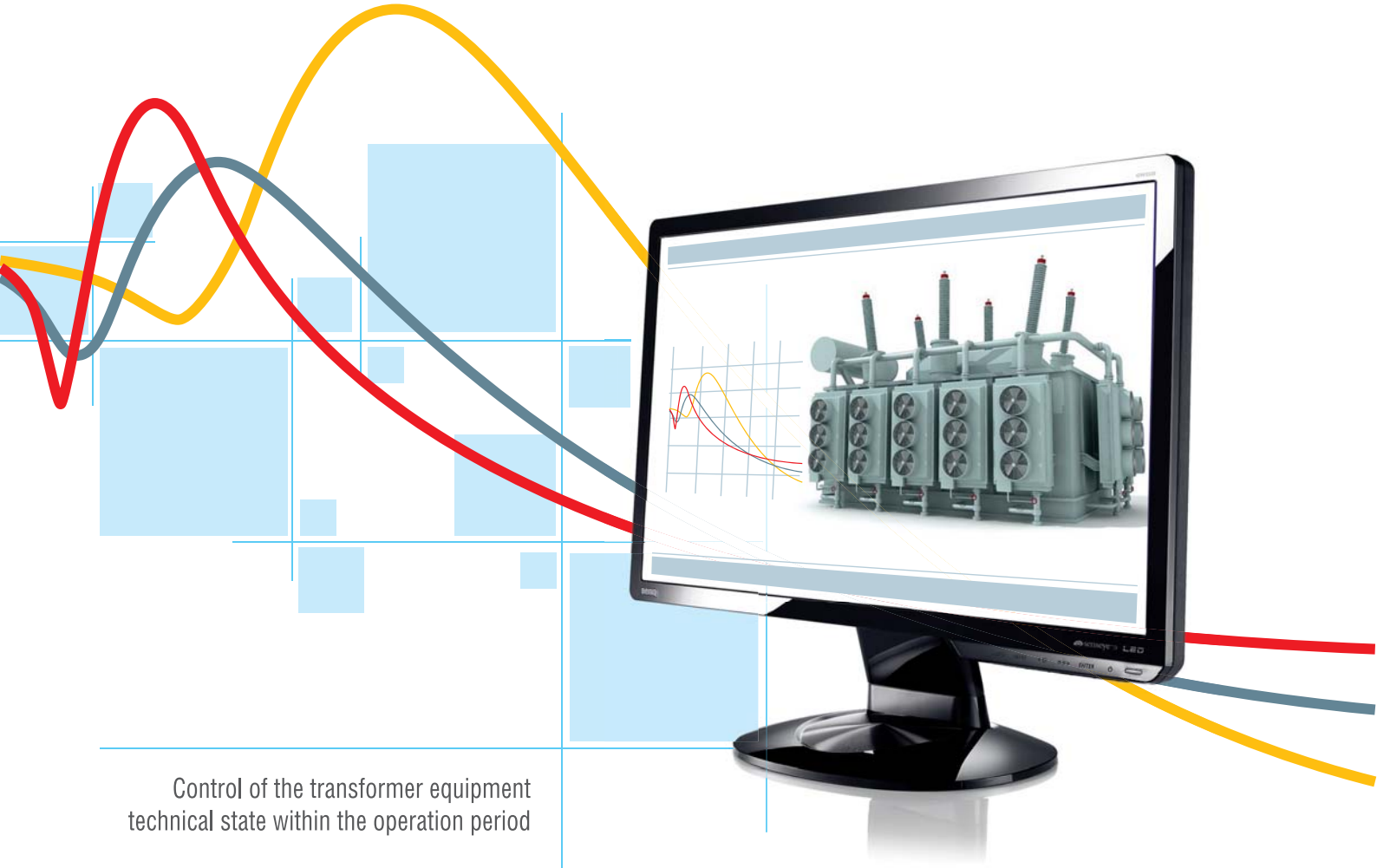


Control of the transformer equipment technical state within the operation period

Generation of diagnostic, warning and emergency signals and messages

Diagnostic parameters and events database maintenance

Transmission of the information about equipment technical state to the substation automatic control system (ACS SS)

TRANSFORMER MONITORING, DIAGNOSTIC AND CONTROL EXPERT SYSTEM

ESMDU-TRANS

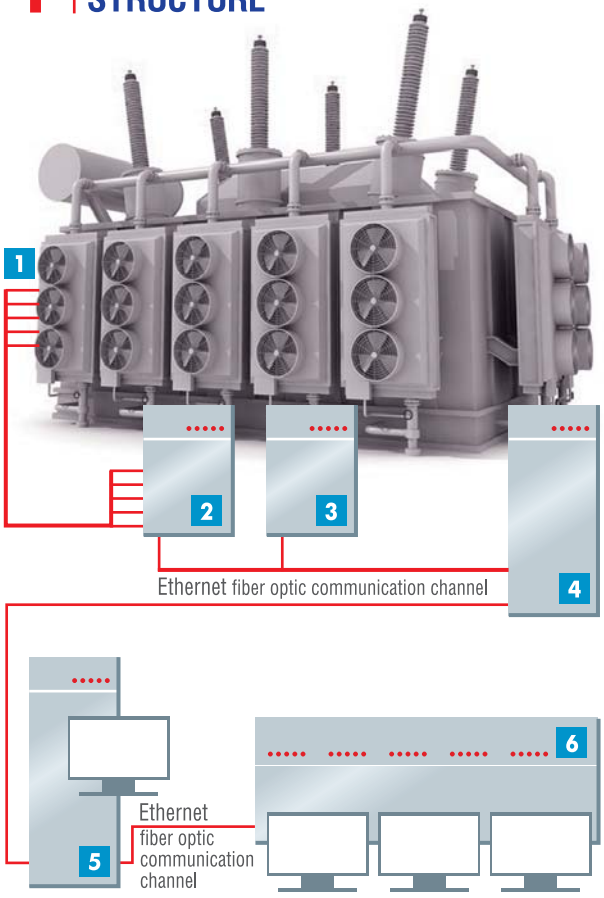
ZTR
ZAPOROZHTRANSFORMATOR

TRANSFORMER MONITORING SYSTEM
ESMDU-TRANS

Transformer Monitoring, Diagnostic and Control Expert System “ESMDU-TRANS” produced by «Zaporozhtransformator» PJSC provides the following functions:

- Registration and analysis of electric energy quality at all voltage sides (HV, MV, LV) within steady-state processes.
- Registration and analysis of transient emergency and non-emergency processes, including: switchings (ON/OFF) and short circuits modes.
- Monitoring of electric, thermal and mechanical parameters of the main units of the transformer with expert estimation of the equipment technical state, load capacity and service life.
- Cooling system remote automated optimal control.
- Tap changers remote automated optimal control.

1 ESMDU-TRANS STRUCTURE



1 Sensors and transmitters:
control and measuring instruments, moisture analyzer, dissolved gas analysis (DGA) device, current transformers, OLTC
2 Connection cabinet
3 Cooling system control cabinet
4 Diagnostic cabinet
5 Workstation cabinet
6 Automated Control System (ACS)

2 ESMDU-TRANS HARDWARE

- Interrogation time of sensors is 160 up to 400 mks which enables recording of current and voltage oscillograms in transient and emergency processes.
- Highly reliable hardware including real time controllers cRIO (National Instrument).
- Data is transferred to automatic control system of substation by means of fiber optic line according to protocols required by the Customer.
- Installation of sensors and devices of different manufacturers by agreement with Customer.

3 ESMDU-TRANS SOFTWARE

- Application of functional diagnostic methods (diagnostics of separate units of equipment).
- Analysis of instantaneous values of currents and voltages within transient and emergency processes, oscillogram recording.
- Calculation of additional diagnostic parameters: active and reactive constituents of power, excitation current, losses in windings, excitation branches, total losses in equipment, winding resistance, reactance, harmonic characteristics of currents and voltages.
- Simultaneous application of continuous control results and periodic diagnostic results in expertise algorithms.
- Currents and voltages oscillogram recording during emergency processes to nonvolatile memory of actual time controller.
- Recording of all measured and calculated diagnostic parameters in database with possibility of further processing and analysis: creation of parameter trends, formation of reports.

4 VIZUALIZATION OF DIAGNOSTIC PARAMETERS

Monitoring System includes the virtual instruments for system total control, self-diagnostics as well as for visualization of the following expert algorithms:

1. Electric energy parameters (steady-state processes)
- Monitoring of chosen voltage side parameters: phase voltage effective values, current values, appearent full power values; power active and reactive constituents, Cosfi, main frequence.
- Quality control of chosen voltage side of electric energy: deviations of main frequency and voltage, asymmetry of inverse and zero sequence, unsinusoidality ratio.
- Monitoring of phase currents and voltages sum.
- Statistics of overvoltages registration with respect to set values.
- Current, voltage and power spectrum control.

2. Electric energy parameters (transient processes)
- Control of voltage and current amplitude of transient processes.
- Transient and emergency processes registration statistics.

3. Parameters of the transformer protection devices
- Monitoring of alarms from protection devices.

4. Magnetic system parameters
- Control of magnetic system thermal and electromagnetic parameters.

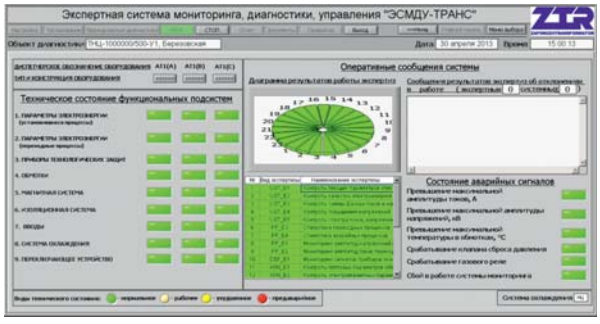
5. Windings parameters
- Control of windings thermal and electromagnetic parameters

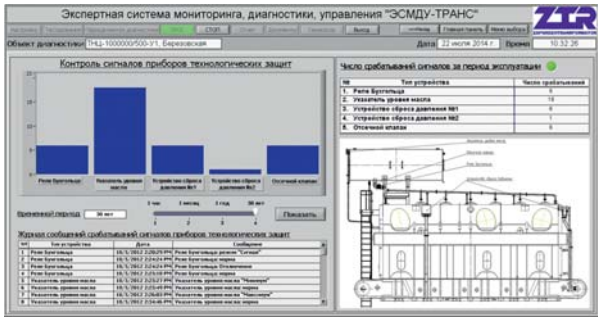
6. Insulation system parameters
- Physical-chemical oil properties control.
- DGA control of oil from tank with different methods.
- Control of moisture content in oil.
- Control of solid insulation, residual life, overloads.

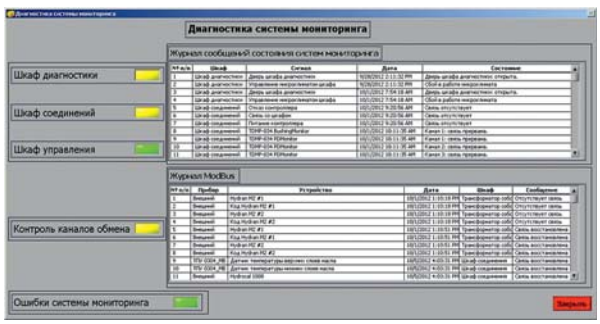
7. Bushings parameters
- Control of bushings parameters at each voltage side.
- Control of phases conduction currents sums.
- Control of partial discharge level.
- DGA control of oil filled bushings.

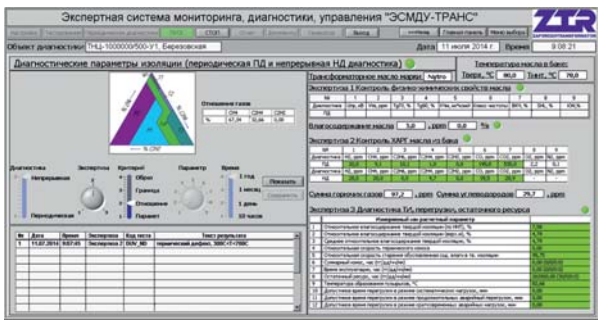
8. Cooling system parameters
- Control of cooling system functioning parameters

9. Tap changer parameters
- Control of tap changer functioning parameters









5 ESMDU-TRANS SPECIFICATION

Architecture	Diagnostic cabinet with real time controller installed near the transformer. Cabinet of computer workstation installed at premises of substation.
Inputs and outputs	AC transmission channels: 0-1 A, 0-5 A DC transmission channels: 4-20 mA AC voltage transmission channels : 0-100 V RTD inputs: Pt-100 Relay signals channels: dry contact Number of channels is determined by type of controlled equipment and requirements of the Customer.
Data storage	Nonvolatile memory of controller is used for keeping information of emergency events. SQL database is used for keeping of long-term data, archiving of alarms and events.
Data visualization	Appendix installed in PC. Web-server for data browsing at the remote working place.
Link	RS-232, Ethernet 10/100, fiber optic element
Supported protocols	IEC 61850, IEC 60870, Modbus, OPC
Diagnostic cabinet	Material: stainless steel Protection degree: IP54 installation: close to the transformer on the separate foundation
Cabinet of workstation	Material: stainless steel Protection degree: IP54 Installation: indoors of substation
Operating temperature	From -40 up to +60°C
Standards applied	Electromagnetic compatibility: IEC 61000, GOST 32137-2013

ZTR can supply expert monitoring system both for own-produced new transformer equipment so for the transformer equipment already installed at customer`s premises.

ZAPOROZHTRANSFORMATOR

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