



# Offshore Wind Cost Reduction Pathways

Health & Safety Review, PMSS

May 2012



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## Abbreviations

APS	Association of Project Safety
CAA	Civil Aviation Authority
EWEA	European Wind Energy Association
G9	G9 Offshore Wind Health and Safety Association Limited
HSE	Health & Safety Executive
MCA	Maritime and Coastguard Agency
MW	Megawatt
OEM	Original Equipment Manufacturer
PMSS	Project Management Support Services Limited
RIBA	Royal Institute of British Architects
PPE	Personal Protective Equipment
R-UK	Renewables UK
SCADA	Supervisory Control And Data Acquisition
TCE	The Crown Estate

## 1. Introduction & Methodology

The Crown Estate, as part of the overall aim of de-risking the delivery of offshore wind in the UK, wishes to ensure that health and safety considerations are identified as part of the cost reduction pathway study.

All 3 work streams (Supply chain, Technology and Finance) contain subject matter that could directly or indirectly impact on health and safety.

There are three main health and safety considerations articulated for protecting people explicit to the Project Charter.

1 – “Seeking to eliminate health and safety risks as well as reducing costs”

2 – “Assessing the potential health and safety performance of the cost reduction pathways, with a view to ensuring neutral or positive impact”

3 – Considering the potential cost implications of mitigation measures required to ensure a neutral or positive impact on health and safety performance in the cost reduction pathways identified”

The Crown Estate stated expectations in respect of the cost reduction work stream consultant’s engagement with industry and their outputs from the analysis were:

- Clear demonstration of risk reduction or risk neutrality for any given proposal. i.e. that risks and risk reduction measures are clearly articulated, quantified and ranked for the benchmark and work stream proposals respectively.
- Issues will be considered contemporaneously with work stream subject matter.
- Risk exposure and mitigation will be demonstrated qualitatively and quantitatively where possible.
- Subject matter and explanations articulated within project output content.
- Conclusions deal only with differential aspects and that background papers articulate comparisons with benchmarks e.g. fixed foundation such as a mono-pile benchmark compared to a floating foundation proposal.
- Life cycle consideration.

The following list gives examples of indicators that are considered positive in reducing the exposure to risk. The list is not exhaustive:

- Stepping up through hierarchical design mitigation strategies (such as illustrated in the Construction (Design & Management) Regulations 2007 Designers Guide referenced below which contains a simple hierarchical list and information on Design Risk Management in practice).
- Intrinsic safety introduced.
- Reduction in exposure hours for a particular element of work.
- Reducing the frequency of offshore trips and / or offshore transfers.
- Reducing the frequency of any exposure to potentially hazardous activity.
- Reducing quantity of interfaces requiring positive management.
- Improving methodology to reduce number of operations.
- Improving methodology to reduce or eliminate man / machine interfaces.
- Increased prefabrication / maximising onshore activity (compared to equivalent offshore activities).
- Maximising remote operation offshore.
- Reduced utilisation of, or dependency upon emergency services.
- Integrated welfare arrangements.

- Improved ergonomics.
- Reducing dependency on training and experience – simplifying the activity or process.
- Simplifying construction and decommissioning activity.
- Harmonisation of standards and equipment with increased positive health and safety influence.
- Improved contract terms or vessel charter conditions that do not force accelerated working in the event of a schedule over-run.
- Timely implementation of robust health and safety assurance provisions within financing framework.
- Insurance provisions requiring health and safety assurance provisions within premiums.

Interviews were carried out with Utilities, Developers, OEMs, Contractors and Consultants. The interview minutes of meeting between work stream consultants and industry were reviewed specifically for HSE by PMSS during early February 2012, and the findings are provided where appropriate within these notes. A subsequent workshop was held on the 19<sup>th</sup> March 2012 with the purpose of pulling out the major items of specific HSE significance and proposing potential mitigation owners, as well as clarifying the process moving forward to ensure we can clearly identify the affect on health & safety of any cost reduction proposal.

## 2. Findings – February 2012

The objective of the evaluation exercise was to review the minutes of various meetings and determine that Project Charter requirements were respected, and specifically to determine if the implication of suggestions made, that reflect on industry performance in terms of HSE, are positive or neutral, and in the case of a negative outcomes that mitigations are provided.

The reports were analysed as far as unique topics existed, and those were abstracted and keywords summarised. The following table identifies the relevant HSE sensitive matters discovered from the process which have been scheduled according to the defined work stream. Where they fall outside a defined work stream a separate list was provided. Positive or neutral factors are in standard text, HSE negative matters are in *italics* with further discussion below the table. There are several obvious crossovers between pathways, these have not been exhaustively referenced, and the value from these statements will be the arising discussion. PMSS recommended that the majority of tabled subjects and PMSS contentions were considered against all pathways and defined by team consensus.

Technology	Supply Chain	Finance	Other
Standardisation.	Industrialisation.	Financial attractiveness.	Bundling; clustering; increasing site sizes.
Dedicated offshore.	Strengthen capabilities.	Incentives for supply chain.	Increased partnering.
<i>Larger turbine. (4)</i>	Mass produced jacket foundations.	Investment security.	Stable and predictable political environment.
<i>Increased weather windows. (2)</i>	<i>Increased competition. (1)</i>	Infrastructure investment.	Secured finance.
<i>Lack of validation of support structures / relaxation of design standards. (3)(8)</i>	<i>High growth – “evolution –v- revolution” (1)(9)</i>	<i>Certifiers over-selling advantages to banks: and banks not appreciating the risks. (5)</i>	<i>Lack of onshore test facilities. (9)</i>
“Design to include reliability case”	Motherships.	Stable market.	<i>Lack of onshore and offshore test sites. (9)</i>
Do better –v- bias toward continual innovation.	<i>Helicopters. (10)</i>		Improved surveys and survey coverage – eliminate survey duplication or crossover.
Direct drive – simpler and more robust.	External consultants to improve (HSE) at company level –v- project level.		<i>Component handling constraints. (7)</i>
Plug & play.	Modularisation.		<i>Lack of experience transfer from project to project. (6)</i>
Incremental growth – no big steps.	Sufficient quayside space.		6 sigma processes.
Accelerated life-time testing.	No diver intervention.		HSE is critical.
24/7 working	Better SCADA – remote operation.		Transparency in application of HSE in UK.
Condition monitoring.	Lack of sharing between Scotland and England.		Keep everything simple.
The right tools.			Risk placed where it is best managed.
			Nothing should impact health & safety negatively.
			Everything will be safe!



The following list cross references with the (*bracketed numbers*) in the above table and articulates the contentions developed:-

1 – Requirement for increased competition will attract inexperienced companies and operatives. Whilst companies may be technically competent in their chosen general markets, long term experience in offshore wind will not exist. The right solutions are sometimes derived from long term learning. The negative impact from an HSE perspective is inadequate consideration of HSE in technology designs, insufficient appraisal / training of new entrant companies and consequently vulnerable operatives.

2 – The aspiration to increase the operational weather window brings challenges of access methodologies, vessel endurance and robustness and the operational limits to emergency response.

3 – Lack of validation of support structures – suggesting that a “safe place of work” is potentially compromised by structural inadequacy.

4 – Confidence in technology providers getting it right first time e.g. next generation 6 - 7MW turbines – leading to HSE issues within technology hardware and operation. This is considered particularly true when there are no precedents either from wind industry or outside (i.e. difference between evolutionary design versus paradigm shift).

5 – Certifiers over-selling the value to banks – banks accepting and not testing / verifying investment decisions in sufficient depth – resulting in unsafe equipment / situations.

6 – Lack of experience transfer from project to project – continued re-learning – repeated mistakes.

7 – Component handling constraints – risk of installation equipment being used too close to operational limits – caps the size of technology?

8 – Issue revolving around modification (or adaptation) of current standards to be more appropriate for offshore wind farms that could make structures more efficient and lighter? However the counter argument and risk would be that such modifications could lead to unknown long term performance issues and possible compromise a “safe place of work”

9 – Lack of test locations / sites, implying that technology & equipment may be deployed before fully tested / validated. It is considered that this is probably unlikely in the case of turbines but it is important to understand how new vessels and construction methodologies are tested before they are used on a live contract offshore.

10 – Issues revolving around welfare, accommodation and transportation – bringing welfare to the workplace; mother ships –v platforms, and the potential imported incident tolerance use of helicopters.

### 3. Workshop Outputs - March 2012

A workshop was held in London in March 2012 to test PMSS initial findings – a worksheet was designed to promote discussion of the subject matter identified, proposed place for best mitigation, a statement on impact, a suggestion on which work stream(s) should deal with the matter, and initial views on potential mitigations or investments.

The resulting tabular conclusions were as follows – noting that “-” indicators could be conversely stated, but again the value being in the discussion and more detailed analysis that would inevitably follow:

CONTENTION REQUIRING MITIGATION	+ / N / -	Tech'	Supply Chain	Finance
Secured finance - implying secure investment naturally leads to safer technology.	+			
Motherships as opposed to permanent offshore accommodation.	-			
Implication of 24/7 working – influence on accommodation, fatigue, working time directives, staffing levels and quantity of competent resource requirements in the industry.	-			
Helicopters - questioning the merits of tolerating imported accident record to OSW.	-			
High growth – “evolution –v- revolution” implying continuous innovative stretch leads to a less safe product.	+			
Increased competition - leading to requirement for competence standards definition and maintenance within the increased capacity of the supply chain.	-			
The right tools - focusing on elimination of diver activity by remote tools and long term health issues avoidance – for example manual handling, exposure to noise, substances and the like.	+			
Enhanced experience transfer from project to project.	+			
Standardisation - implying better attention to elements and interfaces - reducing HSE risk / exposure.	+			
External consultants to improve (HSE) at company level –v- project level. Systemisation of lessons learnt – recognizing experience aggregation and experience is not being fully tapped at corporate levels.	+			
“Design to include reliability case” - increased reliability = less visits = less exposure. Lack of validation of support structures / modification of design standards. Certifiers over-selling advantages to banks: and banks not appreciating the risks. Certification does not explicitly deal with HSE. Benefits of robust Design Risk Management process.	+			
Accelerated life-time testing.	+			
Lack of offshore test sites.	-			
Partnering - vertical collaboration = safe HSE.	+			
Improved surveys and survey coverage – eliminate survey duplication or crossover.	+			
Manufacture larger turbine - implying risk that more smaller turbines exacerbates exposure to activity that has a risk; the mitigating factor being to reduce exposure hours offshore	+			
No diver intervention – low tolerance of imported known risk from other offshore industries.	+			
Increased weather windows – Emergency Response issues.	-			
Lack of sharing /harmonisation internationally - implying fragmentation and lack of communication / coordination of effort.	-			
Lack of transparency in application of HSE in UK – discussing the perceived complexity and “black-box” nature of the application of HSE – the fear of criminal action and the apparent “distancing” of senior management in European organization.				

Group Contentions arising from the workshop outputs table – “The 10”

- 1 – We need to systematically evaluate if the offshore wind industry should tolerate imported risk from industries perceived as related – most specifically the use of helicopters and acceptance of diving operations versus the development of fast transfer vessels and bespoke tools that eliminate the need for divers. Simple acceptance of known mortality / accidents rates provides immediate negative HSE impact.
- 2 – We need to compare the mothership concept against permanent offshore accommodation structures considering remote working living conditions. Also, experienced mariners continually express the risk of extreme low probability – high impact metocean events. This should be tested scientifically to establish if this could lead to an offshore wind disaster within the period of study.
- 3 – We need clear evaluation of the Implication of, and increase in 24/7 working – the influence on accommodation, fatigue, working time directives, staffing levels and quantity of competent resource requirements in the industry to facilitate this. Night working without robust mitigation yields HSE negative implications.
- 4 - A call for increasing weather windows for working brings a question of emergency response capability and potentially negative HSE impact.
- 5 – Safety in Design is identified as a key recurring theme – call for designs to include reliability cases –calls for validation of support structures / modification of design standards. A concern over certifiers over-selling advantages to banks and banks not appreciating the HSE risks with what they are funding - certification does not explicitly deal with HSE. The benefits of robust Design Risk Management processes should be extolled.
- 6 – Pace and endurance of innovation “never ending” new technology and “big-steps” as opposed to evolution leads to increased HSE exposure. Question – should the pace be controlled?
- 7 – Increased competition will attract a wider audience and thereby import inexperienced contributions leading to elevated exposure. This implies a robust competence gateway is required for organizations and individuals if neutral or positive HSE is to be maintained.
- 8 – Knowledge capture and industry wide learning is not currently seen as sufficient, or successful in reducing risk and exposure. Extensive experience and knowledge lies at project level and within consultant organisations, and is either inadequate or missing at corporate level. It is believed that fuller engagement should be fostered at corporate level so intelligence is spread initially across project portfolios with a view to full international knowledge sharing. This is viewed as HSE neutral, but a lost opportunity. An issue of lack of transparency and “fear” of UK HSE Regulations and consequences partly fuels this within European organisations operating in UK offshore wind. Encouraging partnering and enhancing vertical collaborations are seen as areas to evaluate and promote.
- 9 – With respect to finance we need to visibly acknowledge that secure investment sources will naturally lead to earlier investment and HSE risk mitigation.
- 10 – Apparently obvious HSE benefits need to be objectively stated and tested – the subject matters identified in this category such as standardisation, accelerated life time testing, more test sites made available earlier, coordinated surveys.

## 4. Risk Mitigation & Ownership

Mitigation holders were not covered in the workshop but it is considered necessary to find a “home” for each one and to flag up where there are either no bodies looking at or responsible or where there are multiple agencies with potential for confusion and no clear line of responsibility – the following table contains known information and makes suggestions on potential action parties that could be approached:-

REF	CONTENTION	KNOWN ACTION PARTIES	NOTES	SUGGESTED FURTHER ACTION PARTIES	NOTES
1	We need to systematically evaluate if the offshore wind industry should tolerate imported risk from industries perceived as related – most specifically the use of helicopters and acceptance of diving operations versus the development of fast transfer vessels and bespoke tools that eliminate the need for divers. Simple acceptance of known mortality / accidents rates provides immediate negative HSE impact.	TCE  R-UK	Report on use of helicopters.  Update HSE guidelines in progress	G9  HSE  CAA  MCA	
2	We need to compare the acceptability of the mothership concept against permanent offshore accommodation structures considering working and welfare arrangements for extended periods. Also interlinked, experienced mariners continually express the risk of extreme low probability metocean events, and the dependence upon the masters experience to get through.	R-UK  TCE	Update HSE guidelines in progress  Reports on low probability / high impact lessons from other industries	G9 HSE MCA	
3	We need clear evaluation of the Implication of, and increase in 24/7 working – the influence on accommodation, fatigue, working time directives, staffing levels and quantity of competent resource requirements in the industry to facilitate this. Night working without robust mitigation yields HSE negative implications.	R-UK	Update HSE guidelines in progress	G9 HSE	

4	A call for increasing weather windows for working brings a question of emergency response capability and potentially negative HSE impact.	R-UK	Update HSE guidelines in progress	G9 HSE MCA CAA	
5	Safety in Design is identified as a key recurring theme – call for designs to include reliability cases –calls for validation of support structures / modification of design standards. A concern over certifiers over-selling advantages to banks and banks not appreciating the HSE risks with what they are funding - certification does not explicitly deal with HSE. The benefits of robust Design Risk Management processes should be extolled.	R-UK	Update HSE guidelines in progress	G9 HSE Association for Project Safety	
6	Pace and endurance of innovation “never ending” new technology and “big-steps” as opposed to evolution leads to increased HSE exposure. Question – should the pace be controlled?	R-UK		G9	
7	Increased competition will attract a wider audience and thereby import inexperienced contributions leading to elevated exposure. This implies a robust competence gateway is required for organisations and individuals if neutral or positive HSE is to be maintained.	R-UK	Update HSE guidelines in progress	G9 HSE	
8	Knowledge capture and industry wide learning is not currently seen as sufficient, or successful in reducing risk and exposure. Extensive experience and knowledge lies at project level and within consultant organisations, and is either inadequate or missing at corporate level. It is believed that fuller engagement should be fostered at corporate level so intelligence is spread initially across project portfolios with a view to full international knowledge sharing. This is viewed as HSE neutral, but a lost opportunity. An issue of lack of transparency and “fear” of UK HSE Regulations and consequences partly fuels this within European organisations operating in UK offshore wind. Encouraging partnering and enhancing vertical collaborations are seen as areas to evaluate and promote.	TCE R-UK	Update HSE guidelines in progress	G9 EWEA	
9	With respect to finance we need to visibly acknowledge that secure investment sources will naturally lead to earlier investment and HSE risk mitigation.			G9	
10	Apparently obvious HSE benefits need to be objectively stated and tested – the subject matters identified in this category and standardisation, accelerated life time testing, more test sites made available earlier, coordinated surveys.	R-UK	Update HSE guidelines in progress	G9	

## 5. Conclusions

The initial review of questionnaire returns gave a good spread of suggestions and subject matter for consideration. Most of the aspirations, if implemented were positive in nature from an HSE perspective.

A vision has been expressed in many of the returns which are aspirations for the industry to out-perform other offshore industries – sample of such are “HSE is critical” and “Nothing should impact on health and safety negatively”

Emerging themes have been identified that require active review and mitigation – in broad headings these are:-

- Tolerability of imported risks such as use of helicopters and extensive diving operations.
- Assessment of low probability, high impact events such as extremely severe weather.
- People issues that impact on design such as 24/7 working, appropriate and safe welfare facilities.
- Pressures on technology such as increased accessibility requirements – including possible impact on emergency response capabilities; also the pace of growth of components and how that impacts on vessels and installation methodology.
- Growth issues relating to competence and resources of companies and individuals entering the industry.
- Knowledge capture, sharing and learning lessons – including collaborative survey data.
- Clarity on application of UK HSE Law – linked to robust HSE knowledge and understanding at corporate level.
- The understanding and acknowledgement that secure finance will result in earlier investment in HSE related matters.

Much is already being done to address HSE issues in the industry. Renewables UK are pursuing an industry wide accord & updating HSE Guidelines focusing on offshore; G9 have issued a statement explaining how they will move ahead in tackling HSE related risks; TCE have carried out several specific studies and commissioned guidance; MCA are looking at small vessel classification and APS have issued guidance on design risk management. However, to our current knowledge the more philosophical questions posed above are not being addressed directly.

We conclude that the way forward is to foster discussion and ownership specifically around these topics now and to watch health and safety matters through the cost reduction “decade” by clearly establishing health and safety impacts on any suggested cost mitigation – going back to the basic principles outlined in TCE paper “The Crown Estate - Offshore Wind Cost Reduction Pathway Development – health & safety guidance note” (\*) If these principles and disciplines are followed we will be able to identify both benefits and threats where mitigations will be required in HSE terms against all cost reduction proposals.

To facilitate discussion and derive action plans against the matters raised in this paper, it is suggested that a workshop be held, facilitated by R-UK.

## 6. References

- The Crown Estate - Offshore Wind Cost Reduction Pathway Development – Analysis Tender Document – dated 29th July 2011.
- The Crown Estate – Project Charter – Offshore Wind Cost Reduction Pathway Development – Version 6 - Dated 29th July 2011.
- (\*)The Crown Estate - Offshore Wind Cost Reduction Pathway Development – PMSS health & safety guidance note – dated 2<sup>nd</sup> September 2011.
- The Crown Estate - Offshore Wind Cost Reduction Pathway Development – PMSS health & safety report – dated 6<sup>th</sup> February 2012.
- The Construction (Design and Management) Regulations; 2007 and Approved Code of Practice.
- Designers Guide to Design Risk Management as published by APS and RIBA.
- Renewables-UK Health and Safety Guidelines – 2010.
- Renewables-UK Health and Safety Guidelines for the Marine Energy Industry.
- Renewables-UK Supplementary Health and Safety Guidelines for training, wind turbine safety rules, PPE, jack-ups, switchgear, lifts and medical fitness.

## 7. Appendices

The Crown Estate - Offshore Wind Cost Reduction Pathway Development – PMSS health & safety guidance note – dated 2<sup>nd</sup> September 2011.

### 1.0 Introduction

The Crown Estate, as part of the overall aim of de-risking the delivery of offshore wind in the UK, wish to ensure that as part of the execution plan and subsequent appraisal process, health and safety considerations are clearly articulated and quantified, and differentially summarised against benchmarks in a consistent manner in the work stream.

It is required that robust and accurate health and safety differentials within any proposed pathway is presented with the project output as directed by the Integration Team Project Manager, recognising sensitivities, so that the workstream reports may be placed in the public domain without compromise or conflict, whilst maintaining the spirit of sharing across the industry.

It is recognised that all consultants chosen to deliver workstreams may not have specialist health and safety backgrounds, and this guidance is designed to go some way to explaining the intent of the programme and to suggest a simple and logical method of dealing with representation of health and safety matters in the workstream outputs.

### 2.0 Applicability

This guidance note applies to 3 workstreams as defined in the Project Charter namely “Technology”, “Supply Chain” and “Finance”. It is considered that all 3 workstreams contain subject matter that may directly or indirectly impact on health and safety.

Any questions or advice required during the delivery phase regarding health and safety matters, or interpretation of this guidance note please contact:- Mr Chris Lloyd, Round 3 Development Manager

### 3.0 Health and Safety within the Project Charter

There are three main health and safety considerations for protecting people articulated explicitly in the Project Charter.

#### 1 – “Seeking to eliminate health and safety risks as well as reducing costs”

The requirement of the programme is to reduce cost, but not to the detriment of safety. Risk elimination and reduction can be carried out in a number of ways during planning, design, construction operation and decommissioning. Elimination is simply doing away with an element or an activity and thereby completely taking away all associated health and safety risks. Reduction of risk can be done in many ways, and for guidance a list of examples of risk reduction indicators is given below.

#### 2 – “Assessing the potential health and safety performance of the cost reduction pathways, with a view to ensuring neutral or positive impact”

Cost reduction pathways may be complex and introduce or exacerbate as well as eliminate or reduce health and safety risk. The requirement for any given proposal is that health and safety risks for the cost reduction proposal are collected in a logical manner, rated, ranked and compared against a bench-mark. A logical process is required to enable factual representation, and therefore firstly a matrix to assess levels of risk into High, Medium and Low is provided. Secondly, a suggested template to tabulate and score aggregated risks is also provided. Definitions of negative, neutral and positive health and safety impacts are given below.

#### 3 – Considering the potential cost implications of mitigation measures required to ensure a neutral or positive impact on health and safety performance in the cost reduction pathways identified”



If supplementary measures or provisions are required in a cost reduction proposal to maintain a neutral or positive health and safety impact overall, then those requirements and costs should be defined and taken account of within the workstream outputs – both in terms of risk ratings / scoring and aggregated cost analyses, as far as is practical.

### 4.0 Definitions

- **Benchmark** Rationalised appraisal of an organisation, structure, product, methodology, time-line or piece of equipment that:-
  - 1 – Complies with UK health and safety legislation, ACoPs and Guidance.
  - 2 – Complies with UK Industry Best Practise.
  - 3 – Indicates that it of a good standard that could reasonably be expected in the offshore wind industry today at each of the reference sites.
- **CDM** Construction (Design and Management) Regulations; 2007.
- **DRA** Design Risk Assessment.
- **DRM** Design Risk Management
- **Life Cycle** Assembly, Transport, Construction, Operations and Decommissioning.
- **Negative Impacts** Increases the exposure to risk on balance.
- **Neutral Impacts** Neither increases nor decreases the exposure to risk on balance.
- **Positive Impacts** Decreases the exposure to risk on balance – demonstrated by one or more risk reduction indicators. (See below)
- **RAM** Risk Assessment Matrix.
- **Reference Sites** The 4 reference sites as detailed in Project Charter.

### 5.0 The Crown Estate Health and Safety Expectations in Respect of Work Stream Consultants Deliverables.

- Clear demonstration of risk reduction or risk neutrality for any given proposal. I.e. That risks and risk reduction measures are clearly articulated, quantified and ranked for the benchmark and work stream proposals respectively.
- Issues will be considered contemporaneously with work stream subject matter.
- Risk exposure and mitigation will be demonstrated qualitatively and quantitatively.
- Subject matter and explanations articulated within project output content.
- Conclusions deal only with differential aspects and that background papers articulate comparisons with benchmarks e.g. fixed foundation such as a mono-pile benchmark compared to a floating foundation proposal.
- Life cycle consideration.

### 6.0 Examples of Risk Reduction Indicators

The following list gives examples of indicators that are considered positive in reducing the exposure to risk. The list is not exhaustive:-

- Stepping up through hierarchical design mitigation strategies (such as illustrated in the CDM Designers Guide referenced below which contains a simple hierarchical list and information on DRM in practise).
- Intrinsic safety introduced.
- Reduction in exposure hours for a particular element of work.
- Reducing the frequency of offshore trips and / or offshore transfers.
- Reducing the frequency of any exposure to potentially hazardous activity.
- Reducing quantity of interfaces requiring positive management.
- Improving methodology to reduce number of operations.
- Improving methodology to reduce or eliminate man / machine interfaces.
- Increased prefabrication / maximising onshore activity.
- Maximising remote operation.

- Reduced dependency on emergency services.
- Integrated welfare arrangements.
- Improved ergonomics.
- Reducing dependency on training and experience – simplifying the activity or process.
- Simplifying construction and decommissioning activity.
- Harmonisation of standards and equipment with increased positive health and safety influence.
- Improved contract terms or vessel charter conditions that do not force accelerated working in the event of a schedule over-run.
- Timely implementation of robust health and safety assurance provisions within financing framework.
- Insurance provisions requiring health and safety assurance provisions within premiums.

### 7.0 Risk Assessment Matrix

Risks are to be graded High (H), Medium (M), or Low (L). The following simplified matrix illustrates The Crown Estate preferred criteria for definition of risk and allocation of grades.

Severity		Manageable	Moderate	Major	Serious	Critical	
<i>Health and Safety</i>		Minor injuries possible	Minor injuries (twisted ankle etc) OR Failure to comply with improvement notice.	More than minor injuries (hospitalisation) OR Failure to comply with prohibition notice.	Major injuries	Loss of life / permanent disability	
<i>Financial</i>		Minor under performance over a year	Minor under performance (3-5% total return) over a couple of years	Significant under performance (10%+) for a year OR Large (5-10% total return) under performance over two years	Significant (10%+) under performance for a couple of years OR Large (5% total return) under performance for many years	10% of total return or under performance over many years	
Likelihood		Level L▼S►	1	2	3	4	5
Never heard of in industry	Less than 10%	1	L	L	L	L	M
Has occurred in industry	Less than 25%	2	L	L	L	M	M
Has occurred in UK	25% - 50%	3	L	L	M	M	H
Happens several times per year in UK	50% +	4	L	M	M	H	H
Happens several times per year on a typical UK project	90% +	5	L	M	H	H	H

### 8.0 Quantitative Demonstration of Neutral or Positive health and safety

#### Impact.

The following is a suggestion of how the proposal could be represented (against a benchmark standard and reference site) in terms on demonstrating a neutral or positive (or negative) health and safety effect related as a differential to the proposal on balance. The Crown Estate appreciate that this level of detail is applicable in a straightforward manner to the Technology and significant aspects of the Supply Chain workstreams; the expectation being for the Consultant to demonstrate reasoning appropriate to the level of cost reduction. It is also appreciated that some elements of Supply Chain and most of Finance workstreams may not be able to quantify health and safety

risk in this manner; in these circumstances alternative methods of logically demonstrating health and safety neutrality or positivity may be proposed and agreed with the Project Manager.

Benchmark Risk Profile (A)		Risks Increased or Introduced (B)		Risks Decreased or Eliminated (C)		Proposal Risk Profile (D=A+B-C)		Differential Risk profile (A-D)	
"Benchmark"		"Proposal"							
Risk	Count	Risk	Count	Risk	Count	Risk	Count	Risk	Count
H		H		H		H		H	
M		M		M		M		M	
L		L		L		L		L	

Following review, the proposal is then scored by taking the sum of the counts of differential high risks x 3, medium risks x2, and low risks x 1.

The following as a sample of the calculation applied:-

Benchmark Risk Profile (A)		Risks Increased or Introduced (B)		Risks Decreased or Eliminated (C)		Proposal Risk Profile (D=A+B-C)		Differential Risk profile (A-D)	
e.g. Reference Technology		e.g. Proposed Technology							
Risk	Count	Risk	Count	Risk	Count	Risk	Count	Risk	Count
H	5	H	1	H	2	H	4	H	-1
M	10	M	2	M	3	M	9	M	-1
L	15	L	6	L	7	L	14	L	-1

Benchmark	= (5x3) + (10x2) + (15) = 50
Proposal	= (4x3) + ( 9x2) + (14) = 44
Differential	= (-1x3) + ( -1x2) + (-1) = -6

## 9.0 References

- The Crown Estate - Offshore Wind Cost Reduction Pathway Development – Analysis Tender Document – dated 29th July 2011.
- The Crown Estate – Project Charter – Offshore Wind Cost Reduction Pathway Development – Version 6 - Dated 29th July 2011.
- The Crown Estate – Offshore wind cost reduction pathway development- Integration of health and safety aspects
- The Construction (Design and Management) Regulations; 2007 and Approved Code of Practice.
- Designers Guide to Design Risk Management as published by APS and RIBA.
- Renewables-UK Health and Safety Guidelines – 2010.
- Renewables-UK Health and Safety Guidelines for the Marine Energy Industry.
- Renewables-UK Supplementary Health and Safety Guidelines for training, wind turbine safety rules, PPE, jack-ups, switchgear, lifts and medical fitness.

## Record of Changes

Rev #	Date	Description	Approved
A	2012-04-02	Formatting document	ALM
B			
C			
D			
E			
F			
G			
0	2012-05-03	Final Issue to TCE	AJC
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## Distribution List

#	Function Title	Company	Name (optional)
1		The Crown Estate	Adrian Fox
2			
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Notes:			

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