Concawe
Environmental Science for European Refining

# Report

Report no. 11/20

# European downstream oil industry safety performance

## Statistical summary of reported incidents - 2019

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## Statistical summary of reported incidents – 2019

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This report was prepared by C. Banner and C. Davidson (Anything Hosted) at the request of Concawe Safety Management Group (SMG).

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## ABSTRACT

The 2019 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 forty-two Concawe Member Companies and Joint Ventures comprised of member companies, together representing more than 98% of the European refining capacity. Total work hours reported (613 million) were around 6% higher in 2019 than in 2018. In 2019, there were three fatalities reported by the industry, all were Manufacturing contractors. The number of Lost Workday Injuries recorded in 2019 (595) is 1.5% higher than those in 2018 (586). The combined number of Tier 1 and 2 process safety releases across Manufacturing and Marketing in 2019 declined 13% since 2018 (236 releases in 2019 and 270 in 2018). However, the number of Manufacturing Tier 1 events rose 12% from 75 in 2018 to 84 in 2019.

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

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## EXECUTIVE SUMMARY

For 2019, information was received from forty-two Concawe Member Companies and Joint Ventures (comprised of member companies), together accounting for greater than 98% of the available refining capacity in the EU-28, Norway, and Switzerland. The purpose of collecting this data is 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. Data also serve 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 2019 results for Manufacturing, Marketing and the combined downstream oil industry are shown in the table below.

| **All reporting companies** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sector** | **Manufacturing** | | | **Marketing** | | | **Both Sectors** | | |
| **Workforce** | **OS** | **CT** | **AW** | **OS** | **CT** | **AW** | **OS** | **CT** | **AW** |
| Hours worked Mh | 118 | 167 | 285 | 157 | 171 | 328 | 275 | 338 | 613 |
| Fatalities | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 3 |
| FAR - FA/100Mh | 0.0 | 1.8 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.5 |
| LWI | 182 | 153 | 335 | 141 | 119 | 260 | 323 | 272 | 595 |
| Lost time through LWI - Days | 5,601 | 4,768 | 10,369 | 5,610 | 2,533 | 8,143 | 11,211 | 7,301 | 18,512 |
| LWIF - LWI/Mh | 1.5 | 0.9 | 1.2 | 0.9 | 0.7 | 0.8 | 1.2 | 0.8 | 1.0 |
| LWIS* - Lost days/LWI | 32.2 | 40.1 | 35.4 | 41.6 | 25.1 | 34.5 | 36.3 | 33.2 | 35.0 |
| AI | 279 | 290 | 569 | 284 | 163 | 447 | 563 | 453 | 1016 |
| AIF - AI/Mh | 2.4 | 1.7 | 2.0 | 1.8 | 1.0 | 1.4 | 2.0 | 1.3 | 1.7 |
| Distance travelled - million km | | | | | | | 205 | 613 | 818 |
| Number of Road Accidents | | | | | | | 151 | 199 | 350 |
| RAR+ | | | | | | | 0.7 | 0.3 | 0.4 |

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

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

+ RAR is the Road Accident Rate calculated as the number of Road Accidents per million km driven where distance is reported

There were three fatalities reported for 2019, all were Manufacturing contractors who died as a result of separate incidents. Two fatalities were the result of falls from height and the third was as a result of a dropped object. This compares with 10 fatalities in 2018, of which seven were Manufacturing contractors. Continued efforts are needed to achieve the target of zero fatalities in our industry.

In addition to fatalities Lost Workday Injuries (LWI) are also studied to identify further opportunities for continuous safety performance improvement. A total of 595 LWIs were reported in 2019 (586 in the previous year) and 587 of these were allocated to the agreed 16 incident categories within the membership company submissions. As in previous years, a relatively small number of categories contribute to most LWIs reported. In order of frequency (highest first) Slips and Trips (same height), Struck by and Falls from Height together account for over 59% of all LWIs reported in 2019 and this order holds true for both Manufacturing and Marketing.

For 2019, 41 companies submitted Process Safety Event (PSE) data for the Manufacturing operations and 19 submitted Marketing PSE data. The combined number of Tier 1 and 2 process safety releases across Manufacturing and Marketing in 2019 declined 13% since 2018 (236 releases in 2019 and 270 in 2018). However, the number of Manufacturing Tier 1 events rose 12% from 75 in 2018 to 84 in 2019. The low proportion of total LWI related to Tier 1 events (1% of LWI), is encouraging and underlines the importance of high technical standards and strict procedures in process safety.

# 1. INTRODUCTION TO 2019 REPORT

The collection and analysis of incident data is widely recognised by the downstream oil refining industry as an essential element of an effective safety management system. Concawe started compiling statistical data for the European downstream oil industry in 1993 and this is the twenty-sixth report on this topic (see references of past reports in the reference list [1-25]). This report covers data collected for 2019 as well as a full historical perspective from 1993. It also includes comparative figures from other industry sectors where available. For 2019, information was received from all forty Concawe Member Companies and two Joint Ventures comprised of member companies when the data is not submitted by the Member Company partners. These 42 submissions in 2019 represent more than 98% of the European Refining capacity. From the outset, most Concawe 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. In the last 10 years, the average representation was around 97% of the European Refining capacity.

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 into 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 safety 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,

Concawe does not report individual company data but rather aggregates the data at the membership level.

In 2009, Concawe 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 2019 PSE data represents 41 out of 42 of the Manufacturing companies and 95% of European refining capacity. Following concerted efforts from Concawe representatives and within the membership, the number of respondents has increased in 2019. The improvement in the completeness of the data will further improve the benchmark reliability.

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

In 2014, the members decided to commence collecting additional information in relation to the nature of Marketing retail operations. Companies have been asked to indicate if they have no retail activity and to describe their retail operations as either Company Owned Company Operated (COCO), Company Owned Dealer Operated (CODO), Dealer Owned Company Operated (DOCO) or Dealer Owned Dealer Operated (DODO). Concawe would like to improve the report in the data coverage for retail and transport contractors.

As from 2018, additional information was gathered regarding the causal factors of Lost Workday Injuries. This information is in line with the requirements of API RP754 (2016). This data is presented in table format in **Appendix 3**. Over time this will allow assessment of the main factors contributing to Lost Workday Injuries from which approaches to address incident prevention can be developed.

For the first time in 2019, the possibility to link reported Tier 1 Process Safety Events with Lost Workday Injuries was provided to members. The intention is, again over time, to build an understanding of the types of Process Safety Events and their causal factors that lead to direct injury.

**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 2019

| No of Companies | Manufacturing | | | Marketing | | |
|---|---|---|---|---|---|---|
| | Own Staff | Contractors | All Workers | Own Staff | Contractors | All Workers |
| Submission | 42 | 42 | | 25 | 21 | |
| Including | | | | | | |
| Lost Days | 37 | 34 | | 23 | 16 | |
| All Injuries | 37 | 34 | | 15 | 15 | |
| Road Accidents* | 31 | 28 | | 17 | 12 | |
| Distance Travelled | 24 | 22 | | 17 | 12 | |
| Process Safety | | | 41 | | | 19 |
| Retail Operations | | | | | | |
| No Retail | | | | | | 18 |
| COCO | | | | | | 10 |
| CODO | | | | | | 7 |
| DOCO | | | | | | 4 |
| DODO | | | | | | 5 |

* Several Companies do not report their Road accidents and related exposure hours separately. These incidents are included in their overall statistics in cases where relevant criteria (LWI, AI) are met.

# 2. 2019 PERSONAL SAFETY PERFORMANCE RESULTS

The aggregated 2019 results for Manufacturing, Marketing and the combined downstream industry are shown in **Table 2**.

***Table 2*** Aggregated 2019 results for all reporting companies

| All reporting companies | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sector | Manufacturing | | | Marketing | | | Both Sectors | | |
| Workforce | OS | CT | AW | OS | CT | AW | OS | CT | AW |
| Hours worked Mh | 118 | 167 | 285 | 157 | 171 | 328 | 275 | 338 | 613 |
| Fatalities | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 3 |
| FAR - FA/100Mh | 0.0 | 1.8 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.5 |
| LWI | 182 | 153 | 335 | 141 | 119 | 260 | 323 | 272 | 595 |
| Lost time through LWI - Days | 5,601 | 4,768 | 10,369 | 5,610 | 2,533 | 8,143 | 11,211 | 7,301 | 18,512 |
| LWIF - LWI/Mh | 1.5 | 0.9 | 1.2 | 0.9 | 0.7 | 0.8 | 1.2 | 0.8 | 1.0 |
| LWIS - Lost days/LWI | 32.2 | 40.1 | 35.4 | 41.6 | 25.1 | 34.5 | 36.3 | 33.2 | 35.0 |
| AI | 279 | 290 | 569 | 284 | 163 | 447 | 563 | 453 | 1016 |
| AIF - AI/Mh | 2.4 | 1.7 | 2.0 | 1.8 | 1.0 | 1.4 | 2.0 | 1.3 | 1.7 |
| Distance travelled - million km | | | | | | | 205 | 613 | 818 |
| RA | | | | | | | 151 | 199 | 350 |
| RAR | | | | | | | 0.7 | 0.3 | 0.4 |

OS: Own staff; CT: Contractors; AW: All workers
* LWI severity is calculated for those LWI where lost days are reported
+ RAR is calculated for those RA where distance is reported

## 2.1. 2019 FATALITIES

There were three fatalities reported for 2019, all were Manufacturing contractors who died as a result of separate incidents. Two fatalities were the result of falls from height and the third was the result of a dropped object.

During a maintenance operation (filling sand) on the cooling water filtration tanks of the refinery's water treatment plant a removable safety barrier filter was disconnected. The contractor fell 10m from the third stage of the installation. The reported causal factor was change management.

A second contractor died as a result of a skull fracture when an unstable line under construction fell and struck the rolling ladder on which the contractor was working. The ladder fell, throwing the contractor onto steel plates below. The reported causal factor was work monitoring.

The third fatal incident occured during lifting of a 7 ton heat-exchanger bundle. An unintentional lift of the bundle caused it to fall from a trestle, fatally injuring a contractor.

These fatalities underline the need for Manufacturing operational safety focus on working at heights. in particular and with Manufacturing contractors in general.

While this represents a reduction in annual number of fatalities since 2018 when 10 fatalities were reported, it remains higher than the two previous consecutive years of the lowest number of annual fatalities recorded (two fatalities in both 2016 and 2017). The 2019 data indicate that continued efforts are essential to achieve the target of zero fatalities in our industry.

## 2.2. 2019 LOST WORKDAY INJURIES

In 2018, there were a total of 595 Lost Workday Injuries, with 56% of these in Manufacturing and 44% in Marketing. In both Manufacturing and Marketing the split between staff and contractor LWI is 54 versus 46%.

There was an overall decrease in Lost Workday Injury Frequency (LWIF) compared with 2018. The LWIF went from 1.02 LWI/Mh in 2018 to 0.98 LWI/Mh in 2019 across all workers. All forty-two companies reported LWI in both 2018 and 2019. Of these, 22 companies (52%) reported a lower overall LWIF in 2019 than in 2018, 3 companies had the same LWIF in 2018 and 2019 (7%) and 17 companies (40%) had a higher LWIF in 2019.

As in 2018, Manufacturing staff are the sector with the highest LWIF (1.54 in 2019, compared with 1.50 in 2018) and the only sector (compared with Manufacturing contractors, Marketing staff and Marketing contractors) with poorer performance since 2018. Marketing contractors have the lowest recorded LWIF of all sectors in 2019 at 0.70. The largest reduction in LWIF since 2018 is seen in Marketing staff (7.2% decrease). Refer to **Table 3** and **Appendix 2** for the details.

For comparison purposes, the LTIF (frequency of LWIs + Fatalities) has been calculated for each category of workers, compared with the LWIF and presented in **Table 3** below.

***Table 3*** Comparison of LWIF and LTIF in 2019

| | LWIF | LTIF |
|---|---|---|
| All Workers | 0.98 | 0.98 |
| Manufacturing Staff | 1.54 | 1.54 |
| Manufacturing Contractors | 0.93 | 0.93 |
| Marketing Staff | 0.90 | 0.90 |
| Marketing Contractors | 0.70 | 0.70 |

No difference between the two reported measures are apparent as the number of fatalities (3) is small relative to the number of LWI (595).

The effective investigation of 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.

**Table 4** indicates a relatively small number of categories contribute to most LWIs reported. In order of frequency (highest first) Slips and Trips (same height), Struck by and Falls from Height together account for over 59% of all LWIs reported in 2019 and this order holds true for both Manufacturing and Marketing, as detailed in **Table 5**. Other frequent categories include Cut, puncture, scrape, Caught in, under or between, Overexertion, strain and Road Accidents, each accounting for >5% of reported LWI in either Manufacturing or Marketing sector.

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

*Table 4* Categories of LWIs in 2019

| LWI 2019 | | | | | |
|---|---|---|---|---|---|
| **Category** | | **Manufacturing** | **Marketing** | **Combined** | **%** |
| Road Accident | Road Accident | 7 | 13 | 20 | 3.4 |
| Heights/Falls | Falls from height | 30 | 19 | 49 | 8.3 |
| | Staff hit by falling objects | 10 | 8 | 18 | 3.1 |
| | Slips & trips (same height) | 117 | 105 | 222 | 37.8 |
| Burn/Electrical | Explosion or burns | 16 | 3 | 19 | 3.2 |
| | Exposure electrical | 4 | 1 | 5 | 0.9 |
| Confined Space | Confined Space | 1 | 0 | 1 | 0.2 |
| Other Causes | Assault or violent act | 0 | 12 | 12 | 2.0 |
| | Water related, drowning | 0 | 0 | 0 | 0.0 |
| | Cut, puncture, scrape | 19 | 19 | 38 | 6.5 |
| | Struck by | 35 | 43 | 78 | 13.3 |
| | Exposure, noise, chemical, biological, vibration | 21 | 3 | 24 | 4.1 |
| | Caught in, under or between | 29 | 18 | 47 | 8.0 |
| | Overexertion, strain | 21 | 11 | 32 | 5.5 |
| | Pressure release | 3 | 1 | 4 | 0.7 |
| | Other | 14 | 4 | 18 | 3.1 |
| | Total | 327* | 260 | 587 | 100 |

*Eight Manufacturing LWI not allocated to an incident category

*Table 5* Categories of LWIs in 2019 split Manufacturing vs. Marketing

| LWI 2019 | | | | | |
|---|---|---|---|---|---|
| **Categories** | | **Manufacturing** | **%** | **Marketing** | **%** |
| Road Accident | Road Accident | 7 | 2.1 | 13 | 5.0 |
| Heights/Falls | Falls from height | 30 | 9.2 | 19 | 7.3 |
| | Staff hit by falling objects | 10 | 3.1 | 8 | 3.1 |
| | Slips & trips (same height) | 117 | 35.8 | 105 | 40.4 |
| Burn/Electrical | Explosion or burns | 16 | 4.9 | 3 | 1.2 |
| | Exposure electrical | 4 | 1.2 | 1 | 0.4 |
| Confined Space | Confined Space | 1 | 0.3 | 0 | 0.0 |
| Other Causes | Assault or violent act | 0 | 0.0 | 12 | 4.6 |
| | Water related, drowning | 0 | 0.0 | 0 | 0.0 |
| | Cut, puncture, scrape | 19 | 5.8 | 19 | 7.3 |
| | Struck by | 35 | 10.7 | 43 | 16.5 |
| | Exposure, noise, chemical, biological, vibration | 21 | 6.4 | 3 | 1.2 |
| | Caught in, under or between | 29 | 8.9 | 18 | 6.9 |
| | Overexertion, strain | 21 | 6.4 | 11 | 4.2 |
| | Pressure release | 3 | 0.9 | 1 | 0.4 |
| | Other | 14 | 4.3 | 4 | 1.5 |
| | Total | 327* | 100 | 260 | 100 |

*Eight Manufacturing LWI not allocated to an incident category

As in 2018, Concawe collected causal factors where available for each LWI, see **Figure 1** and **Appendix 3**. Causal factors are described in alignment with API RP754 (2016) and multiple factors may be recorded per LWI. Causal factors were not available for 16% of LWI (94 LWI incidents) and represents an improvement in reporting compared with 2018 (23% of LWI), the first year of causal factor data reporting for LWI. In many cases, this reflects ongoing investigations and causal factors for such incidents may be recorded by Concawe in future.

The most commonly reported causal factors across all LWI are Human Factors (31% of causal factors reported), Safe Work Practices & Procedures (11%), Risk Assessment (8%), Knowledge and Skills (8%) and Procedures (7%). Almost 16% of LWI causal factors were reported as Other (used to specify where an incident cannot be logically classed under any other category). There was little difference in the application of these factors in Manufacturing and Marketing related incidents with Human Factors and Safe Work Practices & Procedures, consistently the first and second most frequently reported factor, respectively. Manufacturing incidents reported Design and Risk Assessment as third and fourth most frequent causal factors. Knowledge and Skills and Risk Assessment were the third and fourth most frequently reported causal factors in Marketing incidents.

There was little difference between the most frequently reported causal factors in some of the most commonly occurring incident categories. Human factors was the most commonly assigned causal factor in Slips and Trips, Struck by and Falls from Height LWI incidents in both Manufacturing and Marketing. Safe Work Practices & Procedures, Design and Risk Assessment were also commonly reported causal factors in these incident types. Causal factors for Manufacturing Explosion and Burns LWI incidents were evenly attributed to Human Factors, Knowledge and Skills and Safe Work Practices or Procedures.

*Figure 1* Causal factors recorded for all Lost Workday Injuries in 2019

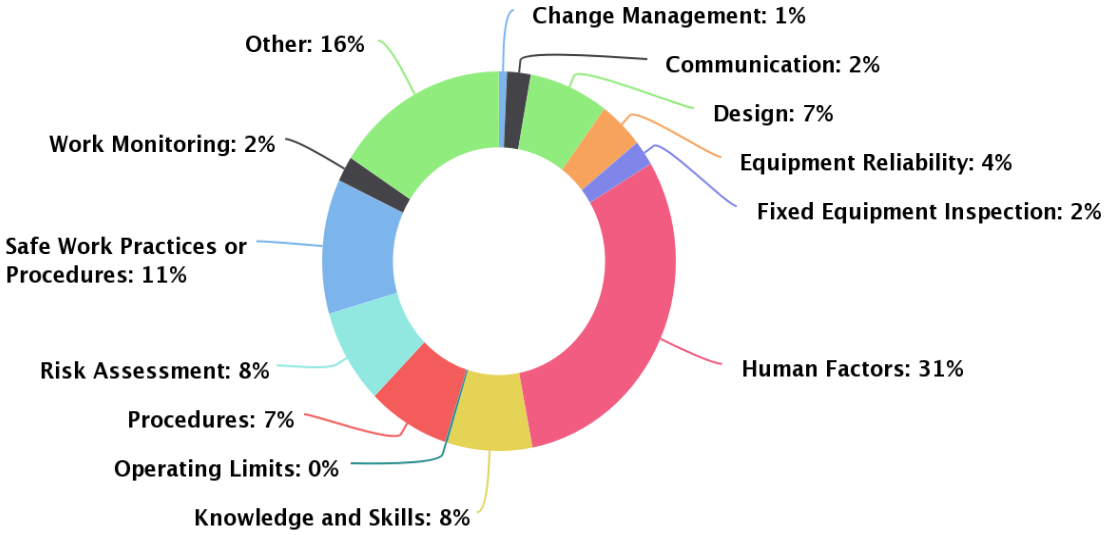



**Table 6** shows the Lost Workday Injury frequency statistics broken down in to quartiles. This demonstrates a wide range of variability in performance between the top performing members (Quartile 1 – Q1) and the bottom performing members (Quartile 4 – Q4).

*Table 6* 2019 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 | 0.41 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.17 | 0.00 | 0.30 | 0.08 | 0.00 | 0.53 | 0.20 |
| Q2 | 0.46 | 1.50 | 0.98 | 0.00 | 0.75 | 0.34 | 0.85 | 1.36 | 1.04 | 0.33 | 1.05 | 0.71 | 0.55 | 1.45 | 1.00 |
| Q3 | 1.51 | 2.79 | 1.93 | 0.81 | 1.12 | 0.98 | 1.52 | 2.55 | 2.09 | 1.18 | 2.87 | 1.87 | 1.51 | 2.79 | 1.88 |
| Q4 | 3.33 | 11.46 | 6.59 | 1.50 | 19.44 | 5.04 | 2.86 | 14.68 | 7.44 | 3.12 | 19.82 | 7.34 | 3.00 | 10.64 | 6.35 |

The quartile distribution ranges and average values for each quartile for the 2019 All Injury Frequency (AIF) are shown in **Table 7**. The average performance indicator figures for the industry conceal a wide range of individual values between reporting companies.

*Table 7* 2019 AIF quartile distribution ranges and average values for each quartile range

| 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 | 1.09 | 0.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.44 | 0.00 | 0.73 | 0.23 | 0.00 | 1.22 | 0.59 |
| Q2 | 1.23 | 2.19 | 1.68 | 0.25 | 0.99 | 0.75 | 1.02 | 1.94 | 1.58 | 0.80 | 1.57 | 1.24 | 1.24 | 2.19 | 1.60 |
| Q3 | 2.20 | 5.59 | 3.59 | 1.06 | 1.79 | 1.31 | 1.98 | 5.84 | 3.91 | 1.69 | 4.51 | 3.00 | 2.22 | 5.40 | 3.56 |
| Q4 | 5.88 | 11.46 | 8.62 | 2.19 | 19.44 | 6.34 | 7.26 | 22.03 | 9.98 | 4.75 | 19.82 | 9.94 | 5.59 | 10.64 | 8.47 |
| | | | | | | | | | | | | | | | |

## 2.3. PERFORMANCE TRENDS IN THE LAST 10 YEARS 2010 TO 2019

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 ten 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**.

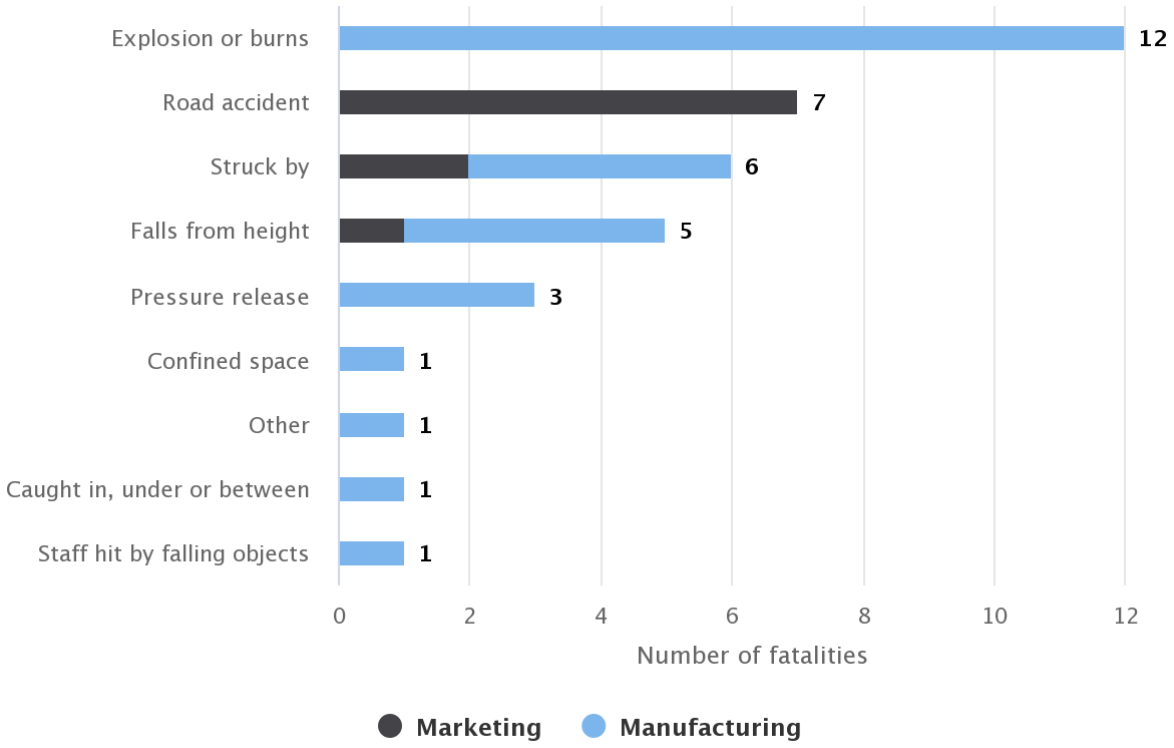
*Table 8* Fatalities by sector 2010-2019

| Fatalities over 10 years by sector | | | |
|---|---|---|---|
| Year | Manufacturing | Marketing | Total |
| 2010 | 11 | 3 | 14 |
| 2011 | 8 | 1 | 9 |
| 2012 | 4 | 6 | 10 |
| 2013 | 3 | 2 | 5 |
| 2014 | 6 | 1 | 7 |
| 2015 | 4 | 3 | 7 |
| 2016 | 2 | 0 | 2 |
| 2017 | 1 | 1 | 2 |
| 2018 | 7 | 3 | 10 |
| 2019 | 3 | 0 | 3 |
| Total | 49 | 20 | 69 |

While the total number of fatalities in 2019 (3) is down since 2018, it remains higher than in the previous 2 years (each with 2 fatalities). With no Marketing related fatalities reported in 2019, this is only the second year that this has been achieved, the other in 2016. Increased focus on understanding causal factors and putting in place clearly defined preventative actions are required to achieve and sustain our objective of zero fatalities in both Manufacturing and Marketing.

**Figure 2** summarizes the categories of all fatalities which were allocated by participating companies in the period 2013 to 2019.

***Figure 2*** Number of fatalities by category 2013-2019




Since Concawe moved to reporting fatalities against the same 16 categories as Lost Workday Injury in 2013, 'Explosions or Burns' (twelve fatalities), 'Road Accident' (seven fatalities) and 'Struck by' (six fatalities) have been the largest contributors to fatalities in the industry. Together, the three categories account for approximately 69% of the fatalities experienced in the industry since 2013.

Until 2013, Concawe compiled fatality data against broad categories that could change year to year. Expanding this to 16 distinct categories 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.

Explosion or burns and Road Accidents are the most prevalent fatal incident categories recorded in the period 2009-2018. Road Accidents have declined as an overall percentage of all fatalities compared to 1998-2008 when they represented almost half of all fatalities. This could be because of an increase in focus on Road Safety and the introduction of in-vehicle technology to help drivers. No fatal Explosion or burns and Road Accidents were recorded in 2019.

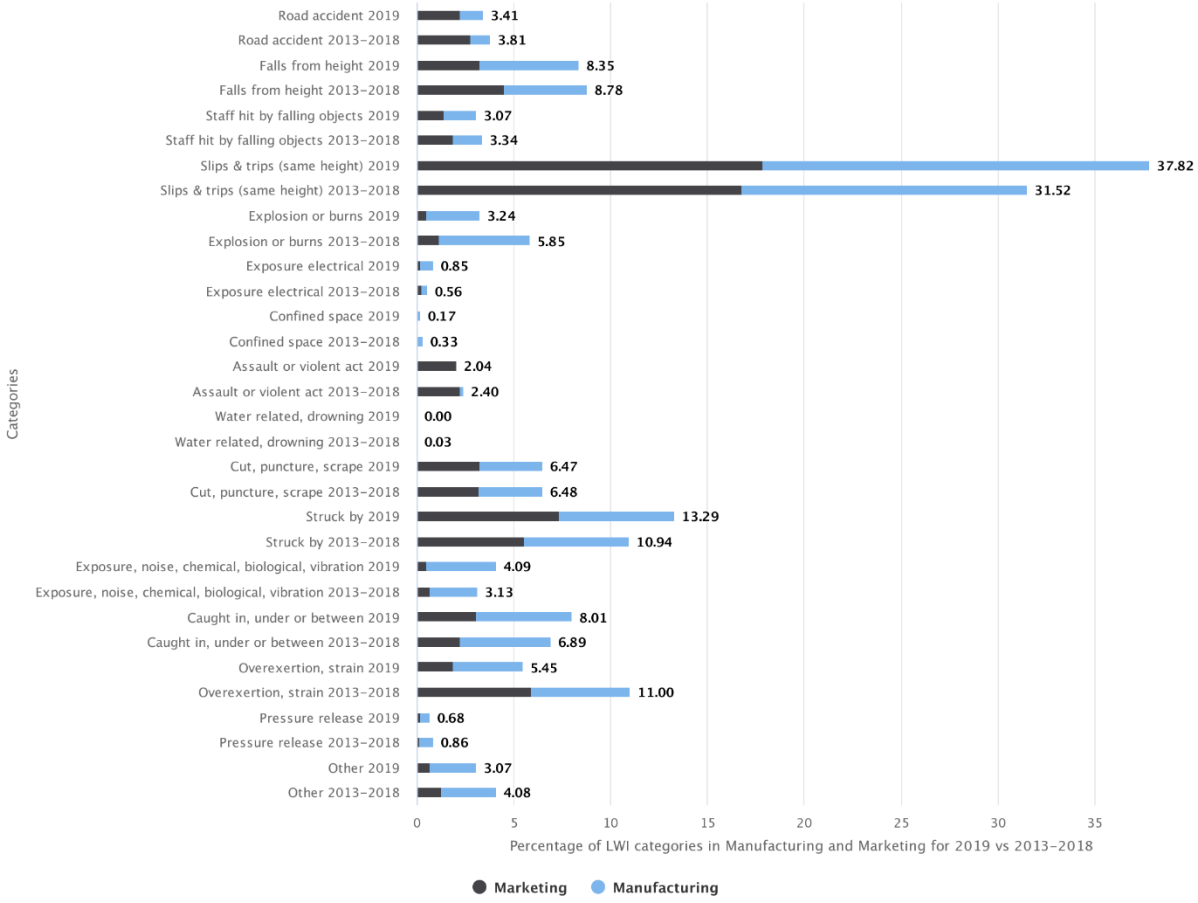
Struck by and Falls from Height categorised incidents are the next most prevalent, the former category accounting for over 16% of fatalities since 2013.

The 2019 reported fatalities, places working at height (Falls from height and staff hit by falling objects) among the most frequently reported work scenarios leading to fatal incidents. These fatalities also underline the

focus required on the prevention of incidents with Manufacturing contractors given that they account for 13 out of 17 (76%) fatalities reported in the last 4 years.

LWI category data has been available since 2013; a summary is shown in **Table A2-6 (Appendix 2)** and in **Figure 3**.

***Figure 3*** LWI categories in Manufacturing and Marketing in 2019 compared with period 2013-2018




Since Concawe began collecting LWI data against the 16 categories in 2013 a pattern has been emerging in the data. As in fatalities, a limited number of categories contribute to most LWIs. In 2019, almost 74% of LWIs were as a result of the following, Slips & Trips (same height) 37.8% (cf. 31.5% in 2013-2018), Struck by 13.3% (cf. 10.9% in 2013-2018), Falls from Height 8.4% (cf. 8.8% in 2013-2018), Caught in under between 8.0% (cf. 6.9% in 2013-2018) and Cut, Puncture, Scrape 6.5% (cf. 6.5% in 2013-2018). 2019 saw the largest increases in LWI for the categories of Struck by (increase of 21.5% cf. 2013-2018 average reported annual figures) and Slips and Trips (20% increase). Overexertion strain and Explosion or burns in 2019 were reported at levels 50 and 45% less, respectively than 2013-2018 average annual reported figures. The pattern of categories is broadly consistent year to year and similar across both Manufacturing and Marketing, see **Figure 3**.

Concawe started collecting information about LWI incident categories split between staff and contractors for the first time in 2018. For the most

frequent LWI incident category, Slips and Trips, the staff / contractor split in 2019 is 64 / 36% (cf. 65 / 35% in 2018). The main causal factor attributed to Slips and Trips incidents in 2018 and 2019 was Human Factors (42%), followed by Safe working practices or Procedures (7%) and Design (7%). The next most frequent LWI incident category is Struck by 44 / 55 % (cf. 52 / 48 % in 2018) and Falls from Height 49 / 51 % (cf. 46 / 54% in 2018). The LWI incident category with the greatest differences between staff and contractors in 2019 is Overexertion strain at 81 / 19 %. Contractors LWI related to Hit by falling objects, Cut, puncture, scrape and Caught in under or between were greater in 2019 than those related to staff.

No direct correlation is observed between categories of LWI and fatalities in the period 2013 – 2019 (**Figure 4**). However, a focus on reducing LWI in the following areas may have the potential to address the causes of the majority of 13 fatalities recorded in the last two years. These areas are:

- Process Safety to address Explosion, Burns related incidents
- Operational safety focused on Working at Height
- Road Accidents

***Figure 4*** LWI and Fatalities category data for 2013-2019

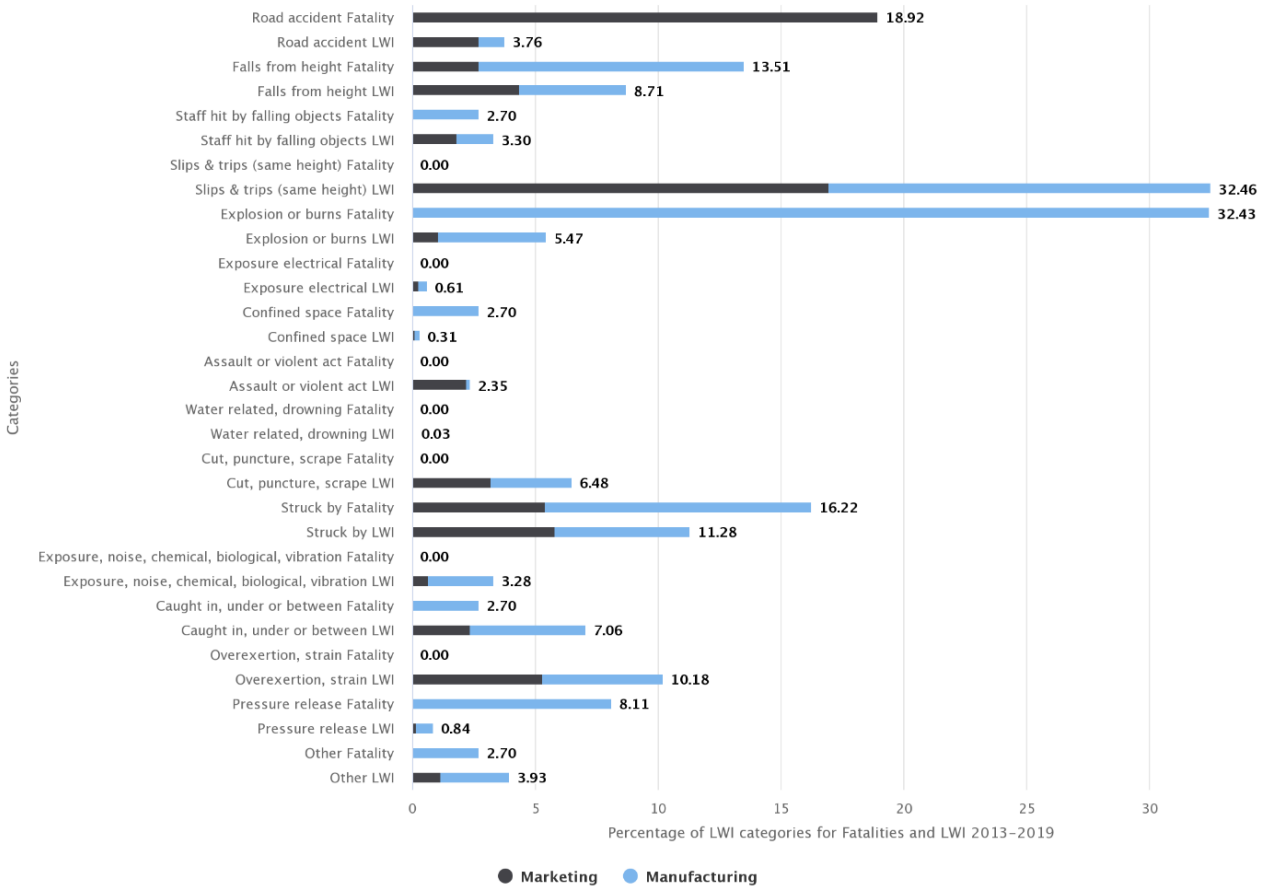
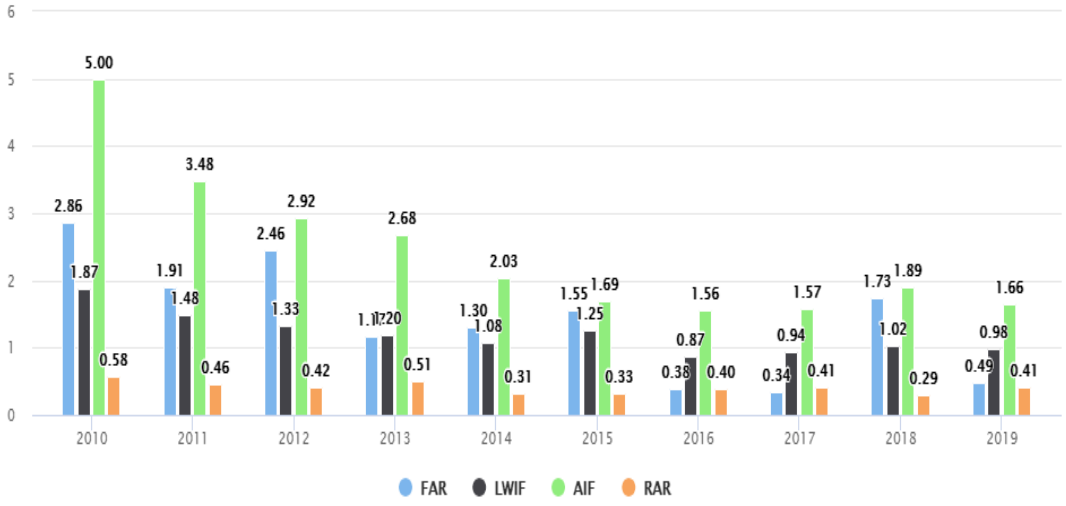


**Figure 5** shows the historical evolution of the main performance indicators over the past 10 years across all workers. No fundamental improvement in performance has been observed in the last four years. Fatal accident rate FAR is 0.49 in 2019 which is lower than 2018 (1.73 but higher than the two previous years (0.38 and 0.34 in 2016 and 2017). The Lost Workday Injury Frequency LWIF of 0.98 in 2019 follows a similar pattern as the FAR, being lower than 2018 (1.02) and higher than the two previous years (0.87 and 0.94 in 2016 and 2017). Similarly, the All Incident Frequency AIF of 2019 is 1.66, lower than that in 2018 (1.89) and higher than the best performance of 1.56 in 2016. The Road Accident Rate RAR in 2019 is 0.41 as it was in 2017, but higher than 0.29 recorded in 2018. This is accompanied by an approximate 16% decrease in kilometres driven since 2018. (see **Table A2-1**).

***Figure 5*** Performance indicators over the last 10 years 2010-2019 European downstream oil industry



**Figures 6a and 6b** show the Fatal Accident Rate FAR for company versus contract staff split for Manufacturing **6a** and Marketing **6b**. While FAR are in general higher in Manufacturing than in the Marketing, both sectors display a high degree of variability over the last 10 years. Own staff have in general a lower FAR than contractors with one recorded fatality in the last four years over both sectors. Further effort is required to reduce contractor and maintain staff fatalities at zero.

***Figure 6a*** Fatal Accident Rate (number of fatalities per million hours worked) – Manufacturing in the last 10 years 2010-2019

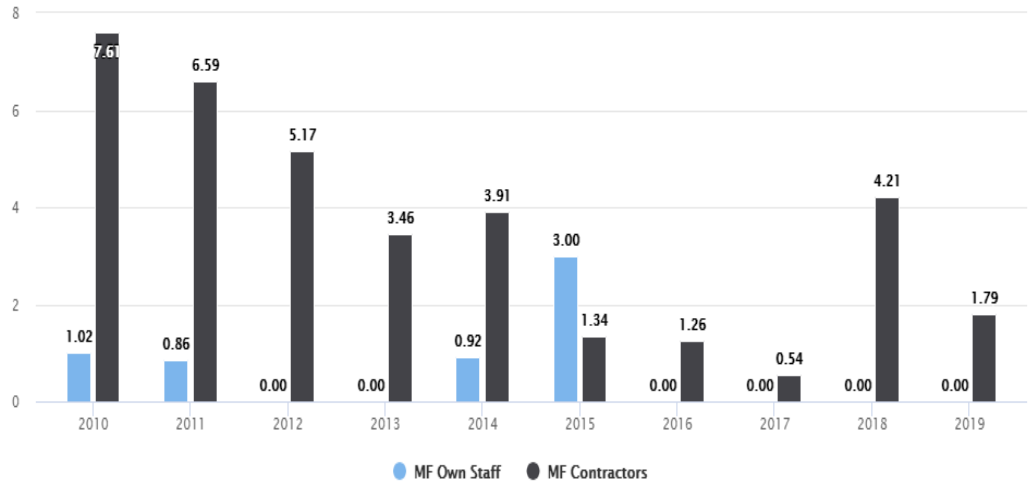



***Figure 6b*** Fatal Accident Rate (number of fatalities per million hours worked) – Marketing in the last 10 years 2010-2019

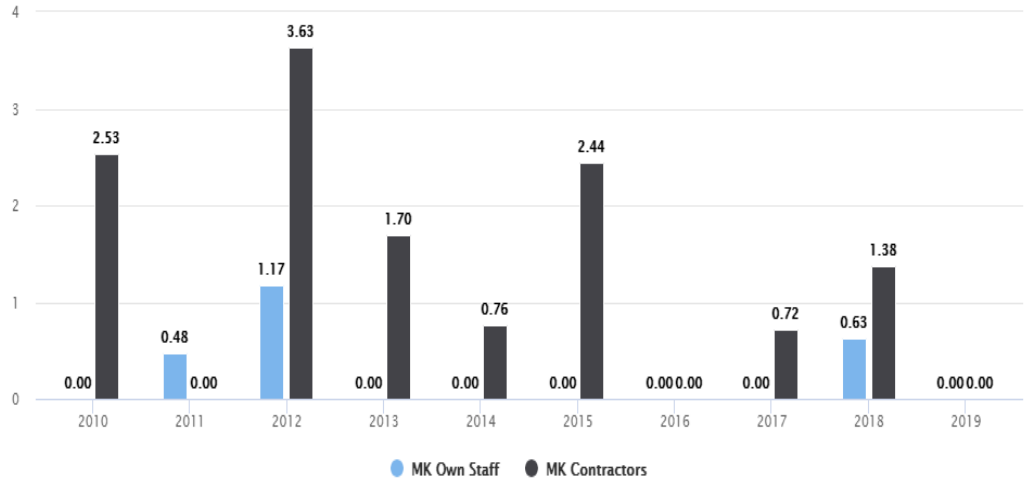
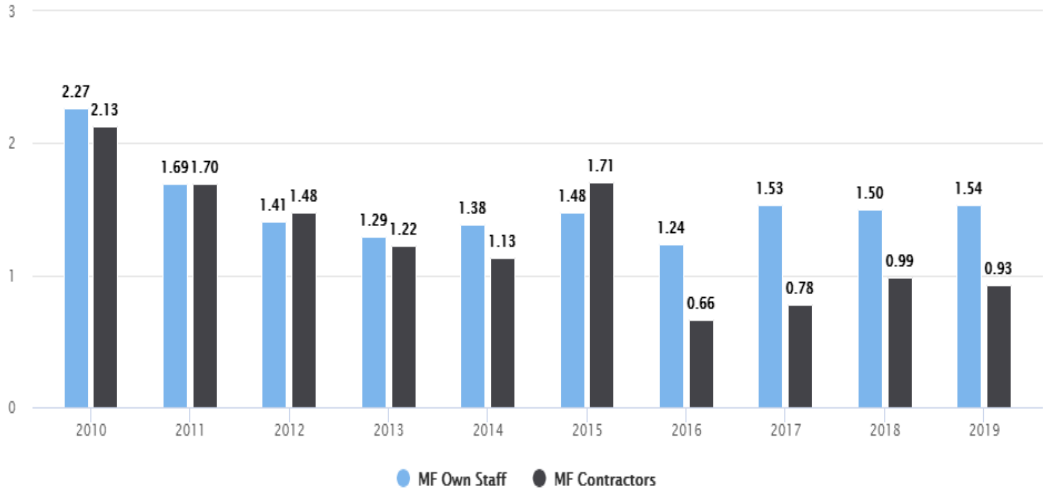


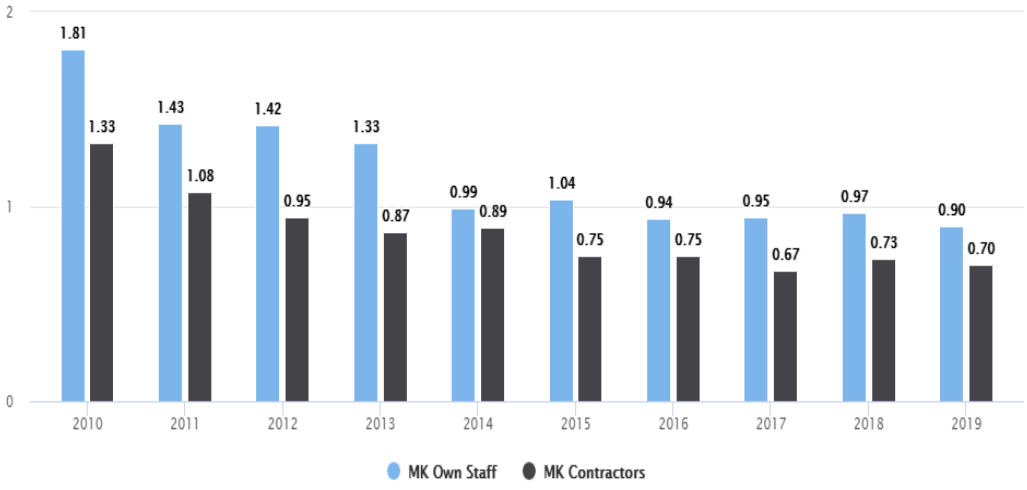
**Figure 7a** shows Manufacturing own staff LWIF in 2019 at 1.54, similar to rates recorded in 2017 and 2018. Manufacturing contractor LWIF is consistently lower than Manufacturing staff over the last four years.

***Figure 7a*** Lost Workday Injury Frequency (number of lost workday injuries per million hours worked) – Manufacturing in the last 10 years 2010-2019



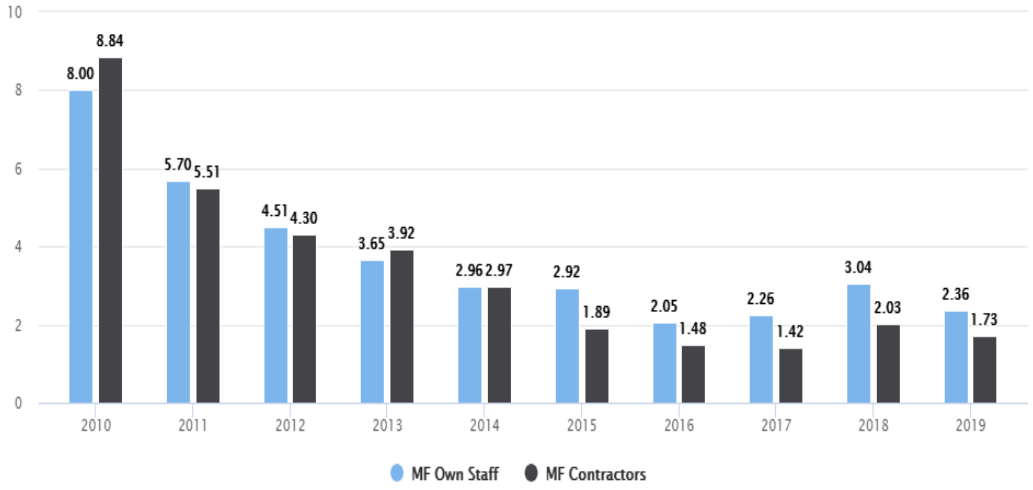

Marketing contractors LWIF of 0.70 in 2019 is similar to the rates recorded over the past four years (0.67 – 0.75), while Marketing staff LWIF has decreased very slightly to 0.90 and is the lowest ever recorded. (see **Figure 7b**). Refer to **Appendix 2** for the details.

***Figure 7b*** Lost Workday Injury Frequency (number of lost workday injuries per million hours worked) – Marketing in the last 10 years 2010-2019



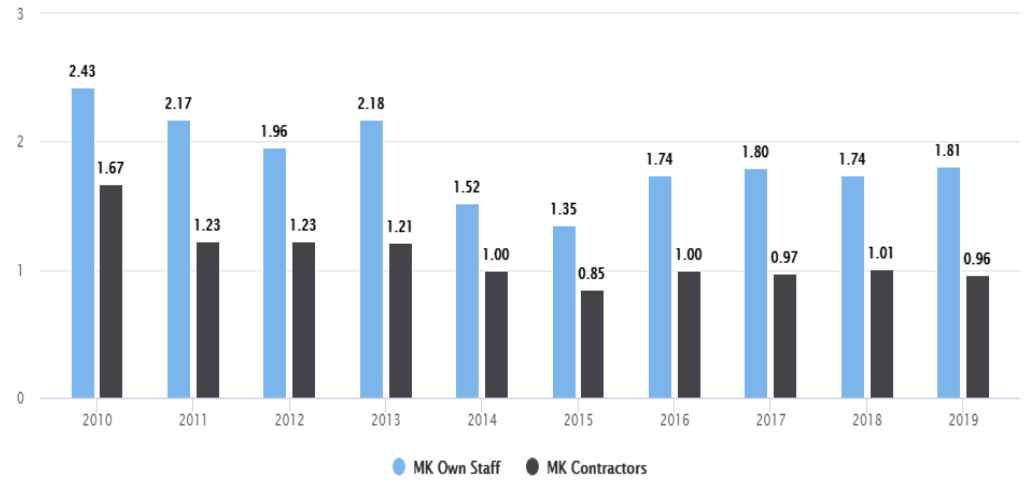
Historical figures (see **Appendix 2**) suggest that AIF peaked around 1996-97 but this was considered at the time likely the result of improved reporting standards. The downward trend in recorded Manufacturing AIF since 2010 ended in 2016. Since then own staff and contractor AIF have increased to 2.36 and 1.73, respectively in 2019 (**Figure 8a**).

***Figure 8a*** All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Manufacturing in the last 10 years 2010-2019



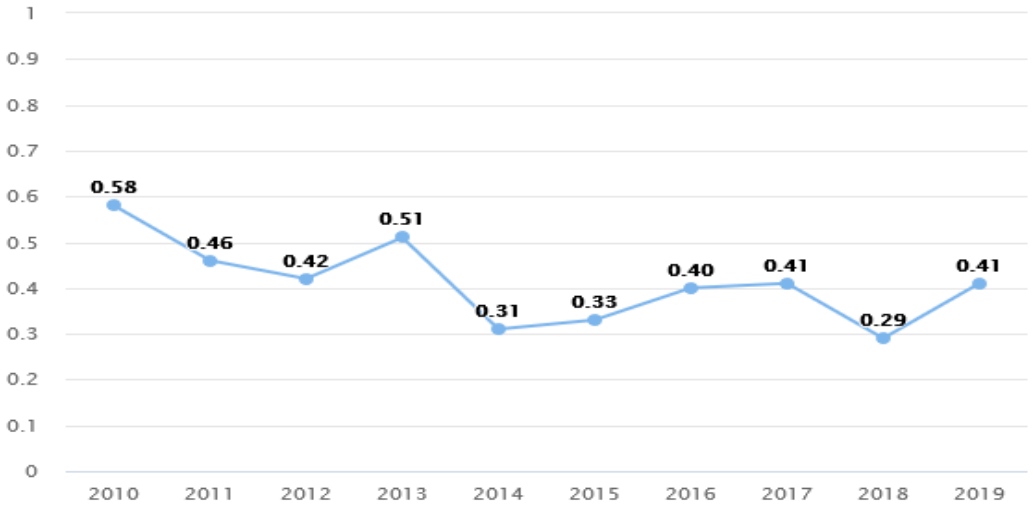
Marketing own staff AIF has plateaued over the last 4 years at around 1.74-1.81, higher than the lowest recorded in 2015 of 1.35. Similarly, Marketing contractor AIF has plateaued at around 0.96 -1.00, higher than the lowest recorded, 0.85 in 2015 (**Figure 8b**).

***Figure 8b*** All Injury Frequency (sum of fatalities, LWI, RWI, MTC per million hours worked) – Marketing in the last 10 years 2010-2019




The Road Accident Rate in 2019 returned to 0.41, a rate similar to those recorded in 2016 and 2017. Levels dropped from 0.41 in 2017 to 0.29 in 2018, the lowest rate recorded. Road safety has been a major focus for the industry and a sustained effort is required in order to improve performance to below the lowest rates recorded in 2014, 2015 and 2018. These accidents mainly occur in the Marketing activity where the bulk of the driving takes place. See **Figure 9**.

***Figure 9*** Road Accident Rate (number of road accidents per million km driven) last 10 years 2010-2019 - 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 Concawe report, the Safety Management Group of Concawe expanded the scope of industry wide safety performance indicators to address process safety, following the reporting guidelines that were developed by the API [26, 27]. 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 Concawe Membership was requested to report their PSPI as defined by the API in 2008 [26] and as further refined in the ANSI/API recommended practice that was published in 2010 [27]. The PSPI-data that were requested are the number of Tier 1 and 2 Process Safety Events (PSE). The Concawe 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 [28] as an alternative for classifying the PSE. In 2017, Concawe moved to reporting against the revised definitions in the 2nd edition of the API Recommended practice 754 (2016) [32].

In 2019, 41 companies and joint ventures submitted PSE data for the Manufacturing operations, one more than in 2018 and 19 submitted Marketing PSE data, also one more than last year.

The aggregated 2019 results per sector and for the whole of the European downstream oil industry are shown in **Table 9**.

***Table 9*** Aggregated 2019 Process Safety (PS) results for all reporting companies

| Sector | Manufacturing | Marketing | Both Sectors |
|---|---|---|---|
| Companies - Total | 42 | 25 | 25 |
| - PS Reporting | 41 | 19 | 19 |
| - % | 98 | 76 | 76 |
| Hours worked - Total Mh | 285.5 | 327.7 | 613.2 |
| - PS Reporting[(a)] | 279.8(279.8) | 207.9(207.9) | 487.7(487.7) |
| - % | 98 | 76 | 76 |
| T-1 PSE | 84 | 8 | 92 |
| T-2 PSE | 131 | 13 | 144 |
| T-1 PSER PSI/Mh reported | 0.30 | 0.04 | 0.19 |
| T-2 PSER PSI/Mh reported | 0.47 | 0.06 | 0.30 |
| Total PSER PSI/Mh reported | 0.77 | 0.10 | 0.48 |

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

The total number of Tier 1 and Tier 2 process safety events reported at Manufacturing sites where the higher process safety risks exist has decreased in 2019 (215 in 2019, cf. 250 in 2018).

The 2019 ratio of Tier 1 to Tier 2 process safety events was 0.64 (92 Tier 1 and 144 Tier 2), up from 0.41 in 2018 (78 Tier 1 and 192 Tier 2) and from 0.32 in 2017 (70 Tier 1 and 217 Tier 2).

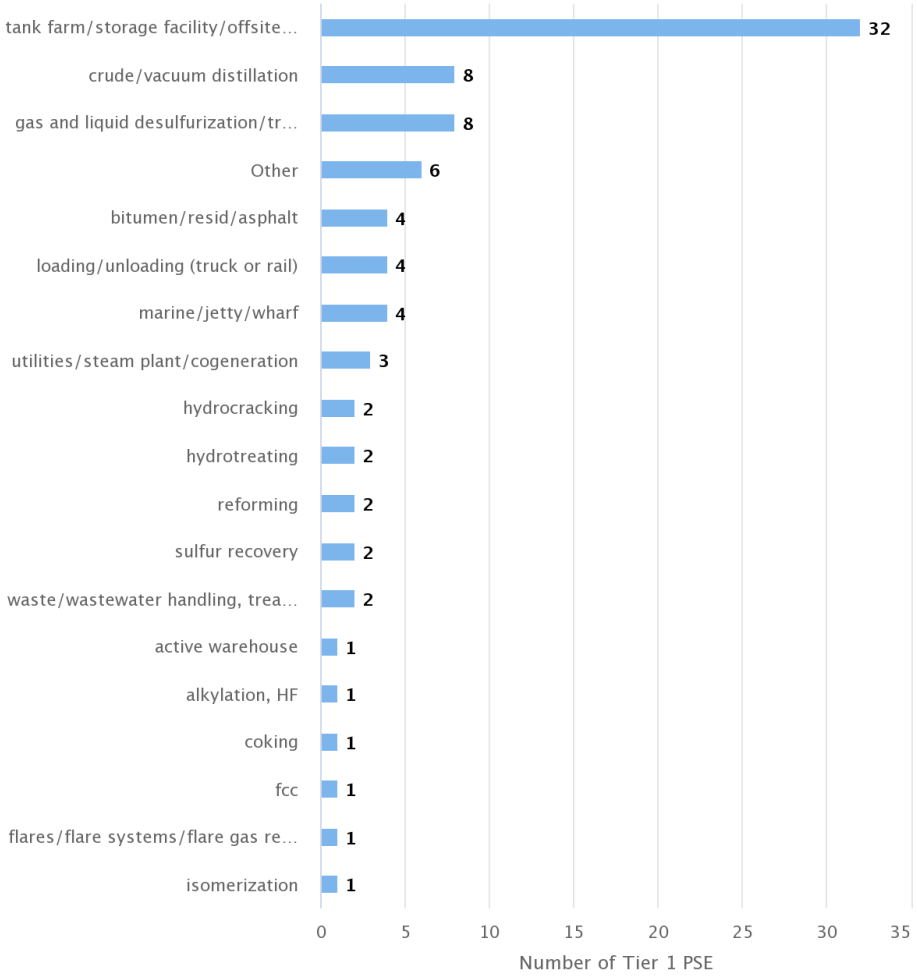
The Tier 1 PSER in 2019 was up at 0.19 compared with 0.16 in 2018 and 0.14 in 2017. The Tier 2 PSER was 0.30 in 2019, down from 0.40 in 2018 and 0.48 in 2017.

The number of Tier 1 PSEs resulting in LWIs was reported for the first time in 2019. Seven Tier 1 PSE (7.6% of Tier 1 PSE) resulted in LWI. The low proportion of total LWI related to Tier 1 events (1% of LWI), is encouraging and underlines the importance of high technical standards and strict procedures in process safety, which should never be viewed as a routine job. Of these seven cases, two LWI were categorized as “Explosion or burns” (direct contact with hot released material), two as “Slips & Trips” (moving away from loss of containment), and one each of “Exposure, noise, chemical, biological, vibration” (direct contact with hot released material), “Caught in, under or between” (unknown scenario) and “Pressure Release” (uncontrolled release from hose under pressure). “Equipment Reliability” was cited as a causal factor in three of these incidents, as was “Safe Work Practices or Procedures” and “Design”. “Human Factors”, “Change Management” and “Risk Assessment” were each cited as causal factors in 2 incidents.

Since 2017 Concawe has been collecting additional information regarding the circumstances of Tier 1 Process Safety Events. This information for the 92 Tier 1 PSE in 2019 are provided in table form in **Appendix 4**. The following comments relate to the notable responses within each category:

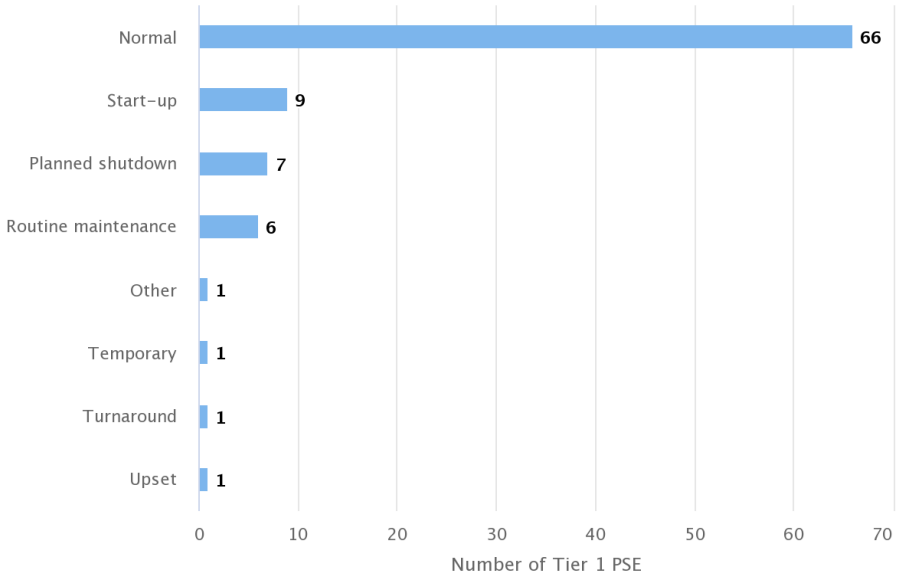
**Type of Process:** Tier 1 Process Safety Events in 2019 most frequently occurred in storage facilities or transfer piping (38% of all refinery Tier 1 events), see **Figure 10** and **Table A4-1**. This finding is in alignment with 2018 and 2017 data. Note that seven PSE Tier 1 attributed to petrochemical processes are not included in **Figure 10**.

***Figure 10*** Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2019 by Refining Process



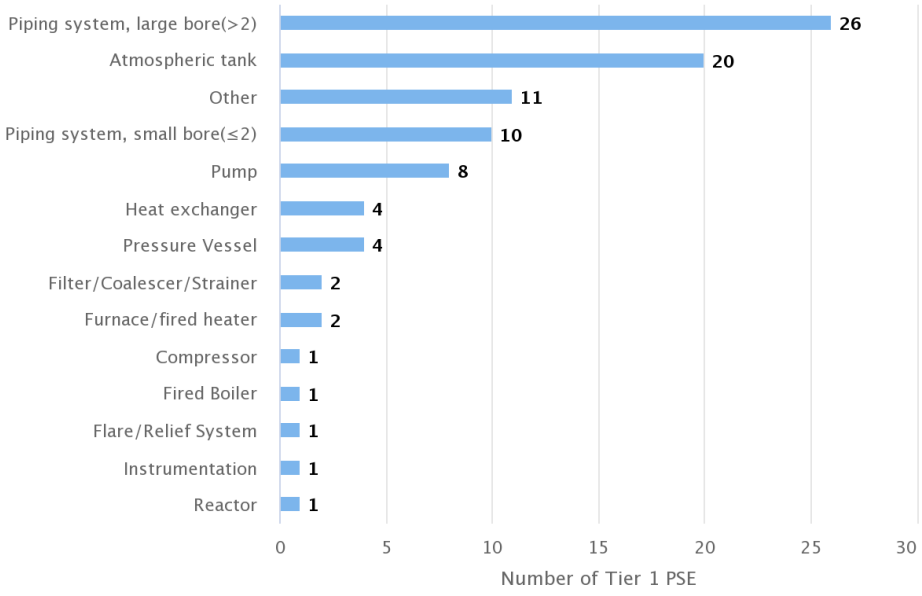

**Mode of Operation:** Seventy-two percent of Tier 1 incidents occurred during normal operation, see **Figure 11** and **Table A4-3**. This is also in alignment with 2018 and 2017 Tier 1 data.

***Figure 11*** Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2019 by mode of operation



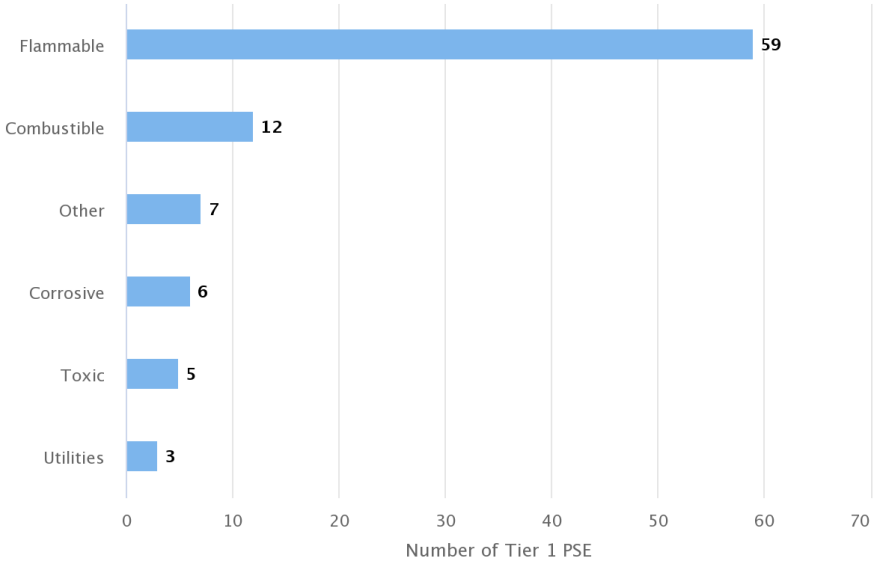

**Point of Release:** As in 2017 and 2018, large bore piping remained the main point of release for Tier 1 events (28% of events in 2019), see **Figure 12** and **Table A4-4**.

***Figure 12*** Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2018 by point of release



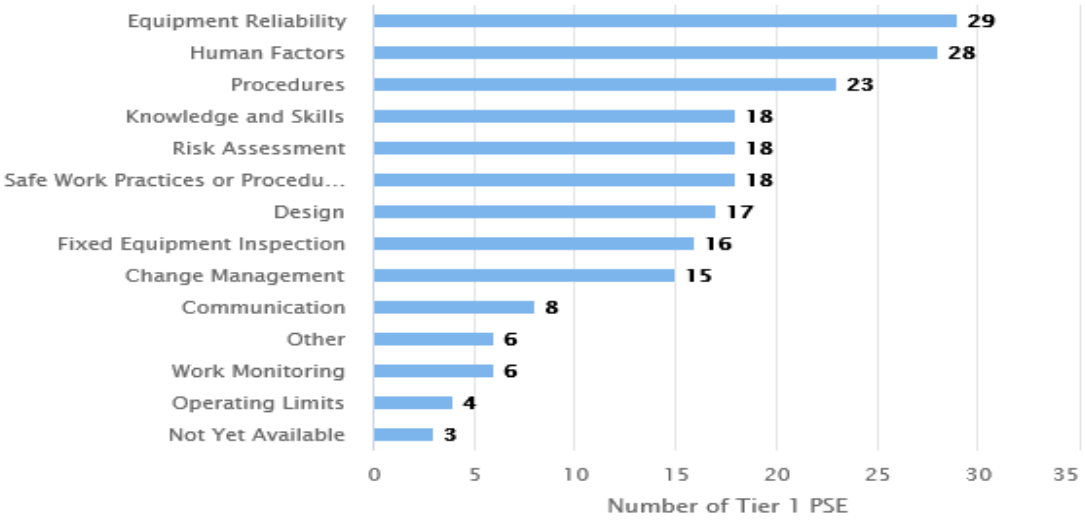
**Type of material: Figure 13** and **Table A4-5** indicates that flammable material was most frequently released in Tier 1 events in 2019 (64% of events). Again, this aligns with data from 2017 and 2018.

***Figure 13*** Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2019 by type of material




**Causal Factors:** Equipment Reliability (allocated to 32% of events), Human Factors (30%) and Procedures (25%), are the most frequently cited causal factors for Tier 1 events in 2019, see **Figure 14** and **Table A4-6**. Interestingly Design and Fixed Equipment Inspection attributed to 24% and 22% of Tier 1 events in 2018, were assigned to less events (18 and 17%) in 2019.

***Figure 14*** Number of Tier 1 Process Safety Events (Manufacturing and Marketing) reported in 2019 by Causal Factor (note that more than one causal factor may be assigned to an event)



Over time, the collection of this information across the industry is expected to result in an evaluation of the main factors contributing to process safety incidents, which will facilitate the development of approaches to address incident prevention.

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.

**Tables 10, 11, 12 and 13** show the quartile ranges for PSE and PSER.

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

| **Manufacturing and Marketing PSE** | | | |
|---|---|---|---|
| PSE | Low | High | Average |
| Q1 | 0 | 1 | 0.2 |
| Q2 | 1 | 4 | 2.3 |
| Q3 | 4 | 9 | 6.6 |
| Q4 | 10 | 36 | 17.0 |

*Table 11* Manufacturing PSE quartile distribution ranges and average values for each quartile range

| Manufacturing PSE | | | |
|---|---|---|---|
| PSE | Low | High | Average |
| Q1 | 0 | 1 | 0.2 |
| Q2 | 1 | 3 | 2.1 |
| Q3 | 3 | 9 | 5.6 |
| Q4 | 9 | 32 | 16.0 |

*Table 12* Total PSER quartile distribution ranges and average values for each quartile range

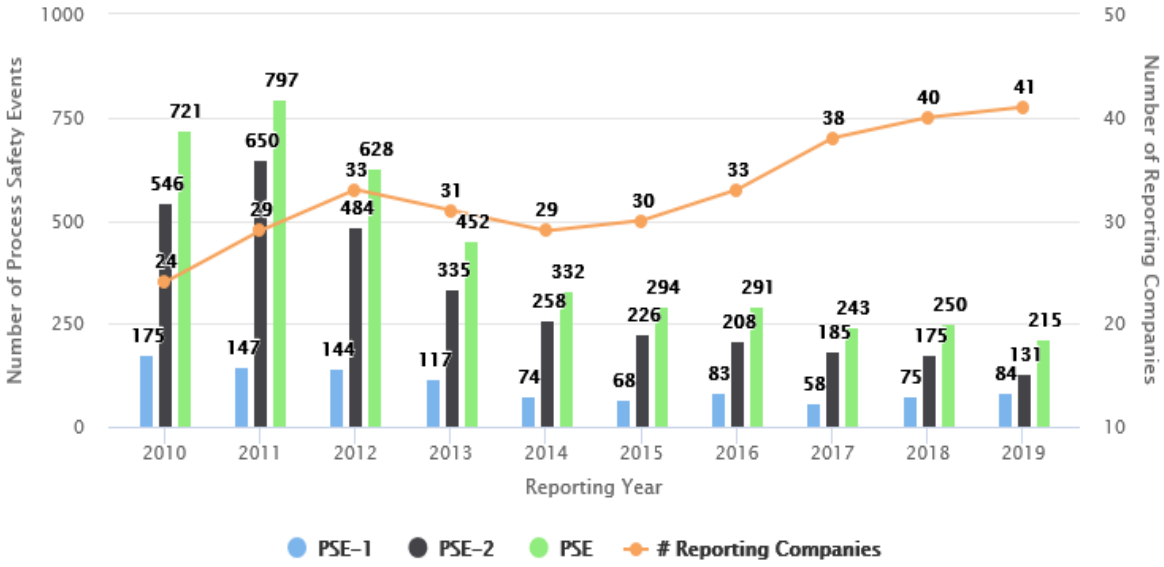
| Manufacturing and Marketing PSER | | | |
|---|---|---|---|
| PSER | Low | High | Average |
| Q1 | 0.00 | 0.19 | 0.03 |
| Q2 | 0.25 | 0.46 | 0.30 |
| Q3 | 0.51 | 1.86 | 1.01 |
| Q4 | 2.10 | 10.64 | 4.61 |

*Table 13* Manufacturing PSER quartile distribution ranges and average values for each quartile

| Manufacturing PSER | | | |
|---|---|---|---|
| PSER | Low | High | Average |
| Q1 | 0.00 | 0.25 | 0.05 |
| Q2 | 0.27 | 0.58 | 0.37 |
| Q3 | 0.59 | 1.86 | 1.23 |
| Q4 | 2.10 | 11.46 | 4.76 |

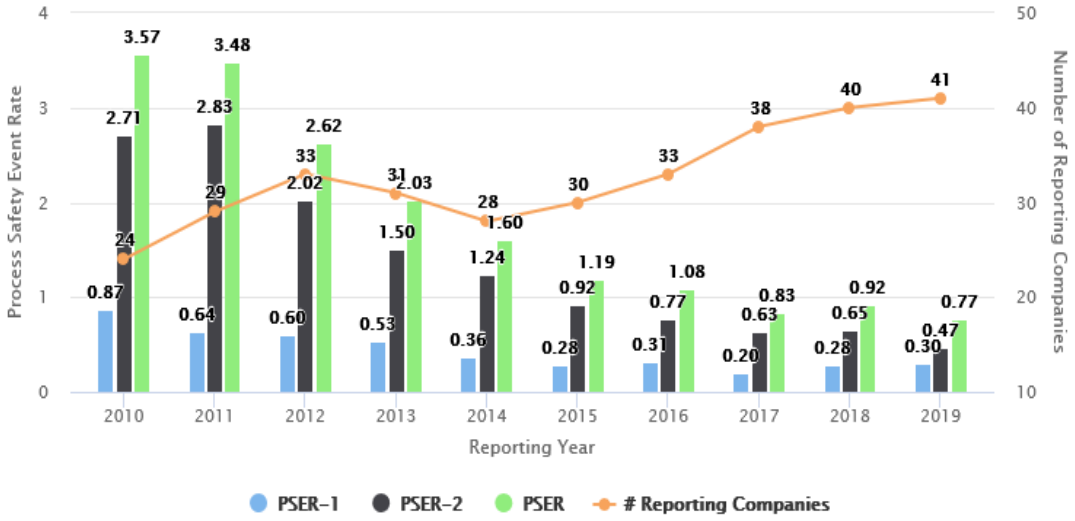
**Figure 15** shows counts of the total Manufacturing PSE for the period 2010 to 2019 for which Concawe has data. **Figure 16** shows the same data expressed as rates. The data given are for Manufacturing, as only that data is sufficiently robust to allow the analysis provided in these presentations.

*Figure 15* Process Safety Events (PSE) last 10 years 2010-2019 - Manufacturing Staff and Contractors




As the number of reporting companies has risen over the past five years the total number of PSE in Manufacturing has reduced slightly and in 2019 is at 215. The annual number of Manufacturing Tier 1 has increased slightly year on year since 2017, with a total of 84 Tier 1 events reported in 2019. The lowest number of Manufacturing Tier 2 PSE was recorded in 2019 (131).

*Figure 16* Process Safety Event Rate last 10 years 2010-2019 - Manufacturing Staff and Contractors




With the exception of 2018, the year on year decline in total Manufacturing PSER continues with the lowest rate recorded in 2019 at 0.77. This is largely driven by the decrease in PSER Tier 2 (0.65 in 2018 and 0.47 in 2019), with Tier 1 PSER slightly increased in 2019 at 0.30 cf. 0.28 in 2018. It is worth considering whether future reporting of Tier 2 PSE causal factors may help understanding of the drivers for this performance improvement.

# 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, see **Table 14**. The IOGP statistics concern the upstream oil industry covering oil and gas exploration and production activities [29]. In comparison with IOGP statistics for European onshore, Concawe recorded a lower fatality rate yet higher lost workday injury and all injury frequencies.

***Table 14*** Comparison of oil industry safety performance (own staff and contractors)

| | Concawe 2019 | International Association of Oil & Gas Producers - IOGP Europe 2019 | |
|---|---|---|---|
| | | Onshore | Onshore and Offshore |
| FAR | 0.49 | 0.63 | 0.73 |
| LWIF | 0.98 | 0.63 | 0.80 |
| AIF | 1.66 | 1.43 | 2.28 |

FAR is per 100 million work hours
LWIF and AIF per million work hours

The American Petroleum Institute (API) reports that the rate of job-related nonfatal injuries and illnesses for the US Petroleum Refining sector decreased from 0.7 per 100 full-time workers in 2017 to 0.4 in 2018 [30]. Note this figure does not refer to lost workdays. Note also that this figure is based upon 200,000 work hours as a denominator compared with 1,000,000 work hours used by Concawe. The Concawe 2018 LTIF expressed per 200,000 hours is 0.21.

The US Refining Tier 1 and 2 PSE Rates recorded by API in 2018 are 0.0608 and 0.1574, respectively [33]. These values are comparable with 0.032 and 0.08 recorded by Concawe when expressed per 200,000 work hours.

The number of employee fatalities recorded by the European Chemical Industry Association (Cefic) for Responsible Care companies in 2017 was 5 and the Lost Time Injury Rate (LTIR) was 6.3 [31]. The number of employee fatalities has decreased annually since 2014, when 23 employees were fatally injured. As a measure of number of lost time incidents per million working hours, this value is comparable with the Concawe LWIF, which in 2017 was 0.94. LTIR recorded by Cefic had previously decreased from 7.9 in 2011 to 6.9 in 2016. The widespread implementation of HSE management systems across chemical companies and senior management engagement are seen as factors influencing this improved performance.

# 5. REFERENCES


1. Concawe (1996) European downstream oil industry safety performance. Statistical summary of reported incidents – 1993 & 1994. Report No. 1/96. Brussels: Concawe

2. Concawe (1996) European downstream oil industry safety performance. Statistical summary of reported incidents – 1995. Report No. 3/96. Brussels: Concawe

3. Concawe (1997) European downstream oil industry safety performance. Statistical summary of reported incidents – 1996. Report No. 4/97. Brussels: Concawe

4. Concawe (1998) European downstream oil industry safety performance. Statistical summary of reported incidents – 1997 and overview 1993 to 1997. Report No. 4/98. Brussels: Concawe

5. Concawe (1999) European downstream oil industry safety performance. Statistical summary of reported incidents – 1998. Report No. 1/99. Brussels: Concawe

6. Concawe (2000) European downstream oil industry safety performance. Statistical summary of reported incidents – 1999. Report No. 1/00. Brussels: Concawe

7. Concawe (2001) European downstream oil industry safety performance. Statistical summary of reported incidents – 2000. Report No. 3/01. Brussels: Concawe

8. Concawe (2003) European downstream oil industry safety performance. Statistical summary of reported incidents – 2001. Report No. 2/03. Brussels: Concawe

9. Concawe (2004) European downstream oil industry safety performance. Statistical summary of reported incidents – 2002. Report No. 6/04. Brussels: Concawe

10. Concawe (2004) European downstream oil industry safety performance. Statistical summary of reported incidents – 2003. Report No. 11/04. Brussels: Concawe

11. Concawe (2005) European downstream oil industry safety performance. Statistical summary of reported incidents – 2004. Report No. 10/05. Brussels: Concawe

12. Concawe (2006) European downstream oil industry safety performance. Statistical summary of reported incidents – 2005. Report No. 7/06. Brussels: Concawe

13. Concawe (2008) European downstream oil industry safety performance. Statistical summary of reported incidents – 2006. Report No. 2/08. Brussels: Concawe

14. Concawe (2009) European downstream oil industry safety performance. Statistical summary of reported incidents – 2007. Report No. 6/09. Brussels: Concawe

15. Concawe (2009) European downstream oil industry safety performance. Statistical summary of reported incidents – 2008. Report No. 7/09. Brussels: Concawe

16. Concawe (2010) European downstream oil industry safety performance. Statistical summary of reported incidents – 2009. Report No. 7/10. Brussels: Concawe

17. Concawe (2011) European downstream oil industry safety performance. Statistical summary of reported incidents – 2010. Report No. 5/11. Brussels: Concawe

18. Concawe (2012) European downstream oil industry safety performance. Statistical summary of reported incidents – 2011. Report No. 5/12. Brussels: Concawe

19. Concawe (2013) European downstream oil industry safety performance Statistical summary of reported incidents – 2012. Report No. 5/13. Brussels: Concawe

20. Concawe (2014) European downstream oil industry safety performance Statistical summary of reported incidents – 2013. Report No. 8/14. Brussels: Concawe

21. Concawe (2015) European downstream oil industry safety performance Statistical summary of reported incidents – 2014. Report No. 5/15. Brussels: Concawe

22. Concawe (2016) European downstream oil industry safety performance Statistical summary of reported incidents – 2015. Report No. 12/16. Brussels: Concawe

23. Concawe (2017) European downstream oil industry safety performance Statistical summary of reported incidents – 2016. Report No. 6/17. Brussels: Concawe

24. Concawe (2018) European downstream oil industry safety performance Statistical summary of reported incidents – 2017. Report No. 11/18. Brussels: Concawe

25. Concawe (2019) European downstream oil industry safety performance Statistical summary of reported incidents – 2018. Report No. 6/19. Brussels: Concawe

26. API (2008) Guide to reporting Process Safety Incidents – Version 3. Washington DC: American Petroleum Institute

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

28. 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

29. IOGP (2020) Safety performance indicators – 2019 data. Report No. 2020s. London: International Association of Oil & Gas Producers

30. API Workplace Safety Report (WSR) - 2009-2018. American Petroleum Institute.

31. Cefic (2017) Cefic Responsible Care Key Performance Indicators 2017

32. API (2016) ANSI/API Recommended practice 754. Process safety performance indicators for the refining and petrochemical industries. 2nd Edition. Washington DC: American Petroleum Institute

33. API 2019 Process Safety Event Public Reporting 2015-2019

# 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) [26, 27]. 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. LTIF | Lost Time Injury Frequency is calculated from the sum of fatalities and LWI divided by the number of hours worked expressed in millions |
| 13. 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. |
| 14. LWIF | Lost Workday Injury Frequency is calculated from the number of LWIs divided by the number of hours worked expressed in millions. |
| 15. LWIS | Lost Workday Injury Severity is the total number of days lost as a result of LWIs divided by the number of LWIs. |
| 16. 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. |
| 17. 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. |
| 18. RAR | Road Accident Rate is calculated from the number of accidents divided by the kilometres travelled expressed in millions. |
| 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. 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. |
| 21. RA 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. |

| | |
|---|---|
| 22. 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. |
| 23. 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 Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-25] for further details |
| 24. 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 Concawe has modified the unit and costs in API RP754 to reflect SI units and € costs. See previous Concawe safety reports [18-25] for further details |
| 25. Total days lost | The number of calendar days lost through LWIs counting from the day after the injury occurred. |

## Concawe Categorization for Fatalities and LWIs

| Previous Category | Current Concawe 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. |

| Previous Category | Current Concawe Incident Category | Description |
|---|---|---|
| | Other | Used to specify where an incident cannot be logically classed under any other category. |

*Guidance*

| | |
|---|---|
| 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. |
| 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.<br><br>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. |
| Lost Time Injury Frequency | The LTIF is similar to the LWIF because the number of fatalities is low in relation to the number of LWI. The LTIF permits comparison with other sectors such as IOGP and Cefic. |
| 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. |

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

| | |
|---|---|
| Road Accident Rate (RAR) | As 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, 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. |

# APPENDIX 2 HISTORICAL DATA 1993 TO 2019

*Table A2-1* Performance indicators - All sectors

| Year | Fatalities | FAR | AIF | LWIF | LWIS | RAR | Million Hours Reported | Distance Travelled Million km |
|---|---|---|---|---|---|---|---|---|
| 1993 | 18 | 5.04 | 7.88 | 4.66 | 27 | 3.8 | 357.0 | 252 |
| 1994 | 19 | 5.36 | 7.42 | 3.96 | 25 | 3.1 | 354.8 | 227 |
| 1995 | 13 | 3.55 | 11.15 | 4.64 | 24 | 2.6 | 366.4 | 627 |
| 1996 | 14 | 3.33 | 10.72 | 4.71 | 19 | 2.0 | 420.6 | 705 |
| 1997 | 15 | 3.39 | 11.40 | 4.57 | 23 | 1.9 | 442.0 | 720 |
| 1998 | 12 | 2.55 | 9.91 | 4.48 | 22 | 1.5 | 469.7 | 369 |
| 1999 | 8 | 1.78 | 9.45 | 4.27 | 21 | 0.9 | 448.5 | 474 |
| 2000 | 13 | 2.74 | 8.78 | 4.25 | 25 | 0.9 | 475.1 | 1084 |
| 2001 | 14 | 2.83 | 9.53 | 4.28 | 24 | 0.8 | 495.5 | 1112 |
| 2002 | 16 | 3.33 | 6.92 | 3.91 | 23 | 1.1 | 480.0 | 1123 |
| 2003 | 22 | 4.14 | 6.34 | 3.22 | 30 | 1.0 | 531.6 | 1459 |
| 2004 | 12 | 2.34 | 6.28 | 3.17 | 33 | 1.0 | 513.3 | 1016 |
| 2005 | 11 | 1.89 | 4.47 | 2.57 | 35 | 0.9 | 581.7 | 1364 |
| 2006 | 7 | 1.47 | 4.62 | 2.48 | 30 | 1.6 | 477.5 | 557 |
| 2007 | 15 | 2.79 | 4.00 | 1.88 | 35 | 0.9 | 538.2 | 1069 |
| 2008 | 11 | 1.98 | 3.69 | 1.71 | 28 | 0.9 | 555.5 | 1004 |
| 2009 | 0 | 2.02 | 4.00 | 1.83 | 30 | 0.8 | 545.3 | 1,036 |
| 2010 | 14 | 2.86 | 5.00 | 1.87 | 30 | 0.6 | 522.2 | 1,011 |
| 2011 | 9 | 1.91 | 3.48 | 1.48 | 42 | 0.5 | 577.2 | 1,084 |
| 2012 | 10 | 2.46 | 2.92 | 1.33 | 29 | 0.4 | 538.9 | 1,164 |
| 2013 | 5 | 1.17 | 2.68 | 1.20 | 34 | 0.5 | 540.5 | 1,178 |
| 2014 | 7 | 1.30 | 2.03 | 1.08 | 43 | 0.3 | 539.3 | 1,271 |
| 2015 | 7 | 1.55 | 1.69 | 1.25 | 29 | 0.3 | 554.7 | 1,112 |
| 2016 | 2 | 0.38 | 1.56 | 0.87 | 34 | 0.4 | 559.6 | 833 |
| 2017 | 2 | 0.34 | 1.57 | 0.94 | 34 | 0.4 | 594.3 | 953 |
| 2018 | 10 | 1.73 | 1.89 | 1.02 | 35 | 0.3 | 579.1 | 978 |
| **2019** | **3** | **0.49** | **1.66** | **0.98** | **35** | **0.4** | **613.2** | **818** |

*Table A2-2* Performance indicators – Manufacturing Staff

| Year | Fatalities | FAR | AIF | LWIF | LWIS |
|---|---|---|---|---|---|
| 1993 | 2 | 2.67 | 12.71 | 3.84 | 50 |
| 1994 | 3 | 3.98 | 10.24 | 2.93 | 29 |
| 1995 | 1 | 1.08 | 12.23 | 3.58 | 29 |
| 1996 | 0 | 0.00 | 14.83 | 3.94 | 28 |
| 1997 | 2 | 1.76 | 15.09 | 4.78 | 24 |
| 1998 | 1 | 0.92 | 10.76 | 4.70 | 20 |
| 1999 | 0 | 0.00 | 12.46 | 4.45 | 16 |
| 2000 | 0 | 0.00 | 13.89 | 3.14 | 30 |
| 2001 | 5 | 5.56 | 9.91 | 3.35 | 27 |
| 2002 | 4 | 5.44 | 9.67 | 2.95 | 28 |
| 2003 | 2 | 2.50 | 8.38 | 2.90 | 38 |
| 2004 | 3 | 3.30 | 6.63 | 1.87 | 51 |
| 2005 | 0 | 0.00 | 5.11 | 1.83 | 44 |
| 2006 | 0 | 0.00 | 5.06 | 1.98 | 28 |
| 2007 | 0 | 0.00 | 3.93 | 1.78 | 33 |
| 2008 | 1 | 0.83 | 3.69 | 1.51 | 32 |
| 2009 | 3 | 2.63 | 5.60 | 2.20 | 34 |
| 2010 | 1 | 1.02 | 8.00 | 2.27 | 28 |
| 2011 | 1 | 0.86 | 5.70 | 1.69 | 76 |
| 2012 | 0 | 0.00 | 4.51 | 1.41 | 32 |
| 2013 | 0 | 0.00 | 3.65 | 1.29 | 33 |
| 2014 | 1 | 0.92 | 2.96 | 1.38 | 44 |
| 2015 | 3 | 3.00 | 2.92 | 1.48 | 41 |
| 2016 | 0 | 0.00 | 2.05 | 1.24 | 34 |
| 2017 | 0 | 0.00 | 2.26 | 1.53 | 35 |
| 2018 | 0 | 0.00 | 3.04 | 1.50 | 42 |
| **2019** | **0** | **0.00** | **2.36** | **1.54** | **32** |

*Table A2-3* Performance indicators – Manufacturing Contractors

| Year | Fatalities | FAR | AIF | LWIF | LWIS |
|---|---|---|---|---|---|
| 1993 | 8 | 20.68 | 13.11 | 5.35 | 20 |
| 1994 | 1 | 2.63 | 12.73 | 4.57 | 36 |
| 1995 | 0 | 0.00 | 12.57 | 7.39 | 24 |
| 1996 | 3 | 5.03 | 18.66 | 8.26 | 19 |
| 1997 | 1 | 1.78 | 28.45 | 8.84 | 23 |
| 1998 | 0 | 0.00 | 25.08 | 9.32 | 24 |
| 1999 | 2 | 3.53 | 24.47 | 8.14 | 19 |
| 2000 | 2 | 3.07 | 20.96 | 8.00 | 23 |
| 2001 | 3 | 4.09 | 18.13 | 6.89 | 24 |
| 2002 | 6 | 9.89 | 14.34 | 6.31 | 23 |
| 2003 | 6 | 8.41 | 12.78 | 4.55 | 42 |
| 2004 | 5 | 6.16 | 10.23 | 3.54 | 30 |
| 2005 | 3 | 3.36 | 8.02 | 3.07 | 33 |
| 2006 | 2 | 2.07 | 6.82 | 2.88 | 31 |
| 2007 | 8 | 7.01 | 6.20 | 2.30 | 25 |
| 2008 | 4 | 3.09 | 5.28 | 1.81 | 26 |
| 2009 | 6 | 4.75 | 6.07 | 2.21 | 33 |
| 2010 | 10 | 7.61 | 8.84 | 2.13 | 32 |
| 2011 | 9 | 6.59 | 5.51 | 1.70 | 34 |
| 2012 | 7 | 5.17 | 4.30 | 1.48 | 26 |
| 2013 | 4 | 3.46 | 3.92 | 1.22 | 32 |
| 2014 | 5 | 3.91 | 2.97 | 1.13 | 46 |
| 2015 | 2 | 1.34 | 1.89 | 1.71 | 18 |
| 2016 | 2 | 1.26 | 1.48 | 0.66 | 42 |
| 2017 | 1 | 0.54 | 1.42 | 0.78 | 36 |
| 2018 | 7 | 4.21 | 2.03 | 0.99 | 37 |
| **2019** | **3** | **1.79** | **1.73** | **0.93** | **40** |

*Table A2-4* Performance indicators – Marketing Staff

| Year | Fatalities | FAR | AIF | LWIF | LWIS |
|---|---|---|---|---|---|
| 1993 | 2 | 1.20 | 6.07 | 5.68 | 23 |
| 1994 | 13 | 8.07 | 5.95 | 5.16 | 21 |
| 1995 | 1 | 0.62 | 12.00 | 4.93 | 22 |
| 1996 | 2 | 1.11 | 8.64 | 4.89 | 18 |
| 1997 | 4 | 2.40 | 8.62 | 4.61 | 23 |
| 1998 | 3 | 1.64 | 7.73 | 3.41 | 21 |
| 1999 | 2 | 1.12 | 6.50 | 3.67 | 23 |
| 2000 | 0 | 0.00 | 4.71 | 3.68 | 29 |
| 2001 | 3 | 1.42 | 6.68 | 3.63 | 27 |
| 2002 | 4 | 2.10 | 5.66 | 3.61 | 22 |
| 2003 | 2 | 0.98 | 5.73 | 3.33 | 19 |
| 2004 | 0 | 0.00 | 6.62 | 3.90 | 25 |
| 2005 | 3 | 1.40 | 4.17 | 2.98 | 36 |
| 2006 | 0 | 0.00 | 3.73 | 2.63 | 23 |
| 2007 | 2 | 1.18 | 3.98 | 2.12 | 31 |
| 2008 | 1 | 0.62 | 4.04 | 2.13 | 27 |
| 2009 | 1 | 0.62 | 3.28 | 1.75 | 22 |
| 2010 | 0 | 0.00 | 2.43 | 1.81 | 26 |
| 2011 | 1 | 0.48 | 2.17 | 1.43 | 32 |
| 2012 | 2 | 1.17 | 1.96 | 1.42 | 29 |
| 2013 | 0 | 0.00 | 2.18 | 1.33 | 34 |
| 2014 | 0 | 0.00 | 1.52 | 0.99 | 43 |
| 2015 | 0 | 0.00 | 1.35 | 1.04 | 40 |
| 2016 | 0 | 0.00 | 1.74 | 0.94 | 25 |
| 2017 | 0 | 0.00 | 1.80 | 0.95 | 36 |
| 2018 | 1 | 0.63 | 1.74 | 0.97 | 31 |
| **2019** | **0** | **0.00** | **1.81** | **0.90** | **42** |

*Table A2-5* Performance indicators – Marketing Contractors

| Year | Fatalities | FAR | AIF | LWIF | LWIS |
|---|---|---|---|---|---|
| 1993 | 6 | 7.83 | 3.66 | 2.90 | 21 |
| 1994 | 2 | 2.49 | 4.34 | 2.21 | 25 |
| 1995 | 11 | 18.16 | 7.03 | 3.09 | 21 |
| 1996 | 9 | 11.85 | 3.54 | 2.57 | 11 |
| 1997 | 8 | 7.60 | 3.37 | 2.01 | 20 |
| 1998 | 8 | 6.79 | 5.87 | 3.50 | 19 |
| 1999 | 4 | 3.30 | 5.60 | 3.23 | 18 |
| 2000 | 11 | 9.66 | 2.86 | 4.06 | 17 |
| 2001 | 3 | 2.48 | 8.20 | 4.52 | 17 |
| 2002 | 2 | 1.29 | 4.41 | 3.79 | 20 |
| 2003 | 12 | 6.82 | 3.40 | 2.68 | 31 |
| 2004 | 4 | 2.77 | 3.33 | 2.79 | 43 |
| 2005 | 5 | 2.73 | 2.61 | 2.28 | 28 |
| 2006 | 5 | 4.58 | 3.79 | 2.32 | 19 |
| 2007 | 5 | 3.94 | 2.35 | 1.39 | 22 |
| 2008 | 5 | 3.46 | 1.88 | 1.31 | 20 |
| 2009 | 1 | 0.71 | 1.64 | 1.27 | 28 |
| 2010 | 3 | 2.53 | 1.67 | 1.33 | 36 |
| 2011 | 0 | 0.00 | 1.23 | 1.08 | 19 |
| 2012 | 4 | 3.63 | 1.23 | 0.95 | 29 |
| 2013 | 2 | 1.70 | 1.21 | 0.87 | 37 |
| 2014 | 1 | 0.76 | 1.00 | 0.89 | 37 |
| 2015 | 3 | 2.44 | 0.85 | 0.75 | 25 |
| 2016 | 0 | 0.00 | 1.00 | 0.75 | 37 |
| 2017 | 1 | 0.72 | 0.97 | 0.67 | 28 |
| 2018 | 2 | 1.38 | 1.01 | 0.73 | 28 |
| **2019** | **0** | **0.00** | **0.96** | **0.70** | **25** |

*Table A2-6* Lost Workday Injury causes 2015-2019 – Staff and Contractors in both Manufacturing and Marketing

| | | LWI 2019 | | | | 2018 | 2017 | 2016 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| **Causes** | | **Manufacturing** | **Marketing** | **Combined** | **%** | **%** | **%** | **%** | **%** |
| Road Accident | Road Accident | 7 | 13 | 20 | 3.4 | 3.4 | 2.9 | 4.1 | 4.2 |
| Heights/Falls | Falls from height | 30 | 19 | 49 | 8.3 | 9.6 | 7.8 | 7.3 | 8.6 |
| | Staff hit by falling objects | 10 | 8 | 18 | 3.1 | 2.6 | 3.1 | 3.0 | 3.1 |
| | Slips & trips (same height) | 117 | 105 | 222 | 37.8 | 33.0 | 36.5 | 30.1 | 29.5 |
| Burn/Electrical | Explosion or burns | 16 | 3 | 19 | 3.2 | 6.5 | 4.5 | 7.3 | 6.0 |
| | Exposure electrical | 4 | 1 | 5 | 0.9 | 0.2 | 0.9 | 0.4 | 0.7 |
| Confined Space | Confined Space | 1 | 0 | 1 | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 |
| Other Causes | Assault or violent act | 0 | 12 | 12 | 2.0 | 1.9 | 2.0 | 3.0 | 3.1 |
| | Water related, drowning | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Cut, puncture, scrape | 19 | 19 | 38 | 6.5 | 8.6 | 6.4 | 5.7 | 4.6 |
| | Struck by | 35 | 43 | 78 | 13.3 | 11.5 | 13.3 | 8.3 | 11.9 |
| | Exposure, noise, chemical, biological, vibration | 21 | 3 | 24 | 4.1 | 3.1 | 4.7 | 3.5 | 2.6 |
| | Caught in, under or between | 29 | 18 | 47 | 8.0 | 7.2 | 3.8 | 6.1 | 9.0 |
| | Overexertion, strain | 21 | 11 | 32 | 5.5 | 5.5 | 9.5 | 15.2 | 13.9 |
| | Pressure release | 3 | 1 | 4 | 0.7 | 0.7 | 0.7 | 1.2 | 0.7 |
| | Other | 14 | 4 | 18 | 3.1 | 5.8 | 3.6 | 4.5 | 1.8 |
| | Total | 327 | 260 | 587 | 100 | 100 | 100 | 100 | 100 |

# APPENDIX 3 LOST WORKDAY INJURIES 2019 - CAUSAL FACTORS

| | | Number of Incidents | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MF/MK | Incident Category | Change Management | Communication | Design | Equipment Reliability | Fixed Equipment Inspection | Human Factors | Knowledge and Skills | Operating Limits | Procedures | Risk Assessment | Safe Work Practices or Procedures | Work Monitoring | Other | Not Yet Available |
| MF | Assault or violent act | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MK | Assault or violent act | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 10 | 0 |
| MF | Caught in, under or between | 0 | 5 | 4 | 1 | 1 | 14 | 8 | 0 | 6 | 7 | 7 | 2 | 2 | 1 |
| MK | Caught in, under or between | 0 | 0 | 2 | 1 | 1 | 6 | 6 | 0 | 3 | 5 | 4 | 0 | 3 | 1 |
| MF | Confined space | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MK | Confined space | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MF | Cut, puncture, scrape | 0 | 0 | 0 | 2 | 1 | 9 | 5 | 0 | 6 | 8 | 4 | 2 | 5 | 0 |
| MK | Cut, puncture, scrape | 0 | 1 | 1 | 2 | 0 | 5 | 2 | 0 | 1 | 1 | 2 | 0 | 4 | 6 |
| MF | Explosion or burns | 2 | 2 | 4 | 0 | 0 | 5 | 5 | 0 | 3 | 4 | 5 | 1 | 3 | 0 |
| MK | Explosion or burns | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 1 |
| MF | Exposure electrical | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| MK | Exposure electrical | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| MF | Exposure, noise, chemical, biological, vibration | 1 | 2 | 3 | 7 | 4 | 9 | 3 | 0 | 4 | 3 | 9 | 3 | 5 | 1 |
| MK | Exposure, noise, chemical, biological, vibration | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| MF | Falls from height | 0 | 1 | 6 | 2 | 0 | 13 | 3 | 0 | 5 | 6 | 5 | 2 | 5 | 2 |
| MK | Falls from height | 2 | 0 | 1 | 1 | 0 | 12 | 1 | 2 | 0 | 1 | 7 | 1 | 9 | 1 |
| MF | Other | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 2 | 2 | 0 | 5 | 0 |
| MK | Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 1 |
| MF | Overexertion, strain | 0 | 0 | 3 | 1 | 0 | 8 | 4 | 0 | 3 | 2 | 6 | 0 | 2 | 2 |
| MK | Overexertion, strain | 0 | 0 | 1 | 0 | 0 | 5 | 0 | 0 | 1 | 1 | 5 | 0 | 1 | 2 |
| MF | Pressure release | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| MK | Pressure release | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| MF | Road accident | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 |
| MK | Road accident | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 3 |
| MF | Slips & trips (same height) | 0 | 1 | 17 | 4 | 5 | 60 | 8 | 0 | 9 | 10 | 14 | 3 | 34 | 12 |
| MK | Slips & trips (same height) | 0 | 2 | 2 | 1 | 0 | 47 | 5 | 0 | 6 | 6 | 5 | 0 | 15 | 31 |
| MF | Staff hit by falling objects | 1 | 0 | 0 | 2 | 3 | 5 | 0 | 0 | 1 | 0 | 2 | 0 | 3 | 0 |
| MK | Staff hit by falling objects | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 2 |
| MF | Struck by | 0 | 3 | 11 | 3 | 3 | 15 | 6 | 0 | 6 | 4 | 9 | 2 | 9 | 2 |
| MK | Struck by | 0 | 1 | 4 | 3 | 0 | 15 | 3 | 0 | 4 | 2 | 4 | 0 | 6 | 12 |
| MF | Water related, drowning | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MK | Water related, drowning | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 6 | 18 | 60 | 34 | 18 | 253 | 64 | 2 | 62 | 67 | 95 | 18 | 131 | 86 |

# APPENDIX 4 TIER 1 PROCESS SAFETY EVENTS 2019

*Table A4-1* Tier 1 Process Safety incidents by Type of Process (Refining)

| Type of Process: Refining | Number of Tier 1 events |
|---|---|
| 1. active warehouse | 1 |
| 2. alkylation, HF | 1 |
| 3. alkylation, sulfuric | |
| 4. bitumen/resid/asphalt | 4 |
| 5. calcining | |
| 6. coking | 1 |
| 7. crude/vacuum distillation | 8 |
| 8. fcc | 1 |
| 9. flares/flare systems/flare gas recovery | 1 |
| 10. gas and liquid desulfurization/treating (H2S absorbers, amine systems, Merox) | 8 |
| 11. hydrocracking | 2 |
| 12. hydrogen | |
| 13. hydrotreating | 2 |
| 14. isomerization | 1 |
| 15. loading/unloading (truck or rail) | 4 |
| 16. marine/jetty/wharf | 4 |
| 17. Other (describe) | 6 |
| 18. pilot plant | |
| 19. reforming | 2 |
| 20. sulfur recovery | 2 |
| 21. tank farm/storage facility/offsites/storage and transfer piping | 32 |
| 22. utilities/steam plant/cogeneration | 3 |
| 23. vapor recovery/light ends | |
| 24. waste/wastewater handling, treatment or disposal | 2 |
| **Total** | **85** |

*Table A4-2* Tier 1 Process Safety incidents by Type of Process (Petrochemical & other process)

| Type of Process: Petrochemical | Number of Tier 1 events |
|---|---|
| 1. acetic acid and derivatives | |
| 2. active warehouse | |
| 3. amines derivatives | |
| 4. aromatics derivatives (cumene, dis-proportionation, aromatic isomerization, linear alkylbenzene) | |
| 5. benzene | |
| 6. butadiene | |
| 7. butane | |
| 8. cyclohexane | |
| 9. dehydrogenation (propylene, butylenes) | |
| 10. diisocyanates (TDA, MDA, IPDA, etc.) | |
| 11. ETBE | |
| 12. ethane | |
| 13. ethanol | |
| 14. ethyl benzene and derivatives | |
| 15. ethylene and derivatives | |
| 16. ethylene dichloride and derivatives | |
| 17. ethylene oxide | |
| 18. flares/flare systems/flare gas recovery | |
| 19. formaldehyde and derivatives | |
| 20. glycols (ethylene, propylene) | |
| 21. hexane | |
| 22. hexanol | |
| 23. isobutane | |
| 24. isobutene | |
| 25. isocyanates | |
| 26. isopropanol | |
| 27. LNG | |
| 28. loading/unloading (truck or rail) | 2 |
| 29. methane | |
| 30. methanol | |
| 31. methyl mercaptan | |
| 32. MTBE | |
| 33. NGL fractionation | |
| 34. Other (describe) | 2 |
| 35. paraxylene | |
| 36. pentane | |
| 37. phenol | |
| 38. pilot plant | |
| 39. polyethylene | |
| 40. polypropylene | |
| 41. polystyrene | |
| 42. propane | |
| 43. propylene | |
| 44. propylene oxide and derivatives | |
| 45. specialty chemicals | |
| 46. styrene-butadiene | |
| 47. synthesis gas (CO, H2), | |
| 48. tank farm/storage facility/offsite/storage & transfer piping | 3 |
| 49. toluene | |
| 50. utilities/steam plant/cogeneration | |
| 51. waste/wastewater handling, treatment or disposal | |
| 52. xylene | |
| **Total** | **7** |

*Table A4-3* Tier 1 Process Safety incidents by Mode of Operation

| Mode of Operation | Number of Tier 1 events |
|---|---|
| 1. Emergency shutdown | |
| 2. Normal | 66 |
| 3. Other (describe) | 1 |
| 4. Planned shutdown | 7 |
| 5. Routine maintenance | 6 |
| 6. Start-up | 9 |
| 7. Temporary | 1 |
| 8. Turnaround | 1 |
| 9. Upset | 1 |
| **Total** | **92** |

*Table A4-4* Tier 1 Process Safety incidents by Point of release

| Point of Release | Number of Tier 1 events |
|---|---|
| 1. Atmospheric tank | 20 |
| 2. Blower/Fan | |
| 3. Compressor | 1 |
| 4. Cooling Tower | |
| 5. Filter/Coalescer/Strainer | 2 |
| 6. Fired Boiler | 1 |
| 7. Flare/Relief System | 1 |
| 8. Furnace/fired heater | 2 |
| 9. Heat exchanger | 4 |
| 10. Instrumentation | 1 |
| 11. Other (describe) | 11 |
| 12. Piping system, large bore(>2) | 26 |
| 13. Piping system, small bore(?2) | 10 |
| 14. Pressure Vessel | 4 |
| 15. Pump | 8 |
| 16. Reactor | 1 |
| **Total** | **92** |

*Table A4-5* Tier 1 Process Safety incidents by Type of Material

| **Type of Material** | Number of Tier 1 events |
|---|---|
| 1. Emergency shutdown | 12 |
| 2. Normal | 6 |
| 3. Other (describe) | 59 |
| 4. Planned shutdown | 7 |
| 5. Routine maintenance | 5 |
| 6. Start-up | |
| 7. Temporary | 3 |
| **Total** | **92** |

*Table A4-6* Tier 1 Process Safety incidents by Causal Factor

| **Causal Factors** | Number times Causal Factor assigned* |
|---|---|
| 1. Change Management | 15 |
| 2. Communication | 8 |
| 3. Design | 17 |
| 4. Equipment Reliability | 29 |
| 5. Fixed Equipment Inspection | 16 |
| 6. Human Factors | 28 |
| 7. Knowledge and Skills | 18 |
| 8. Operating Limits | 4 |
| 9. Procedures | 23 |
| 10. Risk Assessment | 18 |
| 11. Safe Work Practices or Procedures | 18 |
| 12. Work Monitoring | 6 |
| 13. Other | 6 |
| 14. Not Yet Available | 3 |
| **Total** | **209** |

*More than one causal factor may be assigned to a single Tier one event

# APPENDIX 5 CONCAWE MEMBER COMPANIES THAT SUBMITTED DATA

The following member companies provided the data upon which this report is based. The report includes additional data from two member company joint ventures when these are not provided in the member company submissions.

| | | | |
|---|---|---|---|
| ALMA Petroli | Gruppo API | ATCP | BP |
| CEPSA | ENI | Equinor | ESSAR |
| ExxonMobil | GALP Energia | Gunvor | H&R |
| Hellenic Petroleum | IPLOM | Irving | Rompetrol |
| Q8 | Gruppa Lotos | LUKOIL | MOL Group |
| Motor Oil (Hellas) | Neste | Nynas | OMV |
| Petroineos | Phillips 66 | PKN Orlen | Preem |
| Raffinerie Heide | Repsol | Rosneft | Sara |
| Saras | Shell | St1 | Tamoil |
| Total | Valero | VaroEnergy | VPR Energy |

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