sigma **ECM**®

EQUIPMENT CONDITION MONITORING

Treetech

FOR MORE THAN 25 YEARS, TREETECH HAS PIONEERED IN THE DEVELOPMENT OF INTELLIGENT SENSORS AND ONLINE HIGH-VOLTAGE DEVICE PROGNOSIS, DIAGNOSIS, AND MONITORING SOFTWARE IN ORDER TO MAINTAIN THE ELECTRICAL SYSTEM CONTINUITY WITH SAFETY AND REASONABLE COSTS. TODAY, THERE ARE MORE THAN 90,000 SENSORS AND 400 SYSTEMS OPERATING IN 50 COUNTRIES.

WITH A CROSS-FUNCTIONAL TEAM COMING FROM MORE THAN 35 YEARS OF JOINT PRESENCE AT TECHNICAL AND MANAGERIAL LEVELS IN POWER SUPPLY COMPANIES, DEVICE MANUFACTURERS, AND IT AND ELECTRONIC AREAS, TREETECH DEVELOPS INNOVATIVE, INTERNATIONALLY AWARDED SOLUTIONS, AND WITH TENS OF INTELLECTUAL PROPERTY REGISTERS BOTH IN BRAZIL AND ABROAD.

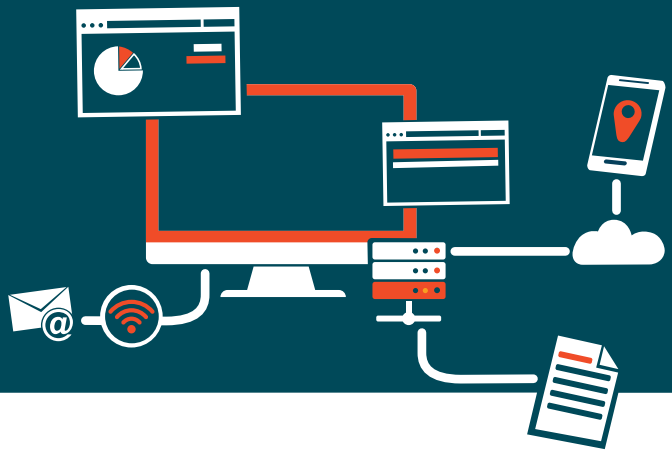
ENCOMPASSING THIS ENTIRE KNOWLEDGE, TREETECH HAS DEVELOPED THE SIGMA ECM®, THE MOST COMPLETE AND INNOVATIVE ELECTRIC DEVICE OPERATING STATUS DIAGNOSIS AND PROGNOSIS SOFTWARE TO BE USED BY MAINTENANCE ENGINEERING TEAMS IN MANAGING POWER SUPPLY AND INDUSTRIAL COMPANIES SUBSTATIONS.

SIGMA ECM®

A MONITORING SYSTEM SHALL BE CAPABLE OF DIGITIZING DATA GATHERED IN THE SUBSTATION AND TRANSFORMING IT INTO USEFUL INFORMATION FOR DECISIONS TO BE TAKEN BY MAINTENANCE, OPERATION, AND PLANNING. THE TREETECH MONITORING SYSTEM CONSISTS OF INTELLIGENT ELECTRONIC SENSORS (IEDs) AND SIGMA ECM® SOFTWARE, CAPABLE OF ONLINE MONITORING POWER TRANSFORMERS AND ENABLING THEIR SMART MANAGEMENT.

VARIABLES ASSOCIATED WITH DEVICE STATUS AND OPERATION ARE GATHERED BY THE IEDs AND FORWARDED TO SIGMA, WHICH TREAT THEM WITH MATHEMATICAL ALGORITHMS AND MODELS DEVELOPED IN COMPLIANCE WITH BRAZILIAN (NBR) AND INTERNATIONAL (IEC AND IEEE) STANDARDS. SUCH TREATMENT LEADS TO THE DIAGNOSIS OF THE CURRENT EQUIPMENT STATUS AND ITS FUTURE STATUS PROGNOSIS, IN ORDER TO DETECT DEFECTS THAT ARE STILL ON THEIR EARLY STAGES.

THE SOFTWARE-LOADED PC CAN BE LOCATED IN THE SUBSTATION CONTROL ROOM OR ON A REMOTE LOCATION, ALLOWING ACCESS TO ALL INFORMATION TO OTHER PERSONS CONNECTED TO THE INTRANET NETWORK.



THE SIGMA ECM® ACQUIRES, STORES AND TREATS MEASUREMENTS PERFORMED ON MONITORED EQUIPMENT, GENERATING THE DIAGNOSIS AND PROGNOSIS OF EVENTUAL PROBLEMS THAT MAY LEAD TO ELECTRIC POWER SUPPLY INTERRUPTIONS

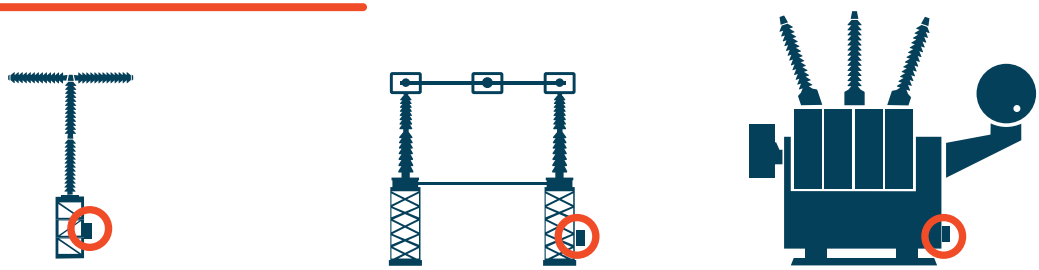
Modular and **Scalable**, the sigma ecm adapts to your companys technical needs and features the following functionalities:

- Data digitizing
- Portability
- Alarm classification
- Customized initial screen
- Device Diagnosis and Prognosis
- Event history
- Oscillographies and graphs
- Engineering modules
- Chromatographic and physical-chemical reports

SYSTEM

TOPOLOGY

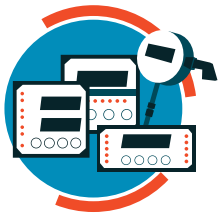
The **ECM®** follows-up online the operation of all power substation devices. It acquires and stores all measurements (electrical, mechanical, and chemical), which are monitored by the installed IEDs, creating the **bequipment behavior history databank** during the entire operation.



SUBSTATION DEVICES

TESTS, REPORTS, AND ADDITIONAL INFORMATION

The user may enter Chromatographic and Physical-chemical Tests. From such data, the Sigma system generates reports and automatic analyses about the device, based on pre-selectable methods. Additionally, the user may enter a series of information about its device into the system, generating reports and analyses with achieved data.



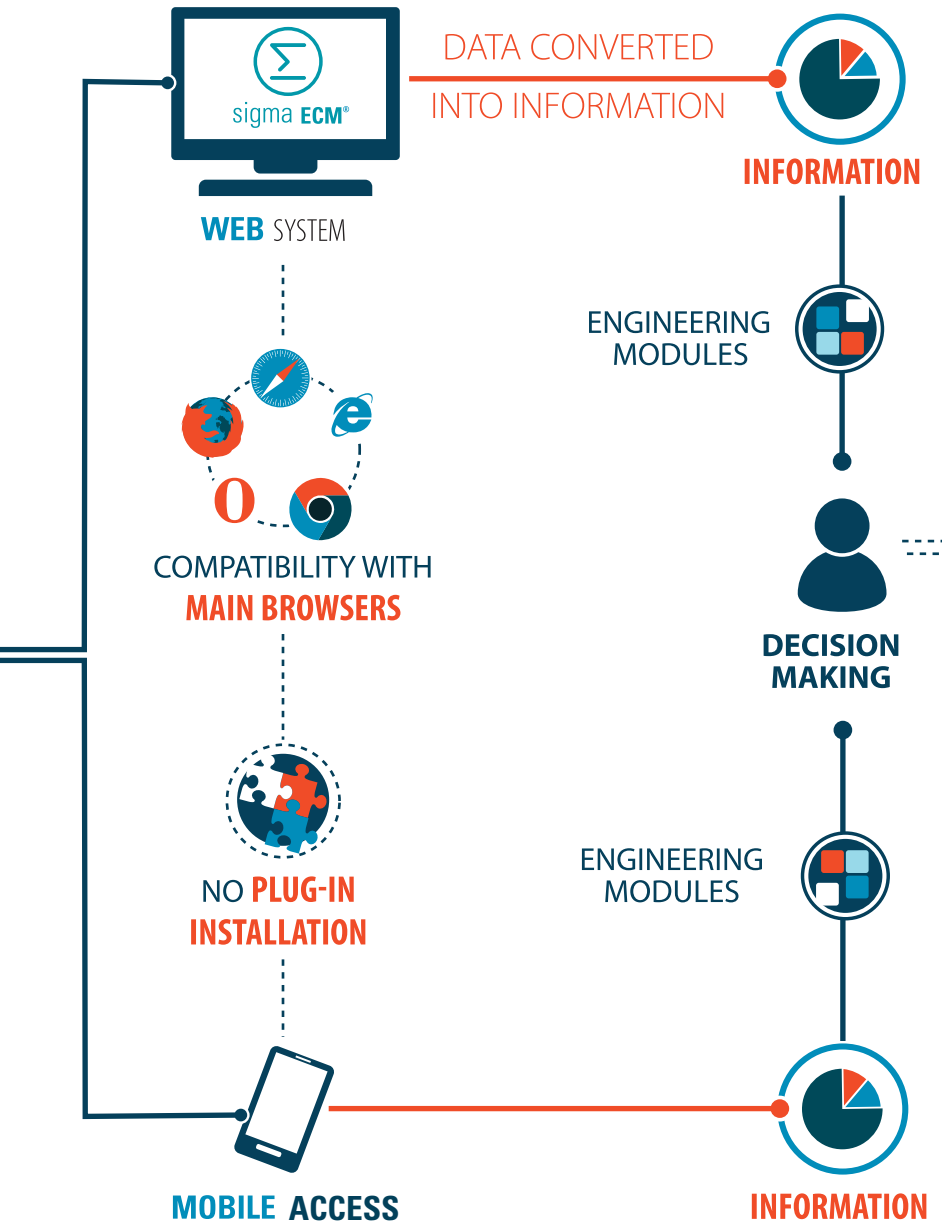
INSTALLED SENSORS

Variables associated with device status and operation are gathered by the IEDs and forwarded to the Sigma ECM®, which treats them by means of mathematical algorithms and models developed in compliance with Brazilian (NBR) and international (IEC and IEEE) standards. Such treatment leads to the diagnosis of the current equipment status and its future status prognosis, in order to detect defects that are still on their early stages.

DATA

Treetech IEDs are autonomous, resistant to extreme temperature variations and to electromagnetic interference and exceed the quality requirements demanded by national and international technical standards.

DATA IS CONVERTED BY THE **SIGMA ECM ®** INTO **INFORMATION,** SUPPORTING THE USER IN THE **DECISION-MAKING** PROCESS



PREVENTIVE MAINTENANCE

The Sigma ECM® features all **alarms** from sensors installed on devices, and it also allows the user to classify them, making it easier to **identify the most severe problems** supporting **maintenance management**.

PREDICTIVE MAINTENANCE

The Sigma ECM® generates statu**diagnosis** and **prognosis** for each piece of equipment, enabling to **anticipate possible** failures.

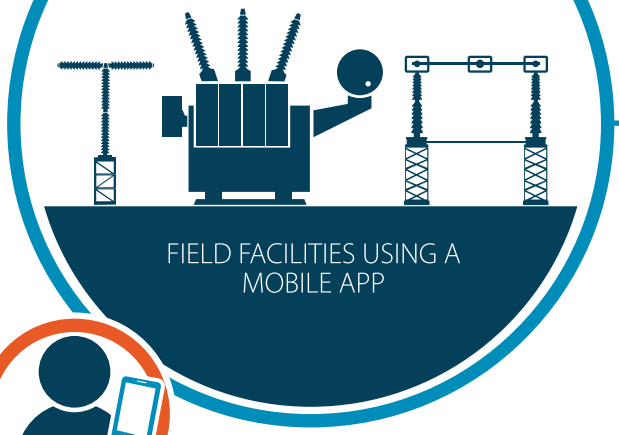
EXPERT SYSTEM

It performs sensor and engineering model **information crosscheck** from an array of decision-making rules for discarding hypothesis, establishing causes, recommending actions, and providing prognosis about future problems.

COMPLETE AND MODULAR

The system serves **monitors all substation devices** (power transformer, circuit breaker, switch disconnector, CT-PT, and dry transformer).

SYSTEM **BENEFITS**



MODULAR SYSTEM

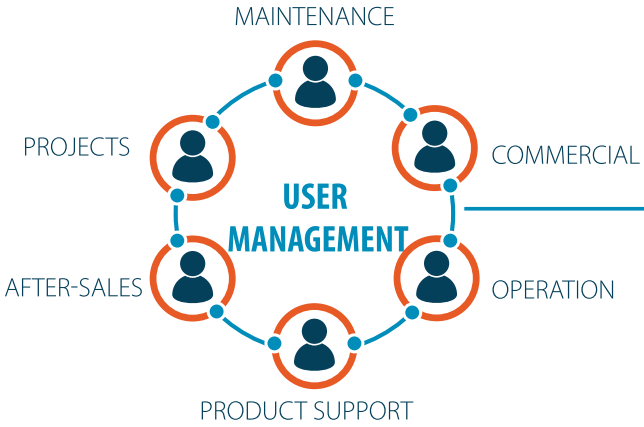
Each of the IEDs works independently in the system. They do not require centralizing devices such as PLCs and MMIs; All devices are integrated into the same platform; Use of already existing sensors; an IED can be installed as a standalone sensor for later being added to others.

FIELD SERVICES

WI-FI GPRS RADIO

COMMUNICATION

Communication between IEDs and the Sigma ECM® can be implemented by means of wireless technology (GPRS, Wi-Fi, Wi-Max, Radio), twisted pair or fiber optics.



MULTI-USERS

Several users can simultaneously access the software with different clearance levels. A system operation history is recorded for administrators control purposes.

CONTROL ROOM

SYSTEM **MODULES**

The Sigma ECM® has been developed so that the user can have a pleasant experience, with tools and resources that make information access easier and without requiring plug-ins to be installed. Additionally, Sigma ECM® resources have been developed with technologies compatible with main browsers.

SUPERVISION

Digitizing main measurements from sensors installed in the transformer. It is important to point out that the Sigma ECM® is capable of integrating different equipment/systems from different manufacturers.

SYSTEM

Feel free and customize your initial page with the information customer deems relevant or view whether there is any alarm engaged. Therefore, every time you login the Sigma ECM®, you will have this updated information beforehand.

View and define the Sigma ECM® users clearance levels, from accessing supervisory items, engineering to receiving e-mails

Control the Sigma ECM® public. Follow how frequently users are accessing the monitoring system by means of reports the administrator can consult by periodicity our per user;

Access to the Sigma ECM® for as many users as required. The user is not bound to a limited number of simultaneous accesses.

Plot graphs with any variables you want and benefit from zoom and graph point amount resources without installing plug-ins or export data to any spreadsheet you want.

EXPERT

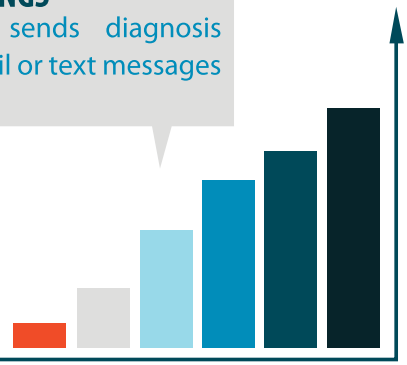
The Expert module is capable of crosschecking information gathered from sensors and from diagnosis generated by engineering modules, indicating the diagnosis and the recommended action.

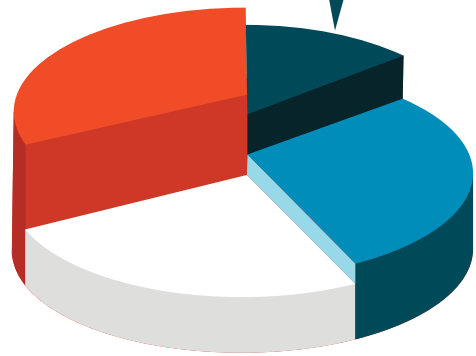
AUTOMATIC WARNINGS

The system automatically sends diagnosis warnings and alarms via e-mail or text messages (SMS).

OSCILLOGRAPHY

Download switch or circuit breaker motor power consumption, voltage, and current curve oscillographies.





ALARM CLASSIFICATION

Each alarm, from each sensor, can be classified according to user-established criteria.

TRANSFORMER REGISTER

Specific electric device register, making its identification easier. Possibility of connecting the companys ERP system and attaching files.

BI INTEGRATION

The system allows full integration with BI platforms, thus enabling dashboards to be generated and an intuitive information view.

EXPERT SYSTEM

This tool crosschecks information from sensors and engineering models, based on an array of decision-making rules for discarding hypothesis, establishing causes, recommending actions, and providing prognosis for possible future problems.

SUBSTATION/REMOTE

SWITCH TEMPERATURE DIFFERENTIAL

Together with temperature monitors, it allows detecting switch thermal failures at their early stage, thus preventing major problems from happening.

FINAL WINDING-OIL GRADIENT

It foresees future oil and winding temperatures after thermal stabilization, based on existing load currents and room temperature conditions.

CHROMATOGRAPH/PHYSICAL-CHEMICAL TEST

It evaluates and stores laboratory-conducted test data by means of IEC 60599 and IEC 60599 Duval methods.

COOLING EFFICIENCY

Together with temperature monitors, it monitors the cooling system efficiency, detecting any efficiency reduction by comparing measured temperatures against expected ones.

LOAD SIMULATION EXISTING AND HYPOTHETICAL CONDITIONS

Together with TM1 and TM2, it allows simulating the transformer load, checking how the oil, winding temperatures should evolve, as well as the operation of cooling elements, and the insulation work life reduction.

ENGINEERING

COOLING MAINTENANCE

Assisted by a contact, it allows accurately knowing the operating time of fan and pump arrays.

SWITCH MAINTENANCE

Together with the switch torque monitor, it allows a switch status-based maintenance, such as: squared switched current sum (I2), total number of operations, and overall switch service time.

INSULATION AGING

In addition to temperature monitors, it online evaluates the insulation work life reduction, indicating the current remaining work life percentage.

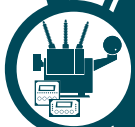
WATER ON PAPER

With a moisture monitor and temperature monitors, it online monitors moisture on oil and solid insulation.

THE COMPLETE SOLUTION

SYSTEM ARCHITECTURE

Local and autonomous device intrinsic protection
Local and autonomous command and control
Maintenance-free sensors
Data supplied to the Online Monitoring System.
Largest world range of intelligent electronic sensors



INTELLIGENT SENSORS INSTALLED ON ASSETS

CONTINUOUS DEVICE OPERATION PARAMETER MEASUREMENT

ONLINE DEVICE MONITORING, DIAGNOSIS, AND PROGNOSIS

ONLINE MONITORING SYSTEM

sigma ECM®

Data transformed into information for making decisions
Maintenance engineering optimization
Device accident prevention
Reduction of penalties due to unexpected device shutdown
Reduction of insurance costs

Maintenance activity optimization and standardization
Maintenance interface with the operation
Managerial maintenance effectiveness indicators
Operational cost optimization
Maximization of return of investment

sigma EAM®

ADVANCED DEVICE MANAGEMENT SYSTEM

SMART MANAGEMENT OF MAINTENANCE PROCESSES AND EXECUTION RESOURCES

RESULT BENCHMARKING AND KPI CONFIGURATION

SCADA, ERP, AND ONS SYSTEM INTERFACE

ERP

Real time support to the operation
Systemic event indication and recording
Business administration interface
Financial planning information

CASES OF SUCCESS

1 BRAZIL

Celeo Redes S.A. Complete solution: Sensors, Sigma ECM®, and Sigma EAM® for managing devices and maintenance of transmission lines, high-voltage equipment and protection, command, and control systems.

Eletrosul Corporate Sigma ECM® System, monitoring 27 transformers

Cemig Pioneer in circuit breaker monitoring. Large-sized transformer failure prevented by bushing monitoring

2 UNITED STATES

WAPA Treetech solution chosen as patterns and approved as Single Source

SDG&E Blackout prevented in one of the largest power companies in the United States

3 PORTUGAL

REN - pioneer in power transformer monitoring

4 INDIA

CLPT - power transformer monitoring system

5 AUSTRALIA

Queensland Railroad - online transformer monitoring sensors and system

AWARDS AND ACHIEVEMENTS

PSQT NACIONAL 2010 - 1st place in the Innovation category

FINEP NACIONAL 2010 - 1st place in the Innovation category

CNI SP 2008 - Sigma4web® awarded as the best product in Innovation and Productivity

EXPORTA SP 2016 - 1st place as highlight in adapting products and processes for export..

SINGLE SOURCE WAPA - Treetech solution approved as Single Source by WAPA/DOE USA

ORDER OF MERIT - Commander title by appointment of the President of the Republic (Decree nr. 6,247/07, art. 2nd, line III)

SOLUTIONS INSTALLED IN **50 COUNTRIES**

September, 2018

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