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Biomass-fired CHP station depends on PMSXpro process control system

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After a construction period of 18 months, operation has begun on a modern German, biomass-fired combined heating and power station. Every year, the giant heating boiler burns around 90,000 tonnes of biomass in the form of old and used wood at temperatures of up to 1100°C. Horst Endter, Product Manager, ME-Automation Projects GmbH, a sister company of Mitsubishi Electric, describes the development project.

Following an undertaking by a large German city to reduce overall energy consumption by 20% by the year 2020 (relative to 1990) and increase the proportion of renewable energies in the same period by 20% of energy consumed (primary energy), a recently commissioned combined heat and power station represents a milestone in the achievement of this climate protection goal.

After a three-and-a-half-year planning and approval phase, the diggers moved in at the end of April 2012, and September of the same year saw the celebration of the laying of the station's foundation stones. After a successful boiler pressure test by TUV, the boiler was given the stamp of approval at the beginning of March 2013, and after a building time of just 18 months, the station officially began operation in December 2013.

The power station, erected on a 2.3 hectare site, works in combined power and heat mode. It cost 55 million Euro to build.

The fully enclosed fuel storage hall, with a surface area of 1,944 m² and a height of 13.5m, provides a storage volume of 6500m³ and holds 1300 tonnes of fuel, enough for around 3.5 days or 84 hours. The external fuel preparation site is just 300m away. The boiler house stands on a base plate of 900m³ concrete, has a surface area of 866m² and a height of between 18.8m (low part) and 28.6m (high part). The boiler house contains 200 tonnes of steel, and the 280 tonne boiler support structure holds the 730 tonne boiler. Immediately next to the boiler house is the complex flue gas cleaning plant with a 46m high stack.

Every year, the station will produce around 55 million kWh of electricity and around 154 million kWh of district heat from the 90,000 tonnes of biomass. This corresponds to around 4% of the city's current power and heat requirements, and could theoretically supply 12,000 homes. This makes the combined station the largest single project to date in the achievement of this large city's energy and climate protection goals.

The new station achieves one-fifth of the city's climate protection goal of raising the proportion of renewable energies to 20% by the year 2020. Combustion of biomass as a renewable resource leads to a CO₂ saving of around 94.7 million kg per year.

Biomass fuel supply

The majority of the waste wood comes from bulky refuse collections. The comminuted material, free from coarse impurities, is transported by truck to the station's fuel storage hall, where it is deposited in storage containers. The fuel is then conveyed by wheeled loaders to push-feed floor units, from where it is automatically transported to metering and storage containers in the boiler house for supply to the furnace.

Combustion

Via an automatic feed, the fuel reaches the technical heart of the station - the furnace chamber - where it is burned at temperatures of 950-1100°C on a multizone, air-cooled feeder grate with automatic intake. The combustion heat output is around 46 MW. At this point, the nitrous oxides are already largely removed from the flue gases, primarily via flue gas recirculation and secondarily by urea addition. The hot flue gases now flow through the boiler passes to generate steam, and are then freed from further contaminants in a complex flue gas cleaning plant. Emissions from the station comply with the strict limits of the 17th Federal Emissions Protection Law (BImSchV).

Electricity generation

The hot steam generated by combustion of the biomass is extracted from the boiler and supplied to the turbines. The mechanical rotary motion produced in the turbine is converted by an alternator into electrical power, which is then transformed up to medium voltage (20 kV) in an in-house transformer. A 2km cable feeds the resulting CO₂-neutral power from renewable energy into the power network.

When the power station is not producing electricity, it is supplied with power via the infeed cable. An uninterruptible power supply (UPS) and substitute generator ensure that, even on failure of the public power network, the station can be transferred into a safe operating state.

District heat generation

After the high pressure steam has been reduced to a lower pressure in the turbine, it is supplied to the heating condenser, which brings the heating water for district heating to temperature. An underground, heat-insulated pipe system feeds this heating water into the district heating connection network.

The heat is delivered to the consumer via a heat exchanger in the form of a transfer station. The operating temperatures for output are 70-100°C at an operating pressure of 10-15bar.

PMSXpro process control system

The combined heat and power station is monitored via the PMSXpro process control system from ME-Automation Projects, based in Fuldabrück, who completed the project in just 10 months. Guaranteed high reliability is essential, and this is ensured by the PMSXpro process control system, using fully duplicated automation stations and also duplicated process servers for total redundancy.

The duplicated automation stations are Mitsubishi Electric control units from the MELSEC System Q series, which ensure safe automation of process procedures and monitor the fuel store, combustion and boiler, through to the flue gas cleaning. The control system components communicate with each other via an error-tolerant FO network. This control system network is connected via an application server to the office network, so authorised users in the office have access to the PMSXpro process control system via a secure connection. For remote service, two internet access points (DSL and UMTS) with tunnelled VPN connections are available.

The ME-Automation Projects scope of supply includes:

- The network cabinets and distribution racks, their construction and the associated electrical installation of the LV system and entire control system network.
- The control system components, consisting of control and monitoring stations, process servers, archive servers, application server and engineering stations, and all automation stations with a total of over 6000 inputs and outputs. All automation stations are coupled together via a separate FO network and each has a

Profibus Master for connection of further Profibus units.

- Complete programming of the automation stations (including safety control systems) and control system components for all process-technical structures.
- FAT (Factory Acceptance Test) for each structure.
- Cold and warm commissioning and trial operation.
- Documentation to VGB R 170 C.
- The PMSXpro process control system, certified to VGB R 170 A, B and C, from ME-Automation Projects ensures 99.9% utilisation in the Wiesbaden combined heat and power station, which equates to 364 days and 15 hours per year.

Notes:

See how Mitsubishi Electric is able to respond to today's automation demands:

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Image captions:



Picture 1: The new station achieves one-fifth of the city's climate protection goal of raising the proportion of renewable energies to 20% by the year 2020.

[Source: ESWE BioEnergie GmbH]



Picture 2: Every year, the giant heating boiler burns around 90,000 tonnes of biomass in the form of old and used wood at temperatures of up to 1100°C.

[Source: Thinkstock]



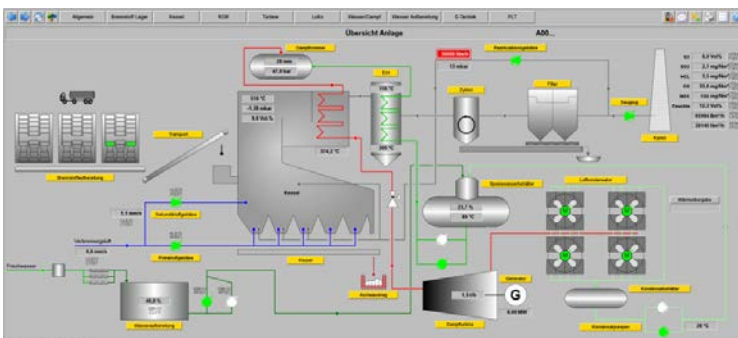
Picture 3: The combined heat and power station is monitored via the PMSXpro process control system from ME-Automation Projects.

[Source: ESWE BioEnergie GmbH, Mitsubishi Electric Europe B.V., ME-Automation Projects]



Picture 4: All information for operating and monitoring the entire process is collected in the central control room.

[Source: ESWE BioEnergie GmbH]



Picture 5: The overview diagram of the plant shows diagrammatically all key data and states in real-time.

[Source: ME-Automation Projects GmbH]

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Note to Editor: if you would like the text in another language please contact Philip Howe at DMA Europa – philip@dmaeuropa.com.

About ME-Automation Projects GmbH

ME-Automation Projects GmbH is a sister company of Mitsubishi Electric and a member of the Mitsubishi Electric Group. It supplies complete, turnkey process automation systems consisting of complete field instrumentation, switchgear, remote process control with the PMSXpro process control system, and corresponding services such as project management, engineering, installation, commissioning, service and maintenance.

For further information see:

www.me-ap.de

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With over 90 years of experience in providing reliable, high-quality products to both corporate clients and general consumers all over the world, Mitsubishi Electric Corporation is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, as well as in products for the energy sector, water and waste water, transportation and building equipment.

With around 129.000 employees the company recorded consolidated group sales of 36,0 billion US Dollar* in the fiscal year ended March 31, 2015.

Our sales offices, research & development centres and manufacturing plants are located in over 30 countries.

Mitsubishi Electric Europe B.V., Factory Automation European Business Group (FA-EBG) has its European headquarters in Ratingen near Dusseldorf, Germany. It is a part of Mitsubishi Electric Europe B.V., a wholly owned subsidiary of Mitsubishi Electric Corporation, Japan.

The role of FA-EBG is to manage sales, service and support across its network of local branches and distributors throughout the EMEA region.

**Exchange rate 120 Yen = 1 US Dollar, Stand 31.3.2015 (Source: Tokyo Foreign Exchange Market)*

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