Safe Wind Farm Operation & Maintenance

Alan Chivers, CEO

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PMSS

Company Overview

- Global consulting firm, established in 1994 and working exclusively in renewable energy;
- Unparalleled depth of knowledge, experience and technical expertise in onshore and offshore wind, wave & tidal, biomass and solar;
- Our consultants are innovative and passionate about results, and go beyond standard solutions to help ensure business success for our clients.
- Offices throughout Europe, and recently announced the opening of our first US office
- PMSS has extensive global experience including the UK, Continental Europe, Asia, Africa, China, Japan, Australia and USA

Our Experience

In a nutshell…

zero

accidents

Accidents or lost time incidents in over 16 years of trading

90

percent

of UK's installed offshore wind capacity has had input from PMSS

1000

onshore wind projects

Successful onshore wind projects completed across 6 continents

40,000

megawatts

of offshore wind project experience throughout Europe, Asia-Pacific and North America

Wind Farm Operation & Maintenance

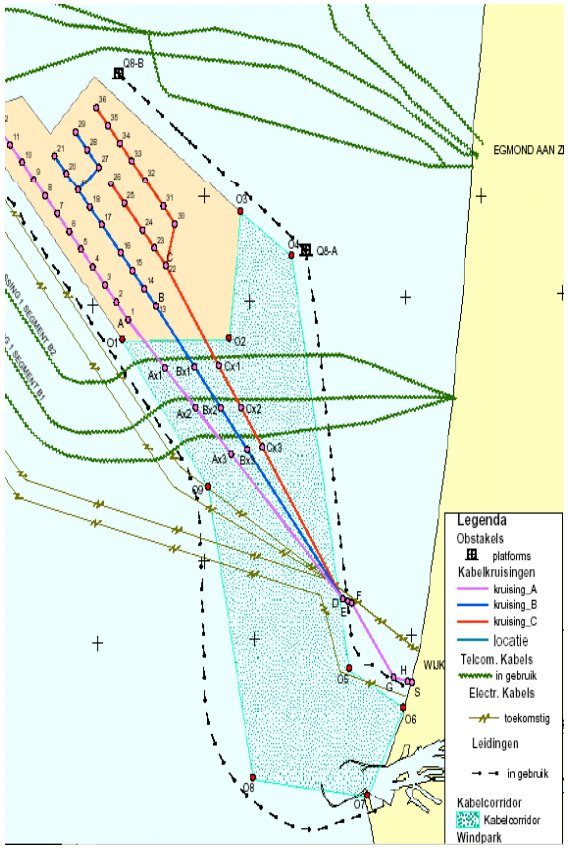
OWEZ - 6 years accident free

Purpose

- Document project background information
- Detail actions that have delivered an accident free record
  - Construction
  - Operations, maintenance
  - Major refit

Description & History of Project

- Offshore wind Farm Egmond aan Zee (OWEZ), The Netherlands, Northern Europe
  - Installed 108MW
  - 36 x Vestas V90 wind turbine generators
  - 70m hub height
  - 116m rotor diameter
  - 10 – 18km offshore
  - 16 – 20m water depth
  - 1 meteorological met mast 116m high



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Description & History of Project

Offshore Wind Farm Egmond aan Zee (OWEZ)

- Offshore demonstration project – supported by government
- Nordzeewind (NZW) as Client
- Vestas and Ballast Nedam (BCE) as PC and O&M
- PMSS HSE Managers

Comprises

- 36 x Vestas V90 WTG's
- Monopiles with internally grouted transition piece
- Scour protection
- 3 x 34 kV export cables to the shore
- 34/150 kV substation onshore
- Design life of the project is 20 years

Timeline

- Constructed in the period 2005 – 2006
- Operations commenced on the 1st January 2007
- 2009 & 2010 major remedial and refit work

Operations are ongoing (August 2011) with the good safety trend being maintained by continuous improvement initiatives

Getting Organised for Safety – “The Top Ten”

1. **Be clear on the contracting structure** i.e. who has the commercial influence.

2. **Be clear in project jurisdiction** as well as being clear on “zone of influence” from the start – preferably by defined locations / assets and coordinates.

3. **Value and permit** the proactive involvement of the Client where they have the appropriate expertise.
   Value and permit the expertise of the Contractor and ensure they have the appropriate expertise.

4. **Be clear on the regulatory framework** – it may not exist – agree how you will work, what rules you will apply with the regulator – get agreement – follow industry best practice.

Getting Organised for Safety – “The Top Ten”

5. Ensure all contributing teams have **strong leaders with a clear HSE focus.**

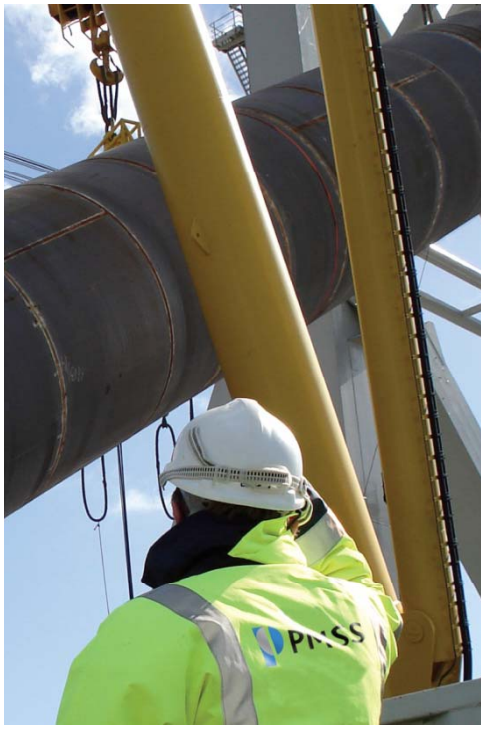
6. Ensure **adequate competence** (training + experience) &resources are available to the project at all times.

7. **Set clear goals.**

8. **Agree whose standards will prevail** in any given situation – map all documents and their primacy.

9. Establish **robust risk assessment** protocol based on ALARP - (As Low As Reasonable Practicable).

10. Make sure **all relevant documents are in place**, signed off and that the team knows them well. Discard anything that is too complex or too long to hold attention.



Competence & Resources

OWEZ benefits from accumulated experience and minimal personnel changes. Typical profiles of HSE critical staff:-

NZW Project MD	years in offshore operations
NZW Operations Manager	15 years wind energy 6 years offshore wind operations
NZW HSE Managers	Collectively 50 years offshore; including 15 years offshore wind.
BCE Operations Manager	6 years offshore wind operations.
BCE Site Manager	6 years offshore wind operations.
BCE HSE Manager	30 years offshore, including 8 years offshore wind.

The team also benefits from expert back-up from parent and advisory resources such as:

Shell, Nuon, Vattenfall, Vestas, Ballast-Nedam and PMSS.

Managing Change – Dealing with Remedial Work

Challenges

- Gearbox: partly reactive replacements; mostly pro-active replacement.
- Generators: small number of reactive replacements; most pro-active replacement.
- Blade replacement after lightning strike.
- Foundation: remedial work – solution to grouting – reactive.
- Cable re-burial – post construction.

Organisational Solution

- Treat remedial work as “construction projects” within the operational control framework.
- Ensure that important issues such as vessel adequacy, site access control, permits to work, electrical control & isolation were taken care of – business as usual.
- The O&M and Client team also proactively participate.
- BCE also took full coordination responsibility by executing the formal role of V&G (health & safety) coordinator under Dutch law.

Achieving “Accident Free” The Foundation

At the Highest Level

The project leaders must believe and be committed to putting safety at the top of the agenda and ensuring safety matters are embedded in project processes. Suitable budgets and time lines must be agreed and undue commercial pressures mitigated before they affect or unduly drive second tier management and subsequently the workforce.

From Everyone

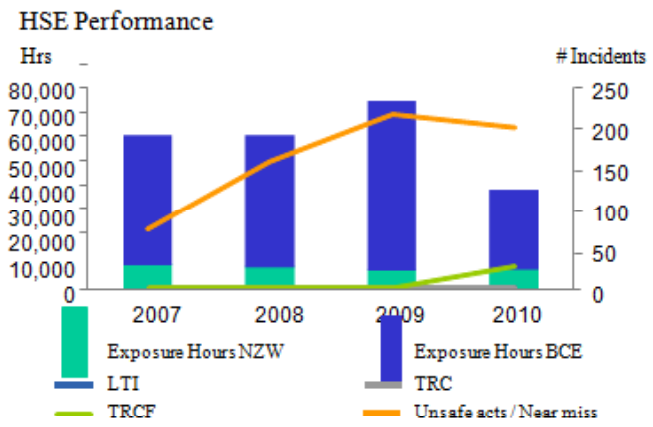
Awareness and commitment from all individuals is one of the most important keys to maintaining a safe working environment. This level of appreciation and respect needs constant ‘maintenance’ and real investment, for example in training, toolbox sessions, workshops, lessons learnt, diligence, cooperation & not forgetting recognition of good performance.

With strong leadership, raised awareness and commitment to safety from the whole team, the foundation stones are laid.

Statistics and Benchmarking

The following tables illustrate the principle figures allocable to the defined project noting that construction (2005 & 2006) had approximately 600,000 man hour's exposure and no serious accidents.

	2007	2008	2009	2010
Exposure Hours NZW	8,736	7,669	6,373	7,871
Exposure Hours BCE	51,809	52,916	67,553	35,971
Total Exposure Hours	**60,545**	**60,585**	**73,926**	**43,841**
LTI	0	0	0	0
Total Recordable Case (TRC)	0	0	0	1**
TRCF (Frequency)	0	0	0	23
Total HAZOBS	**74**	**157**	**216**	**247**



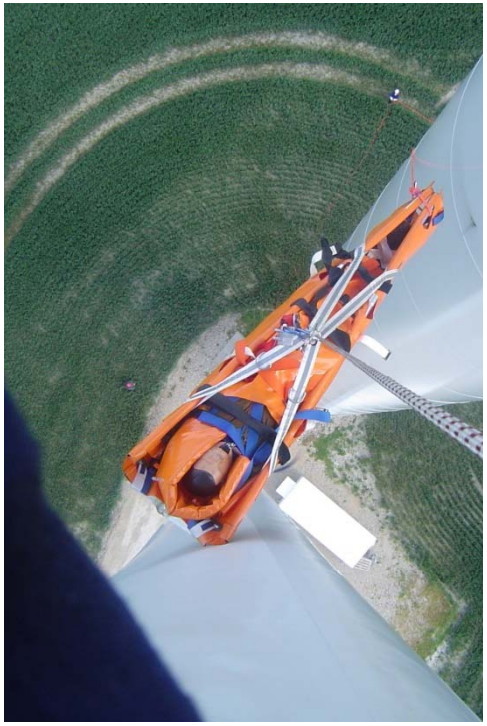
** Note:-
The one recordable case was actually an MTC (Medical Treatment Case) which required 3 stitches to a shin.

We have carried out several bench-marking exercises against other Northern European projects and concluded that the zero LTI is amongst the top performing projects since offshore wind started in earnest around 2000.

Hazardous Observations and Life Saving Rules

Bottom Up and Top Down

The project believes in a combined bottom-up (HAZOB) and Top-Down (RULES) approach is required – one way alone is not sufficient to achieve the desired safety record.



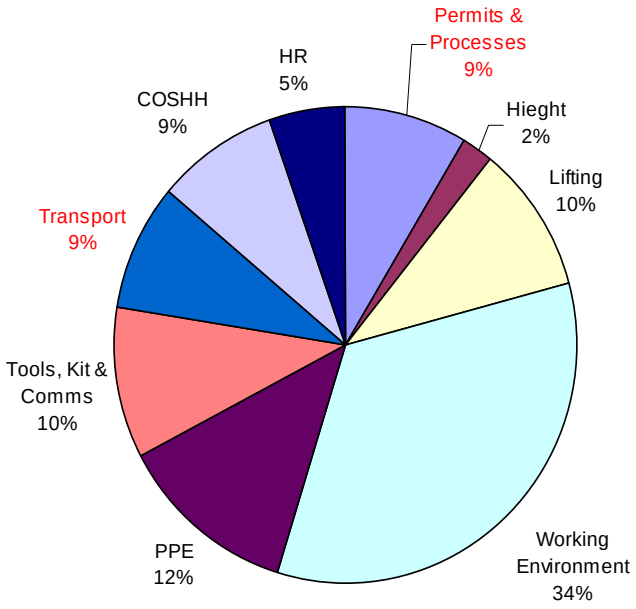
Life Saving Rules

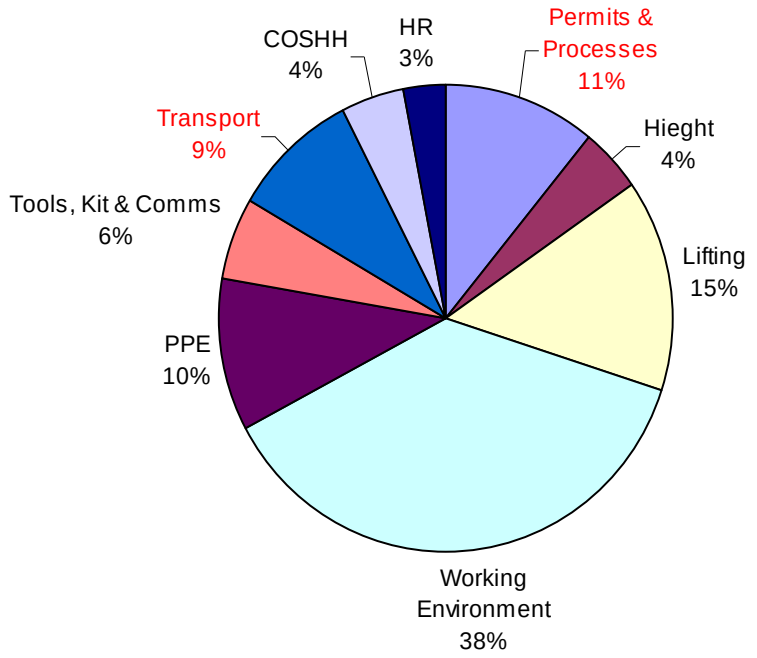
1. Confined spaces permits
2. Verifying isolations
3. Valid permits generally
4. Disarming safety equipment
5. Fall protection
6. Suspended loads – do not work under
7. Smoking / Alcohol / Drugs
8. Journey plan to be followed
9. No phone use whilst driving

Ranking Consequences

2009 and 2010 HAZOB records

Rated and ranked with potential consequences of not taking action where there were differentials and recurrences, or tangible links to life saving rules being violated - the derivative being where we have agreed action, and where resources are being applied.





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Agreed 2011 Focus Areas

Where our review of HAZOBs has led us ….

Working Environment	MARCH
Lifting / Manual Handling	JUNE
Permits & processes	SEPTEMBER
PPE & 2012 Focus	DECEMBER

Focus on Practical Improvements

Deliberate Action

The safety performance is good so far, but we must continue to focus on improvements, learning and improving from observations and incidents is key.

Investments in safety improvements must be made in hard cash and time.

Some of the initiatives at OWEZ:-

1. Tool container in each nacelle
2. Improved handrails
3. New winches
4. Wave radar

Philosphy

- Respectful dialogue
- Transparency
- “No Blame”
- Empowerment to “STOP”
- Positive Intervention
- It’s good to celebrate targets achieved, actions closed and quite simply good HSE attitude and performance.

It’s good to talk

Effective Meetings

Simple and consistent agendas support cooperation and alignment between Owner and Contractor.

Action based decisions tracked by a simple execution plan with defined responsible individuals and sensible deadlines have proven most effective.

Our standard agenda for the monthly HSE gatherings runs as follows:

1. Welcome
2. Items of immediate relevance arising from Hazardous Observations
3. Review of Action List
4. Focus topics – quarterly reviews, upcoming audits and inspections
5. Sharing lessons from outside the project
6. AOB & arrangements for next gathering

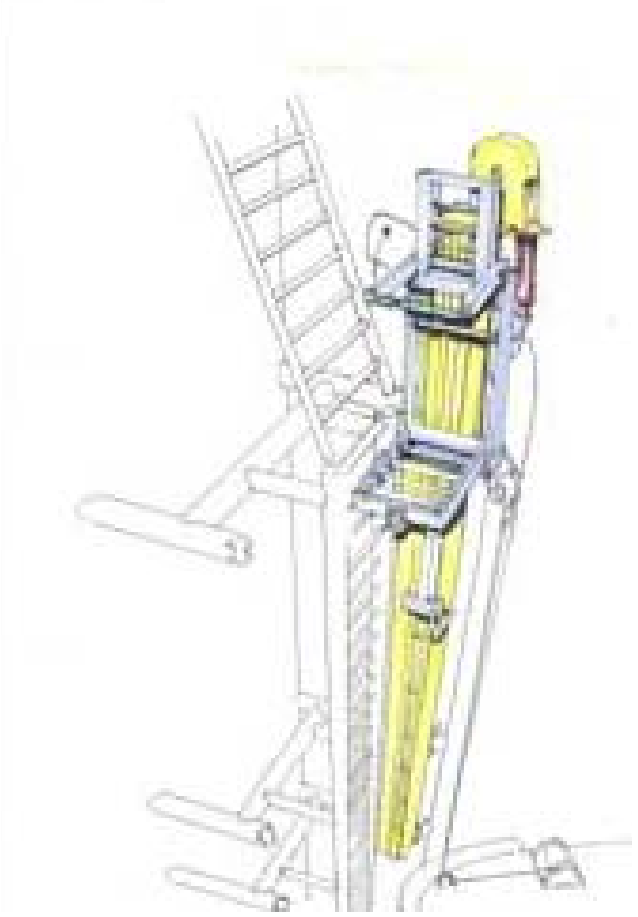
Further Continuous Improvement 2011-2012

Systematic

- OSHAS 18001 Compliance
- Taking best abstracts from Shell Group HSE & Marine
- Taking best practice from RenewableUK learning and initiatives
- Establishing cooperation with adjacent projects

Safe Step

- Planned trial in offshore wind farm in 2012



Conclusions after 6 years

The offshore wind working environment requires a different approach to HSE than onshore wind

1. We have the correct team structure and control mechanisms in place
2. The project has always put safety at #1
3. Communications are good and fully inclusive on all HSE matters
4. Good safety performance so far but we must continue to focus on continued improvements
5. Extensive scope can be dealt with if properly planned and controlled
6. OWEZ as Client, Bouw Combinatie Egmond (Vestas and Ballast Nedam) as Installation & Operations Contractors and PMSS as advisors have acted professionally in the execution of the scope of work and have reacted professionally to the many challenges faced
7. Trend is continually improving
8. We must give big thanks to our collective site team who are careful and dedicated – we have cause to celebrate
9. More sharing & cooperation is needed in the industry
10. We will not let our guard down

Acknowledgements

Nordzeewind (NZW) – Shell Wind Energy and Nuon

BCE Bouw Combinatie Egmond –Vestas and Ballast Nedam

Contact us

PMSS

Alan Chivers
CEO

+44 (0)1794 526 560
ajc@pmss.com