



Power protection solutions  
for mission critical applications

## CERN

**Large Hadron Collider (LHC), the largest and most complex scientific instrument ever built and the highest energy particle accelerator in the world is protected by Borri solutions.**

“Made in Italy protagonist at CERN: after the success of Italian researchers in the discovery of the Higgs Boson the world’s largest centres for scientific research chooses the Italian UPS Borri”

### Key players

#### End-user

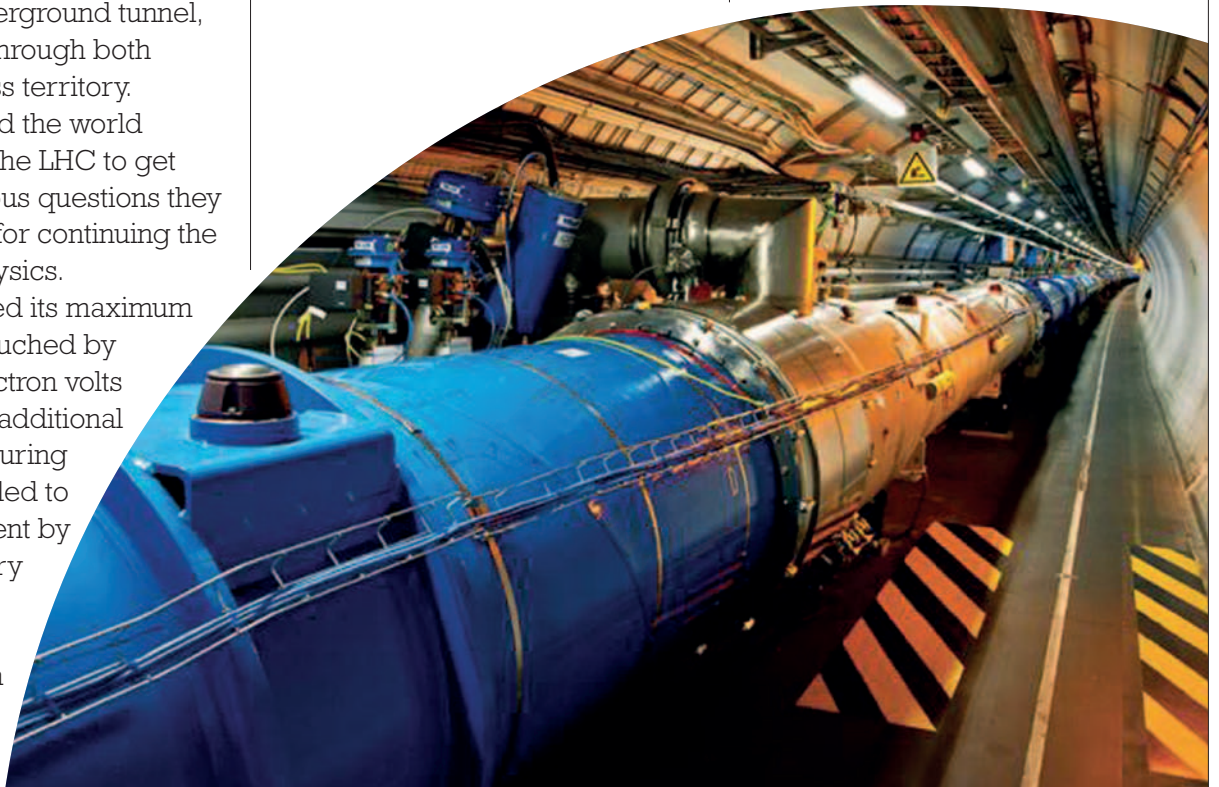
CERN (European Organization for Nuclear Research) is the world's largest particle physics laboratory. Today has 21 member states plus some observers, including non-European countries. CERN main purpose is to provide scientists with the tools needed for research in high energy-physics. In 2008 came into operation at CERN, Geneva, the Large Hadron Collider (LHC abbreviated) particle accelerator largest and most powerful ever built, used for experimental research in the field of physics of particles. The accelerator is located in a 100 meters underground tunnel, running 27 km through both French and Swiss territory. Physicists around the world propose to use the LHC to get answers to various questions they deem essential for continuing the investigation physics. In 2012 it reached its maximum energy never touched by eight trillion electron volts (TeV 8) and the additional data collected during the experiment led to the announcement by CERN's discovery of a particle consistent with the Higgs boson

### The Challenge

A perturbation on the mains that provide power to all the security system and to the particle accelerator results of, in the best of cases, carrying out the shutdown procedure that involves substantial cost and has a serious impact on programming experiments. On 14 February 2013, the CERN started the first stop (LS1 Long Shutdown 1) of the acceleration system of the LHC. During the stop has been performed the maintenance and upgrading of the system, the activities necessary to continue the program of research experiments on subatomic particles. The project included replace-

ment of all UPS (AC and DC) and their batteries with new devices equipped with state of the art technology. The main requirements of the new system are:

- Increase of the reliability of the plant, so as to reduce the need for ordinary and extraordinary maintenance;
- Actual time of machine downtime for ordinary or extraordinary maintenance less than 4 hours;
- Exceeding the existing limit for which maintenance operations implied the accelerator stop, with consequent impact on experiment schedule.



**Our solution**

Borri Spa has provided both AC and DC. After a joint analysis with experts, CERN, has opted for a distributed power protection system, with equipment of various sizes that feed, in a redundant configuration, security systems and controlled shutdown of the accelerator. All UPS units are characterized by Borri technology sinusoidal absorption input (unity power factor and harmonic current distortion less than 3%) and they are derived from B8000FXS, B9000FXS and B9600FXS series with customisations that involved special painting and the system EPO (UPS emergency Power Off). A specific redundancy configuration is also included, with three UPS in cascade, resulting in a system tolerant to the second failure. The protection of the auxiliary 48 Vdc systems has been developed according to the requirements of CERN, from an Oil & Gas based rectifier, RTB.e series 100 A, with a custom redundancy system, providing a dual path for both the power supply of the loads, and the charging of the backup batteries. Even the battery cabinets have been develo-

ped ad hoc, to meet the higher safety and maintainability requirements of the installation.

Borri UPS also protect: Atlas project data center, with a system of three B9600FXS 500 kVA UPS in parallel with a 2000 A centralised static bypass switch and 4 minutes autonomy; LHC data center, with two B9600FXS 400 kVA UPS in parallel (dual feed redundant configuration) and 10 minutes autonomy Batteries are VRLA type (sealed lead acid) in

all AC UPS systems and Ni-Cd type for DC UPS systems

**Advantages for the customer are:**

- Considerable energy savings for increased system performance thanks to the latest state of the art technology.
- Increased system reliability and reduced maintenance shutdowns due to the second fault tolerant configuration.

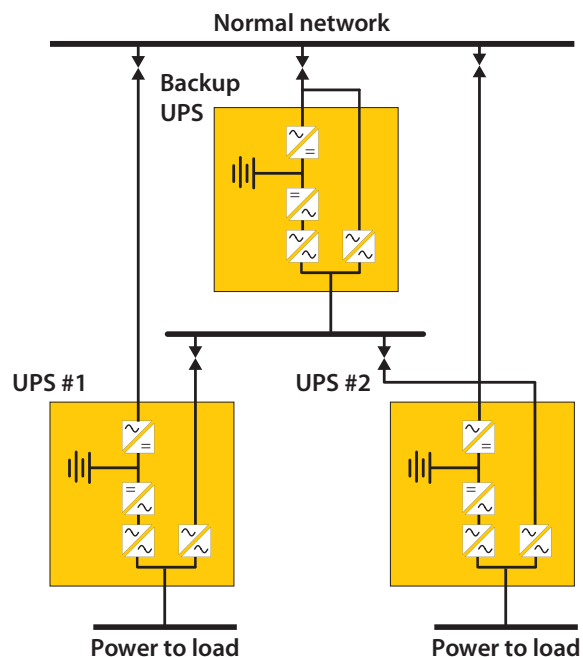


**The system**

At the end of June 2014 185 UPS (DC and AC systems with backup batteries) were installed, together, in various areas of the particle accelerator ring, replacing the previous UPS systems.

Borri UPS protect emergency auxiliary systems, air conditioning and all critical systems required for controlled shutdown of the accelerator, in addition they protect two data centers dedicated to Atlas and LHC projects.

Commissioning was carried out by Borri technicians and CERN specialists. The supply also includes all maintenance service with a 4 hours mean time to repair on routine or emergency maintenance, as required by CERN requirements.





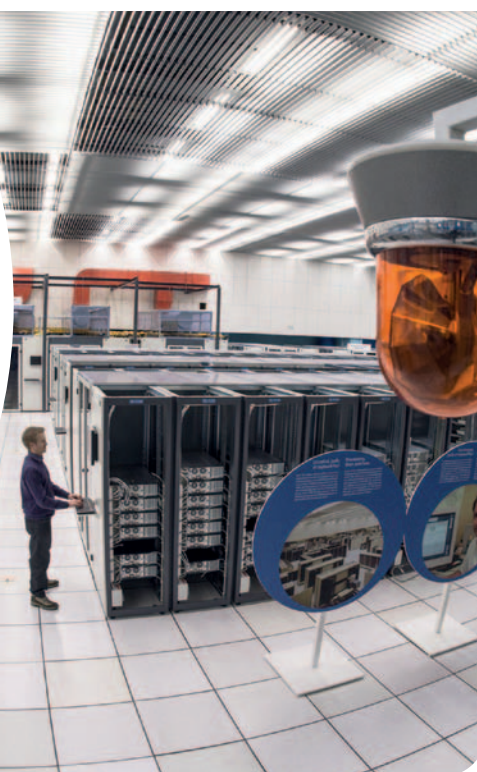
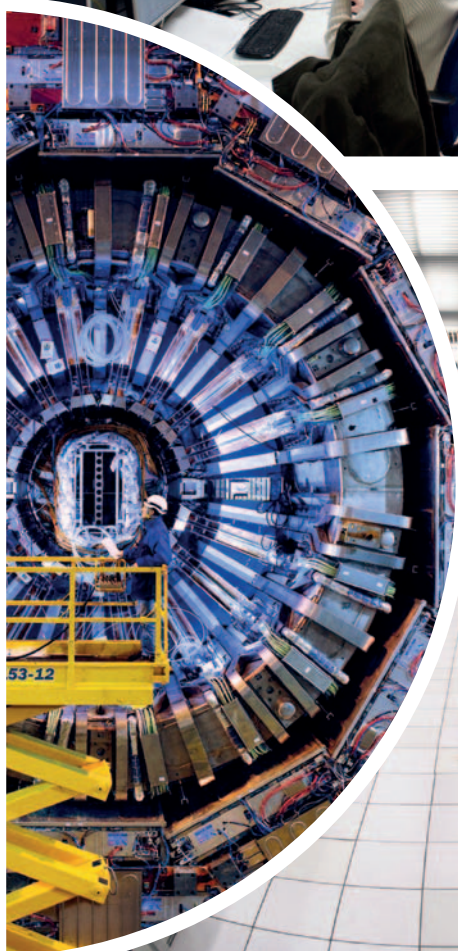
## Validation tests

UPS were first approved by CERN through inspections at the vendor to verify the design, the manufacturing process, the plan of internal quality and performance. Once approval was obtained Borri provided CERN with a sample for each system who carried out all type tests in their laboratories, in accordance with their internal procedures, including tests for resistance to alpha particle radiation. The acceptance procedure develop-

ped by the specialists of CERN provided for the execution of the Factory Acceptance Test at the testing area Borri of all supplied systems. The tests included repetition of some of the type tests, such as efficiency tests and battery ripple testing. Complete on site functional tests were also performed on each delivered system, according to CERN Site Acceptance Test procedure.

## Results

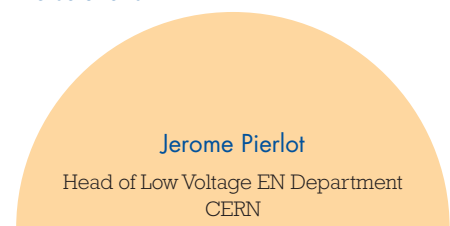
The complex supply for CERN demonstrates the ability of Borri to meet the needs of an industry that requires high-tech solutions for applications with very high reliability. No less important was the ability to support the client in his need for customisation of both product testing services, with specialised staff and technical service, is able to offer tailor-made solutions that follow all the phases of testing in factory and on-site.



“Having a supplier, such Borri with a long tradition in offering customised products has allowed us to collaborate proactively in the design stage and to have solutions able to meet all our complex needs. In addition Borri has shown great flexibility responding promptly to needs that arose during the commissioning of the solutions”

Jerome Pierlot

Head of Low Voltage EN Department  
CERN



## Future developments

At the end of the long stop LS1, scheduled for September 2014, a total of 250 systems have been installed. It also provides for the integration of new functionality for the firmware rectifiers, following additional requirements that emerged during the first months of operation of the systems.



## Who we are

Borri is a company specialised in custom design, manufacturing and servicing of power electronics equipment for oil & gas, energy and utilities, industrial process and service, ICT, solar static power converters and storage systems. Borri's R&D department is one of the most complete regarding the different disciplines in the field of power conversion.

Long experience in magnetic component design and semiconductors is combined with the most advanced digital regulation algorithms and microcontroller programming know-how.

Borri has a leading position in the oil and gas market thanks to its proven customizing expertise and continuous pursuit of excellence in a state-of-the-art product and is approved supply in more than 40 vendor list.

However, wide experience in several branches of power electronics such as UPS systems for data centers and inverters for renewable energy and storage, make Borri a leader in this technology not only for oil and gas applications.

UPSaver, the latest patented three-phase solution, based on its green conversion operation can guarantee the best PUE for green data centers: proof of the ongoing company commitment to innovation.

Under Astrid brand the company

offer systems for green energy: confirmation of Borri's commitment to sustainability. Thanks to his highly skilled custom engineering Borri follows the entire process in-house: from preliminary studies to design, production and after-sales service guaranteeing a state of art solutions.

Based in Italy with 15,000 m<sup>2</sup> production space and a large full-testing area, the company can call on more than 80 years experience and multidisciplinary research and development.

Borri has strong presence with over 1000 worldwide installations for critical applications, qualified staff and partners across the globe providing on site service and technical support everywhere.