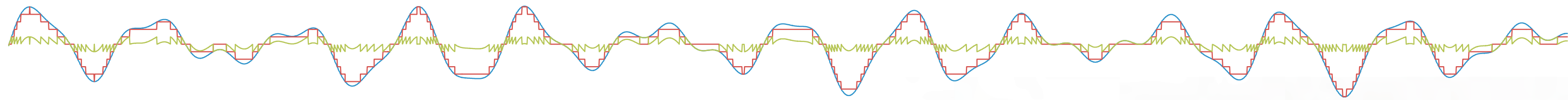


Quantor Hybrid Hydraulic PTO

WES Power Take-off Systems, Stage 3



Introduction

Artemis Intelligent Power and Quoceant are currently building a unique test facility which will demonstrate and validate their jointly-developed, generic 'Quantor' wave energy power-take-off system (PTO) in realistic operating conditions.

The test-rig's electric drive-system emulates the wave induced motions and inertial behaviour of a wave energy converter (WEC). It does this safely within a richly instrumented and exactly repeatable, lab-based environment. Although designed for Quantor, the drive-system is intended to also be useable by other PTO and offshore systems.

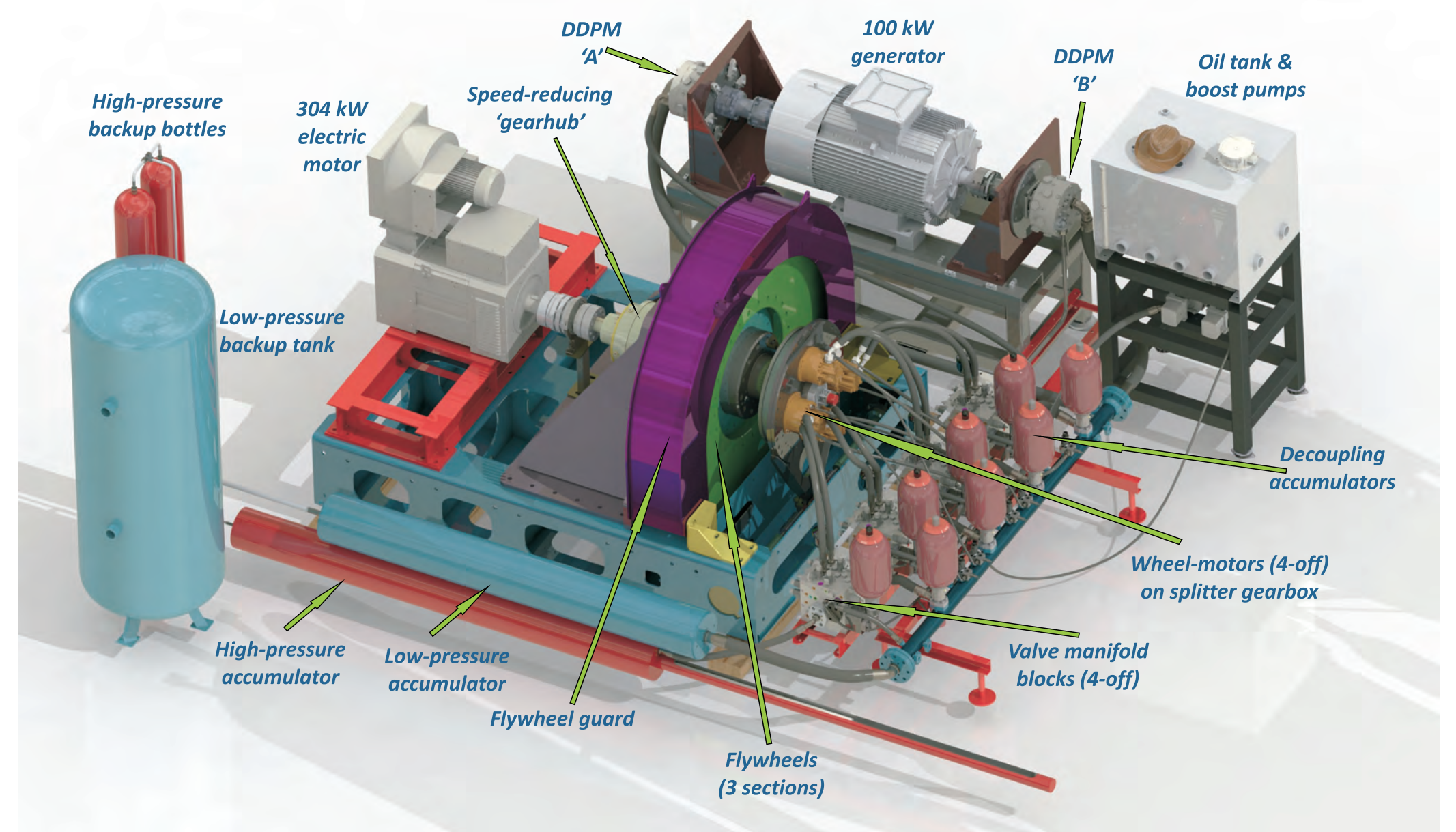
The physical nature of the WEC is represented by a flywheel spinning bi-directionally at instantaneous speeds of up to 170 rpm in closed-loop response to regular or spectral wave conditions. Energy is captured from the flywheel by the Quantor PTO and then converted back to electricity.

Quantor combines complementary hydraulic technologies with shared roots in the demanding requirements of wave energy. These are quantised control, as developed for the Pelamis WEC, and Digital Displacement® (DD) technology as developed by Artemis since 1994.

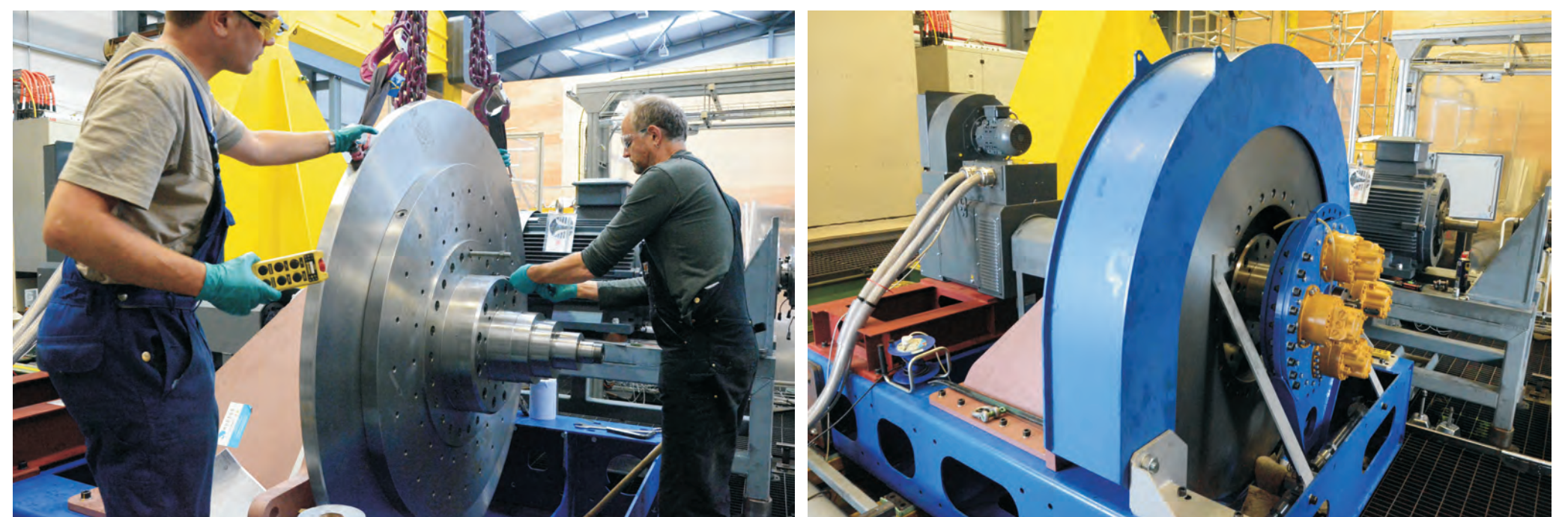
The aim is to maintain the very high WEC-to-wire efficiency of the Pelamis system whilst improving WEC hydrodynamic controllability, and hence the overall energy productivity and return on investment.

The test-rig and Quantor comprise a 'hardware in the loop system'. The designs and specifications of the physical components are informed by a detailed simulation model within Matlab Simulink. The lab control system is developed within the same model and then ported into the top-level command computer.

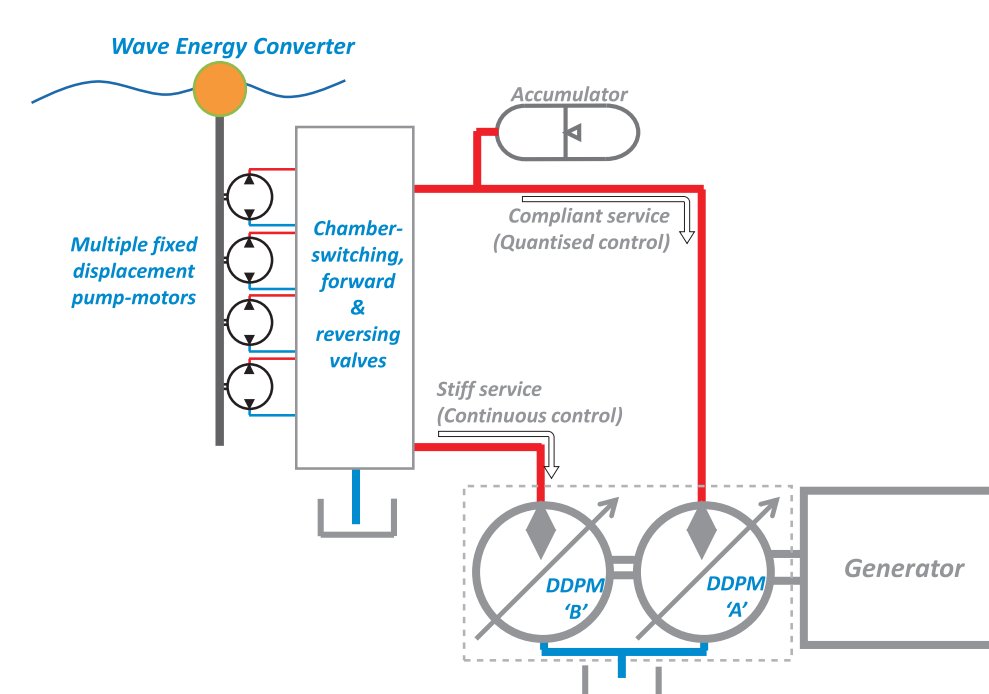
Quantor is a generic PTO system. The version described here uses rotary actuators (wheel-motors) to capture energy from the WEC. Alternatively, linear Quantor versions using hydraulic rams are possible. During this Stage 3 project and the preceding Stage 2 project, Artemis and Quoceant have maintained close dialogue with a wide range of offshore equipment and WEC developers.



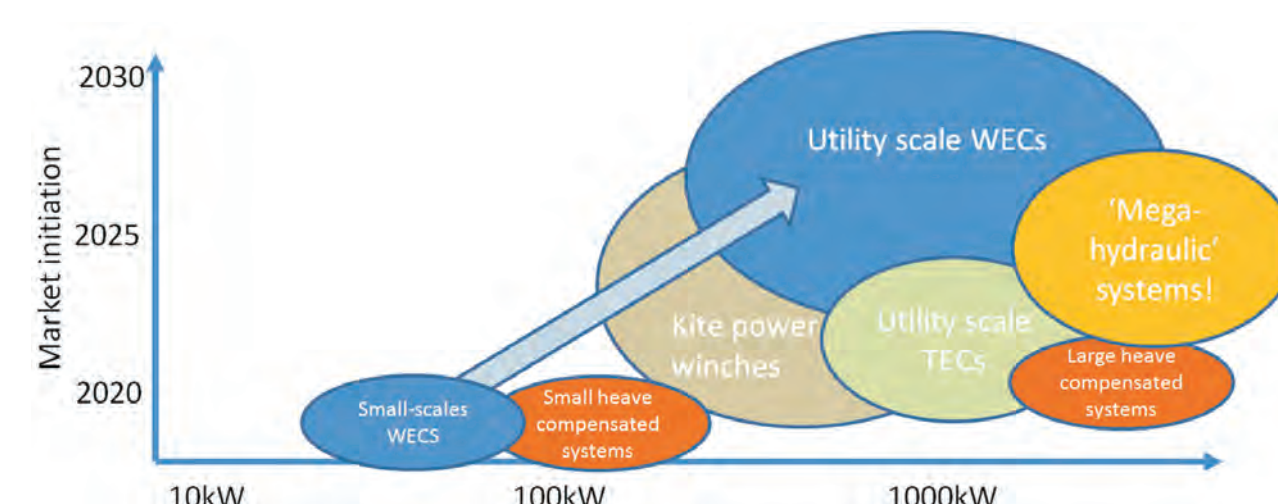
Electrically-driven test-rig with Quantor hydraulic PTO. The green bi-directional flywheel emulates the WEC's wave-induced motions and inertia. Energy is captured from the flywheel by four hydraulic 'wheel-motors'. These are connected via the valve manifold blocks to changing combinations of 'quantised' and continuous control. Quantised control transfers wheel-motor energy to the high-pressure accumulator. The Digital Displacement pump-motors (DDPMs) provide continuous control, pressure-transformation and generator drive.



Left: Installation of the flywheel onto the drive-line. It is actually made up of three elements, having a total mass of 2.5 tonnes. These can be used in different combinations depending on the WEC that is to be simulated. In this shot the front element is still to be mounted. Right: All three flywheel elements and the safety guard are in place. The front flywheel is in the static 'parked' position and stabilised by the angled grey strap.



Left: Block diagram illustrating the Quantor PTO concept. Right: Artemis 'M96' Digital Displacement pump-motor DDPM specially developed during the project.



Illustrating the envisaged range of markets for Quantor technology. The Stage 3 project is at around the 100kW level of most current WEC projects but higher power levels will be required in future. As well as refining its 100kW scale technology, Artemis also developing megawatt-scale machines for this future market.