

# *Comparative Analysis of Legal Requirements for Certification and Approval Processes in the Offshore Wind Industry in European Union Member States*

Demonstrated by

Fire Protection Systems on Wind Power Offshore Substations of the *SIEMENS AG*

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## **Abstract**

The principal objective of this thesis is to demonstrate legal requirements in selected European Union Member States for certification and approval processes in the Offshore Wind Industry. Special emphasis is put on rules and regulations regarding Fire Protection Systems on Wind Power Offshore Substations. National and international existing norms and guidelines will be examined in regard to suitability for application in different European Union Member States that have already established a significant Offshore Wind Industry. Potential similarities will be outlined and a recommendation is given for simplification and efficiency gains in future certification and approval processes on a pan-European level. The thesis was written in cooperation with the company *SIEMENS AG* and is therefore following specific demands for increasing market activity in Great Britain as well as a potential market entry in France. In a coherent view, this thesis shall serve the long-term goal of unified certification and approval processes on European Union Level.

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Die vorliegende Masterarbeit mit dem Titel

“Comparative Analysis of Legal Requirements for Certification and Approval Processes in the Offshore Wind Industry in European Union Member States – Demonstrated by Fire Protection Systems on Wind Power Offshore Substations of the *Siemens AG*”

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## 1 Introduction

Since the initial development of the European Union in the 1950's, member states pursued different strategies in regard to securing energy demands in their jurisdictions. As a matter of course, this was done by promoting the respectively easiest available source of energy. France, with almost no fossil fuels available, was concentrating on nuclear power, Great Britain focused on its oil deposits in the North Sea and Germany set on its energy production by exploiting coal reserves (Kramer, 2011, S. 381). As a result, a common policy on energy supply in the European Union was not developed and the sectoral approach was endured for decades. In contrast to production, *distribution and trade* began to become trans-national in the early 1990's; liberalization in the energy sector and an increasing interconnected power supply system enabled electricity to be traded at exchange markets. Fluctuations in supply and demand could be absorbed and a flexible distribution of electricity was enabled. Especially with regard to limited possibilities of power storage and the associated loss, the trans-national distribution of electricity provided a number of benefits in the European Union.

A pursuing coherent approach to energy supply emerges gradually since 2007. With the Treaty of Lisbon<sup>1</sup>, a legal basis for European Energy Policies was created.<sup>2</sup> *Security of Supply* and *Efficiency of Production* were defined as unified objectives additionally to already existing common policies on *Environmental Protection* and, as mentioned before, *trade and distribution* of electricity. With the Treaty of Lisbon, the way for integrated harmonized energy policies on European Union level was paved.

Especially in the field of *Security of Supply* as well as *Environmental Protection*, Offshore Wind Energy plays an important role; dependence on imports of fossil fuels can be mitigated and for achieving the ambitious European Union climate targets, Offshore Wind Energy is considered to be indispensable.

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<sup>1</sup> International treaty between 27 member states of the European Union, signed December 13, 2007

<sup>2</sup> Article 194 TFEU Treaties

## 1.1 Problem Definition

Politically intended fast expansion, in conjunction with limited experience in the Offshore Wind Industry, lead to partial indefinite legal frameworks and therefore insufficient legal certainty.

Such difficulties can be observed in almost all central and adjacent areas in the Offshore Wind Industry; approval procedures for whole new projects, manufacturing specifications and carriage requirements for technical equipment.

The present thesis focuses on the legal framework in the field of standardization, certification and approval processes. Furthermore, the issue is demonstrated by Fire Protection Systems on Wind Power Offshore Substations<sup>3</sup>. Unlike single Wind Turbines, most Offshore Sub Stations are classified as *Workplaces* in the legal sense. Certification and approval, with its main intention of ensuring minimum quality standards and safety requirements as well as enabling a regulatory and monitoring system, is highly relevant in this field. It was therefore chosen as the main study area to exemplify the general issue of legal frameworks in the Offshore Wind Industry.

Furthermore, Germany serves as the main jurisdiction to demonstrate the topic initially on a national basis, subsequently, expanding the observation field to Great Britain and finally giving an encompassing estimation on the situation in the European Union. A detailed introduction to the topic of certification and approval as well as involved companies can be found in chapter 3.6.

Whereas approval procedures in Germany are centralised and responsibility lies mainly with one public body, namely the *Federal Maritime and Hydrographic Agency*, certification is done by several different companies, with various backgrounds and understandings of the Offshore Wind Industry. Certification procedures from companies that are mainly active in the Shipping Industry differ completely from those having their origin in land based industries. Obviously, this results in several uncertainties for producers and operators, relying on having their products certified in order to perform successfully on the market. This effect is being reinforced by the circumstance, that certification is not based upon a harmonized standard. Instead certification companies develop their

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<sup>3</sup> See section 2.1

own guidelines by adapting procedures and methods from related and already established industries such as *Oil and Gas* and *Onshore Wind*. This in turn leads to examinations that are based on several different fundamentals. On the state level, this phenomenon continues; regulatory bodies in EU member states follow different approaches to classification of the Offshore Wind Industry; whereas Great Britain associates Offshore Wind installations closely with shipping, in Germany a tendency can be observed that Offshore Wind installations are more considered as onshore construction sites. For manufacturers and operators, involved transnationally in the Offshore Wind Industry, transferability of components, equipment and also procedures is therefore not necessarily ensured. Compliance has to be checked each time again and, if necessary, costly and time consuming adaptations are to be implemented.

Having in mind the variety of certification companies and their different guidelines on the national level, as well as different approaches between European Union member states, it can be concluded, that it is a long way ahead to certain unification effort on European Union level.

A complete harmonization, organized by an international body such as *the International Maritime Organization* for the Global Shipping Industry, is hardly possible and may not even be useful in the Offshore Wind Industry; shipping mostly takes place at the *high sea*, a legal vacuum outside the jurisdictions of single countries. An international regulatory body is therefore mandatory.

Conversely, so far the Offshore Wind Industry is based in National Waters or the *Exclusive Economic Zone*<sup>4</sup> of European Union Member States, which have sovereign authority in the construction area. As long as Offshore Wind installations do not expand to International Waters, always specific national legal systems will apply.

A harmonized policy on energy supply, as well as common climate targets determined on European Union level, are contradicting to national significant distinctions in the legal framework of construction and operation of Offshore Wind projects.

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<sup>4</sup> See section 3.1

## 1.2 Purpose and Methodology

The present thesis shall contribute to easier compliance and greater transparency in the field of certification and approval processes for manufacturers and operators of Offshore Wind installations. For having a particular application field and to serve a specific demand of the company *Siemens AG*, the topic will be demonstrated on the basis of Fire Protection Systems on Wind Power Offshore Substations. Necessity and Functioning of the platforms themselves, as well as installed Fire Protection Systems, relevant to certification and approval, will be introduced in chapter 2.

Subsequently, a general overview to the topic of legal frameworks in the Offshore Wind Industry in Europe is given; chapter 3.1 starts with the characteristics of the geographical location of Offshore Wind Parks. National Waters-, *Exclusive Economic Zone*- and Open Sea installations will be discussed and distinctions in regard to legal requirements outlined. Additionally, in chapter 3.2 an overview is given of how Offshore Wind installations are realised in EU member states, including variances of how the industry is generally classified. As a next step, the legal framework in which Offshore Wind Parks are to be remained is introduced, starting with relevant international conventions (chapter 3.3), followed by EU legislation (chapter 3.4) and finally coming down to national jurisdictions (Chapter 3.5). Here Germany serves as the initial point.

The process of certification, aiming at the preservation of minimum standards and serving as the basis on which approval procedures are based upon, is demonstrated in chapter 3.6. Relevant companies authorised for certification are introduced and subsequently the topic of approval processes is covered. Finally, standards grown from the industry itself and how these standards fit into the context of certification and approval and to what extent meeting the satisfaction of public authorities is discussed. A critical view closes the essential topic of certification and approval.

Chapter 4 starts with transnational aspects of the Offshore Wind Industry in Europe. Different law traditions and how they may affect legal requirements for global engagement of companies like *Siemens* are outlined. The issue is shown specifically for the future Offshore Wind Project

*Doggerbank*, which will be located far offshore and therefore a similar situation like in Germany is present, namely Offshore Wind Parks in great distance to shore that require *High Voltage Direct Current Transmission*<sup>5</sup> in order to minimise losses during electricity transport to the coast. This in turn leads to the question of transferability of established systems from Germany to Great Britain by considering before mentioned legal aspects in regard to different law traditions. Furthermore, an outlook is given on a possible expansion of Offshore Wind installations to the *High Sea* outside any European jurisdiction.

Chapter 5 focuses on advantages and disadvantages of regulatory systems in Germany and Great Britain. Subsequently, considering advantages of both countries, a recommendation is given for efficiency gains in future projects. Furthermore, chapter 5.3 deals with the question of possibilities to adapt proven procedures from the Global Shipping Industry. Together with an outlook to the French Offshore Wind market in chapter 5.4, a summarising overall evaluation and solution approach is given to the before mentioned problem definition of contradicting issues in the European Union regarding common achievement of harmonised energy objectives.

### **1.3 Restrictions**

In order to follow specific demands of the company *Siemens AG* as well as to be able to deal with certain issues in depth whilst keeping a reasonable scope, the present thesis focuses on Wind Power Offshore Substations and disregards single Offshore Wind Turbines. Furthermore not all European Union Member States participating in Offshore Wind are considered. From a pragmatic view, it seems reasonable to use a highly regulated jurisdiction like Germany, with certain experience in the Offshore Wind Industry, as the initial observation field. Furthermore, the potential of Offshore Wind in Germany is by far not reached and therefore, not least due to decided Nuclear Power exit, strong expansion can be expected.

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<sup>5</sup> See section 2.3 for technical description

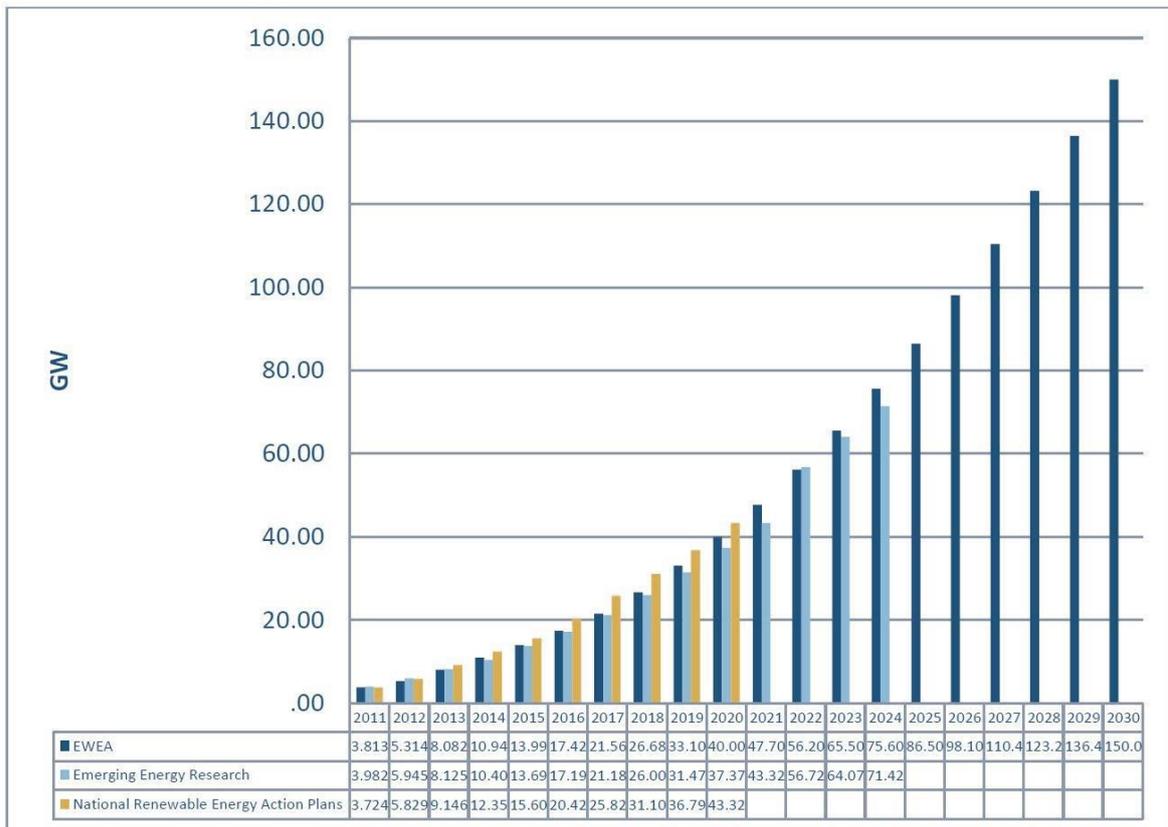
The additionally considered countries are Great Britain and France. Great Britain, with even longer experience in the Offshore Wind Industry and certain significant differences, as explained in chapter 3.2, serves as a highly suitable country for a comparative observation to Germany. Furthermore the *Siemens AG* realized Wind Power Offshore Substations in both countries and therefore a specific comparison seems reasonable. Besides Germany and Great Britain, France was chosen to be considered as specific plans for major expansion of Offshore Wind installations are present and therefore France forms a highly relevant area for the present study.

## **2 Wind Power Offshore Substations**

The following chapter will start with a general introduction to the current situation and expected continuation of the Offshore Wind Industry in Europe. Subsequently, the *Energy Sector* of the *Siemens AG* is then introduced and business activities in the Offshore Wind Industry outlined. After this fundamental consideration, the focus is then put on functioning of *Wind Power Offshore Substations*, which serve exemplary as one area to which legal requirements for certification and approval is essential. After a general introduction to the platforms, including technical description and distinction between *High Voltage Direct Current* and *High Voltage Alternating Current* platforms, applied Fire Protection Systems are described in chapter 2.5.

### **2.1 Introduction to Offshore Wind Parks**

A widespread development of Offshore Wind Farms in the North Sea and elsewhere clearly shows that Wind Power forms an essential part on the overall ratio of renewable energies in Europe. The potential is by far not reached and if Offshore Wind Power is continued to be promoted and subsidised by European governments, further growth of the industry can be expected. The following figure shows growth forecast by different institutions. It can be seen, that *European National Action Plans* are slightly more optimistic than the research institutions *European Wind Energy Association* and *HIS Emerging Energy Research*. However, due to general agreement by independent research bodies and national governments, it is becoming apparent, that a common vision on Offshore Wind Industry is present in the European Union.



**Figure 1: Cumulative Offshore Wind Power Capacity Installations 2011-2030** (European Wind Energy Association, 2012, S. 3)

Furthermore, it is anticipated, that 60% of European Offshore Wind Power Capacity is located in the North Sea and additional 20% along the Atlantic Coast by 2020 (Long, 2014, S. 694). As mentioned already before, France is seen as a high potential country for Near Shore Installations along the Atlantic Coast.

A significant growth of the industry as well as publicly effective promotion should not conceal the fact, that only 0.7% of Europe's overall electricity demand in 2013 could be covered by Offshore Wind Power. This ratio is expected to grow up to 3.5% by the year 2020 and doubling to 7% by 2030 (Long, 2014, S. 694). This equals a growth close to 20-fold from 2.9 GW in 2010 to 42 GW by 2020. Table 1 shows that in four years installed capacity raised from 2,9 GW in 2010 to more than 8 GW by the end of 2014. However, growth ratio must increase in order to realise the desired target of 42 GW in 2020. With a view to Great Britain and its ambitious plans of new Offshore Wind Parks in the area of *Doggerbank*, as well as many already planned and approved projects in

the German *Exclusive Economic Zone*, the objective can still be met. Provided, that financing and guaranteed acceptance price of electricity by Offshore Wind Power is furthermore ensured. The project of the British Wind park *Doggerbank* with its 1500 turbines planned, producing energy equivalent to seven Nuclear Power Plants, is briefly introduced in chapter 4.2.

**Table 1: Number of Wind Farms, Turbines and MW Connected to GRID End of 2014** (*European Wind Energy Association, 2015, S. 10*)

<b>Country</b>	<b>BE</b>	<b>DE</b>	<b>DK</b>	<b>ES</b>	<b>FI</b>	<b>IE</b>	<b>NL</b>	<b>NO</b>	<b>PT</b>	<b>SE</b>	<b>UK</b>	<b>Total</b>
No. of Farms	5	16	12	1	2	1	5	1	1	6	24	74
No. of Turbines	182	258	513	1	9	7	124	1	1	91	1301	2488
Capacity Installed	712	1048,9	1271	5	26	25	247	2	2	212	4494,4	8045,3

Further development and growth of the industry mainly depends on EU energy and climate change policies. The fixed agreement to provide 20% of gross energy consumption in the European Union out of Renewable Energies by 2020<sup>6</sup>, surely is a dominant drive for further significant growth of the Offshore Wind Industry in Europe. Factors that may slow down such developments are Environmental Protection initiatives and potential conflicts with other users of the marine environment (commercial shipping, fishing industry). Additionally, national policies on energy transmission into the inland as well as development of Onshore Wind are strong influencing factors. Especially in a federal state system like Germany with relatively strong power on provincial level, high voltage line transmission always faces severe opposition. A “Not in my backyard” mentality in regard to high voltage transmission lines to Southern Germany, lead to delays and even cancellation of line extension. In more centralistic organised states like France, installation of inland high voltage line transmissions might be easier to realise.

<sup>6</sup> Art.3, Dir. 2009/28/EC

## **2.2 Business Activity of the Company Siemens AG in the Offshore Wind Industry (disguised)**

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## **2.3 Construction and Functioning of Wind Power Offshore Substations**

Following, Wind Power Offshore Substations will be introduced. The platform *BorWin beta*, built by *Nordic Yards* and technically equipped by *Siemens* will serve as a specific example. As part of the Offshore Wind Park *Global Tech*, *BorWin beta* is located approximately 100 kilometres to the northwest of Juist. The platform is a so called HVDC transmission platform. Basically the platform combines two functions in regard to power transmission ashore; raising electrical current to 362 kV and, at the same time, converting the electricity from Alternating Current to Direct Current.

The conversion to Direct Current minimises losses during transmission to shore.

As electricity conversion is also associated with certain losses and distance of transmission is decisive whether a transmission to Alternating Current is profitable, HVDC platforms are used only for transmission distances of 70 kilometres and more. For Wind Parks located Near-Shore below 70 kilometres distance (e.g. in Great Britain), a conversion to Direct Current is not profitable, as losses by conversion together with higher installation costs of HVDC platforms would result in higher expenditures than by transmission as Alternating Current. The following figure visualises this aspect and shows schematically the different costs combination when using a HVDC and HVAC transmission system for grid integration of Offshore Wind Energy.

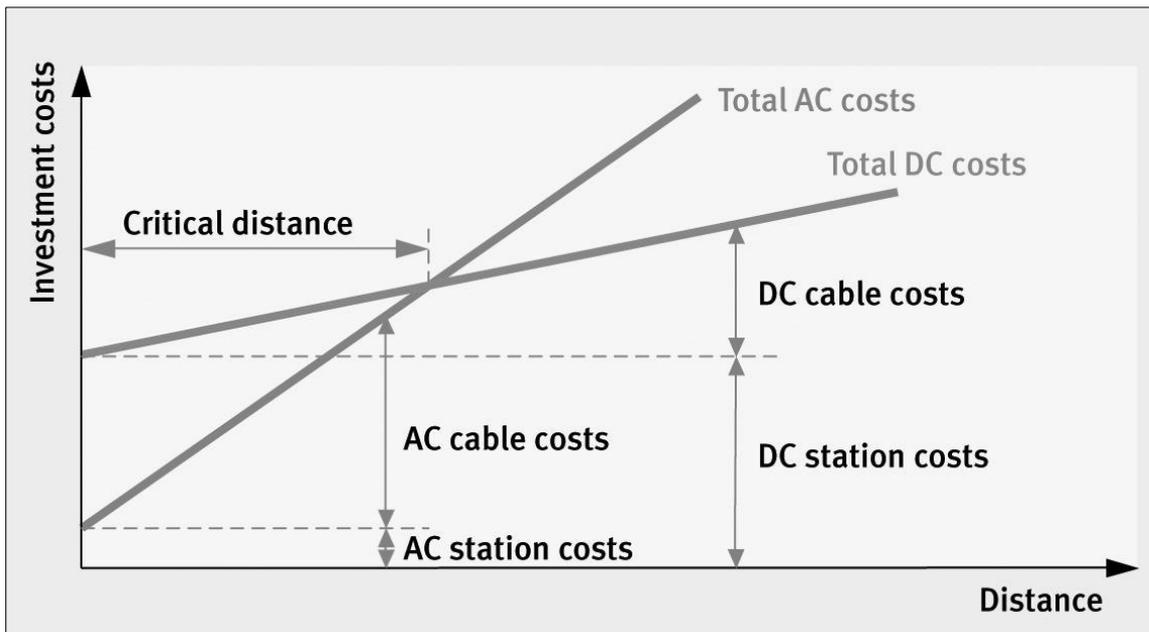


Figure 2: Distant Depending Costs (schematic) for DC/AC current transmission (BINE Information Service, 2012, p. 19)

At this point, the focus is put on HVDC platforms, as they form the standard in the German *Exclusive Economic Zone*<sup>7</sup> with Wind Parks located all more than 70 kilometres away from shore. (Some turbines are situated within the range, but can be disregarded for the purpose of the present thesis).

Furthermore, as Near Shore areas in Great Britain are limited and future projects switch to more distant sea areas, the HVDC transmission system will become highly relevant in Great Britain as well. An assessment of transferability of established procedures from German HVDC platforms to potential British HVDC platforms can be found in chapter 4.3. The following introduced platform *BorWin Beta* is certified as *permanently manned* and designed for a maximum of 34 persons.

During unmanned operation, the platform can be remote-controlled from a control centre ashore. In

<sup>7</sup> See chapter 3.1

order to grant a better overview, the platform structure can be divided into the following four essential areas: High Voltage Systems (all components and systems serving directly or related to the High Voltage current transmission), Auxiliary Systems (all additional necessary systems like emergency energy supply, air conditioning systems, etc.), accommodation areas and tanks. The following figure shows how Offshore Wind Energy is firstly collected at transformer platforms subsequently converted at HVDC platforms and finally transported ashore.

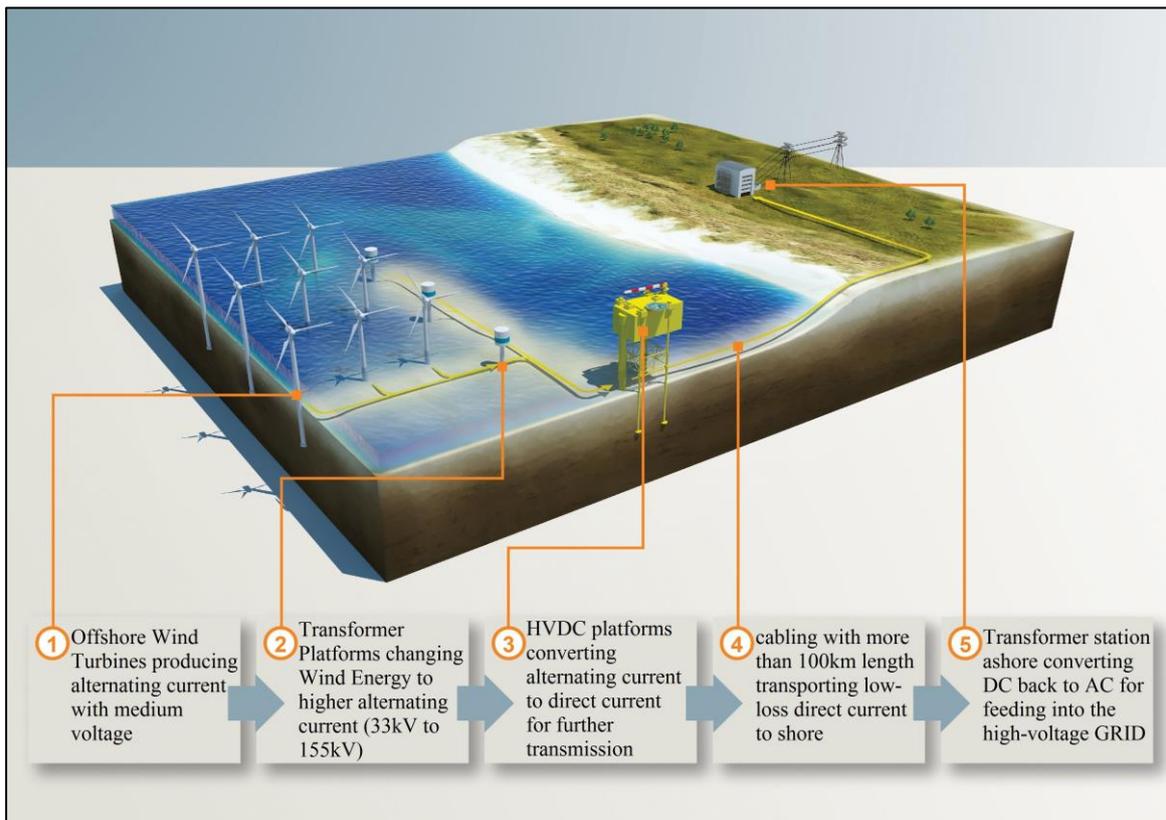


Figure 3: GRID Connection of Offshore Wind Energy by HVDC transmission platforms (Siemens AG, 2013)

## 2.4 High Voltage Energy Systems (disguised)

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## 2.5 Fire Protection Systems (disguised)

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### **3 Conceptual Distinction and Legal Framework in the Offshore Wind Industry**

So far the general issue of harmonised policies on energy supply and common climate targets were opposed to national distinctions regarding realisation and implementation of same one. The issue was shown by the specific example of Wind Power Offshore Substations.

As a next step, the present chapter will demonstrate the used ‘tools’, regulating and forming a legal framework for the Offshore Wind Industry. Beginning with the geographical locations and classification of different sectors of the sea in chapter 3.1, chapter 3.2 will oppose different approaches in regard to location, regulation, and compensation of the industry in selected European Union Member States. Subsequently, chapter 3.3 and 3.4 introduce common international, respectively EU regulations, that are applicable in the Offshore Wind Industry. On the national level, the legal issues are demonstrated on the German jurisdiction in chapter 3.5. Chapter 3 closes with the topic of certification and approval including an introduction of the relevant certification bodies, institutions and authorities.

#### **3.1 Divisions of the Seas**

As already mentioned before, Offshore Wind installations in Europe are based in different, international defined, areas of the sea. With the location, various legal aspects are captured, which are further outlined in chapter 3.2. Subsequently, the different zones are described. Figure 6 shows spreading of *National Waters* and *Contiguous Zone*, the *Exclusive Economic Zone* and the *High Sea*. The legal basis for classification of the sea is the *United Nations Convention on the Law of the Sea*, (UNCLOS), which is further discussed in chapter 3.3.1.

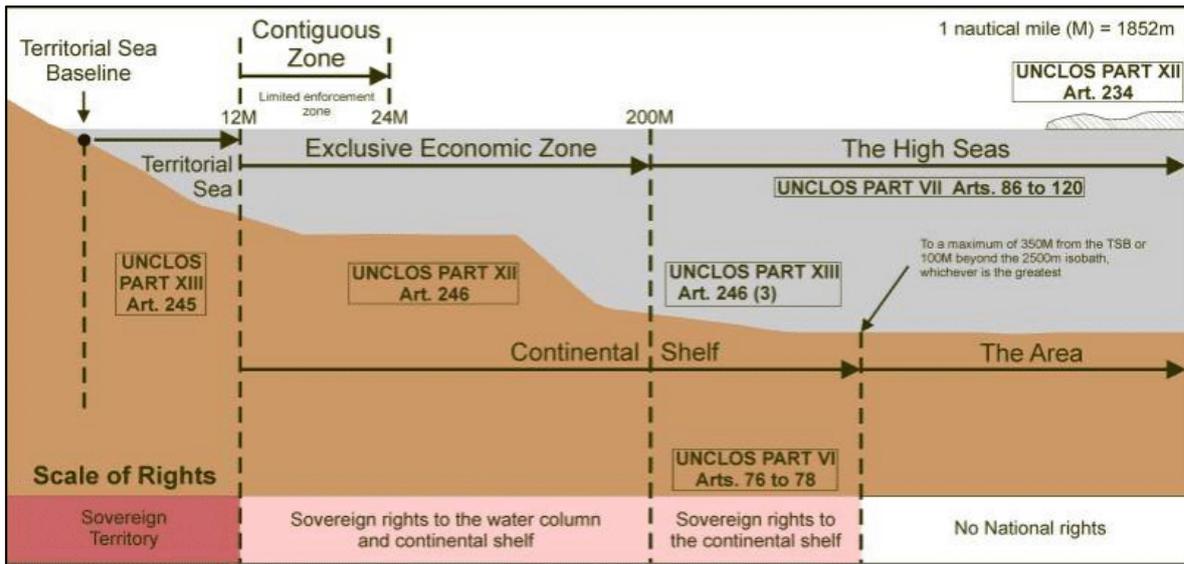


Figure 4: Maritime Zones as affected by UNCLOS (National Oceanography Centre, Southampton, 2015)

### *Territorial Waters*

The *Territorial Waters* of a state extend to a distance of 12 nautical miles from the baseline, which in turn, is defined as the Low Water Line along the coast. (In case of islands, bays, headlands, etc., the baseline can be extended as defined in article 7 of the UNCLOS). The Territorial Waters are completely liable to state sovereignty. Article 2(2) and article 49(2) of the UNCLOS define that sovereignty covers air supremacy as well as use of the seabed. Sovereignty is restricted, especially by the right for so called *Innocent Passage*. Therefore a complete territorial autonomy is not given (see Art.2 (3) UNCLOS). *Innocent Passage* is not linked to permissions by the state, but is fixed from the outset (Vitzhum, 2006, S. 1067).

### *Contiguous and Exclusive Economic Zone*

Seawards to the *Territorial Waters*, the *Exclusive Economic Zone* begins. Single sovereign rights for the coastal state are assigned, which all are situated below *Territorial Sovereignty*. Besides exclusive rights to exploit natural resources, the coastal state has the right for custom and immigration inspections as well as actions against any vessel serving environmental protection. *Contiguous Zone* and *Exclusive Economic Zone* differ to the legal extent of these inspections.

UNCLOS Part XII Art. 246 regulates these differences in detail. Under specific conditions, the

right for exploitation can be extended to the end of the *Continental Shelf*. Requirements therefore are listed in UNCLOS Art. 76, 77 and 78. *Contiguous Zone*, *Exclusive Economic Zone* and *Continental Shelf* do not belong to state territory and therefore are classified “between” territory and no man’s land (High Sea).

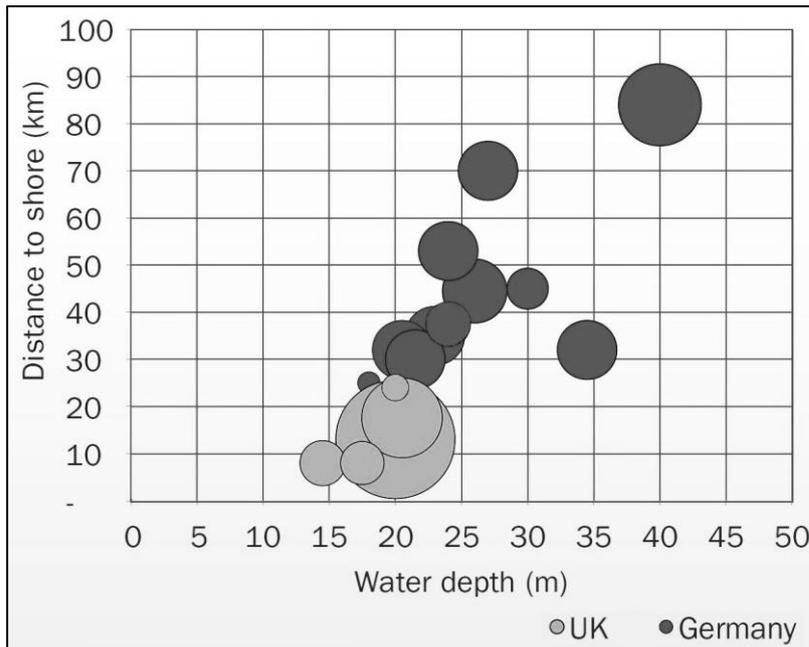
### *High Sea*

The *High Sea* is defined as *Global Commons* and therefore intended for the *Community of States*. In regard to use and exploitation, all states have equal rights, which is determined in UNCLOS Art. 87(1). An international institution, the *International Seabed Authority* is responsible for administration in regard to use and exploitation. This applies only for the seabed and not the sea, respectively surface itself. Chapter 4.4 will discuss the issue of potential Wind Power Installations in the area of the *High Sea*.

## **3.2 Offshore Wind – Significant Distinctions in the European Union**

With a view to Germany, Great Britain and France, several significant distinctions in the Offshore Wind Industry can be observed. Reasons have politically, economically, geographically and also traditional mind-set origins. For companies, engaged transnationally in the industry, these distinctions must be carefully taken into account and consequences considered from the beginning of any project. Following, three main areas, in which significant differences are present, are further discussed.

### 3.2.1 Location



**Figure 5: Water Depth and Distance to Shore of Offshore Wind Farms in 2014,** (European Wind Energy Association, 2015)

In regard to location of Offshore Wind Farms in the European Union, Germany holds a special status. As it can be seen from figure 8, Offshore Wind Parks in Germany are far more located offshore than in the UK. Two main reasons have pushed these developments.

Firstly, the Wadden Seas and its protected status as a National Park, and secondly, aspects of tourism. The Wadden Sea with its broad and sensitive flora and fauna should be protected from massive impacts of construction sites and Wind Turbine fundamentals. It was therefore chosen from the beginning of Offshore Wind Power developments in Germany, not to intervene in this area. However, cable connections are lead through the Wadden Sea but installation is linked to many protective requirements in order to minimise interference with the ecosystem. Responsible for environmental compatibility in Germany is the *Federal Maritime and Hydrographic Agency*. Environmental impact assets are not limited to cable installations inside the territorial waters, respectively the Wadden Sea but also for any projects in the *Exclusive Economic Zone*, far away from the coast, environmental impacts are carefully assessed before granting permission (Bundesamt für Seeschifffahrt und Hydrographie, 2015). The second aspect for installations far offshore were concerns regarding decrease of tourism due to visibility of Offshore Wind Parks from the coast (Internationales Wirtschaftsforum Regenerative Energien, 2015). Technical consequences resulting from these high distances are discussed in chapter 2.3.

In Great Britain a totally different situation is present. So far, all Wind Parks are located close to shore with a maximum distance of approximately 25 kilometres (see figure 8). The enormous length of coastline (more than 3000km, disregarding rivers, bays and fjords) enables a wide range of construction areas. Therefore coast sections where tourism would be affected can be avoided. Also no such ecosystem as the Wadden Sea exists in Great Britain. The coastline is mainly characterised by rocks and fast dropping water depths. If and to what extent the environment is affected in Great Britain, is not falling in the context of the present work and therefore will not be discussed. The close distance to shore is linked to several advantages, such as of financial and logistical nature; shorter distance of grid connection cables, lower water depth and no need for HVDC transformation (see chapter 2.3) are main factors that reduce costs. Less swell in proximity to the coast and shorter distance enable more continuous installation as well as fast response in case of technical interferences during operation phase (Green & Vasilakos, 2011, S. 496-502). Surely, these circumstances also pushed Great Britain into a lead position in the Offshore Wind Industry.

### **3.2.2 Regulatory Systems**

In the field of public regulation of the Offshore Wind Industry, Germany and Great Britain follow two different approaches. In Great Britain, a more self-regulating strategy is followed and authorities promote a safety culture that is grown from the industry itself. Surely, Great Britain benefits from long time experience in the Offshore Oil & Gas Industry, which enables such self-regulated industry. In contradiction, Germany has kept technical expertise on the public side. Authorities are not only responsible for formal approval, but also for technical inspections and surveys. In the field of certification and approval, an overlap is present, as after certification, a re-check and approval is necessary from public side. In contradiction, in Great Britain, only formal approval procedures are present, all technical responsibility for ensuring safety and environmental compatibility is passed by the state to recognized certification bodies. At this point, a superficial overview should be given in order to understand aspects of different approaches in Europe to the

Offshore Wind Industry. The topic of certification and approval, including distinct definition is further and in detail discussed in chapter 3.6. The aspect of comparability to the Shipping Industry, pronounced more in Great Britain and directly linked to the topic of public regulation, is discussed in chapter 5.3.

### **3.2.3 Financial Aspects and Remuneration**

Obviously, a financial incentive must be present in order to push energy companies in the Offshore Wind market. Benefits must be higher than costs to ensure profitability for energy producing companies. Costs for Offshore Wind Projects can be divided into three main areas; 1) initial capital costs for planning and installation of Offshore Wind Farms, 2) variable costs arising from operation and maintenance and 3) dismantling costs at the end of the lifetime of Wind Turbines and all supporting structures such as platforms and fundamentals (Prässler & Schächtele, 2012, p. 6). The Offshore Wind Industry can still be considered as quite young and has not yet reached market competitiveness with traditional electricity generation. Facing economic, technical and regulatory challenges, the Offshore Wind Industry is confronted with many barriers that require state support in order to push the industry in profitable condition (Markard & Petersen, 2009, S. 3545-3556). Therefore, different types of subsidy schemes by European governments were developed and implemented. In addition to locational and regulatory differences, the financial aspects consequently insert further distinctions between European Union countries in regard to realisation of Offshore Wind Projects. In the following, a brief overview is given on how remuneration schemes differ in Germany, Great Britain and, as an early stage country, France. Chapter 5.4 deals with further regional aspects in France such as the issue of national protectionism and chances for foreign companies to get involved in future Offshore Wind Projects. Firstly, the following table shows a comparison of support policies in the before mentioned countries. Subsequently the single models are further explained.

**Table 2: Support Policies for Offshore Wind, (Prüssler & Schächtele, 2012, p. 10)**

Country	Primary Support Mechanism	Level of Remuneration	Duration
Germany	Feed-in tariff	<u>Phase 1:</u> 19ct/kWh; 15 ct/kWh for extended months <u>Phase 2:</u> 3,5ct/kWh	<u>Phase 1:</u> 8 years plus possible extension <u>Phase 2:</u> after Phase 1 until end of year 20
Great Britain	Tradable Green Certificates	Electricity Market Price plus 2 renewable obligation certificates (ROCs)	20 years
France	Tender System / Feed-in tariff	FIT corridors provided in invitation to tender: <u>1 Corridor (Channel):</u> 11,5-17,5 ct/kWh <u>2 corridor (Atlantic):</u> 14,0-20,0 ct/kWh	20 years

Feed in tariffs are the most common support mechanisms in the European Union. For the countries, considered in the present study, it applies to Germany and France. The principle behind feed-in tariffs is a fixed, predetermined price for operators to be obtained for a predefined period.<sup>8</sup>

Contradicting to this system, in Great Britain electricity suppliers must prove a predefined share of renewable energy contained in their energy mix. This is based on green certificates, for which the price is formed by the interaction of supply and demand (Prüssler & Schächtele, 2012, p. 10).

Furthermore, energy producers in Great Britain get the present market price for the sold electricity. Additionally to the feed-in tariff, France implemented a tender system, which require Offshore Wind Project operators to bid for the right to develop a new project (Prüssler & Schächtele, 2012, p. 11). As it can be seen, also commercial aspects of the industry differ in European Union

<sup>8</sup> Predefined period in Germany is 8 years and additional extension depending on geographical location + 1.7 months for every meter beyond a water depth of 20m and +0.5 months for every nautical mile beyond a distance to shore of 12 nautical miles.

Countries. As the main observation field of the present study lies in the legal aspects of certification and approval, the intention is just to give brief insight, respectively indication of related areas where there same aspect of missing harmonization, as the main problem definition, is also present.

### **3.3 Relevant International Conventions**

Initially the international legal level will be regarded and how it affects Offshore Wind Projects. Two conventions, namely UNCLOS and SOLAS will be introduced in the following chapters as they both have certain impact on the Offshore Wind Industry. As all installations so far are based in National Waters or the *Exclusive Economic Zones* of European Union Member States, influence and effect of international conventions are limited. Nevertheless, especially the UNCLOS regulates some essential prerequisites, namely classification and division of sea areas as already discussed in chapter 3.1. The SOLAS convention can be considered as a support instrument in the Offshore Wind Industry that is used and consulted in all areas with lack of specific regulations from the industry or not yet developed standards. Especially in Great Britain, where the Offshore Wind Industry is classified near to the Shipping Industry (compare chapter 1.1), the SOLAS convention is much more called in and consulted in the Offshore Wind Industry.

Further on, the next closer level will be regarded, namely the European framework. In chapter 3.5 the issue is then finally coming down to the national level and relevant laws in the German jurisdiction are introduced.

#### **3.3.1 UNCLOS**

Chapter 3.1 (Division of the Seas) already covered several aspects directly linked to the *United Nations Convention of the Law of the Sea*. In the context of breaking down the relevant legal framework from the International-, via European- to the National Level, the *United Nations Convention of the Law of the Sea* forms the unmitigated legal basis from where everything starts.

By allocating sea areas to single nations, a peaceful and controlled use of the sea is possible in the first place. Evolving from an international conference in 1982, it came into force 1994. For the first time, a clear arrangement was made for the definition of *National Waters*, *Contiguous Zone* and the *Archipelagic Waters*. Additionally *the Exclusive Economic Zones* of single member states and the *International Seabed Authority* were implemented. Further protection of the marine environment, marine scientific research and development as well as passing on of maritime technologies was regulated. All these aspects were based on the principle of *Common Heritage of Humanity* instead of only regarding the *Freedom of the Seas*. These international common agreements form important preconditions for the development of such technologies as Offshore Wind installations. Even no specific regulation for the Offshore Wind Industry is embedded in the *United Convention of the Law of the Sea*, it still forms and promotes a common respectful and responsible handling of the seas and therefore follow similar objectives as the Renewable Energy Policy in the European Union.

### **3.3.2 SOLAS**

The *International Convention for the Safety of Life at Sea* is an international agreement for minimum safety standards in the Global Shipping Industry. Emerged in 1913, it was a direct reaction to the sinking of the Titanic. Today the fifth version is in force with several continuous implemented amendments. Shipping activities, especially during construction phase of Offshore Wind installations are affected more or less by SOLAS. But also for fixed Offshore Wind installations, the SOLAS convention is applied to a limited extent. Due to missing specific guidelines and regulations, safety issues on Wind Power Offshore Substations are realised by consulting the SOLAS requirements. In Germany, where the Offshore Wind Industry is under strong influence of public authorities like trade supervisory boards and professional associations (see chapters 3.6.1.6 and 5.1 for a more detailed explanation of this issue), applicability of the SOLAS convention is more limited as public authorities require higher, respectively different

standards. In contrast to Germany, in Great Britain the whole Offshore Wind Industry is more characterised similar to shipping, which enables practicality of international shipping rules and guidelines like the SOLAS convention to a higher extent. Certification bodies, which concentrate technical and safety related issues of Offshore Wind installations, without having to consider additional requirements by public authorities (like in Germany), are traditionally familiar with testing and examinations towards the SOLAS convention. This essential difference between Germany and Great Britain will be revised and further discussed in chapter 5. However, due to growing experience and development of the Offshore Industry in European Union Member States, it can be concluded that appliance of the SOLAS convention decreases and is replaced by specific standards and guidelines from certification bodies (as described in chapter 3.6.1) and/or own standards developed from the Offshore Industry itself, e.g. the Offshore Code of Practice (see chapter 3.6.3).

### **3.4 European Union Directives**

As described in the previous chapter, international guidelines, respectively conventions like the SOLAS convention are more and more superseded by more specific set of rules, emerging from classification bodies and or the industry itself. Same can be observed on the European Union Level. By the attempt for increasing harmonization, several policies and standards, valid transnationally in the European Union, have emerged. Attention should be paid to the fact, that European standards like the Euro Code are well established since the 1970's and therefore not to be understood as new developments for the Offshore Wind industry. However, their application comes along with essential benefits for transnational engagement, especially for Wind Turbine and Sub Station producing companies. Same applies to European directives as further explained in the following sub chapters.

### **3.4.1 Marine Equipment Directive**

The Marine Equipment Directive 96/98/EC regulates authorization of equipment and products in the Maritime Industry. The main principle is mutual recognition by several states and/or institutions. Therefore it provides a significant simplification as equipment and products have to be certified only once. Especially in the Shipping Industry this principle provides several benefits as vessels are engaged in *National Waters* of different countries and have to comply each time with the particular legal requirements of each state (Bundesamt für Seeschifffahrt und Hydrographie, 2014). Also in regard to Classification Societies and Flag States, equipment is accepted mutually. Therefore, procedures of change of ships flag or change of class are simplified a lot, as equipment do not have to be certified each time again.

With a view to the Offshore Wind Industry, it may seem less important as installations are fixed and the respective jurisdiction does not change. But when it comes to production and equipment of same ones, companies like *Siemens* engaged transnationally can equip their products (in this context Wind Power Offshore Substations) equally, no matter where the platforms are installed. Therefore the Marine Equipment Directive provides a significant benefit in the field of harmonisation of certification of equipment and products. If and to what extent there is a possibility of implementing the same principle not only for technical and safety equipment, but also for procedures (in this special case Fire Protection Concepts) is evaluated in chapter 4.3.

### **3.4.2 Euro Code 3**

The Euro Code consists presently of ten codes, all dealing with standardisation of construction. The European Commission concluded on a program for elimination of trade barriers in 1975. First Euro codes for engineering construction evolved in the 1980's (Scia Group NV, 2015). Code number 3, responsible for steel constructions, finds widespread application in the construction business of Offshore Wind Turbine and Platform Fundaments (Det Norske Veritas, 2014, p. 3). It follows the same principle as the before mentioned Marine Equipment Directive, namely harmonisation and

mutual recognition transnationally across Europe. As production of Offshore Wind Components lies with just a few companies and components are then distributed in several countries, such unified standard enables companies like *Siemens* to produce fundamentals and towers consistently and independent from the planned installation site in different jurisdictions of the European Union. In conclusion, in the field of harmonization by mutual acceptance, a certain effort can be observed, that enables the Offshore Wind Industry to act transnationally with less barriers.

### **3.5 National Laws and Public Involvement (Demonstrated on German Jurisdiction)**

So far international conventions and European Union Directives were considered, that form the overall framework in which Offshore Wind Projects are to be remained and which patterns the basic legal requirements for Offshore Installations. Coming to the next lower step, national laws regulate specific aspects in a more detailed way. The present chapter will introduce two German laws that decisively regulate and control the Offshore Wind Industry in German *National Waters* and the *Exclusive Economic Zone*.

#### **3.5.1 Offshore Installation Ordinance (orig. Seeanlagenverordnung)**

Based upon the *Federal Maritime Responsibilities Act*, the *Offshore Installations Ordinance* regulates geographical aspects of installations within the *Exclusive Economic Zone* of the Federal Republic of Germany. The *Federal Maritime and Hydrographic Agency* is responsible for enforcement and compliance. Therefore it is the first point of contact for any project development consortium in the Offshore Wind Industry. The Agency is mainly responsible for:

- Determination of suitable sea areas in agreement with the Federal Ministry for Environment, Nature Protection and Reactor Safety and the involved Federal States.
- Approval of Offshore Wind Energy Plants inside the *Exclusive Economic Zone*.
- Section Approval of Grid Connection passing through the *Exclusive Economic Zone*.

By a decree (January 15, 2012), the process of several single approvals, (Project Planning, Environmental Studies, Impact Assessments) was superseded by one *Planning Approval Process* (Bundesministerium für Verkehr, 2012, S. 112). Consequently enforcement of any necessary subsequent approvals, due to changes in the project plan, will be more difficult to realise. Concerns of this nature mainly arise from project consortiums as they see process reliability as endangered (Wehkamp, 2015, S. 5). Furthermore, the *Offshore Installations Ordinance* does only provide limited procedures for influence on geographical location of the Offshore Wind Park approval applications and is therefore only conditionally suitable as a control instrument regarding long-term division of the Offshore Wind Energy areas in the German *Exclusive Economic Zone* (Kruppa, 2007, S. 75). To compensate this deficiency, the *Spatial Planning in the German Exclusive Economic Zone* (orig. Raumordnungsplan) was released ( Bundesamt für Seeschifffahrt und Hydrographie, 2009). This decree follows a more holistic approach and considers future increase of fixed installations within the *Exclusive Economic Zone* (Buchholz, 2008, S. 4).

### **3.5.2 German Renewable Energies Law (orig. Erneuerbare Energien Gesetz)**

Whereas the *Offshore Installation Ordinance* focuses on the geographical aspects and the approval of Offshore Wind Projects as a whole, the *Renewable Energies Law* regulates as a next step several significant aspects regarding Operation of Offshore Wind Energy Parks, namely obligations of Plant Operators and Grid Operators, the priority of power input of Renewable Energy and, as one of the most important aspects, different compensation models for Offshore Wind Energy.

The Renewables Energy Law determines in §1 a fixed target amount of Renewable Energy for the total share of *Electrical Supply*. This target is defined as a legal obligation in §4 and therefore commitments between Plant Operators and Grid Operators without additional contractual agreements arise. Furthermore the *Renewable Energies Law* prescribes compulsion for Renewable Energy, both, for the supply of the power grid as well as the take-up from same one. Under certain conditions, Plant- and Grid Operators may deviate from this principle, eg.in case safety and

reliability of general power supply is endangered. These exemptions are described in §§ 6, 9 and 11 (Trautmann, 2013, S. 157).

Regarding remuneration, the *Renewable Energies Law* was adjusted several times in order to adapt to actual market conditions. In the beginning, basic compensation<sup>9</sup> was considerable higher, whereas the initial rate<sup>10</sup> was positioned lower. In several steps, this system was reversed and by the last adjustment of the Renewable Energy law in 2014, basic compensation was raised to 3,9ct/kWh and initial rate set to 15,4ct/kWh (Bundesministerium der Justiz, 2014, p. 28). Reasons for this development were unforeseen risks in the beginning of Offshore Wind Projects and state interest to push already approved projects into realisation phase (Trautmann, 2013, S. 160).

Whereas the basic compensation is fixed and independent from the geographical location of the Wind Energy Plant, the initial rate raises continuously with increasing distance to the coastline as well as increasing water depth.

### **3.6 Certification and Approval in the Offshore Wind Industry**

The terms *certification* and *approval* often are used undifferentiated even though significant differences exist in their application as control instruments for the Offshore Wind Industry. An issued approval for any Offshore Wind Park Installation (Wind Turbine, Substation, Grid Access, etc.) as well as whole projects by Maritime Authorities is based upon certified components- and equipment parts. Therefore certification can be seen as a prerequisite for approval. For the assessment whether permission for a project is granted, respectively an Offshore Wind Park is approved, Maritime Authorities rely on certification bodies (KPMG Rechtsanwaltsgesellschaft mbH, 2013, p. 17). These bodies possess the technical expertness to evaluate suitability of any components and equipment supposed to be installed within the scope of an Offshore Wind Project. Especially when it comes to any components and equipment related to safety, certification is

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<sup>9</sup> Guaranteed sales price for electricity generated by Offshore Wind Energy

<sup>10</sup> Additional compensation, amount and period of payment depending on location and date of commissioning

mandatory. (In this context, the term safety includes Fire Protection and environmental issues). Single component parts are then *certified* once deemed to fulfil all requirements according to the particular standard. Following, chapter 3.6.1 will deal with the jurisdiction for certification, including several selected companies and their published standards that are applied in the industry. Subsequently, approval processes in general are described in chapter 3.6.2, followed by a specific demonstration of responsible authorities in two European Union Member States, namely Germany and Great Britain. Additionally, chapter 3.6.3 deals with standards grown from the industry itself. Due to growing experience, own set of rules and guidelines are published, that are used additionally to the publications by certification bodies as described in chapter 3.6.1. An evaluation with regard to extent of applicability and legitimation is followed by a final conclusion and critical view on the topic of certification and approval in chapter 3.6.4. The following figure shall firstly enable a general overview to the before mentioned complex system of certification and approval. Procedures, necessary to realise an Offshore Sub Station in the German *Exclusive Economic Zone* are shown. Chapter 5 revives this issue and expands it to the British jurisdiction.

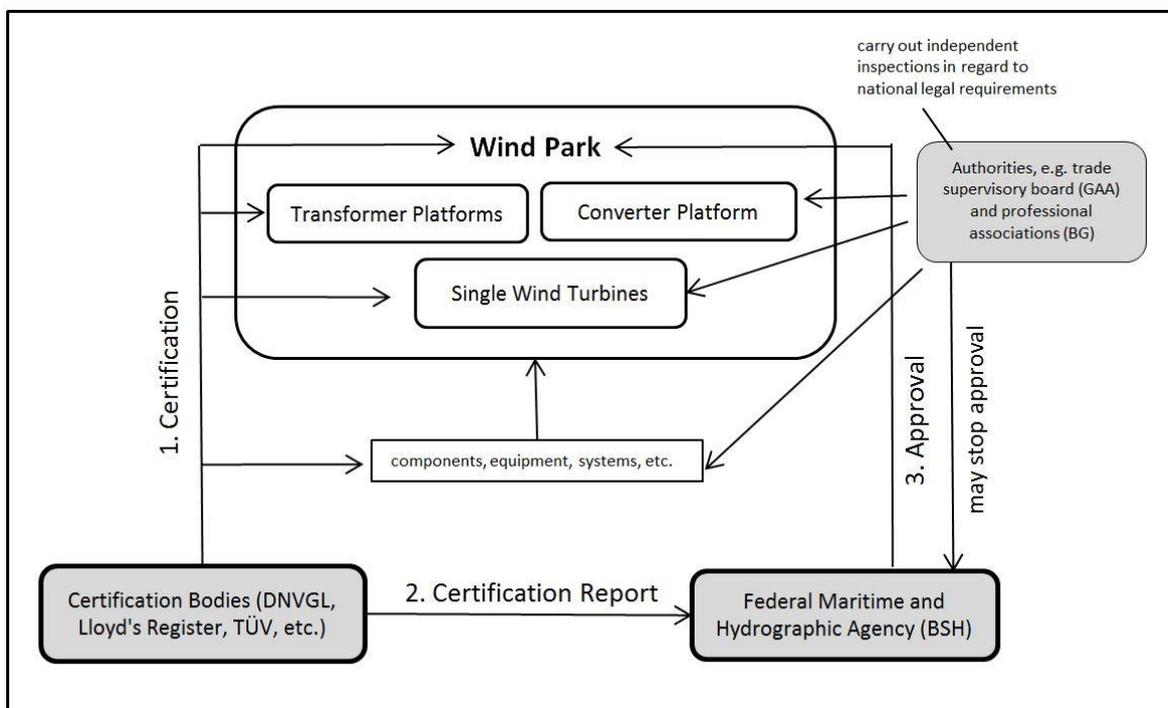


Figure 6: Way to Approved Wind Power Offshore Projects (Own figure)

### 3.6.1 Jurisdiction for Certification

The term *Certification* describes a method to ensure that certain requirements of products and services are met. The appropriate requirements can result from statutory provisions, European guidelines, and agreements between manufactures and customers or consumers expectations. For ensuring a certain reliability of the system and enabling people to rely on the results determined by certification bodies, it is important that respective companies, responsible for certification are somehow also accredited and legitimized by someone with the necessary expertise. Here public authorities are mainly responsible and at least reserve a kind of ultimate responsibility even the system of certification is more and more becoming a market economy orientated system (Ernstthaler, Strübbe, & Bock, 2007, S. 2). Problematic aspects resulting therefrom are discussed in chapter 3.6.4.

Even companies like DNVGL and Lloyd's Register traditionally acted only as Ships Classification Societies, their role has changed towards service companies with a diversified service range. One significant area of operation is certification services in maritime primary and secondary industries. Besides the Oil & Gas Industry, the Offshore Wind Industry is a growing market for all kind of certification of components and equipment. The following chapters will introduce the most important companies together with their publications and guidelines, relevant in the Offshore Wind Industry. Besides Classification Societies, also two other companies that have entered the Offshore Wind market are introduced, namely the *TÜV Group* and the *VdS Schadenverhütung*.

#### 3.6.1.1 DNVGL

After merging of the two companies, *Det Norske Veritas* and *Germanischer Lloyd* in 2013, the company DNVGL offers a wide range of services and consulting in the Offshore Wind Industry. As the present thesis puts the focus on certification procedures, additional services (Offshore Renewables Due Diligence, Offshore Renewables Control Solutions, Offshore Renewables Project Engineering, Offshore Renewables Energy Assessment and Offshore Renewables Device

Modelling Tools (DNVGL, 2015)) will not be considered. In the field of certification for Wind Power Offshore Substations, the guideline *Offshore Substations for Wind Farms* serves as the standard set of rules and is widespread used in the industry. Another standard is *Guidelines for the Certification of Offshore Wind Turbines*, published by Germanischer Lloyd in 2012 before merging with DNV. By pooling expertise from both companies, DNVGL became one of the leading certification bodies in the Offshore Wind Industry. For the four so far realised Wind Power Offshore Substations in the North Sea by *Siemens*, the DNV OS-J201 (*Offshore Substations for Windfarms*) was the main reference in all regards of Fire Protection Systems.

#### 3.6.1.2 Lloyd's Register

Lloyds Register, originally the British Maritime Classification Society, offers a similar service range as DNVGL with even longer experience due to Oil & Gas Activities in Great Britain since the early 1970's. In 2014, a new and extensive guideline for all Offshore Activities was released. Besides the whole range of aspects for the Oil % Gas Industry, part 3 of the publication *Classification of Offshore Units* deals in several chapters exclusively with the Offshore Wind Industry. In regard to the planned British Wind Park Project *Doggerbank*, the publication considers the increasing distance to shore as well as increasing size of turbines. The project *Doggerbank* is further discussed in chapter 4.2. HVDC technology (refer to chapter 2.3) by *Siemens* will firstly be used in Great Britain in the *Doggerbank* Wind Park due to necessary current transformation, which in turn, is required because of the greater distance to shore. Here it remains to be seen, if certification of the HVDC platforms can be based on DNVGL standards, as already established on the platforms based in the German *Exclusive Economic Zone*, or if certification needs to be done according to Lloyds Register standards. The possibility for *Siemens* to transfer their concepts on HVDC Wind Power Offshore Substations directly from Germany to Great Britain is further discussed in chapter 4.3.

### 3.6.1.3 Bureau Veritas

Originated in ships classification, Bureau Veritas was founded in 1828 in Antwerp. Since 1833, the head office is based in France. Today Bureau Veritas is one of the largest provider of certification services in the area of quality, safety health and environment. In the context of certification of Offshore Substations, Bureau Veritas becomes of particular importance in regard to planned Offshore Wind installations in France. Here the same issue as already explained in the previous chapter of discrepancies and different requirements of single classification companies will become highly relevant. Certification in the Offshore Wind Industry is a rewarding business opportunity and Bureau Veritas, as a French company, may be favoured by French Project initiators. This aspect of preference of national companies and also how it may affect foreign companies like *Siemens* is resumed in a final consideration in chapter 5.4.

### 3.6.1.4 VdS

The company *VdS Schadenverhütung (loss prevention) GmbH* is part of the *German Insurance Association*. Their main business segment is the certification of Fire Protection and Security Equipment. Initiated by the Insurance Industry with the main intention of loss prevention and therefore insurability, the VdS today examines and certifies Fire Protection Equipment and entire systems. As mentioned in in chapter 1.1, in Germany the Offshore Wind Industry and in particular Offshore Substations are characterised similar to land based workplaces rather than to the Shipping Industry. For companies like the VdS, originally engaged in examination and certification of Fire Protection in land based workplaces, this enables activity in a new market segment. For the Offshore Wind Industry, the VdS has developed and published own specific guidelines, concentrating on Fire Protection Systems (compare VdS 3523 Fire Protection Guideline – Wind Turbine). Also the Offshore Code of Practice as described in chapter 3.6.3.2, was decisively influenced and co-designed by the VdS. Furthermore acceptance of the VdS in the Offshore Wind Industry is shown by widespread application of their guidelines on all Wind Power Offshore Substations realised by *Siemens* (compare chapter 2.5).

### 3.6.1.5 TÜV Group

For the TÜV Group basically the same principles apply as already outlined in the previous chapter for the company VdS but with a broader service range offered in the Offshore Wind Industry that is not limited to Fire Protection Equipment. Rather the TÜV Group, especially the TÜV Rheinland offers a holistic service for certification of whole Offshore Wind Projects. The company is entitled by the *Federal Maritime and Hydrographic Agency* to conduct certifications in all stages of the realisation of Offshore Wind Projects. Therefore, the TÜV Rheinland acts on behalf of the public authority and can ensure a final project approval. In chapter 3.6 a clear distinction was made between certification and approval. However, in the case of TÜV project certification, both processes are located close to each other and a certified project by the TÜV Rheinland company directly will result in a project approval by the *Federal Maritime and Hydrographic Agency*. At this point the TÜV Rheinland directly benefits from the before mentioned lack of mutual communication and understanding between Classification Societies and the German Public Authorities. By the close cooperation between the TÜV Rheinland and the *Federal Maritime and Hydrographic Agency*, the TÜV Rheinland can ensure compliance with all national specific laws and requirements. Furthermore, due to experience in many land based industries, supplementary requirements by additional involved public bodies in Germany in the Offshore Wind Industry like the *trade supervisory board* and *professional associations* can be taken into account from the beginning. This may form an advantage in comparison to Classification Societies, which also have the global expertise in maritime industries but may disregard specific national laws and requirements.

### 3.6.1.6 Conclusion on the Topic of Certification

After having considered several companies involved in the issue of certification of equipment, products and systems, at the present stage, the question may arise if and why involvement of companies like *VdS* and *TÜV Group* is necessary in addition to class regulations. One aspect, surely being of importance are specific requirements by German authorities like the *trade*

*supervisory board* (orig. Gewerbeaufsichtsamt) and *professional associations* (Berufsgenossenschaften) that are not covered or considered by Classification Societies. Their requirements in turn evolve from the before mentioned classification as Onshore Construction Sites of Wind Power Offshore Substations and Wind Turbines in Germany (compare chapter 1.1). Lack of mutual understanding between authorities other than the *Federal Maritime and Hydrographic Agency* and Classification Societies may legitimise or even require involvement of companies like the *VdS* and *TÜV Group*. Their experience in specific national laws (in this case Germany), ensures compliance not only with standards requested by the *Federal Maritime and Hydrographic Agency* but all other public bodies like the mentioned trade supervisory board and professional associations. It has to be kept in mind that before mentioned aspects primarily apply to the German Offshore Wind Industry with involvement of many authorities additional to the *Federal Maritime and Hydrographic Agency*. This issue is resumed and further evaluated in chapter 5 together with a comparison to the situation in Great Britain.

### **3.6.2 Approval by Maritime Authorities**

Chapter 3.6 already introduced the general principle and distinctions of *certification* and *approval*. Furthermore, the applicable laws for approval processes were outlined and described in chapters 3.5.1. and 3.5.2. Intention of the following two sub-chapters therefore is restricted to demonstrating the actual processes of approval of Offshore Wind Projects in Germany and Great Britain. It has to be kept in mind, that the term approval of Offshore Wind Projects has a different meaning in both countries. Whereas in Germany, the *Federal Maritime and Hydrographic Agency* is directly involved in technical and environmental matters and the final approval is based on different own surveys and investigations, in Great Britain the *approval* is more formal. Acting of the respective authorities is limited to determining the respective sea areas and legally pronouncing them for Offshore Wind installations. This issue is further outlined in chapter 5.2.

### 3.6.2.1 Germany

Chapter 3.5 already introduced relevant legal sets of rules that are applied mainly by the *Federal Maritime and Hydrographic Agency*. At this point, a general overview is given of activity of the agency in order to be able to highlight differences to the British system. In Germany, the *Federal Maritime and Hydrographic Agency* is the main decision maker for approval of Offshore Wind Projects in the *German Exclusive Economic Zone* in the North Sea and the Baltic Sea. As almost all Offshore Wind Projects are located outside National Waters (disregarding several trial installations inside the 12nm zone where the respective federal state is responsible), the *Federal Maritime and Hydrographic Agency* is responsible for almost all German Offshore Wind Projects. Within the scope of the *plan approval procedure* (orig. Planfestellungsverfahren), several surveys regarding environmental issues, minimum construction standards, dismantling programs and safety issues are directly done by the *Federal Maritime and Hydrographic Agency*. Therefore several standards were published as a guideline for project initiators for successful passing of the *plan approval procedure*. Therefore the *Federal Maritime and Hydrographic Agency* reserves technical expertise on their side and does not pass responsibilities completely to the Certification-, respectively Classification Societies. Especially in the field of binding construction standards, traditional in the hand of Classification Societies at least in the Shipping Industry, is regulated in detail by several own standards such as the "*Standard Baugrunderkundung - Mindestanforderungen für Gründungen von Offshore-Windenergieanlagen*", "*Standard Konstruktive Ausführung von Offshore Windenergieanlagen*" and "*Mindestanforderungen an den Korrosionsschutz an Offshore-Anlagen in der AWZ*". Therefore control in this area is preserved on the public side. This aspect is further evaluated in chapter 3.6.4.

### 3.6.2.2 Great Britain

In Great Britain, the situation is different. The *Maritime and Coastguard Agency* (British Flagstate authority, comparable to the German *Federal Maritime and Hydrographic Agency*) is not involved

in the approval of Offshore Wind Projects along the British Coast. Responsibility here lies with the following authorities, respectively public administrations:

- The Crown Estate
- The Department of Trade and Industry
- The Department for Environment, Food and Rural Affairs
- The Department for Transport

The Crown Estate is responsible for the property management of British grounds and therefore issues license agreements for sea areas intended to use for Offshore Wind Projects. The *Department of Trade and Industry* is responsible for British Energy Policies and is not involved as an executing body but sets the whole framework for the industry such as Climate and Renewable Energy targets. Finally the *Department for Transport* is responsible for related shipping activities in the Offshore Wind Industry. According to the listed responsibilities, it can be seen, that in Great Britain involvement of public side is limited to formal and political issues and state institutions stay out of technical aspects, which are passed to the certification industry. This is a decisive difference to the German system as described in the previous chapter 3.6.2.1.

Also opposed to Germany, Great Britain didn't proclaim an *Exclusive Economic Zone* but established several comparable areas in order to be able to use sea areas adjacent to the National Waters (Kruppa, 2007, S. 135). For the purpose of Offshore Wind, the so called Renewable Energy Zone was created where installation of Wind-, Wave- and Tidal power plants can be granted (The Stationery Office Limited, 2004). The allocation of rights to use sea areas for Offshore Wind is done by tender processes by the Crown Estate, which holds a monopole on land property. This system is inspired by the Oil & Gas industry where granting is also done by tender systems in Great Britain (Kruppa, 2007, S. 136).

### 3.6.3 Standards Grown from the Industry

Due to continuous development and growth of the Offshore Industry in Europe, it is obvious, that own expertise, generated from the industry itself, is increasingly generated and used. This aspect applies especially to the *Offshore Code of Practice* as further outlined in chapter 3.6.3.2. But also the NORSOK Standards, even if not developed from the Offshore Wind Industry, but having their origin in the Oil & Gas Industry, can serve as a suitable example for guidelines emerged from the industry itself, rather than from public regulatory bodies. The NORSOK Standards will be introduced in chapter 3.6.3.1 as it is used and referred to also in the Offshore Wind Industry with its several intersections with the Oil & Gas Industry. Development from the industry can have significant advantages, as guidelines are custom-made for the specific industry and therefore generate the utmost benefits. On the other side, there is the danger of constructing rules and regulations following an ‘as one pleases’ approach with disregarding necessary and important regulatory fundamentals, not at least in regard to safety. This issue, together with several additional problematic aspects from the topic of approval and certification will be discussed more detailed in chapter 3.6.4.

#### 3.6.3.1 NORSOK

Originated in the Norwegian Oil & Gas Industry, the NORSOK Standards form a detailed and extensive set of rules regarding all areas of offshore operations. Due to wide-ranging guidelines, application and adaption in and for the Offshore Wind Industry is highly reasonable. Especially in the field of occupational health & safety and Environmental Protection, strong overlapping between the Oil & Gas Industry and Offshore Wind Industry is present. Also, as raised from the early 1960’s, expertise has grown continuously and the still quite young industry of Offshore Wind can benefit from a long range of experience. Therefore it is often referred to once Offshore Wind guidelines and rules have reached a limit or haven’t yet clearly established any kind of regulatory system for the respective area. As the NORSOK standards are highly regarded worldwide in the

maritime industry, certification bodies as well as maritime authorities have reasonable confidence in these standards, which, in turn, enables again Offshore Wind Power Operators to refer to the NORSOK standards with no or less danger of facing legal conflicts or non-acceptance from the public side.

### 3.6.3.2 Offshore Code of Practice

*The European Wind Turbine Committee*, constituted by European Insurance- and Re-Insurance companies, founded the initiative *Offshore Code of Practice* in 2010. The general association of German insurers and the foundation *Offshore Wind Energy* supported the initiative and the first version of the code was published in 2014 by the *General Association of German Insurers*. In case of significant changes in technology and risk management issues, updated versions shall be released. Reasons for the development of such code were complexity of Offshore Wind Projects, limited experience at the time of construction of Offshore Wind Turbines and the general young age of the industry (Gesamtverband der Deutschen Versicherungswirtschaft e. V. [German Insurance Association], 2014, p. 7).

As the code was mainly promoted by the insurance industry, obviously the main intention is minimising of risk during installation and operation phases of Offshore Wind Projects. A proactive, as well as a holistic approach shall motivate all involved parties to implement risk management systems. A therefore obtained risk transparency can minimise *damage risk* and ensure long term insurability (Gesamtverband der Deutschen Versicherungswirtschaft e. V. [German Insurance Association], 2014, p. 7). Experts with most different knowledge were involved in the development of the code: Insurance and re-insurance companies, production-, operation-, and development companies, investors, financial institutions, consultants, energy suppliers, shipping companies and certification bodies. Especially the involvement of certification bodies ensured legal compliance and acceptance from public side to some extent. The aspect of acceptance and legal compliance is further discussed in chapter 3.6.4.

#### 3.6.4 Critical View

Independence is one of the most effective conditions when it comes to ensuring a certain quality standard by examination and re-view of material, components, procedures and human qualification. Keeping the regulatory influence on the public side in Germany may be the most effective way to ensure such mentioned independent regulation. As already briefly mentioned in chapter 3.2.2, the British approach gives more power to certification bodies and public authorities act more reserved. An attempt to evaluate advantages and disadvantages of both systems can be found in chapter 5.2. For now, emphasis shall be put on the certification procedures in Germany and Great Britain. Certification bodies in their role in an intermediate state between public authority and a pure commercial profit organisation surely form the most critical aspect when it comes to ensuring independency. This effect is reinforced by the fact, that more and more companies entering the market of certification and therefore a climate of strong competition is formed (compare chapter 3.6.1). Naturally, this puts the customer (in this context, manufacturers and operators in the Offshore Wind Industry) into a stronger position with the choice to choose freely from a wide range of companies that offer certification services. Certification may be done in favour of the respective company instead of putting the certification itself in the first place. These aspects shouldn't be understood as facts but rather as potential dangers resulting from such competitive situation in the market of certifications services. Legitimation of such guidelines like the *NORSOK Standards* and the *Offshore Code of Practice* is not clearly defined as the decision for acceptance by Classification Societies (certification) or public authorities (approval) is often done on a case by case basis. Especially due to still unregulated fields and missing expertise (more on the public side than on classification bodies), relying on related rules or own developments from the industry is the only choice. The rapid growth of the Offshore Wind Industry is another factor that pushes public authorities in a position of not being able of keeping up. They are therefore reliant on support and assistance from the industry itself.

#### 4 Transnational Aspects in European Offshore Wind Industries

At this point, transnational issues, that may affect transferability between different jurisdictions, shall be outlined. The present situation is as follows; as mentioned already before, in Germany exclusively HVDC platforms are used due to greater distance to shore of Wind Parks in the German *Exclusive Economic Zone*. (For a detailed description of locations refer to chapter 3.2.1.)

In contrast, in Great Britain, due to near-shore installations, HVDC platforms are not needed and the electricity is transported to shore by HVAC transmission technology. (For technical details and distinction of both technologies refer to chapter 2.3.)

Due to expected development of Wind Parks in Great Britain, that are also located far off-shore and *Siemens'* activity in both countries, there is certain demand for a harmonisation, respectively transfer of already existing HVDC procedures from Germany to Great Britain, including but not limited to Fire Protection Concepts. Two main aspects have to be considered when planning transferability; firstly, technical differences of HVDC and HVAC transmission affect Fire Protection Concepts and secondly, legal requirements in regard to certification and approval, as was shown before, differ in both countries. Furthermore, the issue of Common Law traditions in Great Britain and Civil Law traditions in Germany have to be considered. Following, chapter 4.1 outlines significant distinctions of both legal views. Chapter 4.2 describes the planned British wind park *Doggerbank*, which is located far offshore and requires HVDC current transmission. Chapter 4.3 then deals in particular with transferability of Fire Protection Concepts already used and approved in Germany to the British jurisdiction. Finally, an outlook is given to potential further shifting of the Offshore Wind Industry into *International Waters* with no regulatory authority of any country. Developments must be understood as only theoretically as advantages due to less regulation face severe problems and disadvantages in regard to far distance of energy transmission and therefore energy losses. Nevertheless, with increasing technological development, there is a certain chance of such development in the greater future.

#### 4.1 Civil and Common Law Traditions and Possible Effects on Fire Protection Concepts

In the context of transferability of Fire Protection Concepts from the German to the British jurisdiction as described in the previous chapter, the topic of Civil Law and Common Law traditions may have a certain influence and have to be considered.

Beginning with a brief introduction of both law systems and their distribution zone, subsequently an estimation is given on how they may affect systems like Fire Protection Concepts in the Offshore Wind Industry.

The Common Law tradition emerged in England during the Middle Ages and was later applied also in English colonies across the continents. In contradiction, the Civil Law tradition has its origin in the Continental Europe. Figure 10 shows worldwide application of the different systems.

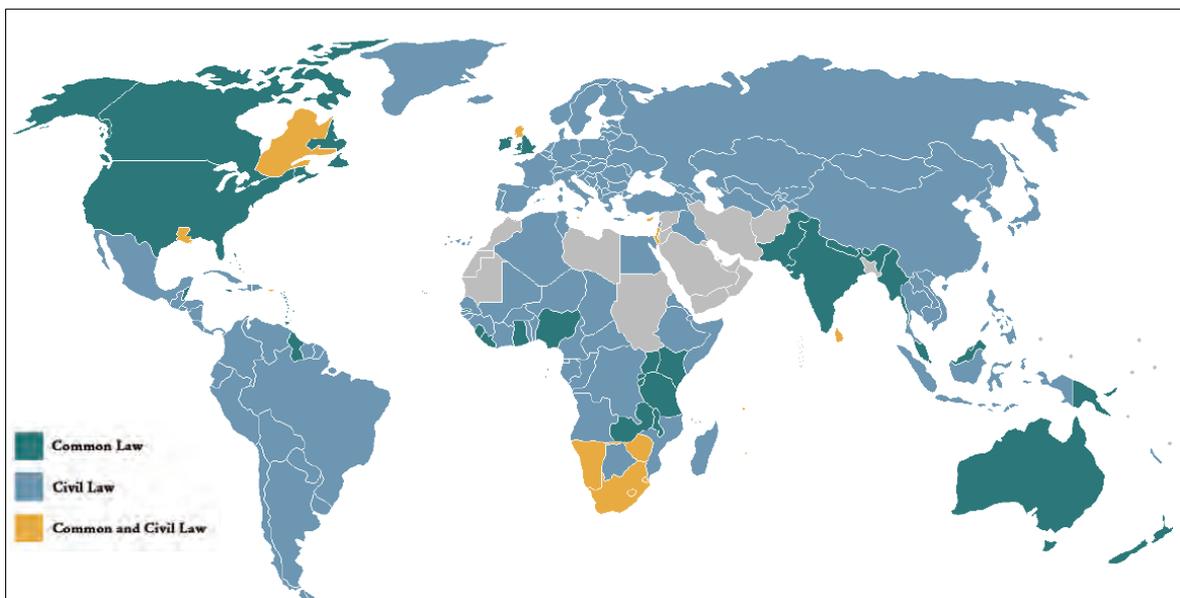


Figure 7: Civil and Common Law Application Worldwide (School of Law, University of California, 2010)

Until today, even Great Britain with its nearness and part of the European Union, has preserved the Common Law tradition (School of Law, University of California, 2010).

Common Law can be described as uncodified, meaning, in a simplified way, judging is not based on legal statutes but on precedent cases. Decisions are based on similar previous cases. Therefore the British Law is significantly shaped by judges rather than legislative bodies that develop new laws. In contradiction, the Civil Law approach is based on written legal codes and laws. These are

continuously developed and adapted according to the respective legal concept of a state. The judge in Civil Law systems is obliged to apply the legal codes and laws to the facts of the respective case. This very simplified description of Common and Civil Law systems shall emphasize the opposed approach of both systems, which might have to be considered by companies engaged in the Offshore Wind Industry in several, different juristically formed countries.

In the adjacent Shipping Industry and especially in chartering, this issue is highly relevant. In any charter party the geographically place of jurisdiction is stated and therefore decided which law tradition is applied in cases of legal disputes regarding the contract (Tetley, 2003).

Back to the main observation field of transnational Offshore Wind Industry, the question is raised, if such different law traditions are relevant and if yes, to what extent they must be considered.

Besides the intention of concepts and clear procedures to ensure safety standards and to enable reacting to any incidents effectively and in the best possible way, an important aspect is providing legal cover for the underlying company and persons in charge in case of accidents and incidents.

As long as smooth operation is present, such systems like Fire Protection Concepts and other Quality Management Systems are called moderate attention. Only after a certain incident, these systems are subject to considerable devotion.

At this point, the question of legal traditions becomes relevant. Besides the genuine distinction of Common and Civil Law traditions as explained in the beginning of the present chapter, several other differences exist. Worth mentioning is the field of contractual law in both systems. Whereas the Common Law tend to solely invoking contractual terms, the Civil Law approach also considers subjective matters such as good faith and proportionality (Valck, 2008, p. 77).

Furthermore the issue of how legally binding requirements by the public side are determined differs in Germany and Great Britain. Safety standards in Germany are clearly defined, for example the specific obligation to equip an Offshore Wind Turbine with an elevator. Same situation would be solved differently in Great Britain, the obligation would be to construct the turbine *to state of the art* standards but no specific requirements would be defined. But, in case of an incident that could

have been avoided by installing an elevator, the legal system would judge the Wind Turbine as not equipped according to *state of the art* and therefore the underlying company would face severe legal action. Additionally, in Germany a principle is implemented to cover the company from severe financial compensation payments. By defining natural persons and putting them into charge for pre-defined areas, in case of accidents and incidents, the person will be burdened with responsibility (Personalization). Obviously, this does not release a company from certain responsibility but puts a natural person in the first line. This principle could be seen in the case of the grounding of the passenger vessel *Concordia*, where the captain was held liable while the company was put out of the public focus and could effect a ransom payment<sup>11</sup>.

The above outlined aspects are further considered in chapter 4.3 where transferability of construction and equipment standards as well as processes and procedures is further evaluated. However, subsequently the far offshore located Wind Energy Project *Doggerbank* is introduced, serving as the legitimation why the issue of transferability is highly relevant.

## **4.2 British Offshore Wind Project *Doggerbank***

As already briefly described in chapter 3, the Wind Park Project *Doggerbank* in Great Britain will be the first British wind farm requiring HVDC transformation due to greater distance to shore than all so far realised Offshore Wind Projects in the British jurisdiction. All present near shore installations do not require transmission to *Direct Current* and electricity can be transmitted as *Alternating Current* directly to shore. For a detailed technical explanation of HVDC transmission technology, refer to chapter 2.3. At this point the project is introduced itself in order to be able to evaluate transferability of already realised HVDC technics to the British jurisdiction as evaluated in the following chapter 4.3. In particular, the *Doggerbank* project is observed, due to specific interest

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<sup>11</sup> Statements and examples are based on a discussion between experts from leading companies active transnationally in Germany and Great Britain. Discussion took place on a workshop initiated by the German foundation “Stiftung Windenergie” on January 14<sup>th</sup> 2015 in Hamburg. Reference is the official report of the meeting (Wehkamp, D. S. (2015). Protokoll Workshop Arbeitskreis Offshore Design – Genehmigungsfähigkeit. Hamburg: Stiftung Offshore Windenergie)

of the company *Siemens*. Firstly, *Siemens* is already engaged in the British Offshore Wind Industry and secondly they have the expertise of HVDC transmission, the technology which is inevitable for the far offshore located Wind Park *Doggerbank*.

Until 2020, Wind Turbines with an overall capacity of 9 GW are planned in the area of Doggerbank. The terrain has a size of approximately 8660 square kilometres and is located between 125 and 290 kilometres easterly of the British county Yorkshire. The sand bank Doggerbank was selected due to relatively shallow waters with only 13 m depths in places (Stride, 2010). The responsible consortium consists of *RWE Innogy*, *Scottish and Southern Energy* as well as the Norwegian energy companies *Statoil and Statkraft*. The first construction permit for the two wind farms *Doggerbank Creyke Beck A and B* was granted already. If the whole Wind Park with all single farms will be realised as planned, one quarter of Great Britain's energy demand could be covered (RWE Innogy, 2015).

#### **4.3 Transferability of HVDC Concepts into British Jurisdiction**

Chapter 3.4.1 outlined the principle of transnational mutual acceptance by the *European Marine Equipment Directive* for equipment and products in maritime industries. Application of this standard surely will simplify the introduction of HVDC platforms in Great Britain for foreign companies like *Siemens*. In the field of general construction of the fundamentals and the platform itself, following the Euro Code 3 as described in chapter 3.4.2 will ensure legal compliance also in the British jurisdiction. Same applies for technical equipment of HVDC platforms, provided that products are certified according to the European Marine Equipment Directive 96/98/EC as described in chapter 3.4.1.

Regarding management systems such as Fire Protection Concepts, which have to be certified according to specific national requirements, a complete transferability is not inevitable possible. Keeping in mind legal issues of Common and Civil law as described in chapter 4.1, especially the case of incidents and accidents and therefore liability is highly relevant. Also another issue of

different law fields must be considered; whereas in the British law a development towards class action lawsuits<sup>12</sup> can be observed (Secretary of State for Business, Innovation and Skills, 2013, p. 102), the German law does not provide such class recourse claims. Therefore it has to be assumed that such protections are not considered in German based Procedures and Management Systems. In the special case of *Siemens*' HVDC systems and their transfer to the British jurisdiction, surely the company will benefit from its size and presence of local company own expertise all around Europe. Especially in Great Britain, *Siemens* is represented for a long time due to company's activity of construction of Wind Turbines and HVAC current transmission platforms. In conclusion, for transferring construction standards and technical equipment standards of the HVDC platforms from Germany to Great Britain, certain present instruments for harmonisation like the *Euro Code 3* and *European Union Directives* will contribute to smooth execution. In the field of operating procedures, specific national requirements must be considered as a harmonisation, not at least due to different law areas and legal understandings as explained in chapter 4.1, is not completely given. Transferability therefore has to be investigated for several concepts. Local legal expertise, both internal and external from Classification Societies and additional certification bodies will be necessary to ensure legal compliance of the entire system of HVDC transformation in the British jurisdiction.

#### **4.4 Outlook to *High Sea* Installations outside EEZ of EU Member States**

In regard to legal requirements Offshore Wind installations in the *High Sea* outside the jurisdiction and control of any state is an interesting reflection because the question of regulation inevitably rises. Especially the development of floating turbines theoretically enables spreading of Wind Turbines outside the *Exclusive Economic Zone* of any European Union Member State and pushes the topic in a more real position. Several trial installations of floating Wind Turbines already exist. In Norway the *Hywind Project* with a 2,3 MW *Siemens* turbine was installed in the *Amoy Fjord*

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<sup>12</sup> lawsuit that allows a large number of people with a common interest in a matter to sue or be sued as a group

near to Stavanger and started operation in September 2009. Further projects exist in Portugal, France and Japan. Spreading of floating systems to the *High Sea* once the trial status has overcome and commercial application is possible, a similar system like the *Flag States* for shipping would be necessary in order to establish a control mechanism.

Furthermore, as already briefly outlined in chapter 1.1, an international organisation like the IMO for shipping could take the role as a transnational regulating institution to prevent uncontrolled outgrowths with no any minimum safety and quality standards and therefore danger for the environment and people involved directly in the construction and operation of such installations. At this point it should be made aware again, that such developments are highly theoretically.

Considering the limited sea area in the North Sea with a complete division between all coastal states by *Exclusive Economic Zones* or, as in Great Britain, *Renewable Energy Zones* (compare chapter 3.6.2.2), *High Sea* installations are not even possible in this area. Consideration is therefore, at least in Europe, limited to the Atlantic Ocean. However, pushing these thoughts to the very great future, the *High Sea* offer an extremely big area in comparison with coastal waters and therefore might even be necessary one day, if areas close to shore are all occupied. Even though the issue is for now purely hypothetical, it fits in the context of legal requirements and regulatory systems and therefore is mentioned as a thought-provoking issue at this point.

## **5 Chances for Improvement and Simplification**

The present chapter resumes issues of distinctions in Germany and Great Britain in chapter 5.1, including the different meaning of approval procedures in both countries. Subsequently advantages and disadvantages of the different systems are outlined in chapter 5.2. Here the issue of endangered independency due to lack of public involvement in Great Britain and missing links between Classification Societies in Germany and public authorities form the basis for further evaluation and an approach to solutions and recommendations for improvement in the field of certification and approval in the Offshore Wind Industry. Chapter 5.2.1 concentrates on these aspects from the regulatory European level, whereas chapter 5.2.2 resumes the issue precisely on the corporate level and outlines specific possibilities for improvement for companies engaged in the Offshore Wind Industry. Bringing the topic to a concrete level, finally a recommendation for the company *Siemens AG* in the specific field of Fire Protection is given. Serving as an example, the adjacent Global Shipping Industry and how established procedures can help improving alignment on European Level in the Offshore Wind Industry are discussed in chapter 5.3. Finally, an outlook to the growing Offshore Wind market in France is given. Chances for *Siemens* to enter the market as well as potential barriers are evaluated.

### **5.1 National Distinctions and Opportunities for Unification on European Union Level**

One of most important distinction in the process of realisation of Offshore Wind installations between Great Britain and Germany surely is the less involvement of Maritime Authorities in Great Britain. Certification bodies are trusted to such extent, that they remain responsible for the final decision of approval of Offshore Wind Parks. State influence is limited to defining appropriate sea areas and releasing same one as intended for Offshore Wind installations. Authority in regard to technical issues is passed to the certification bodies. Figure 11 shows schematically the elimination of approval processes in Great Britain. The missing link, as indicated in red, was already outlined

in chapter 3.6.1.6 together with a consideration if certification companies, other than Classification Societies (TÜV Group, VdS) might be able to bypass this barrier by already established cooperation with the respective authorities from land based construction industry. The issue of a missing link is resumed in chapter 5.2.

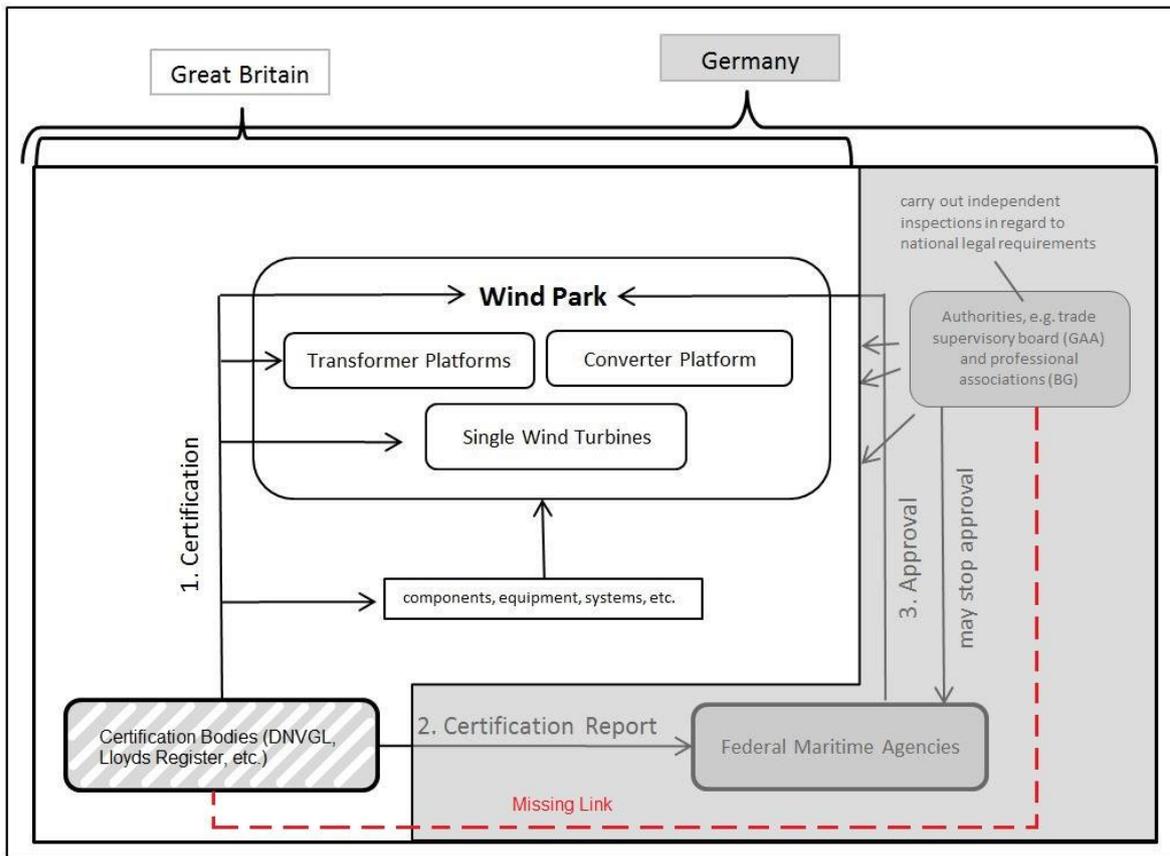


Figure 8: Processes for Realising Offshore Wind Projects in Germany and Great Britain (Own figure)

However, Great Britain's approach of public restraint is linked to the fact, that the Offshore Wind Industry is classified near to the Shipping Industry as explained in chapter 3.2.2. The principle in shipping of close cooperation between the Flag States (which can be seen as the equivalent to Maritime Authorities) and the Certification/Classification companies as well as passing responsibilities to same ones is transferred in Great Britain to the Offshore Wind Industry. Linkage and transferability to the Shipping Industry is discussed more detailed in the following chapters 5.2 and 5.3.

Contradicting, in Germany, the Offshore Wind Industry is attributed more to land based constructions. Therefore, additional authorities like the *trade supervisory board* (orig. Gewerbeaufsichtsamt) and *professional associations* (orig. Berufsgenossenschaften) are involved and produce own requirements that often go beyond standards developed by the certification bodies. The following chapter tries to give an estimation of advantages and disadvantages of both systems respectively in Germany and Great Britain.

In regard to opportunities for unification, the European Union Directives, as explained in chapter 3.4, surely form a certain instrument that ensures transnational conformity. However, this is limited to construction norms and technical equipment. A similar development in the field of Fire Protection Concepts could be achieved by a European guideline, which considers and overcomes barriers regarding common and civil law traditions as described in chapter 4.1.

## **5.2 Advantages and Disadvantages of Certification and Approval in GB and GER – Comparison Criteria and Recommended Action**

Even though the big Classification Societies have a long tradition and can be characterised as responsible independent bodies, they remain commercial business companies with competitive pressure and therefore a complete independence, as remained by Public Authorities, cannot be guaranteed. Especially, due to competitors entering the market of certification service (refer to chapter 3.6.1), a cost pressure and run for customers is present. In this context, customers are all companies, which rely on certification of their products, installations and procedures in the course of an Offshore Wind Project. Therefore they gain a powerful position, as they can freely choose and change certification companies in case of discrepancies. It therefore can be concluded, that less or even missing involvement of public authorities might endanger independent conscientiously certification procedures. In conclusion, a preservation of technical expertise on the public side in Germany (compare chapter 3.2.2) can be seen as an advantage in regard to safety and quality standards.

A less regulated system like in Great Britain therefore brings along advantages for project initiators as they face less bureaucratic barriers and Offshore Wind Projects may be realised more efficient, in economic terms and more effective, in terms of avoiding interminable approval processes.

On the other hand, especially in regard to safety, the Maritime Industry in Great Britain has established an autonomous exceptional high standard, which might render public authorities obsolete. Raised from the Oil & Gas industry, where insurability is an important topic and insurance companies have the required power to enforce such high standards, safety awareness and acceptance of Quality Management Systems including, Continuous Improvement, Risk Assessments, Auditing, Reviews, etc. are highly accepted procedures. This general mentality surely is transferred to the Offshore Wind Industry, not at least due to engagement of same companies (Energy Companies, Offshore Supply Shipping Companies, etc.).

The question, if insurance companies, which have taken over a powerful role, as insurability decides whether an Offshore Wind Project can be pushed into realisation phase, might constitute similar barriers as authorities in Germany responsible for giving a final approval of a project and therefore only an illusory freedom on the British market might be present, forms an important aspect when comparing both jurisdictions. Offshore Wind projects are related to several unforeseen risks, not at least due to consolidated character, including a variety of stakeholders. Furthermore delayed grid connection, weather influences, hindered approval procedures and environmental issues such as unexpected ammunition or other unsuitable seabed, require financially strong insurances that can offset rising costs and therefore ensuring progress of the project without letting single stakeholders run into bankrupt.

Whereas in Germany insurance companies can rely on two independent systems, namely approval from the public side and certification from the industry side, that offer a degree of certainty before giving an insurance contract, in Great Britain they have to stand between these two systems.

Insurers are put in line before public approval is given and therefore they face a higher risk. In the

event of insurance cases additional aspects from different law traditions as discussed in chapter 4.1, will also affect consequences for insurance companies.

Having so far considered the issue of advantages from an outside observers point, subsequently the topic is discussed from the political, respectively regulatory perspective, followed by a concise view of the company *Siemens* and giving specific recommendations for action that could improve transfer procedures and decrease transfer costs in the process of allocation of certified systems, equipment and concepts from Germany to Great Britain. By combining competence from both jurisdictions, synergy effects may emerge that will benefit to successful new market entries. This issue is further discussed on the specific case of the French market in chapter 5.4.

The following two tables shall initially summarise and display before carved out aspects in the Offshore Wind Industry in Germany and Great Britain. Subsequently, the topic will be further discussed on a more concrete level, namely by referring each outlined aspect specifically on action possibilities firstly on the public regulatory side (chapter 5.2.1) and secondly on the industry side with putting the focus on the company Siemens AG (chapter 5.2.2).

Aspects in the following tables shall be understood and interpreted as the respectively most significant characteristic in both regarded jurisdictions. Meaning, that the distinction of topics between Germany and Great Britain not to be assumed as absolute but elements from both tables apply also in the other country but in a less pronounced way.

**Table 3: Offshore Wind Industry, Present Conditions Germany (own table)**

<i>Present Condition</i>	<i>Consequences</i>	<i>Directly Affected Parties</i>	<i>Solution Approach</i>	<i>+ Adv.</i>	<i>- Disadv.</i>
Certification by different companies not based on harmonised standards	Legal uncertainty, companies cannot follow a clear concept in preparation for certification	Industry, Certification Companies, Public Approval	1) Determination of guidelines, standards to which certification should be examined by client	Results of certification liable according to before determined standard	Workload for client, expertise needed, directly engaged in the certification process
			2) Certification order always to be done with highest available standards	Most effective way to have all legal requirements ensured and covered	Higher costs, unnecessary adaptations to be made → Economic efficiency endangered
Certification focuses on technical issues, (plant safety)	Personal Protection, as req. by public side might be disregarded	Industry, Certification Companies, Public Approval	Certification procedures to be developed towards a holistic approach	Integrated system, covering requirements by all stakeholders	Way to certified product, system may be extended → final project approval takes longer
Involvement of additional authorities besides FMHA <sup>13</sup>	Certification companies may not cover add. requirements → Delay in approval, rectifications necessary	Industry, Certification Companies	Establishing cooperation between certification companies and authorities (trade supervisory board, professional associations)	Higher standards from different positions considered	Danger of over-regulation, topic of certification to become more complex and complicated
Principle of open risk survey of Classification Societies	Contradicting to principle of norms and standards → monitoring and reliance on certification difficult	Industry, Public Approval	Combination of both approaches or European agreement on one system	Meaningful case by case decisions possible	reliance on certification difficult, lack of comparability, valuation basis missing, lack of control by MFHA

<sup>13</sup> Federal Maritime and Hydrographic Agency

**Table 4: Offshore Wind Industry, Present Conditions Great Britain (own table)**

<i>Present Condition</i>	<i>Consequences</i>	<i>Directly Affected Parties</i>	<i>Solution Approach</i>	<i>+ Adv.</i>	<i>- Disadv.</i>
Offshore Wind Industry closely linked to shipping	Isolated system established, not in conformity with European Union requirements (Euro Code, MED <sup>14</sup> )	Industry, Certification Companies, Public Approval	Establishing a pan-European regulating system by considering advantages from GB and vice versa	Transferability of standards in the European Union	British industry forced to implement changes, dismiss of an established system
Strong influence of insurance companies	Dependence on insurance companies for certification / approval → powerful position	Industry, Insurance Companies	public side to interfere and contribute rather than reliance on insurance companies	Balanced system, considering all interests	Approval procedures to become more elaborate and time-consuming, danger of over-regulation
Public regulation bodies act reserved	Industry develops own dynamics, danger of economic interests to surpass safety and quality issues	Industry, Certification Companies	Balance between regulation and free evolvement of the industry	Industry can grow and expand effectively with certain public control acc. 'as much as necessary, as less as possible'	Lack of public control
Self-regulated industry	Barrier for harmonisation towards a pan-European system	Industry, Certification Companies, Public Approval	Including positive aspects from experienced industry and transfer them into an integrated regulatory system, applicable in all European Union Member States	Effort on the public side kept to a necessary minimum, experience from the Oil & Gas Industry can freely develop, pan-European benefit from same one	Other European jurisdiction forced to change developed procedures that do not harmonise with British standards

<sup>14</sup> Marine Equipment Directive

### 5.2.1 Regulatory European Level Perspective

The present chapter shall provide several issues for consideration that might simplify transnational engagement for companies involved in the Offshore Wind Industry.

Pooling of public responsibility, by the approach of an international, respectively European agency, responsible for regulation and maintaining of certain safety standards in the Offshore Wind industry could form an effective instrument, serving alignment on European Level. Companies engaged transnationally would directly benefit, as systems and procedures could be transferred freely between different jurisdictions in Europe. But also supporting secondary industries would benefit in regards to liability and contractual issues with project initiators. The Global Shipping Industry here could serve as an example and in particular the SOLAS convention as introduced in chapter 3.3.2. This does not necessarily mean release of national control. Also in the Shipping Industry, national additional requirements are enforced by the *Flag States*. But a convention like SOLAS could form a basic frame for orientation, supplemented by additional national requirements of each European country having Offshore Wind installations in their *Exclusive Economic Zone* or similar sea areas<sup>15</sup>. Here the British approach with its classification of the Offshore Wind Industry similar to the Global Shipping Industry (as described in chapter 3.6.2), could be seen as an advantage and role model for other European Union Member States. A factor, that cannot be ignored, is the different situation in Global Shipping and Offshore Wind. As mentioned in the beginning of the present thesis in chapter 1.1, shipping mostly takes place at the *High Sea* outside the jurisdiction of any country. However, the Offshore Wind Industry is fixed in a particular jurisdiction. The principle of SOLAS and related *International Maritime Organisation* cannot be transferred one to one. Extent of comparability and aspects that could be assumed are further discussed in the following chapter 5.3. For now, a second recommendation approach is the issue of a missing link between authorities like the *trade supervisory board* and Classification Societies as

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<sup>15</sup> Compare chapter 3.3.2 p. 47, *Exclusive Economic Zone* and *Renewable Energy Zone*

explained in chapter 3.6.1.6 and plotted in figure 11 – *Processes of Realising Offshore Wind Projects in Germany and Great Britain*. The issue applies mainly to Germany, as a direct complaint hereof is rising from the industry (Wehkamp, 2015). A similar situation can be expected in the British jurisdiction, where also several authorities are involved in the process of realising Offshore Wind Projects as described in chapter 3.6.2.2. Worth mentioning in this context are the *Crown Estate*, the *Department of Trade and Industry*, The *Department for Environment, Food and Rural Affairs* and the *Department for Transport*. Surely room for improvement exists by better information flow and communication of national requirements by the authorities to the Classification Societies. They, in turn, could take up important issues and include them into their own certification requirements in order to avoid subsequent complaints by maritime authorities (e.g. trade supervisory board) and therefore delays in project realisation.

## **5.2.2 Industry Perspective and Recommendation for the Company Siemens AG**

The so far considered aspects in regard to simplification and improvement mainly focused on a state-regulatory pan-European level for future developments of the industry. Additionally, in order to bring the discussion to a more precise level, specific possibilities for companies engaged in the Offshore Wind Industry under the present circumstances shall be outlined at this point.

Having in mind all so far discussed problematic aspects and distinctions in single countries, still some improved scope of action for companies like *Siemens* may exist without disregarding the *rules of the game* as determined by regulatory bodies in the European Union. An approach, which might seem trivial on the first sight, might be to fulfil higher standards by covering legal requirements always based on the most regulated and demanding jurisdiction. The result could be a *one for all* standard that is exceeding essentials in some countries. Partial inefficient means can be redeemed by advantages due to one single standard that is covering all requirements and therefore do not need to be adapted for different jurisdictions. Obviously such approach cannot be applied when facing contradicting demands, but certain room for such practice surely exists.

Farsighted planning and having in mind future developments in the industry is another important factor that has to be considered on the company level. An example is the increasing importance of *Safety, Health and Environmental* issues which are demanded from the regulatory side. Due to general growth of the industry and increasing distance from shore, more personnel will be working offshore at the same time, which in turn will indispensable lead to higher safety requirements (Statoil, 2011). Being prepared for such future developments by appropriate personnel planning and personnel development measures can mitigate difficulties for companies engaged in the Offshore Wind Industry. A further approach for companies could be an increased cooperation and communication between all engaged companies of one Offshore Wind Project consortium. Necessarily, due to the dipolar character of the industry, many companies have to work together in order to realise Offshore Wind Parks and therefore a broad pooled and concentrated knowledge and expertise is already present on the business level.

A driving force in innovative industries has changed from concealment of knowledge towards sharing and networking in order to tackle challenges from progressive globalization (Joe Tidd, 2004, p. 52). This aspect is highly relevant in the Offshore Wind Industry with its innovative character and involvement of companies with different national backgrounds.

Making use of and sharing these backgrounds with local specific expertise can be effective measures in order to overcome regulatory barriers and ensuring legal compliance within the European Union.

The planned installation of HVDC transmission platforms by Siemens and therefore a transfer of knowledge and established systems from Germany to Great Britain was already described in chapter 4.3. At this point specific related issues shall be outlined in order to understand possibilities and difficulties related to this project. The intention should be not having to start from the beginning but making use of grown expertise and experience from already established HVDC platforms in the German *Exclusive Economic Zone*. Delivery of HVDC transmission platforms is a project business, which is characterised by phases of high and low workload and manpower

requirements. Between delivery of one platform and starting of a new project, idle phases are present. Instead of coping these challenges by a high amount of personnel leasing, a culture that promotes *employee mobility* could be created. Two advantages would directly result for *Siemens* if employees are encouraged and therefore willing to work in other countries (in this case Great Britain) for a certain time; firstly, already build up expertise can benefit to new projects and therefore synergy effects can arise. Secondly, by the principle of personnel leasing, company own expertise, knowledge and experience is given away to some extent as leased personnel is leaving and joining competitors after finishing one project. This principle should be realised vice versa from Great Britain to Germany. Exchange of knowledge from two jurisdictions but within one corporate environment preserves knowledge and at the same time creates synergy effects from two different regulated industry fields. By applying such principle, significant competitive advantages for successful entries of additional markets like France may arise. The aspect is further discussed in chapter 5.4. After the so far discussed general issues and an integrated recommendation for general activity in the Offshore Wind Industry of the *Siemens AG*, following an approach to the concrete case of implementing Fire Protection Concepts in both jurisdictions is discussed, including further recommendation for process improvement.

The issue of a missing link between Classification Societies and authorities like the trade supervisory board and professional associations was already discussed in chapters 5.1 and 5.2. Intensified communication and exchange of information was recommended in order to consider and include additional requirements in the classification guidelines and publications. In the specific case of Fire Protection Concepts, such approach could be extended to the very initial level of development on the industrial side. Concepts developed first internally within the *Siemens* cooperation should consider the respective jurisdiction and therefore additional involved authorities. By such approach, several revisions and needed amendments could be minimised. Also costs for consultancy service and certification by Classification Societies can be decreased, as a mature concept will produce less workload when submitted.

As mentioned before, in Germany, additional requirements are demanded by the trade supervisory board and professional associations. In Great Britain, even less influence by the public side is present, still specific and detailed national particularities may be present which should be considered. Beneath the major player *Crown Estate*, such requirements may arise from the *Department for Environment, Food and Rural Affairs* and the *Department for Trade and Industry* as briefly described in chapter 3.6.2.2.

Two preconditions are important for realising such early consideration of all national legal aspects in the development of Fire Protection Concepts. Firstly, as already mentioned, an exchange of knowledge and information inside the *Siemens* cooperation between Germany and Great Britain must be established. Secondly, the initiations of networks and associations with comprehensive participation of all involved parties in the Offshore Wind Industry form an effective instrument for ensuring information exchange. The *Offshore Wind Energy Foundation* (orig. *Stiftung Offshore Windenergie*), forms a good example of such method. However, by combining the industry generally and trying to cover all fields of the industry, important detailed aspects may be skipped or missed. Therefore such systems should be established also on several single specific levels. A network or association only responsible for single sub-sections such as Fire Protection may result in a more effective discussion and therefore higher benefit for all concerned parties. Bringing together experts from different stakeholder groups, but responsible for the same issue (in this example Fire Protection), is essential for functioning of such networks. Public regulation bodies, Classification Societies, manufacturers and operators of Offshore Wind Parks, as well as representatives from secondary supporting industries such as shipping and transport, surveillance, HSE consultants (Health, Safety, Environment) and medical emergency and rescue companies should be united in networks and associations in order to generate and share knowledge and considering mutual demands of the specific and complex topic of Fire Protection in the Offshore Wind Industry.

### 5.3 Learning from the Global Shipping Industry

The aspect of comparability of Shipping and Offshore Wind was mentioned already at various points of this thesis. The present chapter shall discuss this issue more in detail, giving specific examples and evaluating the different extent of similarities in Germany and Great Britain.

As the topic of certification is equally relevant in the Shipping Industry and the Offshore Wind Industry, obviously many companies cover both areas and could use experience from shipping for establishing procedures in the Offshore Wind Industry.

The Global Shipping Industry, in regard to safety and quality standards, is regulated mainly by two systems, respectively institutions; the Flag State and the particular classification society. Their acting is closely intertwined, however both systems concentrate on two different areas, each highly relevant for safe shipping. Whereas the Classification Societies' work is focused on the technical issues, the flagstate handles all legal aspects and at the same time authorizes Classification Societies to act on behalf of them. This proven system has grown over centuries, with the first classification society formed in London in 1760 (IACS Limited, 2015, p. 5).

Against this background, it is more than conceivable, that the Offshore Wind Industry with only several years of experience and its commercial starting in Denmark by the end of the 1990's (Hau, 2014, p. 758), has by far not reached an equivalent level of practice. Observing the status quo of the Global Shipping Industry and the Offshore Wind Industry, several similarities regarding responsibility and involvement of public and private bodies can be detected; Classification Societies basically serve the same function in both industries and also the flagstate, which can be understood as a synonym for a specific agency in the particular country where a ship is registered, is the same body that is also responsible for regulating the Offshore Wind Industry. This mainly applies to Germany, where the *Federal Maritime and Hydrographic Agency* is the executing body of the flagstate and at the same time responsible for approval of Offshore Wind Projects in the German *Exclusive Economic Zone*.

However, in the Offshore Wind Industry, responsibilities are not limited to these two institutions and in both countries, Germany and Great Britain, many more public agencies are decisively engaged in controlling Offshore Wind Projects. In the field of approval, in Germany the *trade supervisory board* and *professional associations* have the legal power to set up own requirements (compare chapter 3.6.1.6 and 5.1). Furthermore certification activities are not limited to Classification Societies but are divided between many competitors, all with different approaches and backgrounds.

In Great Britain a similar situation is present, even the public side acts more reserved (compare chapters 3.2.2 and 3.6.4). The *Crown Estate*, the *Department of Trade and Industry*, the *Department of Environment, Food and Rural Affairs* and the *Department for Transport*, all are involved in the process of approval even if only formal as explained in chapter 3.2.2. A detailed explanation of responsibilities of single British authorities can be found in chapter 3.6.2.2.

Coming back to the initial point of what could be learned, surely a more transparent situation is present in the Global Shipping Industry where responsibilities are more centralised to the two systems of Flag States and Classification Societies. The Offshore Wind Industry as a whole and especially producing- and operating companies surely would benefit from a similar development with less involved bodies and a clear division of responsibilities as well as a centralisation of approval accountabilities to just one authority.

#### **5.4 Potential Business Activity for the Siemens AG in France (disguised)**

*Text has been removed due to copyright reasons.*

## **6 Summary**

Present initial situation in the European Offshore Wind Industry is characterised by mutual alignment on energy supply policies and harmonised climate targets in regard to reduction of CO<sub>2</sub> emissions. In contradiction thereof, significant distinctions in regard to legal frameworks for

realisation and implementation are present. Due to actual enormous growth and public promotion of the industry in several European Union Member States, a further expansion can be concluded. This is reinforced by the fact, that governments as well as independent research organisations consider the Offshore Wind Industry being indispensable for reaching the ambitious European Union climate targets. Against this background, companies engaged transnationally in the industry demand legal certainty in order to be capable to realise the set targets.

Here they face several problems, namely lack of pan-European harmonization requirements for certification and approval procedures in European Union Member States and an unclear market for certification services. Furthermore, the general assessment of the Offshore Wind Industry from the public side differs in Europe. Where some jurisdictions see the industry closely located and characterised to the Global Shipping Industry, other countries try to approach this new area by applying rules and standards originally raised from the Onshore Wind Industry.

Obviously this result in further uncertainties for companies engaged in numerous European jurisdictions. Tangible plans of the company *Siemens* to transfer already implemented systems from one jurisdiction to another formed further legitimation for the present thesis.

By approaching the above mentioned several aspects from an integrated view, the present work tried to cover a wide range of issues related to legal requirements and obligation for certification and approval. However, to demonstrate the topic on a specific and concrete example and to please special demands of the company *Siemens*, Wind Power Offshore Substations, necessary for transformation of Alternating Current to Direct Current before transportation to shore, served as one specific field of the industry where the topic of legal requirements for certification and approval processes is highly relevant.

Results of the present thesis can be summarized as follows: even in some areas a certain progress on unification of legal requirements on European Union level is present, many uncertainties exist, especially due to different characterization of the industry.

Further, the present thesis showed up that due to rapid growth of the industry, public authorities are not capable to catch up and to cover all fields that require regulation and control measurements.

This in turn leads to the fact that guidelines and standards rise from the industry itself. The process is accompanied by numerous companies entered the market of certification procedures. Besides the traditional responsible Classification Societies, other companies, originated in land based industries, started offering certification services for the Offshore Wind Industry.

The aspect of endangered independency due to a strong competitive market and the development of certification services as a market orientated system are further discussed issues. In addition, uncertainties for companies relying on certification services are present, as certification follows not a harmonised standard but depends on the respective background of each company. The phenomenon continues on the state level, where not a single authority is responsible, but instead several agencies or public bodies are involved. Surely, this is linked to the dipolar character of the industry somewhere between land and sea.

Subsequent to this general consideration, the situation in Germany and Great Britain in regard to above mentioned problems was evaluated. Results thereof can be summarised as follows; whereas in Great Britain the public side acts more passively and is mainly responsible only for determination of sea areas for Offshore Wind installations, the technical expertise and responsibility for ensuring compliance of minimum standards is passed to the Classification Societies. Insurance companies gained a powerful regulatory position, as their requirements determine whether a project is insurable, which in turn forms the prerequisite for pushing an Offshore Wind Park into realisation phase.

On the other hand, in Germany, the public side and especially the *Federal Maritime and Hydrographic Agency*, are more directly involved in the process of regulating the Offshore Wind Industry. This is shown for instance by own published guidelines and specific technical provisions for construction and operation of Offshore Wind Farms, which cannot be found to such extent in Great Britain.

Additionally a clear missing link between public authorities and certification bodies was indicated. This applies especially to Classification Societies. Originated in the Global Shipping Industry, they are used to cooperation with only one authority, namely the respective flagstate. By reviewing and comparing the well-established and long-time grown Global Shipping Industry, it was further demonstrated to what extent the relatively young industry of Offshore Wind is lacking standards and procedures in terms of certification and approval for new initialised projects.

A recommendation for a development that is culminating in a pan-European regulation agency, similar to the *International Maritime Organisation* for the Global Shipping Industry was expressed. Especially in regard to further expansion and growing distance to shore of Offshore Wind Farms in European Union Member States, an integrated and effective pan-European control mechanism seems reasonable.

For companies engaged transnationally in the Offshore Wind Industry, certain action measures can be applied independently from political and regulatory developments on the European Level. Instead of just responding to imposed statutory requirements from the regulatory side, companies themselves can counteract and therefore improve processes in the field of certification and approval. Here the aspect of networking and sharing knowledge rather than concealment was expressed in order to cope with today's challenges in a progressive globalised world economy. From a company's view, and in particular from *Siemens'* perspective, the recommended action for transferring HVDC systems from Germany to Great Britain and for a successful market entry in France can be summarised as follows; sharing and transferring expertise from the two different regulated Offshore Wind markets Germany and Great Britain could be an effective measure to handle and react to not yet fully established regulatory systems on the French Offshore Wind market. In particular, experience and knowledge, generated corporate-internally by Siemens on an insurance dominated market in Great Britain and a highly publicly regulated market in Germany should be bundled in order to establish synergy effects that can be used for competitive advantages in case of a successful market entry in France.

Additionally, build up employee expertise should be preserved by minimising personnel leasing and instead encourage employee mobility during times of fluctuating workload.

In general, the French market offers a certain field for business activity due to lack of national experience in the Offshore Wind Industry. Chances should be increased by strategically pronounced cooperation with French key players such as Bureau Veritas.

Leading research institutions anticipate a further growth of the Offshore Wind Industry (compare chapter 2.1), which will open up opportunities on existing and also new markets. The demonstrated results and aspects in the present study therefore shall provide an integrated guidance and approach to the topic of transnational certification and approval processes in different jurisdictions of the Offshore Wind Industry in European Union Member States.

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### **Versicherung**

Ich versichere hiermit, dass ich die vorliegende Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

Bremen, den 26. Juli 2015

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(Philippe Badel)