HIGH VOLT

Test with the best.®

8.71/6 Type WV on-site

ON-SITE TRANSFORMER TEST SYSTEM

- Induced AC voltage test
- Measurement of no-load loss and current
- Measurement of short-circuit impedance and load loss
- Temperature-rise test
- Special tests

ON-SITE TRANSFORMER TEST SYSTEM

Fig. 1 **On-site transformer test of a 1100 MVA unit at nuclear power plant**

FACTS IN BRIEF

The on-site test system for power transformers is able to perform the induced AC voltage test, the measurement of no-load loss and current, the measurement of short-circuit impedance and load loss, the temperature-rise test, and special tests according to the international standard IEC 60076.
The test system is based on state-of-the-art frequency converter technology and carries out tests generating a precise voltage waveform with a total harmonic distortion (THD) < 5 % and a partial discharge (PD) noise level < 20 pC. The test system is maintenance-free.
The modular design and the newest digital control technology allow two or more test systems to be connected in parallel making it possible to test even largest power transformers in the GVA range.
Generally the test system can be set up on-site within an hour. There is no need for additional “lifting” or “assembly”.

APPLICATION

1) Induced AC voltage test by exciting the low-voltage winding of the transformer under test for the HVAC test voltage on its HV side. The frequency converter supplies the excitation three-phase or single-phase voltage of ≥ 100 Hz, which can be adapted to different transformer LV windings by a step-up transformer with several taps. The standard output voltages of the step-up transformer range from 8.9 kV to 80 kV.

2) Measurement of no-load loss and current at rated voltage and power frequency (50/60 Hz) in three-phase and single-phase mode. For the loss measurement the power measuring system is connected to the LV side of the transformer under test.

BENEFITS

- FREELY ADJUSTABLE FREQUENCY 40 TO 200 Hz
- THD < 5 %
- PD NOISE LEVEL < 20 pC
- PARALLEL OPERATION ALLOWS TESTING OF EVEN LARGEST POWER TRANSFORMERS IN THE GVA RANGE

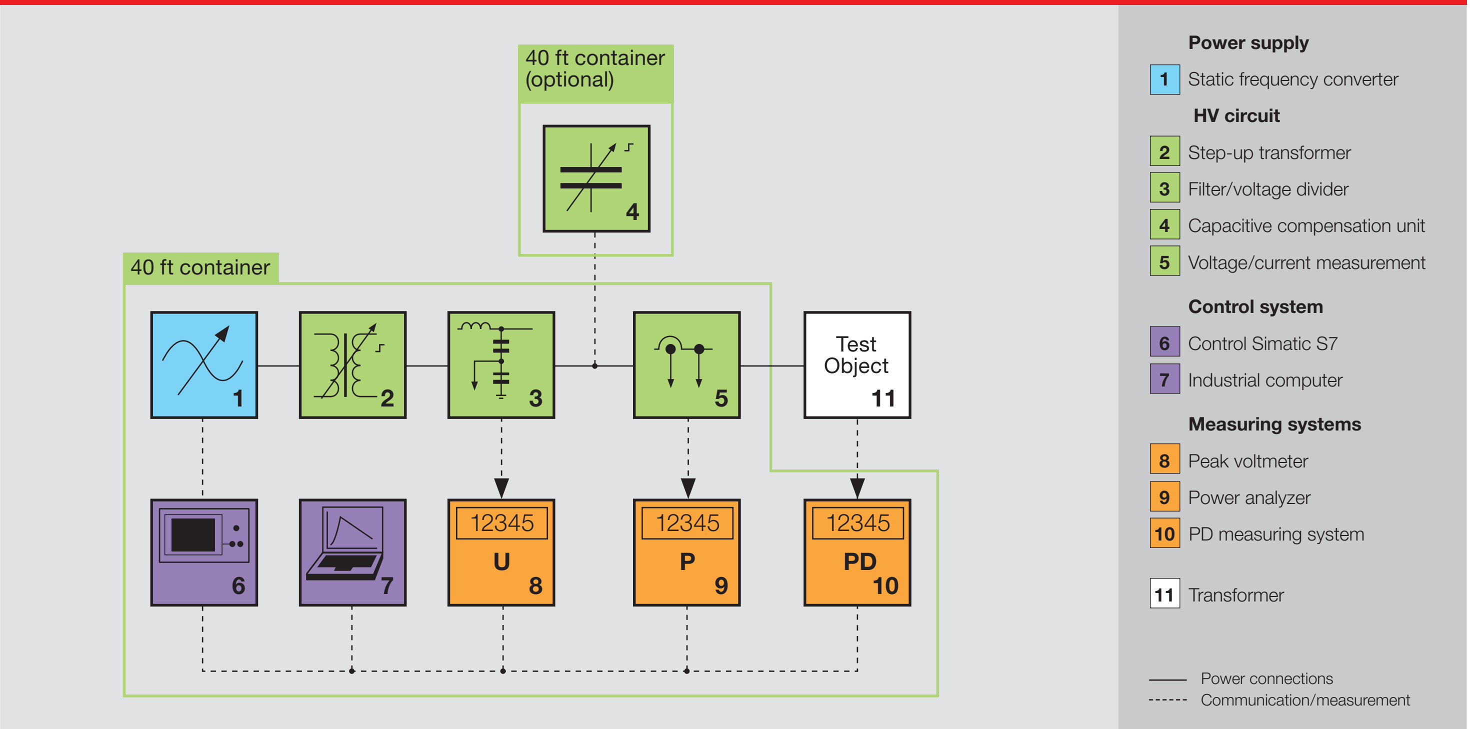

Fig. 2 **Block diagram of on-site transformer test system**

SYSTEM AND COMPONENTS

3) Measurement of short-circuit impedance and load loss at rated current and power frequency (50/60 Hz) in three-phase and single-phase mode using a loss-measuring system. A capacitive compensation unit is required.

4) Temperature-rise test with increased feeding power to heat up the test object with the sum of load and no-load losses at 50/60 Hz. A capacitive compensation unit is required.

5) Special tests such as the determination of sound levels under no-load and load conditions or the measurement of the zero-sequence impedance(s) at 50/60 Hz.

- EASY AND FAST TEST SETUP
- MAINTENANCE-FREE
- LOW INVESTMENT AND LIFE-CYCLE COSTS

The central feeding source is the static frequency converter (1) [see *fig. 2*]. It supplies the active as well as the reactive power with variable amplitude and frequency to the test circuit. The output voltage of the converter is adjusted to the required test voltage level by the step-up transformer with several taps (2). The EMC interferences are suppressed by the filter (3). The associated filter capacitor is built as a divider and gives an input signal to the peak voltmeter (8) for the test voltage measurement and control. An adapted and fine graduated HV capacitive compensaton unit (4) enables compensation of the reactive power during the optional measurement of load losses or the temperature-rise test.

A measurement system consisting of voltage and current measuring transducers (5) and a power analyzer (9) are applied for precision power measurements. The computer control (7) together with the Control Simatic S7 (6) enables automatic execution of complex test procedures as well as data storage in a central database for further evaluation or even generation of a complete transformer test protocol. The test system is rounded off by a multi-channel PD measurement system (10).

All components of the test system are installed in a 40 ft container. The optional capacitive compensation is set up on a separate 40 ft trailer.

TECHNICAL PARAMETERS

1 Power ratings

One of the most important parameters of a transformer test system is the available active and reactive power for exciting the transformer under test. The required test power depends on the power and voltage rating of the transformers under test and the specific design as well as on the tests to be performed.
During the induced AC voltage test the transformer under test is a linear, mostly ohmic-capacitive load. The required test power is low but increases with increasing test frequency.
In case of the measurement of no-load loss at 50/60 Hz, the transformer under test is fully excited and the no-load current contains a considerable amount of harmonics. The transformer under test represents a non-linear load. The required test power is low but the test power source should behave like a very stiff AC power supply to avoid interferences from the no-load current harmonics on the test voltage wave shape.
In contrast, during the measurement of short-circuit impedances and load loss as well as the temperature-rise test the transformer under test represents a linear and ohmic-inductive load. The temperature-rise test requires the highest values of active and reactive power to be fed to the test object. The static frequency converter delivers the active and a minor part of the required reactive power. The main part of the reactive power has to be provided by an adapted and fine graduated capacitive compensation unit (HVCC). *Fig 3* illustrates the reactive-active power characteristic of a 620 kW/1000 kVA test system at 50 Hz as well as with a HV capacitor bank of 12 Mvar. Each point under the curves represents one available combination of active and reactive power of the test system. For standard systems and corresponding test parameters refer to *table 1.*

2 Sine wave shape

The test system completely fulfills the requirements of IEC 60076 defining a THD < 5 % of the test voltage. *Fig. 4* shows a typical oscillogram of the output voltages of the transformer test system while performing a no-load loss measurement of a power transformer of 500 MVA. Despite an extreme non-linear current consumption (THD of transformer current 43 %), the achieved THD of the test voltage does not exceed 3.2 %.

3 PD level

The maximum PD noise level measured according to IEC 60270 does not exceed 20 pC. The test system therefore exceeds the requirements of IEC 60076-3.

4 Frequency

One of the major advantages using static frequency converter technology is the continuously variable frequency from 40 to 200 Hz. As a result, only one static frequency converter is used as central power source for the loss measurements at 50/60 Hz as well as for the induced voltage test with common test frequencies ≥ 100 Hz. The test system has a quartz oscillator-stable output frequency of ± 0.01 Hz. That is the basis for precise measuring results.

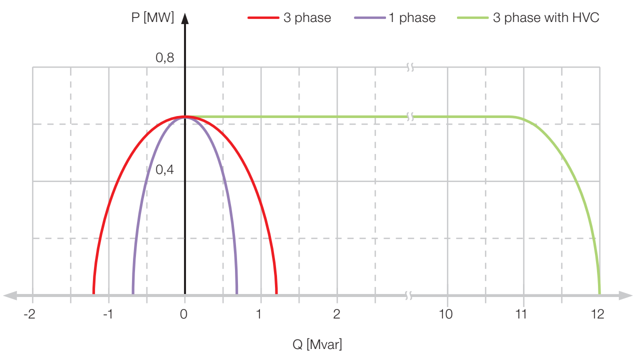

Fig. 3 **P-Q diagram of test system (three-phase and single-phase at 50 Hz)**

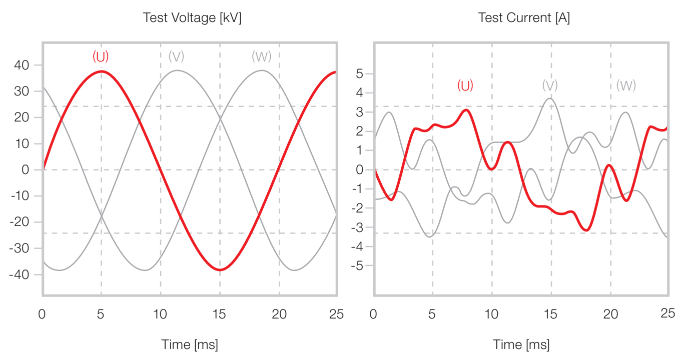

Fig. 4 **Test voltage and current waveform – no-load loss measurement at 100 % with THDu < 3.2 % and THDi = 43 % (500 MVA transformer)**

Table 1 **Parameters of test system**

Test System Type WV 620-1000/80							
Active power	620 kW	Test	induced	no-load loss	load-loss	temp. rise
Apparent power	1000 kVA	HVCC	–	–	12 Mvar	12 Mvar
Max. output voltage	80 kV	Transformer under test	1000 MVA	500 MVA	100 MVA	80 MVA

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