Monitoring and Optimizing Power Generation Assets

The primary task of plant asset management is to reduce costs by identifying performance problems, improving predictive maintenance, and optimizing asset lifecycles. The ABB 800xA system provides real-time asset monitoring, notification, and maintenance workflow of the entire range of assets. It establishes the link all the way from the field up to the Enterprise Resource Planning level (ERP) (Fig. 1).

Personalised workplaces provide a number of configurable options that allow users to tailor the workplace to suit their needs, such as an operator, an engineer, a maintenance technician, a manager supervisor, a system administrator, or even a corporate level manager.

The plant manager and the operation & maintenance staff use powerful tools for informed decision-making. They shall not only receive data about specific assets, but shall also be able to monitor and optimize their assets efficiently. This is possible by using available OPTIMAX® solutions, integrated with alarming, diagnostic and maintenance workflow functions of the automation platform.

The contract encompasses concept design, the entire hardware and software for the turbine and boiler controllers and all auxiliary systems.
The system includes software modules—called Asset Monitors—that monitor asset condition and performance. When a special condition is detected, the Asset Monitor can generate a condition report and a work order for maintenance purposes. This can be automatically linked to the CMMS, or can generate a message (phone, pager, email) to notify remote service personnel [see InControl 7-2006]. Asset Monitors can exist in any part of the plant hierarchy, such as field devices, electrical or mechanical equipment, control loops, process areas, plant, or enterprise.

Examples of OPTIMAX® Asset Monitors for power generation equipment:

- Condition monitoring and diagnosis for rotating machinery.
- Plant performance monitoring and efficiency analysis.
- Sensor validation.
- Lifetime monitoring of critical plant equipment.
- Special instruments for combustion monitoring (e.g. coal flow, flame scanners, etc.).

In addition to monitoring and diagnosis, the workplace offers software modules—called Asset Optimizers—that are capable of minimizing predefined cost functions. Optimization approaches merely based on human know-how are no longer sufficient for utilities operating in today’s energy markets. Therefore, Asset Optimizers are used when plant managers are seeking to improve their operations or maintenance strategies, in terms of directly minimizing a cost objective for their assets.

Examples of OPTIMAX® Asset Optimizers are:

- Unit Commitment (load scheduling) to determine the optimal load profile for multiple units, based on total costs including ageing and emission costs. This is increasingly important since new emissions regulations (e.g. within the EU) have a substantial impact on the profitability of today’s utilities. In addition, deciding whether or not it makes sense to buy or sell power or fuel, start or stop a unit, save lifetime, or postpone a preventive maintenance outage can be easily answered.

- Combustion Optimization Systems (COS) increase the average efficiency and reduce emissions by implementing advanced closed-loop optimization.

- Boiler startup optimization to reduce startup times of utility steam generators.

- Optimization of maintenance schedules, such as sootblowing in boilers, or compressor washing in gas turbines.

By combining multiple Asset Monitors and automatically generating the required work orders, the plant staff can prevent unplanned maintenance work and reduce downtime. By adding Asset Optimizers, plant managers can improve Return On Asset (ROA) based on condition and lifecycle of assets.
High degree of standardization and flexibility with Profibus for power stations

Profibus is being used more and more often to integrate power station process systems such as drives, instruments, electrical switchgears and other subsystems. Profibus offers a high degree of standardization for planning and documentation and is extremely flexible with regard to operating and maintaining a plant. A „plug and operate“ Profibus module has been available as a standard integration feature on ABB’s 800xA DCS system since 2003.

ABB has a long experience using Profibus for field device integration. Examples of successful integrations of MNS switchgear in Gas Turbine Power Plants are Petkim (Turkey), Hazira (India) and Baku 1+2 (Azerbaijan). In 2004, Profibus was introduced as a standard feature for large gas turbines at the field level (e.g., mass flow and volume measurement). Because of the many years of positive experience, ABB expanded the use of Profibus on the Gissi CCPP project in Italy to various other power plant areas such as HRSG, WSC and BoP systems.

On the RABA Suhl waste incineration plant, complete plant subsystems delivered by various suppliers, such as chemical water treatment, were integrated into the 800xA DCS using Profibus. The Profibus connection is completed using either standard shielded bus cables (RS 485) or fiber optic cables. This enables even longer distances to be reliably spanned without interference. Profibus is also suitable for intrinsically safe connections and for high data throughput. Time-consuming and labor-intensive interconnections using a trunk cable, marshalling racks and junction boxes are greatly reduced when Profibus is used. Furthermore, installation and commissioning time can be shortened.

Redundant Profibus control greatly enhances availability because the process redundancy is distributed across various Profibus lines.

GSD (Generic Station Description) files uniformly specify the interface. These files are read directly into the process control system engineering stations and are available for controlling, operating and monitoring the DCS system. Interfaces are thereby simply integrated and transparently documented for operation and maintenance.

Additional signals can be introduced to the system at any time without any new cabling. Another advantage is the excellent diagnostic capability of Profibus. It enables faults to be quickly fixed and thereby optimizes the availability of the system.
ABB has been awarded a contract to modify the ABB EGATROL gas turbine control system in conjunction with a retrofit at the 640 MW Ruwais Cogeneration Power Station, owned by the Abu Dhabi Oil Refining Company, UAE. The project is designed to ensure that the power station can operate at its full capacity, even if the station supply fails.

The Ruwais Refinery is situated 250 km west of Abu Dhabi in the United Arab Emirates (UAE). The Refinery’s power station is producing steam and power with four GT13E2 gas turbines and three boilers. The retrofit assignment was given to ABB by Toledo, an electromechanical construction company in Abu Dhabi, which together with Carlo Gavazzi Impianti SpA of Italy, received the contract from the local operation company Takreer.

**Original supplier of EGATROL**
As the original supplier of EGATROL, ABB was responsible for the EGATROL concept, software structure and design rules. ABB was chosen for this project because it was considered to have the expertise necessary to modify the control system for the four gas turbines. On each turbine, a new transformer was installed and connected to the generator’s medium voltage (MV) bus duct on one side, and via a new ABB SACE switch to the low voltage (LV) bus on the other side. Before the project, the LV bus could only be fed from the MV station supply and from the emergency diesel. The auxiliaries were always running on station supply, or in case of failure, on a very limited emergency supply. One customer benefit is a future increase in availability, since the new installation allows the customer to continue operation of the turbines, even if the station supply should fail.

ABB’s main assignment included:
- Defining the operating concept for the new breaker arrangement with respect to the turbine operating condition.
- Hardware and software planning and implementation.
- Provide assistance with loop checking, functional testing and commissioning.

Special care had to be taken to integrate the new operating concept into the existing protection and re-closing concepts. It was also necessary to integrate the third party DCS system, and to update the clients plant information management system.

**Minimum downtime for gas turbines**
ABB was able to execute the project quickly and efficiently. Total shut-down time, including installation, was only two weeks for the last turbine. The whole project was successfully commissioned ahead of the project schedule and handed over to the customer for normal operation.

“I would like to express my satisfaction for the job ABB did in implementing the modifications for the EGATROL system for the project at Ruwais Refinery GUP. The project involved the installation of the auxiliary transformers for the existing gas turbines and associated modification of control and protection systems. Working with ABB proved highly efficient and timing was perfect. As a result, we were able to deliver the expected final results and finish the job in advance of the planned completion date.”

Alessandro Logoteta
Deputy Project Manager
CARLO GAVAZZI IMPIANTI SpA
An entirely new workstation concept

The new modern control room is a reality. It provides superior ergonomics for operators and improved economy for plant owners.

While technology at the user interface level has seen significant advances over the past twenty years, the overall control room layout has received relatively little attention. Most control consoles still look the same as they always have, the only difference being that analog instruments have been replaced by computer screens and pushbuttons by a mouse and keyboard. There are still huge mimic panels - they have merely been replaced here and there with large video displays.

ABB has now thoroughly rethought control room organization and conducted a major study to examine how to best support the way control room staff works. The results of the study were surprising: for example, in many control rooms, the large video displays are ignored, either because the image quality is inadequate, or because the information displayed is never useful to the operators. In many control rooms, the only purpose of the large display is to impress visitors.

ABB has now developed a new type of workstation to address this situation. It consists of two 800xA workstations, one with a series of standard screens, which are arranged side-by-side, and the other with a large video display, which is used exclusively by the assigned operator. The large screens have double or triple the resolution of a normal screen (depending on type) and can be implemented as either several 55-inch TFT displays or as a seamless video wall. It is installed near enough so that details can still easily be distinguished, and is ideally suited for plant overviews or for showing long, detailed trend lines.

This workstation also fulfills every ergonomic wish. The work surface, the row of computer screens and the large display panel feature individual motorized height adjustment, which facilitates easy switching from a sitting to a standing position.

The effectiveness of operating resources is maximized with ABB’s new workstation. Without exception, results are positive; not only with respect to the actual work done in the control room, but also regarding the health of the employees.

New extended version of 800xA: risk-free testing of controller applications on the target system

This spring, a number of useful features were added to ABB’s successful 800xA process control system. The new, extended version makes it possible to risk-free pretest controller applications directly on the present live controller.

ABB has introduced version 5 of its 800xA process control system, which includes an entirely new collection of useful features allowing easier and more reliable working with your process control system.

For example, reprogramming controllers while they are online was revolutionized. Load-Evaluate-Go enables new applications to be loaded into the controller without immediately becoming active. During the test phase, the program is executed on the controller; that is, it reacts to inputs, but it does not affect the process. Instead, the application’s hypothetically generated output signals, events, alarms, etc. are displayed on a workstation. There they can be compared to the real outputs of the “old”, still active application. This enables users to test and monitor the new application right down to the last detail without risk of interfering with an operating process, and to only bring it online when it proves to execute its tasks correctly. The new application is switched to active mode on the fly, without any process shutdown whatsoever. Powerful new features were also added to the programming environment in the new fifth version of 800xA. It is now possible to temporarily reserve individual application sections for a specific person, as well as developing application sections off-line and easily and reliably importing them into the online system. These options greatly extend the horizons of distributed engineering.
Protect your investment with ABB’s Life Cycle Concept

Increasing productivity while cutting operating costs are major challenges for today’s plant owners. Advanced technology can help meet these new demands and at the same time, protect previous capital investments.

The chart (below) shows the results of a survey demonstrating the different life spans of the various components used in a control system. Cabling is the only component that comes close to the life cycle of a complete plant, while I/O modules and controllers last for 20 and 15 years respectively. We see that computers have a lifetime of about 5 years.

This demonstrates the tremendous importance of continuous plant support and well balanced strategies to handle the different life cycles.

ABB’s control systems are designed for continuous evolution. In other words, the life cycle of the system itself depends on the life cycle of the modules used.

Life cycle phases
ABB has defined four life cycle phases:

During the “active” phase, the product is actively sold and maintained and new versions or functional extensions are continuously added. Migration from older products is also actively supported.

During the “classic” phase, the product is fostering only. It is no longer actively sold, but remains available to extend existing installations. R&D is limited to corrective activities, new features are not planned and the price of the product may change due to reduced volume or rising product maintenance costs. Step-up and migration programs are available.

During the “limited” phase, support for the product is mainly provided by the service department. R&D no longer supports the product and availability is no longer guaranteed. Spares come from manufacturers’ stock or are used and refurbished modules. Even service support may become more and more limited. Migration and step-up programs are available.

The “obsolete” phase is the end of the product life cycle.

This life cycle policy applies to ABB’s own products for hardware and software.

How long a product stays in a particular life cycle phase depends on a variety of factors. These include availability of electronic components and of the technology, or of third party components as well as the availability of new products/systems replacing the current one, to name just a few. And last but not least, it depends on market demand.

Migrating a system means transitioning an existing system in a certain life cycle phase to a more modern system. The decision to migrate or not is always plant specific and takes into consideration both the installed system and its configuration, as well as the existing engineering data.

Even small expenditures can have major impact. With step-by-step upgrades, the overall capital investment can be split into manageable portions. The customer benefits are:

■ higher cost-effectiveness, performance and availability of the existing systems
■ extended service life of the plant
■ lower fuel consumption
■ higher plant output
■ reduced emissions

ABB provides a full range of life cycle services:
From spare parts, equipment repair, and training, to remote monitoring and technical support. We feel obliged to safeguard your investment as long as technically feasible and economically justifiable by offering customized migration solutions.
The considerable customer benefits offered by the SIL 2-certified AC800M High Integrity Controller are easy to measure: less training, fewer spare parts and a system-wide, consistent operator interface.

The effectiveness of safety functions should be measurable and should comply with recognized international standards. In 1998, the new IEC 61508 standard established a basis for implementing safety features in programmable process control systems. This was primarily driven by the demands of the offshore industry, on whose drilling platforms the combination of highly automated complex processes and the omnipresent highly flammable substances literally created an explosive mixture.

A series of application related standards later emerged. These were based on the very general IEC 61508, which goes into great detail about protection computers and programming them. Among the new standards is DIN EN 50156 (2004) - electrical equipment for furnaces and ancillary equipment. In the standards, each protective function is assigned a specific reliability or SIL class based on the process, depending on the risk it poses to humans, the environment and the system itself. In addition to technical specifications for the equipment, the standards also include specifications for:

- all activities from the start of planning right through to the final decommissioning of the system, including planning and verification
- validation of the effectiveness for the entire system
- the level of knowledge of the persons responsible for planning, installing, maintaining and operating the system

This broadens the scope of the protective specifications to cover the entire life cycle of a system. In order to comply with these requirements, either all designers, start-up and maintenance personnel must be trained on the dedicated protective system, or the protective system used must be seamlessly integrated into the existing DCS environment. To meet these requirements, ABB developed the certified AC800M HI controller, an extension to the AC800M family of products.

Integration of the AC 800M HI into the operating process control system is so sophisticated that, during everyday operation, control room operators do not notice which drives are only part of the operating process control system and which are also, or exclusively, tied to the protective system.

Another important advantage of the AC800M HI is that it is a high performance controller—it can also be used to configure complex protective system algorithms. This allows to implement really all normal and abnormal operating conditions in the control algorithm and thus eliminates the need to force protection functions e.g. during run-up or trial runs. The result is a faster run-up in the early starting phase and eliminates the risk that a forcing which was required for run-up remains active in operation. The AC800M HI controller’s extensive features and considerable computing power enable better utilization of the system within the safe operating range; e.g. by using complex, multidimensional families of curves instead of fixed upper and lower limits for individual parameters.

The AC800M HI controller will be installed as part of the RABA waste-to-energy project in Suhl Germany, which is scheduled to start commercial operation in October 2007.
ABB at User’s Conference in Bahrain

ABB participated in the seventh GT13E2 Users’ Conference, which was held in Bahrain from March 5 to 7, 2007. Fifty customers from around the world attended this three-day event, which was organized by Hidd Power Company (HPC). At the conference, ABB was able to demonstrate that by implementing a professional product/system life cycle management program, it is possible to safeguard previous investments in equipment. HPC gave a number of presentations, and sponsored a tour of its plant. The next GT13E2 Users’ Conference is scheduled to be held in fall of 2008.

PRODUCT NEWS

TP810 Overspeed Protection Device receives SIL3 Certificate

The TP810 is ABB’s solution for turbine overspeed protection. It is integrated into System 800xA, but can be used in any open DCS environment due to its Profibus interface. The TP810 has recently been certified by TUV Rheinland for SIL3.

Power Generation Information Manager V5.0 released

Power Generation Information Manager PGIM, ABB’s solution for data collection and information management in power plants, is now available in release 5.0. It is tightly integrated into the latest System 800xA release, and offers improved performance and a number of enhanced functions such as thin client and improved alarm reporting capability.

Touch base with ABB at the following plant automation events in June:

- VGB Industry conference, Friedrichshafen, Germany
  June 5-6. Gas turbines and gas turbine operation
  www.vgb.org

- WTE Forum 2007, ABB Baden, Switzerland, June 12
  Spotlight on waste combustion installations!
  How can you improve the efficiency of your waste combustion installations and ensure they are cost effective? Advance registration required.
  www.abb.com/powergeneration

- Power-Gen Europe, Madrid, June 26-28
  Europe’s leading power generation conference and exhibition.
  www.powergeneurope.com