HIGH FREQUENCY POWER SUPPLIES

IMPROVING THE PERFORMANCE OF YOUR ELECTROSTATIC PRECIPITATOR

ANDRITZ

ENGINEERED SUCCESS

Switched integrated rectifier

Improving electrostatic precipitator performance and reducing particulate emissions

The ANDRITZ Switched Integrated Rectifiers (SIR) reduce the particulate emission level and improve the overall performance of Electrostatic Precipitators (ESP) without a need for costly extensions. The SIRs from ANDRITZ provide a robust and reliable technology with the greatest expertise and service capabilities in the air pollution control industry. ANDRITZ now also provides a wide range of its advanced, high-voltage power supplies for electrostatic precipitators.

ANDRITZ offers a broad portfolio of innovative plants, equipment, systems and services for many industries.

LOWERING PLANT EMISSIONS

Switched integrated rectifiers can decrease ESP dust emissions by up to 60% without any need to enlarge the ESP. In certain cases, emission levels well below 20 mg/Nm³ were achieved with old ESPs by using the high-frequency technology. Compared to a conventional T/R set for the same power rating, much more dust will be collected by the SIR equipment. With ANDRITZ's proprietary ESP optimization software (EPOQ), the SIR is able to fight the most difficult forms of dust.

REDUCED INVESTMENT, INSTALLATION, OPERATING AND MAINTENANCE COSTS

- Limited free space needed; no cabinet space required.
- Installation and commissioning time reduced to half a day compared to several days for a conventional T/R and its control cabinet.
- The SIR loads the 3-phase mains symmetrically.
- An SIR typically uses approximately 65% of the kVA required by a conventional T/R and can still provide the same kW to the ESP. This feature helps to save operating costs by consuming less kVA.
- The SIR provides industry-leading efficiency in excess of 97% when using silicon carbide components. Its smaller dimensioned cables result in cost savings on cabling material.
- Easy installation (in combination with smaller size and weight) and fewer cables reduce installation time (and potential rebuild costs when upgrading).

ROBUST AND RELIABLE

- Robust and proven design solutions.
- Modular design, so the unit can remain on the roof for maintenance work.
- Minimized downtime (less than 1 hour) in the event of component failure thanks to the modular design and standard spare parts.

EXTENSIVE ESP PROCESS EXPERIENCE

Thanks to ANDRITZ's design capabilities as well as its process and operating experience with ESP technologies, the SIR can be easily integrated into ESP upgrade solutions.

BENEFITS AT A GLANCE

- Reduced plant emissions
- Lower investment, installation, operating and maintenance costs
- Robust and reliable
- Includes extensive ESP process experience for all ANDRITZ-design and other ESPs

SIR MODELS AVAILABLE

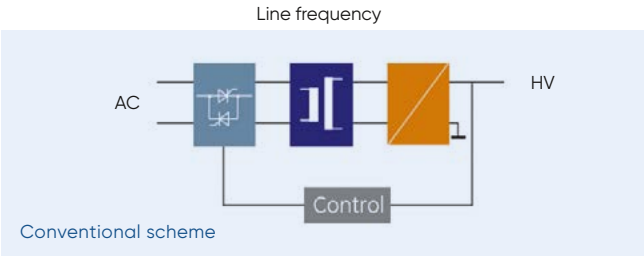
60 kV / 1,000 mA
70 kV / 800 mA
70 kV / 1,500 mA
70 kV / 1,700 mA
70 kV / 2,500 mA
85 kV / 400 mA
85 kV / 700 mA
85 kV / 1,200 mA
85 kV / 1,400 mA
85 kV / 2,100 mA
100 kV / 250 mA
100 kV / 1,200 mA
100 kV / 1,800 mA

High-frequency power supply

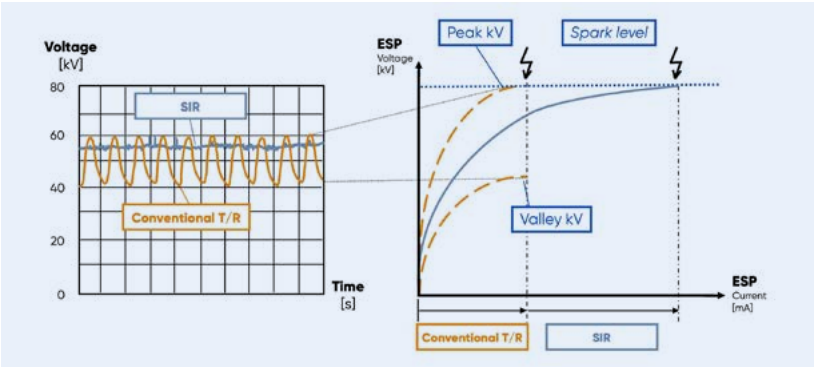
A technology for the future – SIR is a high-voltage power supply for electrostatic precipitators based on high-frequency and highly efficient power conversion. ANDRITZ has been developing this innovative technique since the early 90s.

SIR technology combines a transformer/high-voltage rectifier (T/R) and a control system to energize and control ESPs in one integrated unit. The high-frequency power supplies are also known as SMPS (switched mode power supplies). More than 5,500 SIR units are in operation worldwide in power plants and in industrial processes producing cement, pulp and paper, chemicals, glass, and steel, for example.

The SIR controller is the ultimate control technology for ESPs. With integrated rapping control and pulse optimization software (EPOQ), the SIR controller optimizes the process in terms of plant-specific and fuel-specific conditions, providing the client with the lowest possible particulate emissions. With a Windows®-based PC, the user can configure and monitor the SIR(s). The Ethernet network can also be used for a DCS ModbusTCP connection and/or for our ProMo/ProMoBas (ANDRITZ Process Monitoring System).



In high-frequency power supply technology (HFPS), the mains are rectified and the resulting voltage is chopped by using a transistor bridge to a high-frequency voltage, which is connected to a high-voltage transformer. The output of the transformer is connected to a diode rectifier that supplies the current to the ESP. A conventional high-voltage power supply for ESPs comprises a single-phase transformer followed by a rectifier set that connects to the ESP. The power flow is controlled by means of an anti-parallel pair of thyristors in the transformer primary circuit.



WHY THE HIGH FREQUENCY?

Thanks to the high frequency, the SIR can produce a smooth output voltage and thus greatly increase the efficiency of the ESPs (expressed in mg/Nm³).

THE MAIN DIFFERENCES BETWEEN THE SIR AND CONVENTIONAL TECHNOLOGY

		Input phase	Power factor	Ripple %	Arc shutdown	
Conventional technology T/R set	1,200 – 3,000 kg (Control cabinet included)	1-phase	cos ϕ = 0.63	30%	10 ms	Thyristor 50 Hz
High-frequency technology SIR unit	350 – 620 kg	3-phase	cos ϕ = 0.92	< 1%	10 µs	Transistor 25 – 50 KHz

Case studies

ANDRITZ solution with SIR dramatically decreases emissions and exceeds customers' expectations

CHALLENGE 1

A plant operating 3 boilers, T3, T4 and T5, fired with high-resistance South African coal, was exceeding particulate emission levels as the new legislation required 50 mg/Nm³. Two of the smaller units, T3 and T4, rated 120 MWe, had to use SO_3 conditioning as the specific collection area of the ESPs was too low. The third boiler (T5), rated 220 MWe, had the same emission problem. All units mixed 8–12% biomass into the coal feed.

ESP STATUS (T3 AND T4)

- Each boiler had a 2-casing ESP, designed by Research Cottrell, with 4 fields each and was equipped with magnetic impact rappers
- 4 conventional T/Rs rated 70 kVp/1,250 mA, i.e. one T/R feeding two parallel bus sections in each field
- Problems in supplying enough power to the ESP that was operating with low-resistance dust due to the use of SO_3 conditioning
- Particulate emission 180–200 mg/Nm³

THE SOLUTION

A turnkey control system upgrade of the ESPs' power supply with a performance guarantee of 50 mg/Nm_3:

- The 4 old, conventional T/Rs were replaced by 8 SIRs 70 kV/800 mA.
- The power input to the two casings was increased from 100 kW to 220 kW using the low-voltage ripple SIR technology.
- After the installation of 8 SIRs at boiler T3, the particulate emission dropped below 20 mg/Nm³ at 220 kW power input.

Due to the successful upgrade at boiler T3, we were commissioned to upgrade T4 and later also the larger T5 unit.

CUSTOMER BENEFITS

- **Emission reduction in compliance with the operating permit requirements, avoiding a costly ESP extension.**
- **Substantial free space created in the MCC room.**

CHALLENGE 2

A 525 MWe utility burning low-sulfur coal with major mechanical ESP issues required lifetime extension, including a full mechanical retrofit. To meet future environmental requirements, the customer wanted to operate below 10% opacity and, if possible, also reduce the cost of operation by removing the SO_3 conditioning system. ANDRITZ's contractual obligation after the upgrade was to operate below 10% stack opacity with SO_3 conditioning.

ESP STATUS

- Unit 5 had a 2-casing, 2-cell CE Walther ESP with 4 fields each
- 16 conventional T/Rs
- Before upgrade: 11% stack opacity with 6 ppm SO_3 conditioning

THE SOLUTION

- Full mechanical retrofit and splitting the electrical fields to accommodate 32 SIRs rated 70 kV/800 mA
- After installation, ESP performance exceeded customer expectations, with a power input to the ESP of 1,759 kW and an opacity of only 1.6% with no SO_3 conditioning
- As step two, ANDRITZ optimized the ESP by installing the unique EPOQ software in the first three fields, resulting in power savings of 750 kW and a new power input of 1,009 kW, and maintained 1.6% opacity without SO_3 conditioning.

CUSTOMER BENEFITS

- **Considerable annual energy savings of 6,000 MWh.**
- **ANDRITZ as complete ESP solution provider with SIR technology exceeds customer expectations by enabling the customer to remove the SO_3 conditioning system and providing savings in operating and maintenance costs.**
- **The plant is able to comply with future mercury regulations by doing away with SO_3 conditioning.**

ANDRITZ – your full-service provider

Retrofits and upgrades to meet new environmental needs

ANDRITZ has extensive experience in the conversion of existing air pollution control systems to new technologies when required by new legislation, changed regulations, or fuel and process changes in ageing equipment.

The ANDRITZ technical solutions for air pollution equipment retrofits and upgrades encompass the following options:

- Mechanical and electrical refurbishment
- Control systems upgrade
- Extension of fields/size
- Flue gas conditioning
- Any combination of the above options

ANDRITZ upgrade projects can always be combined with long-term service agreements, which ensure the performance of the equipment throughout its lifetime. Together with the above-mentioned solutions and services, we provide a broad variety of mechanical parts, either of ANDRITZ or other OEM design, for ESP internals.

LOCAL ACCESS TO GLOBAL EXPERTS AND ADVANCED TECHNOLOGY

International technology group ANDRITZ offers a broad portfolio of innovative plants, equipment, systems and services for the pulp and paper, iron and steel, minerals, biomass, waste-to-energy and power generation industries. Innovative products and services in the industrial digitalization sector are offered under the brand name Metris (ProMoBas for Air Pollution Control) and help customers to make their plants more user-friendly, efficient and profitable. ANDRITZ has around 27,000 employees worldwide and more than 280 locations in over 40 countries.

Software tools and web-based applications for inspections and maintenance are available on our website for our customers.

A large package of services and information can be provided by our specialists at the ANDRITZ locations worldwide:

- ESP process specialists
- Remote optimization
- Commissioning and service

REDUCING THE COST OF ELECTRICITY

Our standard SIR

> 95% **electrical efficiency**

SiC (Silicon carbide) SIR

> 97% **electrical efficiency and increased ambient temperature**

Reduced environmental footprint

< 10 mg/Nm³

particulate emissions

Using its extensive ESP design, process and operating experience, ANDRITZ has developed a technology for the future. Robust and reliable, SIR can reduce ESP dust emissions by up to 60% without a need to enlarge the ESP.

CLEAN AIR FOR A BETTER TOMORROW

ANDRITZ is a leading global supplier of innovative air pollution control technologies. Our product range combines 130 years of experience with the specific knowledge gained from over 200 installations around the world. ANDRITZ offers high-end technologies and is a partner you can rely on. Contact us all over the world.

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