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European downstream oil industry safety performance

Statistical summary of reported incidents – 2015

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ABSTRACT

In this twenty-second annual report on European downstream oil industry safety performance, 2015 statistics are presented on work-related personal injuries for the industry's own employees and contractors. Information was received from 38 Concawe Member Companies representing 97.1% of the European refining capacity. Trends over the last twenty-two years are also highlighted and the data are compared to similar statistics from related industries. This report also presents the seventh year of results for Process Safety Performance Indicators from Concawe members.

KEYWORDS

Accidents, AIF, Concawe, FAR, fatality, incidents, injury, LWI, LWIF, marketing, oil industry, refining, RAR, RWI, safety statistics, Process Safety Performance Indicators, Process Safety Events

INTERNET

This report is available as an Adobe pdf file on the Concawe website (www.concawe.org).

CONTENTS

SUMMARY

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

This report is the twenty-second Concawe review on safety, compiling statistical data for the European downstream oil industry. This latest version incorporates data for 2015 and gives a full historical perspective from 1993. It also includes comparative figures from other related industry sectors. For 2015, information was received from 38 Concawe Member Companies, together accounting for 97.1% of the available refining capacity in the EU-28, Norway and Switzerland.

The results are reported mainly in the form of key performance indicators that have been adopted by the majority of oil companies operating in Europe as well as by other industry sectors.

Unfortunately, in 2015, the total number of fatalities (7) was equal to that recorded for 2014 with the fatal accident rate (1.27 per hundred million hours worked) being marginally lower than in 2014 (1.32 per hundred million hours worked) due to an increase in recorded working hours and these results remain at historical low levels. Of the 7 fatalities, 4 occurred as the result of one incident (3 Staff and 1 Contractor), a fire during refinery shutdown. The remaining 3 Fatalities were Marketing Contractors, 2 as a result of “road accidents” and 1 resulted from being “struck by”. In summary 57% of fatalities were caused by “explosion or burn”, 29% were caused by a “road accident” and 14% resulted from “struck by”.

Accident frequencies in the European downstream oil industry are generally at low levels and the 2015 performance continues this trend. Standing at 1.0, the Lost Work Injury Frequency (LWIF) indicator for 2015 is slightly lower than that achieved in 2014 (1.1), and is the lowest recorded since 1993, which maintains the positive trend of being less than 2.0 as has been the case since 2007. The responsible management of safety in the oil industry has resulted in a low level of accidents despite the intrinsic hazards of the materials handled and the operations carried out.

During the process of data collection and verification in 2016, an error was found in the hours reported by one company for the 2013 and 2014 years (as reported in the 2014 and 2015 reports). The results for 2013 and 2014 have been corrected where necessary within this report.

For the seventh consecutive year, Concawe Member Companies were asked to provide Process Safety Performance Indicator (PSPI) data which describe the number of Process Safety Events (PSE) expressed as unintended Loss of Primary Containment (LOPC). Thirty-one Companies provided data in 2015, two more than in 2014 (29 Companies) but one less than in 2013 (32 Companies) and two less than the peak in 2012 (33 Companies). The 2015 data represents 86% of the respondents and 96% of the reported hours worked. Up until 2012 the number of respondents was increasing each year but it now seems to have plateaued. From the responses for 2015, a Process Safety Event Rate (PSER) indicator of 0.8 for all PSEs was recorded, a reduction from 0.9 recorded in 2014 and a continuation of the year by year reduction since the commencement of data collection in 2009.

1. INTRODUCTION

The collection and analysis of accident data are widely recognised by the oil industry as an essential element of an effective safety management system.

Concawe started compiling statistical data for the European downstream oil industry twenty-three years ago and this is the twenty-second report on this topic (see references of past reports in the reference list [1-21]. This report covers data collected for 2015 and includes a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available.

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 but all those who do, collect data separately for “Manufacturing” (i.e. refining) and “Marketing” (i.e. distribution and retail, also including “head office” staff) and this split has also been applied in the Concawe data. Additionally, the data are split between own personnel and contractors, the latter being fully integrated in all of the companies’ safety monitoring systems. The purpose of collecting this information is twofold:

- To provide member companies with a benchmark against which to compare their performance, so that they can determine the efficacy of their 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.

From the outset, a majority of Concawe member companies have participated so that the sample has always represented a large portion of the industry. By 1995 virtually all Concawe members participated, representing about 93% of the European refining capacity (somewhat less for distribution and retail). Over the years this level of participation has peaked to >97%, although the actual number of participating companies fluctuated in line with the structural changes and mergers occurring in the industry as did the percentage of the refining capacity represented. For 2015, 38 Member Companies responded with the submission of a completed questionnaire, although not all companies could supply all the requested data. The statistics presented represent all except two EU-based refineries covering 97.1% of the refining capacity in the area where Concawe operates.

The geographical area covered is the EU-28, Norway and Switzerland.

A number of key performance indicators have been adopted by the majority of oil companies operating in Europe as well as by other industries. Although there are differences in the way different companies collect basic data, these fairly straightforward parameters allow an objective comparison. There are differences noted between companies in their precise definitions or interpretation of metrics, meaning direct comparison of data from different companies could lead to erroneous conclusions. For this reason, Concawe does not report individual company data but rather aggregates, averages and ranges of variation.

20 out of the 38 participating companies stated their willingness to share their data openly with other companies.

2. PERFORMANCE INDICATORS

A number of 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 injury or incident - the number of hours worked being the common denominator representing the level of activity. Such parameters have the advantage of relying on a small number of straightforward inputs, which allows meaningful statistical analysis even when the data sets are incomplete. The performance indicators considered in this report are:

- The number of work-related fatalities and the associated Fatal Accident Rate (FAR) is expressed as the number of fatalities per 100 million hours worked.
- The All Injury Frequency (AIF) includes all recordable injuries and is expressed as the number of injuries per million hours worked.[1]
- The Lost Workday Injury Frequency (LWIF) is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
- Related to LWIF is the Lost Workday Injury Severity (LWIS) that expresses the average number of lost workdays per LWI.
- The Road Accident Rate (RAR) is expressed in number of road accidents per million kilometres travelled.
- The Process Safety Performance Indicators (PSPI) [17,18] measure the number of Process Safety Events (PSEs) are expressed as the number of unplanned or uncontrolled releases of any material, including non-toxic and non-flammable materials from a process with the severity defined by the consequences experienced or released amount thresholds.

A more complete set of definitions is given in **Appendix 1** and the PSE criteria are further explained in **Appendix 2**.

There are, however, subtle differences in the way these parameters are used by different companies and how the data is collected and reported. The features, relevance and reliability of each indicator are further discussed below.

Fatalities and Fatal Accident Rate (FAR)

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. Heinrich[2] 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.

[1] AIF is often referred to as TRCF – Total Recordable Case Frequency. Refer **Appendix 1**.

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

Lost Workday Injury Frequency (LWIF) and Lost Workday Injury Severity (LWIS)

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.

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.

All Injury Frequency (AIF)

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.

Road Accident Rate (RAR)

It is no surprise that, since road accidents remain a cause of both fatalities and lost work injuries 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, Concawe 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.

3. 2015 RESULTS

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

Table 1 Submission of results for 2015

No of companies	Manufacturing[b]			Marketing		
	Own staff	Contractors	All workers	Own staff	Contractors	All workers
Submission	35	33		22	17	
Including						
Road accidents[a]	7	2		9	8	
Distance travelled	14	3		15	12	
Process Safety			30			17
Retail Operations						
COCO						11
CODO						5
DOCO						4
DODO						2

a) Several Companies do not report their Road accidents separately and these incidents and so included these in their overall statistics.

b) One reporting member reported no refining activities in 2015

Most companies submitted data for their own Manufacturing and Marketing staff (several companies have no retail activity). This year there were 35 companies which reported Manufacturing statistics and one company which only reported Marketing data. This results in a total of 36 member companies reporting. Total own staff injuries are recorded by all companies, in the Manufacturing and/or Marketing categories, but this is not the case for lost days. A number of companies do not record road accidents separately. Contractor data are generally less complete.

In 2014 the members decided to commence the collection of some additional information in relation to the nature of Marketing retail operations and this has been done again for 2015. As a result, companies have been asked to describe their retail operations as either Company owned company operated, Company owned dealer operated, Dealer owned company operated or Dealer owned dealer operated. In 2015, answers were provided by 11 companies and they are presented in **Table 1**. At this stage this information is provided for interest and no attempt has been made to analyse further in relation to the safety statistics.

The PSE data were requested for the seventh time in 2015 for all workers in both Manufacturing and Marketing sectors. In 2015, 30 companies submitted PSE data for the Manufacturing operations and 17 submitted Marketing PSE data. These numbers are slightly higher than the number of respondents in 2014. The results are presented in Section 5.

The aggregated 2015 results per sector and for the whole of the European downstream oil industry are shown in **Table 2**. **Figure 1a** shows the average performance indicators and their range of variability amongst reporting companies. **Figures 1b** and **1c** show the results for all injuries and AIF and lost time injuries and LWIF on a cumulative frequency basis, which allows individual companies to benchmark their own results against the group. For AIF and LWIF, which are the most

universally used indicators, the distribution per quartile and average for each quartile are shown for the different sectors (**Figure 2a/b**).

Table 2 Aggregated 2015 results for all reporting companies

Sector		Manufacturing			Marketing			Both Sectors		
Work Force		OS	CT	AW	OS	CT	AW	OS	CT	AW
Hours worked	Mh	107	155	261	169	123	292	275	278	553
Fatalities		3	1	4	0	3	3	3	4	7
Fatal Accident Rate	F/100 Mh	2.8	0.6	1.5	0.0	2.4	1.0	1.1	1.4	1.3
Lost work incidents	LWI	156	135	291	173	92	265	329	227	556
Lost time through LWI	days	6,219	4,576	10,795	5,351	1,635	6,986	11,570	6,211	17,781
LWI frequency	LWI/Mh	1.5	0.9	1.1	1.0	0.7	0.9	1.2	0.8	1.0
LWI severity*	lost days/LWI	40.6	35.8	38.4	39.9	25.2	35.1	40.3	32.2	37.0
All recordable incidents	AI	322	299	621	283	123	406	605	422	1,027
All incidents frequency	AI/Mh	3.0	1.9	2.4	1.7	1.0	1.4	2.2	1.5	1.9
Distance travelled	million km							406	703	1109
Road Accidents	RA							198	156	354
Road Accident Rate+	RA/million km							0.48	0.22	0.32

*) LWIS 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

Figure 1a Average 2015 performance indicators with range of variability

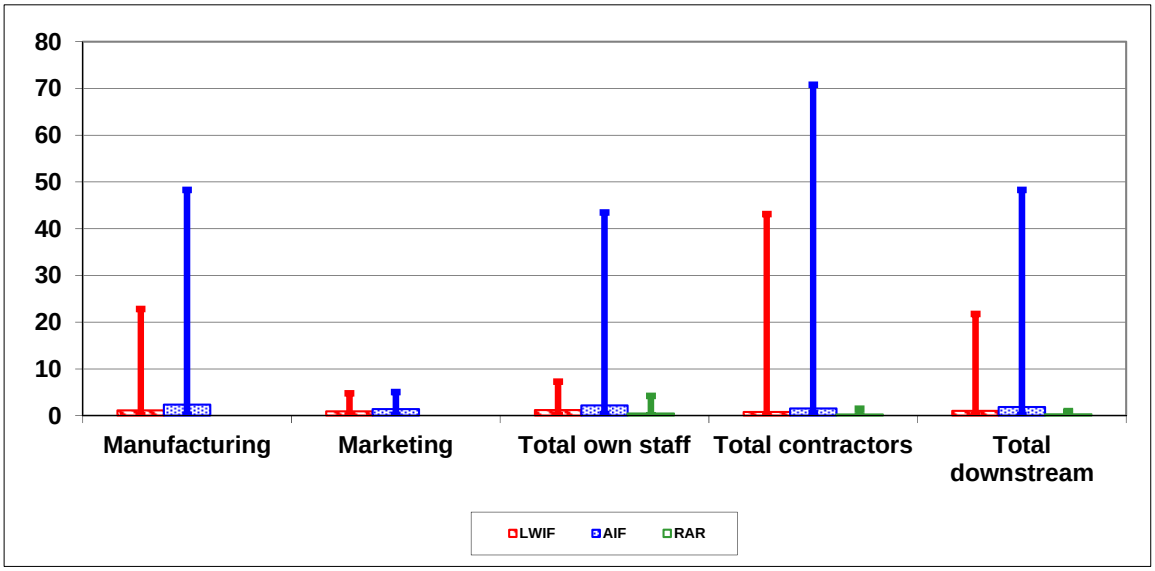


Figure 1b Cumulative Frequency Analysis All Injury Frequency

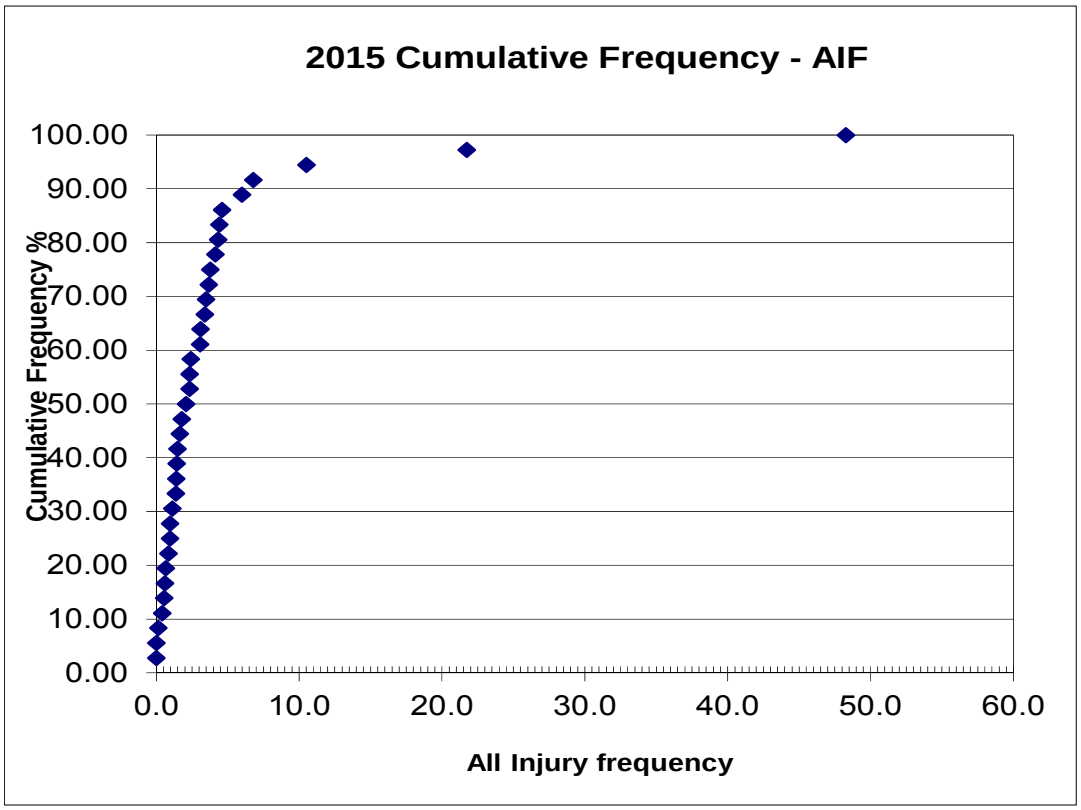


Figure 1c Cumulative Frequency Analysis Lost Work Injury Frequency

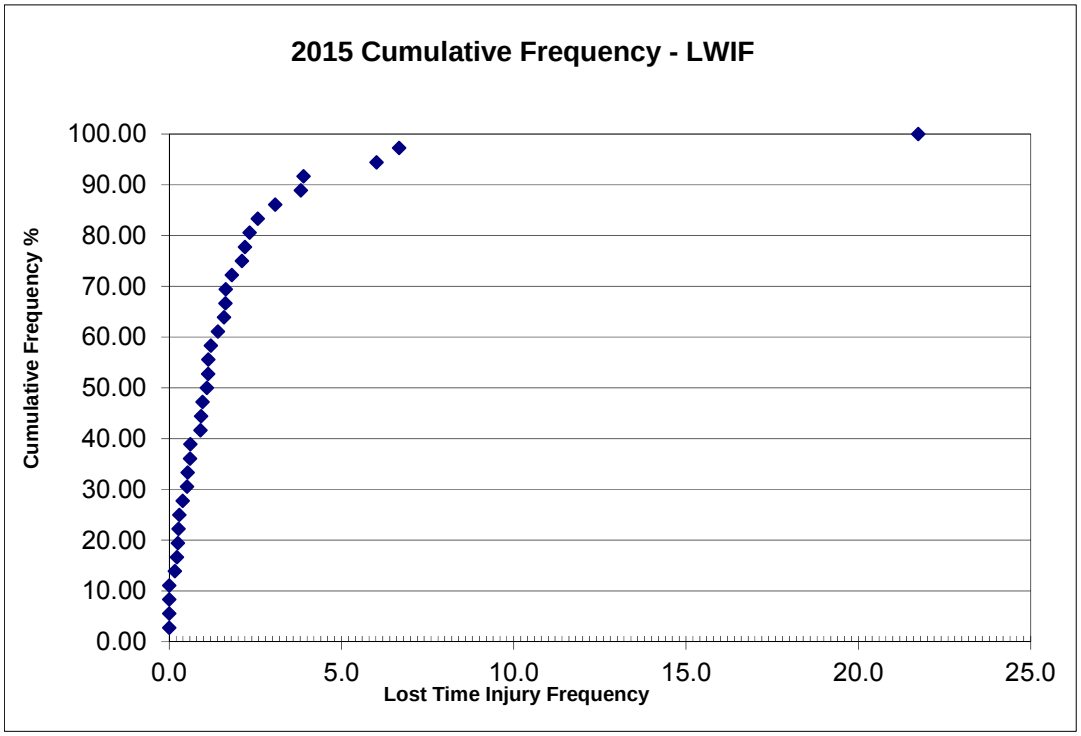


Figure 2a AIF quartile distribution ranges and average values for each quartile range

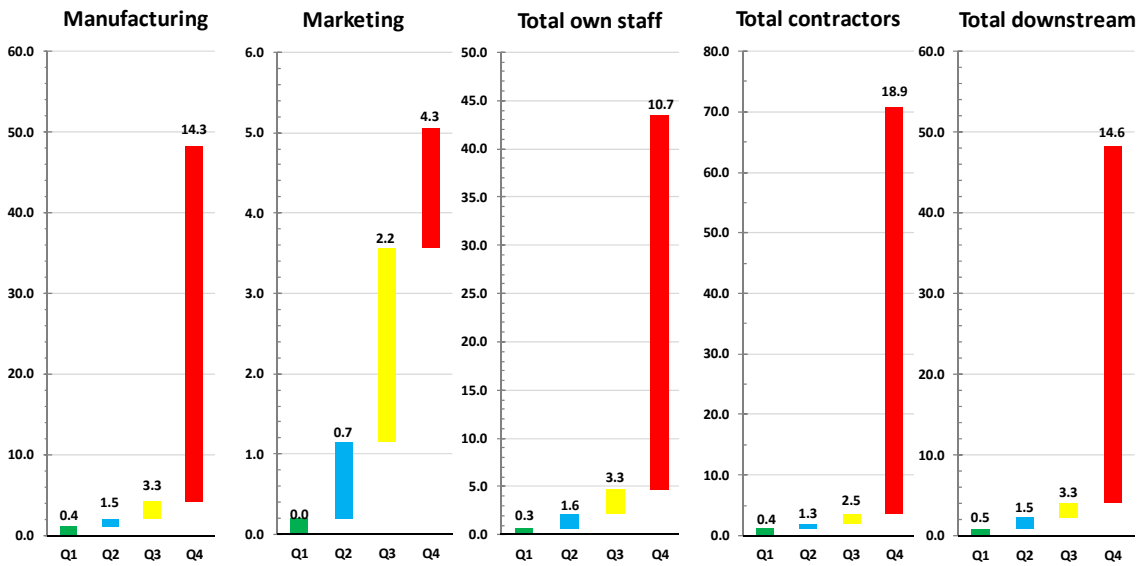


Table 3 AIF quartile distribution ranges and average values for each quartile range

	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	1.07	0.44	0.00	0.19	0.04	0.00	0.68	0.34	0.00	1.04	0.42	0.00	0.96	0.47
Q2	1.07	2.03	1.55	0.19	1.15	0.72	0.68	2.10	1.56	1.04	1.94	1.27	0.96	2.21	1.48
Q3	2.03	4.13	3.26	1.15	3.56	2.25	2.10	4.72	3.33	1.94	3.66	2.52	2.21	4.05	3.28
Q4	4.13	48.29	14.27	3.56	5.05	4.32	4.72	43.48	10.70	3.66	70.78	18.86	4.05	48.29	14.63

Figure 2b LWIF quartile distribution ranges and average values for each quartile range

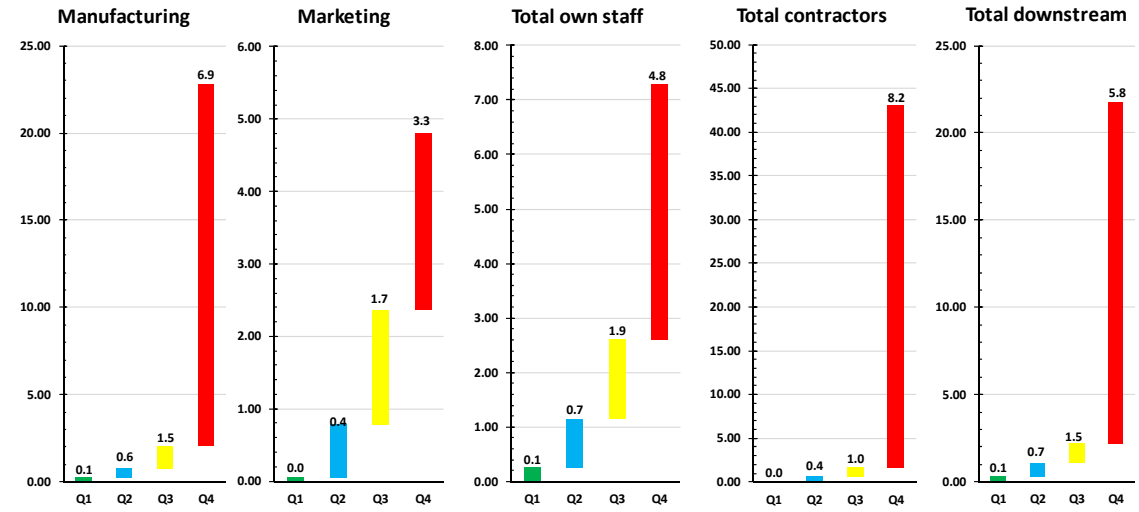
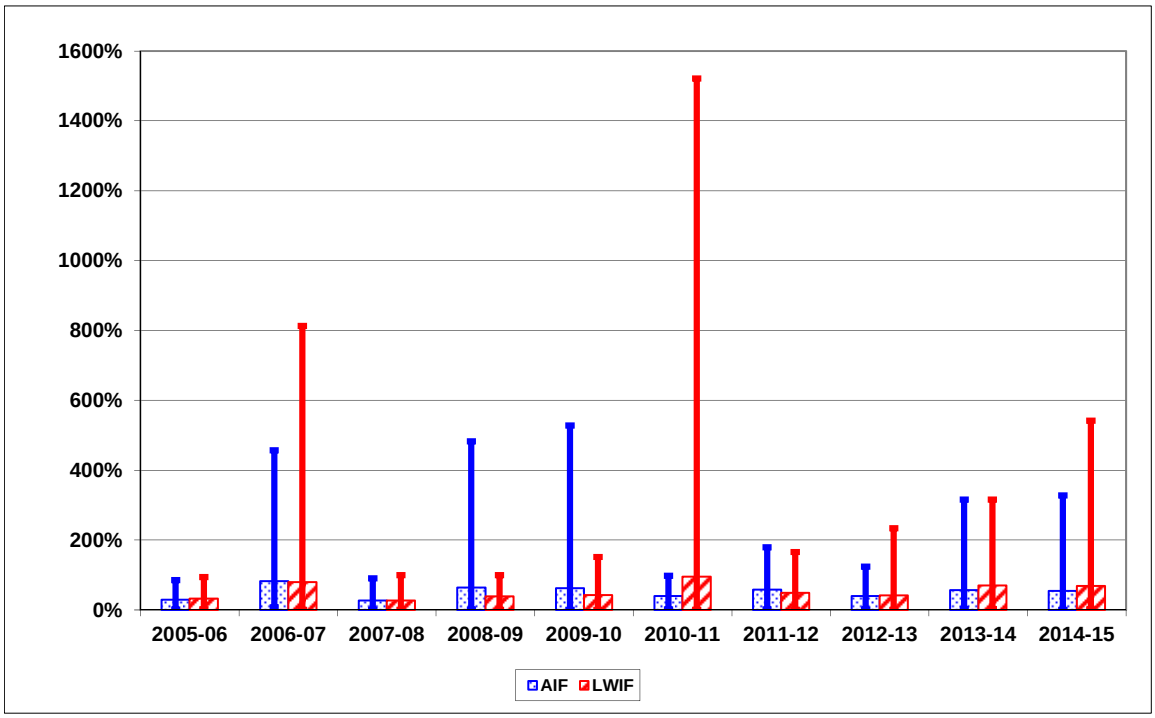


Table 4 LWIF quartile distribution ranges and average values for each quartile range

LWIF	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	0.27	0.12	0.00	0.05	0.00	0.00	0.26	0.07	0.00	0.13	0.00	0.00	0.32	0.13
Q2	0.27	0.74	0.56	0.05	0.79	0.38	0.26	1.14	0.69	0.13	0.64	0.42	0.32	1.10	0.73
Q3	0.74	2.04	1.52	0.79	2.37	1.69	1.14	2.61	1.86	0.64	1.71	1.04	1.10	2.18	1.52
Q4	2.04	22.83	6.87	2.37	4.80	3.33	2.61	7.28	4.76	1.71	43.15	8.18	2.18	21.74	5.81

The average performance indicator figures conceal a wide range of individual values between reporting companies. **Figure 3** shows that the variability is significantly less when looking at year-on-year figures for each company individually.

Figure 3 Year-on-year performance indicator variations
Average for all reporting companies



In summary, there are large differences in reported figures between companies but, for the most part, these differences also do not change much over the years. This reflects genuine levels of performance achieved by different organisations but also differences in the way companies monitor and classify incidents and collect their data.

LWI Causes

The analysis of the data collected on causes for fatalities and injuries has generated much interest amongst the membership. In 2013, Concawe members agreed to adopt 16 cause categories to describe both fatalities and lost work time injuries (LWI). These cause categories are aligned with other organisations (e.g. IOGP). In 2015 these cause categories continue to be used to categorise fatalities and LWIs. A summary of the categories and explanation is provided in **Appendix 3**. A total of 556 LWIs were reported in 2015 and 546 were allocated to the agreed categories within the company submissions (all companies except one).

The results are described in **Table 5** below.

Table 5 Causes of LWI in 2015

LWI 2015						2014	2013
Causes 2014		Manufacturing	Marketing	Combined	Percentage	Percentage	Percentage
Road accident	Road accident	7	16	23	4.2%	3.9%	4.4%
Height/Falls	Falls from height	21	26	47	8.6%	8.6%	10.3%
	Staff hit by falling objects	7	10	17	3.1%	4.6%	3.6%
	Slips & trips (same height)	79	82	161	29.5%	27.1%	32.7%
Burn/ electrical	Explosion or burns	27	6	33	6.0%	6.2%	4.8%
	Exposure electrical	4	0	4	0.7%	0.5%	0.6%
Confined space	Confined Space	1	0	1	0.2%	0.2%	0.8%
Other causes	Assault or violent act	2	15	17	3.1%	2.8%	1.7%
	Water related, drowning	0	0	0	0.0%	0.0%	0.2%
	Cut, puncture, scrape	11	14	25	4.6%	8.6%	5.0%
	Struck by	28	37	65	11.9%	10.9%	9.6%
	Exposure, noise, chemical, biological, vibration	11	3	14	2.6%	2.5%	2.6%
	Caught in, under or between	31	18	49	9.0%	7.7%	7.3%
	Overexertion, strain	43	33	76	13.9%	10.0%	12.4%
	Pressure release	4	0	4	0.7%	0.9%	0.9%
	Other	5	5	10	1.8%	5.6%	3.1%
	Total	281	265	546	100.0%	100%	100%

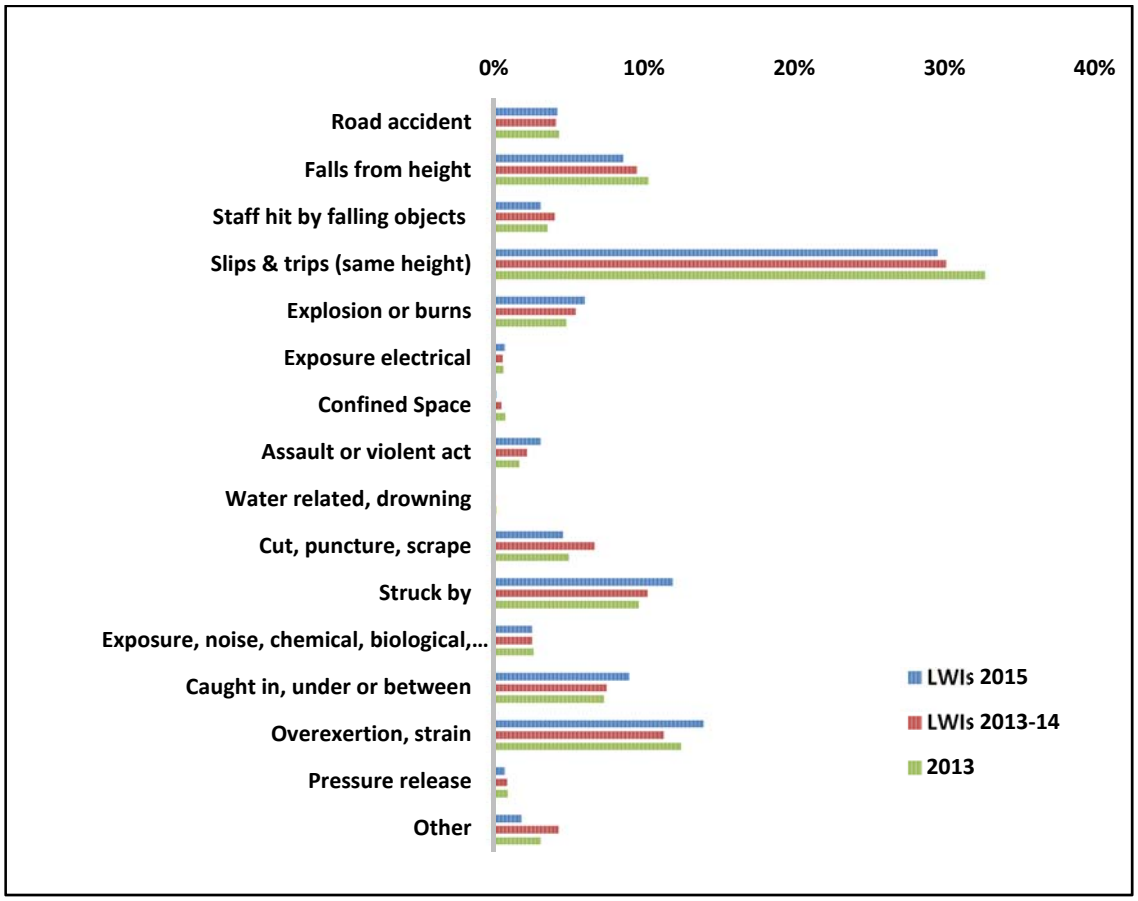
Note: Not allocated 10 LWI, 9 staff, 1 contractor, Manufacturing

As this is the third year of using the new 16 categories for all incidents, a summary of the 2014 and 2013 results has been included in the table for comparison. The outcome in terms of the % allocation of causes is very consistent from 2013 through 2014 and 2015. This consistency in the causes will clearly aid in identifying areas of concern for all Companies. After only 3 years of collecting the new data it is already possible to draw some limited conclusions about the causes of LWI which could suggest areas of focus. Slips & trips (same height), 29.5%, Struck by, 11.9%, Overexertion & strain, 13.9%, Falls from height, 8.6%, Explosions or burns, 6.0% are the major causes of LWIs in 2015 and together account for 79% of all LWIs.

Explosions or burns' also accounted for 4 fatalities in one incident while 'Road accident' caused 2 fatalities and 'Struck by' a further 1 fatality for a total of 7 fatalities in 2015.

The causal data is relatively consistent across the 3 years of collection. **Figure 4** provides a visual presentation of the 2015 causes recorded versus those of 2013-2014 causes.

Figure 4 Visual representation of LWI causes 2015, 2013 & 2014



4. HISTORICAL TRENDS

The performance indicators are of particular interest when considering their evolution over the years. The historical trends for the European downstream oil industry as a whole are shown in **Figures 5a/b** and **Table 6**.

Figure 5a Historical evolution of main performance indicators
Yearly data for the whole European downstream industry

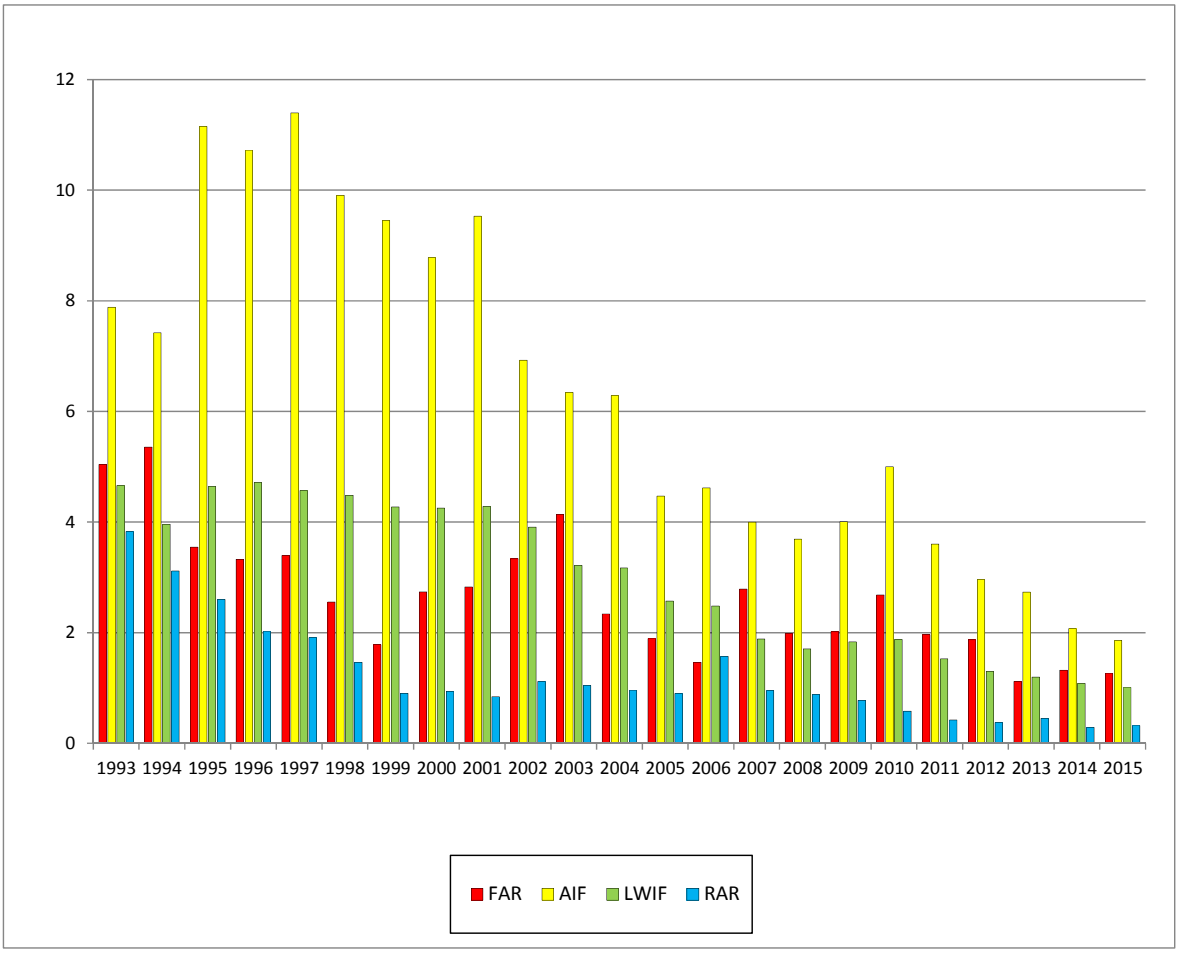


Figure 5b Historical evolution of main performance indicators
3-year rolling average for the whole European downstream industry

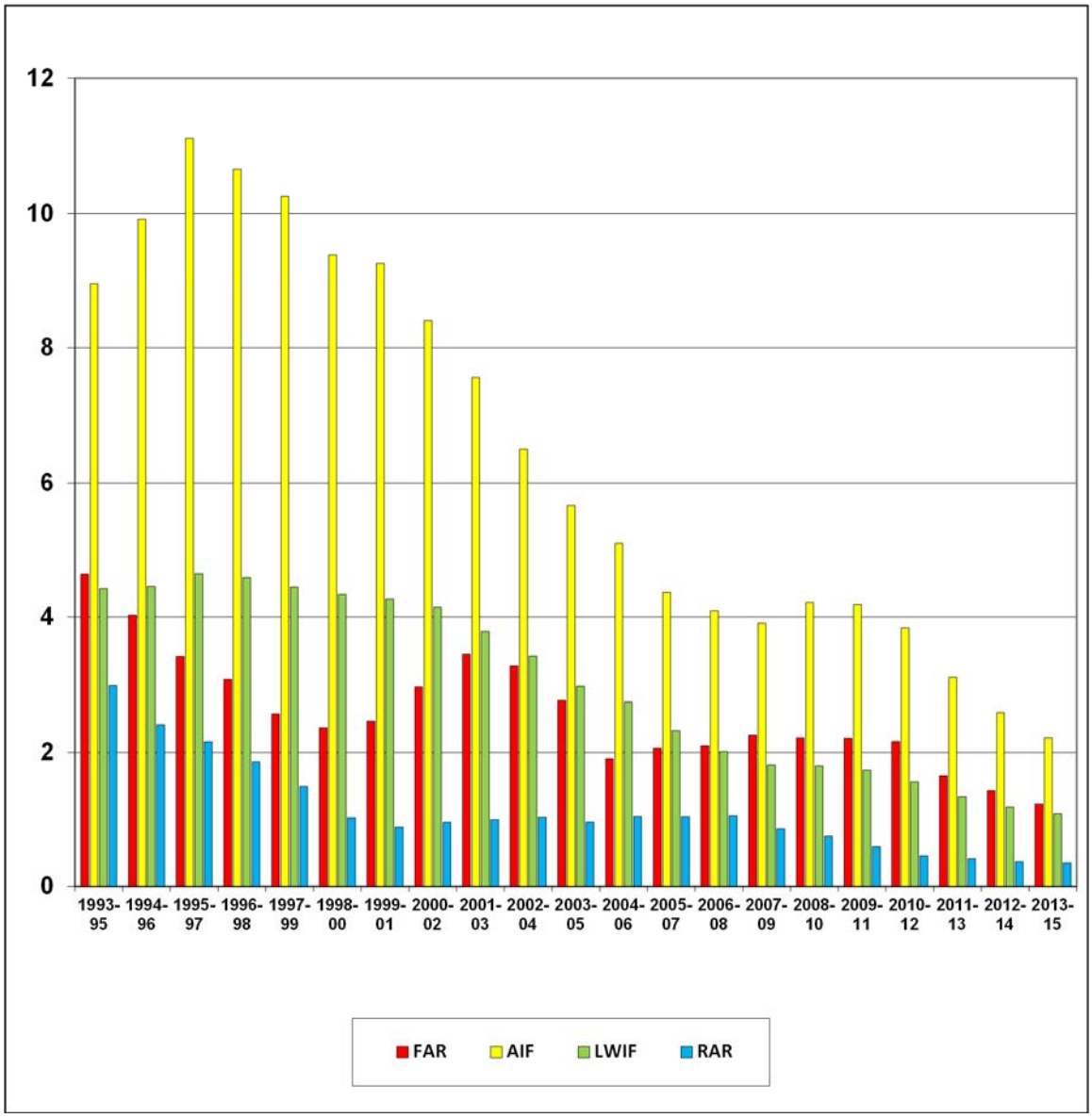


Table 6 Historical evolution of performance indicators

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**
Averages							
1993-2015	12	2.5	5.8	2.8	27	1.0	490.8
3-year rolling average							
Year	Fatalities	FAR	AIF	LWIF	LWIS	RAR	Million Hours Reported
1993-95	17	4.6	8.9	4.4	25	3.0	359.4
1994-96	15	4.0	9.9	4.5	22	2.4	380.6
1995-97	14	3.4	11.1	4.6	22	2.2	409.7
1996-98	14	3.1	10.7	4.6	21	1.9	444.1
1997-99	12	2.6	10.3	4.4	22	1.5	453.4
1998-00	11	2.4	9.4	4.3	23	1.0	464.4
1999-01	12	2.5	9.3	4.3	23	0.9	473.0
2000-02	14	3.0	8.4	4.1	24	1.0	483.5
2001-03	17	3.5	7.6	3.8	25	1.0	502.3
2002-04	17	3.3	6.5	3.4	28	1.0	508.3
2003-05	15	2.8	5.7	3.0	32	1.0	542.2
2004-06	10	1.9	5.1	2.7	33	1.1	524.2
2005-07	11	2.1	4.4	2.3	33	1.0	532.5
2006-08	11	2.1	4.1	2.0	31	1.1	523.7
2007-09	12	2.3	3.9	1.8	31	0.9	546.4
2008-10	12	2.2	4.2	1.8	29	0.7	541.1
2009-11	12	2.2	4.2	1.7	33	0.6	542.5
2010-12	12	2.2	3.8	1.6	34	0.5	538.7
2011-13	9	1.7	3.1	1.3	35	0.4	543.5
2012-14	8	1.4	2.6	1.2	35	0.4	533.5
2013-15	**7**	**1.2**	**2.2**	**1.1**	**38**	**0.4**	**539.7**

Figures 6a-c show the 3-year rolling average for FAR, AIF and LWIF segmented into the Manufacturing and Marketing activities, each split between own staff and contractors.

Figure 6a Historical evolution of Fatality Accident Rate segmented 3-year rolling average
(MF: Manufacturing; MK: Marketing)

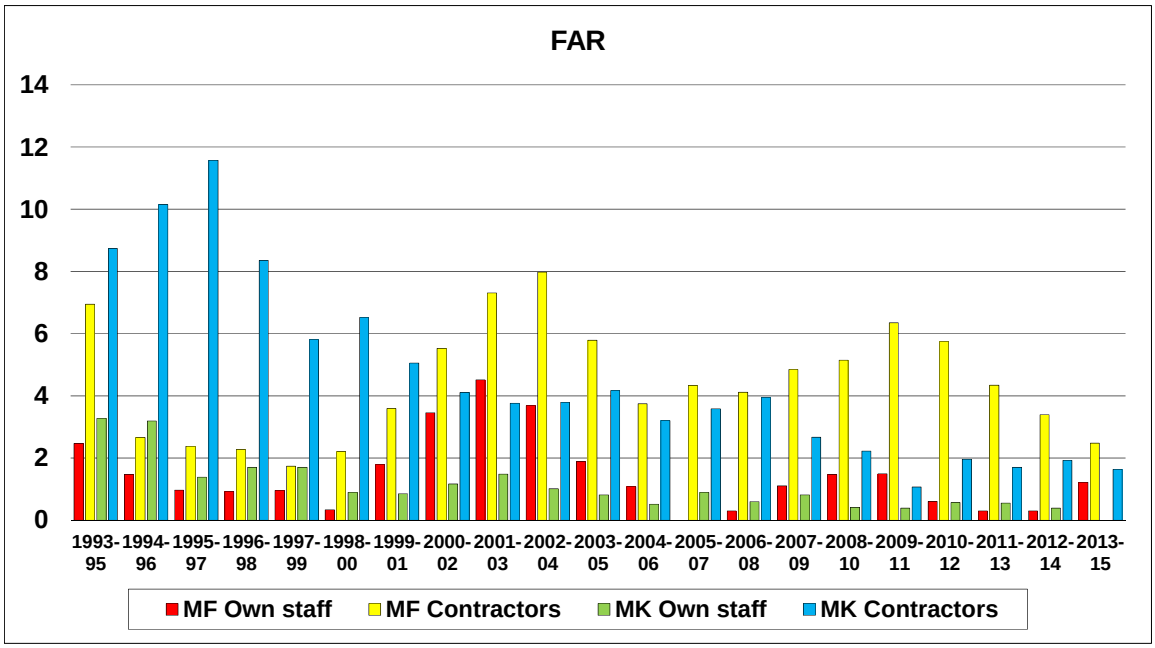


Figure 6b Historical evolution of Lost Work Injury Frequency segmented 3-year rolling average
(MF: Manufacturing; MK: Marketing)

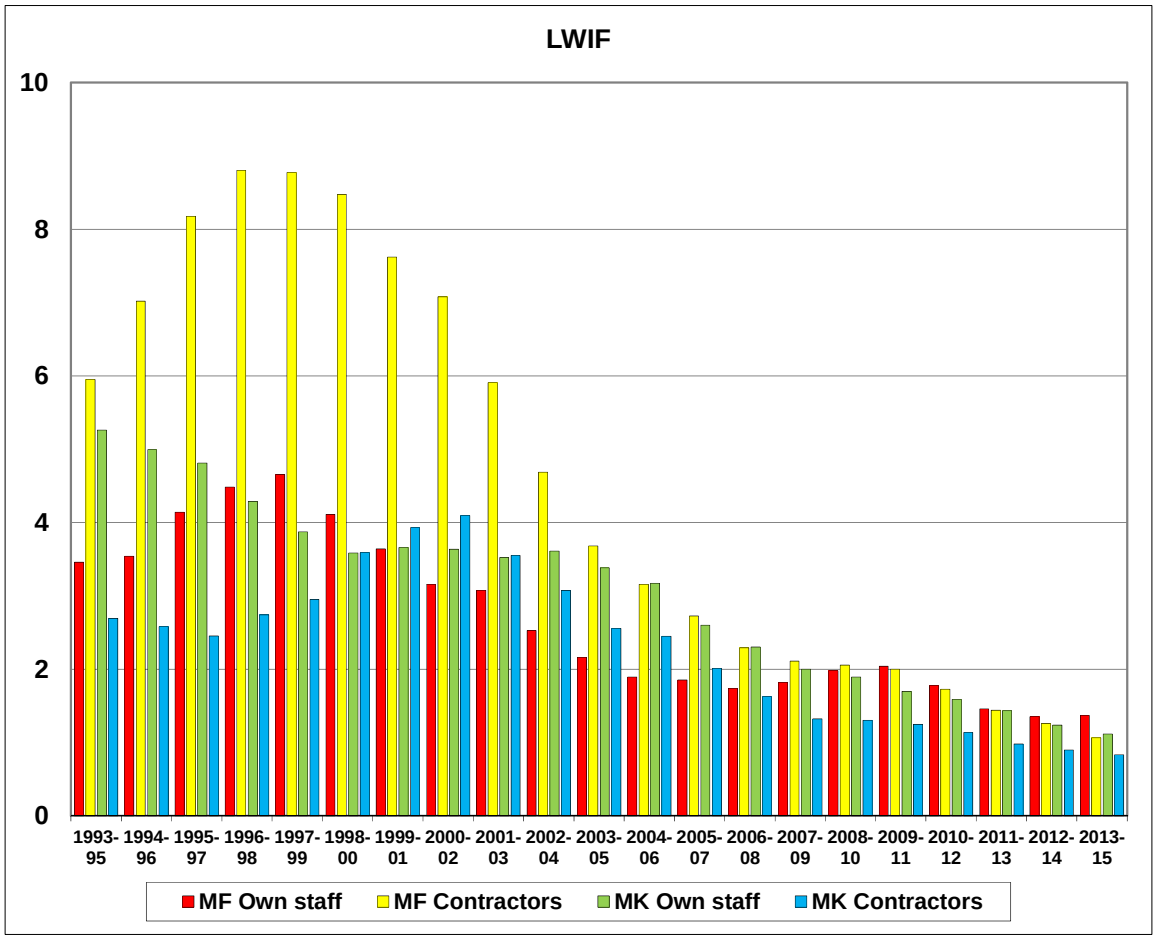
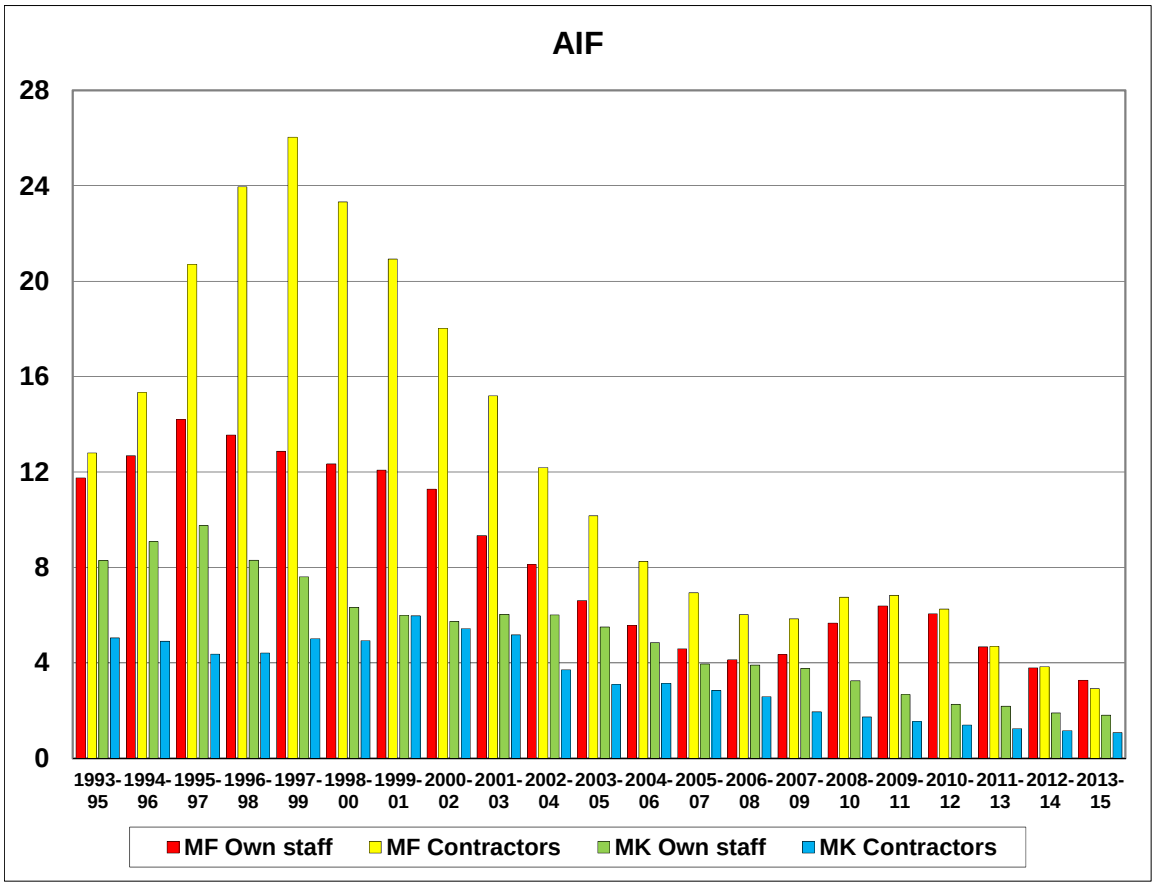


Figure 6c Historical evolution of All Injury Frequency segmented 3-year rolling average
(MF: Manufacturing; MK: Marketing)



A total of 7 fatalities were reported for 2015, with 4 fatalities resulting from one incident, which occurred during a refinery shutdown, and the other 3 being the result of separate incidents. The absolute number of fatalities and the FAR have been at consistently low levels since 2004 and this continues in 2015. In 2015, 4 fatalities (3 employees and 1 contractor) occurred in Manufacturing while the 3 fatalities in Marketing were all contractors. 4 of the 7 fatalities were contractors. As discussed in Section 2, it should be kept in mind that the FAR is notoriously prone to large variations.

The LWIF of 1.0 recorded for 2015 is the lowest value since the collection of this data commenced in 1993 and maintains the trend of less than 2.0 for the ninth consecutive year, the longest consistent period since Concawe 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.

The figures suggest that AIF peaked around 1996-97 but this is likely the result of improved reporting standards. Since this time the trend has been slowly downward.

Furthermore, it can be concluded that the improvement in the personal safety performance of contractor staff is catching up with that of own staff. For the LWIF, the performance even appears to be better for contractor staff. Therefore, it can be concluded that the sector is finding the balance between managing the safety

performance of both contractor and own staff. However, further performance improvement for both groups remains a feasible target.

In 2015, the road traffic accident rate was again 0.3, consistent with the rates achieved over the last few years. Road safety has been a major focus for the industry and it is pleasing to see the sustained reduction in the number of accidents being maintained. These accidents essentially occur in the Marketing activity where the bulk of the driving takes place. However, there were still 2 fatalities as a result of a road accident in 2015.

Figure 7 Relationship between the frequencies FAR, AIF and LWIF

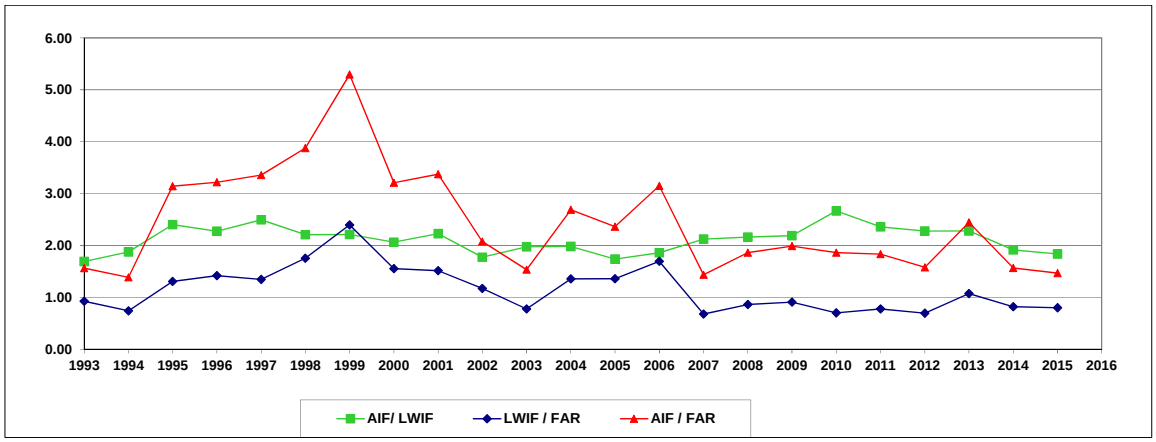


Figure 7 illustrates the relationship between the frequencies, FAR, AIF and LWIF and illustrates the declining number of fatalities until 1999 whereas the total number of incidents remained fairly constant. The period from 2000 to 2003 saw a steady increase in fatalities while both AI and LWI were still on a decreasing trend, resulting in a decrease of the ratios. The lower number of fatalities from 2004 to 2009 reversed the trend resulting in relatively steady ratios with a small positive spike in 2006 when there were only 7 fatalities. Following a spike in the graph in 2013 caused by the reduced number of fatalities (6), the graphs have returned to the trend with 7 fatalities recorded in both 2014 and 2015 and a slight reduction in both AIF and LWIF.

Figure 8a details the causes of the 7 fatalities recorded in 2015 while **Figure 8b** shows the causes of all fatalities recorded since the change to new causal categories in 2013. **Figure 9** shows the percentage of the main causes over the last 5 years and for all years since this information was first collected in 1998. In 2015, 4 fatalities were due to explosion or burns, 2 fatalities resulted from road accidents and 1 fatality was caused as a result of being struck by equipment.

For the last 5-year period, construction/maintenance/operations activities and road accidents remain the principal causes of fatalities although the proportion of road accident fatalities has reduced somewhat. Construction/maintenance/operations represents by far the biggest proportion of fatalities. While there is only 3 years of data with the new categories it may also be helpful to focus on the most common causes over those 3 years and this data is presented in **Figure 7b**.

Figure 8a Causes of fatalities in 2015

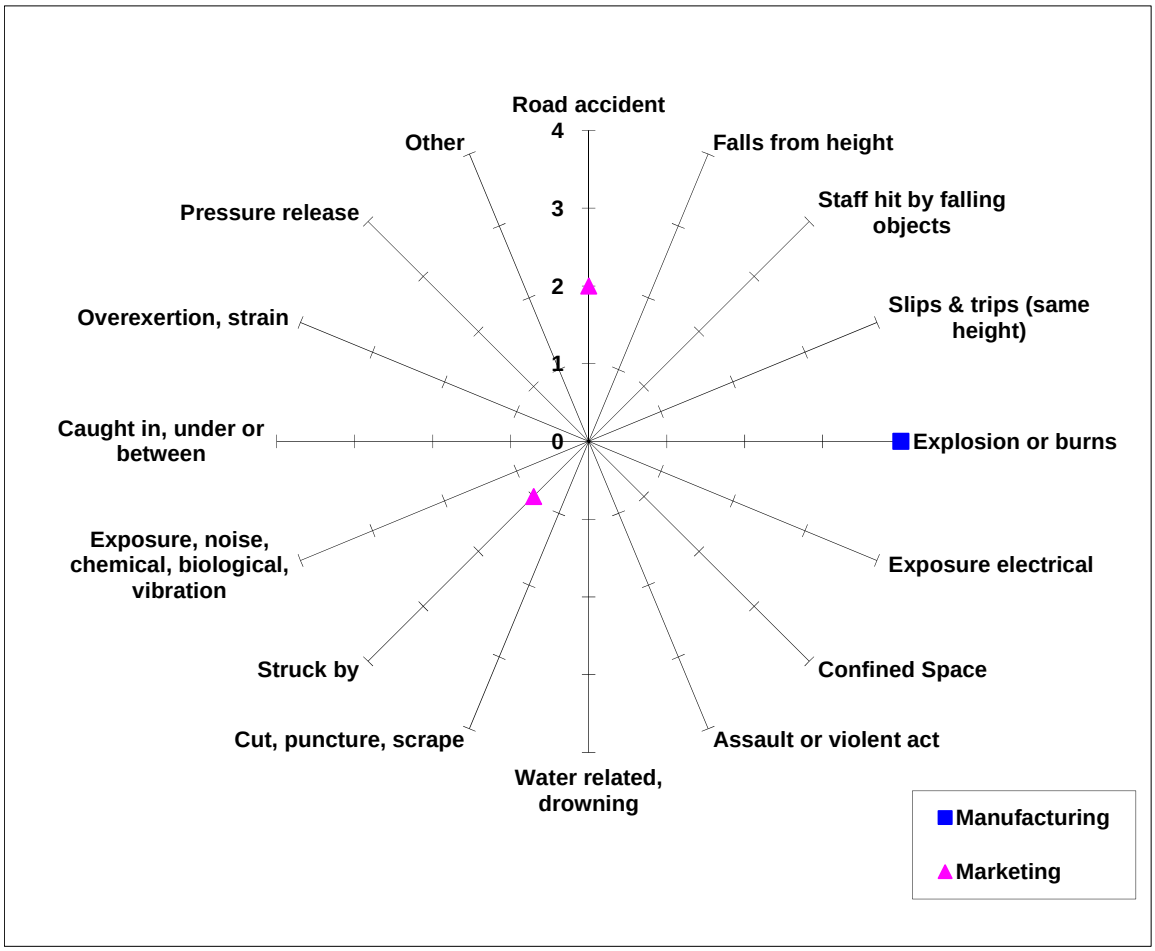


Figure 8b Causes of fatalities in 2013, 2014 & 2015

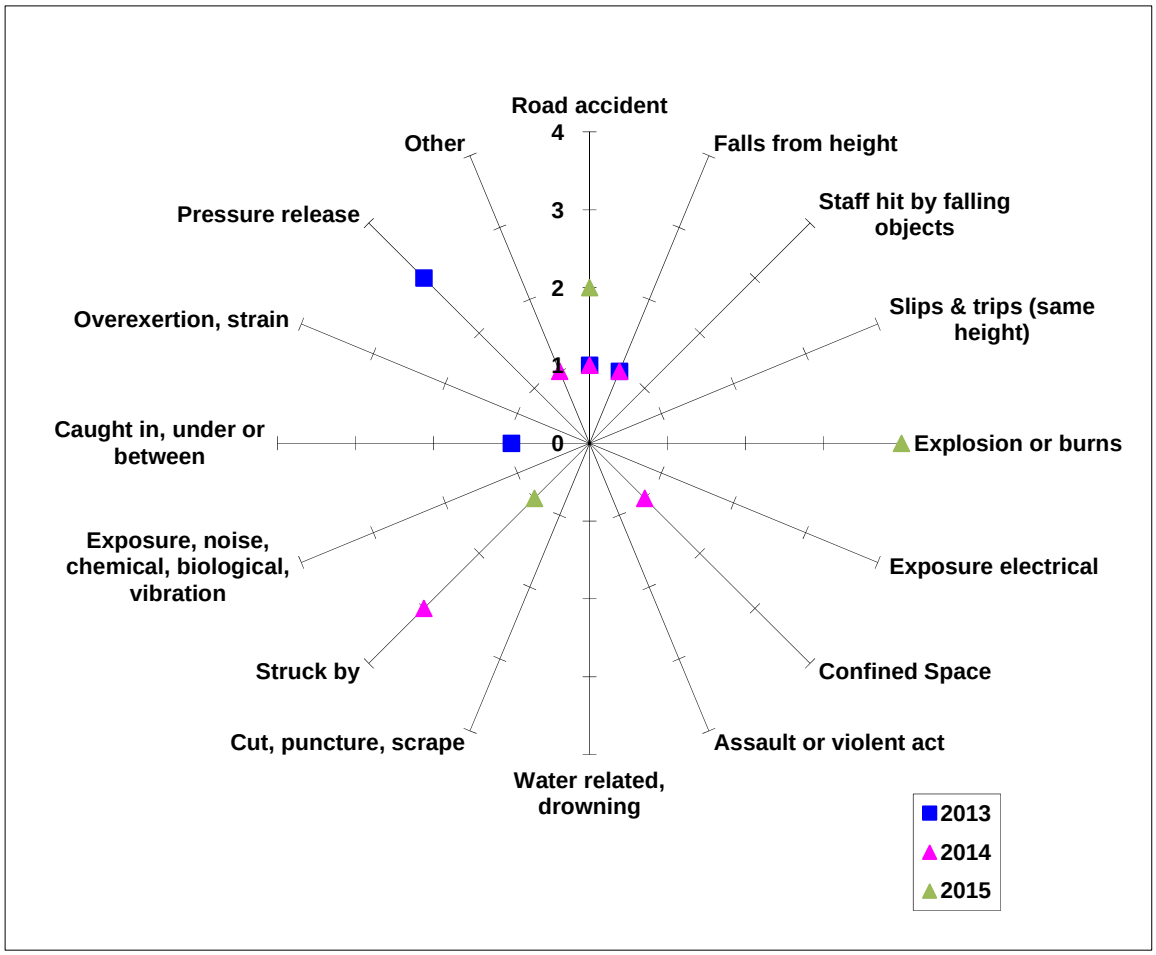
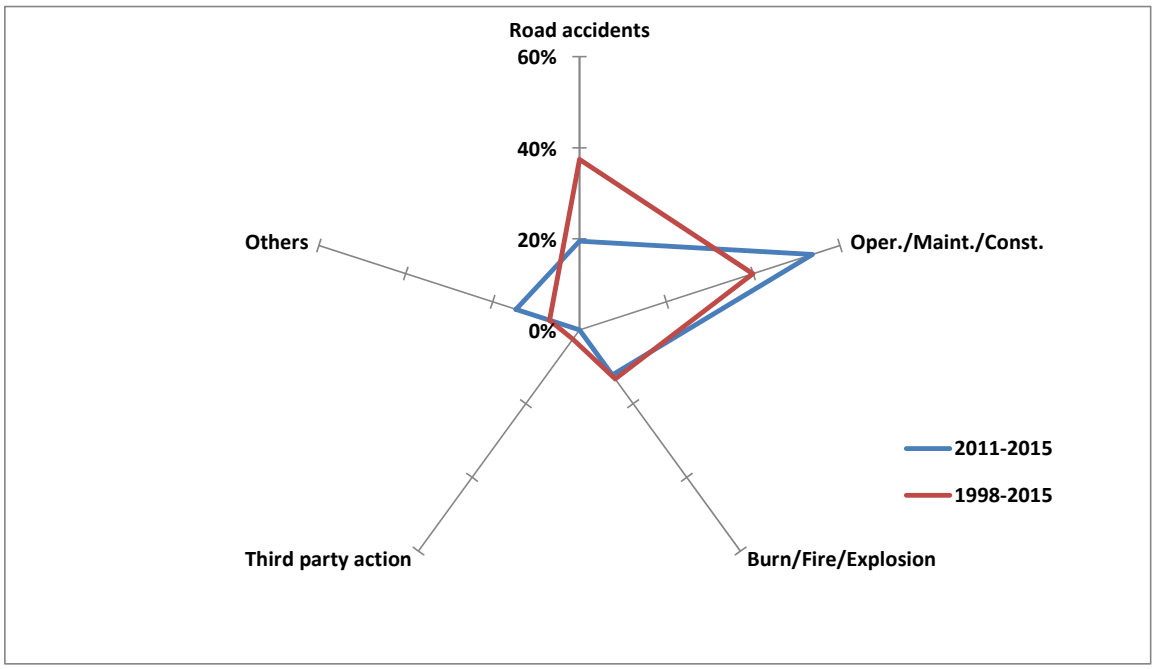


Figure 9 Causes of fatalities from 2011 to 2015 and from 1998 to 2015



5. 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. In 2010 the Safety Management Group of Concawe decided to expand the scope of industry wide safety performance indicators to address process safety, following the reporting guidelines that were developed by the API [22,23]. Combining a focus on process safety in conjunction with the personal safety factors collected thus far will contribute to a further reduction in serious injury rates in the industry.

The Concawe Membership was requested to report their PSPI indicators as defined by the API in 2008 [22] and as further refined in the ANSI/API recommended practise that was published in 2010 [23]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE's), as further defined in **Appendix 2** of this report. The definitions of these slightly differ from those that are described in the ANSI/API guideline to align the quantities to SI-metric units (kg/m/sec) and the inclusion of the European Classification and Labelling definitions that are in force in the EU [24] that can be used as an alternative for classifying the PSE. However, for the time being most Concawe members have expressed a preference for reporting their PSE's according to the ANSI/API definitions.

The aggregated 2015 results per sector and for the whole of the European downstream oil industry are shown in **Table 7**. **Figure 10a** shows the total Process Safety Event Rate (PSER) on a cumulative frequency basis which allows individual companies to benchmark their own results against the group. The PSER is the number of PSE per million total work hours reported. The distribution per quartile and average values for each quartile range are shown for Total PSE and Total PSER in **Figures 10b/c**.

In **Figures 11a/b/c** the cumulative frequencies for the PSER are given for Manufacturing only, as the data are sufficiently robust to allow the analysis provided in these presentations. These allow individual companies to benchmark their results for the Manufacturing sector against the group.

Table 7 Aggregated 2015 Process Safety results for all reporting companies

Sector		Manufacturing	Marketing	Both Sectors
Companies	Total	35	22	21
	PS reporting	30	17	16
	%	86%	77%	76%
Hours worked Mh	Total	266.4	291.2	557.6
	PS reporting	249.9 (236.0)[a]	248.1	497.9 (484.0) [a]
	%	96%	85%	89%
T-1 PSE	PSI	70	25	95
T-2 PSE	PSI	217	82	299
T-1 PSER	$PSI/Mh_{reported}$	0.28	0.10	0.19
T-2 PSER	$PSI/Mh_{reported}$	0.92 [a]	0.33	0.62
Total PSER	$PSI/Mh_{reported}$	1.15	0.43	0.79

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

Figure 10a Cumulative Frequency Analysis Total PSER

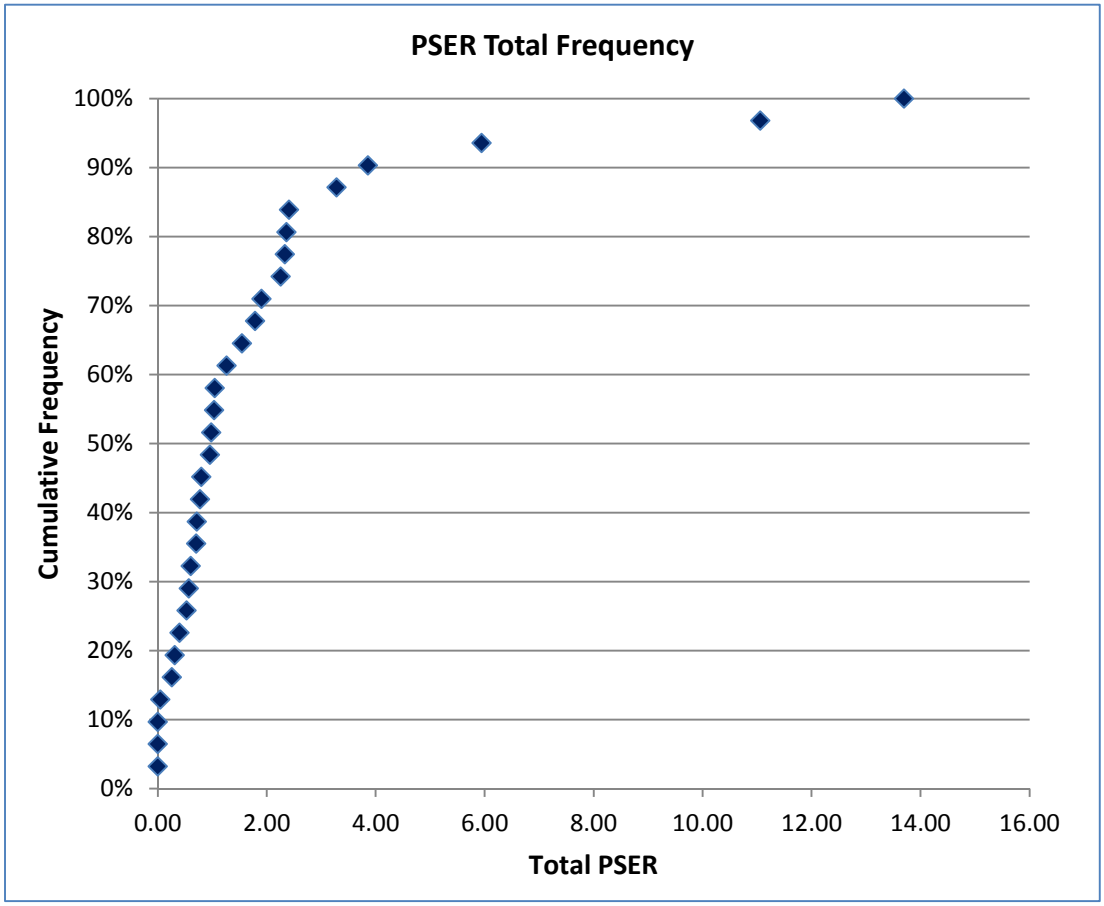


Figure 10b Total PSE quartile distribution ranges and average values for each quartile range

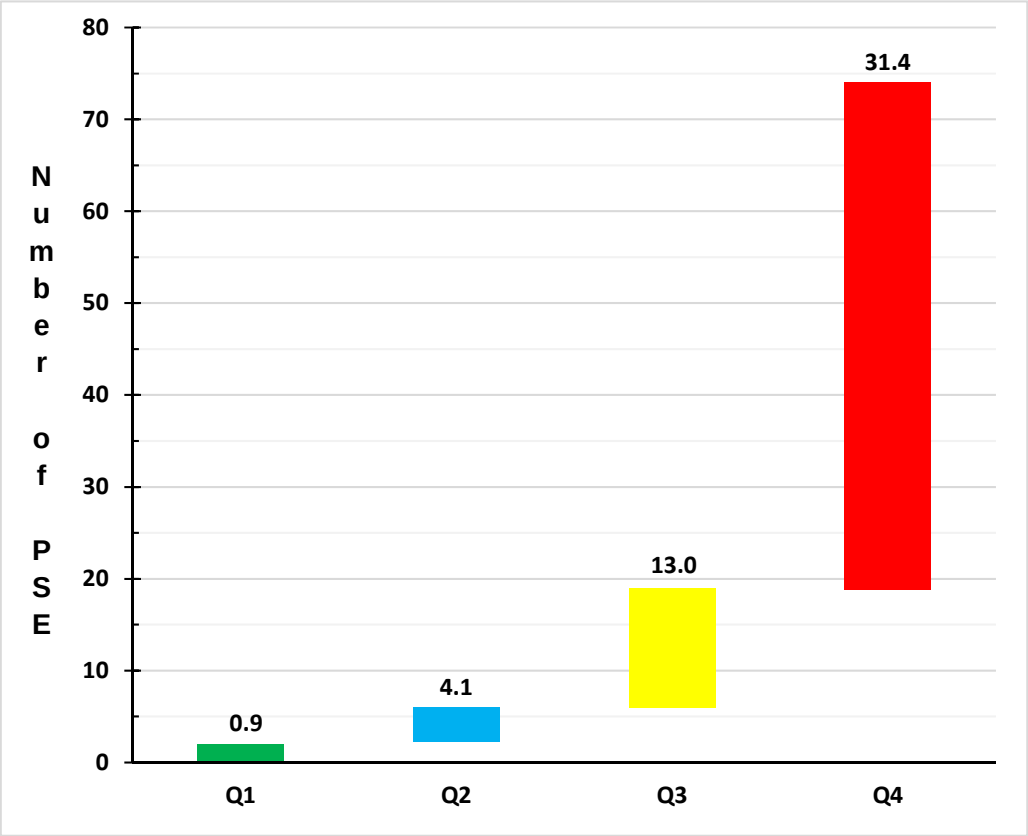


Table 8 Total PSE quartile distribution ranges and average values for each quartile range

PSE	Low	High	Average
Q1	0	2	0.9
Q2	2.5	6	4.1
Q3	6	19	13.0
Q4	18.5	74	31.4

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

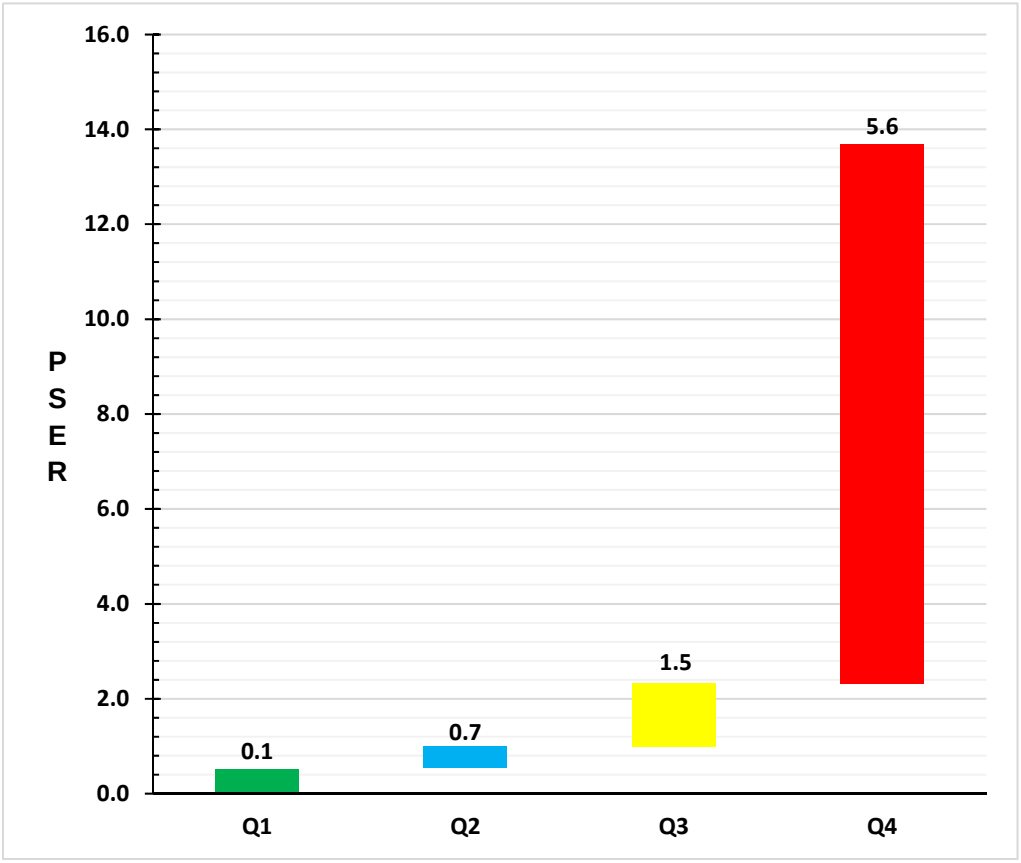


Table 9 Total PSER quartile distribution ranges and average values for each quartile range

PSER	Low	High	Average
Q1	0	0.53	0.1
Q2	0.55	0.99	0.7
Q3	0.99	2.34	1.5
Q4	2.30	13.70	5.6

Figure 11a Cumulative frequency chart for all Manufacturing PSER

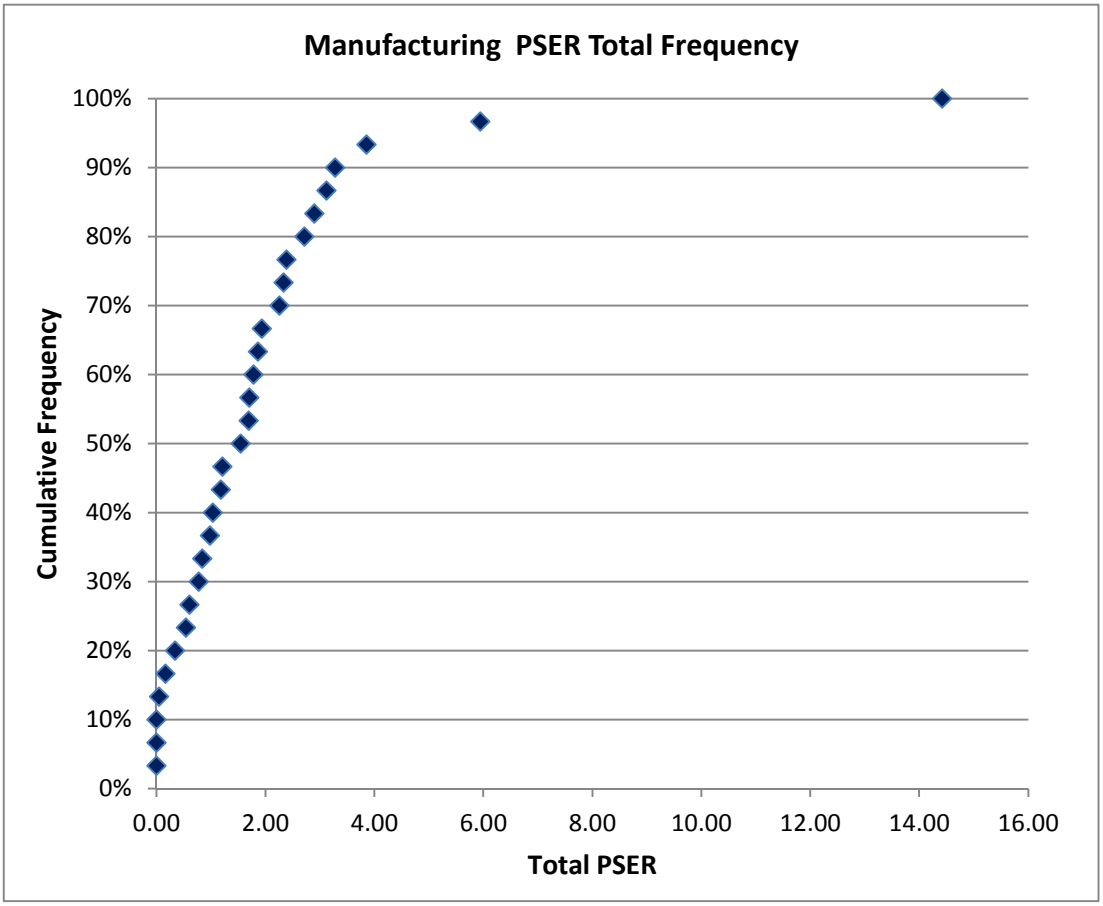


Figure 11b Cumulative frequency chart for Tier 1 Manufacturing PSER

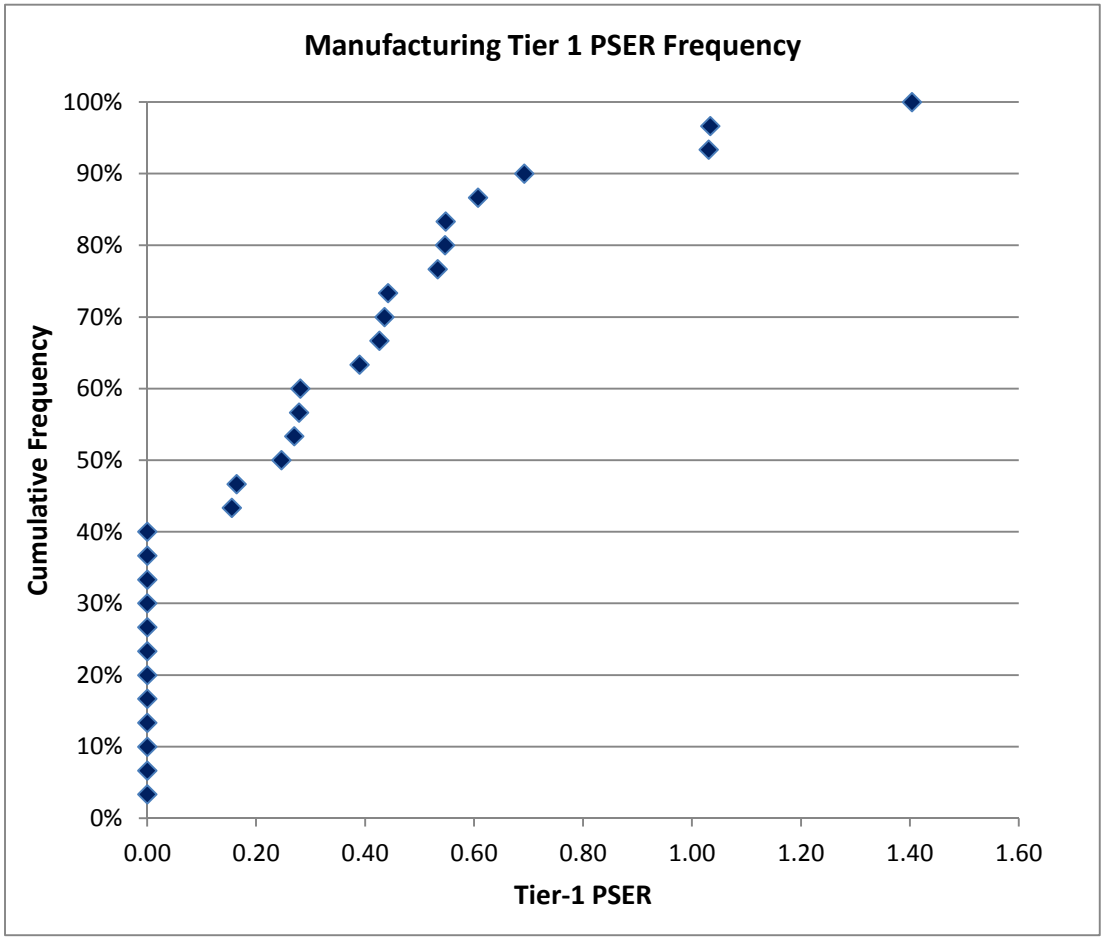
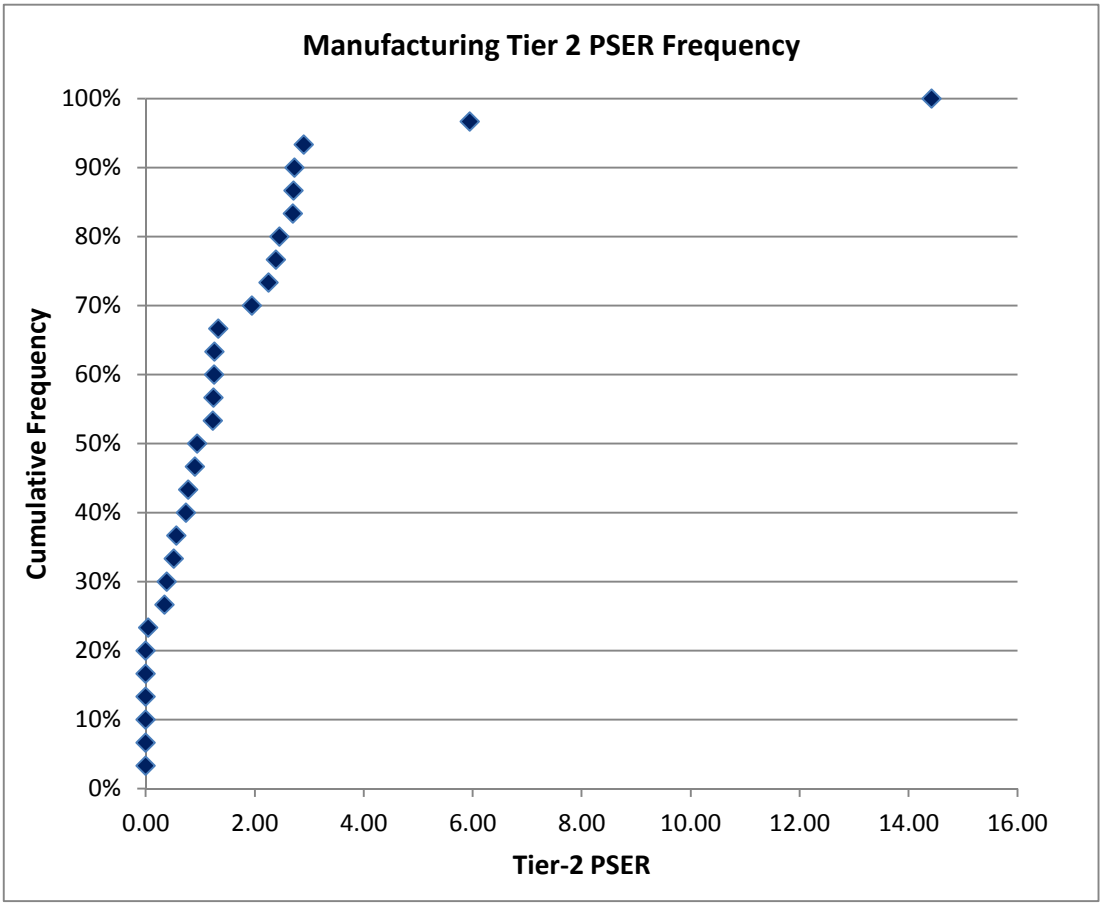


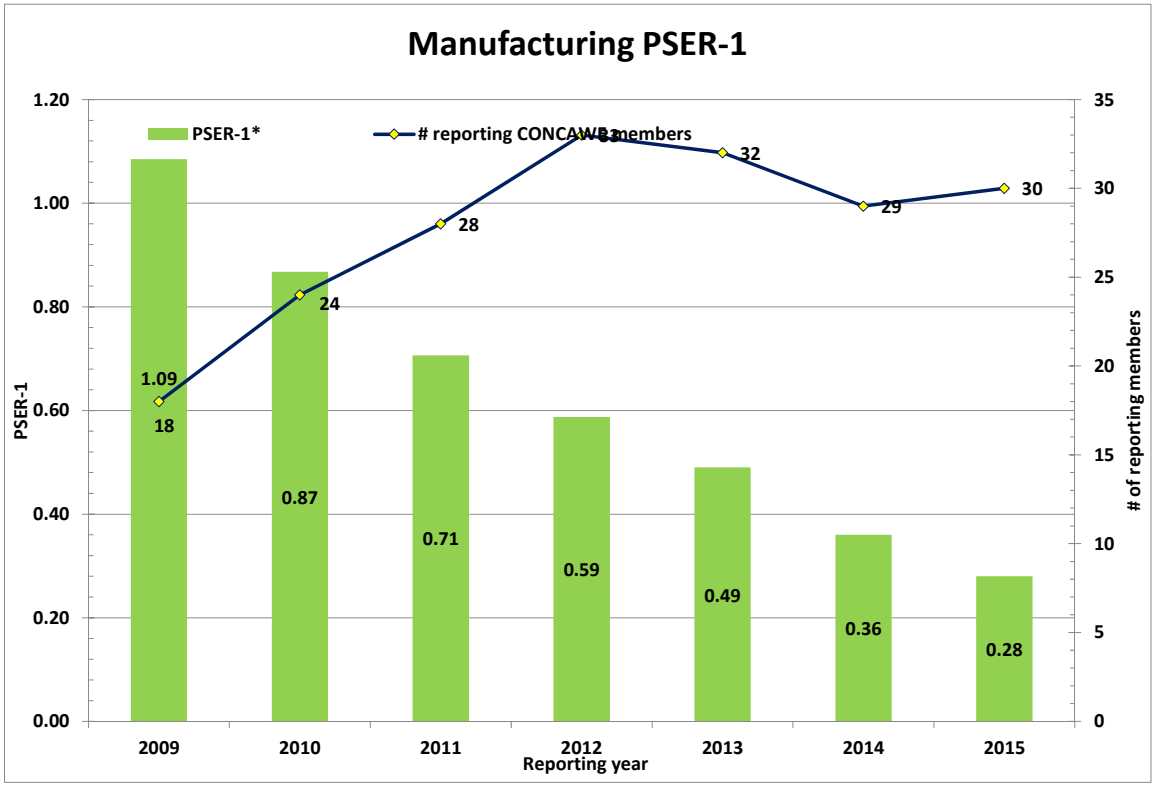
Figure 11c Cumulative frequency chart for Tier 2 Manufacturing PSER



The data provided suggests that one Tier 1 PSE in the Manufacturing sector resulted in 4 fatalities. The number of LWIs resulting from the PSEs is not established, as this information is not available.

The extent of reporting of Process Safety data was a slight increase versus that reported for 2014. In this seventh year of data collection a total of 86% of the Manufacturing operations and 77% of the Marketing operations provided the requested information. The results for 2015 are included in this report and continue to show a significant reduction in the number of Process Safety Events (PSE) and in Process Safety Event Rates (PSER) versus prior years. This is demonstrated in the range of graphs for Manufacturing and Total PSPI (Process Safety Performance Indicator) responses presented in **Figures 12a-e** which show the results recorded by this survey over the 7 years of Concawe reporting and the associated trends.

Figure 12a Manufacturing PSER-1 2009-2015



* PSER-1 the number of releases of hazardous substances per 1 million hours worked causing a fatality, injury, fire or explosion leading to damages valued over € 25,000 or above set threshold values indicative to have the potential to cause these (see appendix 2).

Figure 12b Manufacturing Total PSEs 2009-2015

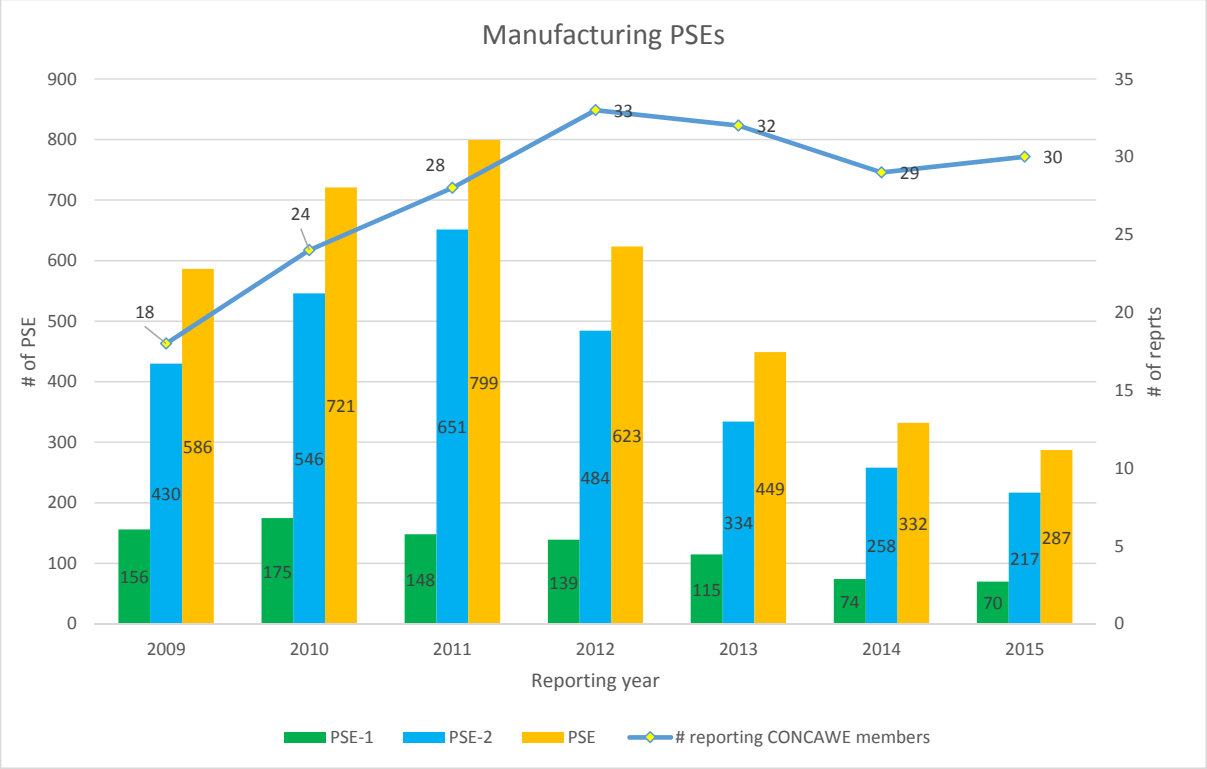


Figure 12c Average Manufacturing PSEs 2009-2015

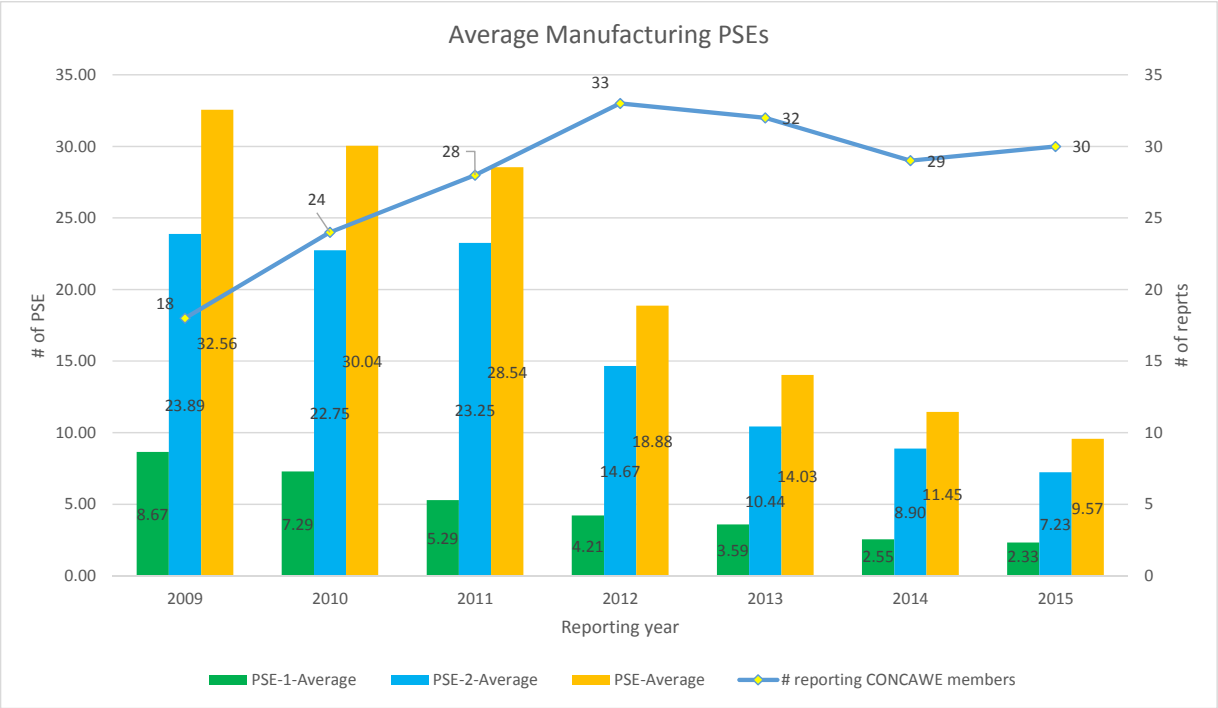


Figure 12d Manufacturing PSERs 2009-2015

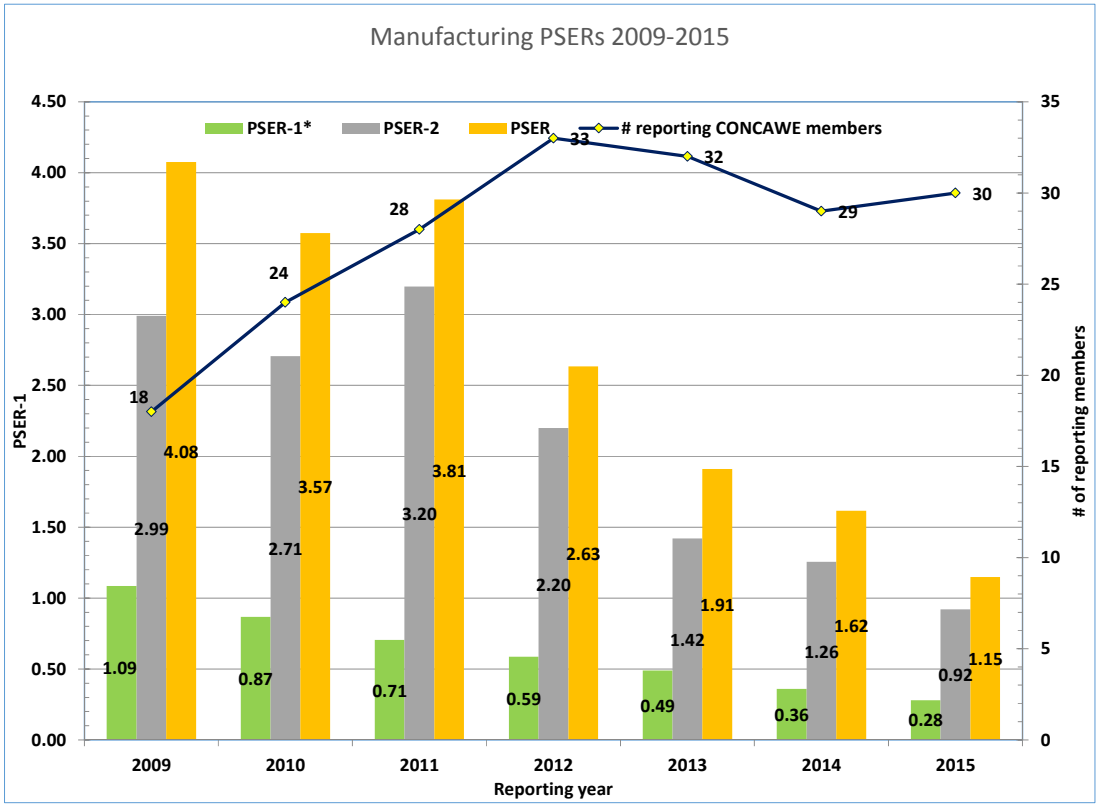
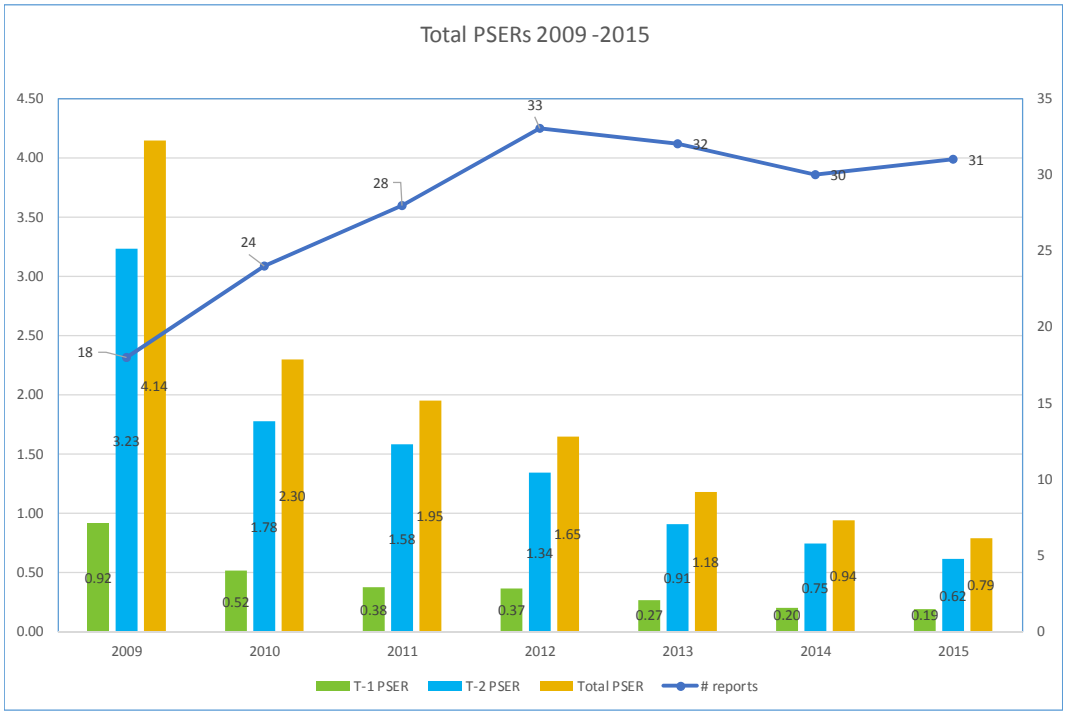


Figure 12e Total PSERs 2009-2015



6. 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.

Table 10 Comparison of the safety performance of the downstream oil industry

	CONCAWE	IOGP 2015[1]		CEFIC	API 2013
	2015	Europe	World	2012	Manufacturing
FAR	1.3	1.2	1.5	Not reported	NA
AIF	1.9	2.2	1.2	Not reported	NA
LWIF	1.0	0.7	0.3	4.9	5.6[2]

IOGP International Association of Oil & Gas Producers

CEFIC Conseil Européen des Fédérations de l'Industrie Chimique

API American Petroleum Institute

(1) Own staff and contractors

(2) Estimated from 2.1 injuries per 100 FT oil and gas workers (own & contractor staff), API WIIS-report 2003-2012

The IOGP statistics concern the "upstream" oil industry covering oil and gas exploration and production activities [25]. For 2015, OGP recorded somewhat lower safety metrics to those collected by Concawe for the 2015 data for European downstream activities. The "upstream" operation recorded a higher FAR but somewhat better results for the other safety metrics across the globe.

The 2012 data for the EU chemical industry (CEFIC) [26], the 2015 data for IOGP [25] and the 2013 data for API [28] have been shown as these reports are publicly available.

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APPENDIX 1 EUROPEAN OIL INDUSTRY STATISTICS DEFINITIONS AND GUIDING NOTES

1.	Hours worked	Hours worked by employees and contractors. Estimates should be used where contractor data is not available.
2.	Fatality	This is a death resulting from a work related injury where the injured person dies within twelve months of the injury.
3.	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.
4.	Total days lost	The number of calendar days lost through LWIs counting from the day after the injury occurred.
5.	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.
6.	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.
7.	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.
8.	LWIF	Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions.
9.	LWIS	Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs.
10.	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.
11.	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

12.	RAR	Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions.
13.	FAR	Fatal Accident rate is calculated from the number of fatalities divided by the number of hours worked expressed in hundred millions
14.	COCO	Company owned and operated sites
15.	CODO	Company owned, Dealer operated sites
16.	DOCO	Dealer owned, Company operated sites
17.	DODO	Dealer owned and operated sites
18.	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).
19.	PSE	A Process Safety Event is an unplanned or uncontrolled LOPC. The severity of the PSE is defined by the consequences of the LOPC.
20.	Tier 1 PSE	A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence. A T-1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO_2 or compressed air), from a process that results in one or more of the consequences listed below: • An employee, contractor or subcontractor “days away from work” injury and/or fatality; or • Hospital admission and/or fatality of a third-party; or • Officially declared community evacuation or community shelter-in-place; or • Fires or explosions resulting in greater than or equal to €25,000 of direct cost to the Company; or • A pressure relief device (PRD) discharge to atmosphere greater than the threshold quantities described in **Table A2-1** of **Appendix 2** that: ▪ contained liquid carryover; or ▪ was discharged to an unsafe location; or ▪ resulted in an onsite shelter-in-place; or ▪ resulted in public protective measures (e.g., road closure); or • A release of material greater than the threshold quantities described in **Table A2-1** of **Appendix 2** in any one-hour period.

21. Tier 2 PSE

A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. A T-2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO_2 or compressed air), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:

- An employee, contractor or subcontractor recordable injury; or·
- A fire or explosion resulting in greater than or equal to €2,500 of direct cost to the Company; or
- A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device greater than the threshold quantity in **Table A2-2** of **Appendix 2** that results in one or more of the following four consequences:
  - liquid carryover; or
  - discharge to a potentially unsafe location; or
  - an onsite shelter-in-place; or
  - public protective measures (e.g., road closure) and;
- A release of material greater than the threshold quantities described in **Table A2-2** of **Appendix 2** in any one-hour period.

22. 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.

Other definitions and guidance

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.

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.

Separate statistics are collected for Manufacturing and Marketing

Where data are not available directly, Members are requested to present the best estimate possible.

APPENDIX 2 CONCAWE PROCESS SAFETY PERFORMANCE INDICATORS DEFINITIONS

Within Concawe the decision was taken to start gathering Process Safety Performance Indicator (PSPI) data as of 2010.

Aligning this initiative with developments globally, the decision was taken to adopt the indicators of the ANSI/API guideline "Process Safety Performance Indicators for the Refining and Petrochemical Industries" that was published as ANSI/API Guideline 754 in April 2010 [REF 1].

The performance indicators that Concawe collects from its membership for the European Refining and Distribution Industry are the Tier 1 and 2 PSPI of the ANSI/API guideline with alteration to use the criteria that are embedded in EU-legislation and the fact that in Europe quantities are reported in the SI-metric system (kg/m/sec). The classification of Process Safety Events (PSE) otherwise should follow the scheme set in the ANSI/API guideline.

The reporting of these indicators is still evolving but limited analyses can now be performed for the European Refining and Distribution Industry that allows comparing with other regions where this data is collected and reported.

In the API guidance 4 Tiers of PSPIs are mentioned. However, the data collection and evaluation within Concawe is restricted to only Tier 1 & 2 PSPIs.

The criteria for the classification of Tier 1 and 2 PSEs are provided below taken from the ANSI/API guidance modified for the European context. This includes Table A2-1 and 2.

Tier 1 Performance Indicator — Process Safety Event (T-1 PSE)

Tier 1 Indicator Purpose

The count of Tier 1 process safety events is the most lagging process safety performance indicator (PSPI) and represents incidents with greater consequence resulting from actual losses of containment.

Tier 1 Indicator Definition and Consequences

A Tier 1 Process Safety Event (T-1 PSE) is a loss of primary containment (LOPC) with the greatest consequence as defined by this document. A T-1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen or other inert gases, compressed CO_2 or compressed air[1]), from a process that results in one or more of the consequences listed below:

[1] Non-toxic and non-flammable materials (e.g., steam, hot water, nitrogen, compressed CO_2 or compressed air) have no threshold quantities and are only included in this definition as a result of their potential to result in one of the other consequences. Event involving these only become reported, if these result in one of the consequences indicated.

- An employee, contractor or subcontractor “days away from work” injury and/or fatality; or
- A hospital admission and/or fatality of a third-party; or
- An officially declared community evacuation or community shelter-in-place; or
- A fire or explosion resulting in greater than or equal to €25,000 of direct cost to the Company; or
- A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device that results in one or more of the following four consequences:
    - liquid carryover; or
    - discharge to a potentially unsafe location; or
    - an on-site shelter-in-place; or
    - public protective measures (e.g., road closure);

  and a PRD discharge quantity greater than the threshold quantities in **Table A2-1**; or
- Any release of material greater than the threshold quantities described in **Table A2-1** in any one-hour period.

Calculation of Tier 1 PSE Rate

The Tier 1 PSE Rate shall be calculated as follows:

Tier 1 PSE Rate = (Total Tier 1 PSE Count / Total Work Hours) x 1,000,000[2]

[2] Total work hours include employees and contractors. The 1,000,000 hours is the Concawe denominator that is also applied in the operational safety statistics frequency estimations.

Table A2-1 Tier-1 Material Release Threshold Quantities

Threshold Release Category	Material Hazard Classification[1,3,4]	Threshold Quantity (outdoor release)	Threshold Quantity (indoor[2] release)
1	TIH Zone A or EU-CLP Category 1 Hazardous Materials[5]	5 kg	2.5 kg
2	TIH Zone B or EU-CLP Category 2 Hazardous Materials[5]	25 kg	12.5 kg
3	TIH Zone C or EU-CLP Category 3 Hazardous Materials[5]	100 kg	50 kg
4	TIH Zone D or EU CLP Category 4 Hazardous Materials[5]	200 kg	100 kg
5	Flammable Gases or Liquids with Boiling Point ≤ 35°C and Flash Point < 23°C or Other Packing Group I Materials	500 kg	250 kg
6	Liquids with Boiling Point > 35°C and Flash Point < 23°C or Other Packing Group II Materials	1000 kg	500 kg
7	Liquids with Flash Point ≥ 23°C and ≤ 60°C or Liquids with Flash Point > 60°C released at a temperature at or above Flash Point or strong acids/bases or Other Packing Group III Materials	2000 kg	1000 kg

[1] Many materials exhibit multiple hazards. Correct placement in Hazard Zone or Packing Group shall preferentially follow the rules of the UN Recommendations on the Transportation of Dangerous Goods, Section 2 [REF 2] or the Classifications according to DOT 49 CFR 173.2a [REF 3], as explained in the ANSI/API guideline 754 Annex B. Alternatively, the classifications of EU Regulation EC-1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 [REF 4] that implement the UN harmonised System can be used.

[2] A structure composed of four complete (floor to ceiling) walls, floor and roof.

[3] For solutions not listed on the UNDG, the anhydrous component shall determine the TIH hazard zone or Packing Group classification. The threshold quantity of the solution shall be back calculated based on the threshold quantity of the dry component weight.

[4] For mixtures where the UNDG classification is unknown, the fraction of threshold quantity release for each component may be calculated. If the sum of the fractions is equal to or greater than 100%, the mixture exceeds the threshold quantity. Where there are clear and independent toxic and flammable consequences associated with the mixture, the toxic and flammable hazards are calculated independently.

[5] For vapours, the hazardous classifications only apply to inhalation toxicity. Whereas for liquids, the oral and dermal toxicity should be assessed, as well as described in the ANSI/API guideline Annex B.

Tier 2 Performance Indicators – Process Safety Events (T-2-PSE)

Tier 2 Indicator Purpose

The count of Tier 2 process safety events represents LOPC events with a lesser consequence. Tier 2 PSEs, even those that have been contained by secondary systems, indicate system weaknesses that may be potential precursors of future, more significant incidents In that sense, Tier 2 PSEs can provide a company with opportunities for learning and improvement of its process safety performance.

Tier 2 Indicator Definition and Consequences

A Tier 2 Process Safety Event (T-2 PSE) is a LOPC with lesser consequence. A T-2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO_2 or compressed air[1]), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:

An employee, contractor or subcontractor recordable injury; or

- A fire or explosion resulting in greater than or equal to €2,500 of direct cost to the Company; or
- A pressure relief device (PRD) discharge to atmosphere or to a downstream destructive device that results in one or more of the following four consequences:
    - liquid carryover; or
    - discharge to a potentially unsafe location; or
    - an onsite shelter-in-place; or
    - public protective measures (e.g., road closure);

  and a PRD discharge quantity greater than the threshold quantity in **Table A2-2**; or
- A release of material greater than the threshold quantities described in **Table A2-2** in any one-hour period.

Calculation of Tier 2 PSE Rate

The Tier 2 PSE rate shall be calculated as follows:

Tier 2 PSE Rate = (Total Tier 2 PSE Count / Total Work Hours) x 1,000,000[5]

Table A2-2 Tier-2 Material Release Threshold Quantities

Threshold Release Category	Material Hazard Classification[1,3,4]	Threshold Quantity (outdoor release)	Threshold Quantity (indoor[2] release)
1	TIH Zone A or EU-CLP Category 1 Hazardous Materials[5]	0.5 kg	0.25 kg
2	TIH Zone B or EU-CLP Category 2 Hazardous Materials[5]	2.5 kg	1.25 kg
3	TIH Zone C or EU-CLP Category 3 Hazardous Materials[5]	10 kg	5 kg
4	TIH Zone D or EU CLP Category 4 Hazardous Materials[5]	20 kg	10 kg
5	Flammable Gases or Liquids with Boiling Point ≤ 35°C and Flash Point < 23°C or Other Packing Group I Materials	50 kg	25 kg
6	Liquids with a Boiling Point > 35°C and Flash Point < 60°C or Liquids with Flash Point > 60°C released at or above Flash Point; or Other Packing Group II and III Materials or Strong acids and bases	100 kg	50 kg
7	Liquids with Flash Point > 60°C released at a temperature below Flash Point or Moderate acids/bases	1000 kg	500 kg

In order to simplify determination of reporting thresholds for Tier 2, Categories 6 and 7 in Tier 1 have been combined into one category in Tier 2 (Category 6). The simplification is intended to provide less complicated requirements for those events with lesser consequences.

[1] Many materials exhibit multiple hazards. Correct placement in Hazard Zone or Packing Group shall preferentially follow the rules of the UN Recommendations on the Transportation of Dangerous Goods, Section 2 [REF 2] or the Classifications according to DOT 49 CFR 173.2a [REF 3], as explained in the ANSI/API guideline 754 Annex B. Alternatively, the classifications of EU Regulation EC-1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 [REF 4] that implement the UN harmonised System can be used.

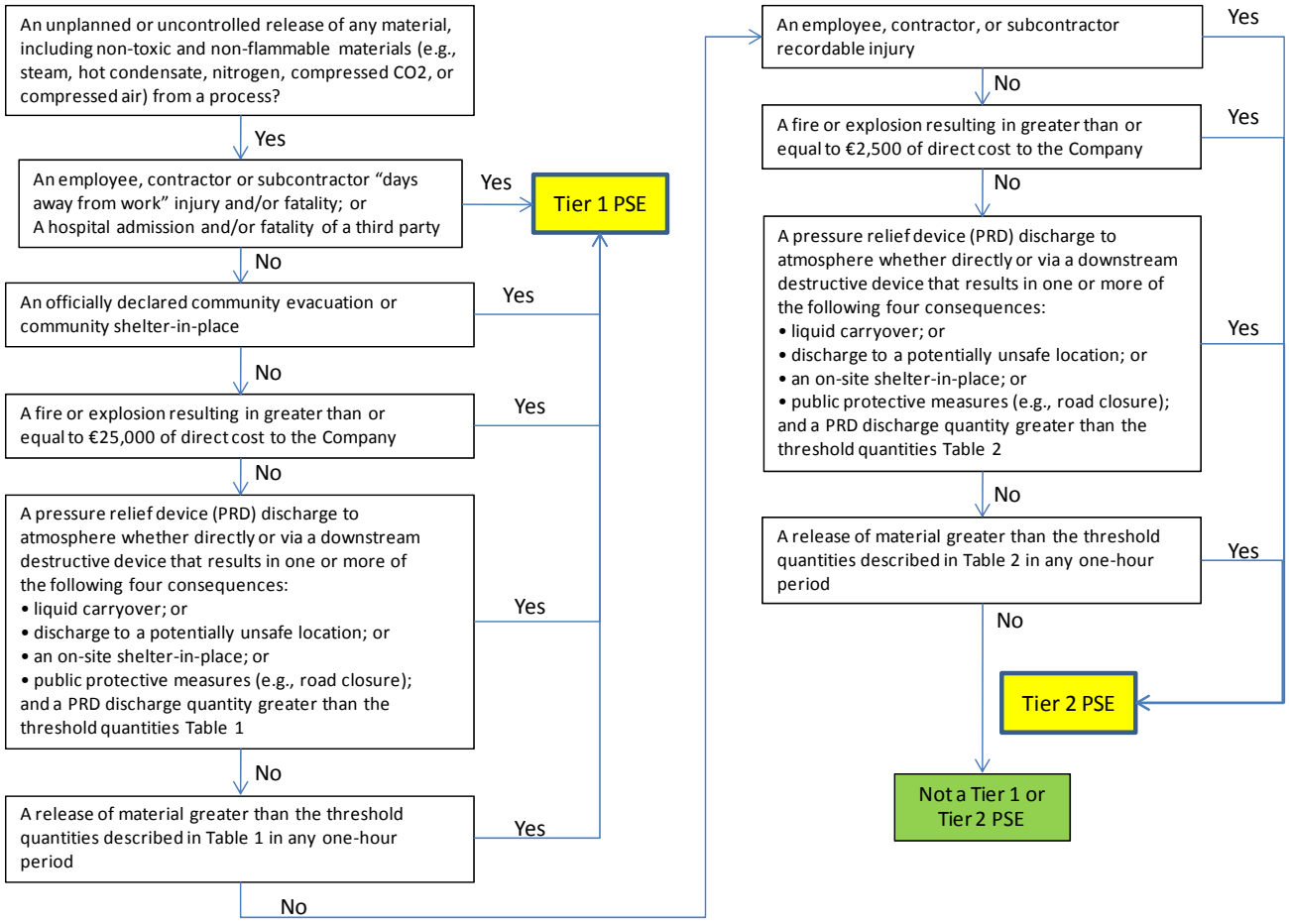
[2] A structure composed of four complete (floor to ceiling) walls, floor and roof.

[3] For solutions not listed on the UNDG, the anhydrous component shall determine the TIH hazard zone or Packing Group classification. The threshold quantity of the solution shall be back calculated based on the threshold quantity of the dry component weight.

[4] For mixtures where the UNDG classification is unknown, the fraction of threshold quantity release for each component may be calculated. If the sum of the fractions is equal to or greater than 100%, the mixture exceeds the threshold quantity. Where there are clear and independent toxic and flammable consequences associated with the mixture, the toxic and flammable hazards are calculated independently.

[5] For vapours, the hazardous classifications only apply to inhalation toxicity. Whereas for liquids, the oral and dermal toxicity should be assessed, as well as described in the ANSI/API guideline Annex B.

PSE Classification Decision Logic Tree



Bibliography of Appendix 2

The following documents are directly referenced in this recommended practice.

[1] API (2010) ANSI/API Recommended practice 754. Process safety performance indicators for the refining and petrochemical industries. Washington DC: American Petroleum Institute

[2] UNECE (2009) European agreement concerning the international carriage of dangerous goods by road (ADR 2009) ECE/TRANS/202, Vol. I and II. Geneva: United Nations Economic Commission for Europe

[3] U.S. Government (2006) 49 CFR – Chapter 1 – Part 173. Classification of a material having more than one hazard

[4] EU (2008) Regulation (EC) No. 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No. 1907/2006. Official Journal of the European Union No. L353, 31.12.2008

FURTHER READING

The following documents are not directly referenced in this note but provide a useful source of relevant information.

[A] API (2008) API guide to report process safety incidents – December 2007 (report year 2008). Washington DC: American Petroleum Institute

[B] Center for Chemical Process Safety (2009) Guidelines for process safety metrics. Hoboken, New Jersey: John Wiley& Sons, Inc.

[C] Baker, J.A. et al (2007) The report of the BP U.S. refineries independent safety review panel - January 2007

[D] Broadribb, M.P. et al (2009) Cheddar or Swiss? How Strong are your Barriers? (One company's experience with process safety metrics). Presentation at 5th Global Congress on Process Safety, April 26-30, 2009, Tampa FL

[E] Center for Chemical Process Safety (2007) Guidelines for risk based process safety. Hoboken, New Jersey: John Wiley& Sons, Inc.

[F] NEI (2007) Regulatory assessment performance indicator guideline. NEI 99-02 Revision 5. Washington DC: Nuclear Energy Institute

[G] OECD (2008) Guidance on developing safety performance indicators related to chemical accident prevention, preparedness and response. Series on Chemical Accidents No. 19. Paris: Organisation for Economic Coordination and Development

[H] U.S. Chemical Safety and Hazard Investigation Board (2007) Investigation report - Refinery explosion and fire (15 killed, 180 injured). BP, Texas City, March 23, 2005. Report No. 2005-04-I-TX

APPENDIX 3 CONCAWE CATEGORIZATION OF CAUSES FOR FATALITIES AND LWIS

Categorization of Fatalities or LWIs		
Previous Category	**Incident Category (Concawe)**	**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.

APPENDIX 4 CONCAWE MEMBER COMPANIES THAT CONTRIBUTED TO THE DATA COLLECTION FOR THIS REPORT

The following members of Concawe provided the data on their safety performance on which this report is based:

ALMA Petroli s.a.	ATCP	Gruppo API
BP	CEPSA	ENI
Total ERG	ESSAR	ExxonMobil
GALP Energia	Gunvor Commodities Trading	H & R
Hellenic Petroleum	INEOS	IPLOM
KOCH Industries	Q8	Gruppa Lotos
LUKOIL	LyondellBasell	MOL Group
Neste Oil	Nynas	OMV
P66	PKN Orlen	ROMPETROL
Sara	Shell	SRD
Statoil	ST1	Total
Valero	Varo Energy	

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