

Managing the ups and downs of energy generation for Wave Star

Alternative energy solution uses Rockwell Automation Allen-Bradley ControlLogix PAC and advanced control algorithm to effectively harness power from the sea

Solutions

A Rockwell Automation solution was installed, which included:

- Allen-Bradley ControlLogix PAC
- Flex I/O
- FactoryTalk View
- Allen-Bradley Powermonitor
- Engineering support

Results

- Real time management of hydraulic-fluid-based power generation system
- Process control adapts to the random environmental conditions
- Power monitoring to help towards achieving optimum power extraction
- Single integrated HMI and software giving a "global" view of the process



Background

Since 2003, Wave Star has been dedicated to the development of reliable, commercial wave energy technology. With its new 500kW prototype, the company has reinforced its position as one of the world's leading wave energy developers.

After more than three years of constant operation in the sea, Wave Star has proved the patented concept with a 1:10 scale test machine. Day in and day out the machine has been working – through more than 15 storms – with a minimum of maintenance. This in itself is a milestone in international wave energy.

Right from the start, Wave Star has used Rockwell Automation as a key supplier with its extremely powerful yet easy-to-use Allen-Bradley ControlLogix PAC being at the very heart of the operation. Proven already in off-shore and green energy generation applications, ControlLogix is steadily becoming the controller of choice.

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Challenge

In September 2009, a research section of the commercial 500kW wave energy machine was installed in the North Sea near Denmark. An impressive 40m long, with two 5m diameter floats it represents a shortened "test" version of the complete machine. Located 300m off Hanstholm in the North Sea at a water depth of 7m, it is already connected to the grid. Due for operational use and sale in 2011, the complete machine will be 70m long with 20 floats.

Laurent Marquis, Technical Director at Wave Star explains: "Unlike other wave power concepts the Wave Star machine, which is based on standard offshore technology, does not form a barrier against the waves but instead sits at right angles. This way, the waves run along the length of the machine and the energy is utilised in a continuous process.

"Projecting from each side of the Wave Star machine," he continues, "there are a number of half submerged hemispherical floats. When a wave rolls in, the floats ride the crests and are raised, one after the other, until the wave subsides. Each time a float is raised, a piston forces hydraulic oil into the machine's transmission system at a pressure of up to 200 Bar. This oil flow drives a hydraulic motor, which is connected to a generator that produces the electricity."

As the machine is several wave lengths long, the floats will work continuously to harness energy and produce a smooth output. The machine also exhibits efficient storm protection concept, when the waves reach a certain height, the floats are automatically lifted out of the water.

Although the concept sound simple, the random nature of the waves in terms of height, frequency and length means that an advanced control system was required in order to extract as much energy as possible in the most efficient way. The control system has to measure and manage multiple variables in the hydraulic system – such as speed, movement, acceleration, pressure and loads – and does so by using an advanced algorithm, developed by Wave Star, running on an industry and off-shore proven Allen-Bradley ControlLogix PAC from Rockwell Automation.

Solution

The solution employed by Wave Star, although simple is extremely powerful and is a good example of how a suite of control, visualisation and I/O components from a single supplier can work in harmony to achieve the desired objective. Not only does it deliver the closed-loop capabilities needed by Wave Star to manage the energy generation operation, but it also gives clear visibility of the process, informing the operator of all important variables and functions.

"The regulation that the PAC has to achieve is extremely complex," explains Marquis. "With multiple floats and multiple inputs there is a huge amount of data traffic, which the PAC has to manage as efficiently as possible." Allen-Bradley Flex I/O is also a major part of the architecture, connecting many of the data points to the PAC, with process visibility, database values and historical data capture being provided by FactoryTalk View on a central HMI.





Completing the Rockwell Automation Solution is its Allen-Bradley Powermonitor technology, which is used to collate information on the power being generated, such as load and power quality, which is then fed back to the PAC to help achieve optimum generation.

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Results

Rockwell Automation has been an intrinsic part of the project since 2004, with its Allen-Bradley ControlLogix PAC being the brain behind the process throughout its development. "I have always appreciated the work and

effort that the Rockwell Automation engineers have put into this project," elaborates Marquis. "The support has been superb and I have always felt that the engineers have been very engaged. I have worked with Rockwell Automation in the past, in roles at other companies, and the helpful support ethic has always been the same.

"Speedy response has also been a major plus factor," he concludes, "and it is nice to know that we are working with qualified people using products that are both easy to understand and easy to manage. We don't see Rockwell Automation as a supplier, but more as an unofficial partner in the project... we are only a small company and at every stage they have treated us as equals."

Additional Information

www.rockwellautomation.com

The results mentioned above are specific to Wave Star's use of Rockwell Automation products and services in conjunction with other products. Specific results may vary for other customers.

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