

## «TDM-TS» - Cooling Control System for High-Power Transformers

«TDM-TS» multipurpose microprocessor system is for effective operation control of fans and oil pumps in the cooling systems of high-power transformers (220 – 500 kV).

«TDM-TS» includes the whole set of monitoring and control functions, which provides sustaining optimal temperature parameters for the power transformer in all the operation modes, including transient modes (switching on/off).

«TDM-TS» system consists of the four main parts:

- the set of sensors;
- the microprocessor device (controller) for the sensor signal measurement and processing and for control signals formation;
- the control board with contactor switches for connecting pump and fan motors;
- the protective enclosure for the device mounting beside the transformer.

### «TDM-TS» Control Functions:

«TDM-TS» system has got the following control functions:

- ❖ Transformer cooling system activation during the transformer start-up. The controller operation algorithms depend on the cooling system type and the initial oil temperature.
- ❖ Switching on/off the fan and pump motors of the cooling system for maintaining the transformer tank temperature at the desired level.
- ❖ Fast activation of additional cooling system elements when the transformer loading grows up. This function allows avoiding transformer winding overheating.
- ❖ Switching the cooling system beforehand, in accordance with the planned loading schedule - «pre-cooling» function. This function allows bringing down the temperature of the hottest spots of the winding.
- ❖ Planned deactivation of cooling system fans and pumps during planned transformer switch off.

For the control functions to be realized to the full extent, all the elements of the transformer cooling system are divided into several groups in accordance with their level of importance:

- First-level equipment – the equipment which is active as long as the transformer is switched on. This is the base level of the cooling system.



- The equipment of the second and further levels – the equipment which is activated in consecutive order as the temperature and load grow up.

- The equipment under repair or maintenance, which cannot be operated at present, it has got the least level of importance.

### «TDM-TS» Monitoring and Diagnostic Functions.

With additional sensors and special data processing algorithms «TDM-TS» controller constantly monitors the

condition of the cooling system basic elements – fans and oil pumps.

Additionally such informative parameters as transformer core and winding clamping strength and oil level in the transformer tank are monitored.

The additional monitoring and diagnostic functions make «TDM-TS» system an outstanding means of cooling system control for power transformers.

«TDM-TS» system solves the following important questions:

- ❖ On-line diagnostics of bearings in the motors of fans and oil pumps.
- ❖ Measurement and analysis of fast load changes, overloads and defective conditions of the equipment.
- ❖ Monitoring of pump vanes condition, based on analyzing the consumed current and power spectrums.
- ❖ Oil level monitoring by differential analysis of the sensors indications, installed in the top and bottom parts of the transformer tank.
- ❖ Evaluating of the transformer mechanical strength, as well as



the core and winding clamping strength, on the base of the transformer tank vibration measurements.

- ❖ Voltage monitoring for the base and reserve power supply feeders; automatic switching to the reserve power supply.

### «TDM-TS» Controls and Communications Interfaces.

«TDM-TS» system functions automatically, in accordance with the parameters and local settings. The current cooling system condition, as well as the calculated parameters of the transformer, are indicated by the LEDs on the device front panel. All the information about the cooling system condition and mode of operation is uploaded into SCADA via fiber-optic or twisted pair cable by IEC 61850 protocols.

Efficient operation management and cooling system parameter setting is done through the SCADA network computer.

If there is the need, the «TDM-TS» system settings can be changed on-site by the staff. For that sake the controller can be supplied with color screen and the multi-function operation button. The information about the transformer cooling system current condition is also displayed in this case.

### «TDM-TS» System Design.

«TDM-TS» control system is supplied cased in metal, with the automatic heater. All the system elements are meant for operating at the ambient temperature of up to 40°C below zero, and -50°C with the heater.

In the top part of the inner system panel there is the place for «TDM» diagnostic monitoring system connection, thus the system functions can be extended to monitoring and diagnostic with minimal costs.

For a one-tank transformer one «TDM-TS» device is sufficient. For a transformer group with a complicated cooling system «TDM-TS» should be used with «TDM-TS-2,3» the expansion boards.

If the number of the cooling system motors for one power transformer exceeds 12 (it is the number of the control relays in one «TDM-TS» system), then an extended variant of the system «TDM-TS-2» or even «TDM-TS-3» can be used. Such a system can control 24 or 36 fan and oil pump motors correspondingly.

### Input and Output Interfaces of «TDM-TS» System

№	Sensor	Item	Note
1	Transformer tank temperature, coolers temperature*	12	
2	Fan and oil pump currents*	12	
3	Transformer phase load currents	4	
4	Oil pressure (differential) in the transformer tank	3	4-20mA
5	Transformer tank surface vibration	3	4-20mA
6	Ambient temperature and pressure	1	
7	Additional isolated digital input	4	
8	Voltage of fan and oil pump motors	1	
9	Voltage of cooling system feeders	2	
10	GPS time synchronization	1	
11	Motor activation relays*	12	
12	Signal relays	3	

(\*) – When an extended version is supplied («TDM-TS-2» or «TDM-TS-3») then the number of sensors and relays multiples twice or thrice.

### «TDM-TS» System Specifications

№	Sensor	Item	Note
1	Protective enclosure dimensions, mm	600 * 800 * 1600	IP67
2	Protective enclosure weight, kg	200	
3	Power supply of the enclosure electrical equipment, V	220	AC/DC
4	Power consumption (heater included), W	1000	
5	Operation temperature range, °C	-40 ÷ +50	