HIGH VOLT

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8.02/4 Type WRV T

AC RESONANT TEST SYSTEM FOR ON-SITE TESTING OF EXTRUDED HV CABLES

- AC withstand testing
- PD diagnostics

AC RESONANT CABLE TEST SYSTEM

Fig. 1 **AC resonant test system for on-site testing of extruded HV cables, type WRV 90/150 T**

FACTS IN BRIEF

The test system is able to perform tests on extruded cables according to IEC 60840 and 62067 after they have been installed. These standards require testing with AC voltage in the frequency range f_{min} = 20 Hz to f_{max} = 300 Hz only and do not allow DC or VLF.

Test system and test object form a series resonant circuit that due to the physics guarantees a pure sinusoidal waveform of the test voltage. In case of cable failure, only minimal damage may occur due to the limited amount of energy stored in the test circuit.

The operating frequency range determines the wide load range for testing very short cables to cable lengths of several kilometers.

Generally the test system can be set up on-site within an hour. There is no need for additional "lifting" or "assembly". A standard three-phase diesel generator can be used for the feeding of the test system.

The modular design allows several test systems to be connected in series or parallel to enable testing with higher voltages or power requirements.

BENEFITS

- PURE SINUSOIDAL WAVEFORM
- FREQUENCY RANGE 20 TO 300 Hz
- PD NOISE LEVEL < 10 pC
- LOW LOSSES
- SERIES AND PARALLEL OPERATION OF SEVERAL TEST SYSTEMS
- EASY AND FAST TEST SET-UP

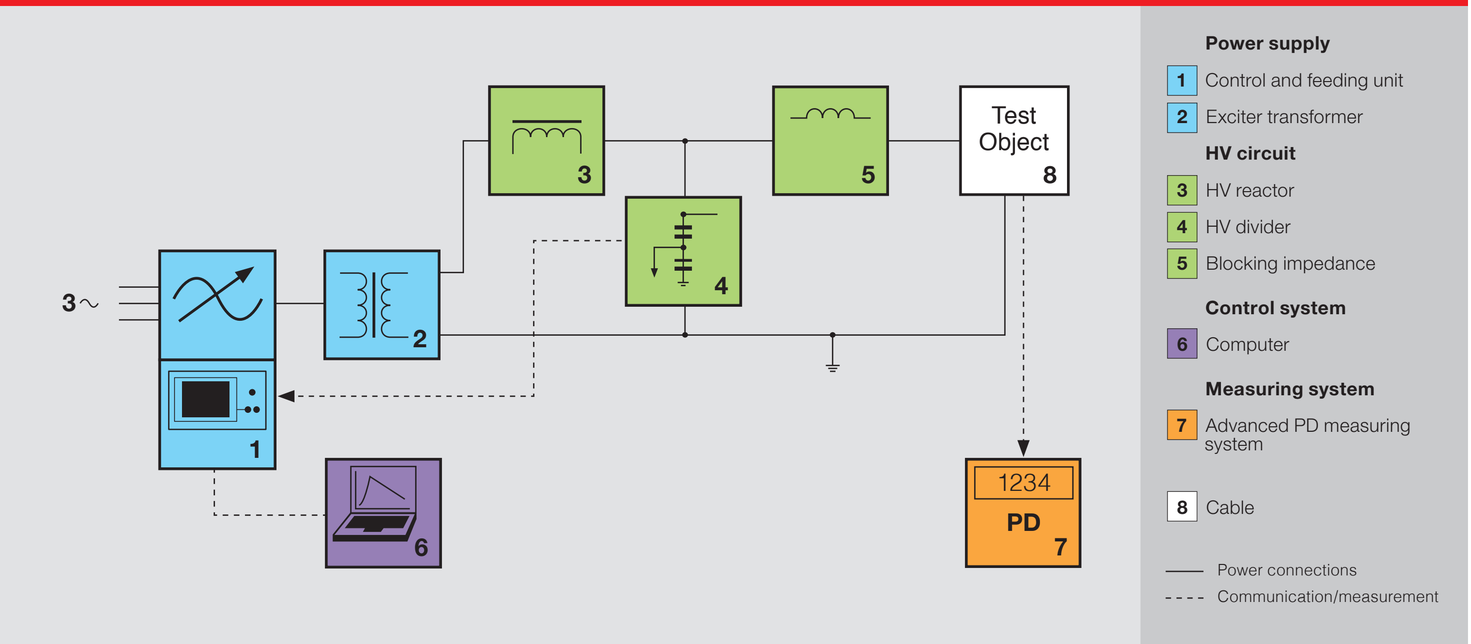

Fig. 2 **Block diagram of AC resonant test system for on-site testing of extruded cables**

APPLICATION

1) On-site test
The main application for the AC resonant test system is the AC withstand testing after the cable has been installed. These tests will be repeated during the lifetime of the cable. The tests can be combined with PD diagnosis on cable joints and terminations.

2) Routine test
The system can also be used for tests on super-long cables, for example, submarine cables in the factory.

- LOW NOISE EMISSION
- MAINTENANCE-FREE
- LOW LIFE-CYCLE COSTS

SYSTEM AND COMPONENTS

The control and feeding unit (1) [see *fig. 2*] consists of a static power inverter and a control system. The power inverter converts the three-phase input voltage into a single-phase output voltage with a rectangular waveform.

The frequency is automatically adapted exactly to the resonant frequency of the HV series resonant circuit formed by the resonant reactor (3) and the cable to be tested. The test voltage is regulated by the inverter output voltage and measured by a calibrated measuring system consisting of a peak voltmeter and voltage measuring divider (4).

The exciter transformer (2) isolates the inverter from the test circuit and increases the inverter output voltage, depending on the required test voltage and losses of the HV series resonant circuit. In case of a failure in the cable to be tested, high transient voltages can be generated in the HV circuit. The blocking impedance (5) protects the reactor against such transient overvoltages.

The test system can be conveniently controlled by a PLC and an operator panel implemented in the control and feeding unit. Optionally, a connected computer (6) allows the operator to comfortably perform complex testing and data recording.

Sensitive PD measurement on joints and cable terminations can be performed by means of an advanced PD measuring system (7).

AC RESONANT CABLE TEST SYSTEM

TECHNICAL PARAMETERS

Standard test systems are available for test voltages up to 260 kV and test currents up to 190 A [see *table 1*]. Test systems can be combined in series or parallel if higher test voltages or higher testing power are required. They allow a maximum test voltage of up to 520 kV and a maximum test current up to 500 A. For series connection, there needs to be an insulating support for the second reactor.
Tests on short cables corresponding to a low capacitance value will be done at high frequencies up to 300 Hz and on long cables corresponding to a high capacitance value at low frequencies down to 20 Hz [see *fig. 3, table 2*].

The load range of a test system is determined by the inductance, design frequency, rated voltage and current of the reactor. The full voltage can be generated between the design frequency and 300 Hz. Below the design frequency, the output voltage is reduced. This limitation is given by the rated current [see *fig. 4, table 2*].

Parallel operation of two systems doubles the output current and, in the process, the cable length that can be tested. Series operation doubles the output voltage but bisects the testable cable length [see *table 2*].

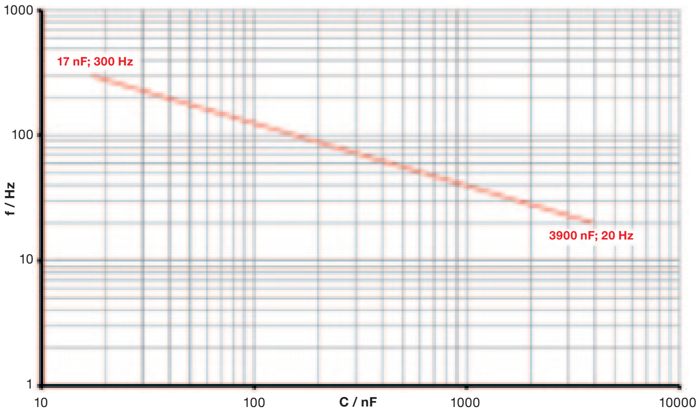

Fig. 3 **Test frequency depending on total load capacitance (example WRV 83/260 T)**

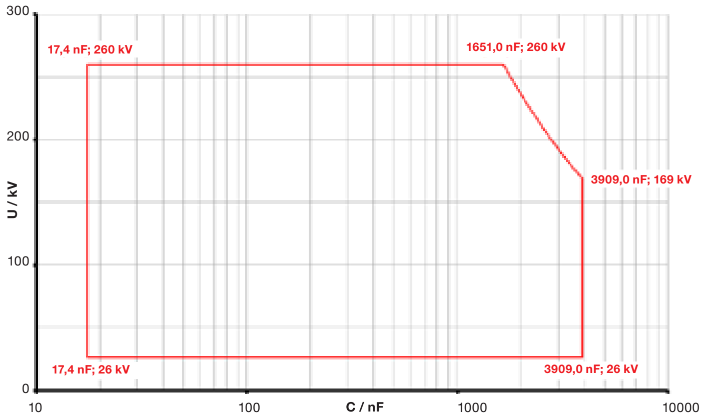

Fig. 4 **Operating range of reactor (example WRV 83/260 T)**

Table 1 **Standard test systems**

WRV 190/110 T	
Output voltage	110 kV
Output current	190 A
WRV 90/150 T	
Output voltage	150 kV
Output current	90 A
WRV 50/160 T	
Output voltage	160 kV
Output current	50 A
WRV 83/260 T	
Output voltage	260 kV
Output current	83 A
Series/Parallel Operation	
Output voltage	up to 520 kV
Output current	up to 500 A

Table 2 **Combination of two test systems and corresponding parameters (example type WRV 83/260 T)**

Test system		WRV 83/260 T	2 x WRV 83/260 T parallel	2 x WRV 83/260 T series
Rated voltage	kV	260	260	520
Rated current	A	83	166	83
Minimum frequency of the rated voltage	Hz	31	31	31
Inductance of the reactor	H	16.2	32.4	8.1
Minimum capacitance at 300 Hz	nF	17	34	8
Maximum capacitance at design frequency	nF	1650	3300	825
Maximum capacitance at 20 Hz	nF	3900	7800	1950
Reduced voltage at 20 Hz	kV	169	169	338