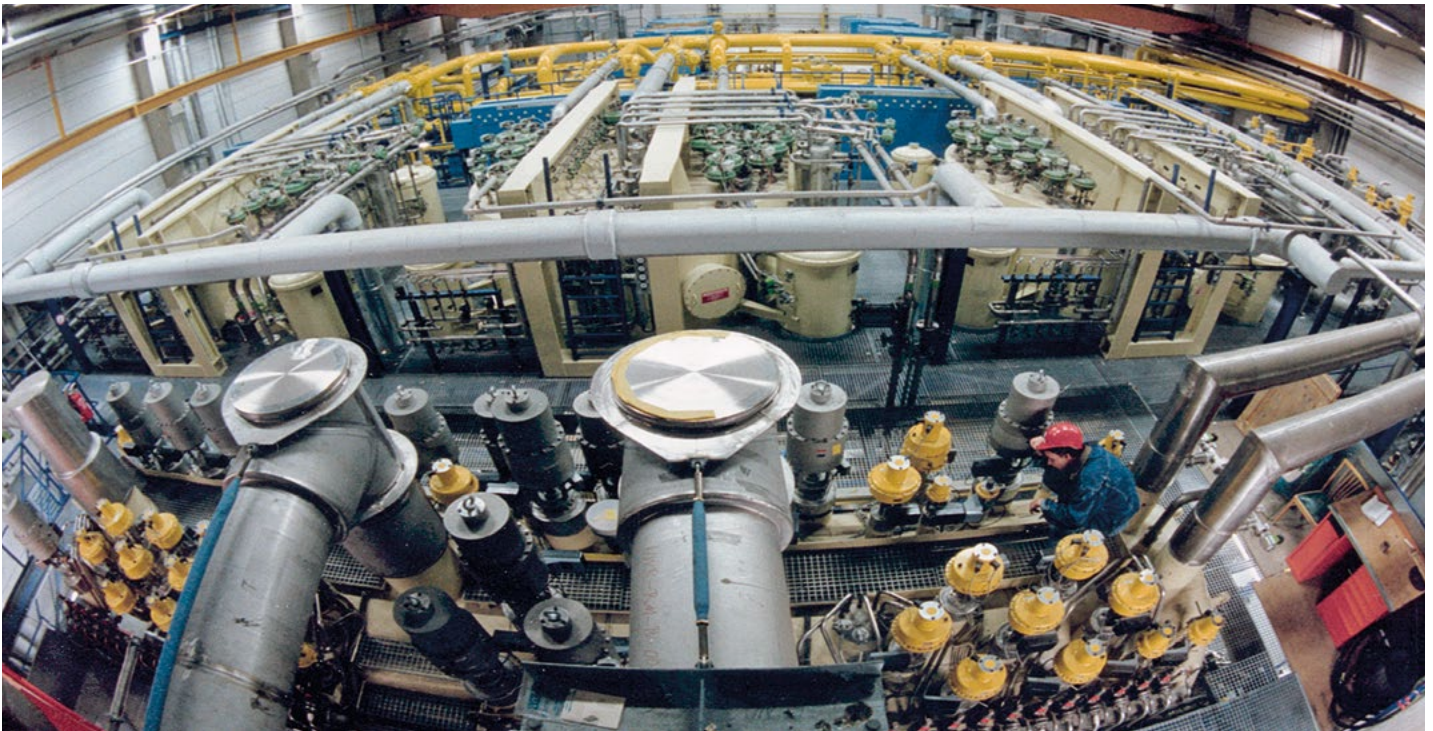


Controlling and Monitoring liquid Helium at the Deutsches Elektronen-Synchrotron

Fieldbus ensures best-in-class availability of the refrigeration system



Europe's largest refrigerator: The cryogenic plant at DESY in Hamburg

Application

The Deutsches Elektronen-Synchrotron (DESY) is one of the world's leading laboratories for particle acceleration and, with the XFEL linear accelerator at its disposal, boasts unparalleled research capabilities. At this plant, X-ray flashes of light are generated, making it possible to observe processes in the nano cosmos in real time. These flashes of light are a billion times richer in energy than conventional X-ray sources and are generated using superconductive magnets. The super-low

temperatures that are required to operate these magnets are achieved using liquid helium. The particular flow properties of superfluid helium deliver the cooling capability that is required for the XFEL particle accelerator to achieve peak performance. This aggregation state occurs at a temperature of 2.0 Kelvin. In order to produce superfluid helium in sufficient quantities, the operators of the DESY research center needed to ramp up the performance of the cryogenic plant.



Segment Protectors with short-circuit protection for connecting devices: When working on a valve or measuring instrument, communication is protected, and with it the availability of plant operations.

Goal

The cryogenic plant at the European XFEL is operated continuously, 24 hours a day, 365 days a year. In ramping up the performance of the cooling system, the level of availability of more than 99% achieved in the past had to be maintained, as any inadvertent shutdown would result in downtime of the particle accelerator for several hours. The high level of utilization means that rescheduling a scientific experiment would take several months. The consequences of this would be disastrous—both for the scientists and for the research taking place at the site in Germany. An evaluation of the fault statistics generated from years of operation revealed that improving the availability of the process control system would have a positive impact on the overall availability of the plant.

Solution

The process instrumentation is connected to the Experimental Physics and Industrial Control System (EPICS) via fieldbus technology. The operator receives operating messages and system status updates via EPICS. The Segment Coupler 3 (SK3) integrates valves, pressure transmitters, and flow transmitters—all equipped with PROFIBUS PA technology—into the IO controller (IOC) to form a network. All of the components required for automation—the IOC, power supply, SK3, and fiber optic cable in the form of a double ring—are redundant in design. The PROFIBUS PA fieldbus installation itself is monitored on an ongoing basis by the FieldConnex® advanced diagnostic module (ADM).

The trunk-and-spur topology is used for PROFIBUS PA applications: With this topology, the field devices are connected to the Segment Protectors installed in the field via short spurs. The integrated short-circuit protection protects communication during normal operations. Alarms and detailed diagnostic messages are reported to a separate system via a PROFIBUS master class II connection. Diagnostics in the instrumentation and of the physical layer itself make it possible for maintenance staff to monitor the plant and perform maintenance on demand. This ensures the very high level of availability of the

cooling system. Remote parametrization of all instruments and commissioning work was particularly effective with minimum cost and staff, and under significant time pressure.

Benefits

In the past, using PROFIBUS DP to control the DESY cryogenic plant has proven beneficial several times over. The documentation process is completely straightforward, for example using Excel or Visio. Upgrading the plant with PROFIBUS PA technology, the process instrumentation is now as easy to handle as the motor controls and compressors. The ability to configure all instruments remotely saves personnel considerable time and effort when installing and commissioning the instrumentation. A check of the ADM also shows that the system is robust and running without fault.

Of course, DESY appreciates the excellent diagnostic capabilities of the fieldbus protocol. These diagnostic capabilities help to trace system errors at an early stage and ensure maximum plant availability by enabling a predictive approach to maintenance. But the greatest benefit for the research institute is without a doubt the reliability of PROFIBUS.

At a Glance:

- The Deutsches Elektronen-Synchrotron (DESY) relies on PROFIBUS DP and PA technology
- PROFIBUS PA systems with FieldConnex® infrastructure components offer impressive ease of use and reliability
- The diagnostic capabilities of the fieldbus protocol ensure maximum plant availability