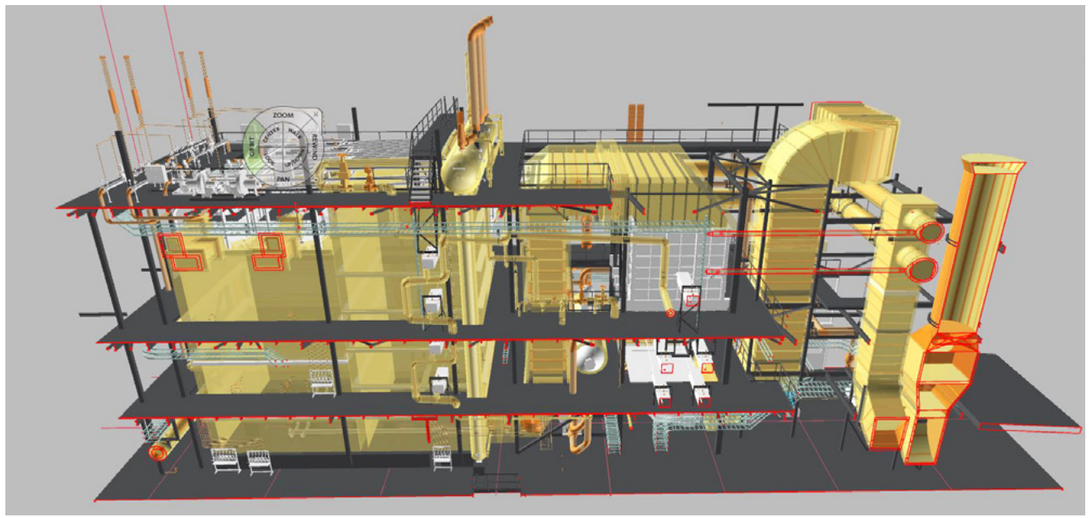
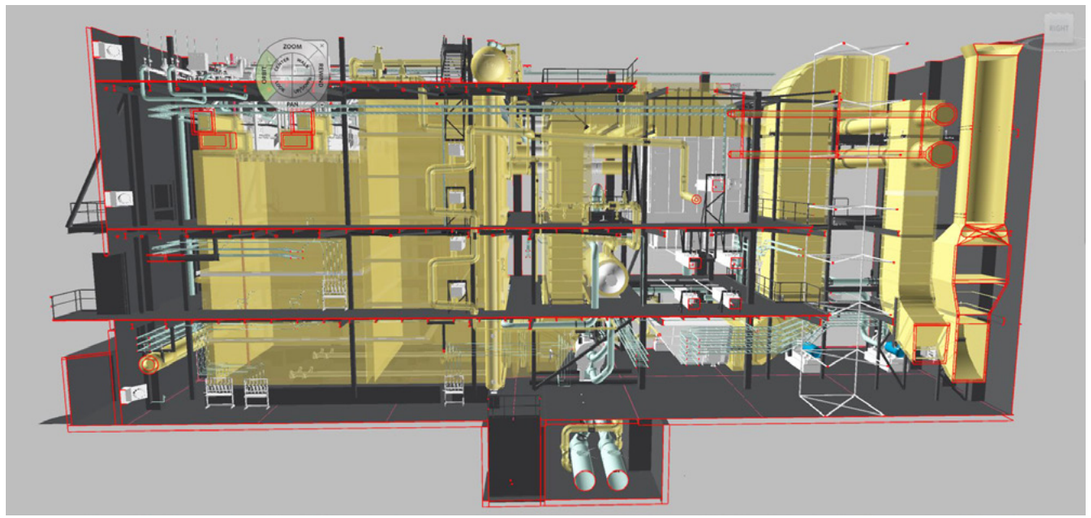


The new boiler is designed for a fuel power of 130 MW and in accordance with the warranty the degree of efficiency will be 95.6 per cent. Illustration: Valmet



With the burners at the top of the boiler, the flames are directed downwards. The flue gases exit at the bottom of the boiler and then pass upwards and downwards in a vacuum exhaust in which economiser 1 is located. Illustration: Valmet

Full reinvestment in RYA DISTRICT HEAT FACILITY

Göteborg Energi will be replacing two boilers at Rya HVC with a new one. It will increase production capacity slightly and improve environmental performance. The new boiler will be built for 130 MW of added fuel power and, just like the existing one, will be used for the production of district heating.

ARTICLE WITTEN BY KJELL-ARNE LARSSON AT NORDISKA PROJEKT, SWEDEN

There are currently two boilers at the Rya hot water facility. They were built in the mid-1980s as oil-fired boilers. Around the year 2000, they were converted for wood pulp incineration.

"The boilers have reached the end of their technical life. There were also new environmental requirements issued in August 2019 that are difficult to meet. With this investment, we are ensuring good environmental data and high availability for Rya HVC," says Michael Winterkvist, head project manager for the project at Göteborg Energi.

The plan was to keep the building for the boilers and that's what we'll do. A feasibility study showed that it would be difficult to accommodate two boilers, so we invested in one, only bigger.

Over the last six months, there has been a significant amount of preparatory work carried out to decommission the equipment. This has involved work that includes separating the equipment from other plant, including surrounding control and electrical systems. New shell valves have been installed on the district heating pipes and a new stairwell with a lift has been built. Pipes and cabling have been relaid to render demolition of the existing equipment possible as the other plant in the area must be operational during the rebuild. This preparatory work has been procured separately and is not included in the main delivery, but rather executed as a smaller subproject.

Increased capacity

The environmental permits allows the hot water facility to be run at up to 130 MW (as added fuel power) and produce 500 GWh per year. Whereas, the old boilers managed 110 MW, the new boiler is now designed for 130 MW.

"We also prioritised a high level of efficiency and now have a guarantee of 95.6 per cent," Michael Winterkvist explains.

Just like today, the fuel for the new boiler will be wood pellets that are ground to powder. The boiler is designed to be able to incinerate pulp from I2 and A2 grade industrial pellets. The equipment for processing pellets at Rya HVC was also refurbished four years ago. The reconditioning included a hopper, lift, pellet silo and pipe conveyor. Valmet won the tender and is subsequently responsible for all equipment after the pipe conveyor. The replacement of the older boilers also includes a complete, new fuel preparation with three new mills, boiler, flue gas purification and ash management. The delivery also includes all necessary construction work, as well as electricity and automation.

Record size

The new boiler is the biggest boiler - at least in Europe - for the incineration of wood pulp fuel. (However, there are larger systems that have been converted from coal to wood pellets). Biogas/natural gas is used as the starter, supporting and reserve fuel. The boiler has four burners located at the top of the furnace. The specification also makes it possible to incinerate using bio-oil.

"Previously, in Helsingfors we built a wood pulp boiler of 92 MW with two burners. With 130 MW of added fuel power, the boiler in Gothenburg will be the largest we deliver," says Kari Arola, planning manager and assistant project leader at Valmet.

With the burners at the top of the boiler, the flames are directed downwards. The flue gases exit at the bottom of the boiler and then pass upwards and downwards in a vacuum exhaust where economiser 1 is located. An SCR step then follows for cleaning NOx (nitrogen oxide) before economiser 2. No ash forms at the bottom of the furnace, but instead follows the flow of the flue gas and is captured in textile hose filters. The ash is transported to a silo with a humidifier at the bottom. The ash can be kept dry or can be dampened. The boiler can be equipped with smooth pipe economisers to prevent the ash from settling.

The district heating power produced from the heat exchanger will run up to 120 MW and the temperature will reach between 105 °C and 120 °C, normally 110 °C.

"We will execute a total delivery of all process equipment, all steel structures and build the foundation. Even the ABB 800 Xa control system is included, along with all required installation work. The project will be executed according to a really tight delivery schedule, where we will start by demolishing the two old boilers," says Kari Arola.

Environmental requirements

In accordance with the new environmental requirements the boiler must be constructed using Best Available Technology. The threshold for emissions to air is stipulated at 140 mg/normal cubic metre for NOx and 5 mg/normal cubic metre for dust. It will be possible to measure the ash from the silo either dry or wet. This will be prioritised later on, as the aim is for the ash to be recycled and returned to the forest. The ash from the existing boilers has been stored, so there will be a new procedure to send it for recycling.

Base load

"Just like the existing ones, the new boiler will be responsible for a base load in winter time," says Michael Winterkvist. During spring and autumn it will be used for peak and reserve loads. It's good that the boiler has a large load area as it provides increased inflexibility in heat production that will make production easier to optimise in the future. Another advantage

”Handling biofuel can involve major risks. It is important to establish what can ignite, in this case it’s primarily dust from the wood fuel. It is also important to look at which parts of the equipment may be potential sources of ignition, for example the hammer mills that are part of the new equipment,”

/ Kristoffer Tannerfeldt, Risk Manager at Firefly.

of firing with wood pulp, especially during spring and autumn, is that the boiler can be started quickly and respond to increases in the heating demand.

Fuel management and powder preparation

Ingenjörsfirman J. Mared AB is a subcontractor to Valmet. Mared is responsible for all equipment, starting in the direction of flow after an existing pellet conveyor and up to the fuel injectors before the boiler.

Using three shaftless screw conveyors, the wood pellets are fed into a smaller silo for pellets. This has a bottom with a complete screw trough with three screw conveyors that feed the pellets to three hammer mills. There are stone traps and magnetic separators before the hammer mills. In full operation, two mills will be used with the third as reserve. This is to maintain a high level of availability when maintenance and repairs are required for any of the mills. There are three CPM Champion hammer mills each with 800 kW of power.

”These are the biggest mills in the world for milling to wood powder,” says Thomas Magnusson, Head of Operations for Ingenjörsfirman J. Mared AB. Each mill has 672 flails and rotates at 1,000 revolutions per minute.

After the mills, the wood powder is sucked through a powder filter (Simatek cyclone filter). The pulp is fed to a buffer stock before it is distributed on four lines via the screw extractor to each fuel injector.

The delivery also includes a Firefly spark extinguishing system, which detects and extinguishes any glowing and hot particles. Firefly gas detectors will also be installed in silos for detecting the development of gas.

”Our delivery to Valmet and Göteborg Energi is the biggest to date. The scope combined with the short construction time is challenging, as are the standards and requirements we have to meet. For example, corrosion protection class C5 Marine applies to surface treatment outdoors.

Amongst other things, Valmet is producing design documents for construction and Mared is designing its equipment within these. Mared’s undertaking includes delivery, assembly, training, start-up, functional responsibility and service.

”All machinery we are delivering is based on well-proven and robust technology for which we have a number of previous references. I also want to emphasise the good collaboration we have, both with our customer Valmet and with the principal Göteborg Energi,” says Thomas Magnusson from Ingenjörsfirman J. Mared AB.

Several spark extinguishing systems

The pellet processing equipment for the existing hot water facility was refurbished four years ago. The refurbishment included, as mentioned, a hopper, lift, pellet silo and pipe conveyor. Göteborg Energi then had a spark extinguishing system from Firefly installed. The company will now also deliver a system for the new upgraded fuel preparation facility. The company’s spark extinguishing system will be installed after each hammer mill and before the cyclone filters. The system consists of IR-based detectors and water nozzles that are controlled by a control unit. The detectors detect sparks and hot particles that can cause ignition in the process. They are installed to detect particles at a temperature and energy that is less than the ignition temperature (MIT), as well as the ignition energy (MIE) of the relevant material, in this case wood dust.

–”Handling biofuel can involve major risks. It is important to establish what can ignite, in this case it’s primarily dust from the wood fuel. It is also important to look at which parts of the equipment may be potential sources of ignition, for example the hammer mills that are part of the new equipment,” says Kristoffer Tannerfeldt, Risk Manager at Firefly.

When a spark or hot particle is detected, the system’s extinguishing function is activated within a couple of milliseconds. A short spray of water under high pressure from a number of water nozzles extinguishes it. This does not affect operation of the fuel facility or the boiler. In the event of an incident resulting closely repeated detections, a high risk level alarm is triggered to the plant’s control system and the process is stopped.

”The location of the spark extinguishing system is important,” says Kristoffer Tannerfeldt. When designing a spark extinguishing system, we start with flow data and also use other information about the process and the structure and dimensions of the plant.

”The use of biofuel is increasing among energy companies in today’s society and other sectors are also handling more and more wood and wood material. This creates dust that involves a risk of fire and explosion. Many players such as Göteborg Energi are focusing on reducing risks and, in addition, all facility owners are responsible for mapping and minimising risks, including in accordance with the ATEX classification. Under ATEX, action must be taken in three stages. The first stage is to minimise the risk of the occurrence of a dusty/explosive environment. The second stage is to minimise the risk of ignition and the presence of sources of ignition. The third stage is to manage the effects in the event of any dust explosion. A Firefly system makes it possible to effectively manage sources of ignition and reduce the risk of ignition,” concludes Kristoffer Tannerfeldt, Risk Manager at Firefly. ■

FACTS
Ryaverket HVC
Reinvesting in Gothenburg’s hot water facility
Schedule: April - December 2021
Developer: Göteborg Energi AB
Preparatory work: in-house
Supplier of complete hot water boiler including control system and erection: Valmet
Value: approx. SEK 500 million

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