

Report

Safety indicators used by authorities in the petroleum industry of UK, US and Norway

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KEYWORDS:Safety, Safety indicators,
Petroleum industry,
Regulation**VERSION**

1

DATE

2011-09-26

AUTHOR

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CLIENT(S)

The Norwegian Research Council

CLIENT'S REF.

Tor-Petter Johnsen

PROJECT NO.

504120

NUMBER OF PAGES/APPENDICES:

24+ 4 appendices

ABSTRACT

The purpose of this report is to give a brief introduction to different perspectives upon safety indicators and a presentation of authorities' use of indicators in UK, USA and Norway.

The report elaborates on the complexity of comparing indicators. The main reasons are that indicators can serve different purposes, and they might be grounded on different perspectives and contexts. The report proceeds to present the development and use of existing safety indicators in UK, US and Norway. On this background it provides a brief discussion of aspects to be considered when comparing indicators from the three countries.

The overall conclusion is that it is difficult to compare the safety status of the petroleum industry in UK, US and Norway through the use of safety indicators. Hence, it is also difficult to compare the effect of the different regulatory regimes that the authorities of these countries represent. However, a comparison might be useful if the purpose is to learn more about how indicators might function, what for and for whom they might be useful, and how indicators can be used for regulatory purposes. Comparisons must take contextual factors such as for instance features of the actual regulatory regimes into consideration.

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**REPORT NO.**

SINTEF A20542

ISBN

978-82-14-05196-4

CLASSIFICATION

Unrestricted

CLASSIFICATION THIS PAGE

Unrestricted

Document history

VERSION	DATE	VERSION DESCRIPTION
Version No. 1	2011-09-26	

Table of contents

1	Introduction.....	5
2	Challenges of performing comparison between countries.....	7
2.1	The term 'indicators'.....	7
2.2	Perspectives and focus of attention.....	7
2.2.1	The predictive versus retrospective perspective.....	8
2.2.2	The technical-human-organizational perspective.....	9
2.2.3	Different aspects of HSE.....	9
2.3	Data and comparability.....	9
3	General status of indicators of UK, US and Norway.....	13
3.1	UK Indicators.....	13
3.2	US Indicators.....	15
3.3	Indicators used in Norway.....	17
4	Discussion and conclusions.....	21
	References.....	23
	Appendix 1 Background data of UK, US and Norway.....	25
	Appendix 2 International statistics from UK, US and Norway.....	29
	Appendix 3 Sources of indicators that might have interest for further work.....	37
	Appendix 4 Search in New York Times 11.04.13.....	39

1 Introduction

Contemporary offshore safety statistics is challenging for several reasons. Internationally it seems to be a lack of scientific based studies, based on empirical data, assessing broader regulatory approaches within different types of regulation. It is a challenge to establish robust longitudinal data catching the relevant factors within one specific regulatory regime. However, the major challenge comes with the issue of comparing data across regimes with different contexts, cultures/values and history.

There are differences in the regulatory regimes of countries involved in the petroleum industry¹. There might be many factors in each country that influence regulation itself, what is given attention through the regulation and what is relevant to measure as indicators of the efficiency or outcomes of the activities. This implies that there might be a difference between what is relevant to measure when the purpose is to evaluate effect of regulation over time in one particular country and what is relevant to measure for comparison between the different countries. However, Hood & al. (2001) discuss that variation in risk regulation regimes are often difficult to explain.

Performance data is also a recognized challenge among regulators. For instance, the Head of HSE Offshore Division Steve Walker (2010) argues that regulators need performance data for notification of action, immediate/long term resource decisions and confirmation of success/failure. The International Regulators' Forum (IRF) has provided guidelines for performance measurement data in the petroleum industry². However, the data provided by regulatory authorities are often more about measuring the activities of the authorities than the effect of these activities³. Companies within the petroleum industry and their industry group often provide data than can/are used as indicators of the development, both by the authorities and themselves⁴.

As an outset for the work with these challenges this study will give a brief introduction to challenges of comparing indicators. It proceeds to give an introduction to the development and use of existing safety indicators by authorities in UK, US and Norway. The main focus of attention will be on the use of measurable data, the themes/content that are covered and the underlying perspectives of the data. The study will neither go into the results of the measurements nor in depth of the applied methods.

On this background the report provides a brief discussion of aspects to be considered when comparing indicators between the three countries.

The study is a part of the research project Robust Regulation, financed by The Research Council of Norway. It is directed at authorities' regulation of the petroleum industry. One of the goals of the project is to compare regulation in UK, US and Norway. However, the concept of "regulation" can be given a variety of meanings. One important distinction is between (1) regulations as a set of rules that have the force of law and (2) regulation conceived as an activity or a task. In the project these two connotations are distinguished by using the plural form in the first case and the singular form in the second case. The project "Robust Regulation" concerns regulation in the second sense. However, in the project, regulation in the first sense is considered to be an important means for the regulation of HSE.

¹ See for instance Appendix 1 for a demonstration of some of the differences between the regulatory regimes of UK, US and Norway

² See <http://www.irfoffshoresafety.com/country/performance/scope.aspx>

³ Telephone interview with Torleif Husebø, PSA 16 May 2011

⁴ Telephone interview with Torleif Husebø, PSA 16 May 2011

2 Challenges of performing comparison between countries

The issue at stake is the use of safety indicators by the authorities of UK, US and Norway. Øyen et al. (2009a) find that there has been an increasing tendency to put ‘everything’ under the umbrella of ‘indicators’. Further, a variety of perspectives and dimensions can be applied when discussing and comparing indicators, and so the focus of attention can become very different.

2.1 The term ‘indicators’

The term ‘indicator’ may be used in several ways, which means that there exist many definitions (See Øyen et al. (2009a) for more thorough discussions). Also, a number of terms such as for example ‘safety performance measures’ or ‘safety outcome measures’ and ‘safety indicators’ or ‘risk indicators’ are sometimes used interchangeably.

Different definitions can have different purposes. For instance, OECD (2003) defines a safety performance indicator as *‘a means for measuring the changes over time in the level of safety (related to chemical accident prevention, preparedness and response), as the results of actions taken’*. Skogdalen et al. (2010, p 109) build upon this definition. They consider a safety performance indicator to be *‘a means for measuring the changes in the level of safety (related to major accident prevention, preparedness and response), as a result of actions taken.’* These definitions reflect that they are made for comparisons over time to demonstrate developments as results of actions. Accordingly, they are not made for comparison between countries and they do not give attention to the needs of special users of the indicators.

Øien et al. (2011a) argue that it may be appropriate to distinguish between the two terms ‘safety indicators’ and ‘risk indicators’. According to them, risk indicators are developed from a risk based approach, whereas safety indicators may be developed from various approaches, such as a safety performance based approach, an incident based approach or a resilience based approach. Thus a probabilistic risk assessment is only one basis for the development of indicators. (See Øien et al. (2011a) for more thorough discussions of the terms). In this connection the term safety can be associated with something positive, while the term risk can be associated with something negative, i.e. the terms can also reflect a difference in the focus of attention from something to achieve versus something to avoid. Seen together, this discussion demonstrates that it is interesting to take into consideration the approach that is applied for the development of indicators.

In addition, Øyen et al. (2009a) associate the term indicator with the term ‘risk influencing factor’ (RIF). They consider a RIF to be ‘an aspect (event/condition) of a system or an activity that affects the risk level of this system or activity’. A given RIF might not be measurable but can be defined theoretically. The measuring of a RIF may be performed by an indicator or a set of indicators where the indicator is an operational variable that defines a RIF measurably. This demonstrates that it is also interesting to look behind the indicators used in different countries and take into consideration the aspects that are given/meant to be given attention through the measured indicators.

The conclusion of these examples and discussions are that when comparing indicators from different countries, it is important to take into consideration their purpose, their underlying assumptions and rationales and their focus of attention.

2.2 Perspectives and focus of attention

For the further discussion of the use of safety indicators by the authorities of UK, US and Norway, it might be useful to take a closer look at differences in perspectives and focuses of attention that indicators might have.

2.2.1 The predictive versus retrospective perspective

One much discussed distinction is between the ‘predictive’ perspective versus the ‘retrospective’ (Øien et al. 2010a). Here the distinction is made between indicators that try to predict the possibility of having a major accident ‘tomorrow’ including all possible causes, or establishing causes after -the-event, i.e. in retrospect.

The dimension ‘leading’ versus ‘lagging’ indicators are often associated with this perspective and have been much discussed, see for instance Hopkins (2009a and b); Hale (2009 a and b); Øien et al. (2011a and b); Vinnem (2010); Kjellén (2009). Øien et al. (2011a and 2011b) explain that leading indicators can be seen as activity based indicators or proactive indicators measuring underlying causes and contributing factors. These are related to active monitoring of inputs that are essential to achieve the desired safety outcome. Lagging indicators can be seen as reactive indicators measuring factors after-the-event factors. These are related to reactive monitoring and show when a desired safety outcome has failed, or when it has not been achieved.

Associated with this perspective we also find the search for indicators of ‘early warnings’ or signals of a dangerous development, (Øien et al., 2009a). When discussing whether the Macondo blowout could have been foreseen, Skogdalen et al. (2010) focus on the ability of indicators to provide early warnings of a major accident, i.e. ‘precursor’ or ‘early warning indicators’.

Fleming (2010) makes an interesting distinction that can be associated with the notion of early warnings. He distinguishes between status indicators and curative indicators. His examples of curative indicators are leadership, data management, organizational learning and communication. Examples of status indicators are rate of maintenance problems, ratio of corrective to preventative maintenance to critical systems, rate of plant changes not incorporated into design documentation before next turnaround. The first group of indicators can be seen as indicators measuring the ability of an organization to create safe conditions and handle unexpected dangerous events while the latter can be seen as indicators measuring weaknesses of the organization that might result in an accident.

Also, Fleming (2010) makes a useful comparison between outcomes and indicators. He finds that outcomes are retrospective and objective of nature and they can serve as important performance measures whereas indicators are predictive of future, they may be subjective and they might be of interest only for prediction. However, he demonstrates that the distinction between predictive versus retrospective is not simple and straight forward. For instance, the same data such as LTI (lost time injury frequency rate)⁵ and Leak Rates can be used both for retrospective and predictive purposes; they can describe retrospective outcomes at a certain point of time, and their development over time can be used for subjective predictions about the future. Also, there are ongoing discussions about how LTI- and Leak-rates can be understood, what their foundation might be, how they might interact and whether they can be used to tell something about other topics than injuries and leaks. The latter topic will be elaborated in section 2.2.3.

Seen together, this perspective distinguishes between indicators that focus upon *existing conditions* that can be associated with the likelihood of a major accident in the future and indicators that focus upon the use of *experiences of the past* to anticipate the future.

⁵ LTI-rate – *lost time injury frequency rate* is defined as the number of lost-time injuries per one million hours of work. A lost-time injury is an injury due to an accident at work, where the injured person does not return to work on the next shift (Kjellén, 2000)

2.2.2 The technical-human-organizational perspective

Another perspective is the so called technical-human-organizational perspective; see Øien et al. (2010a) who consider another high risk industry, i.e. the nuclear industry. This perspective is related to the development in accident investigation, moving from technical to human and further to organizational causes. Here the assessment of plant safety is conducted by evaluating two areas. One is the physical system design and performance. The other is operational system design and performance. The latter is about the organizational and human contribution and covers terms like operational safety, human performance and safety culture. One example here can be indicators that focus on different types of behaviour, (Lamvik & Ravn, 2006). Another is indicators that focus on different types of knowledge.

There are also other themes that can be associated with this perspective. One is whether the indicators focus on direct or indirect causes. Another used distinction is whether the indicators focus on the sharp versus the blunt end (Vinnem, 2010). Øien et al. (2011b) direct the attention towards different phases in the progression of the work. Finally, indicators concerning the status/levels of different barriers against accidents and their negative outcomes can be of technical, human or organizational nature.

This reveals that when comparing between countries, it is of interest to study how the indicators give attention to technology, humans and organization and the interactions between these elements.

2.2.3 Different aspects of HSE

Indicators might be directed at different aspects of HSE (HSE: Health, Safety and Environment) such as for instance major hazards, occupational hazards and illnesses, helicopter transportation hazards, physical and psychosocial working environment aspects, attitudes and safety culture, as well as perceived risk, (Vinnem, 2010). The indicators might also be different for different types of damages, such as damages to persons, assets or environment (Øien et al. 2011b).

However, applying indicators for one aspect on other aspects can be problematic. In particular there have been discussions about the usefulness of applying indicators for occupational hazards and personal safety as indicators either for major hazards (Vinnem, 2010), major accident or system safety (Øien et al. 2011b), or process safety (Hopkins, 2007; 2009 a and b). For instance, in hindsight of the Macondo blowout, the rather high confidence in safety, based on a positive development in personal injuries (LTI-rates) as the primary safety performance measure, has been much discussed, (see for instance Fleming, 2010). When discussing personal safety versus process safety, Hopkins (2007) argues that the distinction leading/lagging indicators is particularly complicated when applied to process safety.

When comparing outcome indicators related to HSE, it is also important to note that there might be differences in how they are defined and reported. For instance, what does reported injuries mean? Do they only include injuries leading to absence from work or all injuries? Are serious accidents and fatal accidents included? Does 'lost time injuries' mean absence in three days or in three days or more?

Again, this reveals that when making comparisons it is important to be cautious about the direction of attention that the indicators represent. The discussions also underline the importance of being cautious about their definitions, generalizability and use.

2.3 Data and comparability

Comparing the use of indicators for the authorities of different countries is made complicated due to varying opportunities to develop statistics and make them public. As is revealed in Appendix 1, the IRF (2011) provides some self reported background information about the regulatory bodies of different countries. A comparison of this information demonstrates that the authorities of different countries are working under different conditions and apply different principles in their legislation and follow-up of the petroleum industry. Also, through their Performance Measurement Project, IRF provides performance statistics from

different countries, see Appendix 2. When looking into these, it is evident that there are variations with respect to types of data provided about the safety performance of the country, and how well the data fit into the form that IRF applies. It is a challenge that there are differences between countries in the traditions of reporting and various authorities' requirements to do that⁶. There are also differences in the authorities' traditions for making available data open for transparency (Steinzor, 2011).

The quality of indicators or performance data has been an issue at stake. For instance, Fleming (2010) argue that good indicators are accurate (with direct relationship to system status, and difficult to manipulate), productive (related to future system states and performance) and current (giving real time information). Skogdalen & al. (2010, p 121-122) refer to the work of the American Petroleum Institute (API) about developing Process Safety Performance Indicators for the Refining and Petrochemical Industries. They list that the success of indicators is related to the extent to which they are:

- Able to drive process safety performance improvement and learning.
- Easy to implement and understand by stakeholders (e.g., workers and public).
- Statistically valid at one or more of the following levels: industry, company and site.
Statistical validity requires a consistent definition, a minimum data set size, a normalization factor, and a relatively consistent reporting pool.
- Appropriate for industry, company, or site level benchmarking

With reference to Vinnem, Skogdalen & al. (2010) add that major accident indicators must also reflect hazard mechanisms, i.e. be valid for major hazards, be sensitive to change, show trends, be robust to manipulation and influence from campaigns giving conflicting signals, and not require complex calculations. Also, the International Atomic Energy Agency (IAEA) has suggested characteristics of quality for safety performance indicators, (IAEA, 1999).

When comparing indicators from different countries, national characteristics might influence the data in ways that make it difficult to draw conclusions. For instance, Lamvik and Ravn (2006) discuss that there might be differences in safety performance between countries due to contextual factors such as elements of national culture. One example is differences related to continuity such as traditions of contract length, work force, crew organization and the role and function of management. Another example is differences related to flexibility in government, authorities and industrial relations. There might also be differences in complexity of systems, degree of multinational workforce, responsibility delegated to the operator /contractor.

Further, different regulatory regimes might themselves create conditions that complicates comparisons, For instance, when comparing management functions, especially the role of so-called "paperwork", Lamvik and Ravn (2006) found that requirements to documentation influenced the behaviour of the management. Supervisors with experiences from both South East Asia and the North Sea argued that the extensive paperwork obligations in the North Sea resulted in less time spent outside the office in the North Sea than when they worked in South East Asia.

The relevant level of aggregation of indicators for comparison is also an issue of concern for both the authorities and the project of Robust regulation. Is it of interest to develop indicators at the company level, according to types of activities or the overall development of the industry?

These discussions illustrate once more how important it is to be careful when comparing data from different countries, i.e. it is important to pay attention to the degree of regulatory requirements to reporting, the

⁶ Telephone interview with Torleif Husebø, PSA 16 May 2011

sources of information, transparency, quality and level of aggregation of the data. Also national contexts such as culture and regulatory properties are relevant.

3 General status of indicators of UK, US and Norway

The regulation of UK, US and Norway is functioning under different conditions, see Appendix 1, and the use and status of the indicators varies between the countries, see for example Appendix 2. These differences influence both what types of indicators the authorities refer to, what climate there is for cooperation and what kind of information the authorities can require from the companies⁷. Below, a more thorough introduction to the different countries' work with indicators is provided. Other sources of indicators that the work has come across and that might have interest for further work are presented in Appendix 3.

3.1 UK Indicators

UK has regulations requiring the companies to report injuries, diseases and dangerous occurrences, i.e. the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)⁸. Health and Safety Executive (HSE) provides yearly⁹ reports upon statistics (HID Statistics) about offshore accidents, dangerous occurrences and ill health. These annual reports are based on incidents reported to HSE under the requirements of RIDDOR. For offshore operations, they cover incidents directly affecting offshore installations or workers or visitors on offshore installations. The reports do include offshore wells and most activities in connection with them, as well as offshore pipelines, pipeline works and certain activities in connection with pipeline works. Incidents on offshore windfarms are included. They also include certain diving operations in connection with operations on an offshore installation, i.e. offshore diving and diving support activities associated with an offshore installation only. However, the reports do not include incidents arising from marine activities that are not directly connected with offshore operations (e.g. vessels or rigs in transit) or air transport activities (including transport to, from or between installations), except incidents affecting helicopters whilst located on an installation which are included if they occur. An overview of the main indicators used for the period from April 2009 to March 2010 is presented in Table 1 below (HSE, 2010).

In addition, HSE's Offshore Division has performed programs (HSE, 2007). The first was called Key Program 1 (KP1). This was launched in 2000 with the aim to reduce hydrocarbon releases. In particular, it focused on process plant. Here the success was measured according to number of major and significant hydro carbon releases.

Key Program 3 Asset Integrity Inspection (KP3) was initiated out of concerns for major accidents on the UK continental shelf (UKCS) (HSE, 2007). The work started in 2004 and focused on the effective management and maintenance of safety critical elements (SCEs). The report illustrates how the relationship between major hazards, development of SCE's and their maintenance management is considered (for further information, see p 9 in the report (HSE, 2007))¹⁰. KP3 involved targeted inspections of nearly 100 offshore installations representing about 40 percent of the total. The inspection program was structured using a template containing 17 elements covering all aspects of maintenance management and a number of SCE systems tests. An element covering 'Physical state of plant', was also included allowing the inspection

⁷ Telephone interview with Torleif Husebø, PSA 16 May 2011

⁸ Reportable injuries and dangerous occurrences are defined in regulation 3 of RIDDOR. Further description of 'Major Injuries' is provided in RIDDOR under Schedule 1. Reference to over-3-day injuries in this annual report includes all other RIDDOR reportable injuries that are less severe than Major Injuries. Description of reportable Dangerous Occurrences is provided in Schedule 2.

⁹ From April to March the year after

¹⁰ The SCE's are the parts of an installation and its plant (including computer programs) the purpose of which are to prevent, control or mitigate major accident hazards (MAH) and the failure of which could cause or contribute substantially to major accidents, i.e. the SCEs represent the barriers which prevent, control or mitigate the major accident scenarios. The thought was that the maintenance management strategy must be developed to provide assurance that the SCE's will be available when required, they will operate with the required reliability and they be able, as necessary, to survive incidents against which they are designed to protect (HSE, 2007, p 9)

team's judgment of the general state of the platform to be recorded. The performance, on inspection, of each template element was scored using a traffic light system which enabled overall installation performance to be recorded on a matrix. In addition to performance indicators from the industry, the report includes evaluations of the regulatory approach taken in the program. The criteria for the evaluation of the work of the program are also demonstrated in Table 1.

One of the results from the work of KP3 was the establishment of a workgroup, the 'Installation Integrity Workgroup' (HSE, 2007). The workgroup was set up by the industry itself and involves 30 oil companies, contractor organizations and independent verification bodies. Among other activities, the workgroup has developed new Key Performance Indicators (KPI's)

HSE and Chemical Industries Association (CIA) (2006) take into account that performance measurements may be divided into reactive monitoring, (identifying and reporting on incidents and learning from accidents) and active monitoring, (feedback on performance before an accident or incident occurs). HSE and CIA emphasize the importance of utilizing both leading and lagging indicators and use the term 'dual assurance' approach.

Table 1, Overview of indicators applied in UK

Source	Indicator	Description	Comments
Offshore Safety statistics (HSE, 2010)			Incidents reported to HSE under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)
	Fatal injuries to offshore workers	Number of incidents. Injury rates calculated by using offshore population data	Injury rates are calculated using offshore population data from the industry's Vantage personnel tracking system. Up to and including 2003/04, data from the Inland Revenue was used. For 2009/10, the estimated offshore population (based on total number of hours worked divided by 2000 hours per worker year) was 26,598, a 5.76% reduction compared to the previous year's figure of 28,224. Injuries are categorized according to severity and nature. The report shows the ratio of over-3-day to major injuries and calculates three-year rolling averages to smooth out variations and give a clearer picture of overall trends. Part of body injured, kind of accident, age of injured person, work process environment (type of activity being carried out when the incident occurred), agent of accident against severity of injury are also differentiated
	Major Injuries to offshore workers	Number of incidents. Injury rates calculated by using offshore population data	
	Over-3-day injuries to offshore workers	Number of incidents. Injury rates calculated by using offshore population data	
	Incidents of ill-health to workers offshore	Number of incidents	
	Dangerous occurrences offshore	Number of incidents. Split by type	Well related dangerous occurrences are split into sub-categories.

Source	Indicator	Description	Comments
	Hydrocarbon Releases (HCR) Minor, Major & Significant	Number of releases, classified according to severity	The classification of a hydrocarbon release incident as ‘Significant’ or ‘Major’ implies the <u>potential for that release, if ignited</u> , to directly cause or escalate to an event severe enough to be viewed as a ‘Major Accident’. Emergency action is normally required to be taken to limit the potential consequences of ignition of a reportable leak of hydrocarbon. (Severity Classification’ guidance for Major, Significant and Minor HCRs can be found on the HSE website at https://www.hse.gov.uk/hcr3/help/help_public.asp) Detailed supplementary data relating to HCRs reported under RIDDOR are voluntarily reported to HSE by offshore operators
KP3 factors (HSE, 2007)			
	Consistency of approach		
	Identification of common areas of good and poor practice across the industry		
	Ability to report on an industry wide basis		
	Facilitation of engagement		
	Raising the profile of integrity management across the industry		
	Performance indicators of the industry		

3.2 US Indicators

Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) provides limited information about safety indicators¹¹. When searching on the homepage of BOEMRE on the word ‘indicators’, the main result is related to discussions about socioeconomic impacts of activities on the OCS activities¹². These are related to ongoing social science and economic studies administered by different regions.

The main reason for the limited information about safety indicators is that BOEMRE have limited access to information. US legal and regulatory conditions do not require annual updates of the offshore petroleum industry’s risk level (Skogdalen et al., 2010). Traditionally the industry has been required to report LTI and oil emissions, lately the industry has also been required to report gas emissions¹³.

In addition, the authorities have taken initiative to make the industry report performance data on voluntary basis. According to the homepage of BOEMRE¹⁴, Mineral Management Service (MMS), the U.S. Coast Guard, and representatives of the Outer Continental Shelf (OCS) oil and gas industry developed a suite of consensus formulas for gauging the industry’s safety and environmental performance since 1997. These formulas, called the OCS Performance Measures, are used to calculate 20 annual, OCS-wide, performance indices. The indices provide the public with information about performance trends, and they allow OCS lease

¹¹Telephone interview with Torleif Husebø, PSA 16 May 2011

¹² <http://www.mms.gov:8765/query.html?rq=0&qt=+indicators&charset=iso-8859-1&col=boemre>

¹³Telephone interview with Torleif Husebø, PSA 16 May 2011

¹⁴ <http://www.boemre.gov/perfmeas/>

operators to compare their performance with industry "averages." The performance measures are presented in Table 2.

BOEMRE¹⁵ informs that the data used in the OCS Performance Measures calculations is generated by OCS lease operators who participate in the OCS Performance Measures Program. During the first quarter of each year, participating operators submit to BOEMRE their performance data for the previous year. The BOEMRE uses the data to calculate the annual performance indices on behalf of the OCS Performance Measures Steering Committee. The OCS Performance Measures Program depends on participation by OCS lease operators. The statistics includes the year 2009. A look into the statistics about the participation rate of these surveys demonstrates that this is very low.

As a result of the U.S. Chemical and Hazard Investigation Board (CSB) investigation of the 2005 BP Texas City Incident, CSB recommended the development of an American National Standards Institute (ANSI) standard¹⁶. The purpose was to create "performance indicators for process safety in the refinery and petrochemical industries. The intention was to ensure that the standard identifies leading and lagging indicators for nationwide public reporting as well as indicators for use at individual facilities. The work should include methods for the development and use of the performance indicators." As a result, the American Petroleum Institute (API)¹⁷ issued Process Safety Performance indicators for the Refining and Petrochemical Industries in 2010, ANSI/API RP 754. These identify leading and lagging process safety indicators that are supposed to be useful for driving performance improvement. The indicators are divided into four tiers that represent a leading and lagging continuum. Tier 1 is the most lagging and Tier 4 is the most leading. Tiers 1 and 2 are suitable for nationwide public reporting and Tiers 3 and 4 are intended for internal use at individual sites. The identified performance indicators are based on the following guiding principles¹⁸:

- Indicators should drive process safety performance improvement and learning
- Indicators should be relatively easy to implement and easily understood by all stakeholders (e.g., workers and the public)
- Indicators should be statistically valid at one or more of the following levels: industry, company, and site
- Indicators should be appropriate for industry, company or site level benchmarking

For the purpose of getting a better understanding about discussions of indicators in US, a search was performed from the web site of New York Times to reveal discussions about indicators. The result of the search was negative. The search is presented in Appendix 4.

¹⁵ <http://www.boemre.gov/perfmeas/>

¹⁶ <http://www.api.org/Standards/new/api-rp-754.cfm>

¹⁷ The American Petroleum Institute (API) is a national trade association that represents all aspects of America's oil and natural gas industry. It has more than 400 corporate members, from the largest major oil company to the smallest of independents. The members are producers, refiners, suppliers, pipeline operators and marine transporters, as well as service and supply companies that support all segments of the industry. <http://www.api.org/aboutapi/>

¹⁸ <http://www.api.org/Standards/new/api-rp-754-rp-755.cfm>

Table 2, Overview of indicators applied in US¹⁹

Source	Indicator	Description	Comments
OCS Performance Measures			OCS: Outer Continental Shelf
	Recordable injury/illness	For more thorough definitions, see http://boemre.gov/perfmeas/formulas.htm	The statistics also provides background information such as Total Wells Spudded, Participants' Wells Spudded, Total OCS Platform count
	Production DART ²⁰ case	Lost Workday Incident Rates	OCS Participant Incident rate (PIR). For production, drilling and construction respectively
	EPA NPDES Noncompliance		OCS Participant Incident rate (PIR). For production, drilling and construction respectively
	Fire/explosion	Number of reported non-compliances on EPA NPDES Monitoring Reports	OCS Participant Incident rate (PIR)
	Well blowout	Numbers	OCS Industry Incident Rate (IIR)
	Oil spill number <1bbl	Blowouts	OCS Industry Incident Rate (IIR)
	Oil spill number 1 to < 10bbl	Numbers and spills	OCS Participant Incident rate (PIR)
	Oil spill number >10 bbl	Numbers and spills	OCS Industry Incident Rate (IIR)
	Oil spill volume < 1 bbl	Numbers and spills	OCS Industry Incident Rate (IIR)
	Oil spill volume 1 to < 10bbl		OCS Participant Incident rate (PIR)
	Oil spill volume > 10bbl		OCS Industry Incident Rate (IIR)
	Oil spill volume all sizes		OCS Industry Incident Rate (IIR)
	MMS ²¹ Incidents of Noncompliance (INC)		OCS Industry Incident Rate (IIR). For Drilling and Production respectively
	In addition Process Safety Performance Indicators for the Refining and Petrochemical Industries is recently developed for use. The first edition came in April 2010		The American Petroleum Institute (API)

3.3 Indicators used in Norway

Petroleum Safety Authority Norway, (PSA)²² has been engaged in measuring the development of the Norwegian petroleum industry and effects of the PSA's activities. The actors in the Norwegian petroleum industry are required by law to report incidents that could lead to severe accidents to the authority. This is required for both major accident and occupational accidents. The PSA and the industry have a tradition of close cooperation and sharing of experiences.

¹⁹ Author's comment: I don't understand why fatalities are not listed in the overview-statistics of BOEMRE/MMS

²⁰ Author's comment: Unfortunately, the meaning of the acronym DART is not found.

²¹ Mineral Management Service

²² Telephone interview with Torleif Husebø, PSA 16 May 2011

The approach of the PSA has been to follow up trends over time and try to interpret the development²³. This has been done both at the level of the corporates and at the sectorial level. The main question has been whether the industry demonstrates continuous improvement or not.

Also, the risk level of the Norwegian offshore petroleum industry has been analysed and presented on an annual basis by the PSA. The scope of this risk level work covers all aspects of Health, Environment and Safety (HES) within the authority's jurisdiction (Vinnem, 2010). The first report was presented early in 2001, based on data for the period 1996 – 2000. The methods used to collect data and analyse the risks were developed through the 'Risk Level Project' (RNNP). Since then, annual updates have been performed. Also, since its beginning RNNP as tool has been through a development (Petroleum Safety Authority Norway, 2009b). This development has been done in cooperation with the different stakeholders.

RNNP uses statistical, engineering and social science methods in order to provide a broad illustration of risk levels, including risk due to major hazards, risk due to incidents that may represent challenges for emergency preparedness, and risk perception and cultural factors (Vinnem, 2010). The statistical approach is based on recording occurrence of near misses and relevant incidents, performance of barriers, and results from risk assessments. Safety culture, motivation, communication and perceived risk are covered through the use of social science methods; questionnaire surveys and interviews, audit and inspection reports, as well as accident and incident investigations (Petroleum Safety Authority Norway, 2008).

The 'Risk Level Project' focuses on risk to personnel and cover major accidents, occupational accidents and working environment factors. In the 'Risk Level Project' the risk level is assessed based on statistical analyses and subjective evaluations of risk. However, as Øien et al. (2011b) argue, the focus in the RNNP is on the total risk of all oil and gas facilities on the Norwegian continental shelf, which may conceal negative development on one or a few installations.

The following indicators have been established (Petroleum Safety Authority Norway, 2009a and b):

- Indicators for events related to major accident risk
- Indicators for barriers related to major accident risk
- Indicators for serious occupational accidents and diving accidents
- Indicators for working environment factors
- Indicators for other 'Defined Situations of Hazard and Accident' (DSHA)

The work also includes information about:

- Experiences of risk
- HSE-Climate
- Qualitative evaluations related to the issues

An overview of the main indicators used for 2009 are presented in Table 3 below (Petroleum Safety Authority Norway, 2009b).

In 2009 the Petroleum Safety Authority Norway also applied information drawn from RNNP and combined it with Environment Web databases to monitor developments in acute discharges to the sea on the Norwegian Shelf (Petroleum Safety Authority Norway, 2011). Risk in this connection is confined to frequencies and volumes of acute discharges. The actual and potential environmental consequences of these spills were not assessed.

²³Telephone interview with Torleif Husebø, PSA 16 May 2011

In hindsight of the Macondo blowout, Skogdalen et al.(2010) discuss the ability of the indicators used in RNNP to provide early warnings of such an accident. Their discussion results in suggestions for extending the safety indicators of RNNP related to well integrity and the two barrier principle, well planning, schedule and cost, undesired incidents and well monitoring and /intervention.

Table 3, Overview of indicators applied in Norway²⁴

Main topic	Indicator/factor	Description	Comments
Major accidents			Indicators at the sub level of these indicators include indicators about barriers and the maintenance and follow up of these.
	Not ignitable hydrocarbon leaking		Information from the industry
	Ignited hydrocarbon leaking		Information from the industry
	Well incident, loss of well control		Information from the PSA
	Fire/explosion in other areas, not hydrocarbon		Information from the industry
	Ship on collision direction		Information from the industry
	Drifting object		Information from the industry
	Collision with field related vessel/facilities/shuttle-tanker		
	Damage on facility-construction (innretningskonstruksjon)/stability-/anchoring/positioning error		Information from the industry and the PSA
	Leakage from subsea production facilities/pipeline/riser/wellflowline (brønnstrømsrørledning)/ loading buoy-/loading hose		Information from the PSA
	Damage on subsea production facilities/pipelinesystems/divinig equipment caused by fishing equipment		Information from the PSA
	Evacuation (precautious (føre-var)/emergency evacuation)		Information from the industry
	Helicopter incidents		Information from the industry
Occupational accidents and diving accidents			Parts of the information is derived from a survey asking employees about their own evaluation of accidental risk and HSE-climate
	Occupational accident	Number of events	Information from the PSA
	Diving accident	Number of events	Information from the PSA
Work related illness			Parts of the information is derived from a survey asking employees about their own evaluation of the working environment, own health and welfare and HSE-climate
	Work related illness		Information from the industry
Other topics			
	Man overboard		Information from the industry
	Complete power failure (Full strømstans)		Information from the industry
	H2S discharge		Information from the industry
	Falling objects		Information from the industry and the PSA

²⁴ For normalizing the trends, the project applies data about, facilities, wells, production volumes, work hours (arbeidstimer), diving hours, hours of flying helicopter (helikopter flytimer), hours of person-flying helicopter (helikopter personflytimer)

4 Discussion and conclusions

The previous presentations reveal that there are a number of issues to take into consideration when discussion indicators. Issues at stake are:

- The purpose of the indicator (for whom and for what)
- The approach that is applied for the development of indicators, positive (safety) or negative (risk)
- The aspects that are given attention (the safety aspect or risk influencing factor that the indicator is trying to measure)
- Whether the applied indicators are of a predictive or retrospective nature
- How the indicators give attention to technology, humans and organization and the interactions between these elements
- The definitions, generalizability and use of indicators
- The authorities' requirements to reporting, available sources of information, traditions of transparency and making results from the reporting public and finally the quality of data and levels of aggregation in the reporting, both in data from the industry and in the reports from the authorities.
- The national contexts such as culture and regulatory properties.

When comparing UK, US and Norway, it appears that there are regulatory differences between the three countries. In addition, there are differences in the legal requirements and traditions of cooperation with respect to reporting and transparency. Hence, the access to information for developing indicators and the representativity and quality of these varies.

Regarding focus of attention, there are also variations between the indicators of the three countries, especially with respect to their preventive nature. Norway and UK have applied more predictive indicators than US. Also, the indicators of UK and Norway pay more attention to early stages of the development of an accident than US. However, if taking the work of the American Petroleum Institute and the discussions in hindsight of the Macondo accident into consideration, it seems that the attention towards preventive indicators is increasing in US. The discussions in hindsight of the accidents reveal that it is important to be cautious about conclusions drawn on the background of indicators both with respect to their context and their generalizability.

Regarding evaluation of authorities own efforts to prevent accidents, it is worth noting that authorities seem to use statistics of their own activities as indicators for their own performance. However, without explanations of causal links between statistics of activities and developments in safety and/or control of risks, such statistics do not say anything about the efficiency of the authorities' efforts.

The overall conclusion is that it is a very difficult to compare safety status of the petroleum industry in UK, US and Norway and the efficiency of regulatory regimes by the help of safety indicators.

When discussing comparison of national statistics at the level of authorities it is important to clarify whether the indicators are developed for:

- Comparison between countries with respect to:
 - Revealing different strategies of regulation?
 - Measuring efficiency of regulation?
 - Measuring safety performance?
- Preventive purposes or reporting a status at a given time?
- Evaluation of a development of issues of concern:

- At which level (For instance national, group of activities, company)?
- For what perspective of time (For instance evaluation of a campaign, following trends over a long period of time)?

However, a comparison might be very useful if the purpose is to learn more about how indicators might function, what for and for whom they might be useful and how indicators can be used for regulatory purposes. An important issue for the use of indicators at the level of authorities is that they must be related to contextual factors and in particular the features of the regulatory regime they are associated with.

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Appendix 1 Background data of UK, US and Norway Provided by International Regulator's Forum (IRF) 2011²⁵

Country	UK	US	Norway
Organization	Health and Safety Executive	Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)	The Petroleum Safety Authority Norway (PSA)
Regime scope	Health & Safety. The Health and Safety regime applies onshore and offshore with specific legislation (alongside general H & S legislation) for the upstream oil and gas industry.	Authorization includes regulation of oil, gas, and sulphur exploration, development, and production operations on the United States Federal Outer Continental Shelf (OCS). BOEMRE also regulates the use of Federal offshore sand for beach nourishment and coastal protection projects. In 2005, BOEMRE was authorized to lease and regulate alternative energy projects on the Federal OCS.	The PSA is the relevant agency responsible for safety, emergency preparedness and the working environment in the petroleum industry. The regulatory regime applies to offshore installations and exploration, production and exploitation operations, as well as to their associated onshore processing facilities and refineries.
Administering Agency/Arrangements	HSE is a UK Government, non-departmental public body reporting to an executive board.	Federal government: the Bureau of Ocean Energy Management, Regulation and Enforcement is a bureau within the US Department of the Interior.	The PSA is an independent, government agency, which is accountable and provides advice to the Ministry of Labour.
Legislation Type	National Health and Safety at Work etc. Act 1974 and supporting regulations. A combination of legislation applicable to all industries with additional specific major hazard regulations for the offshore oil and gas industry. Non major hazard legislation is applied offshore on an activity basis.	The OCS Lands Act (OCSLA) is the primary statute governing offshore oil and gas, and marine mineral activities. The Energy Policy Act of 2005 amended OCSLA to add new authority for alternative energy projects in Federal offshore waters. Regulations governing OCS oil and gas, mineral, and alternative energy activities can be found in Title 30 of the Code of Federal Regulations.	Acts, Royal Decrees and Regulations. These formulate requirements in a performance-oriented fashion. The requirements are extensively substantiated by referencing recognised national and international standards.
Extent Of Government Approval	Duty holders must prepare and submit a safety case to HSE for assessment and acceptance, before an offshore installation can operate in the UK sector.	Lease issuance, exploration and development/production plan approvals, drilling permits, completion and work-over permits, production safety system permits, structural permits, pipeline rights-of-way, and decommissioning plans. Permits for geological and geophysical operations on un-leased lands	The PSA does not approve any plans or applications as such, but requires duty holders to apply for consent to commence and carry out various petroleum industrial activities/operations (specified by requirements of the regulations).
Nature of Duties Imposed	Primarily goal setting legislation which sets required standards and objectives to be achieved by duty holders, for the continued safe operation of their installations.	Hybrid regulatory approach; prescriptive regulations including 96 industry standards; performance objectives can be achieved by alternate means with BOEMRE approval.	All companies have a general duty to ensure compliance with requirements of acts, statutory rules and regulations as well as their own, set requirements for their operations. The supervisory activities of the PSA do not exempt the duty holders of this duty.

²⁵ <http://www.irfoffshoresafety.com/country/>

Country	UK	US	Norway
Physical Objects in The Regime	<p>Offshore specific legislation applies to Offshore Installations as defined in the regulations. These include fixed and floating production installations, plus non-production installations such as MODU's, FSU's, flotels and others, according to their exposure to major hazard risks. In total, there are around 290 surface installations and another approx 25 mobile drilling rigs in the UK sector on an annual basis.</p>	<p>- Oil and gas exploration and production in the Gulf of Mexico (3200 platforms, ~75 MODUs, 33,000 miles of pipeline, subsea production systems, wide range of support equipment), offshore California (23 production platforms, 188 miles of pipeline, development from existing facilities, record extended reach wells), and the Beaufort Sea (production from an artificial island, second production project in construction, ongoing exploration). Planning for additional oil and gas exploration in the Chukchi Sea and Beaufort Sea is underway.</p> <p>- 1 offshore wind farm lease (Nantucket Sound) is currently being evaluated for lease issuance.</p> <p>- BOEMRE assists the US Coast Guard on the review of offshore LNG gasification ports. 17 applications have been received and 7 have been approved. Two facilities are now operating.</p>	<p>Offshore installations and onshore facilities. These include exploration and production installations, including FPSO's, MODU's, flotels, subsea arrangements, wells, pipelines and off- and onshore processing plants. Also, the main functions of pipe laying barges, lifting barges, diving or other support vessels are regulated by the regime.</p>
Assurance Mechanisms	<p>Government Inspectorate. Inspections of duty holders and their installations against the control of major hazards as described in the safety case, and compliance with relevant statutory provisions.</p>	<p>- BOEMRE inspectors and investigators are based in 7 district offices (5 in the GOM, 1 in California, 1 in Alaska), and fly offshore regularly. OCS Lands Act mandates annual inspections. Inspectors have authority to issue Incidents of non-compliance which may be a warning or a facility shut-in. Civil penalties may be issued when violations pose actual harm or threat of harm to personnel or the environment.</p> <p>- Industry self-inspections and records are required by regulation.</p> <p>- Drills (spill response, BOPE, H2S, evacuation, etc) are required and may be initiated by BOEMRE without notice.</p> <p>- 3rd party reviews (design, fabrication, and installation) are required for deepwater or novel structures.</p>	<p>The PSA assures that the industry is adhering to statutory regulations by conducting audits and verifications, and by - if necessary - employing its delegated regulatory powers.</p>

Country	UK	US	Norway
Financial Basis	Cost recovery for upstream oil and gas industry by charging an hourly rate for certain work.	Approximately 50% of the funding for BOEMRE's offshore program are from rental fees on OCS leases and cost recovery assessments. The remainder of the funding is from annual congressional appropriations.	Government general budget allocation. Expenses related to regulatory supervision, such as staff's working hours and travel expenses, must be refunded by the duty holders in accordance with rates set by the government. The refunded costs are paid into the Treasury. Typically, these amount to about 45% of the PSA's total operational budget.
Environmental Regulation Responsibilities	Although the Health & Safety Executive (HSE) is responsible for assessing the integrity & safety of offshore installations in the UK via the Offshore Safety Case Regulations (OSCR). DECC (Department of Energy and Climate Change) is responsible for developing the environmental regulatory framework for the UKCS. DECC administer and ensure compliance with that environmental regime in relation to offshore oil and gas exploration and production and decommissioning. This includes the approval of Oil Pollution Emergency Plans (OPEPs).	The National Environment Policy Act (NEPA) is the foundation of environmental policymaking in the United States. The intent of the NEPA process is to help public officials make decisions based on an understanding of environmental consequences and take actions that protect, restore, and enhance the environment. The NEPA established the Council on Environmental Quality (CEQ) to advise agencies on the environmental decision making process and to oversee and coordinate the development of Federal environmental policy. The CEQ issued regulations (40 CFR 1500-1508) in 1978 implementing NEPA. BOEMRE prepares environmental impact statements and environmental assessments at various stages including leasing, exploration plans and development plans. BOEMRE also coordinates with other Federal bureaus and agencies in reviewing environmental implications of planned OCS activities	The PSA's role with regard to protecting the natural environment is directed primarily at the preventive side by helping to ensure that environmentally harmful incidents do not occur. In addition, the PSA has a role in connection with the operator's emergency preparedness for stopping a leak or blow-out.
Oil spill response	The implementation of any counter pollution measures deployed to minimise the pollution incident is the responsibility of the operator, their third party oil spill responder and the Maritime and Coastguard Agency (MCA). MCA, an Executive Agency of the Department for Transport is responsible, if required, for deploying any counter pollution measures to minimise pollution incident, and the Secretary of State's Representative (SoSRep) has ultimate powers of intervention.	BOEMRE is responsible for planning (i.e. reviewing preparations) for potential oil spills related to oil and gas operations on the Federal Outer Continental Shelf. Operators are required to submit Oil Spill Response Plans for approval by the Bureau. These plans must address worst case discharge and response capabilities including equipment and response time. BOEMRE conducts annual inspections of equipment and conducts drills to test industry response. Through a unified command structure, BOEMRE shares responsibility with the United States Coast Guard (USCG) in incident response. The USCG acts as the Federal On Scene Coordinator and leads the operational spill response and BOEMRE focus is on source control.	Issues related to oil spill response is the responsibility of the Norwegian Climate and Pollution Agency (Klif) . The Norwegian Coastal Administration (NCA) is responsible for the operational side of such clean-ups. Both the NCA and the Norwegian Clean Seas Association for Operating Companies (Nofo) will answer questions about the equipment used to clean up spills.

Country	UK	US	Norway
Transparency	<p>The offshore section of HSE's website (www.hse.gov.uk/offshore/) provides a wide range of related information, including annual offshore health & safety statistics, reports of key intervention programmes, full details of HSE's internal assessment procedures and standards, and safety alerts and information.</p>	<p>Nearly all aspects BOEMRE's functions and responsibilities are addressed at the website www.boemre.gov. The website addresses the organization and responsibilities of each division and region of the bureau. All of the environmental studies and technical research that has been conducted is posted to the website. Statistics and investigation reports conducted by BOEMRE are posted or linked within the website. All Notices to Lessees which provide clarification of regulations are posted on the website. The site also provides a Fast Fact query function that allows the public to query many aspects of the data that BOEMRE controls including but not limited to:</p> <ul style="list-style-type: none"> • Applications for Permit to Drill • Boreholes Drilled • Exploration and Development Plans • Facility Measurement Points • Lease Owner • Offshore Statistics by Water Depth • Pipeline Locations • Pipeline Permits • Platform Structures • Plugging and Abandonment Liability • Production Data 	<p>The PSA's webpage is probably the most informative source of information about our regulatory system and activities. Almost everything we do and think of as a regulator is duly accounted for here.</p> <p>Most of the postings are also published in English. (This costs us a bit, but we do it for the benefit of media and for our good colleagues in other countries!)</p> <p>The website accounts for our organization and it also introduces you to some of the people that are happily working with the PSA, our day-to-day supervisory activities, and it features a number of articles related to regulatory professional issues. Statistics are posted here as well as our annual reports, such as the annual Risk Assessment Report and our annual report in magazine format – the Safety, Status and Signals, which has been well received by the industry as well as of our regulatory colleagues.</p> <p>Should a major accident occur in Norwegian waters or onshore, the PSA will quickly mobilize its Emergency Response Team, not least in part to be able to inform the central government and the public about the position. The PSA website will also change to bring the latest news about an accident.</p> <p>You might also want to know that the PSA has a dedicated special webpage about what we as a regulator does in regard to the Deepwater Horizon/Macondo catastrophe.</p>

**Appendix 2 International statistics from UK, US and Norway
Provided by International Regulator's Forum (IRF) 2011²⁶**

²⁶ <http://www.irfoffshoresafety.com/country/performance>

UK -- CY 2009

	Number of Fatalities / Injuries	Derived Rates (per million hours worked)				Comments
Fatalities	0	N/A				
Major injuries	42	0,7748				
Injuries > 3 days LTI & RWI	133	2,4535				
Injuries 1 > and <= 3 days	N/A	N/A				UK does not record these injuries under RIDDOR95
Total Hours Worked	54 208 872					
	Number/Mass of Hydrocarbon Gas Releases		Derived Rates (per 100 million BOE)			
Major Gas Release number	1		0,2616			UK uses different definitions when reporting in UK reports - see Footnotes (3)
Major Gas Release mass	700		183,0975			Not published in UK other than for IRF.
Significant Gas Release number	8		2,0925			UK uses different definitions when reporting in UK reports - see Footnotes (3)
Significant Gas Release mass	834,50		218,2784			Not published in UK other than for IRF.
Total Gas Production (million BOE)	382,31		--			
	Number of Collisions / Fires			Derived Rates (per 100 Offshore Installations)		
Major Collisions	0			0		
Less than major Collisions	4			1,2698		
Major fires	0			0		
Less than major Fires	2			0,6349		

Number of Offshore Installations	315			--		Data for UK installations from DECC website (29/07/2010). Data for MODU is average attendance based on data from North Sea Reporter
					Derived Rates (per 100 Well-related activities)	
Major Loss of Well Control	0				0	
Less than major Loss of Well Control	3				1,5385	
Number of Well-related Activities	195				--	Data from DECC website (29/07/2010)
Derived rates relative to offshore installations (Collisions, Fires; also Loss of well control?)						
Derived rates relative to well related activities (Loss of Well Control)						

U.S. -- CY 2009

	Number of Fatalities / Injuries	Derived Rates (per million hours worked)				Comments
Fatalities	4	0,0286				
Major injuries	59	0,4221				
Injuries > 3 days LTI & RWI	73	0,5223				
Injuries 1 > and <= 3 days	53	0,3792				
Total Hours Worked	139 777 539					Hours worked is estimated from information submitted through a voluntary MMS/USGC/Industry program. In CY 2009, the companies that submitted hours worked through this program represented 47.2% BOE of the total OCS production..
	Number/Mass of Hydrocarbon Gas Releases					
Major Gas Release number	NA					MMS currently receives reports of gas release events, but does not receive the information about the mass/amount of the release that is needed to classify the incidents.
Major Gas Release mass	NA					
Significant Gas Release number	NA					
Significant Gas Release mass	NA					
Total Gas Production (million BOE)	453,38					
	Number of Collisions / Fires			Derived Rates (per 100 Offshore Installations)		
Major Collisions	20			0,5356		
Less than major Collisions	9			0,2410		
Major fires	3			0,0803		
Less than major Fires	12			0,3214		

Number of Offshore Installations	3 734					
					Derived Rates (per 100 Well-related activities)	
Major Loss of Well Control	2				0,1006	
Less than major Loss of Well Control	4				0,2012	
Number of Well-related Activities	1 988					

Norway -- CY 2009

	Number of Fatalities / Injuries	Derived Rates (per million hours worked)				Comments
Fatalities	1	0,0241				
Major injuries	31	0,7476				
Injuries > 3 days LTI & RWI	54	1,3022				Not currently published in Norway
Injuries 1 > and <= 3 days	63	1,5192				Inclusive 15 restricted workday incidents
Total Hours Worked	41 468 640					
	Number/Mass of Hydrocarbon Gas Releases		Derived Rates (per 100 million BOE)			
Major Gas Release number	3		0,4644			
Major Gas Release mass	14 320		2 216,7183			
Significant Gas Release number	5		0,7740			
Significant Gas Release mass	863		133,5913			
Total Gas Production (million BOE)	646					
	Number of Collisions / Fires			Derived Rates (per 100 Offshore Installations)		
Major Collisions	1			1,0526		
Less than major Collisions	0			0,0000		
Major fires	0			0,0000		
Less than major Fires	0			0,0000		
Number of Offshore Installations	95					
	Number of Losses of Well Control				Derived Rates (per 100 Well-related activities)	
Major Loss of Well Control	0				0,0000	

Less than major Loss of Well Control	0				0,0000	
Number of Well-related Activities	206					
Derived rates relative to offshore installations						
Derived rates relative to well related activities						

Appendix 3 Sources of indicators that might have interest for further work

Other sources and Guidelines	Type	Comments
International Regulators' Forum (IRF)	Performance measurements	Statistics reported by national authorities of different countries to IRF Performance Measurement Project. The guidelines of the IRF focus on the following themes (International Regulators' Forum, 2011): <ul style="list-style-type: none"> • Fatalities • Hours worked • Gas releases – Number of releases • Gas releases – Amount of releases • BOE (Barrels of Oil Equivalent) gas production • Collisions, fires and losses of well control • Well related activities
International Association of Oil & Gas Producers (OGP)	OGP Safety performance indicators	OGP's main aim is to coordinate the members' activities vis-à-vis regulatory authorities (Ryggvik, 2011). The statistics are about fatalities and injuries of humans
Oil & Gas UK	A system of Key Performance Indicators (KPI's)	Directed at hydrocarbon releases, verification compliance, safety critical backlog (Paterson, 2010 ²⁷)
Center for Chemical Process Safety (CCPS)	Guidelines for Process Safety Metrics ISBN: 978-0-470-57212-2	The Global Community Committed to Process Safety
Center for Chemical Process Safety (CCPS)	Process Safety Leading and Lagging Metrics	The Global Community Committed to Process Safety
National Offshore Petroleum Safety Authority (NOPSA)	According to CEO Jane Cutler ²⁸ , the National Offshore Petroleum Safety Authority Australia (NOPSA) has industry performance data. These are inspired by Ptil.	National Offshore Petroleum Safety Authority (NOPSA) is a Statutory Agency regulating Commonwealth, State and Territory coastal waters with accountability to the relevant Ministers.Australia
SINTEF Offshore Blowout Database	SINTEF Offshore Blowout Database http://www.exprosoft.com	See also Holand (2010) for overview of indicators, data sources and evaluation of quality of data from different countries that are included in the database. Holand makes references to requirements that could have prevented blowouts. In particular he compares conditions in US, UK and Norway.

²⁷ Paterson, R. (2010) Presentation at International Regulators' Forum, 18-20 Oct. Vancouver

²⁸ Presentation at International Regulators' Forum, 18-20 Oct. Vancouver

Appendix 4 Search in New York Times 11.04.13

Indicators

Type of search: Advanced search

Delimitation: Past year

Themes covered: Cars, radiation, insurance, dating, business, security, health, crime, military development, animal abuse; most hits (12) on business

Link:

<http://query.nytimes.com/search/query?frow=0&n=10&srcht=s&query=indicators&srchst=nyt&hdlquery=&bylquery=&daterange=past365days&mon1=01&day1=01&year1=1981&mon2=04&day2=13&year2=2011&submit.x=26&submit.y=9>

Specification of search:

Search words: Safety Indicators

Number of hits: 29 Relevant articles: 1, but not important.

Search words: Indicators

Number of hits: 382

Delimited to section for

Technology: 12, none of relevance

Science: 14, none of relevance

Week in review: 2, none of relevance

World: 32, none of relevance

US: 37, none of relevance

Front page: 26, none of relevance

Most of the hits in the delimited search were associated with economy and none of direct relevance



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