SPS-AC Line

for PolySilicon Production

FRIEM®

SPS-AC Line

SPS-AC Power Supply

Founded in 1950 to design and manufacture High Power Converters, FRIEM continued to develop its know-how in energy conversion particularly for the electrochemical industry. Thanks to its experience, in 1984 FRIEM could start its first Power Supply for a PolySilicon CVD Reactor. Its vast knowledge in such a particular field and its capability of following the requests of continuous improvement coming from the market, drove FRIEM to develop the new SPS-AC Line, the latest generation of AC technology Power Supply for PolySilicon production. CVD Reactors No. of Rods: greater than 100!

SPS-AC Advantages

Increased Production Capacity

The design of the SPS system is based on the **Load Supply Independency** achieved with multi-phases Transformers and independent SVV Power Controllers. This design **grants the best Production continuity and capacity** among all the AC Power Supply Systems. Moreover each SVV Power Controller is provided with the **Re-start function**: in case of a transient fault, the SVV Power Controller automatically re-starts allowing the Reactor to continue the production.

Improved Harmonics and Power Factor

The Harmonics and Power Factor are improved thanks to the multi-phases design and to the voltage sequence control (VSC) used in the SPS-AC.

Reduced Unbalance on the MV Phases

The multi-phases design, besides granting the Load Supply Independency, is able to reduce the unbalance on the MV phases from typical value of 20% down to the 5%.

High Electrical Efficiency

FRIEM's AC Thyristor Technology grants the highest electrical efficiency.

Compact Size

Reduced number and size of cubicles, reduced space and time required for installation and start-up.

SPS-AC Line General Characteristics

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- **Re-start Function and Protections:** Maximum Production capacity together with safety.
- **µ-Processor Current Regulation:** High Accuracy and Fast Response.
- **User-Friendly HMI:** Reduced Commissioning Time and High Process Optimization.
- **Measurements and Recording:**
  - Current, Voltage and Power of Each SVV Power Controller.
  - Complete list of Alarms, Events and Trip recording.
  - Oscillographic Recordings and Load Profile.

Protections:

- **Bars to ground:** Provided with self-diagnostic and/or redundant system.
- **Machine Protections:** Thyristor/Fuse Failure, Overcurrent, Over/Under Voltage, Over Temperature, Cooling System Failure.
- **System Protections:** Bars to Ground Protection, Silicon Rods Break (with Automatic Restart).
- **Self-diagnostic:** Communication Failure, Internal Fault, Lack of Aux. Power Supply.

Operating Characteristics	
Design	3-phase or 6-phase AC power converter
Connection	Voltage Multi taps
Secondary voltage taps	3,4 or 5
Semiconductor Type	Thyristors
Technology	On-phase Voltage Control
AC Input Voltage	From 6,6kV to 69kV, 50 or 60Hz
Transformer Construction	Dry-type cast resin or oil immersed
AC Output Voltage	From 170V to 2000V Regulated
AC Output Current	From 20A to 4000A Regulated
Output Regulation	Current Regulation standard ±1% accuracy by means of Thyristor gate control
Regulator	Current and Voltage Digital Regulator, FRIEM's DRP high performance type
Reference Standard	IEC 146 and IEC 76

SPS-AC Line

Pre Start Unit

Due to high resistivity, the Silicon filament results in being non-conductive. Therefore high voltage is applied with a dedicated unit, the Pre-Start, in order to obtain a small current flow and starting the warm-up of the filaments. Depending on the Silicon's purity and on the initial temperature, the voltage level can be different.

As soon as the hairpins are in conduction at a set current, the SPS switches on the relevant Main Power Supply. Since the Pre-Start time is very short, the Pre-Start supplies only a few hairpins contemporarily. Moreover one Pre-Start unit is generally common for more than one Reactor.

Operating Characteristics	
Connection	Inverter/Converter and Step-up Transformer
Technology	IGBT or Thyristor
AC Input Voltage	From 380V-3Ph to 440V-3Ph, 50 or 60Hz
Output Voltage	From 12kV to 400V Regulated
DC Output Current	From 0,1A to 40A Regulated
Output Regulation	Current and Voltage Regulation standard ±1% accuracy
Control Automation	PLC and Operator Panel
Reference Standard	IEC

Main Transformer

The Main Transformer is especially designed for Power Converter application. The secondary winding is provided with taps (usually 5 taps) in order to allow the huge voltage variation required by the Deposition Process. Moreover, according to the number of Rods in the CVD Reactor and their internal disposition, the Main Transformer can be provided with multiple secondary windings in order to grant the Load Independency and reduce the harmonics, power factor and unbalance problems on the MV network.

Main Control Panel

Each SPS Unit is equipped with a Main Control Panel, type SMC, which controls all the automations and protections of the Power Supply System. The SMC is equipped with a PLC and a Touch Screen HMI showing all the measurements, alarms and trips and allowing local control of the Power Supply. Local or Remote Control can be easily and safely selected both from the panel itself and from the Plant's DCS.

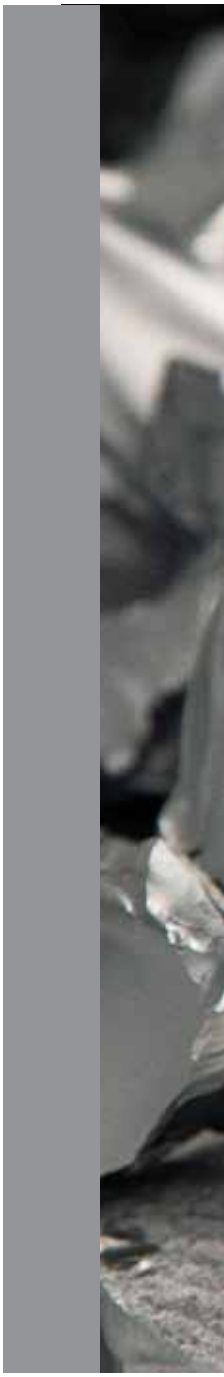
SVV Power Controller

The SVV Power Controller, based on AC thyristor technology, allows the full control of the Power supplied to the Reactor's Rods. In order to cover the huge Voltage range required by the Deposition Process, each SVV Power Controller includes more stages to be connected with the secondary taps of the Main Transformer. According to the Reactor's configuration, more cubicles can compose the SPS-AC Power Supply. Being that the operating and protection parameters of each SVV Power Controller cubicle are independent, even in case of fault on one or more hairpins, all the remaining rods can continue the deposition, therefore increasing the production capacity.

System Accessories

Besides the Power Supply itself, FRIEM is capable of offering to the customer a complete package, including:

- **MV Switchgear**
- **Load/Earth Switching System**
- **Busbar System**
- **Remote SPS Supervision**
- **Power Factor Improvement and Harmonic Filter System**



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CSQ IQNet **ISO 9001-2008 STANDARD**

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