



Renewable energy feed-in management

Flexible connection concepts

The ambitious climate goals in Germany can only be achieved with a considerable change in existing infrastructures. This transition is already in full swing - the legally defined incentive systems (remuneration models) are taking effect and resulting in the desired continuous increase in generation and feed-in from localised energy sources such as PV, wind, CHP and biogas. However, the natural fluctuations to which some of these energy sources are subjected continue to cause considerable challenges in guaranteeing grid stability despite improvements in the forecasting capability of relevant influencing factors (such as wind and sunshine). To prevent grid overloading and for voltage stability, a power capacity of 5.5 GWh from renewable energy sources, with an equivalent value of about € 610m, had to be adjusted across Germany in 2017. In view of these volumes, feed-in management should be organised as effectively and efficiently as possible to avert unnecessary costs.

New framework conditions

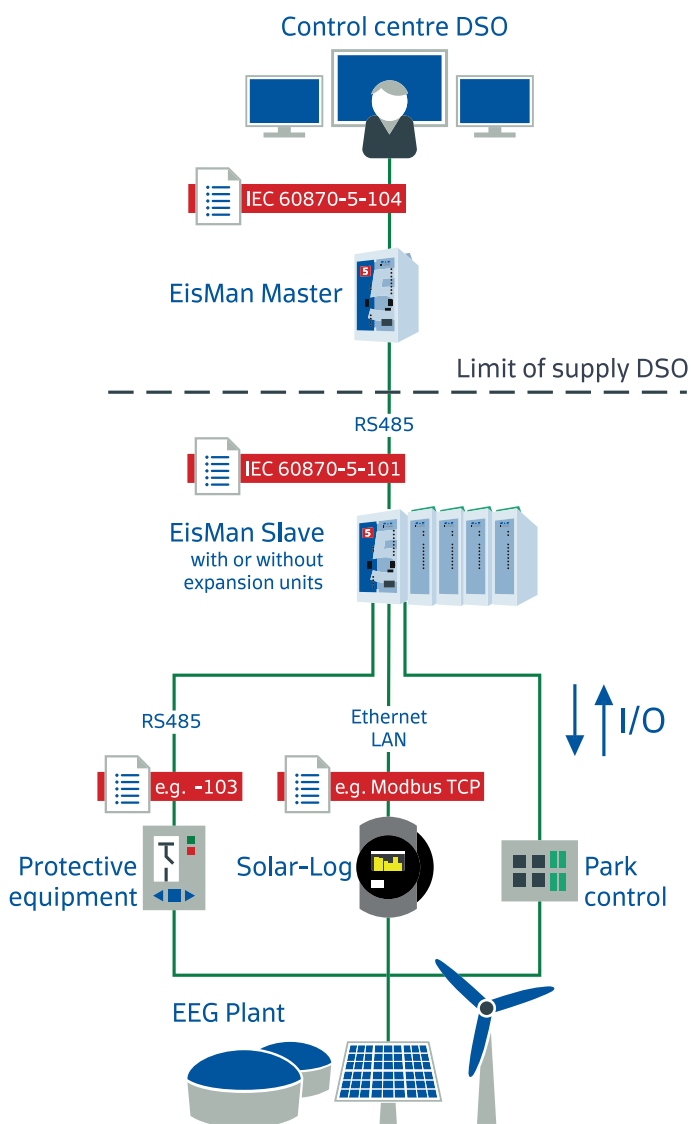
In addition to the requirements for monitoring and controllability of renewable energy systems, stipulated by law, recent years have also seen rapid changes to technical and organisational framework conditions in the supply sector:

- The continual availability of up-to-date information and intervention capabilities remotely are becoming more important given the higher number of decentralised feeders. In particular, the future must also see the ever growing number of small systems taken into account and monitored.
- The issue of IT security must be planned in as a key component of the solution and be understood as a continually advancing process.
- Extending beyond the two fundamental types for satisfying the requirements laid down in §9 of the German Renewable Energies Act (EEG 2017) for the monitoring and controllability of renewable energy systems
 - by using digital commands and signals
 - using closed-loop control with analogue set points and measurands a number of new control strategies and requirements have established themselves. Keywords in this context:
- Distribution System Operators (DSOs) are creating their own "standards" through the definition of technical connection conditions. As a consequence, the boundaries of responsibilities are also shifting, resulting in part to new procurement concepts. Plant builders and system operators are increasingly assuming responsibility for the procurement and installation of telecontrol equipment.

New requirements of the solutions

Following on as a consequence of the changed framework conditions, the requirements made of existing solutions are also undergoing change. Issues becoming increasingly important:

- Extensive pre-sales support
 - Assistance in the identification of telecontrol requirements for the respective technical connection conditions
 - Creation of solutions that are compliant with technical connection conditions
 - Consulting to avert costly errors upfront
- High levels of flexibility as regards connectivity of the telecontrol solution
- Capabilities for autonomous configuration and startup of the telecontrol equipment
- Simulation capabilities for preliminary testing
- Extensive diagnostic capabilities for speedy fault localisation and rectification
- Savings potential by using predefined, standard solutions.



Example of a connection concept in the form of EisMan Master/Slave



The most important basic devices for our renewable energy solutions (from left to right): FW-5-GATE, FW-5-GATE-4G, VPP-1 expansion module, m5

From the device to the solution

SAE IT-systems has set itself the goal of not only selling systems, but also to work together with our customers to find exactly the right solutions. For many years now, we have been facing the increasing complexity of this issue and have been working closely with many customers - from the conceptual design phase to project realisation. In the process, we have dealt with the most diverse range of control strategies, such as EisMan master/slave, and implemented them in countless technical configurations.

We are proud of the comprehensive know-how that we have accumulated in this market sector.

Our solutions, our recommendations

We create bespoke and ready-to-use solutions to your specifications in terms of capacity, communication channel, dimensions and housing type. Our solutions are based on powerful telecontrol units of the FW-5 family, and the m5 for the smallest of applications. Thanks to its compact base system with tailored expansion capabilities, the net-line FW-5-GATE is ideal for use in renewable energy plants. It complies fully with requirements in terms of available space, usable communication channels and protocols, and functionality. For connections to a mobile network, variants FW-5-GATE-4G and FW-5-GATE-450 of the FW-5-GATE are also available, with integrated mobile modem.

Inputs/outputs

The system can grow with the demands for volumes of information, and can be expanded with additional input/output modules. The VPP-1 and 4DI4DO expansion modules are of particular interest for this application area. They can convert the single and pulse commands of the control centre for specification of power stages 0%, 30%, 60% and 100% into persistent commands. The modes available:

- BBO (break before operation)
- BAO (break after operation)

So when the control centre specifies a new power stage, either a time gap or time overlap of the active power stages can be defined. The RES-1 expansion module enables acquisition of metered values as S0 pulses, as well as additional measurands and command outputs.

Typical components

Our solutions usually include the following components:

- Cabinets, enclosure and mounting plates
- Power supply units/UPS
- Terminal strips (with and without labelling)
- Wiring and connectors

Secure communication to German Association of Energy and Water Industries (BDEW) whitepaper

The security aspects of the BDEW whitepaper should generally be observed in the planning of systems and installations. For renewable energy installations, safeguarding communication plays a key role. We have been working hard on this issue. Our devices feature a high level of IT security, and are more than capable of facing up to the complex security and practical requirements of today and tomorrow.

- Secure encryption and hash algorithms, e.g. for encrypting project files with AES-256
- User profile with individual role based access control (RBAC)
- VPN tunnel from the station (end-to-end encryption with IPsec IKEv1/IKEv2 or OpenVPN protocol)
- Secure file transfer with FTPS (File Transfer Protocol over SSL), e.g. for station updating
- Secure web communication with HTTPS (HyperText Transfer Protocol Secure)
- Accesses and services such as USB port, USB Ethernet and web server can be disabled
- Integrated firewall (whitelist concept)
- Syslog for central logging of operational messages and processes

setIT configuration software

Within a network area, there are often multiple renewable energy systems of the same type that require identical configuration. Using the innovative setIT configuration tool, it is possible to select the necessary settings quickly, easily and intuitively. Process points, individual stations and entire communication lines can be duplicated using copy & paste. The intelligent duplication assistant propagates the settings of the original station but amends them in such a manner that directly executable parameter sets are produced in a clear structure. Predefined stations and stations already realised from other projects can also be incorporated. To adapt the station addresses to your control system, address data and defaults such as ASDU, IP address and constants can even be set from a web browser.



Web-based system visualisation

The optional visIT visualisation tool enables, by importing process variables from setIT, tailored user interfaces to be created easily. visIT runs as a web visualisation on the tele-control station and has access to its process data and archive values. This means all information relevant for service and operation can be shown (such as online values, operation logs and alarm lists). This enables service personnel on site to detect and rectify faults speedily and reliably. The software can be displayed on almost all HTML5-enabled terminals, smartphones and tablets.



More flexibility with PLC programs

setIT already provides extensive logic functions. With optional PLC programming using codeIT, FW-5 telecontrol units allow any type of regulation to be implemented. Analogue set points from the control centre can thus be converted into commands for the power stages in the PLC program of the FW-5. Conversely, single and double commands from the control centre can be converted into an analogue set point corresponding to the options at the power system connection point of the EEG plant.

For typical use in EEG plants we provide a PLC program which covers all requirements. In addition to management of the plant during normal operation, plant behaviour during failures can also be securely defined in this manner. The questions addressed include the following (*The information in blue italics is variable and can be adapted as desired in codeIT*):



How does a plant behave in the event of a power outage and system restart?

- If the power fails, *all active commands are reset*.
- When the system restarts, the command output for **100%** is selected as the initial value.
- If no communication is established after a system restart or if no power stage command is triggered when communication has been established, power stage **100%** (or the last valid value) is activated (*where necessary, cosine φ is specified*).

How does a plant behave in the event of communication failure?

If communication to the central components fails for longer than **300 seconds**, the command output for power stage **100%** is set (*where necessary, cosine φ is specified*). The system signal "communication fault", which is generated when the connection to the control centre is interrupted, is used as the start signal for time monitoring. This signal is delayed by the parameters which have been carried out in the protocol setting. When the connection to the control centre is restored after an interruption on the mobile radio channel, command power stage **100%** is set after **120 seconds**, unless another specification is made by the control centre during this time.

This is what ready-to-use solutions look like:



System with clever connection option for variable capacity

In a lockable Rittal cabinet, four or eleven single commands (from 5 kVA system rated power) are used to specify the power stages. Check-back takes place by means of the corresponding number of single-point signals. System disconnection command "Emergency off" and its check-back signal are also realised digitally. The actual feed-in of P, Q and U is measured by means of three separate measurands. The reactive power is classified with three single commands as underexcited, neutral or overexcited and acknowledged by single-point information.

A special feature of this configuration is the standardised wiring on specific connectors. This allows extremely simple and fast connection of the telecontrol station.



System with specification using set points for fine-tuning of power

The active and reactive power is specified by means of analogue set points with corresponding check-back by means of analogue measurands. Potential-free contacts allow the $\cos \varphi$ and Q(U) characteristic curves to be used for a reactive power procedure according to Section 2.5.4 of the Technical Guidelines for Generating Plants Connected to the Medium-Voltage System of the DSO. Furthermore, a double command is provided to prevent the plant from automatically recoupling to the power system. The installations are already loaded with the customer-specific configuration before delivery. After installation, the IP and ASDU addresses can be entered specifically for the plant using the web browser.



System with field-specific capacity and LTE connection

Whether for operation in accordance with the schedule or for short-term feed-in regulation - the lean solution permits different connection concepts to be realised. Check-back signal inputs for operating mode and power stage, power control via commands or set points, control stages according to German Renewable Energies Act (EEG) with BBO/BAO control modes, mains disconnection with monitoring, TCP/IP and serial ports, integrated LTE modem for mobile connection to strict security standards - everything included!

The typical starter solution

In the simplest case, the power stages are set as 0%, 30%, 60% and 100% with check-back taking place via three digital inputs/outputs (if no output is set, this corresponds to 100% feed-in power). A system disconnection command can optionally be set with a fourth output. The current active power is transmitted by means of an analogue measurand or is applied as a metered value via a digital input.



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