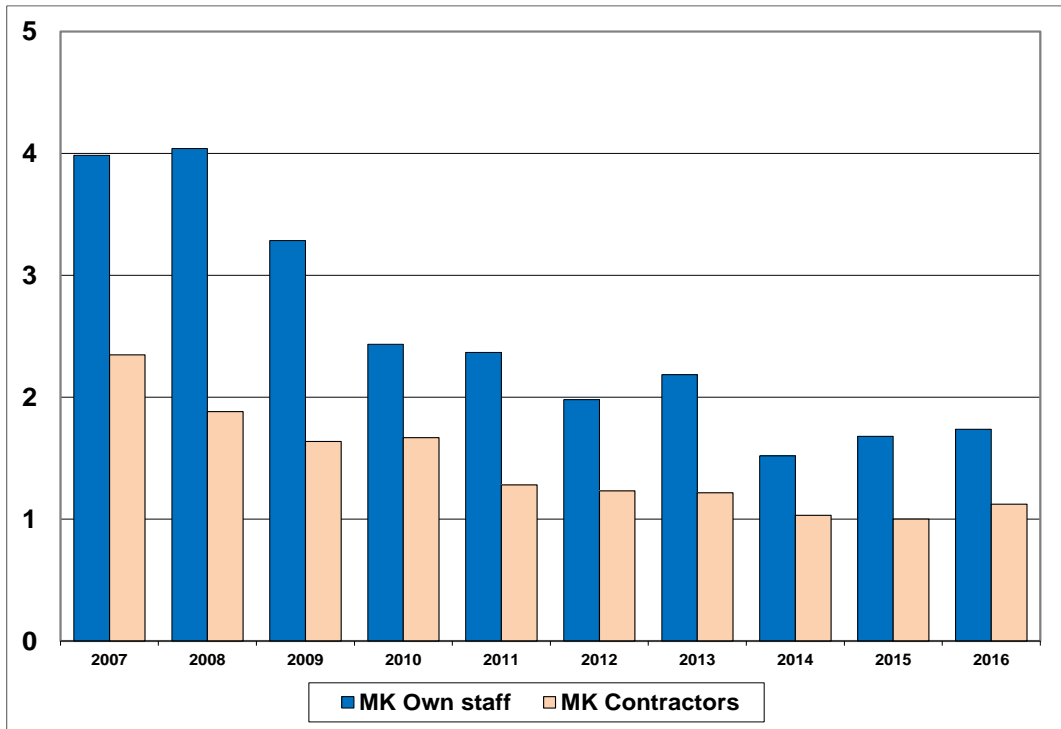
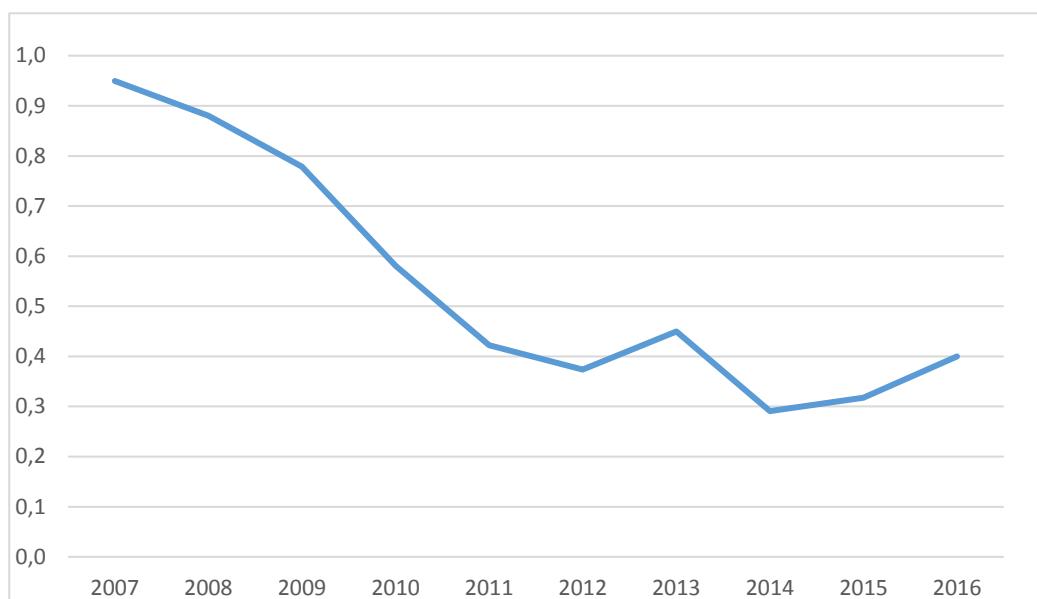


Figure 6b All Injury Frequency – Marketing 2007-2016



For 2016, the road traffic accident rate increased slightly to 0.4, but remained consistent with the low rates achieved since 2011. Road safety has been a major focus for the industry and a sustained reduction in the number of accidents is being maintained. These accidents essentially occur in the Marketing activity where the bulk of the driving takes place. See **Figure 7**.

Figure 7 Road Accident Rate 2007-2016 - European downstream oil industry



Analysis of the relative performance between the frequency datasets over the past 10 years shows a consistent and stable relationship between all reported incidents and both fatalities and Lost Workday Injury. This would suggest action to improve the performance in one or more of the fatality and Lost Workday Injury will have a beneficial impact on the overall safety performance indicators of the European downstream oil industry.

3. PROCESS SAFETY

The American Petroleum Institute (API) has recommended the adoption of Process Safety Performance Indicators (PSPI) in addition to personal safety performance indicators such as those contained in this report. This is intended to better address the potential causes of major process safety incidents, which can have catastrophic effects in the petroleum industry. As from the 2009 Concaawe report, the Safety Management Group of Concaawe expanded the scope of industry wide safety performance indicators to address process safety, following the reporting guidelines that were developed by the API [23, 24]. The expectation is that expanding the focus to include process safety in conjunction with the personal safety will contribute to a further reduction in serious injury rates in the industry.

The Concaawe Membership was requested to report their PSPI as defined by the API in 2008 [23] and as further refined in the ANSI/API recommended practice that was published in 2010 [24]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE). The Concaawe definitions slightly differ from those in the 2010 ANSI/API guideline to allow for the use of SI-metric units (kg/m/sec) and for the inclusion of the European Classification and Labelling definitions [25] as an alternative for classifying the PSE. In 2017, Concaawe will move to reporting against the revised definitions in the 2nd edition of the API Recommended practice 754. [28]

In 2016, 33 companies submitted PSE data for the Manufacturing operations and 14 submitted Marketing PSE data. The method for validating the number of contributing Marketing companies has been upgraded in 2016 resulting in a restatement 3 lower than the equivalent number in 2015 (see footnote to Table 1).

The aggregated 2016 results per sector and for the whole of the European downstream oil industry are shown in **Table 8**. **Tables 9** and **10** show the quartile ranges for PSE and PSER. **Figure 8** shows counts of the total PSE for the period 2009 to 2016 for which Concaawe has data. **Figure 9** shows the same data expressed as rates for the period 2009 to 2016. The data given are for Manufacturing only, as only that data is sufficiently robust to allow the analysis provided in these presentations.

Table 8 Aggregated 2016 Process Safety results for all reporting companies

Sector	Manufacturing	Marketing	Both Sectors
Companies - Total	37	23	22
- PS reporting	33	14	13
- %	89%	61%	59%
Hours worked - Total Mh	283.0	275.4	558.4
- PS reporting	263.3(246.0) ^a	212.3(190.3) ^a	475.6
- %	93%	77%	85%
T-1 PSE	79	11	90
T-2 PSE	203	56	259
T-1 PSER PSI/Mh reported	0.30	0.05	0.19
T-2 PSER PSI/Mh reported	0.85	0.29	0.59
Total PSER PSI/Mh reported	1.07	0.32	0.73

(a) Between brackets the number of hours reported by companies that provided T-2 PSEs is given. This number is applied when calculating the T-2 PSER.

This section discusses the data provided by Manufacturing locations only as this is the largest dataset available and where the higher process safety risks currently exist. The total number of Tier 1 and Tier 2 process safety events reported appears to have plateaued over the period 2014 to 2016. However analysis of the 2016 performance of the Manufacturing companies which contributed Process Safety data in 2015 shows a decrease in total process safety events from 287 to 240. The apparent plateau is therefore caused by data from companies reporting in 2016 but not in 2015.

Tier 1 and 2 process safety incidents are investigated in detail within member companies and considerable effort is expended in identifying root causes and responding accordingly. As with Fatalities and Lost Workday Injury cases in personal safety, such events are now relatively infrequent occurrences at each site so establishing trends on a site by site basis and across the industry is a challenge. To overcome this, many members now look to Tier 3 process safety events for their site based improvement activity. The definition of a Tier 3 incident is often asset specific and therefore trending such events across the Industry is not practicable at this time.

Table 9 Total PSE quartile distribution ranges and average values for each quartile range

PSE	Low	High	Average
Q1	0	2	1.3
Q2	2	6	4.0
Q3	6	14	10.0
Q4	16	69	26.6

Table 10 Total PSER quartile distribution ranges and average values for each quartile range

PSER	Low	High	Average
Q1	0.0	0.3	0.2
Q2	0.3	0.9	0.6
Q3	1.0	3.0	1.7
Q4	4.9	11.7	7.6

The 2016 ratio of Tier 1 to Tier 2 process safety events for Concaawe (0.39) is very similar to the 5-year rolling average figure reported by the US API for US refining industry 2010-2015 (0.40) [27]. The Concaawe T1 PSER whilst initially above the US API figure for the period 2011 to 2013 is now lower. The Concaawe T2 PSER was much higher than the US equivalent in 2011 (3.20 vs 1.34) but is now much closer to the US figure (0.92 to 0.94) for 2015, the last year for which publicly quoted figures are currently available. In 2016 the Concaawe T2 PSER dropped again to 0.85.

The number of LWIs resulting from the PSEs is not established, as this information is not currently available.

Figure 8 Process Safety Events 2009-2016 - Manufacturing Staff and Contractors

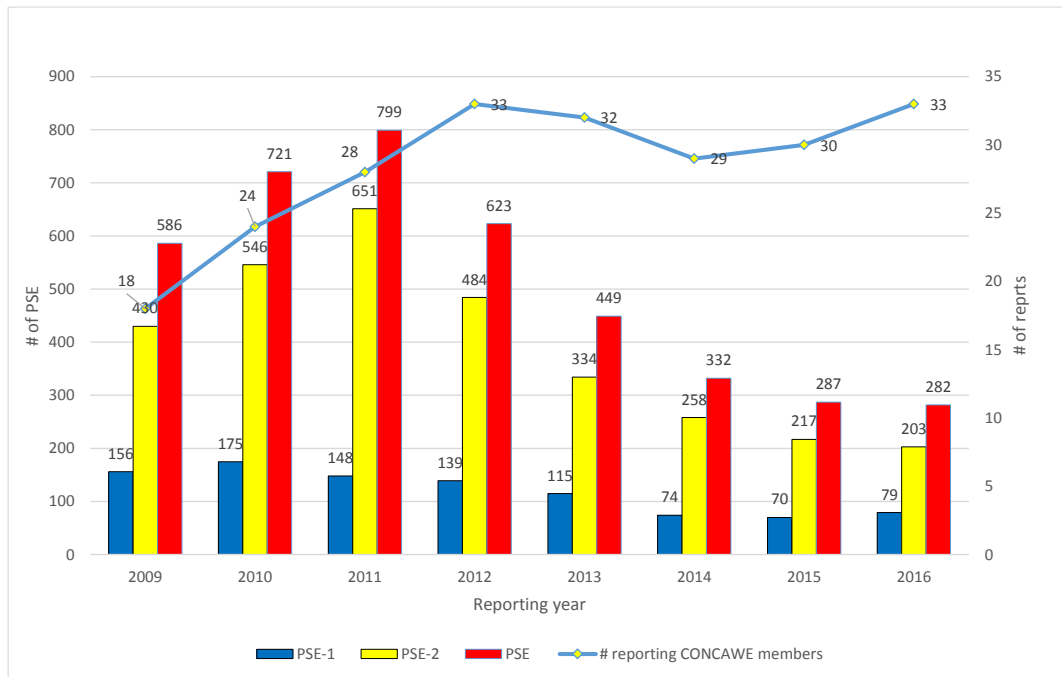
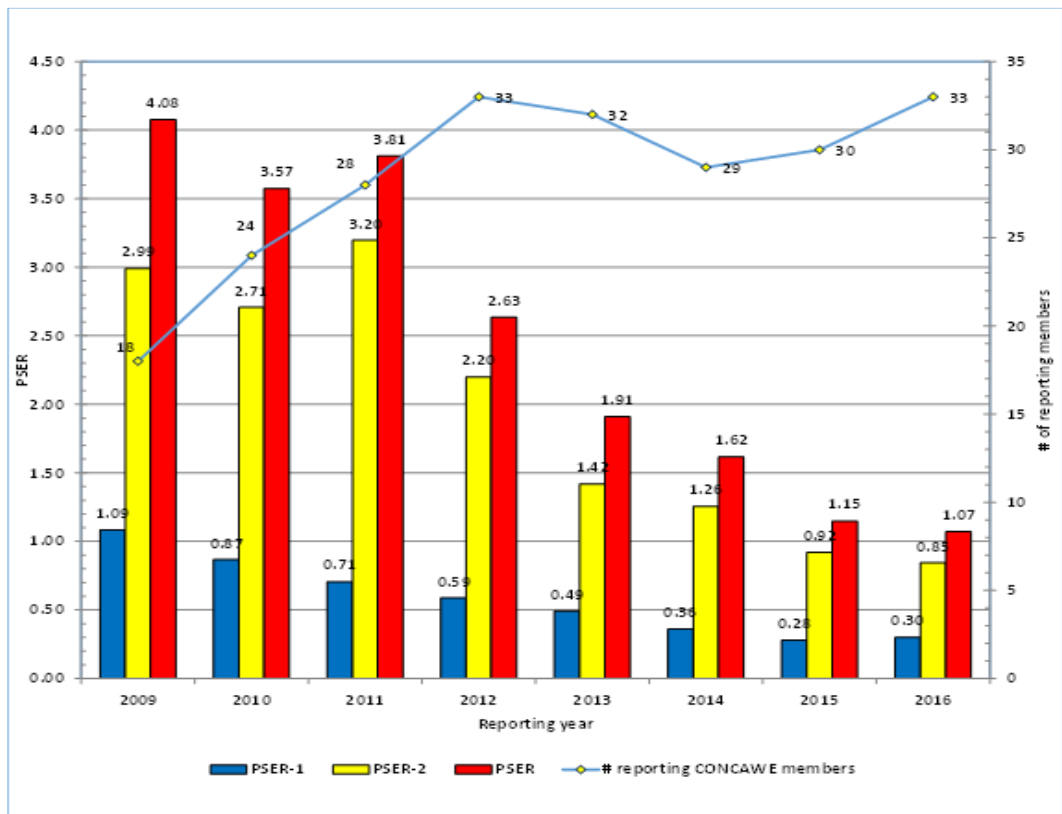


Figure 9 Process Safety Event Rate 2009-2016 - Manufacturing Staff and Contractors



4. COMPARISON WITH OTHER SECTORS

Most of the safety performance indicators used in the oil industry, and particularly LWIF, have also been adopted in many other sectors so that meaningful comparisons are possible. At the time of publishing this report, the comparison data in **Table 11** were publicly available from the IOGP [26] and the API [27].

Table 11 Comparison of oil industry safety performance

	CONCAWE 2016	IOGP Onshore 2016 ⁽¹⁾		IOGP On & Offshore 2016 ⁽¹⁾		API 2015
		Europe	World	Europe	World	Manufacturing
FAR	0.4	0.8	1.5	5.1	1.7	NA
LWIF	0.9	0.4	0.2	0.7	0.3	3.0 ⁽²⁾
AIF	1.6	1.1	0.8	2.1	1.0	NA

IOGP International Association of Oil & Gas Producers

API American Petroleum Institute

⁽¹⁾ Own staff and contractors

⁽²⁾ Estimated from 0.6 non-fatal injuries per 100 FT oil and gas workers, each assumed to work 2000 hours per year. The rate is therefore 0.6 per 200,000 exposure hours. API WIIS-report 2006-2015

The IOGP statistics concern the upstream oil industry covering oil and gas exploration and production activities [26]. In comparison with IOGP statistics for European onshore, Concaawe recorded significantly lower fatalities but higher LWIF and AIF.

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APPENDIX 1 EUROPEAN OIL INDUSTRY STATISTICS DEFINITIONS AND GUIDING NOTES

Several safety performance indicators have become “standard” in the oil industry and in many other industry sectors. They are mostly expressed in terms of frequency of the incident with the number of hours worked being the common denominator. This taken to be representative of the overall level of activity. Such parameters have the advantage of relying on a small number of straightforward inputs allowing meaningful statistical analysis even when the data sets are incomplete. The “standard” performance indicators considered in this report are FAR, LWIF, LWIS, RAR, AIF, and PSE(R) [23, 24]. There are subtle differences in the way these parameters are used, collected, and reported by different companies. The features, relevance and reliability of each indicator are therefore discussed below in the guidance section.

Abbreviations and Definitions

- | | |
|-----------------------|--|
| 1. AIF (TRCF) | All Injury Frequency (Total Recordable Case Frequency) which is calculated from the sum of fatalities, LWIs, RWIs and MTCs divided by number of hours worked expressed in millions of hours. |
| 2. COCO | Company owned and operated sites. |
| 3. CODO | Company owned, Dealer operated sites. |
| 4. Contractor | A company or an individual engaged to carry out specified work under a contract on company premises (incl. retail stations and office buildings). Off-site contractor activities are considered only for transportation and loading/unloading of hydrocarbons and other products performed on behalf of the company. |
| 5. Distance travelled | This is the distance, expressed in millions of kilometres, covered by company owned delivery vehicles, contractor delivery vehicles and company cars whether leased or owned. It should also include kilometres travelled in employee’s cars when on company business. |
| 6. DOCO | Dealer owned, Company operated sites. |
| 7. DODO | Dealer owned and operated sites. |
| 8. FAR | Fatal Accident rate is calculated from the number of fatalities divided by the number of hours worked expressed in hundred million. |
| 9. Fatality | This is a death resulting from a work-related injury where the injured person dies within twelve months of the injury. |
| 10. Hours worked | Hours worked by employees and contractors. Estimates should be used where contractor data is not available. |
| 11. LOPC | Loss of Primary Containment (LOPC) is an unplanned or uncontrolled release of any material from primary containment, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO ₂ , or compressed air). |
| 12. LWI | Lost Workday Injury is a work-related injury that causes the injured person to be away from work for at least one normal shift because he is unfit to perform any duties. |
| 13. LWIF | Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions. |
| 14. LWIS | Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs. |

15. Marketing	Marketing includes all non-manufacturing activities including Retail Operation which comprises the selling of products to the public at Company owned and operated sites (COCO), Company owned, Dealer operated sites (CODO), Dealer owned, Company operated sites (DOCO) and Dealer owned and operated sites (DODO) as well as "Head Office" personnel and other Marketing activities. COCO and DOCO retail operations are likely to be operated by staff and/or contractors while CODO are likely to be operated by contractors. DODO retail operations are not usually operated by Company staff or contractors and hence their hours are not usually included.
16. MTC	Medical Treatment Case is a work-related personal injury which requires treatment by a medical professional and does not result in time away from work or restriction in duties. It excludes all cases involving first aid treatments as specified in OSHA 1904.7(b) (5) even if these treatments are performed by a medical professional.
17. RAR	Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions.
18. PSE	A Process Safety Event is an unplanned or uncontrolled LOPC. The severity of the PSE is defined by the consequences of the LOPC.
19. PSER	Process Safety Event Rate (PSER) is calculated as the number of PSE (Tier 1, Tier 2 or Total) divided by the total number of hours worked (including contractor hours) expressed in millions.
20. Road Accidents	Any incident involving any of the vehicles described above that occurs on or off-road resulting in a recordable injury (fatality, LTI, MTI, RWI), asset damage greater than EUR 2.500 or loss of containment greater than a Tier 2 Process Safety incident. It excludes all accidents where the vehicle was legally parked, the journey to or from the driver's home and normal place of work, minor wear and tear, vandalism, or theft. On-site incidents involving cars or trucks should be covered in the site statistics.
21. RWI	Restricted Workday Injury is a work-related injury which causes the injured person to be assigned to other work on a temporary basis or to work his normal job less than full time or to work at his normal job without undertaking all the normal duties.
22. Tier 1 PSE	A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence. Refer to the definitions in API (2010) ANSI/API Recommended practice 754 for further details. Note Concaawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concaawe safety reports [18-22] for further details
23. Tier 2 PSE	A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. Refer to the definitions in API (2010) ANSI/API Recommended practice 754 for further details. Note Concaawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concaawe safety reports [18-22] for further details
24. Total days lost	The number of calendar days lost through LWIs counting from the day after the injury occurred.

Concaawe Categorization of causes for Fatalities and LWIs

Previous Category	Current Concaawe Incident Category	Description
Road accident	Road accident	Incidents involving motorised vehicles designed for transporting people and goods over land e.g. cars, buses, and trucks. Pedestrians struck by a vehicle are classes as road accidents. Fatal incidents from a mobile crane would only be road accidents if the crane were being moved between locations.
Height/Falls	Falls from height	A person falls from one level to another.
	Staff hit by falling objects	Incidents where injury results from being hit by flying or falling objects.
	Slips & trips (same height)	Slips, trips, and falls caused by falling over or onto something at the same height.
Burn/electrical	Explosion or burns	Burns or other effects of fires, explosions, and extremes of temperature. "Explosion" means a rapid combustion not an overpressure.
	Exposure electrical	Exposure to electrical shock or electrical burns etc.
Confined space entry	Confined Space	Incidents which occur within a confined space. Spaces are considered "confined" because their configurations hinder the activities of employees who must enter, work in, and exit them. Confined spaces include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels and pipelines.
Construction / Maintenance & Other	Assault or violent act	Intentional attempt, threat, or act of bodily injury by a person or persons or by violent harmful actions of unknown intent, includes intentional acts of damage to property.
	Water related, drowning	Incidents/events in which water played a significant role including drowning.
	Cut, puncture, scrape	Abrasions, scratches, and wounds that penetrate the skin.
	Struck by	Incidents/events where injury results from being hit by moving equipment or machinery, or by moving objects. Also includes vehicle incidents where the vehicle is struck by or struck against another object.
	Exposure, noise, chemical, biological, vibration	Exposure to noise, chemical substances (including asphyxiation due to lack of oxygen not associated with a confined space), hazardous biological material, vibration, or radiation.
	Caught in, under or between	Injury where injured person is crushed or similarly injured between machinery moving parts or other objects, caught between rolling tubulars or objects being moved, crushed between a ship and a dock, or similar incidents. Also includes vehicle incidents involving a rollover.
	Overexertion, strain	Physical overexertion, e.g. muscle strain.
	Pressure release	Failure of or release of gas, liquid or object from a pressurised system.
	Other	Used to specify where an incident cannot be logically classed under any other category.

Guidance

<p>Fatalities and Fatal Accident Rate (FAR)</p>	<p>Because of their very low numbers, fatalities and, therefore, FAR are not necessarily reliable indicators of the safety performance of a Company or Industry. A single accident can produce several fatalities and cause an abnormally high result in the indicator for a certain year. Conversely, the lack of fatalities is certainly no guarantee of a safe operation. The safety pyramid of H.W. Heinrich² implies that for every fatality there have been many other incidents with less serious injury outcomes. These less severe incidents provide the opportunities to address equipment, standards, training, attitudes, and practices that may prevent both the less, and the more serious incidents.</p>
<p>Lost Workday Injury Frequency (LWIF) and Lost Workday Injury Severity (LWIS)</p>	<p>The LWIF is the most common indicator in the oil and other industries and has been in use for many years. It is now common practice to include not only a company's own staff but also contractors in the statistics and this is done almost universally in the oil industry. All companies without exception collect employee LWIF data for at least their own staff and this is, therefore, the most frequently used and reliable indicator.</p> <p>Not all companies keep track of the number of lost days and, in some cases, the numbers are skewed by local interpretation. The overall LWIS reported is calculated taking account only of those companies that report the data. It should also be noted that the difference in interpretation of days lost results in a wide variation in the results and hence trends are difficult to identify.</p>
<p>All Injury Frequency (AIF)</p>	<p>As LWIF figures become progressively lower they appear to reach a plateau. Companies that have achieved very low LWIF levels may need a more meaningful indicator to monitor trends and detect improvements or deterioration of performance. AIF would provide such an indicator, since it records fatalities, Restricted Work Injuries (RWI) and Medical Treatment Cases (MTC) in addition to LWIs. Although it is still less widely used than LWIF, reporting improves year by year with more companies including this indicator into their performance reporting. It should also be noted that not all companies operate a restricted work system and also restricted working is not allowed in some countries. As the total number of injuries is not reported by all companies, only the worked hours for which this number is available are taken into account in the calculation of the overall AIF figure.</p>
<p>Road Accident Rate (RAR)</p>	<p>It is no surprise that, since road accidents remain a cause of both fatalities and Lost Workday Injury in the oil industry, a number of companies have chosen to calculate and monitor these separately outside of their impact on the overall statistics. This allows some extra focus on this key area of concern. The separate road accident data is still incomplete and the overall figures should therefore be considered as indicative only. For this reason, Concaawe only reports RAR data for the whole downstream industry and all personnel involved (own staff and contractors), since the level of reporting is insufficient for the segmented data to be analysed. It must be noted, however, that the vast majority of road accidents occur in distribution and retail activities where both sales employees and truck drivers travel longer distances.</p>

² Industrial Accident Prevention. H.W. Heinrich, 1931.

APPENDIX 2 HISTORICAL DATA 1993 TO 2016

Table A2-1 Performance indicators - All sectors

Year	Fatalities	FAR	AIF	LWIF	LWIS	RAR	Million Hours Reported
1993	18	5.0	7.9	4.7	27	3.8	357.0
1994	19	5.4	7.4	4.0	25	3.1	354.8
1995	13	3.5	11.2	4.6	24	2.6	366.4
1996	14	3.3	10.7	4.7	19	2.0	420.6
1997	15	3.4	11.4	4.6	23	1.9	442.0
1998	12	2.6	9.9	4.5	22	1.5	469.7
1999	8	1.8	9.4	4.3	21	0.9	448.5
2000	13	2.7	8.8	4.3	25	0.9	475.1
2001	14	2.8	9.5	4.3	24	0.8	495.5
2002	16	3.3	6.9	3.9	23	1.1	480.0
2003	22	4.1	6.3	3.2	30	1.0	531.6
2004	12	2.3	6.3	3.2	33	1.0	513.3
2005	11	1.9	4.5	2.6	35	0.9	581.7
2006	7	1.5	4.6	2.5	30	1.6	477.5
2007	15	2.8	4.0	1.9	35	0.9	538.2
2008	11	2.0	3.7	1.7	28	0.9	555.5
2009	11	2.0	4.0	1.8	29	0.8	545.5
2010	14	2.7	5.0	1.9	30	0.6	522.2
2011	11	2.0	3.6	1.5	41	0.4	559.8
2012	10	1.9	3.0	1.3	29	0.4	534.3
2013	6	1.1	2.7	1.2	34	0.5	536.5
2014	7	1.3	2.1	1.1	43	0.3	529.7
2015	7	1.3	1.9	1.0	37	0.3	553.0
2016	2	0.4	1.6	0.9	34	0.4	558.4

Table A2-2 Performance indicators – Manufacturing Staff

MF Own staff					
Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	2	2.7	12.7	3.8	50
1994	3	4.0	10.2	2.9	29
1995	1	1.1	12.2	3.6	29
1996	0	0.0	14.8	3.9	28
1997	2	1.8	15.1	4.8	24
1998	1	0.9	10.8	4.7	20
1999	0	0.0	12.5	4.5	16
2000	0	0.0	13.9	3.1	30
2001	5	5.6	9.9	3.3	27
2002	4	5.4	9.7	2.9	28
2003	2	2.5	8.4	2.9	38
2004	3	3.3	6.6	1.9	51
2005	0	0.0	5.1	1.8	44
2006	0	0.0	5.1	2.0	28
2007	0	0.0	3.9	1.8	33
2008	1	0.8	3.7	1.5	32
2009	3	2.6	5.6	2.2	34
2010	1	0.9	8.0	2.3	28
2011	1	0.9	5.7	1.7	77
2012	0	0.0	4.6	1.4	32
2013	0	0.0	3.7	1.3	33
2014	1	0.9	3.0	1.4	44
2015	3	2.8	3.0	1.5	41
2016	0	0.0	2.1	1.2	34

Table A2-3 Performance indicators – Manufacturing Contractors

MF Contractors					
Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	8	20.7	13.1	5.4	20
1994	1	2.6	12.7	4.6	36
1995	0	0.0	12.6	7.4	24
1996	3	5.0	18.7	8.3	19
1997	1	1.8	28.4	8.8	23
1998	0	0.0	25.1	9.3	24
1999	2	3.5	24.5	8.1	19
2000	2	3.1	21.0	8.0	23
2001	3	4.1	18.1	6.9	24
2002	6	9.9	14.3	6.3	23
2003	6	8.4	12.8	4.6	42
2004	5	6.2	10.2	3.5	30
2005	3	3.4	8.0	3.1	33
2006	2	2.1	6.8	2.9	31
2007	8	7.0	6.2	2.3	25
2008	4	3.1	5.3	1.8	26
2009	6	4.7	6.1	2.2	32
2010	10	7.6	8.8	2.1	32
2011	9	6.7	5.6	1.7	31
2012	4	3.0	4.4	1.4	28
2013	4	3.3	4.1	1.2	34
2014	5	3.9	3.0	1.1	46
2015	1	0.6	1.9	0.9	36
2016	2	1.2	1.5	0.7	42

Table A2-4 Performance indicators – Marketing Staff

MK Own staff					
Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	2	1.2	6.1	5.7	23
1994	13	8.1	6.0	5.2	21
1995	1	0.6	12.0	4.9	22
1996	2	1.1	8.6	4.9	18
1997	4	2.4	8.6	4.6	23
1998	3	1.6	7.7	3.4	21
1999	2	1.1	6.5	3.7	23
2000	0	0.0	4.7	3.7	29
2001	3	1.4	6.7	3.6	27
2002	4	2.1	5.7	3.6	22
2003	2	1.0	5.7	3.3	19
2004	0	0.0	6.6	3.9	25
2005	3	1.4	4.2	3.0	36
2006	0	0.0	3.7	2.6	23
2007	2	1.2	4.0	2.1	31
2008	1	0.6	4.0	2.1	27
2009	1	0.6	3.3	1.7	22
2010	0	0.0	2.4	1.8	26
2011	1	0.5	2.4	1.6	32
2012	2	1.2	2.0	1.4	28
2013	0	0.0	2.2	1.3	33
2014	0	0.0	1.5	1.0	42
2015	0	0.0	1.7	1.0	40
2016	0	0.0	1.7	0.9	25

Table A2-5 Performance indicators – Marketing Contractors

MK Contractors					
Year	Fatalities	FAR	AIF	LWIF	LWIS
1993	6	7.8	3.7	2.9	21
1994	2	2.5	4.3	2.2	25
1995	11	18.2	7.0	3.1	21
1996	9	11.8	3.5	2.6	11
1997	8	7.6	3.4	2.0	20
1998	8	6.8	5.9	3.5	19
1999	4	3.3	5.6	3.2	18
2000	11	9.7	2.9	4.1	17
2001	3	2.5	8.2	4.5	17
2002	2	1.3	4.4	3.8	20
2003	12	6.8	3.4	2.7	31
2004	4	2.8	3.3	2.8	43
2005	5	2.7	2.6	2.3	28
2006	5	4.6	3.8	2.3	19
2007	5	3.9	2.3	1.4	22
2008	5	3.5	1.9	1.3	20
2009	1	0.7	1.6	1.3	28
2010	3	2.5	1.7	1.3	36
2011	0	0.0	1.3	1.1	21
2012	4	3.3	1.2	0.9	29
2013	2	1.7	1.2	0.9	37
2014	1	0.8	1.0	0.9	38
2015	3	2.4	1.0	0.7	25
2016	0	0.0	1.1	0.9	37

Table A2-6 Lost Workday Injury causes 2013-2016 – Staff and Contractors in both Manufacturing and Marketing

LWI 2016						2015	2014	2013
Causes		Manufacturing	Marketing	Combined	Percentage	Percentage	Percentage	Percentage
Road accident	Road accident	2	18	20	4.1%	4.2%	3.9%	4.4%
Height/Falls	Falls from height	19	17	36	7.3%	8.6%	8.6%	10.3%
	Staff hit by falling objects	10	5	15	3.0%	3.1%	4.6%	3.6%
	Slips & trips (same height)	63	85	148	30.1%	29.5%	27.1%	32.7%
Burn/ electrical	Explosion or burns	29	7	36	7.3%	6.0%	6.2%	4.8%
	Exposure electrical	2	0	2	0.4%	0.7%	0.5%	0.6%
Confined space	Confined Space	1	0	1	0.2%	0.2%	0.2%	0.8%
Other causes	Assault or violent act	0	15	15	3.0%	3.1%	2.8%	1.7%
	Water related, drowning	0	0	0	0.0%	0.0%	0.0%	0.2%
	Cut, puncture, scrape	14	14	28	5.7%	4.6%	8.6%	5.0%
	Struck by	17	24	41	8.3%	11.9%	10.9%	9.6%
	Exposure, noise, chemical, biological, vibration	10	7	17	3.5%	2.6%	2.5%	2.6%
	Caught in, under or between	22	8	30	6.1%	9.0%	7.7%	7.3%
	Overexertion, strain	30	45	75	15.2%	13.9%	10.0%	12.4%
	Pressure release	5	1	6	1.2%	0.7%	0.9%	0.9%
Other	19	3	22	4.5%	1.8%	5.6%	3.1%	
Total		243	249	492	100.0%	100%	100%	100%

APPENDIX 3 CONCAWE MEMBER COMPANIES THAT SUBMITTED DATA

The following member companies provided the data upon which this report is based.

ALMA Petroli s.a.	Gruppo API	ATCP
BP	CEPSA	ENI
ESSAR	ExxonMobil	GALP Energia
Gunvor	H&R	Hellenic Petroleum
IPLOM	Rompetrol	KOCH Industries
Q8	Gruppa Lotos	LUKOIL
MOL Group	Motor Oil (Hellas)	Neste
Nynas	OMV	Petroineos
P66	PKN Orlen	Preem
Raffinerie Heide	Repsol	Saras
Shell	St1	Statoil
Tamoil	Total	Total ERG
Valero	VaroEnergy	

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