KNX Award 2008
Category: Special
Winner: Schacke Elektrogrosshandelsgesellschaft (Austria)

Central control of public lighting via KNX means big savings in electricity for the City of Salzburg

Some time ago, the City of Salzburg drew up a concept for improving the energy efficiency, safety and security offered by the control system governing the city's public lighting. A KNX system was chosen for this demanding task, as it represented a very cost-effective solution. For this, the system integrator, Schäcke, earned itself the KNX Award 2008, category: Special.

Salzburg extends over an area of 65.65 km2 and has a population of 150,269 (2007 data). The public lighting (street lighting) system for the city of Salzburg consists of 19,000 fixtures using 2.9 megawatts of electrical power. There are 200 floodlights illuminating 30 different sights, including the fortress Hohensalzburg, various buildings, and the hills immediately surrounding the city. The Department of Public Lighting for the Municipality of Salzburg, as operator of the street lighting, applies a number of cost-reducing measures. From midnight onwards, for example, the voltage along entire streets and at major junctions is reduced to 180 volts, which results in a dimming of the lights. The lighting in the various zones is switched on and off on the one hand via ripple control on the 230/400 V line network, and on the other hand via radio transponders. The entire system, with a total line network of 600 km, is overseen by 33 employees.

An emphasis on energy efficiency, safety, security and rational management

The operators of the street lighting in Salzburg wanted to further improve a number of properties of the system, and thus set the following requirements:

- Energy efficiency: with a total power of 2.9 megawatts, the cost of one hour of lighting (at € 0.11 per kWh) is € 319. Every minute saved reduces the total annual cost of operating the public lighting system. In fine weather, the control system should switch the lighting on at exactly 180 lux in the evening, and off at 40 lux in the morning. A so-called "long delay mode" should be available to prevent the lamps from being switched on again in response to poor weather (thunderstorms, snow clouds) shortly after being switched off.
- Longer lamp life: the lamps used are mercury-vapour lamps and sodium burners with an average power of 150 W. These need a burn-in period after being switched on of about 8-10 minutes before they reach full lighting power. This needed to be taken into account in the system's switching thresholds, in order to extend the life of the lamps. Before the lights are switched on again, a cooling-down period is therefore always necessary.
- Maximum reliability: the system must have a highly redundant design.

The task of implementing these specifications was entrusted to the company Schäcke AG, which offered a solution involving a combination of KNX and function modules (programmable logic control with KNX telegrams as inputs and outputs). The main argument for choosing this particular supplier was its sensationally low

price: the cost for the entire KNX system setup including engineering work was just € 10,250. Equivalent quotes involving the use of an industrial PLC system were many times higher. Although it would have been possible to program the algorithms using an industrial PLC system, the cabling work would have been excessive. Between the measuring room on the top floor and the control system service room on the ground floor of the headquarters of Salzburg state's energy utility Salzburg AG is an estimated 300 m of cabling. It was possible to retain an existing bus line. Prior to implementation of the system, measurements of light curves were taken at dusk and dawn over the course of several months in order to establish the necessary parameters for ensuring a perfect combination of energy efficiency, preservation of the lamps and public safety.

Complex functions achieved economically thanks to KNX

The KNX system has a redundant design. The two systems, which are not connected via line couplers, each function completely independently and are self-monitoring. Cyclical data transmissions pass from one component to the next in intervals of 30 seconds, ending with a switching actuator which operates according to a step function, whose cycle is repeatedly restarted. If just one component in this cyclical chain fails, then the step time (1 minute) elapses and a fault signal is relayed to the switch room of Salzburg AG. System 2 runs in the background, parallel to the first system, in order to ensure the uniform deterioration of the two systems, and is likewise self-monitoring. The switch room is notified in the same way if there is a fault in system 2. If system 1 goes into fault mode, system 2 replaces it as the control system for the entire city's street lighting.
The control algorithms were implemented with two redundant KNX function modules. Two light value sensors are housed in a heated, temperature-controlled measurement container. When the light measurement system switches the lights off or on for the first time in the morning or evening, the energy utility's switch room is given a 4-minute advance warning. When the lights are switched on in the evening, this advance warning is necessary in order to allow a 4 MW generator to be started up and synchronised. On all subsequent occasions on which the lights are switched on, switching-on is delayed by 10 minutes, in order to bridge short-term drops in light level and to prevent hot restrikes of the lamps. In case of failure of the room temperature controller, the function module sends notification of this fault to the switch room. A special feature of the algorithms is the fact that they allow the weather itself, via changes in the lux values, to influence the control system.

Possibility of monitored manual intervention

In special cases, for example for inspection of the city's street lighting or if difficulties are being experienced in providing the required 2.9 megawatts of power, the Salzburg AG switch room staff have the possibility of stopping the street lighting from being switched on. If necessary, during inspection work, the street lighting can be switched on or off manually; manually switching the lighting off overrides the central control, effectively putting it temporarily out of operation. Meanwhile, in the background, the KNX control prepares for the switching-on of the street lighting, but does not execute it. Only when the switch room staff reactivate the system is the street lighting immediately switched on again.
For security reasons, there can be no IP connection to the state energy utility (Salzburg AG)'s network. Salzburg AG's control IT system and network are

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completely isolated from the Internet and any third-party systems, and function entirely independently. This prevents the invasion of viruses, which could theoretically cause the collapse of the energy supply throughout the state of Salzburg. For security reasons, the interface from and to Salzburg AG's IT system needed to be implemented using binary inputs and switching actuators.

Parties involved:

Operator: Municipality of Salzburg, Department of Public Lighting, A-5024 Salzburg, Austria
Designer/system integrator: Schäcke GmbH, A-5020 Salzburg, Austria

Info: Schäcke GmbH, A-5020 Salzburg, Austria, www.schaecke.at

Box 1

Use of KNX in this project

- Because the switching-on and -off of the public lighting is automated, big savings in electricity and longer lamp life are possible.
- This failsafe KNX system was used for the automation because, according to calculations, an industrial PLC system would have cost many times more. The value of the investment, which included components and engineering work, was € 10,250.

Box 2

Technical highlights of this project

The combination of a decentralised KNX system for sensors and actuators with a function module allowed tough demands to be fulfilled in terms of automation, such as:

- Short delay for the first time the lights are switched off in the morning and on in the evening
- For subsequent occasions where the lights are switched off or on, a so-called "long delay mode" applies
- The duration of the long delay mode itself varying according to the brightness curve over Salzburg
- A situated is prevented where the lamps are switched on again soon after being switched off
- Hot restrike of the 19,000 lamps is prevented, which helps to extend their life

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Photos:

Figure 1. Salzburg city centre by night, viewed from the Gaisberg. Source: Schäcke

Figure 2. The heated measurement container with the light value sensors. Source: Schäcke

Figure 3. KNX components in the measuring room on the top floor. Source: Shäcke

Figure 4. The headquarters of Salzburg AG, where the KNX control system for the city's street lighting was implemented. Source: Shäcke

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