

Using Abundance Correctly – Power-to-Heat

The energy transition is in full swing. By 2050, the aim is for Germany to obtain the energy it needs primarily from renewable energy sources such as wind, hydro power, solar power, geothermal energy, and sustainable raw materials. However, a major problem so far has been a lack of sufficient options to store the energy. That is why Power-to-Heat (P2H) – the process of converting excess power into thermal energy – is becoming increasingly important as a suitable technology. ELWA Elektro-Wärme GmbH & Co. KG, based in Maisach near Munich, Germany produces Power-to-Heat systems for power plants using measurement and control technology from JUMO.

Energy management is relatively straightforward for conventional power plants. If more power is needed in winter or at night then one simply has to increase the plant's output. But that's not so easy anymore, especially with renewable energy. What should be done on a sunny, windy summer's day, when thousands of photovoltaic systems are running at full capacity and the wind turbine installations in the North Sea and Baltic Sea are generating a huge amount of energy? What can be done with all this energy from Mother Nature? This exact scenario arose on Mother's Day in Germany in 2016. As a result, energy producers even had to pay money for the excess energy to be fed into other networks.

These so-called "negative energy prices" are, of course, not a sustainable solution, and alternatives need to be found. One highly promising solution is to convert power into thermal energy. Power-to-Heat systems can be used in power plants, biogas plants, or with heat pumps. In the case of combined heat and power plants working together, P2H systems optimize efficiency and utilization. ELWA produces modular solutions which can be expanded at any time. They were developed with the aims of maximum operational safety, availability, and ease of servicing. The system comprises at least one power station with an individual output from < 100 kW to 1.68 MW. There is no upper limit on the number of power stations.

A heat output drop in a particular subsystem is immediately compensated by the other systems. If enough power has been held in reserve, the electrics and hydraulics of the faulty system can be disconnected to carry out maintenance work. Additionally, all components can be replaced using standard tools. The system does not require more installation space than an individual system offering the total output.

The stations are switched in parallel and are equipped with bypass pipes. The customer merely needs to connect the pipe connections and power cables. The ELWA P2H control system with its user-friendly 8.4 inch display is installed in a separate control cabinet, and can control any number of P2H

subsystems. Because of this, the system can be expanded at any desired time.

Safety is a particularly important aspect. P2H systems do not just require reliable power control, the measurands pressure and temperature must also be continually monitored and controlled. ELWA relies on JUMO products for these tasks.

For example, the reliable JUMO TYA 202 three-phase thyristor power controller is installed in the plants.

The JUMO TYA 202 switches resistive inductive loads using a three-phase economy circuit in star-delta three-phase operation. The microprocessor-controlled power controller displays all parameters in an LCD display with background lighting. It can be operated using the four keys at the front. The configuration can be carried out easily and quickly on the device thanks to the standard LCD with plain text display. A simple preconfiguration can be carried out via the mini USB connector on the front. The standard dual energy management enables an equal distribution of energy in the network, thereby saving energy costs.

All JUMO power controllers are equipped with an Ethernet-based communication protocol. This interface allows more data to be made available in a shorter time. As a consequence, the constant transfer of process data such as load current, load voltage, and impedance is possible. However, data concerning energy consumption and diagnosis functions such as mains voltage fluctuations, partial load failure, and excess temperature are also evaluated.

Another JUMO product that is used in Power-to-Heat plants is the JUMO dTRANS p02 DELTA pressure transmitter. It measures the differential pressure of non-aggressive and aggressive gases, vapors, and liquids (-40 to +85 °C). The pressure transmitter operates according to the piezoresistive measuring principle. The output signal is a load-independent direct current which is linearly proportional to the input pressure. For flow measurement, the output signal can be set with a square-rooted extracted characteristic line in relation to the input pressure.

ELWA also uses JUMO technology to monitor the temperature. The JUMO safetyM STB/STW safety temperature limiter reliably monitors heat-related processes and, in the event of a malfunction, puts the plants into a safe operating status. A range of different RTD temperature probes, surface-mounted thermostats, microstats, and the JUMO DICON touch two-channel process and program controller are also installed. If special operating media is being used, the JUMO AQUIS touch modular multichannel measuring device for liquid analysis is also available for monitoring purposes.

The plant is controlled entirely using the JUMO mTRON T measurement, control, and automation system. JUMO mTRON T, with its modular design, uses an Ethernet-based system bus and an integrated PLC. The universally deployable system stands out mainly with its simple, application-oriented, and user-friendly configuration concept. At its heart is a central processing unit with a process map for up to 30 input/output modules. The CPU has superordinate communication interfaces including a web server. For individual control applications, the system has a PLC (CODESYS V3), program generator and limit value monitoring functions, as well as math and logic modules.

In addition to enabling visualization of all processes, the convenient multifunction panel enables easy-to-operate controllers and program generators. User-dependent access to parameter and configuration data for the overall system is also supported. The recording functions of a full-fledged paperless recorder, including a web server, are implemented as a special feature. Predefined screen masks that come as a standard feature considerably reduce startup times. All acquired data is then analyzed and archived using the JUMO PCA3000 software.

Through the comprehensive portfolio for Power-to-Heat plants from ELWA, JUMO was able to offer an all-in-one solution from a single source, which won over the customer thanks to the wide variety of coordinated products.

Author:

Michael Brosig
Head of Press Office
JUMO GmbH & Co. KG, Germany
michael.brosig@jumo.net



Fig. 1: Detailed view of the plant with JUMO products



Fig. 2: Entire plant

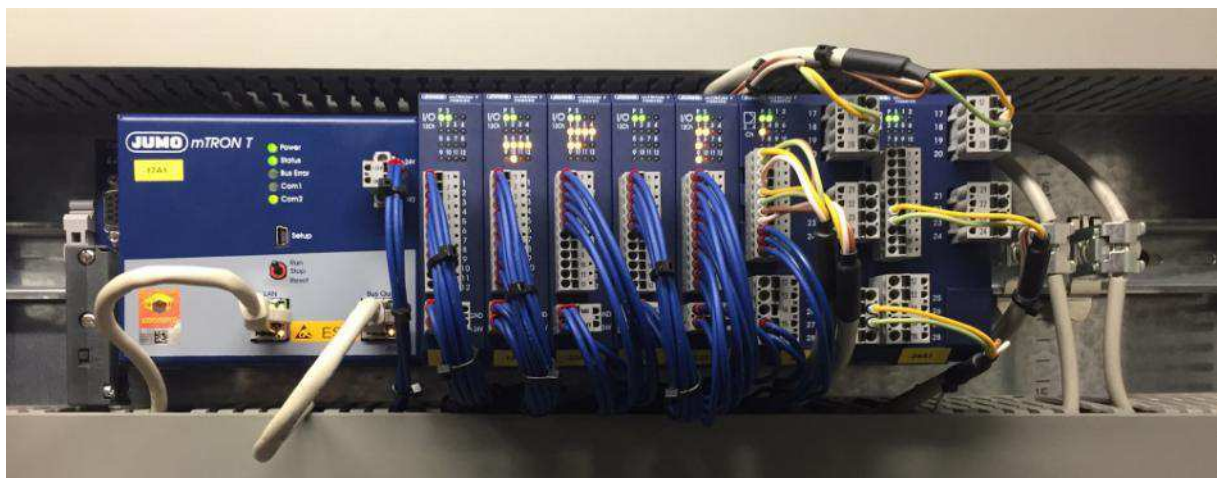


Fig. 3: Installation situation of the JUMO mTRON T



Fig. 4: The JUMO DICON touch – two-channel process and program controller



Fig. 5: JUMO dTRANS p02 series pressure transmitter