Networked Power

Today's power plants are dynamic facilities that can be supervised and managed via the Internet. One of the most powerful control systems on the market is made by Siemens. It consolidates all of a plant’s functions and is easy to use, thereby increasing efficiency and cutting operating costs. Instead, control room operators can access the system via a web browser.

The system’s intuitive navigation feature makes it easy to operate. We can process data and functions more efficiently by using templates,” says Frank-Peter Kirschning, head of the Rheinhausen steam power plant in Karlsruhe. “It’s crucial when a fault occurs, because malfunctions have to be quickly located and diagnosed. Once the source is discovered, the control system indicates its location. The SPPA-T3000 system was recently installed at the Karlsruhe plant as part of a comprehensive upgrade,” he said. “It was used to have many different systems that were linked through interfaces — a set-up that often caused faults,” says Kirschning. “The new control system is completely homogeneous and a lot simpler to use.” As a result, plant operation is more efficient and less costly. Another advantage of the SPPA-T3000 is that it has been designed to serve as a platform that can be expanded through the addition of further software modules. For customers with long-term service contracts, Siemens offers a remote monitoring service. Here, operating data related to turbines and gas turbines are transferred via the Internet to Siemens’ Power Diagnostics Centers in Erlangen, Mülheim an der Ruhr, Germany, or to Orlando, Florida (Pictures of the Future, Fall 2004, p. 67 / Spring 2005, p. 48). The underlying software for this service was developed by GO’s Dr. Hans-Gerd Brummel together with a team headed by Dr. Claus Nebecker, project manager at the Intelligent Vision & Reasoning Department at Siemens Corporate Research (ICSR) in Princeton, New Jersey. Known as PowerMonitor, the diagnostic software can detect hidden faults in any of a turbine’s key components early on by continuously evaluating data supplied by hundreds of sensors.

Extreme Stresses. It’s pretty hot in the interior of a gas turbine. Exhaust gases with temperatures of 1,500 degrees Celsius are thrust into the turbine from the combustion chamber at pressures of more than 15 bar. The gases cause the turbine blades to rotate at up to 3,600 rpm. Such thermal stresses can create cracks and fissures, and in extreme cases, even cause metal parts to break off. These parts would severely damage the turbine if they got inside, causing up to a week’s down-time.

“But if a crack is discovered early, the damaged part can be replaced when the turbine is not in use,” says Dr. Hans-Gerd Brummel, manager for R&D at Power Diagnostics. “If the repair is carefully planned, it can be performed within two days.” To detect faults, the turbine is continuously monitored by about 500 sensors. The resulting data is analyzed by PowerMonitor. To make all of this possible, the self-adaptive software is first trained on the turbine. During this period, vibration analysis to ensure that they are perfectly balanced. Here, PG’s power plant team works with Power Diagnostics, particularly in adapting the installation of new turbine blades. Until recently, such analyses were performed by specialized technicians on location. But today, with the assistance of the plant’s operators, such evaluations can be performed remotely.

Good communication is also essential for distributed power generation. This is the case, for example, when a wind turbine, a landfill gas facility and a geothermal power plant are involved in creating a virtual power generation facility. Such a network can supply energy in a particularly economical and reliable manner and helps to conserve resources (Pictures of the Future, Spring 2002, p. 58). To control the network, operators can use technology such as Siemens’ Advanced Management System (DEMS) from Siemens.

The first step is to make an in-depth plan of the facility’s operation. To determine what kind of load the virtual power plant has to cover, a day of operation is divided into a grid of 15-minute periods and loads are calculated for each of these. Other relevant factors are known times of peak demand and weather conditions, which affect photovoltaic facilities and wind turbines. Everything else is taken care of automatically. The DEMS uses the resulting data to draw up a plan of operation for the distributed power plant. The network is controlled automatically, and the DEMS transmits the commands to the individual power generation facilities by data lines or mobile radio. Much of the data that is collected is not transmitted, however, because DEMS does not need to analyze the operation of the individual facilities as closely as does the SPPA-T3000 system. “The focus in the virtual power plant is not on the optimal operation of the individual facilities but on the overall power generation network,” says Dr. Thomas Werner, DEMS Product Manager at Siemens Power Transmission and Distribution (PTD).

At present, only large-scale facilities can be economically integrated into virtual power plants. However, PTD and energy utility RWE have recently developed a new model for organizing the technical and economic aspects of virtual power plants. This new concept will make it possible to integrate facilities that are not owned by the network operator. Once a unified communication and control standard has been established, it will even be possible to feed electricity into virtual power plants from private plants as well. “That’s the idea we are working on,” says Reinhard Remberg from the Strategic Marketing Department at PTD.