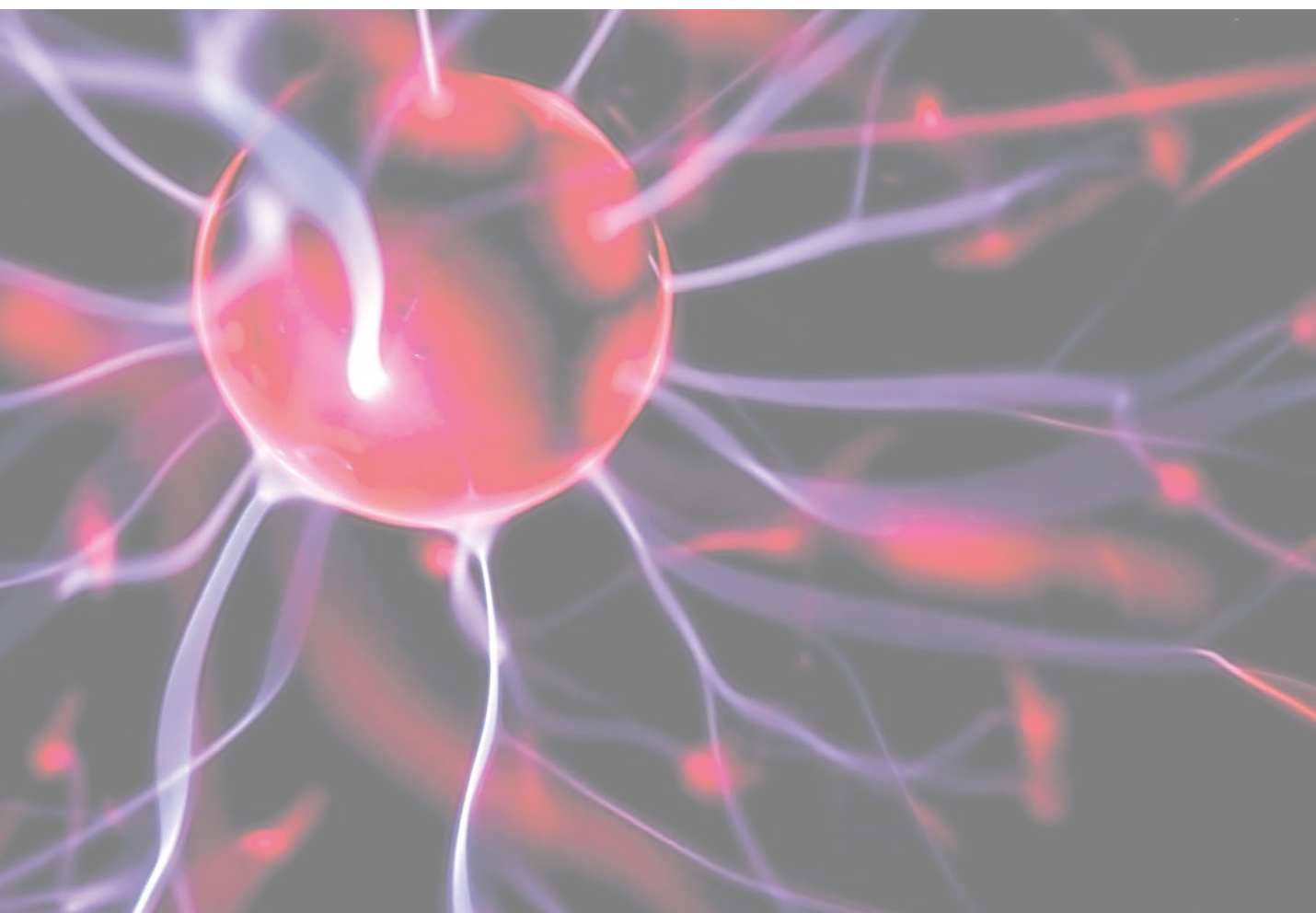


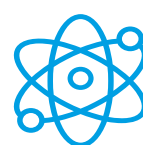


ITALIAN  
POWER  
TECHNOLOGY



PARTICLE ACCELERATORS  
NUCLEAR FUSION

**BIG  
SCIENCE**



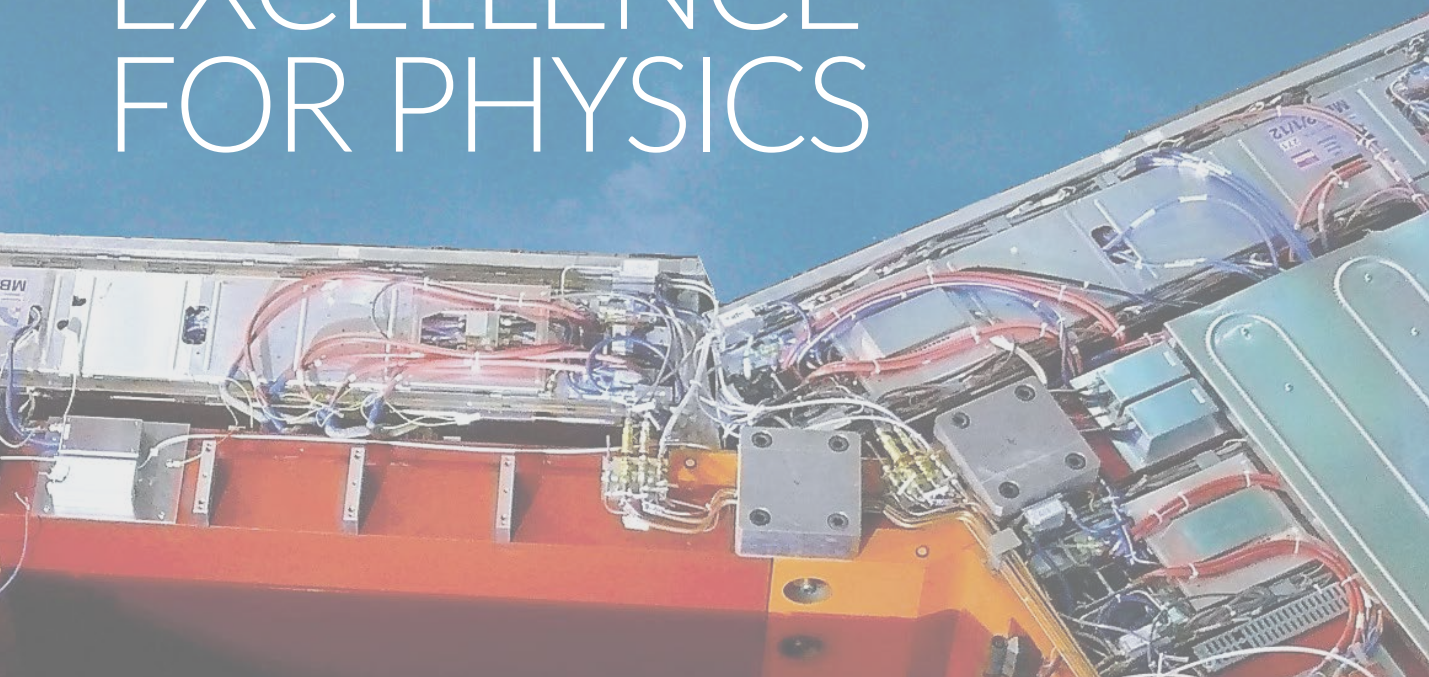


# INDEX

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# EXCELLENCE FOR PHYSICS



The field of physics needs the best technology currently available and a high adherence to technical specifications given by the researchers.

Technological knowledge developed and the references acquired over the years, combined with a business vocation always devoted to the development of highly customized solutions, makes EEI the ideal partner for the realization of power systems in the fields of research and nuclear physics. For these sectors of activities EEI designs and manufactures special power supplies with special performance suitable for the following applications.

## MAGNETS POWER SUPPLY

DC converters for the power supply of magnets dipoles, quadrupoles and sextupoles for particle accelerators and similar applications. These drives are available as a cabinet or with a 19" rack architecture. Solution with active rectifier stage (regenerative inverter) available as an option.

## HIGH DYNAMIC PERFORMANCE POWER SUPPLY

Power supplies for power reactors and systems used in the context of nuclear physics, such as experiments on plasma.

## SCANNING MAGNET POWER SUPPLIES

Dynamic and precise power supplies for scanning magnets used in particle accelerators, for hadrontherapy applications.

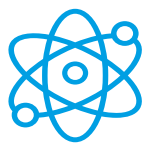
SERIES	DESCRIPTIONS	MAIN CHARACTERISTIC	ARCHITECTURE
EEI-SMPS	Scanning magnet power supplies for voxel and painting mode	Voltage complete excursions 30 $\mu$ s Current flap top stabilization < 200 $\mu$ s.	Cabinet architecture
EEI-RMPS	High precision power supply for particle accelerators magnets	Voltage precision up to 30 ppm Current precision up to 10 ppm	19" Rack architecture Multiple rack cabinet
EEI-CMPS	High precision power supply for particle accelerators magnets	Voltage precision up to 30 ppm Current precision up to 10 ppm	Cabinet architecture
EEI-HDPS	High dynamic behaviour for nuclear research and plasma confinement	Response time up to 12,5 $\mu$ s and rise time up to 30 $\mu$ s	Modular cabinet solution or rack according to request
EEI-RC	Command and control driving boards	Upon Customer specification	Rack architecture
Special projects	Power supply, choppers and drives	Upon Customer specification	



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## ENERGY

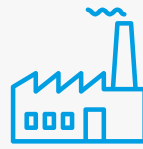
- Solar
- Storage
- Wind
- Hydro
- Cogeneration
- Fuel Cell



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## BIG SCIENCE

- Particle Accelerator
- Nuclear Fusion
- Special Projects



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## INDUSTRY

- LV solutions
- MV solutions
- Power Quality
- Special Projects



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## ROPEWAYS

- Revamping
- Drives and Inverters
- Blondins, material lifting

## EEI. THE COMPANY

Since 1978 EEI is a leader company active in the international Market with a background of different and consolidated experiences in power electronics, automation systems and production technologies in many industrial fields.

From experiences of collaboration with the major worldwide manufacturers and the special knowledge acquired, EEI is able to work with quality and expertise in various fields:

- Ropeway systems
- Drive and control of industrial systems
- Static Energy Conversion
- Special projects
- Big Science

### EEI ENERGY DIVISION

EEI also offers innovative solutions in new sectors, with important applications in the field of renewable energy sources, by designing and providing static converters for the connection to the grid of various types of energy production systems. "EEI Energy Division" has been created to give energy producers the best performance, the most advanced technical solutions and attentions to Customer needs, which are the mission of EEI.

### EEI ENERGY DIVISION MAIN FIELDS OF APPLICATIONS ARE:

- Solar
- Wind
- Storage
- Hydro
- Cogeneration
- Fuel Cell

### THE COMPANY

More than 40 years of experience in power electronic applied to several industrial applications: from energy conversion systems to innovative solutions for Physics Laboratories.

### PHILOSOPHY

Providing winning solutions for being eco-sustainable, efficient and reliable.

### MISSION

Generate and distribute energy demonstrating respect for the environment.

# DMPS SERIES

## HIGH PRECISION POWER SUPPLY FOR DIPOLE MAGNETS MODULAR CABINET

For the power supply of dipole magnets of big size in the field of particle accelerators, EEI designed and built converters of EEI-DMPS series. EEI-DMPS series power supplies offer the very high precision features that characterize the drives manufactured by EEI for physics sector, with the ability to provide a highly stabilized output current up to 4000A  $\pm$  1500 V in a modular cabinet.

### MAIN APPLICATION

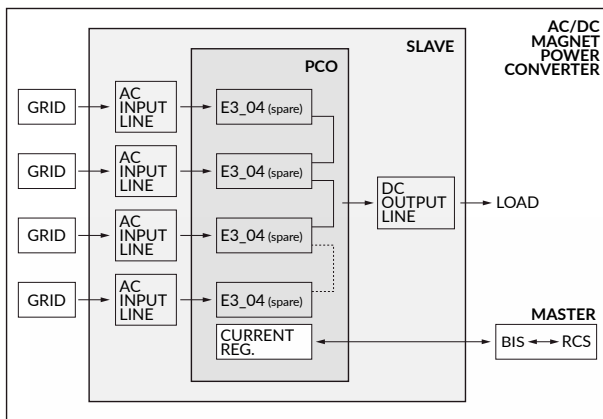
- Dipole magnets for particle accelerator

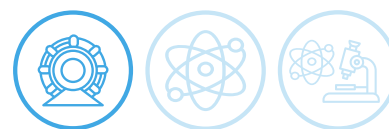
In their standard version cabinets have a DC-link busbar fed by a AFE (regenerative inverter) rectifying stage.

DC output stage is composed of IGBT boosters with modular architecture, in order to enable a better energy quality output. For a further reduction of output voltage ripple, linear regulation stage is available upon request.

### OPTIONS

- Active Front End/ Diode-Thyristor bridge rectifier
- Multipulse input
- Dynamic breaking module
- Increased DC-link capacitor bank size
- Output crowbar
- Earth fault detection circuit
- Customer regulation boards
- Customer transducers
- Local/remote control





MODEL	EEI - DMPS
<b>MAIN PARAMETERS</b>	
Nominal output current	3000A
Nominal output voltage	+/- 1500 V
Nominal output power	900 kW
Line input voltage	400 +/-10% /3p; 47...63Hz (other on request)
Power factor (with output power >20%)	≥ 95%
Minimum efficiency (Inom, 50% output power)	≥ 85%
DC output voltage resolution	up to 30 ppm of Vnom
Small signal voltage control bandwidth (-3dB)	> = 500 Hz
Output Voltage rise time (10%-90%)	< 3 ms
Output current resolution	up to 10 ppm of Inom
Current regulation bandwidth (-3dB)	100 Hz
<b>MECHANICAL DATA</b>	
Architecture	Cabinet
Dimensions (LxDxH)	upon customer specifications
Cooling	Water cooling
Acoustic noise at 1m	< 65 dBa
Ambient temperature	0 - 40°C
<b>INTERFACE AND REGULATION</b>	
Regulation mode	CC or CV mode, selectable
Displays	Touch-panel HMI; LED indications for failures
Interface analog	Analog interface for current & voltage measuring and setting
Interface digital	Digital interface for current & voltage measuring and setting, output ON/OFF with status; indication and reset of alarms; polarity indication
Ramp function	Programmable di/dt ramp function
DAC resolution	16 bit (12 bit)
ADC resolution	16 bit (12 bit)
<b>OPERATION AND MAINTENANCE</b>	
Total number of cycles	> 10 <sup>8</sup>
MTBF	> 50000 h
MTTR	< 4 h
MTTR (semiconductors and capacitors)	< 1 h

# RMPS SERIES

## HIGH PRECISION POWER SUPPLY FOR MAGNETS - 19" RACK

Drives of series EEI-RMPS are the most reliable and effective solution for the power supply of magnets used in particle accelerators for physics research and medical application. EEI drives supply DC output current with extraordinary precision and stability, to ensure proper functioning of research equipment.

### MAIN APPLICATION

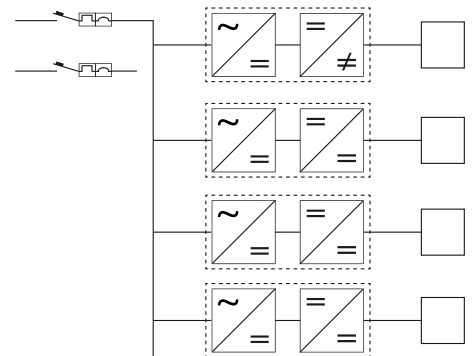
- Corrections magnets for particle accelerator
- Ultra high stable laboratory magnets

EEI-RMPS series power supplies are based on a 19" rack architecture that ensure an easy installation, inspection and maintainability of equipment. Each unit is composed by a rectifying stage for the power supply of a H-bridge converter. DC-link is equipped with proper thin-film filter capacitors for an improved energy stability output. The additional output filter improves current stability.

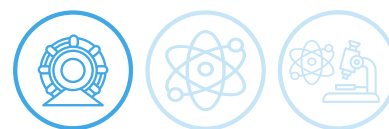
Output current is measured through high precision embedded DCCT-DC or through external probes. EEI-RMPS series drives can be assembled together in a cabinet that includes incoming line section together with auxiliaries and unit monitoring and control. Connection to the main cabinet is made with fast connectors for a simpler and more reliable joining.

### OPTIONS

- Active Front End/ Diode-Thyristor bridge rectifier
- Multipulse input
- Dynamic breaking module
- Increased DC-link capacitor bank size
- Output crowbar
- Earth fault detection circuit
- Customer regulation boards
- Customer transducers
- Local/remote control







MODEL	EEI - RMPS
<b>MAIN PARAMETERS</b>	
Nominal output current	10A - 50A
Nominal output voltage	30V - 50V
Nominal output power	1,5 kW - 15 kW
Line input voltage	400 +/-10% /3p; 47...63Hz (other on request)
Power factor (with output power >20%)	≥ 90%
Minimum efficiency (Inom, 50% output power)	≥ 85%
DC output voltage resolution	up to 30 ppm of Vnom
Small signal voltage control bandwidth (-3dB)	> 2 kHz
Output Voltage rise time (10%-90%)	< 100μs
Output current resolution	up to 10 ppm of Inom
Current regulation bandwidth (-3dB)	100 Hz
<b>MECHANICAL DATA</b>	
Architecture	19" rack - multiple unit on a single cabinet
Cooling	Air cooling (water cooled available as an option)
Acoustic noise at 1m	< 65 dBa
Ambient temperature	0 - 40°C
<b>INTERFACE AND REGULATION</b>	
Regulation mode	CC or CV mode, selectable
Displays	LCD display: 2 lines - 16 alphanumerical digits for parametrization, operating statue and alarm message; LED indications for failures
Interface analog	Analog interface for current & voltage measuring and setting
Interface digital	Digital interface for current & voltage measuring and setting, output ON/OFF with status; indication and reset of alarms; polarity indication
Ramp function	Programmable di/dt ramp function
DAC resolution	16 bit
ADC resolution	16 bit
<b>OPERATION AND MAINTENANCE</b>	
Total number of cycles	> 10 <sup>8</sup>
MTBF	> 50000 h
MTTR	< 4 h
MTTR (semiconductors and capacitors)	< 1 h

# CMPS SERIES

## HIGH PRECISION POWER SUPPLY FOR MAGNETS MODULAR CABINET

For the power supply of magnets of larger size in the field of particle accelerators, EEI designed and built converters of EEI-CMPS series. EEI-CMPS series power supplies offer the very high precision features that characterize the drives manufactured by EEI for physics sector, with the ability to provide a highly stabilized output current up to 4000A in a single cabinet.

### MAIN APPLICATION

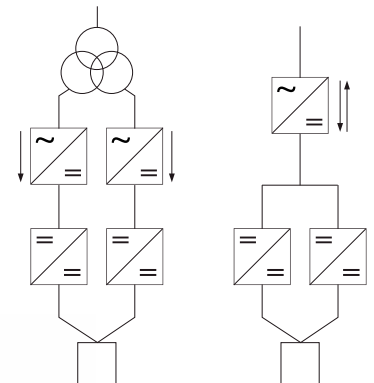
- Dipole, quadrupole and sixth-pole magnets for particle accelerator
- Ultra high stable laboratory magnets

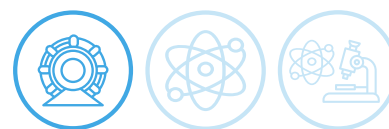
For Higher output currents EEI can offer cabinets of EEI-CMPS series: power supplies belonging to this series are equipped with the main drive and with all the electromechanics for protection and disconnection.

In their standard version cabinets have a DC-link busbar fed by a SCR rectifying stage: upon request solution with IGBT regenerative inverter. DC output stage is composed of IGBT boosters with modular architecture, in order to enable a better energy quality output. For a further reduction of output voltage ripple, linear regulation stage is available upon request.

### OPTIONS

- Active Front End/ Diode-Thyristor bridge rectifier
- Multipulse input
- Dynamic breaking module
- Increased DC-link capacitor bank size
- Output crowbar
- Earth fault detection circuit
- Customer regulation boards
- Customer transducers
- Local/remote control





MODEL	EEI - CMPS AIR	EEI - CMPS WATER
<b>MAIN PARAMETERS</b>		
Nominal output current	50A - 300A	300A - 4000A
Nominal output voltage	30V - 90V	70V - 300V
Nominal output power	4,5 kW - 27 kW	27 kW - 400 kW
Line input voltage	400 +/-10% /3p; 47... 63Hz (other on request)	
Power factor (with output power >20%)	≥ 90%	≥ 90%
Minimum efficiency (Inom, 50% output power)	≥ 85%	≥ 85%
DC output voltage resolution	up to 30 ppm of Vnom	up to 30 ppm of Vnom
Small signal voltage control bandwidth (-3dB)	> 2 kHz	> 2 kHz
Output Voltage rise time (10%-90%)	< 100μs	< 1ms
Output current resolution	up to 10 ppm of Inom	
Current regulation bandwidth (-3dB)	100 Hz	100 Hz

<b>MECHANICAL DATA</b>		
Architecture	Cabinet	Cabinet
Dimensions (LxDxH)	600mm x 900mm x 2200mm	upon customer specifications
Cooling	Air cooling	Water cooling
Acoustic noise at 1m	< 65 dBa	< 65 dBa
Ambient temperature	0 - 40°C	0 - 40°C

<b>INTERFACE AND REGULATION</b>		
Regulation mode	CC or CV mode, selectable	
Displays	Touch-panel HMI; LED indications for failures	
Interface analog	Analog interface for current & voltage measuring and setting	
Interface digital	Digital interface for current & voltage measuring and setting, output ON/OFF with status; indication and reset of alarms; polarity indication	
Ramp function	Programmable di/dt ramp function	
DAC resolution	16 bit	16 bit
ADC resolution	16 bit	16 bit

<b>OPERATION AND MAINTENANCE</b>		
Total number of cycles	> 10 <sup>8</sup>	> 10 <sup>8</sup>
MTBF	> 50000 h	> 50000 h
MTTR	< 4 h	< 4 h
MTTR (semiconductors and capacitors)	< 1 h	< 1 h

# HDPS SERIES

## HIGH DYNAMICS POWER SUPPLY

Experiments and research upon the nuclear fusion makes large use of coils for the confinement and control of plasma.

The drives that supply current to those coil must join together high precision and optimal dynamic behavior with response times up to  $12\ \mu\text{s}$  and set achievement times up to  $30\ \mu\text{s}$ .

EEL power supply can be provided in a cabinet or 19-inch rack architecture solution, according to performance and customer requests.

### MAIN APPLICATIONS

- RFX Padua experiment
- JT-60SA experiment

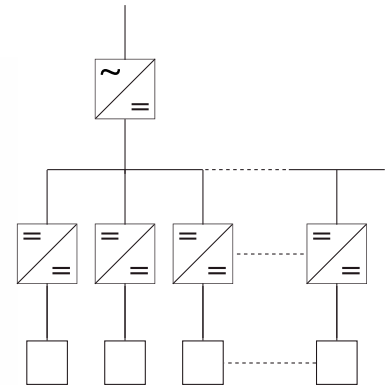
EEL power supply belonging to EEL-HDPS series are provided in a complete solution, inclusive of all electromechanical components for protection and disconnection.

Command and control of DC/DC units is made through DSP with signal transmission over fiber optic, in order to achieve the level of coordination among the units that is necessary in this type of application.

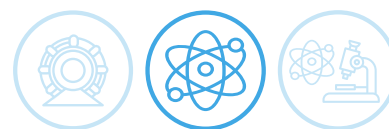
Cabinets of EEL-HDPS converter includes the capacitive banks that is needed to support effectively the drives during system functioning.

### OPTIONS

- Active Front End/ Diode-Thyristorbridge rectifier
- Multipulse input
- Dynamic breaking module
- Increased DC-link capacitor bank size
- Output crowbar
- Earth fault detection circuit
- Customer regulation boards
- Customer transducers
- Local/remote control







## MODEL

## EEI - HDPS

### MAIN PARAMETERS

Nominal output current	upon Customer Specifications
Nominal output voltage	upon Customer Specifications
Nominal output power	upon Customer Specifications
Number of DC/DC units	upon Customer Specifications
Line input voltage	400 +/-10% /3p; 47...63Hz (other on request)
Power factor (with output power >20%)	≥ 90%
Minimum efficiency (Inom, 50% output power)	≥ 85%
DC output voltage resolution	< 1%
Small signal voltage control bandwidth (-3dB)	> 20 kHz
Response time	< 12,μs
Rise Time	< 30μs

### MECHANICAL DATA

### INCOMING LINE / AC/DC UNIT

### DC/DC CONVERTER

Technology	SCR rectifying bridge - IGBT Regenerative inverter	IGBT converter
Architecture	Cabinet	Cabinet / 19"rack
Dimensions (LxDxH)	upon customer specifications	upon customer specifications
Cooling	Air or water cooling	Air or water cooling
Acoustic noise at 1m	< 65 dBa	< 65 dBa
Ambient temperature	0 - 40°C	0 - 40°C

### INTERFACE AND REGULATION

Regulation mode	CC or CV mode, selectable
Displays	Touch-panel HMI; LED indications for failures
Interface analog	Analog interface for current & voltage measuring and setting
Interface digital	Digital interface for current & voltage measuring and setting, output ON/OFF with status;
Ramp function	indication and reset of alarms; polarity indication
DAC resolution	Programmable di/dt ramp function
ADC resolution	16 bit

16 bit

### OPERATION AND MAINTENANCE

Total number of cycles	> 10 <sup>8</sup>
MTBF	> 50000 h
MTRR	< 4 h
MTRR (semiconductors and capacitors)	< 1 h

# SMPS

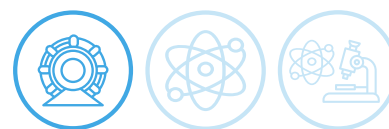
## SCANNING MAGNET POWER SUPPLY

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Dynamics and precision characterize the best of EEL's low voltage power supplies, the power supplies for the scanning magnets, which provide very high performance for the "VOXEL" and "PAINTING" functions required in oncological hadron therapy applications.

A set of 4 quadrant power supplies, 600A-600V in switched mode was designed and delivered in 2015 to EBG MED AUSTRON. The power supplies feed the scanning magnets, support the "VOXEL MODE" and "PAINTING MODE" functions with variable current ramps, complete excursions of the voltage set in 30  $\mu$ s and stabilization of the current flap top in less than 200  $\mu$ s.



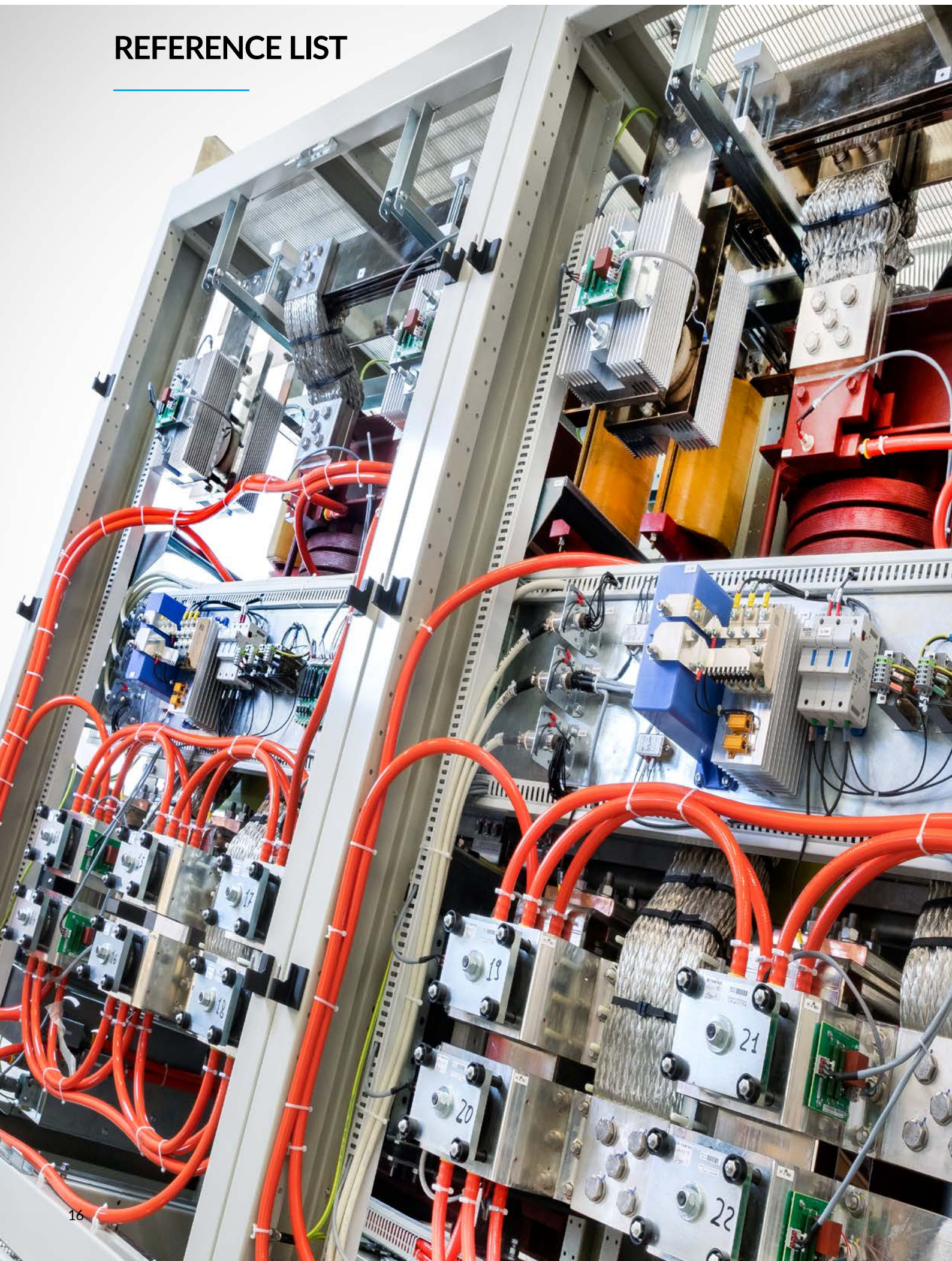


MODEL	EEI-SMPS
<b>MAIN PARAMETERS</b>	
Voxel mode cycle period - ms	6 to 10000
Delay from new set point to voltage ramp start - $\mu$ s	12.5
Equivalent switching frequency - kHz	80
V ramp, voltage ramp time 0 to $\pm$ 100% - $\mu$ s	30
du/dt nom. - kV/s	$\pm$ 20000
I ramp, current ramp time for step up to 5% - $\mu$ s	100
Settling time to accuracy band - $\mu$ s	200
Painting mode cycle period - ms	6 to 10000
Load inductance - mH	2.5
Load resistance - m $\Omega$	21
Load time constant - ms	119
I nom - A	$\pm$ 600
di/dt nom.	$\pm$ 220
V nom	$\pm$ 600
<b>MECHANICAL DATA</b>	
Architecture	Cabinet
Dimensions (LxDxH)	upon customer specifications
Cooling	Water cooling
Acoustic noise at 1m	< 65 dBa
Ambient temperature	0 - 40°C
<b>INTERFACE AND REGULATION</b>	
Regulation mode	CC or CV mode, selectable
Displays	Touch-panel HMI; LED indications for failures
Interface analog	Analog interface for current & voltage measuring and setting
Interface digital	Digital interface for current & voltage measuring and setting, output ON/OFF with status; indication and reset of alarms; polarity indication
Ramp function	Programmable di/dt ramp function
DAC resolution	16 bit
ADC resolution	16 bit
<b>OPERATION AND MAINTENANCE</b>	
Total number of cycles	> 10 <sup>8</sup>
MTBF	> 50000 h
MTTR	< 4 h
MTTR (semiconductors and capacitors)	< 1 h



## REFERENCE LIST

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## CERN

The European Organization for Nuclear Research, known as CERN is an international organization whose purpose is to operate the world's largest particle physics laboratory, which is situated in the northwest suburbs of Geneva on the Franco-Swiss border.

The Large Hadron Collider (LHC) is the world's largest and highest-energy particle accelerator, built with the aim of allowing physicists to test the predictions of different theories of particle physics and high-energy physics. The co-operation between EEI R&D office and CERN started in the year 2001 and represents the typical example of the EEI approach to its partners requests. EEI designed and manufactured two different series of fundamental equipment for the LHC particle accelerator.

The 26V - 20kA Power Converter is now used to supply the superconductive magnetic dipoles of the CMS magnet of the laboratory, in the context of subnuclear particle detection. It includes four three-phase SCR rectifiers, 5000 A each one, in parallel connection, where both converter bridge and filter inductances are water-cooled

Main features of the equipment are:

- High current Output: 20.000 A
- High precision and stability through Cern regulation Control Board.
- Water cooling system of semiconductors by 4 indipendent circuits that minimize the power module dimensions.

### THE 444 FOUR-QUADRANT AC/DC CONVERTER WITH +/- 600A/10V

output used for the power supply of the superconductive magnetic dipoles placed in the tunnel.

Main features of the equipment are

- High precision and low output noise
- Reduced volume and low weight
- Water cooling system
- Galvanic isolation between mains input and magnet load
- High reliability
- Fast repairability

EEI received from CERN the "CMS Gold Award of the Year 2004" for the best Italian Electrical Supplier of the 2004



## MED AUSTRON



MedAustron in Wiener Neustadt is destined to become in the near future one of the major Center for Ion Beam Therapy and Research in Europe. The Center is under construction and treatments will be carried out from 2015 and will involve 1.400 patients every year. The non-clinical research will focus on medical radiation physics, radiation biology and experimental physics.

These operations are planned to be conducted after the treatments of the patients, during the night and at weekends. This research will be conducted in a separate irradiation room.

The planning and development of the technical heart of the system, the particle accelerator (synchrotron), is done in cooperation with the CERN.

The accelerator complex consists of the injector with ion sources and an ion linac that will accelerate particles up to the synchrotron injection energy of 7 MeV/u.

This is followed by a synchrotron capable of accelerating particles to the planned extraction energy, ranging from 60 MeV to 250 MeV for protons and 120 MeV/u to 400 MeV/u for carbon ions, suitable for the medical application.

For non-clinical research only, a proton energy extended up to 800 MeV is also possible.

For MED Austron EEI will supply a complete set of AC/DC Power Supply for the Magnets, with nominal power up to 230 kW, with a  $I_{nom}$  current of 3300A at  $\pm 70V$  and a  $I_{nom}$  precision up to 10ppm.

## RFX

Consorzio RFX is a research organization promoted by CNR, ENEA, Padua University, Acciaierie Venete S.p.A. and INFN, under the patronage of Euratom - ENEA Association.

Reversed Field eXperiment (RFX) is an experiment carried out in the facilities of Institute for Ionized Gas (IGI) of the National Research Council (CNR) in Padova.

The experiment studies the confinement of a plasma for a controlled nuclear fusion, by the use of a magnetic field in a Reversed Field Pinch (RFP) configuration.

Historically RFX is a step forward in the RFP configuration to higher plasma currents.

EEI supplies to RFX experiments includes four power supply units DC bus, each of them containing four section, for a total of:

- 48 DC/DC Chopper
- 48 Magnetic Coils

### MAIN FEATURES OF THE EQUIPMENT ARE:

- Synchronized supply of coils creating a rotating corrective field.
- High flexibility in coordination and control, DSP based, with fiber optical signals transmission
- High dynamic DC/DC converters with a current of 450A at 400V, with a control time of 100ms
- Large capacitive energy storage of 1F for each 12 DC/DC group.

## INFN – OPERA

LNGS (Laboratori Nazionali del Gran Sasso) is one of the major INFN (Istituto Nazionale di Fisica Nucleare) laboratories and is the largest underground laboratory in the world.

It is located under a 1.400m layer of stone under Gran Sasso d'Italia mountain, in the nearby of the town of L'Aquila.

The OPERA experiment has been designed to perform the most straightforward test of the phenomenon of neutrino oscillations. This experiment exploits the CNGS high-intensity and high-energy beam of muon neutrinos produced at the CERN SPS in Geneva pointing towards the LNGS underground laboratory.

EEL supplied two power supplies for the OPERA experiment spettroscopie.

Every magnet power supply is composed by two power supply units (rack), each of them containing a 20Vdc/1700A supply system with the following main features:

- Maximum Output Current: 1700A
- Maximum Output Voltage: 20V
- Current Setting Resolution:  $\pm 5 \cdot 10^{-4}$
- Current Reproducibility:  $\pm 2.5 \cdot 10^{-4}$
- Current Readout Resolution:  $\pm 5 \cdot 10^{-4}$
- Residual Current Ripple:  $\pm 5 \cdot 10^{-4}$
- Linearity Error:  $\pm 5 \cdot 10^{-4}$
- Current stability:  $\pm 5 \cdot 10^{-4}$
- Possibility of reversing the magnet current polarity

EEL supplied also High precision current measurement device for Physics Power Supply Systems.

## DESY

### XFELPROJECTAT DEUTSCHESELEKTRONEN-SYNCHROTRON

The European XFEL is a research facility currently under construction in the Hamburg area, Germany. From 2017 on, it will generate extremely intense X-ray flashes to be used by researchers from all over the world.

EEL has been awarded for the supply of diode rectifiers with nominal voltage 60V or 120V and nominal current from 500A to 2400A.

**BEAM DUMP POWER SUPPLIES.** A set of switched-mode power supplies were provided to DESY, Germany. They feed the beam dump magnets of the European XFEL. Each free-standing cabinet features two  $\pm 140$  A,  $\pm 130$  V outputs. The two output currents are sinusoidal and  $90^\circ$  out of phase, so that the beam follows a circular path on the target. High maintainability was achieved through N+1 redundancy of the key components.



## CNAO



CNAO (National Center for Oncological Hadrontherapy) is the first hospital in Italy specifically dedicated to cancer treatment through hadron therapy. The Center is located in Pavia and its aim is to cure solid tumors by the use of protons and carbon ions.

CNAO uses a synchrotron to accelerate protons and carbon ions. Protons and ions are produced in two sources, pre-accelerated by a linear accelerator, followed by an injection line for the transfer of particles in the synchrotron, where the particles beam will be further accelerated and extracted at energies up to 250 MeV for protons and 400 MeV/u carbon ions.

EEL designed and manufactured 7 power supplies for quadrupole and sextupole magnets of the synchrotron accelerator of the CNAO.

The control loop, working at 40 kHz, is managed by a National Instruments PXI chassis with a 3 M-gate FPGA and four DSP.

The current feedback, made of a 24 bit ADC, and the output stage, realized with a mosfet series linear regulator, assures the required precision and speed.

### MAIN FEATURES OF THE EQUIPMENT ARE:

- Supply Voltage 400 Vca
- Output current = 650 A
- Output Voltage 160 Vdc
- Output current ripple < 5 ppm
- Output current stability < 5 ppm
- Dynamic response = 1300 A/s

## ESRF

### SET OF COMPLETE RACKS OF DC POWER SUPPLIES

A set of complete racks of water-cooled, 3U-high, 0-60V, 0-160A, low-ripple (< 10mV peak) DC power supplies were provided to the ESRF (Grenoble, France) to supply an experimental solid-state RF amplifier.

The racks include power and water distribution to the power supplies, a general and individual circuit breakers and a digital flowmeter with a water temperature measurement, interlocked with the power supplies. The power supplies feature an Ethernet interface, along with custom digital I/Os and remote voltage sense.





## SINCROTRONE TRIESTE

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Elettra is an international multidisciplinary laboratory specialized in synchrotron radiation and its use in the science of matter. It is located in Basovizza on the outskirts of Trieste and is operated by Sincrotrone Trieste.

The laboratory features a 2.4 GeV, third-generation synchrotron radiation source, also named Elettra, and a fourth-generation light source based on a free-electron laser, FERMI@Elettra.

For Sincrotrone Trieste EEI designed and manufactures set of 2 AC/DC power supply for the magnets dipoles, with nominal current of 750A at  $\pm 55\text{Vdc}$ .

## ENEA CNR

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The Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA) (National Agency for New Technologies, Energy and Sustainable Economic Development) is an Italian Government sponsored Research and Development Agency.

The agency undertakes research in areas which will help to develop and enhance Italian competitiveness and employment, while protecting the environment.

## QST (JT-60SA)

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Power supply system for resistive wall mode control.

EEI provided the power supply system for the resistive wall mode control of the JT-60SA (advanced superconducting tokamak, Japan). The system comprises a rectifier (fed from a 6.6 kV line) and 18 fast inverters, rated at 300 Apk, 240 Vpk.

The inverters feature a high bandwidth (3 kHz) and low latency ( $< 50 \mu\text{s}$ ). SiC power semiconductors were employed.

## INFN

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N. 4 power supplies for dipoles and N.7 power supplies for quadrupoles from 100A to 300A used in the new BTF 2 LINE.

## SESAME

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Power supply for the main ring dipole magnets

A free-standing, 4-quadrant, 550 A, 800 V switched-mode power supply was delivered to the SESAME project, Jordan.

The power supply feeds the 16 series connected dipole magnets of the main storage ring.



# EEI SERVICE

## AFTER SALES AND TECHNICAL SUPPORT

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### EEI SERVICE

EEI offers a superior support for the wide range of its products with an effective and professional After Sales Service, with the aim of a full Customer satisfaction.

EEI Service can provide a full set of services:

- On-site intervention
- Preventive maintenance contracts
- Spares
- Repairs
- Training

EEI operates worldwide fully in compliance with the international quality rules, through skilled staff and precision instruments.

### ON-SITE INTERVENTION

EEI has a team of skilled technicians able to respond immediately with corrective actions and always ready for intervention. They are prepared to support the Customer during start-up of the equipment and during the lifetime of the inverter in order to ensure maximum technical assistance and high maintenance level.

Activities performed by our technical staff includes:

- Diagnostic and functional tests
- Start-up and commissioning of brand new equipment
- Modernization and rewamping of regulation systems
- On-site repairs
- Maintenance programs
- Periodical inspections



#### PREVENTIVE MAINTENANCE PROGRAMS

In order to assist our Customers in keeping their equipment operating economically and at peak performance, EEI offers preventive maintenance contracts. The frequency of visits is established based on duration of daily operation and work week. Extra non-warranty service visits are provided at a preferred contract rate.

#### SPARES

EEI spare parts are available at the EEI headquarters in Vicenza and in its Service Center located all over the world. EEI's flexibility allows to produce in its laboratories, and in a short time, electronic boards manufactured even more than 20 years ago.

#### REPAIRS

The repairs of all type of EEI products can either take place at the EEI manufacturing facility or at the Customer location.

#### TRAINING

Training courses organized for Customers's staff users and maintenance managers, for the correct operation and maintenance of standard EEI drives and for specific EEI customized project.



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EFFICIENCY,  
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