Case study

Assessment of fluid-structure interaction

THE CHALLENGE

Tidal turbines are constantly exposed to the harsh marine environment, and have to be designed to withstand a range of aggressive and turbulent conditions.

After previously suffering a blade failure, our client was keen to fully address all of the technical risks associated with their new blade design. One such risk arises through the complex interplay between structural dynamics and hydrodynamics, which leads to phenomena such as:

- **Resonance**, where a harmonic forcing acts on the blade at or close to a natural frequency
- **Flutter**, where the coupling between the structural and hydrodynamic characteristics of the blade cause it to be dynamically unstable under certain conditions
- **Divergence**, where the hydrodynamic sensitivity to small deflections leads to a static instability
- **Galloping**, where the hydrodynamic behaviour of the blade in deep stall causes a dynamic instability.

Frazer-Nash were asked to undertake an assessment of the new blade design and assess its susceptibility to these issues before manufacturing could commence.

OUR APPROACH

Rather than deploying complex, expensive and hard-to-validate numerical simulations, we called on our experience from the aeronautical domain, employing classical methods that are well validated, well understood and fast.

We tailored this analysis to the blade design in question by using simple, yet effective, two-dimensional CFD analysis and extracting data from an existing FE model.

We were able to clearly map out the flow regimes under which these phenomena could occur alongside the operating regime of the turbine. This gave a clear, visual guide as to the margin of safety. We also gave recommendations as to how best to use a forthcoming test deployment to de-risk this area further.

Client

Atlantis Resources Corporation

Business need

Structural integrity assessment of Tidal turbine.

Why Frazer-Nash?

Marine technology experts at Frazer-Nash have supported a number of tidal device developers to ensure their products are designed to operate and thrive in these challenging environments.

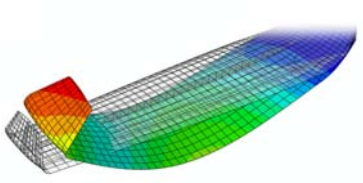

Figure 1: FE model of the new blade design showing a blade mode.

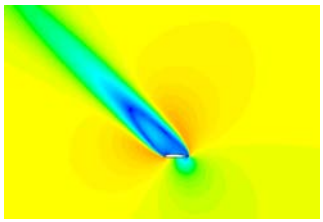

Figure 2: CFD analysis of the blade section in deep stall

For more information please contact **Neil Adams** on **0141 341 5400** or email **renewables@fnc.co.uk**

FRAZER-NASH CONSULTANCY