Control strategy of the MGR Wave Energy Converter (WEC)

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ABSTRACT. This paper introduces the control strategy of a new wave energy converter design, the MGR. The objective of the control algorithm is to maximise the energy output. The MGR is a submerged near shore converter that takes advantage of the oscillating water column created by the wave when it passes on the converter's platform. The wave column moves the platform, transmitting the force to a single acting cylinder. Accumulators are used to damp cylinder pulses and provide constant flow, pumping pressurised sea water to the coast, where is turbined generating electricity. The working principle, submerged and profiting oscillating water column, is similar to AWS and CETO I. The main innovations are the removable modules arrangement, the variable working pressure and the use of springs to recover the original position working in vacuum environment.

The energy absorbed by the WEC is maximum when platform's movement is tuned to the incident wave frequency, resonance is then said to occur. Due to constructional problems, and no well-defined frequency of real waves, it is difficult to match both frequencies. To achieve resonance condition, there are two control algorithms (both based in system's pressure): the first aims to work under the optimal pressure controlling turbine jet overture in real time according to the coming wave; and the second one controls the generators load (torque) to rotate at the optimal rotation speed (that depends on the pressure too).

The first algorithm calculates in real time the adequate working pressure in function of wave size (H height and T period). Studying the energy balance and flow, the equation that defines this relationship is developed. Once defined the minimum wave size, the extra energy of larger waves is used to increase the pressure, absorbing the maximum energy according to the wave size. To get the pressure on the jet nozzle, the pressure drop in the hydraulic circuit has to be taken into account.

On the other hand, the second algorithm sets the generators load, adapting it to the

absorbed energy. The permanent magnets single feed synchronous generator has been chosen for the MGR. The generator can work in isolate mode or network operation. It uses the torque as setpoint, and turbine optimal speed is used as reference to set the torque, taking into account the relation the water flow produced and the actual working pressure.

This paper demonstrates that the MGR is fully controllable in order to maximise the energy output according to the coming wave size signal, working with variable system pressure.

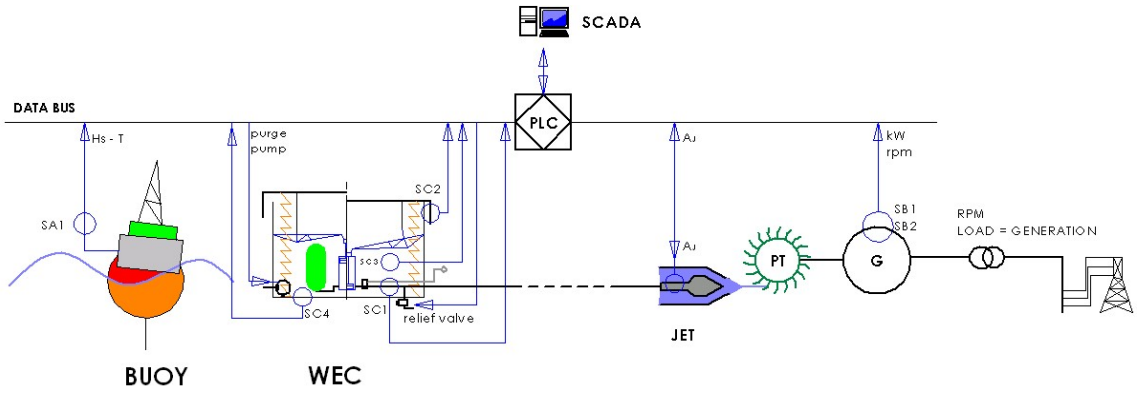

Fig. 1. Simplified control schema including sensors and encoders