DOLPHYN HYDROGEN

Overcoming Safety and Regulatory Challenges in the Offshore Production of Hydrogen from Wind

HYDROGEN SAFETY CONFERENCE 2025

SEAN BAKER

Sustainability is our business

Agenda

1 Introductions
2 Dolphyn Hydrogen Overview
3 Regulatory Framework
4 Safety Philosophies
5 Key Activities Undertaken
6 Challenges & Lessons Learned

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Introductions

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Introductions

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ERM and Dolphyn Hydrogen

ERM is the largest global pure-play sustainability consultancy with over 8,000 experts working on sustainability challenges globally.

Hydrogen is at the core of ERM's expertise, and our hydrogen capabilities span the value chain.

Dolphyn Hydrogen is an independent business, created by ERM to commercialise the Dolphyn Technology Innovation and maximise contribution to a low carbon future.

ERM has proudly been developing Dolphyn since 2018, with funding from UK Government (e.g. DESNZ) and devolved governments in Scotland and Wales.

Dolphyn Hydrogen Overview

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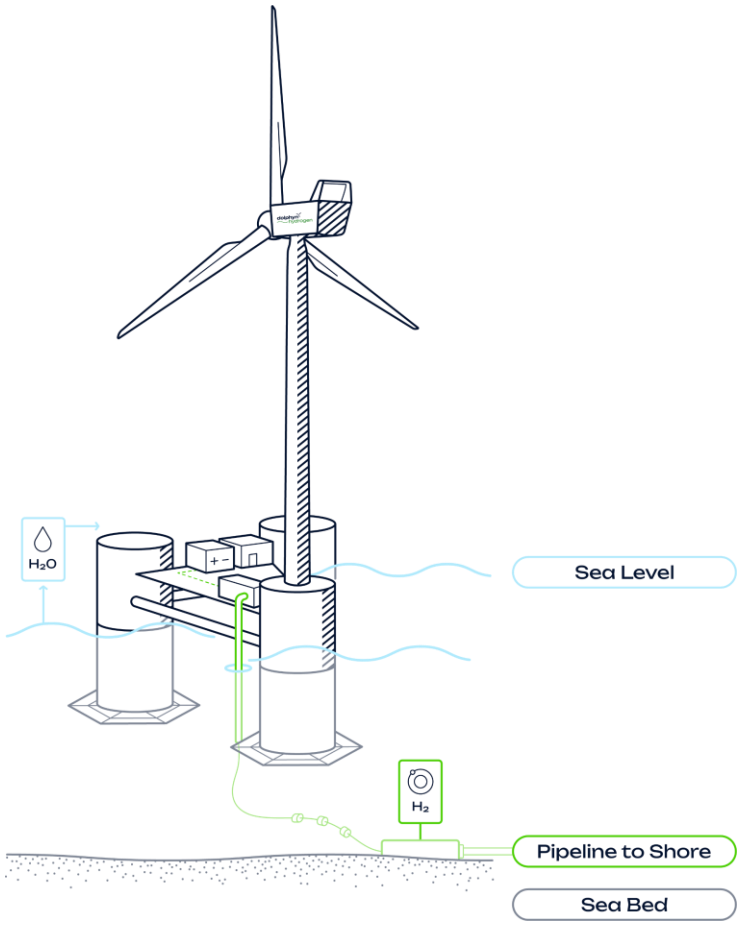
Technology overview

A new design to producing ultra low carbon hydrogen



DIRECT HYDROGEN GENERATION
No Grid Connection is required

6 YEARS OF TECHNOLOGICAL DEVELOPMENT
FEED completed and trials of key technologies

SCALABLE SOLUTION
incorporating a modular design, with best proven technologies

ENABLES WIND ENERGY EXPANSION
further offshore in high wind areas

BUILT TO SCALE
Producing green hydrogen at an economic cost

SAFETY FIRST
As always at ERM, we put safety at the centre of our Design

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Dolphyn Hydrogen

Deployment Phase	Operational from	Location	Hydrogen production rate (tons/year)
First offshore production of H_2 (~0.5 MW trials)	2024	META Milford Haven, Wales, UK	N/A
First Commercial Project (2 phases - 130MW)- T&D Site allocation	2026 -2030	UK Celtic Sea	~11,000
300 MW+ commercial scale developments (at least 3No.)	2028 -2032	UK, EU & Global	27,000+ per project
GW+ scale developments (at least 5No.)	2032 on	UK, EU & Global	>100,000+ per project

Full Scale Commercial Projects

Regulatory Framework

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Regulatory Framework

Legislation and best practice from various sectors

- Offshore Renewables
- Offshore Oil & Gas
- Onshore Oil & Gas
- Pipelines

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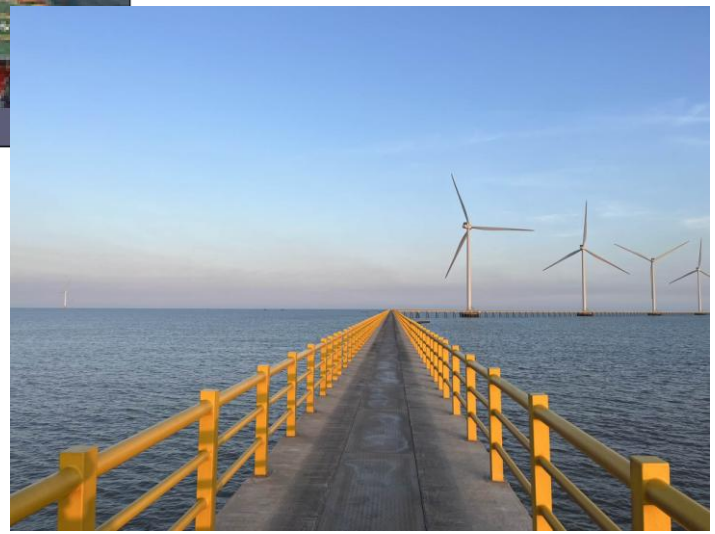
Key Challenges

The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015 (SCR 2015) apply to **oil and gas operations** in external waters.

"offshore oil and gas operations" means all activities associated with an installation relating to exploration and production of petroleum, including the design, planning, construction, operation and decommissioning of the installation, but excluding the conveyance of petroleum from one coast to another;

"production installation" means an installation which –

(a) extracts petroleum from beneath the seabed by means of a well; or
(b) is used for the conveyance of petroleum by means of a pipe,



Safety Philosophy

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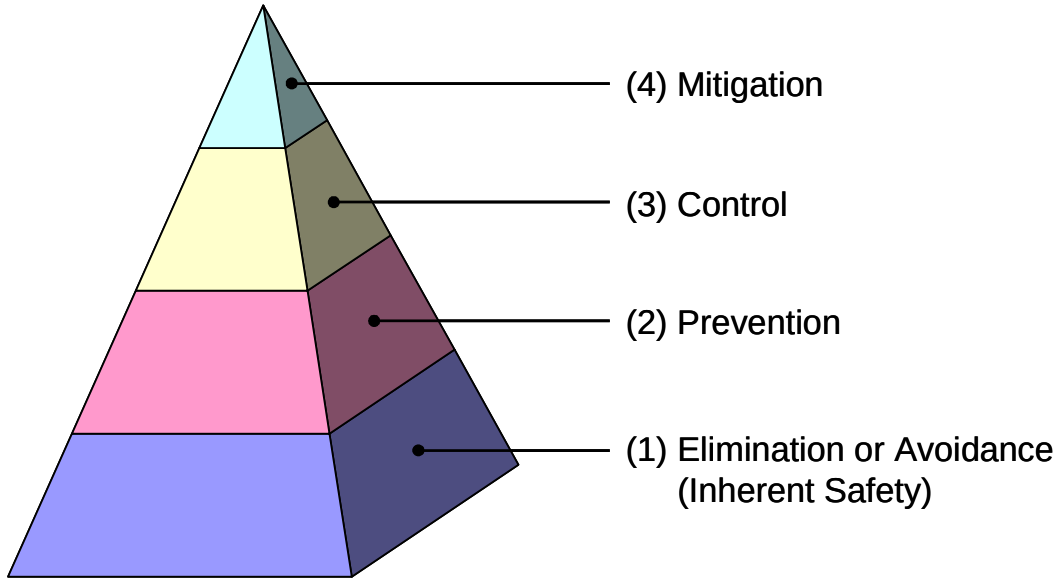
Inherent Safety

The Dolphyn facilities have been designed such that they are, as far as reasonably practicable, inherently safe. Key principles include:

Eliminate	• Sources of ignition
Reduce	• Hydrogen and other hazardous materials • Equipment items / leak sources • Activities offshore • Consumables required
Separate	• Location of laydown areas • Riser and pipeline routing • Confined / congested areas



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Offshore Manning

Dolphyn will be operated as a Normally Unattended Installation (NUI)

Key design objective is to minimise personnel intervention by:

1. Minimising equipment and inventory of hazardous substances
2. Selecting equipment based on availability, reliability and low maintenance requirements
3. Use of proven technology to ensure the reliability and availability
4. Minimising requirements for local intervention
5. Designing for full remote operation from an onshore control room

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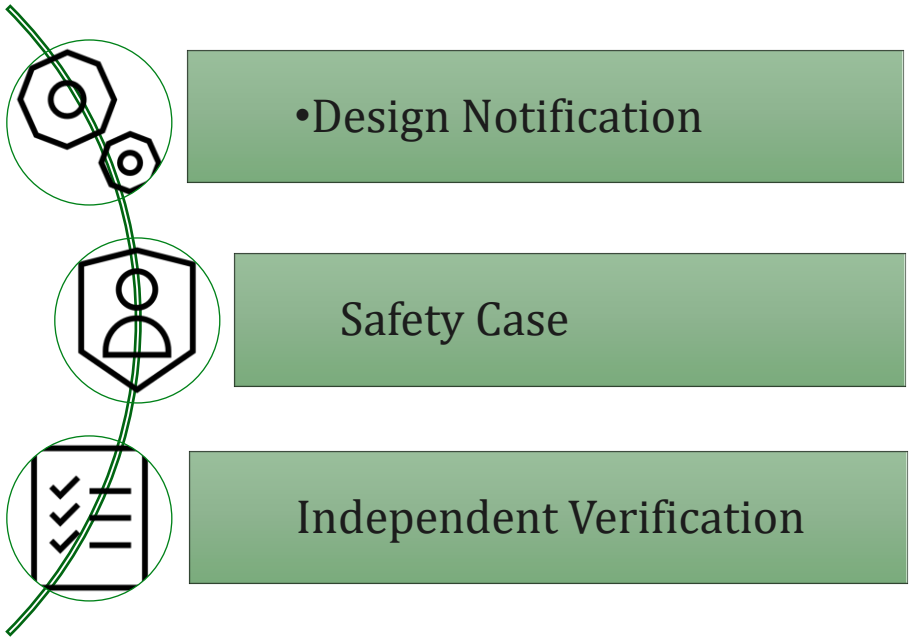
Key Activities

Safety Case

Dolphyn does not strictly come under the provisions of safety case regulations, but broad adherence to these Regulations is being undertaken as representative of good practice.

The Safety Case Regulations requires a demonstration by the Duty Holder that:

- **All hazards with the potential to cause a major accident have been identified;**
- **All major accident risks have been evaluated, and**
- **Measures are taken to control the major accident risks to a level that is 'As Low As Reasonably Practicable' (ALARP) and to ensure compliance with the relevant statutory provisions.**



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Safety Studies

A key requirement of effective hazard management is to be able to demonstrate that a **structured, formal process** has been adopted specifically including the **identification and assessment of all potential hazards, consequences and adequacy of controls**.

A **formal hazard identification and assessment** process is being carried out for Dolphyn to demonstrate that:

- All potential hazards and consequences have been identified,
- Risks have been assessed and understood,
- Controls to manage the causes and consequences are provided.

HAZard IDentification (HAZID) study	HAZard and OPerability (HAZOP) study
Fire and Explosion Risk Assessment (FERA)	Non-Process Major Accident Hazard Risk Assessment
Structural Blast and Fire Loads Assessment	Bowtie Analysis
Escape, Evacuation and Rescue Analysis (EERA);	Emergency System and Survivability Analysis (ESSA).

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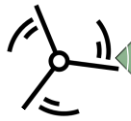
Hazard Identification

Major Accident Hazards

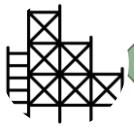


WTG Nacelle / Blade Fire

Loss of Containment of hydrogen from vessels, electrolyser, fuel cell, cooler, metering or pipework

Loss of Containment of Hydrogen from the export riser / pipeline

Failure of turbine blades or other dropped objects during lifting



Structural collapse, loss of stability, loss of station keeping, or ship impact

Electrical incidents / fires relating to switchgear, transformers, HVAC or batteries

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Dolphyn Hydrogen Trials

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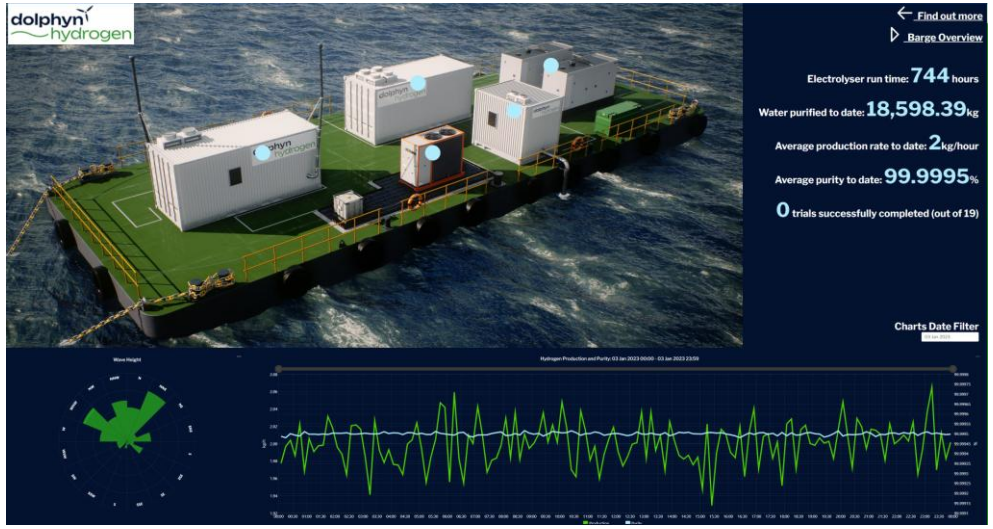
First trials in 2024

A new design to producing ultra low carbon hydrogen.



- Series of ‘mini tests’ in Pembroke Port META demonstration zone to gain operational and performance insight
- Trial proves the end-to-end desalination and hydrogen production system in a floating marine environment
- Digital twin to capture real time data analysis during trials and incorporate the digital backbone for future scaling
- Working with local suppliers and stakeholders
- Gaining real world experience of supply chain, fabrication and operation
- First production of hydrogen from seawater in a floating marine environment in the UK.

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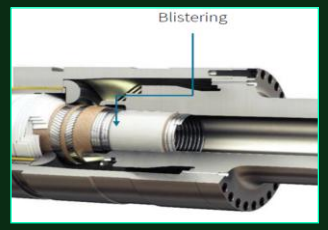
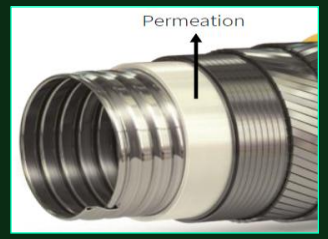
Riser Trial

Adaptation and qualification of O&G technology for hydrogen



Rapid gas decompression test of HDPE inner liner



Permeation test of HDPE inner liner

Rapid gas decompression test of elastomer end fitting seal

Autoclave test of duplex steel carcass

Challenges and Lessons Learned

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Key Challenges

Development challenges after 6 years of work

REGULATORY

- Lack of prescriptive guidance and established processes
- Response from competent authority uncertain
- Roundtables with key regulators defined a pathway to success

TECHNICAL

- Marine motion impact on process systems
- Operation off-grid: Battery Energy Storage System (BESS) for ‘black start’
- Adaptation of existing floating wind platform designs to incorporate topsides equipment
- Unattended operation – requirement for maintenance visits e.g. following a trip

PROJECT

- Vendor engagement on concept / small scale projects
- Availability of technical data for design and risk assessment
- Management of interfaces

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Lessons Learned

Gaps in existing industry regulations and standards for the offshore production of hydrogen from wind. **Vital to go beyond what is required for regulatory compliance.**

Use of expertise and best practice from other sectors is essential for safe deployment and provides a well-established framework.

Safe deployment of the concept at large scale can be achieved. **No significant barriers to deployment.**

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Ongoing work and next steps

CELTICSEAPOWER | dolphyn hydrogen | CATAPULT Offshore Renewable Energy | WALES&WEST UTILITIES

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Dolphyn is actively looking for project partners and investors to deliver projects in the UK and elsewhere

www.dolphynhydrogen.com

Thank you

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