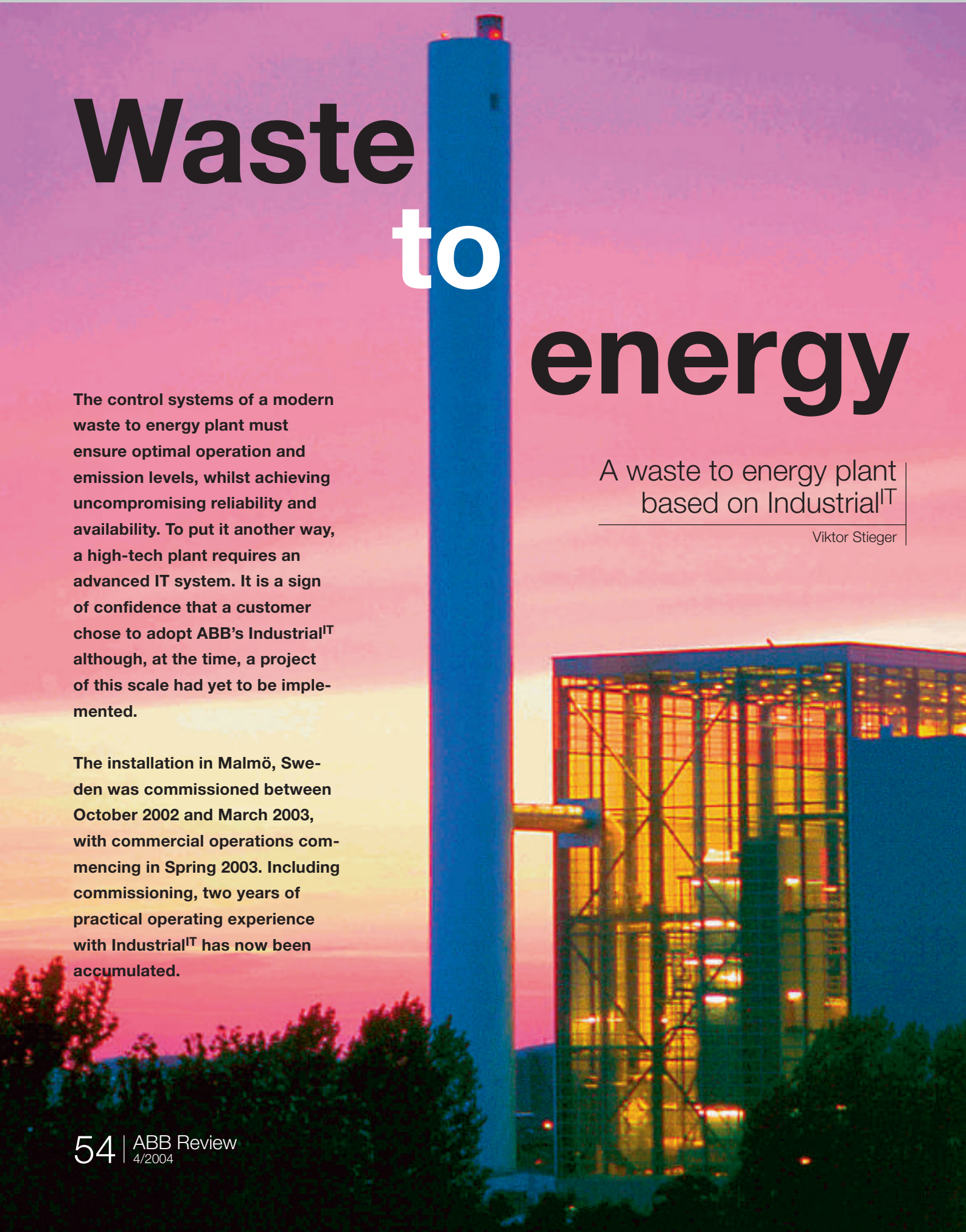
Waste to energy

A waste to energy plant based on Industrial^{IT}

Viktor Stieger

The control systems of a modern waste to energy plant must ensure optimal operation and emission levels, whilst achieving uncompromising reliability and availability. To put it another way, a high-tech plant requires an advanced IT system. It is a sign of confidence that a customer chose to adopt ABB's Industrial^{IT} although, at the time, a project of this scale had yet to be implemented.

The installation in Malmö, Sweden was commissioned between October 2002 and March 2003, with commercial operations commencing in Spring 2003. Including commissioning, two years of practical operating experience with Industrial^{IT} has now been accumulated.



The SYSAV (Solid Waste Company of Southwest Scandia) project

The expansion and modernization of installations for the incineration and thermal utilization of domestic and industrial refuse is being promoted in Sweden. Since 1973, SYSAV has operated two incineration lines at the same site in the city of Malmö. To expand capacity, construction of a third line began in 1999. The new facility is dimensioned for a capacity of 25 tonnes/hour or 200,000 tonnes/year, making it one of the largest installations of its type in the world. 145,000 MWh of electrical energy and 540,000 MWh of district heating are produced every year.

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The plant was built by an international consortium. Besides the automation technology for control and protection described here, ABB also supplied the medium voltage equipment, standby power supply, low voltage distributors, motor control centers, frequency converters, cabling and instrumentation.

The 'waste to energy' process.

Refuse is combusted in a grate stoker furnace at about 1000°C. The primary and secondary air feeds are co-regulated with the grate feed for optimal combustion and power control. The ash contained in the smoke is drawn out in the boiler and further purified. The dust concentration is reduced to 20 mg/m³ by electric dry filters.

After filtering, the temperature of the exhaust gas is still about 350 °C. This is cooled to about 120 °C in a heat exchanger, and then cleaned in a three part wet scrubber to remove heavy metals, acid, sulfur dioxide and other substances. In a further wet filter, solid particles are reduced to 1 mg/m³. The exhaust is warmed to 200 °C in another heat exchanger and nitrogen oxides catalytically reduced. A final heat exchanger cools the gases to 70 °C. A ventilator evacuates the gases through a 100 m high stack.

800 °C hot exhaust gases are used to generate 100 tonnes/hour of steam at 40 bar in the waste heat boiler (equivalent to approx. 70 MW). A steam turbine converts this to up to 26 MVA of electrical power. The overall efficiency is boosted further by using heat exchangers to recover heat from cleaned gases and from the waste heat of the operating chambers. The return feed temperature of the district heating system is raised by 6 to 10 °C using two 9 MW heat pumps.

The wastewater from the exhaust filtering system is chemically treated to precipitate residues. These are mixed with the boiler ash to form a so-called 'Bamberg cake' and stored in a specially prepared landfill. The remaining water is treated further, through a filtering process.

Through the choice of this sophisticated technology and the design of the plant, SYSAV is achieving emission levels that are lower than the already stringent Swedish requirements.

Demands and solutions

Operating philosophy.

The principal criteria for SYSAV are:

- Low emissions
- Optimal thermal utilization of the waste
- Plant availability
- Staff safety
- Economical operation

Through a transparent information policy, SYSAV has also achieved a high level of approval in the local population. The attractive architectural treatment of the plant aims at underlining the important role it fulfills in a modern society.

Technical demands.

The customer's specifications for the realization as a whole as well as for details were precise. The solution sought had to take into account SYSAV's 30 years of operating experience with the plant and its existing operating schedule. ABB was able to fulfill these demands with its ICE (Instrumentation, Control and Electrical) scope of supply.

New expandable technologies.

These requirements dovetailed with ABB's intentions for Industrial^{IT}. When the detailed concept was being determined in 2001, various aspects of Industrial^{IT} had not yet been applied. Their implementation required trust, courage and persistence. These innovations had to be achieved while upholding the proven attributes of reliability, safety and economical operation.

Integrated systems, continuous data, all signals available in a process control system.

It was intended to realize the project using as few suppliers, systems and product types as possible. This allows the customer to optimize operations, training and spare part costs. ABB supplied all process control systems hardware and software for the plant with the exception of some standard packaged units.

Data interchange with sub-systems was an important and critical criterion. SYSAV wanted to have all data available in the control system. The integration of the low voltage distribution system MNS-INSUM was achieved with LON-Bus. SPA-Bus is used for the medium voltage installation. The process signals of third-party packaged units use Profibus, Modbus or AF100 fieldbus. Distributed S800 I/O stations with a redundant AF100 fieldbus integrate direct field signals.

A single operator interface for all process (Operate^{IT}).

The customer wanted a single operator interface for controlling all processes. Operate^{IT} replaces the functionality of all specialized operator systems, and applies a unified display and operating philosophy. The productivity of all interfaces in an extreme situation (eg, power failure or emergency stop) was an important criterion. Process overview, speed of operator reactions, alerting and the correct sequence of event notifications were all successfully tested under such conditions.

Availability, safety and redundancy

To meet the tough requirements, the proven Advant AC450 controller was used. SYSAV uses AC800M and Operate^{IT} for infrastructure equipment and has implemented this part itself, thereby accumulating valuable experience.

The plant operates around the clock all year round, only shutting down for an annual three-week revision. The reliability of the control systems must limit downtime to at most 16 hours per year. Furthermore, the failure of a central process control component may not halt production. Accordingly, the following key components are redundant: Operator controls, AC450 controllers, power supplies, AF100 fieldbus and MB300 process bus. The redundancy of control permits access to any control function from any station. Besides the higher reliability, the redundant structure allows upgrade installations while the plant is still operating.

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During the entire commissioning phase and operations to date, there has been only one plant shutdown due to control system failure. This is a significant success for Operate^{IT} because it had not been used for an application of this scale before. Due to the redundancy, teething troubles could be worked on and updates installed while the plant was in operation.

Network security

Recent global experience with virii and hacker attacks has raised security concerns. It is part of the philosophy of Industrial^{IT} that systems remain as open as possible. The plant network is connected to SYSAV's decentral regional network. Remote support from ABB is also possible using a data link. These accesses require appropriate network security measures. Possible weaknesses and remedies were discussed with SYSAV. Solutions were implemented on different levels (operational regulations, updating with security patches, firewalls, access restrictions etc.).

Process information management 'Optimax'

This system assures the long-term storage and management of process data and events and doubles as a reporting system. Besides standard reports, emission reports are generated according to EU and Swedish standards.

Linking the maintenance system to process data and documentation.

SYSAV and ABB jointly selected the Datastream's MP2 system for operations and maintenance. MP2 supports object related maintenance. The documentation of the entire plant is stored electronically and is accessible to operating staff. Data such as operating hours and start/stop counts are also available.

Continuous documentation

It was an important requirement, that the complete electrical documentation was implemented according to SYSAV's standards with a single CAD tool. This facilitates future maintenance of the documentation by SYSAV. Equally, the entire plant documentation was made available in a structured PDF form to be readily available to all staff.

Training

Personnel were trained in courses at the ABB University and on-site. Besides performing its own maintenance, SYSAV wishes to implement future changes to the software autonomously.

Observations from the customer's point of view

Important factors supporting SYSAV's decision to work with ABB were:

- ABB offers the necessary products and systems.
- ABB has cooperative experience with the process suppliers in the 'waste to energy' sector.
- ABB was prepared to fulfill SYSAV's special demands.
- ABB's Industrial^{IT} platform is promising.
- ABB is well represented in Sweden and Malmö.

SYSAV chose Operate^{IT} at an early stage, before experience with the system was available. The subsequent success shows that the system fulfills SYSAV's objectives and that the right choice was made.

The total integration of ABB subsystems and all ABB products is an important part of Industrial^{IT}'s success. SYSAV would like to continue in this direction and fill in the remaining gaps. It attaches great importance to the continuity of development and compatibility to existing systems.

Viktor Stieger
ABB Switzerland Limited, Utility Automation Systems
Baden, Switzerland
viktor.stieger@ch.abb.com