CENTER FOR OFFSHORE SAFETY

ANNUAL PERFORMANCE REPORT

FOR 2017 REPORTING YEAR


September 17, 2018

NOTICE

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COMMONLY USED ACRONYMS

API – American Petroleum Institute

APR – Annual Performance Report

ASP – Audit Service Provider

BSEE – Bureau of Safety and Environmental Enforcement

COS – Center for Offshore Safety

DART – Days Away from Work, Restricted Work, and Job-Transfer Injury and Illness Frequency

F/G – Fire/Gas

GoM – Gulf of Mexico

HVLE – High Value Learning Event

LFI – Learning from Incidents and HVLE

LFIP – Learning from Incidents and HVLE Program

LOPC – Loss of Primary Containment

MIT – Maintenance, Inspection, and Testing

MOC – Management of Change

OCS – Outer Continental Shelf

PRD – Pressure Relief Device

PSE – Process Safety Event

RIIF – Recordable Injury and Illness Frequency

SEMS – Safety and Environmental Management System

SPI – Safety Performance Indicator

SPIP – Safety Performance Indicator Program

WPCS – Well Pressure Containment System

1.0 2017 COS MEMBERS AND PARTICIPANTS

COS MEMBERS

Operators	Rig Contractors	Service Companies	Associations
Anadarko	Pacific Drilling	Baker Hughes, a GE Company	ASQ
BHP	Rowan	Halliburton	IADC
BP E&P		Helmerich & Payne	IMCA
Chevron USA		Oceaneering	MSRC
Cobalt		Schlumberger	NOIA
ConocoPhillips		SBM Offshore	OMSA
ExxonMobil		SubSea7	OOC
Hess			Opito
Murphy E&P			
Noble Energy			
Shell International E&P			
Statoil North America			

10 Operators and 5 Rig Contractors and Service Companies shared SPI data for use in this APR.

COS members listed as Associations above do not provide data.

2.0 INTRODUCTION

The Center for Offshore Safety (COS) is designed to promote the highest level of safety for offshore drilling, completions, and operations through leadership and effective management systems addressing communication, teamwork, and independent third-party auditing and certification. COS enables operational excellence in part by enhancing and continuously improving industry's safety and environmental performance and stimulating cooperation within industry to share industry learnings.

This COS Annual Performance Report (APR) provides information shared by its members under the following COS programs:

- Safety Performance Indicators (SPI), and
- Learning from Incidents and Events (LFI)

The COS member data provided through the LFI and SPI programs enable continual improvement of performance-based management systems

The SPI originated from major hazard bow ties, developed within COS, that cover both process safety and personal safety. The information can be used for driving improvement and, when effectively acted upon, contribute to reducing risk of major incidents by identifying weaknesses in barriers intended to prevent the occurrence or recurrence of incidents and mitigate consequences. The scope of the SPI data covers COS member wells, projects, and production facilities and operations in the US Outer Continental Shelf (OCS).

The LFI data covers the same scope, but also allows for the submittal of data for incidents and events which occur outside the US OCS. In the context of this report, the term safety is inclusive of personal safety, process safety, health, security, and the environment.

2.1 SPI Program

The objectives of this program are twofold. First, it provides a means for sharing data related to key safety performance indicators. Second, it assesses past performance to identify potential opportunities which could lead to improvements in future performance.

The SPI used in this program were selected from assessments of major hazards in the offshore industry. Most of the SPI are outcomes or consequences of the failure of prevention and/or mitigation barriers. Over time, the intent of this program is to better identify safety performance indicators that will help detect potential problems prior to the occurrence of a major consequence.

Publications by the American Petroleum Institute, UK Health and Safety Executive, Center for Chemical Process Safety, International Association of Oil and Gas Producers, and the Organization of Economic Cooperation and Development, as well as the experience shared by COS members, were valuable to the development of this program.

Unless otherwise specified, all frequencies stated in this report are normalized by total work hours multiplied by 200,000. Work hours are reported based on a 12-hour work day offshore.

2.2 LFI Program

The main objective of the program is to provide COS members a mechanism for sharing information from incidents that meet the criteria for an SPI 1 or SPI 2, as well as High Value Learning Events (HVLE). The LFIP also serves to complement the SPI Program by collecting additional information on SPI 1 and SPI 2 events, which are described in more detail in Section 4. This information is analyzed and shared to enable industry learning and reduce the risk of recurrence.

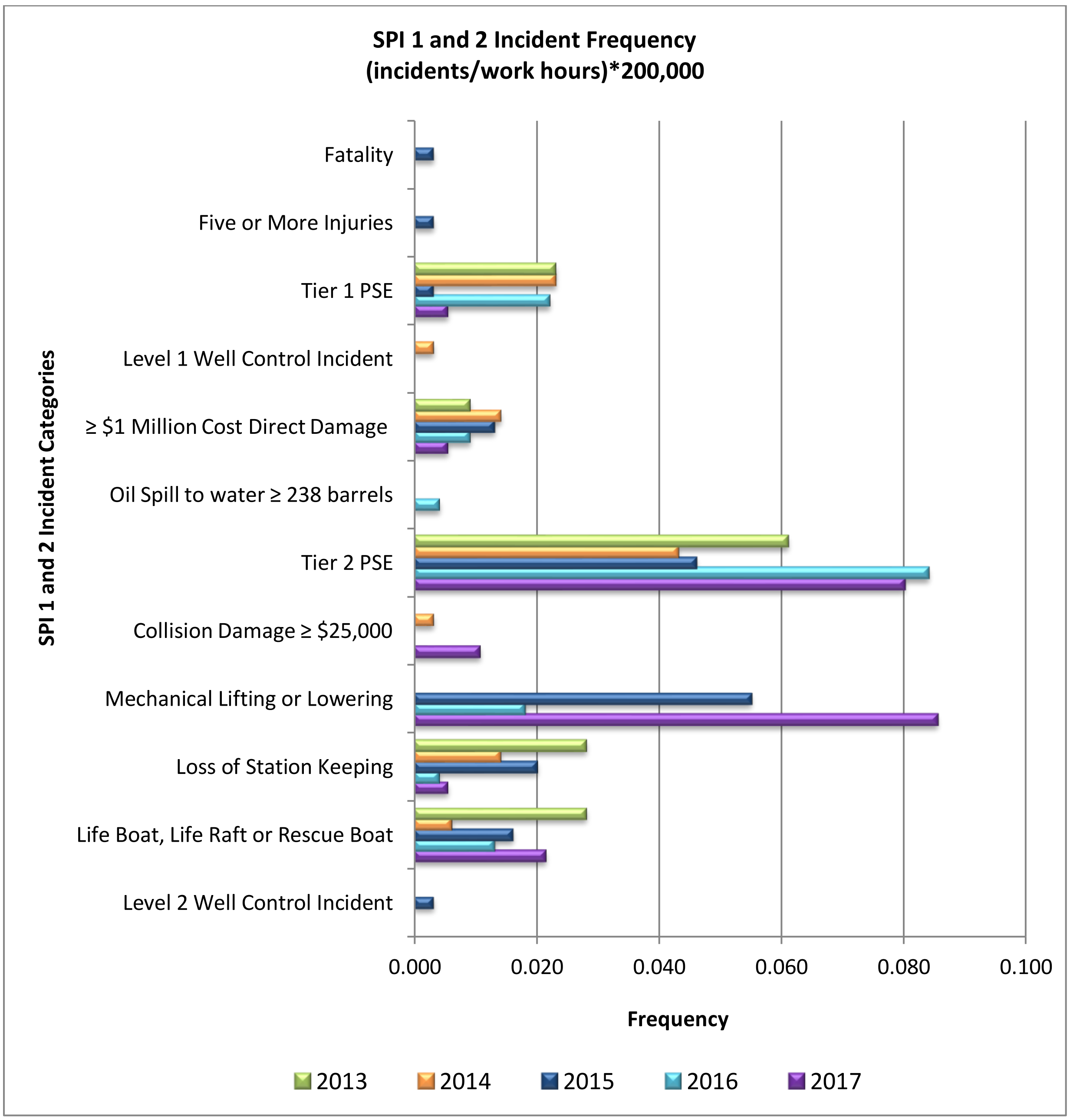
3.0 EXECUTIVE SUMMARY

Publication of SPI and LFI Program data began in 2014, reflecting 2013 performance. This report provides the associated program information for the 2013-2017 reporting years. This section provides a summary of the data; more detail can be found in Sections 4 (SPI) and 5 (LFI).

3.1 SPI Data Summary

This report provides COS member data for 2013-17. The data reported for 2017 represents over 37 million operator and contractor work hours in the US OCS which are comparable to the 45 million, 61 million, and 69 million reported for 2016, 2015, and 2014, respectively. The frequency of all SPI 1 and SPI 2 incidents are shown below in Figure 3.1.

Figure 3.1: SPI 1 and SPI 2 Frequency



Participating members reported 1 **SPI 1** for 2017 and represents the lowest number of SPI 1 reported to COS in the five years of reporting. The reported consequences included a Tier 1 Process Safety Event and ≥ $1 Million Direct Costs from damage. Participating members also reported 38 **SPI 2** for 2017. The reported consequences included Tier 2 Process Safety Events, Collisions with Damage ≥ $25,000, Mechanical Lifting or Lowering incidents, Loss of Station Keeping incidents, and Life Boat, Life Raft, or Rescue Boat Events.

There were no incidents resulting in **Fatalities**, **Five or More injuries**, **Level 1** or **Level 2 Well Control Incidents**, or an **Oil Spill ≥ 238 bbl**. reported for the 2017 reporting year.

The 2017 **Tier 1 PSE** frequency was lower than reported for 2016, returning to approximately 2015 levels. Although there were 4 fewer reported **Tier 2 PSE** for 2017 as compared to 2016, the frequency of Tier 2 PSE is approximately the same for the 2016 and 2017 reporting years. These two years represent the highest reported frequencies in the five years of COS reporting for this type of incident.

There was 1 incident that resulted in **≥ $1 Million Cost (Direct Damage)** reported for the 2017 reporting year. This is the lowest frequency in the five years of COS reporting of this type of incident.

There were 16 Incidents involving **Mechanical Lifting or Lowering**, which is a significant increase from the 4 reported for the 2016 reporting year. The definition for this safety performance indicator was changed for the 2015 reporting year; therefore, both the frequency and the count for these types of incidents are provided for only the 2015-2017 reporting years. This represents the highest reported frequency in the three years of COS reporting for this type of incident (under the revised definition).

The 2 incidents reported for 2017 involving **Collisions with Damage ≥ $25,000** were only the second time such incidents have been reported to COS in the five years of reporting and represent the highest frequency reported in that time frame.

The frequency of incidents involving **Loss of Station Keeping Resulting Drive Off or Drift Off** was approximately the same as for 2016. Incidents involving **Life Boat, Life Raft, or Rescue Boat Events** trended up for 2017 as compared to 2016. This represents the second highest frequency reported to COS for this type of incident in the five years of reporting.

Of the 39 SPI 1 and SPI 2 incidents reported for 2017, 23 (59%) involved **failure of equipment as a contributing factor**. This represents a continuation of the upward trend and is the second highest percentage reported to COS in the five years of reporting.

There was an approximately 20% increase in the frequency of **incidents involving cranes or personnel/material handling** reported in 2017 as compared to 2016.

Of the 10 Operators which shared **SPI 5 data (critical Maintenance, Inspection, and Testing (MIT) tasks completed as per plan),** the combined average for 2017 was 93.3% and continues the downward trend for this rate from its high of 99.1% reported for 2014. It is the lowest combined average in the five years of data reported to COS.

Additionally, 5 Contractors shared **SPI 5 MIT data.** The combined average for contractors for 2017 was 97.1%, which represents a slight decrease from the average of 97.8% reported for 2016.

The combined **Days Away from Work, Restricted Work and Transfer of Duty Rate (DART)** reported for 2017 was 0.214 and represents an increase from the 0.168 reported for 2016. The combined 2017 **Recordable Injury and Illness Frequency (RIIF)** reported for 2017 was 0.488 and represents the first increase in reported RIIF after three years of declining RIIF. The 2017 data is the second highest reported RIIF in the five years of COS reporting.

Two (2) **Oil Spills to Water ≥ One Barrel** were reported by participating COS members, which matches the number reported in 2016.

3.2 LFI Data Summary

This section provides a high-level summary of the LFI data. More detail can be found in Section 5 of the report.

The effectiveness of this program is dependent on active participation by COS members to facilitate maximum learning opportunities through:

- Timely sharing of quality information from incidents and High Value Learning Events (HVLE) that meet the reporting criteria; and
- Reviewing submitted incidents and HVLE, along with other aspects of this report, to identify and implement applicable learnings appropriate to different levels and functions within their own organizations.

The LFI data presented in this report includes information from 53 LFI submittals received for the 2017 reporting year, with 33 of the reported incidents and HVLE occurring in the US OCS, 12 at US Onshore / State Waters, and 8 at International locations (refer to Figure 3.2 below). To support the COS mission to promote the highest level of safety for the US offshore oil and natural gas industry, the findings presented in this report are focused on incidents and events that occurred in the US OCS. A separate section discussing data associated with incidents outside the US OCS (international and US Onshore / State Waters) is provided in this report.

Figure 3.2: Incident Location (All Submittals)

Location	2013	2014	2015	2016	2017	TOTAL
US OCS	46	51	47	43	33	**220**
US Onshore / State Waters*	0	0	2	1	12	**15**
International	2	1	0	17	8	**28**
TOTAL	**48**	**52**	**49**	**61**	**53**	**263**

** Note – The US Onshore/State Waters category is new for 2017 data reporting. US Onshore/State Waters statistics for prior years were generated from submittal content.*

A review of the 2017 reporting year incident and event data resulted in the identification of multiple learning opportunities related to the following topics:

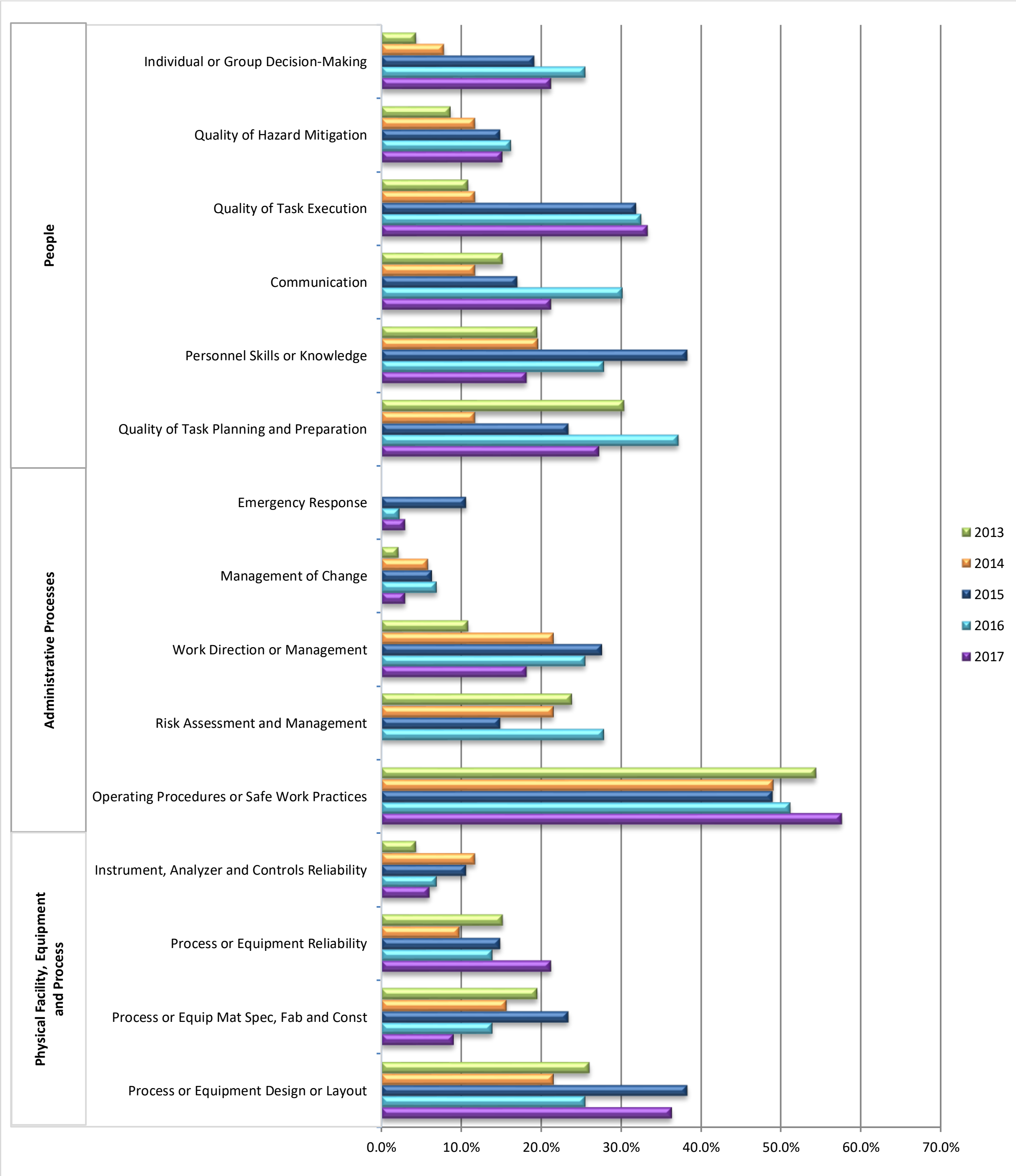
- Loss of Primary Containment (LOPC)
- Mechanical Lifting or Lowering
- Maintenance, Inspection and Testing

For this year's report, LOPC was identified as a broader category to include both Process Safety and Non-Process Safety release events. Maintenance, Inspection and Testing was noted in 2016, and continues as a focus topic in 2017. In addition to the topics mentioned above, there were other key learnings captured from all LFI data for the top three Areas for Improvement (AFI) identified for 2017:

- Operating Procedures or Safe Work Practices,
- Process or Equipment Design or Layout, and
- Quality of Task Execution

Across all 5 reporting years, Operating Procedures or Safe Work Practices was the most frequently identified AFI, as shown in Figure 3.3 below.

Figure 3.3: Areas for Improvement Distribution (US OCS only, Chart)



NOTE - LFI submittals typically identified more than one AFI. The graph above illustrates the percent of times an AFI was identified relative to the number of LFI forms submitted for US OCS events (46 in 2013, 51 in 2014, 47 in 2015, 43 in 2016, and 33 in 2017). Because the number of AFI exceeds the number of LFI forms, the sum of the percentages will be > 100%.

3.3 Other Notable COS Accomplishments for 2017-18

3.3.1 SEMS Audit Service Provider (ASP) Accreditation Program

In accordance with the Memorandum of Understanding signed in 2015, COS is currently the only accreditation body authorized by BSEE to accredit SEMS ASP pursuant to 30 CFR 250, Subpart S.

As of the writing of this report, 6 ASP have been fully accredited:

(1) ABS Quality Evaluations

(2) CICS-Americas

(3) DNV GL Business Assurance

(4) ERM Certification and Verification Services

(5) Gulf Tech

(6) M&H Auditing

In addition, the following ASP has been provisionally accredited:

(7) AcuTech Consulting Group

3.3.2 SEMS Audit and Certification Program

As of the publication of this APR, the following COS Member Companies have successfully attained or re-attained COS SEMS Certification:

- Anadarko Petroleum Corporation
- BHP Billiton Petroleum
- BP E&P, Inc.
- Chevron USA, Inc. (Deepwater Assets)
- Cobalt International Energy, LP
- ConocoPhillips Co.
- ExxonMobil
- Helmerich & Payne International Drilling Co.
- Hess Corporation
- Marathon Oil Company
- Murphy E&P, Co.
- Noble Energy
- Shell E&P Co.
- Pacific Drilling Services, Inc.
- Schlumberger
- Statoil Gulf Services, LLC.

3.3.3 COS at OTC

COS hosted its sixth-annual SEMS ½-day at the 2018 Offshore Technology Conference. Keynote speakers included:

- Fawaz Bitar, BP
- Stephen Barrett, Oceaneering
- Director Scott Angelle, Bureau of Safety and Environmental Enforcement (BSEE)
- Rear Admiral John Nadeau, United States Coast Guard (USCG)

In addition, COS hosted 2 technical sessions around the theme *Interaction of Culture, Systems, and Human Performance – The Next Step Change in Safety Management* focusing on the revision to API Recommended Practice 75 and real-world application of the concepts of human performance and safety culture.

3.3.4 COS Safety Leadership Award

The winners of the 2017 COS Safety Leadership Awards were:

Operator: Chevron – *Human Performance*

Contractor: Baker Hughes, a GE Co. – *What Lies Beneath*

For 2018, COS will be announcing the winners of the 2018 COS Safety Leadership Award at the 6th Annual COS Safety Forum, September 18-19 – Houston, TX. Finalists for the award are:

Operator Finalists:	Contractor Finalists:
BP – *Systematically Delivering a Safe and Effective Facility Turnaround*	ABS – *The ABS Guide for the Prevention of Dropped Objects*
ExxonMobil – *SSH&E Sharing & Learning App*	Baker Hughes, a GE Co. – *Threat Response Drills – Prevention of Process Safety Events*
Shell – *Conditional Rate of Change Alarm (CROC) for Detection of Large Subsea Leaks*	Schlumberger – *Schlumberger's HSE Risk Reporting Program and Mobile Application*

3.3.5 Guidelines for a Robust Safety Culture

The COS Guidelines for a Robust Safety Culture offers guidance describing a robust safety culture by providing:

- A description of specific safety culture characteristics, including the value and purpose of each.
- Factors specific to each characteristic that encourage and demonstrate a robust safety culture.
- Potential barriers specific to each characteristic that may prevent a robust safety culture

3.3.6 COS Safety Shares

As part of the COS commitment to the mission of promoting safe operations by sharing industry knowledge, COS launched the COS Safety Shares Program. As of the publication of this APR, three COS Safety Shares are publicly available (www.centerforoffshoresafety.org), with more under development:

- COS2016043 Bosun Trapped Between Cargo on Vessel
- COS2016046 Subsea Leak from Well Jumper
- COS2016055 Inadvertent Activation of Critical BOP Function Results in Subsea Release

4.0 SAFETY PERFORMANCE INDICATORS

4.1 Introduction

COS members share Safety Performance Indicator (SPI) data with COS through the SPI Program. The data is confidential and blinded. This is the fifth year that COS members have shared SPI data. Benchmarks with other data sources are shown where definitions are comparable.

While the data for 2013 was limited to reporting of deepwater (≥ 1,000 feet water depth) COS member activity only, the data for 2014-17 includes all COS member activity on the US OCS. A normalization factor for work hours is utilized to enable year-to-year comparisons. The summary of the SPI can be found in Figure 4.1 below.

Figure 4.1: Safety Performance Indicators (SPI)

SPI 1 is the frequency of incidents that resulted in one or more of the following:

A. Fatality
B. Five or more injuries in a single incident
C. Tier 1 process safety event
D. Level 1 Well Control Incident - Loss of well control
E. ≥ $1 million direct cost from damage to or loss of facility / vessel / equipment
F. Oil spill to water ≥ 10,000 gallons (238 barrels)

SPI 2 is the frequency of incidents that do not meet the SPI 1 definition but have resulted in one or more of the following:

A. Tier 2 process safety event
B. Collision resulting in property or equipment damage ≥ $25,000
C. Mechanical Lifting or Lowering Incident
D. Loss of station keeping resulting in a drive off or drift off
E. Life boat, life raft, rescue boat event
F. Level 2 Well Control Incident - Multiple Barrier Systems Failures and Challenges

SPI 3 is the number of SPI 1 and SPI 2 incidents that involved failure of one or more piece of equipment as a contributing factor.

SPI 4 is a crane or personal/material handling operations incident

SPI 5 is the percentage of planned critical maintenance, inspection and testing (MIT) completed on time. Planned critical MIT deferred with a formal risk assessment and appropriate level of approval is not considered overdue.

SPI 6 is number of work-related fatalities.

SPI 7 is the frequency of days away from work, restricted work, and job-transfer injury and illnesses (DART)

SPI 8 is the frequency of recordable injuries and illnesses (RIIF)

SPI 9 is the frequency of oil spills to water ≥ 1 barrel

As referenced above, SPI 1-5 are based on structured assessments of major hazards facing the offshore industry. SPI 6-9 are indicators that have been reported historically by industry and were not directly related to the assessment work.

There are characteristics of the data reported for SPI 1 and SPI 2 incidents that limit some aspects of the analysis and trending. An incident may have consequences that meet both SPI 1 and SPI 2 definitions but are not counted in both classifications. The higher consequence drives the classification. For example, a collision that results in ≥ $1 million direct damage cost meets the SPI 1E definition, but also meets the SPI 2B consequence of collision resulting in ≥ $25,000 in damage. Yet per the SPI Program structure, it is only counted as an SPI 1E incident and not an SPI 2B collision.

Although definitions used for some of the SPI are the same or similar to regulatory definitions, the numbers in this report will not necessarily match regulatory data due to this report being based on COS member company data and not all companies operating in the US OCS.

4.2 Summary

This report provides COS member data for 2013-17. The data reported for 2017 represents over 37 million operator and contractor work hours in the US OCS which are comparable to 45 million, 61 million, and 69 million reported for 2016, 2015, and 2014, respectively. This is a decrease of over 17% from the hours reported for 2016. Work hours are reported only by Operators for work occurring within 500 meters of their facilities.

Participating members reported 1 **SPI 1** for 2017, as compared to 8 for 2016, and represents the lowest number of SPI 1 reported to COS in the five years of reporting. The reported consequences included a Tier 1 Process Safety Event and ≥ $1 Million Direct Costs from Damage to a Facility, Vessel, or Equipment. No incidents resulting in Fatalities, Five or More Injuries, Level 1 Well Control Incidents, or an Oil Spill ≥ 238 bbl. were reported for 2017.

Participating members also reported 38 **SPI 2** for 2017, as compared to 26 for 2016. The reported consequences included 15 Tier 2 Process Safety Events, 2 Collisions with Damage ≥ $25,000, 16 Incidents involving Mechanical Lifting or Lowering, 1 Loss of Station Keeping Incident Resulting in a Drive Off or Drift Off, and 4 Life Boat, Life Raft, or Rescue Boat Events. No incidents resulting Level 2 Well Control Incidents were reported for 2017.

There were no incidents resulting in **Fatalities**, **Five or More injuries**, **Level 1** or **Level 2 Well Control Incidents**, or an **Oil Spill ≥ 238 bbl**. reported for the 2017 reporting year. SPI 2F Level 2 Well Control Incidents was introduced for the 2015 reporting year; therefore, the frequency for this type of event is only provided for the 2015-2017 reporting years.

The 2017 **Tier 1 PSE** frequency was lower than reported for 2016, returning to approximately 2015 levels. Although there were 4 fewer reported **Tier 2 PSE** for 2017 as compared to 2016, the frequency of Tier 2 PSE is approximately the same for the 2016 and 2017 reporting years. These two years represent the highest reported frequencies in the five years of COS reporting for this type of incident.

There was 1 incident that resulted in **≥ $1 Million Cost (Direct Damage)** reported for the 2017 reporting year. This the lowest frequency in the five years of COS reporting of this type of incident.

There were 16 incidents involving **Mechanical Lifting or Lowering**, which is a significant increase from the 4 reported for the 2016 reporting year. The definition for this safety performance indicator was changed for the 2015 reporting year; therefore, both the frequency and count of these types of incidents are provided for only the 2015-2017 reporting years. The data shown in the first two APR (for the 2013 and 2014 reporting years) have been moved to SPI 4.

The 2 incidents reported for 2017 involving **Collisions with Damage ≥ $25,000** were only the second time such incidents have been reported to COS in the five years of reporting and represent the highest frequency reported in that time frame.

The frequency of incidents involving **Loss of Station Keeping Resulting Drive Off or Drift Off** was approximately the same as for 2016.

Incidents involving **Life Boat, Life Raft, or Rescue Boat Events** trended up for 2017 as compared to 2016. This represents the second highest frequency reported to COS for this type of incident in the five years of reporting.

Of the 39 SPI 1 and SPI 2 incidents reported for 2017, 23 (59%) involved **failure of equipment as a contributing factor**. This represents a continuation of the trend observed last year (38% for 2015, 47% for 2016), and is the second highest percentage reported to COS in the five years of reporting. The largest contributors for 2017 are the "Process Equipment /Pressure Vessels/Piping" category, followed by the "Other" and "Mechanical Lifting Equipment/Personnel Transport Systems" categories. Specific definitions and descriptions of the equipment categories are found in Appendix 3.

There was an increase in the frequency of **incidents involving cranes or personnel/material handling** reported in 2017 as compared to 2016. This represents a ~20% increase in the frequency of this type of incident year-over-year.

Of the 10 Operators which shared **SPI 5 data (critical Maintenance, Inspection, and Testing (MIT) tasks completed as per plan),** the combined average for 2017 was 93.3%, ranging from 80.9% to 100%. This is a decrease from the data reported for 2016 (average 94.8%, ranging from 80.9% to 99.6%), and continues the downward trend for this rate from its high of 99.1% reported for 2014. It is the lowest combined average in the five years of data reported to COS.

Additionally, 5 Contractors shared **SPI 5 MIT data**. The combined average for contractors for 2017 was 97.1%, ranging from 90.2% to 100%, which represents a slight decrease from the data reported for 2016 (average 97.8%, ranging from 93.7% to 100%).

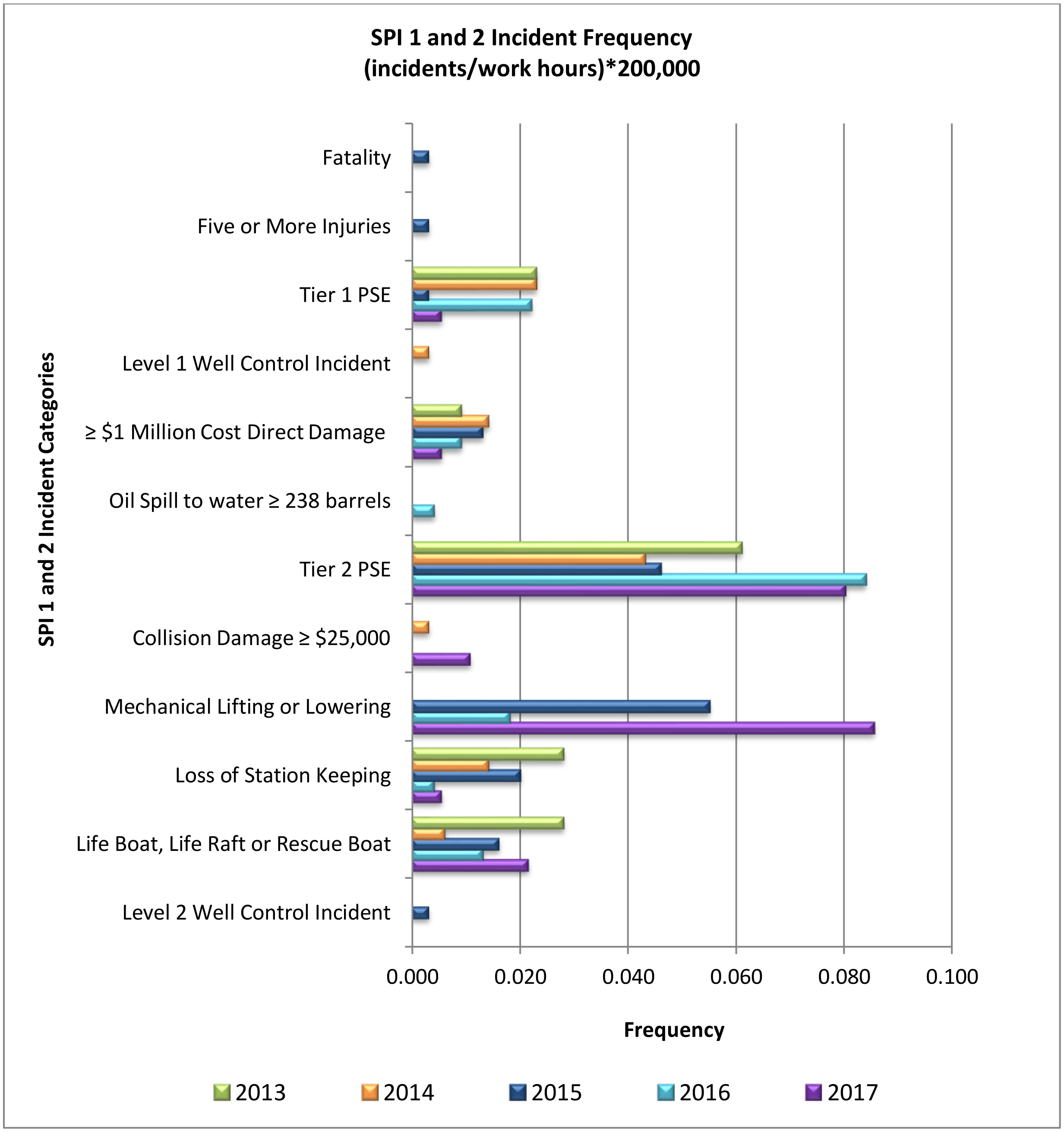
The combined **Days Away from Work, Restricted Work and Transfer of Duty Rate (DART)** reported for 2017 was 0.214, which is an increase as compared to the 0.168 reported for 2016.

The combined 2017 **Recordable Injury and Illness Frequency (RIIF)** reported for 2017 was 0.488, which is an increase as compared to the 0.279 reported in 2016 and represents the first increase in reported RIIF after three years of declining RIIF. The 2017 data is the second highest reported RIIF in the five years of COS reporting.

Two (2) **Oil Spills to Water ≥ One Barrel** were reported by participating COS members, which matches the number reported in 2016. The frequency was 0.011 in 2017, which is a slight increase from the 0.009 reported for 2016.

The frequency of all SPI 1 and SPI 2 incidents are shown below in Figure 4.2; specific definitions for the SPI can be found in Appendix 2.

Figure 4.2: SPI 1 and SPI 2 Frequency

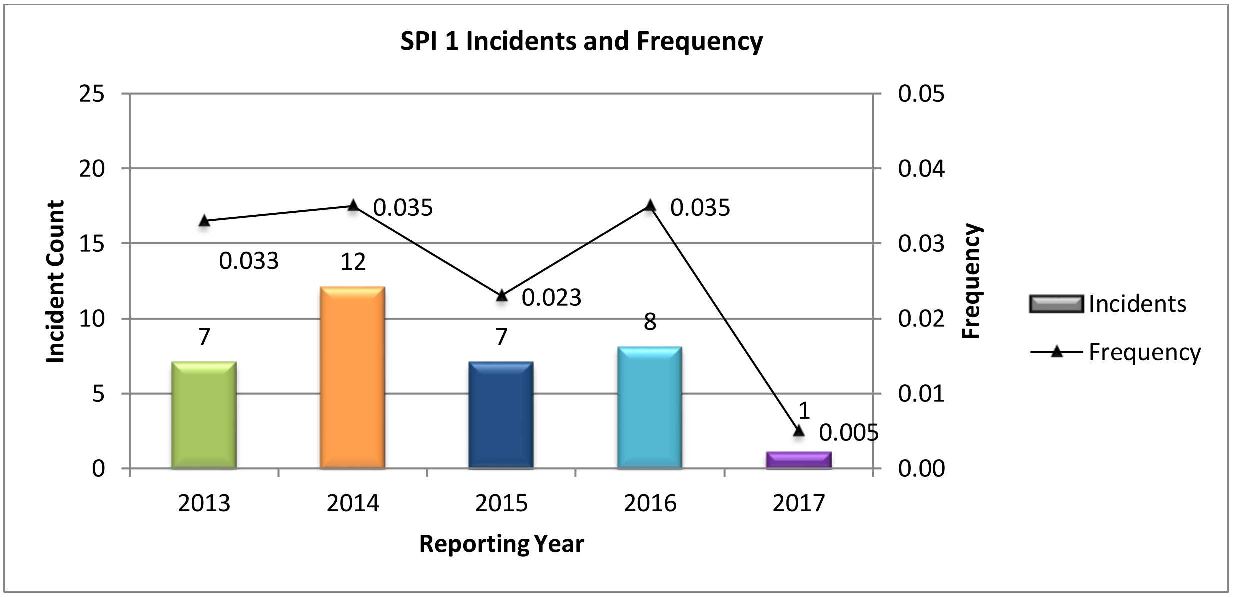


4.3 SPI 1 Results and Trends

SPI 1 is the frequency of incidents that resulted in one or more of the following:

A. Fatality
B. Five or more injuries in a single incident
C. Tier 1 process safety event
D. Level 1 Well Control Incident - Loss of well control
E. ≥ $1 million direct cost from damage to or loss of facility, vessel and/or equipment
F. Oil spill to water ≥ 10,000 gallons (238 barrels)

Figure 4.3: SPI 1 Incident Count and Frequency



- Only 1 SPI 1 incident was reported at a frequency of 0.005 for 2017. This represents a decrease in both the actual number of incidents and the frequency when compared to previous years. This the lowest frequency of SPI 1 incidents in the five years of COS data. Only deepwater (≥ 1000 feet water depth) operations were in scope for 2013.
- The single SPI 1 incident reported for 2017 occurred on or within 500 meters of a facility.

Figure 4.4: SPI 1 Incident Count per Sub Group (Chart)

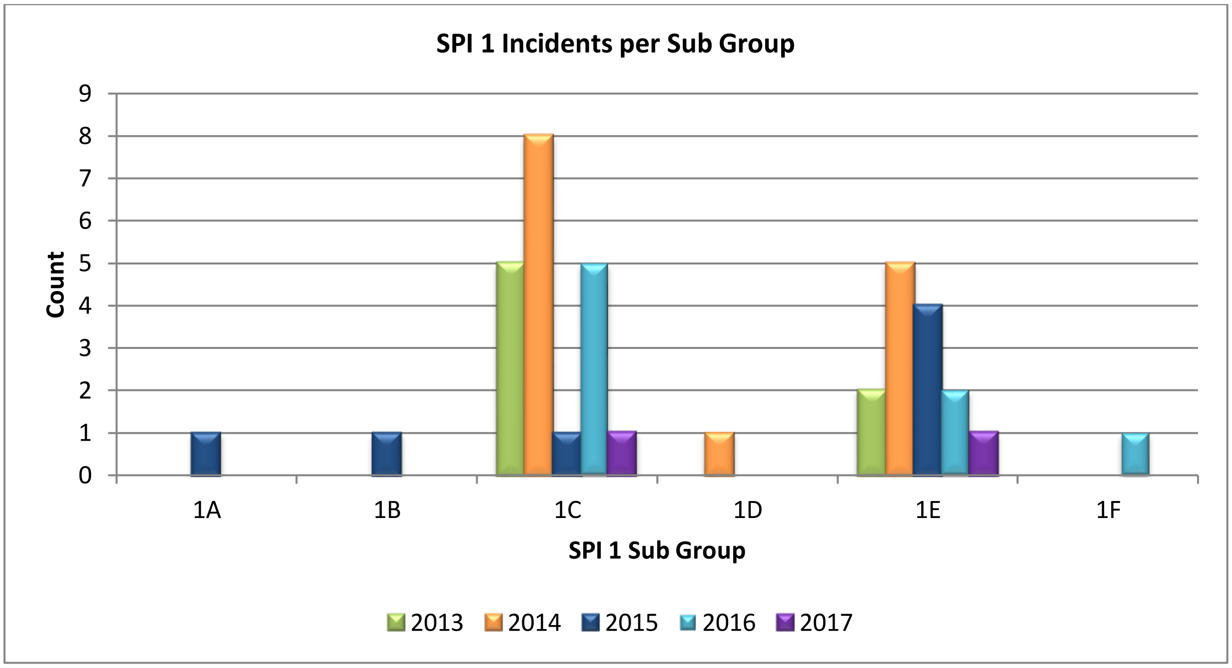
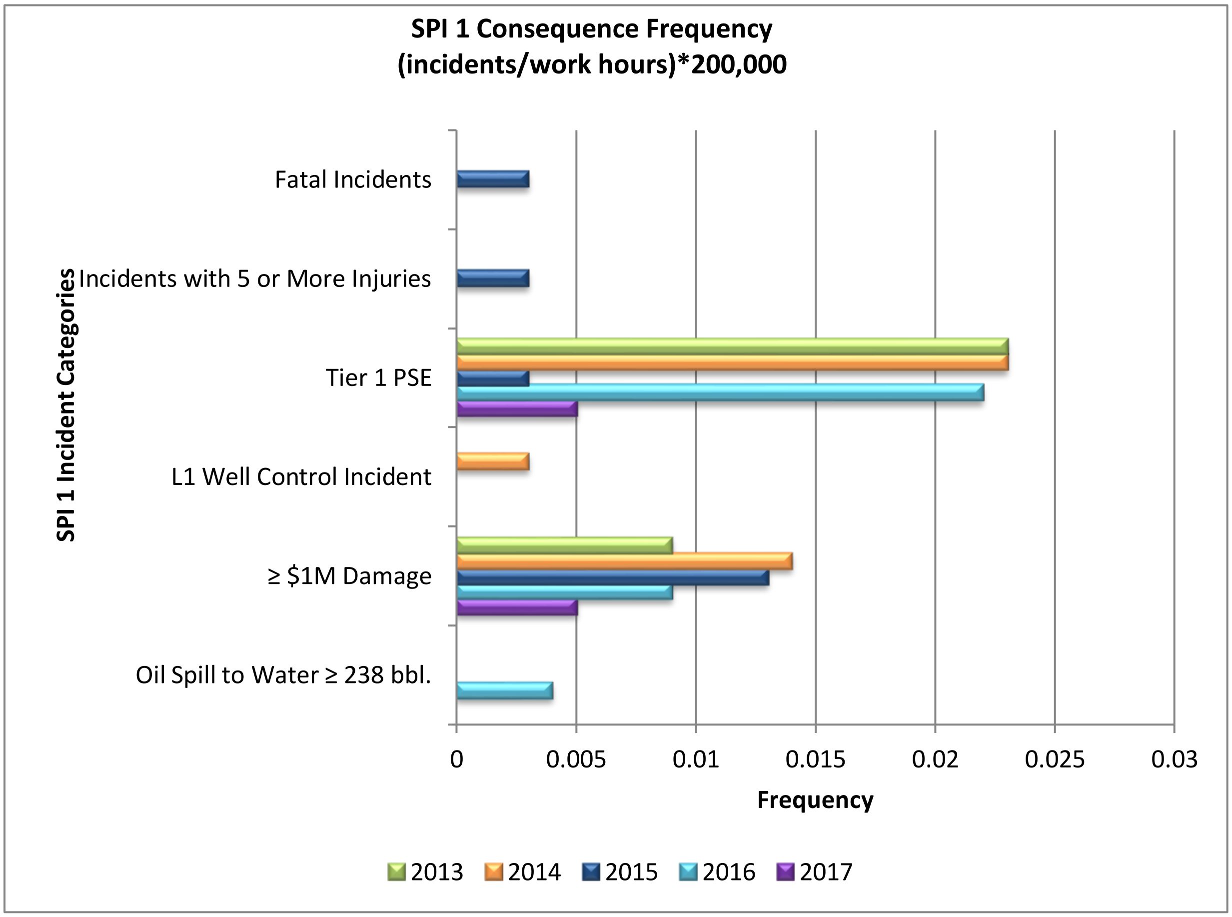


Figure 4.5: SPI 1 Incident Count per Sub Group (Table)

Year	Fatal Incidents (1A)	Incidents with 5 or More Injuries (1B)	Tier 1 PSE (1C)	Level 1 Well Control Incident (1D)	≥ $1MM Direct Damage (1E)	Oil Spill to Water ≥ 238 bbl. (1F)
2013	0	0	5	0	2	0
2014	0	0	8	1	5	0
2015	1	1	1	0	4	0
2016	0	0	5	0	2	1
2017	0	0	1	0	1	0

Note – The total count of SPI consequences shown in the table above for SPI 1A-1F may be greater the total count of SPI 1 incidents, as one incident can have multiple consequences.

Figure 4.6: SPI Incident Frequency per Sub Group



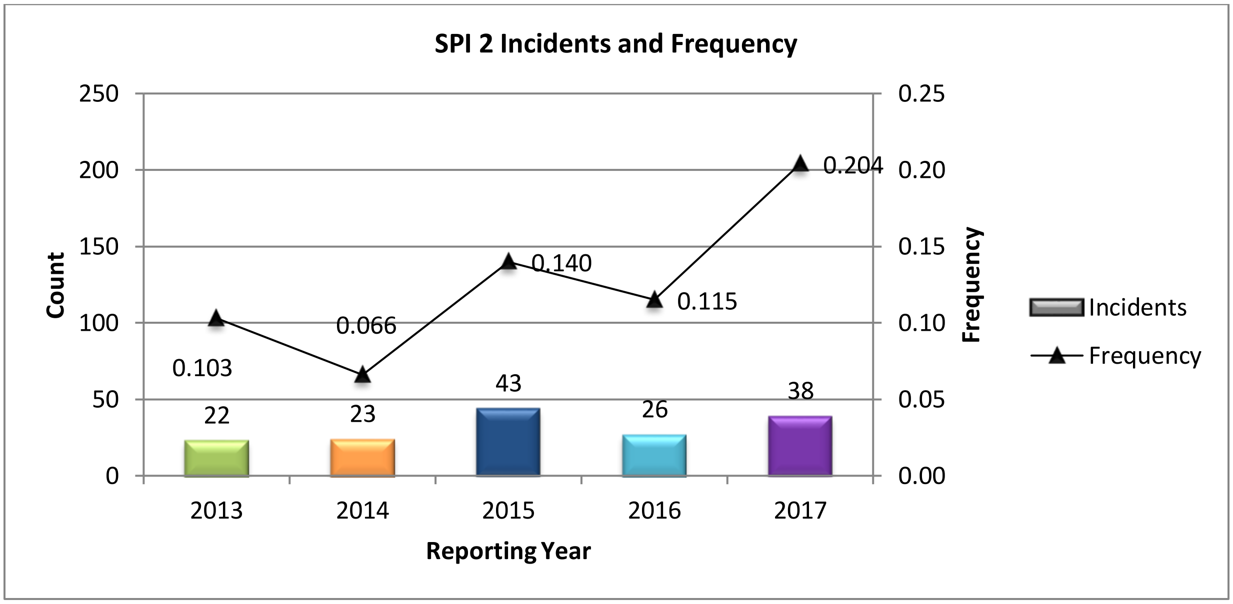
- Overall, 2017 had the lowest frequency of SPI 1 incidents reported.
- No incidents resulting in a Fatality, (1A), in Five or More Injuries, (1B), a Level 1 Well Control Incidents (1D), or an Oil Spill ≥ 238 barrels (1F) were reported for 2017.
- There was 1 SPI 1 incident reported for 2017 that involved a Tier 1 Process Safety Event (1C) and ≥ $1 Million Direct Costs from Damage to or Loss of a Facility, Vessel, or Equipment (1E) for a frequency of 0.005.

4.4 SPI 2 Results and Trends

SPI 2 is the frequency of incidents that do not meet the SPI 1 definition but have resulted in one or more of the following:

A. Tier 2 process safety event
B. Collision resulting in property or equipment damage ≥ $25,000
C. Mechanical Lifting or Lowering Incident
D. Loss of station keeping resulting in a drive off or drift off
E. Life boat, life raft, rescue boat event
F. Level 2 Well Control Incident - Multiple Barrier Systems Failures and Challenges

Figure 4.7: SPI 2 Incident Count and Frequency



Note – The definition of SPI 2C "Incidents involving Mechanical Lifting or Lowering" was modified for reporting years 2015 and beyond to include minimum thresholds to qualify as an SPI 2C. The previous broader definition has been retained as SPI 4.

- A total of 38 SPI 2 incidents were reported for 2017 at a frequency of 0.204. This is an increase from the 0.115 frequency reported for 2016 and is the highest reported frequency for these types of events in the five years of COS data. This increase was largely driven by a significant increase in the number of incidents Involving Mechanical Lifting. Only deepwater (≥1,000 feet water depth) operations were in scope for 2013.
- For 2017, all 38 reported SPI 2 incidents occurred on or within 500 meters of a facility.

Figure 4.8: SPI 2 Incident Count per Sub Group (Chart)

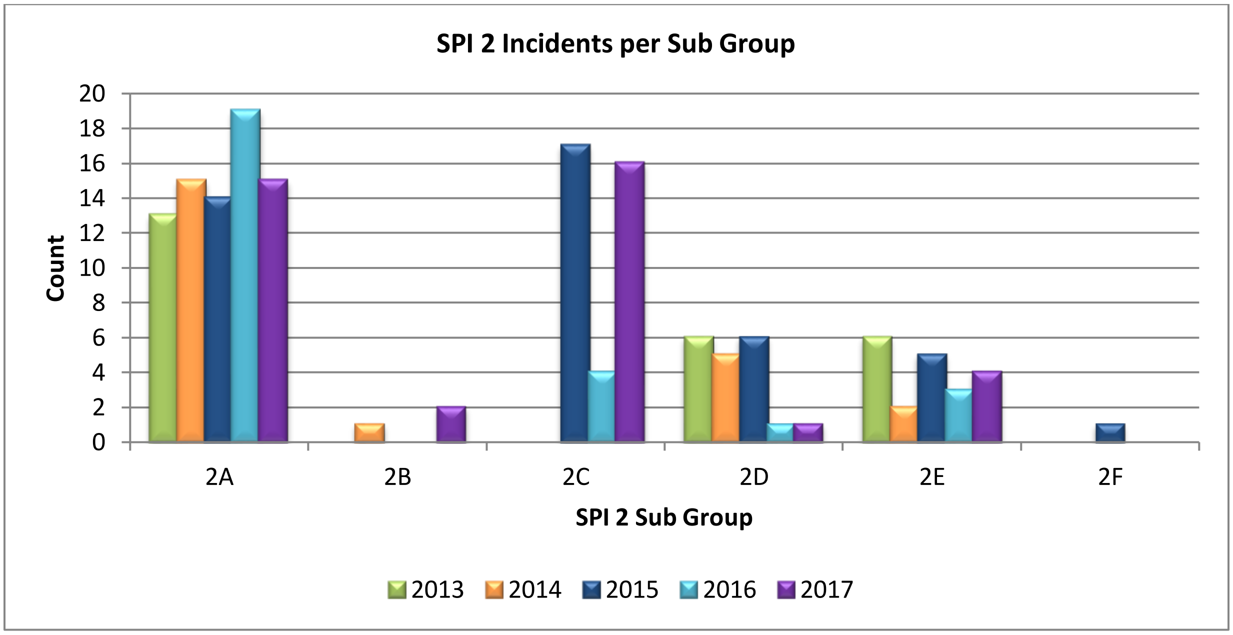
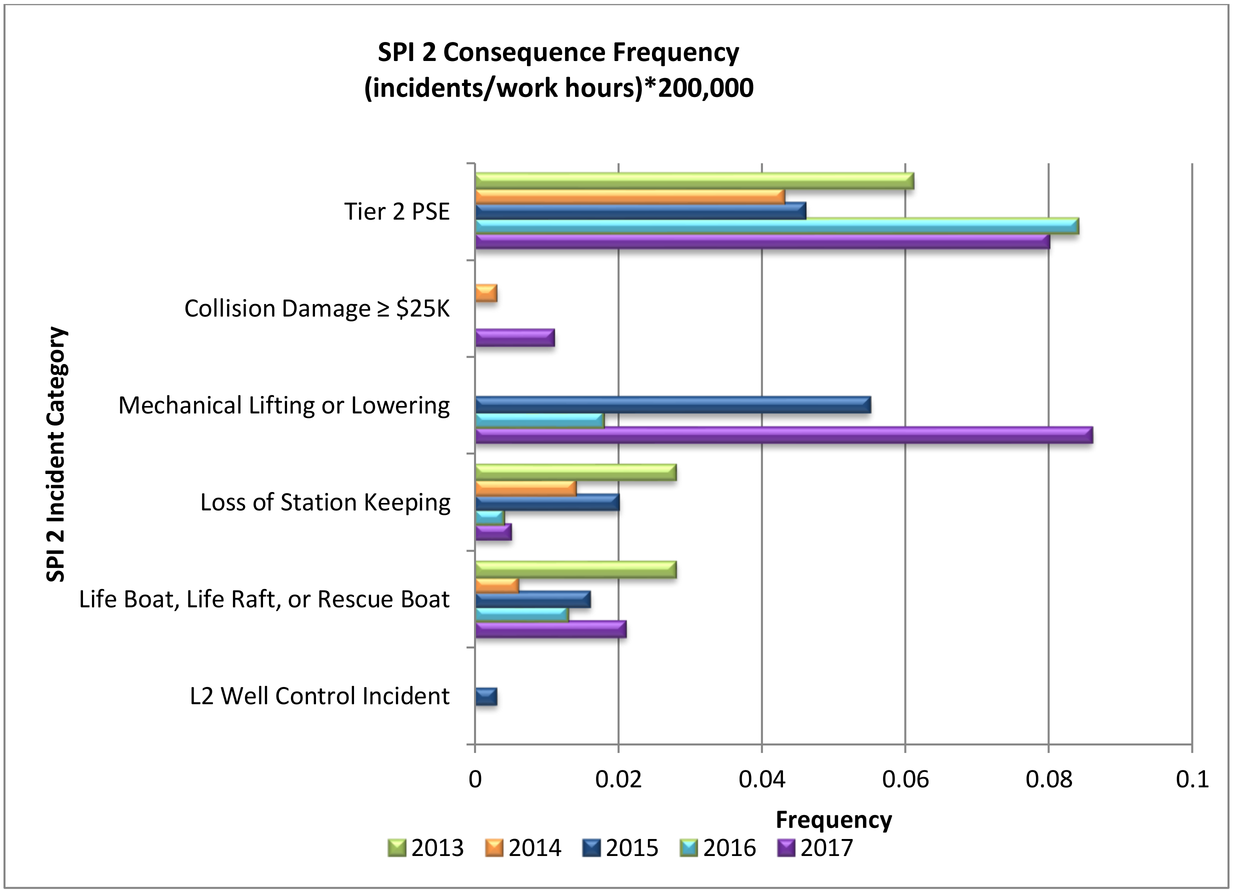


Figure 4.9: SPI 2 Incident Count per Sub Group (Table)

Year	Tier 2 PSE (2A)	Collision ≥ $25,000 (2B)	Mechanical Lifting or Lowering (2C)	Station Keeping (2D)	Life Boat, Life Raft, or Rescue Boat (2E)	Level 2 Well Control Incident (2F)
2013	13	0	NA	6	6	NA
2014	15	1	NA	5	2	NA
2015	14	0	17	6	5	1
2016	19	0	4	1	3	0
2017	15	2	16	1	4	0

Note – The total count of SPI consequences shown in the table above for SPI 2A-2F may be greater the total count of SPI 2 incidents, as one incident can have multiple consequences.

Figure 4.10: SPI 2 Incident Frequency per Sub Group



- No incidents involving Level 2 Well Control Incidents (2F) were reported for 2017. SPI 2F Level 2 Well Control Incidents was introduced for the 2015 reporting year; therefore, the frequency for these types of events is only provided for the 2015-2017 reporting years.
- There were 15 Tier 2 Process Safety Events (2A) reported for 2017, for a frequency of 0.080. This is close to the frequency of 0.084 reported for 2016 and is the second highest reported frequency for this type of event in the five years of COS data.
- There were 2 incidents reported for 2017 involving Collisions with Damage $\geq$ $25,000 (2B), only the second time such incidents have been reported to COS in the five years of reporting, for a frequency of 0.011. This is the highest frequency for this type of event reported in that time frame.
- There were 16 Incidents involving Mechanical Lifting or Lowering (2C) for a frequency of 0.86. Although there were a similar number of incidents reported for 2015 (17), the frequency of SPI 2C events is the highest reported frequency in the three years of COS data for this type of event due to reduction in total work hours reported. The definition for this safety performance indicator was changed for the 2015 reporting year; therefore, both the count and frequency of these types of incidents is provided for only the 2015-2017 reporting years. The data shown in the first two COS Annual Performance Reports (for the 2013 and 2014 reporting years) have been moved to SPI 4.
- There was 1 incident involving Loss of Station Keeping Resulting in Drive Off or Drift Off (2D) reported for 2017 for a frequency of 0.005; this equals the lowest frequency reported to COS (2016) in the five years of reporting.

- There were 4 incidents reported involving Life Boat, Life Raft, or Rescue Boat Event (2E) for a frequency of 0.021, which represents an increase in the frequency as compared to 2016. This is the second highest frequency reported for this type of event in the five years of COS data.

4.4.1 Tier 1 and Tier 2 Process Safety Event Consequences

Tier 1 and Tier 2 PSE are determined by assessing the consequences of a loss of primary containment (LOPC) event against defined thresholds (see Appendix 2). If it meets or exceeds a threshold, then it is classified as either a Tier 1 PSE or a Tier 2 PSE, but not both. In 2014, participating COS members began sharing consequence data for reported Tier 1 and Tier 2 PSE. PSE consequence data reported for 2017 is presented below.

Consequence data was collected for the 1 Tier 1 PSE shared for 2017, with the following consequences:

- Days Away from Work Injury
- Fire (≥$100,000 Direct Cost Damage)
- Explosion (≥$100,000 Direct Cost Damage)
- Release of Non-Toxic Materials
- Outdoor Release

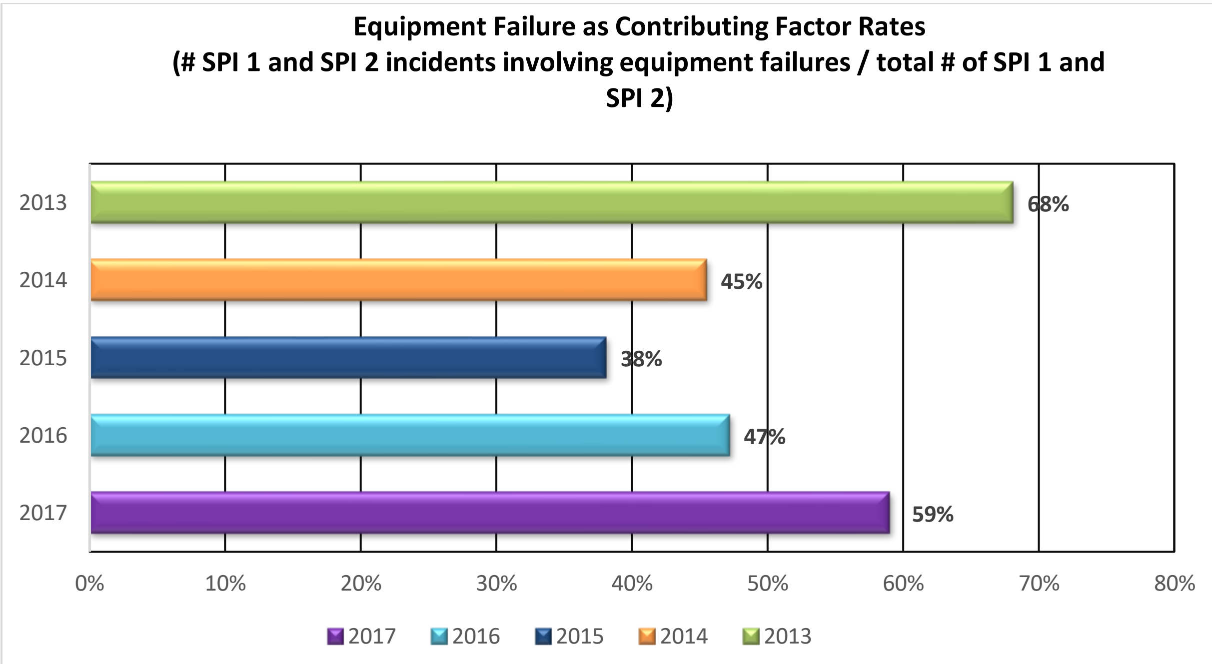
Consequence data was collected for 10 of the 15 Tier 2 PSE reported for 2017, with the following consequences:

- 1 – Fire ($2,500 to $100,000 Direct Damage Costs)
- 5 – Non-Toxic Material Release
- 2 – Indoor Release
- 7 – Outdoor Release
- The type of material released was not reported for 5 of the Tier 2 PSE
- The location (i.e. indoor, outdoor) of the release was not reported for 8 of the reported Tier 2 PSE

4.5 SPI 3 Results and Trends

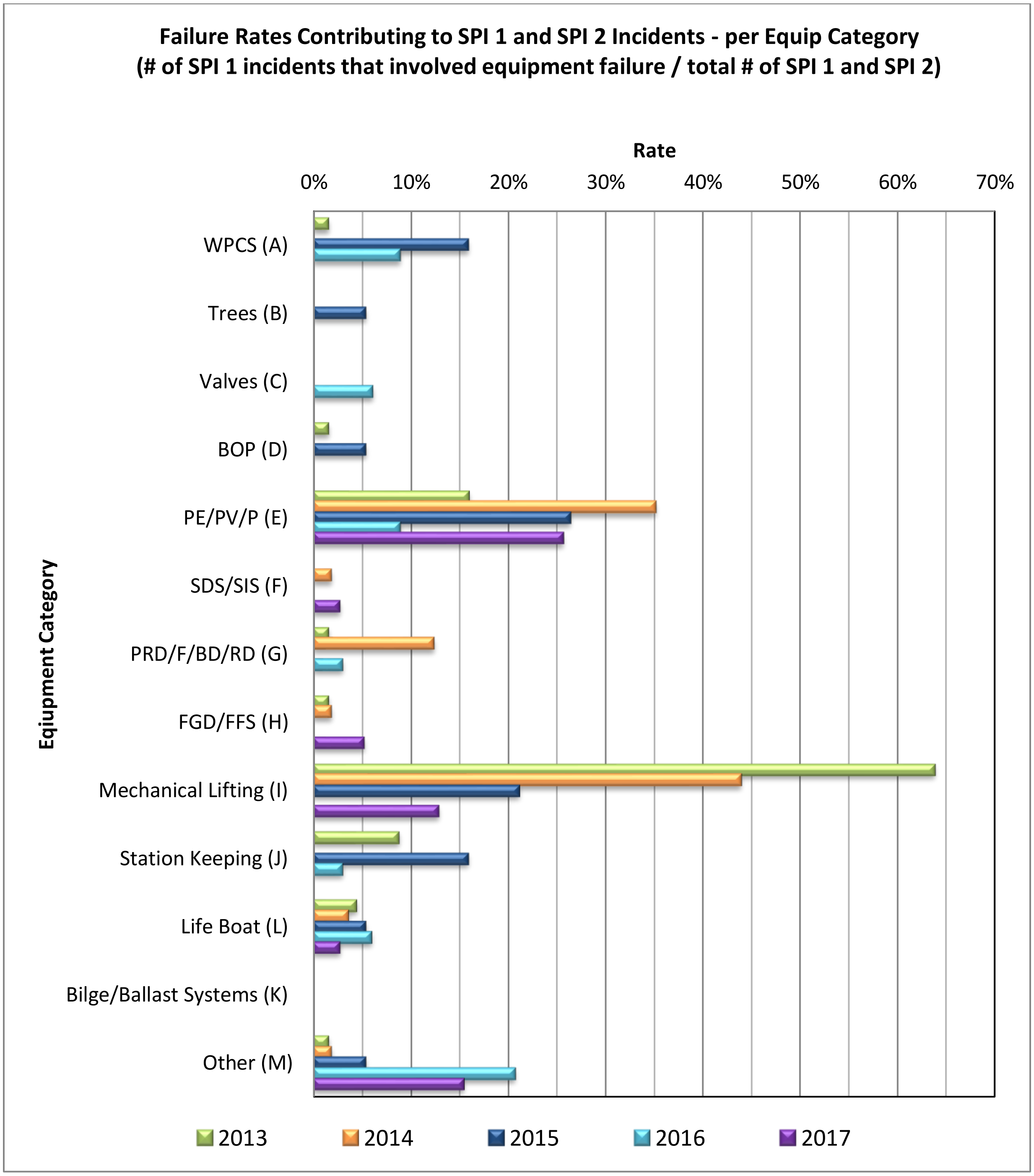
SPI 3 is the number of SPI 1 and SPI 2 incidents that involved failure of one or more piece of equipment as a contributing factor.

Figure 4.11: Equipment Failure as Contributing Factor Rates



- 23 of the 39 (59%) SPI 1 and SPI 2 incidents reported for 2017 involved failure of equipment as a contributing factor. This represents an upward trend from the 38% reported for 2015 and 47% reported for 2016.

Figure 4.12 SPI 3 Failure Rates Contributing to SPI 1 and SPI 2 Incidents – per Equipment Category



- 26% (10 of 39) of SPI 1 and SPI 2 incidents reported for 2017 involved "Process Equipment / Pressure Vessels / Piping" equipment failure as a contributing factor, which represents an increase from the 9% reported for 2016. This was the most frequently picked equipment category reported for 2017.
- 15% (6 of 39) of SPI 1 and SPI 2 incidents reported for 2017 involved "Other" equipment, which represents a decrease from the 21% (7 of 34) reported for 2016.
- 13% (5 of 39) of SPI 1 and SPI 2 incidents reported for 2017 involved "Mechanical Lifting and Lowering Equipment". This is an increase from the 0% reported for 2016 but is lower than the 21%

reported for 2015. Due to the changes in the definition of SPI 2C, only data from the 2015 reporting year onwards is comparable.

- 5% (2 of 39) of SPI 1 and SPI 2 incidents reported for 2017 involved "Fire/Gas Detection and Fire Fighting Systems" equipment. This was the first time this type of equipment has been reported as a contributing cause in three years.
- 3% (1 of 39) of SPI 1 and SPI 2 incidents reported for 2017 involved "Shutdown Systems / Automated Safety Instrumented Systems" equipment. This is only the second time this category has been reported as a contributing cause to an incident in the five years of COS data.

Figure 4.13: SPI 3 Incident Counts by Equipment Type

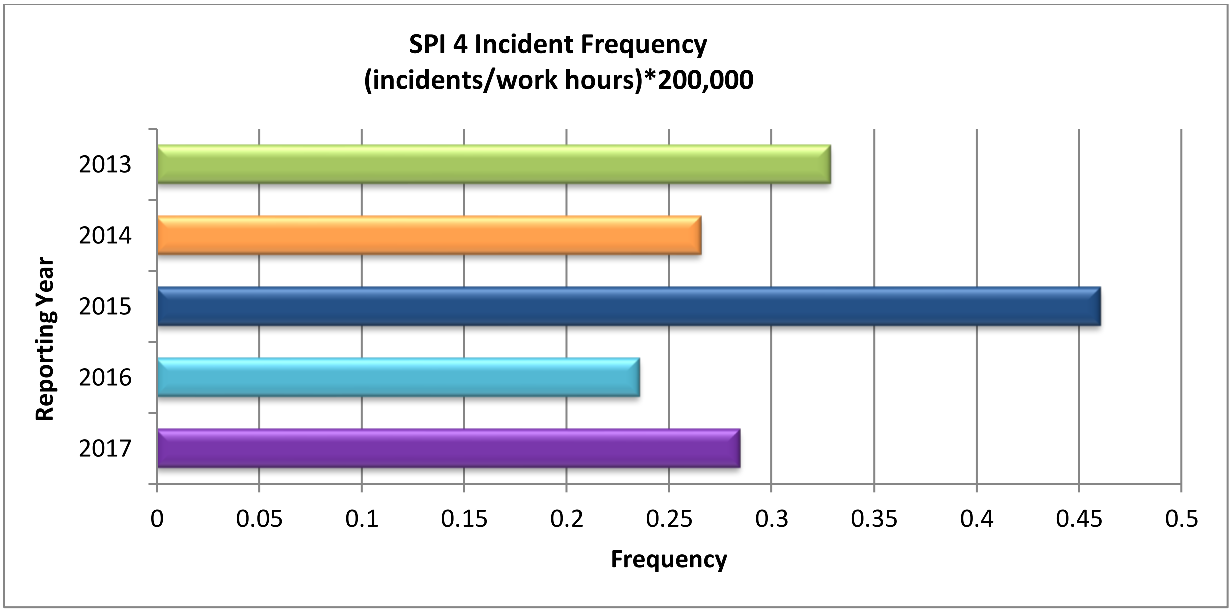
Equipment	2013 Failures (Count)	2014 Failures (Count)	2015 Failures (Count)	2016 Failures (Count)	2017 Failures (Count)
A - Well Pressure Containment System (WPCS)	1	0	3	3	0
B - Christmas Trees	0	0	1	0	0
C - Downhole Safety Valves (Valves)	0	0	0	2	0
D - Blowout Preventers and Intervention Systems (BOP)	1	0	1	0	0
E - Process Equipment/Pressure Vessels/Piping (PE/PV/P)	11	20	5	3	10
F - Shutdown Systems/Automated Safety Instrumented Systems (SDS/SIS)	0	1	0	0	1
G - Pressure Relief Devices/Flares/Blowdown/Rupture Disks (PRD/F/B/RD)	1	7	0	1	0
H - Fire/Gas Detection and Fire Fighting Systems (FGD/FFS)	1	1	0	0	2
I - Mechanical Lifting Equipment/Personnel Transport Systems	44	25	4	0	5
J - Station Keeping Systems	6	0	3	1	0
K - Bilge/Ballast Systems	0	0	0	0	0
L - Life Boat/Life Raft/Rescue Boat/Launch and Recovery Systems	3	2	1	2	1
M - Other	1	1	1	7	6

Note – The total count of SPI 3 equipment categories in the table above may be greater the total percentage of SPI 3 reported, as one incident can have multiple types of equipment fail.

4.6 SPI 4 Results and Trends

SPI 4 is the frequency of crane or personnel/material handling operations incidents.

Figure 4.14: SPI 4 Crane or Personnel / Material Handling Frequency



- This SPI is the previous (reporting years 2013 and 2014) SPI 2C data that has been moved to a new SPI 4 category with no change in definition.
- The incident frequency for 2017 was 0.284, which represents a ~20% increase from the 2016 frequency of 0.235. The lower frequency in 2016 (despite the same number of reported incidents) is due to the higher number of work hours reported for 2016.

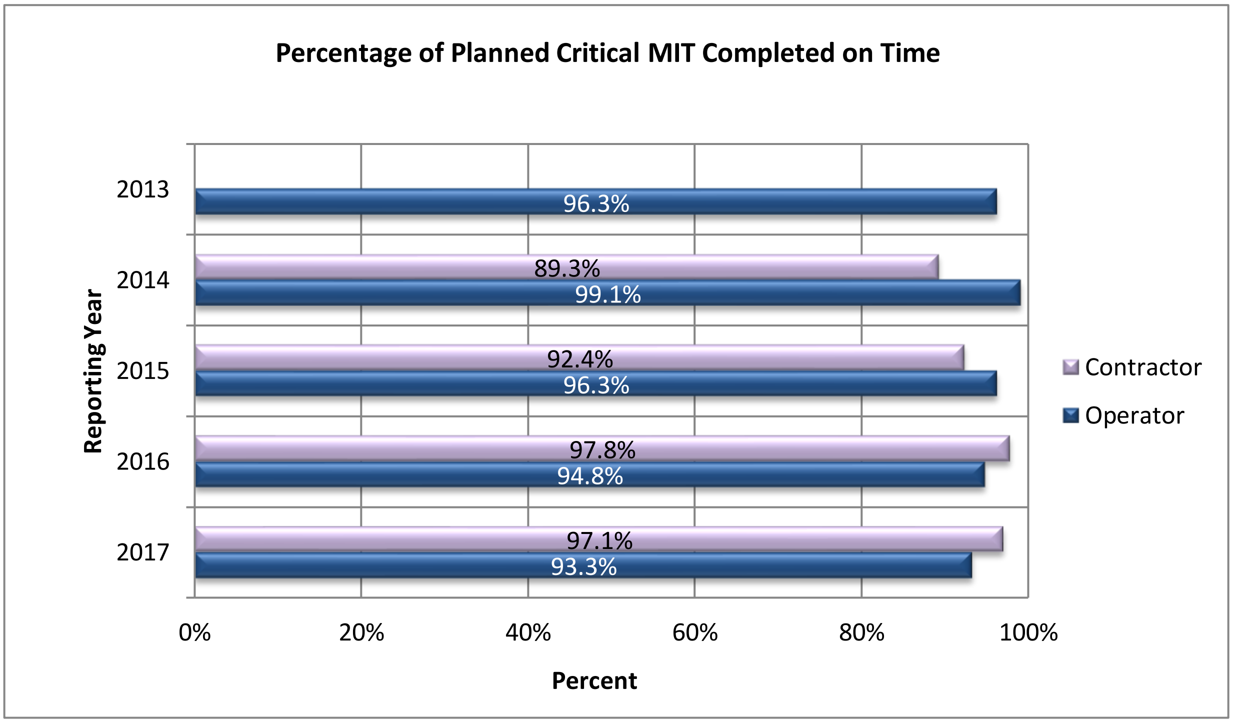
Figure 4.15: SPI 4 Crane or Personnel / Material Handling Count and Rate

	2013	2014	2015	2016	2017
Count	70	82	108	53	53
Rate	0.328	0.265	0.460	0.235	0.284

4.7 SPI 5 Results and Trends

SPI 5 is the percentage of planned critical maintenance, inspection and testing (MIT) completed on time. Planned critical MIT deferred with a formal risk assessment and appropriate level of approval is not considered overdue.

Figure 4.16: Percentage of Planned Tasks Complete per Plan



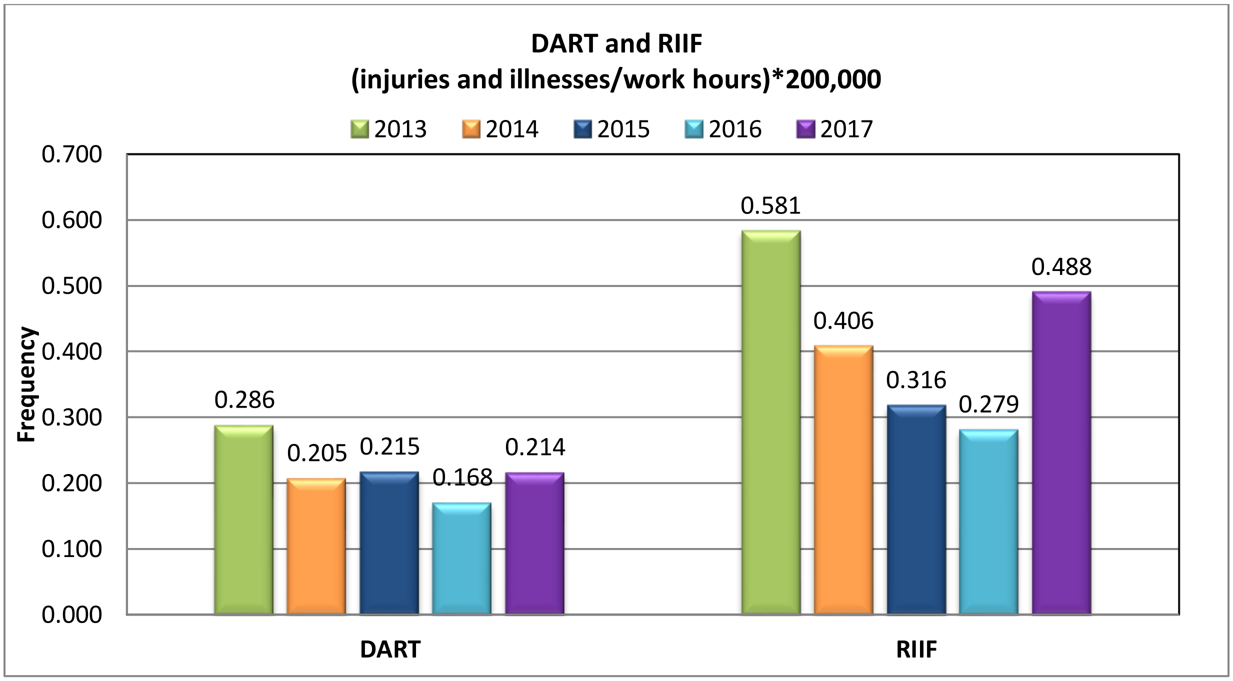
Note – Contractors data not reported for 2013

- Of the 10 Operators which shared SPI 5 data, the combined average for 2017 was 93.3%, ranging from 80.9% to 100%. This is a decrease from the data reported for 2016 (average 94.8%, ranging from 80.9% to 99.6%), and continues the downward trend for this rate from its high of 99.1% reported for 2014. It is the lowest combined average in the five years of data reported to COS.
- Of the 5 Contractors which shared SPI 5 data, the combined average for 2017 was 97.1%, ranging from 90.2% to 100%. This is comparable to data reported for 2016 (average 97.8%, ranging from 93.7% to 100%), and represents the second highest percentage reported to COS in the four years of collecting this data. Contractors were not asked to report SPI 5 in 2013.
- Overall SPI 5 data, when combined for Contractors and Operators, was 94.7% for 2017, which represents a decrease from the average of 97.4% for 2016 and the 95.1% for 2015. It is the same as the 94.7% average reported for 2014.
- Note – each company defines what maintenance, inspection and testing tasks qualify as “critical”.

4.8 SPI 6-9 Results and Trends

- SPI 6 is number of work-related fatalities
- SPI 7 is the frequency of days away from work, restricted work, and job-transfer injuries and illnesses (DART)
- SPI 8 is the frequency of recordable injuries and illnesses (RIIF)
- SPI 9 is the frequency of oil spills to water ≥ 1 barrel

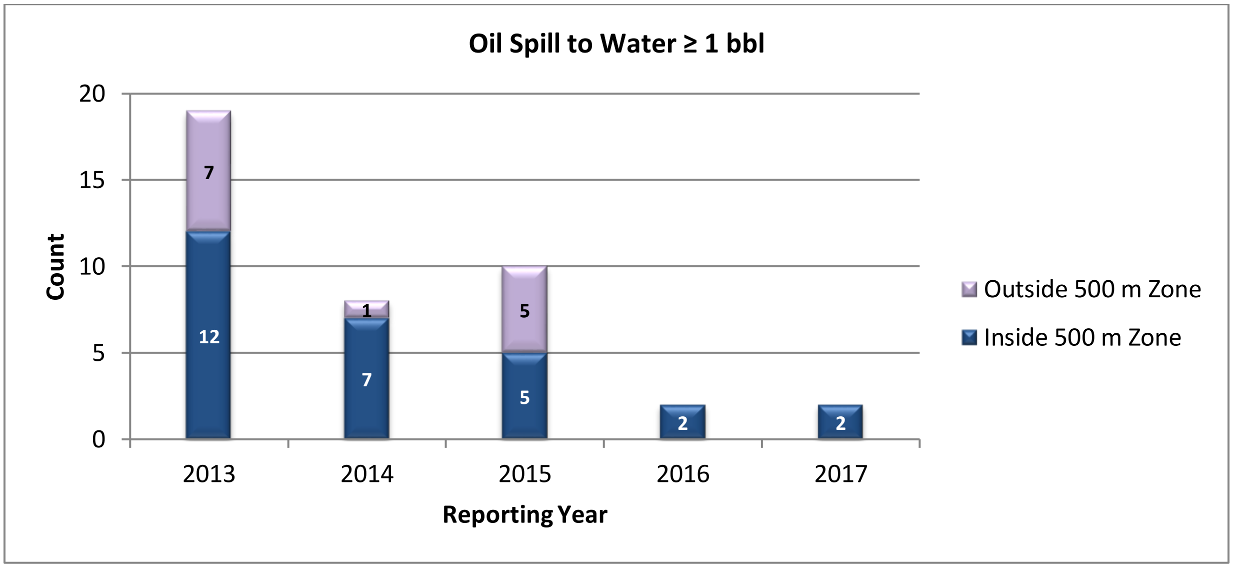
Figure 4.17: SPI DART and RIIF Chart[1]



- No fatalities (SPI 6) were reported for 2017. One fatality has been reported to COS in the five years of reporting.
- The combined Days Away from Work, Restricted Work, and Transfer of Duty Frequency (DART) (SPI 7) reported for 2017 was 0.214, which is an increase from the 0.168 reported for 2016.
- The combined Recordable Injury and Illness Frequency (RIIF) (SPI 8) reported for 2017 was 0.488, which is a significant increase from the 0.279 reported for 2016 and represents an increase in this indicator for the first time since 2013. This is the second highest RIIF reported to COS in the in the five years of reporting.

[1] NOTE – Although all 10 operators submitted both DART and RIIF data, the chart only reflects the data from 9 operators. There was an unresolved discrepancy in one operator's data where the RIIF was lower than the DART, which is an impossibility (as all DART are also RIIF). Including this data would not change the rates significantly and do not affect the conclusions in this report.

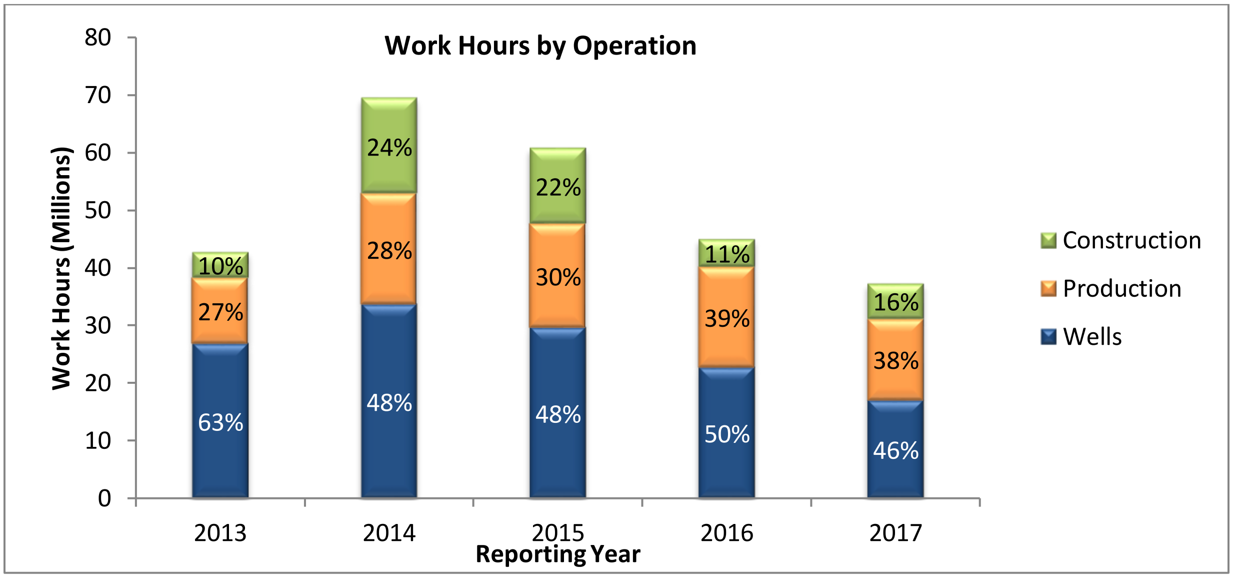
Figure 4.18: Oil Spill to Water Count



- 2 Oil Spills to Water ≥ One Barrel (SPI 9) were reported by participating COS members for 2017, both within the 500 m zone. This is identical to what was reported for 2016. The frequency of the Oil Spill to Water ≥ One Barrel was 0.011 for 2017.

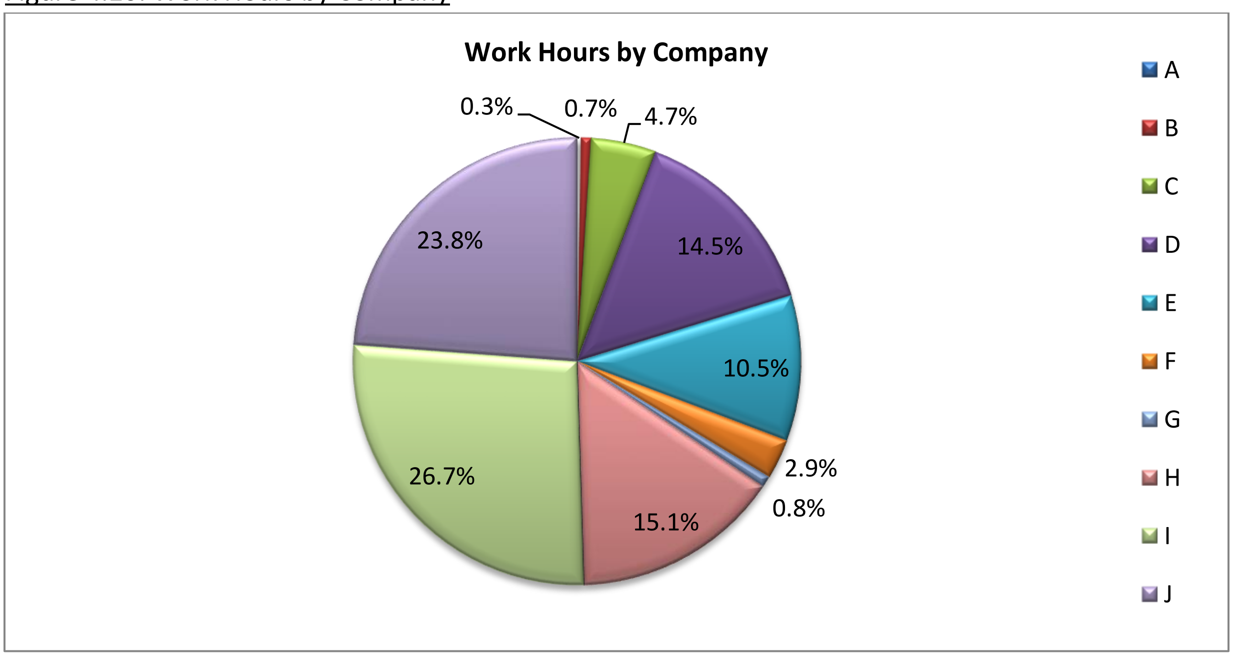
4.9 Normalization Factor (Work Hours)

Figure 4.19: Work Hours by Operation Type



- The scope of the COS SPIP expanded in 2014 to all of the US OCS vs. deepwater only for 2013.
- 37,315,347 work hours were reported for 2017, continuing the trend of decreasing work hours being reported.
- Work hours are reported only by Operators for work occurring within 500 meters of their facilities and include both Operator and Contractor work hours.

Figure 4.20: Work Hours by Company



- Two operators reported 50.5% of the work hours reported for 2017.
- To maintain data confidentiality, letters used to designate member companies are uniquely assigned for individual companies.

5.0 LEARNING FROM INCIDENTS AND HIGH-VALUE LEARNING EVENTS

5.1 Introduction

The Learning from Incidents and Events (LFI) Program was established to provide a means for COS members to share and learn from incidents and High Value Learning Events (HVLE) that occur in offshore operations. Reporting is voluntary and data confidentiality is maintained through a process administered by a 3rd-party before submittal to COS.

The LFI section of this report provides an analysis and comparison of the SPI 1, SPI 2, and HVLE LFI data submitted for reporting years 2013 to 2017 and includes learnings that can be shared within companies to potentially prevent recurrence of similar or more severe incidents.

The data are comprised of the reported learnings from SPI 1 and SPI 2 incidents, as well as those from HVLE. A summary of the definitions for SPI 1, SPI 2, and HVLE can be found in Figure 5.1 below.

Figure 5.1: Description of SPI 1, SPI 2 and HVLE

SPI 1 is the frequency of incidents that resulted in one or more of the following:

A. Fatality
B. Five or more injuries in a single incident
C. Tier 1 process safety event
D. Level 1 Well Control Incident - Loss of well control
E. ≥ $1 million direct cost from damage to or loss of facility / vessel / equipment
F. Oil spill to water ≥ 10,000 gallons (238 barrels)

SPI 2 is the frequency of incidents that do not meet the SPI 1 definition but have resulted in one or more of the following:

A. Tier 2 process safety event
B. Collision resulting in property or equipment damage ≥ $25,000
C. Mechanical Lifting or Lowering Incident
D. Loss of station keeping resulting in drive off or drift off
E. Life boat, life raft, rescue boat event
F. Level 2 Well Control Incident - Multiple Barrier Systems Failures and Challenges

HVLE is an event that may be considered by a COS member or the industry for use as a reference in process hazard analyses, management of change, project design, risk assessment, inspection, operating procedures review and / or training.

The submitted data include 3 key fields:

- **Description of the Incident or HVLE**: A brief explanation of activities, conditions, and acts leading up to, during and after the incident or HVLE, including sufficient details to facilitate clear understanding.
- **Areas for Improvement**: A selection of pre-determined general categories and subcategories. Submitters had the option to add comments to provide further clarity and content.
- **Lessons Learned**: Companies outlined their incident investigation conclusions with the goal being to reduce the likelihood of similar incidents

Within the Areas for Improvement (AFI) fields, submitters choose from three general categories and 15 sub-categories. Multiple AFI can be selected for a single incident or event. The three general categories are:

- **Physical Facility, Equipment, and Process**: Enhancements in the quality of the physical process and equipment design, layout, material specification, fabrication, or construction were highlighted for improvement
- **Administrative Processes**: Enhancements in the quality, scope or structure of administrative processes for managing various aspects of work execution were highlighted for improvement
- **People**: Enhancements to the personnel actions linked to the execution of work tasks were highlighted for improvement

5.2 Summary

The effectiveness of this program is dependent on active participation by COS members to facilitate maximum learning opportunities through:

- Timely sharing of quality information from incidents and HVLE that meet the reporting criteria; and
- Reviewing submitted incidents and HVLE, along with other data in this report, to identify and implement applicable learnings appropriate to different levels and functions within their own organizations.

The LFI data presented in this report includes information from 53 LFI submittals received for the 2017 reporting year, with 45 of the reported incidents and HVLE occurring in the US and 8 at international locations (refer to Figures 5.2 and 5.3 below). Of the 45 US events, 31 occurred in water depths $\geq$ 1,000 feet, 2 in water depths < 1,000 feet, and 12 at a US Onshore/State Waters facility. To support COS' mission to promote the highest level of safety for the US offshore oil and natural gas industry, the findings presented in this report are focused on incidents and events that occurred in the US OCS. A separate section discussing data associated with incidents outside the US OCS (International and US Onshore/State Waters) is provided in this report.

Figure 5.2: Incident Location (All Submittals)

Location	2013	2014	2015	2016	2017	TOTAL
US OCS	46	51	47	43	33	**220**
US Onshore / State Waters*	0	0	2	1	12	**15**
International	2	1	0	17	8	**28**
TOTAL	**48**	**52**	**49**	**61**	**53**	**263**

** Note – The US Onshore/State Waters category is new for 2017 data reporting. US Onshore/State Waters statistics for prior years were generated from submittal content.*

Figure 5.3: Incident Category Distribution per Submittal Type (US OCS Only)

Year	2013	2014	2015	2016	2017	TOTAL
COS SPI 1	2	5	7	5	0	**19**
COS SPI 2*	38	38	21	17	8	**122**
HVLE	6	8	19	21	25	**79**
TOTAL	**46**	**51**	**47**	**43**	**33**	**220**

**Note – The definition of SPI 2C "Incidents involving Mechanical Lifting or Lowering" was modified for reporting years 2015 and beyond to include minimum thresholds to qualify as an SPI 2C. The previous broader definition has been retained as SPI 4.*

A review of the 2017 reporting year incident and event data resulted in the identification of multiple learning opportunities related to the following topics:

- Mechanical Lifting or Lowering
- Loss of Primary Containment (LOPC) (Process Safety and Non-Process Safety Release Events)
- Maintenance, Inspection and Testing

For this year's report, LOPC was identified as a broader category to include both Process Safety and Non-Process Safety release events. Maintenance, Inspection and Testing was noted in 2016, and continues as a focus topic in 2017. In addition to the topics mentioned above, there were other key learnings captured from all LFI data of the top three Areas for Improvement (AFI) identified for 2017:

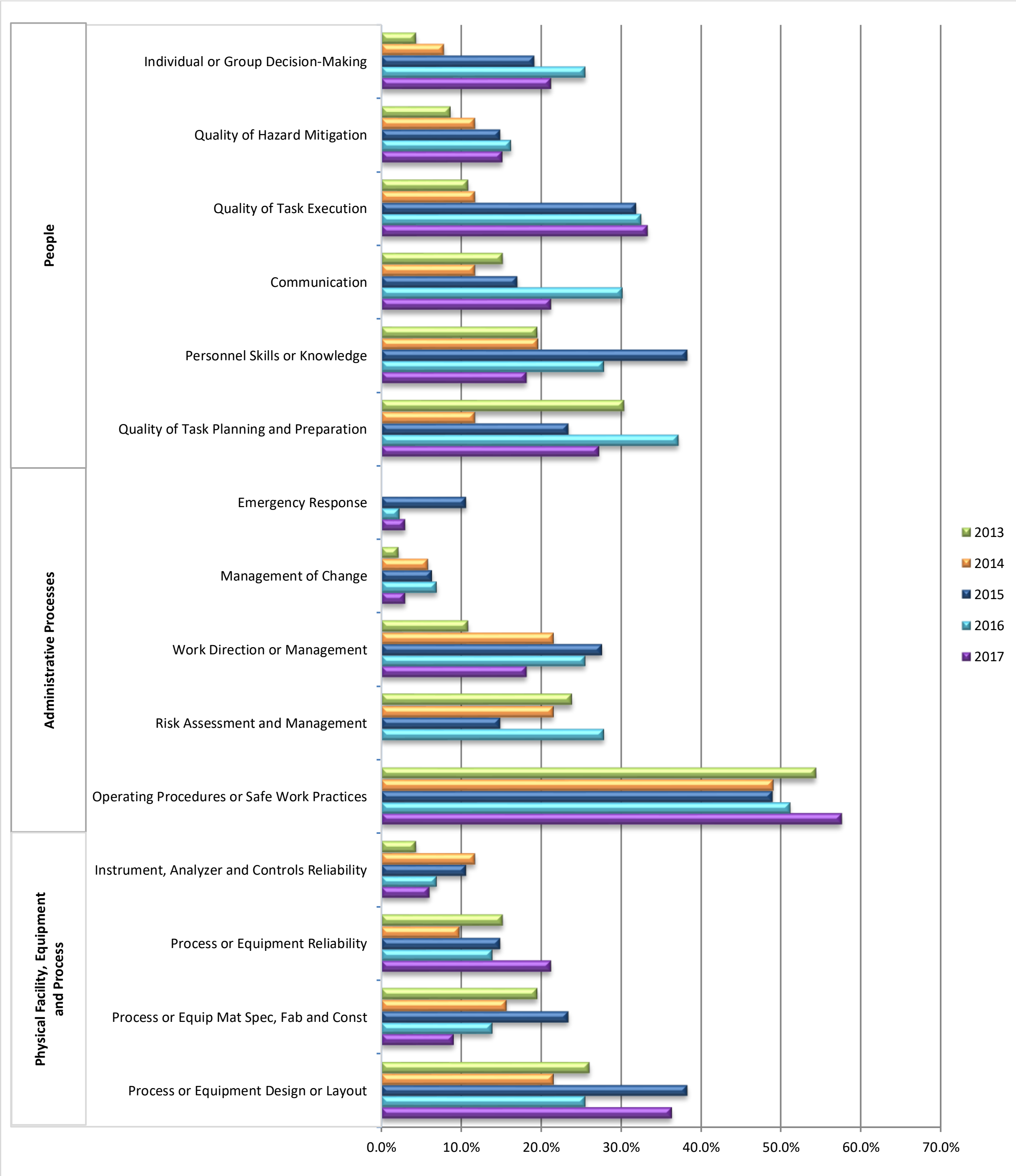
- Operating Procedures or Safe Work Practices,
- Process or Equipment Design or Layout, and
- Quality of Task Execution

Across all 5 reporting years, Operating Procedures or Safe Work Practices was the most frequently identified AFI, as shown in Figures 5.4 and 5.5 below.

Figure 5.4: Area for Improvement Distribution (US OCS Only, Table)

Area for Improvement	2013	2014	2015	2016	2017	5-yr Avg (%)
Operating Procedures or Safe Work Practices	25 (54%)	25 (49%)	23 (49%)	22 (51%)	19 (58%)	**52**
Process or Equipment Design or Layout	12 (26%)	11 (22%)	18 (38%)	11 (26%)	12 (36%)	**30**
Quality of Task Execution	5 (11%)	6 (12%)	15 (32%)	14 (33%)	11 (33%)	**24**
Quality of Task Planning and Preparation	14 (30%)	6 (12%)	11 (23%)	16 (37%)	9 (27%)	**26**
Communication	7 (15%)	6 (12%)	8 (17%)	13 (30%)	7 (21%)	**22**
Personnel Skills or Knowledge	9 (20%)	10 (20%)	18 (38%)	12 (28%)	6 (18%)	**25**
Risk Assessment and Management	11 (24%)	11 (22%)	7 (15%)	12 (28%)	0 (0%)	**18**

Figure 5.5: Areas for Improvement Distribution (US OCS only, Chart)



NOTE - LFI submittals typically identified more than one AFI. The graph above illustrates the percent of times an AFI was identified relative to the number of LFI forms submitted for US OCS events (46 in 2013, 51 in 2014, 47 in 2015, 43 in 2016, and 33 in 2017). Because the number of AFI exceeds the number of LFI forms, the sum of the percentages will be > 100%.

For 2017, the largest changes in AFI selection from the prior reporting year were:

- Process or Equipment Design or Layout increased from 26% to 36%
- Risk Assessment and Management decreased from 28% to 0%
- Quality of Task Planning decreased from 37% to 27%
- Personnel Skills or Knowledge decreased from 28% to 18%
- Communication decreased from 30% to 21%

5.3 2017 Learnings

A review of the 2017 reporting year LFI data resulted in the identification of learning opportunities related to the following topics:

- Mechanical Lifting or Lowering
- Loss of Primary Containment (Process Safety and Non-Process Safety Release Events)
- Maintenance, Inspection and Testing

5.3.1 Mechanical Lifting or Lowering

A total of 9 Mechanical Lifting or Lowering LFI forms were reported for 2017, matching the number reported for 2016. While the relative percentage of these events is lower than the prior 3 years (2013-2015), this activity continues to represent a high percentage of overall activities identified. Operating Procedures or Safe Work Practices was the most frequently cited AFI, followed by Quality of Task Execution and Process or Equipment Design or Layout (See Appendix 6, Chart 7).

Selected learning opportunities within these top three 2017 AFI categories and Lessons Learned narratives are excerpted below:

<u>Operating Procedures or Safe Work Practices</u>

- Although the pipe tally in use lists the outside diameter of each component it does not specify when to change insert sizes.
- The Driller and AD focused their attention on fixing the pipe tally; this resulted in a poorly orchestrated and essentially unsupervised series of events leading up to the incident.
- Throughout the project various methods were used to move the heavy flanges without evidence of awareness of the heavy flange weight. Safe work practices were available for personnel. Team formed to identify best practice for transporting blind flanges on same deck level and equipment to lift by use of crane or chain fall.
- A weekly checklist was developed including a check to ensure that moving parts are free and the lifeboat boat swings out and smoothly from the stowed position. Annual opening-up and examining the one-way clutches by the approved service supplier will be included in the maintenance strategy.
- Work controls for crane operations were updated with 'thermal-crane boom being damaged in high heat areas' hazard and large signs stating 'DANGER - HOT EXHAUST' were placed in various areas around the exhaust.
- Work instruction requires verification of RRT mechanical stop but does not specify how to perform the verification. Create rig specific procedural discipline verification process and provide coaching to crews.

Quality of Task Execution

- The 4" pipe was picked up with 4.5" inserts allowing the drill pipe to slide through once the double was hoisted.
- RRT mechanical stop not manually engaged by floorhand to verify hydraulic lock. Assistant driller failed to verify RRT was properly engaged per work instruction. Incorporate CCTV of RRT engagement to use in safety meetings to re-enforce requirements.
- The unsuccessful space-out of cement stand resulted in unanticipated additional movement of the cement head and equipment while in open hole. Instead of implementing a pause to discuss adjustments stipulated by changing operational conditions the crew attempted to progress ahead without a job plan.
- The operator would give the Toolpusher a thumbs up when the casing elevators were latched. This time the operator had given the thumbs up but had not stowed the positioner out of the traveling path.
- Lack of Awareness: Crew failed to notice that the riser gantry crane hooks were not fully engaged in the locked position.

Process or Equipment Design or Layout

- Maintenance and storage of blind flanges created a risk of injury from manual handling. Weight labeling of portable production equipment/materials and modification of flange storage containers is under consideration.
- Mark both sides of RRT with alignment markings that indicates the RRT mechanical and primary locks are properly engaged. Survey rig floor and order red/yellow zone mats to replace current area's painted red/yellow.
- An alarm intended to notify that the positioner was NOT stowed was responded to. There were similar 2 alarms activating prior to the event (positioner alarm and trip tank level alarm). When the level alarm ceased the Toolpusher assumed the positioner was stowed and began to lower the block.

Additional Lessons Learned

- **Incident Description** – “While picking up doubles of 4” slipped from the auxiliary pipe skate the main side elevators were latched onto the first double. As the main driller hoisted the block the double of 4” pipe slipped through the elevators falling 61’ to the rig floor. The double of 4” heavy wall came to rest on the main side aft side of the rig floor. No personnel were injured as a result of the event.”

  Learnings: “*When conditions change every location should have a pre-defined hold point in the form of a pause checklist or other tool/process to ensure hazards are identified /properly mitigated prior to re-commencing work. Teams should confirm knowledge and understanding of protocol in place for their respective locations. Teams should not rely on verbal discussions to drive job sequence but rather use available work package tools to document the specific cadence of how steps should be executed for each operation. Pipe tallies and BHA’s should highlight all elevator insert changes on a separate line and not in* *the comments. Establish a color-code system as an additional visual barrier to help your location ensure pipe and tool suitability."*

- **Incident Description** – "Aluminum cargo box loaded with 4' ~2000lbs spool piece with spool piece strapped to internal tie downs transported to dock and loaded on boat. In the process of lifting cargo box to platform in ~6' seas the box being lifted contacted a box adjacent to it causing box to tilt tie down point in box failed (during shipment or during lift) and spool piece rolled into the door causing the door to open and the spool piece to fall out of the box and fall to boat deck. Approximate height of drop 6' – 8'"

  Learnings: "> Following procedures and correct procedure steps; identify the proper shipping container for the material to be shipped

  > Work environment; unloading cargo in rough seas deck layout for delivery of material – anticipate unloading of boat in rough seas while loading the boat at the dock"

- **Incident Description** – "While lowering a lifeboat during a quarterly abandonment drill onboard a floating offshore installation personnel on board heard abnormal noise coming from the cables. The coxswain continued lowering the boat to the water so that the personnel were not suspended above the water for a long period of time. The drill was stopped due to concerns about the integrity of the winch personnel were transferred to another vessel and safely lifted back to the platform and temporarily reassigned to other lifeboats. Subsequently the approved service supplier examined all lifeboat launching appliances and sent the roller ratchet mechanism of the lifeboat where the noise was heard ashore for detailed examination."

  Learnings: "Periodic ownership care and inspection of lifeboat launching systems are key to the successful launching and recovery of lifeboats."

- **Incident Description** – "As the Assistant Driller was retracting the primary hydraulic racker with the cement head the main arm of the hydraulic racker came into contact with the lo-torque actuator body positioned on the cement head. The contact resulted in the actuator separating from the lo-torque; subsequently the 65lb actuator fell 45' to the rig floor being managed as a Red Zone at time of incident."

  Learnings: "-Locations should review pipe racking system operations to ensure procedures are well-known and implemented regarding flagging protocols.

  -Teams should confirm knowledge and understanding of protocol in place for their respective locations.

  -Teams should not rely on verbal discussions to drive job sequence but rather use available work package tools to document the specific cadence of how steps should be executed for each operation.

  -Consider implementing a second or third checker when creating pipe tallies. If there is a large volume of work to be executed in between wells, ensure the pipe tally is atop the priority list in advance of commencing operations at the new location."

- **Incident Description** – “Crew was in the process of running casing. As a joint of casing was lowered into the well the casing elevators came in contact with the casing positioning system causing equipment damage. The contact caused the casing positioning system backstop to break free and fall to the rig floor. The backstop fell approximately 30 feet and weighed 15.6 lbs. DROPS calculator potential outcome is fatality.

  Learnings: “Ensure front line supervisors are aware of the risks of fatigue the importance of sleep in avoiding fatigue and the signs and indications of fatigue.

  Operations and HSE leaders should emphasize/ensure nuisance alarms are not ignored and are addressed to avoid potential confusion. Consider use of an interlock system between positioner and elevators to prevent the elevators from latching if the positioner is not in the stowed position.

- **Incident Description** – “While picking up riser to begin well riser gantry crane malfunctioned releasing riser joint to fall 19' in riser bay. The operator received a "Green Light" on his remote console. When the operator began to lift the riser joint the crane stopped moving and began to give a general alarm on the remote console. The crane was placed in override mode and attempted to lift the riser joint with no success. The crane was powered down and the hook lost hydraulics and released the riser joint. The joint fell 15 ft striking other joints and then fell 4 ft more to bottom of bay. The riser bay had been barricaded to prevent personnel from entering the work area, so no personnel were injured as a result of the incident.”

  Learnings: “A Product Information Bulleting has been created and distributed to give affected rigs guidance on how to inspect and correct RGC riser capture devices.

  The JSA and work procedure has been updated to require visual confirmation that the forward and aft hooks are fully engaged prior to lifting the riser joint.

  An adjustment has been made to the hydraulic proximity switches.

  Added "yoke landed" criteria to software.”

5.3.2 Loss of Primary Containment (LOPC)

A total of 7 LOPC LFI Forms were submitted in 2017 (2 Tier 2 PSE and 5 HVLE). This LOPC category represents a broader data set than previous year data summaries which included only Tier 1 and 2 Process Safety Events. For 2017, Process or Equipment Reliability AFI were cited most frequently, followed equally by Process or Equipment Design or Layout, Individual or Group Decision-Making, Operating Procedures or Safe Work Practices, and Quality of Task Execution.

Specific learning opportunities within each of the top 5 AFI categories, and Lessons Learned narratives are excerpted below:

<u>Process or Equipment Reliability:</u>

- Turbo charger failed released oil straight into exhaust causing it to combust and catch fire; Large closing force on the air intake shut-off valve with engine running at high speed caused the O-ring to roll off its seat allowed air to continue to feed the pump allowing it to continue to run.

Process or Equipment Design or Layout:

- Mud gas separator (MGS) filled with oil forcing 10.0 parts per gallon (ppg) to be displaced from (MGS) at a slow rate. Oil began percolating up through the 10.0 ppg Calcium Chloride ($CaCl_2$) remaining in the mud leg returning to the gumbo box.
- Crew members were utilizing a common industry practice to reduce the potential for hose connection separation by utilizing quick connects. This method may have actually contributed to an inadequate connection by causing a side load on the hose connection.

Quality of Task Execution

- Worker did not identify potential for release of base oil from vacuum prior to breaking seal. Worker should have checked equipment prior to use.
- Procedure existed for filling tank manually called for continuous monitoring while filling. Tank overflowed while filling level not monitored appropriately. Procedure not followed.

Additional Lessons Learned

- **Incident Description –** "During section milling operations a gel sweep was being circulated into the well when the pump operator saw flames coming from the exhaust of the pump engine and below the grating at the operator console. He quickly throttled down the pump and put it in neutral. The operator did not have time to activate the ESD while evacuating the pumping unit. Upon alarm activation personnel began using fire extinguishers to attempt to snuff out the fire. At this point the lift boat fire hoses were deployed and activated to continue controlling the fire. The crew supervisor was able to gain access and shut the fuel valve. The engine shut down and fire was put out. No injuries resulted. Crews mustered in ~3 mins and the fire was out in ~15 mins."

  Learnings: "Importance of drills. Perform drills often and incorporate the use of firefighting systems into the drills so personnel know where they are located and how to operate them. ESD's don't always work properly. Have CO_2 extinguishers readily available to suffocate the air intake. Install a remote ESD station along the route of egress in case the primary ESD cannot be activated."

- **Incident Description –** "A gasket on the hydraulic return manifold failed and approximately 350 gallons of hydraulic oil was lost in the crane cabin containment. (Crane was not actively lifting at the time of incident.) All oil was cleaned up. No spill to water"

  Learnings: "Crane maintenance program will be reviewed and potentially updated."

- **Incident Description –** "The drill crew was assisting the coil tubing crew with the initial circulation on the well at 0.75 barrel per minute pump rate. The pumping flowpath transitioned through the rig gas buster to the gumbo box with fluid captured in the Marine Portable Tank (MPT) on +40 deck. Initialized circulation and pumped 2.25 barrels of completion brine when wellbore fluid returns began to flow into the gumbo box at a more rapid rate than pump rate indicating the rig gas separator was unloading. Work was shut down immediately however fluid from the gas buster continued to drain overwhelming the gumbo box capacity to feed through the 3" flowline to the +40 deck. Majority of the fluid was captured in the MPT with the remaining overflowing the gumbo box"

Learnings: "Utilize high level indicator to warn personnel of impending dump. Establish procedures to manually dump an MGS during displacements involving multiple fluid densities to prevent significant imbalances from developing. Assess & validate the Gumbo Box outflow system can transport fluid at a greater rate than the MGS can dump."

- **Incident Description –** "While conducting a slickline survey run one of the crew members observed a gas release at the stuffing box. Crew members immediately attempted to stop the leak by applying pressure through a hand pump that supplies hydraulic fluid/pressure to packing gland. The gas continued to escape. The crew notified the control room and then changed out the pump. After further attempts to stop the leak with the second pump failed the crew closed the upper and lower wireline valves which secured the well and stopped the leak."

  Learnings: "Ensure that work crews understand the procedural steps to be followed in every operation including well control. Ensure that work crews verify that equipment status has not changed when exposed to adverse conditions including weather. Service Provider is currently revising the Well Control procedure to include emergency checklist"

- **Incident Description –** "Oil was discovered in the pedestal of knuckle boom crane #4. The crane was in the process of going back in the rest after being operated for 1.5 hours. (not actively mechanically lifting at time of LOPC.) The source of the leak was coming from the fine filter housing on the crane. An O-ring on the filter canister failed therefore allowing the release. Approximately 168 gallons released into crane pedestal and containment."

  Learnings: "Confirmed that crane o rings and filter housing are in crane preventative maintenance plan."

5.3.3 Maintenance, Inspection and Testing (MIT)

In 2017, 2 LFI Forms were classified as MIT for the primary activity, and an additional 6 LFI Forms were identified as having MIT as a "secondary" activity, for a total of 8 events. Operating Procedures or Safe Work Practices was the most frequently cited AFI, followed by Personnel Skills or Knowledge and Work Direction or Management. (See Appendix 6, Chart 8).

Selected learning opportunities within these top three 2016 AFI categories and Lessons Learned narratives are excerpted below:

<u>Operating Procedures or Safe Work Practices</u>

- Throughout the project various methods were used to move the heavy flanges without evidence of awareness of the heavy flange weight. Safe work practices were available for personnel. Team formed to identify best practice for transporting blind flanges on same deck level and equipment to lift by use of crane or chain fall.
- Dropped object prevention programs should include a working at heights component which covers tethered tool requirements and inventory/maintenance/inspection criteria. Leaders should verify these components are in place and functioning properly.

- No procedures in place to survey the job & identify proper valve alignment prior to lancing lines. Update operational and safety procedures associated with high pressure lancing to include valve alignment and line tracing
- There are no requirements on what is to be included in the work pack for activities such as battery cell replacements.

Personnel Skills or Knowledge

- The crew did not identify the risk of modifying equipment with standard split key rings as a connector for a tether. The Drops standard discusses tools at heights but expanded training needed to be provided to explain proper connectors modification and expectations.
- Job equipment preparation training is not adequate. Develop training and competency program for equipment/maintenance personnel.
- The individuals creating the work pack also believed that the Senior Authorized Electrical Person conducting the task was knowledgeable about the system leading them to believe that the high-level steps would be sufficient.

Work Direction or Management

- Sharing of tethered tool kits between multiple work teams can lead to an uncontrollable inventory/maintenance/inspection program.
- Supervisor did not enforce the dedicated roles and acted as an entrant. Retrain all supervisors on dedicated roles.

Additional Lessons Learned

- **Incident Description –** "Worker was in the process of greasing rollers on the Pipe Handling Machine. As the worker was repositioning from the top roller to the bottom roller, the grease gun released from the tool tether and fell to the rig floor rotary table. The grease gun weighed 2.4-lbs and fell approximately 45 feet."

  Learnings: "Dropped object prevention programs should include a working at heights component which covers tethered tool requirements and inventory/maintenance/inspection criteria. Leaders should verify these components are in place and functioning properly. Assess if the workforce at your location understands the expectations for equipment and/or tool modifications. Assess if your location has an adequate amount of tethered tool kits available for each work team if inventory is controlled and if tools and tethers are in good working condition."

- **Incident Description –** "Two contractor workers were tasked with removing corrosion from bolts on an antenna located at the crown of the rig. The workers were utilizing a pneumatic bristle blaster for removing the corrosion; while stopping to inspect the work piece the bristle blaster detached from the air supply hose and fell 179 feet to the top of the rig motor shed below. All access points to the rig were barricaded for the job at hand and no personnel were in the area. The bristle blaster fell within the drop-zone barricade."

  Learnings: "Minimize and mitigate forces on threaded connections when working at heights. Examples include: Utilize swivel connections to prevent torque on threaded connections Where practical reduce the number of threaded connections. Utilize smaller diameter hose whips to provide hose flexibility vs. using 1" hoses. Move regulators or similar equipment away from the tool. Use thread locking sealant on threaded connections to combat loosening of threads. Utilize multiple independent retention devices on tools as needed when working at heights. (e.g. secure tool separately from air hose)."

- **Incident Description –** "On 10 August 2017, an electrician was notified that the galley hood vent fan wasn't working causing the kitchen to fill with heat and smoke. As the employee was removing the fan belt shroud of the galley exhaust unit; the worker shifted his body position. This moved caused the left index finger to come between the rotating belt and sheave resulting in a laceration at the distal knuckle of the left index finger."

  Learnings: "Each asset to review exhaust fans for similar design where electrical isolation may not provide energy isolation. Identify and create an isolation scheme that will allow energy isolation in a manner that will not create exposure for employees. (e.g. post incident the asset identified a breaker that would isolate electricity to the fan motor as well as power to the solenoid closing the louvers. Closing the louvers effectively eliminated the air flow that was continuing to drive the fan) Each asset to survey for similar exposures where electrical isolation may not provide energy isolation. Identify and create an isolation scheme that will allow energy isolation in a manner that will not create exposure for employees."

- **Incident Description –** "IP (pit cleaning crew night supervisor) was using a high pressure (6500 psi) flexible lance to clean a 90 degree flow line inside the sandtraps. As the IP fed the lancing line into the flow line the nose of the lancing line contacted a closed valve and doubled back on itself. The end of the lance came back out of the flow line and contacted the IP. IP received a laceration to his left inner bicep. The IP was not wearing his Kevlar PPE as outlined in the job specific checklists procedures and SJAs. The IP was assisted out of the pit by his co-workers and was escorted to the on-site medic. The on-site medic cleaned, covered and bandaged the laceration. The IP was sent on-shore for further treatment."

  Learnings: "The importance of using proper PPE (job specific) was re-emphasized in pre-tour & general weekly safety meetings. The expectation that crew supervisors be designated supervisors and not get involved in doing the work was highlighted. Stop the job authority was reviewed and emphasized with all personnel. A lance "stiffener" was sourced for future operations to ensure the hose on the lance cannot bend enough in the lines to enable the high pressure nozzle to come out the same end of the line that it is fed in."

- **Incident Description –** "Two individuals were conducting the task of replacing a battery cell on the back up battery bank for a Flash Gas Compressor (FGC). When the jumper to the adjacent battery cell was lifted the individuals heard the compressor shut down. Upon realizing that the compressor shut down was likely caused by the removal of the jumper they then dropped the jumper back on the battery re-establishing the connection albeit at a higher resistance. This then resulted in sparking and ignition of the jumper."

  Learnings: "Ensure that your maintenance process is robust and produces work packages that contain consistent fit-for purpose details. Actions being taken are to implement Corrective Maintenance at all Platforms. Revise Quality Assurance Planning Checklist to include requiring marked up reference drawings for work packages where isolation is necessary. Revise Planning Team Lead Structured Work Week to include dedicated quality assurance time for work order review and maintenance process adherence checks. Ensure that the Permit to Work documents and process are clearly understood to ensure consistent application of the tools."

5.3.4 Additional Learnings

This section highlights observations from a variety of incidents and categories, and includes selected AFI and Lessons Learned opportunities.

- 1. Assess activities where visual and/or mechanical confirmation of load-bearing equipment is not present. Consider use of cameras or other engineered solutions where line of sight confirmation of critical equipment function is obstructed. 2. Gap assess work instructions/job packages to ensure alignment with OEM requirements for all safety-critical systems; confirm supporting materials accent OEM's requirements. 3. Review procedures/JSA systems to ensure only the correct versions are available to the work force in the site's database. 4. Verify there is a process within your company's management system that ensures applicable learnings across regional boundaries are implemented and tracked.

- Ensure personnel are taking appropriate precautions when the potential for residual pressure exists including line-of-fire exposure considerations & reliable pressure check/bleed points. - Ensure personnel understand the forces resulting from small pressure over large area. - Ensure drawing is used in pre-job planning & it clearly identifies elevation of equipment. - Ensure personnel understand hydrostatic forces can be present - Check with equipment owners to verify if pre-use equipment inspection lists are available for personnel to use. - Ensure pre-use equipment inspections are performed via spot-checks. - Assess which work parties will be involved in a given task & ensure the appropriate parties are present for the pre-job planning discussions.

- Dropped object prevention programs should include a working at heights component which covers tethered tool requirements and inventory/maintenance/inspection criteria. Leaders should verify these components are in place and functioning properly. Assess if the workforce at your location understands the expectations for equipment and/or tool modifications. Assess if your location has an adequate amount of tethered tool kits available for each work team if inventory is controlled and if tools and tethers are in good working condition.

- Develop and implement a standard process for managing Supply Vessels at locations engaged in H2S operations. Develop and implement robust voyage orders and itinerary to accompany cargo manifest. Orders shall include specific details outlining any non-routine activity. Marine Assurance validates that personnel are properly trained and appropriate equipment are on vessel prior to voyage. Enforce review of all potential risks during vessel-location interface in work planning including H2S concerns.
- Ensure front line supervisors are aware of the risks of fatigue the importance of sleep in avoiding fatigue and the signs and indications of fatigue. Operations and HSE leaders should emphasize/ensure nuisance alarms are not ignored and are addressed to avoid potential confusion. Consider use of an interlock system between positioner and elevators to prevent the elevators from latching if the positioner is not in the stowed position.
- Crew members were utilizing a common industry practice to reduce the potential for hose connection separation by utilizing quick connects. This method may have actually contributed to an inadequate connection by causing a side load on the hose connection.
- Dropped object prevention programs should include a working at heights component which covers tethered tool requirements and inventory/maintenance/inspection criteria. Leaders should verify these components are in place and functioning properly.
- OEM manual for slip joint specifies that the locking mechanisms be functioned, greased and visually inspected prior to running. The work package/JSA utilized for task omitted this step; therefore, these steps were not executed by the crew.
- Risks can become normalized when tasks are performed multiple times without incident.
- Presence of hydrostatic pressure or potential for trapped pressure was not recognized during the job planning.
- All work parties were not part of the initial pre-job safety meeting to discuss the task and share relevant information as well as voice any questions and/or concerns.

5.3.5 Noteworthy Trends for 2013-2017 Data (US OCS)

2017 represents the fifth year of data collection, and the following observations relate to the entire data set of 220 US OCS submittals for the reporting period from 2013 to 2017.

- The total number of LFI Forms categorized as US OCS shared for 2017 was 33. While this number is down from prior year reporting totals, the 25 HVLE reported in 2017 represents 76% of the total submittals. The increase in the absolute number and percentage of HVLE for each of the past five years suggests increased sharing behavior amongst COS Members.
- Site Type selection for 2017 yielded the highest number of “Drilling Rig on Production Facility” in 5 years, and the lowest number of “Fixed Production Facility” and “Mobile Offshore Drilling Unit” events in 5 years. Similarly, the Operation Type reporting showed a shift towards “Wells-exploration, appraisal/production drilling, wireline, completion, workover, abandonment, intervention activities”.

- For 2017, several AFI showed the highest selection frequency in 5 years, and several others had the lowest frequency of selection:
    - Highest AFI frequency in 5 years:
        - Operating Procedures or Safe Work Practices - 58% (continues to be the most frequently selected AFI)
        - Process or Equipment Reliability - 21%
        - Quality of Task Execution - 33%
    - Lowest AFI frequency in 5 years:
        - Personnel Skills or Knowledge - 18%
        - Process or Equip Material Spec, Fab and Construction - 9%
        - Risk Assessment and Management - 0%

5.4 Areas for Improvement

This section summarizes the improvement areas identified across all 33 LFI submittals in reporting year 2017. The following information can be used by COS members to gain insight into potential improvement opportunities for their own operations.

A total of 96 Areas for Improvement (AFI) were selected for the 33 incidents and HVLE. Multiple improvement areas relating to a single incident or HVLE is consistent with industry experience and demonstrates that a majority of incidents and HVLE can have multiple factors and associated barrier failures.

Within the AFI fields, submitters chose from 3 general categories (Physical Facility/ Equipment/ Process, Administrative Processes, and People), and 15 sub-categories.

Among the 15 sub-categories, the most frequently reported improvement areas are listed below along with the percentage of reports that selected this improvement area:

- Operating Procedures or Safe Work Practices (58%)
- Process or Equipment Design or Layout (36%)
- Quality of Task Execution (33%)
- Quality of Task Planning and Preparation (27%)

The selection of Operating Procedures or Safe Work Practices continued as the most often identified AFI for the past four years. For 2017, Process or Equipment Design or Layout, and Quality of Task Execution were the 2nd and 3rd most frequently selected AFI. The associated AFI comments, not already shared in Section 5.3 Learnings are presented below:

5.5 Operating Procedures or Safe Work Practices AFI Comments:

- There were 2 procedures in the drilling contractor's online database for installing the slip joint; one of which was incomplete – a redundant/earlier version. The work team referenced the procedure that was incomplete instead of selecting the most updated version.

- Drawings did not clearly identify elevation of equipment to assist in recognition of hydrostatic pressure in the system.
- Procedure to rack back bottom hole assembly does not include any guidance on the use of the Tugger. Commissioning procedure inadequate. Collision Checklist does not contain an adequate level of detail to complete the task. The crew believed the checklist was only required to be utilized at the start of tour.
- Original OEM operating procedure was not a controlled document and not available to offshore personnel in order for them to understand data from the top tension riser monitoring system.
- Procedures lacked instructions for H2S operations including the type of equipment (H2S and Escape SCBAs) required when operating in an environment where H2S release is a risk.
- The operating procedures manual did not require the fittings to be removed from the tubing head adapter. This task had been completed multiple times without incident while having the exhaust fittings installed.

5.6 Process or Equipment Design or Layout AFI Comments:

- Visual confirmation to verify full engagement of locking mechanisms was not feasible due to the submerged position of the slip joint assembly below water line on this design of drillships which is considerably lower than other conventional designs/locations.
- Rig floor is often slick despite using an anti-skid coating paint.
- Manifold bleed port did not have a needle valve in place. Requirement for the needle valve was not clearly identified.
- Design specifications do not require valves in the bleed ports.
- Design of the tugger cable and HydraRacker allows for an unintended interaction between the two systems when the HydraRacker is located at a specific location on its guide track.
- No block valve in place to isolate the well gas lift shut down valve. Fluid barrier was required in its place.

5.7 Quality of Task Execution AFI Comments:

- With exhaust fittings installed there was only 1.5” of clearance between the tubing head and the circular hatch opening. Removing the fitting would have dramatically reduced the margin for error while hoisting the tubing head through the main deck opening.
- Task was not fully executed per the procedures. Verification that unit was fully de-energized was not completed and wiring was not properly disconnected.
- Closing the louvers effectively eliminated the air flow that was continuing to drive the fan

5.8 Quality of Task Planning and Preparation AFI Comments:

- Pre-check was not performed on the manifold to confirm appropriate bleed point was used.
- The was no evidence of hazard identification by the team involved in the work. A routine permit was being used for the work but was not updated with any additional hazards or controls. No evidence of a written job plan.

- Heat from the exhaust was not identified as a hazard and no controls were in place regarding this particular hazard.
- The proper tethered tool was not located on the rig floor for the crews to utilize. This was due to not having an inventory or routine inspection of tools as per Drops standard.
- Vessel H2S compliance rely heavily on informal request for training /equipment by email.
- Risks can become normalized when tasks are performed multiple times without incident.
- Pipe tally used to calculate the stand space-out was off it had not been updated from the previous well.
- All potential hazards were not adequately identified during the pre-job planning process.
- JSA procedural steps were modified to reflect the need for visual confirmation of riser joint being fully latched (secondary check on green light indicator of successful latch.)

5.9 Learnings from Incidents Outside the US OCS

There were 20 events associated with International or US Onshore/State Waters locations in 2017, representing 38% of the 53 events. Twelve of these events were associated with the new "US Onshore/State Waters" category that was first introduced for reporting year 2017. Reporting of Non-US OCS events for the past two years (2016-2017) was significantly higher than for the first 3 years of LFI data collection (2013-2015). While the COS Mission is focused on safety in the US OCS, COS recognizes the value of learnings from other industry events and accepts LFI Submittals for US Onshore/State Waters and International events.

Figure 5.6: Incident Category Distribution for Incidents Outside of US OCS

Incident Location	2013	2014	2015	2016	2017	TOTAL
International	2	1	0	17	8	**28**
US Onshore/State Waters	0	0	2	1	12	**15**
TOTAL	**2**	**1**	**2**	**18**	**20**	**43**

The 20 Non-US OCS events for 2017 included 2 Tier 1 PSEs, 1 Tier 2 PSE, and 17 HVLE. The top three Areas for Improvement (AFI) identified for 2017 were Operating Procedures or Safe Work Practices, Quality of Task Planning and Preparation, and Personnel Skills or Knowledge.

Some of the Lessons Learned associated with these 20 events are listed below:

- **Incident Description –** "A contractor Company was performing Corrosion Under Insulation inspection on FPSO pipes. To inspect the pipe an Inspection Tech was using a hole saw to create an access hole in the cladding to expose the pipe surface. While drilling a hole in the LP-Separator A gas outlet pipework cladding the holesaw's pilot bit went straight through the pipe and started a gas leak. Production Operators shut down one field and blew down the A train high pressure and low-pressure separators. 4.9 m3 of gas released to the atmosphere. Potential fatality for two people that were working on the pipe. Production loss around 120 000 bbl. in 4 days."

  Learnings: "The Inspection Tech was drilling a hole in the cladding of a live pipe; there was gas inside the LP separator and Train A was running. Torque applied by the drill machine was higher than pipe's strength – this pipe was an 8" duplex stainless steel with nominal wall thickness 3.76mm. The holesaw's pilot bit hole was enough to went throughout the cladding and pipe. The cladding only consisted of a thin metal sheet with no insulation in between the pipe and the cladding. The cladding was also bent toward the pipe."

- **Incident Description –** "While conducting inspections at a marine terminal, workers noticed product leaking from two 550-gallon chemical tote tanks. One tote tank was leaking from the weld around one of its legs the second tote was leaking product from its lower drain line. Approximately .5 gallon of chemical was released to the truck bed and pavers."

  Learnings: "Structural examination of the first tote revealed stress cracking at its leg weld with two potential causal scenarios: 1. During cargo handling operations forklift forks could have applied lateral force to the tote legs in a sufficient amount to compromise the integrity of the weld. 2. During normal lifting and lowering of full tote tanks via crane or hoist or during transport (i.e. bumps in road) flexing of the bottom of the tote tank could have degraded the integrity of the weld over time."

- **Incident Description –** "During the preparation to lift a 1500 bbl. tank from horizontal to vertical position using both blocks on the crane. The 165-ton crane began to take slack out of the rigging. Once partial weight was put on line the auxiliary line sheave parted."
  Learnings: "Some Cranes can perform lifts utilizing both load lines and others cannot ensure the Manufacturer of the crane has authorized the use of lifting with both load lines of the crane before making the lift. If both load lines are approved by the manufacturer to be used ensure that the boom is in line with the load and the load is below the boom head before lifting."

- **Incident Description –** "A crew was conducting tightness testing on the Chemical Injection Scale Squeeze high pressure system which required incremental pressurization in 4 stages up to 4034 psig. A leak was encountered at 3027 psig and the crew identified the leak point and began the depressurization procedure to fix the leak at the clamp connection. The crew moved to depressurization point 2 to bleed the remaining trapped pressure located downstream of the check valve. The automated valve opened to allow nitrogen to vent through two opened bleed valves nitrogen entered the low pressure 150 class piping and a release of pressure occurred from the filter pots rated for 275 psig. No injuries or equipment damage occurred from the event."
  Learnings: "Risk Recognition: Tightness Testing campaign was not classified as 'high risk' work. Addressing Abnormal Conditions: On a campaign requiring significant number of work packs or test packs it is critical to define what criteria and conditions would make a particular test pack / work pack abnormal to ensure proper risk assessment safeguard review and technical and leadership oversight."

- **Incident Description –** "During the installation of cables for an EQD (Emergency Quick Disconnect) as part of an upgrade to a control system work van an arc occurred while cutting the cable to length. The technician locked out the work van at the incoming breaker and initially checked the circuit with a voltage meter being worked on to verify there was not any power. Once the arc took place the technician re-verified with a voltage meter which confirmed no power to the cable. After tracing all electrical lines multiple times it was discovered that the work van had 2 electrical circuits and the incoming breaker did not isolate both circuits. No lock out/tag out procedure in place for the work van involved and it was previously decommissioned by a previous group."
  Learnings: "Detailed electrical schematics are needed for each piece of equipment and if not available work should not commence. Engineering developed a complete set of schematics for electrical and other functions of the work van. An equipment specific lock out/tag out procedure was needed and it was created. An electrical permit-to-work did not exist. A permit-to-work process for electrical work was developed and implemented to aid in verification of critical items by the lead electrician and the supervisor."

- **Incident Description –** "A CTS (Constant Tension System) A-Frame was brought in for routine maintenance and slight modification to the frame. The maintenance and modification of the A-Frame was a defined and planned out task. The work was performed and completed successfully and was staged for shipment back to the offshore operation. A secondary person that was involved in the initial maintenance and modification came back behind the crew and made a decision to test the functions of the frame although it was not a requirement and the employee was not instructed to do so. The employee began testing the function of the frame the frame tipped over in a forward motion and landed in the strike zone of active simultaneous operations taking place on an ROV cage."

  Learnings: "An All-Stop was initiated for all employees working in the vicinity and the overall situation was evaluated and a risk assessment and JSEA were completed as part of the pre-job planning to upright the A-Frame. Communications were conducted with all employees regarding the emphasis needed on hazard identification and communications when simultaneous operations are taking place."

- **Incident Description –** "An Assistant Mechanic was drilling a 3.5mm hole into the rescue craft access stair handrail in order to install a safety barrier clip. When the drill bit penetrated the wall of the handrail pipe there was a release of an unknown flammable gas that caused a fire and subsequent injury to the employee drilling the hole. The incident resulted in a burn injury which required recovery time in hospital and lost days from work."

  Learnings: "Hazardous gas can be accumulated over time in hollow and enclosed structures. Specific standards/procedures to be in place for work on such structures. Handrail design should consider features/measures to limit or avoid the potential for accumulation of gases inside hollow and enclosed structures. Examples include using angle irons for hand rails non-metallic tubulars weep or vent holes in tubulars etc. PPE to be worn as designed with all fastenings secured; e.g. FRC to be buttoned to the neck. Alerts from at least 3 known previous incidents of similar nature in the E&P industry had not been seen prior to the incident. Sharing lessons learned is important and necessary for prevention of similar incidents."

- **Incident Description –** "A labourer working for a local contracting company was cleaning a portable concrete mixer prior to starting work. The concrete mixer which was located in the contractor camp had been switched on and was rotating whilst the IP (Injured Person) was cleaning the equipment. During the cleaning process the IP's left hand got caught in the teeth on the concrete mixer's gears. The IP immediately removed his hand which had sustained a serious injury. The IP was evacuated to the nearby hospital where he underwent reconstructive surgery on his hand."

  Learnings: "Conduct equipment inspections of all machinery / equipment to ensure they meet quality and safety requirements and remove any equipment from site that is not fitted with the required safety features (e.g. guards). Ensure standard operating procedures are in place for maintenance and operation of all machinery and those activities (e.g. minor maintenance / cleaning) that are not covered under a Permit To Work.

Identify and deliver work specific training packages for unskilled activities. Clarify supervisory lines and site accountability on sites where the contractor has multiple contracts with different lines of business."

- **Incident Description –** "A contractor was tasked with moving a welding containment to another location for onsite equipment repair. The unit was powered down and wiring disconnected and moved. The assigned welder powered up the unit and proceeded to prepare for the task. During preparation the welder discovered wiring on the ground and in the way. As the welder picked up and started to move the wiring the wires began to spark. An electrician was called in to assess and it was discovered that the air conditioning wires were never disconnected from the power source after the unit was removed."

  Learnings: "The lock out/tag out procedure was revised to address the circuits specific to the unit involved. The risk assessment and JSEA were revised and reviewed with the contractor and applicable in-house personnel to ensure all steps and hazards were identified and controls agreed upon. The verification process was reviewed with all applicable personnel including expectations and consequences."

APPENDIX 1 – DEFINITIONS

Note: please reference **Appendix 2: SPI Definitions and Metrics** for detail on the SPI, their minimum-release threshold values and specific normalization factors for each SPI. Please reference **Appendix 3: Equipment Definitions** for specific definitions of equipment.

Barrier: A constraint on a hazard that reduces the probability of an incident or its consequences. There are two types of barriers: Prevention and Mitigation.

Consequence: The harm that could result from an incident.

Contractor: An individual, partnership, firm or corporation retained by the Owner or Operator to perform work or to provide supplies or equipment. The term Contractor shall also include subcontractors.

Deepwater: Exploration and production activity occurring in 1000 feet or deeper water depth.

Facility: All types of offshore structures permanently or temporarily attached to the seabed (mobile offshore drilling units, floating production systems, floating production, storage and offloading facilities, tension-leg platforms, and spars) used for exploration, development, production, and transportation activities for in the OCS, including pipelines regulated by the Department of Interior (DOI).

Formation Fluid: The subterranean fluid trapped by a reservoir formation; can include natural gas, liquid and vapor petroleum hydrocarbons, and interstitial water.

Hazard: Types of chemical, thermal, toxic, kinetic, or potential energy with the ability to cause harm to people, the environment, or facilities.

High Value Learning Event: An event that may be considered by a COS member or the industry for use as a reference in process hazard analyses, management of change, project design, risk assessment, inspection, operating procedure review, and/or training. An HVLE should meet one or more of the following criteria:

A. Identify a previously unknown risk, situation, operational or mechanical hazard, or critical equipment failure.
B. Identify a previously unknown combination of factors that resulted in an unexpected condition or event.
C. Identify a routine operation or activity that created a previously unidentified risk or consequence.
D. Identify a situation where established industry designs, controls or procedures failed to prevent an event (e.g. well kick, loss of wall thickness).
E. An event that is part of a pattern in industry events which could indicate that certain hazardous conditions are not well understood.

Incident: A work-related event that has one or more consequences.

Loss of Primary Containment (LOPC): An unplanned or uncontrolled release of material from primary containment.

Major Hazard: A **Hazard** that can reasonably be foreseen as having the potential to cause a SPI 1 consequence.

Mitigation Barrier: Barrier to the right of the top event in a bow tie that can reduce or minimize the probability of a consequence. For example, active fire protection is a mitigation barrier.

Operator: The individual, partnership, firm, or corporation having control or management of operations on the leased area or a portion thereof. The Operator may be a lessee, designated agent of the lessee(s), or holder of operating rights under an approved operating agreement.

Prevention Barrier: Barrier to the left of the top event in a bow tie that can prevent or reduce the probability of a top event occurrence. For example, a safety instrumented system is a prevention barrier.

Production: Production covers offshore oil and gas production activities including flow lines and pipelines.

Projects: Projects include all offshore construction activities.

Safety Performance Indicator: A measurement that provides insights into the strength of barriers. SPI are inclusive of those that measure performance with respect to protection of personnel, the environment, and offshore facilities and property.

Safety Performance Indicator Program: A program developed, implemented and continually improved through which SPI are established, collected, analyzed and reported for specific safety issues of concern so that actions can be taken by relevant stakeholders to improve safety performance.

Wells: Wells include all offshore exploration, appraisal and production drilling, wireline, completion, workover, and intervention activities.

APPENDIX 2 – SPI DEFINITIONS & METRICS

SPI Number	SPI Definition	SPI Metric	Reporting Entity
SPI 1	Frequency of work-related incidents resulting in one or more of the following consequences: A. Fatality: One or more fatalities. B. Injury to 5 or more persons in a single Incident C. Tier 1 Process Safety Event: (API RP 754 Tier 1 Process Safety Event) An unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO2, 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; ○ a hospital admission and/or fatality of a third-party; ○ an officially declared community evacuation or community shelter-in-place; ○ a fire or explosion resulting in greater than or equal to $25,000 of direct cost to the Company; ○ a pressure release device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences: ▪ liquid carryover ▪ discharge to a potentially unsafe location ▪ an onsite shelter-in-place ▪ public protective measures and a PRD discharge quantity greater than the threshold quantities in Table A-C in any one-hour period; or ○ A release of material greater than the threshold quantities described in Tables A-C in any one-hour period.	# of SPI 1 incidents/ total work hours * 200,000	COS Operator for all incidents within the 500-meter zone and for incidents to direct employees while offshore COS Contractor for incidents outside the 500-meter zone while offshore

SPI Number	SPI Definition	SPI Metric	Reporting Entity
	D. Level 1 Well Control Incident: Loss of well control o Uncontrolled flow of formation or other fluids resulting in: ▪ Seabed/surface release. ▪ Underground communication to another formation or well. o Includes shallow water flows that result in damage or loss of facilities/equipment o Excludes planned shallow gas mitigation operations. E. $1 million or greater direct cost from damage to or loss of facility / vessel / equipment (excludes costs associated with downtime or production loss). F. Oil spill to water ≥ 10,000 gallons (238 barrels)		
SPI 2	Frequency of work-related incidents that do not meet the definition of a SPI 1 incident but have resulted in one or more of the following: A. Tier 2 Process Safety Event: (API RP 754 Tier 2 Process Safety Event) An unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g., steam, hot condensate, nitrogen, compressed CO2, compressed air), from a process that results in one or more of the consequences listed below and is not reported as a Tier 1 PSE: o An employee, contractor or subcontractor recordable injury; o A fire or explosion resulting in greater than or equal to $2,500 of direct cost to the Company; o A pressure release device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences: ▪ liquid carryover ▪ discharge to a potentially unsafe location	# of SPI 2 incidents / total work hours * 200,000	COS Operator for all incidents within the 500-meter zone and for incidents to direct employees while offshore COS Contractor for incidents outside the 500-meter zone while offshore

SPI Number	SPI Definition	SPI Metric	Reporting Entity
	▪ an onsite shelter-in-place ▪ public protective measures ▪ and a PRD discharge quantity greater than the threshold quantity in Tables D-F in any one-hour period; or o a release of material greater than the threshold quantities described in Tables D-F in any one-hour period. B. Collision that results in property or equipment damage ≥ $25,000 C. Incident Involving Mechanical Lifting A mechanical lifting (or lowering) incident that results in one or more of the following consequences. Mechanical lifting includes lifts of an asset or personnel (personnel transfer and man-riding). Consequences: o Four or less recordable injuries in a single incident that occurs during the lift o Between $25,000 and $1 million direct damage to or loss of an asset (including the load itself) o A loss of primary containment of a material meeting a Tier 2 Process Safety Event threshold quantity o A dropped load that strikes live process equipment o Not included: ▪ Lifting incident resulting only in a first aid injury ▪ Lifting incident resulting only in direct damage to an asset (including the load itself) < $25,000 ▪ Lifting incident resulting only in a slipped load ▪ Dropped load or object into the water valued at < $25,000 ▪ Manual lifting incidents		

SPI Number	SPI Definition	SPI Metric	Reporting Entity
	D. Loss of station keeping resulting in drive off or drift off defined as a malfunction or improper operation of the dynamic positioning system E. Life boat, life raft, or rescue boat event that resulted in a recordable injury or equipment damage or malfunction during life boat, life raft, or rescue boat operations or that take it out of service. F. Level 2 Well Control Incident One barrier system within the well design failed and other barrier system(s) either failed or were challenged beyond design capacity resulting in an influx without uncontrolled flow.		
SPI 3	Number of SPI 1 and SPI 2 incidents that involved failure of one or more of equipment as a contributing factor. COS Equipment categories: A. Well pressure containment system B. Christmas trees C. Downhole safety valves D. Blow out preventer and intervention systems E. Process equipment/pressure vessels, piping F. Automated safety instrumented systems / shutdown systems G. Pressure relief devices, flare, blowdown, rupture disks H. Fire/gas detection and fire-fighting systems I. Mechanical lifting equipment/personnel transport systems J. Station keeping systems K. Bilge/ballast systems L. Life boat, life rafts, rescue boats, launch and recovery systems M. Other	Number of SPI 1 and 2 incidents involving failure of equipment / total number of SPI 1 and 2 incidents * 100	COS Operator for all incidents within the 500-meter zone and for incidents to direct employees while offshore COS Contractor for incidents outside the 500-meter zone while offshore

SPI 4	Crane or personnel/material handling incidents defined as a failure of the crane itself (e.g., the boom, cables, winches, ball ring), other lifting apparatus (e.g., air tuggers, chain pulls), the rigging hardware (e.g., slings, shackles, turnbuckles), or the load (e.g., striking personnel, dropping the load, damaging the load, damaging the facility). Reference MMS NTL 2008-G17.	Number of incidents as defined by MMS NTL 2008-G17 / total work hours * 200,000	COS Operator for all incidents within the 500-meter zone and for incidents to direct employees while offshore
SPI 5	Number of planned critical maintenance, inspections and tests completed on time. A planned task can be deferred if a proper risk assessment was completed and approved, and a new due date set. It is up to each company to define critical equipment	Number of critical maintenance, inspections and tests tasks completed on time / number of critical maintenance, inspections and tests tasks planned (expressed as a %)	COS Owner of Equipment
SPI 6	Number of work-related fatalities	Number of work-related fatalities	COS Operator when within the 500-meter zone and for direct employees while offshore COS Contractor when outside the 500-

			meter zone while offshore
SPI 7	Number of DART injuries and illnesses. BSEE defines DART injuries or illnesses as those that resulted in "Days Away from work, Restricted duty, and Job Transfer' outcomes.	# DART / total work hours * 200,000	COS Operator when within the 500-meter zone and for direct employees while offshore (same as reported on BSEE-0131 Form)
SPI 8	Number of recordable injuries and illnesses	Number of recordable injuries and illnesses/ total work hours * 200,000	COS Operator when within the 500-meter zone and for direct employees while offshore (same as reported on BSEE-0131 Form)
SPI 9	Number of spills greater or equal to 1 barrel that enter the water	Number of spills ≥ 1 barrel / total work hours * 200,000	COS Operator for all spills within the 500-meter zone COS Contractor for spills outside the 500-meter zone while offshore
Work Hours	For offshore workers, the hours worked are calculated on a 12-hour work day. Work hours are collected in the following categories: ○ Total US OCS construction workforce hours inside 500 meters	Total Workforce Hours for the various categories	COS Operator when within the 500-meter zone (same as reported on

	○ Total US OCS well workforce hours inside 500 meters ○ Total US OCS production workforce hours inside 500 meters ○ Total US OCS workforce hours inside 500 meters		BSEE-0131 Form)

Table A – Tier 1 Process Safety Events - Non-toxic Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is 'acute', i.e. equals or exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	**Outdoor Release**	**Indoor Release**
Flammable Gases – e.g. • methane, ethane, propane, butane, • natural gas, • ethyl mercaptan	500 kg (1,100 lb)	250 kg (550 lb)
Flammable Liquids with Boiling Point < or equal to 35˚C (95˚F) and Flash Point < 23˚C (73˚F) – e.g. • liquefied petroleum gas (LGP), • liquefied natural gas (LNG), • isopentane	500 kg (1,100 lb)	250 kg (550 lb)
Flammable Liquids with Boiling Point > 35˚C (95˚F) and Flash Point < 23˚C (73˚F) – e.g. • gasoline, toluene, xylene, • condensate, • methanol, • > 15 API Gravity crude oils (unless actual flashpoint available)	1,000 kg (2,200 lb) or 7 barrels	500 kg (1,100 lb) or 3.5 barrels
Combustible Liquids with Flash Point ≥ 23˚C (73˚F) and < or equal to 60˚C (140˚F) – e.g. • diesel, most kerosenes, • < 15 API Gravity crude oils (unless actual flashpoint available)	2,000 kg (4,400 lb) or 14 barrels	1,000 kg (2,200 lb) or 7 barrels
Liquids with flash point > 60˚C (140˚F) released at a temperature at or above its flash point – e.g. • asphalts, molten sulphur, • ethylene glycol, propylene glycol, • lubricating oil	2,000 kg (4,400 lb) or 14 barrels	1,000 kg (2,200 lb) or 7 barrels
Liquids with flash point > 60 ˚C (140˚F) released at a temperature below its flash point – e.g. • asphalts, molten sulphur, • ethylene glycol, propylene glycol, • lubricating oil	Not Applicable	Not Applicable

Table B – Tier 1 Process Safety Events - Toxic Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is 'acute', i.e. equals or exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	Outdoor Release	Indoor Release
TIH Hazard Zone A materials - includes • acrolein (stabilized), • bromine	5 kg (11 lb)	2.5 kg (5.5 lb)
TIH Hazard Zone B materials- includes: • hydrogen sulphide (H2S), • chlorine (Cl2)	25 kg (55 lb)	12.5 kg (27.5 lb)
TIH Hazard Zone C materials- includes: • sulphur dioxide (SO2), • hydrogen chloride (HCl)	100 kg (220 lb)	50 kg (110 lb)
TIH Hazard Zone D materials- includes: • ammonia (NH3), • carbon monoxide (CO)	200 kg (440 lb)	100 kg (220 lb)
Other Packing Group I Materials – includes: • aluminum alkyls, • some liquid amines, • sodium cyanide, • sodium peroxide, • hydrofluoric acid (> 60% solution)	500 kg (1,100 lb)	250 kg (550 lb)
Other Packing Group II Materials – includes: • aluminum chloride, • phenol, • calcium carbide, • carbon tetrachloride • some organic peroxides • hydrofluoric acid (< 60% solution)	1,000 kg (2,200 lb) or 7 barrels	500 kg (1,100 lb) or 3.5 barrels

Table C – Tier 1 Process Safety Events - Other Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is 'acute', i.e. exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	Outdoor Release	Indoor Release
Other Packing Group III Materials – includes: • sulphur, • lean amine, • calcium oxide, • activated carbon, • chloroform,	2,000 kg (4,400 lb) or 14 barrels	1,000 kg (2,200 lb) or 7 barrels

• some organic peroxides, • sodium fluoride, • sodium nitrate		
Strong Acids or Bases - includes: • sulphuric acid, hydrochloric acid, • sodium hydroxide (caustic), • calcium hydroxide (lime)	2,000 kg (4,400 lb) or 14 barrels	1,000 kg (2,200 lb) or 7 barrels
Moderate Acids or Bases- includes: • diethylamine (corrosion inhibitor)	None	None

Table D – Tier 2 Process Safety Events - Non-toxic Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is ‘acute’, i.e. equals or exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	Outdoor Release	Indoor Release
Flammable Gases – e.g. • methane, ethane, propane, butane, • natural gas, • ethyl mercaptan	50 kg (110 lb)	25 kg (55 lb)
Flammable Liquids with Boiling Point < or equal to 35˚C (95˚F) and Flash Point < 23˚C (73˚F) – e.g. • liquefied petroleum gas (LGP), • liquefied natural gas (LNG), • isopentane	50 kg (110 lb)	25 kg (55 lb)
Flammable Liquids with Boiling Point > 35˚C (95˚F) and Flash Point < 23˚C (73˚F) – e.g. • gasoline, toluene, xylene, • condensate, • methanol, • > 15 API Gravity crude oils (unless actual flashpoint available)	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel
Combustible Liquids with Flash Point ≥ 23˚C (73˚F) and < or equal to 60˚C (140˚F) – e.g. • diesel, most kerosenes, • < 15 API Gravity crude oils (unless actual flashpoint available)	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel
Liquids with flash point > 60˚C (140˚F) released at a temperature at or above its flash point – e.g. • asphalts, molten sulphur, • ethylene glycol, propylene glycol, • lubricating oil	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel

Liquids with flash point > 60 ˚C (140˚F) released at a temperature below its flash point – e.g. • asphalts, molten sulphur, • ethylene glycol, propylene glycol, • lubricating oil	1,000 kg (2,200 lb) or 10 barrels	500 kg (1,100 lb) or 5 barrels

Table E – Tier 2 Process Safety Events - Toxic Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is 'acute', i.e. exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	Outdoor Release	Indoor Release
TIH Hazard Zone A materials - includes • acrolein (stabilized), • bromine	0.5 kg (1 lb)	0.25 kg (0.5 lb)
TIH Hazard Zone B materials- includes: • hydrogen sulphide (H2S), • chlorine (Cl2)	2.5 kg (5.5 lb)	1.3 kg (2.8 lb)
TIH Hazard Zone C materials- includes: • sulphur dioxide (SO2), • hydrogen chloride (HCl)	10 kg (22 lb)	5 kg (11 lb)
TIH Hazard Zone D materials- includes: • ammonia (NH3), • carbon monoxide (CO)	20 kg (44 lb)	10 kg (22 lb)
Other Packing Group I Materials – includes: • aluminum alkyls, • some liquid amines, • sodium cyanide, • sodium peroxide, • hydrofluoric acid (> 60% solution)	50 kg (110 lb)	25 kg (55 lb)

Other Packing Group II Materials – includes: • aluminium chloride, • phenol, • calcium carbide, • carbon tetrachloride • some organic peroxides • hydrofluoric acid (< 60% solution)	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel

Table F – Tier 2 Process Safety Events - Other Material Release Threshold Quantities for LOPC

LOPC is a recordable when release is ‘acute’, i.e. exceeds a threshold quantity in any one-hour period.

Material Hazard Classification (with examples)	Outdoor Release	Indoor Release
Other Packing Group III Materials – includes: • sulphur, • lean amine, • calcium oxide, • activated carbon, • chloroform, • some organic peroxides, • sodium fluoride, • sodium nitrate	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel
Strong Acids or Bases - includes: • sulphuric acid, hydrochloric acid, • sodium hydroxide (caustic), • calcium hydroxide (lime)	100 kg (220 lb) or 1 barrel	50 kg (110 lb) or 0.5 barrel
Moderate Acids or Bases- includes: • diethylamine (corrosion inhibitor)	1,000 kg (2,000 lb) or 10 barrels	500 kg (1,000 lb) or 5 barrels

APPENDIX 3 – EQUIPMENT DEFINTIONS

Equipment	Equipment Definition
Well Pressure Containment System	The casing and wellhead (with cement support and isolation where applicable) and tubing, tubing hardware and tubing hanger represent the equipment are located below the BOP or Christmas Tree, and comprise the "well pressure containment system", and as such represent the ability to contain pressure when a BOP or Christmas Tree has been closed.
Christmas Trees	Equipment attached to the uppermost connection of the wellhead or tubing spool to contain wellbore fluids in both the tubing and in the annular space between the casing and tubing during producing operations. The subsea tree may provide locations where nitrogen and chemical additives can be injected into the annulus or tubing string. The tree consists of assembled equipment that includes a wellhead connector, valves, choke, tree cap, and control system to operate the various components.
Downhole Safety Valves	• Downhole safety valve: A device installed in a well below the wellhead with the design function to prevent uncontrolled well flow when actuated, e.g. SSCSV or SCSSV. • Subsurface controlled subsurface safety valve (SSCSV): An SSSV actuated by the pressure characteristics of the well. • Surface controlled subsurface safety valve (SCSSV): An SSSV controlled from the surface by hydraulic, electric, mechanical, or other means.
Blow Out Preventer and Intervention Systems	Equipment installed on the wellhead or wellhead assemblies to contain wellbore fluids either in the annular space between the casing and the tubulars, in the tubulars or in an open hole during well drilling, completion, and testing operations. For the purposes of SPI data collection, this also includes pressure control equipment used in intervention operations, such as wireline and coiled tubing BOPs, lubricators, etc.
Process Equipment, Pressure Vessels and Piping	• Process Equipment/Pressure Vessel: A container associated with drilling, production, gathering, transportation, and treatment of liquid petroleum, natural gas, natural gas liquids, associated salt water (brine) designed to withstand internal or external pressure above ambient conditions. This definition includes containers used for pressurized storage of toxic and hazardous chemicals. • Piping System: An assembly of interconnected pipes that are used to convey, distribute, mix, separate, discharge, meter, control, or snub flows of hydrocarbons or toxic and hazardous chemicals.
Automated Safety Instrumented Systems / Shutdown Systems	• Automated Safety Instrumented System - a system implementing one or more safety functions, with specified safety integrity level(s), that detect abnormal process conditions and take automatic, necessary actions to achieve or maintain a safe state for the process with respect to a hazardous event.

Equipment	Equipment Definition
	• Shutdown Systems - a system of manual stations that, when activated, will initiate the shutting in (isolation and cessation) of all process stations of a platform production process and all support equipment for the process. May also be integrated with Fire and Gas Detection systems for automatic initiation.
Pressure Relief Devices, Flare Systems, Blowdown Systems, Rupture Disks	• Pressure Relief Device – A device actuated by inlet static pressure and designed to open during emergency or abnormal conditions to prevent a rise of internal fluid pressure in excess of a specified design value. The device also may be designed to prevent excessive internal vacuum. The device may be a pressure relief valve, a non-reclosing pressure relief device, or a vacuum relief valve. • Flare System – used to safely dispose of relief gases in an environmentally compliant manner through the use of combustion. • Blowdown System - a collection of controls, valves and pipes that allow controlled depressurization of liquid or gas pressure contained within a process, piping, or pressure vessel to reduce or eliminate pressure induced stresses during a time of potential heat weakening of vessels and piping, as well as a reduction of the inventory of fuel present on the facility. • Rupture Disk – A pressure containing, pressure and temperature sensitive element of a rupture disk device. A rupture disk device is a non-reclosing pressure relief device actuated by static differential pressure between the inlet and outlet of the device and designed to function by the bursting of a rupture disk. A rupture disk device includes a rupture disk and a rupture disk holder.
Fire and Gas Detection and Fire Fighting Systems	• Manual fire alarms (pull stations), call stations, and audible alarms / beacons • Automatic Fire Detection Systems - The primary function of an automatic fire detection system is to alert personnel of the existence of a fire condition and to allow rapid identification of the location of the fire. The detection system(s) may be used to automatically activate emergency alarms, initiate Emergency Shutdown (ESD), isolate fuel sources, start fire water pumps, shut-in ventilation systems, and activate fire extinguishing systems such as gaseous agents, dry chemical, foam or water. The types of fire detectors commonly used on offshore platforms are as follows: o Flame Detectors - e.g., Infrared (IR) Detectors, Ultraviolet (UV) Flame Detectors, Combination (IR/UV) o Heat Detectors – e.g., Fusible Plugs or links, Heat-pneumatic or Theronistor Sensors, Rate of Rise Detectors, Fixed Temperature Detectors o Products of Combustion / Smoke Detectors – e.g., Ionization Detector, Photoelectric Detector • Gas Detection System – The primary function of a fixed gas detection system is to alert personnel to the presence of flammable gases, toxic gases, or a combination of both. o Flammable Gas Detection – designed to respond to a broad range of hydrocarbon gases / vapors (e.g., methane, ethane, propane and vapors

Equipment	Equipment Definition
	from the evaporation of hydrocarbon liquids). The predominant sensors for flammable gas detection in general, normally occupied spaces are the infrared (IR) sensor or the catalytic bead sensor. o Toxic Gas Detection – many gas detection systems include both flammable gas and toxic gas detection for hydrogen sulfide, sulfur dioxide, and fluorine in the same system. The semiconductor and electrochemical sensors are most commonly used for the detection of the toxic gases. o Excludes portable gas monitoring instruments. • Fixed fire-fighting systems include the following: fire water pumps & drivers, distribution piping, fire hoses, stations, and nozzles, water spray systems / monitors, foam systems (fixed or portable), dry chemical systems, gaseous systems (e.g., CO2, Halon, FM-200 & FE-13, Inergen), and water mist / fine water spray systems. • Fire water systems are installed on offshore platforms to provide exposure protection, control of burning, and/or extinguishment of fires. The basic components of a fire water system are the fire water pump, the distribution piping, the hose / nozzle, and deluge / sprinkler system. Additives such as foaming agents may be included to aid in extinguishing flammable liquid fires. • Excludes portable fire extinguishers
Mechanical Lifting Equipment / Personnel Transport Equipment	• Crane (includes base mounted drum winches) - a type of machine, generally equipped with a hoist, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and to move them horizontally. Includes: o Boom chords, foot pins, hoist (hydraulics and brakes), lift cylinder, sheave assembly, stops, tip extension or jib, pendant lines o Counterweights o Gantry, mast or A-frame pins o Hook block o Overhaul ball o Main hoist (hydraulics and brakes) o Auxiliary hoist (hydraulics or brakes) o Pedestal or crane base o Load management system (MIPEG, CCM-7000 etc.) o Crane safety system (anti two block, high & low angle kick outs) • Top Drive - a device used on a drilling rig to actually rotate the drill pipe in order to drill the well. Includes main drill line hoist (hydraulics or brakes), crown-o-matic, top drive track, assembly rollers or wheels and bearings, hydramatics or hydromatics. • Pipe racking system (PRS) including main hoist (hydraulics or brakes), track, hydraulic system, claws or fingers. • Drawworks, Air Hoists, Tuggers

Equipment	Equipment Definition
	• Chain fall - a type of hoist with a chain attached to a fixed raised structure or beam and used to lift very heavy objects. Includes clutch, brake and sprocket. • Rigging Accessories including hooks, chains, shackles, slings (below the hook), wire rope, D-ring, elevators, bails
Station Keeping Systems	The station keeping systems for a floating structure are typically a single point mooring, a spread mooring, vertical tension legs, or a dynamic positioning (DP) system. • Single point mooring components may include but not limited to: hoisting system, hawser, swivels, roller bearings, risers, u-joint connectors, counter weights, chain, chain table, wire rope, synthetic rope, connecting hardware, clump weight, buoy, and anchor. • Spread mooring components: winch / windlass, chain jack, brakes, power, fairlead, wire rope, synthetic rope, connecting hardware, clump weight, buoy, and anchor • Vertical tension leg moorings are used by TLPs (tension leg platforms) and are comprised of: mooring tendons, seafloor foundations • Dynamic positioning system consists of components and systems acting together to achieve reliable position keeping capability. The dynamic-positioning system includes the power system (power generation and power management), thruster system and dynamic positioning control system.
Bilge/Ballast Systems	The vessel structure, machinery, piping, or controls related to ballast movement, watertight integrity and stability.
Life Boat, Life Rafts, Rescue Boats and Launch and Recovery Systems	• Life Boat / Survival craft is a craft capable of sustaining the lives of person in distress from the time of abandoning the ship. • Rescue boat is a boat designed to rescue persons in distress and to marshal survival craft. • A life raft is an inflatable appliance which depends upon non-rigid, gas filled chambers for buoyancy and which is normally kept not inflated until ready for use. • Launch and Recovery Systems - systems used to deploy or retrieve a lifeboat, life raft, or rescue boat. Components may include but not limited to: winch, fall wire (lifting wire), sheaves (pulleys), davits, davit arms, connecting hardware, secondary securing method (gripes, safety pendants), cradle, lifting points, releasing hook(s), brake, brake release, power source to winch / davit / davit arm, free fall railing.

APPENDIX 4 – LIST OF FIGURES (Body of Report)

APPENDIX 5 – LFI CATEGORY DESCRIPTIONS

Site Type: The primary site where the incident or event occurred. Only one selection can be made.

- Aircraft
- Diving Vessel
- Drilling Rig on Production Facility
- Fixed Production Facility
- Floating Production Facility
- Floating Storage and Offloading Facility
- Mobile Offshore Drilling Unit
- Offshore Supply or Support Vessel
- Offshore Construction Vessel
- Seismic Vessel
- Subsea Production System
- Other

Operation Type: The primary operation that was underway at the time of the incident or event. Only one selection can be made.

- Aviation
- Marine-diving, seismic, transportation, rig moves, etc.
- Production-petroleum/natural gas production, flow lines, pipe lines
- Projects-includes offshore construction activities
- Wells-exploration, appraisal/production drilling, wireline, completion, workover, abandonment, intervention activities
- Other

Activity Type: The primary (most closely linked to incident or event) activity that was occurring at the time of the incident or event. Only one selection can be made.

- Confined Space Entry
- Diving
- Drilling Operations - Normal, Routine
- Energy Isolation
- Emergency Response (Actual or Drill)
- Helicopter Flight
- Helicopter Landing or Take-Off
- Hot Work
- Maintenance, Inspection and Testing
- Marine Vessel - In-Transit
- Marine Vessel - Station Keeping
- Material Transfer or Displacement
- Mechanical Lifting or Lowering

- Production Operations - Normal, Routine
- Simultaneous Operations
- Start-up or Shut-down Operations
- Working at Height
- Other

Areas for Improvement: All of the Areas for Improvement that apply to the incident or event being shared. The Areas for Improvement cover three general categories: Physical Process and Equipment; Administrative Process; or People. Multiple Areas for Improvement can be selected across the general categories.

5.11.1 Physical Facility, Equipment and Process

Select one or more of the following AFI when enhancements in the quality of the physical process and equipment design, layout, material specification, fabrication, or construction were highlighted for improvement, including:

5.11.1.1 Process or Equipment Design or Layout – Select this AFI if the design or layout of the process or equipment was highlighted for improvement. Include cases where issues with the design or layout were significant contributors to subsequent human actions.

5.11.1.2 Process or Equipment Material Specification, Fabrication and Construction – Select this AFI if the quality and compatibility of the material specification, fabrication or construction of the process or equipment, prior to its use was highlighted for improvement, including process or equipment provided by vendors or third parties on a permanent or temporary basis. This category includes the use of defective parts or equipment, or improper installation.

5.11.1.3 Process or Equipment Reliability – Select this AFI if the ability of the process or equipment to function without defects or breakdown was highlighted for improvement, including improvement in maintenance, inspection, testing and operating requirements.

5.11.1.4 Instrument, Analyzer and Controls Reliability – Select this AFI if the ability of instrumentation, analyzers, and control systems, including software, to function without defects or breakdown was highlighted for improvement including improvement in maintenance, inspection, testing and operating requirements.

5.11.2 Administrative Processes

Select one or more of the following AFI when enhancements to the quality, scope or structure of administrative processes for managing various aspects of work execution were highlighted for improvement. **Note** - If the identified gap was related to **"failure to follow"** Administrative Processes, do **NOT** select these categories. Instead, use the appropriate category in Section 5.11.3 People.

5.11.2.1 Risk Assessment and Management – Select this AFI if the process for systematic identification and evaluation of potentially significant risks was identified for improvement. This includes but is not limited to HAZOPS, facility hazard assessments, and Job Safety Analysis (JSA).

5.11.2.2 Operating Procedures or Safe Work Practices – Select this AFI if the improvement opportunity involves creating or modifying operating procedures or safe work practices to prevent recurrence. This includes specific operations, maintenance, testing, contractor selection or other procedures and practices.

5.11.2.3 Management of Change – Select this AFI if the process for identifying, approving, and managing significant technical, administrative or organizational changes was identified for improvement. Specific improvement areas may include MOC use not required (but should have been), MOC review incomplete or incorrect, or MOC actions not completed (e.g. drawings not updated).

5.11.2.4 Work Direction or Management – Select this AFI if the process for directing work activities or managing the number or types of work allowed at a given time or location was identified for improvement. This includes but is not limited to permit-to-work, simultaneous operations and supervision of the area or work team.

5.11.2.5 Emergency Response – Select this AFI if the capability or processes for responding to a situation to prevent the escalation of incident or event consequences was identified for improvement. This category includes opportunities related to emergency preparedness, such as access to equipment and trained personnel, insufficient or absence of drills, etc.

5.11.3 People

Select one or more of the following AFI when enhancements to the personnel actions linked to the execution of work tasks were highlighted for improvement, including:

5.11.3.1 Personnel Skills or Knowledge – Select this AFI if personnel knowledge of the relevant tasks, or the ability of personnel to execute the task correctly and safely, was identified for improvement. This category includes gaps in training (e.g. not required, not completed, or training needs improvement), assessment/verification (not performed, needs improvement, etc.), or remediation (not required, not completed, etc.).

5.11.3.2 Quality of Task Planning and Preparation – Select this AFI if personnel planning and preparation of the task prior to initiating the activity were identified for improvement, including team actions such as reviewing procedures, and completing JSAs, toolbox talks, or job walkthroughs. Note – this category will most often apply when appropriate procedures were in place, but personnel failed to follow them in the pre-work planning phase.

5.11.3.3 Individual or Group Decision-Making – Select this AFI if decisions made by one or more people involved in the execution of the task were identified for improvement. This may be selected only if personnel involved in the task had sufficient skills and knowledge, but chose to execute the task in a manner different than the documented procedure or practice.

5.11.3.4 Quality of Task Execution – Select this AFI if the quality or thoroughness of executing the intended task procedure or practice was highlighted for improvement. This applies where the person or personnel were attempting to follow the prescribed procedures or practices, but errors or incomplete execution contributed to the incident or event.

5.11.3.5 Quality of Hazard Mitigation – Select this AFI if a person or personnel either failed to put in place barriers or the quality, number, or location of barriers were insufficient to mitigate the potential impacts of relevant hazards was highlighted for improvement.

5.11.4.6 Communication – Select this AFI if the effectiveness of communication was identified for improvement. This includes communication between team members and between the team and other individuals or groups. Also included are difficulties with language or terminology.

5.12 Additional Comments

Enter Areas for Improvement that were identified in areas outside the Physical Facility, Equipment and Process; Administrative Processes; and People categories described above. A detailed description of the identified improvements should be included. Also, any additional description of “Other” Site, Operation or Activity Types could be included in this Additional Comments section. This input cell is limited to 750 characters. The first use of an acronym should always be preceded by the term for which it is used.

5.13 Lessons Learned

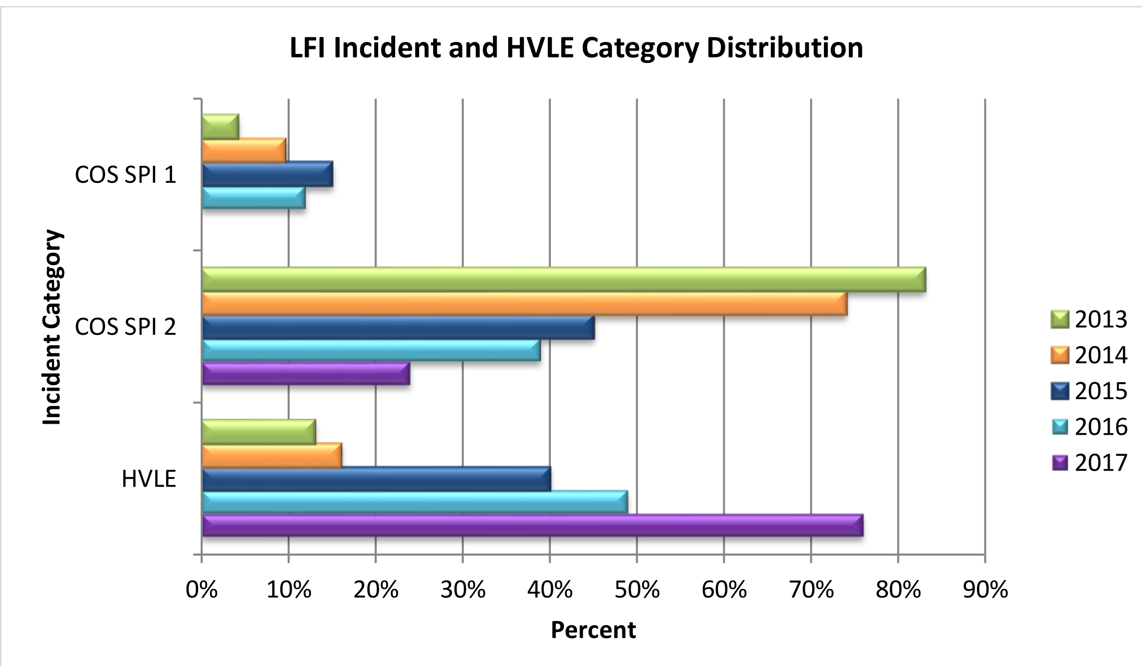
Enter a description with sufficient content to explain the context of the incident, lessons learned and actions taken to reduce the likelihood of a recurrence. These may include equipment, processes and/or human factors. Lessons Learned and actions taken should be directly related to the areas for improvement listed above. This input cell is limited to 750 characters. The first use of an acronym should always be preceded by the term for which it is used.

APPENDIX 6 – LFI DATA CHARTS (US OCS Data)

Refer to the charts listed in this appendix for additional details on the distribution of incidents and HVLE across reporting fields contained in the LFI Report Form (and not previously displayed in the body of the report). The following charts are contained in this Appendix:

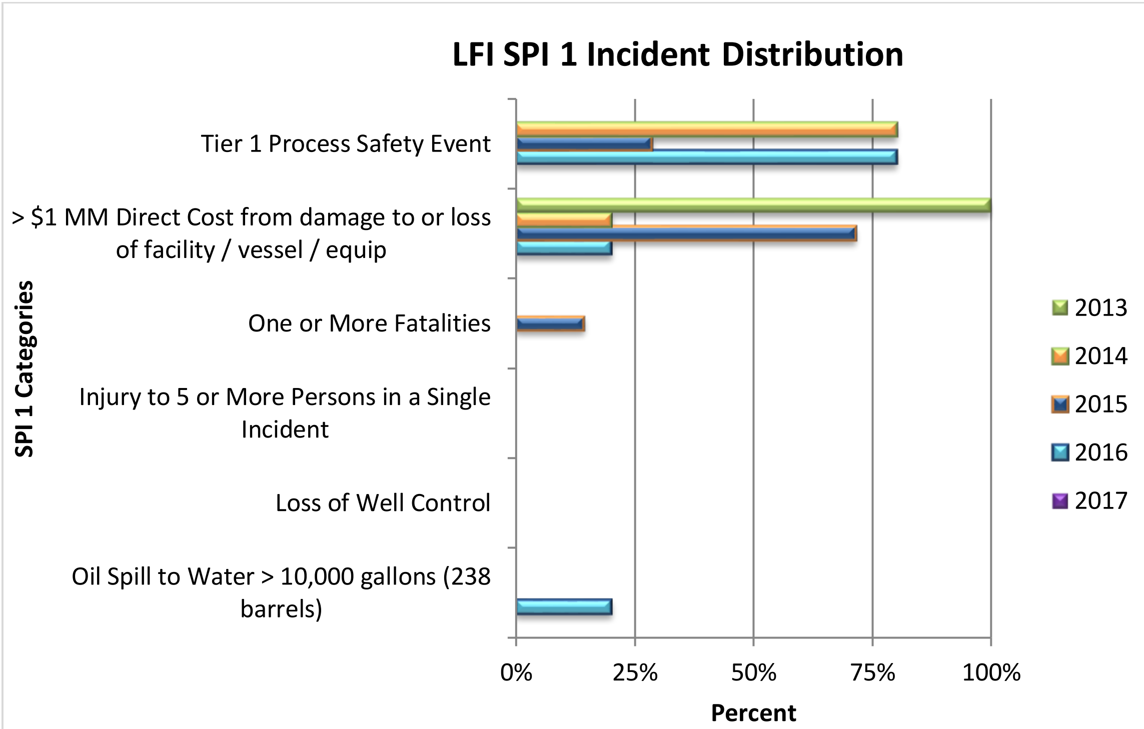
- Chart 1 – LFI Incident and HVLE Category Distribution
- Chart 2 – LFI SPI 1 Incident Distribution
- Chart 3 – LFI SPI 2 Incident Distribution
- Chart 4 – LFI Incident and HVLE Site Type Distribution
- Chart 5 – LFI Incident and HVLE Operation Type Distribution
- Chart 6 – LFI Incident and HVLE Activity Type Distribution
- Chart 7 – LFI SPI 2C (Mechanical Lifting or Lowering) AFI Distribution
- Chart 8 – Maintenance Inspection and Testing AFI Distribution
- Chart 9 - Process Safety (Tier 1 and Tier 2) AFI Distribution
- Chart 10 – Area for Improvement Category Distribution by Year

Chart 1 – LFI Incident and HVLE Category Distribution



- Number of occurrences represented above (by year): 2013 = 46, 2014 = 51, 2015 = 47, 2016 = 43, 2017 = 33
- HVLE increased to 76% in 2017
- Decrease in SPI 2 incidents and increase in HVLE for 2015-2017 are due in part to SPI 2C (Mechanical Lifting or Lowering) definition changes

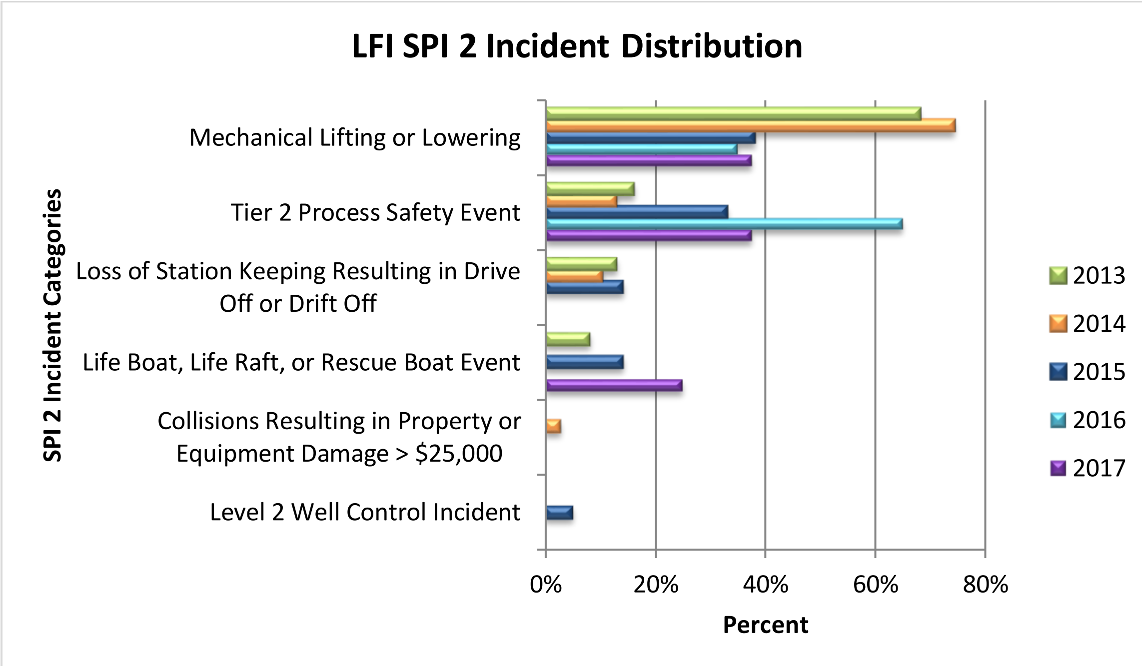
Chart 2 – LFI SPI 1 Incident Distribution



[1] *This chart depicts the number of SPI 1 consequences divided by the total number of SPI 1 LFI submitted in the given year. The total percentage in a given year can exceed 100% when multiple consequences occur for one incident.*

- There were no SPI 1 events reported in the US OCS for 2017
- Number of occurrences represented above (by year): 2013 = 2, 2014 = 5, 2015 = 8, and 2016 = 6, 2017 = 0

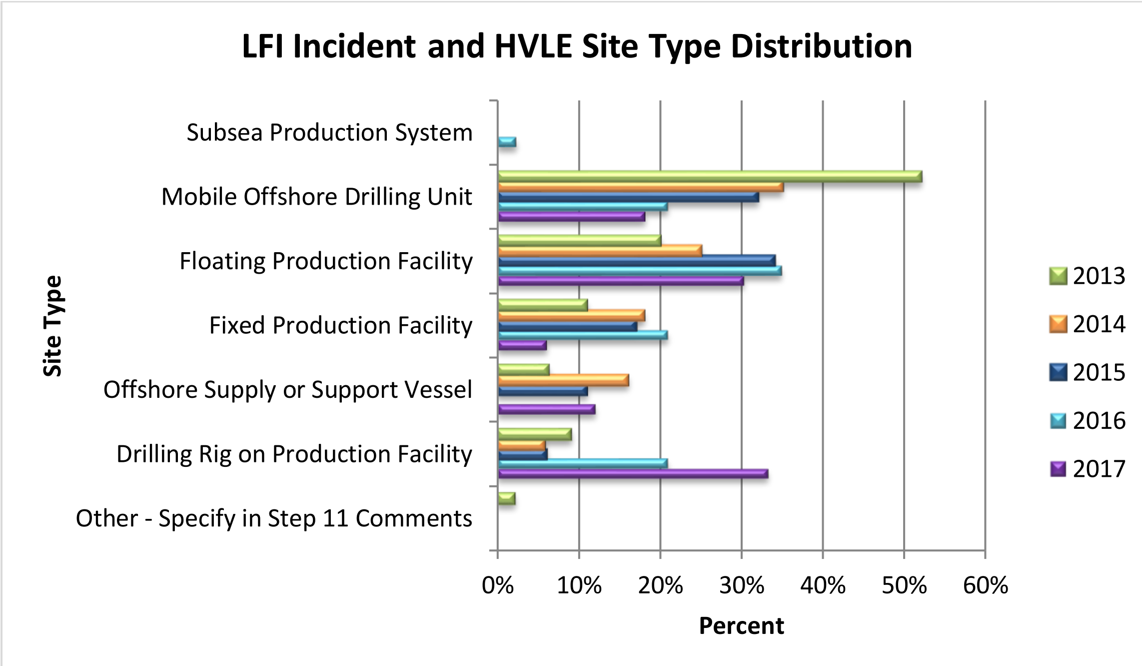
Chart 3 – LFI SPI 2 Incident Distribution



[1] *This chart depicts the number of SPI 2 consequences divided by the total number of SPI 2 LFI submitted in the given year. The total percentage in a given year can exceed 100% when multiple consequences occur for one incident.*

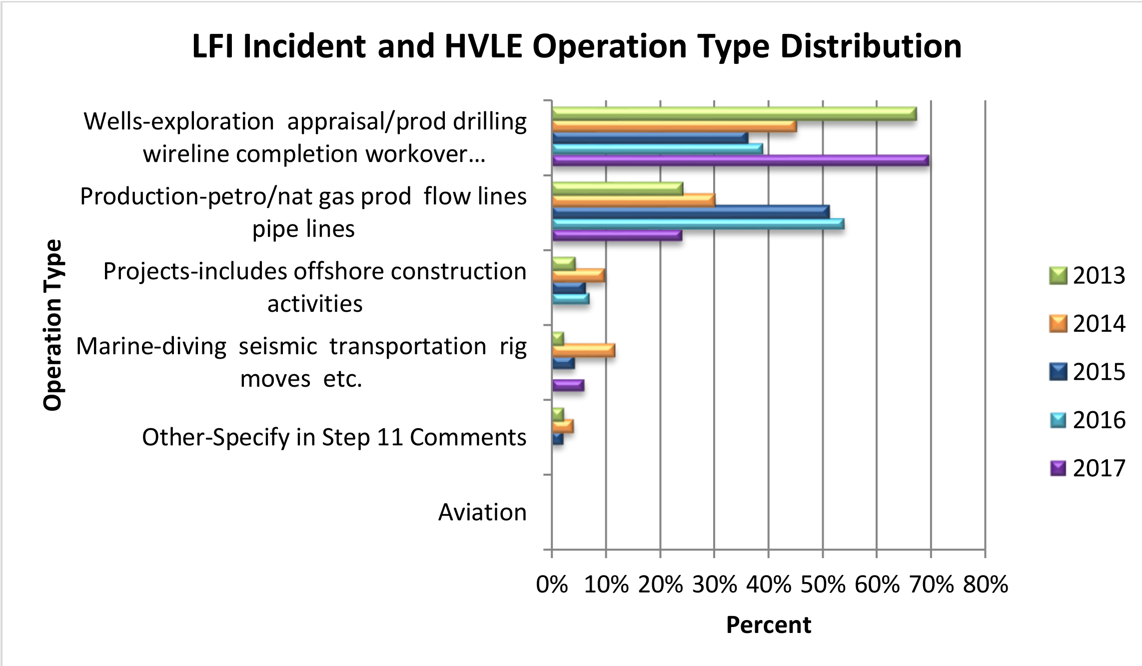
- Mechanical Lifting or Lowering category definition was modified in 2015. As such the 2015 - 2017 data for this category can't be correlated to the corresponding data for 2013-2014.
- Number of occurrences represented above (by year): 2013 = 40, 2014 = 38, 2015 = 22, 2016 = 17, 2017 = 8
- Level 2 Well Control Incident was a new category for 2015. As such the 2015 - 2017 data for this category can't be correlated to the corresponding data for 2013-2014.

Chart 4 –LFI Incident and HVLE Site Type Distribution



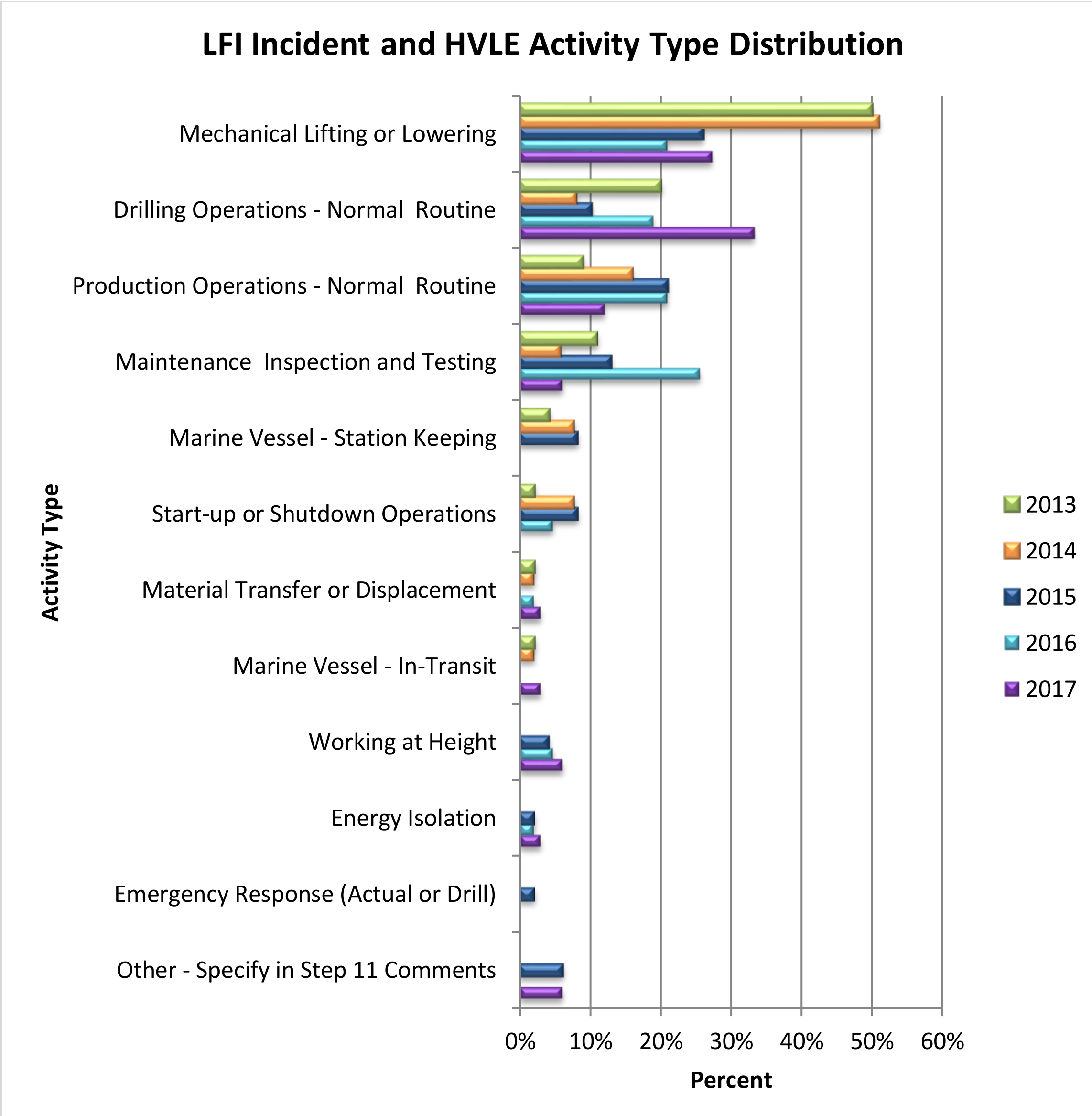
- Number of occurrences represented above (by year): 2013 = 46, 2014 = 51, 2015 = 47, 2016 = 43, 2017 = 33
- For 2017, Drilling Rig on Production Facility shows the highest percentage for all 5 years, and Fixed Production Facility and MODU were the lowest percentage for all 5 years. This may be indicative of a relative increase in drilling activity.
- 2016 is the only year a Subsea Production System incident was reported in the APR

Chart 5– LFI Incident and HVLE Operation Type Distribution



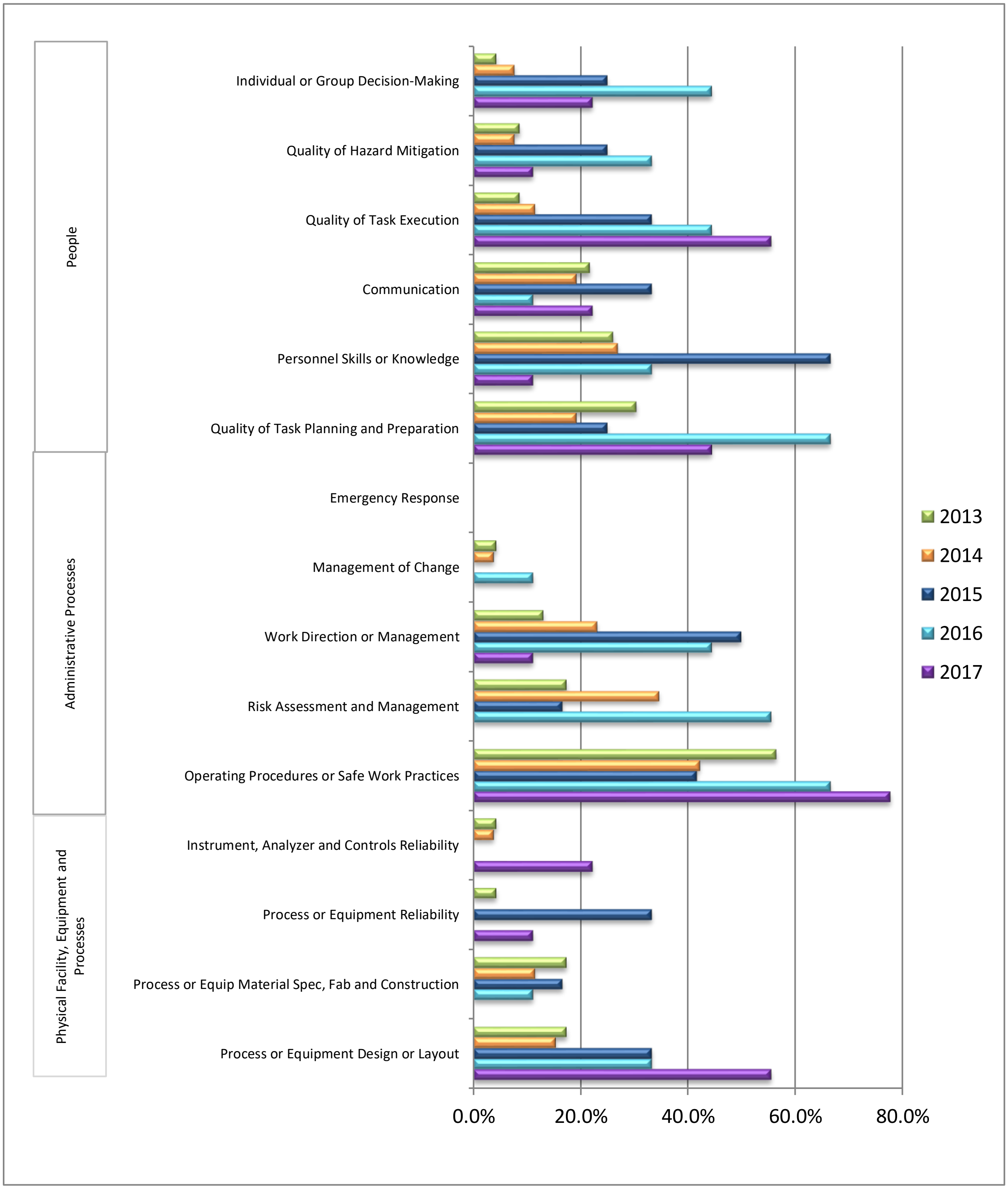
- Number of occurrences represented above (by year): 2013 = 46, 2014 = 51, 2015 = 47, 2016 = 43, 2017 = 33
- For 2017, “Wells…” showed the highest percentage in 5 years, and “Projects…” at 0% was the lowest in 5 years

Chart 6 – LFI Incident and HVLE Activity Type Distribution



- Number of occurrences represented above (by year): 2013 = 46, 2014 = 51, 2015 = 47, 2016 = 43, 2017 = 33
- This chart presents the primary activity for each event (LFI Submittals identify only one activity for each event). Secondary activities are not captured in this chart (e.g. Mechanical Lifting or Lowering during Maintenance Inspection and Testing).
- The decrease in mechanical lifting or lowering reported in 2015-2017 is due in part to the change in SPI 2C reporting thresholds made in 2015.

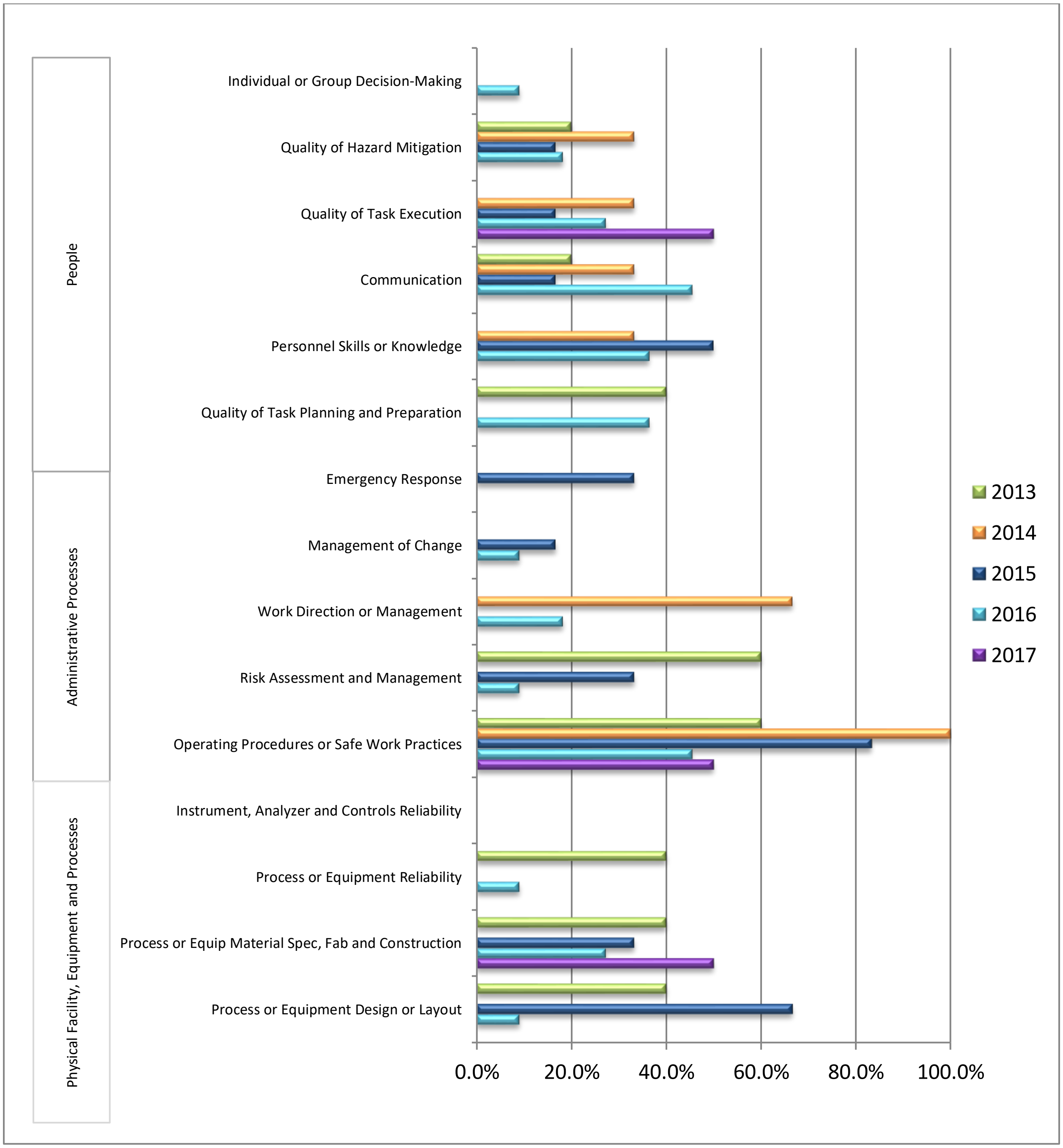
Chart 7 –Mechanical Lifting or Lowering AFI Distribution (AFI selection per total number of Mechanical Lifting or Lowering Activity submittals)



[2] This chart depicts the number of Mechanical Lifting or Lowering Activity AFI selected divided by the total number of Mechanical Lifting or Lowering Activity LFI submittals in the given year.

- Number of incidents represented above (by year): 2013 = 23, 2014 = 26, 2015 = 12, 2016 = 9, 2017 = 9
- For 2017, Process or Equipment Design or Layout and Operating Procedures or Safe Work Practices showed the highest % for the 5-year period

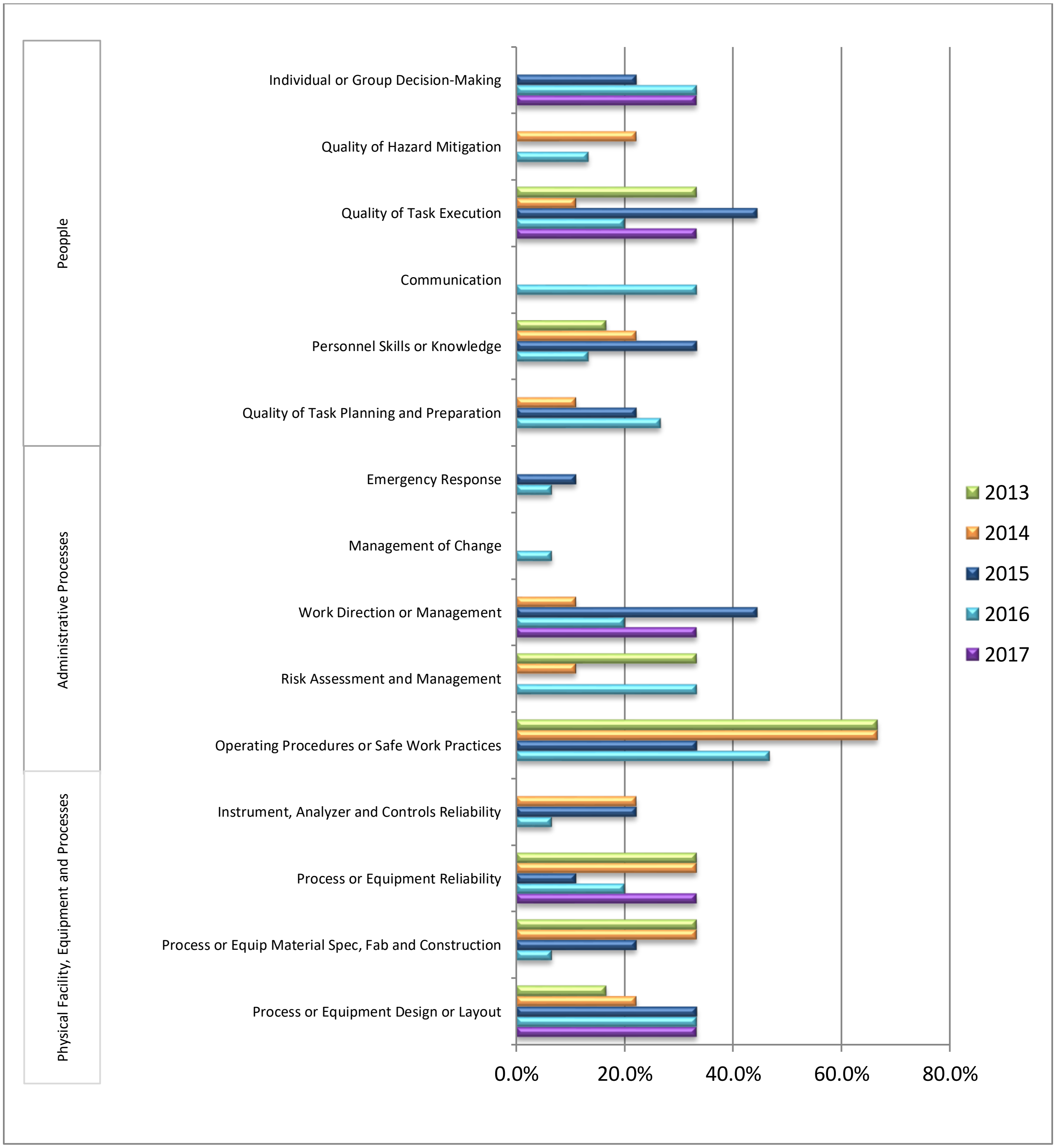
Chart 8 – Maintenance Inspection and Testing AFI Distribution (AFI selection per total number of MIT submittals)



[1] *This chart depicts the number of Maintenance Inspection and Testing Activity AFI selected divided by the total number of Maintenance Inspection and Testing LFI submittals in the given year.*

- Number of incidents represented above (by year): 2013 = 5, 2014 = 3, 2015 = 6, 2016 = 11, 2017 = 2

Chart 9 – Process Safety (Tier 1 and Tier 2) AFI Distribution (AFI selection per total number of PSE submittals)



[1] *This chart depicts the number of AFI selected divided by the total number of PSE submittals in the given year.*

- Number of Process Safety LFI Forms represented above: 2013 = 6, 2014 = 9, 2015 = 9, 2016 = 15, 2017 = 3

- Chart 10: LFI Areas for Improvement (AFI) Distribution