Embracing transferable skills to accelerate the Energy Transition

THE
ENGINEERING
ANALYSIS
EXPERTS

Global Underwater Hub

PDL

About PDL

PDL is an engineering consultancy based in the North of England.

We use a wide range of toolsets including; Mathcad®; Finite Element Analysis; Computational Fluid Dynamics and OrcaFlex® to solve a range of our client's complex engineering challenges.

Our team of analysts, provide experience and key niche skills, developed over many years, to give our clients confidence in their systems and designs.

Our clients typically work in safety critical industries, where it's important the design works first time and every time it is needed.

We've supported the Subsea Industry for over 20 years. In this time, we have been able to use transferrable skills to support our clients meet the needs of new industries.

As engineers, we like numbers more than words, so here are some numbers, with only a few words, to describe who we are and what we do

3500 **colleagues** across our Engineering Group

2500 **projects** successfully completed to date

2001 the year that we were born

91% STAFF RETENTION

91% **staff retention** rate

90% REPEAT BUSINESS

90% of business comes from **existing clients**

42

brilliant people currently employed

INCLUDING **34** ENGINEERING ANALYSTS

with specialist knowledge and experience

INCLUDING **17** MENTORS

to support professional development

2 **2 sides of our business:** Engineering Consultancy and MAXIM® Engineering Software Consultancy

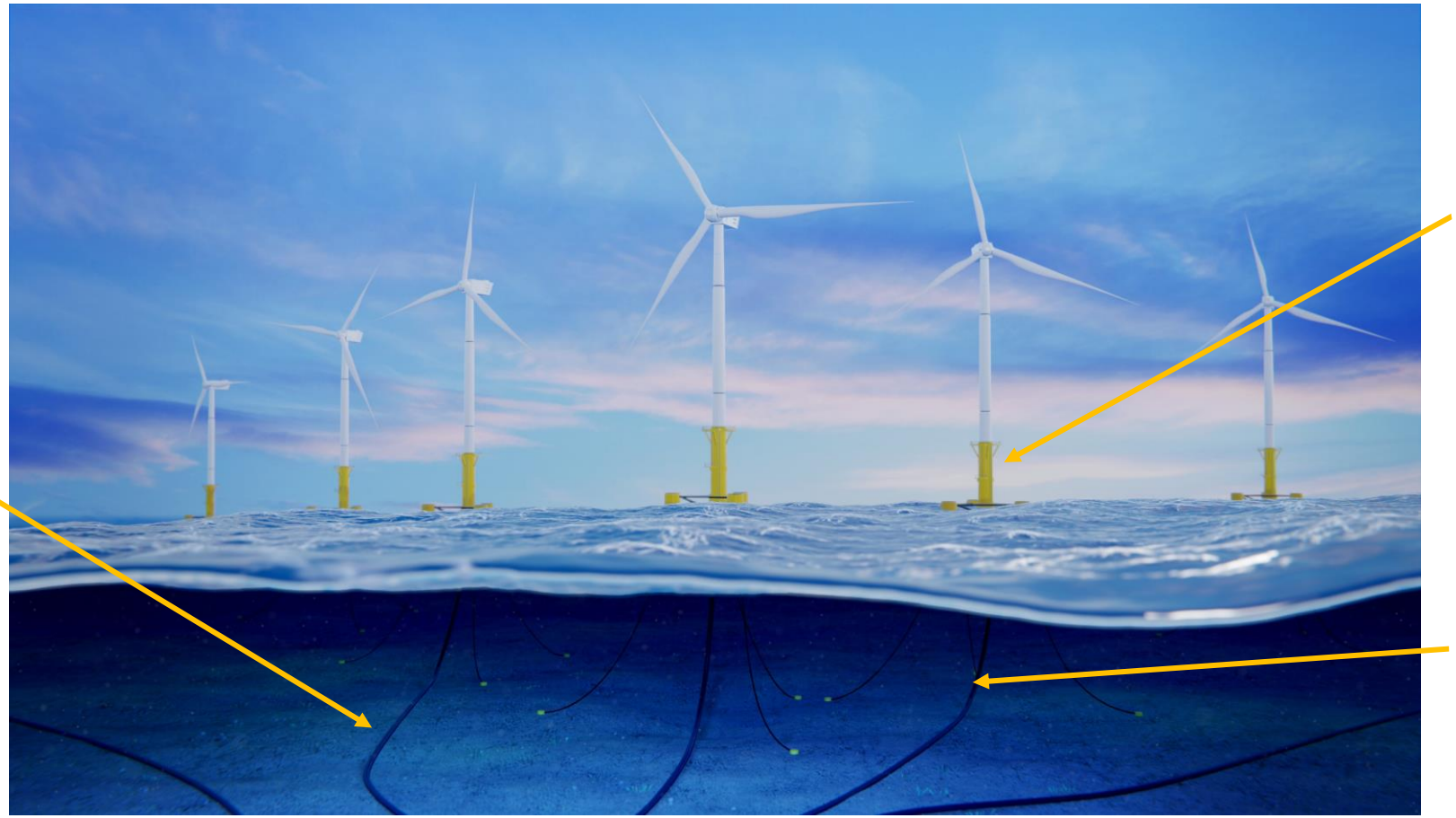
1 **1 great team** highly skilled in engineering, software and communication

PDL | PART OF **VULCAIN GROUP**

THE **ENGINEERING ANALYSIS** EXPERTS

Floating Offshore Wind

Deriving loads on Flexible Risers



Fatigue of deck mounted structures

Thermal assessment of umbilicals

Loading on Dynamic Cables

Context:

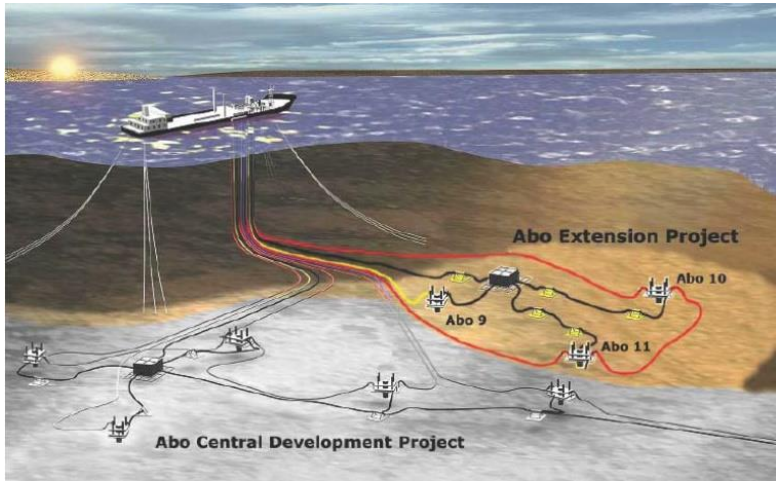
- A set of flexible risers required a life extension assessment to determine the number of safe working cycles/years of operation.

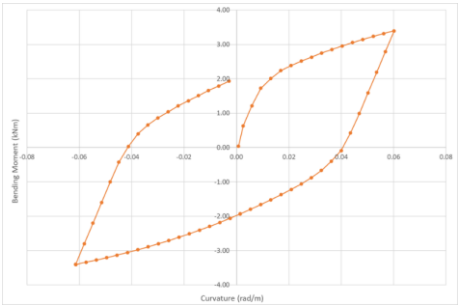
Gains:

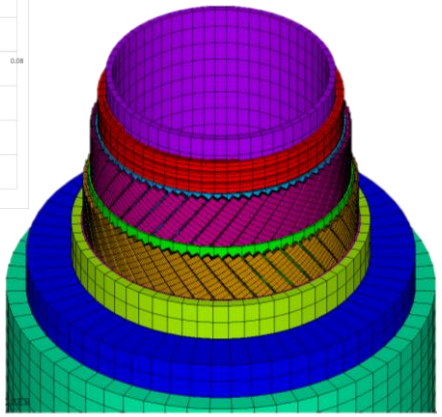
- Using Global Dynamic Analysis, you can determine the loading applied to the risers (cables and mooring systems) accounting for wave loading, vessel (floater) motion and currents.
- These loads can then be applied to intricate local FEA models to understand the loading on individual layers.
- The accumulated fatigue damage on the armour wires or cables can then be determined.

Considerations:

- The complicated 'stick-slip' stiffness behaviour of cables is not well understood and requires more physical testing and industry guidance.







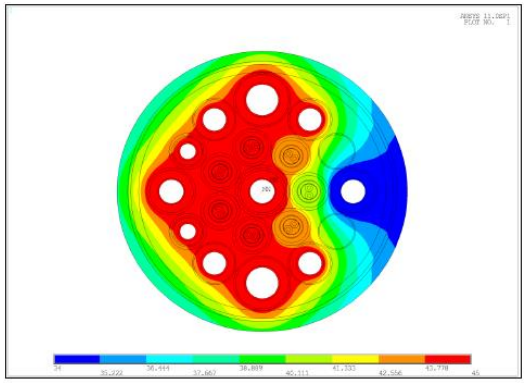
Thermal assessment of High Voltage Cables

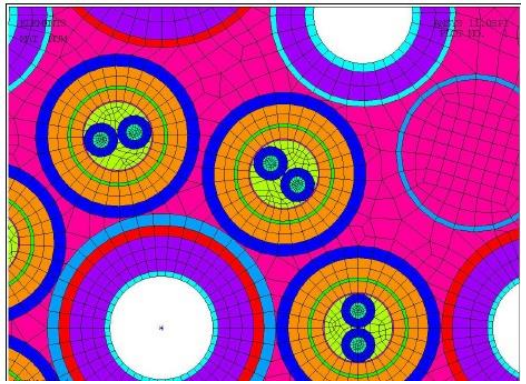
Context:

- An umbilical component had a relatively low temperature limit; transient thermal assessments were used to assess variations in temperature over time, informing what the operating duration should be.

Gains:

- Thermal assessments of varying complexity are available to the industry. As power cables increase in voltage, thermal loading and the impact on cable protection systems can be understood.
- Cyclic thermal loading on the polymer CPS could cause fatigue issues.





Fatigue Assessment for Offshore Structures

Context:

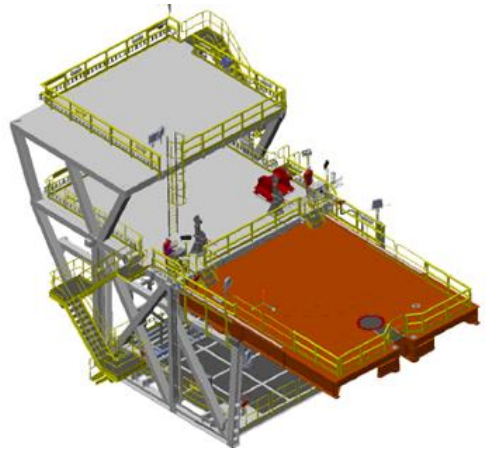
- A deck mounted structure required structural and fatigue assessment for a 20 year period. Areas of high stress were identified and redesigns were proposed.

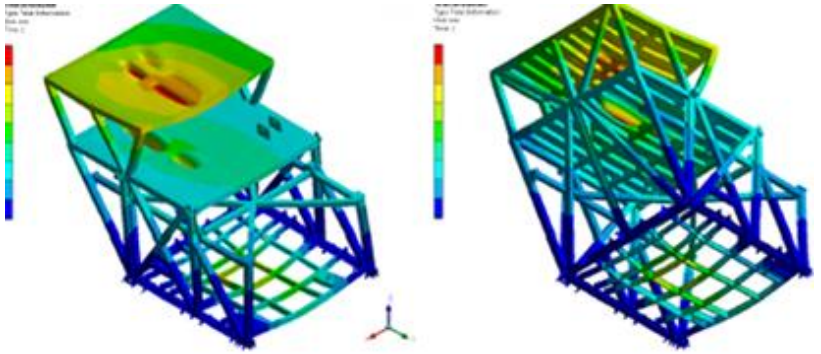
Gains:

- Widely used and understood standards, DNVGL-RP-0005 (fatigue) and DNV 2.22 (static structural assessment) for static structural assessments and fatigue considerations.
- The offshore environment is harsh, with complicated loading scenarios and sequences for the fatigue routines that can multiply easily. Understanding how to interpret the results and use engineering judgement is important.

Considerations:

- Floaters will see onerous loading throughout their life with waves, wind, mooring loads and turbine loads.





Hydrogen Industry

Blast analysis for Chemical Industry

Composite Materials for Oxygen storage

Pressure Containment and Cyclic Loading for the Oil & Gas Industry

Cyclic Loading for Hydrogen Containment

Context:

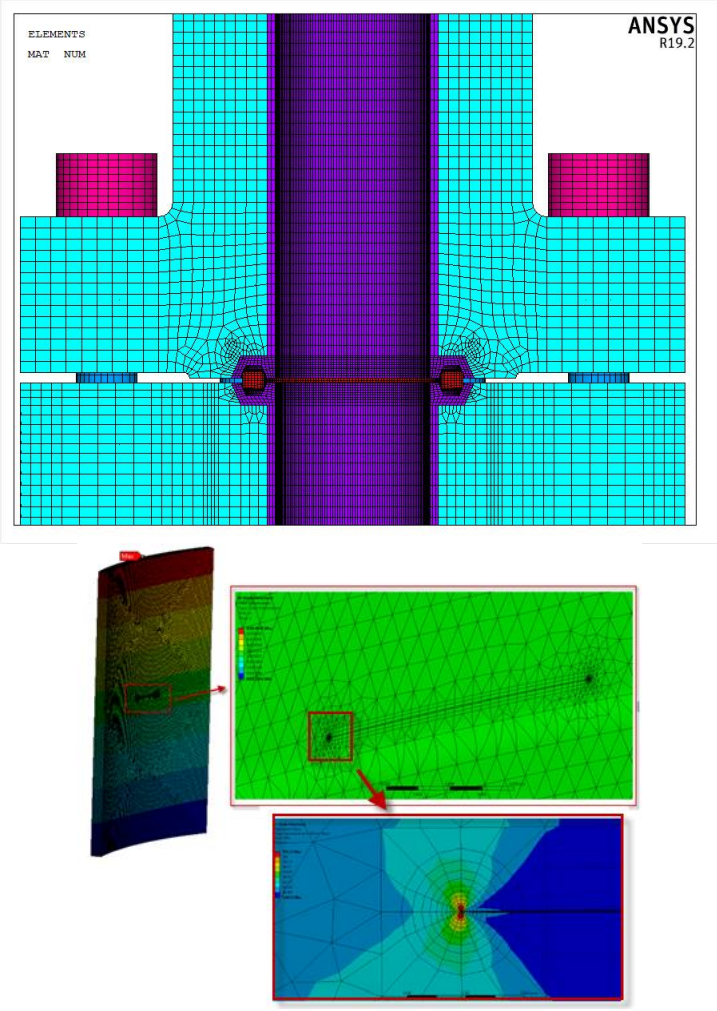
- Structural assessment of a High Pressure, High Temperature flanged connection for a subsea application.

Gains:

- Widely used and understood standards, ASME VIII Div 2 and 3 and API 579-I ASME FFS-I for static structural assessments and fatigue considerations.
- The same methodology is applicable for containment of hydrogen.

Considerations:

- Material test data is needed within a hydrogen environment. Small concentrations of hydrogen has a large impact on the material properties.



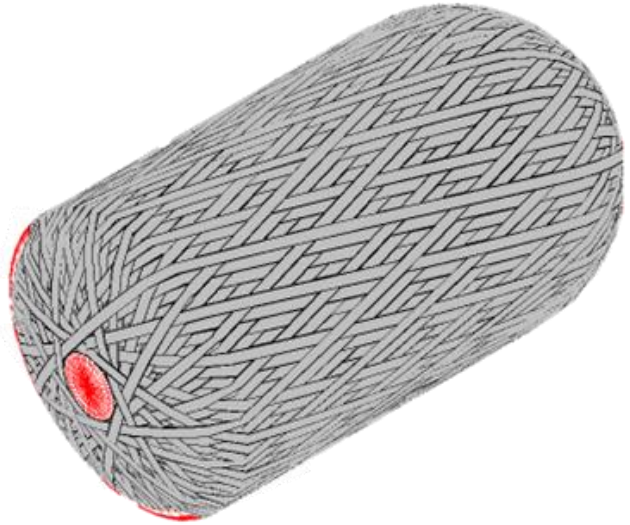
Pressure Containment using Composite Materials

Context:

- Evaluated the burst performance of filament wound Type 3 (metal liner) Composite Overwrap Pressure Vessel. The client was interested in the optimum layer thickness and wind angle of the filaments.

Gains:

- The use of composite materials have a weight saving advantage and the storage of hydrogen is often at high pressure.
- The ability to calculate stresses in each layer of the cylindrical sidewall and top/bottom hemisphere were used to evaluated multiple composite designs and arrangements without the need to physically build and test every scenario.
- The methodology is understood and can be replicated for other applications.



Blast analysis for Hydrogen Systems

Context:

- Safety case for a new steam generator facility required an assessment to confirm surrounding facilities are safe when subjected to a number of accidental events.

Gains:

- Empirical calculations are available to determine blast energy, overpressure as a function of distance. Fragment velocities and expected range for vessel explosion and vapour cloud explosion.
- For hydrogen storage and production facility assessments, the same methodology and calculations are used.

Step 9 - Calculate blast parameters

Actual radial distance to explosion centre

$$r = \begin{bmatrix} 5 \\ 10 \\ 20 \\ 30 \\ 40 \\ 50 \\ 60 \\ 70 \\ 80 \\ 90 \\ 100 \end{bmatrix} m$$

Combustion energy-scaled distance
(Ref. [02] eqn. 5.2)

$$r_{dash.s} := \frac{r}{\left(\frac{E_s}{p_a}\right)^{\left(\frac{1}{3}\right)}}$$

Conclusion

- We shouldn't underestimate the engineering challenges when deploying new technologies at scale offshore.
- We are fortunate to have skills, knowledge and expertise in the offshore environment to support this.
- There are differences between established and new industries, especially financing and risk ownership. In the short term, this could accelerate the energy transition, but might not allow for a sustainable supply chain and industry in the future.

You don't have to reinvent the wheel, just attach it to a different wagon.

Mark McCormack

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