Transformer Loss Measurement Systems

FEATURES

- 100kV, 2500A - SINGLE PHASE, 3 PHASE LOSS MEASUREMENT SYSTEM FOR LOAD & NO LOAD LOSS MEASUREMENT OF POWER TRANSFORMERS
- THREE CONVENIENT METERING UNITS, EACH CONTAINING A HIGH VOLTAGE MEASURING CAPACITOR AND A PRECISION CURRENT SENSOR.
- FULLY AUTOMATED MEASUREMENT WITH MANUAL OVERRIDE
- REAL TIME MEASUREMENT AND GRAPHICAL BAR GRAPH & WAVE FOR DISPLAY FOR ANALYSIS.
- WIDE MEASUREMENT RANGE FROM 100V TO 120kV & 1A TO 2500A
- MEASURES & DISPLAYS VOLTAGE, CURRENT & POWER FOR EACH PHASE COMPUTES & DISPLAYS THREE PHASE VALUES.
- DISPLAYS TEST WAVEFORMS SIMPLE AND CONVENIENT CALIBRATION PROCEDURE
- TEST WINDING PROVIDED FOR EASE OF CALIBRATION & SELF CHECKING
- 14 CHANNEL TEMPERATURE SENSING FACILITY FOR CONNECTION TO TEST SPECIMEN
The losses of power system equipment, such as transformers, motors and generators have traditionally amounted to a very large value every year. These losses are becoming increasingly significant with the increasing cost of electricity. The value of losses varies per kilowatt depending on the power system and if these are core (voltage) or copper (load) loss related. Therefore, it is very important for an electrical equipment manufacturer as well as utilities to quantify these losses at the development and production level to come up with acceptable efficiency for their equipment and then to confirm the efficiency by actually measuring the losses during open circuit and short circuit tests.

The Transformer Loss Measuring System (TLMS) manufactured by ELTEL Industries is a measurement system for the accurate measurement of impedance and loss of single-phase or poly-phase power and distribution transformers. These measurements are typically conducted during short-circuit and open-circuit test of transformers. In addition to measuring transformer, these metering systems can be used to measure the characteristics of generators, or motors using the two-frequency load test. The system offers AUTOMATIC computer operation with MANUAL override and provides high accuracy over a very wide range of voltage, current and power factor. A variety of voltage and current ratings are available for each specific application.

As the typical test samples exhibit a low power factor and a wide range of impedance, meaningful measurements of losses is possible only if the test equipment offers accurate measurement of losses at low power factor, and over a very wide operating range of voltage and current. For this very reason, the TLMS offers voltage and current ranges with a span larger than 1000-1 and phase accuracies of better than one minute.

The TLMS is configured to allow convenient calibration that complies with: NBS Technical Note 1204, “Calibration of Test Systems for Measuring Power Losses of Transformers”. In addition to this, the systems are equipped with other features not available on any competitive equipments - that allow simple and easy calibration of the system. One of these is the use of “test windings”.

The TLMS does not use instrument transformers that would power conventional instruments with nominal voltages (100 volts) and nominal current (5 amperes), but rather converts the measuring voltage and current to a low voltage signals that are directly suitable for digital converters (ADC) and digital signal processors (DSP). This reduces the complexity of the measuring system, increases its reliability and improves its accuracy. voltage and current. Measurement accuracy, linearity, consistency and repeatability are also very critical. These important factors, combined with a variety of other significant features have.
**ELECTRONICS**

The analog and digital electronics process the signals from the voltage and current sensors providing a multiplicity of voltage and current ranges, calculating the voltage, current and power in the test circuit, determining optimum range settings, and providing the PC with the measured values for display and report applications.

The electronics module is line powered from 100...260 volts, 50...60 Hz and is housed in a 19-inch rack cabinet.

**COMPUTER SYSTEM**

The TLMS is a computerized automated system and does not have any manual controls to perform its operation. A high configuration, Industrial IBM compatible PC system including a fast Pentium processor, ample memory, CD drives, a 19-inch flat-screen color LCD display with a keyboard and a laser printer is part of the TLMS system. The PC is operated on the Windows operating system and uses the customized operating software. This software package is a sophisticated menu structured program which gives the user complete flexibility and control along with an unsurpassed data management system.

**CALIBRATION PROCESS**

The ELTEL TLMS configuration has been especially tailored to provide easy calibration. As the system basically consists of three items - namely:

- Voltage divider,
- Current to voltage converter (resistor),
- Analog-to-Digital converter system,

these three items can be easily calibrated separately and then the individual calibrations assembled together to provide a calibration for the whole TLMS.

Thus, the voltage divider which provides an nominal output of 5 volts, can be conveniently calibrated against a standard transformer or divider carrying a calibration from NPL, NIST, NRC or similar.

Similarly, the two-stage current transformer and current-to-voltage converter in each metering unit can be conveniently calibrated against a calibrated precision current-to-voltage converter carrying a calibration from one of the national standardizing laboratories. The precision current-to-voltage converter is in reality a precision, two-stage, current transformer and a precision non inductive shunt.

The Analog-to-Digital converter system can be calibrated easily using a DC or AC calibration source and a calibrated voltmeter.

The corrections from the above calibrations, both magnitude and phase, are easily entered onto the calibration table in the system's personal computer.

There is also an alternate method of calibrating the TLMS, namely via a phantom load. In this connection, the output of the calibrated voltage divider is fed to a control unit including a precision phase shifter, and the output of this control unit is used to drive a precision transconductance amplifier. The current output from the amplifier is injected into the test windings of the metering unit generating a phantom load current. The generated phantom load can be adjusted with respect to current and power factor with respect to the test voltage.

Additional metering may be installed in the phantom load circuit to display voltage, current, power and power factor.

All of the above test equipment, namely:

- Precision high-voltage divider,
- The Current to voltage converter,
- The comparator to read out the ratio and phase errors of the current and voltage sensors,
- The transconductance amplifier and its control unit,

Can be purchased by the user, calibrated at a national standardizing laboratory and then used to calibrate his TLMS.

Alternatively, ELTEL, having all of the above test equipment available and calibrated, can come and calibrate the TLMS at the client's site.
### SPECIFICATIONS AND RANGES

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<tr>
<th>Measurement</th>
<th>Description</th>
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<tbody>
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<td>Seamless operation from 0 to 100% of rated current</td>
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<tr>
<td>Voltage</td>
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