

Calambio Engineering AB

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Waste to Energy References

1 LIDKÖPING ENERGI AB, LIDKÖPING SWEDEN

This project involves removal of 1980s 2x15 MWth municipal waste fired hot water boilers and replacing them with one new 20 MWth CHP boiler. The project also includes a new 10 MW el turbine to service both the new boiler no 7 and an existing boiler no 6. The project was initiated 2019 and field erection started early 2020 and will be finalised autumn 2021. Steam turbine will be commissioned early 2022 and a new scrubber tower for boiler 5 and 6 will be retrofitted summer 2022.

The complete project is performed within an existing building with all other parts of the plant in full commercial operation.

The combustion system is based on a bubbling fluidized bed. The plant is equipped with SNCR and a dry bag filter. There is also a two-stage scrubber tower for near zero emissions of NH₃, HCl, SO₂ and heavy metals to air and ammonia to water. Flue gas condensate is reused as make up water for all 5 boilers. Scrubber and flue gas condensate cleaning is detail designed by Calambio.

Calambio runs the project on EPCM basis, and the scope includes investment analysis, total project management including planning, contract work, procurement, logistics, public authorities contacts, HSE planning, detail engineering (including all process design, 3D layouts, piping, pressure vessels, civil engineering, power, and automation) construction site management and commissioning.

Total budget 350 MSEK (35 M€).



Figure – Scrubber tower installation, Lidköping.

2 CHP TRANSTORP, NYBRO, SWEDEN

A 22 MW_{th}/ 5,6 MW_{el} combined heat and power plant for Nybro Energi AB. Built 2015-2016. Nybro Energi AB is a municipal company handling electricity and district heating in the community of Nybro in Sweden.

The plant is a green field installation and includes all installations on the site. Up to 70.000 tonnes of municipal and industrial waste is handled every year. All fuel handling is performed indoor. An odour control system is included. A key feature is very high flexibility regarding waste composition and load range. Iron and aluminium are separated online.

The combustion system is based on a bubbling fluidized bed. The plant is equipped with a dry cleaning of Sulphur and chlorides. An SNCR system is also included.

The plant produces district heating and industrial hot water (that cannibalises on production of electricity)

Cooling system allows for full capacity the year round.

The Calambio EPCM scope includes investment analysis, total project management including planning, contract work (436 contracts), procurement, logistics, public authorities contacts, HSE planning, detail engineering (including all process design, 3D layouts, piping, 6 km district heating network, pressure vessels, civil engineering, power, and automation) construction site management and commissioning.

Total budget 480 MSEK (50 M€).

More information on this plant on video at www.calambio.se



W2E CHP Transtorp, Nybro, Sweden. 22 MW_{th}, 5,6 MW_{el}.

3 CHP STEGEHOLM, VÄSTERVIK, SWEDEN

This plant includes a 22 MW_{th} boiler and a 5,0 MW_{el} steam turbine for Västervik Miljö & Energi AB in Sweden. VMEAB is a municipal company handling electricity, district heating and waste in the community of Västervik in Sweden. The plant is installed between an older plant and the Baltic Sea in an extremely tight location. A fuel preparation plant is included at a different location and can handle Up to 200.000 tonnes of municipal and industrial waste every year (also feeding other boilers). The plant was built 2013-2014 (planning 2010-2012).

The combustion system is based on a bubbling fluidized bed. The plant is equipped with a dry cleaning of Sulphur and chlorides but also including a flue gas scrubber. The boiler is equipped with SNCR.

The fuel receiving station is located very close to private residences. Extensive work was placed in systems for odour control and also logistics.

The Calambio EPCM scope includes several feasibility studies, investment analysis, total project management including planning, contract work (about 500 contracts), procurement, logistics, public authorities contacts, HSE planning, detail engineering (including all process design, 3D layouts, piping, pressure vessels, civil engineering, power, and automation) construction site management and commissioning.

Total budget 500 MSEK (55 M€).



W2E CHP Stegeholm, Västervik, Sweden. 20 MW_{th}, 5,0 MW_{el}.

4 **BIO-EL, FREDRIKSTAD AS, NORWAY**

20 MW_{th} , 6 MW_{el} combined heat and power plant for Hafslund Energimiljø AS. Hafslund is a Power company in Norway.

The combustion system is based on a circulating fluidized bed boiler for municipal waste. The plant includes cogeneration of district heating and process steam for several local industries. The turbo generator is also set up for operation with a vacuum condenser. Cooling media is the accept from the nearby municipal sewage treatment plant.

Total project management including planning, contract work, procurement, logistics, public authorities contacts, HSE planning, layouts, detail engineering, construction site management and commissioning.

Total budget 400 MNOK (45 M€).

The project was executed in 2007-2008 in collaboration with BG Innovasjon AS.



Bio-El Fredrikstad. CHP 20 MW_{th} 6 MW_{el}. Also, possible to operate with vacuum condenser.

5 INDUSTRIAL POWER PLANT, PERSTORP AB, SWEDEN

Calambio has been contracted for three different Waste to Energy projects has been performed for Perstorp AB in Sweden. Perstorp AB world leading in manufacturing and marketing of polyalcohols (the base ingredient in paint) and formaldehyde.

5.1 Incinerator for liquid waste

In 2001 a small incinerator with a capacity of 3 MW_{th} was docked to an existing coal/ oil fired boiler for combustion of liquid waste in accordance with EN 2000/76.

The Calambio EPCM scope included project management and detail engineering of the complete installation. The plant was made redundant about 2012 when the boiler from 1963 was made redundant.

5.2 Waste firing of existing boiler

In 2004-2006 an existing 55 MW_{th} fluidized bed combustor was rebuilt from peat/ biomass/ coal combustion to firing of assorted waste fuels according to EN 2000/76. This includes 40.000 tonnes of by-products from the meat industry, demolition waste, some liquid waste and various waste sludges.

The flue gas cleaning was complemented with a scrubber and an ammonia stripper for a waste industrial air flow. Also, a condensate cleaning plant was added.

The scope also included completely new technology for odour free and sanitary safe handling of animal by-products (all categories including mad cow disease contaminated), process control etc.

The Calambio EPCM scope included project management, environmental permits, and complete detail engineering. The detail engineering included complete recalculation of the boiler, extensive rebuild of the furnace heat balance and also changes to superheaters and economizer sections.

5.3 Hazardous waste incinerator

2004 – 2007 a new 40 MW_{th} boiler for steam production was built. The boiler is on the one hand an oil-based backup boiler but is also equipped with a 15 MW_{th} incinerator for hazardous waste. Hazardous waste from all of Perstorp European plants are burned in this combustor. The plant is completed with a combined WESP (wet electrostatic precipitator) and scrubber and thus yields very low emission. SO₂ emissions when burning heavy fuel oil is 2-3 ppm. A complete Atex classified Tank Park and rail/ truck unloading was also included.

The Calambio EPCM scope included project management and complete detail engineering. The detail engineering includes detail design of furnace, scrubber, hazardous waste handling system, civil works, piping, layouts, control system, environmental permits etc.



Perstorp, Sweden. Hazardous waste incinerator with WESP and animal by-products silo in the foreground. 55 MW CFBC in the background.

6 NORSKE SKOG, FOLLUM, NORWAY

In 2008 the Norwegian pulp and paper company Norske Skog, Vardar AS (a green energy investor) and power company Ringerikskraft AS investigated the possibility to integrate a 45 MW CFBC waste incinerator at the Follum paper mill.

Our scope included project management for a feasibility study, pre-engineering, and environmental permits in cooperation with BG innovasjon AS.

Due to Norske Skog closing the Follum plant altogether the plant was never realized.



Rendered picture of the proposed Follum waste to energy plant.

7 OTHER WASTE RELATED PROJECTS

Other projects include for example.

- Feasibility and pre-engineering studies for rebuilding an existing 15 MW grate fired boiler for assorted wastes, primary impregnated wood, contaminated water and sludge. Building start scheduled for 2023. (2020-ongoing)
- Feasibility studies for retrofit of 2 x 15 MW grate fired boilers from 1972 for municipal waste at Kristinehed for Halmstad Energi & Miljö AB, Halmstad Sweden. Including principal design of completely new flue gas cleaning. (2020-2021)
- Concept design of condensing power plant based on combustion of by-products from process for converting waste plastic/ rubber to synthetic diesel. (2016)
- Feasibility study for municipal waste combustion in Longyearbyen, Svalbard (not recommended). (2014)
- Process design and procurement of main components for 4 x 30 MW_{th} process gas fired steam boilers for the petrochemical industry at Perstorp Oxo, Stenungsund, Sweden. The fuel also involves off gases and some liquid waste streams. (2006-2010)
- Troubleshooting during rebuild of existing BFBC boiler for waste firing. Öresundskraft AB in Ängelholm, Sweden. (2005-2006)
- Trouble shooting and redesign of one of the very first waste fired CFBC combustors in the mid-1980s.
- Basic principal concept studies for plants on Cyprus, in Turkey, India, Benin, Burundi, Côte d'Ivoire, Kongo Kinshasa, Egypt, Indonesia, China and a few more.
- Research and development work at Götaverken Energy AB for the first CFBC boiler for waste in the mid 1980s.

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