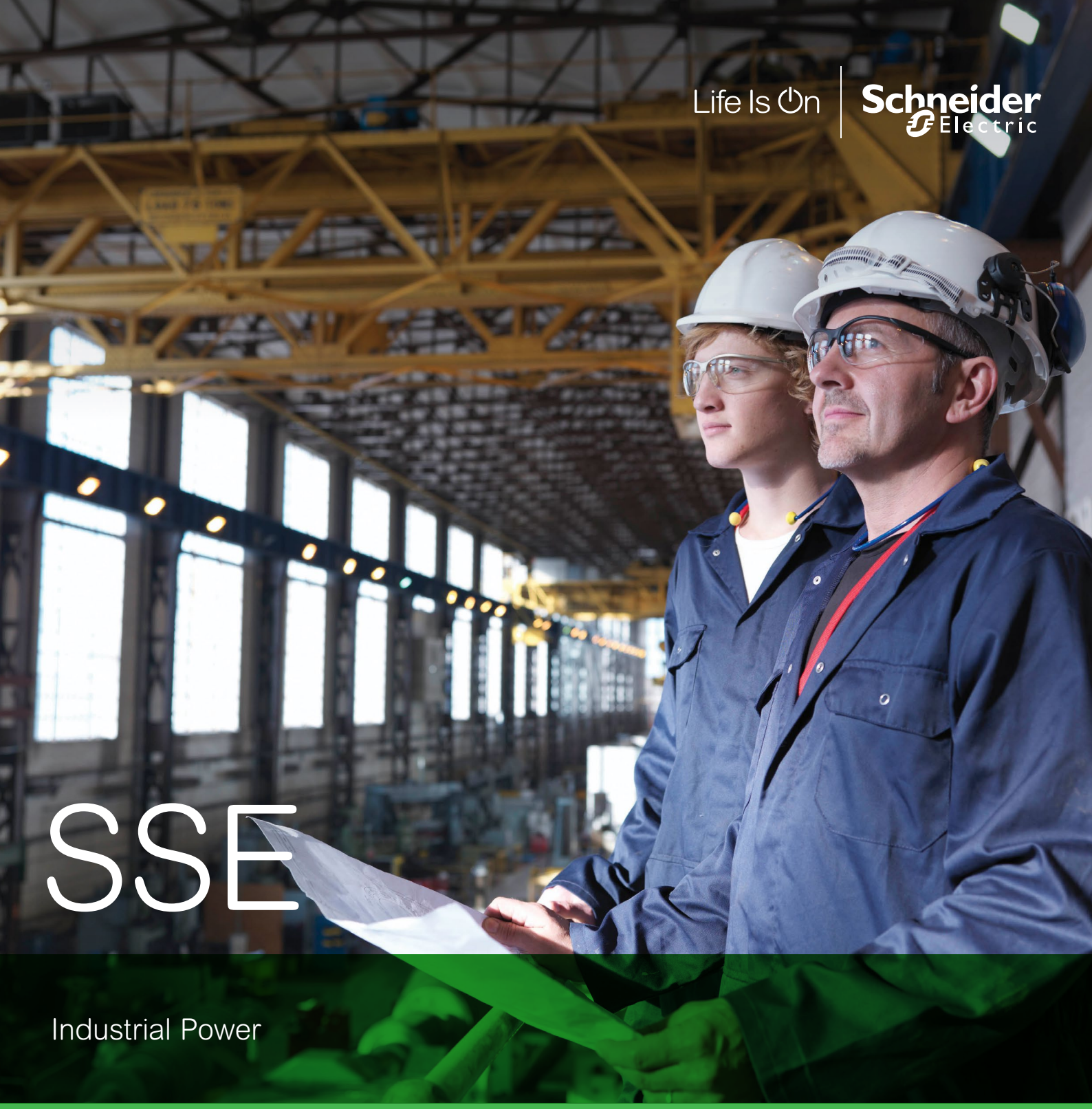

SSE

Industrial Power

SSE
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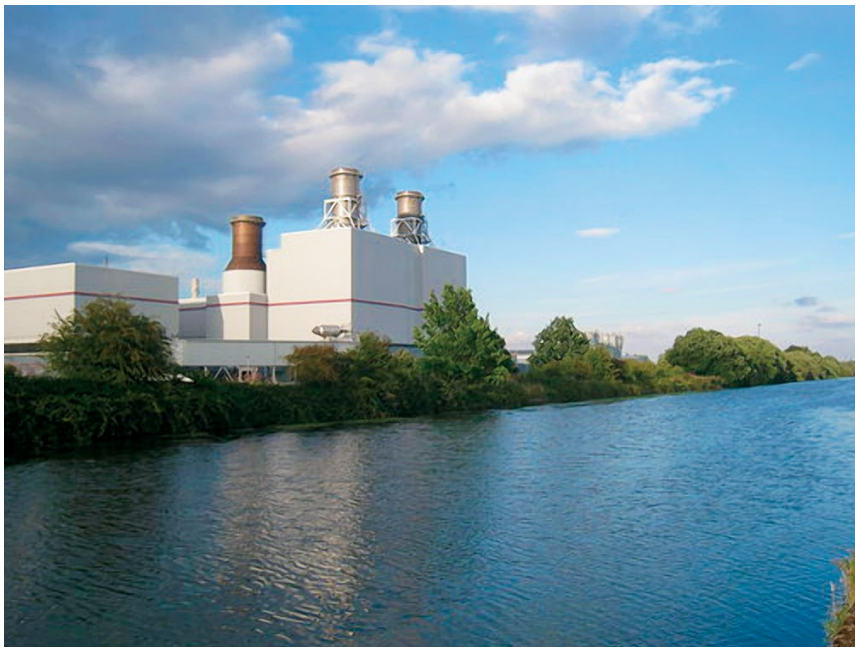

Schneider Electric powers U.K. electricity demand.

> "The migration approach offered by Schneider Electric showed that an alternative to the existing vendor's upgrade solution was a viable option."
>
> – Hugh Ferguson, C&I Engineer & DCS Upgrade Project Manager, Keadby Power Station

The River Trent, once a major commercial waterway marking the traditional boundary between Northern and Southern England, has a history of changing course over the ages. Even the works of William Shakespeare mention the river's meandering. "Henry IV, Part 1" has Henry Hotspur say, "See how this river ... cuts me from the best of all my land ... I'll have the current in this place damm'd up ... and here the smug and silver Trent shall run." The river's banks have stabilized since then, and it is the source of recreation and drinking water, as well as cooling water for a large number of coal-and gas-fired electrical power plants along its route. One of those plants, Keadby Power Station at Scunthorpe in North Lincolnshire, is operated by SSE, one of the largest energy companies in the United Kingdom. The Keadby plant, which began commercial operation in 1996, is a 720-megawatt (MW) combined-cycle gas turbine generating facility.

Goals

- The company needed to address the obsolescence of its existing distributed control system (DCS) and to provide an expandable solution to extend the working service life of its Keadby Power Station
- The vendor needed to deliver the total upgrade solution in time for a planned major shutdown and in parallel with other plant projects with minimal commissioning time

Challenges

- Incomplete loop drawings, faded conductor idents, and the risk of human error during I/O change-out were considered significant upgrade obstacles
- Limited documentation available on existing software applications presented software migration and testing dilemmas for the project team

Solutions

- Enterprise control system
- Foxboro™ DCS
- SimSci™ ROMeo Online Performance Suite
- SimSci Dynamic Simulation Suite

Results

- The solution was delivered on time for the planned outage and within the SSE budget for the project
- The upgrade addressed both the obsolescence and expandability issues
- Plant personnel realized major benefits of simulation, including improved operator training and familiarization, and the facility now has a rigorous test-bed for process testing

The Keadby power-generating plant includes two General Electric frame 9FA gas turbines, one Alstom steam turbine, two Babcock three-pressure waste heat recovery boilers, and a Siemens GT10B auxiliary gas turbine. It is maintained and operated by a staff of 53, including managers, engineers, and technicians. When SSE management realized the facility's DCS was approaching plantwide obsolescence, the company chose Schneider Electric to upgrade the plant to a more flexible, scalable, and supportable solution.

SSE is a vertically integrated energy utility, and is involved in the generation, transmission, distribution, and supply of electricity as well as the storage, distribution, and supply of natural gas, telecommunications, contracting, and energy services. SSE has more than 10 million customer accounts in the U.K., supplying natural gas and electricity to more than 3.5 million homes and businesses. It owns the U.K.'s largest onshore gas storage facility at Hornsea in East Yorkshire and is currently building a new, larger facility at Aldbrough. In addition, the company has one of the largest electrical contracting businesses in the U.K., operating from 60 regional offices. As the U.K.'s largest street lighting contractor, SSE also maintains over 1 million lights.

The company has a total of more than 11,300 MW of capacity, 2,000 MW of which is installed renewable capacity. As such, SSE is the U.K.'s second largest generation business overall, and the largest generator of electricity from renewable sources. SSE, formed with the merger of Scottish Hydro Electric and Southern Electric, also has an ownership interest in more than 100 thermal and renewable power stations.

Shining the light on a new infrastructure approach

Before the upgrade, the majority of the plant was operated by a sitewide Emerson Westinghouse Distributed Process Family (WDPF) DCS. A moderate-sized control system, this included 26 fault-tolerant controllers; 12 human-machine interface (HMI) workstations, including one historian and comprising 6,046 hardwired I/O, eight control level data links (modbus, Allen-Bradley DH+, GE-GSM); three supervisory level data links (modbus-TCP, ODBC, OSI-PI); and 190 process screens, including approximately 130 overlays and 48 sequences.

SSE engineers initially identified seven key criteria for the DCS upgrade project at Keadby Power Station. At the top of the list was that the upgrade had to be completed in time for a scheduled major plant outage and the system migrated with minimal site commissioning time. In addition, the new DCS had to address the pressing obsolescence issues and remain current for the remainder of the plant's expected service life. Sufficient expandability in terms of controller memory, I/O capacity, and network bandwidth together with simplified online configuration was also considered a key requirement. Because of the potential impact on operating procedures and other human factors, engineers also specified that the new plant solution should maintain the existing control strategies and HMI interface standards.

Upgrading systems in harmony with existing operations and upgrades

As planning progressed, it became clear that the DCS upgrade had to be conducted in parallel with essential major maintenance activities as well as other expansion projects. Furthermore, site works needed to take place with minimal disruption to the outage program. A risk assessment of the project requirement identified two key areas of concern: the I/O upgrade, and application software migration. For the I/O upgrade, plant engineers at Keadby cited challenges such as faded conductor identification labels, incomplete loop drawings, human error risks, and the potential impact on the outage program associated with on-site rewiring and testing of approximately 6,000 loops.

"Although the existing system had been reliable in the past, problems were emerging," said Hugh Ferguson, C&I engineer at Keadby Power Station and project manager for the DCS upgrade project. "An increasing number of components were either no longer available or no longer repairable. Plus, controller memory was near capacity and most of the data highway bandwidth was already utilized."

Migration of the application software was also considered a potential problem area. Documentation was limited and there were no control narratives available. This meant that the application software itself had to be used as the source for the migration process, raising concerns over the potential for human error, the skill sets required, and the functional acceptance test criteria.

Based on the potential obstacles, it was not clear whether there was an alternative to upgrading to Ovation, the next generation of the WDPF platform. However, because of concerns over software acceptance testing and continued support for the existing I/O hardware, SSE decided to initiate a bid process for the project.

Six DCS vendors prequalified for the proposed migration project, with four vendors asked to present formal technical evaluations of their proposed solutions.

Schneider Electric was ultimately selected by SSE because of it's proven plug-in I/O card migration solution for WDPF. Other critical factors included WDPF migration expertise, in-house simulation capabilities, and the incorporation of a model-based plant simulator for application software testing and operator training.

Mastery of the migration process

Schneider Electric WDPF migration-style fieldbus modules are a plug-in replacement for WDPF Q-Line I/O cards, which allow the existing WDPF I/O racks, power-supplies, and field wiring to be retained and reused by the new Foxboro DCS. Semi-automated tools were offered to migrate the Westinghouse application to the delivery mechanism for enterprise control, consisting of the hardware and software components necessary to provide a true aggregated view of information across an organization, enabling a robust foundation for collaboration between people, processes, and systems.

The SimSci Dynamic Simulation Suite provides both model-based plant simulation and a platform for enabling a complete Operator Training Simulator (OTS) solution comprising virtualized DCS control processors, interfaces to third-party virtual controllers, and a feature-rich training environment. The SimSci solution provides the full power of rigorous dynamic simulation and control system emulation for process engineers, plant engineers, operators, and managers to improve plant design, check out controls, train operators, and improve plant performance. It also offers a modern alternative to dated, fragmented, empirical, and hard-to-use products with which many engineering firms and plants currently struggle.

Schneider Electric also demonstrated an extensive track record for supporting the Foxboro DCS, a key component of the enterprise control system, and were able to offer a number of products to further enhance the system including Sequential Function Charts for DCS sequences and the ROMeo Online Performance Suite for plant performance metrics.

ROMeo is an advanced, unified modeling environment delivering online optimization applications to help users obtain peak performance from their operating units. ROMeo offers process optimization across an entire enterprise with online modeling and equation-based optimization capabilities providing more accurate, current operating information to better manage changing market pressures, product values, energy costs, and equipment performance.

“The migration approach offered by Schneider Electric showed that an alternative to the existing system was a viable option,” said Ferguson. “Simulation is also proving particularly useful at resolving hard-to-replicate problems, and was invaluable in leveraging the experience of plant operators during migration of the application software.”

Initially, migration of the DCS application software and development of the OTS plant model were undertaken as separate, parallel activities by separate Schneider Electric project teams. Once completed, these two elements were then combined to allow functional testing in the factory prior to installation at site.

Once the system architecture and hardware had been specified, the Schneider Electric DCS team began by developing migration tools and carrying out code analyses; breaking the application down into HMI components, interlock/protection logic, sequences, unique strategies, and typicals. Migrated DCS components were then tested on a modular basis via a combination of code reviews and basic Foxboro DCS functional testing.

The OTS team’s first task was to mark-up plant piping and instrumentation diagrams in order to clarify the required scope and topology of the SimSci DYNSIM process model. Once the model had been constructed, this was followed by model acceptance testing to demonstrate the validity of the resulting process simulation.

The DCS and OTS teams joined together for the integration and testing phase. The DCS controls and third-party gas turbine controls (GE-Mark-Vie) were loaded and I/O cross-references between these and the process model were built and verified.

> "Plant simulation greatly assisted the software migration process and allowed us to catch a number of software integration issues before the system was accepted for installation on site. I am therefore convinced that without it the plant would not have returned to service as smoothly as it did, and would certainly have required much more commissioning time," said Ferguson. "But if you are using a simulator for software acceptance testing, avoid integrating DCS code too early since (just like on the real plant) control updates often take time, particularly if they require additional (virtual) plant run-ups to install or test."

Virtual plant commissioning was implemented on a plant area-by-area basis; balance of plant 1, balance of plant 2, gas turbines, waste heat recovery boilers, and the steam turbine. Virtual plant commissioning on the simulator mimicked that which would have occurred on the real plant and included plant pre-start, start-up, steady-state operation, and shut down by an experienced Keadby operator. Once it had been demonstrated that it was possible to operate the plant in accordance with existing operating procedures, SSE gave the "green light" to progress with the site installation phase of the DCS upgrade.

A plan well devised is a plan well executed

The project was delivered in time for Keadby's planned shutdown and within SSE budget parameters. The equipment upgrade was completed in less than 13 days, compared with the 18 days that were scheduled. There was only one minor two-hour delay to the return-to-service program attributable to the migration to the new DCS. The unique migration solution with plug-in I/O modules allowed for minimal plant downtime for the project.

In addition, the expandability issue has been resolved as the new DCS now supports up to 2,000 nodes and the central processor loading is at less than 25 percent of capacity. Keadby also enjoys simplified online configuration.

Schneider Electric also successfully delivered a model-based OTS system, DCS sequence enhancements, process interlock diagnostics/overrides, an online heat balance reconciled performance package via the Automated Rigorous Performance Monitoring product that is part of the ROMeo suite, and alarm performance analysis via the third-party PAS PlantState Suite.

"The project has satisfied all of our technical objectives, and we now have a supportable system with the capacity we need to proceed with a number of control improvements that were being held-up by the limitations of the previous system" said Ferguson. "Not only was the migration completed with minimal impact on routine plant operations, it has been possible to retain much of the look and feel of the previous system but at the same time making improvements to consistency, operability, and system configurability. Furthermore, we now have a number of new tools in our toolbox. For example, not only did the simulator play an important role in the migration project, is it now proving particularly beneficial both for staff training and as a rigorous test-bed for control and process changes."

The extensive migration upgrade at the Keadby Power Station resulted in several gains for the plant and SSE acknowledged Schneider Electric for providing a standardized and successful migration solution.

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