What the doctor ordered
Roughly half a million patients a year, 7,000 operations a month and 20 births a day: those are the figures that define the Charité University Hospital Berlin as the largest of its kind in Europe and among the most highly regarded worldwide. More than 13,000 staff work around the clock for the well-being of the patients. They leave nothing to chance – especially not the power supply. To be able to maintain hospital operation in the event of a power outage, the Charité has an extensive backup power supply system that includes equipment supplied by MTU Onsite Energy. As well as gensets on the Virchow Clinic campus with the first two examples of the new MTU Series 1 600 engine supplied in Germany, there are two gensets driven by Series 4000 engines in the south section of the Charité central campus. And the latest addition is a complete turnkey system supplied by MTU for the north section of the Charité central campus that replaces the old emergency power supply system.

Emergency supply sustainable for 50 hours
In addition to the two diesel gensets driven by MTU Type 12V 4000 G23 engines, the turnkey installation also includes cooling, fuel and exhaust systems, air supply and extraction system and control system. The generators have a combined electrical output of roughly 1,700 kilovolt-amperes (kVA). So each of the gensets has an electrical output rating of 850 kVA. The engines themselves have a higher output so that they have some power in reserve for when the Charité central campus is extended. A 2,000-liter service tank for each genset and a 20,000 liter supply tank provide enough fuel to run the emergency power supply system for roughly 50 hours.

Backbone of hospital operation
The backup power supply systems provide the electricity for important installations such as the main diagnostic suite and the dermatology and nuclear medicine departments. They also supply the psychiatry, neurology and pathological diagnosis units. The latter is where tissue and blood samples from patients are examined in the laboratory. In serious cases, the analyses have to be completed in a very short time. The main heating system and the hospital kitchens are also dependent on the emergency gensets in the event of a mains power cut.

Emergency power = Safety systems power + replacement power
“The emergency power supply is divided into safety systems power and replacement power,” explains Thomas Flügel, the hospital’s technical manager. The safety systems supply provides the electricity for all electrical equipment on which the life and health of patients is directly dependent if there is a power cut. That includes things like some of the lighting, ventilation systems, equipment for therapeutic gases such as oxygen, medical equipment such as respirators, contrast agent injection equipment, surveillance monitors and nurse call and fire alarm systems. The replacement power supply, on the other hand, covers all electrical equipment that is necessary for maintaining hospital operation – lifts, lighting, parts of the kitchen, heating and cooling systems and sterilization equipment. Large medical apparatus such as life-support machines or incubators for premature
babies are not connected to this system. Such equipment usually has its own emergency power supply.

“The power supply is the backbone of hospital operation – without it, nothing works,” explains Flügel. “In a hospital, you can’t afford to experiment – you have to be able to rely on the emergency power plant one hundred percent.”

**Complete package from MTU**

MTU acted as general contractor for the installation, planning the project including managing the construction work and installing additional systems such as the chimneys for expelling the exhaust, the fuel supply tank and the fire barriers which prevent the spread of a fire through holes in walls and ceilings. In addition, the MTU project team itself installed and set up the genset control systems and implemented coordination with external interfaces such as the central emergency power supply control system. “We were glad to have a large, experienced company such as MTU on board in this project,” relates Thomas Siebeck, managing director of IBB Ingenieurbüro Siebeck, the consultants responsible for overseeing the building work on behalf of the Charité. “It was important for us to be able to utilize the wealth of knowledge that the company had to offer.” The planning of the installation involved two central tasks – firstly the strict noise abatement requirements, as the generator house is next to the patients’ accommodation. “We designed the noise insulation so that the 120 decibels – that’s equivalent to a pneumatic drill – produced by the gensets when running is hardly perceptible outside the building,” explains Jochen Thurner, MTU project manager. Secondly, the German clean air regulations prescribe stringent exhaust emission limits due to the inner-city location of the Charité hospital’s central campus. MTU was able to meet those requirements by using emission-optimized engines with diesel particulate filters fitted to the exhausts.

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**Safety systems supply + replacement supply = Emergency supply**

**Safety systems power supply:** electrical equipment for safeguarding life and health of the patients in the event of a mains power failure

Examples: basic lighting, ventilation systems, equipment for therapeutic gases (e.g. oxygen), medical equipment (e.g. respirators, contrast agent injection equipment, surveillance monitors, nurse call and fire alarm systems)

**Replacement power supply:** electrical equipment for maintaining hospital operation

Examples: lifts, lighting, parts of the kitchen, heating and cooling systems, sterilization equipment.
We designed the noise insulation so that the 120 decibels – that’s equivalent to a pneumatic drill – produced by the gensets when running is hardly perceptible outside the building.

Jochen Thurner, MTU project manager
Up and running in ten seconds

If the mains power grid goes down, the two emergency gensets start up entirely automatically with the aid of starter batteries – of which there are two for each genset. Starting actually only requires one starter system, the other is for additional safety. The startup command comes from the overall emergency power supply control system which can see all loads to be supplied. When there is a power cut, each generator unit starts one second later and runs up to its rated speed of 1,500 rpm, at which it produces a frequency of 50 hertz. So that they can be up and running as quickly as possible, the engines are kept continually preheated. Due to their high torque, they have rapid and high load uptake capabilities. The gensets achieve fully operational status with stable voltage and frequency levels within ten seconds. From that moment on the electrical load can be connected. That high load uptake capacity is a major advantage for the Charité as it means that all electrical equipment allocated to the safety power supply can be connected at once. Other power-consuming equipment follows as planned and required.

Electricity demand equivalent to a power plant module

The emergency power supply comes from the generators at a voltage of 10,000 volts and so has to be converted down to a usable low voltage by a transformer. Backup power supply systems usually operate at low voltage so that the electricity is directly usable. But not at the Charité: “We also use a high voltage of 10,000 volts for our internal power grid because we have to work with high power levels,” explains Flügel. The Charité central campus site, for example, has a power requirement of around 12.5 megavolt-amperes, which roughly equates to the output of one power plant module. “The advantage is that we can synchronize directly with the mains power grid. In addition, the electricity can be distributed over long distances with lower losses and the emergency supply to all buildings can be can be managed by control centers.”

Thoroughly tested under real conditions

Before the emergency power systems were delivered to Berlin and went into operation in July 2010, MTU comprehensively tested them using a simulated load connection sequence on its own ultramodern genset test bench in Friedrichshafen. What is more, Flügel regularly runs emergency drills – with the hospital staff and the backup power supply systems. Once a month there is a test run to make sure that the emergency power supply systems function perfectly. The electricity produced in the process is fed into the hospital grid.

“We were glad to have a large, experienced company such as MTU on board in this project,” relates Thomas Siebeck, managing director of IBB Ingenieurbüro Siebeck, seen here planning the emergency supply system together with Thomas Flügel, technical manager at the Charité (l to r).

Energy

King Friedrich I of Prussia established a plague house outside the gates of Berlin in 1710. In 1727, King Friedrich Wilhelm I appointed it a hospital, naming it “Charité” – French for charity.

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View inside the technical control room of the Charité on the hospital's central campus with the general grid map for the site's electricity supply in the background. Staff can see everything exactly from here.

"In a hospital, you can’t afford to experiment – you have to be able to rely on the emergency power plant one hundred percent."

Thomas Flügel, technical manager, Charité Hospital Berlin

The Charité’s 85-meter-high multistorey ward building is unmistakable from the air. Not far from it (left foreground) is the iconic glass dome of the Reichstag building.