ENERGIE

The world´s largest biofuel CHP plant Alholmens Kraft, Pietarsaari

Project background

Pietarsaari, founded in 1652, is located on the Swedish-speaking west coast of Finland. The total area is 93 km^2 and there are 19 600 inhabitant living in Pietarsaari. 56% of the working population are employed by service sector, 1% by forestry and agriculture and 40% by the industry, the biggest employer being the pulp and paper mill of UPM-Kymmene.

During the last years the utilisation of biofuels on large scale has been focused on forest industry sites where large amounts of biomass is available.

When the planning of Alholmens Kraft new power plant (AK2) was started, the most important objectives were:

- electricity production with competitive price
- exploitation of process steam in the paper mill and in town's district heating
- exploitation of pulp and paper mill and saw mill by-products as fuel
- optimisation of the plant size and process parameters
- sufficient fuel resources within economical transportation distance

The main innovation

Alholmens Kraft Ltd builds the worlds largest biofuelled power plant and the CFB boiler one of the biggest. The plant is an industrial CHP plant producing steam for forest industry and as a utility producing district heat for the municipality. The wood fuel procurement system is also innovative and based on bailing the forest residues. Alholmens Kraft Ltd aims to use annually 300 000 bales of forest residues.

Project description

Alholmens Kraft power plant introduces the "best-practise" biomass/fossil fuel cofired power plant concept with extremely diverse fuel selection – suitable to be replication almost anywhere in Europe.

The main objective of the work is the demonstration of new multifuel power plant concept. The aim is to demonstrate novel technology for solid multifuel and low emission cogeneration in new commercial size. The plant shall be pro-environmental and cost-effective. The concept allows utilisation of fossil fuel with cofiring biomass and waste.

The planning of the construction project was started in 1996. At the beginning of 1997 Alholmens Kraft Ltd was founded. When the investment decision was made in February 1999, the construction work was started immediately. The commercial operation is scheduled to start in October 2001.

Plant description

Alholmens Kraft power plant is being built in the vicinity of UPM Kymmene pulp and paper mill. This enables the power plant to utilise wood based fuels provided by the pulp and paper mill and also to produce process steam for the mill.

The power plant is combined condensing and CHP plant. The CFB boiler is manufactured by Kvaerner Pulping.

The dimensioning of the turbine plant allows pure condensing mode. In that case the process steam and district heat are produced by the existing power plant.

Technical details

Power	240 MW_e
Capacity to produce process steam	100 MW_{th}
District heating capacity	60 MW_{th}

Boiler is about twice as big as the solid biofuelled boilers in average.

The boiler was chosen to be a CFB boiler. It is possible to burn mixtures of the design fuels or single design fuel. Optimal fuel for this boiler design is biomass. The furnace cross-section is 8.5 x 24 m and height 40 m. Kvaerner Pulping Finland was in charge of the design and manufacturing of the boiler. Highlights of the boiler:

High efficiency and availability

- Stable steam generation with variable load (paper mill and district heating)
- Efficient and reliable homogenisation of fuel mixture
- Minimum slagging, fouling and corrosion risk with optimal fuel mixtures and material selection

Low emissions

- NO_x emission minimisation with air staging and ammonia injection

Boiler capacity	550 MW_{th}
Steam production	194 kg/s
Steam pressure	165 bar
Steam temperature after the superheaters and reheater	545 °C
Boiler efficiency	92%

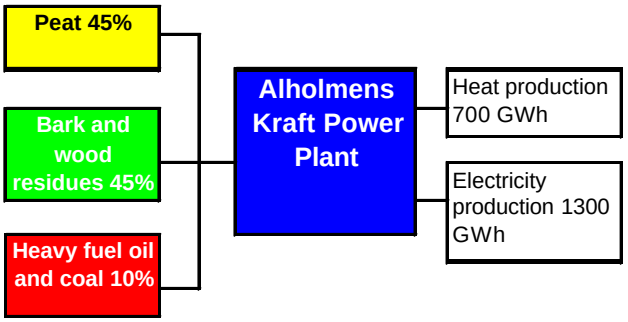
The full load is achieved with peat and wood residue mixture and/or coal combustion. It is also possible to reach the full load when relatively dry wood fuel is used. There are altogether 11 fuel feeding points in the boiler. The requirement set on fuel feeding system is very high since it has to supply almost 1000 m^3 of fuel in hour.

The power plant's turbogenerator is a three casing, reheated, condensing turbine with extractions to district heat and process steam. Hydrogen cooled generator has output rate 306 MVA.

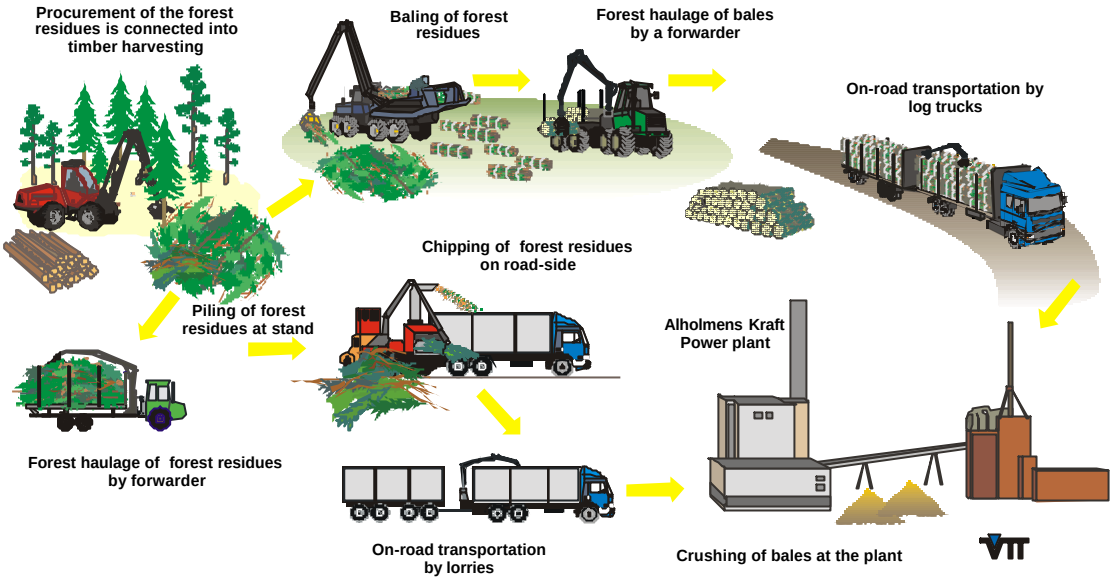
Turbine	
Live steam	194 kg/s, 162 bar, 545°C
Reheat	177 kg/s, 37 bar, 545°C

There are about 50 persons working in the plant operation and maintenance. In addition to that the plant gives work to more than 400 persons working in fuel production and transportation.

Annual fuel consumption		3500 GWh/a
Fuel	Source	Share
Wood based fuels	Pulp and paper mill	30-35%
Sawing and forest residues	Sawmills within short distance, forestry sector	5-15%
Peat	Production sites close to the plant	45-55%
Coal or oil	Imported fuel, mostly for start-up or support fuel	10%



Annual fuel utilisation and energy production



Forest fuel supply chain from forest to the plant. VTT Energy.

Fuel

One of the starting points of the power plant design was the maximum exploitation of bark and other wood based fuels, peat resources from neighbouring areas and existing commercial port and the possibility to import coal. The share of a particular fuel may vary seasonally.

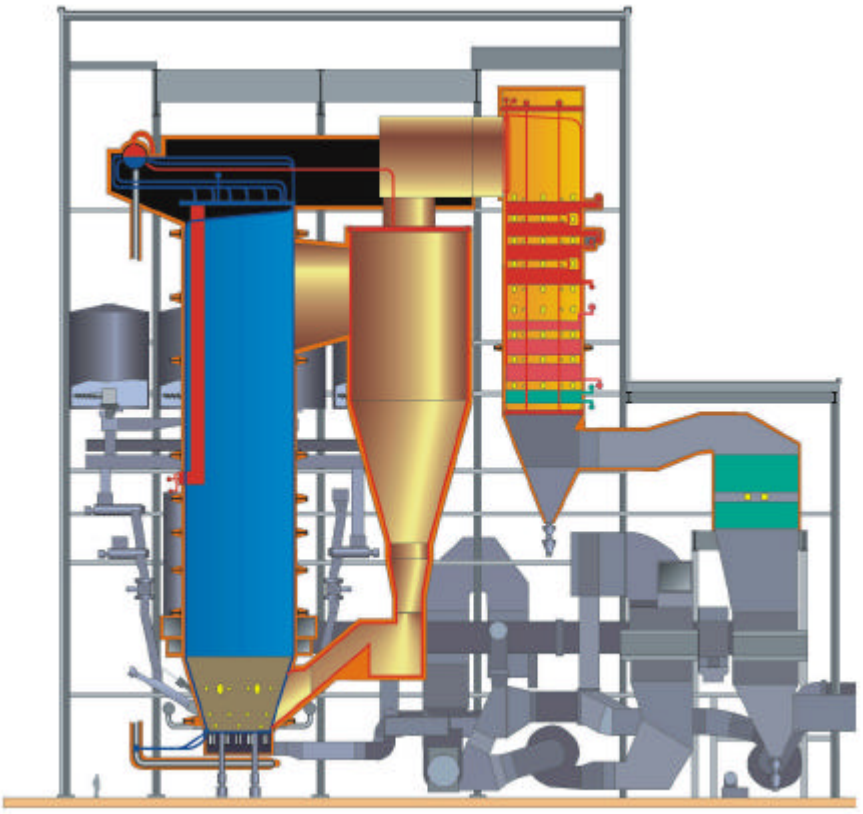
The plant is aimed to use 150 000–200 000 solid-m^3 of logging residue annually. The logging residue is hauled to the plant as loose material or as bales. The plant owner participates in a project, which aims to develop a new logging residue harvesting method, where the logging residues are baled in the stand. The main idea is to use traditional timber harvesting equipment. Four forest contractors has acquired already baling machine and are in the commercial use. It produces some 20 bales per hour. The volume of one bale is about 0.5 solid m^3 (450–500 kg, 3.3 m long). An ordinary timber truck is used and it can take 60 to 70 bales at one load. Totally there is will be 5–6 baling chains in action. The plant has already stored 80 000 bales at the plant and in the forests. The bales or loose logging residues are crushed at the plant.

Production costs of the baling method are estimated by Metsäteho to be about 45–55 FIM/MWh (7.2–9.2€/MWh), when the maximum transportation distance is 80 km and forest haulage distance 300 m. An annual working period is 10 months and working is carried out in two shifts.

A bundler collecting and compressing the forest residues. Timberjack.

Pulp, sawlogs and forest residue bales.

Loading of bales into the log truck.



CFB boiler of the plant manufacturer by Kvaerner Pulping.

Economical data

The total investment cost was about 1 billion FIM (170 million €). The investment's degree of domestic origin is about 70%. The project was supported by the EU´s THERMIE programme.

Environmental impact

By firing biomass the CO_2 emissions can be reduced. The concept applies improved efficiency of SO_2 and NO_x removal technologies.

In addition to electricity the plant produces process steam to the UPM-Kymmene Oyj Wisaforest site and district heat to the City of Pietarsaari. The project shall end up with a fully developed and demonstrated multifuel fired power plant with high efficiency, low emissions and environmental load.

Fossil fuels, coal and heavy fuel oil, are only used for start-up and support purposes.

When high sulphur fuels, peat or coal, are used in the plant, lime stone is used to absorb sulphur so that the SO_2 emission does not exceed the limit of 100 mg/MJ. When the share of wood based fuels is higher, the mass flow of lime stone is smaller since the alkalis in ash react with fuel sulphur resulting lower sulphur dioxide emission. Fly ash and the gypsum from sulphur retention reaction are aimed to be utilised in recycling.

Nitrogen oxide emission is controlled by using low-NO_x technologies. If the emission reaches the limit of 50 mg/MJ ammonia spraying is started in cyclones.

Emission discharge limits	
SO_2	100 mg/MJ
NO_x	50 mg/MJ
Particle discharges	30 mg/m^3_n

Owner

Alholmens Kraft Ltd is owned by the Swedish power companies Graninge and Skellefteå Kraft and Finnish power companies Pohjolan Voima (PVO), Kattenö, Oulun Seudun Sähkö and Revon Sähkö. UPM-Kymmene, Katternö, Kokkola city, Päijät-Hämeen Voima own the Pohjolan Voima shares.

Users

Process steam is used to the UPM Kymmene Wisaforest pulp and paper mill and heat is supplied to district heating company of the city of Pietarsaari. Electricity is produced to owners.

Builder and constructor

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Main manufacturers and service suppliers for Alholmens Kraft

Boiler, peripheral equipment of the boiler and the boiler house
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http://www.timberjack.com

Turbine
LMZ (Russia)

Generator
VA Tech (Austria)
http://www.vatech.co.at/

Links to the pages of Alholmens Kraft owners:
http://www.graninge.se/
http://www.graninge.fi/
http://www.oulunseudunsahko.fi/
http://www.skekraft.se/
http://www.upm-kymmene.com/
http://www.pohjolanvoima.fi/
http://www.kokkola.fi/

Links to the www-pages of equipment suppliers
http://www.kvaerner.com/
http://www.kopar.fi/
http://www.siemens.fi/
http://www.sulzer.com/
http://www.roxon.fi/
http://www.yit.fi/
http://www.interasfaltti.fi/
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http://www.vatech.co.at/
http://abb.com/fi
http://www.timberjack.com

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