DOUBLY FEED INDUCTION GENERATOR FOR BIOMASS COMBINED HEAT AND POWER SYSTEMS

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Abstract: *Due to concerns regarding environmental problems this paper present the potential of biomass CHP (Combined Heat and Power) systems to improve ancillary services in distributed generation systems. Thermal power SG (synchronous generator), advantages and disadvantages comparison with DFIG (Doubly Feed Induction Generator) are also shortly described.*

Keywords: biomass, combined heat and power, distributed generation, ancillary services, grid codes, DFIG

1. Introduction

A lot of literature in Power Systems study cogeneration biomass power plant grid couplet with SG and them grid his control. That why the aim of this paper is to propose to open a detailed study of DFIG in state of SG for biomass power plant with steam turbine and capacity between 1-5 MW_e . This capacity is suitable with DG from rural area and for sawmills.

International Council on Large Electricity Systems (CIGRE) defines DG unit as a generation unit that is not centrally planned, not centrally dispatched, usually connected to the distribution network and smaller than 50-100 MW [3], [4].

There are a wide variety of potential benefits to distributed energy systems both to the consumer and the electrical supplier that allow for both greater electrical flexibility and energy security [1], [2]. A system with appropriate levels of security and power quality is not necessarily to run in an optimal manner. For example, reactive power injected at terminals of a transmission line can increase the active power transit capacity. Similarly, if some transmission capacities are reserved to allow the supply of ancillary services, less power for energy can be transmitted. Moreover, the provision of ancillary services plays a role in amount of losses and impacts the aging of infrastructures. More generally, the consequences on the various resources of the power system have to be taken into account while using ancillary services in order to use the resources of the system in an optimal manner.[5].

Ancillary services are defined as services provided in addition to real power generation. They include, amongst others, reactive power control, provision of spinning reserve, frequency control, and power quality improvement.[6].

2. BIOMASS COMBINED HEAT AND POWER (CHP) PLANTS

2.1 Biomass cogeneration

Waste wood biomass conversion uses basic two categories of technologies, one is thermochemical that use high temperatures to convert feedstock to energy However, the technologies have potential to produce electricity, heat, bio products, and fuels. The other

technologies are biochemical and use biological agents to convert biomass feedstock to clean energy. In addition, this technology has the potential to produce electricity, heat, bio products, and fuels [7]. Biomass combustion is the main technology route for bioenergy, responsible for over 90 percent of the global contribution to bioenergy. The selection and design of any biomass combustion system is mainly determined by the characteristics of the fuel to be used, local environmental legislation, the costs and performance of the equipment necessary or available as well as the energy and capacity needed (heat, electricity)[9].
For example biomass cogeneration systems used in sawmills are indirect fired and compound from biomass boiler condensing steam turbine with extraction and synchronous generator as shown in Fig. 1.

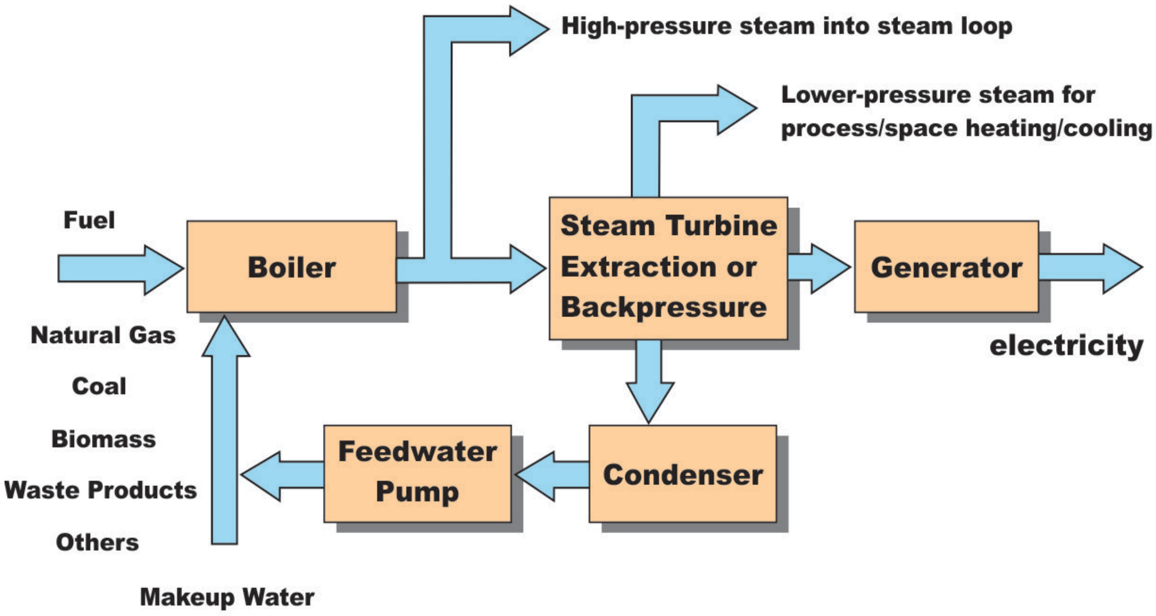
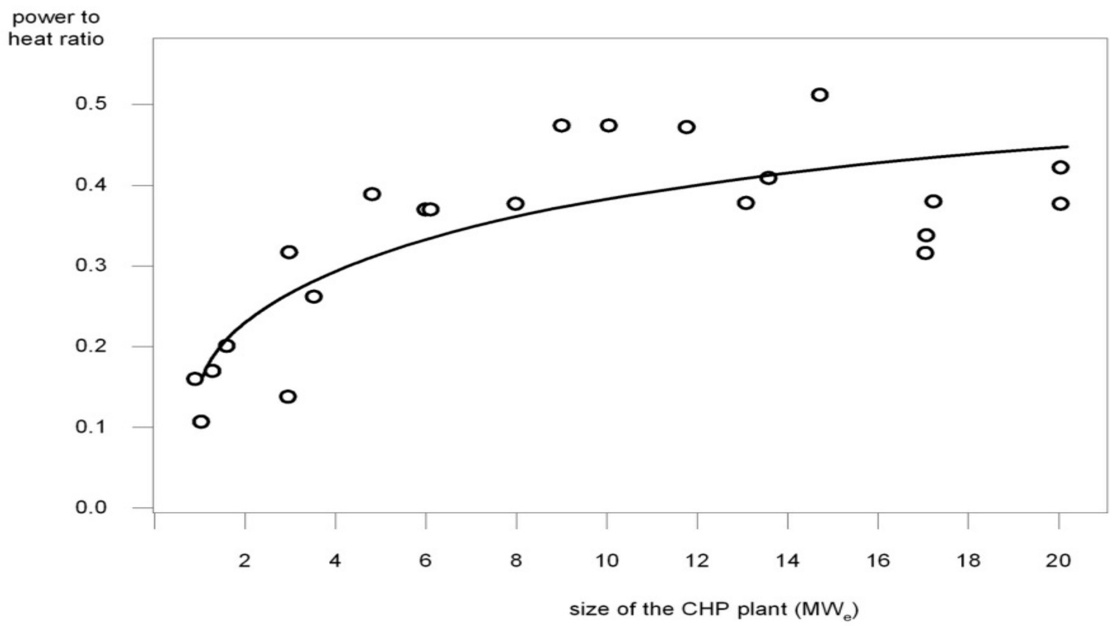


Fig. 1. Combined Heat and Power Diagram – Indirect Fired [8]

Biomass used is a result from wood industrialization has humidity between 50-60% and is burned in grate-fired or circulating boilers. Steam produced is expanding in turbine witch produced mechanical power for synchronous generator, then pass in condenser and boiler thru feed water pump. Low-pressure steam produced is used for drying chambers, space heating or cooling systems.



Sweden with 1–20MW [9].

2.2 Steam turbine

Steam turbines are the most common technology used in power plants and industries. Depending upon the exit pressure of the steam, steam turbines fall into two types: backpressure turbines and condensing turbines. Backpressure turbines operate with an exit pressure at least equal to atmospheric pressure, and are suitable for some sites with a steam demand of intermediate pressure. Condensing turbines have the advantage of changing electrical and thermal power independently and they work with an exit pressure lower than atmospheric pressure [10].

Governing systems for steam turbine is containing three basic functions: normal speed load control, over speed control, and over speed trip. In addition, the turbine controls include a number of other functions such as start-up/shutdown controls an auxiliary pressure control [12]

2.3 Synchronous generator

In grid-tied operation the voltage characteristic is given by the mains grid. The SG has to be synchronized to the grid's voltage with regard to its voltage magnitude, frequency, phase sequence, and phase shift by use of the above-described control capabilities. The rotor is then forced by the stator field to rotate with the network frequency [11]

2.4 Doubly Fed Induction Generator

The stator of a doubly fed induction generator (DFIG) is connected to the grid directly, while the rotor of the generator is connected to the grid by electronic converters through slip rings, as shown in Fig. 3.The generator can deliver energy to the grid at both supersynchronous and subsynchronous speeds. Thing that can help biomass cogeneration power plants to compensate different humidity and low quality fuel[13].

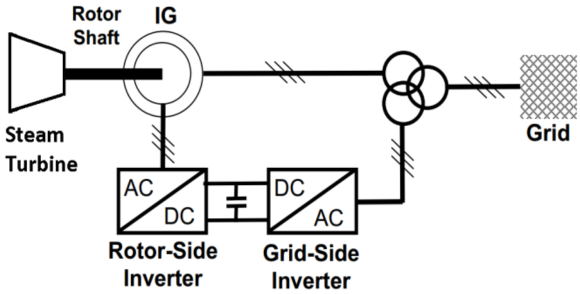


Fig. 3 Exemplary of DFIG grid connection

3. Conclusions

Since Power Electronics develop powerful models of inverters for wind turbines new possibilities and opportunities in research of cogeneration power plant for a large integration in DG has been opened.

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