SIPREC T

W1C Single Phase Thyristor - HV Power Supply for Electrostatic Precipitator ESP

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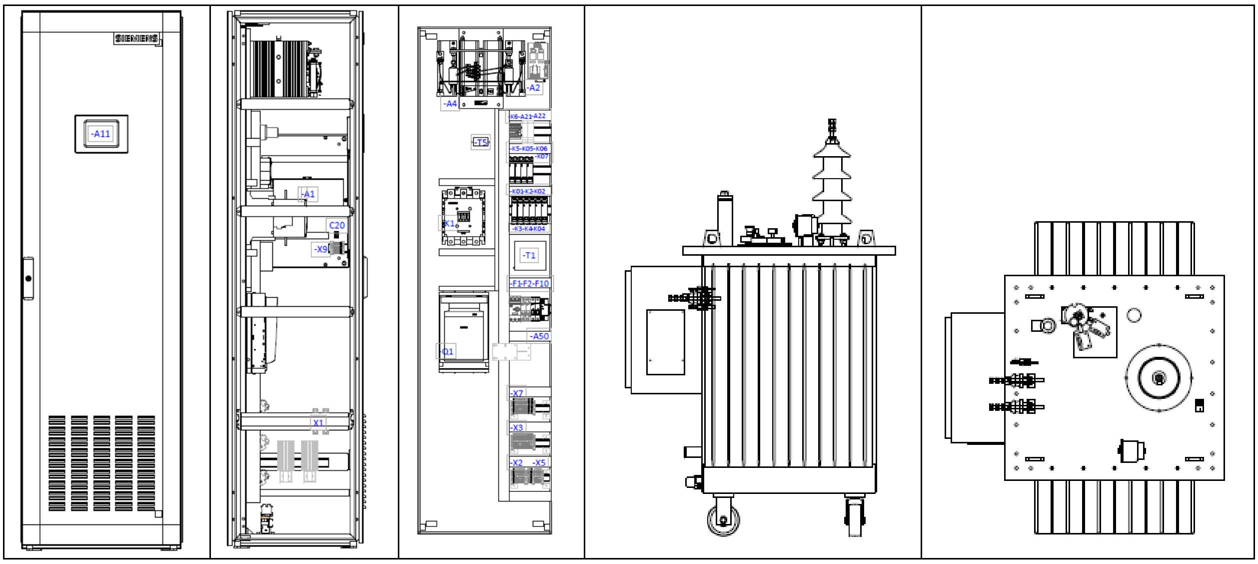
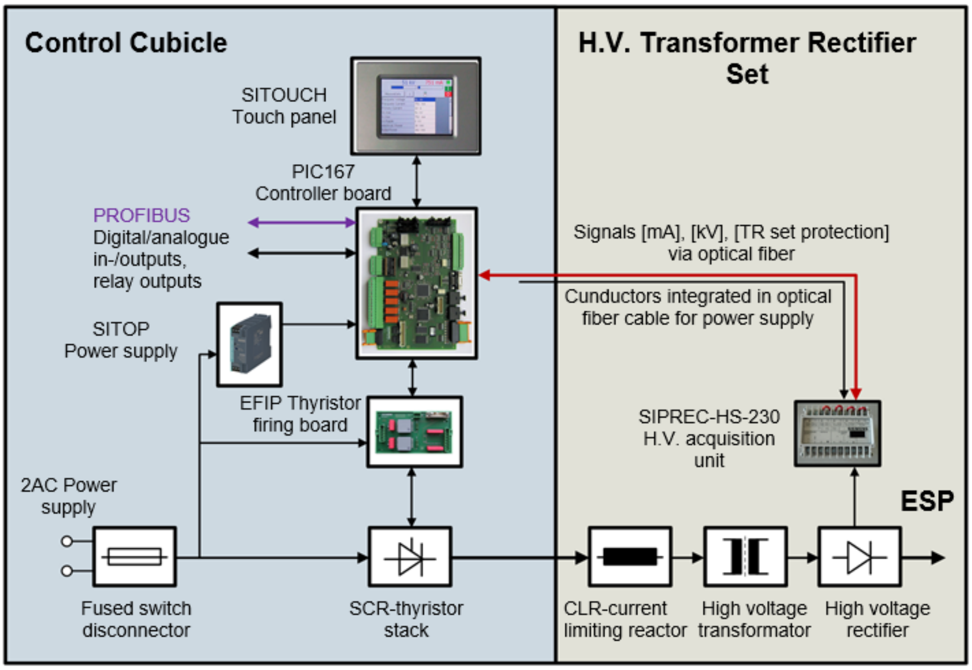
SIPREC T Technical Description

SIPREC T consists of the HV control cubicle with integrated SIPREC thyristor controller and the SIPREC TR50 / TR60 HV transformer rectifier set.



The standard SIPREC control cubicle (W x D x H: 600 / 800mm x 500mm x 2000mm) mainly consists of the fused disconnector, current transformer, SCR thyristor stack and SIPREC controller components. Within the vessel of the HV transformer rectifier set the CLR, HV transformer, HV rectifier, HV choke and HV divider are integrated. Additional components can be added according to the requirements.

SIPREC T Technology Concept



The mains power supply (2AC 400V .... 690V, 50Hz / 60Hz) is connected to a fuse switch-disconnector. With the SCR thyristor stack (W1C / two antiparallel thyristors) the low voltage supplied to the HV-transformer is stepless controlled by the SIPREC controller. The high voltage generated by the HV-transformer is rectified by the bridge rectifier providing the ESP voltage with a 100Hz ripple (at 50Hz mains frequency). The achievable maximum voltage / current values depend on the ESP breakdown voltage and load conditions.

Standard Type Range:

Mains voltage 2AC 380-690 V	Type (mA_{eff} / kV_p)	Secondary current [mA_{arith}]	Connected load [kVA]	Weight cubicle [kg]	Weight TR set [kg]
Secondary peak voltage 86 kV_p	SIPREC T 280 / 86	200	17	160	740
	SIPREC T 560 / 86	400	34	160	810
	SIPREC T 840 / 86	600	51	160	870
	SIPREC T 1120 / 86	800	68	170	1050
	SIPREC T 1400 / 86	1000	84	170	1130
	SIPREC T 1680 / 86	1200	101	170	1360
	SIPREC T 2240 / 86	1600	135	180	1550
	SIPREC T 2800 / 86	2000	168	220	1710
	SIPREC T 3500 / 86	2500	210	230	1800
	SIPREC T 4200 / 86	3000	252	260	2350
Secondary peak voltage 111 kV_p	SIPREC T 280 / 111	200	22	180	930
	SIPREC T 560 / 111	400	44	180	970
	SIPREC T 840 / 111	600	66	190	1160
	SIPREC T 1120 / 111	800	88	190	1240
	SIPREC T 1400 / 111	1000	110	200	1540
	SIPREC T 1680 / 111	1200	131	200	1670
	SIPREC T 2240 / 111	1600	175	240	1900
	SIPREC T 2800 / 111	2000	219	240	2220
	SIPREC T 3500 / 111	2500	273	250	2500
	SIPREC T 4200 /111	3000	328	260	2910

SIPREC T Functions

The operating mode of the electrostatic precipitator ESP (wet / dry) is governed by the raw gas / particulate (aerosol) conditions. As electrostatic precipitators are used in virtually all process industries, conditions specific to the plant process like startup / shutdown operation, load cycling and varying gas conditions due to changed fuels / raw materials etc. must be considered in addition.

Maximum particulate (aerosol) collection efficiency under greatly differing operating conditions requires process-specific control of precipitator voltage / current by the automatic precipitator control system. The SIPREC controller is equipped with automatic optimizing functions which ensure maximum collection efficiencies under any load condition. In addition, parameter sets tailored to the specific process conditions can be activated.

Full exploitation of the optimization potential requires that all the SIPREC controls of an electrostatic precipitator are interlinked with each other (PROFIBUS). The necessary optimization and coordination functions are performed by the SIPREC ODS visualization, diagnostic and optimization expert software installed at a PC equipped with a PROFIBUS interface. Typical examples are energy optimization to reduce operating costs, coordination of rapping cycles, coordination and optimization for intermittent operation (back corona conditions) and diagnostic functions.

Flashover Detection

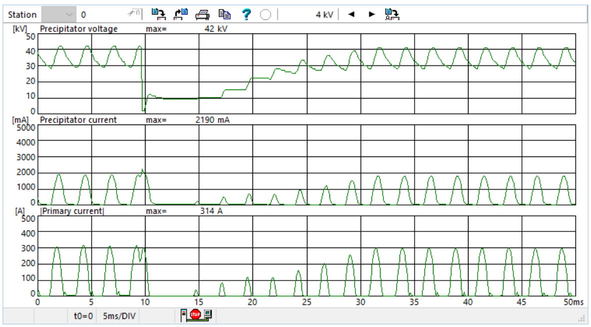
The precipitator voltage is controlled at an optimum level just under the flashover limit. When the flashover limit is reached, a flashover occurs. The SIPREC T controller detects each flashover and initiates appropriate corrective action.

Partial discharges typical for wet ESP's are difficult to detect by common detection methods. None detected discharges, however, lead in possible damages to the ESP internals, ESP casing or insulators. SIPREC T provides in addition to the common flashover / spark detection a special detection for partial discharges to prevent the formation of arcs and to protect the wet ESP.

Flashover Processing

After detection of a flashover, the SIPREC controller first identifies the type of flashover based on its time of occurrence and the precipitator voltage and current profiles. For this purpose, the following types of flashover are distinguished:

- self-quenching flashover (spark) in dry-type electrostatic precipitators
- non-self-quenching flashover
- follow-up flashover
- wet ESP partial discharges



SIPREC oscilloscope: signals for secondary voltage / secondary current / rectified primary current at flashover processing

SIPREC automatically optimizes the flashover reactions as a function of the intensity and type of the preceding flashovers. For precipitator operation just below the ESP breakdown voltage, this ensures a fast as possible flashover response (rapid recharging of the electrostatic precipitator) to achieve maximum / maximized corona power.

Voltage Control in the Area of the Flashover Limit

For optimum ESP performance, the maximum possible ESP voltage / time area and thus the maximum ESP corona power must always be attained (the exception is operation with back corona or energy minimization).

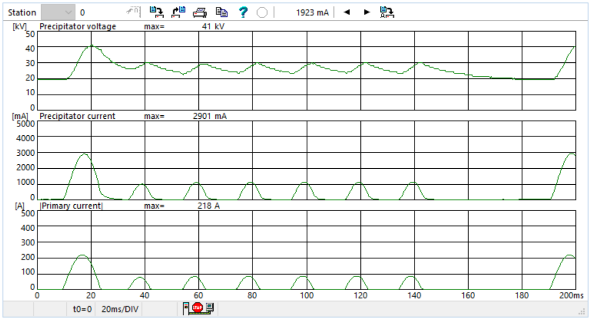
The flashover limit varies depending on actual operating conditions (dust concentration / composition, gas humidity, gas temperature etc.). Therefore, the ESP voltage / current must be constantly adapted as quick as possible but without unnecessary number of provoked flashovers.

For this purpose, the SIPREC T controller optimizes the ESP voltage adaption to the changing flashover level based on Fuzzy Logic optimized set-points.

Pulse Operation

In pulse operation (intermittent operation), the line voltage half-waves are individually controlled as compared with full-wave operation (continuously powered).

Pulse operation provides an effective method of overcoming back corona and achieves higher dust collection efficiencies under such conditions than full-wave operation.



SIPREC oscilloscope: Signals for secondary voltage / secondary current / rectified primary current at pulse operation

Optimum adjustment of the pulse parameters is essential for good precipitator performance in the pulsing mode. The operating results achieved do not only depend on the characteristics of the dust to be collected, process parameters like raw gas dust content, flow rate and temperature but also on the location of the electric field in gas flow direction and the thickness of the dust layer on the collecting electrodes.

Optimum Operating Point with Fuzzy Logic

The ESP voltage V_{prec} must be adapted continuously to the flashover limit V_{FO}.

V_{FO} varies depending on actual operating conditions (dust concentration / composition, gas humidity, gas temperature etc.).

Fuzzy Logic adapts the behavior of the power supply to the best possible operating point and the fast power electronics carries out the commands of the overlaid control even faster than the reaction time of the precipitator.

Collecting Electrode Rapping

Besides voltage supply, the effectiveness of collecting electrode rapping is of key importance to achieve best possible dry ESP collection efficiency.

To ensure effective collecting electrode rapping, the rapping intervals must be individually optimized for each electric field to suit the respective operating conditions.

In applications involving highly resistive dust or dust with a pronounced sticking behavior, the precipitator voltage may have to be reduced or even cyclically blocked during electrode rapping.

The collecting electrode rapping can be controlled by SIPREC I or the rapping signal of the external control (PLC / DCS) can be connected to SIPREC I.

The SIPREC I controller provide 10 selectable rapping parameter sets which are adjusted and activated in accordance with the respective process conditions (e.g. rapping mode, interval settings, rapping current decrease, power-off cycle).

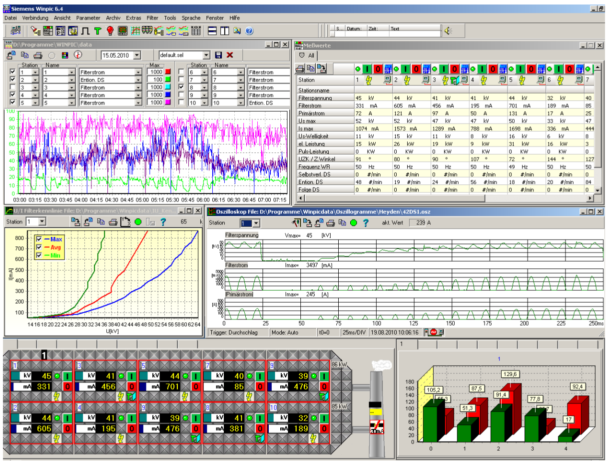
The coordination of the rapping intervals in the individual electric fields is accomplished with the aid of the SIPREC ODS system.

Addon: SIPREC ODS

The SIPREC ODS program based on WINDOWS operating system supports the SIPREC HV power supply systems for the central operation, visualization, data archiving of measured operating values, for optimization of the ESP operation and diagnostic purposes.

SIPREC ODS optimize the ESP collecting efficiency at lowest power consumption. The extensive diagnostic functions enable beside the fault analysis the evaluation of the ESP operating process and provide information for the predictive maintenance. Furthermore, the

diagnostic functions also form the basis for the fast and inexpensive Siemens Energy remote service.



For further information please see our separate SIPREC ODS brochure.

Take advantage from our experience

We are looking forward answering your questions concerning the modernization of ESP high voltage power supplies & controls, the signal & data exchange to the PLC / DCS, the possible increase in ESP collecting efficiency, potential for power savings or other questions related to the ESP operation.

Just get in contact with us.

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