Manufacturer-neutral building management systems in energy-optimized properties

by Wonderware GmbH

Assignment

The energy concept of the new Federal Environmental Agency building in Dessau entails intense thermal insulation, controlled ventilation with geothermal heat exchanger and heat recovery technology, a system for solar-assisted refrigeration and a photovoltaic system.

The objectives were to reduce the overall energy consumption to 50% below the limits defined by the thermal insulation ordinance and to cover the entire energy demand by at least 15% from regenerative forms of energy.

Special requirements were placed on the central building control systems used in this building project with regard to the stability and long-term storage of data. The Wonderware Historian measures and documents all consumption data. Accompanying research projects utilize Wonderware’s ActiveFactory software for extensive monitoring.

Ideal Energy Utilization

The building's basic heat supply is effected through a district heating network with a connection capacity of 1,730 kW in wintertime. The cooling capacity in summer is about 200 kW. Approx. 9% of the energy demand comes from an external landfill gas - heat and power unit (CHP), with an efficiency of 87% (51% heat, 36% electricity).

The building is ventilated by controlled ventilation with geothermal heat exchanger and heat recovery technology. A three meter deep and 4,800 m long geothermal grid pipe system is used for conditioning a large proportion of the incoming air. A fiber-optic cable also installed along uses impulse lasers to capture 3,000 temperature values.

During the summer months, used air is discharged off through the atrium. From the offices, the air passes into the corridors through an overflow element and from there through open doors into the inner courtyard. Due to the thermal uplift, the air flows out through ventilation hatches in the glass roof. For the overnight cooling of the offices, ventilation flaps are automatically regulated by the building automation based on time and temperature. The air is eventually transferred to the outside via the atrium through convection. In winter, an exhaust system including a heat recovery function is operated (heat recovery coefficient = 74%).

Company Overview

Federal Environmental Agency – Dessau Berlin, Germany

The Federal Environmental Agency (FEA) commenced work on 2 May 2005 in its new head office in Dessau in the federal German state of Saxony-Anhalt. Over 750 of the some 1,300 employees nationwide moved into the newly constructed building in the so-called gas district close to Dessau central station.

“By taking advantage of synergies it is possible to realize energy optimization of the overall system and, in doing so, to achieve a significant reduction of energy demand and primary energy consumption.”

Gerd Schablitzki, Head of the Building and Technology Department, Federal Environmental Agency
The IT rooms are air conditioned by means of a solar-assisted cooling system. An absorption-cooling-machine with a power of 80 kW generates the required cooling effect through evaporation and absorption. The regeneration is effected primarily (160 from 200 kW) by solar-heated hot water coming out of a thermal solar system with 354 m² vacuum pipe collectors. In case of a solar energy failure and/or shutdown of the fuel cells, the required heat is supplied by buffer storage facilities or externally by the City of Dessau. A compression refrigerating machine is used to cool the air in the auditorium.

According to planning, the building’s power consumption is about 40.4 kWh per m²NGFa. A photovoltaic system with a size of 228 m² (net) integrated into the glass roof of the atrium has a power of 31.92 kWp and produces 24,173 kWh/a of energy.

The lighting of the offices comes from direct shining fluorescent lights with an electronic control gear (ECG) regulated depending on daylight as well as presence of people. A sun screen installed between the double- and ventilated single-glazing can be operated manually.

**High-level Building Management System**

The mostly automated and economic operation of the entire technical building equipment is coordinated by a central building management system. The basic application developed by the engineering office “von Keitz” was used to ensure easy use, central monitoring of technical equipment and the analysis of energy data.

As part of a parallel research project, planning and building processes are documented and the energy efficiency achieved is being monitored in detail and subsequently evaluated. The project is supported by the Federal Ministry for Economics and Labour and is part of the promotion concept ‘Energy-optimized building, sub-complex 3’.

The research results are also to be used in education and presented to the public by participation in the project ‘SolarBau:Monitor’.

Based on buildings where this has already been realized, the sub-concept is supposed to test and demonstrate the synergetic effect of the following cost saving strategies:

- Reasonable use of “traditional” insulation measures;
- Increased use of solar technologies;
- Rational energy utilization through advanced, adjusted systems used in technical building equipment.

Only by exploiting the multiple effects resulting from this, energy optimization of the overall system ‘building’ and subsequently a significant reduction of the energy demand or primary energy consumption, respectively, can be achieved.

**Realization**

Generic tools were used to accomplish above mentioned targets. The PLC programming was performed with the Siclimat X system. The integrated SCADA export function enabled the automatic export/import of all the data points from the automation level directly into the visual display level during the entire project phase. This method ensures the swift and error-free transfer of all the information from field level, such as physical units, scaling, plain texts, status texts, etc. As a spin-off, useful databases were created that facilitate operation and error diagnosis later in time.

The state-of-the-art IT technologies of the ArchestrA-based components of Wonderware’s FactorySuite were incorporated into the entire application. Particularly helpful are the inheritance properties of the InTouch HMI smart symbols. New functions can be implemented into all system images and graphical objects in next to no time. Errors in the visual display of individual objects are basically impossible and expensive rework is avoided. To implement a fully integrated object-oriented application, each data point was provided with a system identification code (SIC). This SIC uniquely defines each object along with all its properties and constitutes the basis for a generic method of working. The first part of the SIC consists of geographical and physical allocation; the
second part describes the properties and the function of the assembly units. Using a SIC entails the following advantages:

- As a database index, it is used for realizing user control functionalities, such as free function description, information for the maintenance personnel in case of an error, allocation for higher-level programs (SAP, energy data accounting, and maintenance programs);
- Operators and research staff can filter their data with ActiveFactory’s easy-to-use filter functions and copy the selection into their mathematical model;
- Customized trend module per equipment image.
- Customized time switch program per system, switching command or set point;
- Automatic generation of reports and analyses;
- Automatic screen rotation for monitoring personnel;
- Changes on field level are automatically documented – no search is necessary;
- Quick implementation and support during adjustment.

Web technologies of the Wonderware software were used in order to meet the high requirements regarding data processing. Each authorized user can access the historical data as well as current information with reference to the entire building through the Internet, saving a lot of time and travel expenses. Should problems occur, specialists can quickly react from anywhere in the world.

**New Time-regulated Switch Program**

To allow an unlimited number of jobs to be processed by the PLC/DDC and also to be able to act on the control level, a new time switch program has been integrated into the application. Plans programmed in the PLC are updated daily by the control level for the following week. The operator can assign a time function to practically every adjustable data point. This is very helpful, as it allows all the systems in the building to be analyzed and optimized throughout the year.

The remote alarming can be controlled with the same user interface as the time switch program. Every alarm event can be configured for remote messaging from the user interface without needing special programming.
The integration of the central building control systems into Microsoft Office programs such as Excel, Word and Outlook for the reporting, consumption data evaluation and automatic forwarding of information by e-mail, fax or text message eliminates the need for training or expert personnel.

Particular attention was paid to ensuring that the entire system is easy, almost intuitively to use. Many years of experience in industry and building control technology have been considered during the development of this basic application.

However, a new feature in this application allows the user to assign each assembly a particular location on the floor plan. In addition, special features (key authorization, security areas) can be highlighted visually. They can be positioned using a freely movable grid in the floor plans and layouts. The coordinates are stored permanently in a database and every change is immediately visible on all the operator terminals.

**Outlook**

All the functions of the basic application used here can be easily integrated into existing applications. Current projects include the properties of the German Ministry of Foreign Affairs, the buildings of the exhibition center in Frankfurt as well as buildings in the City of Bremen.

To add to the basic application, an energy savings program based on Wonderware System Platform is currently being developed. By means of statistical and mathematical algorithms, this program is supposed to optimize the energy consumption of all the relevant systems. This tool features an independent reporting system for documenting the energy savings achieved.

The free scalability of Wonderware products and the use of open source codes provide continuing value of the investment in building management systems.

This document was realized thanks to the support of:

Siniko von Keitz, Engineering Office and Federal Environmental Agency