

REC SERIES AUTOMATIC CIRCUIT RECLOSER

REC15_AL / REC25_AL



 TAVRIDA ELECTRIC

ISO 9001:2008 certification
ISO 14001:2004 certification

Presentation

Introduction

Today Electricity companies across the Globe require increasingly sophisticated equipment to meet the demands of the automation and control of their grids and to ensure a continuous and reliable supply to electricity consumers. Switching equipment installed remotely on outdoor overhead lines should have inbuilt communications capability for data

retrieval and a long-lasting uninterruptable performance at low maintenance costs.

Tavrida Electric has accumulated 20 years of experience in solid-insulated recloser technology and is proud to present the Rec series automatic circuit reclosers.

- **Maintenance free**

The lifetime maintenance free Outdoor Switching Module (OSM) provides 30 000 rated current and 200 full rated short circuit CO operations.

Tavrida Electric Rec series reclosers are designed to keep utility expenses to a minimum over their entire lifespan. They are installed to significantly improve a network's reliability key performance indicators and their use results in a quick return on investment.

- **Lightweight**

Tavrida Electric's light weight vacuum circuit breaker and robust aluminum tank result in a total weight of 68 kg for OSM15 rated 15.5 kV and 72 kg for OSM25 rated 27 kV, making it the most lightweight outdoor switching module on the market.

As a result, shipment, handling, installation and commissioning are fast and simple.

- **Sophisticated measurements system**

The OSM 15 and OSM25 are equipped with six combined current and voltage sensors built into the bushings. This makes the Rec series reclosers ideal devices for selfhealing loop automation solutions.

- **Advanced control and protection**

Tavrida Electric reclosers provide protection from various faults, including: short circuits, earth faults, high impedance earth faults, broken wires, islanding, incorrect tap changer operations, network overload and over- or under-generation. Embedded Intelligent Electronic Device (IED), Remote Terminal Unit (RTU) and metering capability ensure that the Rec series reclosers are SCADA-ready with no additional expenses.

- **Advanced user software**

TELARM® user software provides exceptional management tools for power quality, for protection and for fault simulation along with advanced local and remote communications ability.

TEL SCADA® is the new release of the Tavrida Electric SCADA system, which targets the requirements of advanced distribution automation.

TEL SCADA® is a cost effective solution that allows utilities to view and monitor all types of data from remote sources and control field devices using an advanced graphical user interface.

- **Perfect solution for Smart Grids**

Complex measurement system combined with IED and RTU makes the Rec series recloser the perfect solution for Smart Grids. Tavrida Electric reclosers allow utilities to implement Smart Grid philosophies and deploy advanced self-healing or fault detection, isolation, and restoration (FDIR) systems.

- **Environmentally friendly**

The Tavrida Electric OSM is an air insulated outdoor circuit breaker with a patented combined insulation that makes it the environmentally friendly - no oil or hazardous SF_6 despite its compact size.

An aluminum tank offers excellent protection against corrosion. UV resistant silicon rubber bushings are capable of withstanding temperatures ranging from -40 to +55°C and provide excellent hydrophobicity.

Design reliability is proven by the most severe climate and heavy pollution tests at the Koeberg Insulator Pollution Test Station (KIPTS) in South Africa.





Application overview

The fundamental designation of automatic circuit reclosers is to provide consecutive auto-reclosing cycles in order to clear transient faults and minimize network outage time. In addition to reliability improvement and reduction of SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index) and MAIFI (Momentary Average Interruption Frequency Index), the Rec series reclosers can be used as a sectionalizer, automated load-break switch or outdoor protection device in substation and distributed energy applications. This flexibility in functionality makes the Rec series reclosers the perfect solution for various medium-voltage applications with rated voltages of up to 27 kV.

- **Feeder application: Radial line recloser**
When a recloser is installed on a radial feeder it automatically clears transient faults and isolates permanent faults. More than one recloser can be installed on a feeder to isolate faults selectively and ensure fewer customers are affected.
- **Feeder application: Loop recloser**
A loop recloser further improves the reliability of a power supply by automatically reconfiguring a network in the event of a failure.
- **Feeder application: REZIP recloser (sectionalizer)**
REZIP recloser is used to automate various networks where traditional time and current grading is impossible. Unlike a conventional recloser, the REZIP recloser can be used in ring and meshed networks and self-healing schemes. Any number of REZIP reclosers can be connected in series. The algorithm provides the set-up simplicity of a traditional sectionalizer and at the same time reducing the fault clearing time and network reconfiguration time in far more complex networks.
- **Substation application: Transformer and feeder protection device**
Tavrida Electric reclosers can be used to quickly build cost-effective unmanned outdoor substations. A recloser provides full protection and automation functionality required at the substations.
- **Distributed energy application: Renewable source protection device**
The Rec series automatic circuit reclosers offer the capability to easily connect various Distributed Energy Resources (DER) to the grid and enhance the reliability of the electricity supply. The reclosers have the ability to automatically disconnect the DER from the grid in case of power quality issues and to quickly connect it back when the power supply is stable.

Outdoor Switching Module – OSM

Introduction

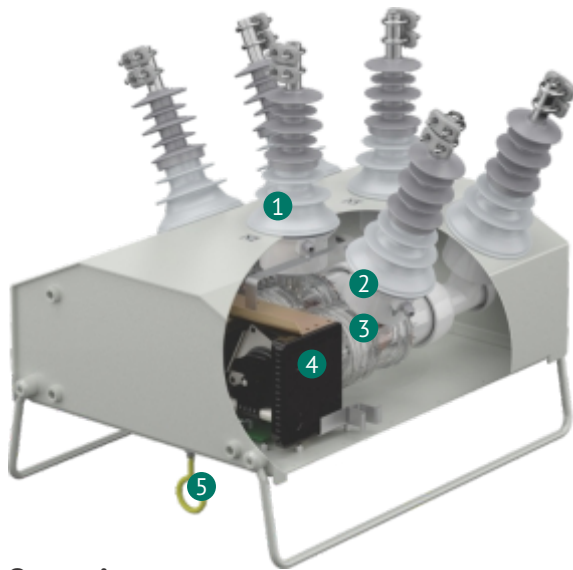
The Rec series automatic circuit reclosers make full use of the advantages of Outdoor Switching Modules enhanced with the application of combined voltage and current sensors providing accurate measurements of voltages and

currents (3 phase + residual). Recloser Control Cubicles (RC) have a powerful microprocessor to support protection and communications functionality suitable for radial and ring feeders with various types of neutral earthing arrangements.

Design

OSM15 and OSM25 provide switching and reclosing on power networks. OSMs utilize indoor switching modules (ISM) contained within a sealed tank. ISM incorporates vacuum interrupters (VI) inside a polycarbonate housing. Each VI is embedded in a polymer bushing. This bushing also encases current and voltage sensors to form single and completely solid insulation of each OSM pole. Voltage and current are measured on all six bushings. The bushing insulation is of a multilayer patented design. Polycarbonate provides mechanical support and excellent dielectric strength, while silicon rubber gives UV protection and an extended creepage distance. Being of the same kind, polycarbonate and silicon rubber, when applied together, create solid-state and jointless insulation without air-

bubble voids having the life expectancy of 30 years. This multilayer patented insulation with the unrivalled dielectric strength of 31 kV/mm withstands the lightning impulse voltage as high as 150 kV, which is the highest in its class on the market. The field-proven design is applicable for the use in aggressive environment such as sand storms, salt fog, steady downpour or snowfall and intense solar radiation. The tank is made of corrosion proof, powder coated aluminum and provides IP65 protection. This ensures maximum life and reliability with a fully insulated arrangement inside the durable aluminum alloy housing. The ceramic breather is located at the base of the tank to prevent a build-up of condensation. Voltage and current are measured on all six bushings.



- 1) Main circuit bushings made from UV-stable polymer and covered with silicone rubber.
- 2) Rogowski coils for current sensing and voltage sensors for voltage measurement embedded in all six bushings.
- 3) World's smallest vacuum interrupters with extremely long mechanical and electrical lifespans.
- 4) Three single-coil actuators linked by a synchronizing shaft.
- 5) Mechanical trip hook for manual opening of the OSM.

Operation

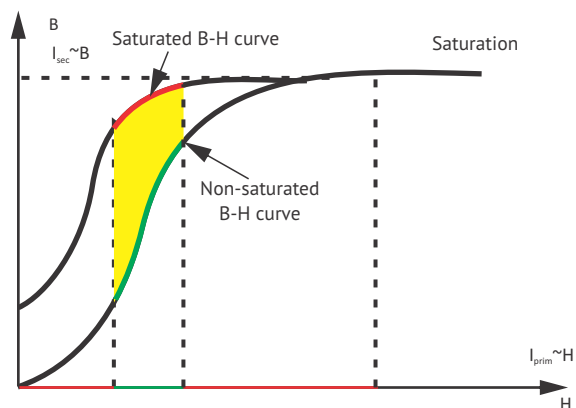
The OSM mechanism is operated by three separate magnetic actuators, one per pole. These magnetic actuators are mechanically interlocked to guarantee correct a three phase operation. The device is latched into the closed position by

magnetic latching. Each magnetic actuator utilizes a single coil which is used for both opening and reclosing operations and is the result of the "fourth generation" development of magnetic actuators by Tavrida Electric.

Current and Voltage Sensing

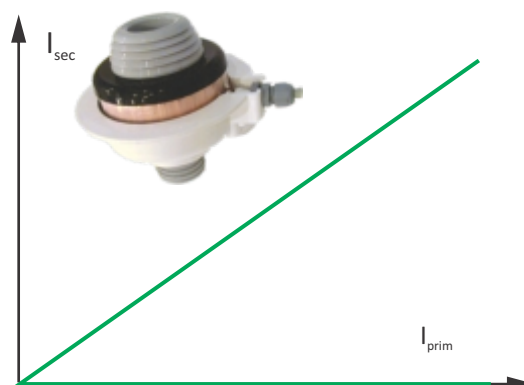
Voltage sensing is carried out by conductive rubber screens that are capacitively coupled to the HV terminals. Current sensing is performed by six Rogowski sensors, one sensor per each HV terminal. Rogowski sensors are current sensors that produce a safe, low voltage output. Three star connected sensor secondaries monitor phase currents and another three delta-connected sensor's secondaries provide residual current measurement. Rogowski sensors are fundamentally air-cored CTs making them unsusceptible to current saturation when exposed to fault currents. Furthermore, Rogowski sensors, unlike conventional current transformers, do not generate potentially hazardous voltages when the secondary is an open circuit, as the absence of an iron core

eliminates circuit loading and saturation concerns. As the iron core of the current transformer becomes more saturated, the CT's accuracy declines significantly, which limits the accuracy of its readings. CT's reasonable accuracy is only maintained for currents in the range between 20-120% of rated primary current. This means that conventional transformers are not efficient for identifying low currents where Rogowski sensors provide accurate primary current readings across all ranges and outperform current transformers. Excellent linearity of Rogowski sensors eliminates problems with selection of the CT rating which may need to be specified individually for a certain project.



Legend:

- High accuracy measurements
- Low accuracy measurements
- Measurement error caused by the core saturation



Benefits of using Rogowski Current Sensors:

- Wide dynamic range of measurement, giving current readings from milliamps to kA.
- Excellent linearity (Rogowski coils have no magnetic materials to saturate).
- No damage from large overloads & no danger from open circuited secondary windings.
- Non-intrusive current sensing drawing no power from the main circuit.

OSM technical specification

Parameter	Rated data	
	OSM15	OSM25
Current Sensing	6 x Rogowski Current Sensors	6 x Rogowski Current Sensors
Voltage Sensing	6 x Capacitive Voltage Sensors	6 x Capacitive Voltage Sensors
Rated maximum voltage	15,5 kV	27 kV
Rated continuous current	630 A	630 A
Peak withstand current, kA	40 kA	31,5 kA
Fault break capacity	16 kA	12,5 kA
Full Load Operations	30000	30000
Fault break capacity operations	200	200
Short time current withstand, 4 seconds	16 kA	12,5 kA
Cable charging current	10 A	25 A
Line charging current	5 A	5 A
Lightning impulse withstand test voltage	110 kV	125 kV/150 kV ¹
Power-frequency withstand test voltage (1 min. dry)	50 kV	60 kV
Power-frequency withstand test voltage (10 s. wet)	45 kV	50 kV
Ambient temperature	-40°C to +55°C	-40°C to +55°C
Degree of protection	IP65	IP65
Humidity	0 - 100%	0 - 100%
Altitude ²	3000 m	3000 m
Weight of the tank	68 kg	72 kg
Dimensions, LxWxH	744x644x649 mm	744x720x730 mm

1. Provided on request.

2. Altitudes above 1000 m should be de-rated in accordance with IEC 62271-111

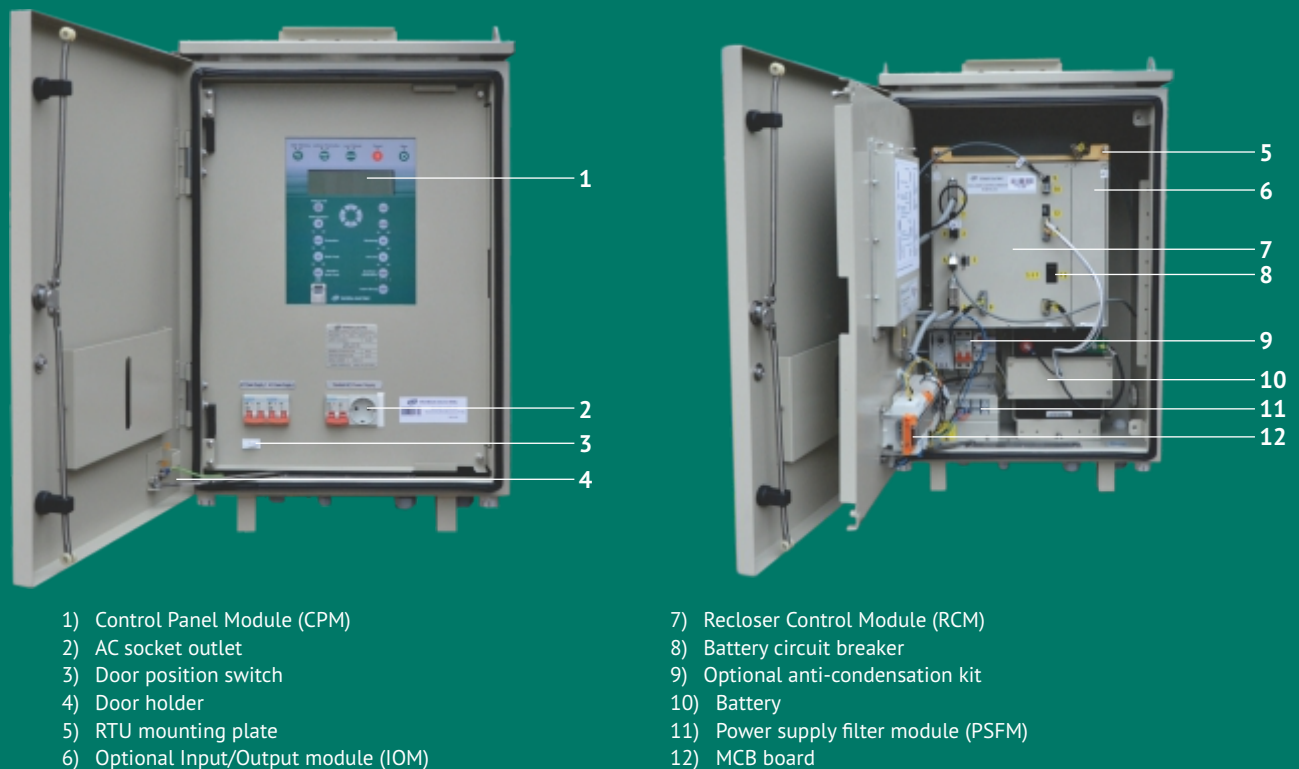
Recloser Control cubicle – RC

Introduction

Recloser control cubicles (RC) are microprocessor based controllers that provide advanced protection and automation, instantaneous metering, data logging and RTU for remote control in one single package

RC5_3 control cubicle

The recloser control cubicle RC5_3 is a new generation control box that is the result of more than 20 years of recloser production and service experience.



The enclosure is made from lightweight powder-coated anodized aluminum and provides an IP65 degree of protection. The control panel has a graphical LCD for clear event indication, comprising six-lines of 40-characters. Heavy duty battery for back-up power supply and smart charger are designed to provide optimum charging and long life of the battery up to 10 years.

Parameter	Rated data
Supply voltage, AC	85 – 265 V
Operating duty cycle	0-0,1-CO-1-CO-1-CO
Degree of protection	IP65
Ambient temperature	- 40°C...+55°C
Weight	41 kg
Dimensions, WxDxH	620x409x835 mm
Operating time after the loss of AC supply	48 hours at 25 °C
Remote control	In-built RTU, I/O module
Door limit switch	Yes
230 VAC socket for laptop	Yes

Protection and automation

Various protection elements: Directional overcurrent, directional sensitive earth fault, earth fault, over- and undervoltage, over- and underfrequency, current and voltage unbalances; separate autoreclosing elements, automatic backfeed restoration, voltage reclose control and many more.

Function	ANSI	IEC
Overcurrent	50/51	I>, I>>, I>>>
Earth Fault	50N/51N	I0>>, I0>>>, I0>>>>
Sensitive Earth Fault	50/51/67SEF	I0>/SEF
Auto-Reclose (4 shots)	79	AR
Undervoltage	27	U<
Overvoltage	59	U>
Voltage Unbalance (broken wire)	47	U2/U1
Current Unbalance	46	I2/I1
Underfrequency	81U	f<
Overfrequency	81O	f>
Automatic backfeed restoration	-	ABR
Synchro-check	25	SYNC
Loss of supply	-	LS
Hot Line (Live Line)	-	-
Cold Load Pickup Restraint	-	-
Inrush filter	68	-
Switch on to fault	50 SOTF	-
Lockout	86	-
User Defined Logic	PSL	-
Controller self-supervision	-	-

Measurements

The recloser can measure phase, neutral and sequence currents, phase-to-phase and sequence voltages and three-phase active and reactive power and energy.

6x Rogowski coils, and 6x Capacitive voltage sensors provide:

- Ia, Ib, Ic, I1, I2, I0
- Ua, Ub, Uc, Uab, Ubc, Uca, U1, U2, U0
- Active and reactive power and energy per phase
- Power factor, frequency

Data logging and monitoring

Highly comprehensive, remotely accessible separate log files for load and fault profiles, events, malfunctions, lifetime and change messages.

- Event log; 1000 events , up to 32 oscillography records
- Malfunction log; 1000 events
- Load profile; 9000 readings
- Fault profile; 10 000 readings
- Change messages; 100 records
- Comms log
- Protection counters
- Lifetime counters
- Log filling counters
- SCADA counters

Communications

The control cubicle has various local communication interfaces and can be connected with any third party modem via RS-232/RS-485 or the Ethernet using Modbus, DNP3, IEC 60870-5-104 TELARM® Protocol.

Interfaces		Protocols	
<ul style="list-style-type: none"> • RS-232 • RS-485 • GPRS 	<ul style="list-style-type: none"> • Bluetooth • Ethernet • USB 	<ul style="list-style-type: none"> • IEC 60870-5-104 • DNP3 	<ul style="list-style-type: none"> • Modbus • TELARM® Protocol (TDI)

TELARM® software

The Tavrida Electric Automated Relay Manager (TELARM®) is designed for the specific needs of electrical distribution networks. TELARM® user software provides a user friendly communication interface between RC and PC directly or via remote communications schemes and consists of three main applications:

TELARM® Basic gives control and indication functions via a personal computer interface (PCI):

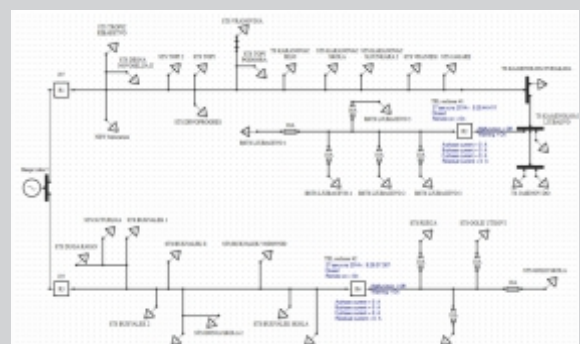
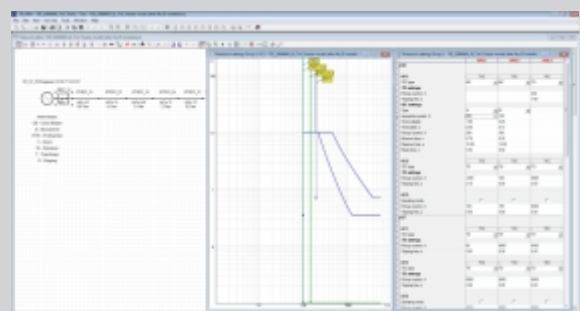
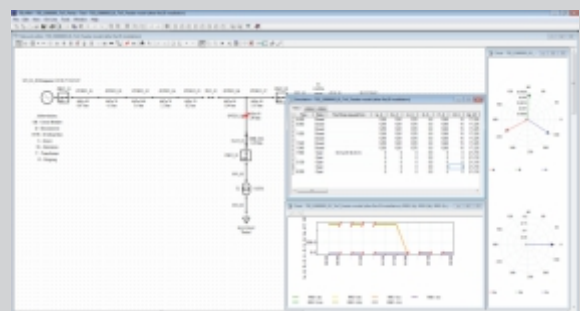
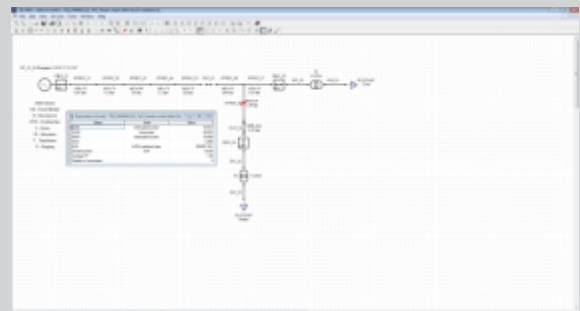
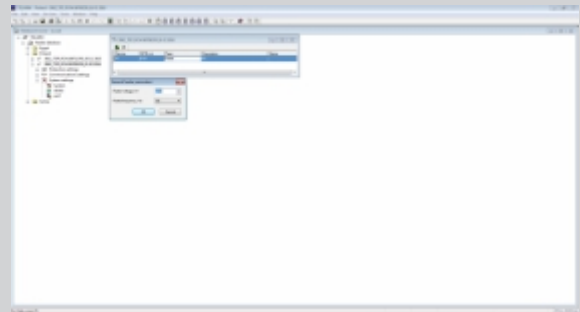
- Downloading of logs, profiles, oscillograms and settings;
- Uploading protection, communication and systems settings;
- Recording of logs and detailed fault profiles;
- Local control functions.

TELARM® Master provides the ultimate engineering tools:

- Off-line system designed with *Network editor* allowing users to make the electrical scheme of a network. Network elements such as lines, sources, reclosers, transformers, fuses, loads etc. with their parameters can be mapped in the scheme. Once the network data have been entered it is possible to find the ideal location of the recloser based on reliability indices (SAIDI, SAIFI, etc.).
- Software *Simulation* of normal or fault regimes on grids. While running simulation the dynamic behavior of all devices (fuses and reclosers) for the particular fault is calculated. Setting different fault types at different locations one can test the correctness of operation.
- Automatic or semi-automatic configuration of protection settings with the aid of Auto-coordination or Auto-correction algorithms. The auto-coordination algorithm takes into account all of the important factors generally considered by protection engineers. At the same time, it significantly reduces the requirements of the qualification of the engineer who is involved in setting calculations. It also allows for the substantial reduction of the number of man-hours required for programming the microprocessor relays.

TELARM® Dispatcher is proprietary remote control and monitoring system that works as a standalone elementary SCADA or in parallel with TEL SCADA or third-party system, acting as a back-up method of controlling and monitoring reclosers. TELARM® Dispatcher offers a number of features not available with most conventional SCADA systems, such as remote access to system logs, fault and load profiles and the remote control of protection settings. It features:

- Remote control functions;
- Graphical user interface;
- Remote downloading of indication data;
- Remote downloading/uploading of settings and logs.

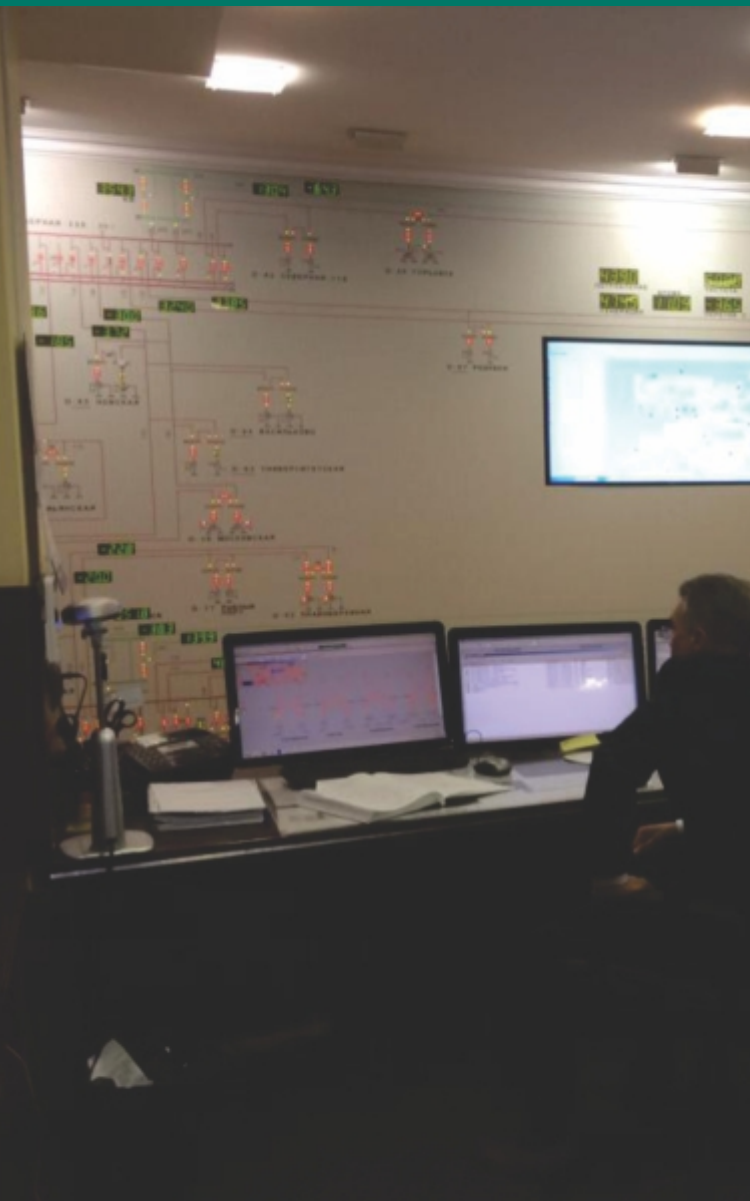


TEL SCADA® software

The Tavrida Electric TEL SCADA® system is designed to monitor and control Rec series reclosers or third-party equipment installed in overhead lines, substations and switching stations over standard communication protocols such as DNP3 and IEC 60870-5-101/103/104.

TEL SCADA® application provides the following benefits for utilities:

- Low-cost solution reduces utility's management costs and improves distribution network performance;
- Software architecture allows easy expansion of the system and adding new functionality;
- Configurable user-friendly interface provides easy monitoring and data management;
- Wide range of tools provides data filtering, storage, reporting and archiving capability
- Combination of TEL SCADA and TELARM software provides extra features for Tavrida Electric equipment such as log files remote download and configuration of settings.



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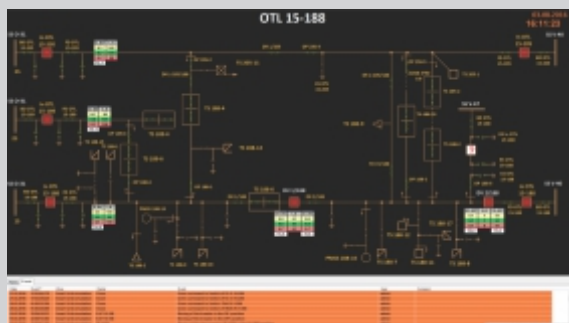
TEL-SCADA

TEL Rec series recloser

4.0.2016.07.31

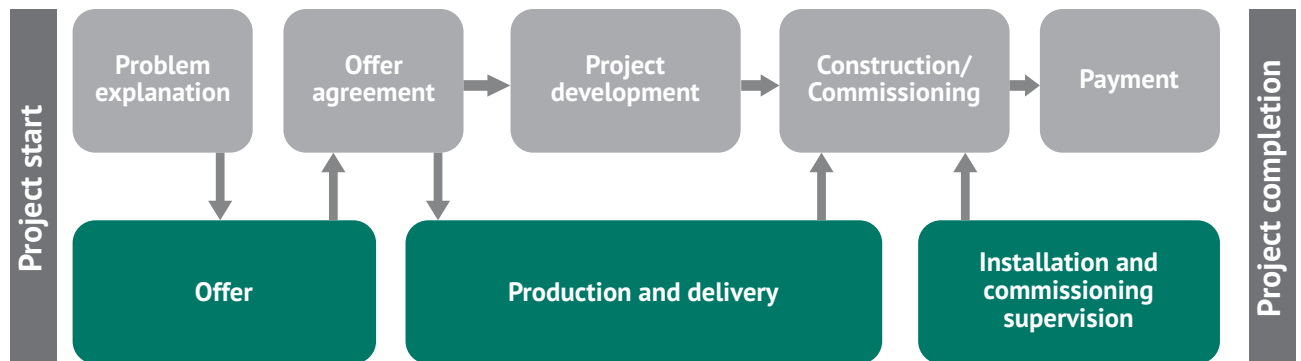
Integrator

(module assembly 22.06.2016)



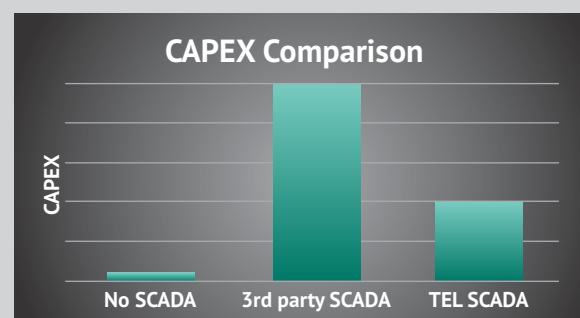
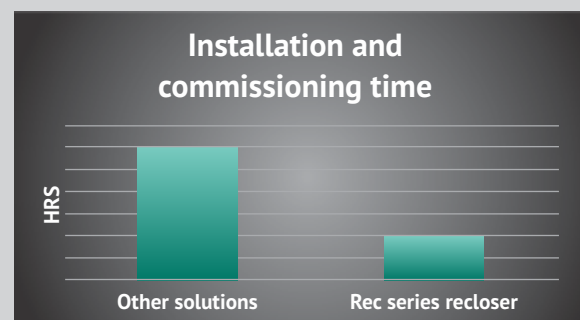
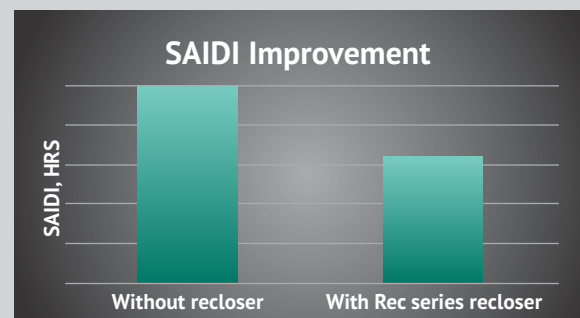
Smart approach for distribution automation

The utilities industry is becoming more and more complex, as Distribution Network Operators (DNOs) adapt to new regulations, integrate distributed generation sources, connect sophisticated intelligent devices and try to meet rising customer demands for smarter grids. The variety of available solutions makes the selection of appropriate equipment for the operators very difficult. Certainly, in the implementation of smart grids, utilities face one serious challenge - inefficient project management. Tavrida Electric provides true simplification for the DNO's. To be the market leader Tavrida Electric provides not only products but also turnkey solutions. Tavrida Electric proposes an ultimate project approach for automation distribution. To ensure that the recloser operates efficiently in the distribution network, Tavrida Electric experts analyze the system, identify the most feasible locations for installation and forecast the expected network performance improvement. To further simplify network automation, Tavrida Electric protection engineers calculate, upload and test protection settings prior to site delivery. As a result, the recloser is designed to be a Plug and Play solution.



Tavrida Electric project approach provides the following benefits:

- A full scope of services from careful analysis to solution development, project implementation and customer support throughout the equipment lifetime ensures investment efficiency. Tavrida Electric specialists analyze the customer's problem to identify the root cause and engineer the optimal solution to decrease the number of interruptions and power outage time.
- Configured settings and project supervision guarantee high performance and cost-effectiveness by reducing engineers' and maintenance personnel man hours. Saved time allows utilities to focus on greater significance tasks and completing more projects.
- TELARM® Dispatcher or TEL SCADA ensure easy remote control and provides hierarchical information of the power grid. The essential part of Smart Grid solutions is an efficient supervisory control and data acquisition system. This is crucial for operational expenditure and network performance optimization.



Reference list

South America:	> 8 500 pcs.
North America:	> 1 200 pcs.
Australia:	> 3 000 pcs.
South Africa:	> 3 000 pcs.
North Africa:	> 1 500 pcs.
Russian Federation:	> 4 500 pcs.
Middle East:	> 500 pcs.
European Union:	> 5 000 pcs.
Other countries:	> 10 000 pcs.

>10 years
on the market

~30%
of world market

>40K
automatic
circuit reclosers
in operation



Mexico



Oman



Estonia



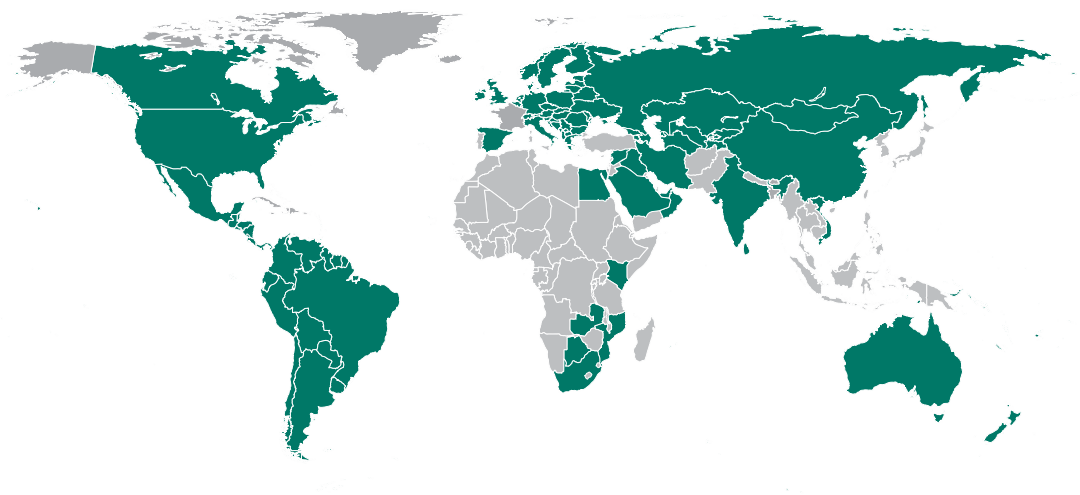
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China



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