CARBONA

April 5, 2004

CARBONA TO DELIVER BIOMASS GASIFICATION PLANT TO DENMARK

Project

Carbona Corporation, through its sister company Carbona Inc., has signed a contract with I/S Skive Fjernvarme for delivery of a Biomass Gasification Plant to Skive, Denmark for a Combined Heat and Power (CHP) plant. The CHP plant will produce 5.5 MW of electricity and 11.5 MW of district heat for the town of Skive.

The CHP plant is based on a new concept for biomass power generation that is a combination of gasification/gas cleanup technology developed by Carbona and its partners and gas engines. Such plants are referred to as Biomass Gasification Gas Engine (BGGE) power plants. The BGGE plant, which will be the first commercial application of Carbona's novel technology, will start construction in late fall and initial operations by the end of 2005.

Project Rationale

The incentive for building a BGGE plant in Skive is to increase heat and electricity production from renewable resources in Denmark. The CHP plant, besides providing 70% of the annual district heating production of I/S Skive Fjernvarme, will produce 40 GWh "green electricity" per year using biomass which is a CO_2 neutral renewable fuel.

The BGGE concept was selected by Skive, because in small scale decentralized CHP power generation, the electrical efficiency must be maximized to make the plant economically feasible. The Carbona technology enables the BGGE plant to produces about 50 % more electricity than a conventional steam process from the same amount of biomass.

The project is financed on commercial basis. However, since the plant will be a first of a kind, subsidies are being provided by the U.S. Department of Energy, the European Union and the Danish Energy Agency. DOE has provided continued financial support to Carbona for the project under its Small Modular Biopower program through the National Renewable Energy Laboratory.

This project is also a unique model of international cooperation between public and private sectors to fulfill the environmental demands of the Kyoto Protocol. Successful completion of this project will provide an attractive option to achieve carbon emission reductions targets and also enable Carbona to offer competitively the BGGE technology to the world wide "green electricity" power market. Such CHP plants being small and modular meet the requirements of distributed power generation, renewable portfolio standards and the Clean Forest initiative in USA.

BGGE Power Plant

The BGGE plant consists of two modules - the gasification plant and the power plant**.** A simplified process flow sheet is attached.

The main systems of the gasification plant are fuel feeding, gasification and gas cleanup. The fuel feeding prepares and introduces the fuel - wood pellets - into the gasifier. The gasifier is a fluidized bed reactor that operates at a temperature of about 850^{o}C and converts the wood pellets into a fuel gas containing carbon monoxide (CO), hydrogen (H_2) and methane (CH_4) as main combustible components. In the gas clean-up section, harmful impurities are removed

from the fuel gas so that it can be used safely in the gas engines. The first step in the gas cleanup is a novel catalytic cracker that destroys tar compounds generated during the gasification process. Next the fuel gas is cooled and passed through bag filters to remove dust and then scrubbed with water to remove remaining impurities.

In the power plant module, the clean fuel gas is combusted in specially modified gas engines to generate electric power. Heat recovered from the engine exhaust and elsewhere in the plant is used to produce district heat. The fuel gas can also be combusted in separate gas boilers which gives the plant greater operating flexibility. BGGE plant besides having higher efficiency also has much lower emissions compared to conventional biomass based power plants.

The nominal capacity of the BGGE plant is 5.5 MWe electric power and 11.5 MWth of district heat from about 100 tons per day of wood pellets. However, the plant has a wide range of output both in total capacity and in the mix of power and heat production to meet the seasonal requirements of Skive.

Project Participants

I/S Skive Fjernvarme is the owner of the CHP plant and also acts as the main contractor on the project having the responsibility to integrate the work of all subcontractors. I/S Skive Fjernvarme is a non-profit energy company owned by Skive commune, supplying more than 2600 consumers in the Skive area with district heat and electricity. The annual production of heat and electricity is 114 GWh and 58 GWh respectively.

Carbona has the responsibility to provide the complete Gasification Plant and assistance for the start up and initial operation of the CHP plant. Carbona is a technology based company with extensive know-how in gasification and related systems for production of electric power and heat from biomass and other solid fuels. Carbona offers a variety of options for use of its technology depending on plant size and customer's requirements. Carbona was formed in 1996 to take over the gasification business of Enviropower Inc. which had originally licensed the technology from the Gas Technology Institute of Des Plaines, Illinois.

Other main subcontractors of Skive Fjernvarme are GE Jenbacher GmbH to provide the gas engines, COWI A/S for district heat and power generation and Rambøll Group for the building and plant erection.

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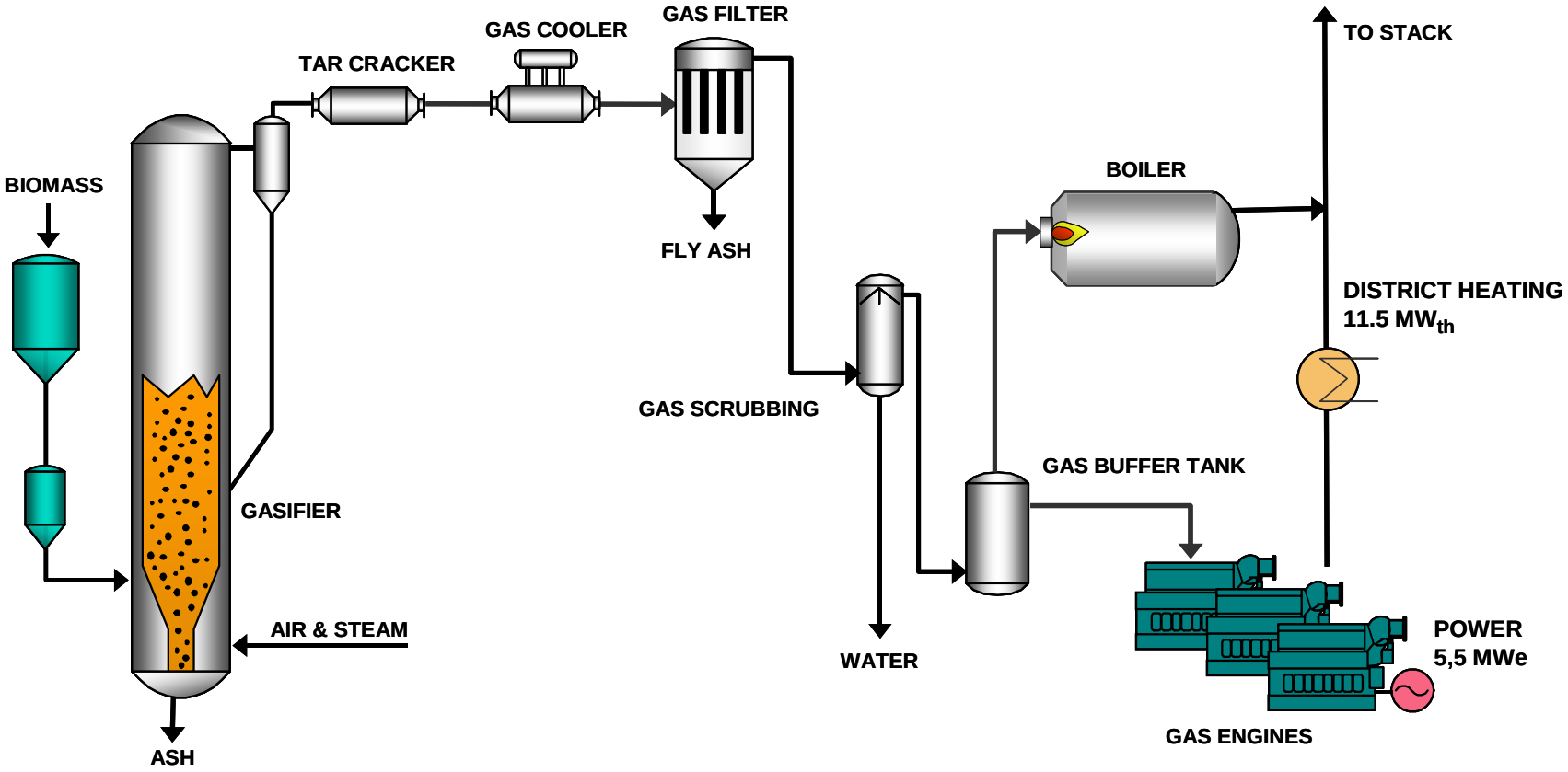

Figure: Simplified flow sheet of the BGGE plant in Skive.