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OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

This report concerns offshore safety regulations and technology for petroleum operations in Australia, Brazil, Canada, Denmark, and the United Kingdom.

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AUSTRALIA

OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

Executive Summary

The Australian regulatory regime relating to the safety of offshore petroleum facilities reflects a performance-based, rather than prescriptive, approach. Safety cases are required to include detailed risk assessments and descriptions of the "control measures" that will be used to reduce health and safety risks. Such measures include blowout preventers and other emergency shut-down equipment and systems. An operator is required to explain the use of particular standards or codes in identifying control measures and setting performance standards. Independent "validation" of critical control measures is also required.

I. Introduction

Australia has enacted a number of changes relating to the regulation of offshore petroleum activities in recent years, including the establishment of a dedicated national regulatory body responsible for administering the safety regime.[1] The Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) is now the primary legislation that governs the lease, license, and permit processes and other arrangements relating to petroleum exploration and recovery in offshore areas.[2] Regulations made under this Act govern specific aspects such as environmental[3] and safety[4] matters. Each of the six states and the Northern Territory also have regulatory regimes governing petroleum activities in coastal waters[5] and are in the process of

[1] The National Offshore Petroleum Safety Authority (NOPSA) commenced on January 1, 2005. *See* History of NOPSA, http://www.nopsa.gov.au/history.asp (last visited June 23, 2010). NOPSA was established by amendments to the Petroleum (Submerged Lands) Act 1967 (Cth) made by the Petroleum (Submerged Lands) Amendment Act 2003 (Cth). This legislation has been repealed and replaced by the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth), *available at* http://www.comlaw.gov.au/ComLaw/Legislation/ActCompilation1.nsf/current/bytitle/C6672EC2444B2894CA2576F6000032F4?OpenDocument&mostrecent=1.

[2] *See Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) s 4, which provides an outline of the legislation. The legislation reflects an intergovernmental agreement that provides for the states and Northern Territory to have jurisdiction for "coastal waters," being the first three miles of the territorial sea, and for the Commonwealth government to have jurisdiction for "offshore areas" beyond that point. *Id.* s 5.

[3] *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*, *available at* http://www.comlaw.gov.au/ComLaw/legislation/legislativeinstrumentcompilation1.nsf/current/bytitle/155E3908BB3F2E7BCA257690001104CA?OpenDocument&mostrecent=1.

[4] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009*, *available at* http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/current/bytitle/B07E4BE0CFA4D33CCA25773B00269ED9?OpenDocument&mostrecent=1.

[5] *See supra* note 2 for information about the areas of jurisdiction of the Commonwealth and state governments.

amending their legislation in order for it to correspond with the Commonwealth regime.[6] Relevant agencies at the state level play a central role in administering the regulatory regimes for both coastal waters and offshore areas.

The Australian government may make further changes to the regulatory regime in response to the recommendations of a Commission of Inquiry established to examine the circumstances and likely causes of the August 2009 incident involving a blowout and subsequent oil spill at the Montara Wellhead Platform.[7] The terms of reference for the inquiry included reviewing the adequacy of the regulatory regime and its enforcement.[8] The Commission's report was provided to the government on June 18, 2010, but has not yet been made public.[9]

II. Overview of the Regulatory Regime

The Commonwealth regulatory regime for offshore petroleum facilities reflects a performance-based approach, with operators required to produce a range of planning documents and have these accepted by the relevant regulatory body before an offshore facility may be constructed, installed, or operated. This includes a safety case, which must be approved by the National Offshore Petroleum Safety Authority (NOPSA).[10] The monitoring and inspection of the facility by NOPSA is then based on compliance with the safety case.[11]

The safety case is required to contain a detailed description of procedures, systems, and equipment relating to a response to an emergency situation.[12] Under the safety case regime, it is the operator's responsibility to identify and analyze risks and hazards, and to determine measures to reduce those that are appropriate to the facility and the activities performed. In essence, "the

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[6] *See* NOPSA, *Legislation and Regulations*, http://www.nopsa.gov.au/regs.asp, for links to relevant state and Northern Territory legislation. This website notes that "the mirror laws of Tasmania, Queensland and New South Wales are not yet fully in place."

[7] For information about this incident, *see* Australian Maritime Safety Authority, Major Oil Spill – Montara Well Head Platform, http://www.amsa.gov.au/Marine_Environment_Protection/Major_Oil_Spills_in_Australia/Montara_Wellhead/index.asp (last visited June 17, 2010).

[8] Commission of Inquiry into the Montara Well Head Platform Uncontrolled Hydrocarbon Release, Terms of Reference, *available at* http://www.montarainquiry.gov.au/downloads/Commission %20of%20Inquiry_ToR.pdf.

[9] Press Release, Hon Martin Ferguson, Montara Commission of Inquiry Report Received (June 18, 2010), *available at* http://minister.ret.gov.au/TheHonMartinFergusonMP/Pages/10-144-montara-commission-of-inquiry-report-received.aspx.html.

[10] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) reg 2.44. *See also* National Offshore Petroleum Safety Authority (NOPSA), Guidance Note N-04300-GN0060, The Safety Case in Context: An Overview of the Safety Case Regime (Rev. 1, Feb. 2010), *available at* http://www.nopsa.gov.au/document/N-04300-GN0060%20-%20The%20Safety%20Case%20in%20 Context.pdf. Aspects of the regime are currently under review. *See* Department of Resources, Energy and Tourism, Offshore Petroleum Safety Regulation Inquiry and Review of the National Offshore Petroleum Safety Authority Operational Activities, Government Response (Draft for Consultation, May 2010), *available at* http://www.ret.gov.au/resources/Documents/Offshore%20Petroleum%20Safety/offshore _pet_safety_reg_inquiry_gov_response.pdf.

[11] NOPSA, The Safety Case in Context, *supra* note 10, at 1.

[12] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) div 1, subdiv. C.

operator has to show through reasoned and supported arguments within the safety case that there is nothing else that could reasonably be done to reduce risks further."[13]

In addition, regulations require the approval of an environment plan[14] and a well operations management plan (WOMP).[15] The WOMP is required to "show that the risks identified by the titleholder in relation to the well activity will be managed in accordance with sound engineering principles, standards, specifications and good oil-field practice."[16] Environment plans establish the legally binding environmental management conditions that an operator of an offshore petroleum activity must meet.[17] These plans must cover the matters set out in the regulations, including an Oil Spill Contingency Plan (which must include "emergency response arrangements").[18]

The oversight and approval of environment plans and WOMPs are the responsibility of the relevant resources agency in each state or territory (known as the "Designated Authority") with delegated functions relating to offshore petroleum activities.[19]

III. Blowout Preventers

A. Are Blowout Preventers (BOPs) Required?

The safety regulations provide that safety cases must cover a number of matters, including a detailed emergency response analysis that identifies "the technical and other control measures necessary to reduce the risks associated with emergencies to a level that is as low as reasonably practicable."[20]

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[13] NOPSA, Guidance Note N-04300-GN0271, Control Measures and Performance Standards 13 (Rev. 0, May 2010), *available at* http://www.nopsa.gov.au/document/Guidance%20Note%20-%20Control%20Measures%20and%20Performance%20Standards.pdf.

[14] *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 6.

[15] *Petroleum (Submerged Lands) (Management of Well Operations) Regulations* (Cth) reg 5, *available at* http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/C1781DB1F08281F8CA256F70008111D0?OpenDocument.

[16] *Id.* reg 6(1)(c).

[17] *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) reg 7.

[18] *Id.* reg 14. An Oil Spill Contingency Plan is also typically required by the Department for the Environment, Water, Heritage and the Arts for environmental impacts assessments conducted under the Environment Protection and Biodiversity Conservation Act 1999 (Cth). *See* Australia Maritime Safety Authority, Response to the Montara Wellhead Platform Incident – Report of the Incident Analysis Team (Mar. 2010) (AMSA Montara Report) 18, *available at* http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/Incident_and_Exercise_Reports/documents/Montara_IAT_Report.pdf.

[19] *See* Department of Resources, Energy and Tourism, Offshore Petroleum Exploration Acreage Release, Joint Authority/Designated Authority (2010), *available at* http://www.ret.gov.au/Documents/par/fact/documents/Joint%20Authority.pdf.

[20] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) reg 2.16(2)(h).

"Control measures" are defined by NOPSA as being "any system, procedure, process, device or other means of eliminating, preventing, reducing or mitigating the risk of hazardous events at or near a facility."[21] This includes technical measures involving physical equipment, as well as administrative or procedural measures such as inspections and testing requirements.[22]

As the relevant regulations are not prescriptive in nature, they do not specifically refer to a requirement for BOPs. What is required is for the analysis in the safety case to consider, among other matters "the incorporation into the facility of both automatic and manual systems for the detection, control and extinguishment of: (i) outbreaks of fire; and (ii) leaks or escapes of petroleum."[23]

The safety case must also make "adequate provision" for "emergency shut-down systems"[24] and procedures for "shutting down or isolating, in the event of emergency, each of those pipes so as to stop the flow of petroleum or greenhouse gas substance into the facility through the pipe."[25]

NOPSA guidance material on the content and level of detail of safety cases refers to BOPs in the context of drilling and well intervention operations, stating that the facility description may address different systems as appropriate, including "Surface BOP,"[26] and also in the context of addressing lifting operations, including "BOP Cranes."[27]

In the context of fire and explosion related systems, the guidance material states that:

> The information must be appropriate to the facility and the activities to be conducted at the facility and may address, but is not necessarily limited to, the following:
>
> - Loss of containment prevention
> - Detection systems (fire, gas, smoke, etc.)
> - Ignition prevention (Hazardous Area Equipment, shutdown on gas detection, etc.)
> - Flammable atmosphere prevention (layout/congestion, ventilation etc.)
> - Fire and explosion protection – both passive and active (e.g. structural coatings, deluge, water curtain, water mist, CO2, portable fire extinguishing equipment, support vessel equipment, fire walls, blast walls, etc.)
> - Emergency shutdown / blowdown / depressurisation / isolation

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[21] Control Measures and Performance Standards, *supra* note 13, at 4.

[22] *Id.*

[23] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) reg 2.17(2)(d).

[24] *Id.* reg 2.19(f).

[25] *Id.* reg 2.21(1).

[26] NOPSA, Guidance Note N-04300-GN0106, Safety Case Content and Level of Detail 30 (Rev. 1, Feb. 2010), *available at* http://www.nopsa.gov.au/document/N-04300-GN0106%20-%20Safety%20Case%20Content%20and%20Level%20of%20Detail.pdf.

[27] *Id.* at 31.

- Pipeline isolation
- Well control systems – ***blow out preventers***, diverter, choke & kill, Koomey unit, etc.[28]

BOPs are therefore one of the control measures that would be addressed in detail in the safety case in order to obtain NOPSA approval.

Where a state has not yet amended its own legislation to match the new Commonwealth regulations, some clauses in the "Schedule of Specific Requirements as to Offshore Petroleum Exploration and Production"[29] may still apply. This Schedule is a "set of standing directions issued under [section] 574 of the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)"[30] and reflects the more prescriptive approach that applied under the previous regulatory regime. All of the clauses relating to BOPs and other blowout prevention equipment will be revoked once the relevant amendments have been made to the regulations of each state.[31] In the meantime, companies are advised to "contact the relevant Designated Authority to confirm precisely which clauses continue to apply to their jurisdiction."[32]

A number of clauses in the Schedule relate to BOPs, including:

- An application for approval to drill must include a description of the type of blowout prevention equipment to be used (cl. 501(2)(h));
- Blowout preventers and "related well control equipment" must be "installed, operated, maintained and tested in accordance with the manufacturers recommendations or with API RP 53, Recommended Practice for Blow-out Prevention Equipment Systems For Drilling Wells" (cl. 505(1));
- Blowout preventer equipment must be tested in a specified manner (cl. 506); and
- Blowout prevention drills must be conducted weekly for each drilling crew (cl. 508).

B. Are There Specifications for BOPs?

Due to the nature of the performance-based regime, detailed specifications for BOPs are not set out in the Commonwealth safety regulations. The safety case is required to include "performance standards" for the systems, equipment, and procedures used to manage the risk of a major accident event (MAE).[33]

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[28] *Id.* at 34 (emphasis added).

[29] Offshore Petroleum and Greenhouse Gas Storage Acts, Schedule, Specific Requirements as to Offshore Petroleum Exploration and Production (May 2010) (Schedule of Specific Requirements), *available at* http://www.ret.gov.au/resources/Documents/Upstream%20Petroleum/OPGGSA%20Schedule%20of%20Specific%20Requirements%20100507.pdf.

[30] *Id.* at 1.

[31] *Id.* The clauses marked * are now covered by the various regulations. All of the clauses relating to blowout preventers are marked in this way in the Schedule.

[32] *Id.*

[33] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) regs 1.5 &.2.5(3)(i).

NOPSA guidelines state that operators may decide to base their safety case on compliance with specific codes or industry standards, or on fundamental engineering or management systems.[34] In terms of taking the approach of complying with standards in identifying control measures, NOPSA states that:

> For some facilities, compliance with industry standards, codes or practices may play an important role in providing evidence that necessary and appropriate control measures have been identified. In principle, such standards may be Australian Standards, equivalents from overseas organisations, international industry practices such as those from the American Petroleum Institute, or company-specific standards. However, whichever standards are being used, these standards, and the control measures that they apply, should all be shown to be suitable and appropriate to the specific facility, taking account of its type, scale, activities, location, etc.
>
> It is common for an operator to adopt a suite of standards, perhaps taken from a number of different organisations. In such cases, significant effort may be necessary to show that this overall suite of standards is suitable and appropriate, as well as the individual parts.[35]

NOPSA also provides guidance on the use of codes and industry standards in developing performance standards for individual control measures:

> If a performance standard is based on industry standards and codes for the control measure to meet, then the performance standard should include the key requirements (some of which may be contained within the codes and standards) that the control measure will be measured against during its life and not simply list the codes and standards that apply.[36]

Operators would therefore need to explain the application of particular international or industry standards or codes in the context of blowout prevention systems and equipment. Revisions to the safety case may also be needed over time, as it is considered to be a "living" document that "should be updated on a continuous basis in line with the principles of continuous improvement."[37]

Where a particular state has not yet amended their safety regulations to reflect this performance-based approach, the requirements relating to BOPs in the Schedule of Specific Requirements may apply, as discussed above.[38]

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[34] Control Measures and Performance Standards, *supra* note 13, at 13.

[35] Safety Case Content and Level of Detail, *supra* note 26, at 20. *See also* Control Measures and Performance Standards, *supra* note 13, at 17, stating that "the fire and explosion risk analysis should not simply assume that industry codes and standards are suitable by default; they must justify this for the specific situation, and must assess whether alternative measures are reasonably practicable and more effective."

[36] Control Measures and Performance Standards, *supra* note 13, at 30.

[37] NOPSA, Guidance Note N-4300-GN0087, Safety Case Lifecycle Management 1 (Rev. 1, Feb. 2010), *available at* http://www.nopsa.gov.au/document/N-04300-GN0087%20-%20Safety%20Case%20Lifecycle%20Management.pdf.

[38] *See*, in particular, Schedule of Specific Requirements, *supra* note 29, cls. 503-508.

IV. Additional Requirements for Emergency Shut-off Equipment

As noted above, the safety case must make provision for "emergency shut-down systems."[39] This includes "effective means of controlling and operating all relevant emergency shut-down valves for a pipe."[40] The regulations do not set out prescriptive requirements for particular equipment or systems. The need for, and adequacy of, specific control measures, and the applicable performance standards, would be assessed by NOPSA as part of the safety case approval process.

There are clauses relating to emergency shut-down systems and equipment in the Schedule of Specific Requirements that will apply in those states that have not yet amended their legislation.[41]

V. Relief Well Requirements

The regulations do not contain specific requirements relating to relief wells. However, the legislation requires an operator of an offshore facility to maintain adequate insurance against expenses and liabilities associated with the clean-up of oil spills.[42] The Australian Maritime Safety Authority notes that this "typically includes pollution cleanup, well control and relief well drilling, removal of debris and liability to third parties."[43]

VI. Verification of Safety Equipment

The safety regulations allow NOPSA to require an operator to provide a "validation" in respect of a proposed offshore petroleum facility and any proposed significant changes to an existing facility.[44] Validation is "a statement in writing by an independent validator in respect of the design, construction and installation (including instrumentation, process layout and process control systems) of the facility, to the extent that these matters are covered by the scope of the validation agreed between the Safety Authority and the operator."[45]

The regulations provide that an operator must not submit a safety case to NOPSA before there has been agreement on the scope of validation for the facility.[46] It is NOPSA policy to

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[39] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) reg 2.19(f).

[40] *Id.* reg 2.21(2)(a).

[41] *See*, in particular, Schedule of Specific Requirements, *supra* note 29, cls. 601A, 623-626.

[42] *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) s 571.

[43] AMSA Montara Report, *supra* note 18, at 15.

[44] *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) reg 2.40(1).

[45] *Id.* reg 2.40(2). The validator must have "the necessary competence, ability and access to data, in respect of each matter being validated, to arrive at an independent opinion on the matter." *Id.* reg 2.40(5).

[46] *Id.* reg 2.24(4).

request a validation in respect of all proposed facilities and any significant changes to existing facilities.[47]

NOPSA guidance material relating to validation states that all "Safety Critical Elements" that provide barriers to identified major accident events should be subject to validation.[48] In addition, there may be agreement regarding the particular standards or code that the elements will be validated against, with the validator making a statement with respect to compliance with the standards and the appropriateness of those standards.[49]

VII. Best Available Technology

The regulations do not make specific reference to the use of best available safety technology. However, guidance material published by NOPSA states:

> There is no prescribed methodology for demonstrating that the necessary control measures have been identified to reduce risks to ALARP [as low as reasonably practicable]. However there are several basic approaches which may be used to support an operator's provision of justification within the safety case. These include:
> - Case law
> - Risk acceptance criteria
> - Comparative assessment of risks, costs and benefits
> - Comparison with recognised codes and standards
> - Benchmark against good practice
> - ***Best available technology***
> - Clear description and justification for rejection of control measures
> - Performance of control measures
> - LOPA (Layers of Protection Analysis)
> - Engineering judgement approach
> - Practical tests of equipment or systems in situ
>
> In practice, it is likely that most operators will need to use a combination of approaches in their demonstration of ALARP.[50]

There is no additional information provided in the guidance material regarding the definition of "best available technology."

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June 2010

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[47] NOPSA, Validation Guideline 4, *available at* http://www.nopsa.gov.au/document/N-04200-GL0525%20-%20Validation.pdf.

[48] *Id.* at 6.

[49] *Id.* at 8.

[50] Safety Case Content and Level of Detail, *supra* note 26, at 48 (emphasis added).

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BRAZIL

OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

Executive Summary

Constitutional principles grant to the federal government the monopoly to explore, among other things, petroleum and natural gas in Brazil. Law No. 9,478 of August 6, 1997, opened the activities of the Brazilian oil industry to private initiative and created the National Petroleum Agency (ANP – Agência Nacional do Petróleo, Gás Natural e Biocombustíveis). ANP is a federal agency subordinated to the Ministry of Mines and Energy in charge of regulating the petroleum, natural gas, and biofuel industry in the country. ANP's regulations enable the agency to reject safety measures included in Development Plans that are not in accordance with the most current oil industry safety standards.

I. Introduction

This report sets forth the constitutional principle that grants to the federal government the monopoly to explore the reserves of petroleum and natural gas in Brazil. The report then discusses the regulatory framework currently in force regarding operational security and highlights the comments made by the president of ANP, Haroldo Lima, that there is a possibility of making ANP's regulations stricter in light of the accident that occurred in the Gulf of Mexico.

II. Offshore Safety Technology

A. Constitutional Principle

The Brazilian Constitution of 1988 declares that the federal government (*União*) retains, inter alia, the monopoly to the exploration and production of deposits of petroleum and natural gas and other fluid hydrocarbons through its state company, Petrobrás.[1] Law No. 2,004 created Petrobrás on October 3, 1953, with the objective of executing, on behalf of the federal government, the activities of the oil sector in Brazil.[2]

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[1] CONSTITUIÇÃO DA REPÚBLICA FEDERATIVA DO BRASIL DE 1988 [C.F.] arts. 177, 177(I), *available at* the website of the Brazilian Presidency, http://www.planalto.gov.br/ccivil_03/Constitu icao/Constituiçao.htm. For information on Petrobrás, *see* http://www.petrobras.com.br/pt/quem-somos/nossa-historia/.

[2] Lei No. 2004, de 3 de Outubro de 1953, art. 5, http://www.planalto.gov.br/ccivil_03/Leis/L2004.htm. On August 6, 1997, Article 83 of Law No. 9,478 revoked Law No. 2004 of October 3, 1953.

B. National Agency of Petroleum

In 1997, Law No. 9,478 of August 6, 1997, opened the activities of the Brazilian oil industry to the private sector and created the National Petroleum Agency (*ANP -Agência Nacional de Petróleo, Gás Natural e Biocombustíveis*), a federal agency subordinated to the Ministry of Mines and Energy responsible for the regulation, making of contracts, and inspection of the economic activities of the petroleum industry in Brazil.[3] Decree No. 2,455 of January 14, 1998, further regulates ANP.[4]

C. Operational Security

On May 31, 2000, the ANP issued Administrative Act (*Portaria*) No. 90, which approved the Technical Regulation of the Development Plan (*Regulamento Técnico do Plano de Desenvolvimento*).[5] The Technical Regulation defines the content and establishes the procedures on how to present the Development Plan for the oil and natural gas fields, as established in Article 44(IV) of Law No. 9,478 of August 6, 1997.

Article 2 of the Act requires the concession holder to present a Development Plan to the ANP within the time limit established in the concession contract. In the area of operational security, section 1.3 of the Technical Regulation determines that the development proposed for each field of oil or natural gas must meet the following basic principles, which are mandatory for approval of the Development Plan:

> a) Ensure the conservation of petroleum resources, which means the efficient recovery of oil in existing oil fields, and control the decline of the reserves and minimize losses on the surface;
>
> b) Ensure operational safety requiring the use of norms and procedures related to occupational safety and the prevention of operational accidents;
>
> c) Ensure environmental preservation, which implies the use of processes that minimize the impact of operations on the environment.[6]

According to Mr. Heller Redo Barroso, a Brazilian attorney who is an expert on petroleum regulation:

> Under [the] Brazilian regulatory framework, Concessionaires [Franchisees] must, before starting oil field development activities, submit a Development Plan to ANP's approval. Regulated under Portaria [Ordinance] 90 of 2000, the Development Plan encompasses several aspects of an oil field development, identified by a given technical depth,

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[3] Lei No. 9,478, de 6 de Agosto de 1997, arts. 7, 8, https://www.planalto.gov.br/ccivil_03/Leis/L9478.htm.

[4] Decreto No. 2.455, de 14 de Janeiro de 1998, http://www.planalto.gov.br/ccivil_03/decreto/D2455.htm.

[5] Portaria ANP No. 90, de 31 de Maio de 2000, http://nxt.anp.gov.br/NXT/gateway.dll?f=templates&fn=default.htm&vid=anp:10.1048/enu.

[6] *Id.*, Technical Regulation sec. 1.3 (translation by the author).

> including field production system installation activities and production per se, and information on production pace and the like.
> . . .
> [W]e understand that, based on "assurances/warranties of operational security and safety and prevention of operational accidents" ANP may dismiss Development Plans that do not have subsea projects that meet the required operational safety and security standards … [T]he regulation allowed ANP to reject a development plan that lacks equipment designed for maximum safety and security.
> . . .
> There has been a heated debate about the possibility of legislation to impose specific safety and security requirements. [However,] such regulations would not be in line with the dynamics of the oil and gas industry, [which are] always subject to technological developments. Therefore, refusal of a development plan seems a more effective way to enforce such preventive control.[7]

On December 6, 2007, ANP issued Administrative Act (*Resolução*) No. 43, which created the Operational Safety Rules for Drilling and Production Facilities of Oil and Natural Gas (*Regime de Segurança Operacional para as Instalações de Perfuração e Produção de Petróleo e Gás Natural*).[8] The rules consist of the regulatory framework established by ANP to ensure operational safety, considering the responsibilities of the concession holder and the functions of ANP in the conduct of drilling and production activities of oil and natural gas.[9]

The Act also approved the Technical Regulation for the Management System of Operational Safety of Drilling and Production Facilities of Oil and Natural Gas (*SGSO – Regulamento Técnico do Sistema de Gerenciamento da Segurança Operacional para as Instalações de Perfuração e Produção de Petróleo e Gás Natural*).[10]

SGSO's objective is to establish the requirements and guidelines for the implementation and operation of a Management System of Operational Safety, aimed at the operational safety of offshore drilling and production facilities of oil and natural gas, in order to protect human life and the environment through the adoption of seventeen management practices.[11]

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[7] Email from Mr. Heller Redo Barroso, a Brazilian attorney who is the Head of Heller Redo Barroso Advogados, a law firm dedicated, inter alia, to the petroleum and natural gas industry (June 21, 2010) (on file with author), following a telephone interview with Mr. Marcos Macedo, who is associated with the company.

[8] Resolução ANP No. 43, de 6 de Dezembro de 2007, art. 1, http://nxt.anp.gov.br/NXT/gateway.dll/leg/resolucoes_anp/2007/dezembro/ranp%2043%20-%202007.xml.

[9] *Id.* art. 1(§1).

[10] *Id.* art. 2.

[11] Regulamento Técnico do Sistema de Gerenciamento da Segurança Operacional das Instalações Marítimas de Perfuração e Produção de Petróleo e Gás Natural, http://nxt.anp.gov.br/NXT/gateway.dll/leg/resolucoes_anp/2007/dezembro/ranp%2043%20-%202007.xml.

D. New Regulations

The president of ANP, Haroldo Lima, was quoted as saying in an interview with a Brazilian newspaper[12] that although the safety systems adopted by Brazil and its inspection are very rigid, new methodologies may be adopted if it is necessary.[13] Lima further said that what happened in the Gulf of Mexico deserves ANP's full attention and, if applicable, warrants making the rules even more rigorous.[14] Currently, the agency is analyzing the documentation sent by all oil companies working in Brazil regarding their safety systems in response to a request made by ANP.[15]

III. Concluding Remarks

According to the regulations issued by ANP in the area of operational safety and from Mr. Barroso's explanation, it seems that instead of listing all safety equipments necessary for an offshore drilling operation, such as blowout preventers, acoustic triggers, relief wells, and many others, ANP prefers to analyze the Development Plan presented by the oil companies and, before approving the plan, make the necessary technical demands to ensure that the safety system being used is in accordance with their technical requirements and uses the best safety technology available.

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June 2010

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[12] Romona Ordoñez, *ANP Pode Mudar Critérios de Segurança para Exploração de Petróleo no Brasil por Causa de Vazamento nos EUA*, O GLOBO, June 19, 2010, *available at* http://oglobo.globo.com/economia/mat/2010/06/18/anp-pode-mudar-criterios-de-seguranca-para-exploracao-de-petroleo-no-brasil-por-causa-de-vazamento-de-oleo-nos-eua-916921018.asp.

[13] *Id.*

[14] *Id.*

[15] *Id.*

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CANADA

OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

Executive Summary

Since 2009, offshore drilling has been regulated by Canadian agencies that have broad discretion in deciding what types of safety equipment and industry practices are acceptable. Failure to satisfy the standards of these regulators with respect to such types of equipment as blowout preventers will result in the rejection or revocation of licenses to drill or operate wells. Canada's drilling regulations do not require relief wells to be constructed at the same time as primary wells, but regulators reportedly require companies to show plans to construct relief wells in the event of a blowout. In light of the Gulf disaster, the government and regulators are considering proposals for more detailed standards.

I. Offshore Drilling in Canada

Canada is the world's sixth largest producer of petroleum and is the largest supplier of crude oil imports to the United States.[1] In fact, Canada currently supplies approximately 19% of those imports.[2] Nevertheless, drilling for petroleum off the country's three lengthy coastlines has yet to be commenced on a large scale. There are only three offshore rigs currently in operation, as opposed to the thousands operating in the Gulf of Mexico, even though Canada appears to have large offshore reserves. These vast deposits are believed to exist off both the East and West Coasts and in the Arctic. However, drilling in the Arctic is difficult and expensive, the proven East Coast reserves are almost 350 miles offshore and in some very deep waters, and there is a moratorium on drilling off the West Coast that was put into place by the federal government several years after the oil spill near Santa Barbara California in 1969. The depth of the waters, the dangers of earthquakes, and the narrowness of British Columbia's straits were thought to pose great dangers to the environment by federal authorities and their supporters in the environmental movement.

In recent years, the government of that province has been trying to persuade the federal government to allow exploration in some offshore areas to promote economic growth despite continuing public concerns. The provincial government argues that the West Coast is being

[1] Canada, Department of Foreign Affairs and International Trade, Canada-U.S. Energy Relations, available at http://www.canadainternational.gc.ca/washington/bilat_can/energy-energie.aspx?lang=eng (last visited June 21, 2010).

[2] *Id.*

deprived of economic opportunities by the only federal moratorium on offshore drilling. The federal government has considered the possibility of allowing some West Coast exploration, but has not formulated any plans to open up areas off the West Coast to private companies. In fact, in the aftermath of the Gulf of Mexico disaster, the federal Minister of the Environment announced that the moratorium will not be lifted "anytime soon."[3]

In the Arctic, one exploratory license to drill offshore was granted by the National Energy Board, but there is no oil currently being produced in the offshore areas of Canada's far north.[4] Licensing of companies to explore the region has commenced in recent years, but a number of companies that have submitted bids and been awarded exploration licenses have asked the federal government to relax its safety standards in order to make drilling in the Arctic more economically competitive. Some regulations have been amended in recent years. A critic with the World Wildlife Fund stated that "the federal government has shifted away from a prescriptive regulatory framework to one that encourages industry to meet soft regulatory outcomes" and that "this shift is a leap of faith that industry will put the public-interest in front of self-interest and shareholder profits."[5] The International Association of Oil and Gas Producers have made much the same point in the following terms:

> [Canada's regulatory agencies,] including the NEB, are working with the federal and provincial governments to undertake a "Frontier and Offshore Regulatory Renewal Initiative" (FORRI). FORRI is intended to move the current suite of primarily prescriptive regulations to regulations that are goal-oriented. To that end, the vast majority of [the current regulations] will eventually be stripped out…and placed in associated regulatory guidance documents for which compliance would not be legally binding. This will open up operators to identify the best standards to apply, whether they are national, regional, international or industry standards, and may be those referred to in the regulatory guidance documents, or alternates so long as compliance with the goal oriented regulations can be demonstrated.[6]

However, Prime Minister Harper has repeatedly stated that Canadian regulators require adherence to stricter standards than their U.S. counterparts.[7]

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[3] Larry Pynn, B.C. Offshore Drilling Moratorium Stays: Prentice, Vancouver Sun, May 21, 2010, *available at* http://www.canada.com/news/offshore+drilling+moratorium+stays+Prentice/3058241/story.html?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3a+canwest%2fF75+(canada.com+National+News).

[4] Telephone Interview with National Energy Board in Calgary (June 21, 2010).

[5] Andrew Mayeda, *Canadian Offshore Drilling Regulations Relaxed Last Year*, VANCOUVER SUN, May 10, 2010, http://www.vancouversun.com/technology/Canadian+offshore+drilling+regulations+relaxed+last+year/3010351/story.html.

[6] INT'L ASS'N OF OIL AND GAS PRODUCERS, OGP: REGULATORS' USE OF STANDARDS, Rep. No. 426, at 16 (Mar. 2010), http://www.ogp.org.uk/pubs/426.pdf.

[7] Peter Overby, *BP Sought to Ease Canada's Policies on Relief Wells*, NPR, June 3, 2010, http://www.npr.org/templates/story/story.php?storyId=127381814&ft=1&f=1003.

The region in which significant offshore oil production is underway is off the coast of Newfoundland. Three large projects are already in production and more exploration was approved prior to the Gulf disaster. While oil and gas production in the Arctic falls entirely under federal jurisdiction, responsibility for regulating oil and gas drilling off the coast of Newfoundland is shared under an agreement with the province. A Canada-Newfoundland and Labrador Offshore Petroleum Board has been established to manage the offshore petroleum resources of Newfoundland. This Board generally follows standards that are similar to those followed by the NEB.

The federal government also shares regulatory responsibility for oil and gas exploration off the coast of Nova Scotia with the government of that province. However, while natural gas reserves are being tapped off the coast of Nova Scotia, petroleum is not currently being extracted in that area.

The Gulf disaster recently elicited a response from the Canada-Newfoundland Offshore Petroleum Board. The Board had already approved exploratory drilling by Chevron in the Orphan Basin, about 430 kilometers northeast of St. John's and operations commenced this month. The project is known as Lona O-55. At 2,600 meters (1.62 miles) below sea level, it will reportedly set a record for the deepest offshore project drilled in Canada.[8]

On May 20, 2010, the Board announced it was imposing "special oversight measures" on the project "in light of the situation unfolding in the Gulf of Mexico and heightened public concern over drilling operations currently underway in the Newfoundland and Labrador offshore area." The Board stated that "prior to penetrating any of the targets, Chevron must hold an operations timeout to review and verify, to the satisfaction of the chief safety officer and the chief conservation officer, that all appropriate equipment, systems and procedures are in place to allow operations to proceed safely and without polluting the environment."[9] Under the new measures, Chevron must provide daily reports on its drilling program to a team of board members and must meet with the oversight team every two weeks. The Board's actions have been summarized as follows:

> Chevron also must provide field reports regarding the rig's blowout preventer and all associated backup equipment. The company will be expected to monitor the massive oil spill caused by a blowout at the Deepwater Horizon rig in the Gulf of Mexico, and report any "lessons learned" from the incident.[10]

The audits and inspections aboard the Stena Carron drill ship, which will drill the well, have been increased to every three or four weeks from every three or four months.[11]

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[8] *Canada: Authorities Stop Chevron Drilling Project Off Newfoundland*, OFFSHORE ENERGY TODAY.COM, May 21, 2010, http://www.offshoreenergytoday.com/canada-authorities-stop-chevron-drilling-project-off-newfoundland/.

[9] *Id.*

[10] *Id.*

[11] *Id.*

II. Canadian Regulations

A. Blowout Preventers and Other Safety Equipment

Relevant sections of Canada's Oil and Gas Drilling Regulations provide as follows:

Well Control

. . .

36. (1) The operator shall ensure that, during all well operations, reliably operating well control equipment is installed to control kicks, prevent blow-outs and safely carry out all well activities and operations, including drilling, completion and workover operations.
(2) After setting the surface casing, the operator shall ensure that at least two independent and tested well barriers are in place during all well operations.
(3) If a barrier fails, the operator shall ensure that no other activities, other than those intended to restore or replace the barrier, take place in the well.
(4) The operator shall ensure that, during drilling, except when drilling under-balanced, one of the two barriers to be maintained is the drilling fluid column.

37. The operator shall ensure that pressure control equipment associated with drilling, coil tubing, slick line and wire line operations is pressure-tested on installation and as often as necessary to ensure its continued safe operation.

38. If the well control is lost or if safety, environmental protection or resource conservation is at risk, the operator shall ensure that any action necessary to rectify the situation is taken without delay, despite any condition to the contrary in the well approval.

Subsurface Safety Valve

47. (1) The operator of an offshore development well capable of flow shall ensure that the well is equipped with a fail-safe subsurface safety valve that is designed, installed, operated, and tested to prevent uncontrolled well flow when it is activated.

(2) If a development well is located in a zone where permafrost is present in unconsolidated sediments, the operator shall ensure that a subsurface safety valve is installed in the tubing below at the base of the permafrost.

Wellhead and Christmas Tree Equipment

48. The operator shall ensure that the wellhead and Christmas tree equipment, including valves, are designed to operate safely and efficiently under the maximum load conditions anticipated during the life of the well.[12]

[12] Canada Oil and Gas Drilling and Production Regulations, SOR/2009-315, §§ 36-38, 47-48, *available at* http://laws.justice.gc.ca/eng/SOR-2009-315/page-2.html. Corresponding Newfoundland regulations can be found in, Newfoundland Offshore Petroleum and Production Regulations, vol. 143, no. 16, Apr. 18, 2009, § 36(1)-(4), *available at* http://www.gazette.gc.ca/rp-pr/p1/2009/2009-04-18/html/reg2-eng.html.

These regulations thus require blowout preventers to be used in oil wells. They do not state how fast they must be able to shut down, if they must be able to open and close, if they are required to fully close, or if certain kinds of brands of blowout preventers are required. It appears that these are matters that are left to the discretion of regulators in granting exploration, drilling, and production permits.

A spokesman for the Canada-Newfoundland and Labrador Offshore Petroleum Board has stated that the blowout preventers for the Lona well were tested repeatedly before being deployed. However, Chief Executive Max Ruelokke has also stated that he expects the new regulations for blowout preventers will be enacted in the aftermath of the Gulf disaster. Mr. Ruelokke stated that "there will be improvements and changes made to [blowout preventer] systems and I'm pretty certain there will be changes made to control systems." He said, "We don't believe there's any need to change what we are doing now immediately, but I expect the world is going to shift underneath our feet when it comes to control of a subsea well."[13]

B. Acoustic Control Systems

Canada's drilling regulations do not specifically mention acoustic control systems and there are no reports of such systems being required.

C. Relief Wells

Canada's 2009 drilling regulations do not specifically require companies drilling for oil to simultaneously construct relief wells or to show that they are capable of constructing relief wells. However, it has been widely reported that the National Energy Board only issues licenses to drill in the Arctic to companies who produce a safety plan than includes contingency plans for the construction of a relief well during the same season that the main well is drilled.[14] Some companies have contended that because the drilling season is so short, this requirement is impractical and that technological advances have made it unnecessary.[15]

D. Third-party Verification

Canada does not have third party verification of safety equipment on oil rigs. The National Energy Board is an independent regulatory agency established by the federal government and the Canada-Newfoundland and Labrador Offshore Petroleum Resources Board is an independent regulatory agency established by both the federal and provincial governments.

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[13] Scott Haggett, *Regulator Says No Repeat of BP Disaster in Canada*, REUTERS, June 2, 2010, http://in.reuters.com/article/idINN0217735520100602.

[14] Mike DeSouza & Andrew Mayeda, *Safeguards in Place to Prevent Oil Spill Disaster in Canada:* Prentice, CANWEST NEWS SERVICE, May 5, 2010, http://news.globaltv.com/technology/Safeguards+place+prevent+spill+disaster+Canada+Prentice/2986302/story.html.

[15] *Id*.

E. Use of Best Available Safety Technology

Canada's drilling regulations do not specifically require companies to use the best available safety technology. However, government officials have consistently maintained that the NEB's policy is to ensure that safety plans meeting high standards are submitted and followed. The Environment Minister recently stated that the NEB "licenses well drilling on the basis of the highest possible technical requirements in terms of both shear rams and things such as relief wells, which again, is another fail-safe mechanism."[16] Jim Prentice also stated that the NEB was one of the most highly respected regulators in the world.[17] Nevertheless, critics in the House of Commons have called for the government to enact much more specific and stringent laws and to abandon what they term as "deregulation."[18]

III. Conclusion

While Canada's federal regulations respecting drilling do specifically require offshore wells to have blowout preventers, offshore safety requirements are mostly established through NEB and other regulator's policies. The government contends that these regulators have very high standards and that enforcement of them is vigorous. However, the Gulf disaster has prompted critics to call for the introduction of much more detailed legal requirements. Board spokesman Sean Kelly reportedly stated as follows:

> We recognize that there's a lot of public interest in this, and there's concern about whether (a spill) could happen here. Part our review is to say, "Well, what else can we do that would help address some of those concerns?"[19]

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June 2010

[16] *Id.*

[17] *Id.*

[18] *Id.*

[19] *Id.*

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DENMARK

OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

Executive Summary

Under its Offshore Safety Act and associated Executive Orders and guidelines, Denmark has requirements for aspects of offshore drilling safety technology. The requirements include the use of blow-out preventers and acoustic control systems. In addition, offshore drilling guidelines state that an operations plan should include a tentative program for plugging the well and for re-establishing the well site; the plan must later be finalized and submitted for approval. However, there are no explicit legal requirements for relief wells. Danish law does not require third-party verification of drilling rig equipment, but there may be independent verification of an installation's compliance with the law and mandatory third-party verification of certain structures. The Offshore Safety Act and its underlying regulations contain an inherent requirement to use the best available safety technology.[*]

I. Introduction

Denmark owns only a small portion of North Sea oil and is a minor producer in comparison with Norway and the United Kingdom, which own the largest share and have been the driving forces behind the area's oil production. In 2008, Denmark produced about 290,000 barrels of oil per day. Self-sufficient in oil since 1997, the country's domestic consumption was about 190,000 barrels per day in 2008. As an oil exporter, Denmark is a particularly important supplier for Sweden.[1] It was ranked as the world's thirty-seventh largest oil producer in 2008 (Norway was eleventh), and the thirty-fifth largest oil exporter (Norway was sixth).[2]

The Danish Energy Agency (*Energistyrelsen*) (DEA), established in 1976 and as of November 23, 2007, under the Ministry for Climate and Energy,[3] has the authority to implement all the regulations and to administer hydrocarbon activities on the Danish continental shelf,

[*] This report is limited to relevant material available in English translation.

[1] M. Höök et al., *Future Danish Oil and Gas Export*, 34:11 ENERGY 1826-1834 (Nov. 2009), *available at* http://www.tsl.uu.se/uhdsg/Publications/Denmark_Article.pdf.

[2] U.S. Energy Information Administration, *Country Energy Profiles*, http://www.eia.doe.gov/country/country_energy_data.cfm?fips=DA (last visited June 21, 2010) (*see* chart at right of webpage).

[3] Ch. 7, "Denmark", *in* INT'L ASS'N OF OIL AND GAS PRODUCERS, OGP: REGULATORS' USE OF STANDARDS, Rep. No. 426 (Mar. 2010), http://www.ogp.org.uk/pubs/426.pdf.

although its decisions can be referred to the Minister for Climate and Energy.[4] The DEA, along with the Danish Maritime Authority, is a key supervisory authority for health and safety matters related to offshore installations. The DEA is also responsible for the implementation of relevant European Union directives. Under the DEA, the Offshore Installations Division is the specific unit in charge of offshore installation health and safety issues, while the Oil and Gas Division handles environmental issues connected with offshore installations, except for emissions-related matters, which are handled by the Danish Environmental Protection Agency.[5]

Denmark's worst oil spill occurred on March 25, 2001, when more than 764,000 gallons of oil spilled as the result of a collision between an oil tanker and a freighter in international waters between eastern Denmark and northwest Germany. Some of the oil formed a slick of about 9.3 miles long and about 162 feet wide in the Groensund Strait between the Danish islands of Moen, Bogoe, and Falster; the bulk of it stayed in the Baltic Sea off southern Denmark.[6]

II. Some of the Basic Laws on Offshore Safety

A. Subsoil Act

The basic framework for petroleum exploration and recovery in Denmark is provided in Act No. 293 of June 10, 1981, as revised by Consolidated Act No. 889 of July 4, 2007, as amended in 2008, on the Use of the Danish Subsoil (the Subsoil Act).[7] The Act regulates exploration and recovery activities of minerals, and in particular hydrocarbons, in the Danish subsoil and the Danish Continental Shelf. The Act stipulates, among other provisions, that:

> **10**. Exploration and production shall be carried on in a safe and appropriate manner that prevents any waste of hydrocarbons. Before production and measures aimed at production are initiated, a plan for the activities, including the organization of production and the layout of production installations (production measures, etc.), shall have been approved by The Minister for Transport and Energy.[8]

It also stipulates in general that prior approval by the Danish Energy Agency is required before drilling activities may commence:

> **28.** Any works to be carried out in connection with activities covered by this Act, including drilling wells, sinking shafts, and driving adits and drifts, may not be initiated until the approval of The Minister for Transport and Energy has been obtained for equipment, working programme and working methods in each individual case.

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[4] DANISH ENERGY AGENCY (DEA), A GUIDE TO HYDROCARBON LICENSES IN DENMARK § 1.1.1, at 5 (July 2009) (hereinafter GUIDE), http://www.ens.dk/en-US/OilAndGas/Licences/Guide/Documents/Guide ToHC.pdf.

[5] *Health and Safety*, DEA, http://www.ens.dk/EN-US/OILANDGAS/HEALTH_AND_SAFETY/Sider/Forside.aspx (last visited June 22, 2010).

[6] *The World's Oil Spill List*, POLITICOL NEWS (May 31, 2010), http://www.politicolnews.com/worlds-oil-spill-list/.

[7] Consolidated Act on the Use of the Danish Subsoil, *in* GUIDE (ANNEX), *supra* note 4, at 20-35.

[8] *Id*. art. 10, at 22.

The Subsoil Act implements two significant European Union Directives applicable to oil drilling: Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the Conditions for Granting and Using Authorizations for the Prospection, Exploration and Production of Hydrocarbons[9] and Directive 85/337/EC of the European Parliament and of the Council of June, 27, 1985, on assessments of the environmental consequences.[10]

B. Offshore Safety Act

The major piece of legislation on safety of Danish offshore installations is the Act on Safety, etc. on Offshore Installations for Exploration, Extraction and Transport of Hydrocarbons (Offshore Safety Act). The Act provides in general that recognized norms and standards in the field of health and safety are to be followed:

> Art. 42[(1)] Recognised norms and standards that are important to safety and health shall be followed in connection with the conditions mentioned in sections 38-41 above [on construction, arrangement, and equipment of offshore installations].
> (2) Norms and standards according to subsection (1) may be deviated from in cases where it is convenient for obtaining a higher level of health and safety or to be in keeping with the technical development. It is presumed by the deviation that health and safety risks are reduced as much as reasonably practicable. [11]

The sections of this report set forth below provide some of the health and safety requirements for offshore installations in Denmark, general emergency response rules, and certain specific aspects of safety technology applied in offshore drilling operations.

III. General Health and Safety Requirements for Offshore Installations and Emergency Response

All offshore installations operating in Denmark must have the requisite approvals and permits issued by the DEA: the Operation Permit, the manning and organization plan approval,

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[9] Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the Conditions for Granting and Using Authorizations for the Prospection, Exploration and Production of Hydrocarbons, 1994 OFFICIAL JOURNAL OF THE EUROPEAN UNION [O.J.] (L 164), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri= CELEX:31994L0022:EN:HTML.

[10] Council Directive of 27 June 1985 on the Assessment of the Effects of Certain Public and Private Projects on the Environment (85/337/EEC), OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES [O.J.] (L 175) 40-48, *available at* http://ec.europa.eu/environment/eia/full-legal-text/85337.htm.

[11] Act on Safety, etc. for Offshore Installations for Exploration, Extraction and Transport of Hydrocarbons No. 1424 (Offshore Safety Act), Dec. 21, 2005, *as amended by* Act. No. 107 of Feb. 7, 2007), *as subsequently amended by* Act No. 1400 of Dec. 27, 2008, § 2 (which inserted a new Article 34a having to do with MCE issuance of rules regarding specific international regulations and technical specifications on companies, installations, facilities, etc.), *available at* http://193.88.185.141/Graphics/ENS_OlieogGas/Sikkerhed/UK/Legislation/Offshore%20Safety%20Act/PDF/The%20Act/CA2005_1424,%202007_107,%202007_512,%202008_1400e%20Offshore%20Safety%20Act.pdf (last visited June 23, 2010) (unofficial English translation); Act to Amend Various Acts Within the Administrative Sphere of the Ministry of Climate and Energy, *in* GUIDE (ANNEX), *supra* note 4, at 35.

and the Contingency Plan approval.[12] An installation candidate must undergo an evaluation of its health and safety and operational conditions and of any other relevant information, such as health and safety certification, in order to obtain an Operation Permit. Offshore installations must have in place a safety organization, in accordance with Danish regulations on fixed and mobile installations (Order 408/1999 and 1102/1992, respectively), which typically require that each work area on an installation have elected safety representatives. The safety representatives, among other groups, such as the Safety Committee, are to cooperate with management representatives to uphold and improve safety and health conditions on the installation. The offshore installations must also have a Work Place Assessment System (WPA), developed and used through a cooperative effort between management and safety representatives, among other groupings, "to ensure that all workplaces and all work functions are mapped and evaluated with regard to potential improvements of the safety and health conditions and that relevant improvements are prioritised (prioritised action plan) and implemented as planned."[13]

Under the Offshore Safety Act, the Minister for Transport and Energy can lay down more specific rules on the structure of the offshore installation, including rules on subdivision of areas on offshore installations, arrangement of workplaces, access routes, and arrangement and use of equipment, among other matters (art. 43). The Minister for Climate and Energy is given authority under the Act to lay down rules in connection with specific international decisions and technical specifications pertaining to requirements for enterprises, installations, plants, products, etc., referred to in regulations issued pursuant to the Act but not published in the Danish Law Gazette.[14]

The Offshore Safety Act also has a section on emergency response. It provides that all offshore installations, before they become operative, must establish an emergency response plan to cope with the results of accidents. The plan must coordinate with the authorities' rescue and combating measures and "to the greatest possible extent with emergency response plans prepared for other offshore installations."[15] Supervisory authorities can order changes to the plan to ensure efficient rescue and combating efforts.[16] Hydrocarbon-production operating companies and operators and other companies that transport oil or natural gas through pipelines between two or more offshore installations and land-based installations must also make the necessary plans and take the necessary measures to secure their own respective installations and pipelines, etc., as well as the oil/gas supply in emergency situations and other extraordinary situations.[17] The Minister for Transport and Energy has the authority under the Act to prescribe more specific rules on emergency response measures, including rules on co-ordination of individual offshore installations' emergency response with the authorities' rescue and combating measures and with the national contingency plan to safeguard Denmark's energy supply.[18]

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[12] Health and Safety, *supra* note 5.

[13] *Id*.

[14] Offshore Safety Act art. 43a(1).

[15] *Id*. art. 45(1) & (2).

[16] *Id*. art. 45(3).

[17] *Id*. art. 45(4).

[18] *Id*. art. 45(5).

The Executive Order on Emergency Response, etc. Pursuant to the Offshore Safety Act (Executive Order No. 688)[19] stipulates that before an offshore installation or its parts are put into use, an emergency response plan pursuant to article 45(2) of the Offshore Safety Act is to be submitted to the authorities (art. 3 (1)). The plan should contain the following:

1) alarm and communications systems and procedures for this,
2) organisation of the emergency response stating emergency response management, manning, distribution of responsibilities and implementation procedures,
3) equipment and crew available,
4) instructions for the contribution of the equipment and for rescue and combating measures, and
5) drills.[20]

The emergency response plan must also state how quickly response measures pursuant to the plan can be implemented, stipulate the use of stand-by vessels and helicopters as well as criteria for their capacity, and include measures for handling danger from poisonous gases if such a potential danger exists. The Executive Order further states that the plan is to be kept updated and changes in it should be regularly communicated to the supervising authority.[21] In addition, "[w]here specific risks may arise, the offshore installation shall be provided with alarm systems, e.g. gas and fire detectors which, in an appropriate manner, warn against this."[22]

IV. Safety Technology Requirements

In general, in regard to applicable standards for construction of offshore installations and their integrity, the DEA has indicated that some of the standards "are issued by the Danish Standards Association, which distributes ISO, IEC and EN standards, as well as the American Petroleum Institute (API), Det Norske Veritas (DNV), AGA, the American Gas Association and ASTM International (ASTM)."[23] For work performed on mobile units on Denmark's continental shelf, a number of International Maritime Organization (IMO) standards apply, e.g., the "MODU" Code for the Construction and Equipment of Mobile Offshore Drilling Units is applicable drilling rigs. "In addition, a number of rules laid down by the classification societies certifying the installations also apply."[24]

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[19] Executive Order on Emergency Response, etc. Pursuant to the Offshore Safety Act No. 688 of June 22, 2006 (hereinafter Exec. Ord. No. 688), *in force* July 1, 2006, *as amended by* Exec. Ord. No. 1359 of Dec. 11, 2006, *in force* Dec. 31, 2006, http://193.88.185.141/Graphics/ENS_OlieogGas/Sikkerhed/UK/Legislation/Offshore%20Safety%20Act/PDF/O2006_688e%20Emergency%20Response.pdf.

[20] *Id*. art. 3(2).

[21] *Id*. art. 3(3)-(6).

[22] *Id*. art. 4.

[23] *Installation Integrity*, DEA, http://www.ens.dk/en-US/OilAndGas/Health_and_Safety/integrity/Sider/integrity.aspx (last visited June 24, 2010).

[24] *Id*.

A. Blow-Out Preventers

According to the *Guidelines for Drilling: Operation 1988* (2009),[25] a drilling program for operations should include, among other information, material on blow-out preventers:

> a) A list of the blow-out prevention equipment available onboard the drilling platform, specifying manufacturer, size, working pressure, and arrangement. Information regarding the control system operating the blow-out preventer stack. A list of the blow-out prevention equipment available on the drill floor ready for mounting on the drill pipe.
>
> b) Procedure for kick control, stating i.a., the data and calculations which by routine are updated to ensure the necessary background for handling emergency situations. Information on how blow-out preventers, measuring equipment, drilling fluid circulation and mixing equipment are expected to be used under such conditions.
>
> c) Programme for drills in connection with equipment as mentioned in sections 2.16.a and 2.16.b.
>
> d) Programme for pressure testing of blow-out preventers and casing at different stages in the drilling operations[.][26]

The drilling program should also include a contingency plan for use in the event of major accidents or emergency situations regarding safety as well as environment.[27]

During drilling operations, precautions should be taken to prevent damage such as blow-outs. The Guidelines state:

> [A]ll necessary steps shall be taken to prevent explosion, blowouts, pollution, or other damage. Safety related equipment shall be installed as drilling operations progress and shall comply with the following requirements. Apart from possible drilling when setting the conductor pipe, drilling must not be carried out before blowout preventers/diverter system and related equipment have been installed and tested.[28]

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[25] Guidelines for Drilling – Exploration 1988 (2009), *in* GUIDE (ANNEX), *supra* note 4, § 2.16 at 228-259. The Guidelines are a "[r]eprint of the Guidelines from September 1988, however, the names and addresses of authorities mentioned have been updated. As the guidelines have otherwise not been updated for more years, the Danish Energy Agency should be consulted before using the drilling guidelines." *Id.* at 229. The *Guidelines* "apply to approval and supervision, which in consequence of the Danish Subsoil Act have been delegated to the Danish Energy Agency." *Id.* at 230. The *Guidelines* note that "specifications are given as guidance and that other means of achieving corresponding conditions regarding safety and information might be approved." *Id.*

[26] *Id.* § 2.16, at 234-235.

[27] *Id.* § 2.25, at 236.

[28] *Id.* § 5.1, at 239.

Among the requirements are that the well must be cased.[29] In this connection, "[s]urface casing shall be installed in such a manner that a good anchorage of the blow-out preventer is secured."[30] In addition:

> Prior to drilling out from surface casing, the blow-out preventer and the kill and choke systems shall be installed. These shall normally include at least one annular preventer and a system of ram preventers containing at least one set of pipe rams and one set of blind or shear type blind rams together with kill and choke lines connected to the choke manifold. After the installation, all rams and connections shall be function and pressure tested to pressures approved by the Danish Energy Agency.[31]

There is a similar requirement in connection with drilling out from intermediate and subsequent well casings:

> Prior to drilling out from intermediate and subsequent casings, a complete blow-out preventer, and kill and choke systems shall be installed. Normally the blow-out preventer system shall include at least one annular preventer and a system of ram preventers containing at least 2 sets of pipe rams, 1 set of blind rams and 1 set of shear rams. The last two may be combined in 1 set of shear type blind rams. After installation, all rams and connections shall be function and pressure tested to pressures approved by the Danish Energy Agency.[32]

The Guidelines also have requirements on the maintenance and testing of blow-out preventers:

> 5.13 The disassembly or other maintenance of blow-out preventers may take place only when the well is secured against blow-out by a minimum of 2 independent and tested barriers, accepted by the Danish Energy Agency in general or specifically.
>
> 5.14 Pressure or operational testing of the blow-out preventers and the connected equipment shall be carried out regularly and after disassembly, as well as when drilling operations or other conditions make it reasonable.[33]

In addition, in test production, blow-out preventers are to be pressure- and function-tested.[34]

According to the *Guidelines for Fixed Offshore Installations* (June 2009), the process equipment system "shall be designed and built so as to ensure safe and efficient processing of flow liquids and gases during all possible production systems."[35] The process equipment, which

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[29] *Id.* § 5.2, at 239.

[30] *Id.* § 5.2(b), ¶ 1, in part.

[31] *Id.* § 5.2(b), ¶ 3.

[32] *Id.* § 5.2c, ¶ 3.

[33] *Id.* at 241.

[34] *Id.* § 8.3, ¶ 3, at 244.

[35] Ch. 4, "Process Equipment" (as revised July 2008), § 3, "General Guidelines," Guidelines for Fixed Offshore Installations, DEA, (June 2009), http://www.ens.dk/en-US/OilAndGas/Health_and_Safety/Regulations offshore/OSA/Documents/Guidelines%202009.pdf.

includes, among other equipment, that used for shut-off and blow-out (defined in section 2.1 of the Guidelines) is to be signed and installed according to the Executive Order on Design of Equipment on Fixed Offshore Installations (No. 700 of June 26, 2008), which implements the EU Council Directive 98/37/EC of 22 June 1998 (compilation of the Machine Directive 89/392/EEC as subsequently amended) and Directive 94/9/EC of 23 March 1994 (ATEX-Directive).[36] Moreover, the process equipment is to be "designed, built, installed and controlled" in conformity with API [American Petroleum Institute] RP 14C, Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems on Offshore Production Platforms, and API RP 14E Recommended Practice for Design and Installation of Offshore Production Platform Piping System.[37]

Some of the other API standards (and ISO standards) used by Danish oil and gas regulators that may be relevant are: API 6A Specification for Wellhead and Christmas Tree Equipment (cf. ISO10423), API 14A Specification for Subsurface Safety Valves (cf. ISO 10432), and API RP 14B RP for Design, Installation and Operation of Subsurface Safety Valve Systems (cf. ISO 10417). Some of the other ISO guidelines that the regulators use include: ISO 10418 Recommended Practices for Analysis, Design, Installation and Testing of Basis Surface Safety Systems on Offshore Production Platforms; ISO 10432 Specification for Subsurface Safety Valves; ISO 13628-2, 2000 Petroleum and Natural Gas Industries – Design Operation of Subsea Production; and ISO 13628-3 Design and Operation of Subsea Production System -Through Flowline (TFL) Systems.[38]

B. Acoustic Controls

As noted above, Executive Order No. 688 prescribes that alarm and communications systems must form part of an emergency response plan. The Order further specifies that remote control equipment must be in place for emergencies, and that part of the minimum requirements for such equipment includes a system to remotely control wells.[39] The Executive Order also has the general provision that if offshore installations that are usually unmanned are manned, "suitable communications systems shall be brought along or be available."[40]

C. Relief Wells

Without specifically mentioning relief wells, the *Guidelines for Drilling: Operation* stipulate that the drilling program for operations should include a tentative plan "for plugging the well and for re-establishing the well site," and the final plan must be submitted for separate approval.[41] Thus, according to an energy resource manager with the Danish government:

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[36] *Id*.

[37] *Id* § 3.3.

[38] Annex B: "Standards referred in Danish Guideline for Design of Fixed Offshore Installations – 'Retningslinier for design af faste offshoreanlæg 2008,' " *in* INT'L ASS'N OF OIL AND GAS PRODUCERS, *supra* note 3.

[39] Exec. Ord. No. 688, *supra* note 19, art. 11, pt. V, "Remote Control."

[40] *Id*. art. 14.

[41] Guidelines for Drilling – Exploration 1988 (2009), § 2.23, *in* GUIDE (ANNEX), *supra* note 4, at 235.

> there are no explicit legal requirements of relief wells or the capability to drill such wells. Drilling programs must, according to section 28 in the Subsoil Act, be approved by the Danish Energy Agency on a case-by-case basis. Drilling relief wells may be a requirement stated in a permit dependent of the situation.[42]

D. Third-Party Verification and Best Safety Technology

According to the DEA, "a pivotal element" of its supervision of manned and unmanned fixed offshore installations, mobile units, and pipelines is the health and safety management system that a company has in place, which must be used to substantiate compliance with Danish laws and regulations. This system "incorporates third-party verification, which must be carried out by acknowledged experts."[43] Thus, while Danish law does not require mandatory third-party verification of equipment on drilling rigs, there may be independent verification by experts of the compliance with the law of an installation, parts thereof, or equipment, as partial substitution for the health and safety management system that must be established by the operator of a fixed offshore installation (under section 19)[44] and by operating companies (under section 20).[45] The Offshore Safety Act states: "Independent verification that the installation, parts thereof or its equipment fulfil requirements laid down in or pursuant to this Act can partially replace the systems mentioned in sections 19 and 20. *(2)* Such verification shall be made by experts recognised by the supervisory body."[46]

The Minister of Climate and Energy is authorized by regulations underlying the Act to require mandatory verification. According to Article 22 of the Act:

> **22.** The Minister for Transport and Energy may lay down more specific rules on the contents of the systems mentioned in sections 19 and 20, including rules on reporting routines as well as audit and control procedures. Furthermore, the Minister for Transport and Energy can lay down more specific rules on the verification system referred to in section 21 above, including rules determining that some parts of the installation must be verified.

In addition, Executive Order 729/2009, section 34, states:

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[42] E-mail correspondence with Hans Erik Christensen, Project Manager, Energy Resources, DEA (June 30, 2010) (on file with author).

[43] Ch. 5, "Health and Safety," *in* DEA, DENMARK'S OIL AND GAS PRODUCTION 2008 (July 2009), http://www.ens.dk/Documents/Netboghandel%20-%20publikationer/Olie-%20og%20gasressourcer/2009/HTML/dogp08_uk/html/kap05.htm.

[44] Offshore Safety Act art. 19.

[45] *Id*. art. 20.

[46] *Id.* art. 21.

Independent Verification of Installations, Equipment, etc.

> **34** Independent verification of the fact that an offshore installation, parts thereof or its equipment fulfil requirements laid down in or pursuant to the Offshore Safety Act can partially replace the management system.
> (2) Delimitation between the part of the system which is covered by independent verification pursuant to (1) and the other part of the system must appear from the management system.
> (3) It must appear from the management system how the responsibility for the involvement of the independent verification pursuant to (1) is defined and who is accountable in the organisation.
> (4) It must be documented by certificate issued by the expert, who has carried out the independent verification pursuant to (1), that the equipment in question or part of the installation fulfils the existing requirements in the legislation, including approved standards pursuant to section 42 of the Offshore Subsoil Act.[47]

Third-party verification of supporting structures such as jackets or legs is mandatory, the DEA manager noted.[48]

The Offshore Safety Act contains a provision on the use of the best available safety technology. It states:

> In connection with the design of a fixed offshore installation and changes to this, the operator shall ensure that the health and safety risks that are connected with the construction, layout, equipment of the installation and all activities connected with the installations have been identified, assessed and reduced as much as reasonably practicable. The design shall reasonably consider any future needs for extension of the capacity and function of the installation. Taking into account the design life of the installation, among other things, it shall as far as possible be endeavoured to use the best possible technology.[49]

The DEA official confirmed that the ALARP (as low as is reasonably practicable rule) "applies to installations, equipment, workplaces, etc. Furthermore, recognized standards must be followed. So inherently there is a requirement of using best available safety technology regarding reduction of safety risks."[50]

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[47] Exec. Ord. on Management of Safety and Health on Offshore Installations, etc., No. 729 of July 3, 2009, DEA, http://www.ens.dk/en-US/OilAndGas/Health_and_Safety/Regulationsoffshore/OSA/Documents/EO2009_729e%20Management%20of%20Health%20and%20Safety.pdf.

[48] Christensen, *supra* note 42.

[49] Offshore Safety Act art. 33(1).

[50] Christensen, *supra* note 42.

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UNITED KINGDOM

OFFSHORE SAFETY REGULATIONS AND TECHNOLOGY

Executive Summary

Legislation for safety requirements for offshore oil installations is generally provided by secondary legislation. This legislation does not typically specify the technicalities of certain equipment, or even require the use of certain equipment. It instead takes a "goal setting" approach, setting out aims that should be reached and leaving the individual offshore installation operator some leeway in determining the methods to achieve these goals.

I. Blowout Preventer Systems

There are two regulations within the Offshore Installations and Wells (Design and Construction, etc.) Regulations[1] that govern the use of blowout preventer systems in the United Kingdom. The regulation that applies to blowout preventer systems does not state the technicalities that should be used in the construction or equipment; it merely provides that suitable control equipment should be provided for and used, specifically:

> Before an operation in relation to a well (including the drilling of a well) is begun elsewhere than at a borehole site to which the Borehole Sites and Operations Regulations 1995*(a)* apply, the well-operator shall ensure that suitable well control equipment is provided for use during such operations to protect against blowouts.[2]

This Regulation applies to any well that is drilled for the purposes of exploring or exploiting natural gas or oil that is from, or connected in anyway to, an offshore installation located in the territorial waters of Great Britain or in the United Kingdom Continental Shelf. Guidance provided by the Health and Safety Executive for the operation of this Regulation notes that it provides a duty on well operators that may be discharged as follows:

> Well-operators can make sure they are discharging their duty for ensuring the provision of well control equipment under this regulation, by reviewing the contractor's arrangements. This means taking reasonable steps to make sure that the contractor has the equipment specified for well control (eg checking that the necessary equipment is available at the site, asking the contractor providing equipment to produce evidence that the equipment to be provided is what is needed and is suitable for conditions in the well).

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[1] Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996, SI 1996/913, http://www.opsi.gov.uk/si/si1996/Uksi_19960913_en_5.htm.

[2] *Id.* reg. 17.

> If necessary, the well-operator should check that the contractor has suitable policies, procedures and management controls to ensure suitable equipment is supplied.[3]

Thus, there are no specific technical requirements as to how the blowout preventer should function or be built; rather, there is a general duty that "suitable well equipment" should be in place. General regulations apply to this equipment that give operators a general duty to prevent and/or mitigate fires and explosions, maintain the suitability and condition of the plant, and minimize the impact of any emergencies that may arise.[4]

In addition to the specific requirements that control equipment is provided to protect against blowouts, there is also a general duty of care from the well operator to ensure that the well is properly designed, constructed, equipped, etc. to ensure that "so far as is reasonably practicable there can be no unplanned escape of fluids from the well."[5] Examples include regulations 9, 12, 13, and 19 of the Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 (PFEER), which cover the prevention of fire and explosion, control of emergencies, mitigation of fire and explosion, and suitability and condition of the plant. Regulation 19 covers the inspection and testing of blowout equipment, including verification by a competent and independent person; compliance is demonstrated by following, at a minimum, API RP 53 – Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells.[6]

II. Regulations for Other Emergency Shut-off Equipment

As noted above, there are no specific requirements for emergency equipment, just that the operator have safety equipment in place that meets the standards placed in the regulations. The acoustic signal and color of lights used for the general platform, "prepare to abandon," and toxic gas alarms are specified in the Regulations, which reflect the industry agreed standard.[7]

III. Requirement for Relief Wells or the Capability To Drill Relief Wells

There are no specific regulations in the UK that refer to relief wells. However, the regulations that govern the design and construction of wells also apply to relief wells.[8]

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[3] Health and Safety Executive, A guide to the well aspects of the Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 Guidance on Regulations, L84, ¶ 35, *available at* http://www.hse.gov.uk/pubns/priced/l84.pdf.

[4] The Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995, SI 1995/743, ¶¶ 9, 12, 13, 19.

[5] Offshore Installations and Wells (Design and Construction, etc.) Regulations, SI 1996/913, reg. 13.

[6] For guidance on PFEER, *see* http://www.hse.gov.uk/pubns/priced/l65.pdf.

[7] *Id.* Reg.11(2).

[8] Email from industry representative (on file with author).

IV. Third-Party Verification of Safety Equipment

There are various regulations that place safety requirements on duty holders of offshore installations. These include the requirement that duty holders must ensure that all equipment on the installation is constructed or adapted so that it is suitable for the purpose for which it is to be used and that the equipment should be "maintained in an efficient state, in efficient working order and in good repair."[9]

The Offshore Installations (Safety Case) Regulations 2005 further require duty holders to make a verification plan, including a record of the safety critical elements of the plant, and invite an independent and competent person to comment on the record.[10] This plan acts as an additional tool to the installation's routine maintenance plan by identifying errors or failures that could occur.[11] Ideally:

> The scheme should ensure that safety-critical elements and specified plant (see above) are "suitable." In this context, suitable includes being appropriate for the intended use, dependable and effective when required, and able to perform as intended. It follows that performance standards for emergency equipment which is defined as safety critical should require that the equipment is available and functioning at all times when the applicable emergency situation could arise. The operating procedures for the installation should recognise that this may not be easily achieved and must impose operating restrictions to mitigate the effects of an emergency if the required SCE is not functioning. The verification scheme should provide independent checks to confirm continuing suitability throughout the installation's life cycle.[12]

The means for achieving the goals of the verification plan are described as follows in the Offshore Installations (Safety Case) Regulations:

> (a) examination, including testing where appropriate, of the safety-critical elements and the specified plant by independent and competent persons;
> (b) examination of any design, specification, certificate, CE marking or other document, marking or standard relating to those elements or that plant by such persons;
> (c) examination by such persons of work in progress;
> (d) the taking of appropriate action following reports by such persons;
> (e) the taking of other such steps as may be properly provided for pursuant to regulation 19 and Schedule 7; and
> (f) the taking of any steps incidental to the means described in sub-paragraphs (a) to (e) of this paragraph.[13]

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[9] The Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995, ¶ 19.

[10] Offshore Installations (Safety Case) Regulations 2005, SI 2005, ¶ 19, *available at* http://www.hse.gov.uk/pubns/priced/l30.pdf.

[11] Health and Safety Executive, A Guide to the Offshore Installations (Safety Case) Regulations 2005, 2005, ¶ 97, http://www.hse.gov.uk/pubns/priced/l30.pdf.

[12] *Id.*

[13] Offshore Installations (Safety Case) Regulations 2005, SI 2005 ¶ 2, § 6. http://www.opsi.gov.uk/si/si1996/Uksi_19960913_en_8.htm.

Duty holders should select the most appropriate means of verification for each aspect of the plan. The means are life-cycle dependent and should include an examination, where appropriate, before a safety-critical element is:

> (a) first used on the installation; and
> (b) first used on the installation after modification or repairs (other than running repairs).[14]

V. Other

In addition to the regulations, a series of guidance documents and approved codes of practice (ACOP) exist to support the interpretation and application of the regulatory regime.[15] The ACOP documents are quasi-legal documents and the regulations are deemed to have been met if the provisions of the ACOPs are followed.

The Regulations tend not to make reference to specific pieces of equipment. To fully understand how they work they must be considered in their entirety. The Management and Administration Regulations 1995 help to complete the picture.[16]

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[14] *Id*. ¶19, § 3.

[15] The operator has the responsibility to show that any safety equipment meets the goals of the legislation. INT'L ASS'N OF OIL AND GAS PRODUCERS, OGP: REGULATORS' USE OF STANDARDS, Rep. No. 426, at 43 (Mar. 2010), http://www.ogp.org.uk/pubs/426.pdf.

[16] http://www.hse.gov.uk/pubns/priced/l70.pdf.