

Embedded PC controls local smart power grid

Music festival keeps the party going using green energy



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The Pukkelpop Festival in Belgium has long focused on environmental sustainability. For the summer 2015 event, the organizers managed to cover their power needs with locally generated, sustainable energy. Solar panels provided the main power source, coupled with two small wind power systems and batteries for backup. This green system featured a Beckhoff Embedded PC and EtherCAT I/O to monitor the availability of the power supply as well as the overall power consumption. The project was implemented by Belgium's UC Leuven Limburg University (UCLL), which will continue to analyze the data, examining the power quality of stand-alone green energy systems.

"The goal was to supply locally generated 'green' power for the main stage, the catering area and the information booths. Solar panels were intended to be the main sources of power," explains Joël Claes, coordinator of the INET (Intelligent New Energy Technologies) panel of experts from UCLL, which implemented the project on behalf of the Pukkelpop organizers. Engineers installed 150 solar panels above the entrance to the festival grounds, each boasting a maximum output of 255 watts per unit. The panels were linked to six 5,000-watt inverters. Also installed were two small wind turbines producing 500 and 1,000 watts, respectively. "We realized during the planning phase that in order to avoid power failures, a certain amount of power supply flexibility was necessary, as was a robust energy management system. That's why we installed one battery per inverter and two backup batteries in addition to the overall power requirements of approximately eight 30 kW batteries, each with 40 Ah of output," explains Joël Claes.

Intelligent stand-alone power grid

UCLL engineers built an intelligent power grid on the site to integrate the different sources and consumers. Joël Claes explains: "The stage required the power to be supplied by a pair of inverters, and the various information booths were connected to another inverter. Via a switching matrix, we were able to

switch each consumer to a charged battery while using the solar panels to recharge the other batteries as necessary. We controlled the switching matrix with a Beckhoff CX5000 Embedded PC, while the supply and consumption voltages and currents were read by XFC I/O terminals. EtherCAT enabled a sampling time of only 10 μ s, and it was possible to visualize and analyze the values in real-time and with great detail using the feature-filled TwinCAT Scope 2 software library."

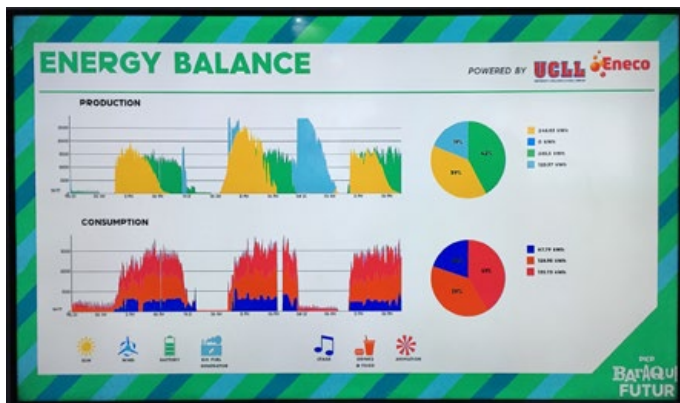
The university also conducted additional power quality studies at the festival. Since the Pukkelpop installation was not linked to the public power grid, the scientists could analyze in detail how the inverters and the AC/DC converters of the batteries affected the local network.

Consumption monitored in real-time

The music never stopped and the Pukkelpop Festival was a great success, with all stage performances running trouble-free on sustainable energy. In the green energy monitoring room, visitors could see how much power was generated and consumed on a moment-to-moment basis. Even the sound and lighting technicians could monitor their power consumption in real-time. Joël Claes: "They adhered to the specified limit of 12 kW at all times. Interestingly, the



The 2015 Pukkelpop Rock Festival in Hasselt, Belgium ran on green energy generated on-site.

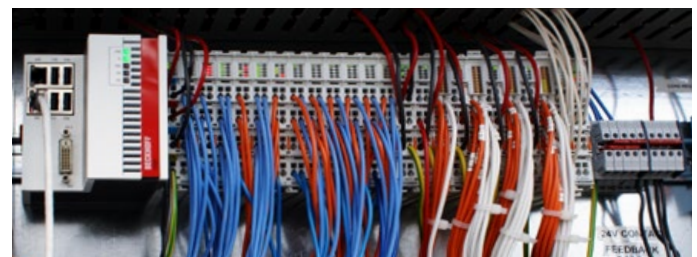


In a control room next to the stage, visitors could see in real-time how much energy was generated and where it was consumed.

ancillary activities around the festival consumed at certain times up to three times more electricity than the stage itself. At the 2016 festival, we want to expand the intelligent power grid by including these activities in the power monitoring as well.”

Openness and flexibility

A CX5000 Embedded PC provided a powerful control solution for the event. Based on continuous readouts, the local festival managers could switch between power sources and consumers in real-time to optimally allocate available power to the consumers. The decision to use the Beckhoff PC control platform was based on system openness and flexibility. An intelligent stand-alone power grid such as the one implemented for the Pukkelpop Festival is fairly unique – certainly for an application with such high power consumption that fluctuates greatly. Thus, the amount of flexibility the designers built in with various energy sources, backups and an open control system was necessary to ensure reliable supply of power. All in all, 307 kWh of locally generated, renewable power were consumed – a result that significantly enhanced the sustainability of the festival.



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Further information:

www.pukkelpop.be

www.ucll.be/

www.beckhoff.be