



D/3[®] DCS



FlexBatch[®]



TotalVision[®]
Process HMI



D/3 Keeps it Cool at Major Particle Accelerator

DESY relies on D/3[®], FlexBatch[®], and TotalVision[®] Process HMI for 24/7 operation of refrigeration plant.

OVERVIEW

The German Electron Synchrotron (DESY)--located in Hamburg and Zeuthen is one of five large accelerator centers in the world at which physicists study the world of elementary particles. Several hundred men and women work together on experiments in international groups, where, over the course of years of collaborative effort, they design, build, and operate complex measuring instruments the size of buildings and evaluate millions of items of data. Four such groups are currently working at DESY at the large underground Hadron Electron Ring Accelerator (HERA).

HERA

Particle physicists from all over the world started their experiments at HERA, a storage ring system, in 1992. The accelerator is housed in a ring-shaped tunnel with a circumference of 6336 metres, only a small part of which actually runs under the DESY site. The HERA proton ring requires some 646 superconducting electromagnets: 422 bending magnets (dipoles), to hold the particles in the required orbit, and 224 focusing magnets (quadrupoles), to keep the particle bunches focussed in the centre of the beampipe. The superconducting magnets operate at a temperature of 4.2 Kelvin (-269°Celsius). They are cooled by liquid helium which is constantly circulated through the interior of the magnets. This requires a large and extremely powerful refrigeration system. No systems of this size had previously been built outside of the USA. For Europe its construction breaks new technological ground. In the field of superconductivity and cryogenics, HERA provides the first opportunity in Europe to gain large-scale experience that will be of major importance for future industrial applications of this energy-saving technology.

THE REFRIGERATION SYSTEM

The refrigeration system for the HERA proton ring and the detectors in the experimental halls consists of three units of identical construction. The fact that all refrigeration consumers are installed underground in the tunnel, most of them outside the DESY site, means that the refrigerant can only be fed in from the experimental halls. To ensure that sufficient space remained here for high-energy physics, a central refrigeration system was built. The entire refrigeration facilities are concentrated in Hall 54 on the DESY site. Here are located the compressors, cold boxes, a distribution box, purification and gas-preheating equipment, and helium dewars (tanks for liquid helium). Outside the building are large tanks for storing helium gas at ambient temperature, the oil coolers for the compressors, and a further tank holding up to 150,000 litres of liquid nitrogen.

NovaTech, LLC
11425 Cronhill Drive
Owings Mills, MD 21117
www.novatechweb.com

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THE REFRIGERATION CONTROL SYSTEM

The refrigeration system is monitored from a central control room which is manned round the clock. Here the operators are given all the information they need to ensure reliable operation of the refrigerator and to ensure that the needs of the consumers are satisfied. The refrigerator operator's task is simplified by a modern process control system, NovaTech's D/3. There are a total of nearly 1000 measuring points to be monitored, roughly half of them in the refrigerator. A further 2000 digital signals from the refrigeration system and 300 control loops have to be processed continuously. The approximately 400 valves in the refrigerator and about the same number again in the consumer units are all remote controlled, about half of them as continuously variable control valves. Recurring process sequences are controlled by means of special batch programs.

THE UPGRADE OF THE D/3 SYSTEM

The reliable operation of the redundant process control computers (PCMs) is the basis for the continuous 24/7 operation of the refrigeration plant. In the first quarter of 2002 the control system was upgraded together with our supplier Newton Integrated Services, NovaTech representative in Europe, from the current OpenVMS based D/3 version 5.0 to version 10.2 running on Windows 2000. Since all the configuration information of the D/3 system can be extracted in ASCII format, the conversion of the whole installation from version 5.0, which was commissioned approximately 10 years ago, was carried out with minimal effort.

This is one of the strongest benefits of the D/3 system. Our investment in our existing applications software is preserved while we take advantage of the new functionality of the latest D/3 version, which will help us to get prepared for the requirements of future operations. The integration facilities - like OPC client and server will help us to exchange information with the machine control systems of the HERA accelerator. The new Ethernet-based network will seamlessly integrate the D/3 into the DESY NT domain.

The FlexBatch Batch Monitoring and Control Package, based on the ISA S88 standard for batch manufacturing, will be used to improve the start-up and shutdown procedures of the refrigeration plant including the cryogenic distribution system in the 6.3 km HERA tunnel. Furthermore the new batch system will be used to implement faster recovery algorithms from quenches in the superconducting magnets.

The new state of the art graphics package, TotalVision Process HMI, will ease the implementation of the new graphics and will allow us to display D/3 information on the LAN for our cryogenic specialists and on the WAN for remote operations and diagnostics by the on call shift.

With this upgrade we can economically extend the life of our process control system. We are looking forward to continuing our D/3 operations for the next decade.