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TECHNOLOGY

P6390

TIDAL TURBINE ABSORBING DYNAMOMETER

Description

The tidal turbine dynamometer is designed to absorb and accurately determine the energy produced in a water flow stream. It is intended to be used within a recirculating type flow channel with a maximum turbine rotor diameter of approximately 300mm. The dynamometer system comprises a sealed dynamometer and fixing strut, an instrumentation/control box and a standard PC. A calibration stand for the torque and thrust measuring load cells is also provided.

The turbine rotor is fixed to a horizontal drive shaft that is connected through a set of bevel gears to a vertical drive shaft running up through the mounting strut. Shaft torque and thrust measuring systems are located within the dynamometer gondola casing.

Load control system

An AC motor/generator is connected to the vertical output drive shaft at the top of the strut and above the waterline. This is controlled by a 1.1kW inverter module located within the instrumentation box. AC current produced by the generator is changed into dc current by the inverter and dissipated within an air-cooled resistive load bank located outside the instrument box. Generator voltage, current and speed are measured and data logged to a P/daq data logging module within the instrument box.

In addition to the load mode, it is possible to motor the dynamometer using the inverter. This is particularly useful for measuring the unavoidable friction losses due to the shaft bearing and seal. This is usually done by fitting a dummy rotor (no blades) of a similar weight to the turbine rotor and motoring the dynamometer at the required operational speed.

Turbine rotor torque and thrust measurement

Two specially designed strain gauge load cells are installed within the dynamometer gondola casing.

The torque load cell is a rotating device that forms part of the turbine rotor drive shaft. This is located within the sealed casing as close as possible to the rotor. A single bearing and shaft seal are positioned between the torque load cell and turbine rotor, this minimises the torque losses and increasing the accuracy of the torque measurement. Slip rings and brushes are used to provide the load cell excitation voltage and output signal.

The thrust force load cell is a static device located inside the gondola casing. The thrust force from the turbine rotor is transmitted through the drive shaft into a bearing housing and this in turn is connected to the load cell by a coupling rod. To ensure the thrust force is reacted into the load cell a flexible bellows is used within the drive shaft downstream of the thrust load cell. This bellows effectively transmits the shaft torque while being weak in the axial direction, thus ensuring thrust forces are shunted directly into the thrust load cell.

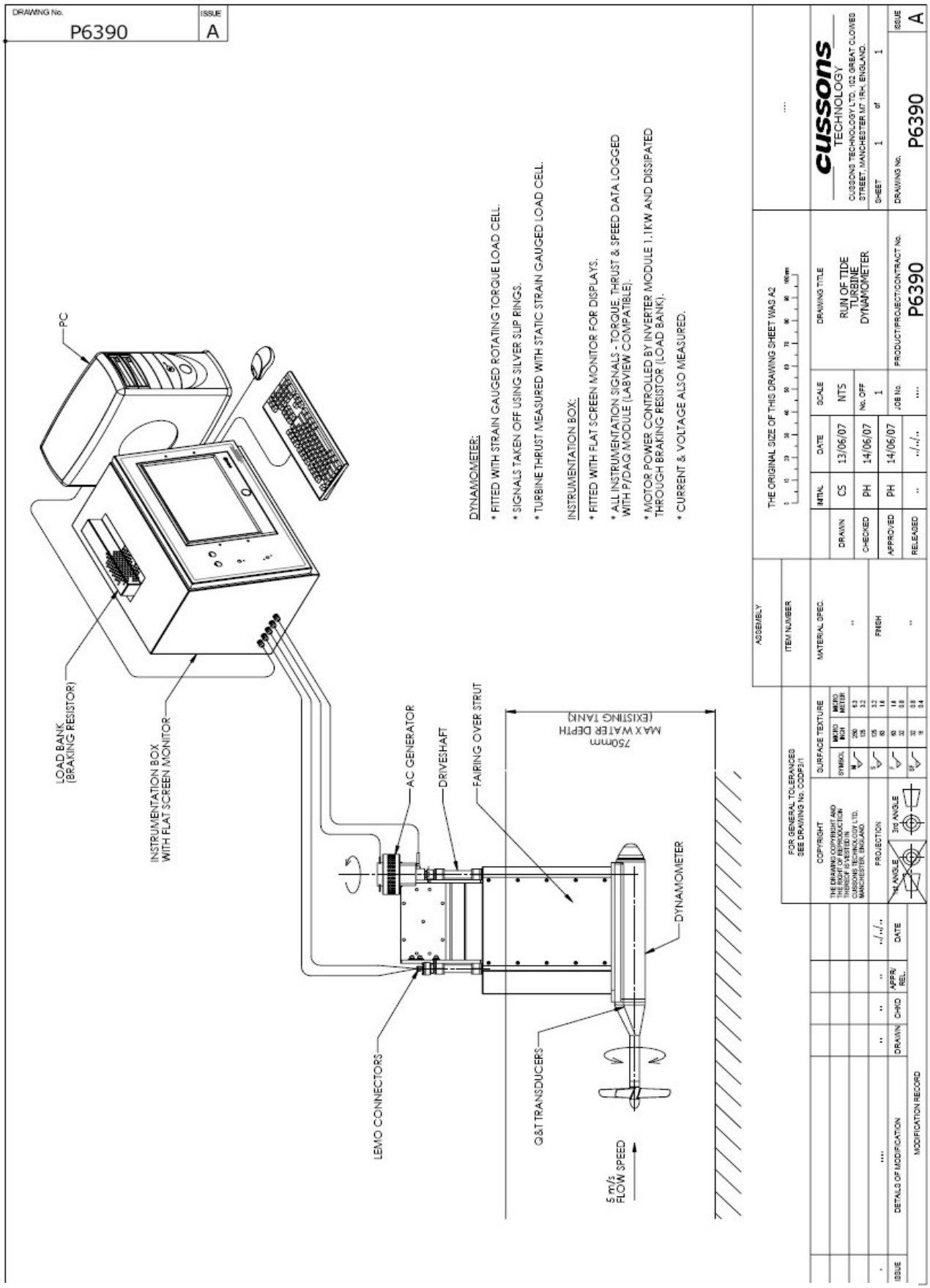
Instrumentation system

This is a stand alone box housing the inverter drive module, power supply for the load cells, load controls, data logging module and a flat screen PC monitor for the display of all measured signals. The resistive load bank will located either on the top or rear of the box. The PC is used for the data logging software programme and allows all measured signals to be displayed in an Excel type spreadsheet or other format as required.

Calibration Stand

The calibration stand is designed to support the complete dynamometer (and strut) in the correct attitude to allow calibrated weights to be applied for loading the dynamometer. A calibration arm of accurate radius is fitted to the dynamometer input shaft and weight hangers are attached to each end of the torque arm. Weights are applied to generate the required torque.

To calibrate thrust, the dynamometer is rotated on the stand and fixed in position with the input shaft vertical. A weight hanger is then directly attached to the shaft and weights applied to create the thrust load.



Full size drawing can be supplied on demand

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