PRECIMEASURE

(TMS) - 2265
TOTAL MONITORING SYSTEM

PRECIMEASURE TMS

Transformers are key components in any electric supply system. The breakdown of a transformer not only brings a lot of economical disadvantage for the energy supplier, but can also result in extreme losses for the consumer. For this reason, we have developed a processor controlled platform that can provide a comprehensive monitoring of the transformer.

Control and supervision of the transformer is possible from the TMS system through its HMI or from the substation computer. All real time transformer parameters such as voltages, currents, oil / winding temperatures, oil level, tap position, alarms, trips etc are available in the system. Separate annunciation panels are no more required.

In addition several diagnostic features can be in built into the systems that are helpful in the transformer asset management. These can cover transformer loss of life, tap statistics, real time over load capabilities etc. The system is capable of interfacing with several third parties individual IEDs such as Dissolved Gas analyzers, Bushing monitors, Fiber optic hot spot measurement systems, Smart breathers etc.

The powerful micro processor based system is architectured with the remote field mounted I/O system and a control room located panel. This localizes the hard wiring resulting in considerable cost savings and ease of maintenance. Data from the system is displayed in a user friendly manner for effective utilization by operating staff.

The features that are provided for a given system shall be based on the customer needs as agreed during the project contract stage. Transformer Protective relays, synchronization equipment etc are generally not included in the scope of our TMS systems.

Control and supervision of the cooling systems and tap changers can be provided from the TMS system as required. As described in the following the tap controls can be provided where parallel operation of transformers is envisaged through AVRs. Alarms caused due to any protective devices such as Buchholz, PRVs, temperature indicators, tap change gears, oil level indicators etc can be visualized through the TMS system, in addition to automatic time stamping and logging of such events.

Insulation loss-of-life of power transformers is closely related to the time function of temperature, moisture, and oxygen content. From these parameters, the most significant determining factor to insulation deterioration is the temperature reached by the hottest-spot in the winding. No significant loss of life takes place for thermally stabilized cellulose insulation below 110 deg C, which is considered to have a nominal life of 180000 hours. The TMS system keeps track of the equivalent ageing of the insulation whenever the hot spot temperature exceeds 110 deg C and compounds this information to arrive at the cumulative loss of life.

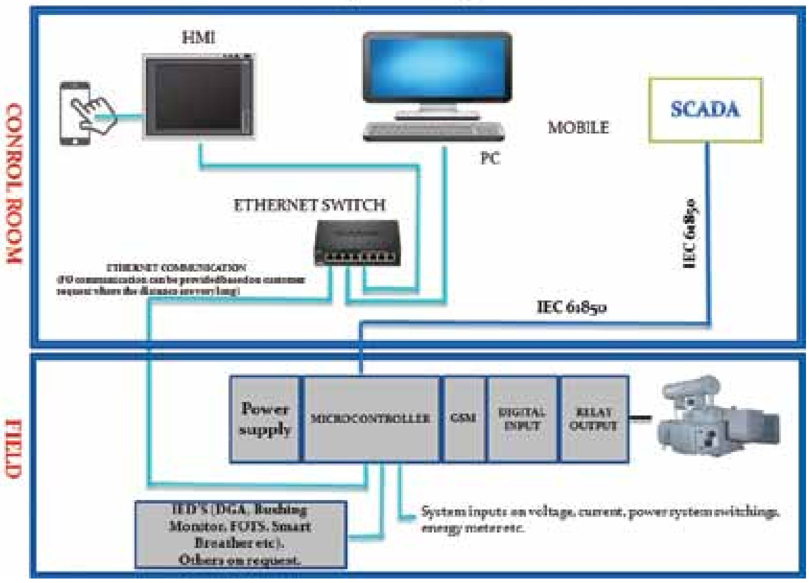
Many a times the operating staffs are compelled to overload a transformer to meet various types of contingencies. At such instances, subject to transformer manufacturers concurrence, it may be permitted to exceed the normal temperature limits for short durations. IEEE C57.91-1955 loading guide lays down the permissible winding and oil temperatures for the various types of contingencies as below:

	NORMAL LOADING	PLANNED LOADING	LONG TIME EMERGENCY LOADING	SHORT TIME EMERGENCY LOADINNG
WINDING HOT SPOT TEMP	120	130	140	180
TOP OIL TEMP	110	110	110	110
MAXIMUM LOADING %	200	200	200	200

The amount of time such overloads can be sustained depends on the present loading and initial temperature values of the oil and windings and also the ambient conditions at the time of overloading. It is possible to estimate the durations for which any given amount of overload can be sustained without exceeding the above temperature values, when the overload commences from these initial conditions. The TMS system calculates such durations and furnishes the overload capabilities in the form of graphical data for operator guidance.

The embedded Digital Tap Change control system enables monitoring of the tap changer and helps in voltage regulation of tap-changing transformers. The tap statistics provide valuable data for monitoring of the on load tap changers.

TMS System Configuration



AVR OVERVIEW

The voltage input to the AVR is derived from the station bus PT. This voltage is compared with a desired or the target voltage which can be the AVR set voltage in case of a simple system. Where it is required to control the voltage at a remote point, the desired voltage is arrived at based on the local bus voltage and the line drops from the bus to the desired location. For this purpose the line current loadings are taken into consideration. To prevent unnecessary frequent operations of the tap changer, dead band limits can be set around the desired voltage level so that the AVR does not issue any raise or lower commands as long as the voltage is within this dead band. The operation of the AVR is achieved using two individually settable timers T1 and T2. If the measured voltage, falls outside the specified bandwidth, after the set delay time T1 an output pulse is issued and the OLTC switches to raise or lower the voltage accordingly. If the deviation returns to within bandwidth limits during the delay time T1, the delay time is decremented. The benefit of decrementing is that the regulator does not start from 0 seconds, if the bandwidth is exceeded regularly. Instead, the time already elapsed is used as a measure for the start of the subsequent delay time. Further the time delay T1 itself is reduced when the voltage violation is excessive. This reduction can be based on the magnitude of such deviation to achieve an integral response for the voltage control function.

In some cases, more than one tap-change operation is required for returning the controlled voltage to within the specified bandwidth. In this case a shorter time delay T2 is employed to generate a subsequent raise / lower pulse. The dead band is settable and is recommended to be set considering the transformer tap voltages so as to prevent unnecessary tap excursions for minor voltage variations.

In case compensation for load voltage drops is called for, the details of the line R and X values are necessary to be inputted to the AVR for determining the compensation duly considering the magnitude and phase angle of the load current. The compensation can be assigned a positive or negative value as appropriate for the power system. Additional data required is obtained from the current transformers or the metering system.

The AVR is also provided with under voltage and over current blocking to override the transient voltage dips and prevent OLTC damage.

The system also obtains the position feedback from the OLTC mechanism for the tap position. This position feedback can be in the form of Binary code, mA signal or resistance value depending on the type or make of OLTC.

Several Tap Changer diagnostics functions are also built into the system for improving the operational efficiencies and guidance related to operation and maintenance of the tap changer. The cumulative numbers of operations performed at each tap, the switching power cumulatively handled at each tap number, cumulative time of operation in any given tap etc are some of the features that can be built into the TMS.

All data are also presented in user friendly platorms that enables trend capturing and guiding the preventive maintenance.

AVR Settings

Desired Voltage	100 – 120V
Bandwidth	0.5 to 9 %
Delay time T1	1 to 999 Seconds
Delay time T2	1 to 999 Seconds
Switching Pulse Duration	1 to 10 Seconds
Under voltage Blocking	60 to 100% of desired voltage level
Over voltage Blocking	100 to 140% of desired voltage level
PT Fuse Failure Blocking	0 to 50% of desired voltage level
Over Current Blocking	50 to 200% of current level
OLTC Parameter Monitoring	Upper Limit, Lower Limit, Tap Change in Progress, Tap Changer Trouble, OLTC Stuck, OLTC Motor Reverse, OLTC Local/Remote, OLTC Drive Mechanism Overload, PT Fuse Fail etc..,

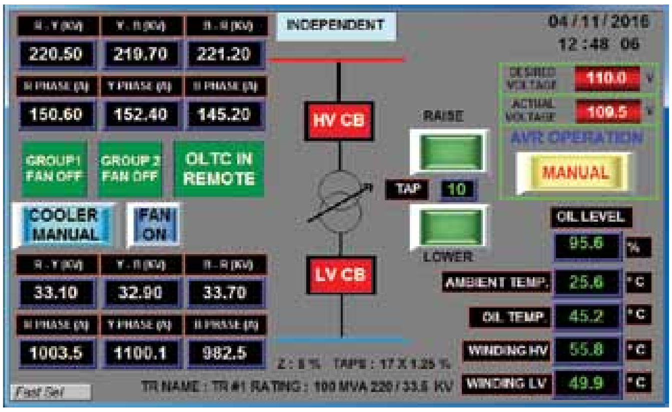
EMBEDDING COOLER CONTROLS IN TMS

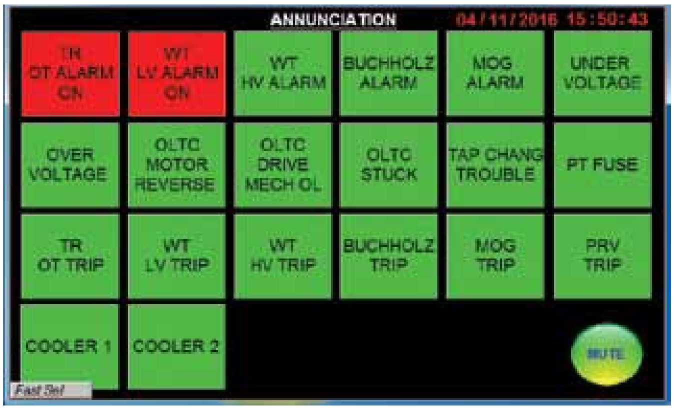
Depending on the customer needs, it is possible for us to incorporate the cooler controls in the TMS itself, thus obviating the need for a separate cooler control unit. The fan and or pump controls based on the oil/ winding temperatures, annunciations for any mal operation, periodic exercising of the cooling systems etc can be provided.

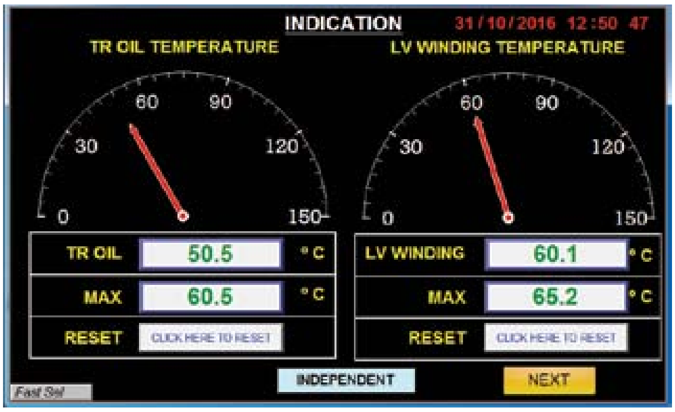
The system monitoring and control from the substation control room or the remote SCADA control is possible through the communication interface. The standard communication is via MODBUS Ethernet. However, communication through IEC 61850 also can be supplied as required. In addition the communication cable can be of fiber optic type if desired. The human interface is provided through user friendly screens for control & supervision. The data from the system can be displayed in report or graphical manner for ease of analysis.

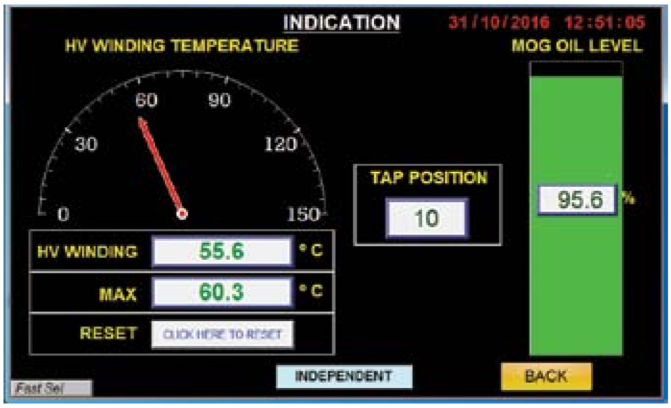
PARALLEL OPERATION OF SIMILAR TRANSFORMERS

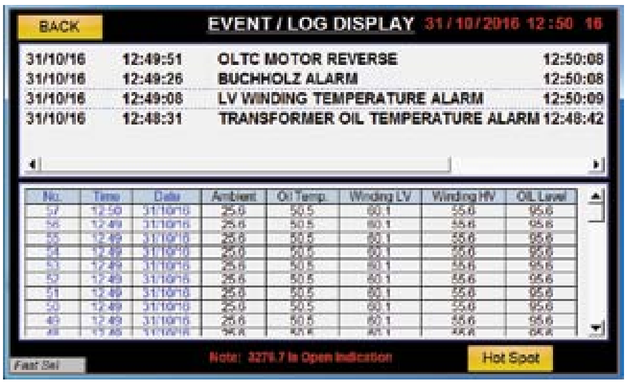
It is common in many stations to operate the transformers in parallel for meeting the load. In such cases it is necessary to ensure that the transformers have the same terminal voltage to prevent circulating currents since these can have a high magnitude and cause overheating. This can be overcome with the Master- Follower facility and special features that are built into the AVR system for this purpose. In case of parallel operation, it is necessary to know the transformers that are actually in parallel at any given time. Information for this is provided through the logic system. Each transformer is provided with a Master-Follower-Independent-Off selection facility. In case OFF position is selected, only manual control from the OLTC drive mechanism is possible when the control location is selected to LOCAL from the actual tap changer motor drive unit. Controls from the TMS are enabled when the selection of control location is made to "Remote" in the OLTC motor drive unit on the transformer. When the INDEPENDENT mode is selected, the AVR controls the tap changer of the particular transformer alone based on the settings adopted. When the MASTER mode is selected the AVR controls the transformer's tap gear as well as of those transformers of the parallel group that have been selected to the FOLLOWER mode. It is ensured through the communication system between the AVRs that all transformers of the parallel group have the same setting. In case the FOLLOWER transformers are not brought to the same tap as the Master within a set time, an alarm is generated to caution the operator. The tap numbers of the Master and the Follower transformers are displayed side by side for ease of monitoring.



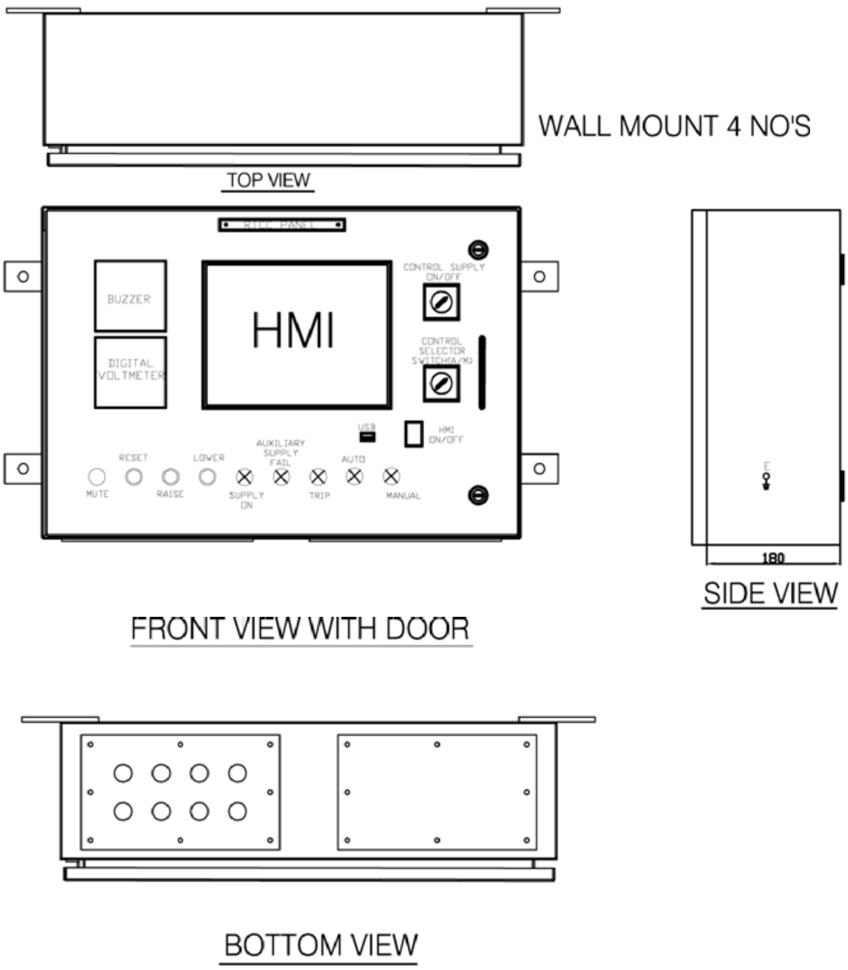








TMS RTCC PANEL



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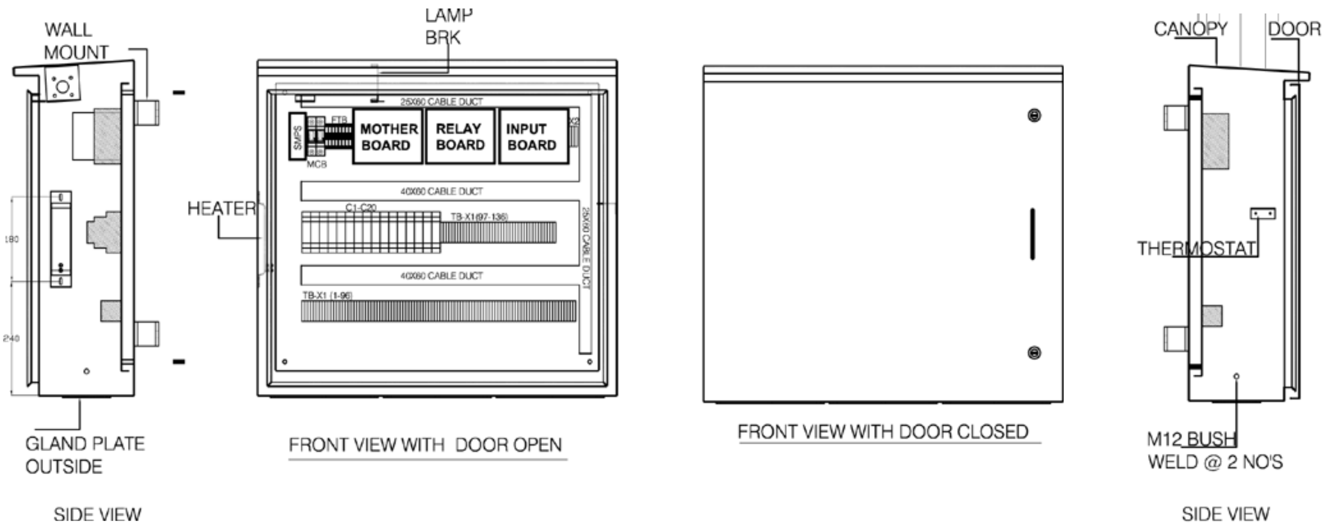

Functional Scope

Temperature	OTI, WTI, Ambient, HOT Spot etc.
Alarm / Trip Status Protective Device	Buchholz, PRV, MOG, Temperature Indicators, OLTC Parameters etc.
HMI	10.1 TFT Touch screen
Operation types	Local, Remote
Tap Position	Resistance Input / mA / Binary coded
Cooler Function	OTI/WTI Analog Instrument Automatic cooler based on Temperature set points. Fan Exerciser based on user selection. Operating status of FAN'S. Running Hours of FAN'S & PUMP'S.
Regulation Mode	Auto, Manual Line Drop compensation (optional feature)
Transformer data	Transformer Loss of life Transformer Overload Capability Cumulative Hours spent at each TAP position. Cumulative TAP counts for each TAP position. Cumulative KVA for each TAP position. Cumulative Kilowatt-hour delivered at each TAP position. OLTC Motor current trends
Options for Parallel Operated transformers	Independent/Master/Follower/OFF mode
LOGs	Alarm and event logging Temperature OTI/WTI/Oil Level/HOTSPOT/Ambient and IED's Data export to text and Microsoft Excel.
IEDs (optional as required)	Fiber optic direct hot spot temp measurement, Dissolved Gas Analyzer, Bushing Monitor, Smart Breather, Others on Request
Mobile	Mobile Access through VNC/GSM
Digital Inputs	Electrically isolated input, Signal voltage 50-250V AC.
Digital Outputs	Electrically isolated relay contacts.
Analog Inputs	Current / voltage/ Resistance
Power Supply	88 – 264VAC / 125V – 373VDC / 47 – 63 Hz
Operating Temperature	0°C to 60°C (Others on request)
Storage Temperature	-40°C to +85°C
Interface	1 x RJ45 (Ethernet MODBUS TCP/IP) 1 x RJ45 (IEC61850 – Copper / FO) 1 x RS485 (MODBUS RTU for IED)
Housing	Din Rail Mounting
EMI/EMC compliances	IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-11, Others on Request