European Commission

JRC SCIENCE FOR POLICY REPORT

Study on the impacts of possible amendments to the ATEX, the Machinery, and the Pressure Equipment Directives with respect to equipment intended for use in the offshore oil and gas industry

Arantxa Aznárez, Dejan Brkić, Stefania Contini, Michalis Christou and Stefano Tarantola

April 2016

Joint Research Centre

EUR 27895 EN

This publication is a Science for Policy report by the Joint Research Centre, the European Commission's in-house science service. It aims to provide evidence-based scientific support to the European policy-making process.
The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

JRC Science Hub
https://ec.europa.eu/jrc

JRC101359

EUR 27895 EN

PDF	ISBN 978-92-79-58010-9	ISSN 1831-9424	doi:10.2790/296021
Print	ISBN 978-92-79-58009-3	ISSN 1018-5593	doi:10.2790/918804

How to cite: Arantxa Aznárez, Dejan Brkić, Stefania Contini, Michalis Christou and Stefano Tarantola; Study on the impacts of possible amendments to the ATEX, the Machinery, and the Pressure Equipment Directive with respect to equipment intended for use in the offshore oil and gas industry; EUR27895 EN; doi:10.2790/296021

Abstract

The purpose of this study is to provide the Commission with the information necessary for the assessment of the economic, social, and environmental impacts of a possible extension of the scope of the EU product safety legislation (ATEX Directive 2014/34/EU, Pressure Equipment Directive 2014/68/EU and Machinery Directive 2006/42/EC) with respect to equipment intended for the use in the offshore oil and gas industry. Whereas equipment on fixed units is in the scope of these three Directives, mobile offshore units and equipment installed on them are currently in general excluded. In addition the Pressure Equipment Directive excludes also well-control equipment. The study investigates whether there are safety issues which could be addressed by extending the scope of the Directives and what would be the impacts of such an extension.

Title Study on the impacts of possible amendments to the ATEX, the Machinery, and the Pressure Equipment Directive with respect to equipment intended for use in the offshore oil and gas industry

- *EU product safety Directives (ATEX Directive 2014/34/EU; the Pressure Equipment Directive 2014/68/EU; and the Machinery Directive 2006/42/EC).*
- *Overview of the structure of the MODU market, forecasts up to 2023 and the major market drivers and restraints.*
- *Several stakeholders have participated in the present study: manufacturers of equipment, drilling contractors, Oil and Gas companies, drilling operators, Public Authorities, Certification Bodies.*
- *An online survey and personal interviews/meetings with the stakeholders have been organised.*
- *Economic and social impact study of the possible extension of the EU product safety Directives to cover oil and gas equipment specifically designed for MODUs and of the extension of the Pressure Equipment Directive to cover well-control equipment.*

Table of contents

Executive summary

Following the explosion of the Deepwater Horizon drilling rig in the Gulf of Mexico in 2010, the Offshore Safety Directive 2013/30/EU (OSD)[1] was adopted in the European Union. This Directive applies to both fixed and mobile offshore units and is the main mechanism for ensuring that the safety and the environmental protection are fully regulated in the Union waters.

Mobile offshore units[2] are considered as seagoing vessels and their safety is subject to rules in the International Maritime Organization (IMO) (see the Code for the Construction and Equipment of Mobile Offshore Drilling Units (2009 MODU Code[3])). However, according to point 6 of the preamble of the 2009 MODU Code, "*the Code does not include requirements for the drilling of subsea wells or the procedures for their control*", being such drilling operations subject to control by the coastal State (although a harmonised approach at EU level does not exist at the moment).

Contrarily to fixed units (both offshore and onshore), mobile offshore units, and the equipment installed on them, are currently excluded from the EU Product Safety Directives, namely the Machinery Directive (MD)[4], the Pressure Equipment Directive (PED)[5] and the ATEX Directive[6]. This exclusion has however exceptions to be considered. For example:

- Floating units intended for production, and the machinery/equipment on-board such units are not excluded from the scope of these EU Product Safety Directives since these are intended to be located on the oil field for the long term and hence considered as fixed units;
- Machinery which may be installed on both fixed and mobile offshore units is also subject to the MD (guidelines to the application of the MD);
- The exclusion under the PED similarly only applies to "*equipment <u>specifically intended</u> for installation on-board mobile offshore units or for the propulsion thereof*". However, equipment intended for installation on both mobile and fixed offshore units falls within the scope of the PED.

As mobile offshore units can be used, among other, for drilling or production, it follows that equipment intended to be installed specifically on drilling units are excluded from the scope of the three Product Safety Directives. Consequently, this study will focus on mobile offshore drilling units (MODU) and their possible inclusion in the Product Safety

[1] Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0030&from=EN

[2] The guidelines to the application of the Machinery Directive (MD) and the Pressure Equipment Directive (PED) define a mobile offshore unit as "*a unit that is not intended to be located on the oil field permanently or for the long term, but is designed to be moved from location to location, whether or not is has a means of propulsion or of lowering legs to the sea floor*".

[3] IMO MODU Code; IMO Resolution A.1023(26)-Adopted on 2 December 2009 http://www.techstreet.com/products/1787107

[4] Machinery Directive 2006/42/EC; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0042&from=EN

[5] Pressure Equipment Directive (97/23/EC); http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01997L0023-20130101&from=EN ; Pressure Equipment Directive 2014/68/EU; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0068&qid=1436865661883&from=EN

[6] ATEX Directive 94/9/EC ; http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01994L0009-20130101&from=EN , ATEX Directive 2014/34/EU; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0034&from=EN

Directives. Anyway, whichever extension of the scope of the legislation cannot be retroactive and it would only apply to new equipment.

Additionally, well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or control well pressure is also specifically excluded from the scope of the PED. The report also studies the possible inclusion of well-control equipment in the PED.

The study aims at providing the European Commission with the information necessary for the assessment of the impacts of an extension of the Product Safety Directives to MODUs and of the PED to well-control equipment.

Therefore, a comprehensive desk research on markets, legislation, and equipment on-board MODUs and fixed facilities (offshore and onshore) has been carried out.

Additionally, an on-line survey "European Commission Survey on Offshore Oil & Gas Equipment 2015 – Cost of compliance with EU product safety legislation" was conducted by the JRC to collect more detailed information and data from various stakeholders groups, namely owners, operators, manufacturers, public authorities and certification bodies. In parallel to the on-line survey, one drilling company and one manufacturer were interviewed. Heterogeneous views exist among the various stakeholder groups and these are, in our view, attributable to conflicts of interest and, in some cases, to an improper comprehension of the EU Product Safety Directives.

A statistical analysis of past accidental events between 1970 and mid-2013 occurred on MODUs showed that it is not possible to state whether there is a safety issue related to the current exclusion of MODUs from the Product Safety Directives but, because of the limitations in the dataset used, it is also not possible to exclude it.

Different policy options regarding the possible extension of the Product Safety Directives and their socio-economic and environmental impacts have been presented and analysed in this report.

In this respect, the report concludes that the extension of ATEX to cover MODUs would have only a small impact regarding electrical equipment, since the requirements for its protection against explosive atmospheres are very similar to these currently applied by the IMO MODU Code/IEC-Ex scheme. In our opinion there might be an increase of safety if mechanical equipment were covered by ATEX, because currently the IMO MODU Code only sets out some recommendations regarding its installation in hazardous zones. An extension of ATEX to cover MODUs would allow a common legislative framework for mobile and fixed units to exist with limited incremental costs for double certification.

As the objectives of the MD are not covered by the IMO MODU Code, there is a gap in the safety of equipment, which could in principle be covered by extending the MD to oil and gas offshore equipment specifically designed to be installed on-board MODUs. In our opinion, the extension of scope of MD would most likely have positive impact on safety and environment, limited impact on costs for ship owners, no impact foreseen for SMEs and increased business for certification bodies. However, the option of extending MD to MODUs would require further investigation. This deeper analysis could go into further detail, clarifying, among other, whether certain equipment (e.g. compensators) can be treated as machinery.

All oil and gas equipment under pressure, which is not classified as well-control and is not specifically designed or modified for use on MODUs, is currently under the scope of PED. A reasonable option could be the extension of scope of PED to cover such limited number of equipment under pressure specifically designed or modified for MODUs. In our opinion, this extension could be achieved with reasonable costs for certification

because of the limited set of equipment currently not covered by the PED. However, we suspect that the overall impact of this extension would be rather limited.

An extension of the PED to cover well-control equipment, which is currently excluded from its scope, would be complicated to implement since the specific essential safety requirements for well-control equipment should be defined and included in the Directive. In other words, the possible extension would not just be limited to removing a paragraph from the list of excluded equipment. Moreover, the same extension, which would only cover hazards due to pressure, would not solve other important aspects linked to operability and reliability of the well-control equipment.

In addition to discussing the extension of the Product Safety Directives individually, the report also describes qualitatively the impacts of extending them in combination and for specific sets of equipment.

Throughout this study, we had to operate under certain constraints. The existence of a wide range of products in the offshore industry, the complex cost structure of the equipment, the limited response rates to the survey (in particular for manufacturers, notified bodies and standardization bodies) and the lack of quantitative data (cost of equipment, production figures, etc…), have made possible only a qualitative assessment of the impacts of the various policy options.

1. Introduction

Following the explosion of the Deepwater Horizon drilling rig in the Gulf of Mexico on 20th April 2010, the European Commission carried out a review of the adequacy of the provisions in force in the European Union to prevent similar accidents occurring in the European offshore oil and gas industry.

On 12th October 2010 the Commission issued a Communication to the European Parliament and the Council entitled "Facing the challenge of the safety of offshore oil and gas activities" [COM(2010) 560 final][7]. Section 2.1 of the Commission Staff Working Document [SEC(2010) 1193 final] [8] accompanying the aforementioned Communication notes that "*EU [product safety] legislation excludes from its scope mobile offshore units and equipment installed thereon"*. It also states that "*some of the EU and EEA Coastal States consider that it would be useful to apply EU legislation to equipment installed and used on mobile offshore units*". Moreover, the Pressure Equipment Directive[9] (PED) also excludes well-control equipment from its scope.

Later on, in 2011, the European Commission launched a legislative proposal which resulted in the Offshore Safety Directive 2013/30/EU[10] (OSD) with the purpose of facilitating an increased protection of the marine environment and coastal economies against pollution, establishing minimum conditions for safe offshore exploration and exploitation of oil and gas to limit possible disruptions to the European Union indigenous energy production, and finally to improving the response mechanisms in case of accidents. Both fixed and mobile offshore units fall within the scope of the OSD.

Mobile offshore units[11] are considered as seagoing vessels and their safety is subject to rules in the International Maritime Organization (IMO) Code for the Construction and Equipment of Mobile Offshore Drilling Units (IMO MODU Code[12]). However, the IMO MODU Code does not cover drilling operations which are now covered by legislation of Member States (a harmonised approach at EU level does not exist at the moment).

Contrarily to fixed units (both offshore and onshore), mobile offshore units and the equipment installed on it, are currently excluded from the EU Product Safety Directives,

[7] [COM(2010) 560 final]; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0560:FIN:EN:PDF

[8] [SEC(2010)1193 final]; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2010:1193:FIN:EN:PDF

[9] Pressure Equipment Directive (97/23/EC); http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01997L0023-20130101&from=EN ; Pressure Equipment Directive (2014/68/EU); http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0068&qid=1436865661883&from=EN

[10] Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0030&from=EN

[11] The guidelines to the application of the Machinery Directive (MD) define a mobile offshore unit as "*a unit that is not intended to be located on the oil field permanently or for the long term, but is designed to be moved from location to location, whether or not is has a means of propulsion or of lowering legs to the sea floor"*.

[12] IMO MODU Code; IMO Resolution A.1023(26)-Adopted on 2 December 2009 www.techstreet.com/products/1787107

namely the Machinery Directive (MD)[13], the Pressure Equipment Directive (PED)[14] and the ATEX Directive[15].

However, according to the guidelines to the application of the Machinery Directive, this exclusion has exceptions. Machinery which may be installed on both fixed and mobile offshore units is subject to the Machinery Directive. The exclusion under the Pressure Equipment Directive similarly only applies to equipment specifically intended for installation on-board or for the propulsion of the mobile offshore unit.

Moreover, the guidelines to the MD and PED state that *"floating units intended for production […], and the machinery installed on-board such units, are not excluded*".

As mobile offshore units can be used, among other, for drilling or production, it follows that equipment especially designed for mobile units and intended to be installed specifically on mobile drilling units is excluded from the three Product Safety Directives. Consequently, this study will focus on mobile offshore drilling units (MODU).

Even though the Product Safety Directives are focussing on the safety and protection of health of persons, the Directives also contribute to the overall safety and the prevention of major accidents, as required by the Offshore Safety Directive.

The purpose of this study is to provide the Commission with the information necessary for the assessment of the economic, social and environmental impacts of an extension of the scopes of ATEX, PED and MD to cover oil and gas equipment especially designed to be installed on MODUs as well as in well-control equipment which is currently excluded from the scope of PED.

This report provides 1) an overview of the global and European offshore drilling market, 2) a summary of the existing, rather articulated, legislation, 3) a description of the main categories of equipment on-board mobile and non-mobile units, 4) a comparative analysis of IMO MODU Code vs the Product Safety Directives, 5) an overview of the equipment specifically intended to be installed on-board MODUs and of the equipment which may be typically installed on both fixed and mobile offshore units. In addition to this, the report discusses the results from an on-line survey entitled "European Commission Survey on Offshore Oil & Gas Equipment 2015 – Cost of compliance with EU product safety legislation", conducted by the JRC to collect more detailed information and data from the various stakeholders groups. In parallel to the on-line survey, twenty-eight other companies were approached but did not express their intention to participate in an interview. Finally, only one drilling company and one equipment manufacturer agreed for interviews.

The report also includes a statistical analysis of offshore accidents and incidents which have occurred on MODUs since 1970. The analysis was conducted with the purpose of identifying – if possible – specific types of equipment, structural components, and systems which were more frequently involved in accidental situations.

The evidence provided by the survey and the statistical analysis of offshore accidents allowed us to investigate whether a safety issue exists or not. If some safety case exists, a formal impact assessment would have to be conducted by the European Commission. The impact assessment is also supposed to find the way in which the EU Product Safety Directives (ATEX, MD, and PED) could help to solve the problem. In view

[13] Machinery Directive 2006/42/EC; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0042&from=EN

[14] Pressure Equipment Directive (97/23/EC); http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01997L0023-20130101&from=EN ; Pressure Equipment Directive 2014/68/EU; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0068&qid=1436865661883&from=EN

[15] ATEX Directive 94/9/EC ; http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01994L0009-20130101&from=EN , ATEX Directive 2014/34/EU; http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0034&from=EN

of a possible Impact Assessment, a number of options for the extension of the legislation and its consequences have been presented and analysed in this report.

This report is organized as follows:

Section 2 introduces the offshore drilling rig market and shows an overview of the global MODU market, and specifically of the European MODU market.

Section 3 describes typical and specific oil and gas equipment that is installed on-board MODUs and classifies it according to whether it can fall within each product safety Directive and whether is covered by the IMO MODU Code.

Section 4 shows an overview of the existing international maritime legislation, specifically the IMO MODU code, and compares it with the Product Safety Directives.

Section 5 is devoted to the well-control equipment. It explains the dual barrier system for well-control, the Well Barrier Elements (WBEs), the Blow-out Preventers (BOPs) and their control unit, and discusses the possible inclusion of the BOPs in the PED.

Section 6 considers the on-line survey. It explains the methodology of data collection from the stakeholders, it includes the profile of the stakeholders who have participated in the survey and provides an overview of the results with a focus on the safety aspects. Details on the answers from different stakeholders are provided in Annexes B-F.

Section 7 includes the interviews carried out by the JRC with two leading companies in the MODU market.

Section 8 illustrates a number of options for the extension of the legislation and a qualitative assessment of their potential consequences.

Conclusions are given in Section 9.

Finally, a set of annexes is provided:

A. Product safety legislation – exclusions in ATEX, PED and MD and guidance

B. Online survey: answers from Companies (equipment manufacturers)

C. Online survey: answers from Companies (MODU owners/operators)

D. Online survey: answers from Certification Bodies

E. Online survey: answers from Public Authorities

F. Online survey: answers from Other types of entities

G. Leading companies in the MODU market

H. List of the contacted stakeholders for a personal interview

I. Statistical analysis of offshore accidents and incidents on MODUs since 1970

2. The MODU market

The overall information on the market is relevant and it demonstrates the economic importance of the offshore sector. On the other hand, it has not been possible to find representative economic data about the equipment on-board MODUs and on the trade flows neither in reports nor via the survey.

2.1. The MODU submarkets

Over the last decade, the majority of wells drilled worldwide (around 3500 wells per year) were drilled using MODUs [1].

The offshore drilling MODU industry is composed of five markets (Figure 1).

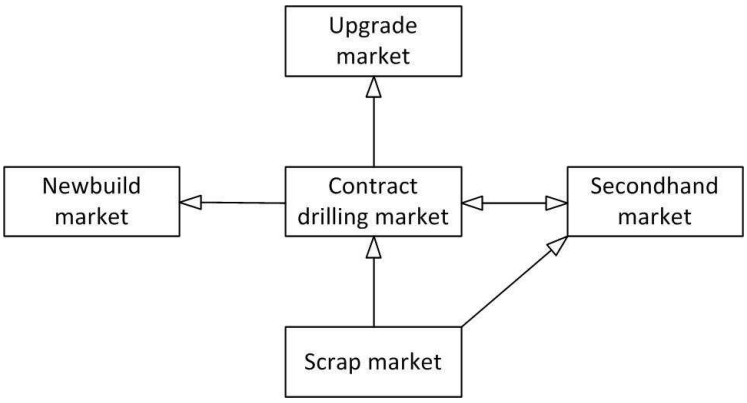


Figure 1. Direction of cash flow through offshore MODU markets [1]

1. In the contract drilling market, MODUs owned and operated by contractors are leased to Exploration and Production (E&P) firms on a day-rate basis to drill or service wells. Day-rates (i.e. contract costs of leasing per day) depend on a number of factors, such as type and age of MODU, length of contract, and area of deployment. Day-rates for MODUs can vary from an average of 60,000US$ per day for the older jack-ups to prices above 650,000US$ per day for the newest generation drill-ships. Longer contracts usually entail lower day-rates since they give rig managers planning security and increase a rig´s utilization rate. Utilization decreases with age as the MODUs will suffer more downtime due to necessary repairs and upgrades, or simply because their outdated technology is not in demand. The significant cost incurred through low utilization rates caused by transit and the continuous development of drilling technology make leasing MODUs the more prudent choice;
2. The MODU new-build market uses shipyard labour and capital to convert steel and third-party equipment into rigs. Turnkey contracts are used for the construction and delivery of rigs. The construction market is dominated by manufacturers from South Korea, China and Singapore. The importance of the Asian manufacturers to the production of MODUs is in part due to the capability of their docks to produce ships on the scale of modern jack-ups, drill-ships and semi-submersibles and due to their mastery of the learning curve for the production of these complex vessels. The main drivers of the current building cycle are the old age of the global jack-up and semi-submersible fleet and the strong demand for deepwater units (advances in technology are allowing the drilling of wells in waters below 10,000 ft (3,048 m) and in more demanding high pressure and high temperature environments). The ascension of deepwater and ultra-deepwater floaters does not, however, mean that midwater and shallow water vessels are destined to go out of business. The demand for deepwater and ultra-deepwater vessels varies regionally, due to the

different water depths in which oil and gas are found around the world, with some regional markets focusing almost exclusively on deepwater and ultra-deepwater projects and others maintaining a strong focus on projects in shallower waters;

3. The upgrade market is a ship repair market which both upgrades and maintains rigs. Upgrades to old rigs' technology, steel and equipment are essential to ensure safe operations and sustain competitiveness and market value;
4. In the second hand market-rigs are sold among and between contractors and other market participants. Rigs may be sold for use in the service market, converted to another use, or sold into the scrap market;
5. In the scrap market, shipbreaking firms buy rigs on the second-hand market, either directly from contractors or via brokers. Equipment is removed and reused or sold as market conditions and demand permit. Following sale, dismantling occurs and the steel is sold for scrap to steel mills. The financial value of individual sales in the scrap market is low, and companies do not frequently report income from scrap sales leading to the smallest and least transparent of the five markets.

MODUs transition through several distinct stages over their lifecycle (Figure 2).

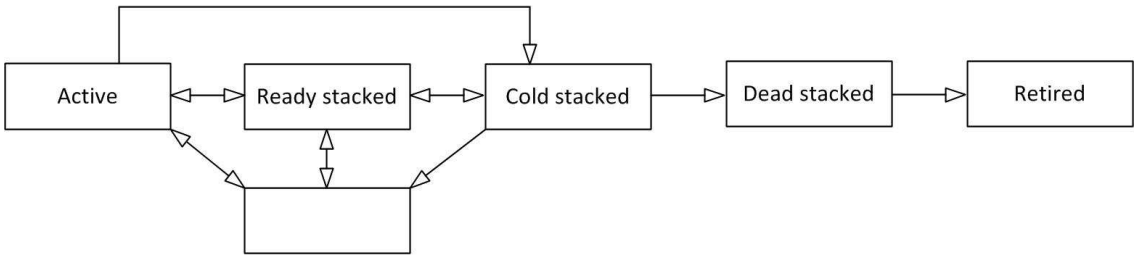


Figure 2. Transitions among rig activity states [1]

Active rigs are working under contract and are the only state in which a rig receives income. Active rigs may be drilling, waiting on location, or in transit or in a mobilization/demobilization status. Active rigs become inactive when their drilling contract expires. If a rig is to be idled for a short period of time, the rig is typically maintained in a prepared or ready-stacked state. Ready-stacked rigs are idle but available for immediate use with minor preparation.

If MODU owners do not expect a rig to be utilized in the near term, the rig is cold-stacked to reduce operating cost and support fleet day-rates. Cold-stacked units are stored in a wet dock and require capital and time to return to working condition. The upgrade and maintenance market is responsible for reactivating cold-stacked units, and frequently sold in the second-hand market. As a MODU ages, it will spend an increasing portion of its time cold-stacked. After being cold-stacked for several years, reactivation costs become prohibitive and a rig is labelled dead-stacked. Units may remain dead-stacked for many years before being dismantled.

2.2. Overview and forecast of the global MODU market

Taking into account the drastic drop in the oil price and the fact that the current situation in the offshore segment is very difficult, with substantially reduced activity (stalled or terminated exploration and development projects, within the EU and worldwide, as they are no longer economic), rigs coming off hire or being stacked,

numerous layoffs and a strong focus on cost-efficient operations, the market analysis for the period 2013-2023 has to be considered with caution [2][16].

Up until 2023, the MODU market is expected to be driven by the vast unexploited and undiscovered deepwater reserves; the technological advances in deepwater exploration and the enhanced oil recovery; and the strong oil demand due to the developing economies of Asia and Africa. The latest technological development, which allows drilling for oil and gas in waters below 3,000 m, has made production from mature and abandoned fields economical again, promoting a new era of offshore exploration and production activity. Until 2023 the majority of growth will come from the deep and ultra-deepwater segment.

There have been numerous major discoveries in previously unexplored territories around the world. The bulk of them have been made in the golden triangle, traditional deepwater and ultra-deepwater areas, made up of the area between the Gulf of Mexico, offshore Brazil and the Gulf of Guinea. In these areas the deepwater industry has become an established market with excellent growth prospects. The Asia Pacific region also has significant deepwater reserves although regional disputes over territory are currently preventing the market from achieving its full potential. The Middle East and Europe have less potential in these areas than other regions.

Regional differences in water depth determine the level of demand for the various types of MODUs, i.e. areas with vast quantities of oil in deep and ultra-deep waters show high demand for drill-ships and semi-submersibles, while the presence of jack ups is strong in areas with hydrocarbon reserves in shallow waters [2, 5]. In particular:

- Jack-ups are the oldest and most widely used MODUs, and operate in shallow waters (≤550 ft~170 metres) and the vast majority of units operate in water depths between 200ft (~60 metres) and 400ft (~120 metres);
- Semi-submersibles represent the second largest category of MODUs; today's sixth-generation units can drill at a depth of more than 10,000ft (~3,000 metres);
- Drill-ships are the preferred type of MODU for deepwater (4,000 ft – 7,000 ft, i.e. ~1,200 – 2100 metres) and ultra-deepwater(>7,000 ft; ~>2100 metres) drilling, due to their ability to operate in harsher and more isolated environments, as well as their capability for storage of production fluids.

In Table 1 the worldwide contracted MODUs in 2015, the worldwide total rig fleet in 2015, and the overall utilization rates is presented. Total MODUs fleet includes active, stacked and under construction MODUs.

Table 1. Worldwide MODU fleet (December2015) [6]

Type of MODU	Contracted MODUs in 2015 (Globally)	Total MODUs fleet in 2015 (Globally)	Utilization rate (%)
Jack-ups	327	643	50.9
Semi-submersibles	116	208	55.8
Drill-ships	88	168	52.4
Other (tender rigs, drill-barges, inland barges, submersibles)	52	164	31.7
Total MODU fleet	583	1183	49.3

[16] The material contained in this section draws relevant information from the 2013 report "The Mobile Offshore Drilling Unit (MODU) market 2013-2023" by Visiongain [2]. On the contrary, another two reports by Visiongain: "The Oil & Gas Drilling Technologies Market 2011-2021" [3] and "Deepwater & ultra-deepwater exploration and production (E&P) market forecast 2014-2024: Prospects for TOP Companies with seismic, drilling, subsea and FPS Technologies" [4] did not result such useful as the one specialized in MODUs.

Additionally 171 of the 263 offshore platform rigs (fixed platforms) are currently contracted, representing a utilization rate of 65%.

On the other hand the main market restraints are related to:

- the high operating costs for exploration, many semisubmersible and drill-ships costing upwards of 500,000US$ per day;
- the tightening supply of drilling and production vessels due to the high demand of these vessels together with the few shipyards with the capability to produce them;
- the legal disputes over sovereign territories in the Arctic Ocean and the South China Sea,
- the difficult access to financing; and
- the lack of qualified professionals.

Significant developments have occurred in the design of platforms and other units over the past 30 years, with increased use of floating and mobile units for production operations. These may also incorporate drilling equipment. This trend is likely to continue, especially when operation in deep water are involved. Such units are not just vessels, but serve as industrial process plants and workplaces with the associated major risks when working on location. Mobile offshore units (MOU) cover a lot of aspects depending on its specific role, such as drilling, accommodation (flotel), production, storage and offloading plus well intervention. Such units can be for floating production, storage and offloading (FPSOs), floating production, drilling, storage and offloading (FPDSOs) and floating production platforms (FPPs) based on semi-submersible vessels. Mobile Offshore Drilling Units (MODUs) is a sub category of the mobile offshore unit (MOU), and is not involved in production and storage. However, a MODU can also be used for production purposes. Its role will then change to cover production as well and it can be classified as MODPU - Mobile Offshore Drilling and Production Unit (used in a production mode for a time and then changed its designation to encompass this widened role).

2.2.1 Description of the EU/EEA MODU market

The North Sea, Barents Sea and the European territorial waters in the Mediterranean make up the European market. The majority of European hydrocarbon reserves are located in shallow waters and only a small part of the traditional UK and Norwegian exploration area, which accounts for the vast majority of spending in the European market, has deepwater reserves. Deepwater and ultra-deepwater reserves are also located further north offshore the Orkney and Shetland Islands, off the Norwegian north coast and around the Faroe Islands. Country's with reserves in the Eastern Mediterranean are also increasingly optimistic about deepwater exploration, brought upon by exploration success offshore Israel, and are offering new blocks in the coming years .

Therefore, it is estimated that the drill-ships market will become increasingly important due to the increase in deepwater drilling projects as companies seek to exploit the existing reserves in a region that offers very favourable working conditions with political stability, operational transparency and personnel and tech support. The challenge in the North Sea is related to the extremely harsh conditions, requiring more sophisticated and very specialized equipment. These harsh conditions will be a further growth incentive for the European market as it will become the primary source of demand for harsh environment units throughout all submarkets. Nevertheless, the midwater market will continue to be strong in Europe, and semi-submersibles and jack ups will maintain a high market share.

The European MODU market was worth US$8,377 mln in 2013. Thanks to the increasing demand for expensive harsh environment MODUs, the European MODU

market will be worth $12,384 mln in 2018 and grow at a Compound Annual Growth Rate (CAGR) of 3.4% over the interval 2018-2023. The North Sea market will grow at a CAGR of 5.7% between 2013 and 2023 and will be worth $14,636 mln in 2023. With the current low prices of crude oil, this estimation can be taken with caution.

The barriers to entry for the global MODU market are related to the fact that it is a very capital intensive market and to the great emphasis on companies' experience and reliability especially since the BP oil spill in the Gulf of Mexico. The European market is among the most difficult markets for new companies to enter because the very stringent regulations with regard to the environment and safety have increased further as a consequence of the BP oil spill in 2010.

The European MODU market drivers are the following:

- Declining regional hydrocarbon supply: European hydrocarbon reserves have been declining for years and many countries in the region have become dependent on non-European states for their energy needs. Companies and governments are now looking to develop previously inaccessible reserves in the region;
- Renewed interest in mature /marginal North Sea fields: The majority of fields in the North Sea have been under production for several decades. With technological improvement in enhanced oil recovery, companies are now becoming interested in developing fields that previously were considered to be economically unviable;
- Barents Sea, Faroe Islands and Shetland Islands: In the last years significant discoveries have been made in the previously unexplored deepwater areas in the North Sea. An agreement reached in 2011 between Norway and Russia ended a 40 year dispute and opened up more than 68,000 square miles to oil and gas exploration in the Barents Sea. The Faroe and Shetland Islands have also seen increasing drilling activity in deepwater over the past years while the Dromberg field offshore Ireland has been estimated to contain up to 1 billion barrels of oil.

The main restraints of the European MODU market include:

- Economic climate: The economic and financial conditions in the region make it difficult for many actors in the oil and gas industry to gain access to the capital needed in an industry where fleet additions are largely financed through debt;
- Clean energy agenda: The governments of the EU/EAA area are working on ambitious policies to fortify the EU's energy security and to combat climate change.

2.2.2 Description of the world MODU market

The development, in terms of Compound Annual Growth Rate (CAGR), of the regional MODU markets throughout the period 2013-2023 has been estimated as follows [2]: South America (7.9%), North America (7.9%), Africa (9.5%), Europe (5.7%), Asia Pacific (8.9%), Middle East (4.0%) and Rest of the world (9.1%).

On the other hand there will be very little overall change in the regional market share during the decade 2013-2023. The Middle Eastern and European markets will lose a small percentage of the market share due to the limited spending on drilling operations in deeper waters. The African market will gain market share due to the significant increase of the drilling activity on Africa's coasts. The markets in the golden triangle will remain the three dominant regional markets while the Asia Pacific market will take over Europe's position as the fourth largest regional market by 2023.

The South American market

The South American market, which includes all MODUs deployed for offshore drilling off the coast of the continents eastern and western shores as well as drilling in the

Caribbean Sea and Mexico, is primarily driven by Brazil's vast deepwater and ultra-deepwater reserves in the Santos, Campos and Espirito Santo basins and Petrobras's pre-salt agenda. Petrobras impressive investment includes the construction of 38 production vessels, 50 drilling rigs and 49 shuttle tankers and support vessels between 2011 and 2020. The main reason for the barriers to entry in the Brazilian market is the national oil company of Brazil, Petrobras, and the country's regulations which currently demands that 65% of the equipment used in operations offshore Brazil be produced in the country. Smaller companies and companies without a strong footing in the Brazilian market will struggle to fulfil these requirements increasing the barriers to entry for the most important MODU market.

Domestic oil production in Mexico has been declining in recent years and the national oil company Pemex is now looking to compensate for the loss in the daily production by increasing its exploration efforts in the Mexican part of the Gulf.

The North American and the Gulf of Mexico markets

The North American region includes vessels offshore Alaska, Eastern Canada, the US, and Cuba. Alaska will see growing investment in its offshore oil and gas industry as exploration drilling in the subarctic and arctic water in the region increases.

In 2012 Cuba also started an offshore exploration program but so far has not encountered any major finds as three different companies, Repsol, PETRONAS and PDVSA, all drilled in different areas offshore Cuba.

The Gulf of Mexico is expected to play a major role in the oil and gas industry over the coming years. The oil spill in the Gulf of Mexico in 2010 has significantly increased barriers to entry in the North American market [2]. Safety and environmental regulations for offshore operations, and even more for deepwater and ultra-deepwater drilling, have been tightened drastically in the US part of the Gulf and Mexico is looking to implement similar regulations.

The African market

The African MODU market, that includes all drilling activity offshore Africa, will be driven by very strong offshore exploration and development activity. In West Africa, geology similar to pre-salt reserves in Brazil and recent pre-salt findings in Angola, have started a new wave of exploration with governments from Gambia to South Africa initiating drilling programs.

On the east coast of Africa large gas findings in deepwater reserves offshore Mozambique and Tanzania have created a potentially very large new market for the MODU industry. Recently, in August 2015, Eni has made a world class supergiant gas discovery at its Zohr Prospect, in the deep waters of Egypt. The discovery well Zohr 1X NFW is located in the economic waters of Egypt’s Offshore Mediterranean, in 4,757 feet of water depth (~1,450 metres), in the Shorouk Block. According to the well and seismic information available, the discovery could hold a potential of 30 trillion cubic feet of lean gas in place (5.5 billion barrels of oil equivalent in place) covering an area of about 100 square kilometres. Zohr is the largest gas discovery ever made in Egypt and in the Mediterranean Sea and could become one of the world’s largest natural-gas findings.

In North Africa the political instability caused by the Arab Spring stopped exploration efforts in several countries but despite this fact the area will also see a strong increase in demand for MODUs. In the period 2013-2023 deepwater drilling operations will take on an even greater market share as most projects in West and East Africa are in deeper waters.

Drill-ships and semi-submersibles will maintain a combined share of over 75% of the market, while jack-ups will have a market share of around 20%. The African MODU market is still very high risk in terms of exploration success rate, less so in the more explored areas of Angola and Nigeria, and all operators in the region try to keep capital expenditure as low as possible .

The Asian Pacific market

The main driver behind development in the Asia Pacific market, that includes the waters of China, Malaysia, Indonesia, Philippines, Brunei, Papua New Guinea, Australia and New Zealand, is the large unexplored deepwater and ultra-deepwater territory in the area and the potential reserves that are to be found. While the region will see strong demand in shallow and midwater operations, the higher expenditure in deep and ultra-deepwaters will account for the majority of growth in the market. In the coming years the market will see growth throughout the various submarkets as many areas are in the very early stages of development.

China will be a driving force in developing deepwater and ultra-deepwater reserves in the region. Apart from the China's national oil companies several international oil companies are investing heavily in exploration and production operations as they look to bring oil and gas to the increasingly energy hungry Chinese market. In Malaysia, Indonesia and the Philippines, the sector will see strong investment as large areas of deeper water have not been explored and shallow and midwater operations are conducted largely by older MODUs which will be replaced over the coming years. A big obstacle to increased growth in the region is the legal dispute about the sovereign borders in the South China Sea which will prevent a large part of deepwater territory in the South China Sea from becoming available for exploration and production.

In Australia production of LNG from reserves off its north-western coast has grown rapidly over the past years. The development of floating liquefied natural gas (FLNG) facilities will give an additional boost to the market as it will make deepwater gas exploration and production more profitable.

A factor that makes entry to Asia Pacific market easy is the distance from other major deepwater markets as in the offshore sector transit times do matter. Because of that many companies only maintain a small part of their global fleet in the Asia Pacific region at any time, thereby reducing competition from major companies.

The Eastern Mediterranean market

Offshore activity in the Red Sea, the Persian Gulf, The Gulf of Oman as well as offshore Israel in the Eastern Mediterranean makes up the Middle East market. The Persian Gulf, where a fleet of over 100 jack-ups operate in shallow waters, is the traditional offshore market of the Middle Eastern region and the one where most money is spent. In general these jack-ups are several decades old but despite low day-rates and increased downtime remain active due to the low technological drilling requirements in the area. Other countries that show similar dynamics are Oman, with reserves in the Gulf of Oman, and Yemen, whose offshore reserves are located in the Gulf of Aden and the Red Sea.

The other market for MODUs in the region is located in the Eastern Mediterranean along the coast of Israel, Lebanon and Syria. Demand for semi-submersibles and drill-ships in the Middle East will be far lower than in other regional markets since only Israel has discovered proven reserves in deepwater areas.

The low technological drilling requirements in the area allow companies to enter the market through acquisition of an older jack-up rig, or via the order of a modern jack-up and become instantly competitive. The fact that jack-ups are the region's main MODU

types, and are much cheaper than drill-ships and semi-submersibles, further simplifies the entry to the market.

The rest of the world market

The rest of the world market is defined as spending on drilling activities in the arctic, along the eastern Russian coast, in the Caspian Sea and in India, Myanmar and Bangladesh. The growth will mainly come from an increase in offshore drilling in South Asia and uptake of expensive drilling projects in Arctic waters. Increased demand for MODUs of all types will come as a result of offshore projects in the Arabian Sea and the Bay of Bengal where Bangladesh, India and Sri Lanka are looking for oil and gas in previously unexplored areas. Drilling in the Arctic will be driven by the vast hydrocarbon potential in the region. Despite various obstacles to explore the Artic, the harsh environmental conditions, the lack of existing infrastructure, the long lead times and the strict regulations, many companies are investing heavily in the region.

3. Inventory of the equipment on-board MODUs

3.1. Typical Oil and Gas equipment

According to the EU Product Safety Directives, equipment which may be typically installed on both fixed and mobile offshore units is already covered by the PED and the MD but not by the ATEX Directive[17].

Besides, well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or control well pressure is also specifically excluded from the scope of the PED. Thus, well-control equipment installed on-board mobile and fixed offshore units as well as that installed on onshore platforms is out of the scope of the PED.

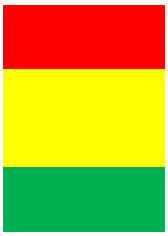
Since the variety of equipment is huge, it has been decided to focus on systems or groups of equipment rather than on individual devices. Six main categories have been identified by grouping certain equipment and considering its importance for the safety of the operations (Table 2 to Table 7):

1. Drilling equipment
2. Well intervention equipment
3. Material handling equipment
4. Well-control equipment
5. Other pressure equipment, and
6. Electrical equipment.

For each system – or group of equipment – it is detailed whether it could be placed in an explosive atmosphere and thus could fall under the ATEX scope, whether it could be considered as "machinery" and therefore could potentially fall within the MD and whether it could be under pressure conditions and therefore could potentially fall within the PED. Finally, it is detailed whether the system is currently covered by the IMO MODU Code.

The applicability of the ATEX/MD/PED Directives and the importance from the safety point of view is presented by colours, according to the following meaning:

- Systems of high importance from the safety point of view and which require further analysis
- Systems of lower importance from the safety point of view, in comparison with the above explained ones, and which would be worth analysing if the necessary resources were available
- Minor systems from the safety point of view that do not require further analysis



[17] MODUs and equipment installed on-board MODUs are currently out of scope of the Product Safety Directives (MD, PED, ATEX). However, this exclusion has exceptions. According to the guidelines to the application of the MD, machinery which may be installed on both fixed and mobile offshore units is subject to the MD, even if is installed on MODUs. Similarly, the exclusion under the PED only applies to equipment specifically intended to be installed on-board or for the propulsion of the mobile offshore units.

Thus, in case of the MD and the PED, the impact of extending their scopes is therefore limited to the MODU itself as well as to the equipment specifically intended to be installed on-board or the propulsion thereof. On the other hand, the extension of the ATEX Directive would impact on the MODU and on the equipment on-board, even if it is not specifically intended to be installed on-board MODUs.

Section 2.1.3 of the MODU Code specifies that "each MODU should be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society" and goes on to further specify that such a classification society "has recognized and relevant competence and experience with offshore petroleum activities".

Classification societies are private institutions in the shipping industry which establish and maintain technical standards for the construction, operation and classification of ships and offshore structures. They also carry out regular surveys of ships in service to ensure compliance with these standards[18].

Today by the term "classification" it is understood whether a ship meets the relevant classification society's rules or it does not. As a consequence it is either 'in' or 'out' of 'class'[19].

There are twelve societies, all belonging to the International Association of Classification Societies (IACS). The primary societies are American Bureau of Shipping (ABS), Det Norske Veritas (DNV, Norwegian) and Lloyd's Register of Shipping (Lloyd's Registry, English). It is very rare to see a MODU that is not classified by one of the three primary societies, with ABS having most of the units[20].

When registering a vessel for international travel, one must choose a nation under the flag of which that vessel will sail. The term "flag of convenience" refers to registering a ship in a sovereign state different from that of the ship's owners. Ships registered under flags of convenience can often reduce operating costs or avoid the regulations of the owner's country. To do so, a vessel owner will find a nation with an open registry, or a nation that allows registration of vessels owned by foreign entities. A ship operates under the laws of its flag state, so vessel owners often register in other nations to take advantages of reduced regulation, lower administrative fees, and greater numbers of friendly ports[21].

In addition to performing surveys for ship owners, Classification Societies also offer their services to Governments to perform statutory surveys on ships registered under their flags on their behalf[19].

The connection between the international maritime regulations, developed by the IMO, and the classification rule requirements for a ship's hull structure and essential engineering systems is codified in the International Convention for the Safety of Life at Sea (SOLAS)[22].

A ship owner that is dissatisfied with class can change to a different one relatively easily. This has led to more competition between classes and a relaxation of standards. Thus, due to the loss of confidence of the shipping industry in the classification societies [7], the role of these and their rules have not been considered in the preparation of this report even though if it is integral to the application of the MODU Code.

According to MODU owners, when the classification society rules are considered, many (though not all) of the "No" entries in in the column headed "Is it covered by IMO MODU Code?" in the below listed tables would be "Yes".

---

[18] www.un.org/depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/hosanee_0910_mauritius_PPT.pdf

[19] www.iacs.org.uk/document/public/explained/CLASS_KEY_ROLE.pdf

[20] www.iacs.org.uk/Explained/members.aspx

[21] https://www.hg.org/article.asp?id=31395

[22] http://maritime-connector.com

Table 2. Drilling equipment

	Can be in explosive atmosphere and requires protection?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Hoisting, lifting, handling and rotary systems *including* Drawworks, Crown block, Travelling block, Drilling hook, Top drive / Drilling machine, Rotary table, Pipe handling machines, BOP crane, X-mas tree crane, etc.*	**Yes**	**Yes**	**No**	**No** Cranes and lifting equipment used in oil and gas operation are not covered with the exception of the protection against explosive atmospheres (IEC)	
Derrick structure Derrick	**No**	**Yes**[***] only for movable derrick structure[****]	**No**	**No; conditionally Yes** The MODU Code (Chapter 12, sections 12.2 and 12.5) does address all lifting and hoisting equipment and drilling derricks. Specific reference to the rated capacity of each reeving in the derrick's equipment provides clear evidence that concern is the operational safety of the lifting operation.	
Tensioning and motion compensating systems *including* Tensioners: Marine riser and surface BOP tensioners, Compensators: Drill string compensators, etc.	**Yes**	**No** but components of active compensator can be treated as machinery	**No**	**No** but it is protected against explosions (IEC)	
Mud circulating system	See Table 5; Well-control equipment				
Cementing system *including* Cement pumps, etc.	**Yes**	**No**[***] components of the systems can be treated as machinery	**Yes**	**No** but it is protected against explosions (IEC)	
String/Pipes Drill string, Casing, etc.[**]	**No**	**No**	**Yes**	**No**	
Marine riser	**No**	**No**	**Yes**	**No**	

[*]Wider and more detailed list could include: Drawworks (assembled machinery), drawworks (stand-alone winch), assembled cylinder operated hoisting systems, hydraulic cylinders ("rams"), travelling yoke, yoke sheaves, equalizers, dead line anchor, fastline wheel, deadline wheel, swivel, drilling line, drillers cabin, drill line / steel wire rope, cranes in derrick, etc.

[**]Not included pipe handling systems with their components: Horizontal pipe handling machines, horizontal to vertical pipe handling machines, fingerboard, manipulator arms, tubular feeding machine, mousehole, etc. which are more suitable for Table 5. Material handling equipment

[***]If parts are in scope of MD then the system would be as an assembly; the Report do not consider the assembly issue

[****]For non-movable derrick structure: There are too many equipment items to conclude with a single YES or NO. Derrick structure and its substructure is not machinery in itself.

Table 3. Well intervention equipment

	Can be in explosive atmosphere?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Wireline equipment	**No**	**No**	**Yes**	**No**	
Snubbing equipment	**No**	**Yes**	**Yes**	**No**	
Coiled tubing equipment	**No**[*]	**Yes**	**Yes**	**No**	

[*]Such equipment may also be in explosive zones.

Table 4. Material handling equipment

	Can be in explosive atmosphere?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Lifting appliances including Cranes, etc.	**Yes**	**Yes**	**No**	**No**[*] but it is protected against explosions (IEC)	
Lifting gear *including* Hooks, Swivels, etc.	**Yes**	**Yes**	**No**	**No**[*] but it is protected against explosions (IEC)	

[*]The MODU Code, Chapter 12, sections 12.2 and 12.5, does address all lifting and hoisting equipment and drilling derricks. Specific reference to the rated capacity of each reeving in the derrick's equipment provides clear evidence that concern is the operational safety of the lifting operation.

Table 5. Well-control equipment

	Can be in explosive atmosphere?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Mud circulating system *including* Mud pumps, Mixing units, Mud centrifuge, Mud cleaner, Mud-gas separator, Drilling pipes, Bit, Dampener, Degasser, Desilter, Valves, Conduits, etc.	**Yes**	**No**[**] Components of the system can be treated as machinery	**Yes**[***]	**No** but it is protected against explosions (IEC)	
Blow-out preventer (BOP) with its control unit *including* BOP stacks, BOP control unit i.e. Koomey unit, etc.*	**Yes**	**No**[**]	**Yes**	**No** but it is protected against explosions (IEC). Some issues related to BOP, and explicitly during the emergency shutdown, are covered by IMO	
Well head *including* Christmas tree, Choke manifold…	**Yes**	**No**	**Yes**	**No** but it is protected against explosions (IEC)	
Packers	**No**	**No**	**Yes**	**No**	
Cementing system	See Table 2; Drilling equipment				
String/Pipes	See Table 2; Drilling equipment				

[*]Wider list could include also: BOP running/retrieving guiding system

[**]Some parts of the whole BOP system can be treated as machinery (for example in the safety-critical equipment analysis)

[***]Pumps are outside of the scope of PED, but the whole mud circulation system is necessary for well-control (pressure well-control). On the other hand, pumps can fall within the scope of the PED if the potential pressure hazard is sufficiently high compared with other hazards such as e.g. hazards created by moving machine parts (in the case of mud pumps, pressure hazards can be sufficiently high)

Table 6. Other pressure equipment

	Can be in explosive atmosphere?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Separators and tanks *including* Separators, Fuel tanks, etc.	**Yes**	**No**	**Yes**	**No** but it is protected against explosions (IEC)Tanks for fuel for the propulsion of MODU are covered by IMO	
Emergency shut-down valves	**Yes**	**No**	**Yes**	**No** but it is protected against explosions (IEC)	
Air hoist	**Yes**	**Yes**	**Yes**	**No** but it is protected against explosions (IEC). Air hoists are lifting and hoisting equipment addressed by section 12.2 of the MODU Code but not if it is used for drilling or any other oil and gas operation.	
Gas lift equipment	**Yes**	**No** Components can be treated as machinery	**Yes**	**No** but it is protected against explosions (IEC)	
Pumps and compressors	**Yes**	**Yes**	**Yes**	**No** but it is protected against explosions (IEC). It is covered by IMO in the context of bilge drainage	
Downhole motor (Mud motor)	**No**	**Yes**	**Yes**	**No**	
Hydraulic jar	**No**	**No**	**Yes**	**No**	
Engines *including* Diesel engine	**Yes**	**No** A motor itself is not a product falling within the MD	**Yes**	**No** but it is protected against explosions (IEC). It is covered by IMO in the context of propulsion of MODU	

Table 7. Electrical equipment

	Can be in explosive atmosphere?	Is it kind of machinery?	Can be under pressure?	Is it covered by IMO MODU Code?	
Underwater systems and appliances *including* Remote Operated Vehicles/ ROV	**No**	**No** for some of them Yes	**No**	**No**	
Electrical power systems *including* Emergency power supply system – generator, Emergency power distribution system, Emergency battery, etc.	**Yes**[*]	**No**	**No**	**No**; conditionally **Yes** but it is protected against explosions (IEC) It is covered by IMO in the context of safety and for the propulsion system of MODU; Chapter 5 of the MODU Code applies to all power installations on MODUs except to those used for oil and gas operations.	
Uninterruptible power system	**Yes**[*]	**No**	**No**	**No**; conditionally **Yes** but it is protected against explosions (IEC) Emergency power supply is addressed by the MODU code. An uninterruptible power supply is implicit to provision of power to certain systems, including BOPs.	
Field equipment *including* Public address flashing lights, Junction boxes, etc.	**Yes**	**No**	**No**	**No** but it is protected against explosions (IEC) It is covered by IMO in the context of safety of MODU	
Control systems *including* Control and instrumentation, Process control system, Safety and automation system, etc.	**Yes**	**No**	**No**	**No** but it is protected against explosions (IEC) It is covered by IMO in the context of navigation of MODU	
Trace heating circuits	**Yes**	**No**	**No**	**No** but it is protected against explosions (IEC)	

[*]It is not wise solution to have such devices in explosive atmosphere but it can happen

Most pumps are excluded from the PED based on art. 2(j) however, the manufacturer has to demonstrate that this exclusion applies (pumps may fall within the scope of PED if its potential pressure hazard is high compared with other hazards).

Currently the BOP is excluded from the scope of the PED based on art. 2(i) regardless of where it is located ((mobile / fixed offshore units or onshore units).

Each piece of equipment on-board MODUs should be assessed about whether it falls within the scope of the Product Safety Directives taking into account their scope and exclusions.

For example, a generator as a single component does not fall within the scope of the MD, but the assembled generator with e.g. a combustion engine, is an assembly of machinery and, hence, falls under the MD.

3.2. Specific Oil and Gas equipment installed on MODUs

Equipment specifically intended to be installed on-board MODUs is currently not covered by any of the EU Product Safety Directives (ATEX Directive, MD and PED).

For example, three types of specific equipment for MODUs which aim at overcoming movable effects caused by weather or other conditions, are described below:

Marine riser system: It consists of riser pipe, riser tensioners and ancillaries. The riser pipe is connected to the top of subsea blow-out preventer (BOP), and is pulled up by the riser tensioner system on-board to keep vertical configuration. The riser pipe serves as a conduit for returning mud to the surface from the hole and as a guide for running drill stem and casing from the floater to the hole under the seafloor. A marine riser system is shown in Figure 3.

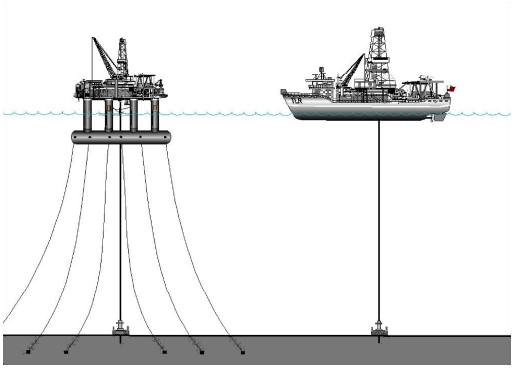


Figure 3. Marine riser system[23]

- **Motion compensating and tensioning system**: Is a device to maintain constant weight on the bit during drilling operation in spite of oscillation of the floater due to wave motion. One of the devices is a bumper sub. The bumper sub is used as a component of a drill string, and is placed near the top of the drill collars. A mandrel composing an upper portion of the bumper sub slides in and out of a body of the bumper sub like a telescope in response to the heave of the rig, and this telescopic action of the bumper sub keeps the bit stable on the bottom-hole. The bumper sub is able to transmit the torque from the drill stem to the drill collar to rotate the bit.

- **Heave compensator**: It is placed in the derrick. There are two types of heave compensator. One is a crown mounted heave compensator and the other is an in-line compensator that is hung below the traveling block in the derrick. Both systems use either hydraulic or pneumatic cylinders that act as spring supporting the drill steam load, and allow the top of the drill stem to remain stationary, as the rig heaves up and down.

[23] Usage rights: Figure labeled for reuse

4. International Maritime Legislation, EU Product Safety Directives and applied Standards

MODUs are subject to international maritime safety regulations, in particular the 2009 IMO MODU Code (Resolution A.1023.(26)) which is correlated with the requirements of the Marine Equipment Directive 96/98/EC[24] (MED).

The purpose of the MED is "to enhance safety at sea and the prevention of marine pollution" and "to ensure the free movement of the above-mentioned equipment within the European Union, the European Economic Area (EEA), Iceland and Norway". The MED applies to equipment installed on-board ships that are registered in the European Union, including Norway and Iceland. The equipment (as listed in Annex A to the MED) must meet specific international conventions, relevant IMO resolutions and circulars, and relevant international testing standards.

The IMO MODU Code has been developed **to provide an international standard for mobile offshore drilling units of new construction which will facilitate the international movement and operation of these units and ensure a level of safety for such units, and for personnel on-board**, equivalent to that required by the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, and the Protocol of 1988 relating to the International Convention on Load Lines, 1966, for conventional ships engaged on international voyages.

The present edition of the MODU Code (2009 edition, as amended), in consideration of the inclusion of classification society rules, addresses virtually all the structure, machinery and electrical systems of a MODU that can be included in the shipyard construction contract with exclusion of equipment intended to be used in oil and gas operations including, but not only limiting to drilling operation. The MODU Code has been amended twice since the 2009 edition was approved and is currently under revision, in consideration of the results of the Macondo incident investigations. The revision includes, inter alia, standards for electrical equipment in hazardous areas.

Related to the IMO MODU CODE, it should be highlighted that:

1. Throughout the development of the Code, it was recognized that it must be based upon sound design and engineering principles and experience gained from operating such units; **it was further recognized that design technology of mobile offshore drilling units is not only a complex technology but is continually evolving and that the Code should not remain static but be re-evaluated and revised as necessary**. To this end the Organization will periodically review the Code, taking into account both experience and future development.
2. Any existing unit which complies with the provisions of this Code should be considered eligible for issuance of a certificate in accordance with this Code.
3. This Code **is not intended to prohibit the use of an existing unit simply because its design, construction and equipment do not conform to this Code**. Many existing mobile offshore drilling units have operated successfully and safely for extended periods of time and their operating history should be considered in evaluating their suitability to conduct international operations.
4. **The coastal State may permit any unit designed to a lower standard than that of the Code to engage in operations having taken account of the local conditions (e.g., meteorological and oceanographic)**. Any such unit should, however, comply with safety requirements which in the opinion of the coastal State are adequate for the intended operation and ensure the overall safety of the unit and the personnel on-board.

[24] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31996L0098&from=en

5. **This Code does not include requirements for the drilling of subsea wells or the procedures for their control. Such drilling operations are subject to control by the coastal State**.

4.1. ATEX Directive vs IMO MODU Code

This section provides a comparison between the requirements of the IMO MODU Code and the ATEX Directive concerning the protection of equipment against explosions and the marking of equipment.

The ATEX Directive is a legal requirement within the EU, hence, the equipment intended to be used outside the EU legally does not have to be certified by ATEX. However, ATEX is often recognized for activities carried out outside the EU.

About 80% of the equipment is certified according to both ATEX (to be placed in the most hazardous zones 0 and 1) and IEC[25], this latter being accepted worldwide but not in Europe, as shown in Figure 4.

In addition, other different worldwide certification schemes exist, such as INMETRO[26] (Brazil), HazLoc[27] (the US), TIIS[28] (Japan), UL[29] (the US, Mexico, Middle East, etc.), CSA[30] (Canada), and old GOST and new CUTR[31] (Russia).

Figure 4. Most common requirements in the world for the equipment intended to be installed in potentially explosive atmospheres[32]

[25] www.IEC.com; IEC is the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres. It uses quality assessment specifications that are based on International Standards prepared by the International Electrotechnical Commission (IEC).

[26] National Institute of Metrology, Standardization and Industrial Quality (INMETRO), Brazil; www.inmetro.gov.br/english/accreditation/sobre_org_cert.asp

[27] Hazardous Location

[28] Technology Institution of Industrial Safety; www.tiis.or.jp

[29] UL Mark for the United States through accreditation by Occupational Safety and Health Administration (OSHA); www.osha.gov, C-UL Mark for Canada through accreditation by the Standards Council of Canada (SCC)

[30] Canadian Standard Association (CSA); www.csagroup.org

[31] Russian Certification; www.gost-r.info/news-2013-03-07.php

[32] Copyright granted by NEMA Enclosures; www.nemaenclosures.com/

Given that MODUs are designed to operate all around the world, the marking according to both ATEX and IEC could be beneficial.

The IMO MODU Code refers to the series of standards IEC 60079 and IEC 61892, and in particular to the standards:

- Series 60079: 60079-4, 60079-4A, 60079-10, 60079-12, 60079-13, 60079-14, 60079-16, 60079-17, 60079-19, 60079-20, 60079-25, 60079-27, 60079-28, 60079-29-1, 60079-29-2, 60079-30-1 and 60079-30-2.
- Series 61892: 61892-1, 61892-2, 61892-3, 61892-4, 61892-5, 61892-6, 61892-7, 61892-8.

A number of small, but essential, differences have been observed between IMO MODU Code and ATEX Directive. In particular:

1. The ATEX Directive considers categories of equipment (category 1, category 2 and category 3) and IMO MODU Code considers hazardous zones (zone 0, zone 1 and zone 2). There is a direct correlation between equipment categories and zones, namely category 1 corresponds to zone 0, category 2 corresponds to zone 1, and category 3 corresponds to zone 2.

2. The ATEX Directive considers hazardous areas caused by gases and dusts while IMO MODU Code only considers hazardous areas caused by gases (since dusts are not generally encountered during offshore drilling operations).

3. Contrarily to the IMO MODU Code, the ATEX Directive does not differentiate between electrical and machinery installations and it only considers "Equipment" and "Protective systems". Thus, the comparison between IMO MODU Code and ATEX Directive related to the technical requirements (see the following points), has been made according to the Essential Health and Safety Requirements of the ATEX Directive and also according to some harmonised standards under ATEX (EN 1127-1, EN 60079-0 and EN 13463-1).

4. In the case of the electrical installations placed in zone 1, the IMO MODU Code allows some protection classes (oil immersion, pressurized enclosures and powder filling) that are not allowed according to the ATEX Directive. In the same way, the IMO MODU Code allows a type of protection (called 's') especially approved by the Administration for electrical installations in hazardous zone 2. For every single case it should be studied if this special protection matches with a protection class allowed by the ATEX Directive.

5. According to ATEX, mechanical equipment intended to be installed in potentially explosive atmospheres shall comply with the requirements of the harmonised standard EN 13463 (Non-electrical equipment to be installed in potentially explosive atmospheres). According to the standard EN 13463-1 (Non-electrical equipment to be installed in potentially explosive atmospheres - Part 1: Basic method and requirements), the following protection classes are used:

    - "f": flow restricting enclosure
    - "d": flameproof enclosure
    - "c": constructional safety
    - "b": control of ignition source
    - "p": pressurised equipment
    - "k": liquid immersion

On the contrary, the IMO MODU Code does not specify any protection class for mechanical equipment placed in hazardous zones, and only sets out the following recommendations:

- Mechanical equipment should be limited to that necessary for operational purposes;
- Mechanical equipment and machinery in hazardous areas should be so constructed and installed as to reduce the risk of ignition from sparking due to the formation of static electricity or friction between moving parts and from high temperatures of exposed parts due to exhausts or other emissions;
- The installation of internal combustion machinery may be permitted in zone 1 and zone 2 hazardous areas, provided that the Administration is satisfied that sufficient precautions have been taken against the risk of dangerous ignition;
- The installation of fired equipment may be permitted in zone 2 hazardous areas, provided that the Administration is satisfied that sufficient precaution has been taken against the risk of dangerous ignition.

4.2. IMO MODU Code vs Machinery Directive (MD)

The IMO MODU Code "does not include requirements for the drilling of sub-sea wells or their procedures for their control." Besides, the MD explicitly excludes seagoing vessels and mobile offshore units together with the equipment on-board such vessels or units.

Contrarily to the MD, the IMO MODU Code does not have a clear definition of the term 'machinery' and does not mention the term "assembly". However, IMO MODU Code refers to marine and industrial machinery in point 4.1.1 "…The provisions apply to both marine and industrial machinery".

4.3. IMO MODU CODE vs Pressure Equipment Directive (PED)

The scope and purpose of the IMO MODU Code and the PED are different.

The PED applies to the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure greater than 0,5 bar.

In the context of this study, the following equipment is excluded from the scope of the Directive:

1. Well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage, which is intended to contain and/or control well pressure. This comprises the wellhead (Christmas tree), the Blow-out Preventers (BOP), the piping manifolds and all their equipment upstream.
2. Pipelines comprising piping or a system of piping designed for the conveyance of any fluid or substance to or from an installation (onshore or offshore) starting from and including the last isolation device located within the confines of the installation, including all the annexed equipment designed specifically for pipelines. This exclusion does not apply to standard pressure equipment such as may be found in pressure reduction stations or compression stations.
3. Ships, rockets, aircraft and mobile off-shore units, as well as equipment specifically intended for installation on-board or the propulsion thereof;

In general, the IMO MODU Code deals with maritime safety and practically treats all machinery and pressure devices from the point of view of the navigation and stability of the platform (ship), and through these principles, it also deals with the safety of the personnel on-board and with environmental issues.

The IMO MODU Code does not explicitly include requirements for the drilling of subsea wells or the procedures for their control, being such drilling operations subject to control by the coastal State.

However, the Code considers BOPs as vital systems / essential services for safety in an emergency, and claims that the power available should be sufficient to supply all those essential services. It specifically claims "the emergency source of power should be capable for a period of 18 hours of closing the blow-out preventer and of disconnecting the unit from the well-head arrangement, if electrically controlled; unless they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period of 18 h". It also states that the blow-out preventer control system, among other essential facilities, should be operable after an emergency shutdown.

4.4. Applied Standards

Today, the most widely used standards in the offshore sector are the Norwegian standards provided by the *Standard Norge* (NORSOK) [33], the *American Petroleum Institute* (API) [34] standards and the *International Organization for Standardization* (ISO)[35] standards.

Norway is a European country with a very extensive experience in the offshore oil and gas activities, and hence its standards are extensively used in Europe and the rest of the world as an example of first class offshore regulation and practice.

On the other hand, the API standards cover the offshore oil and gas activities very thoroughly, and despite the fact that these are not obligatory in the *European Union*, they are widely used both in Europe and in the rest of the world as an example of best practice.

Nevertheless, the use of the API and NORSOK standards outside the US and Norway respectively, is not unjustified since the worldwide accepted ISO standards often include solutions coming from these two standardisation organisations.

The three mentioned standardisation organizations commonly cite each other in their official documents and even work together to develop new standards and to find the best solutions in standardisation. This approach is not in conflict with the philosophy of the OSD, which, in its recital 30, claims *"To ensure safety in design and continuous safe operations, the industry is required to follow the best practices defined in authoritative standards and guidance. Such standards and guidance should be updated based on new knowledge and invention to ensure continuous improvement. Operators, owners and competent authorities should collaborate to establish priorities for the creation of new or improved standards and guidance in the light of the Deepwater Horizon accident experience and other major accidents…".*

Additionally, in Europe standards for offshore oil and gas activities are also provided by the *European Committee for Standardization* (CEN)[36], the *British Standard Institution* (BSI)[37], and the *Deutsche Institut für Normung* (DIN)[38], etc.

---

[33] The Norwegian Standards are freely available in PDF format with no charges from www.standard.no/en/sectors/Petroleum

[34] www.api.org

[35] www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_ics_browse.htm?ICS1=75

[36] www.cen.eu; *fr.* Comité Européen de Normalisation (CEN)

[37] www.bsigroup.com, http://shop.bsigroup.com/

[38] www.din.de

According to the International Association of Oil & Gas Producers (OGP), the relationship among different standardization bodies is shown in Figure 5.

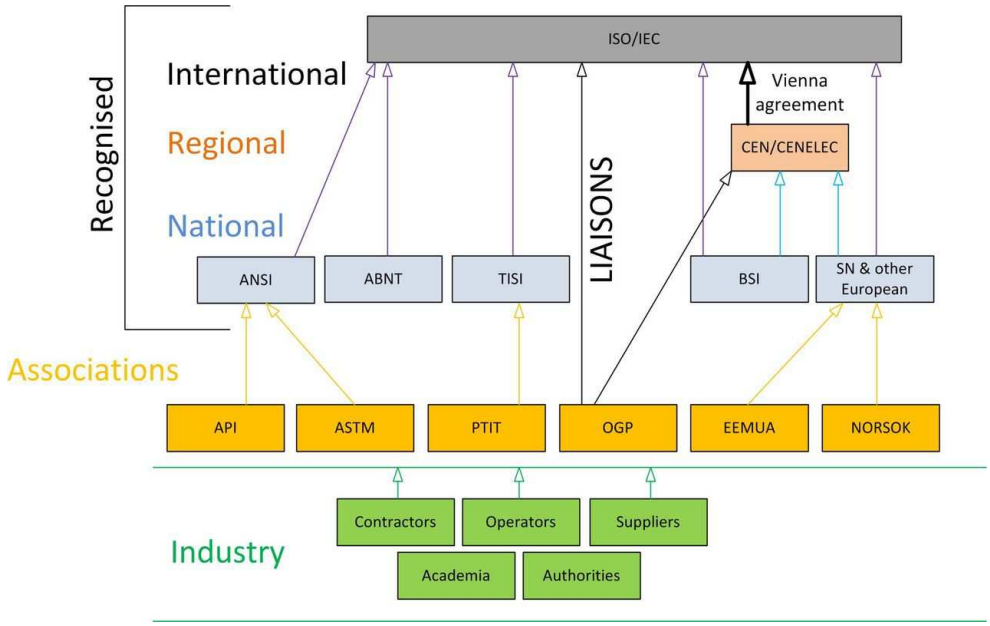


Figure 5. Relationship among different standardization bodies

In Figure 5, API is the American Petroleum Institute, ASTM is the American Society for Testing and Materials, ANSI is the American National Standards Institute, ABNT is the Associação Brasileira de Normas Técnicas[39], PTIT is the Petroleum Institute of Thailand, TISI is the Thai Industrial Standards Institute, OGP is the International Association of Oil & Gas Producers, EEMUA is the Engineering Equipment and Materials Users' Association, SN and NORSOK refer to the Standard Norge, BSI is the British Standard Institution, ISO is the International Organization for Standardization, CEN is the European Committee for Standardization, IEC is the International Electrotechnical Commission, and CENELEC is the European Committee for Electrotechnical Standardization.

The Vienna Agreement[40] is the agreement on technical cooperation between the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) signed on June 27th; 1991.

4.4.1 NORSOK standards

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations[41].

Experts from a wide range of Norwegian companies participate heavily in the development of international and European standards, in order to define safe and economical design and processes. However, Norwegian safety framework and climate conditions may require own standards, or additions and supplements to International

[39] www.abnt.org.br

[40] www.iso.org/va

[41] www.standard.no/en/sectors/energi-og-klima/petroleum/norsok-standards/#.VvEQY0Zwuc0

standards and European standards. The NORSOK standards have been developed to fulfil these needs[42].

The preparation and publication of NORSOK standards is supported by the Norwegian Oil and Gas Association (OLF)[43] and by the Federation of Norwegian Industries[44]. The NORSOK standards are available for free in the official website of the Standard Norge[45]. In addition, the OLF has released a number of free guidelines[46] related to drilling, integrated operations, health, working environment and safety, etc.

The main NORSOK standards are schematically shown in Figure 6[47].

[42] http://www.standard.no/en/sectors/energi-og-klima/petroleum/

[43] www.norskoljeoggass.no/en

[44] www.norskindustri.no/English

[45] www.standard.no/

[46] www.norskoljeoggass.no/en/Publica/Guidelines

[47] www.standard.no/Global/bilder/Petroleum/NORSOK%20Plansje%202.pdf

Figure 6. Scheme of the main NORSOK standards.

Even though Norwegian legislation is considered to be strict in the industry, the *Norwegian Petroleum Safety Authority* (PSA) has followed closely the findings following the *Deepwater Horizon* blow-out and has made a thorough research to reveal any required change and improvement. This includes a review of the Norwegian regulations as well as of the NORSOK standards[48]. As a consequence, four NORSOK standards have been updated:

- NORSOK D-001 "*Drilling facilities*"[49], Revision 3, published in December 2012;
- NORSOK D-002 "*Well intervention equipment*"[50], Revision 2, published in June, 2013;
- NORSOK D-007 "*Well testing system*"[51], Edition 2, published in September 2013;
- NORSOK D-010, "*Well integrity in drilling and well operations*" [52], Revision 4, published in June 2013.

Table 8 shows a list of the main existing NORSOK standards connected with the offshore oil and gas industry.

Table 8. NORSOK standards

Field	Title	Code
Architect	Living quarters area	C-001
	Architectural components and equipment	C-002
	Helicopter deck on offshore installations	C-004
Drilling	Drilling facilities	D-001
	Well integrity in well and drilling operations	D-010
	Well intervention equipment	D-002
	Well testing system	D-007
Electrical	Electrical systems	E-001
Geotechnology	Marine soil investigations	G-001
HVAC	Heating, Ventilation and Air Conditioning (HVAC) and sanitary systems	H-003
Instrumentation	Field instrumentation	I-001
	Safety and automation system	I-002
Metering	Fiscal measurement system for hydrocarbon gas	I-104
	Fiscal measurement system for hydrocarbon liquid	I-105
System Control Diagram (SCD)	System control diagram	I-005
Piping and Layout	Piping and valves	L-001
	Piping system layout, design and structural analysis	L-002
	Piping details	L-CR-003
	Piping fabrication, installation, flushing and testing	L-004
	Compact flanged connections	L-005
Material	Materials selection	M-001
	Structural steel fabrication	M-101

[48] Rygg, O.B. and Dagstad, T. in Safe and sustainable drilling operations, Advantage NZ-2013.

[49] www.standard.no/PageFiles/25325/NORSOK%20D-001u3_2012%20(3).pdf

[50] www.standard.no/PageFiles/29616/D-002u2.pdf

[51] www.standard.no/PageFiles/31156/NORSOK%20D-007u2.pdf

[52] www.standard.no/PageFiles/29619/D-010u4_2013_en_02.pdf

Field	Title	Code
	Material data sheets for structural steel	M-120
	Aluminium structural material	M-121
	Cast structural steel	M-122
	Forged structural steel	M-123
	Surface preparation and protective coating	M-501
	Cathodic protection	M-503
	CO_2 corrosion rate calculation model	M-506
	Welding and inspection of piping	M-601
	Fabrication and installation of GRP piping systems	M-622
	Material data sheets and element data sheets for piping	M-630
	Qualification of manufacturers of special materials	M-650
	Qualification of non-metallic sealing materials and manufactures	M-710
Structrural	Integrity of offshore structures	N-001
	Collection of metocean data	N-002
	Actions and action effects	N-003
	Design of steel structures	N-004
	Condition monitoring of loadbearing structures	N-005
	Assessment of structural integrity for existing offshore load-bearing	N-006
Process	Process systems	P-100
	Process design	P-001
Lifting equipment	Lifting equipment	R-002
	Safe use of lifting equipment	R-003
	Safe use of lifting and transport equipment in onshore petroleum plants	R-005
Mechanical	Mechanical equipment	R-001
	Piping and equipment insulation	R-004
Safety	Technical safety	S-001
	Working environment	S-002
	Environmental care	S-003
	Machinery- working environment analyses and documentation	S-005
	HSE evaluation of contractors	S-006
	Safety Equipment Data Sheets	S-011
	Health, Safety and Environment (HSE) in construction-related activities	S-012
Telecommunication	Telecom systems	T-001
	Telecommunication and IT systems for drilling units	T-003
	Telecom subsystems	T-100
Subsea	Subsea Production Systems	U-001
	Life extension for subsea systems	U-009
Underwater operation	Manned underwater operations	U-100
	Diving respiratory equipment	U-101
	Remotely operated vehicle (ROV) services	U-102
	Petroleum related manned underwater operations inshore	U-103
Pipelines	Life extension for transportation systems	Y-002
Technical information	Documentation for operation DFO	Z-001
	Component identification system	Z-CR-002
	Coding system	Z-DP-002
	Technical Information Flow Requirements	Z-003

Field	Title	Code
	CAD symbol libraries	Z-004
	2D-CAD drawing standard	Z-005
	Supplier`s documentation of equipment	Z-018
MC and preservation	Preservation	Z-006
	Mechanical Completion and Commissioning	Z-007
Reliability engineering and technology	Risk based maintenance and consequence classification	Z-008
Risk analyses	Risk and emergency preparedness assessment	Z-013
Standard Cost Coding	Standard Cost Coding system	Z-014
Temporary equipment	Temporary equipment	Z-015
	Temporary equipment-forms	Z-015

The NORSOK standards make reference to several international standards. Related to electrical installations in hazardous areas, some IEC/EN standards are cited e.g. in NORSOK standard E-001, NORSOK standard D-007, NORSOK standard I-001 and NORSOK standard S-001, see Table 9. Some of them are harmonised under the ATEX Directive while others are not.

Table 9. IEC/EN standards related to electrical installations in hazardous areas mentioned in NORSOK standards.

IEC/EN standards mentioned in NORSOK standards	Title	Harmonised standard under ATEX equipment Directive?
EN-13463-1*	Non-electrical equipment for potentially explosive atmospheres. Basic method and requirements	Yes
IEC 60079-0	Electrical apparatus for explosive gas atmospheres_Part 0: General requirements	Yes
IEC 60079-14	Electrical apparatus for explosive gas atmospheres_Part 14: Electrical installations in hazardous areas (other than mines)	No
IEC 60079-15	Electrical apparatus for explosive gas atmospheres_Part 15: Construction, test and marking of type of protection "n" electrical apparatus	Yes
IEC 61892-7:2007	Mobile and fixed offshore units_Electrical installations_Part 7: Hazardous areas	No

* EN 13463 series has been recently replaced by ISO 80079-36 and 80079-37 standards

4.4.2. ISO standards

The aim of Technical Committee **ISO/TC 67** "*Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*" is the standardization of the materials, equipment and offshore structures used in the drilling, production, transport by pipelines and processing of liquid and gaseous hydrocarbons within the petroleum, petrochemical and natural gas industries[53].

[53] http://www.iso.org/iso/iso_technical_committee?commid=49506

Norway takes part in all sub-committees in ISO/TC 67, and contributes with experts in most of the working groups. Moreover, the Norwegian petroleum industry participates also in many of other international standardization committees[54].

The Technical Committee ISO/TC 67 has 7 subcommittees:

- SC2 "Pipeline transportation systems";
- SC3 "Drilling and completion fluids, and well cements";
- SC4 "Drilling and production equipment";
- SC5 "Casing, tubing and drill pipe";
- SC6 "Processing equipment and systems";
- SC7 "Offshore structures";
- SC8 "Arctic operations".

At the same time the subcommittees have working groups, such as:

- WG2 "Conformity assessment";
- WG4 "Reliability engineering and technology";
- WG5 "Aluminium alloy pipes";
- WG7 "Corrosion resistant materials";
- WG8 "Materials, corrosion control, welding and jointing, and non-destructive examination (NDE)", WG10 "Liquefied Natural Gas (LNG) installations and equipment";
- WG11 "Coating and lining of structures and equipment";
- WG12 "CO2 aspects".

The Technical Committee ISO/TC 67 proposed, on March 2011 after the Macondo and Montara accidents, an action plan expressed in the document ISO/TC 67 N 1119 to address the lessons learned from these accidents[55].

A scheme of the ISO standards used in the oil and gas industry is shown in Figure 7.

4.4.3. API standards

The *American Petroleum Institute* (API)[56] is the national body that represents all aspects of America's oil and gas industry.

The API *Standards Program*, which dates back to the 1920's, is accredited by the American National Standards Institute (ANSI)[57] and provides an ongoing forum for continuous improvement by, and collaboration among, companies, regulators, and other industry stakeholders.

The *American Petroleum Institute* (API) develops each of its standards after an open consultation with representatives from government regulators, engineering companies, contractors, equipment manufacturers and the oil and natural gas industry.

---

[54] Robert Baligira. The effect of Macondo blow-out on risk analysis and risk management. Faculty of Science and Technology, University of Stavanger, 2013. http://brage.bibsys.no/xmlui/bitstream/handle/11250/182281/Baligira_Robert.pdf?sequence=1&isAllowed=y

[55] www.iso.org/iso/tc67actionplan.pdf

[56] www.api.org; the standards can be bought from www.techstreet.com

[57] www.ansi.org

Over 100 API standards are referenced in the *US Government* regulations and raise the level of safety performance across the industry. The implementation of the regulations and industry standards issued by the *American Petroleum Institute* (API) resulted in significant improvements in the reliability and safety of offshore operations as highlighted by the absence of significant accidents over the past two decades before *Macondo* accident. However, *Macondo* accident occurred in the Mexican Gulf in 2010 despite of the already very good existed regulative. This caused the need of further improvements, being the **API Std. 53** "***Blow-out Prevention Equipment Systems for Drilling Wells***"[58] the most important one related to the oil and gas equipment installed on MODUs.

[58] www.techstreet.com/products/1846173

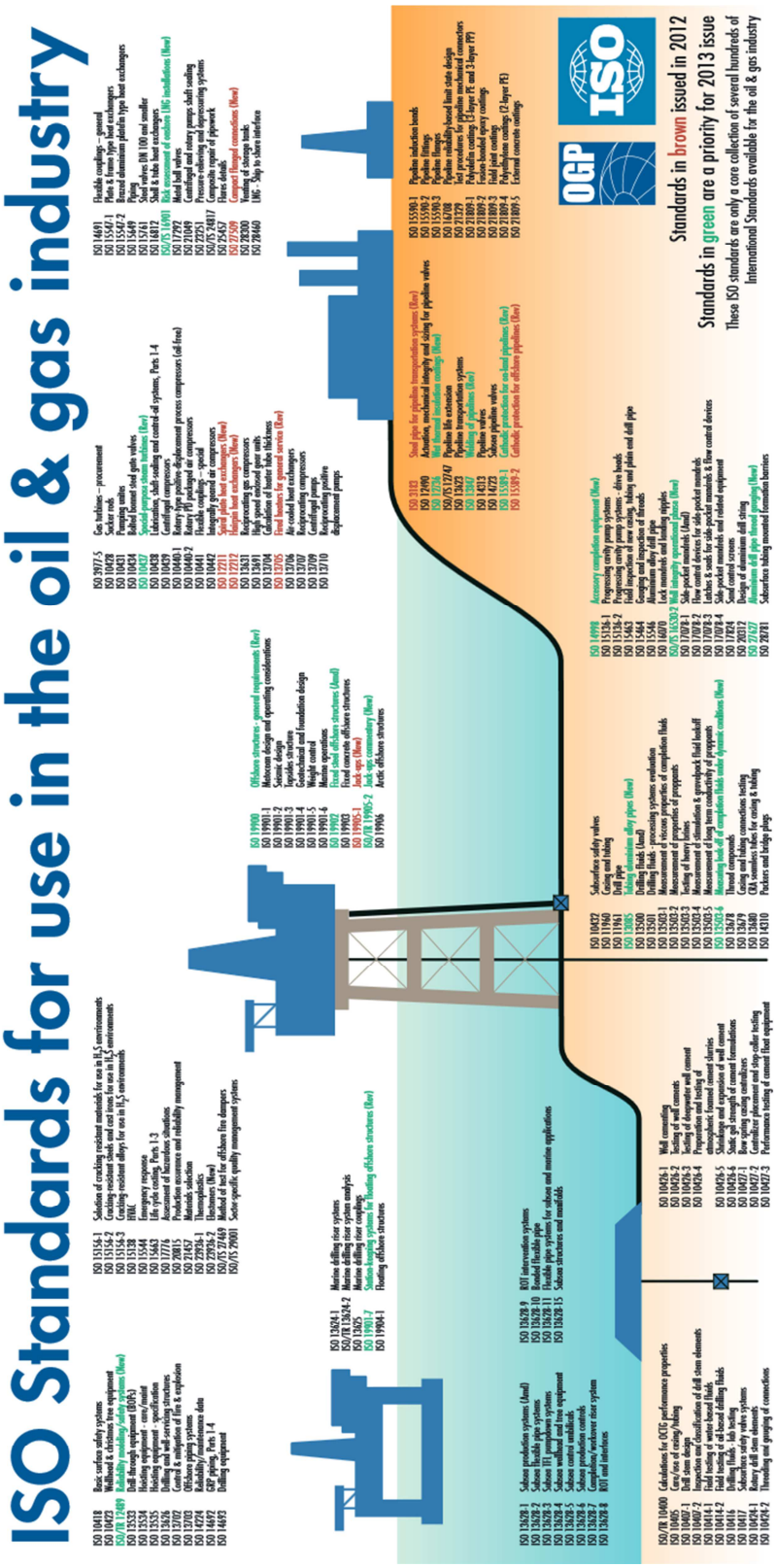


Figure 7. Schematic structure of petroleum standards published by the International Organization for Standardization (ISO)[59]

[59] Copyright granted by the International Association of Oil & Gas Producers (IOGP); www.iogp.org

5. Well-control

Well-control equipment is intended for the prevention or mitigation of the dangerous effects caused by an unexpected release of formation fluid, such as natural gas and/or crude oil, from the well to its surroundings [60]. Technically, well-control involves preventing the formation fluid, usually referred to as kick, from entering into the wellbore during drilling. Formation fluid can enter the wellbore if the pressure exerted by the column of drilling fluid is not great enough to overcome the pressure exerted by the fluids in the formation being drilled. Failure to manage and control these pressure effects can cause serious equipment damage and injury, or loss of lives. Improperly managed well-control situations can cause blow-outs, which are uncontrolled and explosive expulsions of formation fluid from the well, potentially resulting in a fire and explosion. If well-control measures fail to prevent formation fluids entering the wellbore, the blow-out eventually can be stopped using a "blow out preventer" – BOP. As the rams and choke of the BOP remain closed, a pressure test has to be carried out and the drilling fluid with increased density has to be pumped inside the well to kill the kick and to circulate it out.

Well-control includes measures, practices, procedures and equipment, such as fluid flow monitoring, to ensure safe and environmentally protective drilling, completion, abandonment, and workover operations as well as the installation, repair, maintenance, and operation of surface and subsea well-control equipment[61].

5.1. Dual Barrier System for well-control

The standard NORSOK D-010 "Well integrity in drilling and well operations" defines the minimum functional and performance oriented requirements and guidelines for well design, planning and execution of safe well operations. In general, to control a well in a proper way, a concept of two independent barriers has to be considered (in the sense of NORSOK D-010) – see Section 5.3.1. The improved concept of "two barriers" has been introduced with a new version of the NORSOK D-010 standard where safe well-design should include a primary barrier, consisting of the column of drilling mud surrounding the drill string, and a secondary barrier, made up of a system of elements–an "envelope"–including the Blow-out Preventer (BOP) shear ram, high-pressure riser, annulus access valve, casing, and other aspects of the well construction. Also, the first barrier (blue) is in most cases hydraulic, while the second one (red) is mechanical – see Section 5.3.1; Figure 14 and Figure 15.

When a user requests the CE mark on the equipment used to form the barrier, a discussion needs to take place with the manufacturer to justify the requirement and its commercial and legal implications thereof. Each item of equipment is classified under one of the three categories:

- Equipment meeting the definition of Pressure Equipment as established in the Directive, and is not excluded from PED (up to now BOP is excluded from PED but not from MD if it can be treated as machinery); exclusion of well-control equipment from PED; article 1, 2(i);
- Equipment that is excluded from the PED (pumps are excluded but the manufacturer still needs to show that pressure is not a significant design factor. This can be the case of mud pumps since they work under very high pressure; exclusion of pumps; article 1, 2(j);

[60] API *RP 96, Deepwater Well Design and Construction, First Edition, March 2013.*

[61] *Oil and Gas and Sulphur Operations in the* Outer Continental Shelf*, 30 CFR 250 (2013).*

- Equipment that may have to comply with the Pressure Equipment Directive, depending on special requirements of location where it is intended to be installed (applied for BOPs especially designed for MODUs; exclusion for MODUs; article 1, 2(n)).

The responsibility for compliance, where required, lies with the manufacturer. Where pressure equipment is manufactured outside the EEA, the responsibility shall lie with the person or company importing the equipment into the EEA.

Both, PED and IMO MODU Code do not treat the problem of well-control. On the one hand, the PED excludes it as follows "*well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or control well pressure. This comprises the wellhead (Christmas tree), the blow out preventers (BOP), the piping manifolds and all their equipment upstream*". Moreover, "*mobile off-shore units as well as equipment specifically intended for installation on-board or the propulsion thereof*" are currently excluded from the scope of the PED. Thus, the PED applies to the design, manufacture and conformity assessment of pressure equipment and assemblies of pressure equipment with a maximum allowable pressure greater than 0.5 bar unless excluded from the scope of the Directive.

On the other hand the IMO MODU code "does not include requirements for the drilling of subsea wells or the procedures for their control. Such drilling operations are subject to control by the coastal State." on-board. This means that well-control issues are not currently covered in a harmonised way at the European Union level.

Detailed information about the equipment and the procedures to control a well (to form barrier) can be found in the NORSOK D-010 standard "Well integrity in drilling and well operations". A barrier needs to have a structural and a leak-resistant capability of a product to contain the applied pressure, i.e. to have pressure integrity.

Well Barrier Elements (WBEs) – examples

- ***Mud circulating system***

The mud circulating system (Figure 8) usually consists of a mud pump, mud centrifuge, mud-gas separator, drilling pipes, bit, dampener, degasser, mud cleaner (desander, hydrocyclone), desilter, valves, conduits, etc[62]:

- **Mud pump** is a large, high-pressure reciprocating pump used to circulate the mud on a drilling rig. A typical mud pump is a two or three-cylinder piston pump whose replaceable pistons travel in replaceable liners and are driven by a crankshaft actuated by an engine or a motor.
- **Mud centrifuge** consists of equipment that uses centrifugal force to separate small solid components from liquid drilling fluid.
- **Mud cleaner**[63] consists of a cone-shaped device, a hydrocyclone, designed to remove very fine solid particles from the drilling mud. Desander (hydrocyclone) is a centrifugal device for removing sand from drilling fluid to prevent abrasion of the pumps. It may be operated mechanically or by a fast-moving stream of fluid inside a special cone-shaped vessel, in which case it is sometimes called a hydrocyclone.
- **Mud-gas separator** consists of equipment that removes gas from the mud coming out of a well when a kick is being circulated out.
- **Drilling pipes** are used to convey drilling fluid and to transfer rotation from the drilling table to the drilling bit.

[62] depending on how the components are linked to form an assembly

[63] http://oilfield.gnsolidscontrol.com/mud-recycling

- **Bit** is the cutting or boring element used in drilling oil and gas wells (drilling fluid under pressure circulates through nozzles of bit).
- **Dampener** is an air or inert gas device that minimizes pressure surges in the output line of a mud pump. Sometimes is called surge dampener.
- **Degasser** is used to remove unwanted gas from a liquid, especially from drilling fluid.
- **Desilter** is a centrifugal device, similar to a desander, used to remove very fine particles, or silt, from drilling fluid. This keeps the amount of solids in the fluid to the lowest possible level.
- **Valves**
- **Conduits**

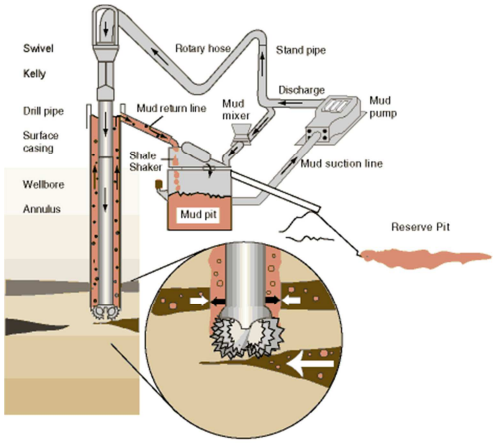


Figure 8. Mud circulating system[64]

A summary for the mud circulating system is given in

Table 10.

Table 10. Pressure equipment; mud circulating system

Onshore	Offshore
Yes	Fixed: Yes Mobile: Yes; Specifically designed for Mobile: Yes/No*
Covered by:	
PED: No (onshore or offshore)**, conditionally Yes for some elements*** IMO MODU: No****/Yes*****	

**if Yes, exclusion 1 2(n) of PED hence is relevant – MODU exclusion*

***Exclusion 1 2(i) of PED – Well-control*

****Mud pump can possibly have pressure as dominant design factor and hence Exclusion 1 2(j) of PED will not apply*

*****IMO MODU Code does not include requirements for the drilling of subsea wells or the procedures for their control. Thus, mud cleaner, mud-gas separator, drilling pipes, bit, dampener, degasser, desilter and similar devices used for in drilling process are not under the scope of IMO MODU Code*

****** pump systems and centrifugal systems are in general under the scope of IMO MODU Code, with the exception of those for oil and gas operations*

[64] Copyright granted by Occupational Safety & Health Administration (OSHA), United States Department of Labour; www.osha.gov

Some typical components of a mud circulating system are shown in Figure 9 and Figure 10.

Figure 9. Desander and desilter[65]

Figure 10. Drilling Bit (with a typical nozzle geometry)[66]

-Packers

A packer is a standard component of the completion hardware of oil or gas wells installed to provide a seal between the outside of the production tubing and the inside of the casing, liner, or wellbore wall. It can be either drilling packer or production packer. It can be removable or permanent packer that can only be removed by drilling it out.

The packer forms the basis of the cased-hole completion design. The packer is a sealing device that isolates and contains produced fluids and pressures within the wellbore to protect the casing and other formations above or below the producing zone. This is essential to the basic functioning of most wells.

---

[65] Copyright granted by Occupational Safety & Health Administration (OSHA), United States Department of Labour; www.osha.gov

[66] Usage rights: Figure labeled for reuse

Packers can be hydraulic, inflatable (use fluid pressure to inflate a long cylindrical tube), etc.

A summary for packers is given in

Table 11.

Table 11. Pressure equipment: packers

Installed on:	
Onshore	Offshore
Yes	Fixed: Yes Mobile: Yes; Specifically designed for Mobile: No*
Covered by:	
PED**: No (onshore or offshore)	
IMO MODU***: No	

**exclusion 1 2(n) of PED hence is not relevant – MODU exclusion*

***explicitly excluded from the scope of PED since it is device which main purpose is to contain and/or control well pressure (Exclusion 1 2(i) of PED)*

****IMO MODU Code does not include requirements for the drilling of subsea wells or the procedures for their control*

Since Macondo, the industry has undertaken significant research and intervention to enhance global standards for well-control equipment (e.g. Well-control Institute[67]).

5.2. The Blow-out Preventer (BOP) and its control unit

A blow-out preventer (BOP) is a large, specialized valve or similar mechanical device, used to seal, control and monitor oil and gas wells to prevent blow-out, the uncontrolled release of crude oil and/or natural gas from well. Blow-out preventers are used on land wells, offshore rigs, and subsea wells. Land and subsea BOPs are secured to the top of the wellbore, known as the wellhead. BOPs on offshore rigs are mounted below the rig deck. Subsea BOPs are connected to the offshore rig above by a drilling riser that provides a continuous pathway for the drill string and fluids emanating from the wellbore. In effect, a riser extends the wellbore to the rig. BOPs come in two basic types, ram and annular. Both are often installed together in drilling rig BOP stacks, typically with at least one annular BOP capping a stack of several ram BOPs.

An annular-type blow-out preventer can close around the drill string, casing or a non-cylindrical object, while a ram-type BOP is similar in operation to a gate valve where pipe rams close around a drill pipe.

Blind sealing rams, which have no openings for tubing, can close off the well when the well does not contain a drill string or other tubing and seal it. Blind shear rams are intended to seal a wellbore, even when the bore is occupied by a drill string, by cutting through the drill string.

A typical blow-out preventer system consists of[68]:

[67] Formally established in 2013 by the International Association Of Drilling Contractors, the well-control Institute (WCI) brings together representatives from drilling industry stakeholders to develop the comprehensive solutions necessary to significantly improve human performance in well-control worldwide; www.iadc.org/well-control-institute

- Blow-out preventer control panel: controls, opens and closes blow-out preventers,
- Blow-out preventer control unit (Accumulator; Kommey unit): a device that stores hydraulic fluid under pressure in special containers and provides a method to open and close the blow-out preventers,
- Blow-out preventer stack (BOP stack): the assembly of well-control equipment including preventers, spools, valves, and nipples connected to the top of the wellhead.

An accumulator (koomey unit) is a storage device for pressurized hydraulic nitrogen, which is used in operating stacks of Blow-out Preventer (BOP). It is a device installed in a hydraulic system to store energy or, in some applications, dampen pressure fluctuations. Energy is stored by compressing a pre-charged gas bladder with hydraulic fluid from the operating or charging system. Depending on the fluid volume and pre-charge pressure of the accumulator, a limited amount of hydraulic energy is then available independent of any other power source. Well pressure-control systems typically incorporate sufficient accumulator capacity to enable the blow-out preventer to be operated with all other power shut down. The control system of Blow-out Preventer (BOP), called an accumulator (Koomey unit), provides the energy to operate stacks of the blow-out preventer. This system consists of typical pressure devices: compressed gas bottles, regulator valves, pumps, hydraulic reservoir, control manifold, and control valves.

A summary for an accumulator for BOP systems (koomey unit) is given in Table 12.

Table 12. Pressure equipment; accumulator for BOP systems (koomey unit)

Installed on:	
Onshore	Offshore
Yes	Fixed: Yes Mobile: Yes; Specifically designed for Mobile: No*
Covered by:	
PED: No** (onshore or offshore)	
IMO MODU: No** (Yes)****	

**Exclusion 1 2(n) of PED hence is not relevant – MODU exclusion; explicitly excluded from the scope of PED since it is a device whose main purpose is to contain and/or control well pressure (Exclusion 1 2 (i) of PED)*

Yes, if their parts (bottles for hydraulic pressure, manifolds, reservoir tanks, valves, etc) are treated separatelyIMO MODU Code does not include requirements for the drilling of subsea wells or the procedures for their control*

***** IMO MODU Code claims that the power available should be sufficient to supply all those service that are essential for safety in an emergency. Thus, "the emergency source of power should be capable for a period of 18 hours of closing the blow-out preventer and of disconnecting the unit from the well-head arrangement, if electrically controlled; unless they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period of 18 h";. It also states that the blow-out preventer control system, among other essential facilities, should be operable after an emergency shutdown.*

A BOP consists of one or more valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and the drill pipe or in open hole (for example, hole with no drill pipe) during drilling or completion operations[69] (stacks of BOP as shown in Figure 11).

[68] A. Bahadori, C. Nwaoha, M.W. Clark, Dictionary of Oil, Gas, and Petrochemical processing, CRC Press, 2014.

[69] www.osha.gov/SLTC/etools/oilandgas/glossary_of_terms/glossary_of_terms_b.html

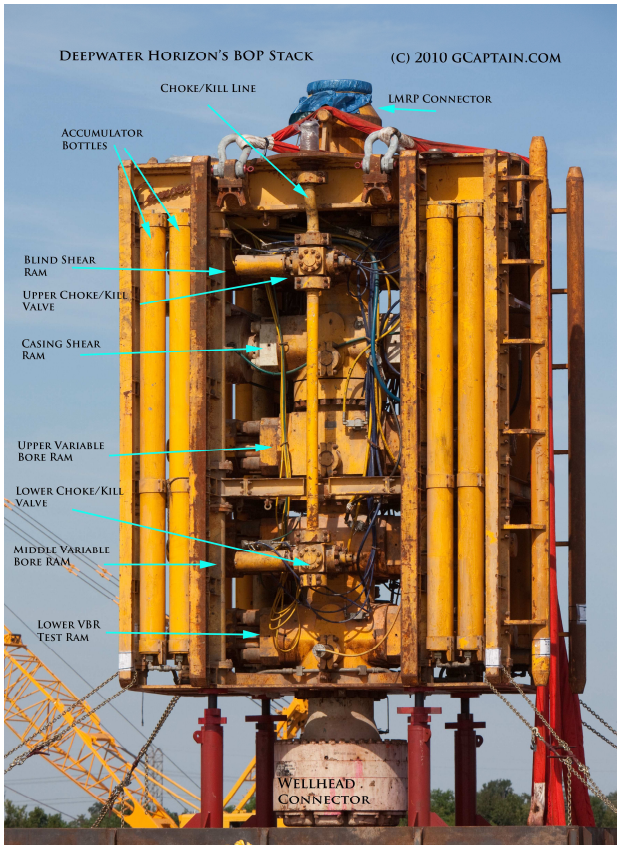


Figure 11. Stacks of Blow-out Preventer (BOP)[70]

The most important types of stacks of BOP are the annular or pipe-ram, which prevents blow-outs from the ring space between the ouside of the drill pipe and the casing, and shear-ram or blind-ram,which can cut drilling pipes.

An annular stack (annular BOP) is a well-control device which has form of large valve, usually installed above the ram preventers, that forms a seal in the annular space between pipe and well-bore[71] (Figure 12).

[70] Copyright granted by Rob Almeida (photographer); http://gcaptain.com/blowout-4-5-billion-surge-orders/

[71] www.canscodubai.com/oil-field-glossary.html

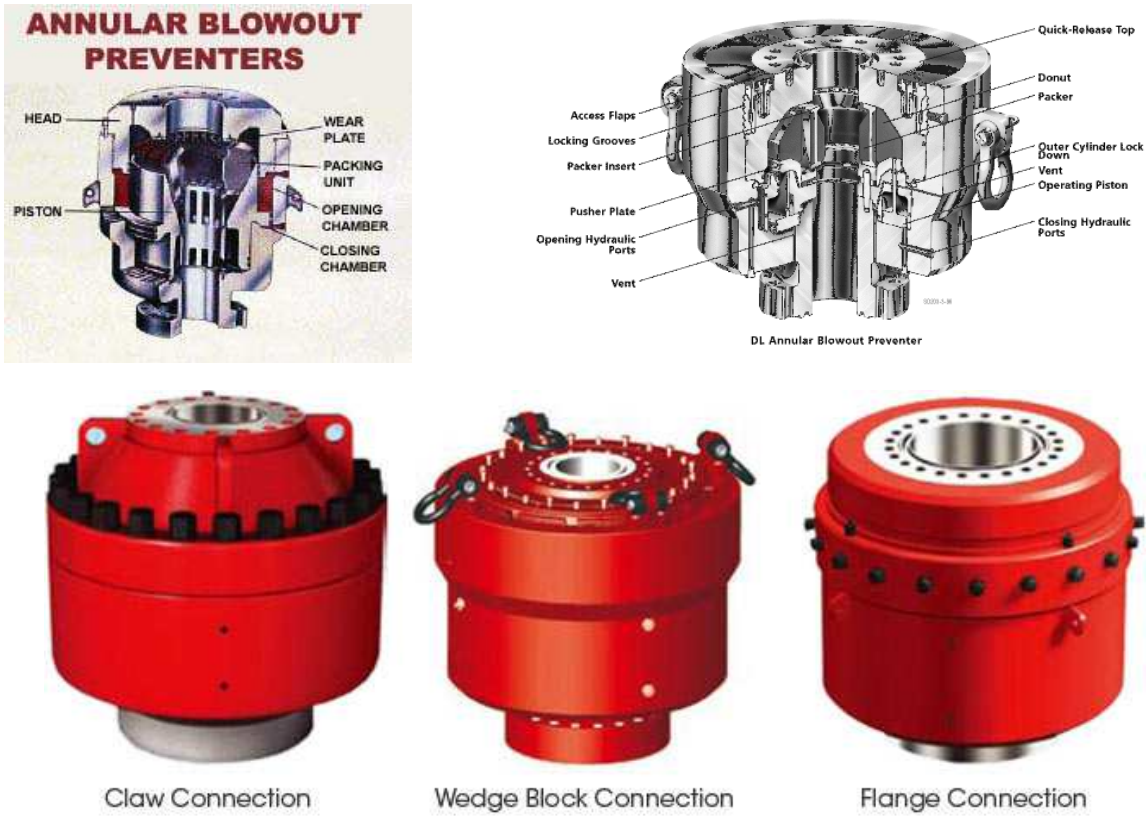


Figure 12. Annular BOP; Annular stack[72]

A BOP that uses blind shear rams to seal off pressure on a hole that is with or without pipe is called shear-ram or blind-ram preventer. Blind-ram type preventers have interchangeable ram blocks to accommodate different drill pipe, casing, or tubing (Figure 13).

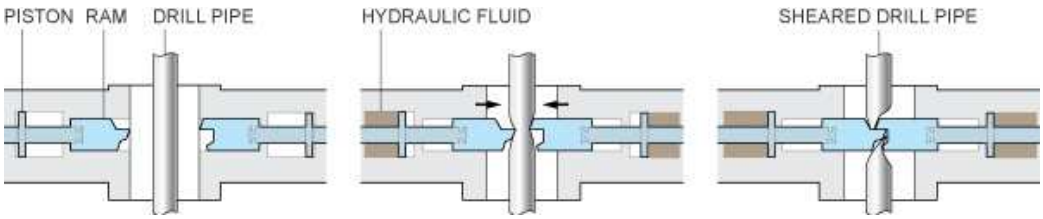


Figure 13. Shear-ram Blow-out Preventer (BOP); Shear-ram stack, Blind-ram[73]

A summary for the BOP is given in Table 13.

[72] Copyright granted by Occupational Safety & Health Administration (OSHA), United States Department of Labour; www.osha.gov

[73] Usage rights: Figure labeled for reuse

Table 13. Pressure equipment; Blow-out Preventer (BOP)

Installed on:	
Onshore	Offshore
Yes	Fix: Yes Mobile: Yes; Specifically designed for Mobile: No/Yes*
Covered by:	
PED: No** (onshore or offshore)	
IMO MODU: No***	

**if Yes, exclusion 1 2(n) of PED hence is relevant – MODU exclusion*

***explicitly excluded from the scope of PED since it is a device which main purpose is to contain and/or control well pressure (Exclusion 1 2(i) of PED)*

****IMO MODU Code does not include requirements for the drilling of subsea wells or the procedures for their control. On the other hand it claims that the power available should be sufficient to supply all those service that are essential for safety in an emergency. Thus, "the emergency source of power should be capable for a period of 18 hours of closing the blow-out preventer and of disconnecting the unit from the well-head arrangement, if electrically controlled; unless they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period of 18 h";. It also states that the blow-out preventer control system, among other essential facilities, should be operable after an emergency shutdown.*

A BOP can be treated as a device under pressure since:

- It is a large, specialized valve or similar mechanical device, usually installed redundantly in stacks, used to seal, control and monitor oil and gas wells. Blow-out preventers were developed to cope with extreme erratic pressures (which means much more than 0.5 bars) and uncontrolled flow emanating from a well reservoir during drilling[74].
- As stated in the patent for the first Blow-out Preventer (Ram Type BOP by Harry S. Cameron) from 1922, a BOP is a device whose purpose is to seal the wellhead and control pressure during drilling and oil production operations[75]. It is installed on the wellhead, and the rams are closed to seal off the well, allowing full control of the pressure during drilling and production. The original design could withstand pressures up to 3,000 psi (about 200 bar), an industry record in 1922 (In comparison, today's BOP can withstand 15,000 psi which is about 1000 bar, working in water depth up to 10,000 ft which is about 3000 metres).

According to NORSOK D-001 "Drilling Facilities", paragraph 5.10.3, a BOP shall as a minimum consist of the following:

- One annular preventer,
- One shear ram preventer,
- Two pipe ram preventers,
- Minimum one choke line outlet,
- Minimum one kill line outlet,
- One wellhead coupling or connector,
- Minimum two manual gate valves,

[74] www.sivainc.com/product/bops/

[75] www.asme.org/about-asme/who-we-are/engineering-history/landmarks/227-first-ram-type-blow-out-preventer, www.asme.org/getmedia/bdc4580b-fca4-42be-b138-a1f34adbf680/227-First-Ram-Type-Blow-out-Preventer.aspx

- Minimum two remote operated gate valves.

The following aspects related to BOPs have to be highlighted:

- A BOP is used onshore and offshore and although there are some differences between them, the applied technical standards are the same;
- In most cases, there are no differences between BOPs for MODU and offshore fixed installations;
- To prevent major accidents in the EU member states, the operator has to maintain a very low ALARP threshold through the application of new knowledge and invention and to apply all the best technical standards and procedures for drilling, according to the Offshore Safety Directive 2013/30/EU (this implicitly means to apply NORSOK, API and ISO standards for BOPs);
- Currently, there are harmonised standards with the PED for the main parts of the BOP control system (accumulator) if its main parts are treated as independent pressure devices (compressed gas bottles, regulator valves, hydraulic reservoir, control manifold, and control valves);

5.3. Technical Standards in Well-Control

In this Section the most important technical standards applying to well-control equipment are presented.

5.3.1. Well-Control Standards by NORSOK

The most important standards by the *Standard Norge* (NORSOK) in field of well-control are:

- NORSOK D-001 "*Drilling facilities*", Revision 3, published in December 2012;
- NORSOK D-002 "*Well intervention equipment*", Revision 2, published in June, 2013;
- NORSOK D-007 "*Well testing system*", Edition 2, published in September 2013;

NORSOK D-010, "*Well integrity in drilling and well operations*", Revision 4, published in June 2013. A Norwegian Oil Industry Association (OLF) report[76] released on May 2012, with contributions from the Norwegian Clean Seas Association for Operating Companies (NOFO) and the Norwegian Shipowners' Association (NSA), mainly focused on prevention of future accidents, has reviewed the major investigation reports after the Macondo accident and identified a number of improvements, mainly related to drilling standards, operator and contractor management systems, well-control exercises and steering documentation and emergency equipment, to reduce blow-out risks on the Norwegian Continental Self (NCS). The majority of the prevention recommendations, which should be implemented through changes to the Norwegian drilling standards Norsok D-001 (drilling facilities) and Norsok D-010 (well integrity in drilling and well operations), are explained below.

-NORSOK D-001; *Drilling facilities.* Rev. 3, published on December 11th, 2012 (corrected on January 10th, 2013);

[76] Summary report. Deepwater Horizon. Lessons learned and follow-up. OLF-The Norwegian Oil Industry Association.
www.norskoljeoggass.no/Global/Publikasjoner/_H%C3%A5ndb%C3%B8ker%20og%20Rapporter/DWH%20rapporter/DWH-summary%20June%202012.pdf?epslanguage=no

NORSOK D-001 "*Drilling facilities*" is a frequently used standard in *Norway* and abroad. This standard was initially introduced in 1998. The standard describes the design, installation and commissioning principles and requirements for the drilling facilities and their systems and equipment on fixed installations and MODUs. Its last revision considers recommendations from key industry forums and the experience gained from the Macondo accident and other relevant incidents. According to already existing regulative in Norway, Blow-out Preventer (BOP) overhaul and recertification are required every five years, and according to NORSOK D-001, it was already required to have alternative blow-out Preventer (BOP) control system on all floating rigs even before *Macondo*. The technical recommendations made by the OLF report, with which the Norsok D-001 has been updated, are the following:

- Norsok D-001 should be updated to identify the diverter system as a safety system designed to handle gas in the riser above the BOP, and to eliminate the possibility of a gas cloud being released over the rig. The use of the diverter in such circumstances should ensure that all explosive hydrocarbons are released in a safe area to the side and ideally downwind of the rig;
- In order to eliminate the possibility of overloading the mud gas separator, Norsok D-001 should be updated to prevent any connection between the diverter system and the mud gas separator. However, a connection from the downstream end of the choke manifold to the mud gas separator is permited;
- Norsok D-001 should include more explicit requirements for primary and back-up BOP control systems, their ability to perform in emergencies and testing of them;
- Norsok D-001 shoud contain a requirement for acitivating BOP functions via ROV intervention. This will facilitate external activation of BOP elements or release functions should all other systems fail. It is recognised that a BOP ram may not be closed fast enough by an ROV to seal off a flowing well;
- Norsok D-001 should be updated to ensure that subsea wellhead casing/tubing hangers are locked down on all strings in contact with hydrocarbon-bearing zones.

-NORSOK D-002; *Well intervention equipment.* Rev. 2, published on June 25th, 2013;

The objective of NORSOK D-002 "Well intervention equipment" is to provide common requirements for well intervention equipment across all exploration and production companies and service companies operating on the Norwegian Continental Shelf.

The standard defines what is considered typical and ordinary well intervention equipment. New equipment, special operations and operations in certain environments may require additional requirements and specifications. These specific additions are excluded from the standard and should be addressed in the risk assessment of the particular job. This standard was initially introduced in 2000.

Standards Norway has, in cooperation with the stakeholders in the petroleum standardisation, carried out a revision process of this standard to:

- update specific requirements/guidelines to be in line with current and future needs/practices;
- be harmonised with NORSOK D-010 "Well integrity in drilling and well operations"[77];
- implement general improvements.

[77] NORSOK D-002 has been updated to reflect the well barrier terminology in the new NORSOK D-010, to provide expanded requirements for capping devices, to update and to reduce external references and to provide further specification of test requirements for pressure control equipment.

-NORSOK D-007; *Well testing system.* Rev. 2, published on September 23rd, 2013;

NORSOK D-007 "*Well testing system*" describes functional, performance and operational requirements for temporary well testing, production clean-up and bleed-off equipment and systems used for hydrocarbon flow from exploration or production wells on both mobile units and fixed platforms. It is a widely used standard in Norway and abroad, and Standards Norway has, in cooperation with the stakeholders in the petroleum standardization, carried out a substantial revision process of this standard to:

- Simplify the standard;
- Update references;
- Include requirements for double barriers;
- Modernize the standard throughout, capturing new equipment and new technical requirements (including but not limited to Safety Integrity Level (SIL) and the Machine Directive);
- Harmonise the standard with DNV standards[78], being the existing gap between the DNV's standard and NORSOK D-007removed.

The new version of the standard includes, not only requirements for well testing, as in the previous version, but also requirements for production clean-up and bleed-off work. It also covers not only *semi-submersibles*, *jack-up* rigs and *drill ships*, but also well intervention vessels. A new Section 4 has been included to foster alignment with NORSOK D-010.

-NORSOK D-010; *Well integrity in drilling and well operations.* Rev. 4, published on June 26th, 2013;

NORSOK D-010 "*Well integrity in drilling and well operations*" defines the minimum functional and performance oriented requirements and guidelines for well design, planning and execution of safe well operations.

The focus of the standard is well integrity where this term is defined to be "*application of technical, operational and organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well*". No other standard organization has made a similar specification for this type of operations, and therefore the international interest is great.

This revision was initiated to enhance the standard to include acceptance criteria for casing cement applied in the drilling, production and abandonment activities, managed pressure drilling and to include new WBE acceptance tables (formation, alternative material to cement, LWI equipment). During the revision process after the Macondo accident, NORSOK D-010 received considerable attention both nationally (Norway) and internationally. The new revision (Rev. 4) of NORSOK D-010 was published in June 2013, the previous one was from 2004, is an important milestone related to the industry's response to further increase the level of safety in drilling operations. The revision of the NORSOK D-010 has been essential for the Norwegian and the European oil and gas industry to partly to reflect the recommendations derived from the Macondo accident.

The new revision provides more information, particularly regarding plugging and abandonment. It includes managed pressure drilling, which was not included in Rev. 3.

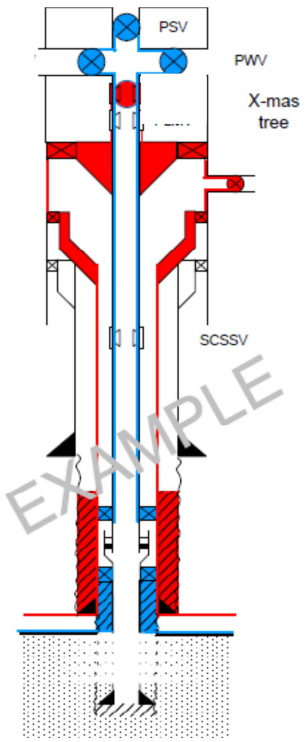
[78] DNV DNV-RP-E102: Recertification of Blow-Out Preventers and well-control equipment for the US Outer Continental Shelf

It has more on relief well plans and requirements for capping equipment. It identifies nine additional well barrier elements to provide a fuller complement of barrier management building blocks. The latest revision resulted from extensive consultation with industry and captures current best practice. However, operators should be ready because Rev. 4 does include more robust safety enhancements that will require greater thoroughness and will likely drive costs up.[79].

There are expectations that the revised NORSOK D-010 is further focused on well integrity as well as on major accidents prevention.

In the new version the requirements for the technical and operational barriers intended to prevent blow-outs in oil and gas wells. are defined in a clearer way. It has been also updated with respect to the inclusion of acceptance criteria for casing cement, and the use of new technology. Knowing that failure of the cement barrier and the lack of adequate qualification were direct causes of the Macondo and Montara accidents, the update of the NORSOK D-010 is very important. In fact, all well barrier schematics have been redrawn, mainly to include in-situ formation as part of the well barrier envelope. Thus, an improved ***concept of "two barriers"*** has been introduced with the new version of the standard. In that way, a safe well-design should include a primary barrier, consisting of the column of drilling mud surrounding the drill string, and a secondary barrier, made up of a system of elements–an "envelope"–including the Blow-out Preventer (BOP) shear ram, high-pressure riser, annulus access valve, casing, and other aspects of the well construction. For the example in Figure 14,production example, and in Figure 15, drilling example, primary Well Barrier Elements (WBE) are shown in blue and secondary Well Barrier Elements (WBE) are shown in red. The primary and secondary barriers must be completely independent in order to prevent a blow-out meaning that if an element from primary or secondary barrier fails, the other barrier should be intact. This is why typically the primary and the secondary barriers do not share elements. In Figure 14, ASCSSV is Annulus Surface Controlled Sub-Surface Valve; and SCSSV is Surface Controlled Subsurface Safety Valve.

[79]www.energyglobal.com/upstream/exploration/10032014/The_story_of_the_worlds_well_integrity_standard/



Typical gas lift production well:

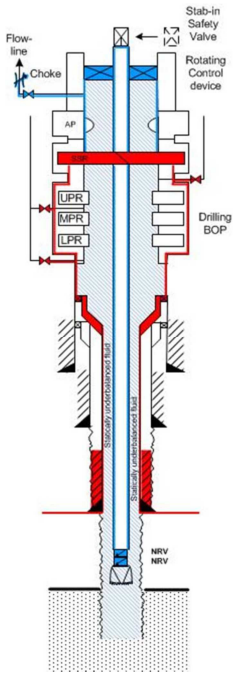
Primary barrier:
-Production packer;
-Casing which are between ASCSSV packer and production packer.;
-ASCSSV packer which are between ASCSSV and SCSSV;
-SCSSV valve;

Secondary barrier:

-Production casing cement;
-Casing;
-Intermediate cement are between casing and intermediate casing;
-Intermediate casing;
-Wellhead;
-Tubing hanger;
-Annulus access line and valve;
-Surface production tree;
-Second annulus access line and valve.
SCSSV is Surface Controlled Subsurface Safety Valve.

Figure 14. Production example of two barriers for prevention of blow-out (NORSOK D-010)[80]

[80] Figure 14.8.1, Figure 13.8.1 and Figure 9.6.8.1 (Figure 22, Figure 23 and Figure 24 in this report) from NORSOK Standard D-010 Well integrity in drilling and well operations. Rev. 4, June 2013 are reproduced by European Commission - Joint Research Centre (JRC).under licence from Standard Online AS 04/2016. © All rights are reserved. Standard Online AS makes no guarantees or warranties as to the correctness of the reproduction. In any case of dispute, the original shall be taken as authoritative. See www.standard.no.



Drilling well:

Primary barrier:
-Fluid column

Secondary barrier:

-In-situ formations;
-Casing cement;
-Casing;
-Wellhead;
-High pressure riser;
Drilling BOP

Figure 15. Drilling example of two barriers for prevention of blow-out (NORSOK D-010)[72]

As pointed out above, NORSOK D-010 was also updated in terms of improved procedures for planning, mixing, pumping and qualification of cement as a primary barrier. The method of placement and qualification of cement as a primary barrier is now better described. The new revision enhances the standard to include acceptance criteria for casing cement applied in the drilling, production and abandonment activities, managed pressure drilling, etc. For example, when abandoning a well, for wells with poor casing cement or no access to the last open hole section, section milling (removal of casing) is an alternative method for placing cement in contact with formation to form permanent well barrier. Figure 16 below shows how permanent well barrier cement could be put in place by the removal of poorly cemented casing by section milling.

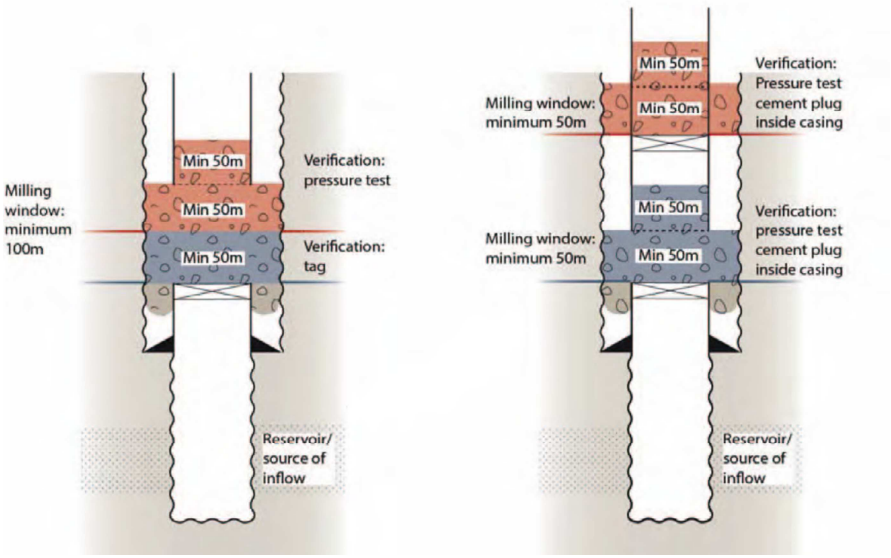


Figure 16. An illustration of how permanent well barrier cement can be put in place through the use of section milling[72]

Due to the update of the NORSOK D-010 with the existing new technologies, an increased understanding of the criticality of cement as the primary barrier and of the likelihood of successful cementing is expected.

In the same way, NORSOK D-010 has been updated with Section (4.6) on "*Activity and operation shut-down criteria*", which includes specific criteria for shut-down of the activities or operations. Experiences from a number of well incidents, both in Norway and abroad, have shown that a normal operation was carried on even if numerous danger signals were present prior to the event (or accident). Because of that, more explicit and specific stop criteria have been defined, e.g. what kind of BOP control pod failures are acceptable before stopping the operation. As a consequence, an increase in the likelihood of safe applications due to the more detailed description of best practices regarding new technologies is expected.

To summarize, the revision includes a large number of changes intended to improve the standard, most of which address recommendations from OLF Deepwater Horizon report. The technical recommendations made by the OLF report to update Norsok D-010 are the following:

1. Should include the term "critical cement job". A requirement for independent design verification of "critical cement jobs" should also be introduced. This verification can be performed by either an independent in-house department or an external third party;
2. Should furthermore require that cement and casing design for slurries placed across hydrocarbon zones be verified in cementing company labs prior to use. For critical slurry designs, slurry properties should be independently verified. This verification can be performed by either an independent in-house department or an external third party;
3. a) Should be updated to define the requirements related to inflow (negative) pressure testing clearly.

   b) Well programmes should provide a detailed procedure and acceptance criteria for all inflow test. Inflow test should be conducted in a controlled manner with detailed procedures which have been approved by an authorised person, and accompanied by a demonstrated risk analysis;
4. Should be further clarified to state that, when changing out the fluid barrier element while the remaining barrier consists of untested cement or mechanical plugs, all displacement to a lighter underbalanced fluid should be done with closed BOP and through the choke and kill lines;
5. Should be updated to include descriptive values for full/partial/seepage and static/dynamic fluid losses so that deviations in return flow can be reported using a common frame of reference. Such data can be used to generate acceptable downhole loss rates for specific fields;
6. In order to solve the need for more practice with well-control emergencies, the standard should be updated to include requirements for routine well-control exercises;
7. Should specify and require periodic testing of emergency subsea well-control activation systems, with due regard to operational activities;
8. Should include more explicit requirements for primary and back-up BOP control systems, their ability to perform in emergencies and testing of them.

6. The on-line survey

6.1. Methodology of data collection from stakeholders

The survey "European Commission Survey on Offshore Oil & Gas Equipment 2015 – Cost of compliance with EU Product Safety Legislation" was developed by the European Commission's DG Joint Research Centre in collaboration with the EC Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW). The aim of the survey was to collect information and data in order to perform an analysis of the MODU market, and then an assessment study - in terms of costs and benefits - of extending the scope of EU product safety legislation (ATEX, Machinery, and Pressure Equipment Directives) to equipment installed on-board and intended for use on MODUs.

The survey was available on-line through the EU Survey platform from June 15th until September 30th, 2015. After that – and until October 15th, 2015 – it was possible to download the survey as a word document and to send the reply by e-mail. Four different versions of the survey were made available, depending on the category of interested stakeholders (Public Authorities, Certification Bodies, Companies and Other types of entities). The Survey was accompanied by a support letter of DG GROW.

The survey consisted of four main sections (which were adapted for the different stakeholders), i.e.:

I. **Respondent's profile**, where general information on the stakeholder's category, organization's location, size, and sector, was requested along information on present and future sources of revenues;

II. **Information related to Market and applied legislation**, which focused on:

- the specific activity carried out by the enterprise/organization concerning equipment installed on offshore oil and gas installations, notably MODUs;
- the legislation currently applied by the enterprise/organization;
- the current compliance of the equipment manufactured/installed/supplied by the manufacturers/installers/suppliers and of the rigs owned by the drilling contractors with EU Product Safety Directives.

For that purpose the equipment was divided in 6 categories (drilling equipment, well intervention equipment, material handling equipment, well-control equipment, other pressure equipment and electrical equipment), being these categories subdivided in further subcategories. An inventory of the equipment categories is given in Section 5.1.

Related to the six categories/subcategories of equipment the enterprises/organizations are asked to:

- Detail the ones they deal with.
- Evaluate the importance of each category of equipment in their total revenue: a. low importance: <40%; b. medium importance: 40-70%; and c. high importance >70%.
- Foresee if they expect any changes in the overall structure of revenue related to the categories of equipment (e.g. a. same level; b. increase; c. decrease; d. unknown).
- Evaluate if the equipment they manufacture/supply/trade/rent/install is in compliance with the EU product safety legislation: a. Compliant and certified; b. Compliant but not certified; c. Not compliant; or d. Unknown.

- Select the standards currently applied among: a. International Standards – ISO; b. International Electrotechnical Commission Standards – IEC; c. EN European harmonised standards – CEN/CENELEC; d. Norwegian Standards – NORSOK; e. British Standards – BS; f. US Standards – such as ASME, API; g. Private Standards – such as DNV, etc., and detail the exact name/number of standard.
- Detail other regulations they currently apply.

III. **Information related to Impact Assessment**, which focused on the impact of the possible extension of the scope of EU Product Safety Directives to cover equipment onboard MODUs, in terms of *inter alia* solved problems, costs, and benefits. The section is structured in the following subsections in which the enterprises/organizations are asked to provide their opinion about:

III.1. Safety of the equipment

- Possible safety problems due to the fact that MODUs are out of the scope of the ATEX Directive, MD and PED.
- Solved problems (safety, environmental, etc.) if the EU Product Safety Directives come into force.
- Suitability of the EU Product Safety Directives for equipment onboard MODUs.
- Necessity of modification of the technical standards currently applied in the sector order to meet the Essential Health and Safety Requirements of the EU Product Safety Directives.
- Barriers to trade due to the extension of the EU Product Safety Directives (ATEX, MD, PED) to the equipment onboard MODUs.

III.2. Advantages/disadvantages due to the extension of the Directives

- Possible disadvantage vis-a-vis their competitors from within/outside EU/EEA (e.g. by creating an uneven playfield) due to the compliance costs.
- Way in which the enterprise/organization would offset the costs related to the compliance with the EU Product Safety Directives (ATEX, MD, PED): a. by increasing investment flows; b. passing the costs to clients by increasing the price of the equipment; c. moving to other markets; or d. other (to be specified).
- Benefits or opportunities foreseen due to the compliance of their products/services with any of the EU Product Safety Directives (ATEX, MD, PED).
- Way in which the compliance of their products/services with any of the EU Product Safety Directives (ATEX, MD, PED) would affect the employment in their companies. It would: a. facilitate the creation of new job positions in your company; b. lead directly or indirectly to a loss of jobs in your company; c. not change the number of posts, but may have a qualitative impact on the necessary workforce (e.g. more skilled personnel); or d. have no impact on employment?

III.3. Cost impact/typical case (only for the most important subcategory of equipment)

This part was specific for companies and certification bodies, which had to select only one of the six categories of equipment listed above, the one

considered as typical for them, for the assessment of impacts. The companies had to estimate the substantive and administrative costs to cover the selected specific subcategory of equipment if the scope of the EU Product Safety Directives is extended. A brief description of the costs required to the companies is shown here:

- **Substantive costs**: Are the costs related to new design, new materials, changes in the production lines, changes in the testing, investments in new production machinery, the certification process and the purchase of the selected specific subcategory of equipment according to the new specifications. It has to be noted that the certification process involves not only substantive costs but also administrative costs (see below).

  Substantive costs of the certification process consists of: EC-type examination and certification (by the NB (Notified Body)); product verification according to the EC type (by the manufacturer); examination of the individual equipment through relevant tests (by the NB); certification of conformity of the applied tests (by the NB); CE marking including other required marking of all the pieces (by the manufacturer); and declaration of conformity for all pieces[81] (by the manufacturer). The substantive costs can be "one-off" (is paid once and not repeated) and "per unit produced".

  The information was required in a table format, see Table 14.

Table 14. Substantive costs to cover the selected specific subcategory of equipment with the EU Product Safety Directives.

	ATEX		MD		PED	
	One-off	Per unit produced	One-off	Per unit produced	One-off	Per unit produced
New design						
New materials						
Changes in production lines						
Changes in the testing						
Investments in new production machinery						
Purchase of the selected specific subcategory of equipment according to the new specifications						
Certification process						
Other comments on the costs						

- **Administrative costs**: Are the costs related to the familiarization with the new regulation, the additional consulting needed and the equipment certification.

  Administrative cost of the certification process consists of: Technical documentation for the authorities and Notified Bodies (by the manufacturer), development/maintenance of the Product Quality System (by the manufacturer), and periodical Product Quality System assurance (by the Notified Bodies).

[81] Which is not self-certification

The administrative costs can be "one-off" or recurring. In the case of the recurring costs, the frequency (how many times per year the cost will be repeated) and the estimated time to perform the action associated with the cost were required.

The information was required in a table format, see Table 15.

Table 15. Administrative costs to cover the selected specific subcategory of equipment with the EU Product Safety Directives

	ATEX			MD			PED		
	One-off	Frequency (times/year)	Hours (h)	One-off	Frequency (times/year)	Hours (h)	One-off	Frequency (times/year)	Hours (h)
Familiarisation with new regulation									
Additional consulting									
Certification process									
Other									

- **Additional substantive and administrative costs:** Different substantive and administrative costs not included previously.

Additionally the following information was required for the chosen specific subcategory of equipment:

- Average annual production (or number of pieces of the equipment supplied/ traded/ rented/ installed);
- Expected time delays in order to manufacture/supply/trade/rent/install it according to que EU Product Safety Directives;
- Expected difficulties in order to comply with the EU Product Safety Directives.

The Certification Bodies had to estimate the costs for the companies and, if applicable, for the Public Authorities related to the certification process of the subcategory of equipment chosen.

III.4. Impact of the extension of the Pressure Equipment Directive 2014/68/EU (97/23/EC) to well-control equipment

Currently the Pressure Equipment Directive 2014/68/EU (97/23/EC) (PED) does not apply to the equipment used for well-control in oil and gas extraction (onshore and offshore, fixed and mobile installations). The European Commission is examining the extension of the scope of this legislation to cover also well-control equipment. The present section focuses on the impact (solved problems, costs, benefits, etc.) of the possible extension of the scope of the PED.

The following aspects were considered within this section of the survey:

- Problems (safety, environmental, etc.) which could be resolved by extending the legislation;
- Suitability of the PED for well-control equipment;

- Particular difficulties that companies may face and affection to the market;
- Necessity of modification of the technical standards which are in use in the sector in order to meet the Essential Safety Requirements of the EU Product Safety Directives;
- Barriers to trade if the PED would be extended to cover equipment used for well-control.

IV. **Concluding questions**, in which the contacted enterprises/organizations were asked for their consent to the publication of their replies, either openly or in an anonymous form. Participants were also asked if JRC could contact them for further questions or clarifications.

6.2. Profile of the stakeholders who have answered the survey

The names of the stakeholders which have participated in the EC survey on offshore safety and have agreed to the publication of their answers with their data included are listed below.

6.2.1 Companies who have answered the survey

Companies were grouped in two main categories, i.e. Manufacturers / installers / suppliers of equipment and Rig operators and owners. Some of these companies are very important in the European MODU market and have a local strong presence also in other regions.

Manufacturers / installers / suppliers of equipment

- *Varco BJ BV* (The Netherlands) (www.nov.com)

  Varco BJ BV operates as a subsidiary of National Oilwell Varco and offers mechanical components for land and offshore drilling rigs, land drill and well servicing rigs, tubular inspection, drill string equipment, and lifting equipment. Varco BJ conducts downhole, handling, supply chain, and well services to customers throughout the Netherlands;

- *Drillmec* (Italy) (www.drillmec.com)

  See a short description of Drillmec in section 7.1;

- Nine companies which did not want to reveal their identity.

Drilling contractors and operators

- Dolphin Drilling LTD Aberdeen (UK) (www.dolphindrilling.no)

  Dolphin Drilling is a well-established name in offshore drilling and has operated in all the major offshore oil and gas regions in the world. In recent years, Dolphin drilling LTD has carried out drilling operations in most of the major areas of offshore activity, including the North Sea, West Africa, East Africa, Mediterranean, India, Brazil and Gulf of Mexico. Dolphin drilling LTD provides services to a broad cross section of oil and gas companies including many of the majors, independents and national oil companies;

- Saipem (Italy) (www.saipem.com)
  See a short description of Saipem in Section 7.2;

- Fifteen drilling contractors did not want to reveal their identity;
- Two operators (O&G companies) did not want to reveal their identity.

6.2.2 Certification Bodies who have answered the survey

All the Certification Bodies answering the survey did not want to reveal their identity.

6.2.3 Public Authorities who have answered the survey

- Health and Safety Executive (UK) (www.hse.gov.uk)

  The Health and Safety Executive (HSE) is a non-departmental public body of the United Kingdom with its headquarters in Liverpool, England. It is the body responsible for the encouragement, regulation and enforcement of workplace health, safety and welfare, and for research into occupational risks in England and Wales and Scotland. Responsibility in Northern Ireland lies with the Health and Safety Executive for Northern Ireland. The HSE was created by the Health and Safety at Work etc. Act 1974. HSE's Energy Division (ED) is responsible for the offshore oil and gas industry;

- Petroleum Safety Authority Norway (Norway) (www.psa.no)

  Petroleum Safety Authority (PTIL-PSA) is an independent government regulator subordinated to the Ministry of Labour and Social Affairs with responsibility for safety, emergency preparedness and the working environment in the Norwegian petroleum industry. Created on 1 January 2004, PSA are based in Stavanger and has just over 170 staff. Before it was established as an independent agency, PSA's duties were part of the responsibilities of the Norwegian Petroleum Directorate (NPD). PSA serves as the regulator for technical and operational safety, emergency preparedness and the working environment in all phases of the petroleum industry. This means that PSA's supervision starts with the initial planning of a development project and continues through the design, construction, operation and possible removal phases. In offshore sector, PSA is responsible for about 80 fixed platforms, 56 rigs, about 300 subsea installations, 8 land-based plants, 25 thousand people and 15.500km of subsea pipelines, all over the Norwegian shelf.

- Five Public Authorities did not want to reveal their identity.

6.2.4 Other types of entities who have answered the survey

- European Community Shipowners' Association (ECSA) (www.ecsa.eu);

  ECSA is the organization representing the interests of the national shipowners' association of EU Member States and Norway. ECSA established in 2014 the first Sectorial Group which covers offshore vessels and MODUs.

- International Marine Contractors Association (IMCA) (www.imca-int.com);

  IMCA is the international association representing offshore, marine and underwater engineering companies, with over a thousand members worldwide. Its members, owners and operators of a wide range of offshore construction support vessels, including dive support, pipelaying and well intervention vessels, carry out marine construction activities for the offshore energy industry all over the world. A number of its members also operate MODUs.

- International Association of Drilling Contractors (IADC) (www.iadc.org);

  Since 1940, the International Association of Drilling Contractors (IADC) has exclusively represented the worldwide oil and gas drilling industry. Membership is open to any company involved in oil and gas exploration, drilling or production, well servicing, oilfield manufacturing or other rig-site services.IADC's contract-drilling members own most of the world's land and offshore drilling units that drill the vast majority of the wells producing the planet's oil and gas. IADC's membership also includes oil-and-gas producers, and manufacturers and suppliers of oilfield equipment and services.

  IADC holds consultative status at the International Maritime Organization and observer status at the International Seabed Authority. The Association is a leader in developing standards for industry training, notably its well-control Accreditation Program (WellCAP)® and rig-floor orientation program, RIG PASS® among others.

  IADC is headquartered in Houston and is one of the city's largest trade and professional associations. IADC also has offices in Washington D.C., the Netherlands, Thailand and the United Arab Emirates, as well as chapters in the UK, Venezuela, Brazil, Australasia, South Central Asia, Southeast Asia, West Africa, the Middle East and across the United States.

- Norwegian Shipowners' Association (NSA) (www.rederi.no).

  The Norwegian Shipowners' Association (NSA) was founded in 1909 and is one of Norway´s most recognized industry organisations, serving more than 160 companies in the field of Norwegian shipping and offshore contractor activities. The members of the NSA employ more than 55.000 seafarers and offshore workers from more than 50 different nations. The main objectives of the NSA are to protect its members' interests with regard to industrial and employment issues, and to play an active role in respect of shared concerns in the industry;

- A large Notified Body with 250 employees or more dealing with non-destructive testing related to MD and PED;

- A small Health and Safety Consultancy (up to 49 employees).

6.3. Results of the survey

A total of fifty one answers to the survey had been collected up until October 16th, 2015. Of these:

- Nine answers were submitted from June 18th, 2015 until June 30th, 2015;
- Seven answers were received during July 2015, but none during August 2015;
- Most of the answers (eighteen) arrived just before the first deadline (September 19th), while an additional six were submitted between September 20th and September 30th;
- The last eleven replies were collected during the first two weeks of October (by October 15th, 2015).

In particular, two answers were obtained through personal interviews, carried out on September 17th and October 2nd, 2015 with Drillmec and Saipem, respectively.

Regarding the types of stakeholders involved, the answers received were as follows:

- Eight from Certification Bodies (15.7%);
- Seven from Public Authorities (13.7%);

- Thirty from Companies (58.8%), of which elven were submitted by manufacturers / installers / suppliers of equipment (21.6%) and nineteen by rig operators and owners (37.2%);
- Six from "Other types of entites" (11.8%): Four of them arrive from different associations, one from a Notified Body, and another one from a Health and Safety Consultancy firm.

An overview of the answers provided by manufacturers / installers / suppliers of equipment and by rig operators and owners are found in Annexes B and C, respectively. Answers by Certification Bodies are summarized in Annex D, while Annex E contains the replies from Public Authorities. Finally, answers submitted by "Other types of entities" are in Annex F.

6.3.1 Results of the survey: safety aspects of the equipment

Special attention has been paid to the safety of the equipment analyzing the existence of any safety issue which could be evidenced via the survey and the analysis of past accidents, and whether these issues could be addressed by an extension of the scope of the three Directives or not.

The views of the stakeholders, sometimes contradicting, have also been included through the analysis of their answers to the following questions related to the safety of the equipment. For each question an overview of the answers of the different stakeholders is included.

1. Is the fact that MODUs are out the scope of the ATEX Directive, MD, and PED creating a safety problem?

Only 3/7 (42.9%) of the Public Authorities, which represent around 6% of the total stakeholders involved in the survey, think that the exclusion of MODUs from the EU Product Safety Directives is creating any safety problem.

On the contrary, (35/51) stakeholders, more than two-thirds (68.6%) of the stakeholders involved, believe that the exclusion of MODUs from the EU Product Safety Directives does not create any safety problem. In detail, there is no safety problem for 3/11 (manufacturers/installers/suppliers); 19/19 (drilling contractors/operators); 8/8 certification bodies; 1/7 of public authorities; and 4/6 of "other types of entities".

13/51 of the stakeholders involved in the survey (25.5%) either did not know or did not answer.

The answers of all the stakeholders involved are shown in the Table 16.

Table 16. Is the fact that MODUs are out of the scope of the EU Product Safety Directives creating a safety problem?

	Companies (Manufacturers)	Companies (Drilling contractors/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	0/11	0/19	0/8	3/7	0/6
No	3/11	19/19	8/8	1/7	4/6
Did not reply	7/11	0/19	0/8	2/7	1/6
Do not know	1/11	0/19	0/8	1/7	1/6

The opinion of the manufacturers and the drilling contractors/operators is quite different. The fact that MODUs are out of the scope of the EU Product Safety Directives does not represent a problem for 100% of the drilling contractors/operators, while only 27% of the manufacturers/installers/suppliers share this opinion. The "other types of entities" group, which are mainly associations representing the drilling contractors, in general terms share their opinion and 67% of them think that the current exclusion of MODUs of the EU Product Safety Directives does not represent a safety problem.

A similar trend is also observed for the Certification Bodies and an opposite tendency is noted for the Public Authorities. While for 100% of the Certification Bodies the current exclusion of MODUs of the EU Product Safety Directives does not create any safety problem, only around 14% of the Public Authorities share the same opinion.

The share of the stakeholders for which the exclusion of MODUs from the scope of the EU Product Safety Directives does not present any problem is shown in Figure 17.

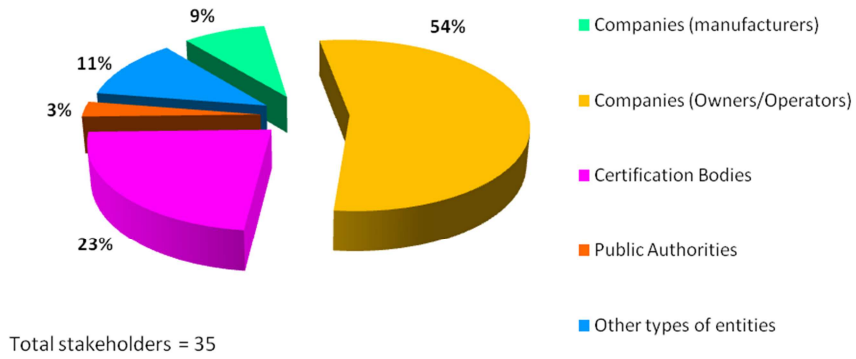


Figure 17. Share of the stakeholders for which the exclusion of MODUs from the scope of the EU Product Safety Directives does not represent any safety problem

2. Potential solved problems due to the extension of ATEX Directive, MD and PED to cover equipment on-board MODUs

The following bullet points **state the view of the concerned stakeholders**.

Manufacturers/installers/suppliers

- (1/11): The consideration of all sources of ignition, taken into account by ATEX Directive, but not by the US standards;
- (1/11): Documentation related to HSE issues. The extension will enforce more documentation to prove that equipment safety has been considered, but without contributing significantly more to the actual equipment safety;
- (2/11): Think that the extension of the Directives will not solve any problem;
- (1/11): Does not know;
- (6/11): did not reply to the question.

Drilling contractors/operators

Drilling contractors/operators say that the extension of the legislation would not solve any problem because:

- Safety, health and environmental problems are already addressed because the standards currently applying to MODU are equivalent to ATEX Directive, MD and PED.
- One company points out that they have never had any problem with the currently used MODUs.
- It could be though that the "man-machine interface safety" aspect would be improved as MD is more specific to man-machine interface safety than some of the current used standards, which have a starting point of unit/system integrity. However the currently applied standards also address similar aspects on men-machine safety as the MD, although it cannot be stated that they are fully covered under MD without an in depth review.

Certification bodies

- 2/8 declared that "safety and (possibly) environmental aspects" could be addressed;
- 1/8 declared that protection of explosions should be addressed, but it could be done by new standards from IEC TC31 (Equipment for explosive atmospheres) and IEC TC18 (Electrical installations of ships and of mobile and fixed offshore units);
- 3/8 believed that extending the scope of EU product safety legislation would not solve any problem;
- 2/8 certification bodies did not reply.

Public Authorities

The related answers of the Public Authorities have been:

- PED provides a considerable level of safety for workers and increases the systems integrity;
- Instead of different regimes of legislation for fixed installations (onshore and offshore) and MODU's, there would be only one regime;
- Instead of different enforcement regimes, the Regulator could supervise more consistently;
- All Stakeholders phase one regime of legislation and enforcement applicable to all equipment, wherever it is installed;
- No confusion of compliance for temporary/mobile well test equipment;
- The EU product safety legislation would better facilitate and improve risk identification, management and communication processes;
- Mainly problems related to safety and environment;
- There are not any severe safety problems which can be resolved by extending the legislation;
- This would bring both MODUs and fixed platforms under the same safety and environmental requirements that meet the EU relevant Directives and also equate them to similar equipment installed onshore. At present, some equipment installed on MODUs only meet standards that are not harmonised in the EU and which do not meet all the EHSRs of the relevant Directives thus undermining the safety system in the EU;
- Following many potential major hazard incidents, it would be of great value to get the EU Product Safety Directives extended to cover mobile units as well, in order, amongst other things, to:

a. Provide a simplified legislation and regime to increase practicability for both the industry and the regulators;

b. Reduce uncertainty and save time when verifying applicable equipment and clarifying supervision roles;

c. Give a common approach to the risks offshore and onshore for the same type of equipment and activity;

d. Ensure compatible measures for reducing risks and protecting personnel wherever they are working;

e. Provide harmonisation of the scope of the relevant Product Safety Directives so work equipment's status will be consistent.

Other types of entities

- Only one believes that extension of scope would solve safety problems and improve features in its services.

A summary of the results is shown in Figure 18.

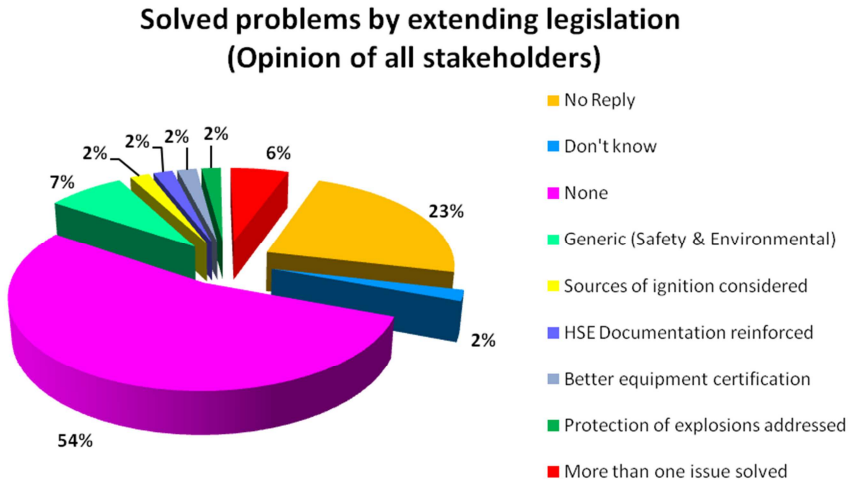


Figure 18. Potential solved problems by extending the legislation; Opinion of all stakeholders

3. Suitability of the PED to cover well-control equipment / Potential solved problems due to the extension of the PED to cover well-control equipment

The following bullet points **state the view of the concerned stakeholders**.

Manufacturers/installers/suppliers

- (1/11) company thinks that the documentation related to the safety of the product would be improved if the EU Product Safety Directives (EU PSDs) are extended. The EU PSDs are stricter and require more HSE documentation than the currently applied legislation (DNV-GL and ABS), especially in the case of the MD, although without contributing directly to equipment safety/quality.
- (10/11) companies have not answered the question.

Drilling contractors/operators

- (1/19) O&G companies think that the extension of the PED would clarify the criteria in the EU/EEA area on acceptance of equipment and suggests a gap analysis of the PED with the standards currently followed in the industry in order to formulate the legislation appropriately.

- On the contrary (13/19) companies do not expect any problem to be solved because:
  1. In their opinion well-control equipment is already well covered by the existing legislation and industry standards, specifically by API standards, in which the ESRs of the PED are already implicit.
  2. In particular for well-control equipment (BOPs, etc.) the already applied API standards go in great detail regarding to equipment required configuration and performance including pressure ratings and safety devices, next to fabrication and in use testing requirements. The application of PED would not add any value as PED is not specific enough for equipment and does not consider these specific requirements.
  3. Well-control equipment is adequately managed by the recently issued API Standard 53 (Blow-out Prevention Equipment Systems for Drilling Wells).
  4. Application of a generic Directive to critical emergency equipment to which the industry is committed to updating specific standards would be wholly counterproductive.
  5. The acceptance and operation of well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the scope of the EU Directives, more focused on verifying suitability of well-control-equipment design to wellbore conditions.

Certification Bodies

- 4 of the 6 Certification Bodies dealing with the PED consider the PED appropriate to cover well-control equipment;
- 2 of the 6 Certification Bodies which deal with the PED are not sure about the suitability of the PED for well-control equipment.
- 3 of the 6 Certification Bodies which deal with the PED think that the extension of the scope of the PED to cover well-control equipment could solve the following problems:
  1. As currently national standards are used, the extension would lead to a harmonization of the legislation across the EEA area;
  2. Safety and environmental problems (without specifying which).

Public Authorities

- PED provides a considerable level of safety for workers and increases the systems integrity.

4. Do you consider that the currently applicable legislation is sufficiently guaranteeing the safety of the equipment?

The question was asked to 86.3% (44/51) of the stakeholders, since it was not asked to Public Authorities. The answers of all the stakeholders involved are shown in the Table 17 and in the Figure 19.

Table 17. Suitability of the currently applicable legislation for guaranteeing the safety of the equipment according to all stakeholders

	Companies (Manufacturers)	Companies (Drilling contractors/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	4/11	19/19	3/8	Not asked	4/6
No	2/11	0/19	2/8		1/6
Did not reply	5/11	0/19	2/8		1/6
Do not know	0/11	0/19	1/8		0/6

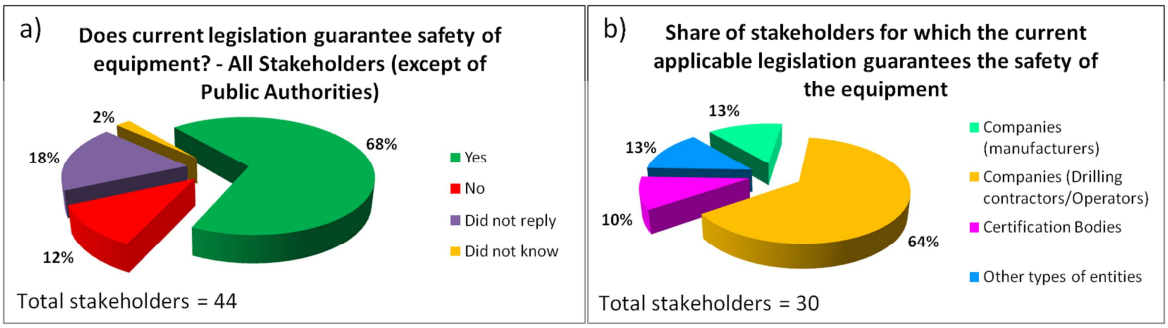


Figure 19. a) Suitability of the currently applicable legislation for guaranteeing the safety of the equipment according to all stakeholders. b) Share of stakeholders for which the current applicable legislation guarantees the safety of the equipment

More than two-thirds (68.2%) of the asked stakeholders, Public Authorities are not taken into account since they were not asked, believes that the current legislation guarantees an adequate level of safety on MODUs. Again the opinion of the manufacturers/installers/suppliers and the drilling contractors/operators diverges. The opinion that the currently applicable legislation sufficiently guarantees the safety of the equipment is supported by 100% of the drilling contractors/operators but only by 36% of the manufacturers/installers/suppliers. The opinion of the "other types of entities" group is again in line with that of the drilling contractors/operators.

Only around 37% of the Certification Bodies think the currently applied legislation guarantees the safety of the equipment. This percentage is incoherent with that obtained for the Certification Bodies in question 1 (100% of the Certification Bodies think the exclusion of MODUs of the scope of the EU Product Safety Directives does not represent a safety problem). The results obtained in question 1 and in question 3 for the manufacturers/installers/suppliers and the drilling contractors/operators are coherent.

The following bullet points state the view of the concerned stakeholders.

The related comments of the involved stakeholders are:

Manufacturers/Installers/Suppliers

- The US standards are as safe as the EU Product Safety Directives.

Drilling contractors/operators

- The currently applied national and international legislation (Class, MODU Code, API, Oil and Gas Offshore Safety Directive 2013/30/EU, Performance standards

for each of the Safety Case and Environmentally Critical Systems (SECS), etc.) warrant an equivalent level of safety and are used globally with a good track record in the field;
- In the majority of Root Cause Analysis the main causes are connected to human factor, not to equipment design or certification;
- There are sufficient controls/inspections based on international standards already applied on a global basis to MODUs;
- MODUs are built according to Class Society requirements and comply with many API recommended practices, which cover the majority of issues with respect to the drilling equipment not covered under IMO MODU Code;
- There is no evidence of systemic defects under current global standards;
- An O&G company points out that MODUs are certified before the spud of a new well by means of a recognized third part;

Manufacturers/Installers/Suppliers

- 2/8 Certification Bodies think the current legislation could guarantee a better level of safety as there is still a room for analysis and improvement to make the industry safer;
- 1/8 Certification Body is not sure as it claims that the level of safety depends mostly on the manufacturer of the equipment and on the third party.

"Other types of entities"

- The currently applicable international and national standards cannot be demonstrated to be inferior to the EU Product Safety legislation. Accidents that currently occur cannot be considered as evidence of systemic defects in global standards that could be remedied by these Directives.
- Although the MODU Code does not include requirements for industrial equipment installed for drilling, other international and national standards for machinery and equipment are in place (flag state, coastal state and classification society rules) to comply with relevant standards such as IEC, NORSOK, API and Class rules. These standards have been in use in the North Sea for over two decades and there is no evidence to suggest that they can be attributed to a major incident. Furthermore, the standards for equipment used on MODUs have been developed to address the specific risks associated with offshore O&G operations, which are not addressed by the more generic EU Product Safety Directives.
- A general reduction of the risk levels offshore is much more likely to be achieved through the Offshore Safety Directive than the EU Product Safety legislation. Under the Oil and Gas Offshore Safety Directive 2013/30/EU, operators of MODUs working in the EU that undertake well operations are already required to have systems in place to identify, prevent, detect, control or mitigate, and respond to major safety and environmental risks, including ensuring that Safety and Environmentally Critical Systems (SECS) are meeting appropriate performance standards. Thus, MODU operators, which are already required to meet robust standards for machinery and equipment through other legislative requirements and to justify the risk mitigation measures they put in place would, through the extension of the EU Product Safety Directives, be required to comply with generic standards that do not address the specifics of MODU operations. This fact could create conflict with the goal based approach on which the Offshore Safety Directive is based and potentially undermine safety.

5. Would the EU Product Safety Directives (ATEX Directive, MD, and PED) be a suitable legislation for equipment on-board MODUs?

In Table 18 and in Figure 20 and Figure 21 the answers of all the stakeholders are shown.

Table 18. Suitability of the EU Product Safety Directives for the equipment on-board MODUs according to all stakeholders

	Companies (Manufacturers)	Companies (Drilling contractors/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	5/11	3/19	5/8	5/7	1/6
No	2/11	13/19	2/8	1/7	3/6
Did not reply	3/11	1/19	1/8	1/7	2/6
Do not know	1/11	2/19	0/8	0/7	0/6

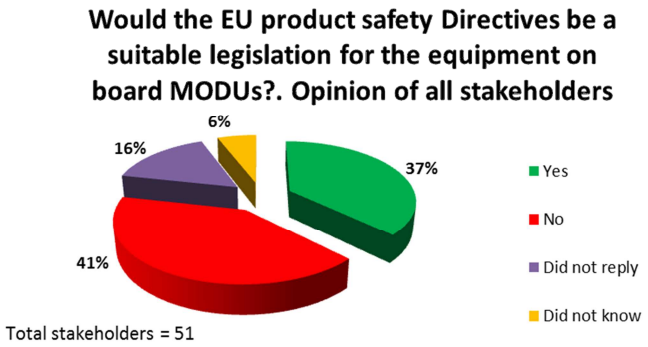


Figure 20. Suitability of the EU Product Safety Directives for the equipment on-board MODUs according to all stakeholders

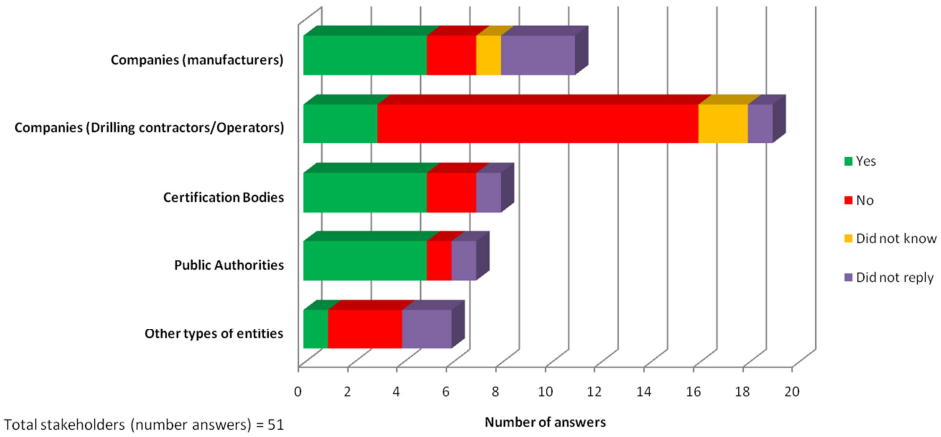


Figure 21. Suitability of the EU Product Safety Directives for the equipment on-board MODUs; Share of the answers of all stakeholders

The question was asked to 100% of the stakeholders and while 37% of the stakeholders think the EU Product Safety Directives would be suitable for equipment on-board MODUs, a slightly larger share of them (41%) think they would not. The rest either did not respond to the question or did not know. Considering the different stakeholders, this opinion is supported (in descendent

order) by: 71.4% of the Public Authorities, 62.5% of the Certification Bodies, 45.5% of the manufacturers/installers/suppliers, 17.8% of the drilling contractors/operators, and 16.6% of the "Other types of entities".

The results obtained for all the stakeholders are coherent with the previous ones. In Table 19 the results to question 4 (suitability of the current legislation to sufficiently guarantee the safety of the equipment on-board MODUs) and question 5 (suitability of the EU Product Safety Directives for the equipment on-board MODUs) of those stakeholders answering in an affirmative manner to both questions are shown.

Table 19. Stakeholders (%) which have answer in an affirmative manner to question 4 (Q4) and question 5 (Q5); Comparison

	Q4. Suitability of the current legislation to guarantee the safety of the equipment on-board MODUs	Q5. Suitability of the EU Product Safety Directives for the equipment on-board MODUs
Manufacturers (%)	36.4	45.5
Drilling contractors/operators (%)	100	17.8
Certification Bodies (%)	37.5	62.5
Public Authorities (%)	14.2 (*)	71.4
Other (%)	66.7	16.6

(*) Answer to question 1 (as question 4 was not asked to Public Authorities)

Three main opinions can be distinguished among the five stakeholders:

- The opinion of the manufacturers/installers/suppliers is not clear as similar percentages are obtained for opposite questions.
- Most of the drilling contractors/operators and "Other types of entities" think the current legislation guarantees an acceptable level of safety for the equipment on-board MODUs and thus only a small percentage of them (around 17%) consider the EU Product Safety Directives suitable for the equipment.
- The Certification Bodies and the Public Authorities have a similar opinion and opposite to that of the drilling contractors/operators and "Other types of entities". Only a low percentage of them think the current legislation sufficiently guarantees the safety of the equipment on-board MODUs and thus a high percentage of them (62-71%) consider the EU Product Safety Directives suitable for the equipment.

The comments coming from the different stakeholders related to the suitability of the EU Product Safety Directives are shown below:

Drilling contractors/operators

- The EU Product Safety Directives cannot stand alone and replace the existing normative references. Other recognized standards should be considered instead.
- For most drilling related equipment and MODU related equipment there are more specific regulations available. European Product Safety Directives would be handled as an additional requirement on top of the existing legislation.
- There is no perceived advantage of extending the legislation from a safety perspective.

- Related to ATEX Directive many markets in the US and Australia have banned ATEX certified equipment for its use offshore.

  Related to this view from the drilling contractors it has to be clarified that North America is presently not operating with the IEC/ATEX schemes although some effort has been made to produce some homogeneity between North American and European Standards, most notably the US and Canada's adoption of a Zone system (NEC 505) modeled after European Schemes. However, despite the great similarity between North American and European Zone systems, they are not identical and are not interchangeable.

- The issue that MODUs not only comply with Flag State, IMO and Class (DNV/ABS/Lloyds) requirements but also with a selection coastal state requirements pending on the area of operation (such as UK PUWER) would complicate the bases (what regulations will be included) for such assessment.

- If finally the Directives come into force:

  1. The extension of these should be applied only to the new equipment and not to the existing one.

  2. In order to formulate the legislation appropriately, a gap analysis of the 3 Directives with the standards and Codes that are being followed should be made. Extensions of the current Directives should be done to adapt them to the MODUs specific case.

Certification Bodies

- The EU Product Safety Directives would be a suitable legislation to cover equipment installed on MODUs although it would not make the equipment safer.

Public Authorities

- The EU Product Safety Directives (ATEX, MD and PED) would be a suitable legislation for the equipment installed on MODUs since they are already applied to similar equipment installed on fixed platforms and it is illogical for the same process and equipment to be subject to different safety requirements when installed in the same location for the same process in the EU.

"Other types of entities"

- The application of the Directives could be justified for fixed installations as these have hydrocarbons on deck for almost 365 days per year while MODUs are exposed to hydrocarbons for less than 20 days per year.

- Whereas the EU Product Safety Directives act upon manufacturers and suppliers, and therefore may be anticipated by the Commission to convey a net benefit to consumers in the EU, this is not the case for MODU owners. Indeed the reverse is true: barriers to trade can result, possibly in breach of the EU´s own treaties.

- The requirements of the Directives will not in every case be allowable as standards outside the EU. The situation would arise, should the EU Product Safety Directives be applied to MODUs, that owners could not maintain compliance to operate outside Union waters, and MODUs potentially coming to EU waters, including ultra- efficient latest generation installations, would be deterred by retrofitting costs. The net effect for EU waters would be a dedicated fleet of older generation rigs and a rather uncertain future for drilling in the EU; particularly in frontier areas such as deep water Mediterranean and the Atlantic rim where older rigs are unlikely to be effective.

6. Do you consider that an extension of the scope of the ATEX Directive would result in safer equipment?

The answers given by the different stakeholders to the question are shown in Table 20 and in Figure 22.

In this case only 74.5% of the stakeholders (38/51) was considered since the question was not asked either to Public Authorities or to "Other types of entities", which were asked about the EU Product Safety Directives as a whole (see question 9).

The answers are quite homogeneous in the sense that low percentages of the considered stakeholders, companies and certification bodies, consider the ATEX Directive would increase the safety of the equipment on MODUs. Considering the different stakeholders, these percentages in descendent order are as follows: 33.3 % of the Certification Bodies (only 3/8 Certification Bodies certify equipment according to the ATEX Directive), 18.2% of the manufacturers/installers/suppliers, and 10.5% of the drilling contractors/operators.

Table 20. Potential increase in the safety of the equipment on-board MODUs due to the extension of the ATEX Directive; Opinion of all stakeholders

	Companies (Manufacturers)	Companies (Drilling contractors/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	2/11	2/19	1/8	Not asked	See question 9
No	5/11	15/19	1/8		
Did not reply	2/11	0/19	6/8		
Do not know	2/11	2/19	0/8		

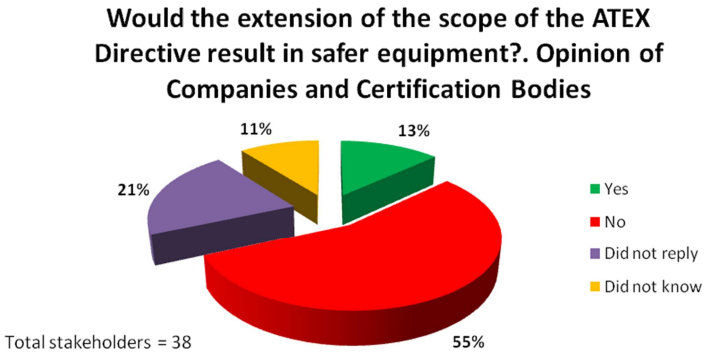


Figure 22. Would the extension of the scope of the ATEX Directive result in safer equipment? Opinion of the Companies and Certification Bodies

Of the 3/8 Certification Bodies which certify equipment according to the ATEX Directive, only one thinks that the extension of the ATEX Directive would result in safer equipment. A second one thinks the opposite because safety is adequately covered by the existing regulations, and the third one has not replied to the question.

The related obtained comments by type of stakeholder are:

Manufacturers/installers/suppliers

- IEC and US standards are more suitable than ATEX Directive although US standards should be updated in order to consider all sources of ignition (e.g. static electricity, friction, etc.);
- ATEX Directive would increase safety in equipment because currently when it is not legally required only electrical risks are considered (but not other risks);
- They consider the fact that ATEX allows self-certification is insufficient guarantee for the safety as there is no third party involved

  Related to that point, it has to be pointed out that the ATEX Directive only allows self-certification for some specific type of equipment with a lower hazard. The involvement of a third party (notified body) in the conformity assessment is required for the majority of the equipment. The above statement that ATEX allows "self-certification" is therefore misleading as it gives the impression that all equipment is self-certified.

Drilling contractors/operators

- Self-certification, as allowed by ATEX Directive, will very likely lower the safety standard. Independent verification as per IEC is a must.
- Most of the Ex equipment already in use comes from ATEX origins but without the certification, or an equivalent international standard.
- Zone ratings and equipment safety already exists within Class, Flag and HSE Case regimes.
- Electrical safety is already covered by other standards and recommended practices. Mechanical requirements of ATEX will be additional.
- ATEX Directive is not giving any added value to the current implemented MODU standards.
- Current design basis provide equivalent or higher level of safety.
- Benefits are unclear and an in depth review is required.
- In order to formulate the legislation appropriately, a gap analysis with the standards and codes that are being followed is suggested. A frame to clearly specify the requirements that are now dispersed under several standards should be set.

7. Do you consider that an extension of the scope of the MD would result in safer equipment?

The answers given by the different stakeholders to the question are shown in Table 21 and in Figure 23.

In this case only 74.5% (38/51) of the stakeholders are considered since the question was not asked either to public authorities or "other types of entities", which were asked the European Product Safety Directives as a whole (see question 9).

Neither the manufactures/installers/suppliers nor the certification bodies could foresee an improvement due to the extension of the MD. Only 10.5% of the drilling contractors/operators could foresee it.

It has to be pointed out that only 2/8 Certification Bodies certify equipment according to the MD. Of these, one thinks that the extension of the MD would not result in safer equipment because safety is adequately covered by the existing

regulations, and the second one has not replied to the question. 6/8 Certification Bodies did not reply to the question as they do not work with the mentioned piece of legislation.

Table 21. Potential increase in the safety of the equipment on-board MODUs due to the extension of the MD; Opinion of all stakeholders

	Companies (manufacturers)	Companies (Owners/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	0/11	2/19	0/8	Not asked	See question 9
No	5/11	13/19	1/8		
Did not reply	3/11	0/19	7/8		
Do not know	3/11	4/19	0/8		

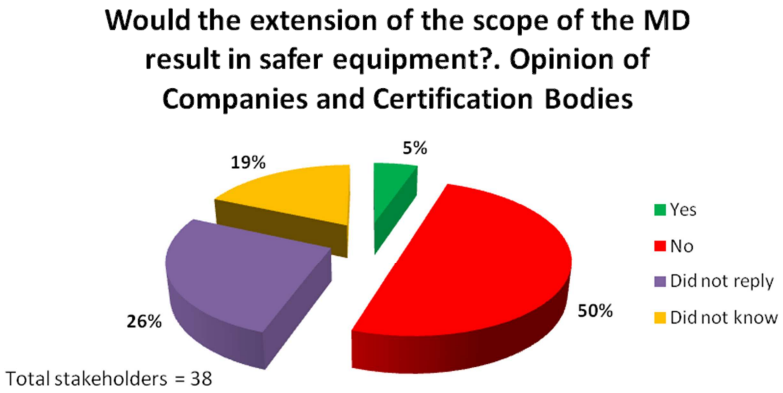


Figure 23. Would the extension of the scope of the MD result in safer equipment? Opinion of the Companies and Certification Bodies

The related obtained comments by type of stakeholder are:

Manufacturers/installers/suppliers

- O&G companies already have very high safety standards, like US OSHA regulations, as well as third parties inspecting the equipment. The extension of the legislation would enforce more documentation related to HSE without contributing to the actual level of safety of the equipment.

Drilling contractors/operators

- Existing global standards have a track record in the field that allows the companies to assess their reliability based on data. The same robust basis is not available for equipment subject to the MD.
- MD is not giving any added value to the current implemented MODU standards.
- Equipment safety already exists within Class, Flag and HSE Case regimes.
- There are already sufficient internationally recognized standards and recommended practices.
- Current design basis provides equivalent or higher level of safety.
- Benefits are unclear and an in depth review is required.

8. Do you consider that an extension of the scope of the PED would result in safer equipment?

The answers given by the different stakeholders to the question are shown in Table 22 and in Figure 24.

In this case only 74.5% (38/51) of the stakeholders are considered since the question was not asked either to public authorities or "other types of entities", which were asked the European Product Safety Directives as a whole (see question 9).

Table 22. Potential increase in the safety of the equipment on-board MODUs due to the extension of the PED; Opinion of all stakeholders

	Companies (Manufacturers)	Companies (Drilling contractors/Operators)	Certification Bodies	Public Authorities	Other types of entities
Yes	0/11	2/19	2/8	Not asked	See question 8
No	4/11	15/19	3/8		
Did not reply	4/11	0/19	1/8		
Do not know	3/11	2/19	2/8		

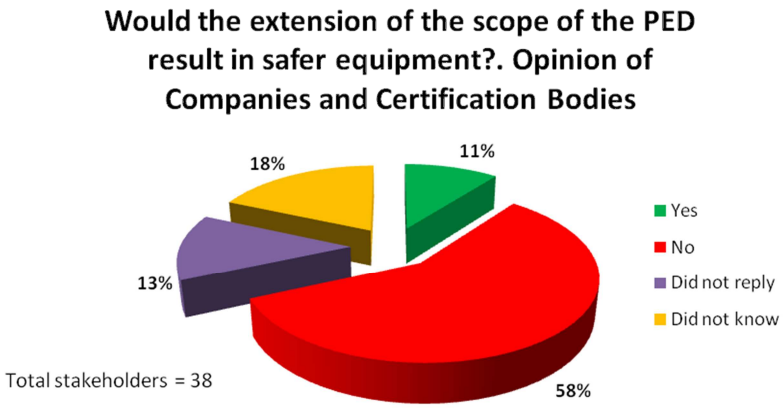


Figure 24. Would the extension of the scope of the PED result in safer equipment? Opinion of the Companies and Certification Bodies

10.5% of the drilling contractors/operators and 33.3% of the Certification Bodies ((6/8) Certification Bodies deal with the PED) think that an extension of the scope of the PED would improve the safety of the equipment. On the contrary, the manufacturers/installers/suppliers ((6/11) deal with the PED) would not expect any improvement in the safety of the equipment related to the PED.

The related obtained comments by type of stakeholder are:

Manufacturers/installers/suppliers

- Currently applied standards are more suitable (e.g. ASME standards)
- API standards, which have been improved since Macondo, are exhaustive for BOPs. They also think that the extension of the legislation will enforce more documentation related to HSE without contributing to the actual level of safety of the equipment.

Drilling contractors/operators

- Existing global standards have a track record in the field that allows the companies to assess their reliability based on date. The same robust basis is not available for equipment subject to the MD and PED.
- MD and PED are not giving any added value to the current implemented MODU standards.
- Equipment safety already exists within Class, Flag and HSE Case regimes.
- There are already sufficient internationally recognized standards and recommended practices.
- Current design basis provides equivalent or higher level of safety.
- Benefits are unclear and an in depth review is required.

Drilling contractors/operators

- No, currently safety is adequately covered by the existing regulations.
- No, because PED would accept some equipment to be self-certified (under module H).

  Related to the concern of the drilling contractors/operators about the "self-certification", it has to be pointed out that this view is not correct and has to be clarified. The PED allows self-declaration (Module A) only for equipment of category I whereas for equipment of category II and higher categories the involvement of a notified body is always required. Stating that equipment is self-certified (under Module H) is wrong. For a conformity assessment procedure based on a quality management system (module H) the Notified Body certifies the manufacturer's quality system and carries out surveillance to make sure that the manufacturer duly fulfils the obligations arising out of the approved quality system. The module H requires the involvement of a notified body and is no way comparable to "self-certification".

9. Do you consider that an extension of the scope of the EU Product Safety Directives (ATEX, MD and PED) would result in safer equipment? (only for "Other types of entities")

66.7% of the "Other types of entities" consider that an extension of the scope of the EU Product Safety Directives would not result in safer equipment whereas only 16.7% of them do. Additionally, another 16.7% do not what to think about this question. Results are shown in Figure 25.

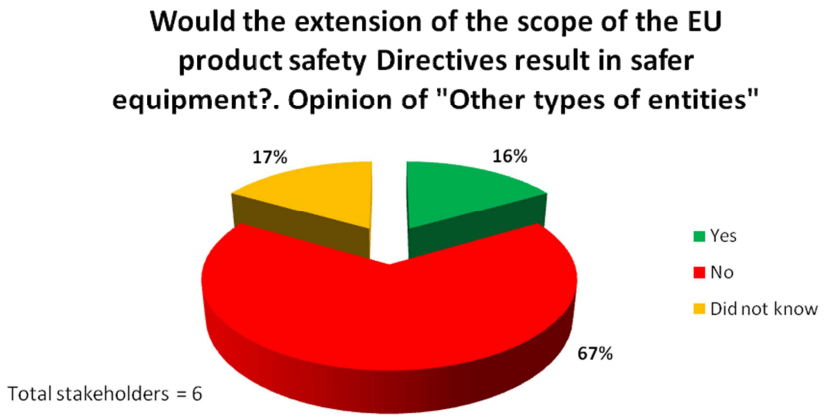


Figure 25. Would the extension of the scope of the EU Product Safety Directives result in safer equipment? Opinion of the "Other types of entities"

In Table 23 a comparison of the affirmative answers obtained for question 5 (suitability of the EU Product Safety Directives for the equipment on-board MODUs), question 6, question 7, question 8 and question 9 (potential increase in the safety of the equipment on-board MODUs due to the extension of the ATEX Directive, MD and PED) is shown.

Table 23. Stakeholders (%) which have answer in an affirmative manner to question 5 (Q5), question 6 (Q6), question 7 (Q7), question 8 (Q8) and question 9 (Q9); Comparison

Stakeholder	Q5. Suitability of the EU Product Safety Directives for the equipment on MODUs	Potential increase in the safety of the equipment on-board MODUs due to the extension of the		
		Q6. ATEX Directive	Q7. MD	Q8. PED
Manufacturers (%)	45.5	18.2	0	0
Drilling contractors/operators (%)	17.8	10.5	10.5	10.5
Certification bodies (%)	62.5	33.3	0	33.3
Public Authorities (%)	71.4	Not asked	Not asked	Not asked
Other (%)	16.6	16.7% (Q9)		

According to the answers of the asked stakeholders, public authorities were not asked, the potential increase of the safety in the equipment on-board MODUs due to the extension of the EU Product Safety Directives is very low.

Only a low percentage of drilling contractors/operators and "Other types of entities" (around 17% in both cases) think the EU Product Safety Directives would be suitable for the equipment on-board MODUs and consequently also a low percentage of them (10.5-16.7%) think the Directives would increase the safety of the equipment. Thus the answers of these stakeholders are coherent.

While 10.5% of the drilling contractors/operators would expect an improvement in the safety of the equipment due to the extension of the MD and PED, none of the manufacturers/installers/suppliers would. This result does not follow the general trend since the position of the manufacturers/installers/suppliers towards the extension of the legislation is in general much smoother than that of the drilling contractors/operators.

On the contrary, inconsistencies have been found for manufacturers and Certification Bodies. A high percentage of manufacturers and Certification Bodies (45.5% and 62.5% respectively) agree with the suitability of the EU Product Safety Directives for the equipment on-board MODUs, whereas only a low percentage of them think these Directives would increase the safety of the equipment.

Safety aspects of the equipment: Summary of the answers of the stakeholders

To summarize the answers of the stakeholders related to the safety of the equipment it can be said that there are different points of view.

The answers of the drilling contractors/operators and "Other types of entities", mainly associations representing the drilling contractors, are coherent as in general terms they do not consider the EU Product Safety Directives suitable for the equipment on-board MODUs and thus do not expect safer equipment due to the extension of the Directives.

A smoother position towards the extension of the Directives is that of the manufacturers/installers/suppliers and certification bodies. Although an important percentage of them consider the EU Product Safety Directives suitable for the equipment on-board MODUs (45.5% of the manufacturers/installers/suppliers, and 62.5% of the Certification Bodies) only a small part of them could foresee an improvement in the safety of the equipment due to the extension of the Directives.

Taking into account the answers of these stakeholders (manufacturers, drilling contractors and their associations, and certification bodies) we have not observed any evidence of safety issues requiring immediate attention from the equipment point of view.

On the contrary, public authorities is the most optimistic group towards the extension of the Directives as 71.4% of them find the Directives suitable for the equipment on-board MODUs and 85% of them think that the extension of the scope of the legislation would lead to a significant/very important reduction of the risk.

In fact, two public authorities, being one of these the Petroleum Safety Authority (PSA) Norway, have given specific examples of potential solved problems for drilling hoisting equipment (well casing elevator and riser running tool). This type of equipment was designed according to the non-harmonised standard EN ISO 13535 (API 8C). The problem was that its design relied on work procedures to ensure the tool was secured for lifting. The procedures failed many times, resulting in the tool being dropped. Discussions took place with manufacturers and a modified design that met the principle of safety integration and hence the requirements of the Machinery Directive (Annex I paragraph 1.1.2) were introduced. Thus, this problem has been already solved.

Another incident related to the Hydraulic workover Snubbing Unit (HWU) which happened in 2010 due to the fact that it was not designed to be "fail safe", has been referenced. No more information has been provided in order to know if the problem has been already solved; e.g. which design standards were used?, afterwards, was the design changed?, Were the EU Product Safety Directives applied?, etc.

According to the Petroleum Safety Authority Norway (PSA Norway), the strength of the EU product safety system is the "safety integration" approach and in particular the hierarchy of risk reduction measures, with relying on user precautions and Personal Protective Equipment (PPE) only after elimination, substitution and engineering means to control the risk have been fully applied to meet the State of the Art.

Additionally, the potential solved problems due to the extension of the legislation would be related to HSE documentation, environmental aspects (without specifying which), the improvement of risk identification offshore and onshore for the same type of equipment and activity, management and communication processes, simplified legislation, clarified supervision roles, and harmonization of the scope of the relevant

Product Safety Directives. Some answers say that some safety problems would be solved but without specifying which.

The following specific technical issues related to the equipment, but not specific for any of the six big categories of equipment identified in this report, have appeared:

- Through the extension of the ATEX Directive all sources of ignition (e.g. static electricity, friction, etc.) could be considered as currently IEC and US standards don´t do it.
- Through the extension of the ATEX Directive the protection of explosions could be addressed (although it could be also done by the standards IEC TC31 (Equipment for explosive atmospheres) and IEC TC18 (Electrical installations of ships and of mobile and fixed offshore units)).
- Through the extension of the Machinery Directive the "man-machine interface safety" aspect could be improved as the MD is more specific to man-machine interface safety than some of the current used standards.
- Through the extension of the PED an increase in the systems integrity would be achieved (as well as in the level of safety for workers).

6.3.2 Results of the survey: Extension of the PED to cover well-control equipment

The opinion of the different types of stakeholders related to the extension of the PED to cover well-control equipment are the following:

Manufacturers

The questions about the extension of the PED to the well control equipment haven´t attracted much interest from manufacturers/installers/suppliers since only 27% of them are dealing with this specific category of equipment. It has not been possible to get their opinion because they mainly either didn´t answer or didn´t know.

Drilling contractors/operators

A clear position against the extension of the PED to well control equipment has been observed for drilling contractors/operators since 68% of them think the PED wouldn´t solve any problem, 63% think the PED is not suitable for well control equipment, 74% would expect difficulties, and 68% would expect barriers to trade due to its extension.

Certification Bodies

Certification Bodies in general support the extension of the PED to cover well control equipment since 67% of those dealing with the Directive find it suitable for well control equipment, 67% wouldn´t expect barriers to trade, and 50% think it would solve some problems.

An incoherency has been found in their answers since 67% of them would expect difficulties due to the extension of the legislation for the companies (the purchase of PED compliant material, change of the design code to a "PED friendly code", certification costs and difficulties due to the change of the technical references, and lack of availability of approved personnel outside EU as currently the equipment is manufactured to a large extent outside the EU/EEA), and 67% of them wouldn´t expect barriers to trade (trade barriers could be glimpsed among the mentioned difficulties for companies).

Public Authorities

The position of the Public Authorities is not very clear as in 80% of the related questions at least a 43% of them either didn´t answer of didn´t know what to expect (the percentage of Public Authorities which didn´t know or didn´t answer increases to 71% for 40% of the questions).

57% of the Public Authorities find the PED suitable for well control equipment although 43% of them are aware of the difficulties the companies could have.

A general comment, even among those supporting the suitability of the PED for well control equipment, is that the Directive would be appropriate only for a part of the equipment because: 1. the acceptance and operation of well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the scope of the EU Directives, more focused on verifying suitability of well control-equipment design to wellbore conditions, and 2. The PED accepts some equipment to be self-certified (under module H) while the drilling rules should require more involvement of a third party.

6.3.3 Results of the survey: general view per type of stakeholder

The survey and the interview results have been analyzed including a comparison of the results for the different stakeholders highlighting the major similarities and differences, and the coherence of their statements; the logical explanation to the results obtained; the unclear points and those points which still require further examination; whether the survey allow to draw general conclusions for a given category of stakeholders, and finally the survey´s ability to represent a population that is to say, if the different stakeholders are representative samples from which extract a general conclusion.

Companies

Eleven companies manufacturing/installing/supplying equipment and nineteen companies owning/operating a MODU have answered the survey. 100% of the manufacturers/installers/suppliers and around 89% of the drilling contractors/operators are present at least in one European country.

Although in other sections of the document the associations of drilling contractors have not been considered together with the drilling contractors, the view of ECSA, an association representing the drilling contractors, has been also introduced in this section since its position is in line with that of the drilling contractors.

These are big-sized companies: 82% of the manufacturers/installers/suppliers and 89% of the drilling contractors/operators have more than 250 employees.

Contradicting views have been gathered concerning equipment installed on MODUs vs. that installed on offshore fixed platforms and onshore platforms as the equipment is almost identical for 82% of the manufacturers/installers/suppliers but only for 5% of the drilling contractors/operators. The reason for that is that drilling contractors/operators, instead of considering a comparison among the common equipment for fixed and mobile rigs, consider the extra specific equipment on MODUs due to their mobile nature and for overcoming the effects caused by weather conditions, and which obviously is not the case on fixed platforms. As a result, only a small part of them consider the equipment identical. On the contrary, for the manufacturers/installers/suppliers, which have focused their comparison in the differences for the common systems in mobile and fixed platforms, probably by comparing the equipment categories they deal with for both types of rigs, found the equipment almost identical.

The equipment mainly considered for the drilling contractors/operators is the following:

- Specific equipment due to the mobile nature of MODUs: marine systems (ballast, bilge, mooring, etc.), positioning equipment and navigation equipment.
- Specific equipment developed to overcome effects caused by weather conditions: marine riser system (riser pipe, riser tensioners and ancillaries), motion compensating and tensioning system, and heave compensator.

According to ECSA the diverging opinions (apart from the marine elements, as highlighted) in the replies with respect to differences in equipment are due to the fact that, in spite of the hardware in some cases not necessarily exhibiting significant differences, the usage pattern and operational envelopes are completely different.

In our opinion, the answers of the drilling contractors/operators could be also interpreted as a justification for applying different legislation to fixed rigs and MODUs. This means that if the equipment on both types of rigs is quite different, it is logical that the EU Product Safety Directives apply to fixed platforms and not to MODUs.

In spite of the diverging opinions of manufacturers/installers/suppliers and drilling contractors/operators, some common answers have been also given by these two stakeholders:

- BOPs installed in jack-ups and fixed rigs are different from those installed in floaters (semisubmersibles/drill-ships).
- Power generation and distribution systems, which vary among MODUs and even more if compared to fixed facilities.

100% of companies (both manufacturers/installers/suppliers and drilling contractors/operators) obtain revenue from EU/EEA, and at least 50% of them get revenue from Asia Pacific, Africa/Middle East and the US. A decrease in revenues is expected by 18% of the manufacturers/installers/suppliers and by 53% of the drilling contractors in case of extension of the legislation.

According to the manufacturers/installers/suppliers an important part of the equipment manufactured, installed, supplied is currently compliant with the EU Product Safety Directives (91% with the ATEX Directive, 73% with the MD and 64% with the PED), whereas the current compliance of the assets of drilling contractors with the EU Product Safety Directives is much lower: 23% with the ATEX Directive, 23% with the MD and 59% with the PED.

100% of the drilling contractors/operators think the current legislation guarantees an acceptable level of safety for the equipment on-board MODUs. In general it can be said that in their opinion everything is already well covered and should not be touched upon. The following statements coming from the drilling contractors are, among many others, only two examples demonstrating this:

- Well-control equipment is already well covered by the existing legislation and industry standards, specifically by API standards, in which the ESRs of the PED are already implicit.
- The acceptance and operation of well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the scope of the EU Directives, more focused on verifying suitability of well-control-equipment design to wellbore conditions.

As a consequence, only around 17% of the drilling contractors/operators consider the EU Product Safety Directives suitable for the equipment and only 10.5% think the new legislation would increase the safety of the equipment.

An inconsistency has been specifically found for manufacturers: 45% find the EU Product Safety Directives suitable, whereas only a low percentage of them (18% for the ATEX Directive and 0% for the MD and the PED) think these Directives would increase the safety of the equipment.

54% of the manufacturers/installers/suppliers think their companies would not be at a disadvantage vis-à-vis their competitors from within EU/EEA in case of extension of the legislation because the same rules would theoretically apply for all competitors and because according to them an important part of the equipment manufactured, installed, supplied, as explained above, is already compliant with the EU Product Safety Directives. On the contrary, 63% of the drilling contractors/operators would expect a disadvantage because the approach to compliance may differ among the MODU owners (the age of the rigs would be a significant factor in the cost).

Related to the possible disadvantages vis-à-vis their competitors from outside EU/EEA, the manufacturers/installers/suppliers are optimistic. 54% of them would not expect any disadvantage because the equipment they manufacture/install/supply is already compliant with the EU Product Safety Directives and they currently manufacture according to the three Directives for many parts of the world. 79% of the drilling contractors/operators think the opposite because it would be an unfair advantage for units which do not have to comply with the EU safety product Directives when competing for working outside Europe.

54% of the manufacturers/installers/suppliers do not indicate the impact in terms of costs that the extension of the legislation would have for their business. Only one company has evaluated the substantive and administrative costs. This company, whose equipment is not compliant with any of the Directives, and which manufactures up to 350 units/sets of drilling equipment (hoisting, lifting, handling and rotary systems) per year evaluates the costs of compliance in € 12.5 mln per year. The breakdown of the costs is shown in Annex B.

The drilling contractors/operators also find it difficult to estimate the impact in term of costs but define it as extremely high. Only three companies have provided rough approximations of the costs (the breakdowns of the costs are shown in Annex C).

- A drilling contractor which is currently planning the replacement of the BOPs and its controls to comply with the latest API specifications says that the operation would have a cost of USD $25 mln. This company is not aware of any EU Product Safety Directives compliant BOPs currently available in the market. The breakdown of the cost is shown in Annex C.
- Another drilling contractor has estimated an overall total cost of compliance with the EU Product Safety Directives in € 28 mln per MODU.
- A third drilling contractor which is active only in Europe and has selected the drilling equipment (hoisting, lifting, handling and rotary systems) as the specific equipment subcategory, has roughly estimated the costs of compliance for this subcategory in the range € 10-75 mln per MODU rig, depending on whether current equipment can be reviewed for certification compliance or needs replacement by new equipment.

In order to offset the costs, 64% of the manufacturers/installers/suppliers would transfer the costs to the clients by increasing the price of the equipment. In the case of the drilling contractors/operators a much more drastic solution could be expected, as 79% of them see the exit of the European MODU market as the best option.

27% of the manufacturers/installers/suppliers and 68% of the drilling contractors/operators would expect time delays in their business if the legislation is extended. These results are again in line with the strong position of the drilling contractors/operators towards the EU Product Safety Directives. Only one manufacturer, a company manufacturing 2,400 pieces per year of drilling equipment, and whose equipment is not compliant with any of the three Directives, has quantified the extra time between 8 and 20 months. In the case of drilling contractors, diverse results have been obtained: 18 months, 2.5 years for BOP sub-components, minimum 3 years, and 5-10 years to re-certificate/renew the equipment in all units.

According to ECSA the manufacturers/suppliers/installers would not likely perceive an extension of the Directives as a disadvantage since the cost would be offset to the MODU owners, though some of them might be concerned by additional legal liabilities. ECSA also thinks that an extension of the Directives would not be perceived as a barrier to trade by the manufacturers/installers/suppliers, as their trade outside of the European community is rather limited compared to drilling contractors.

The section on the extension of the PED to well-control equipment has not attracted much attention from manufacturers/installers/suppliers and only 16% of them have answered those questions. According to ECSA the low interest of the manufacturers/suppliers/installers in the well-control equipment questions is due to the fact that not very many of them manufacture or assemble well-control equipment.

On the other hand, around 71% of the drilling contractors/operators would expect barriers to trade and other types of difficulties due to the extension of the PED to well-control equipment.

Taking into account i) the size of the companies drilling contractors/operating a rig, ii) the fact that five of them are among the top ten offshore drilling contractors in January 2015 and iii) the fact that their answers are in line with those of very important European and International associations representing and serving drilling contractors, it can be concluded that the answers received are representative and robust conclusions can be made for drilling contractors/operators.

On the other hand, considering the small number manufacturing/installing/supplying companies who answered the survey (11), and the fact that most of them (64%) deal with only one or two categories of equipment, out of the six big categories identified in the report, it is difficult to provide conclusions of general validity.

ECSA remarks that MODU Code, flag state requirements, Classification Society requirements, and coastal state requirements are all relevant for a MODU, and not only the MODU Code. ECSA also points out that no MODUs in the Union waters would gain acceptance of its Report on Major Hazards (safety case) without demonstrating full adherence with the MODU Code, compliance with regional seas and flag state requirements, and maintenance of Classification society rules.

ECSA also highlights the Section 2.1.3 of the MODU Code where it is specified that "each MODU should be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a Classification Society" and the fact that such a Classification Society "has recognized and relevant competence and experience with offshore petroleum activities".

ECSA adds that the present edition of the MODU Code (2009 edition, as amended), in consideration of the inclusion of classification society rules, addresses virtually all the structure, machinery and electrical systems of a MODU that can be included in the shipyard construction contract. Furthermore, the MODU Code has been amended twice since the 2009 edition was approved and is currently under revision, in consideration of the results of the Macondo incident investigations.

Certification Bodies

Eight replies from Certification Bodies have been received. 4/8 certify equipment for all types of rigs (MODUs, fixed offshore and onshore), 3/8 only for some installations and 1/8 is certifying according to the PED but deals only with recreational crafts and thus is not involved in the O&G sector. 3/8 answers are coming from different departments of the same Certification Body, a very large and important one, and 2/8 are large and recognized Certification Bodies.

Although an important percentage of them (62.5%) consider the EU Product Safety Directives suitable for the equipment on-board MODUs, only a small part of them could foresee an improvement in the safety of the equipment due to the extension of the Directives (only 33.3% think that the ATEX Directive and the PED would improve the safety of the equipment and 0% think the MD would increase the level of safety).

Related to the differences between the equipment installed on MODUs and on fixed platforms, for 50% of the Certification Bodies the equipment is almost identical with small modifications due to the adverse conditions of use (e. g. salt water, strong vibrations, ice...), and the fact that must endure the dynamic behaviour from wave actions, etc. 25% Certification Bodies replied that the question is not applicable since there is a variety of equipment that is identical while some have different requirements due to special functions or additional load of moving vessels. The other 25% of the Certification Bodies did not reply. Thus, as explained above the differences would be mainly related to the mobile nature of MODUs and to its specific equipment to overcome effects caused by weather conditions.

The Certification Bodies were asked about the expected costs for the companies due to the certification process of one sub-category of equipment. The selected sub-category was treated as a typical case or example and detailed information on costs were asked. They were also asked about the expected cost for the Public Authorities. Only 25% of the Certification Bodies answered the question. The first one said that some extra costs could be expected for companies but not for Public Authorities. The second one said that the well-control equipment would increase its price in 20%. As in the case of the companies, incomplete information was obtained.

Considering that very few Certification bodies replied to the survey, we find the obtained answers not representative of this specific stakeholder. In particular, we did not receive any answers from Standardization Bodies: their answers would have been very valuable as, currently, most of the stakeholders are concerned about the lack of harmonised standards in the sector, which is foreseen as not achievable in a short time.

The answers of the Certification Bodies are very well elaborated and there was no indication that these were driven by some interest. However, the extension of the Directives could be interpreted as an extra source of income for the Certification Bodies, in contraposition with the opinion of the drilling contractors and operators, which find it difficult to estimate the impact in term of costs but define it as extremely high.

Public Authorities

Seven replies from Public Authorities have been received and four of them are coming from countries which are the biggest producers of oil and gas in Europe (EU/EEA).

The views of the Public Authorities and the drilling contractors are divergent in what it has to see with the safety of the equipment and the applied legislation. Whereas in the opinion of 100% of the drilling contractors/operators all the equipment on-board MODUs is well covered by the currently applied legislation and should not be touched upon, 71.4% of the Public Authorities, which is the most optimistic group towards the extension of the Directives, find the EU Product Safety Directives suitable for the equipment on-board MODUs. Also, 86% of the Public Authorities think that the extension of the scope of the legislation would lead to a significant/very important reduction of the risk.

As an example of the view of the Public Authorities, the Petroleum Safety Authority Norway thinks that the strength of the EU product safety system is the "safety integration" approach and in particular the hierarchy of risk reduction measures, with relying on user precautions and Personal Protective Equipment (PPE) only after elimination, substitution and engineering means to control the risk have been fully applied to meet the State of the Art.

The experience of the Petroleum Safety Authority Norway says that many international standards such as those produced by API, do not follow the above principal and rely too much on the user controls. As a consequence the Petroleum Safety Authority Norway does not believe that API "must be adopted" as the basis for best practice worldwide – rather the exact opposite, (*since API is not accepted worldwide)*. According to this Public Authority API has not in many cases proven to be "good enough", is deficient in a number of areas, covers mainly technical requirements but says little about operational requirements and, among other shortcomings, API completely lacks "defined requirements" for the reliability of safety-critical functions/equipment. The Petroleum Safety Authority Norway says that has sufficient knowledge to affirm that there is a gap between the API relevant requirements and the essential safety requirements (EHRS) of the Machinery Directive. They believe this is demonstrated by the lack of any of such API standards being harmonised in the EU.

In view of the Petroleum Safety Authority Norway the situation of having in effect two similar, if not the same, environments (e.g. drilling a well) in Europe with one fully meeting the EU's product safety requirements and a second meeting standards that have not been able to be harmonised with these requirements undermines the EU's new approach.

Norwegian PSA provided examples of near misses, accidents and events that could, but for mm or seconds (i.e. luck), could have resulted in a major event, and their analysis have shown that equipment (including the lack of good instructions for use and maintenance) fell short of EU requirements i.e. the Machinery Directive.

In spite of being very positive towards the extension of the legislation, the Public Authorities are aware of the possible obstacles that companies could have. 86% of them think that companies could face difficulties due to the extension of the legislation and 50% would expect barriers to trade.

Having in mind their experience with the EU Directives and with their domestic legislation in the offshore oil and gas sector, and having in mind that the overall level of safety in offshore as well in onshore industry of those countries are practically among the highest worldwide, reliable conclusions can be drawn. In addition, if we consider the fact that 100% of the Public Authorities answering the survey deal with the ATEX Directive, MD and PED, we can conclude that the obtained answers are representative of the mentioned stakeholder.

In our opinion there is no indication that the received answers of the relevant competent authorities were driven by some other interest aside of increasing the level of safety within the European waters.

6.3.4 Unclear points / points which still require further examination

The following bullet points refer to issues of concern for drilling contractors, operators and manufacturers who participated in the survey.

- As it has not been possible to extract complete information about the expected costs of compliance of the equipment with the EU Product Safety Directives, their estimation still remains as an unclear point. Even though the survey included specific questions related to substantive costs (one-off, per unit produced) and administrative costs, such information was not provided by the respondents although the question was limited to specific subcategories in order to avoid too burden for the respondent.

  The general comment from the drilling contractors/operators is that it is not possible to specify the costs unless the applicability is clarified (Never applicable to existing units?; Applicable to existing units but after a given date in the future?; or Only applicable to MODUs constructed after a given date in the future?). In addition, the drilling contractors/operators have stated that the cost also depends on the possibility that the equipment is reviewed for certification compliance or needs replacement by new equipment. Any retrospective application of the Directives on existing equipment would be technically and financially challenging. Even the manufacturers of equipment whom the drilling contractors are speaking with, have no proposal to comply or are unwilling to give figures at this stage.

  Related to this concern expressed by the drilling contractors/operators, it has to be clarified that **the new legislation would only be applicable as of a certain point in time and cannot be retroactive, thus it would only apply to new equipment**.

  Additionally dates when a new Directive becomes applicable is communicated in a timely manner and subject of the discussion in the legislative process. Moreover,

there are always transitional provisions in such situation. Thus, the legislative process would result in requirements to be met only by the new equipment.

- The drilling companies would find it difficult to comply with the EU Product Safety Directives because of the huge variety of equipment onboard. A large share of the companies suggested the European Commission to conduct a gap analysis to know the compatibility between the currently used standards and installed equipment and the EU Product Safety Directives.

  Taking as an example a specific subcategory of equipment (eg. BOP), these companies are concerned about the compatibility between worldwide used industry API standards, as BOPs are currently designed to these, and the PED. The companies would need that major Original Equipment Manufacturers (OEMs) advise them of anticipated difficulties in maintaining worldwide API compliance whilst adding EU specific Directives requirements.

- In case of the extension of the legislation to MODUs the drilling contractors/operators are concerned about the "self-certification" of equipment as allowed for some equipment by the ATEX Directive. In their opinion the "self-certification" of equipment would lower the safety standards.

  The worry expressed by the drilling contractors and operators is unfounded since, as explained, the ATEX Directive only allows self-certification for some specific types of equipment with low hazard, whereas the involvement of a Notified Body (third party) in the conformity assessment is required for the majority of the equipment.

  Currently, manufacturers/suppliers (or importers, if the manufacturers are outside the EU) must ensure that their products meet Essential Health and Safety Requirements of the ATEX Directive and undergo appropriate conformity procedures. This usually involves testing and certification by a 'third-party' Certification Body (known as a Notified Body).

  Additionally manufacturers/suppliers can draw up a written "Declaration of Conformity" by following the procedure relating to "Internal Control of Production" (referred to in Annex VIII of the ATEX Directive). The self-declaration by the manufacturer or his authorized representative is allowed only in the following cases:[82]:

  - Category 3 of equipment (equipment for zone 2): by preparing a technical dossier that includes drawings, hazard analysis and users` manual in the local language.
  - Category 2 of equipment (equipment for zone 1): Provided that it is not either electrical equipment or equipment dealing with internal combustion engines. In this case the technical dossier must be lodged with a notified body.

  The concern of the drilling contractors/operators about "self-certification" of equipment is also related to the PED as in their opinion the Directive accepts some equipment to be "self-certified" under module H (full quality assurance). It has to be pointed out that this view of the drilling contractors/operators is not correct and has to be clarified. The conformity assessment module H (full quality assurance) requires the involvement of a Notified Body certifying the manufacturer's quality system. The Notified Body carries out surveillance to make sure that the manufacturer duly fulfils the obligations arising out of the approved quality system. Thus, the module H is not comparable to "self-certification". It should be noted also

[82] Declaration of conformity is always needed but it is not a self-declaration. In all cases, regardless of whether a NB is involved in the conformity assessment or not, the manufacturer has to make the Declaration of conformity.

that the term self-certification as such does not exist in PED. What is probably meant is the conformity assessment procedure (Module A – internal production control) whereby the conformity assessment is completed by the manufacturer without the involvement of a notified body. This procedure is only allowed for equipment of category I (lowest hazard category under PED).

7. Interviews with the stakeholders

Two personal interviews were carried by the JRC team, i.e. on September 17th with DRILLMEC (in Piacenza, Italy) and on October 2nd with Saipem (in San Donato Milanese, Italy).

7.1. Interview with DRILLMEC

The interviewed persons were Angelo Calderoni, Vice President R&D; Marco Lombardi, Sales Manager for Offshore and Francesco Colaianni and Luca Abelli, members of the Drillmec's team dealing with legislation, European Directives and certification. On behalf of the European Commission, the interviewers were María Aránzazu Aznárez and Dejan Brkić. The meeting took place in Podenzano on September 17th 2015.

Related to the possible extension of the EU Product Safety Directives (ATEX, MD, and PED) to cover MODUs, DRILLMEC explained that the equipment they manufacture for fixed platform and jack-up units are almost identical. Conversely there is a substantial difference between platform/jack-up rigs and floater-based rigs (i.e. semisubmersibles and drill-ships), such as but not limited to the heave compensation systems. Likewise the BOPs installed on jack-ups and platform-based rigs are different from those installed on floaters. DRILLMEC's packages are manufactured on request and thus tailored according to the specific project requirements. In that way they are certified following requests by the companies, such as to follow certification scheme of ABS, RMRS, CE, NORSOK, ATEX, GOST, API.

The equipment manufactured by DRILLMEC is compliant and certified with ATEX and MD, and also with most of the standards worldwide applied as the equipment is "state-of-the-art". DRILLMEC claims that their equipment can be certified in Europe as in the US without prior modification. Sometimes, there are some specific requirements e.g. painting or galvanization which are different in Europe and US and are more stringent in Russia. As the drilling equipment is out of the scope of PED, both onshore and offshore, this equipment is not compliant with PED. On a case-by-case basis DRILLMEC supplies critical equipment sourced from other companies e.g. BOPs. So, if the PED would finally come into force DRILLMEC will have to be sure that the equipment supplied to them is compliant with the PED. DRILLMEC explained that ATEX requirements for fixed platforms do not differ from IEC requirements used worldwide and on MODUs in European waters.

DRILLMEC also introduced the concept of "continuous mud circulation" applied during drilling operations, one of the most important technological developments after Macondo accident, occurred in the Gulf of Mexico in 2010. As explained in the Norwegian standard NORSOK D-10, there must be "two safety barriers" in the well where the first one is hydraulic and the second one is mechanical. Barriers must be tested, independent, durable and reliable: the safety level provided by the hydraulic barrier can be significantly improved introducing the continuous circulation system manufactured by DRILLMEC.

This is in line with a previous study carried out by the European Commission dealing with an inventory of the Best Available Technologies which can introduce a higher level of safety during drilling operations in European waters. DRILLMEC also manufactures many automated improvements in order to avoid the presence of workers in the drilling floor and during dangerous operations.

To summarize DRILLMEC does not see any obstacle or barrier to trade if the scope of the EU Product Safety Directives (ATEX and MD) would finally be extended to cover also oil and gas equipment specifically designed to be installed on MODUs.

7.2. Interview with Saipem

The meeting took place on October 2nd 2015 in Saipem´s headquarters in San Donato Milanese (MI). The interviewed persons were Franco Pandolfi, Senior Vice President from Drilling Business Unit; Giancarlo Denegri, Vice President; Ricardo Vatta, HSE & Systainability Department; Fortunato Amaddeo, Drilling Business Unit; Marco Cascianini, Drilling Business Unit; Cristian Scaini, Business and Technology Development. On behalf of the European Commission, the interviewers were María Aránzazu Aznárez and Dejan Brkić.

The comments/observations of Saipem are shown below:

1. Currently much of the equipment installed or used on MODUs is excluded from the scope of the EU Product Safety Legislation, and well-control equipment is excluded from the scope of the PED. It should be noted, however, that marine equipment such as marine pollution prevention equipment, life-saving appliances and fire protection equipment installed on European MODUs has to comply with the Marine Equipment Directive 96/98/EC. MODUs are also subject to international maritime safety regulations, in particular the 2009 IMO MODU Code (Resolution A.1023.(26)) which is correlated with the requirements of the Marine Equipment Directive 96/98/EC. The Directive 96/98/EC (or Marine Equipment Directive - MED) applies to equipment installed and used on-board ships that are registered in the EU, including Norway and Iceland. Such equipment (as listed in Annex A to the MED) must meet specific international conventions, relevant IMO resolutions and circulars, and relevant international testing standards. The purpose of the Directive 96/98/EC is "to enhance safety at sea and the prevention of marine pollution" and "to ensure the free movement of the above-mentioned equipment within the EU, the European Economic Area (EEA), Iceland and Norway" (Article 1).
2. **EU Safety Directive 2013/30/EU**[83]**:** All MODUs operating within the EU have, or will shortly have a Report on Major Hazards (RoMH) in compliance with the EU Offshore Oil and Gas Safety Directive 2013/30/EU; this requires owners to identify and assess major safety and environmental risks and from that set in place systems to identify, control or mitigate these risks. For each of these systems there is a requirement those identify as Safety & Environmentally Critical Systems (SECS) and to set Performance Standards for them. These SECS use international standards as a bench mark. Owners then have to internally assure themselves that the SECS are meeting their Performance Standards and this is further independently verified.

   There is a general duty on suppliers, owners and operators of equipment that is not a SECS to undertake assessments of that equipment to ensure it meets applicable regulations, so it can be deemed to be "fit for purpose". An example of such equipment is a workshop tool. These assessments have to be updated on an ongoing basis e.g. when equipment is changed in some way, or used for a different purpose.
3. **MODU standards:** The European Commission Survey compares ATEX, MD and PED against the MODU Code, and in the opinion of Saipem it does not appear to recognize the other standards that MODUs comply with such as Class Rules, Flag Authority Requirements, API, IEC, NORSOK etc. These standards have now been used worldwide since some decades and during that time there is no evidence they are not "fit for purpose" i.e. no major accident can be attributed to inadequate standards of applicable machinery or equipment.

[83] Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC Text with EEA relevance.

4. **Cost Impact:** ATEX, MD and PED are aimed at manufacturers and suppliers, and are non-specific to consumers. Saipem appreciates that consumers are seen as a beneficiary by the European Commission, because equipment certified under these instruments may not be refused entry by any Member State. However in the context of having tens of thousands of items of relevant equipment and sub-components etc. on a MODU, any benefit of cross-EU acceptance is completely submerged by prohibitive cost and unfeasible logistics.

   The Survey, whilst intended for response by MODU owners, is not drafted to be appropriate for users of such equipment such Saipem is. It has proven extremely difficult to obtain meaningful estimates from suppliers of relevant equipment and potential certifiers, therefore specific cost impacts of ATEX, MD and PED application to MODUs cannot be provided with any accuracy. Even in the event that manufacturers, suppliers, certifiers make detailed returns to the Survey it is difficult to envisage how the cost impact on MODU owners may be estimated via such data.

   That cost implications and revenue impacts are related to the on-costs from the suppliers, and retrofitting, downtime etc. Potential inability to retrofit and inferior standards of ATEX, MD and PED in some cases which would prevent retrofitting are further complications and -inevitably - high cost points.

   Costs arising from compliance to ATEX, MD and PED are unlikely to be recoverable by drilling contractors. Where contractual agreements permit this it has proven very difficult to enforce. But even where cost pass-through is achieved, the net cost to the sector results in reduced capacity for spending elsewhere on safety-related improvements.

   Manufacturers cost on the other hand; although not direct costs to MODU owners, will always pass-through from the manufacturers and suppliers. Re-certification, downtime, retrofitting and non-conformance of ATEX, MD and PED with international standards etc. will all fall to the MODU owner to reconcile.

5. **Operations:** Whilst the application of ATEX, MD and PED may be justified for installations that are fixed, it is not justified for installations that are mobile (MODUs), and intermittently and rarely encountering the main major hazards of fixed installations: hydrocarbon releases that could lead to explosions and fires. Due to the nature of drilling it could be said that less than 20 days per year would have an open hydrocarbon column on any MODU in EU waters, and throughout the EU only 2 wells being drilled at any one time would be in this condition.

6. **Barriers to trade:** Saipem also explained that in their opinion, the extension of the scope of the EU Product Safety Directives (ATEX, MD, and PED) to cover relevant equipment installed on MODUs will establish some barriers to trade.
   MODU's inside EU applying for work outside EU waters would need to attempt to maintain dual standards, as ATEX, MD and PED would not necessarily be recognized as international standards. The cost of compliance in the EU and remaining in compliance internationally would be a barrier when competing for work outside EU with non-EU compliant rigs. This applies equally to rigs outside EU; ATEX, MD and PED would be a deterrent to entry to EU for example to latest generation MODUs that are not EU-compliant but nonetheless fitted and certified/classed to latest international standards.
   Inside the EU, barrier to trade arises from differing approaches to compliance, e.g. a MODU owner of an early generation MODU may rely solely on ATEX, MD and PED certification and procedures whereas another, late generation MODU may aim for dual compliance in- and outside EU, i.e. the market would be skewed to favor minimum standards of MD and PED.

7. **Blow Out Preventers (BOPs)**: In opinion of Saipem the application of a generic standard to critical emergency equipment to which the industry worldwide is heavily engaged in updating specific standards API (API Standard 53 - Blow-out Prevention Equipment Systems for Drilling Wells; in case of BOP) would be wholly counterproductive (and counterintuitive).

To summarize Saipem is strongly against the extension of the scope of the EU Product Safety Directives (ATEX, MD, and PED) to cover relevant equipment installed on MODUs. It is also against the extension of PED to cover Blow Out Preventers (BOPs) and related well-control equipment.

8. Policy options

In the light of the analysis performed and of the evidence gathered – which include analysis of the relevant legislation and standards, survey results, interviews with stakeholders, analysis of past accidents, and literature - some qualitative conclusions regarding the socio-economic and environmental impacts of different policy options can be made. These conclusions may be used as an input to a detailed impact assessment according to the established Commission standards that could be carried out by the services of the European Commission.

Data collected through the survey or direct interviews was in some instances not representative of the whole population of stakeholders. In addition, the analysis of past accidental events was subject to some data limitations, such as incomplete/insufficient description, imprecise categorization of events, events collected from very different sources, etc. and is therefore only indicative. Thus, it can be said that the existence of a wide range of products in the offshore industry, the complex cost structure of the equipment, the lack of data on cost of equipment and the lack of information on potential additional costs to make equipment compliant with the Product Safety Directives have made a full quantitative impact assessment of the options impossible.

To properly understand the policy options presented in this chapter, it should be recalled that MODUs and equipment installed on MODUs are currently out of scope of the Product Safety Directives (MD, PED, ATEX) but under the scope of the Marine Equipment Directive. However, the exclusions in the Product Safety Directives have exceptions. For example:

- Floating units intended for production, and the machinery/equipment on-board such units are not excluded from the scope of these EU Product Safety Directives since these are intended to be located on the oil field for the long term and hence considered as fixed units;
- Machinery which may be installed on both fixed and mobile offshore units is also subject to the MD (guidelines to the application of the MD);
- The exclusion under the PED similarly only applies to *"equipment specifically intended for installation on-board mobile offshore units or for the propulsion thereof"*. However, equipment intended for installation on both mobile and fixed offshore units falls within the scope of the PED.

The pros and cons of extending each one of the Product Safety Directives and of the mandatory application of the IMO MODU Code are discussed in Section 8.1.

The impacts of the possible extension of all Product Safety Directives at once are analysed in Section 8.2:

1. Maintaining the exclusion of equipment specifically designed to be installed on mobile offshore drilling units from the scope of the ATEX Directive, PED, and MD (**'do nothing'** option); Baseline option (current situation);
2. Extending the scope of the MD and PED **to all equipment** specifically intended to be installed on MODUs, and the scope of the ATEX Directive to **all equipment** installed on MODUs;
3. Extending the scope of the MD and PED to all **oil and gas equipment not covered by the IMO MODU Code** and specifically intended to be installed on MODUs, and the scope of the ATEX Directive to all **oil and gas equipment not covered by the IMO MODU Code** installed on MODUs**;**

The analysis of pros and cons of the extension of the three Product Safety Directives carried out in Section 8.1 has shown that there might be some other options to be considered. It is therefore necessary to use a systematic approach to deal with the

definition of the options. The first step of this systematic approach is to consider whether there may be a safety issue in the current situation of exclusion of MODUs from the Directives, along with the impacts of the extension of each of them to cover the MODU equipment. In consequence, a revised set of options are proposed and discussed in Section 8.3:

1. Impact of extending the EU Product Safety Directives to cover oil and gas equipment specifically designed for MODUs:
    a. Extending the scope of the MD to selected equipment (moving, lifting, drawworks, rotary tables, etc.) specifically intended to be installed on MODUs;
    b. Extending the scope of the MD to all oil and gas equipment specifically intended to be installed on MODUs;
    c. Extending the MD and the PED to all oil and gas equipment specifically intended to be installed on MODUs;
    d. Extending the scope of the MD and PED to all oil and gas equipment specifically intended to be installed on MODUs, and the scope of the ATEX Directive to all oil and gas equipment on MODUs;
2. Impact of extending the PED to cover well-control equipment. The extension would apply to onshore, fixed offshore and mobile offshore platforms:
    a. Maintaining the exclusion of well-control equipment from the scope of PED ('do nothing' option);
    b. Accepting a technical standard or set of standards to cover well-control equipment;
    c. Introducing a new European Directive to cover well-control equipment;
    d. Extending the scope of PED to well-control equipment;

8.1. Extending the scope of the individual Product Safety Directives

In the following we summarize the conclusions from the detailed analysis of the legislative framework and its comparison with the IMO MODU Code, trying to identify whether there are safety issues. Before entering into the analysis of the pros and cons of extending the 3 Directives, it is useful to make 2 introductory remarks.

A first remark with regard to the EU Product Safety Directives is that each one deals with a different set of hazards (ATEX: explosion, PED: pressure hazard/release from overpressure, MD: personnel injury due to all risks including e.g. uncontrolled movement of equipment, release from rupture, noise, entrapment, hot surfaces, ergonomics, etc.). The IMO MODU Code is a non-compulsory legislation and on the other hand aims at protecting the vessel from accidental events (covers the integrity of the vessel itself and the essential equipment for seagoing operations), and - indirectly - the people on-board and the environment. In that context it focuses on structural safety, navigability and seaworthiness of the MODU, rather than the safety of the equipment. This *difference in the scope* is important when considering the possible extension of the Directives. Also the IMO MODU Code does not applied to fixed and portable equipment for petroleum and other work activities.

A second remark refers to the *compatibility of the EU Product Safety Directives with safety-related goal-oriented legislation*, which in the field of offshore safety is Directive 2014/30/EU (the so-called Offshore Safety Directive – OSD). While both pieces of legislation aim at increasing safety, their relation is synergetic rather than overlapping or contradicting. Indeed, OSD applies to major accident hazards and focuses on the

management of safety and the establishment of minimum requirements in operation, inspection, maintenance, etc. of offshore oil and gas installations. It requires that the equipment and the relevant technical and safety systems are designed, installed and operated according to the highest standards. So, it requires that the objectives of the EU Product Safety Directives are ensured, i.e. that safety zones for protection against explosions have been established and have been calculated according to the accepted standards, that safety of lifting devices is ensured according to the internationally accepted standards, etc. There is no contradiction on this; all the equipment installed on an offshore installation *has to comply with the specific safety standards for the design and operation of the specific equipment*. Moreover, many of the categories of equipment that have been identified as critical for safety in the context of the product safety legislation are also considered as critical for the Safety and Environmental Critical Elements (SECEs) according to the OSD. Therefore, ensuring compliance with high standards according to the EU Product Safety Directives often ensure improved operability of the SECEs. Furthermore, the experience from the operation of similar onshore installations (e.g. chemical industry, refineries, oil/gas storage installations) shows that both the Seveso Directive [84] (goal-oriented legislation for the overall management of safety) and the Product Safety legislation (ATEX, MD, PED) apply, and this is done without any overlaps or contradictions. Also it has to be highlighted that PED only excludes equipment specifically intended for installation on-board mobile offshore units or for their propulsion and MD and ATEX Directive exclude equipment on-board mobile offshore units. However, according to the guidelines to the application of the MD, machinery which may be installed on both fixed and mobile offshore units are subject to the MD even if installed on-board MODUs. PED Guideline 1/27 specifies the same for items of pressure equipment.

On the other hand, well-control equipment on mobile and fixed offshore units as well as on onshore installations is out of scope of PED. However, some components of the well-control system on fixed offshore units and onshore installations are covered by the MD, see Table 5.

Specific issues about the possible extension of each of the EU product safety Directive, and combinations of them, are considered hereafter.

(i) Extension of the scope of the ATEX Directive:

The IMO MODU Code is based on IEC standards (IEC-Ex certification scheme), which are mostly harmonised under the ATEX Directive. The IEC standards for protection of equipment intended to be installed in potentially explosive atmospheres are accepted worldwide with some national deviations and variations. IEC-Ex is increasingly being adopted internationally and becoming more common and referenced by more national authorities worldwide.

The requirements of IEC and ATEX for electrical equipment are very similar and compatible. However, for mechanical equipment, ATEX provides more thorough protection than IEC. In principle, MODUs which already have IEC-Ex certificate could easily obtain also ATEX certificate.

A European IEC-Ex manufacturer will often issue both IEC-Ex and ATEX documentation at the same time. A manufacturer elsewhere in the world can obtain IEC-Ex reports locally and request a NB to issue ATEX documentation.

[84] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC Text with EEA relevance

Knowing that US authorities require an IEC-Ex certificate issued by an US-based lab in order to allow drilling activities in the US- waters, it would be reasonable to require an ATEX certificate for MODUs operating in European waters.

Conclusions with regards to safety: There is no evidence that the current exclusion of MODUs from ATEX decreases their safety in terms of protection against explosions regarding electrical equipment. In our opinion, there might be an increase of safety if mechanical equipment were covered by ATEX. An extension of ATEX to cover MODUs would allow a common legislative framework for mobile and fixed units to exist with limited incremental costs for double certification.

(ii) Extension of the scope of the Machinery Directive:

MD aims at protecting workers and other exposed persons from injuries due to uncontrolled/unexpected operation of the machinery, while IMO MODU Code deals with safety of vessels (ships) and indirectly with the safety of personnel on-board. Clearly, the objectives of MD are not covered by IMO MODU Code. There is therefore a gap in the safety of equipment, which could in principle be covered by extending MD to oil and gas offshore equipment which is with specific demands, i.e. which is specifically designed in order to be placed on-board MODU units. As mentioned in the beginning of this Section, there are no incompatibilities or overlaps with other legislation, while there is the synergy that some equipment of systems are also considered as Safety and Environmental Critical Elements (SECEs) in the context of the Offshore Safety Directive, and would therefore have a safety gain from the improved performance of that equipment. It should also be pointed out that harmonised standards need to be developed for drilling equipment.

It has to be stressed that the potential safety gain from the extension of the MD will not only be the prevention of major accidents. Very often the undesired events that will be prevented will be limited to a few injuries and/or fatalities. This does not exclude the prevention of events where the malfunctioning of an element or a system can escalate into a major accident.

The statistical analysis of past accidents using the Worldwide Offshore Accident Databank (WOAD) dataset (see Annex I) on the one hand confirmed that certain equipment identified as safety-critical has indeed been involved in the causation of offshore accidents, but on the other hand it was not able to identify any major contribution of particular categories of equipment, therefore it could not support any prioritisation of the equipment where MD should apply. This was due to the lack of completeness of WOAD and its sources of information, together with its limited and selective scope (e.g. incidents appearing in newspapers). An analysis of incidents reported to the Competent Authorities could in the future provide further insights on the prioritisation of categories of equipment to which MD should be extended. In lack of such analysis and based only on the examination of the relative hazard potential of the different categories, we could propose that priority and focus should be given to moving equipment, lifting devices, drawworks, rotating tables and other similar equipment.

Conclusions with regards to safety: It appears that there is a gap of safety with regards to certain equipment that could be covered by the Machinery Directive. The option of extending MD to MODUs, either to all oil and gas equipment which is specifically designed to be on-board MODUs or to its limited subset of high-risk categories of equipment (moving/lifting equipment), has a scope and requires further more detailed investigation. This deeper analysis could go into further detail, clarifying, among other, whether certain equipment (e.g. compensators) can be treated as machinery. Design of certain equipment is covered by various standards, but none of them cover safety specifically or has MD structure (based on ESHR). Overall, the extension of scope of MD would have positive impact on safety and environment, limited impact on costs for ship owners, no impact foreseen for SMEs and increased business for certification bodies.

(iii) Extension of the scope of the Pressure Equipment Directive:

There are two aspects to be considered:

- The extension of the scope to include mobile offshore drilling units as well as equipment specifically intended for installation on-board or the propulsion thereof[85];
- The extension to include well-control equipment[86].

Please note that other exclusions of the PED might also apply to the oil and gas equipment (e.g. mud circulation pump). The PED exclusion article 1. 2(j) has to be also considered. According to this exclusion some equipment (engines, turbines, compressors, pumps, etc.) may be excluded from the PED, although operating above 0,5 bar, if its pressure hazard is not a significant design factor compared to the other requirements to meet the static and dynamic operational effects. This is the case of mud circulating pump, which is out of the scope of the PED but could be possibly included if its pressure hazard is sufficiently high compared with other hazards (e.g. hazards created by moving machine parts). Moreover, the whole mud circulating system, including the mud circulating pump, is necessary for well-control operations

This has to be examined on a case by case basis.

Many pieces of equipment in the oil and gas industry are based on specific standards which take safety into account. There are different opinions from stakeholders participating in the survey on whether standards are good enough and are in line with Essential Safety Requirements of the EU Product Safety Directives.

Conclusions with regards to safety: The evidence collected in this study does not allow concluding whether there is a gap in safety based on the current situation.

The PED Directive is in principle relevant for the well-control equipment, such as wellhead, BOP, piping manifolds, etc. This equipment is indeed under pressure, however it is extremely specialised, serving complex operations and control measures. Without doubt it is one of the most critical systems in an offshore installation.

Experience with well-control equipment has shown that it is a very complex and delicate issue. The recent attempt from the United States' BSEE[87] to regulate in a simplified way the inspections of BOPs has proven to be a failure and indeed reduce safety instead of increasing it[88].

It might be useful to have a standard dedicated to well-control equipment to take into account all the particularities, the complexities and the special requirements of well-control equipment, which should take into account the principles of the PED. However, the elaboration of how a standard dedicated to well-control equipment would be enforced by the law is outside the scope of the study.

In case of an extension of the scope of the PED, appropriate Essential Safety Requirements should be defined (specific and / or in addition to the current ones). It is also clear that having specific Essential Safety Requirements would not be the ultimate solution as, by definition, these ESR are typically not so detailed. The final technical solution would be left to the standardisation body, which would develop new or adjust existing standards in order to comply with the Directive.

---

[85] Current exclusion PED article 1, 2(n).

[86] Current exclusion PED article 1, 2(i).

[87] Bureau of Safety and Environmental Enforcement (www.bsee.gov/)

[88] Probabilistic analyses have demonstrated that increasing the frequency of inspections, as required by the proposed by the US BOP Regulation, reduces the overall reliability of the BOP, instead of increasing it.

Should further investigation be decided on the option of extending PED, then 3 separate sub-options may be examined, by deleting one or both of the following articles of PED:

- Article 1.2(i) of the PED excludes "**well-control equipment** used in petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or control well pressure. This comprises the wellhead (Christmas tree), blow out preventers (BOP), piping manifolds and all their equipment upstream".
- Article 1.2(n) of PED excludes "ships, rockets, aircraft and **mobile off-shore units**, as well as equipment specifically intended for installation on-board or the propulsion thereof".

The three sub-options will then be:

- **Sub-option A:** Extension of the scope of the PED to cover MODUs but not to well-control Equipment (this implies the deletion of the words "mobile off-shore units" from article 1.2(n); PED). As a consequence, all pressure equipment installed on-board MODUs, with the exception of well-control equipment, would fall within the scope of the PED.
- **Sub-option B:** Extension to of the scope of the PED to cover well-control equipment but not to MODUs (this implies deleting article 1.2(i); PED)

  Under this option the scope of the PED would be extended to cover well-control equipment installed on mobile and fixed offshore units as well as on onshore units but not to well-control equipment specifically intended for installation on-board MODUs (exclusion in article 1.2(n)). Attention should be paid to ensure that the legislation is clear with regard to the application on fixed and mobile platforms.
- **Sub-option C:** Simultaneous extension of the scope of the PED to cover well-control equipment and MODUs (by deleting article 1.2(i) and by deleting the words "mobile offshore units" from article 1.2(n); PED)

With any of these sub-options, it is clear that the Essential Safety Requirements of the PED should be examined in detail to know whether these are suitable to cover the new equipment and units. On the contrary, additional provisions should be included to cover their specificities and hazards. The extension of the scope of the Directive is not simply a matter of changing the wording in the definition of the scope but changes may be required for the Essential Safety Requirements, the conformity assessment procedures, classification of equipment, etc.

For each sub-option, a separate comprehensive study is needed to quantify the impacts of extending PED to the wide set of pressure equipment on-board MODUs. In all cases, an increase of business for the certification bodies should be expected.

(iv) Mandatory application of the IMO MODU Code:

As mentioned several times throughout the study, IMO MODU Code is the basic standard describing the requirements for stability, integrity, navigability and seaworthiness of the MODU units. The Code is part of the IMO SOLAS rules and is mandatory for vessels with a flag of EU Member States, as required by the Marine Equipment Directive. Although compliance with IMO MODU Code is not mandatory for non-EU flag MODUs, the information collected during the study (e.g. from ECSA) suggests that EU Member States do require compliance with the IMO MODU Code and all Classification Societies apply that Code. Nevertheless, it is useful to make a recommendation for those Member States accepting non-compliant MODUs to drill in their waters to revise their policy, since compliance with the Code is a minimum safety requirement. All the discussions about extension or not of the EU Product Safety Directives are structured around the assumption that operating MODUs are compliant

with the IMO rules (and therefore have explosion safety zones and protection measures according to IEC-Ex, etc.). In practice at the moment in European waters, all MODUs must at least meet relevant recognized norms and standards or the health and safety risks connected with the construction, design and equipment of the MODUs must be reduced as much as reasonably practicable. To make sense, this option should include the mandatory application of the IMO MODU code to all MODUs working in EU waters.

8.2. Extending the scope of all EU Product Safety Directives at once

8.2.1 Maintaining the exclusion of equipment installed on mobile offshore drilling units from the scope of the ATEX Directive, PED, and MD ('do nothing' option)

This is the baseline, expressing the current situation, which implies that different legislation applies to equipment installed on fixed platforms and to equipment installed on-board MODUs. The current situation implies that any non-CE marked equipment designed and manufactured for being used on a MODU cannot be put into service on a fixed platform unless it goes through the full conformity assessment process, which in some cases is a work-intensive and costly process. In that way the transfer of equipment between two very similar facilities would require long administrative procedures, considering also legal issues such as placing equipment on the market (including second hand market).

An important share of the equipment manufacturers that answered the survey claim that the equipment they manufacture is currently compliant with the EU Product Safety Directives. For example, the equipment manufactured by DRILLMEC is compliant and certified with ATEX and MD, and also with most of the standards worldwide applied as the equipment is "state-of-the-art". DRILLMEC claims that their equipment can be certified in Europe as in the US without prior modification. Sometimes, there are some specific requirements e.g. painting or galvanization which are different in Europe and US and are more stringent in Russia. Thus, the compliance of the equipment with the EU Product Safety Directives and other international standards is not in conflict.

MODU owners and operators claim that the current situation does not create any safety problem and guarantees the safety of the equipment since they are already obliged by, the Directive 2013/30/EU "on safety of offshore oil and gas operations", which applies to both MODUs and fixed platforms, to take all necessary measures to prevent major accidents[89] and to limit their consequences for human beings and the environment.

In consequence, this option is the preferred one for operators and owners, since all other options imply certain additional costs. It is worth noting that 3 Public Authorities out of all 51 stakeholders involved in the survey, think that the exclusion of MODUs from the EU Product Safety Directives may create a safety problem. On the contrary, 35 stakeholders (68.6% of the total) believe that the exclusion of MODUs from the EU Product Safety Directives is not creating any safety problem, and 13 stakeholders (25.5% of the total) either did not know or did not answer.

[89]According to the Directive 2013/30/EU, a major accident is defined as an incident a) involving an explosion, fire, loss of well-control or release of oil and gas or dangerous substances involving or with a significant potential to cause, fatalities or serious injuries; or b) leading to serious damage to the installation, involving or with a significant potential to cause, fatalities or serious injuries; or c) any other incident leading to fatalities or serious injury to five or more persons on the offshore installation; or d) any major environmental incident resulting from the events listed in a), b), c).

8.2.2 Extending the scope of the MD and PED to all equipment specifically intended to be installed on MODUs, and the scope of the ATEX Directive to all equipment installed on MODUs

Under this option all the oil and gas and marine equipment will have to comply with both the IMO MODU Code and the EU product safety legislation, which deal with different safety issues. For example, the MD aims at protecting workers from injuries due to uncontrolled/unexpected operation of the machinery whereas IMO MODU Code deals with safety of vessels and indirectly with the safety of personnel on-board.

In our opinion, this option would increase the safety level putting both fixed platforms and MODUs at the same level. On the other hand, it is an extreme option which would imply that each piece of equipment including those specifically designed to be installed on MODUs has to comply with the Product Safety Directives. This can be an expensive exercise as equipment specifically designed to be installed on-board MODUs is currently out of scope of the EU Product Safety Directives. Even though the change in regulation would not be applied retro-actively and would not have an impact on existing units, it would have an economic impact for new equipment especially designed for MODUs. The economic impact will be transferred to the MODU owners and operators, being in some cases unprofitable for them to operate in European waters. In turn, the decision of certain MODU owners and operators of not operating in Europe may result in fewer available MODU owners and operators and higher extraction costs (an "oligopoly" situation).

It needs to be stressed that recently the US Coastal Authority required MODUs operating in US waters to fully comply with the IMO MODU Code and in particular to obtain an IEC-Ex certificate of protection against explosions issued by an US-based lab. As a consequence, most MODUs would be certified in the US although they are operated mostly in EU waters.

It is difficult to predict how the market may react on such a scenario. On the one hand the increased requirements and costs may drive some MODU owners and operators away, resulting in higher extraction costs. On the other hand the same requirements may result in the development of a new market of highly specialised manufacturers and operators/owners targeting the EU offshore industry. In both cases the option implies increased business opportunities for the certification bodies.

8.2.3 Extending the scope of the MD and the PED to all oil and gas equipment not covered by the IMO MODU Code and specifically intended to be installed on MODUs, and extending the scope of the ATEX Directive to all oil and gas equipment not covered by the IMO MODU Code installed on MODUs

'Oil and gas equipment installed on mobile offshore drilling units that is **not covered by the IMO MODU Code**' is equipment referenced in point 6 of the Preamble of the IMO MODU Code as "*this Code does not include requirements for the drilling of subsea wells or the procedures for their control. Such drilling operations are subject to control by the coastal State*". This equipment refers to the six main categories of equipment proposed in Section 3 of this study, which are in general, with the common exception of the protection against explosions, not covered by the IMO MODU Code (see info from Table 2 to Table 7). Specifically, 1. Drilling equipment, 2. well intervention equipment, 3. material handling equipment, 4. well-control equipment, 5. other pressure equipment, and 6. electrical equipment. Note that some equipment can be included in two or more categories. For example, the mud circulating system can be considered both 1. drilling equipment and 4. well-control equipment, whereas the main part of the system, the mud pump, is also 5. other pressure equipment.

Although the survey required the stakeholders to provide answers for a particular category of equipment among the six proposed categories, they could only supply very general information which was not useful to us to even assess qualitatively the impact of this option.

According to the analysis of past accidents performed in this study, it seems that failures of specific pieces of equipment which might fall within the scope of EU product safety legislation did not account for a substantial proportion of events, compared to other causes of analyzed events.

With the current situation, some equipment installed on MODUs meets certain standards, which however may not be harmonised with the EU Product Safety Directives and which may not meet the Directives' essential safety requirements.

This extension of scope would have the following advantages: i) a simplified legislation and regime which would facilitate practices and provide clear rules for both the industry and the regulators, ii) reduce uncertainty and save time when verifying applicable equipment and clarifying supervision roles, iii) give a common approach to the risks offshore and onshore for the same type of equipment and activity, iv) ensure compatible measures for reducing risks and protecting personnel wherever they are working, v) burden for companies would not increase since it is likely that company already deal with this type of equipment on fixed offshore platforms.

The drawback of this option would consist in some incompatibilities with the legislation applied in third countries[90].

In the case of the MD and PED, the machinery and pressure equipment which may be installed on both mobile and fixed offshore units should be already compliant with the EU Product Safety Directives, even if installed on MODUs. So, the impact would be limited only to the currently non covered machinery and pressure equipment on MODUs, which is the machinery and pressure equipment specifically intended to be installed on MODUs.

The extension of the ATEX Directive to cover MODUs would have only a small impact regarding electrical equipment even if it would apply to all oil and gas equipment on MODUs, since the requirements for its protection against explosive atmospheres are very similar to these currently applied by the IMO MODU Code/IEC-Ex scheme. However, there might be an increase of safety if mechanical equipment, for which currently the IMO MODU Code only sets out some recommendations regarding the installation of mechanical equipment in hazardous zones (without specifying any protection class), was better covered by the ATEX Directive.

The impacts for the stakeholders are qualitatively addressed hereafter:

Manufacturers: Most of the oil and gas equipment is manufactured in small batches or single pieces. Thus it might be easy to adapt the manufacturing processes in order to comply with the legislative extension.

From the survey 55% of the manufacturers consider that the costs of compliance with the EU Product Safety Directives would not put their companies at a disadvantage vis-à-vis their competitors from within EU/EEA because the equipment they manufacture is already compliant to a large extent with the EU Product Safety Directives and because the same rules would apply for all competitors.

[90] For instance, if a piece of equipment has to comply with certain requirements of two countries, of which one is non-EU, where the MODU unit periodically operates, being these incompatible, the equipment would be considered as non-compliant in one of the two countries.

The same share of manufacturers consider that the costs of compliance with the EU Product Safety Directives would not put their companies at a disadvantage vis-à-vis their competitors from outside EU/EEA because they already comply with the EU Product Safety Directives and manufacture according to them for many parts of the world. On the contrary, 18% of them think they will be at a disadvantage since in some cases non-compliant equipment from outside EU/EEA is imported as CE marked.

In our opinion, the effect on the overall number of jobs would likely result in a small increase inside the EU/EEA as the equipment should have to be certified following the EU legislation.

MODU owners and operators: Almost all MODU owners and operators are seriously concerned about the possible extension of the legislation and some of them even foresee a move to other markets outside European waters which are considered to be less demanding. According to them, most MODU owners and operators already make use of the best available technologies and technical standards worldwide, which should already ensure a high level of protection through the requirements of the Offshore Directive 2013/30/EU. Furthermore, in their opinion the enforced use of technical standards and the provision of the CE mark to equipment specifically intended to be on-board MODUs[91] would generate significant burden and additional costs, but it would not increase the overall level of safety (However, in relation to the costs of compliance with the EU Product Safety Directives, the survey and the personal interviews have not resulted in clear quantitative data because of the huge variety of equipment on-board MODUs.

Certification and Standardization Bodies: With this option a number of standards for specific equipment would need to be developed or harmonised with the EU Product Safety Directives. On the other hand, since all pieces of equipment that might fall within the scope of the Directives should go through a certification process, a possible increase in business for certification bodies can be expected.

Public Authorities: According to the results of the survey and personal interviews, this would be an optimum option for Public Authorities. Around 71% of them finds the Directives suitable for the equipment specifically designed to be installed on-board MODUs and 85% of them think that the extension of the legislation would lead to a significant reduction of the risk.

This option would also be favourable for the EU/EEA public authorities as they will be dealing with the same legislative framework both for equipment specifically designed to be installed on MODUs, on fixed platforms and onshore. Under this option, after a period of adaptation, there will be more consistency and the work of Public Authorities will be easier to manage and more efficient.

8.3. Discussion of the Impacts of a Revised set of Options

In the following we propose a revised set of options, structured in an additive way to facilitate cost-benefit considerations, as an alternative to the ones established in the Terms-of-Reference of the study.

[91] In case of the MD and the PED, the impact is limited to the MODU itself as well as to the equipment specifically intended to be installed on-board or the propulsion thereof. On the other hand, the extension of the ATEX Directive would impact on the MODU and on the equipment on-board, even if it is not specifically intended to be installed on-board MODUs.

8.3.1 Impact of the extension of the EU Product Safety Directives to cover oil and gas equipment installed on MODUs

As pointed out above, the impact of extending the MD and PED is limited to the MODU itself and to the equipment specifically intended to be installed on-board or the propulsion thereof. On the other hand, the extension of the ATEX Directive would impact on the MODU and on the equipment on-board, even if it is not specifically intended to be installed on-board MODUs.

Section 8.1 concluded that there might be scope for extending the MD in order to better protect workers on-board MODUs. Thus, the option of extending the MD to MODUs requires further more detailed investigation.

On the contrary, the extension of ATEX to cover MODUs would have only a small impact regarding electrical equipment, since the requirements for its protection against explosive atmospheres are very similar to these currently applied by the IMO MODU Code/IEC-Ex scheme. However, there might be an increase of safety if mechanical equipment, for which currently the IMO MODU Code only sets out some recommendations regarding its installation in hazardous zones (without specifying any protection class), was better covered by the ATEX Directive.

The extension of the PED is not so obvious and is not always expected a guaranteed safety gain.

Finally, the evidence collected in this study does not allow concluding whether there is a gap in safety based on the current situation.

It is therefore more logical to build the options around an extension of the Machinery Directive.

The following alternative options are presented including their main impacts as follows:

a. Extending the scope of the MD to all oil and gas equipment not covered by the IMO MODU Code and specifically intended to be installed on MODUs;
b. Extending the scope of the MD and the PED to all oil and gas equipment not covered by the IMO MODU Code and specifically intended to be installed on MODUs;
c. Extending the scope of the MD and the PED to all oil and gas equipment not covered by the IMO MODU Code and specifically intended to be installed on MODUs, and extending the scope of the ATEX Directive to all oil and gas equipment not covered by the IMO MODU Code installed on MODUs. This option is equivalent to that presented in section 8.2.3.

(a). Extending the scope of the MD to all oil and gas equipment not covered by the IMO MODU Code and specifically intended to be installed on MODUs

This option considers all oil and gas equipment not covered by the IMO MODU Code, that is to say the six categories of oil and gas equipment detailed in Section 3. As the objectives of the MD are not covered by the IMO MODU Code, there might be a gap in the safety of the equipment, which could in principle be covered by extending the MD to this type of equipment.

Note that the majority of oil and gas equipment installed on MODUs is already compliant with the MD as this equipment is not specifically designed to be installed on MODUs, but is likely to also be installed on fixed offshore units. In our opinion this extension is likely to have certain safety gain since the essential health and safety

requirements of the MD would apply to this equipment, with limited design, installation, certification and administrative costs which would mainly fall on MODU owners.

In our opinion, the potential safety gains from the extension of the MD will not always be the prevention of major accidents. Prevented undesired events might be limited to few injuries and/or fatalities and small-size environmental pollution.

(b) Extending the scope of the MD and the PED to all oil and gas equipment not covered by IMO MODU Code and specifically intended to be installed on MODUs

This option considers the extension of the MD and PED to the six categories of equipment detailed in Section 3, which are, with the common exception of the protection against explosions, not covered by the IMO MODU Code in case this equipment is specifically intended to be installed on MODUs.

The extension of the PED to cover this specific equipment is likely to have a limited impact if we exclude well-control equipment. The extension of the PED to include well-control equipment is described in section 8.3.2.d.

The cost of equipment would likely to increase, as well as an increase of business for certification bodies could be expected. The results of the survey and the interviews with two companies show that this would be a suitable option for Public Authorities but neither for MODU owners nor for operators.

8.3.2 Options to cover well-control equipment

At the moment all kind of well-control equipment is in a kind of "grey zone" from the view of product safety legislation with the exception of the MD which applies to well-control equipment installed both onshore and offshore (for those parts of this well-control equipment which is classified as machinery, see Tables in section 3.1).

The options related to the extension of the EU Product Safety Directives to cover well-control equipment are the following:

a. Maintaining the exclusion of well-control equipment from the scope of PED ('do nothing' option);
b. Accepting a technical standard or set of standards to cover well-control equipment;
c. Introducing a new European Directive to cover well-control equipment;
d. Extending the scope of PED to well-control equipment;

(a) Maintaining the exclusion of well-control equipment from the scope of PED ('do nothing' option)

With this option well-control equipment installed either on mobile, fixed offshore units or on onshore units would remain excluded from the scope of PED.

On the other hand, well-control equipment installed on-board MODUs would continue to be covered by the IMO MODU Code(which only covers its protection against explosions and the capability of closing the BOP and disconnecting its control unit from the well-head arrangement or the accumulator battery during an emergency shut-down), and by other relevant legislation.

Well control equipment would continue to be in a "grey zone" from the point of view of the product safety legislation. Prevention of major accidents related to well-control equipment installed offshore would continue to be under national legislation and the

Offshore Safety Directive, while onshore well-control equipment would remain in a "grey zone".

Currently, typical BOP control systems are built following standards, legislation and specifications such as ATEX, IEC-Ex, NORSOK, CE marking, EN ISO 10423:2001, EN ISO 13628-4: 1999, API 16D, etc[92]. Thus, according to this option, some pieces of well-control equipment on-board MODUs may be CE-marked, meaning that are covered by the Machinery Directive (this could be the case for some components of the mud circulating and BOP systems, which can be treated as machinery (See Table 5)) and/or by the ATEX Directive. It has to be noted that the application of a CE mark implies conformity with all relevant Product Safety Directives[93].

According to the results of the survey and personal interviews, MODU owners and operators claim that the safety of the well-control equipment is currently very well covered by the Offshore Safety Directive and the widely used API standards, e.g. by the recently issued API standard 53 (Blow-out Prevention Equipment Systems for Drilling wells). As a consequence, this option would be the most favourable one for them.

(b) Accepting existing technical standards to cover well-control equipment

This option explores the possible inclusion of existing standards to cover well-control equipment in the current legislation. Compliance with technical standards could be enforced through the implementation and consistent application of best practices of the Offshore Safety Directive.

Such enforcement of standards could be accomplished through the Technical Committee ISO TC 67 and further, through the Vienna agreement. The enforcement of the standards through the OSD would cover well-control equipment installed offshore but not well-control equipment installed onshore. For this latter, the compliance with the standards would have to be enforced in a different way.

If standards were to be enforced in the legislation, MODUs in EU waters would gain acceptance of their Reports on Major Hazards (safety case) by demonstrating full adherence to such technical standards.

Enforcement of standards could also be made through the Coastal States' or Member States' legislation, but it would not lead to a full harmonisation at European level as Member States could still add specific national requirements.

International standards would easily be accepted by MODUs owners and operators who already comply with a variety of standards.

This option is likely to imply an increase in the business for Certification and Standardisation Bodies.

(c) Introducing a new European Directive to cover well-control equipment

With this option the issue would be regulated more thorough and prescriptive way at European level with respect to the previous option.

A new Directive could cover well-control equipment both offshore and onshore, would have its own appropriate harmonised standards and would be in line with the goal-oriented Offshore Safety Directive.

---

[92] www.efcgroup.net/downloads/BOP-Control-System-BC0114001A.pdf

[93] The 'Blue Guide' on the implementation of EU product rules 2016 (section 4.5.1.6); http://ec.europa.eu/DocsRoom/documents/16210

In that way, the new Directive would capture the very specific safety requirements and specificities of well-control equipment, having, as a consequence, much more detailed Essential Safety Requirements than the PED. The challenge would be to write the requirements in such a way that both safety and technological innovation are duly taken into account.

A number of technical standards which are already applied in Europe for well-control equipment could possibly be harmonised with the new Directive, being this an additional value in comparison with the previous option "Accepting existing technical standards to cover well-control equipment".

According to this option Public Authorities would work under a clear legislative framework while the costs for MODU owners and operators would increase. As in the previous option, an increase in the workload of the Certification and Standardisation Bodies could be expected.

(d) Extending the scope of the PED to cover well-control equipment

Under this option we consider the possible extension of the PED to cover well-control equipment installed on mobile and fixed offshore units as well as on onshore units.

Questions in the survey about the extension of the PED to well-control equipment have not attracted much interest from manufacturers/installers/suppliers and public authorities as most of them either did not answer or did not know.

A clear position against the extension of the PED to well-control equipment has been observed by drilling contractors/operators which would expect difficulties and barriers to trade.

Certification Bodies in general support the extension of the PED to cover well-control equipment. Two-thirds of those dealing with PED find this extension suitable and, contrarily to drilling contractors and operators, would not expect any barriers to trade. However, some inconsistencies have been found in their answers (see Section 6.3.2 for details).

A general comment, even among those supporting the suitability of the PED for well-control equipment, is that only part of the equipment would benefit from this extension because most of the well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the requirements of the PED.

This option would be very complex to implement since specific essential safety requirements for well-control equipment should be defined and included in the Directive. In other words, the possible extension would not just be limited to removing a paragraph from the list of excluded equipment. Moreover, the same extension, which would only cover hazards due to pressure, would not solve other important aspects linked to operability and reliability of the well-control equipment.

However, this option would not be in clash with the requirements of the IMO MODU Code, which "*does not include requirements for the drilling of subsea wells or the procedures for their control. Such drilling operations are subject to control by the coastal State*".

With this option some product safety issues not linked to the pressure hazard would remain unresolved.

9. Conclusions

Following the explosion of the Deepwater Horizon drilling rig in the Gulf of Mexico on 20th April 2010, the European Commission carried out a review of the adequacy of the provisions in force in the EU to prevent similar accidents occurring in the European offshore oil and gas industry. This resulted in the adoption of the Offshore Safety Directive 2013/30/EU (OSD).

Up to now the OSD, which applies to both fixed and mobile offshore units, is the main instrument for ensuring that the safety and the environmental protection are fully regulated in the EU waters.

Contrarily to onshore and offshore fixed units, oil and gas equipment specifically designed to be installed on mobile offshore units are currently excluded from the EU Product Safety Directives, namely the Machinery Directive (MD), the Pressure Equipment Directive (PED) and the ATEX Directive. It should however be noted that floating units intended for production and the machinery/equipment on-board such units, since are intended to be located on the oil field for the long term, are not excluded from the scope of the EU Product Safety Directives. Furthermore, machinery and pressure equipment which may be installed on both fixed and mobile offshore units is also subject to the EU Product Safety Directives. As mobile offshore units can be used, among other, for drilling or production, it follows that equipment designed specifically to fit needs to be installed on drilling units are excluded from the scope of the PED and Machinery Directive[94]. Consequently, this study will focus on mobile offshore drilling units (MODU).

Additionally, well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or control well pressure is also excluded from the scope of the PED. Well-control equipment onshore as well offshore (both on fixed platforms and on-board MODUs) are currently excluded from the scope of PED but not necessarily from the scope of MD or ATEX.

Under the IMO, several international maritime safety regulations, guidelines, and rules that have become part of the requirements for vessel and MODU registration have been developed and adopted by a number of countries. Included under the IMO umbrella are the following: Safety of Life at Sea – SOLAS (Deals primarily with safety issues and communications), MODU code (Deals primarily with construction and equipment), Maritime Pollution - MARPOL (Deals with pollution control and prevention), International Safety Management (Focuses on safety for self-propelled vessels and MODUs), etc. For this study, most important in particular is the 2009 IMO MODU Code (Resolution A.1023.(26)). The present edition of the MODU Code, in consideration of the inclusion of classification society and flag rules, addresses virtually all the structure, machinery and electrical systems of a MODU that can be included in the shipyard construction contract with exclusion of equipment intended to be used for oil and gas operations including, but not only limiting to drilling operation. The IMO MODU Code has been amended twice since the 2009 edition was approved and is currently under revision, in consideration of the results of the Macondo incident investigations. The IMO MODU code covers the integrity of the vessel itself and the essential equipment for seagoing operations and does not apply to fixed offshore platform including mobile units which can be treated as fixed if they are in one position for a long time (as it is very often case of mobile production units). The IMO MODU Code is not a compulsory piece of legislation.

The IMO MODU CODE is correlated with the requirements of the Marine Equipment Directive 96/98/EC (MED), whose purpose is "*to enhance safety at sea and the*

[94] Neither ATEX nor its guidelines include this explicit mention of "specifically designed".

prevention of marine pollution" and "*to ensure the free movement of the above-mentioned equipment within the European Union, the European Economic Area (EEA), Iceland and Norway*". This directive applies to equipment installed and used on-board ships that are registered in the European Union, including Norway and Iceland.

MODU Code, flag state requirements, Classification Society requirements, and coastal state requirements are all relevant for a MODU.

Currently in the MODU sector there is a strong presence of certain standards like ISO standards, IEC standards, Norwegian standards NORSOK, British Standards BS, US standards (ASME and API), and also European harmonised standards (EN).

To avoid any possible misunderstandings, moving equipment, lifting devices and similar equipment used for oil and gas operation is not covered by IMO MODU code (according to preamble of the IMO MODU code).

With the aim of providing the European Commission with the information necessary for the assessment of the impacts of an extension of the EU Product Safety Directives, an exhaustive desk research on markets, legislation, and equipment on-board MODUs and fixed facilities (offshore and onshore) has been done. Additionally, an EU on-line survey "European Commission Survey on Offshore Oil & Gas Equipment 2015 – Cost of compliance with EU product safety legislation" was conducted by the JRC to collect more detailed information and data from the various stakeholders groups. In parallel to the on-line survey, stakeholders were interviewed.

The on-line survey and the conducted interviews show that considerable divergences exist among the opinion of the various groups. Drawing a conclusion from this outcome is not easy. Some of this variation is in our view undoubtedly attributable to conflicts of interest, but we also feel that some of the responses are due to an inadequate comprehension and knowledge of the EU New Approach system. In addition, data collected through the survey or direct interviews was in some instances not representative of the whole population of stakeholders. For example the section on the extension of the PED to well-control equipment has not attracted much attention from manufacturers/installers/suppliers and only a low percentage of them have answered those questions. Also the number of replies from notified bodies is surprisingly low despite the fact that the subject matter might have an impact on their activities.

The views of the various stakeholders groups are summarized hereafter.

- <u>Drilling contactors</u>

The drilling contractors (ECSA) believe that MODUs are already very well covered, not only by the Offshore Safety Directive and the IMO MODU Code, but also by the flag state requirements, the Classification Society requirements, the coastal state requirements, and the currently applied standards such as API. The survey has shown that 100% of the drilling contractors/operators consider that the current legislation guarantees an acceptable level of safety for the equipment on-board MODUs. This was also confirmed by the clear stance expressed by Saipem, a large international MODU owner and operator, during the interview conducted in its central headquarter in Italy. In general it can be said that, in their opinion, everything is already well covered and should not be touched upon. The following statements from the drilling contractors are, among many others, only two examples demonstrating this:

- Well-control equipment is already well covered by the existing legislation and industry standards, specifically by API standards, in which the ESRs of the PED are already implicit.

- The acceptance and operation of well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the scope of the EU Directives and which are more focused on verifying suitability of well-control-equipment design to wellbore conditions.

According to the drilling contractors (ECSA) the manufacturers/suppliers/installers would not likely perceive an extension of the Directives as a disadvantage since the cost would be offset to the MODU owners, though some of them might be concerned by additional legal liabilities. The drilling contractors (ECSA) also think that an extension of the Directives would not be perceived as a barrier to trade by the manufacturers/installers/suppliers, as their trade outside of the European Union is rather limited compared to drilling contractors. ECSA believes that all oil and gas equipment on-board MODUs should remain excluded from the scope of the EU Product Safety Directives. It should be noted however that the exclusion under PED only applies to the MODU itself and the equipment specifically designed for the installation on or the propulsion of such units. Also, in the Guide to the application of the Machinery Directive it is explained that machinery which can be used on both fixed and mobile offshore units is also subject to the Machinery Directive. Given the positions expressed by some stakeholders, the question can be raised whether these rules are actually fully applied.

- <u>Public Authorities</u>

The views of the Public Authorities and the drilling contractors are opposite. Whereas in the opinion of 100% of the drilling contractors/operators all the equipment on-board MODUs is well covered by the currently applied legislation and should not be touched upon, 71.4% of the Public Authorities, which is the most optimistic group towards the extension of the Directives, find the EU Product Safety Directives suitable for the oil and gas equipment specifically designed to be placed on-board MODUs. Also 86% of the Public Authorities think that the extension of the scope of the legislation would lead to a significant/very important reduction of the risk. Some Public Authorities have provided examples of near misses, accidents and events that could, but for mm or seconds (i.e. luck), could have resulted in a major event, and their analysis have shown that equipment (including the lack of good instructions for use and maintenance) fell short of EU requirements i.e. the Machinery Directive.

Related to the API standards currently applied in the MODU sector, the experience of the Norwegian Petroleum Safety Authority shows that these standards have not in many cases proven to be "good enough", are deficient in a number of areas, cover mainly technical requirements but say little about operational requirements and, among other shortcomings, completely lack "defined requirements" for the reliability of safety-critical functions/equipment. As a consequence the Petroleum Safety Authority Norway affirms that there is a gap between the API relevant requirements and the Essential Health and Safety requirements (EHRS) of the Machinery Directive.

- <u>Manufacturers/installers/suppliers</u>

The opinion of the manufacturers/installers/suppliers towards the extension of the Product Safety Directives is positive. More than 50% of them think their companies would not be at a disadvantage vis-à-vis their competitors from either within or outside EU/EEA in case of extension of the legislation. In the same way, only around 1/3 would expect time delays in their business if the legislation is extended.

However, an inconsistency has been specifically found for manufacturers: around 50% finds the EU Product Safety Directives suitable, whereas only a very low percentage of them think these Directives would increase the safety of the equipment.

The section on the extension of the PED to well-control equipment has not attracted much attention from manufacturers/installers/suppliers and only 16% of them have

answered those questions. The low interest of the manufacturers/suppliers/installers in the well-control equipment questions could be due to the fact that not very many of them manufacture or assemble well-control equipment.

On the other hand, considering the small number of manufacturing/installing/supplying companies who answered the survey (11), and the fact that most of them (64%) deal with only one or two categories of equipment, out of the six big categories identified in the report, it is difficult to provide conclusions of general validity.

- <u>Certification Bodies</u>

Although an important percentage of the Certification Bodies (62.5%) considers the EU Product Safety Directives suitable for the equipment on-board MODUs, only a small part of them could foresee an improvement in the safety of the equipment due to the extension of the Directives.

Considering that very few Certification bodies replied to the survey, we find the obtained answers not representative of this specific stakeholder. In particular, we did not receive any answers from Standardization Bodies: their answers would have been very valuable as, currently, most of the stakeholders are concerned about the lack of harmonised standards in the sector, which is foreseen as not achievable in a short time.

The answers of the Certification Bodies are very well elaborated and there was no indication that these were driven by some interest. However, the extension of the Directives could be interpreted as an extra source of income for the Certification Bodies, in contrast with the opinion of the drilling contractors and operators, which find it difficult to estimate the impact in term of costs but define it as extremely high.

Additional considerations

Related to the non-compliance of some of the currently applied standards and codes with the Essential Safety Requirements (ESRs) of the EU Product Safety Directives, in our opinion it would be necessary to review, in consultation with the stakeholders, the ESRs themselves, or the standards, to take into account specificities in their application. The drilling companies think it would be necessary that major Original Equipment Manufacturers (OEMs) advise them in maintaining worldwide API compliance whilst adding the specific requirements of the European Directives.

The drilling companies argued that, since the applicability of the possible extension of the Directives had not been clarified, it was not possible to specify the costs of compliance of the equipment with these. Related to the concern expressed by the drilling contractors/operators, it has to be clarified that the new legislation cannot be retroactive. New legislation would only apply to new equipment[95] and would only be applicable as of a certain point in time after the adoption of revised legislation and taking into account a transitional period allowing the industry to adapt to the new or changed requirements.

We have observed a very common misunderstanding among the drilling contractors/operators in what makes reference to the procedures for assessing the conformity of the equipment according to the EU Product Safety Directives. In case of the extension of the legislation to MODUs, an important part of the drilling contractors/operators are concerned about the "self-certification" of equipment as

[95] Opposite to the Offshore Safety Directive that exceptionally applies retroactively i.e. all oil and gas facilities in the EU waters have to comply with the provisions of the Directive. In that way for MODU operators who currently use uncertified and possibly non-compliant equipment specifically designed for MODUs, better option would be extension of the EU product safety Directives, rather to cover product safety through practice of implementation of the OSD

allowed for some equipment by the EU Product Safety Directives, since it would lower the safety standards. We have to clarify that it is true that in some cases the manufacturer declares that the equipment satisfies the Directive requirements ("Declaration of conformity") without the involvement of a Notified Body but this is only allowed for equipment in the lowest hazard category. For the large majority of the products a notified body is involved in the conformity assessment procedure, including those based on quality assurance modules (such as module H of PED).

There are contrasting opinions of the different stakeholders about the existence of safety issues requiring immediate attention from the equipment point of view. From the statistical analysis of past accidental events between 1970 and mid-2013, it seems that failures of specific pieces of equipment which might fall within the scope of EU product safety legislation did not account for a substantial proportion of events, compared to other causes of analysed events. In addition, it must be pointed out that – due to the limitations in the dataset used (i.e. WOAD) – it was not possible to make a distinction between the failures of pieces of equipment/systems due to design faults and unsafe system components, and those which were due, for instance, to lack of maintenance or improper use of the equipment, which might suggest procedural deficiencies. Thus, from the results of the statistical analysis it is not possible to state that there is a safety issue that could be attributed to the non-coverage of MODUs by the product safety legislation.

Most of oil and gas equipment on-board MODUs are already covered by the EU Product Safety Directives. A possible extension of scope would cover only a minor subset of all oil and gas equipment which is not currently covered and which are specifically designed for MODUs. Although such equipment is not frequently involved in accidents, lack of implementation of the product safety measures can lead to escalation to major accidents. Moreover, accidents caused by equipment specifically designed for MODU in which less than 5 people died will not be treated as major accidents. Therefore, a safety gap could exist, which might be offset by extending the product safety legislation to cover such small subset of equipment at a moderate cost. A more difficult situation concerns the extension of the PED to well-control equipment which is now excluded both offshore and onshore. In this case, the cost of the possible extension of the PED to cover well-control equipment could be high yet possibly producing significant safety gain. Some piece of well-control equipment might already be covered by the MD.

In the light of the analysis performed and of the evidence gathered – which include analysis of the relevant legislation and standards, survey results, interviews with stakeholders, analysis of past accidents, and literature - **some conclusions regarding the socio-economic and environmental impacts of different policy options have been made**.

The analysis is limited to a qualitative assessment. Even though the study collected important information, some aspects are still missing and would require further examination before being able to conclude whether an action is required or not. For example, the actual safety record should be further examined based on information from the competent authorities and other stakeholders. The application of the product safety legislation in the offshore oil and gas industry could be further examined based on information from the national market surveillance authorities. Such information would be essential to have a better understanding of the current situation on the market and to assess which policy or regulatory initiative would be the most appropriate.

The existence of a wide range of products in the offshore industry, the complex cost structure of the equipment, the lack of data on cost of equipment and the lack of information on potential additional costs to make equipment compliant with the Product Safety Directives make a full quantitative impact assessment of the options impossible. In practice, it appeared extremely difficult to collect quantitative data on costs via the

survey or the interviews. Moreover, the numerous items of equipment on-board such installations would require a substantial effort to calculate the impact of the scenarios. We believe that case studies based on well-identified policy options should be carried out to be able to obtain such information.

The conclusions of this study may be used as an input to a detailed impact assessment according to the established Commission standards that could be carried out by the services of the European Commission.

- <u>Extension of scope to MODU for ATEX, MD, PED</u>

The report discusses about the possible extension of scope of the EU Product Safety Directives, namely ATEX equipment Directive, Machinery Directive and Pressure Equipment Directive in order to cover offshore equipment installed on-board MODUs.

1. There is no evidence that the current exclusion of MODUs from ATEX decreases their safety in terms of protection against explosions regarding electrical equipment. However, there might be an increase of safety if mechanical equipment were covered by ATEX. An extension of ATEX to cover MODUs would allow a common legislative framework for mobile and fixed units to exist with limited incremental costs for double certification.

2. The offshore equipment installed on-board MODUs, which can also be installed on fixed offshore platforms, is already under the scope of MD. On the other hand, for equipment which is specifically designed for MODUs (e.g. supplied with movement compensators), an extension of scope of the MD could be an option. The extension of scope of MD would have positive impact on safety and environment, limited impact on costs for ship owners, no impact foreseen for SMEs and increased business for certification bodies.

3. All oil and gas equipment under pressure, which is not classified as well-control and is not specifically designed or modified for use on MODUs, is currently under the scope of PED. A reasonable option could be the extension of scope of PED to cover such limited number of equipment under pressure specifically designed or modified for MODUs. In our opinion, this extension could be achieved with reasonable costs for certification because of the limited set of equipment currently not covered by the PED and we suspect that the overall impact of this extension would be rather limited.

- <u>Extension of scope of PED to include well-control equipment</u>

The specific case of extension of the PED to well-control equipment has been considered in detail. In the current situation well-control equipment is explicitly out of scope of PED, but not out of scope of MD and ATEX. In particular, well-control is out of scope of PED both onshore and offshore (on fixed platforms or on-board MODUs). Four options have been considered that cover well-control equipment:

1. *Maintaining the exclusion of well-control equipment from the scope of PED ('do nothing' option);*

   With this option well-control will remain in a "grey zone" from the legislative point of view. This means that prevention of major accidents would continue to be covered by the Offshore Safety Directive, while product safety legislation would not be harmonised at EU level. However, local regulations of Member States and wide number of technical standards would continue to apply.

2. *Accepting existing technical standard to cover well-control equipment*

Technical standards for well-control equipment could be adopted as obligatory in practice to obtain license for offshore oil and gas operation in the EU's waters according to the Offshore Safety Directive. However, in that way well-control equipment installed onshore would remain uncovered, as the OSD is related to offshore. For onshore well-control equipment, the standards would have to be enforced in a different way. Enforcement of technical standards could also be made through the Coastal States' or Member States' legislation, but it would not lead to a full harmonisation at European level as member States could still add specific national requirements. International standards could be easily accepted by MODUs owners and operators who already comply with a variety of them.

3. *Introducing new Directive for well-control equipment*

   With this option the issue would be regulated more thoroughly and in a prescriptive way at European level with respect to the previous option. A new Directive would capture the very specific safety requirements and specificities of well-control equipment, having as a consequence much more detailed Essential Safety Requirements than the PED. The challenge would be to write the requirements in such a way that both safety and technological innovation are duly taken into account. Public Authorities would work under a clear legislative framework while the costs for MODU owners and operators would increase. As in the previous option, an increase in the workload of the Certification and Standardisation Bodies could be expected.

4. *Extending the scope of PED to well-control equipment*

   This option would be very complex to implement since specific essential safety requirements for well-control equipment should be defined and included in the Directive. In other words, the possible extension would not just be limited to removing a paragraph from the list of excluded equipment. Moreover, the same extension, which would only cover hazards due to pressure, would not solve other important aspects linked to operability and reliability of the well-control equipment.

In case any extensions of the EU Product Safety Directives would be put in place, this extension would only apply to new equipment or to equipment imported in Europe. The options described in this report provide a generic overview of the potential legislative efforts that can be undertaken and, correspondingly, the qualitative impacts assessed have general validity. However, specific changes in legislation (such as inclusion/removal of certain articles in given Directives) would require detailed and structured cost-benefit analyses which are impossible to cover in this study.

Bibliography

[1]. M.J. Kaiser, B. Snyder. The five offshore drilling rig markets. Marine Policy 39, 201-214. 2013.

[2]. The Mobile Offshore Drilling Unit (MODU) Market 2013-2023. Visiongain 2013. www.visiongain.com.

[3]. The Oil & Gas Drilling Technologies Market 2011-2021. Visiongain 2011. www.visiongain.com.

[4]. Deepwater & ultra-deepwater exploration and production (E&P) market forecast 2014-2024: Prospects for TOP Companies with seismic, drilling, subsea and FPS Technologies. Visiongain 2014. www.visiongain.com.

[5]. Handbook of offshore engineering. S. Chakrabarti (Ed.). 2005, Elsevier.

[6]. www.rigzone.com/data/rig_report.asp?rpt=type

[7]. Chartering practice handbook. Thomas J. Pagonis, 2009.

[8]. IHS Petrodata; www.ihs.com/products

[9]. Oilfield manufacturers: www.tradequip.com.

[10]. OGP Risk Assessment Data Directory. Report Nº 434-17 on Major Accidents. March 2010.

Annexes

Important information related to the Product Safety Directives (ATEX, PED and MD) and the guides to the application of these is included in Annex A.

An extensive overview of the answers provided by the manufacturers/installers/suppliers of equipment and by the drilling contractors/operators is found in Annexes B and C, respectively. The answers coming from the Certification Bodies are reflected in Annex D, while Annex E contains the replies from Public Authorities. Finally, answers submitted by "Other types of entities" are shown in Annex F.

Annex G contains the list of the top ten offshore drilling contractors by number of MODUs managed in January 2015.

Annex H shows the list of the thirty one stakeholders contacted for an interview.

Annex I shows a statistical analysis of offshore accidents and incidents which have occurred on MODUs since 1970 with the purpose of identifying – if possible – specific types of equipment, structural components, and systems which were more frequently involved in accidental situations, and to acquire information on the consequences of such events, in terms of fatalities, injuries, and cost of damage. Results from the study could be used as input in future discussions on the extension of the scopes of EU product safety legislation to include equipment installed and used on MODUs. Data for the analysis was obtained from the Worldwide Offshore Accident Databank (WOAD), operated by DNV-GL. An Analysis of WOAD major accidents and its comparison with data from OGP is also included.

The list of the abbreviations contained in the report is shown in Annex J.

The list of annexes is show below:

A. Product safety legislation – exclusion in ATEX, PED and MD and guidance
B. Companies (equipment manufacturers): Overview of their answers
C. Companies (MODU owners/ operators): Overview of their answers
D. Certification Bodies: Overview of their answers
E. Public Authorities: Overview of their answers
F. Other types of entities: Overview of their answers
G. Leading companies in the MODU market
H. List of the contacted stakeholders for a personal interview
I. Statistical analysis of offshore accidents and incidents on MODUs since 1970
J. List of abbreviations

A. Product safety legislation – exclusion in ATEX, PED and MD and guidance

1. ATEX

DIRECTIVE 2014/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast) (Text with EEA relevance) (OJ L 96/309, 29.3.2014)

Article 1 (Scope)

2. This Directive shall not apply to:

…

(e) seagoing vessels and mobile offshore units together with equipment on-board such vessels or units;

…

- The **full text of the ATEX Directive** can be consulted in:

  http://ec.europa.eu/growth/sectors/mechanical-engineering/atex/index_en.htm

- In the same website, the 4th edition of the **ATEX guidelines** is available to assist those who need to apply the Directive:

  In the guidelines is explained the reason for which the mobile offshore units are out of the scope of the Directive: "seagoing vessels and mobile offshore units together with equipment on-board such vessels or units, as they are already covered by the IMO Convention." (source: ATEX Guidelines - see section 5 of the ATEX guidelines for more information)

  And specifies in the guidelines, ATEX Directive specifically excludes from its scope "seagoing vessels and mobile offshore units together with equipment on-board such vessels or units", and equipment for use on-board a ship is subject only to the Marine Equipment Directive (MED) 96/98/EC, excluding all others. Nevertheless, the constructional requirements for explosion-protected equipment at sea are generally the same as onshore: this is illustrated by the reference of the MED to the same or very similar standards, as harmonised under the ATEX Directive. In fact, certain products (as gas detection equipment) are used offshore and onshore, thus requiring certification per the ATEX Directive and/or by the MED, according to their intended use. (source: ATEX Guidelines - see 6.10 of the ATEX guidelines for more information)

2. Pressure Equipment Directive (PED)

DIRECTIVE 2014/68/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment (recast) (Text with EEA relevance) (OJ L 189/164, 27.6.2014)

Article 1. (Scope)

2. This Directive shall not apply to:

…

(i). well-control equipment used in the petroleum, gas or geothermal exploration and extraction industry and in underground storage which is intended to contain and/or

control well pressure; this shall comprise the wellhead (Christmas tree), the blow out preventers (BOP), the piping manifolds and all their equipment upstream;

(j). equipment comprising casings or machinery where the dimensioning, choice of material and manufacturing rules are based primarily on requirements for sufficient strength, rigidity and stability to meet the static and dynamic operational effects or other operational characteristics and for which pressure is not a significant design factor; such equipment may include: (1) engines including turbines and internal combustion engines; (2) steam engines, gas/steam turbines, turbo-generators, compressors, pumps and actuating devices;

…

(n). ships, rockets, aircraft and mobile off-shore units, as well as equipment specifically intended for installation on-board or the propulsion thereof;

- The **full text of the Pressure Equipment Directive** can be consulted in:

  http://ec.europa.eu/growth/sectors/pressure-gas/pressure-equipment/directive/index_en.htm

- In the same website the **Pressure Equipment Guidelines**, which represent a reference for ensuring consistent application of the Directive, are available. They represent, unless otherwise directed, the unanimous opinion of the Member States experts:

  More in particular, PED Guidelines relevant for this study are:

  - Guideline 1/37 (related to Article 1, 2(i)) addresses the following question:
    Are items of pressure equipment such as manifolds, valves and piping used as well-control equipment and placed between a subsea well template and the processing platform for the oil and gas extraction and processing industry covered by the Pressure Equipment Directive (PED)?
  - Guideline 1/27 (related to Article 1, 2(n)) addresses the following question: What is meant by the term mobile offshore unit?

    And answers:

    A mobile offshore unit is an offshore unit that is not intended to be placed permanently or long term on the field, but is designed to be moved from location to location whether or not it has a means of propulsion or of lowering legs to the seafloor (e.g. a unit used solely for exploration).

    For example, floating units intended for production, such as FPSO's (Floating Production, Storage and Offloading installations usually based on tanker designs) and FPP's (Floating Production Platforms based on semi-submersible vessels), are not considered to be mobile.

    Note Items of pressure equipment specifically intended for mobile offshore units are excluded from the PED. However, items of pressure equipment intended to be installed on both FPSO's/FPP's and mobile offshore units are not excluded from the PED.

3. Machinery Directive

DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery, and amending Directive 95/16/EC (OJ L 157/24 of 9.6.2006)

> *Article 1 (Scope)*
>
> *2. The following are excluded from the scope of this Directive:*
>
> *…*
>
> *(f) seagoing vessels and mobile offshore units and machinery installed on-board such vessels and/or units;*

- The **full text of the Machinery Directive** can be consulted in:

  http://ec.europa.eu/growth/sectors/mechanical-engineering/machinery/index_en.htm

- In the same website it can be also seen the Guide to the application of the Machinery Directive (2nd edition June 2010). It has to be considered in particular the point **§ 58** related to the exclusion of Seagoing vessels and mobile offshore units and machinery installed on-board such vessels and/or units (as mentioned in the Article 1, 2(f) of the Machinery Directive):

  Seagoing vessels and mobile offshore units such as, for example, mobile drilling rigs, and machinery installed on them are excluded from the scope of the Machinery Directive by Article 1, 2(f) since they are subject to the Conventions of the International Maritime Organisation. Some of the equipment concerned by this exclusion may also be subject to the Marine Equipment Directive 96/98/EC as amended by Directive 2002/75/EC.

  A mobile offshore unit is an offshore unit that is not intended to be located on the oil field permanently or for the long term, but is designed to be moved from location to location, whether or not it has a means of propulsion or of lowering legs to the seafloor.

  However, floating units intended for production, such as, for example, FPSOs (Floating Production, Storage and Offloading installations - usually based on tanker designs) and FPPs (Floating Production Platforms - based on semi-submersible vessels) and the machinery installed on such units are not excluded from the scope of the Machinery Directive.

  Machinery intended to be installed on fixed offshore platforms such as, for example, oil production rigs, and machinery which may be used on both fixed and mobile offshore units is also subject to the Machinery Directive.

B. Companies (equipment manufacturers /installers /suppliers): Overview of their answers

- 100% of the manufacturers /installers /suppliers are present at least in one European country. 5/11 are present only in EU/EEA while 6/11 are present also abroad (US, Canada, Asia Pacific, Africa/Middle East, Central/South America and Russia).

- 1/11 is a small company (up to 49 employees), 1/11 is a medium size company (50-249 employees) and 9/11 are large enterprises (> 250 employees).

- 4/11 companies do not consent to the publication of their replies, 5/11 consent but in an anonymous form and 2/11 consent with its data included.

- **MODUs vs offshore fixed and onshore platforms (Comparison of the equipment)**: 81.8% of the equipment manufacturers /installers /suppliers agree that the equipment for MODUs is almost identical, with small adaptations, to the equipment for fixed offshore or onshore installations. On the other hand the remaining 19.2% says that there are significant differences. It has to be noted that only 63.6% of the equipment manufacturers /installers /suppliers produce equipment for MODUs and for fixed offshore or onshore installations although the question was answered by the 100% of the equipment manufacturers /installers /suppliers.

  The small differences found by the equipment manufacturers /installers /suppliers are:

  1. Modifications to allow for pitch and roll
  2. Minor adaptations related to health, safety and environment (HSE)
  3. The equipment for fixed platform and jack-up units are almost identical (the main difference is related to the legs). Conversely there is a substantial difference between fixed platform/jack-up rigs and floater-based rigs (i.e. semisubmersibles and drill-ships), such as but not limited to the heave compensation systems. Likewise the BOPs used in jack-ups and fixed rigs are different from those used in floaters.

  In Figure B-1 it is shown the opinion of the manufacturers/installers/suppliers related to the equipment for MODUs in comparison with the equipment for fixed offshore and onshore installations.

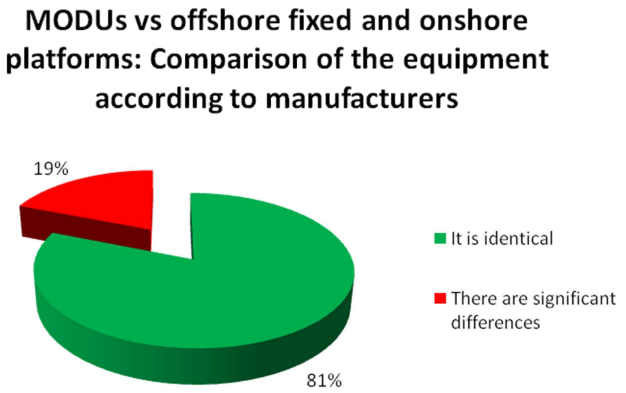


Figure B-1. Opinion of the manufacturers/installers/suppliers related to the equipment on-board MODUs in comparison with the equipment for fixed offshore and onshore installations

- The **origin of the manufacturers of the equipment** their companies deal with is mainly EU/EEA. See Table B-1.

Table B-1. Manufacturers/installers/suppliers: Origin of the manufacturers of the equipment their companies deal with

Manufacturers: Origin share	EU/EEA	US	Asia/ Pacific	Canada	Africa/ Middle East	Central/ South America	Russia
<20%	0	4/11	3/11	3/11	2/11	2/11	1/11
20-40%	3/11	3/11	0	0	0	0	0
40-60%	3/11	0	1/11	0	0	0	0
60-80%	4/11	0	0	0	0	0	0
>80%	1/11	0	0	0	0	0	0

- In Figure B-2a the **countries/regions of origin of the equipment bought by the manufacturers** are shown. In Figure B-2b it is shown **the percentage of equipment bought by the manufacturers in the EU/EEA area**.

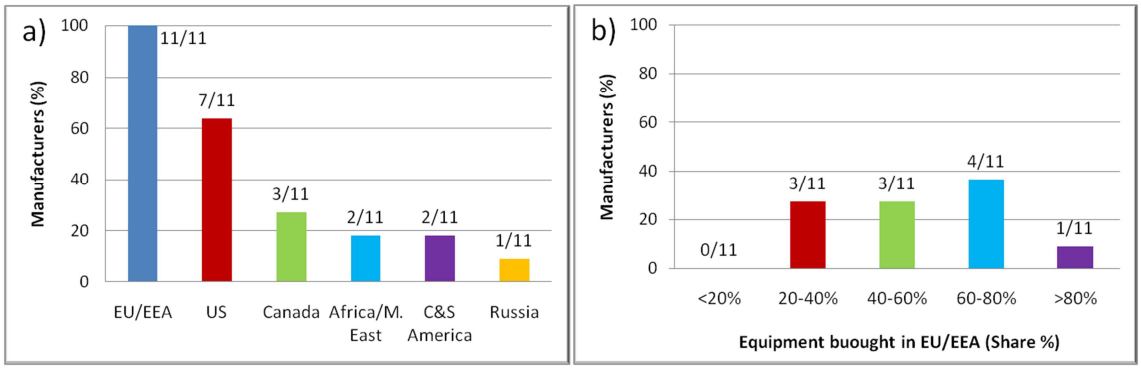


Figure B-2a. Countries/regions of origin of the equipment bought by the manufacturers; Figure B-2b. Percentage of equipment bought by the manufacturers in EU/EEA

All the manufacturers/installers/suppliers buy at least a percentage between 20 and 40% of the equipment they deal with in EU/EEA and 1/11 buys more than the 80% of the equipment in EU/EEA. Related to other regions in the world, in decreasing order; 7/11 of the manufacturers/installers/suppliers buy equipment in the US, 4/11 in Asia/Pacific, 3/11 in Canada, 2/11 in Africa/Middle East and Central /South America and only 1/11 of the manufacturers/installers/suppliers buys equipment in Russia.

- The origin of the **revenues of the manufacturers/installers/suppliers of equipment** is mainly EU/EEA. See Table B-2.

Table B-2. Manufacturers/ installers/ suppliers: Origin of their revenues

Revenue: Origin share	EU/EEA	US	Asia/ Pacific	Canada	Africa/ Middle East	Central/ South America	Russia
<20%	2/11	4/11	4/11	3/11	4/11	1/11	3/11
20-40%	3/11	1/11	1/11	0	0	2/11	0
40-60%	3/11	0	1/11	0	1/11	0	0
60-80%	1/11	0	0	0	0	0	0
>80%	2/11	0	0	0	1/11	0	0

In Figure B-3a the countries/regions from which the manufactures obtain revenue are shown. In Figure B-3b it is shown the share of the revenue obtained in EU/EEA by the manufacturers.

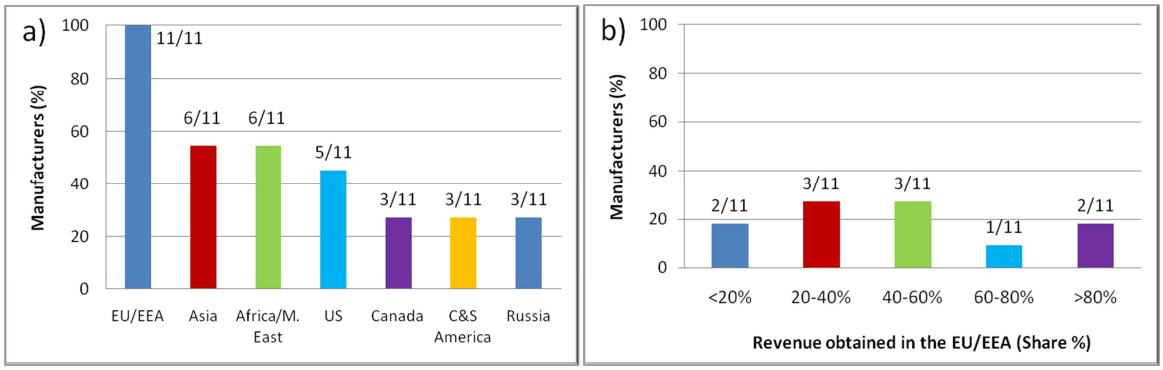


Figure B-3a. Countries/regions from which the manufacturers obtain revenue; Figure B-3b. Share of the revenue obtained in EU/EEA by the manufacturers

All the manufacturers/ installers/ suppliers obtain revenue from EU/EEA, 3/11 obtaining a percentage higher than 60% of their total revenue. Related to other regions in the world, in decreasing order; 6/11 of the manufacturers/ installers/ suppliers obtain revenue from Asia Pacific and from Africa/Middle East, 5/11 from the US and 3/11 from Canada, Central / South America and from Russia.

- **Expected changes in the origin of the revenue in the next years**:

1. 2/11 have answered that they do not expect changes in the origin of their revenues.
2. 1/11 cannot predict the origin/share of its future revenues.
3. 1/11 expects a higher activity in the North Sea (UK/Norway) due to the new fields like Johan Sverdrup in Norway but also due to a lot of brown fields where old rigs are being upgraded to extend their lifetime.
4. 2/11 expects a general decrease in their revenues. 1/11 does not specify the cause and 1/11 thinks that it will be due the fact that the building of new equipment for drilling facilities will be reduced.
5. 1/11 predicts a slight growth in the Asia Pacific region, a sharp decline in the EU/US area and a stable situation or slight decrease in the rest of the regions of the world.

- **Categories of equipment manufactured/installed/supplied:**

  In Figure B-4 the main categories of equipment the manufacturers/ installers/ suppliers are dealing with are shown.

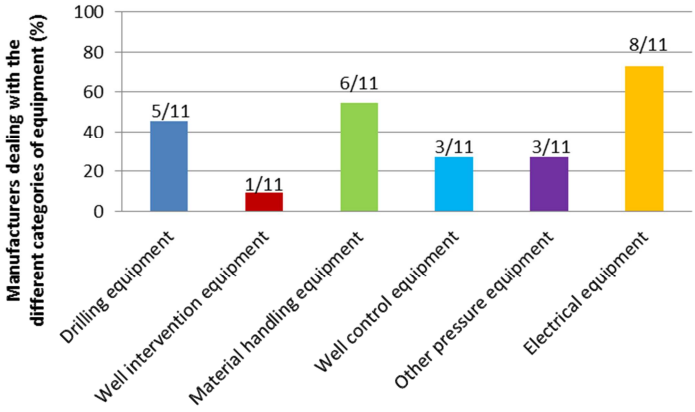


Figure B-4. Categories of equipment the manufacturers/installers/suppliers are dealing with

Drilling equipment (5/11), well intervention equipment (1/11), material handling equipment (6/11), well-control equipment (3/11), other pressure equipment (3/11) and electrical equipment (8/11).

The BOP is manufactured or supplied by 2 of the 3 companies dealing with well-control equipment.

3/11 manufacture/ install/ supply only electrical equipment, 1/11 only drilling equipment, 3/11 manufacture/ install/ suppliers two categories of equipment, 1/11 manufacture/ install/ supply three different categories of equipment, 2/11 four categories of equipment and 1/11 manufacture/ install/ suppliers five of the six categories of equipment.

- **Current compliance with the EU Product Safety Directives (ATEX, MD and PED)**:

  According to the manufacturers/installers/suppliers the current compliance of the equipment manufactured, installed, supplied with the EU Product Safety Directives is as follows, see Table B-3.

Table B-3. Current compliance of the equipment manufactured/installed/supplied with the EU Product Safety Directives (according to the manufacturers/ installers/ suppliers)

	Equipment manufactured/installed/supplied		
	ATEX	MD	PED
Compliant and certified	6/11	4/11	4/11
Compliant but not certified	4/11	4/11	3/11
Not compliant	1/11	2/11	1/11
Unknown	0/11	1/11	3/11

In Figure B-5 and in Figure B-6 the compliance of the equipment manufactured/ installed/ supplied with the EU Product Safety Directives (according to the manufacturers/ installers/ suppliers) is shown.

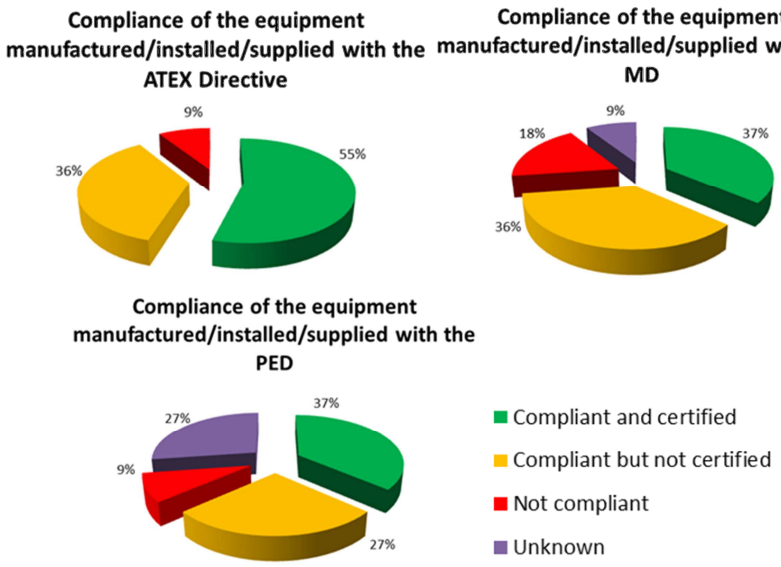


Figure B-5. Current compliance of the equipment manufactured/ installed/ supplied with the EU Product Safety Directives (according to the manufacturers/ installers/ suppliers)

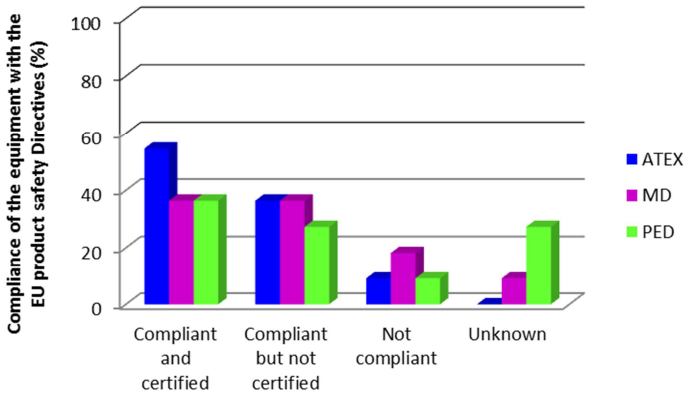


Figure B-6. Current compliance of the equipment manufactured/ installed/ supplied with the EU Product Safety Directives (according to the manufacturers/ installers/ suppliers); comparison

Most of the equipment manufactured/ installed/ supplied is, according to the manufacturers/ installers/ suppliers, compliant with the EU Product Safety Directives, although the equipment manufactured/ installed/ supplied by some companies is not certified. The percentage of equipment compliant and certified according to ATEX Directive is higher than in the case of MD and PED. Only two companies manufacture/ install/ supply equipment compliant and certified with the 3 Directives.

Three companies of the same family sited worldwide but also in Europe, have declared different compliance of the equipment with the EU Product Safety Directives. The equipment manufactured/ installed/ supplied by two of these companies is compliant but is not certified with the Directives while in the case of the third company, the equipment is not compliant/ certified with the Directives. This third company manufactures four categories of equipment which do not comply with any of the Directives because are compliant with US standards; US OSHA related to machinery and US API regarding to pressure equipment.

- **Legislation the manufacturers/installers/suppliers currently apply**: ISO standards (9/11), EN ISO standards (3/11), IEC standards (8/11), EN-harmonised standards (8/11), Norwegian standards NORSOK (4/11), British standards BS

(3/11) and US standards such as ASME and API (7/11) and private standards such as DNV-GL and ABS (2/11). These are:

1. ISO and EN ISO: ISO 1127, ISO 6742-1, ISO 6743-9, ISO 9001, ISO 12924, ISO 13534, ISO 13535, ISO 14693, EN ISO 9614-2, EN ISO 12100, EN ISO 13849-2, EN ISO 13849-5 and EN ISO 13850.
2. IEC standards: IEC 60034, IEC 60079 Series, IEC 60204, IEC 80079-34, IEC 80079-36 and IEC 80079-37.
3. EN-harmonised standards: EN 334, EN 13463, EN 14382, EN 60079 Series and EN 60204.
4. Norwegian standards NORSOK: D-001, S-002 and R-002.
5. US standards (ASME, API, etc.): API 4F, API 6A, API 7, API 7K, API 8C, API 16A, API 520, API 619, API 672 and ASME VIII pressure vessel.

On the other hand the manufacturers/ installers/ suppliers also apply the following legislation: Low voltage Directive 2006/95/EC, Electromagnetic Compatibility Directive 2004/108/EC, Simple pressure vessel Directive 2009/105/EC, US ASTM standards, Guidelines for dropped objects and Russian maritime register of shipping (RS).

- **Currently applicable legislation and safety of the equipment**: (3/11) think that currently applied legislation guarantees safety. (1/11) finds the US standards as safe as the EU Product Safety Directives with the exception of the legislation related to explosive atmospheres and points out that while US standards only consider the electrical sources of ignition, ATEX Directive considers all sources of ignition (e.g. static electricity, friction, etc.). (2/11) thinks that ATEX Directive is not sure as it allows "self-certification". (5/11) did not reply the question.

  As explained above it has to be pointed out that the ATEX Directive does not speak about "self-certification" but about "Declaration of Conformity" which is always mandatory. The manufacturer or his authorized representative is always obliged to draw up a written "Declaration of Conformity" which shall enable the conformity of the equipment with the relevant requirements of the Directive to be assessed. For category 2 of equipment (equipment for zone 1) the technical documentation created to draw up the written "Declaration of Conformity" has to be communicated to a Notified Body.

- **Solved problems with the extension of the EU Product Safety Directives to cover MODUs**:
  1. (1/11): The consideration of all sources of ignition, taken into account by ATEX Directive, but not by the US standards.
  2. (1/11): Documentation related to HSE issues. The extension will enforce more documentation to prove that equipment safety has been considered, but without contributing significantly more to the actual equipment safety.
  3. (2/11): Think the extension of the Directives will not solve any problem.
  4. (1/11): Does not know.
  5. (6/11) Did not reply to the question.

- **Suitability of the EU Product Safety Directives for equipment on-board MODUs**: (5/11) consider the Directives appropriate for MODUs, (2/11) do not consider them pertinent and (1/11) does not know. (3/11) did not reply to the question. This information is shown in Figure B-7.

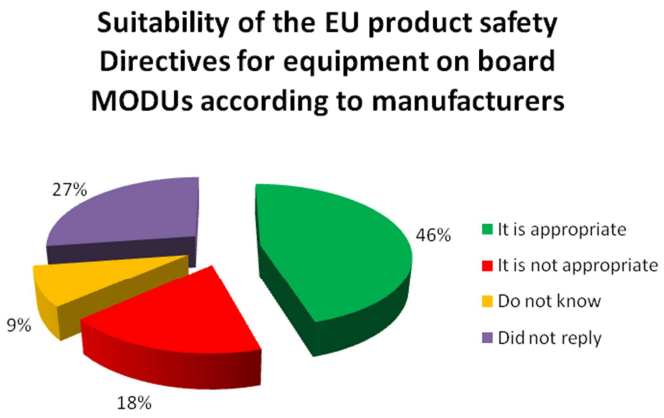


Figure B-7. Suitability of the EU Product Safety Directives for equipment on-board MODUs according to manufacturers

- **Would the extension of the scope of the ATEX Directive result in safer equipment?**: (5/11) say no because they think that IEC and US standards are more suitable (although US standards should be updated in order to consider all sources of ignition).

  (2/11) think that ATEX Directive would increase safety in equipment because currently when it is not legally required only electrical risks are considered (but not other risks). On the other hand despite considering ATEX Directive a safer legislation, they do not agree with the fact that ATEX allows "self-certification".

  As explained above it has to be pointed out that the ATEX Directive does not speak about "self-certification" but about "Declaration of Conformity". A Declaration of conformity is issued by the manufacturer for all equipment and has nothing to do with self-certification.

  (2/11) do not know and (2/11) did not reply to the question.

  These results are shown in Figure B-8 together with these related to MD and PED.

- **Would the extension of the scope of the MD result in safer equipment?**: (5/11) say no because they think that O&G companies already have a very high safety standards, like US OSHA regulations, as well as third parties inspecting the equipment. They also think that the extension of the legislation will enforce more documentation related to HSE without contributing to the actual level of safety of the equipment. (0/11) think that MD would increase the safety of the equipment in MODUs and (3/11) do not know. (3/11) did not reply.

  These results are shown in Figure B-8 together with these related to ATEX Directive and PED.

- **Would the extension of the scope of the PED result in safer equipment?**: (4/11) say no because they think the currently applied standards are more suitable (e.g. ASME standards). They point out that API standards, which have been improved since Macondo, are exhaustive for BOPs. They also think that the extension of the legislation will enforce more documentation related to HSE without contributing to the actual level of safety of the equipment. No one thinks that PED would increase the safety of the equipment in MODUs and (3/11) does not know. (4/11) did not reply.

  These results are shown in Figure B-8 together with these related to ATEX Directive and MD.

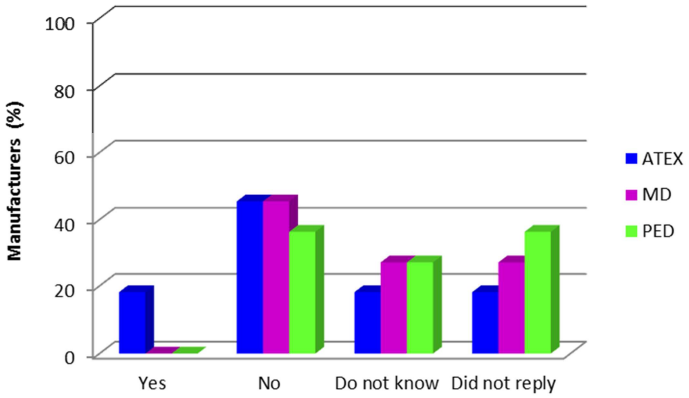


Figure B-8. Would the extension of the EU Product Safety Directives result in safer equipment? Opinion of the manufacturers

- **Is it necessary to modify the currently applied standards to meet the EHSRs (or ESRs) of the Directives?:** (4/11) say no because they consider the requirements of the O&G companies much higher than the minimum requirements of the Directives. (2/11) thinks that the currently applied standards may require some modifications: e.g. to ensure that documentation requirements are met (but not to improve the safety of the equipment) and to add clarity in the field. A company purposes that any specific standard which contain very good information (e.g. DNV and ABS) would, when accepted an international standard, add clarity in the field. (2/11) do not know and (3/11) did not reply.

- **Barriers to trade:** For (3/11) of the companies the extension of the EU Product Safety Directives would not create any barrier to trade. On the other hand (4/11) of the companies think the extension could create barriers to trade. (2/11) do not know and (2/11) did not reply to the question. These results are in Figure B-9.

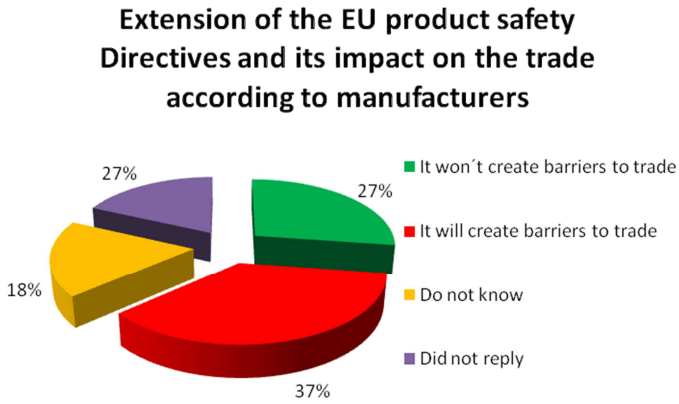


Figure B-9. Extension of the EU Product Safety Directives and its impact on the trade according to manufacturers

- **Will the costs of compliance put your company at a disadvantage vis-à-vis their competitors from within EU/EEA?**: (6/11) of the companies consider that the costs of compliance with the EU Product Safety Directives will not put their company at a disadvantage. The reasons are: 1. The equipment they manufacture/install/supply is already compliant with the Directives; 2. The same rules will theoretically apply for all competitors. (2/11) think they will be at a disadvantage, being their products withdrawn from sale within the EU due to the high compliance costs. (1/11) does not know and (2/11) did not reply to the question.

- **Will the costs of compliance put your company at a disadvantage vis-à-vis their competitors from outside EU/EEA?**: (6/11) of the companies consider that the costs of compliance with the EU Product Safety Directives will not put their company at a disadvantage because they already comply with the EU Product Safety Directives and they manufacture according to them for many parts of the world. (2/11) think they will be at a disadvantage as in some cases products from outside the EU are likely not compliant but are imported as being CE marked. (1/11) does not know and (2/11) did not reply to the question.

- **How would you offset the costs of compliance?**: (1/11) company, whose equipment is compliant and certified with all 3 Directives, does not expect any cost. (7/11) companies would pass the costs to the clients and would increase the price of the equipment. (1/11) company would offset the cost only by passing it to the clients. (2/11) did not reply to the question.

- **Do you expect any benefit of compliance?**: (2/11) companies do not foresee any benefit or opportunity in case of compliance of the equipment they manufacture/install/supply. (1/11) company expects some benefit when specific harmonised standards for the sector are developed. For example, this company would expect a harmonised standard for lifting lugs and eyes as this is a grey area due to the many existing industry standards conflicting in this area. This may result in a situation that the safest methods become a harmonised standard. This company expects the same for fasteners (bolts, nuts), use of chains versus cables, etc. (1/11) company also expects some kind of benefit although it does not explain which. (7/11) did not reply to the question.

- **Societal impact /employment:** (4/11) companies, whose equipment is compliant and certified with the EU Product Safety Directives, think that the extension of the legislation will not have any impact on employment. For (2/11) companies it would facilitate the creation of new job positions in the company because the EU Product Safety Directives will enforce more documentation. (1/11) companies, whose equipment is not compliant with any Directive, expects a direct or indirect loss of jobs as the withdrawal of products from the EU market will lead to reduced sales. (3/11) companies expect no change in the number of post but a qualitative impact on the necessary workforce (e.g. more skilled personnel). (2/11) did not reply to the question.

- **Substantive and administrative costs regarding to the compliance of the specific subcategory of equipment:** (6/11) companies do not know the impact in terms of cost that the extension of the legislation would have for their business. One of this companies, which is not manufacturer but it is supplier/renter/installer, says that this question is in their vendors territory to detail. Drillmec, whose equipment is compliant and certified with ATEX Directive and MD but not with PED, as they do not manufacture pressure equipment but bought it from suppliers, declares that if PED comes into force their suppliers would transmit the cost of compliance with the PED to them. Drillmec cannot estimate this cost. (1/11) company, whose equipment is compliant and certified with the 3 Directives, says the extension of the legislation would not have any cost for them. (3/11) companies of the same family sited worldwide but also in Europe, have declared different compliance with the EU Product Safety Directives for the equipment they manufacture/install/supply:

  One of these, whose equipment is compliant but not certified with the Directives, does not estimate any cost of compliance for the selected subcategory of equipment (material handling equipment).

A second company, whose equipment is also compliant but not certified with the Directives, which has selected the drilling equipment as the specific category to estimate the costs and which produces 2,400 pieces of drilling equipment per year, expects the following qualitative costs:

Related to ATEX Directive:

Substantive Costs: New material (one-off), changes in production lines (per unit produced) and certification process (one-off).

Administrative costs: familiarization with new regulation (one-off and frequency) and certification process (one-off and frequency).

Related to MD:

Substantive Costs: Changes in production lines (one-off and per unit produced) and certification process (one-off).

Administrative costs: familiarization with new regulation (one-off and frequency) and certification process (one-off).

Related to PED:

Substantive Costs: Changes in production lines (one-off and per unit produced) and certification process (one-off).

Administrative costs: familiarization with new regulation (one-off and frequency) and certification process (one-off and frequency).

Finally the third company, whose equipment is not compliant with any of the 3 European Directives, and which manufactures up to 350 units/sets of drilling equipment (hoisting, lifting, handling and rotary systems) per year evaluates the costs of compliance in 12,500,000€ per year. The cost is broken down as follows:

Related to ATEX Directive:

Substantive Costs: New design (one-off cost: 500,000€ and per unit produced cost: 100,000€); new materials (per unit produced cost: 20,000€) and certification process (per unit produced cost: 10,000€).

Administrative costs: Familiarization with new regulation (one-off cost: 100,000€) and certification process (frequency cost: 30,000 € although the frequency is not specified).

Related to MD:

Substantive Costs: New design (one-off cost: 50,000 € and per unit produced cost: 50,000€) and certification process (per unit produced cost: 10,000€).

Administrative costs: Familiarization with new regulation (one-off cost: 100,000 €) and certification process (frequency cost: 20,000 € although the frequency is not specified).

Related to PED:

Substantive Costs: New design (one-off cost: 300,000 € and per unit produced cost: 60,000€) and certification process (per unit produced cost: 10,000€).

Administrative costs: Familiarization with new regulation (one-off cost: 100,000€) and certification process (frequency cost: 20,000€ although the frequency is not specified).

- **Significant time delays:** (3/11) companies expect time delays in their business if the legislation is extended.

One company placed in Europe manufacturing 2,400 pieces per year of drilling equipment (hoisting, lifting, handling and rotary systems) not compliant/certified with any of the 3 European Product Safety Directives, estimates the lead time between 8 and 20 months as the equipment would be stocked and could not be used.

On the other hand (2/11) companies of the same family placed in Europe, whose equipment is compliant but not certified with the 3 European Directives, do not expect any time delay. (1/11) company, whose equipment is compliant and certified with the 3 Directives, do not expect any time delay.

(5/11) did not reply to the question. These results are shown in Figure B-10.

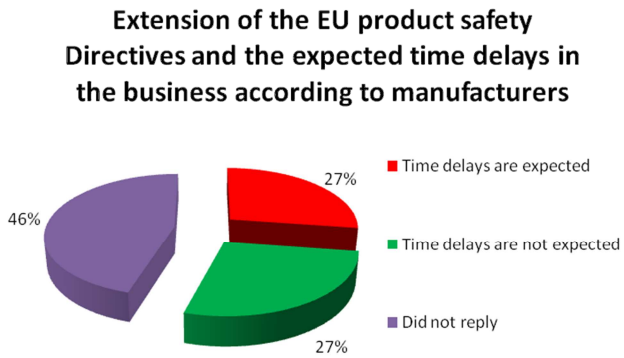


Figure B-10. Extension of the EU Product Safety Directives and the expected time delays according to manufacturers

- **Difficulties of compliance for the selected specific subcategory of equipment:** The difficulties the companies find are: to comply with ATEX Directive because all electrical equipment is considered for hazardous zones (instead of US classes) and in general to comply with the 3 European Product Safety Directives because of the required documentation.
- **Extension of PED to well-control equipment. Solved problems?:** (1/11) companies thinks that the documentation related to the safety of the product will be improved if PED is extended. The European Product Safety Directives are stricter and require more HSE documentation than the currently applied legislation (DNV-GL and ABS), especially in the case of the MD, although without contributing directly to equipment safety/ quality. Some documentation is related to the equipment itself and affects the equipment suppliers. However, the greater part of the documentation requirements are related to the overall drilling systems (and other rig systems) and affect the rig operators/owners.

  (10/11) companies have not answered the question.

- **Extension of PED to well-control equipment. Is PED suitable for well-control equipment?:** (1/11) companies thinks that it is not suitable and (10/11) have not answered the question. Only 3/11 manufacturers/ installers/ suppliers deal with well-control equipment. Results are shown in Figure B-11.

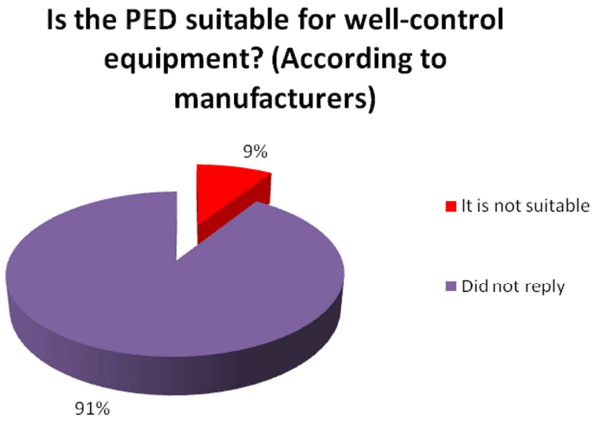


Figure B-11. Extension of the PED to well-control equipment. Is it suitable? (According to manufacturers)

- **Extension of PED to well-control equipment. Difficulties for companies and affection to the market:** (3/11) companies would have difficulties due to the extension of the PED to well-control equipment. These are: Conflict of standards as PED can conflict with API and ASME US standards; market segregation between geographical areas; and for a company buying pressure equipment to different suppliers, an increased cost of the equipment bought.

  (8/11) companies have not answered the question.

- **Extension of PED to well-control equipment. Is it necessary to modify the standards currently used to meet the EHSRs of the PED?:** (2/11) companies think that it is not necessary. (9/11) companies have not answered the question.

- **Extension of PED to well-control equipment. Barriers to trade?:** (1/11) company thinks that the extension of PED to well-control equipment will create barriers to trade. (1/11) company thinks that it will not be any barrier. (9/11) companies do not have opinion about this issue.

C. Companies (MODU owners/ operators): Overview of their answers

- A total of 19 companies owning/ operating a MODU have answered the survey. 17/19 companies are drilling contractors owning a rig or owning/ operating/ providing drilling services to Oil and Gas (O&G) companies. 2/19 answers have arrived from the Exploration and Production (E&P) Business unit of O&G companies operating a MODU, always by means of contractors.

- 17/19 owners/ operators are present at least in one European country while 2/19 companies are placed only in the US. 12/19 owners/ operators are present only in EU/EEA (10/19 in UK or Norway) while 5/19 are present also abroad (US, Canada, Asia Pacific, Africa/ Middle East, Central/ South America and Russia).

- 2/19 of the companies are medium sized (50-249 employees) and 17/19 are large enterprises (> 250 employees).

- 5/19 companies do not consent to the publication of their replies, 12/19 consent but in an anonymous form, 1/19 (Dolphin Drilling Ltd, Aberdeen) consents with its data included and 1/19 company has not answered the question.

- **MODUs vs offshore fixed and onshore platforms (Comparison of the equipment)**: 1/19 of the owners/ operators agree that the equipment for MODUs is almost identical to the equipment for fixed offshore or onshore installations. On the other hand 6/19 say that there are significant differences and 12/19 say that there is a huge variety of equipment onboard MODUs, so they cannot state if all equipment is similar to that in fixed offshore or onshore installations.

  The differences described by the owners/operators are:

  1. Differences in the operations; risk profiles; appropriate standards; and in the certification requirements.
  2. Marine, positioning and navigation equipment.
  3. MODUs have increased well-control equipment and BOP is subsea.
  4. Derrick and riser compensators.
  5. Fixed platforms have no marine systems (ballast, bilge, mooring, etc.) at all.
  6. Some systems (drilling machinery, mud processing machinery) are similar but also contain differences (e.g. Motion compensation systems, etc.).
  7. Power generation and distribution systems vary between MODUs so even more if it is compared to fixed facilities.
  8. Hotel services may be similar, but small differences remain due to e.g. vessel motion.
  9. Equipment in MODUs that is not on present in a fixed or onshore installation: part of hull and machinery; power plant; accommodation and heliport; part of auxiliary equipment; and marine equipment: mooring/ballasting equipment.
  10. Typical in jack ups: Jacking equipment.
  11. Typical in semisubmersibles/ drill-ships: Motion compensating equipment (marine riser compensation, drill string compensation); and remote BOP and control systems (MUX/ Pod hose system).
  12. Typical in jack up/ semisub/ ship further systems: Jacking systems; main/auxiliary/emergency generator power plant and distribution systems

(fixed platforms mostly gas turbine engines); marine systems (ballast/ bilge, etc.); mooring systems; positioning and position keeping/ propulsion systems and all IMO/ Flag state/C lass systems required for floating barges/ ships.

13. Typical equipment on a MODU (Jack up/ semi/ ship) but not on a fixed offshore drilling+production platform: Marine riser system; motion compensating-tensioning systems, riser and drill string; riser tensioning systems; cantilever/ drilling substructure skidding systems (some fixed platforms have drilling substructure skidding systems); subsea BOP and Lower Marine Riser Package (LMRP) systems; BOP launching systems; ultra-high pressure air systems; and nitrogen systems.

The opinion of the drilling contractors and operators related to the equipment on-board MODUs in comparison with the equipment for fixed offshore and onshore installations is shown in Figure C-1.

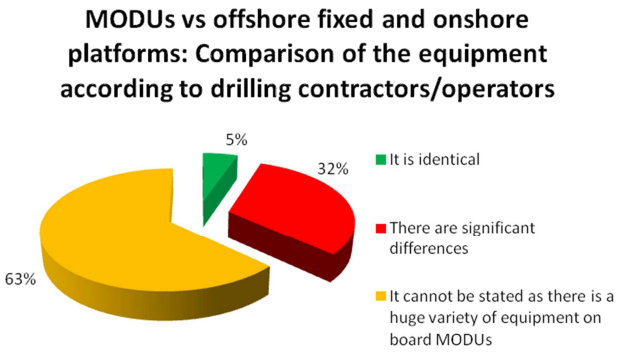


Figure C-1. Opinion of the drilling contractors and operators related to the equipment on-board MODUs in comparison with the equipment for fixed offshore and onshore installations

- The **origin of the manufacturers of the equipment their companies deal with** is mainly EU/EEA, US and Asia Pacific. See Table C-1.

Table C-1. MODU owners/operators: Origin of the manufacturers of the equipment their companies deal with

Manufacturers: Origin share	EU/EEA	US	Asia/ Pacific	Canada	Africa/ Middle East	Central/ South America	Russia
<20%	4/19	2/19	6/19	2/19	0/19	1/19	0/19
20-40%	10/19	7/19	3/19	0/19	1/19	0/19	0/19
40-60%	3/19	7/19	6/19	0/19	0/19	0/19	0/19
60-80%	1/19	1/19	1/19	0/19	0/19	0/19	0/19
>80%	1/19	0/19	0/19	0/19	0/19	0/19	0/19

- In Figure C-2a the **countries/regions of origin of the equipment bought by the drilling contractors/operators are shown**. In Figure C-2b it is shown **the percentage of equipment bought by the drilling contractors/operators in the EU/EEA area**.

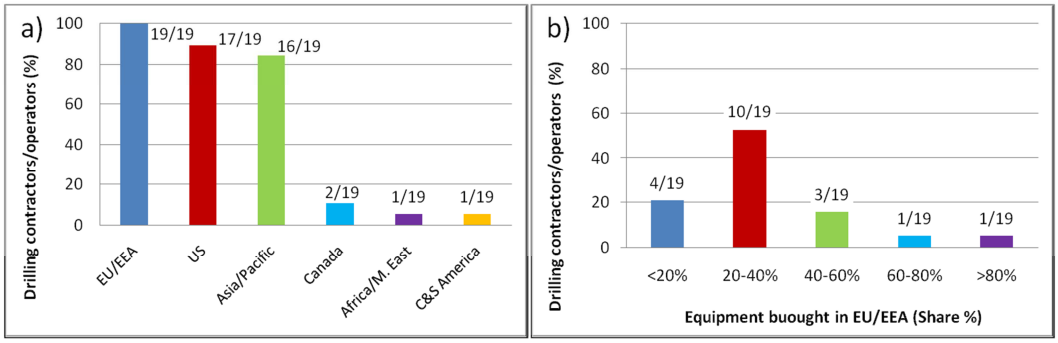


Figure C-2a. Countries/regions of origin of the equipment bought by the drilling contractors/ operators; Figure C-3b. Percentage of equipment bought by the drilling contractors/ operators in EU/EEA

All MODU owners buy a part of the equipment in the EU/EEA area.

The 2 companies sited only in the US buy a percentage lower than 20% of the equipment in EU/EEA.

The most important part of the MODU owners/operators (10/19) buy a percentage between 20 and 40% of the equipment in EU/EEA.

Related to other regions in the world, in decreasing order; 17/19 of the MODU owners/operators buy equipment in the US, 16/19 buy equipment in Asia/ Pacific, 2/19 in Canada and only 1/19 in Africa and Central/ South America.

Approximately 1/3 of the MODU owners/ operators buy a percentage between 40 and 60% of their equipment either in the US or in Asia/Pacific.

It can be said that in general the MODU owners/operators buy the equipment in a diversified way as only 3/19 companies buy more than 60% of the equipment in the same region.

It has to be noted that for the two O&G companies this data is referred to their (E&P) Business units.

- The **origin of the revenues for the MODU owners/operators** is diverse, see Table C-2.

Table C-2. MODU owners/operators: Origin of the revenues

Revenue: Origin share	EU/EEA	US	Asia/Pacific	Canada	Africa/Middle East	Central/South America	Russia
<20%	1/19	4/19	8/19	3/19	4/19	6/19	0/19
20-40%	9/19	2/19	2/19	0/19	8/19	1/19	0/19
40-60%	0/19	3/19	1/19	0/19	1/19	0/19	0/19
60-80%	4/19	0/19	0/19	0/19	0/19	0/19	0/19
>80%	3/19	0/19	0/19	0/19	0/19	0/19	0/19
Not specified	2/19	1/19	1/19	1/19	1/19	1/19	0/19

- In Figure C-a the **countries/regions from which the drilling contractors/ operators obtain revenue** are shown. In Figure C-b it is shown **the share of the revenue obtained in EU/EEA by the drilling contractors/ operators**.

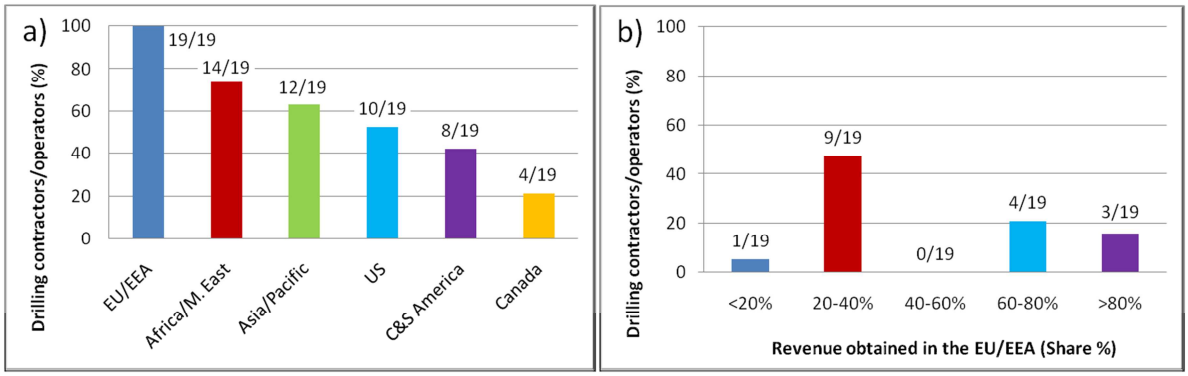


Figure C-3a. Countries/regions from which the drilling contractors/operators obtain revenue; Figure C-3b. Share of the revenue obtained in EU/EEA by the drilling contractors/ operators

All MODU owners/operators obtain revenue from EU/EEA: 9/19 companies obtain a percentage between 20 and 40%, 4/19 between 60 and 80%, and 3/19 obtain a percentage higher than 80% of their total revenue.

Related to other regions in the world, in decreasing order; 14/19 of the MODU owners/operators obtain revenue from Africa/Middle East, 12/19 from Asia Pacific, 10/19 from the US, 8/19 from Central/ South America and 4/19 from Canada.

It has to be noted that for the two O&G companies, which obtain revenues at least from 4 different regions, this data is referred to their (E&P) Business units.

As expected due to the mobile nature of MODUs it can be said that the MODU owners/operators work in a diversified way as only 7/19 companies obtain a more than 60% of the revenue in the same region. Related to the drilling contractors; 4/17 obtain revenue only from one area, 2/17 from 2 different regions, 3/17 from 3 regions, 3/17 from 4 regions, 2/17 from 5 different areas and 3/17 from 6 different areas.

- **Expected changes in the origin of the revenue in the next years**:

1. 3/17 of the drilling contractors have answered that they do not expect changes in the origin of their revenues.
2. 3/17 of the drilling contractors cannot predict the origin/share of its future revenues.
3. 9/17 of the drilling contractors expect a decrease in their revenues: 7/17 expect a decrease in the EU/EEA area because of the current economic situation and the low oil and gas reserves; 1/17 forecasts a general decrease; and 1/17 expects a decrease in the North Africa area and an invariant revenue from the EU area.
4. 1/2 of the O&G companies says that a decrease in the revenue could be expected for the Asia Pacific area.

- **Current compliance with the EU Product Safety Directives (ATEX, MD and PED):**

Table C-3 shows the current degree of compliance of the rigs of the drilling contractors with the EU Product Safety Directives.

Table C-3. Current compliance of the rigs of the drilling contractors with the EU Product Safety Directives

	Compliance of the rigs of the drilling contractors		
	ATEX	MD	PED
Compliant and certified	3/17	1/17	2/17
Compliant but not certified	1/17	3/17	8/17
Not compliant	9/17	9/17	3/17
Unknown	4/17	4/17	4/17

In Figure C- and in Figure C- the compliance of the rigs of drilling contractors/ operators with the EU PSDs (Product Safety Directives) is shown.

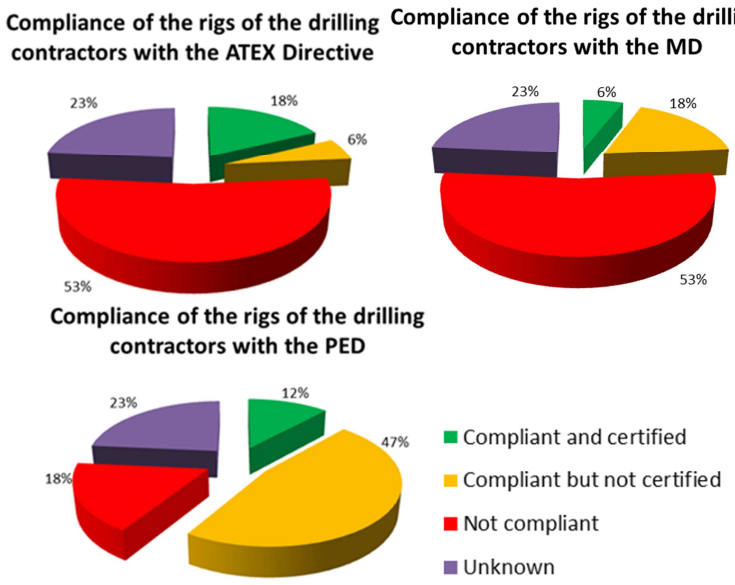


Figure C-4. Current compliance of the rigs of the drilling contractors/operators with the EU Product Safety Directives

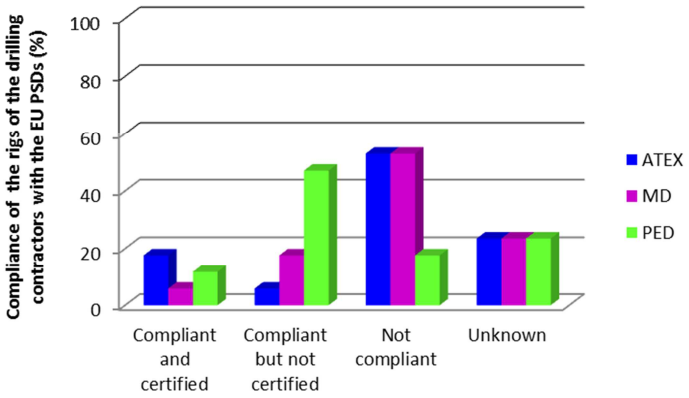


Figure C-5. Current compliance of the rigs of the drilling contractors/operators with the EU Product Safety Directives; comparison

Approximately only 1/5 of the drilling contractors own rigs which are compliant with the ATEX Directive. 13/17 of the drilling contractors either own rigs which are not compliant with the ATEX Directive or do not know if they are.

The number of companies owning rigs compliant and certified with the MD is lower than in the case of the ATEX Directive.

10/17 drilling contractors own rigs compliant with the PED and the rigs owned by 8 of these are not certified. Only one company owns rigs compliant and certified with the 3 Directives.

The O&G companies, operating a MODU always by means of drilling contractors, have not answered this question.

The reasons for which the rigs are not compliant with the EU Product Safety Directives are:

1. MODUs operate globally while the EU Product Safety Directives are not globally accepted. The compliance with the EU Directives would limit the options for trade, e.g. the US authorities do not consider EU standards to warrant equivalent levels of safety and require global standards (IEC).
2. The currently used standards have been proven in service to provide robust levels of safety, equivalent or even higher.
3. Rigs and equipment came into service long before the Directives were issued and any retrospective compliance would be technically and financially challenging. The extension of the European Product Safety Directives should be addressed to the manufacturer rather than the end user.
4. The equipment has been manufactured outside the EU/EEA area.
5. MODUs will rarely encounter hydrocarbons so it is not perceived any safety benefit because of the compliance with the Directives.
6. The EU Product Safety Directives are addressed mainly to equipment manufacturers.
7. The EU Product Safety Directives are implemented country by country and are usually not understood in the same way in all the countries.
8. The European "CE mark" in the equipment will not decrease the number of accidents; the human factor has to be also considered.
9. Taking into account the huge variety of equipment onboard MODUs it is difficult to comply. A gap analysis to know the compatibility between the currently used

equipment/standards and the UE Product Safety Directives should be done. That would be more convenient than a recertification process.

- **Legislation the MODU owners/operators currently apply**: ISO standards are used by (13/19) of the drilling contractors/ operators, EN ISO standards by (3/19), IEC standards by (15/19), EN-harmonised standards by (11/19), Norwegian standards NORSOK by (10/19), British standards BS by (11/19) and US standards such as ASME and API by (15/19) and private standards such as DNV-GL and ABS by (4/19). These are:

  1. ISO: ISO 4309, ISO 6385, ISO 8383, ISO 9000, ISO 9001 Quality Management Systems, ISO 10407, ISO 10423, ISO 11064, ISO 13354, ISO 13533, ISO 13535, ISO 13624, ISO 13628, ISO 13628-7, ISO 13702, ISO 13704, ISO 13920, ISO 14000, ISO 15156, ISO 17631, ISO 18000, ISO 19901 and ISO 19905.
  2. EN ISO: EN ISO standard for piping material, ISO 10407, ISO 10423, ISO 13354, ISO 13533, ISO 13624, ISO 13628-7, ISO 13704 and ISO 15156.
  3. IEC standards: IEC 60112, IEC 60228, IEC 60056, IEC 60079 Series, IEC 60092 Series, IEC 60092-34, IEC 60092-504, IEC 60470, IEC 60526, IEC 60529, IEC 60533, IEC 60945, IEC 60947, IEC 61000, IEC 61508, IEC 61511, IEC 61892.
  4. EN-harmonised standards: EN 953, EN 12079, EN TS 13001-5, EN 13478, EN 13852 and EN 60079.
  5. Norwegian standards NORSOK: C-001, C-002, D-001, D-010, S-001, S-002, R-002, R-003 and Z-013.

     A MODU owner/operator has pointed out that not all NORSOK standards are related to MODUs as they are chiefly in effect for production units. A few NORSOK standards are normative, given that the areas they cover (working environment, drill floor equipment, personnel lifting devices, etc.) are not considered sufficiently addressed by maritime frameworks, but most are not.
  6. British standards: BS EN 60079, BS 31.3, BS 5045 and Provision and Use of Work Equipment Regulations 1998 (PUWER).
  7. US standards (ASME, API, NFPA, NEMA, NACE, etc.): API 4F, API 6A, API 6D, API 7G, API 7K, API 7L, API 8B, API 8C, API 9A, API 9B, API 14B, API 14E, API 16A, API 16C, API 16D, API 16F, API 16J, API 16R, API 53, API 530, API S53, API RP 16Q, API RP 53, API RP 64 and API/DS1/NS2 Standard. ASME B31.1, ASME I, ASME IV, ASME VIII pressure vessel, ASME B 31.3. US NEC 505/500. NACE MR075.
  8. DNVGL standards: D202, C101, E101, D201, C401, D301, E401, D203, D101, B101, E303, E403, E302, E304, E201, E301, A101, C301, C105, C103, C106, C102, C201, C104 and A201.

  On the other hand the MODU owners/operators also apply the following legislation: SOLAS, MARPOL, Class Society requirements, Flag State requirements, CAP 437 (Standards for Offshore Helicopter Landing Areas), Guidance and best practice standards, State Authorities regulations (Netherlands, Denmark, UK, Norway, US and Canada offshore regulations), and IEEE standards[96] (Advancing technology for humanity). The association is chartered under this name and it is the full legal name. IEEE is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and

[96] IEEE standards for the Institute of Electrical and Electronics Engineers

technology that underlie modern civilization. Industry standards and own performance standards are also applied.

MODUs operating at the Norwegian Continental Shelf have to apply the Norwegian Maritime Administration´s regulations for Mobile Offshore Units; IMO MODU Code; and compliance with Self State Authorities (Petroleum Safety Agency Norway).

- **Does 2009 MODU Code (IMO Resolution A.1023 (26)) apply to your company?:**(16/19) companies apply the MODU Code. Of these, (3/19) explain that the applied version of the MODU Code depends on the year the MODU was built and on if the MODU was updated according to a later code. In that way other versions of the MODU Code the companies apply are: 1979 MODU Code (IMO Resolution A.414 (XI)) and 1989 MODU Code (IMO Resolution A.649 (16)). (1/19) One drilling contractor sited in the EU/EEA area says that MODU Code does not apply to its fleet. (2/19) companies have not answered the question.

  A drilling contractor highlights that the MODU Code is in essence a drilling rig specific version of SOLAS and that it is supported by international and national standards such as ISO, IEC and industry specific standards such as API.

- **Currently applicable legislation and safety of the equipment**: (19/19) of the MODU owners/ operators think that currently applied legislation guarantees safety of equipment. This rotund affirmation is based on:

  1. The currently applied national and international legislation (Class, MODU Code, API, Directive 2013/30/EU, Performance standards for each of the Safety Case and Environmentally Critical Systems (SECS), etc.) warrant an equivalent level of safety and are used globally with a good track record in the field.
  2. In the majority of Root Cause Analysis the main causes are connected to human factor, not to equipment design or certification.
  3. There are sufficient controls/ inspections based on international standards already applied on a global basis to MODUs.
  4. MODUs are built according to Class Society requirements and comply with many API recommended practices, which cover the majority of issues with respect to the drilling equipment not covered under IMO MODU Code.
  5. There is no evidence of systemic defects under current global standards.
  6. An O&G company points out that MODUs are certified before the spud of a new well by means of a recognized third part.

  On the other hand an O&G company says that the extension of the legislation would facilitate the certification of the equipment under a unique standard in Europe as well as the definition of responsible parties and liabilities. It would set a clear frame for O&G operations across Europe.

- **Solved problems with the extension of the EU Product Safety Directives to cover MODUs**: (18/19) MODU owners/ operators say that the extension of the legislation will not solve any problem because:

  1. Safety, health and environmental problems are already addressed as the currently applied MODU standards are equivalent to ATEX Directive, MD and PED.
  2. One company points out that they have never had any problem with the currently used MODUs.
  3. It could be though that the "men-machine interface safety" aspect would be improved as MD is more specific to men-machine interface safety than some of

the current used standards, which have a starting point of unit/system integrity. However the currently applied standards also address similar aspects on men-machine safety as the MD, although it cannot be stated that they are fully covered under MD without an in depth review.

- **Suitability of the EU Product Safety Directives for equipment in MODUs**: (13/19) companies do not consider the Directives appropriate for MODUs because:

  1. The EU Product Safety Directives cannot stand alone and replace the existing normative references. Other recognized standards should be considered instead.
  2. For most drilling related equipment and MODU related equipment there are more specific regulations available. European Product Safety Directives would be handled as an additional requirement on top of the existing legislation.
  3. There is no perceived advantage of extending the legislation from a safety perspective.
  4. Related to ATEX Directive many markets in the US and Australia have banned ATEX certified equipment for its use offshore.
  5. The issue that MODUs not only comply with Flag State, IMO and Class (DNV/ ABS/ Lloyds) requirements but also with a selection coastal state requirements pending on the area of operation (such as UK PUWER) would complicate the bases (what regulations will be included) for such assessment.

  (3/19) companies consider the Directives pertinent but:

  1. The extension of these should be applied only to the new equipment and not to the existing one.
  2. In order to formulate the legislation appropriately, a gap analysis of the 3 Directives with the standards and Codes that are being followed should be made. Extensions of the current Directives should be done to adapt them to the MODUs specific case.

  (2/19) companies do not know. Of these, one company, currently using some equipment covered under some of the EU Product Safety Directives, finds it difficult to determine if a general application of these Directives would be suitable.

  (1/19) companies has not answered the question.

  In Figure C- these results are shown.

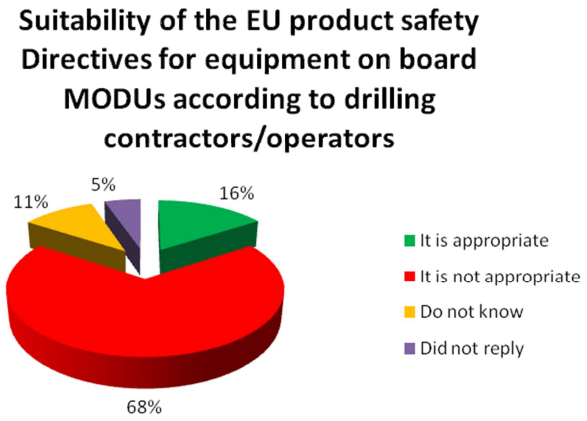


Figure C-6. Suitability of the EU Product Safety Directives for equipment on-board MODUs according to drilling contractors/ operators

- **Would the extension of the scope of the ATEX Directive, MD and PED result in safer equipment?**: (15/19) say that the extension of ATEX Directive would not result in safer equipment because:

  1. "Self-certification", as allowed by ATEX Directive, will very likely lower the safety standard. Independent verification as per IEC is a must.

     It has to be pointed out that the ATEX Directive only allows self-certification for some specific type of equipment with a lower hazard. The involvement of a third party (notified body) in the conformity assessment is required for the majority of the equipment. The above statement that ATEX allows "self-certification" is therefore misleading as it gives the impression that all equipment is self-certified. Most of the Ex equipment already in use comes from ATEX origins but without the certification, or an equivalent international standard.
  2. Zone ratings and equipment safety already exists within Class, Flag and HSE Case regimes.
  3. Electrical safety is already covered by other standards and recommended practices. Mechanical requirements of ATEX will be additional.
  4. ATEX Directive is not giving any added value to the current implemented MODU standards.
  5. Current design basis provide equivalent or higher level of safety.

  (2/19) companies do not know if the extension of the ATEX Directive would result in safer equipment because the benefits are unclear and an in depth review is required.

  (13/19) and (15/19) of the companies say that the extension of MD and PED respectively would not result in safer equipment because:

  1. Existing global standards have a track record in the field that allows the companies to assess their reliability based on date. The same robust basis is not available for equipment subject to the MD and PED.
  2. MD and PED are not giving any added value to the current implemented MODU standards.
  3. Equipment safety already exists within Class, Flag and HSE Case regimes.
  4. There are already sufficient internationally recognized standards and recommended practices.
  5. Current design basis provides equivalent or higher level of safety.

  (4/19) companies do not know if the extension of MD would result in safer equipment. Of these (2/19) do not know if their extension would result in safer equipment because the benefits are unclear and an in depth review is required. Similarly (2/19) companies do not know if the extension of the PED would result in safer equipment and for one of these the benefits are unclear.

  Finally (2/19) companies consider ATEX Directive, MD and PED pertinent but, in order to formulate the legislation appropriately, a gap analysis with the standards and codes that are being followed is suggested. A frame to clearly specify the requirements that are now dispersed under several standards should be set.

  These results are shown in Figure C-.

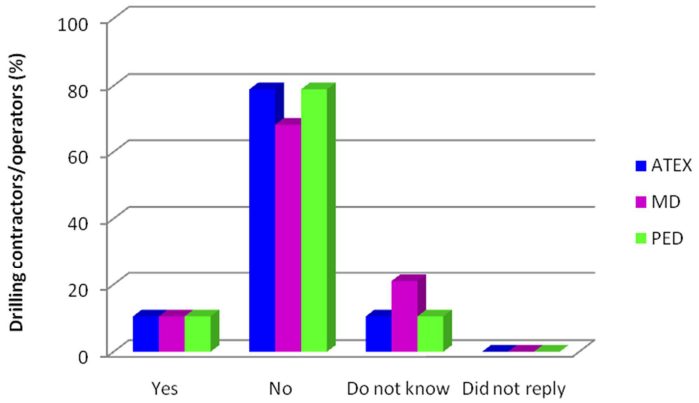


Figure C-7. Would the extension of the EU Product Safety Directives result in safer equipment? Opinion of the drilling contractors/ operators

- **Is it necessary to modify the currently applied standards to meet the EHSRs of the Directives?:** (16/19) companies do not agree with the modification of the currently applied standards because:

  1. This is already the case. Standards are constantly being developed, and significant amendments have and are still taking place after Macondo.
  2. Existing Class, Flag and HSE Case regimes plus associated verification schemes cover EHSRs adequately.
  3. An O&G company: There are a wide range of inspections based on international rules and standards to follow. O&G industry has large experience to manage this equipment. MODUs are certified before the spud (initial drilling) of a new well, by means of a recognized third part.

  (1/19) company thinks that may be the currently applied standards should be modified but not at large. Modifications should consider mechanical requirements of ATEX Directive and should verify the relation men-machine safety interfaces regarding to MD.

  (2/19) companies have not answered the question.

- **Barriers to trade:** For (18/19) of the companies the extension of the EU Product Safety Directives would create barriers to trade because:

  1. The extension would incur significant cost and time to initially determine existing levels of compliance across a massive variety and quantity of equipment, followed by further significant cost and time in replacing or re-certifying non-compliant equipment, which may not be practicable or even achievable in some cases. It has to be considered the downtime while MODUs replace their equipment and the labor of removal of the existing equipment and installation of new equipment. Has the potential to be a major barrier to economic trading as these expenses would incur both when entering and leaving the EU market.
  2. Putting these Directives in place may make the MODU less suitable for other areas of the world. ATEX compliant equipment may not be accepted in the US.
  3. Compliance across the variety and quantity of systems onboard existing MODUs would have massive cost and time impacts, and may not even be possible in some aspects (significant drilling and well-control systems are designed and manufactured in USA, to API standards, not to EU standards). If compliance could be achieved, the associated cost would have to be attempted to be recovered through operational day rates in an already depressed market place (MODUs are already being cold-stacked and scrapped). To move or retain units into an EU area would therefore become prohibitively expensive. Worth

noting that EU/EEA is already one of the most expensive operating areas without application of yet further legislation.

4. The cost of compliance for EU MODUs may put them at a competitive disadvantage in non-EU markets. On the other hand the cost of compliance could create a disincentive to new entrants into the EU market.
5. The majority of the equipment comes from different parts of the world, constructed following oil and gas international standards. So, that could create a real trade barrier.
6. It may also be detrimental to EU manufacturer´s options to sell their products outside of the EU, such as in places where the Directives are not accepted as a standard.
7. It will create significant issues on the supply chain for both owners and operators.

(1/19) company has not answered the question.

These results are shown in Figure C-.

Figure C-8. Extension of the EU Product Safety Directives and its impact on the trade according to drilling contractors/ operators

- **Would the costs of compliance put your company at a disadvantage vis-à-vis their competitors from within EU/EEA?:** (12/19) think they will be at a disadvantage because:

1. The approach to compliance and the associated costs may differ between MODU owners.
2. The age of the rig will be a significant factor in the cost to comply. For example, TDS4 top drive system will in all probability not be upgradeable as it has been substituted by TDS8. Therefore the upgrade cost on a TDS8 may be relatively low compared to a 2-3 million dollar investment to upgrade a TDS4.
3. For small companies the compliance would be achieved in a more difficult way.
4. Especially for MODUs entering the EU/EEA area.

On the contrary, (3/19) companies consider that the costs of compliance with the EU Product Safety Directives will not put their company at a disadvantage as if competitors are within EU then a level playing field exists, although it would be a higher and unsustainable level.

(3/19) companies do not know what to expect because:

1. For a drilling contractor company operating MODUs, as end user, the costs are not yet clear.

2. The fact that a very un-balance competition arises will depend on the applicability of the Directives: Will the Directives… 1. Never be applicable to existing units?; 2. Be applicable to existing units after a period?; or 3. Be applicable to MODUs constructed after a future date?.
3. An O&G company, as client of the equipment manufacturer/ drilling contractor, will probably have additional costs transferred to the equipment rates. However these additional costs will be charged in the same way to their competitors inside the EU.

(1/19) company has not answered the question.

- **Would the costs of compliance put your company at a disadvantage vis-à-vis their competitors from outside EU/EEA?:** (15/19) think they will be at a disadvantage because:
  1. In many areas of operation the EU Product Safety Directives will not be accepted.
  2. MODUs have a certain level of international compliance and anything above this creates additional operating cost which would have to be recouped through the day rate. Additional cost creates financial disadvantage.
  3. When the rigs in EU will be compliant the significant cost of upgrade for a rig from outside would have to be factored in the proposed day rate. This would be a TAX on incoming rigs that would have to be borne by the owner or by the client. Otherwise the particular rig would stop from being tendered.
  4. It will be an unfair advantage for units which do not have to comply with the EU safety product Directives when competing for working outside EU.
  5. For a drilling contractor sited in UK, and with rigs currently operating outside of the EU/EEA area, compliance requirement disparities could potentially create a disincentive to move into the EU market.
  6. For small companies the compliance would be achieved in a more difficult way.

  (1/19) company considers that the costs of compliance with the EU Product Safety Directives would not put its company at a disadvantage vis-à-vis their competitors from outside EU/EEA.

  (2/19) Two companies do not know what to expect.

  (1/19) company has not answered the question.

- **How would you offset the costs of compliance?**: (15/19) companies would move to other markets outside of the EU/EEA area. Of these, one company thinks that as an end user the cost would be prohibitive and another one is concerned about the non-availability of all the equipment on board MODUs in an EU-compliant format. In both cases the exit of the European MODU market is seen as the best option. (7/19) companies would pass the costs to the clients. (5/19) companies would increase the investment flow. (1/19) company points out that the costs of compliance are not recoverable. Thus these costs would reduce its capacity for spending elsewhere on safety improvements. (6/19) companies point out that it is not possible offset the cost as compliance is a baseline for all their operations.

- **Do you expect any benefit of compliance?**: (12/19) MODU owners/operators do not foresee any benefit or opportunity in case of compliance but they see other possible beneficiaries like equipment manufacturers, sellers and installers. The possibility to select the suitable applicable regulation (including ATEX Directive, MD

and PED) is considered a much more beneficial option for system optimization. (7/19) companies have not answered the question.

- **Societal impact/ employment:** For (2/19) companies, a drilling contractor and an O&G one, it would not have any impact on employment. (5/19) companies think that the extension of the legislation would not change the number of posts but might have a qualitative impact on the necessary workforce (the existing personnel should be trained in order to achieve a more specific skills related to the compliance with the EU Product Safety Directives). On the contrary (10/19) drilling contractors believe that the extension of the legislation would lead directly or indirectly to a loss of jobs. The causes are:

  1. The significant cost increase would make it harder to offer prices that the clients would be willing to pay. Thus a loss of market is foreseen.
  2. The extension of the legislation and its associated prohibitive costs, as expected by the drilling contractors, could push the MODUs out of the EU/EEA market to a more cost effective market.
  3. The older rigs may in fact never become compliant either from a technical point of view (not possible to upgrade) or from an economical point of view (too costly to justify spending several million dollars on a 30 year old rig). Thus it is foreseen by the drilling contractors a reduction in the companies´ EU fleet and hence in the number of jobs.

  (2/19) companies have not answered the question.

- **Substantive and administrative costs regarding to the compliance of the specific subcategory of equipment:** The general comment is that question is addressed mainly to the equipment manufacturers/suppliers and not to the drilling contractors and O&G companies. (12/19) companies do not know the impact in terms of cost that the extension of the legislation would have for their business. The related comments to this question are:

  1. It is not possible to specify the costs unless the applicability is clarified (Never applicable to existing units?; Applicable to existing units but after xxx future date?; or Only applicable to MODUs constructed after xxx future date?). Also depends on the possibility that the equipment is reviewed for certification compliance or need replacement by new.
  2. It is difficult to provide a number as most of the vendors the drilling contractor is speaking with have no proposal to comply or are unwilling to give figures at this stage. Typical cost for a standard jack up or semi-submersible rig to comply with the EU Product Safety Directives would be in the range of million-tens of millions of dollars. Moreover this cost does not consider the loss of revenue whilst the rigs would be off contract in a shipyard working towards compliance.
  3. There will be additional costs linked to these proposals which cannot be justified by an increased level of safety. As an example, compliance issues are expected on other continental shelfs where the EU Directives are unknown.
  4. The costs would be related to new equipment costs, testing costs, re-certification costs, retrofitting costs, downtime costs, surveys, etc.
  5. Certification according to ATEX Directive, MD and PED is normally good only between 3 and 5 years so re-certification of the compliant equipment is also expected.

  On the other hand (3/19) companies have provided the following rough approximations of the costs:

1. A company selecting the BOP (including its control units) as the subcategory of equipment to estimate the costs and which is currently planning the replacement of the BOPs and its controls to comply with the latest API specifications says that this operation would have an approximated associated cost of USD$25 MM. This company is not aware of any EU Directives compliant BOPs currently available in the market. Related to the substantive and certification cost of the BOPs and its control units to comply with the EU Directives this company has said:

   Substantive costs: Can be termed as extremely high (10,000€ per component as minimum). It has to be noted that there are dozens of main sub-components in the BOP and in the BOP control systems. Cost likely to lead to MODUs departing EU sector.

   Administrative costs: See Table C-4.

Table C-4. Administrative costs for a BOP and its control unit to comply with the EU Product Safety Directives

	Familiarization with new regulation	Additional consulting	Certification process
To comply with ATEX Directive	50,000 € (one-off cost)	20,000 €/subcomponent (once per year)	20,000 €/subcomponent (once per year)
To comply with MD	50,000 € (one-off cost)	20,000 €/subcomponent (once per year)	20,000 €/subcomponent (once per year)
To comply with PED	50,000 € (one-off cost)	20,000 €/subcomponent (once per year)	20,000 €/subcomponent (once per year)

2. Another drilling contractor, which has not selected a specific category of equipment but instead has considered the whole rig, has estimated the total cost of compliance with the EU Product Safety Directives in 28,000,000€ per MODU. The breakdown of the total amount is shown in Table C-5.

Table C-5. Costs for a MODU to comply with the EU Product Safety Directives

	Substantive costs		Administrative costs		
	Purchase of equipment	Certification process	Familiarization with new regulation	Additional consulting	Certification process
To comply with ATEX Directive	5,000,000€ (one-off cost)	1,000,000€ (one-off cost)	300,000€ (per year)	300,000€ (per year)	300,000€ (per year)
To comply with MD	5,000,000€ (one-off cost)	1,000,000€ (one-off cost)	300,000€ (per year)	300,000€ (per year)	300,000€ (per year)
To comply with PED	15,000,000€ (one-off cost)	1,000,000€ (one-off cost)	300,000€ (per year)	300,000€ (per year)	300,000€ (per year)

3. Another drilling contractor which is placed in Europe and has selected the drilling equipment (hoisting, lifting, handling and rotary systems) as the specific equipment subcategory, has roughly estimated the costs of compliance for this subcategory in the range 10-75 million € per MODU rig, depending on if current equipment can be reviewed for certification compliance or need replacement by new. This drilling contractor, with 10 MODUs in European waters, is concerned about the low level of standardization between equipment on MODUs (although same model, there are small differences). As the equipment make-model and sub models have a large variety on existing MODUs, performing type approvals (grouping of equipment) will be very difficult or not possible, hence it will require individual assessment. This will increase cost/effort/time, etc.

   The substantive and administrative costs shown in Table C-6 and in Table C-7 have been considered.

Table C-6. Substantive costs for drilling equipment (hoisting, lifting, handling and rotary systems) to comply with the EU Product Safety Directives

	Redesign for new equipment interface	New materials	Changes in testing	New production machinery	Purchase of the specific subcategory of equipment	Certification process
To comply with ATEX Directive	1,000,000€ (one-off cost)	75,000,000 € including installation costs (one-off cost)	Up to 10,000€ (one-off cost)	10,000,000€ – 75,000,000€ (one-off cost)	3,000,000€ (one-off cost)	4,000,000€ (one-off cost)
To comply with MD	1,000,000€ (one-off cost)	75,000,000 € including installation costs (one-off cost)	Up to 10,000€ (one-off cost)	10,000,000€ – 75,000,000€ (one-off cost)	3,000,000€ (one-off cost)	5,000,000€ (one-off cost)
To comply with PED	500,000€ (one-off cost)	1,000,000€ (one-off cost)	Up to 10,000€ (one-off cost)	Up to 1,000,000€ (one-off cost)	Up to 500,000€ (one-off cost)	Up to 1,000,000€ (one-off cost)

Table C-7. Administrative costs for drilling equipment (hoisting, lifting, handling and rotary systems) to comply with the EU Product Safety Directives

	Familiarization with new regulation	Additional consulting
To comply with ATEX Directive	8,000€ (every five years)	50,000€ (every five years)
To comply with MD	8,000€ (every five years)	50,000€ (every five years)
To comply with PED	8,000€ (every five years)	10,000€ (every five years)

(4/19) companies have not answered the question.

- **Significant time delays:** (13/19) companies expect time delays in their business if the legislation is extended. The related comments are shown below:

  1. At least 18 months of delays.

2. When last ordered, the main BOP sub-components were on a lead time of 2.5 years to API standards (normal world-wide industry standards). Therefore would be fair to estimate a far longer lead time to order the same components to any new EU Directive requirements.
3. Delays would be expected for equipment suppliers as many of them are not sited in the EU/EEA area.
4. Enough transition time should be allowed in case of extension of the EU Product Safety Directives in order to manufacture, test and provide results to appropriate bodies. At a very minimum 3 years should be considered.
5. It could take as minimum 5 years and up to 10 years to re-certificate or renew the equipment in all the units.
6. No MODU in operation at the current point in time complies fully with the EU Product Safety Directives, given the fact that they operate in an international environment, and will thus be assessed against internationally known and recognized standards. Requiring an entire industry to utilize EU Product Safety Directives certified equipment could mean that the entire drilling industry will face severe delays, which would be debilitating to the security of the European energy supply and the industry in general. Also, double certification (which would be required to retain global mobility) would add administrative burdens and cost with no proven added values.

(1/19) company, taking into account the numerous pieces and types in its assets, finds it difficult to estimate the time delays.

(5/19) companies have not answered the question.

These results are shown in Figure C-.

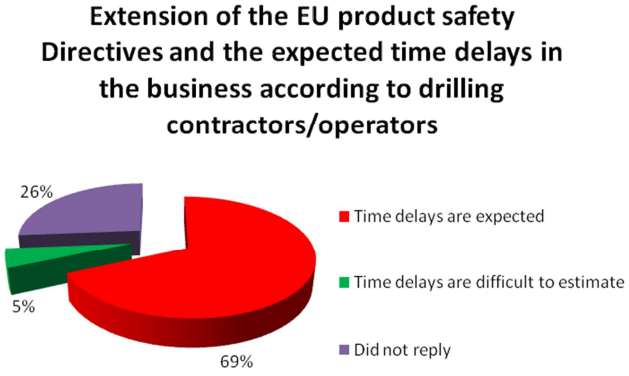


Figure C-9. Extension of the EU Product Safety Directives and the expected time delays according to drilling contractors/operators

- **Difficulties of compliance for the selected specific subcategory of equipment:** (7/19) companies find it difficult to comply with all three Directives (ATEX Directive, MD and PED), (1/19) to comply with ATEX Directive and MD and (1/19) to comply with ATEX Directive. One company is concerned about the mechanical implications of the ATEX Directive. Another company is concerned about the compatibility between worldwide used industry API standards, as BOPs are currently designed to these, and the PED. It would be needed major Original Equipment Manufacturers (OEMs) to advise of anticipated difficulties in maintaining worldwide API compliance whilst adding EU specific Directives requirements.

  The difficulties the companies think they could find to comply with all 3 European Product Safety Directives are:

1. Equipment suppliers lack of knowledge, extensive reviews and Notified Bodies lack of capacity.
2. The replacement/re-certification of most of the equipment.
3. New equipment probably would not be an issue but any retrospective application of the Directives on existing equipment would be technically and financially challenging.
4. Additional costs that are not justified, delayed delivery of equipment and downtimes.
5. Important costs for any new certification/equipment changes which could lead to a significant loss of revenue.
6. The majority of the equipment comes from different parts of the world and is manufactured according to international standards but not exclusive from the EU. So, manufacturers will have to be adapted to the EU standards before starting the operations.

(10/19) companies have not answered the question.

- **Extension of PED to well-control equipment. Solved problems?:** (1/19) O&G company thinks that the extension of the PED would clarify the criteria in the EU/EEA area on acceptance of equipment and suggests a gap analysis of the PED with the standards currently followed in the industry in order to formulate the legislation appropriately. On the contrary (13/19) companies do not expect any problem to be solved because:

  1. Well-control equipment is already well covered by the existing legislation and industry standards.
  2. In particular for well-control equipment (BOPs, etc.) the already applied API standards go in great detail regarding to equipment required configuration and performance including pressure ratings and safety devices, next to fabrication and in use testing requirements. The application of PED would not add any value as PED is not specific enough for equipment and does not consider these specific requirements.
  3. Well-control equipment is adequately managed by the recently issued API Standard 53 (Blow-out Prevention Equipment Systems for Drilling Wells).
  4. Application of a generic Directive to critical emergency equipment to which the industry is committed to updating specific standards would be wholly counterproductive.

  (5/19) companies have not answered the question.

- **Extension of PED to well-control equipment. Is PED suitable for well-control equipment?:** (12/19) companies think that the PED is not suitable for well-control equipment because it is already covered by the currently applied API standards, in which the EHSRs of the PED are implicit. On the other hand (1/19) O&G company thinks that PED is suitable for well-control equipment only on what relates to safety on-board (affecting control lines and koomey unit). The acceptance and operation of well-control equipment follows very specific and extensive regulation and testing procedures that go beyond the scope of the EU Directives, more focused on verifying suitability of well-control-equipment design to wellbore conditions. (6/19) companies have not answered the question. These results are shown in Figure C-.

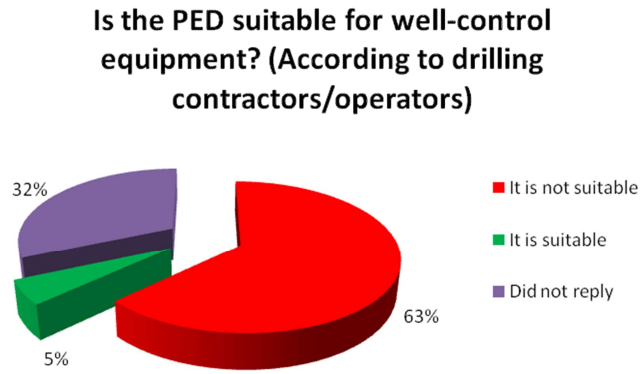


Figure C-10. Extension of the PED to well-control equipment. Is it suitable? (According to drilling contractors/operators)

- **Extension of PED to well-control equipment. Difficulties for companies and affection to the market:** (14/19) companies would have difficulties due to the extension of the PED to well-control equipment. The expected difficulties are:

  1. EU Directives and standards are not recognized in many regions of the world. PED is not a recognized standard in the industry and specifically in the countries where most well-control equipment is manufactured which refer to internationally recognized standards like API standard 53. This will cause additional administrative work and cost for no tangible benefit.
  2. The huge investments that companies should do in order to recertify and replace the equipment would have a negative impact on the market.
  3. More legislation and costs will make the market in the UK even less attractive that it is now.
  4. Costs, equipment availability and lead time (in descending order). EU/EEA market is already one of the most expensive to operate in.
  5. The insufficient capacity of vendors/suppliers will result in a none-availability of MODUs for drilling and thus abandoned work as scheduled by operators. Increase of costs for operators.
  6. Equipment upgrades for older equipment, but this is a problem that companies are facing already from the issuance of more restrictive international Directives.
  7. An O&G company foresees the following process coming out the application of the Directives: a. Revision to identify the equipment which would not comply (by a certification company), b. Upgrades needed to meet the requirements, etc., c. Recertification by the same or different 3rd party. This may cause temporary delays in operations, market restrictions and cost increases.

  (5/19) companies have not answered the question.

- **Extension of PED to well-control equipment. Is it necessary to modify the standards currently used to meet the EHSRs of the PED?:** (14/19) companies think that it is not necessary. One company points out that the ESRs of the PED are already implicit within the relevant API standards. Another company says that the standards are modified as required on a running basis and the EC regulation does not need to attempt to drive this development. (1/19) A company placed in UK thinks that API standards could be reviewed or gap analyzed against ATEX Directive and MD. (4/19) companies have not answered the question.

- **Extension of PED to well-control equipment. Barriers to trade?:** (13/19) companies think that the extension of PED to well-control equipment will create barriers to trade. The affirmation is based on:

  1. PED is not a recognized standard in the industry and specifically in the countries where most well-control equipment is manufactured.
  2. The extension can only increase the costs, which will make the UK less attractive than other areas for MODUs to operate.
  3. The extension would incur significant cost and time to initially determine existing levels of compliance across a massive variety and quantity of equipment, followed by further significant cost and time in replacing or re-certifying non-compliant equipment, which may not be practicable or even achievable in some cases. If compliance could be achieved, the associated cost would have to be attempted to be recovered through operational day rates in an already depressed market place (MODUs are already being cold-stacked and scrapped). To move or retain units into an EU area would therefore become prohibitively expensive. Worth noting that EU/EEA is already one of the most expensive operating areas without application of yet further legislation.
  4. We are going to have to increase effort to ensure we comply with both EU and API requirements (as an industry we are totally committed to the industry recognized standards as API Standard 53).
  5. The majority of the equipment comes from different parts of the world and is manufactured according the O&G international standards. So, the extension could create a real trade barrier.

  (6/19) companies do not have opinion about this point.

D. Certification Bodies: Overview of their answers

- Eight Certification Bodies have provided an answer to the Survey and any of them agreed to publish its answer with its data included. 5/8 Certification Bodies are large sized, one is medium and two are small.
- 1/8 Certification Body **certifies equipment** only **for** onshore installations, 1/8 for fixed offshore, 1/8 for offshore installations (both fixed and MODUs), 4/8 for all types of installations (MODUs, fixed offshore, and onshore). Finally 1/8 Certification Body is certifying according to the PED but is not involved in the O&G rig sector. Thus, in total 5/8 Certification Bodies certify equipment for MODUs, 6/8 for fixed offshore installations, and 5/8 for onshore installations.
- **Other activities carried out by the Certification Bodies are:**
  1. (1/8) Certification according to PED and RCD (Recreational Craft Directive)
  2. (1/8) Maritime/ship related activities
  3. (1/8) Certification of any O&G and non O&G assets, either onshore and offshore (including subsea)
  4. (1/8) Working as Notified Body
- 6/8 Certification Bodies are dealing with PED, 3/8 with ATEX, and only 2/8 with MD. 5/8 Certification Bodies are dealing also with IMO MODU Code and in three cases with the Marine Equipment Directive. Other mentioned legislation is: Classification Society Rules, UK Safety Case Regulations, Shelf state regulations, Maritime authority regulations, National and Industrial standards, etc.

  In Figure D-1a and Figure D-1b **the main activities and Directives/Codes the Certification Bodies are dealing with** are shown.

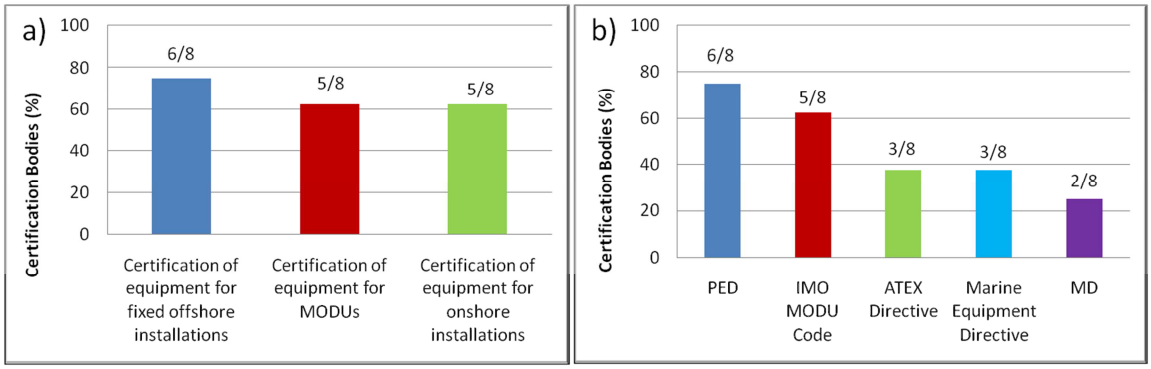


Figure D-1a. Main activities carried out by the Certification Bodies; Figure D-1b. Main Directives and Codes used by the Certification Bodies

- The main **origins of the manufactures of the equipment the Certification Bodies are certifying** are: EU/EEA with at least 60-70%, then US with 30-40% and Asia/Pacific with less than 30%. The revenue for the Certification Bodies comes mainly from the EU/EEA area and then the US. Some increase in the level of revenue are seeing in a movement towards Asian equipment (Singapore, Korea and China) as reported in one of the replies.
- The **importance** (low importance: <40%; medium importance: 40-70%; high importance >70%) **of the main categories of equipment for the Certification Bodies, according to the share in their revenue**, is presented in Table D-1:

Table D-1. Importance of the main categories of equipment for the Certification Bodies

Number of answers	High	Medium	Low
Drilling equipment	3	2	3
Well intervention equipment	2	0	6
Material handling equipment	2	3	3
Well-control equipment	4	2	2
Other pressure equipment	2	4	2
Electrical equipment	3	3	2

Every category of equipment is of high importance for at least 2/8 Certification Bodies. Additionally, 2/8 Certification Bodies expect an overall decrease of the supply chain market driven by the oil price and the general depression in the offshore market worldwide.

- In Figure D-2 the **main categories of equipment (with high importance in terms of revenue) the Certification Bodies are** dealing with are shown.

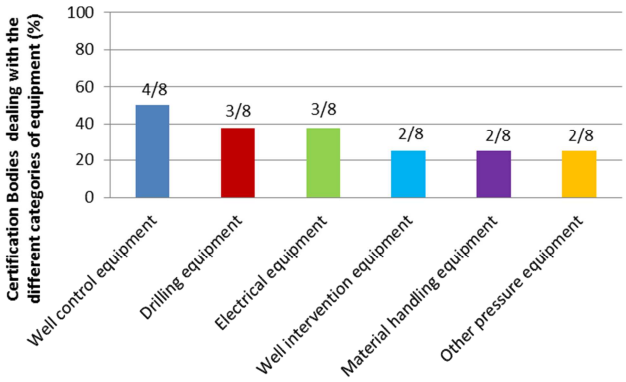


Figure D-2. Main categories of equipment (with high importance in terms of revenue) the Certification Bodies are dealing with

- **Differences between the equipment installed on MODUs and on fixed platforms:** For 50% of the Certification Bodies the equipment is almost identical with small modifications due to the adverse conditions of use (e. g. salt water, strong vibrations, ice...), and the fact that must endure the dynamic behaviour from wave actions, etc. 25% Certification Bodies replied that the question is not applicable since there is a variety of equipment that is identical while some have different requirements due to special functions or additional load of moving vessels. The other 25% of the Certification Bodies did not reply. The opinion of the Certification Bodies related to the equipment on-board MODUs in comparison with the equipment for fixed offshore and onshore installations is shown in Figure D-3.

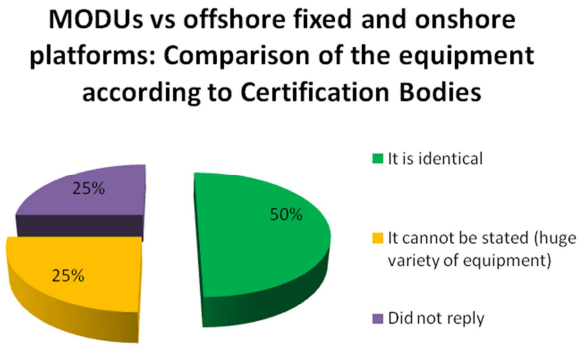


Figure D-3. Opinion of the Certification Bodies related to the equipment on-board MODUs in comparison with the equipment for fixed offshore and onshore installations

- **Standards**: 7/8 Certification Bodies use ISO standards and six use IEC standards. 5/8 Certification Bodies use EN standards while three do not (one Certification Body uses IEC standards evaluated by EN). 5/8 Certification Bodies use NORSOK standards and one Certification Body reported that uses NORSOK standards only for the equipment in the Norwegian shelf. 5/8 Certification Bodies use BS and 6/8 Certification Bodies use US standards such as ASME, ASTM, ANSI, and API.

  For 4/8 Certification Bodies it would be necessary to modify technical standards in order to meet the Essential Health and Safety Requirements (EHSRs) of the EU Directives, while 4/8 believe that it would not be necessary. The reasons are 1. all the modifying that was needed has already been done, and 2. the Essential Health and Safety Requirements (EHSRs) should be solved rather through Safety Case assessments under the national regulations implementing the EU Offshore Safety Directive.

- **Foreseen impacts on the equipment (in terms of design, manufacturing, conformity assessment etc.) of the extension of scope of the EU Product Safety Directives (ATEX, MD and PED):**

  (3/8) Certification Bodies are certifying equipment according to the ATEX Directive. According to its experience with the Directive in fixed installations, the expected impact due to the extension of ATEX Directive to MODUs would be: for (3/3) changes in the testing, (2/3) to undergo a certification process, and (1/3) new design and low impact related to new materials.

  (2/8) Certification Bodies are certifying equipment according to the MD. According to its experience with the Directive in fixed installations, the expected impact due to the extension of the MD to MODUs would be: for (2/2) changes in the testing, (2/2) to undergo a certification process, and (1/2) new design and low impact related to new materials.

  (6/8) Certification Bodies are certifying equipment according to the PED but of these, (1/6) is not involved in the O&G rig sector. According to its experience with the Directive in fixed installations, the expected impact due to the extension of the MD to MODUs would be: for (4/5) to undergo a certification process, (3/5) changes in the testing, (3/5) new materials, (2/5) new design, (2/5) changes in the 3rd party as with the new legislation it would be the a Notified Body, (1/5) changes in the production lines, and for (1/5) the changes would be mainly on paper and no necessarily technical.

  Thus, the expected changes due to the extension of the EU Product Safety Directives would be mainly related to changes in the testing and to the certification process.

- **Would the extension of scope of the EU Product Safety Directives (ATEX, MD and PED) create barriers to trade?:** 4/8 Certification Bodies believe that the extension of scope of the EU Product Safety Directives to cover equipment installed on MODU would create barriers to trade. The reasons are 1.the incompatibility of some items with the Directives (some API materials used by major US companies may not meet the PED traceability assessment), 2. Activities should be focused at international level in ISO, since there is already activity done, e.g. in the drilling and production equipment (TC67/SC4)[97] which would not need duplication of effort.

  On the other hand, 3/8 Certification Bodies believe that the extension of scope of the EU Product Safety Directives would remove barriers to trade.

  1/8 did not provide any answer to this question.

  The opinion of the Certification Bodies related to the impact of the extension of the EU Product Safety Directives on the trade is shown in Figure D-4.

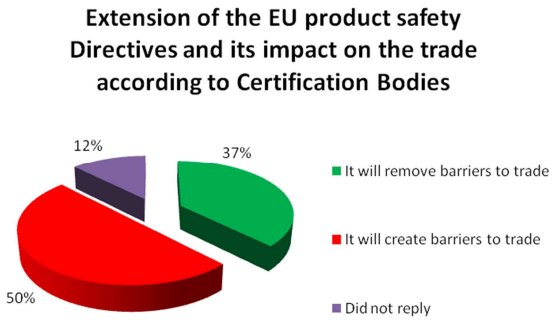


Figure D-4. Extension of the EU Product Safety Directives and its impact on the trade according to Certification Bodies

- **Would the costs of compliance with the EU Safety Directives put EU/EEA companies at a disadvantage compared to their competitors from within/outside EU/EEA (e.g. by creating an uneven playfield)?**

  Within EU/EEA: (6/8) Certification Bodies think that the EU/EEA companies would not be at a disadvantage compared to their competitors from within EU/EEA because 1. The same legislation would apply to all, 2. The EU companies already know the Directives, and 3. The EU supply chain is already under threat from Asia (due to costs). The increase in standards should help the EU by forcing Asian manufacturers towards higher quality. (2/8) do not know.

  Outside EU/EEA: (3/8) Certification Bodies think the EU/EEA would not be at a disadvantage compared to their competitors from outside EU/EEA. (1/8) thinks the opposite because MODUs are used worldwide and EU based units would be at disadvantage when competing for work outside EU. (4/8) do not know.

- **Safety of equipment:** For 100% of the Certification Bodies the current exclusion of MODUs from the scope of the EU Product Safety Directives (ATEX, MD, and PED) doesn´t create any safety problem. The reasons are: the IMO MODU Code is enough; the safety is adequately covered by the existing legislation (i.e. through IACS Maritime Class Society[98] and shelf state regulatory compliance); and the physics of explosion protection are the same but the requirements for the equipment on-board MODUs are higher. This last point could be solved by the new

[97] www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=49570

[98] www.iacs.org.uk

standards IEC TC31 (Equipment for explosive atmospheres)[99] and IEC TC18 (Electrical installations of ships and of mobile and fixed offshore units)[100].

3/8 Certification Bodies say that the currently applicable legislation sufficiently guarantees the safety of equipment installed on-board MODUs.2/8 Certification Bodies think the opposite and one of these bases its answer in the fact that there is a room for analysis and improvement to make the industry safer. 1/8 Certification Body is not sure as it claims that the level of safety depends mostly on the manufacturer of the equipment and on the third party. 2/8 Certification Bodies did not reply.

5/8 Certification Bodies believe that the EU Product Safety Directives (ATEX, MD, and PED) would be a suitable legislation to cover equipment installed on MODUs although one of these think that it would not make the equipment safer. For 2/8 Certification Bodies the EU Product Safety Directives would not be a suitable legislation for the equipment on-board MODUs, and 1/8 Certification Body has not reply.

Only 3/8 Certification Bodies certify equipment according to the ATEX Directive. Of these, one thinks that the extension of the ATEX Directive would result in safer equipment, the second one thinks the opposite because safety is adequately covered by the existing regulations, and the third one has not reply to the question. Obviously 5/8 Certification Bodies did not reply as they are not working with the mentioned piece of legislation.

Only 2/8 Certification Bodies certify equipment according to the MD. Of these, one thinks that the extension of the MD would not result in safer equipment because safety is adequately covered by the existing regulations, and the second one has not reply to the question. 6/8 Certification Bodies did not reply to the question as they do not work with the mentioned piece of legislation.

The most common EU product safety Directive among the Certification Bodies is the PED since 6/8 Certification Bodies certify equipment according to it. Of these, two Certification Bodies think the extension of the PED would result in safer equipment whereas another one does not know. The other three think the extension of the PED would not improve the safety of the equipment because currently safety is adequately covered by the existing regulations and because PED would accept some equipment to be self-certified (under module H[101]). 2/8 Certification Bodies did not reply to the question as they do not work with the mentioned piece of legislation.

- **Costs due to the certification process:** The Certification Bodies were asked about the expected costs for the companies due to the certification process of one sub-category of equipment. The selected sub-category was treated as a typical case or example and detailed information on costs were asked. They were also asked about the expected cost for the Public Authorities. Only (2/8) Certification Bodies answered the question. The first one said that some extra costs could be expected for companies but not for Public Authorities. The second one said that the well-control equipment would increase its price in 20%. As in the case of the companies, only incomplete information was obtained.

[99] www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1232,25

[100] www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1284,25

[101] With regard to module H of PED: module H is a full quality assurance module and is not – as the operators claim- self certification. A module H is based on a quality management system approved and supervised by a Notified Body.

- **Expected benefits due to the extension of the EU Product Safety Directives to cover equipment on-board MODUs:** 3/8 Certification Bodies have not provided any answer while 2/8 cannot foresee any benefit. 3/8 Certification Body can foresee the following benefits:
  - (1/8) New developed products;
  - (1/8) Training for specific certification requirements, associated with EU only.

  The opinion of the Certification Bodies related to the benefits due to the extension of the EU Product Safety Directives is shown in Figure D-5.

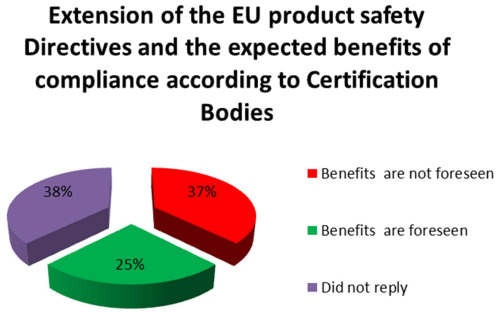


Figure D-5. Extension of the EU Product Safety Directives and its potential benefits according to Certification Bodies

- **Expected time delays due to the extension of the EU Product Safety Directives to cover equipment on-board MODUs.**

  5/8 Certification Bodies don´t foresee any problem related to time availability. CE-marking would be included in line with other regulatory compliance and should not cause delays, when known from the ordering time. It should not make difference in the long run which legislation applies, it may be different legislation than now but the basic process should be the same. Only 1/8 Certification Body foresees such impact. It explains that coordination and additional certifications for EU vs. non-EU service could become complicated. Differences between Certification Bodies could cause problems, particularly in interpretations. 2/8 Certification Bodies do not know if there would be some impacts on time availability.

  The opinion of the Certification Bodies related to the possible time delays due to the extension of the EU Product Safety Directives is shown in Figure D-6.

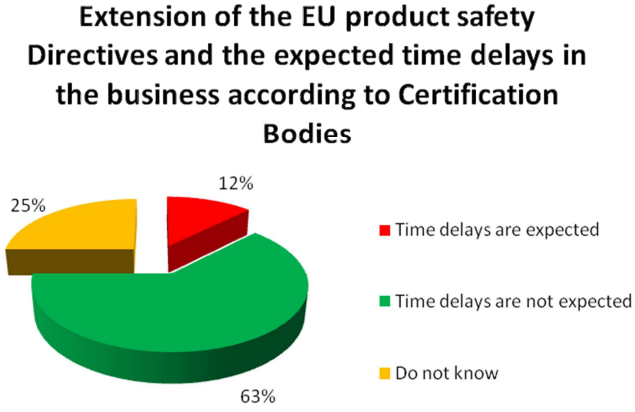


Figure D-6. Extension of the EU Product Safety Directives and the expected time delays according to Certification Bodies

- **Is the PED suitable to cover well-control equipment?:** As pointed out above 2/8 Certification Bodies don´t use the PED as they don´t work with pressure equipment.

  (4/6) Certification Bodies dealing with the PED consider it appropriate to cover well-control equipment. Of these, (1/4) thinks the Directive would be appropriate only for a part of the equipment because it accepts some equipment to be self-certified (under module H which is a full quality assurance module and is not – as the operators claim- self certification) while the drilling rules should require more involvement of a third party. (2/6) Certification Bodies which deal with the PED are not sure about the suitability of the PED for well-control equipment.

  In Figure D-7 the suitability of the PED to cover well-control equipment according to Certification Bodies is shown.

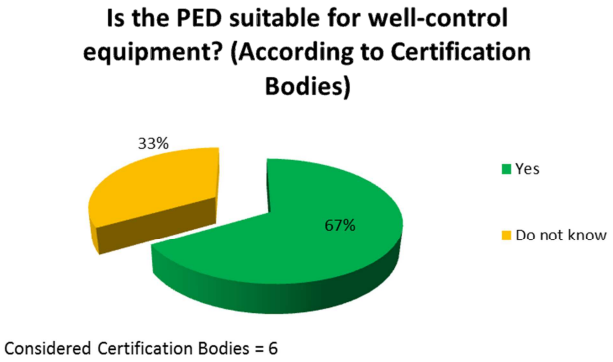


Figure D-7. Extension of the PED to well-control equipment. Is it suitable? (According to Certification Bodies)

- **Would the extension of the PED to cover well-control equipment solve any problem?:** 3/6 Certification Bodies (2/8 Certification Bodies don´t use the PED) think that the extension of the scope of the PED Directive could solve problems. Of these, one Certification Body suggests the application of the PED across the UKCS for all the O&G installations. The potential solved problems would be:

  - As currently national standards are used, the extension would lead to a harmonization of the legislation across the EEA area.
  - Safety and environmental problems (without specifying which)

  1/6 Certification Body does not foresee any solved problem due to the extension of the PED to cover well-control equipment. 2/6 Certification Bodies find it difficult to foresee the potential solved problems.

  In Figure D-8 the opinion of the Certification Bodies regarding the potential solved problems due to the extension of the PED to cover well-control equipment is shown.

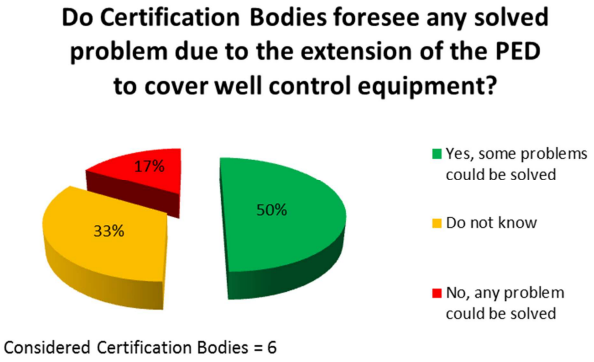


Figure D-8. Extension of the PED to well-control equipment and its potential solved problems according to Certification Bodies

- **Expected difficulties due to the extension of the PED to cover well-control equipment:** (4/6) Certification Bodies would expect the following difficulties:
  - Purchasing of PED compliant material;
  - Change of the design code to a "PED friendly code";
  - Equipment is to a large extent manufactured outside EU according to non-harmonised standards. Thus, certification costs and difficulties due to the change of the technical references.
  - Lack of availability of approved personnel outside EU.

  (1/6) Certification Body would not expect any difficulty and (1/6) did not know.

- **Would it be necessary to modify the technical standards currently in use to meet the EHSRs of the PED?:** (4/6) Certification Bodies would expect the following difficulties:

  4/6 Certification Bodies say that it would be necessary to modify the existing standards to meet the EHSRs of the PED. Of these, (1/6) suggests the inclusion of an annex in the currently applied standards in order to show how to achieve compliance with the EHSRs. On the contrary 2/6 say that it would not be necessary any modification. Another one thinks that more harmonised standards are needed.

- **Would the extension of the PED to cover well-control equipment create any barrier to trade?:** (4/6) Certification Bodies do not foresee any barrier. Of these, one Certification Body does not expect long-term barriers although there could be some difficulties in the beginning. On the contrary, 2/6 Certification Bodies foresee such barriers. The opinion of the Certification Bodies about the potential barriers to trade due to the extension of the PED to cover well-control equipment is shown in Figure D-9.

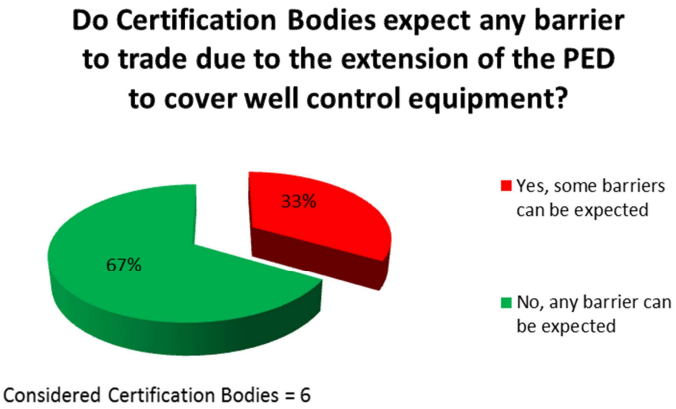


Figure D-9. Extension of the PED to well-control equipment and its impact on the trade according to Certification Bodies

E. Public Authorities: Overview of their answers

- Seven Public Authorities have answered the Survey. (1/7) Public Authority does not consent the to the publication of its reply, (5/7) agree with the publication of the results in an anonymous form, while the Health and Safety Executives Authority from UK consents to the publication of its reply with its data included.

- According to their **size**, (2/7) Public Authorities are large, (4/7) medium while (1/7) is small (taking into account only the offshore section of that Authority). All Public Authorities have their main activities within EU/EEA and (6/7) with a share higher than 80%.

- All Public Authorities **supervise the implementation of** ATEX 2014/34/EU, MD 2006/42/EC and PED 2014/68/EU, and (3/7) also supervise the implementation of the EU Offshore Safety Directive 2013/30/EU. (4/7) deal with the IMO MODU Code and (2/7) with the Marine Equipment Directive 96/98/EC. Other activities the Public Authorities are dealing with are:

  1. Independent government regulator with responsibility for safety, emergency preparedness, and the working environment in the oil and gas industry;
  2. Responsible market surveillance authority within the petroleum industry for EU product safety legislation (ATEX, MD and PED) and other harmonised Product Safety Directives. In these cases the Public Authorities give guidance to the industry on how to understand and apply the various Directives which have been implemented at a national level and carry out market surveillance activities;
  3. Ensuring compliance with domestic health and safety legislation;
  4. Supervision of compliance with the Mining Act, the Metrology Act and the Gas Act;
  5. Supervision of compliance with environmental legislation;
  6. Supervision of compliance with occupational health and safety, working hours and commodities legislation.

  In Figure E-1 the main activities carried out by the Public Authorities are shown.

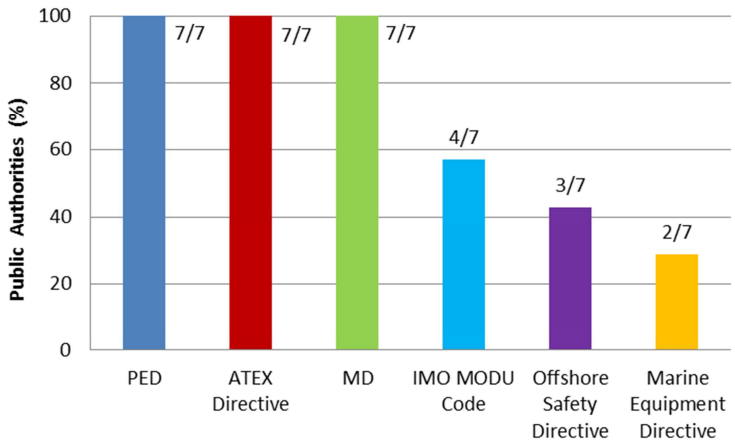


Figure E-1. Main Directives and Codes the Public Authorities are dealing with

- (6/7) Public Authorities use the ISO standards (some of the ISO standards are actually EN ISO as reported by three Authorities) and the IEC standards. (4/7) Public Authorities use the NORSOK standards, (4/7) the US standards such as API

or ASME, (2/7) the DNV standards while none of them uses BS. Additionally, the following legislation is used:

- Domestic health and safety legislation;
- Health and safety at work legislation;
- Rules prepared by classification institutions;
- Regulations prepared by other Public Authorities that do not directly apply to the petroleum activities, but which are still relevant for the field;
- Regulatory requirements that are not directly applied to the petroleum activities, but which govern corresponding or adjacent areas, e.g. requirements stipulated by the Maritime Authority.

o **Main categories of Equipment**: The number of Public Authorities which find the compliance of the equipment categories with the EU product safety legislation of high importance is shown in Table E-1.

Table E-1. Number of Public Authorities which find the compliance of the equipment categories with the EU product safety legislation of high importance

	ATEX	MD	PED
Drilling equipment	5/7	6/7	3/7
Well intervention equipment	6/7	5/7	3/7
Material handling equipment	5/7	6/7	1/7
Well-control equipment	5/7	5/7	6/7
Other pressure equipment	5/7	1/7	6/7
Electrical equipment	6/7	0/7	0/7

The Public Authority Health and Safety Executives did not reply the question, but thinks that all such equipment should comply with relevant technical standards, reflecting a good industry practice.

o **Is the fact that MODUs are out of the scope of the EU Product Safety Directives creating a safety problem?:**

(4/7) Public Authorities think the current situation in which MODUs are out of the scope of the EU Product Safety Directives is creating a safety problem because:

- (1/4) Workers on MODUs are less protected than their counterparts on land;
- (2/4) Different safety standards apply to the equipment being used on fixed platforms and MODUs undertaking similar work, with the latter falling short of the Essential Health and Safety Requirements (EHSRs) of the relevant Directives;
- (1/4) gives specific examples of unsafe situations on MODUs, where the EU Product Safety Directives cannot be currently enforced:
  - ✓ Some equipment is not ATEX compliant in an area where it should have been;
  - ✓ Automation of drilling equipment where the control systems are not built according to the Machinery Directive.

On the contrary, the Public Authority Safety, Health and Safety Executive from the UK thinks that the current situation does not cause any safety problem.

(1/7) Public Authority makes reference to safety statistics without giving a clear answer and (1/7) did not answer.

- **Possible solved problems due to the extension of the legislation:**

(4/7) Public Authorities think that the following problems would be solved:

- Safety and environmental problems (without specifying which);
- Bring both MODUs and fixed platforms under the same safety and environmental requirements that meet the EU relevant Directives and also equate them to similar equipment used onshore. It would facilitate the achievement of the product safety through the application of the harmonised standards. At present, some equipment used on MODUs only meet standards that are not harmonised in the EU and which do not meet all the EHSRs of the relevant Directives thus undermining the safety system in the EU;
- Provide a simplified legislation and regime to increase practicality for both the industry and the regulators. In a common regime the Regulator could supervise more consistently;
- Reduce uncertainty and save time when verifying applicable equipment and clarifying supervision roles;
- Give a common approach to the risks offshore and onshore for the same type of equipment and activity, thus facilitating and improving the risk identification, management and communication process;
- Ensure compatible measures for reducing risks and protecting personnel wherever they are working;
- Provide harmonization of the scope of the relevant Product Safety Directives so work equipment´s status would be consistent.

Additionally (1/7) Public Authorities feels that no problem would be solved due to the extension of the legislation, (1/7) makes reference to accident statistics without giving a clear answer, and (1/7) did not answered the question.

The opinion of the Public Authorities about the possible solved problems due to the extension of the legislation is shown in Figure E-2.

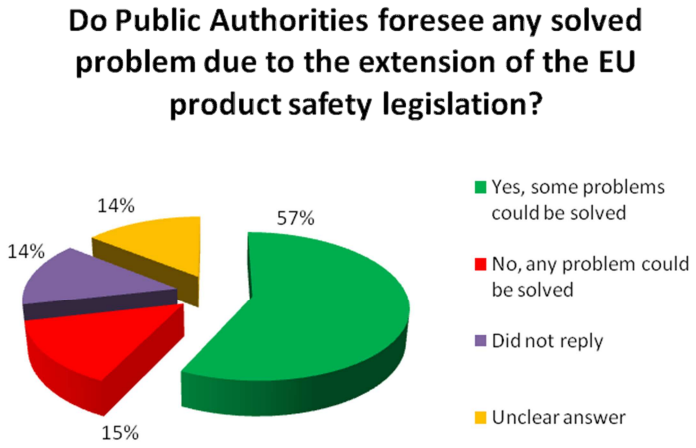


Figure E-2. Extension of EU Product Safety Directives and its potential solved problems according to Public Authorities

- **Would the EU Product Safety Directives be a suitable legislation for equipment on MODUs?**

  (5/7) Authorities say that the EU Product Safety Directives would be a suitable legislation for the equipment installed on MODUs since they are already applied to similar equipment used on fixed platforms and it is illogical for the same process and equipment to be subject to different safety requirements when used in the same location for the same process in the EU. Safety, Health and Safety Executives from the UK thinks that the EU Product Safety Directives would not be suitable for the equipment on-board MODUs. (1/7) Public Authority did not reply the question. These results are shown in Figure E-3.

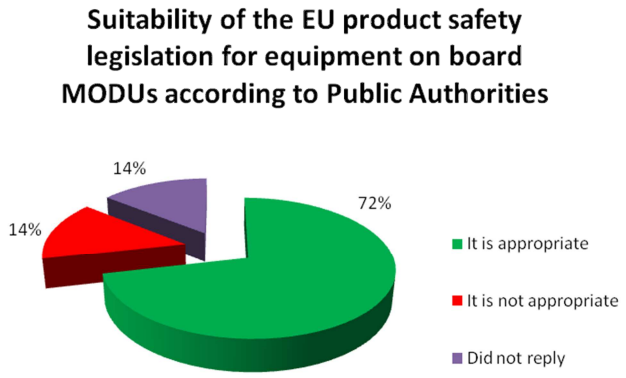


Figure E-3. Suitability of the EU product safety legislation for equipment on-board MODUs according to Public Authorities

- **What particular difficulties companies may face and how this could affect the market?**

  (6/7) Public Authorities think that companies may face difficulties due to the extension of the legislation to cover equipment on MODUs, and these are:

  - MODUs may only spend a limited time in EU waters and may otherwise operate elsewhere in the world. In such situation, companies may have to upgrade some of their equipment and/or reprogram their activities.
  - Demanding compliance with the EU Product Safety Directives (ATEX, MD and PED) would most likely mean high cost implications. There would be two categories of MODUs, with and without implemented harmonised standards. This would potentially limit the competition in a worldwide perspective as these MODUs would be more expensive than MODUs not complying with the EU regulation. A side factor could be that drilling contractors would offer to EU-operators old rigs at cheap daily rates.
  - The difficulties that companies would face go beyond the limits of the EU legislation, and the problem would be how to enforce EU legislation in a worldwide market.
  - Additional tests to demonstrate compliance.

  (1/7) Public Authority did not reply.

- **Is it necessary to modify the technical standards which are in use in the sector in order to meet the Essential Health and Safety Requirements (EHSRs) of the Directives?**

  (4/7) Public Authorities think that it is necessary to modify the standards to meet the EHSRs of the Directives. One of these proposes a gap analysis because the necessary extent of modification is unknown.

  (2/7) think that the answer depends on the Directive considered. On the one hand if ATEX is considered, technical standards within it would not need to be modified as IMO MODU Code refers to IEC standards and most of these standards are harmonised with ATEX. On the other hand, in the case of the Machinery Directive this is not a simple question as there are currently no harmonised technical standards for much of the equipment used offshore. This is the reason for the draft mandate to CEN (TC12) to draw up such standards, e.g. under the Vienna Agreement. For these Public Authorities it would be enough with the standards that do apply to equipment on fixed platforms, as those would not require modification for use on MODUs.

- **Barriers to trade**

  The opinion of the Public Authorities related to the creation of barriers to trade is quite divided. (2/7) Public Authority believes that the extension of the legislation would not create barriers to trade because many companies are already supplying CE marked items to fixed platforms. On the contrary, (4/7) Public Authorities think the extension of the legislation would create barriers to trade. One of these thinks that manufacturers outside the EU would find it more difficult to supply equipment into the EU market place. (1/7) Public Authorities has not answered the question. The opinion of the Public Authorities about the extension of the EU Product Safety Directives to equipment on-board MODUs and its impact on the trade is shown in Figure E-4.

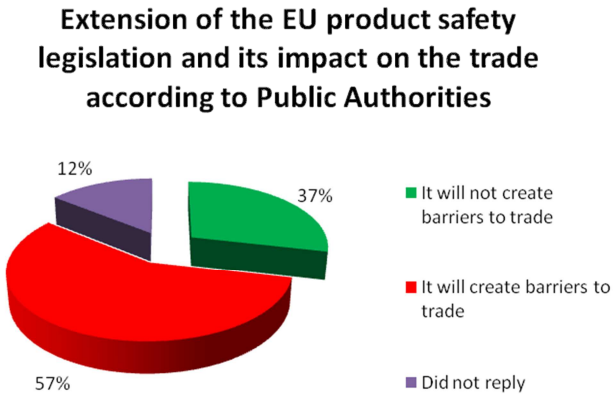


Figure E-4. Extension of the EU product safety legislation and its impact on the trade according to Public Authorities

- **Would the cost of compliance to the EU Product Safety Directives likely to put EU/EEA companies at a disadvantage compared to competitors from within EU/EEA (by creating an uneven playfield)?**

  (3/7) Public Authorities think an uneven playfield would not be created within the EU/EEA. Another (3/7) do not know what to think. Only (1/7) Public Authorities think the EU/EEA companies would be at a disadvantage in comparison with their competitors from within EU/EEA, especially the small and medium enterprises (SMEs).

- **Would the cost of compliance to the EU Product Safety Directives likely to put EU/EEA companies at a disadvantage compared to competitors from outside EU/EEA (by creating an uneven playfield)?**

  (3/7) Public Authorities think the EU/EEA companies would not be at a disadvantage compared to their competitors from outside EU/EEA. One of these says that most of the equipment is produced in small or single batches and thus, the EU/EEA companies supplying to outside the EU would find it easy to modify individual designs to a significant extent with minimal extra cost. In addition, the EU/EEA companies are already supplying CE marked items to fixed platforms.

  Only (1/7) Public Authorities think the EU/EEA companies would be at a disadvantage in comparison with their competitors from outside the EU/EEA. The demanding compliance with the EU Product Safety Directives would potentially limit the competition in a worldwide perspective as these MODUs would be more expensive than MODUs not complying with the EU legislation.

  (3/7) do not know what to think.

- **Would the compliance with the EU Product Safety Directives generate a disproportional amount of administrative burdens compared to the benefits?**

  For companies: (2/7) Public Authorities would expect administrative burdens for companies. For one of these, the demonstration of compliance with the EU Product Safety Directives would require a significant amount of administrative effort compared to the benefits over current arrangements. (2/7) Public Authorities think that no administrative burdens would exist because the requirements are already there for fixed installations offshore and onshore. The administrative burden would be significant only for companies which are currently violating the EU/EEA legislation by supplying non-compliant equipment to fixed platforms. (2/7) did not reply and (1/7) did not know.

  For Public Authorities: (1/7) Public Authority would expect administrative burdens for Public Authorities as the enforcement of compliance with the EU Product Safety Directives would require a significant amount of administrative effort compared to the benefits over current arrangements. (2/7) Public Authorities think that no administrative burdens would exist for Public Authorities because these are already dealing with the Directives for fixed installations and the requirements would be the same. (3/7) did not reply and (1/7) did not know.

- **Would the compliance of products/services of certain companies with the EU Product Safety Directives have a negative impact on the on-time availability of products/services of those companies?**

  (2/7) Public Authorities think that the extension of the legislation would have negative impact on the availability of the equipment. The reason, according to one of these Public Authorities, would be the fact that companies may have to upgrade some of their equipment and/or to reprogram their activities.

  On the contrary, (4/7) Public Authorities don´t foresee any delay. For the *Norwegian Petroleum Safety Authority* (PSA) the reason is that such equipment is already in use on fixed platforms and sufficient time would be provided for the industry to adapt to the new requirements. Additionally, in its opinion taking into consideration e.g. compliance with the ATEX Directive, in 99.5% of the cases an IEC Test Report (ExTR) could underpin an ATEX EC-Type Certificate as the technical requirements (IEC and EN standards) are normally identical. A manufacturer elsewhere in the world could obtain IEC reports (ExTR and Quality Assessment

Report-QAR) locally and submit them to a Notification Body for issue of ATEX documentation.

(1/7) Public Authorities would not know what to expect. The results are shown in Figure E-5.

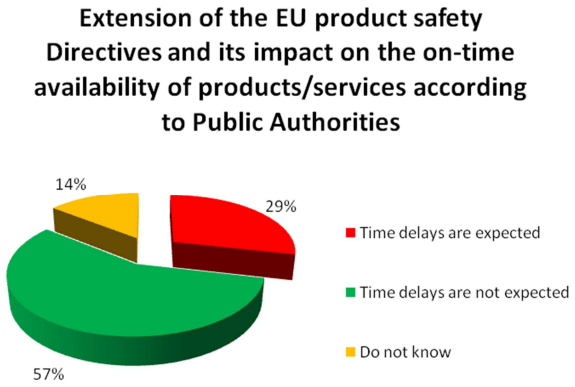


Figure E-5. Extension of the EU product safety legislation and its impact on the on-time availability of products/ services according to Public Authorities

- **Impact of compliance of offshore O&G equipment with the EU Product Safety Directives on risks to health and the environment (including the risk of fire and explosion and the protection of sea water quality)**

(6/7) Public Authorities believe that the extension of the scope of the EU product safety legislation would lead to a significant/very high reduction of the risk. One of these thinks that the reduction of the risk would vary depending on the equipment considered, on average it would be significant but in some cases it would only have a small impact.

For the Public Authority Health and Safety Executives from the UK the extension of the legislation would have only a small impact on the risks to the health and the environment. Indeed, it thinks that there are a number of incidents where compliance with relevant standards may have been a factor.

The opinion of the Public Authorities about the impact of the extension of the EU product safety legislation on risks to health and the environment is shown in Figure E-6.

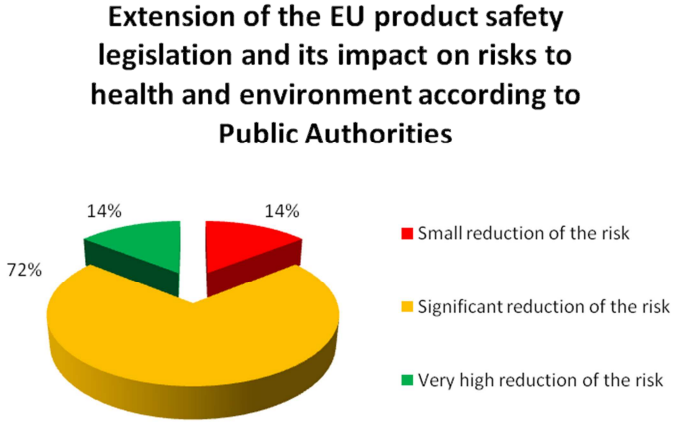


Figure E-6. Extension of the EU product safety legislation and its impact on risks to health and environment according to Public Authorities

Some Public Authorities have provided **examples of accidents/near misses which could have been prevented if the EU Product Safety Directives had been applied:**

- Deepwater Horizon;
- A typical example of such incident is an accident which occurred in the Netherlands in May 2010, during a workover on an "live" offshore gas production well of a normally unmanned platform with a Hydraulic Workover snubbing Unit (HWU), an unexpectedly very serious incident occurred. During the insertion of a new production tubing the operator lost the control of the HWU. As a result several production tubings were blown out of well and ended up on the platform deck area. By a quick intervention of the operator the well was shut in, the blow-out preventer (BOP) was immediately closed and the production was stopped by using the emergency push button.
- The blown out production tubings damaged the methanol injection line of the export gas production pipeline and caused a major gas leak. No persons were injured. In support of the operation a mobile jack-up unit was stationed beside the platform. At the time of the incident there were 71 people aboard of the mobile jack-up unit. This high potential incident could have resulted in multiple fatalities, severe damage to installation and the environment. The incident investigation revealed that, a safety critical part of the HWU was not designed to be 'fail safe', by not implementing inherently safe design measures;
- Lifting equipment: A number of incidents have occurred where the design did not follow the principles of safety integration as required by EU Product Safety Directives. For example non-fixed lifting attachments, such as manually operated side door elevators and riser running tools, where the consequence of failure is the dropping of a very heavy casing and could result in a serious or fatal injury. However, such an incident has the potential of resulting in a major incident involving serious personal injury, the integrity of the drilling rig (installation), or the integrity of the well itself.
    - ✓ Well casing elevator case: The locking mechanism of this lifting accessory relied on a procedure of work to ensure it was correctly locked to secure a casing that is to be lifted above the well prior to lowering it into it. The design of the elevator followed the API 8C standard. EN ISO 13535 is a non-harmonised standard based on API 8C and thus not listed in the EU OJ under the Machinery Directive. In the working conditions it was foreseeable that errors could be made in following the system of work. Such an error has occurred on a number of occasions, resulting in a number of casings being dropped. Due to the very heavy nature of the casing (in the area of 12 – 23 metric tonnes), there is clear potential for fatal and other injury accidents. However there was also the possibility of damage to vital components such as well-control equipment and hence a chain of events leading to a more major incident. Discussions took place with manufacturers and a modified design that met the principle of safety integration and hence the requirements of the Machinery Directive Annex I paragraph 1.1.2, was produced.
    - ✓ Riser running tool case: A similar root cause to the elevator case above as the design relied on work procedures to ensure the tool was secured for lifting. The procedures failed, resulting in the tool being dropped, and could have resulted in a more serious major incident. The riser running tool followed the design principles of API 8C standard which was then developed into the non-harmonised standard EN ISO 13535 (is not listed in the EU OJ under the MD), meaning that there is a clear potential for fatal and other injury accidents. However there was also the possibility of

damage to vital components such as well-control equipment and hence a chain of events leading to a more major incident. Discussions took place with manufacturers and a modified design that met the principle of safety integration and hence the requirements of the Machinery Directive Annex I paragraph 1.1.2, was produced.

According to the Public Authority which has provided the examples of incidents/near misses for lifting equipment, these two cases demonstrate that **drilling hoisting equipment designed manufactured according to the non-harmonised standard EN ISO 13535 (API 8C) do not meet the Essential Health and Safety Requirements (EHSRs) of the Machinery Directive 2006/42/EC**. In consequence, in its opinion the level of safety for workers and the industry would be higher if the products were built according to standards supporting the ESHRs **of the EU product safety legislation.**

- **Societal and employment impact due to the compliance of offshore O&G equipment with the EU Product Safety Directives:** According to the Public Authorities the impact on the society and on the employment would be mainly related to:
  - (4/7) Creation of new job positions in Certification Bodies;
  - (4/7) Increased capacity (posts, skilled staff) from Public Authorities;
  - (3/7) No change in the number of posts but a qualitative impact on the necessary workforce e.g. more skilled personnel.

- **Potential solved problems due to the extension of scope of the PED to cover well-control equipment:**

  (2/7) Public Authorities think that the extension of the PED would solve some problems, and only make reference to general terms e.g. safety and environmental problems, and safer equipment. (2/7) Public Authorities did not know and (3/7) did not answer.

- **Suitability of the PED to cover well-control equipment:**

  (4/7) Public Authorities think that the PED would be a suitable legislation to cover well-control equipment but according to one of these, it would depend on the type of equipment (not specified). (2/7) Public Authorities found it difficult to answer this question and (1/7) Public Authority did not reply. These results are shown in Figure E-7.

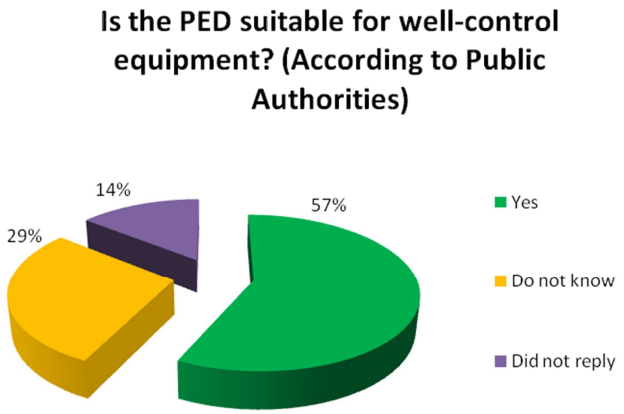


Figure E-7. Suitability of the PED for well-control equipment according to Public Authorities

- **Particular difficulties due to the extension of the PED to cover well-control equipment for companies and affection to the market**

  (3/7) Public Authorities think that companies would face difficulties due to the extension of the PED to cover well-control equipment. For one of these the upgrade/recertification of the existing equipment would be the main difficulty, while for the other two it would be the lack of harmonised standards. (1/7) Public Authority thinks that companies would not face any problem, (2/7) do not know, and (1/7) did not answer.

- **Is it necessary to modify the technical standards currently in use in order to meet the EHSRs of the PED?**

  (3/7) Public Authorities think that a modification of the currently applied standards is needed, although according to one of these, only a partial modification of the standards is needed. A second Public Authority claims a proper review of the standards. (2/7) Public Authorities did not answer and another (2/7) did not know.

- **Would the extension of the PED to cover equipment used for well-control create barriers to trade?:** (1/7) Public Authority thinks that the extension of the PED to well-control equipment, in spite of providing a considerable level of safety for the workers and increasing the systems integrity, would create obstacles to free trade. On the contrary, (1/7) Public Authority thinks that the potential new legislation would not create any barrier to trade. (4/7) Public Authorities do not have an idea of the impact of the extension on the trade. One of these points out the requirements that the Offshore Safety Directive already introduces for the verification of well operations. (1/7) did not reply. See Figure E-8.

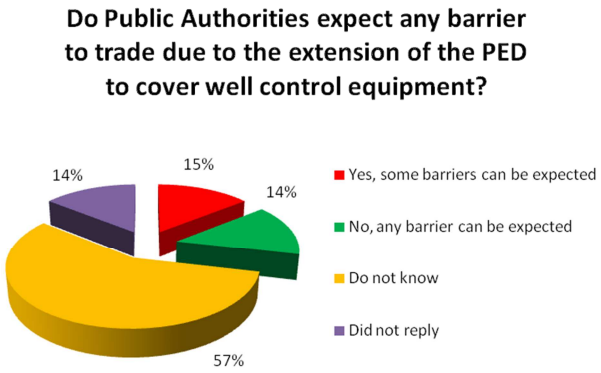


Figure E-8. Extension of the PED to cover well-control equipment and its impact on the trade according to Public Authorities

F. Other types of entities: Overview of their answers

European Community Shipowners´s Associations ECSA

Related to the possible extension of the EU Product Safety legislation (ATEX, MD and PED) to cover MODUs and the equipment installed on such units, ECSA believes that the currently applicable international and national standards cannot be demonstrated to be inferior to the EU Product Safety legislation. Accidents that currently occur cannot be considered as evidence of systemic defects in global standards that could be remedied by these Directives. The application of the Directives can be justified for fixed installations as have hydrocarbons on deck for almost 365 days per year while MODUs are exposed to hydrocarbons for less than 20 days per year. ECSA believes that a general reduction of risk levels offshore is much more likely to be achieved through the Offshore Safety Directive than the EU Product Safety legislation.

It also points out that just differentiating between mobile and fixed rig units is incorrect as in most cases applicable standards are activity related. Thus, production units and fixed platforms will be subject to the same requirements, while mobile drilling units will be subject to an entirely different set of rule parameters given the differences in operational modes and risk picture.

ECSA has reported that the price increase for BOP compliance with PED and ATEX requirements is estimated at 30%. This information is coming from GE Oil & Gas, one of the world´s leading equipment and services´ providers in the oil and gas industry.

ECSA is of the opinion that the extension of the EU Product Safety legislation to MODUs could have the following detrimental effects:

- Reintroducing requirements which can to some extent be considered mandatory may push the industry back to a mind-set of compliance rather than safety.
- It would introduce competitive disadvantage for European MODU owners since it limits the mobility of MODUs.
- It would create significant issues on the supply chain side for owners and operators
- It would constitute an obstacle for EU manufacturers as they would have to adopt double certification to sell their products outside the EU.
- It would create substantial costs due to the need for design, certification, double certification or recertification, retrofit and downtimes. Such increase in the cost could lead to loss of business and inevitable loss of jobs.

International Marine Contractors Association IMCA

IMCA is against the extension the European Product Safety Directives to MODUs. The reasons are:

- It is not justified in terms of a demonstrated need or potential safety improvements.
- Although the MODU Code does not include requirements for industrial equipment used for drilling, other international and national standards for machinery and equipment are in place (flag state, coastal state and classification society rules) to comply with relevant standards such as IEC, NORSOK, API and Class rules. These standards have been in use in the North Sea for over two decades and there is no evidence to suggest that they can be attributed to a major incident. Furthermore, the standards for equipment used on MODUs have been developed to address the specific risks associated with offshore O&G operations, which are not addressed by the more generic EU Directives.

- Under the Offshore Safety Directive (Directive 2013/30/EU), operators of MODUs working in the EU that undertake well operations are already required to have systems in place to identify, prevent, detect, control or mitigate, and respond to major safety and environmental risks, including ensuring that Safety and Environmentally Critical Systems (SECS) are meeting appropriate performance standards. Thus, MODU operators, which are already required to meet robust standards for machinery and equipment through other legislative requirements and to justify the risk mitigation measures they put in place would, through the extension of the EU Product Safety Directives, be required to comply with generic standards that do not address the specifics of MODU operations. This fact could create conflict with the goal based approach on which the Offshore Safety Directive is based and potentially undermine safety.
- The types of operations carried out and the potential exposure to hydrocarbons in terms of volume and duration are major differences between fixed or onshore production installations and mobile drilling units, being the likelihood of fires and explosions considerably lower for MODUs.
- The MODU Code is applied more widely than just to drilling vessels. Some types of offshore vessels that do not have drilling capability but that are operated in a similar manner to drilling units (like well intervention vessels and offshore accommodation units) may be either designed, built to or certified entirely under the MODU Code or incorporate MODU design rules in addition to SOLAS. It would not be appropriate to extend the Product Safety Directives to MODU Code vessels that are not undertaking drilling because:
    a. Their activities, and therefore their risk profiles, differ from drilling operations.
    b. A semi-submersible or jack-up construction vessel carrying out installation, maintenance, upgrade or removal work, for instance, will not be connected to a live well, and will not encounter substantial hydrocarbon releases. On the occasions that a construction vessel works alongside a production platform, such operations are subject to project specific detailed hazard identifications and assessment, and it is the duty of the platform operator to demonstrate that the risks are ALARP (As Low As Reasonably Practicable).
    c. Construction vessels built to the MODU Code may also be engaged in the renewable energy sector, installing offshore wind turbines for example, where the risk of hydrocarbon release is not present. While these vessel activities do not require a Report on Major Hazards, all vessels are subject to flag and Class requirements, and vessel operators are required under the IMO International Safety Management (ISM) Code to assess all identified risks to its ships, personnel and the environment and to establish appropriate safeguards, including specific measures aimed at promoting the reliability of safety critical equipment or systems.
- Demonstrating compliance with the ATEX Directive is administratively burdensome as testing has to be carried out for individual components, which must otherwise be encased in explosion-proof housing.
- MODUs are international assets, and the industry requires an international framework of rules. Requiring MODUs operating in the EU to comply with the EU Directives, which are not a globally accepted standard, could act as a barrier to free movement and undermine the MODU Code's intent to facilitate international movement and operation.

On the other hand IMCA has made the following comments related to the survey on offshore safety:

- It focuses on drilling units, rather than all MODU Code vessels.

- Many of the questions are aimed at companies that manufacture and install equipment on MODUs, rather than the MODU and offshore support vessel operators.
- It is extremely difficult for operators to obtain meaningful estimates from suppliers of relevant equipment and potential certifiers, and therefore specific cost impacts cannot be provided with any accuracy. Nevertheless, extending the EU product safety legislation is likely to create significant costs.
- Resources would be better focused on ensuring a robust and consistent application of the Offshore Safety Directive and supporting general efforts at IMO to improve vessel safety.

International Association of Drilling Contractors IADC

The IADC maintains that the exemption from ATEX Directive, MD and PED of MODUs was, and remains, entirely appropriate. This affirmation is based in the following arguments:

- The fact that MODUs are vessels to which the IMO MODU Code applies and the EU legislation does not, does not mean that MODUs are under-regulated because in fact, drilling and well-control equipment are the most highly regulated safety critical systems in the sector.
- Whereas the EU Product Safety Directives act upon manufacturers and suppliers, and therefore may be anticipated by the Commission to convey a net benefit to consumers in the EU, this is not the case for MODU owners. Indeed the reverse is true: barriers to trade can result, possibly in breach of the EU´s own treaties.
- **Suitability of existing standards**: MODUs must comply with international requirements of Class Rules, ICE, API, ISO, NORSOK, etc. These standards and verification procedures have been used in Europe for over 20 years and are under continuous review and enhancement. There is no evidence anywhere that ascribes increased risk of harm to machinery and equipment standards on MODUs. Current international standards cannot be demonstrated as inferior to the EU Product Safety Directives as there is no evidence of systemic defects in global standards that could be remedied by the Directives coming into effect on MODUs. The safety benefits in this relentless overhaul of international standards are profound: the ALARP (As Low As Reasonably Practicable) threshold is continuously driven lower by the vigorous application of new knowledge and invention.

  The requirements of the recent Offshore Safety Directive 2013/30/EU (OSD) shall soon come into effect in all waters of the Union. The effects include the preparation of a report on major hazards, and associated corporate major accident prevention policy, scheme of independent verification of safety and environmental critical elements, independent verification of well plans and an encompassing safety and environmental management system. This rigorous system ensures that all pertinent equipment and machinery on the MODU is compliant with appropriate authoritative standards and schemes of maintenance, and independently verified.
- **Unsuitability of the Commissions Survey**: The survey was directed at manufacturers and suppliers of relevant equipment and none of the questions were relevant to users. Members of IADC have reported that it has not been possible to get meaningful data from suppliers for them to summarize the cost impacts of the users coming into compliance with the Directives. When considered that on every MODU there are tens of thousands of subject components and systems, a matter of millions of Euros would certainly be required to be spent on every MODU. On the question of standards, the survey does not provide for a complete inventory from owners of the standards and verification systems applying to all machinery and

equipment on a MODU. The survey cannot yield appropriate information to guide the Commission towards a competent judgement in this matter.

- **Unsuitability of the EU Product Safety Directives to MODUs**: The requirements of the Directives will not in every case be allowable as standards outside the EU. The situation would arise, should the EU Product Safety Directives be applied to MODUs, that owners could not maintain compliance to operate outside Union waters, and MODUs potentially coming to EU waters, including ultra-efficient latest generation installations, would be deterred by retrofitting costs. The net effect for EU waters would be a dedicated fleet of older generation rigs and a rather uncertain future for drilling in the EU; particularly in frontier areas such as deep water Mediterranean and the Atlantic rim where older rigs are unlikely to be effective.
- **Disproportionality**: The Member States that publish risk data and trends do not identify machinery and equipment defects as primary objectives for intervention. Globally, the efforts of safety and environment regulators are on reforms of management systems and competency, and on risk based control systems.

  For the existing EU fleet, the cost of retrofitting, re-certification, modification, and maintaining compliance is grossly disproportionate to any safety benefit deriving from the application the EU Product Safety Directives. Recertification to ATEX would probably be unworkable. Displacement of international standards for BOP by the measures required under the Directives would go against industry best practice.

Finally IADC suggest that a thorough analysis of the requirements of the EU Product Safety Directives against all the prevalent industry standard and authoritative practices applied to drilling and well-control systems on MODUs should be done.

Norwegian Shipowners´Association NSA

The Norwegian Shipowners´ Association fully endorses the European Community Shipowners´ Association (ECSA) response and adds some comments in connection with the lack of questions in the survey regarding the use of standards and rules developed by the classification societies. IMO uses the term Recognized Organizations (RO) for the classification societies recognized by IMO. These include among others well-known classification societies such as DNV GL, Lloyd Register of Shipping (LR), and American Bureau of Shipping (ABS).

The classification societies have general requirements which influence the design of the unit, the drilling system/equipment and the surrounding/supporting/auxiliary systems/equipment. Some classification societies have in addition specific requirements and standards for the same systems/equipment.

The Norwegian Shipowners' Association considers the lack of questions regarding classification rules and standards that cover the systems and equipment on-board a MODU to weaken the evaluation of the safety regime of MODU equipment. The existing rules and standards for MODU equipment ensure a very high safety standard and the extension of EU product safety legislation to cover this equipment is unlikely to produce a higher safety standard.

A Notified Body (NB) and a Health and Safety (H&S) Consultancy

The NB, located in Portugal, Africa/Middle East, and in Central/South America and with at least 250 employees, has a percentage between 40 and 60% of its activities located within EU/EEA. On the other hand, the H&S Consultancy, located in the UK and with a maximum of 49 employees, has more than the 80% of its activities located in the EU/EEA area.

The NB deals with non-destructive testing related to the MD and PED and also applies the Low voltage Directive and the Electromagnetic Directive. It currently uses ISO/EN ISO standards, IEC standards and EN standards (EN 13450 and EN 13480). In terms of revenue the electrical equipment and the "other pressure equipment" are the most important subcategories of equipment for the NB.

The H&S Consultancy is currently dealing with the 3 European Product Safety Directives as well as with IEC standards (IEC 80079-36 and IEC 80079-37), EN standards (EN 13463-1, EN 13463-5, EN 13463-6 and EN 1127-1) and BS standards. The drilling equipment and the "other pressure equipment" are the most important subcategories of equipment for the Health and Safety Consultancy in terms of revenue.

The H&S Consultancy thinks that the extension of the EU Product Safety Directives, although initially could create barriers to trade, would be suitable for equipment in MODUs and its extension would solve safety problems and improve features in its services. It cannot say if the currently applied standards in the sector should be modified to meet the EHSRs of the Directives as each assessment would differ.

If the European Product Safety Directives are finally extended to cover MODUs, the NB does not foresee any change in the number of job positions although it could have a qualitative impact on the necessary workforce (more skilled personnel). On the contrary for the H&S Consultancy the extension of the legislation will facilitate the creation of new job positions related to technical conformity.

None of the two entities have answered the part of the survey related to the extension of the PED to well-control equipment.

G. Leading companies in the MODU market

In January 2015 the **top ten offshore drilling contractors** by number of MODUs managed were the following [8]: 1. Transocean, 2. Ensco, 3. Seadrill, 4. COSL, 5. Diamond Offshore, 6. Paragon Offshore, 7. Self-Drilling, 8. Hercules Offshore, 9. Noble Corporation, and 10. Rowan.

In Table G-1 the top ten offshore drilling contractors by number of rigs managed and by number of rigs displayed in the different world markets are shown. It has to be noticed that "total rigs" includes working rigs, non-working rigs and under construction rigs.

Table G-1. Top ten offshore drilling contractors by number of rigs managed (January 2015) [8]

Company	Total rigs	Working rigs	Under construction rigs	Units displayed in the different world markets						
				NW Europe	South America	US Gulf of Mexico	West Africa	Asian Pacific	Eastern Mediterranean	Rest of the world
Transocean	86	52	7	19	6	13	14	26	0	8
Ensco	72	53	7	12	4	17	9	16	12	2
Seadrill	62	37	12	0	15	6	11	22	6	2
COSL	46	39	3	3	3	0	0	36	4	0
Diamond Offshore	41	24	2	5	16	9	2	7	0	2
Paragon Offshore	40	26	0	8	14	3	5	1	9	0
Shelf Drilling	39	30	2	0	0	0	5	17	16	1
Hercules Offshore	35	15	1	1	0	24	3	4	3	0
Noble	35	24	1	3	2	11	1	7	8	3
Rowan	34	25	1	6	2	9	1	5	10	1
Top ten Total	490	325	36	57	62	92	51	141	68	19
Entire fleet	1188	680	180	101	219	121	96	414	167	70
Top ten of Total (%)	41.2	47.8	20.0	56.4	28.3	76.0	53.1	34.1	40.7	27.1

A small overview of some drilling contractors is presented below:

o Transocean (www.deepwater.com)

Transocean is by far the largest company in the MODU market, both in terms of fleet size and revenue. It is a leading international provider of offshore contract drilling services for energy companies, owning and operating among the world's most versatile fleets with a particular focus on deepwater and harsh-environment drilling. The company is active in all the world´s major offshore regions. The majority of Transocean´s deepwater floaters are active in the Gulf of Mexico and Africa while the European market is the prime location for the company´s midwater units. The current strategy of the company is to move towards more high-specification MODUs. Its fleet of 63 MODUs includes the world's largest fleet of high-specification rigs consisting of ultra-deepwater, deepwater and premium jack-up rigs. In addition, it has seven ultra-deepwaterdrill-ships and five high-specification jack-ups under construction.

The company has long-standing partnerships with many of the world´s leading oil and gas companies counting Petrobras, BP, ExxonMobil, and Chevron among its main customers. In the recent years Transocean´s financial performance has been tainted by the company´s involvement in the Deepwater Horizon accident in the

Gulf of Mexico and a minor spill in Brazil which forced the company to temporarily halt all operations in the country;

- Ensco PLC (www.enscoplc.com)

  Ensco plc is a provider of offshore drilling services to the petroleum industry. Ensco plc owns one of the world's newest ultra-deeper water fleet, 4 years old average, and includes 9 drill-ships (and 1 under construction), 11 dynamically-positioned semisubmersibles, 3 moored semisubmersibles and 40 premium jack-up (and 3 under construction), 2 deepwater and 3 shallow water units. Ensco plc also provides drilling management services for customer-owned rigs. Its rigs have drilled some of the most complex wells in virtually every major offshore basin around the globe, and they currently operate across six continents. Their customers are multinational integrated energy companies, national oil companies and independent operators;

- Maersk Drilling (www.maerskdrilling.com)

  Maersk Drilling is part of the A.P. Moller - Maersk Group - a worldwide organisation with 110,000 employees and offices in 125 countries, headquartered in Copenhagen, Denmark. On 21 June 1972 Maersk Storm Drilling Company and Atlantic Pacific Marine Corporation were established with the purpose of purchasing two semi-subs and two barge rigs. These were the very early days of Maersk Drilling. Today, Maersk Drilling owns 26 rigs including six ultra-harsh environment jack-ups, six further jack-ups, four semi-submersibles and 10 drilling barge rigs. In addition, the company has ordered the world's most advanced jack-up drilling rigs, the Maersk Intrepid and the Maersk XL Enhanced 2, 3 and 4. The rigs are purpose-built for weathering the ultra-harsh environment of the North Sea, and their technical features are beyond current state-of-the-art. The company has announced that it is investing in developing the technology that allows drilling in the Arctic;

- Paragon Offshore (www.paragonoffshore.com)

  Paragon Offshore owns a fleet of 40 MODUs and conduct contract labour operations on the Hibernia Platform offshore eastern Canada. They operate for some of the largest oil and gas companies in the world, including National Oil Companies like Petrobras (Brazil), Pemex (Mexico), and ONGC (India). ExxonMobil and Total, who are among the largest major oil companies, and Centrica, Gaz de France and Wintershall, some of the world’s most active independent oil companies, are also among their customers. In all, Paragon provides services to more than 17 different customers in 12 countries on five continents. Their standard specification jack-ups provide drilling services in shallow water with capabilities up to a maximum water depth of 390 feet, being nine of them also capable of operations in harsh environments, which typically command higher dayrates than operations conducted in other environments. Paragon's semisubmersible rigs are capable of operating in water depths of up to 4,000 feet while its drill-ships operate in water depths of up to 7,200 feet depending on the design;

- Noble Corporation (www.noblecorp.com)

  Noble Corporation is another of the traditional offshore drilling company that have been in the business for several decades. The company owns and operates a modern, versatile and technically advanced fleet in the offshore drilling industry. Noble´s fleet is composed of 32 offshore drilling units (8 semisubmersibles with a drill depth between 25,000 ft and 37,000 ft; 8 (of the 9) drill-ships with a drill depth of 40,000 ft, and 15 jack-ups with a drill depth comprised between 25,000 ft and 35,000 ft) focused largely on ultra-deepwater and high-specification jack-up

drilling opportunities in both established and emerging regions worldwide. Noble performs, through its subsidiaries, contract drilling services worldwide including the US Gulf of Mexico, Mexico, Brazil, the North Sea, the Mediterranean, West Africa, the Middle East, India and the Asian Pacific;

- QGOG (www.qgogconstellation.com)

  QGOG is a market leading provider of oil and gas drilling and FPSO services in Brazil. It is also one of the ten largest drilling companies globally, based on drilling rigs in operation. Through its subsidiary QGOG, QGOG Constellation operates in the fast-growing Brazilian oil and gas industry, which requires substantial resources to explore the recent discoveries of vast potential oil and gas reserves off the coast of Brazil.

  QGOG owns and holds interests in a state-of-the-art offshore fleet, constructed by the world's leading shipyards. Its modern fleet includes nine ultra-deepwater rigs in operation or under construction, one deepwater rig, two midwater rigs, nine onshore rigs and partnerships in six FPSOs;

- Dolphin Drilling LTD (www.dolphindrilling.no)

  Dolphin Drilling is a well-established name in offshore drilling and has operated in all the major offshore oil and gas regions in the world. In recent years, Dolphin drilling LTD has carried out drilling operations in most of the major areas of offshore activity, including the North Sea, West Africa, East Africa, Mediterranean, India, Brazil and Gulf of Mexico. Dolphin drilling LTD provides services to a broad cross section of oil and gas companies including many of the majors, independents and national oil companies;

- Stena Drilling (www.stena-drilling.com)

  Stena Drilling is part of the Stena Sphere, a conglomerate of Danish companies which apart from offshore drilling are also active in shipping and operating several ferry routes. Stena Drilling is focused on ultra-deepwater drilling and harsh environment midwater semi-submersibles. Stena's drill-ships operate in Mauritania, Las Palmas de Gran Canaria and the Gulf of Mexico while the semi-submersibles are deployed in the North Sea and in offshore Australia. Due to the specialization within its fleet Stena is achieving high revenues and demand for Stena's MODUs will continue to be strong;

- Saipem (www.saipem.com)

  Saipem is a world leader in drilling services, as well as in the engineering, procurement, construction and installation of pipelines and complex projects, onshore and offshore, in the oil & gas market. The company has distinctive competences in operations in harsh environments, remote areas and deepwater. Saipem provides a full range of services with contracts on an Engineering, Procurement, and Construction (EPC) and/or Engineering, Procurement, Construction, and Installation (EPCI), often 'turn-key'basis, and has distinctive capabilities and unique assets with highest technological content. Saipem operates in more than 60 countries with about 46,000 people from more than 129 nationalities, 11 fabrication yards in 5 continents and 29 engineering and project execution centers worldwide . In the Drilling Offshore sector, Saipem operates both in shallow and deep waters, using 14 MODUs, a state-of-the-art drilling fleet including the ultra-deepwater DP drill-shipsSaipem 10000 and, the new built Saipem 12000 and the fourth and fifth generation semisubmersible drilling units Scarabeo 5 and Scarabeo 7. Saipem has recently expanded its drilling fleet also thanks to the start of the operation of the ultra-deepwater sixth generation semisubmersible drilling units Scarabeo 8 and Scarabeo 9 and of the jack-ups Perro

Negro 8 and Perro Negro 7. Their MODUs are under flag of Portugal or Bahamas. Although Eni is the main shareholder of Saipem, only a small part of Saipem´s vessels are usually contracted to work for Eni.

- Odfjell Drilling (www.odfjelldrilling.com)

  Odfjell Drilling, founded in 1973, is an international drilling, well service and engineering company with 3000 employees and operations in more than 20 countries. The company has established expertise in the operation of ultra-deep water and harsh environment mobile offshore units in both Norwegian waters and internationally. In addition, it has built a position as a major supplier of personnel for drilling operations and maintenance on fixed and floating production platforms in the North Sea. Odfjell Drilling has developed a comprehensive portfolio of services - including world-class engineering services, well services and project management. It has a proven track record of successfully operating semi-submersibles, drill-ships, jack-ups and modular drilling units across the world. Currently Odfjell Drilling owns and operates a fleet of technologically advanced semi-submersibles, operating in the North Sea and beyond;

- North Atlantic Drilling (A Seadrill company) (www.nadlcorp.com)

  North Atlantic Drilling is an offshore harsh environment drilling company, which owns a fleet of eight harsh environment units in operation and one new-build under construction. Its business strategy is to focus the company on modern state-of-the-art offshore drilling units with main focus on harsh environments and the North Atlantic Basin. North Atlantic Drilling is a 70.4 percent owned subsidiary of Seadrill Limited;

In general it can be said that there is a gradual increase in water depth capability as the fleet ages decrease. Regarding the composition of drilling companies' fleets, the following considerations can be made [2]:

- Smaller companies, such as Pacific Drilling and Vantage Drilling, have a very young fleet consisting mainly of deepwater capable MODUs. Such companies are likely to profit the most from the move towards deepwater drilling;
- Companies like Maersk Drilling, Stena, Saipem and QGOG tend to have smaller fleets, mainly focused on high-tech rigs, but also include older midwater floaters.
- Many of the traditional companies, such as Transocean and Noble, maintain a comprehensive fleet of floaters. Most companies in this group have a wide array of floaters servicing the complete range of the market from midwater to ultra-deepwater operations.

Related to the **manufacturers/ suppliers/ traders/r enters and installers of equipment**, some of the leading companies are shown below:

- *National Oilwell Varco* (www.nov.com),

  National Oilwell Varco is also present in many European countries (Belgium, Denmark, France, Germany, Italy, Norway, Poland, Portugal, Romania, The Netherlands, UK, etc.). National Oilwell Varco manufactures a wide range of equipment as drilling equipment, well intervention equipment, material handling equipment, Blow-out Preventers (BOPs) and electrical equipment (electrical power systems and uninterruptible power systems);

- *Varco BJ BV* (www.nov.com)

Varco BJ BV operates as a subsidiary of National Oilwell Varco and offers mechanical components for land and offshore drilling rigs, land drill and well servicing rigs, tubular inspection, drill string equipment, and lifting equipment. Varco BJ conducts downhole, handling, supply chain, and well services to customers throughout the Netherlands;

- *Drillmec* (www.drillmec.com)

  Being part of the TREVl Group, a multinational organization with more than fifty years of activity that counts on more than 7000 employees, Drillmec is an international leader in design, manufacturing and distribution of drilling and workover rigs for onshore and offshore applications as well as a wide range of drilling equipment. Drillmec manufactures conventional and modular drilling packages, hydraulic rig packages as well as derricks and mast for fixed platforms, jack ups, semi-submersibles and drill ships. They also manufacture a full range of hydraulic and electric top drives, drawworks, rotation equipment, mud pumps, pipe handling equipment, control systems and drilling instrumentation;

- *Siemens* (www.siemens.com/entry/cc/en)

  In the O&G sector, which comprises subsea, offshore drilling, offshore production, onshore production, pipelines, LNG, storage and refining/petro, Siemens offers made-to-measure products and technologies for electrification, automation, digitalization, water technologies, compression, and drives;

- *Expro* (http://exprogroup.com/homepage/)

  Expro with more than 40 years of experience and innovation offers tailor-made solutions for customers across the energy sector. Expro's mission is well flow management. It provides services and products that measure, improve, control and process flow from high-value oil and gas wells, from exploration and appraisal through to mature field production optimisation and enhancement.

  With a specific focus on offshore, deepwater and other technically challenging environments, Expro provides a range of mission critical services across three key areas: 1. well test & appraisal services; 2. subsea, completion & intervention services; and 3. production services. Expro provides a range of solutions including: exploration & appraisal testing; subsea safety systems; drilling & completion; flowback & clean-up; production; well integrity & intervention;

H. List of the contacted stakeholders for a personal interview

The contacted stakeholders, mainly companies, in order to participate in the present study by means of an interview/meeting are presented below. Most of these companies have been identified in a web-site related to oilfield equipment [9].

The information facilitated for each company is: name, web address, contact email, size, country where it is located and the main categories of equipment the company deals with.

Related to the equipment categories, the following designation has been used: a. drilling equipment, b. well intervention equipment, c. material handling equipment, d. well-control equipment, e. other pressure equipment and f. electrical equipment.

1. ***Baker Hudges***
   www.bakerhughes.com/products-and-services/pressure-pumping
   www.bakerhughes.com/contact
   Main equipment category: all, d, e
   Size: Large
   Location: Europe, US

2. ***Cameron***
   www.c-a-m.com
   www.c-a-m.com/contact-us
   Main equipment category: d, BOPs, e
   Size: Large
   Location: US

3. ***Franks***
   http://franksinternational.com/
   http://franksinternational.com/contact-us/
   info@franksintl.com
   Reception@franks-int.com
   Main equipment category: all, a
   Size: Large
   Location: US, Norway

4. ***Saipem***
   www.saipem.com
   Main equipment category: all
   Size: Large
   Location: Worldwide, Italy

5. ***Gardner Denver***
   www.gardnerdenver.com/brands/brands_overview
   www.gardnerdenver.com/locations/#
   Angelo.bottarini@gardnerdenver.com
   thomas.it@gardnerdenver.com
   er.it@gardnerdenver.com
   Main equipment category: all
   Size: Large
   Location: Worldwide, Italy

6. Hydril; GE Oil & Gas
www.geoilandgas.com/who-we-are
www.geoilandgas.com/contact-us
Main equipment category: all
Size: Large
Location: Not specified

7. National Oil Varco
www.nov.com/Segments/Rig_Systems/Offshore/Offshore.aspx
rig@nov.com
www.nov.com/OTC_2015_XL_Systems_Contact_Form.aspx
Main equipment category: all
Size: Large
Location: Not specified

8. Oil Works Inc
www.oilworksinc.com/corporate-overview
www.oilworksinc.com/contact
Main equipment category: a, c
Size: Medium
Location: US

9. Texas International Oilfield Equipment
www.texasinternational.com/index.html
www.texasinternational.com/contact.html
Main equipment category: all
Size: Small
Location: US

10. Wison group
http://en.wison.com/Offshore_Marine
info@wison-offshore.com
Main equipment category: MODUs
Size: Large
Location: China

11. Atlas Copco
www.atlascopco.it/itit/products/
http://www.atlascopco.com/us/contactus/contactgroupcenter/#faq_3
Main equipment category: c, d, e
Size: Large
Location: Sweden

12. INA Naftaplin
www.ina.hr
PR@ina.hr
Main equipment category: Users
Size: Large
Location: Croatia

13. Edison
www.edison.it
lucia.caltagirone@edison.it
elena.distaso@edison.it
Main equipment category: Users
Size: Large

Location: Italy

14. Viktor Lenac Shipyard
www.lenac.hr
lenac@lenac.hr
design@lenac.hr
Main equipment category: MODUs, Derricks
Size: Medium
Location: Croatia

15. Gazpromneft
www.gazprom-neft.com
info@gazprom-neft.ru
pr@gazprom-neft.ru
Main equipment category: Users
Size: Large
Location: Russia

16. ExxonMobil
http://corporate.exxonmobil.com/en/engineering/deepwater-drilling
http://corporate.exxonmobil.com/en/company/contact-us/email-us
Main equipment category: Users, a
Size: Large
Location: Not specified

17. Royal Dutch Shell
www.shell.nl/nld/aboutshell/media-centre/contact-media-team.html
media-nl@shell.com
Main equipment category: Users
Size: Large
Location: Netherlands

18. BP Norway
www.bp.com/en_no/norway/about-bp-in-norway/who-we-are/organisation/contact-us.html
bpnorge@bp.com
Main equipment category: Users
Size: Large
Location: Norway

19. Statoil
www.statoil.com/en/about/worldwide/belgium/pages/default.aspx
eu-office@statoil.com
Main equipment category: Users
Size: Large
Location: Belgium

20. Halliburton
www.halliburton.com
http://www.halliburton.com/en-US/locations/halliburton-europe-locations/halliburton-halliburton-europe-locations.page?node-id=hgeyxtaj
Main equipment category: Users, all
Size: Large
Location: Europe (few countries)

21. Caterpillar

www.caterpillar.com/en/company/brands.html
http://www.caterpillar.com/en/contact/mx-au-gb-in-kr-id-se-za sa.html?type=en_GB&cat_lang=English&cat_site=www.cat.com/en_GB
Main equipment category: Various
Size: Large
Location: US

22. OilMan

http://oilmangroup.com/
info@oilmangroup.com
rfq@oilmangroup.com
Main equipment category: c, d, e
Size: Large
Location: Not specified

23. Anadarko

www.anadarko.com
ventures@anadarko.com
Main equipment category: Users
Size: Large
Location: Not specified

24. Chevron

www.chevron.com
www.chevron.com/contact/emailchevron/
Main equipment category: Users
Size: Large
Location: Not specified

25. ConocoPhillips

www.conocophillips.com
www.conocophillips.com/Pages/contact-us.aspx
Main equipment category: Users
Size: Large
Location: US

26. Drillmec

www.drillmec.com
www.drillmec.com/en/p/contacts
Main equipment category: a, c, f, as well as derricks and mast for fixed platforms and MODUs.
Size: Large
Location: Italy

27. ENI Tecnomare

www.eni.com/it_IT/azienda/attivita-strategie/altre-societa/tecnomare/tecnomare.shtml
info@tecnomare.it
Main equipment category: Various
Size: Large
Location: Italy

28. Schlumberger

www.slb.com/services.aspx
www.slb.com/forms/contact/contact_inquiry.aspx?referringURL=http://www.slb.com/contact_us/default.aspx&context=Contact%20Information
Main equipment category: Users
Size: Large
Location: Not specified

29. Baiqiang Valves Group (China) Co., Ltd

www.bekyvalve.com
sale88@bekyvalve.com
Main equipment category: Valves
Size: Large
Location: China

30. SEA Europe_Ships and Maritime Equipment Association

www.seaeurope.eu
info@seaeurope.eu
Oliver Derison: od@seaeurope.eu

I. Statistical analysis of offshore accidents and incidents on MODUs since 1970

I1. Worldwide Offshore Accident Databank (WOAD)

The Worldwide Offshore Accident Databank (WOAD) is an offshore accident and incident database operated by DNV-GL[102]. Information on offshore incident data has been gathered since 1970 and then stored in this databank for public use.

The database contains information on more than 6000 events, including accidents, incidents and near misses, mostly from the UK and the Norwegian sectors and the US Gulf of Mexico.

Typical users of WOAD comprise rig owners, drilling operators, insurance companies, consultants, salvage companies and regulatory authorities.

Information on offshore events is continuously updated and is derived from a variety of sources – mainly public – such as Lloyds Casualty reports, rig owners and operators, newspaper articles, and official publications and reports.

WOAD is not publicly available but access is granted through a database subscription (with charge).

WOAD contains information on the following types of events:

- accidents, i.e. hazardous situations which have developed into an accidental situation. All situations/ events causing fatalities and severe injuries have also been considered as accidents;
- incidents/ hazardous situations, i.e. hazardous situations which have not developed into an accidental situation. Low degree of damage was recorded, but repairs/ replacements were usually required. This type of event also included events causing minor injuries to personnel or health injuries;
- near misses, i.e. events that might have or could have evolved into an accidental situation. No damage and no repairs were required in these cases;
- insignificant events, i.e. hazardous situations, with very minor consequences. In most cases, damages were registered and repairs were not required. Small spills of crude oil and chemicals were also included, as well as very minor injuries to personnel.

WOAD also contains a damage categorization, which is applicable to all event types, i.e.:

- insignificant damage: insignificant or no damage to part(s) of essential equipment; damage to towline, thrusters, generators and drivers;
- minor damage: minor damage to single essential equipment; damage to more non-essential equipment, and damage to non-loadbearing structures;
- significant damage: significant/ serious damage to module and local area of the unit; minor damage to loadbearing structures; significant damage to single essential equipment, and damage to more non-essential equipment;
- severe damage: severe damage to one or more modules of the unit; large/medium damage to loadbearing structures; major damage to essential equipment;
- total loss: total loss of the unit, including constructive total loss from an insurance point of view; however, the unit may be repaired and put into operation again.

Each accidental situation is assigned at least one contributing cause to the event. Causes are divided into two main groups, i.e. human cause and equipment cause. Table I-1 shows the types of human and equipment causes which are found in WOAD.

[102] www.dnvgl.com

Table I-1. WOAD database human and equipment causes

WOAD Accident causes	
Human Causes	
Third party error	Sabotage
Act of war	Unsafe act / No procedure
Improper design	Unsafe procedure
Other	
Equipment causes	
Third party equipment failure	Ignition by heat/exhaust
Earthquake / volcanic eruption	Ignition by open flame
Electric equipment malfunction	Ignition by cigarette/match
Equipment malfunction / failure	Ignition, electrical
Exceeded design criteria	Ignition, hand tool/sparks
Foundation problem	Ignition, lightning
Machinery malfunction	Ignition, weld/torch
Safety system malfunction	Ignition, unknown/other
Structural failure / fatigue / corrosion	Weather, general
(Unspecified)	

I2. Analysis of accidental events involving Mobile Offshore Drilling Units

In order to identify the systems, pieces of equipment and structural components which more frequently contributed to the occurrence of accidental events on offshore installations, an analysis of the information on 1989 events contained in the Worldwide Offshore Accident Databank (WOAD) was carried out.

I2.1. Drawing the data sample

The WOAD database contains technical and accident information on 6451 events, but only **1989** of them were used in the analysis, i.e.:

- Events which occurred on MODUs and worldwide (Figure I-1);
- Events categorized as "*Accidents*", "*Incidents/ hazardous situations*", and "*Near misses*";
- Events to which an "*Equipment cause*" (as defined in WOAD) was assigned, and also those in which no cause was identified.

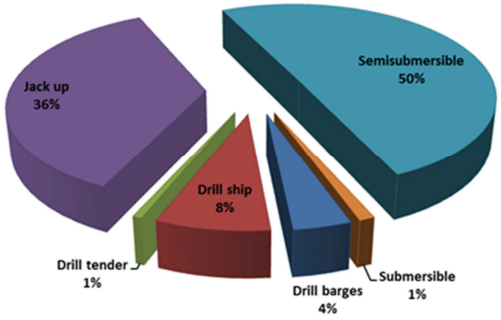


Figure I-1. Types of MODUs involved in accidental events

All descriptions of the events for which no equipment or human cause was provided by WOAD were carefully analysed, in order to identify a cause – if possible.

I2.2. Consequences of past events and trends over time

The analysis consisted of a general evaluation of the consequences associated with the occurrence of past offshore accidental events, and the identification of trends over time.

Three categories of consequences of past events were considered:

- Number of fatalities (both crew and 3rd party);
- Number of injuries (both crew and 3rd party);
- Cost of damages (when provided).

Table I-2 summarises the number of fatalities and injuries sustained by workers (crew and 3rd party personnel[103]), sorted by cause of event. Since 1970, the total number of workers who died in offshore accidental events is 562, whereas 631 workers were injured. Of these 631 injuries, 86% (544) are considered as **severe injuries**[104].

Table I-2. Total number of fatalities and injuries and cost of damage, sorted by cause

	3rd party equipment failure	Earthquake, volcanic eruption	Electric Equipment malfunction/ failure	Equipment malfunction/ failure	Foundation problem	Ignition by heat/ exhaust	Ignition by open flame	Ignition, electrical	Ignition, handtool/ sparks
Fatalities	2	0	0	19	39	0	0	0	8
Injuries	1	0	0	42	17	3	0	8	26
Cost of damage [mln $]	20.76	n/p*	n/p*	194.54	276.47	n/p*	n/p*	23.35	n/p*

	Ignition, lightning	Ignition, weld/ torch	Ignition, unknown/ other	Machinery malfunction	Other	Structural failure/ fatigue/ corrosion	Weather, general	Unspecified	*Total*
Fatalities	0	6	28	2	20	7	190	241	*562*
Injuries	0	9	97	0	27	7	48	346	*631*
Cost of damage [mln $]	n/p*	0.5	103.69	n/p*	1.1	22.6	484.11	879.72	*2006.84*

*n/p: not provided.

The vast majority of the fatalities concerned crew members (86.5%), whereas injuries sustained by the crew account for 76.9% of the total.

Most of the fatalities are due either to the category "*Unspecified*" (43%) or "*Weather, general*"[105] (34%). The first category includes miscellaneous events, which makes it almost impossible to attribute a unique cause to all the events belonging to that

[103] Third parties: Individuals, groups of people or companies, other than the principal contracted parties, that may be affected by or involved with the project. [Definition by OGP - Report 432 (December 2009)].

[104] Note that all types of injuries were considered in the category "*injuries*". According to the definition provided by WOAD, severe injuries are only those which have resulted from the occurrence of an accident.

[105] "*Weather, general*" refers to events in which the weather played an important role in the occurrence of the event, i.e. bad weather conditions were either the main event cause or a factor which contributed to the severity of the consequences.

category. In this case, the event descriptions in the database were properly analysed in order to identify possible causes for such events.

Analogously to the number of fatalities, also the majority of injuries (55%) belong to the "*Unspecified*" category, followed by the category "*Ignition, unknown/ other*" (15%).

The WOAD does not contain all information regarding the total cost of damage associated with past events. In most cases, figures were not provided. Therefore, Table I-2 only shows the cost of damages (in mln $) that could be calculated from the available data[106].

As expected, as for fatalities and injuries, the highest costs of damage are associated with the categories "*Unspecified*" and "*Weather, general*".

The evolution in time of the number of offshore events was also assessed.

As shown in Figure I-2, the number of all types of offshore events (i.e. accidents, incidents, and near misses) increased during the 1970s until the mid-1980s, when a continuous decrease occurred up until the mid-1990s. For the periods between 1995-1999 and 2005-2009, a significant increase in the total number of offshore events is noticed.

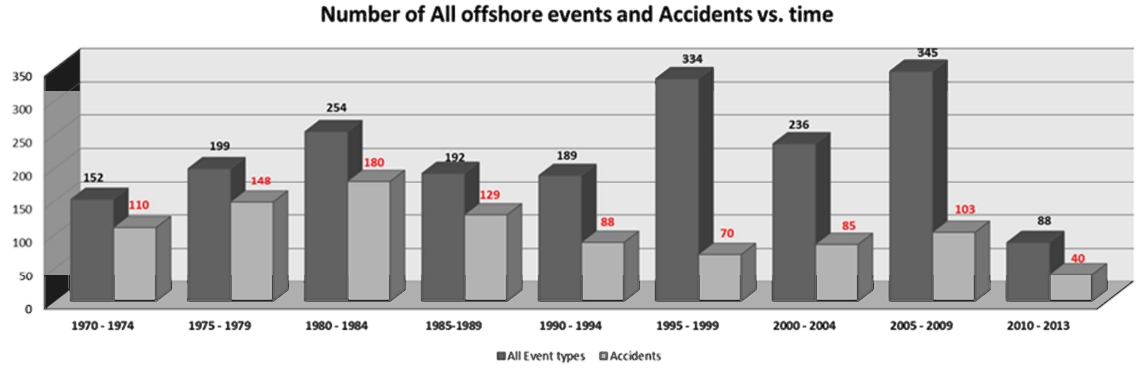


Figure I-2. Number of offshore accidental events over time: all event types and accidents

In the case of accidents, however, there was a continuous decrease in the number of events from the period 1980-1985 until the time interval 2000-2004 (when a 21.4% increase was recorded). After 2010, however, a new decrease in the number of events was recorded, perhaps as a consequence of enhanced safety measures (regulatory, technological, etc.) taken after the Macondo accident in 2010.

In detail, a total of 345 events were recorded during 2005-2009. However, as shown in Figure I-3, of these events, 103 were accidents, 198 were incidents/hazardous situations, and 44 were near misses. In addition, **more than half (around 65%) of these 345 events (224) were associated with insignificant/no damage**, 15.6% with minor damages (54), 9.6% with significant damages (33), whereas events resulting in severe damages accounted for around 8.7% (30) of the total. Only on three occasions there was a total loss of the installation.

Figure I-4 shows the evolution over time of the proportion (%) of accidents and incidents/hazardous situations for all the considered intervals. Note that the percentage of accidents over the total number of events which occurred over a certain time interval decreased until the late 1990s, then increased again during the period 2000 – 2004. A relevant increase has been taking place also since 2010.

[106] This means that the figures provided provide at least the minimum cost of damage associated to events belonging to a specific cause.

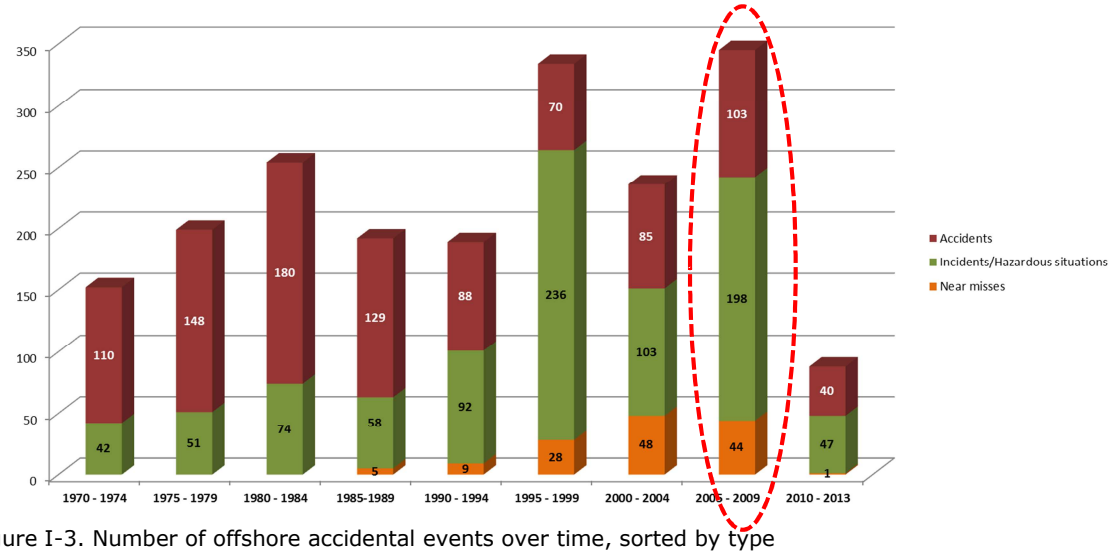


Figure I-3. Number of offshore accidental events over time, sorted by type

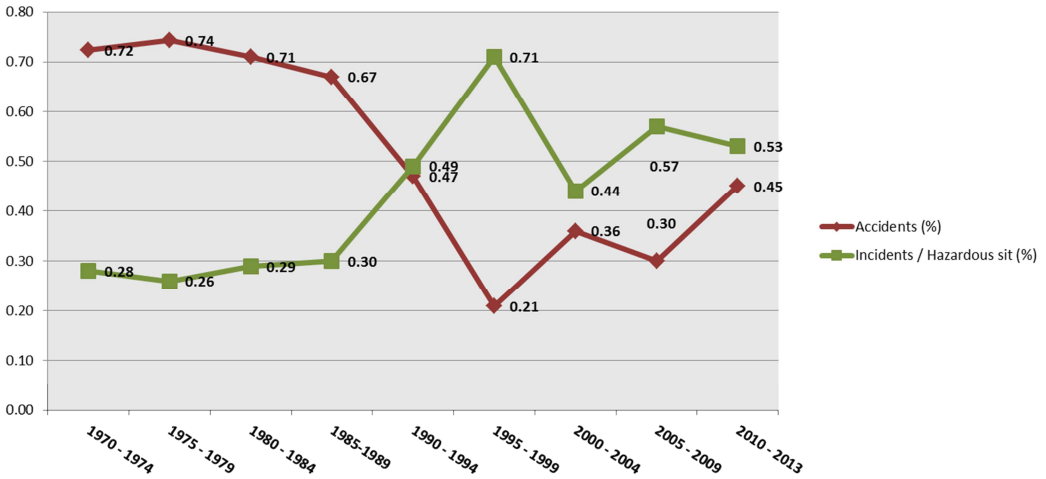


Figure I-4. Percentage of accidents, incidents and near misses over the total events over time

It seems that, for the most recent years (2010-2013), the total number of events decreased, but the proportion of accidents (over the total) which occurred has increased. This *might* then be reflected in an increase in the number of fatalities and injuries for that same time interval. However, most of the fatalities and injuries which occurred during the period 2010-2013 are due to a very small number of accidents.

To sum up, it is evident that the offshore oil and gas industry and regulators carried out a process of enhancement of procedures, standards and safety systems that led to a substantial decrease in the number of accidents since the 1980s up until 2000. New technological advancements, updated and enhanced regulations and procedures were put in place after the Macondo blow-out in the Gulf of Mexico.

Finally, Figure I-5 shows the distribution of fatalities and injuries over a 5-year interval. It can be noticed that both numbers of fatalities and injuries show similar trends over time, i.e.:

- Fatalities and injuries increased until the period 1980 – 1984, then a decrease in these numbers occurred until the period 1990 – 1994;
- Both fatalities and injuries increased again during the period 1995 – 1999;
- Then, for the period 2000 – 2004, fatalities increased while injuries decreased:

- Since 2005, a continuous increase in the numbers of fatalities and injuries is noticed.

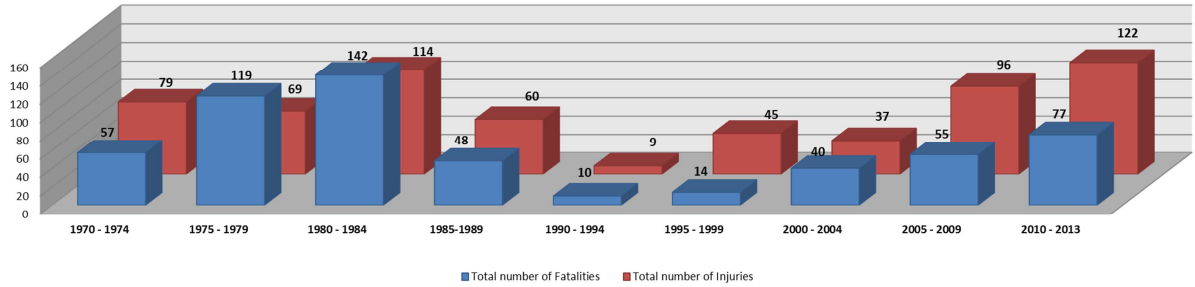


Figure I-5. Total number of fatalities and injuries in offshore accidental events over time

In conclusion, an overall decrease in the number of accidents was noticed from the mid-1980s until the year 2000, probably as a result of enhanced safety procedures, standards and measures which were put in place after the Piper Alpha accident in 1988. However, a continuous increase in the number of accidents was then recorded until 2010, to drop again after the Macondo accident.

It is also important to notice the steady increase in the number of fatalities and injuries since 1990. However, as will be later explained in Section I2.3.2, this increase is not attributable to events caused by equipment failures but rather to accidents involving systems and components which do not seem to be covered by EU product safety legislation.

I2.3. Identification of systems, equipment and structural components involved

Before proceeding with the calculation of the number of accidental events involving specific systems and equipment, it was important to read all the descriptions provided in the WOAD. It must be pointed out that, in many cases, an insufficient description of the causes was given, which made it impossible to identify specific equipment, structural components or systems.

I2.3.1. Identification of specific equipment/ components and systems

In order to perform the analysis in a correct and consistent way, all the categories belonging to the *equipment causes* main category used in the WOAD were studied. These categories are summarised in Table I-3.

While analysing all equipment causes categories, it was extremely important to distinguish between events in which:

- the failure of a specific piece of equipment was the main cause of the accidental event;
- the failure of a specific piece of equipment was a consequence of the accidental event, i.e. the failure resulted from the occurrence of a different event, such as a hurricane or a severe storm.

Therefore, **for only 213 events** out of a total of 1989 analysed events (10.7%) it was possible to identify a specific piece of equipment or structural component as the main cause of the accidental situation[107]. Figure I-5 summarizes the results of the analysis of 213 events with the aim of identifying specific equipment and systems which were more frequently involved in offshore accidental events.

[107] Note that in many cases, "*Unspecified equipment failures*" were mentioned.

It must also be pointed out that, due to insufficiently detailed descriptions, in some cases it was only possible to identify the system to which the faulty equipment belonged.

Table I-3. List of equipment/structural components and systems identified and number of events associated with them

Piece of equipment	Number of events	System involved	Total
Ballast tank	*3*	*Structure*	
Bracing *(Leg or hull)*	*4*	*Structure*	
Hull (cracks)	2	Structure	
Leg (Cracks or unspecified)	*17*	*Structure*	*30*
Platform pin	1	Structure	
Spud can	*2*	*Structure*	
Tubular stem bar	*1*	*Structure*	
Anchor cable	*3*	*Anchoring/Mooring/Towing system*	
Anchor chain	*5*	*Anchoring/Mooring/Towing system*	
Anchor winch braking system	*1*	*Anchoring/Mooring/Towing system*	
Anchor winch motor	*1*	*Anchoring/Mooring/Towing system*	
Anchor winch	*8*	*Anchoring/Mooring/Towing system*	*29*
Mooring line	*3*	*Anchoring/Mooring/Towing system*	
Subsea fairleads	*1*	*Anchoring/Mooring/Towing system*	
Towline pennant	*1*	*Anchoring/Mooring/Towing system*	
Towline	*6*	*Anchoring/Mooring/Towing system*	
Unspecified electrical problem	*6*	*Unspecified electric equipment*	
Unspecified machinery failure	*1*	*Unspecified equipment*	*18*
Unspecified failure	*11*	*Unspecified equipment*	
Chain	*1*	*Crane – Lifting appliances*	
Crane boom – bracings	*1*	*Crane – Lifting appliances*	
Crane boom – clutch	*1*	*Crane – Lifting appliances*	
Crane boom – wiresling	*1*	*Crane – Lifting appliances*	*16*
Crane boom wire	*3*	*Crane – Lifting appliances*	
Crane boom	*4*	*Crane – Lifting appliances*	
Crane (unspecified failed component)	*5*	*Crane – Lifting appliances*	
Elevating rack	*1*	*Elevating system*	*13*
Elevating system (unspecified)	*12*	*Elevating system*	
Flexible hydraulic hose	*4*	*Pipes for fluids*	
Gas line (unspecified)	*2*	*Pipes for fluids*	
High pressure line (unspecified)	*1*	*Pipes for fluids*	*11*
Lubeoil return line	*1*	*Pipes for fluids*	
Oil line	*2*	*Pipes for fluids*	
Water hose	*1*	*Pipes for fluids*	
Casing joint	*1*	*String/Pipes (Casing system)*	
Casing	*4*	*String/Pipes (Casing system)*	*10*
Crossover sub	*1*	*String/Pipes (Drill string)*	

Drill bit	*1*	*String/Pipes (Drill string)*	
Drill string (unspecified)	*1*	*String/Pipes (Drill string)*	
Drill string joint	*1*	*String/Pipes (Drill string)*	
Tubing	*1*	*String/Pipes (Tubing)*	
BOP - Adapter stack	*1*	*BOP equipment*	
BOP shear rams	*2*	*BOP equipment*	
BOP stack	*2*	*BOP equipment*	*9*
BOP (unspecified)	*3*	*BOP equipment*	
Diverter valve	*1*	*BOP equipment*	
Marine riser	*1*	*Riser/Marine riser*	
Riser	*2*	*Riser/Marine riser*	*9*
Riser connection	*2*	*Riser/Marine riser*	
Slip/Telescopic joint	*4*	*Riser/Marine riser*	
Automatic steering system	*1*	*Vessel (not MODU itself)*	
Thruster	*1*	*Vessel (not MODU itself)*	
Engine (Vessel)	*5*	*Vessel (not MODU itself)*	*9*
Propulsion motor + Roller bearings	*1*	*Vessel (not MODU itself)*	
Rudder	*1*	*Vessel (not MODU itself)*	
Crown-O-Matic system (COM) & Kinetic Energy Monitoring System (KEMS)	*1*	*Hoisting and rotary systems*	
Derrick head block	*1*	*Hoisting and rotary systems*	
Drawwork brake	*1*	*Hoisting and rotary systems*	*7*
Drill line	*2*	*Hoisting and rotary systems*	
Hoisting system (unspecified)	*1*	*Hoisting and rotary systems*	
Wire sheave	*1*	*Hoisting and rotary systems*	
AC Switchboard	*1*	*Electric power system*	
Electrical generator	*2*	*Electric power system*	
Transformer	*1*	*Electric power system*	*7*
Electric cable	*2*	*Electric power system*	
Circuit breaker	*1*	*Electric power system*	
(Lifeboat) hook	*1*	*Lifting gear*	
Personnel/work basket	*2*	*Lifting gear*	*6*
Chain sling	*2*	*Lifting gear*	
Lifting collar	*1*	*Lifting gear*	
Azimuth thruster	*1*	*Engine (MODU)*	
Diesel generator	*1*	*Engine (MODU)*	*5*
Engine (unspecified failure)	*3*	*Engine (MODU)*	
Derrick (unspecified)	*2*	*Derrick structure*	
Derrick beam	*1*	*Derrick structure*	*4*
Mast	*1*	*Derrick structure*	
Drill string compensator	*1*	*Tensioning and motion compensating systems*	
Guideline compensator (piston)	*1*	*Tensioning and motion compensating systems*	*4*
Marine riser tensioner	*1*	*Tensioning and motion compensating*	

		systems	
Heave compensator	*1*	*Tensioning and motion compensating systems*	
Casing hanger	*1*	*Wellhead system*	
Choke manifold	*1*	*Wellhead system*	*3*
Wellhead	*1*	*Wellhead system*	
Gas separator	*1*	*Separators and Tanks*	
Heat exchanger	*1*	*Separators and Tanks*	*3*
Tank (unspecified)	*1*	*Separators and Tanks*	
Hydraulic valve (unspecified)	*1*	*Valves*	*3*
Valve (unspecified)	*2*	*Valves*	
Fire damper	*1*	*Fire protection*	
Fire-fighting system (unspecified)	*1*	*Fire-fighting system*	*3*
Fire-fighting system (plugged nozzles)	*1*	*Fire-fighting system*	
Elevator	*1*	*Lifting appliances/accessories*	*2*
Riser elevator	*1*	*Lifting appliances/accessories*	
Air line	*1*	*Air supply/Pneumatic system*	*2*
Pneumatic system (unspecified)	*1*	*Air supply/Pneumatic system*	
Fingerboard	*2*	*Pipe-handling system*	*2*
Pump	*2*	*Pumps and compressors*	*2*
Cement pump	*1*	*Cementing system*	*1*
DP computer	*1*	*Dynamic Positioning system*	*1*
Switchboard wiring	*1*	*Communications system*	*1*
Boiler	*1*	*Generic pressure equipment*	*1*
Eductor system	*1*	*Eductor system*	*1*
Propeller shaft seal	*1*	*Propeller*	*1*

A large number of different pieces of equipment and structural components were identified. The type of equipment/structural component that was most frequently involved in past accidental situations is the (semi-sub or jack up) **leg**[108]**, followed by unspecified failures of the elevating system's elements**. **However, it must be pointed out that problems concerning the leg were mostly due to the presence of cracks, or due to unspecified reasons.**

Due to the high number of different pieces of equipment or structural components identified, the types of equipment identified were also grouped into systems, in an attempt to highlight the ones that proved to be most vulnerable in the past (as shown in Table I-3). A more detailed analysis of the results of this activity is presented in the next section.

I2.3.2. Analysis of data related to identified specific systems

As shown in Table I-2, the identified equipment/structural components were also

[108] It should be noted that legs are not equipment, but rather a structural component of the MODU. In order to take into account all parts of a mobile installation, structural components (legs, hull, pontoons, etc.) have also been included. It should be pointed out that structural components have no relation with EU product safety legislation.

assigned a specific system category[109].

Figure I-6 shows the systems which were more frequently involved in past accidental events. As can be easily noted, the systems which are predominant are the following:

- Structure (30 events);
- Anchoring / Mooring / Towing system (29 events);
- Unspecified equipment (18 events);
- Crane (Lifting appliances) (16 events).
- Elevating system (13 events).

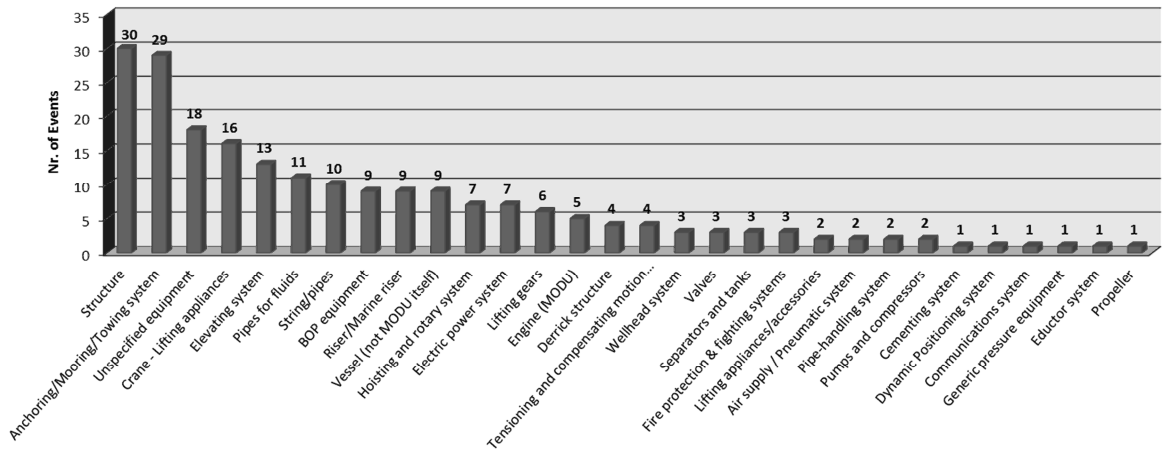


Figure I-6. MODU systems involved in offshore accidental events (WOAD)

Figure I-7 shows the evolution over time of the number of events associated to the five most involved systems.

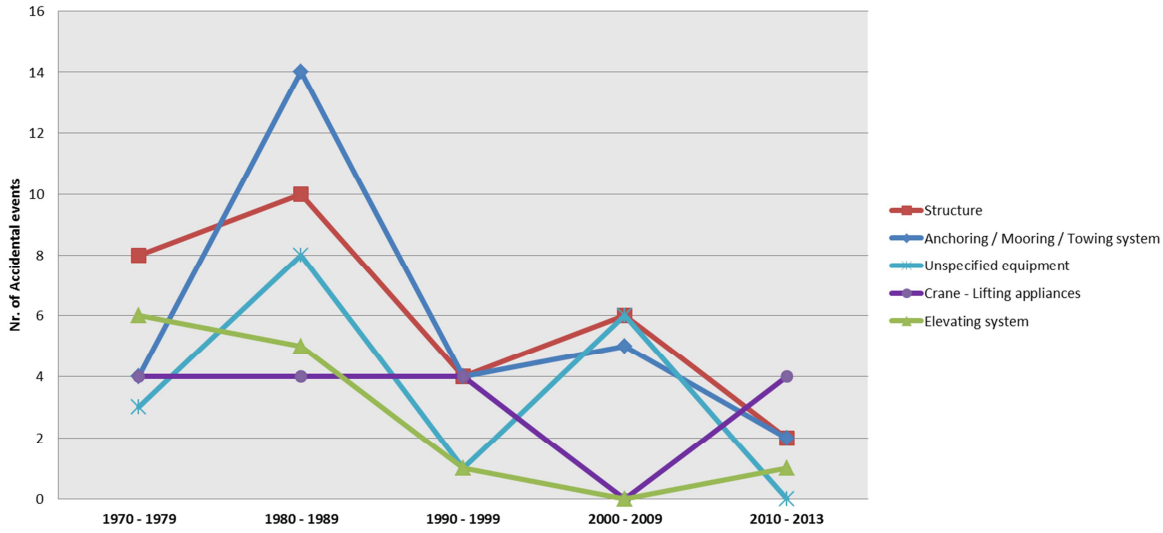


Figure I-7. Number of offshore accidental events over time for the four main categories involved

The highest number of accidental events was concentrated in the 1980s, for most of the systems considered[110].

[109] Categories of systems are described in Section 3.

Figure I-8 shows the evolution over time in the number of fatalities and injuries which are associated with the 213 events caused by an equipment failure. In detail:

- A total number of 64 fatalities were calculated, which account for only around 11% of the total 562 fatalities recorded;
- A total number of 188 injuries were calculated, which account for 30% of the total 631 injuries recorded.

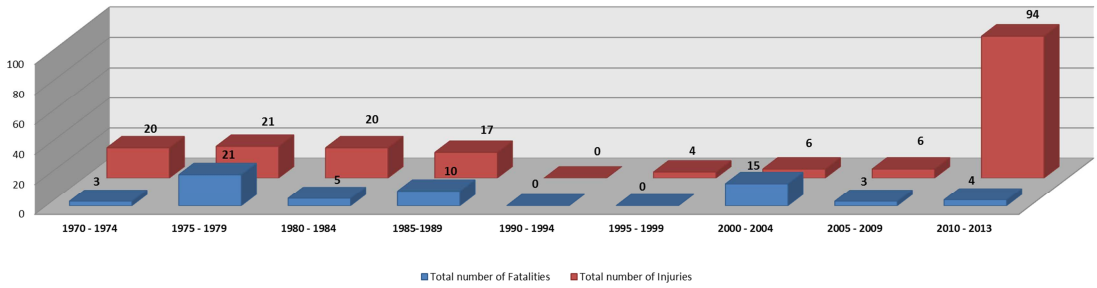


Figure I-8. Total number of fatalities and injuries over time in offshore events due to equipment failures

Most of the fatalities occurred during the 1970s and 1980s, as already detected from the analysis of fatalities for the whole data sample (see Section I2.2). Fifteen fatalities were also registered more recently (2000 – 2004). Almost all fatalities related to this period (11) are linked to just one event, i.e. the total loss of a semi-submersible platform in South America, after the occurrence of fires and explosions, apparently due to pressurisation problems which resulted from the blockage of a fire damper.

On the contrary, the highest number of injuries (94) occurred during the period 2010 – 2013. At a closer look, most of these injuries (90) occurred during only one event, the tilting of a jack up (under construction in South East Asia) due to the failure of the elevating system.

The following pie-charts (Figure I-9) illustrate which types of equipment/ structural components form the categories "Structure" and "Anchoring/ Mooring/ Towing system", respectively.

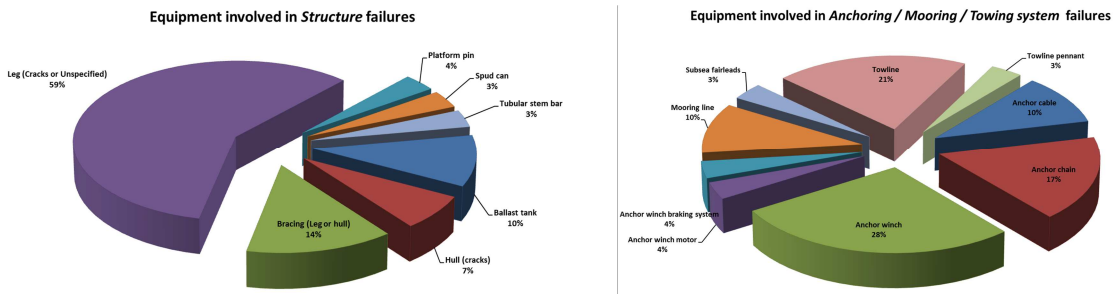


Figure I-9. Types of equipment involved in the "Structure" category and Types of equipment involved in the "Anchoring / Mooring / Towing system".

It should be pointed out that most of the components of these two systems[111] can barely be considered as "equipment". Therefore, it seems that specific

[110] However, the numbers of events considered are not statistically representative.

[111] Anchoring/ Mooring/ Towing system and Structure.

equipment which might fall within the scope of EU product safety legislation is not among the most involved, as resulted from the analysis of past accidents recorded in the WOAD database.

In addition, a deeper analysis of the events involving the two aforementioned systems was performed, in order to retrieve data regarding the number of fatalities, injuries and total cost of damages associated with such events. Results are shown in the next Section.

I2.3.3. Consequences of events and trends over time for the most involved systems

As explained in Section I2.3.2, the systems which were more frequently involved in offshore accidental events are:

- *Structure;*
- *Anchoring/ Mooring/ Towing system.*

Table I-4 and Table I-5 provide information on the total number of fatalities and injuries, as well as the total cost of damage associated to the events in which the two systems were involved.

Table I-4. Fatalities, injuries and cost of damage associated with the "Structure" system

Structure system					
Time period	*Number of events*	*% of the total*	*Fatalities*	*Injuries*	*Associated cost of damage (if provided) [mln $]*
1970 - 1979	8	26.7	10	8	18.8
1980 - 1989	10	33.3	2	4	2.2
1990 - 1999	4	13.3	0	0	n/p
2000 - 2009	6	20.0	0	0	n/p
2010 - 2013	2	6.7	0	1	n/p
Total	30	100	12	13	21.0

Table I-5. Fatalities, injuries and cost of damage associated with the "Anchoring/Mooring/Towing" system

Anchoring / Mooring / Towing system					
Time period	*Number of events*	*% of the total*	*Fatalities*	*Injuries*	*Associated cost of damage (if provided) [mln $]*
1970 - 1979	4	13.8	0	0	4
1980 - 1989	14	48.3	1	7	25.77
1990 - 1999	4	13.8	0	0	N/P
2000 - 2009	5	17.2	0	2	N/P
2010 - 2013	2	6.9	0	0	N/P
Total	29	100	1	9	29.77

For both systems, the highest number of events was registered during the 1980s, i.e. 10 for the "*Structure*" system (33.3%), and 14 for "*Anchoring/ Mooring/ Towing*" system (48.3% of the total events).

The total number of fatalities associated with the "*Structure*" system is twelve (12). However, it should be noted that all fatalities had occurred before 1990 (and most of them even during the 1970s). No fatality related to this system had occurred since then (i.e. until mid-2013).

Only one fatality was registered for the "*Anchoring/ Mooring/ Towing*" system; also in this case, this death occurred during the 1980s.

Thirteen (13) injuries were recorded for the "*Structure*" system. Similarly to the case of fatalities, the majority of these injuries happened during the 1970s and 1980s. One only injury has been recorded since 1990.

In the case of the "*Anchoring/ Mooring/ Towing*" system, most of the injuries (seven out of nine) occurred during the 1980s, whereas the remaining two injuries occurred during the period 2000-2009.

Finally, the highest cost of damage was sustained during the 1970s for the "*Structure*" system, and during the 1980s for the "*Anchoring/ Mooring/ Towing*" system.

Due to the fact that the most involved systems are associated with relatively low numbers of fatalities and injuries, it seemed appropriate to investigate if other systems were related to higher numbers of fatalities and injuries.

The results of this small analysis are shown in Table I-6 and Table I-7.

Table I-6. Types of systems associated with the highest numbers of fatalities

Type of system involved	Number of fatalities
Structure	12
Fire protection system	11
Crane (Lifting appliances)	7
Lifting gear	5

Table I-7. Types of systems associated with the highest numbers of injuries

Type of system involved	Number of injuries
Elevating system	93
Pipes for fluids	19
Structure	13
Pumps and compressors	9
Crane (Lifting appliances)	8

Note that the highest number of fatalities associated to one single system (12) is due to the "*Structure"* system.

The second highest number of fatalities is due to the "*fire protection system"*. In this case, all fatalities are linked to one single event, i.e. the total loss of a semi-submersible in South America due to pressurisation problems which resulted from the blockage of a fire damper.

On the other hand, the highest number of injuries (93) is related to failures of the elevating system. Again, as explained in Section I2.3.2, 90 injuries out of 93 were caused by one single event in South East Asia. The second system in terms of number of injuries is the *Pipes for fluids* category, which mainly includes failures of pressurised

lines.

In conclusion:

- The systems which appear to be more frequently involved in accidental events on MODUs are the *Structure* system and the *Anchoring/ Mooring/ Towing* system;
- The *Structure* system is the most frequently involved system, and it is also the system associated with the highest number of fatalities. However, these fatalities account for only 2% of the total recorded fatalities. Injuries due to structural failures account for 14.7% of the total recorded injuries, but almost all of these injuries are due to one single event[112];
- Concerning events caused by failure of the *Anchoring/ Mooring/ Towing* system, only one fatality was recorded, along with a small number of injuries (9), most of which occurred during the 1980s;
- It seems that no specific piece of equipment which might fall within the scope of EU product safety legislation could be considered as more often the cause of offshore accidental events.

I2.3.4. Considerations on the trends for fatalities and injuries (2010 – 2013)

As mentioned earlier in Section I2.2, according to the data showed in Figure I-10, it can be seen that the number of fatalities and injuries has started to increase again in the last 10-15 years.

Fatalities and injuries which have occurred since 2010 have been analysed.

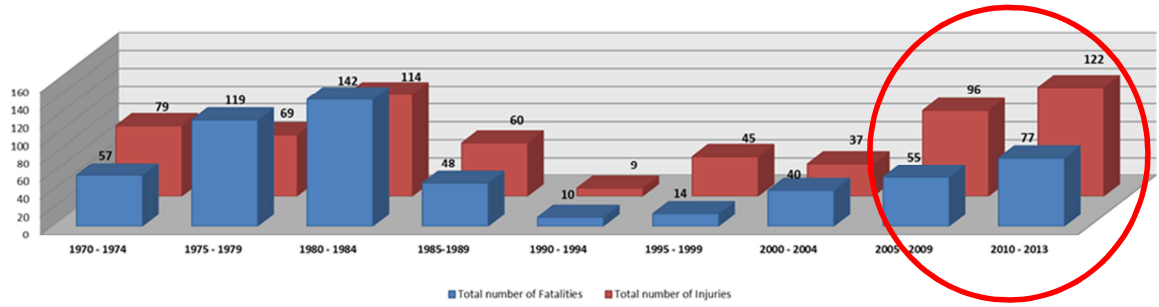


Figure I-10. Total number of fatalities and injuries in offshore accidental events over time (circled in red: 2000-2013)

Of the 77 fatalities recorded in the period 2010–2013, 53 were caused by one accident, i.e. the capsize of a jack up in Russian waters in 2011. Two main causes contributed to the occurrence of the event, i.e. the unsafe towing of the jack up, and adverse weather conditions. No failure of specific equipment was involved.

Again one single event, i.e. the Macondo blow-out in the Gulf of Mexico in April 2010, contributed to the overall number of fatalities with 11 deaths. The remaining fatalities occurred in a number of other events.

Concerning injuries, as already explained earlier in the report, 90 injuries out of 122 are due to the tilting of another jack up, during construction operations, as a result of a failure of the elevating system.

Moreover, the Macondo blow-out also caused 18 injuries among crew and third-party personnel.

Therefore, according to the events analyzed for the period 2010-2013, it appears that an increase in the number fatalities is not attributable to the failure of a specific piece

[112] The tilting of a jack up (under construction) in Southern Asia.

of equipment. On the contrary, the increase in the number of injuries might be attributed to specific equipment, but most of the injuries were the result of one single event.

I2.3.5. Limitations of the dataset

The analysis of past events recorded in the WOAD is subject to some data limitations, which influence the results shown in the previous sections. In particular, the following considerations must be made:

- In many cases, accidental events had incomplete/ insufficient descriptions, with only few details provided. This made it almost impossible to categorize an event in terms of failure of equipment or structural component;
- In a number of cases, the categorization of events was not precise; for instance, an event with no fatalities/injuries or damage to the structure could be categorized as an "*accident*", despite the definition of "accident" used in the database;
- Similarly, many events' descriptions were more focused on the consequences of the event (e.g. damages to the structural parts of the unit, details on injuries sustained by personnel) than on providing information on the causes;
- WOAD collects information on past events from very different sources, from insurance companies and official investigation reports, to newspaper articles. Therefore, details contained in the event descriptions might differ significantly depending on the available source of information.
- WOAD attempts to cover worldwide accidents, but there are areas of the world for which limited information is available. For these areas, accident data is available only for events which have occurred on units owned by private foreign operators [10].

I3. Analysis of WOAD major accidents and comparison with data from OGP

For the sake of completeness, the results of an analysis performed on WOAD accident information by the International Association of Oil and Gas Producers were examined.

OGP Report 434-17 "Risk Assessment Data Directory (RADD) – Major Accidents" was published in 2010 with the aim of providing information on past major accidents in both the onshore and offshore oil and gas sectors, to serve as background for QRA studies, with particular focus on the relative frequency of occurrence of a range of incident types [10].

For the purposes of their analysis, the WOAD database was used, which covered data on accidents which had occurred during the period 1970-2007. In addition, only major accidents were analysed.

According to OGP, a **major accident** is defined as an accident resulting in at least one of the following:

- multiple fatalities;
- total loss or severe damage (for offshore units);
- 1000 barrels of oil spilt.

The terms *total loss* and *severe damage* were defined as by WOAD.

Of particular interest to the present report are OGP's results concerning the number of accidents associated to severe damage or total loss of the unit, sorted by main event.

Starting from this information, the following table (Table I-7) was completed to show the number of accidents which occurred on **all types of installations**, **worldwide**, associated with the **highest levels of damage** and sorted **by type of event**. Due sets of data are displayed:

- data from OGP report, for the period 1970-2007;
- data from the JRC study, for the period 1970-2013 (use of the updated version of WOAD).

It must also be pointed out that – for the purpose of this small additional analysis - the accidents considered were not categorised according to the operation mode at the time of the event. Therefore, accidents related to operational and maintenance errors were also taken into account[113].

From Table I-7, it can be noticed that the numbers provided by WOAD in 2007 and 2013 for the categories "*Loss of buoyancy or sinking*" and "*Other*" are considerably different (*). In the first case, the number of events decreases from 140 (OGP) to 73 (JRC), whereas in the latter the opposite occurs, i.e. from 0 (OGP) to 83 (JRC). This can only be explained by a change in the definition of the accident categories made by WOAD between 2007 and 2013.

Of all main event categories listed in the table, only one-third of them might be related to an extension of scopes of EU product safety legislation, as highlighted in Table I-8.

[113] As opposed to the main accident analysis, which aimed at identifying events due to the failure of specific types of equipment.

Table I-8. Number of accidents by type of event and level of damage [Sources: OGP and WOAD]

	OGP Data	JRC Data	OGP Data	JRC Data
	Events resulting in severe damage	Events resulting in severe damage	Events resulting in total loss	Events resulting in total loss
Anchoring/Mooring failure	0	0	0	0
Blow-out	6	7	2	4
Breakage or fatigue	93	98	12	13
Capsize, overturn or toppling	189	191	73	73
Collision, non-offshore units	42	43	18	18
Collision, offshore units	24	27	14	15
Crane accident	0	0	0	0
Explosion	10	10	0	0
Falling loads/objects	13	14	1	1
Fire	86	89	40	42
Loss of buoyancy or sinking	33	36	140*	73*
Grounding	21	22	10	10
Helicopter accident	0	0	0	1
Leakage into hull	5	5	3	3
List or uncontrolled inclination	14	17	4	5
Machinery/propulsion failure	0	0	0	0
Other	40	41	0*	83*
Out of position, adrift	2	3	0	0
Release of fluid or gas	122	128	1	1
Towline failure	3	3	0	0
Well problem, no blow-out	0	0	0	0
Total	**703**	**734**	**318**	**342**

Table I-9 summarises the number of events which have occurred globally on all types of unit since 1970 in the offshore oil and gas sector, and have led to at least severe damages to the unit.

The following considerations can be made:

- according to the data from OGP, only 237 out of 703 accidents (33.7%) associated with severe damages to the unit could be due to failure of equipment which might fall within the scope of EU product safety legislation;
- this percentage of events is the same even according to the more updated data from the JRC (due to availability of data until mid-2013);

- in case of total loss, the percentage of accidents which might be traced back to causes that an extension of scope of the three EU Directives could address is:
  - **13.8%**, according to data from OGP (i.e. WOAD: 1970-2007);
  - **14%**, according to data from JRC (i.e. WOAD: 1970-2013).

  Also in this case, no major differences in the two datasets were encountered.

Table I-9. Number of accidents sorted by category of event (related to extension of scope of EU Directives)

	OGP Data	JRC Data	OGP Data	JRC Data
	Events resulting in severe damage	Events resulting in severe damage	Events resulting in total loss	Events resulting in total loss
Blow-out	6	7	2	4
Crane accident	0	0	0	0
Explosion	10	10	0	0
Falling loads/objects	13	14	1	1
Fire	86	89	40	42
Machinery/propulsion failure	0	0	0	0
Release of fluid or gas	122	128	1	1
Total	**237**	**248**	**44**	**48**

I4. Summary of Statistical analysis of offshore accidents and incidents on MODUs

The present annex describes the results of the statistical analysis performed on past offshore accidental events, with the aim of identifying – if possible – specific types of equipment, structural components, and systems which were more frequently involved in accidental events on mobile installations, and to acquire information on the consequences of such events, in terms of fatalities, injuries and cost of damages.

Information on the analysed past events was provided by the Worldwide Offshore Accident Databank (WOAD), operated by DNV GL.

The analysis was carried out in support of a study on the socio-economic and environmental impacts of including MODUs equipment into the EU product safety legislation, i.e.

- ATEX Directive (Directive 2014/34/EU - 96/9/EC);
- Machinery Directive (Directive 2006/42/EC);
- Pressure Equipment Directive (Directive 2014/68/EU – 97/23/EC).

Such study is currently being carried out by the Joint Research Centre in collaboration with the Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW).

The results of the analysis showed that the systems which were more frequently involved in past offshore accidental situations are the following:

- Structure;
- Anchoring / Mooring/Towing system;

- *Unspecified* equipment;
- Elevating system;
- Crane (Lifting appliances).

It seems then that failures of specific pieces of equipment which might fall within the scope of EU product safety legislation did not account for a substantial proportion of events, compared to other causes of analysed events. In addition, it must be pointed out that – due to the limitations in the dataset used (i.e. WOAD) – it was not possible to make a distinction between the failures of pieces of equipment/systems due to design faults and unsafe system components, and those which were due, for instance, to lack of maintenance or improper use of the equipment, which might suggest procedural deficiencies.

Structural components of MODUS, in particular semi-sub and jack up legs, were found to be more involved in accidental situations. However, it must be pointed out that problems concerning legs were mostly due to the presence of cracks, or due to unspecified reasons.

It must also be pointed out that the numbers of events involving specific equipment could not be considered statistically representative.

Moreover, it appeared that the highest number of accidents occurred during the period 1980-1989, followed by a decrease in the following decades. This is most probably the result of new legislation, procedures, standards and technological advancements which took place after the Piper Alpha accident in 1988. Even though Piper Alpha was a fixed platform, the whole offshore sector benefitted from the improvements introduced to enhance offshore safety, including MODUs. However, a new increase in the number of accidents was noticed in the late 2000s, just before the Macondo accident in 2010. Due to the fact that accident data are available only until 2013, it is still too early to identify any trend in the occurrence of events as a result of new implemented post-Macondo measures.

Finally, an evaluation of the total number of fatalities, injuries and cost of damage was also performed, in order to calculate the figures related to the failure of specific systems, types of equipment and structural components.

It was noticed that the highest numbers in terms of fatalities and injuries occurred during the period 1980-1989, with a significant drop in the following decade (1990-1999). These numbers have begun to increase again since 2000. However, according to the events analysed for the period 2010-2013, it appears that an increase in the number fatalities is not attributable to the failure of specific equipment. On the contrary, the increase in the number of injuries might be attributed to specific equipment, but most of the injuries were the result of one single event.

The most involved system, i.e. *Structure*, is also the one with the highest number of fatalities. However, these account for only 2% of the total recorded fatalities. Injuries due to structural failures account for 14.7% of the total recorded injuries, but almost all of these injuries are due to one single event. Failures of the *Anchoring/ Mooring/ Towing* system are associated with only one fatality and with a small number of injuries, most of which have occurred during the 1980s.

For the sake of completeness, the present statistical analysis was integrated with the results of an analysis performed on WOAD accident information by the International Association of Oil and Gas Producers were examined. To this aim, data from **OGP Report 434-17 "Risk Assessment Data Directory (RADD) – Major Accidents**" (2010) was used. Again, the WOAD database was used, but in this case only data on accidents which had occurred during the period 1970-2007 were available. Only major accidents (as defined by OGP) were analysed, and conclusions were drawn concerning the number of past major accidents sorted by type of main event (e.g. fire, explosion).

The main conclusions of this small additional analysis – also compared with the results from the JRC - were the following:

- according to the data from OGP, only 237 out of 703 accidents (33.7%) associated with **severe damages** to the unit could be due to failure of equipment which might fall within the scope of EU product safety legislation;
- this percentage of events is the same even according to the more updated data from the JRC (due to availability of data until mid-2013);
- in case of **total loss**, the percentage of accidents which might be traced back to causes that an extension of scope of the three EU Directives could address is **13.8%**, according to data from OGP (i.e. WOAD: 1970-2007) and **14%**, according to data from JRC (i.e. WOAD: 1970-2013).Also in this case, no major differences in the two datasets were encountered.

In conclusion, from the results of the statistical analyses it is not possible to state that there is a safety issue related to the non-extension of the existing product safety legislation to MODUs, but it is also not possible to exclude it.

List of abbreviations

- ABS - American Bureau of Shipping
- ALARP - As Low As Reasonably Practicable
- ATEX - Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast) Text with EEA relevance
- API – American Petroleum Institute
- ASME - American Society of Mechanical Engineers
- BOP – Blow-out Preventer
- BP British Petroleum - company
- BS - British Standards
- CAGR - Compound Annual Growth Rate
- CE - originated as an abbreviation of Conformité Européenne, meaning European Conformity
- CEN – European Committee for Standardization
- CENELEC - European Committee for Electrotechnical Standardization
- CSA - Canadian Standards Association
- DG - Direcorate General
- DNV GL - Det Norske Veritas Germanischer Lloyd – private Certification Body and classification society
- E&P - Exploration and Production
- EC – European Commission
- ECSA - European Community Shipowners' Association
- EHSR – Essential Health and Safety Requirements ç
- EN - European harmonised standards – CEN/CENELEC
- EPA - US Environmental Protection Agency
- EPC - Engineering, Procurement, and Construction
- EPCI - Engineering, Procurement, Construction, and Installation
- EU – European Union
- EU/EEA - European Union/European Economic Area
- FLNG - Floating Liquefied Natural Gas
- FPS - Floating Production System
- GOST - Russian standards
- HSE - UK Health and Safety Executive
- HWU – Hydraulic Workover snubbing Unit
- IACS – International Association of Classification Societies
- IADC - International Association of Drilling Contractors
- IEC - International Electrotechnical Commission
- IEEE- Institute of Electrical and Electronics Engineers
- IMCA - International Marine Contractors Association
- IMO – International Maritime Organization
- IP - Code, International Protection Marking, IEC standard 60529, sometimes interpreted as Ingress Protection Marking
- ISO – International Standardization Organisation
- LMRP - Lower Marine Riser Package
- LNG - Liquefied Natural Gas
- LR - Lloyd Register of Shipping
- MD - Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (Text with EEA relevance)
- MODU – Mobile Offshore Drilling Unit
- NB - Notified Body
- NORSOK – Norwegian Standards
- NPD - Norwegian Petroleum Directorate

- NSA - Norwegian Shipowners' Association
- O&G - Oil and Gas
- OEMs - Original Equipment Manufacturers
- Offshore Directive - Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC Text with EEA relevance
- PDVSA - Petroleum of Venezuela - company
- PED - Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment (recast) Text with EEA relevance
- PSDs – European Product Safety Directives (ATEX, MD and PED)
- PTIL (PSA) - Norwegian Petroleum Safety Authority
- RCD- Recreational Craft Directive
- RO - Recognized Organizations
- SEA - Ships and Maritime Equipment Association
- SECS – Safety and Environmentally Critical Systems
- SOLAS – International Convention for the Safety of Life at Sea
- SSM - Dutch State Supervision of Mines
- UK - United Kingdom
- UL - type of certification - private organization
- US - United States of America
- WBEs - Well Barrier Elements
- WOAD - Worldwide Offshore Accident Databank

List of figures

List of tables

LD-NA-27895-EN-N

JRC Mission

As the science and knowledge service of the Commission our mission is to support EU policies with independent evidence throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society

Stimulating innovation

doi:10.2790/296021

ISBN 978-92-79-58010-9

Publications Office