

Final report

1.1 Project details

Project title	CHP-unit based on ORC-technology for bio-fuels
Project identification (program abbrev. and file)	EUDP 2012-1 File: 64012-0118
Name of the programme which has funded the project	EUDP
Project managing company/institution (name and address)	Faust MicroPower ApS Vester Fjordvej 2, 9280 Storvorde
Project partners	Faust ApS DXT A/S NEK Consult ApS
CVR (central business register)	34615217
Date for submission	Marts 2012

1.2 Short description of project objective and results

This project aims to develop and test a new Danish ORC-unit for generation of combined heat and power (CHP) based on straw.

The project consists of two major parts. First part is the development of a biomass fired boiler system. The next part is the development of a boiler/turbine ORC-cycle with an electrical efficiency about 22%.

The first part of the project is completed with a full running of the boiler system. The boiler can produce the required power at the appropriate temperature level. The emission level is meeting the Danish requirements for biomass plants.

In the second part of the project a ORC-cycle and a turbine has been calculated and designed but not produced.

Danish version

Projektets formål er at udvikle og teste et nyt dansk ORC-anlæg til kombineret generering af el og varme, baseret på halm.

Dette projekt består af to dele. Den første del omhandler udviklingen af et bio-masse fyret kedelsystem. Den anden del består af udviklingen af en kedel/turbineenhed med en virkningsgrad på ca. 22 %.

Den første del af projektet er færdig gjort med en fuldt fungerende kedel. Kedlen kan producere den ønskede effekt på det tilstrækkelige temperatur niveau. Emissionerne er under lever op til de danske krav for biomasse kedler.

I den anden del af projektet er ORC systemet og turbinen beregnet og konstrueret men ikke produceret.

1.3 Executive summary

In order to reduce development cost a relatively small but still saleable unit is developed. The unit is modularised and each module has a size of approximately 100 kW el. It is developed to produce electricity and heat at an attractive price for a customer segment consisting of: small industries, agriculture and minor district heating plants.

The project's main activities are:

1. Development of software for calculation of power cycles with automatic generation of thermodynamic data for the relevant ORC media and heat transfer fluids.
2. Thermal- and fluid design of all heating surfaces / components in the system - based on the calculation routines developed under section 1
3. P&I diagram prepared.
4. Plant design and detailed design of items
5. Manufacturing and procurement of components
6. Transport and erection
7. Control strategy and programming of plant control system
8. Commissioning
9. Trial run
10. Data Collection and Processing
11. Final report

A CHP plant based on ORC technology has the potential to be significantly better than other small power generating units, that are on the market today. This applies to the following operating parameters: electrical efficiency, durability, reliability and fuel flexibility.

With some further development this design has the potential to achieve an electrical efficiency, on the same level as the 10 MW steam plants normally used today without the necessity of a steam temperatures in the range that reduces the lifetime for some plant items to an acceptable level when some fuels are used.

With respect to the business potential there is strong evidence that it can easily be on the same level as the wind industry looks today, when viewed in a worldwide perspective.

For the boiler part we have been through all main project activities and a complete boiler system has been designed, produced and tested. The boiler plant meets all the demanded data for delivering energy to the ORC-cycle.

For the ORC-part we have designed and calculated an ORC-cycle and turbine and we are ready to manufacture all parts. This was planned to be a part of the project under EUDP. But as it was not possible to buy a turbine/generator unit from a subsupplier as expected we had to use our resources to develop it our selves.

We intend to continue the development of the demonstration plant without the EUDP support but of course at a slower speed.

1.4 Project objectives

The main objective for the boiler part was to make power at a sufficient temperature level for the ORC part. This should be done with straw or other biomass fuels. This objective has been reached as the boiler today is producing power over 300°C.

The main objective for the ORC part was to generate at least 22% electrical power. This should be reached with a turbine/generator-unit from a subsupplier. Unfortunately the chosen subsupplier rejected the project shortly after project start. We therefore decided in corporation with EUDP to develop our own turbine/generator unit.

The status for the ORC part is that economiser, heat exchangers and turbine is designed and are ready for manufacture. Nothing in the design phase have indicated that we can't reach the 22% electrical efficiency.

Of course the development of the turbine/generator-unit caused unforeseen time and money but in the long term perspective we expect a great advantage to possess this knowledge in the company.

1.5 Project results and dissemination of results

The project shows that it is possible to produce a small scale biomass boiler unit which can produce power at a sufficient temperature level for the ORC cycle.

Within the time frame and economy for the project it has not been possible to full fill all objectives. Therefore it is not possible to start marketing and sales

1.6 Utilization of project results

The project results are directly used to complete the design of a commercial 100 kW electrical power plant. The developed plant will be brought in the market immediately after successful testing.

1.7 Project conclusion and perspective

The project has shown that it is possible to make a biomass fired boiler plant to planned data. Demonstration of the performance of the designed ORC cycle will be a part of the next phase of the project. All results so far indicate that we are able to meet the main objectives for the project.

