Symphony orchestrates

Symphony® Plus automation delivers flexibility and optimization for conventional and renewable power plants

ADRIAN TIMBUS, MARK BITTO – The power output variability of renewable power generators challenges not only renewable plant operators but also conventional plant operators, who have to be flexible in their response to changing load conditions caused by that variability. Modern control systems for power plants must, therefore, be able to deal with a greater number of activities and a higher volume of information than traditional control systems – as well as comply with strict national grid codes. They must also achieve total plant automation by providing a system platform that improves efficiency, productivity and operations. Further, when used as remote management systems, they need to optimize multiple power plants.

1 Featuring modular DIN rail packaging, the SD Series is the newest addition to ABB's Symphony Plus S+ Control and I/O family.

The fluctuating and intermittent nature of renewable energy plants – such as wind farms and solar power arrays – exporting their energy to the grid increases the challenge of achieving greater cost efficiency, improved environmental compatibility, and better and more flexible plant operation. The variability of renewable power generators also creates demands on conventional plants, which have to be flexible in their response to changing load conditions caused by that variability. The ability to respond quickly and cost-effectively to rapidly changing load requirements is crucial for power generators.

Today's power plant control systems must be able, therefore, to deal with a greater number of variables and activities, and a higher volume and complexity of information than is the case with the control systems of traditional plants. Naturally, they still also have to comply with the strict requirements of national grid codes. Further, when used as remote management systems, these control systems need to optimize the operation and production from multiple power plants.

In other words, the new generation of control systems must achieve complete plant automation by providing a system platform that increases energy efficiency, improves engineering productivity, and supports a more effective, flexible and reliable plant operation with an enhanced energy and maintenance management strategy. The remote monitoring of process information in real time is another important prerequisite for economical and operational stability.

Today's power plant control systems must be able to deal with a greater number of variables and activities, and a higher volume and complexity of information than was the case with the control systems of traditional plants.

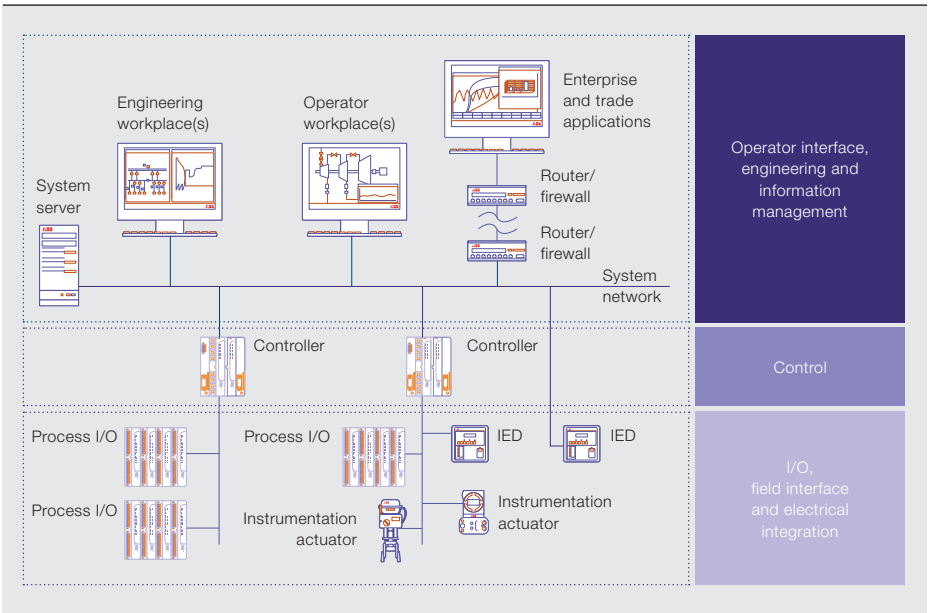
Modern control system requirements

Modern control systems require system architecture flexibility to meet the diverse configurations of today's power plants. While traditional fossil-fuel-fired or combined-cycle power plants are configured as central "block" architectures, renewable plants require the automation system to coordinate control of hundreds or thousands of smaller control units, such as those of wind turbines, solar trackers, remote terminal units or pipeline sensors, that are geographically distributed over a very wide area. All of these units need to be brought into a common operations hierarchy to provide better visibility and control of the entire plant or network.

Control systems, such as ABB's Symphony® Plus automation system, adopt a future-oriented process control concept comprising high-performance technologies, methods and tools that link autonomous systems together and produce total plant automation with increased functionality and reliability. Smaller equipment size, lower power consumption for on-site services and the ability to operate effectively in extreme and demanding environmental conditions are fundamental requirements. Improved avail-ability, reliability, redundancy, remote monitoring and communication are all also essential.

Title picture
The viability of a modern, complex power plant depends on a sophisticated and capable control system. ABB's Symphony Plus is the newest generation of ABB's total plant automation for the power and water industries. How does it help power plant operators run their plants in the most efficient and cost-effective way?

2 Functional overview of Symphony Plus capabilities



When used as remote management systems, modern control systems need to optimize the operation and production from multiple power plants.

Integration of the industry's latest communication standards into modern control systems allows more information to be available than in traditional solutions. Innovative and intelligent technology ensures that information is seamlessly distributed and provided in a role-based context to control room operators, maintenance engineers, plant optimization engineers and plant managers via a common system environment. The ability of the control system to capture more data and transform that into contextual information through a high-performance human-machine interface (HMI) leads to greater awareness, faster response and, ultimately, better decisions.

Historically, process systems and substation automation systems have been segregated and have not been able to communicate easily with each other. Making data available from the individual electrical elements – instrumentation, and low-voltage, medium-voltage and high-voltage systems – to process control systems has been problematic and costly, with each system communicating via different protocols and parallel cabling. To obtain higher levels of availability, operator visibility and operational reliability, the integration of the process and substation automation systems is essential.

Symphony Plus

ABB's Symphony Plus is the latest generation of the Symphony family distributed control system (DCS), developed to meet the unique and demanding requirements of the power generation and water industries.

Symphony Plus provides easy and flexible data access in order to facilitate operational decisions. S+ Operations, the system's versatile HMI, provides the user with intuitive process overview displays designed to overcome system navigational problems associated with autonomous control systems. Using high-performance graphics, operators have direct access to easy-to-use displays, clearly illustrated trend data, alarms and events monitoring (complying with the EEMUA 191 guidelines), and various reports that can be used to optimize system performance.

Centralized, consolidated operations are made possible through the integration of industry standard communication protocols such as IEC 61850, IEC 60870-5/101/103/104, OPC and Modbus TCP. Use of these standards allows for greater and more reliable access to plant data in a way that is less costly than custom interfaces and hardwired connections. A common operations environment and consolidated alarms and events lead operators to better abnormal situational awareness and overall effectiveness. For service engineers, maintenance schedules are optimized through the timely reporting of condition-based and predictive asset performance degradation, thus preventing unexpected and costly downtime.

Renewable plants require the automation system to coordinate control of hundreds or thousands of smaller control units that are geographically distributed over a very wide area.

Design and maintenance of the entire plant automation system are performed through a unified engineering workbench environment. Efficient engineering, configuration, administration, security, commissioning and maintenance of any system device – from a field and electrical device to control, I/O, operator workplace and communication interface – is performed via the system S+ Engineering tool. The tool features a multi-user, distributed engineering environment that isolates engineering activities from runtime activities and provides access based on user function. This is achieved via simplified user interfaces and workflows operating on a common database. A single point of configuration data entry provides versioning, documentation and backup functionality according to local standards.

Symphony Plus is backwardly compatible with all previous generations of the Symphony family, which allows seamless DCS upgrading and retrofit works to be carried out, thus maximizing production uptime and ensuring the project will be completed in the most cost-effective manner while protecting the investments made in the installed system assets.

SD Series

The Symphony Plus SD Series has been developed specifically to address the criteria for improved performance and to meet the requirements of geographically distributed process applications.

The SD Series uses a set of high-performance, scalable process controllers that support all of a plant's control requirements, from discrete and continuous to batch and advanced control applications ➔ 1. Supported by a comprehensive range of I/O options, the SD Series delivers powerful and versatile automation solutions for plant applications of all sizes and types. The common controller environment executes process control applications that are both data- and program-intensive. Redundancy options are available at all levels of control, I/O and communication, resulting in maximum flexibility and availability.

Using ABB's extensive set of field-proven standard function code algorithms and S+ Engineering's graphical design tools to develop control strategies, S+ Operations and other applications communicate with the SD Series control and I/O over a flexible high-speed, high-throughput and high-security network. This permits the integration of field devices, process and electrical systems, and business enterprise systems in a simple, scalable, secure and sustainable manner ➔ 2.

The SD Series controllers integrate intelligent field devices, including transmitters, actuators, motor control centers and intelligent electronic devices (IEDs). The use of IEC 61850, IEC 60870-5-104, Modbus TCP, PROFIBUS DP, and HART standard protocols results in reduced wiring and system footprint and, thus, lower installation costs.

SD Series products have a modular, high-density design and streamlined architecture that reduces control and I/O hardware requirements and cabinet footprint, thus lowering design, installation and operating costs. With a –20°C to +70°C temperature rating and G3 coating, these products are also designed to withstand extreme environmental conditions, which makes them ideal for remote I/O applications such as those found in renewable power applications.

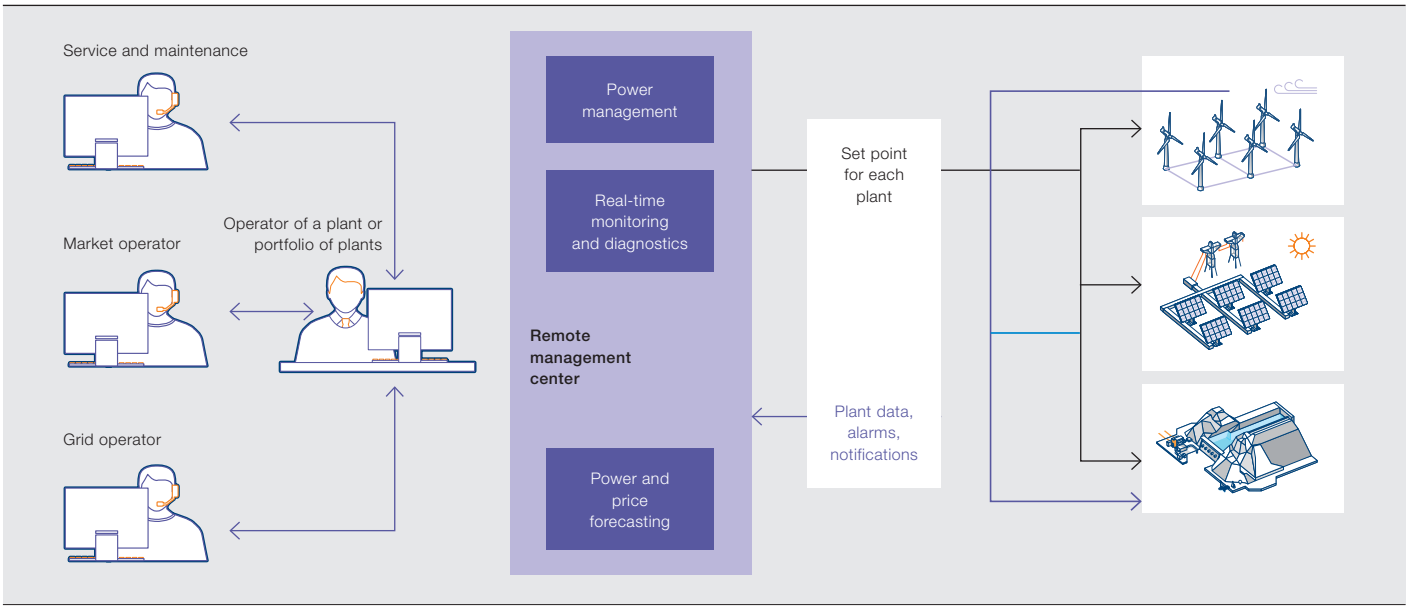
Significantly higher efficiency means lower power consumption (SD Series products use 50 percent less power than typical DCS and other I/O products), lower heat dissipation and the elimination of environment cooling equipment such as cooling fans, louvers, air filters and purging systems. This obviates the use of parts that can negatively affect reliability and productivity, reduces the equipment footprint and lowers installation costs.

The benefits of electrical integration

By utilizing modern automation systems, such as Symphony Plus, that fully integrate the industry's latest communication standards, power plants will achieve optimized operation through:

- The use of only one automation control system for the entire installation
- Smaller and less complex equipment designs
- Shorter engineering, installation and commissioning periods
- Simplified spare parts lists and associated maintenance activities
- Reduced training requirements
- Reduced project risk when working with integrated project teams

3 Overview of Symphony Plus automation solution for remote management of a portfolio of plants



– Optimized life-cycle costs that come with a future-proof system
– Lower energy costs through effective energy management – eg, optimizing the purchase and generation of electricity

Optimization of power plant production

Control system optimization has emerged as the primary solution for the optimization of conventional and renewable power plant production. Achieving complete automation of power plants with a single control and I/O platform has become a major focal point in promoting effective asset performance.

Power plant automation that provides a common operating platform for the control of both process and power systems will allow increased levels of productivity and maximized system uptime to be achieved. All of the operating information may be archived in a common database so that it can be available to any of the users and plant managers involved whenever they require access.

The entire power plant production is therefore covered by one optimized process control system.

Remote monitoring and virtual power plants

The remote monitoring capabilities of modern automation systems present both the operators of individual plants and those managing energy power plant portfolios with a high level of plant operating visibility – providing dynamic decision-making tools that help operators optimize power plant availability, detect any abnormal functionality and ensure that energy efficiencies are being maintained. The operator benefits from improved operation and maintenance regimes, and a consequent reduction in operating expenditure leads to increased business profitability.

> Design and maintenance of the entire plant automation system are performed through a unified engineering workbench environment.

With greater numbers of small solar and wind power producers exporting energy to the grid, there is an increasing need for the creation of virtual power plants (VPPs) and smart grids. Centralized remote monitoring of VPPs allows the energy production from various geographically remote power plants to be accumulated and aggregated. This permits participation in the power purchase market by VPP operators so that they may achieve better energy prices, improved load balancing and the optimization of a power plant's on-site electrical production and consumption ➔ 3.

Ultimately, ABB's Symphony Plus automation solution ensures that the optimization of VPP operations is accomplished.

The article, "Virtual Reality," on page 24 of this edition of ABB Review provides a more detailed description of VPPs.

Adrian Timbus
ABB Power Systems, Power Generation
Zurich, Switzerland
adrian.timbus@ch.abb.com

Mark Bitto
ABB Power Systems, Power Generation
Wickliffe, OH, United States
mark.bitto@us.abb.com