ELVAC RTU for Monitoring and Control of Renewable Energy Sources, EV Charging Stations, EMS and Other Systems in Smart Grids

Usual Applications

- Monitoring and Control System for Renewable Energy Sources (RES)
- Monitoring and Protection of Renewable Energy Sources Connection Points to the Distribution Network
- IED/RTU for Monitoring and Control of Technologies Connected to Energy Management System
- IED/RTU for Monitoring and Control of Balancing Authority

Location Specification

- solar / wind / hydroelectric / biogas / biomass power plant,
- combined heat and power (CHP/cogeneration) station,
- battery storage system,
- balancing authority area,
- electric vehicles (EV) charging station,
- building or enterprise with energy management system (EMS).

Typical Application Requirements

- monitoring and control of RES, energy storage systems or larger EV charging stations for distribution network/system operators (DNO/DSO) or/and facility owner, usually according to DNO operation rules,
- performance control over power plant, energy storage or charging station for network operators – power limitation for network protection, disconnection or switching off,
- regulation of reactive power (V/Q) and network frequency regulation,
- statistic data logging for network performance evaluation and prediction,
- system health status monitoring – maintenance planning,
- SMART GRID connection points monitoring, network disturbances recording and protection,
- system control in relation to the energy prices on market,
- local HMI for visualization of current states in RES and grid connection points,
- data concentration from all other devices in system – eg. energy meters, inverters, power quality meters, weather sensors etc.
- energy management of combined systems – power production, storage and local consumption,
- secure communication to SCADA and other systems,
- communication with SCADA system via GSM/UMTS/LTE or radio modem,
- communication protocols:
  - to SCADA – IEC 61850, IEC 60870-5-104, IEC 60870-5-101, DNP3, OPC UA, MODBUS TCP/RTU,
  - locally – IEC 61850, IEC 60870-5-104, IEC 60870-5-101, IEC 60870-5-103, DNP3, OPC UA, MODBUS TCP/RTU, DLMS.

Monitoring and control of renewable energy sources (RES) in connection to power distribution networks is essential for ensuring stable and efficient operation of the grid. This includes monitoring the output of RES such as solar and wind power, as well as controlling the flow of power from these sources to the distribution network to match changes in demand. It also includes using advanced control algorithms to manage the integration of RES into the grid, such as mitigating the impacts of intermittent power generation and reducing the need for fossil-fuel based power plants as backups.

One important aspect of monitoring RES is the use of real-time data to forecast power generation. This allows grid operators to anticipate changes in power output, adjust power distribution accordingly and allow for reserves for unexpected events. In addition, monitoring systems can detect and diagnose issues with RES equipment, such as malfunctioning solar panels or wind turbines, and dispatch maintenance crews to fix them. Overall, monitoring and control of renewable energy sources in connection to power distribution networks enables the integration of more and more RES into the grid, reduce the dependence on fossil fuel, and help to create a more sustainable and resilient power system.

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With the development of renewable energy sources, especially those dependent on weather and seasonal changes, there is also a close connection with the necessity of building systems for storing surplus energy during times of overproduction so that this energy can be used later when energy in the system may be lacking. Monitoring and regulation by operators of distribution and transmission systems are at least as important as the control over the energy production sources themselves. The technical means used and the demands on them are almost identical. Among the monitored variables, the current state of available accumulated energy (which can be supplied to the grid) and the amount of energy that the device is capable of further accumulating (taking from the grid) will be added. On the control side, managing the direction and volume of energy flow is crucial.

Another current topic in the field of energy system management is the construction of larger electric vehicle charging stations, especially fast-charging systems, whose power ratings already reach hundreds of kW per unit, and the electrification of freight transport can push these values even higher. Many charging complexes will be established at the sites of existing fuel stations, which will often require significant reinforcement of the distribution network at these locations. However, this will also necessitate a system for monitoring and regulating the operation of these stations by the distribution network operator. To cover peak consumption periods, it will often be appropriate to complement charging stations with local energy storage, which will enable the provision of fast-charging services even at times when the distribution network itself cannot provide a sufficient amount of energy. Additionally, it will allow for the purchase of energy for charging during periods when there is an excess of energy in the network, and its price is very low or even negative.

smelvee HUB – Municipal Small Electric Vehicles Charging and Organizing System

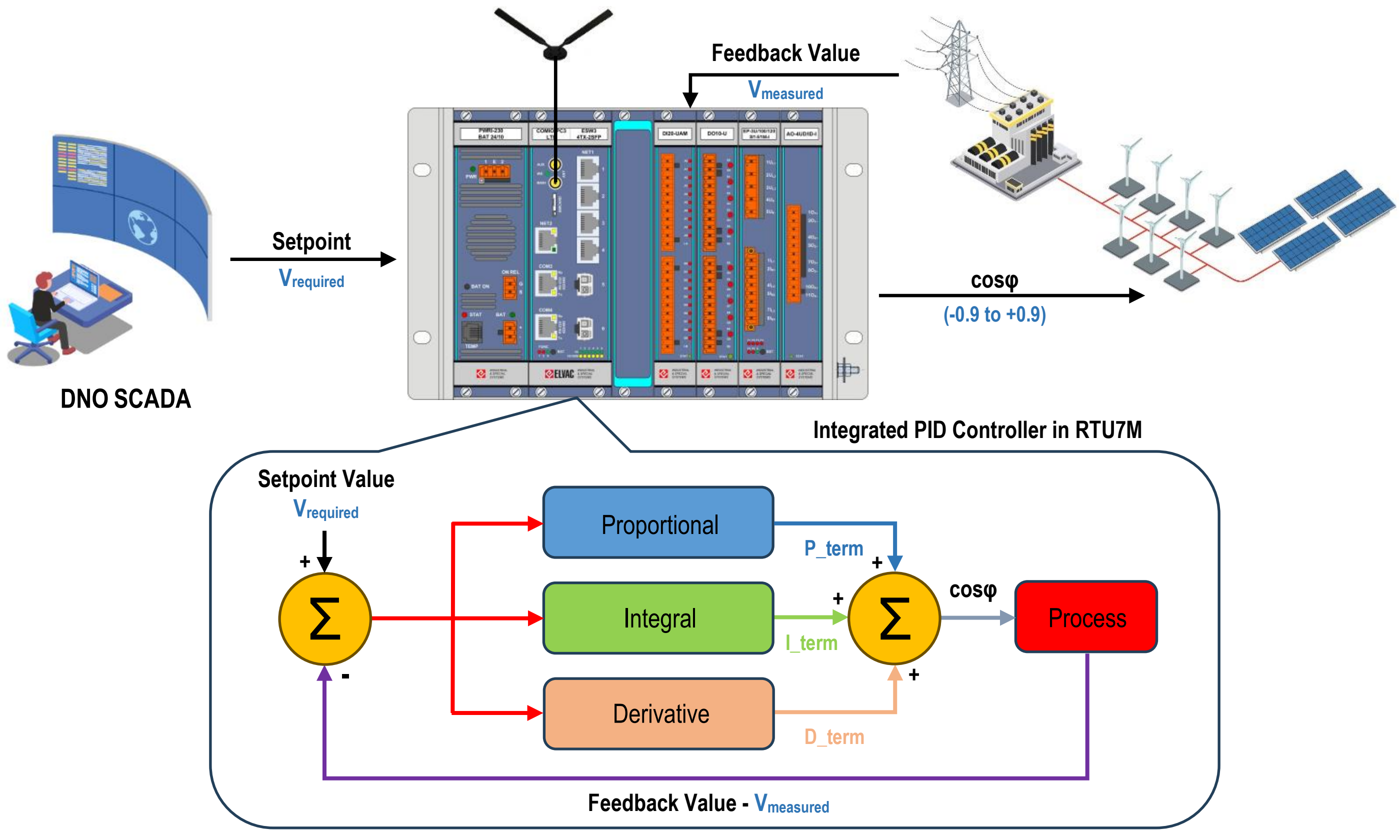
The development of ELVAC RTU systems takes into account all above metioned topics and future trends like energy sharing in community systems. In addition to standard monitoring and control features, it is possible to define automatic reaction of the system to the current financial situation on the electricity market for maximum consumer savings or, conversely, maximization profits of electricity producers.

V/Q Regulation

Primarily, the requirement to supplement V/Q regulation is implemented where production plants during their operation demonstrably negatively affect the quality of electricity for customers by causing significant voltage increases in the distribution system.

<u>Advantages of using V/Q regulation:</u>

- less probability of shutdown of production plants by protection due to overvoltage or undervoltage and related production losses,
- increasing the connectivity (installed power and number) of new power plants to the distribution system,
- elimination of negative impact on the quality of electricity for customers.



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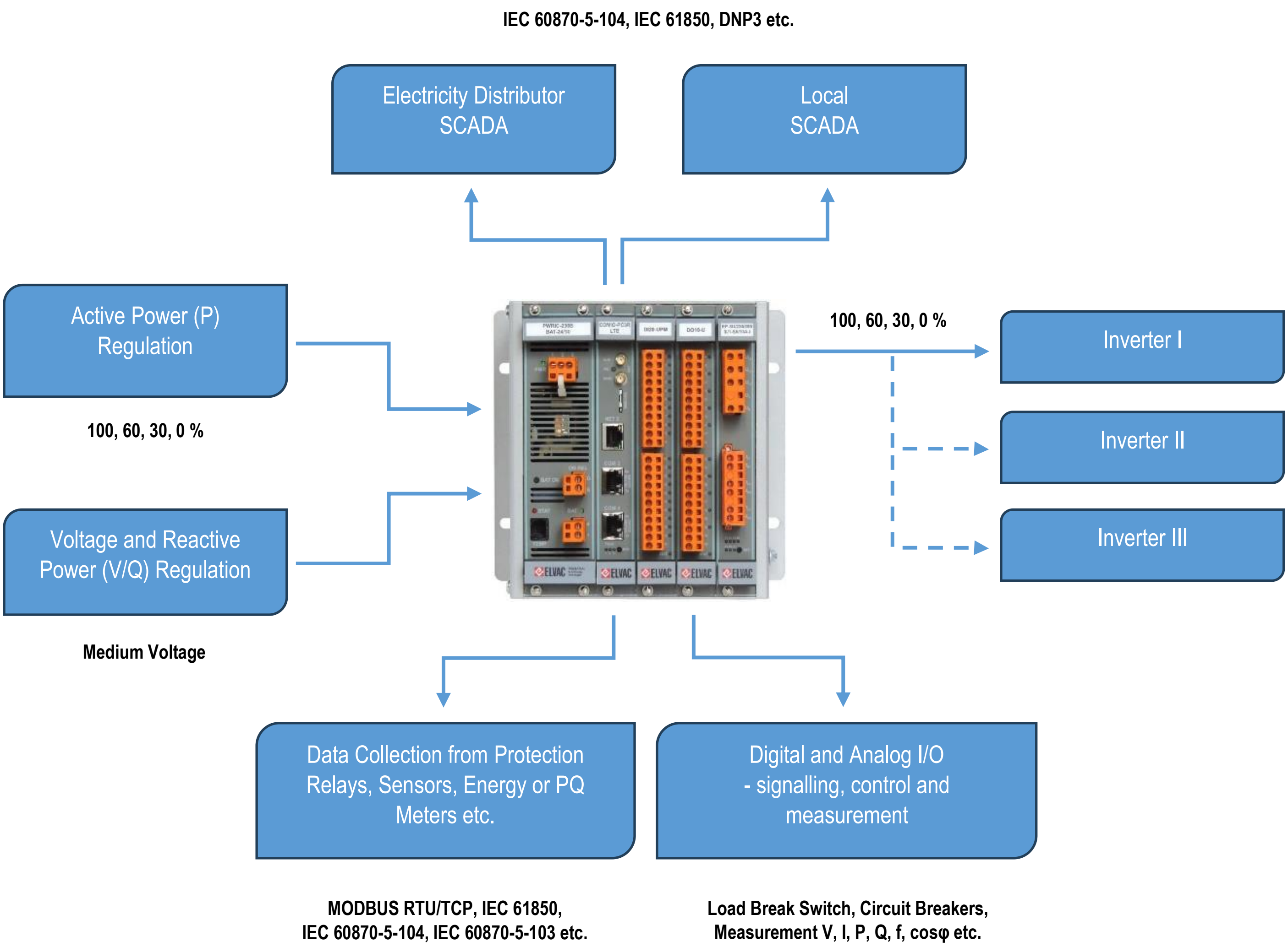
ELVAC RTU7M – System with Added Value

Monitoring of three-phase systems is a classic task of ELVAC RTU systems, and their development takes place in accordance with the current requirements of SMART GRID and IT technologies, such as secure communication. ELVAC RTU systems offer system flexibility thanks to many integrated functions, reducing overall system complexity and simplifying maintenance. ELVAC RTU systems meet the conditions specified by the distribution network operators without the need to use other equipment from other manufacturers.

<u>Integrated features in RTU7M:</u>

- communication with SCADA directly via embedded LTE modem with router functions, optionally via metallic or optical Ethernet,
- secure communication in relation to DNO cyber security requirements,
- integrated digital inputs for signaling the states of your renewables, EV chargers, or other devices in EMS,
- direct communication with inverters,
- active power regulation via communication interfaces or via integrated digital outputs for defining the performance (for ex. 0, 30, 60 , 100%),
- integrated PID controller for regulation of reactive power (V/Q),
- frequency regulation,
- direct voltage and current measurement in RTU for monitoring of the connection point of renewables into electricity distribution network (usually medium or low voltage), including fault detection (ANSI 27/59, 46BC, 47, 50, 50N, 51, 51N, 59, 59N, 67, 67N, 81), the protection relay function and disturbance recording (COMTRADE format),
- power quality measurement,
- programmable automation functions – standard IEC 61131-3 or ELVAC proprietary graphic interface,
- data collection from weather sensors or other optional devices,
- power supply backup in our RTU via power supply with battery charger,
- HMI support,
- data archiving.



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Configuration Example 1

This configuration is designed for monitoring and control of one 3-phase feeder of renewable energy source or other system mentioned above. RTU system is powered directly from 230 V AC and it solves also battery backup for system operation during power loss.

ELVAC RTU7M configuration:

Slot 1 – power supply card RTU7M PWRIC-230B BAT-24/10 with input for 80–260 V AC, with thermal sensor, this card solves also battery backup,
Slot 2 – communication card RTU7M COMIO-PC3-LTE with the following features:

a) wide communication protocols support including IT security features,
b) GSM/UMTS/LTE modem for communication with SCADA,
c) Ethernet LAN port for local parameterization and interconnection with local HMI, eventually for communication with other devices,
d) 2 x serial port for communication with other IEDs (e.g. power meters, power quality meters, inverters, weather sensors etc.),

Slot 3 – digital input card in version RTU7M DI20-UPM for external signaling voltage 24 V DC (wet contact),
Slot 4 – digital output card DO10-U for feeders control (switch), optionally for power plant performance,
Slot 5 – RTU7M EP series card with 3-phase voltage and current measurement, inputs specification depends on used type of sensors or measuring transformers (usual standards 100 V, 230 V, 1 A or 5 A, eventually low power sensors).

Note 1: In case of system topology, where the separate protection relays are used, the system can be delivered without measuring card and the measured data can be taken from a protection relay via a communication line.

Note 2: The modular architecture of the system RTU7M offers the unlimited scalability in terms of the number and types of communication lines, digital and analog I/Os, see our E-catalogue at www.rtu.cz .

Configuration Examples 2

This configuration is designed for monitoring and control of renewable energy sources, where all devices in the system have some communication interface and standard communication protocol. The RTU works mainly as data concentrator and controller. The additional digital I/O card is used for signaling and control of individual signals in power plant.

<u>ELVAC RTU7M configuration:</u>

Chassis – DIN rail mounting, backplane with integrated power supply 10 – 60 V DC (optional battery charger for backup during power loss),
Slot 1 – communication card RTU7M COMIO-PC3B-LTE (optionally COMIO-PC3) with the following features:

a) wide communication protocols support including IT security features,
b) GSM/UMTS/LTE modem for communication with SCADA (optionally Ethernet port for connection with customer standard to SCADA – specific type of modem, optical line etc.),
c) Ethernet LAN port for local parameterization and interconnection with local HMI, eventually for communication with other devices,
d) 2 x serial port RS-485 for communication with other IEDs (e.g. power meters, power quality meters, inverters, weather sensors etc.),

Slot 2 – combined 10 x digital input (dry contact) and 5 x output card in version RTU7M DI10-UAM DO05-U,
Slot 3 – free slot for optional system expansion (digital or analog I/O).

Example of RTU7M with integrated LTE modem

Power supply is integrated on backplane

Example of RTU7M without LTE modem, but dual Ethernet LAN

Configuration Example 3

When only communication interface between power plant technology and SCADA system is required, then the optimal solution can be our RTU7MC3-D, which works as:

- data concentrator from all devices in power plant,
- main communication unit to DNO or local SCADA via LTE modem or Ethernet LAN,
- router with Firewall.

RTU7MC3-D

Optional HMI panels for RTU7M

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