

ORC CHP OFF-GRID APPLICATION

2 x E-RATIONAL ORC 10FT – 1MW_{TH} – 90kWE

Slacks Farm Lochmaben, UK is a cogeneration site in Scotland for heat & power production from wood chips incineration and gasification.

The plant in Lochmaben consists of two 1MW biomass boilers for hot water production, two E-RATIONAL high temperature ORCs, four drying floors (mainly for wood drying) and two 45kWe CHP-units for gasification of wood chips. The electricity produced by the ORC machines is used by the fans of the drying floors. The cooling water of the ORC machines is used to warm the air blown on the drying floors.

Two CHP-units and one of the E-RATIONAL ORC machines are connected to the grid. Due to capacity constraints of the local grid, the plant received a permit to export to the grid that was limited to 180kWe. The second E-RATIONAL ORC needed to have an off-grid solution. By equipping the machine with an electrical grid builder unit, the machine is capable of managing its own micro-grid. The micro-grid produces sufficient electricity to power half of all fans on the drying floor. The ORC's own power consumption (pump and control panel) is, however, powered by the public grid to maintain stability at start-up and shut down, namely the stages of decreased electricity production on the machine.



Hot water at 130°C is produced by the biomass boilers and sent to the ORC machines. The return temperature to the boilers is 115°C. The cooling water circuit of the machine operates at 35°C inlet to 45°C outlet temperature and warms the air blown by the fans on the drying floors. Average net power production of each E-RATIONAL ORC machine at full load is around 75kWe.



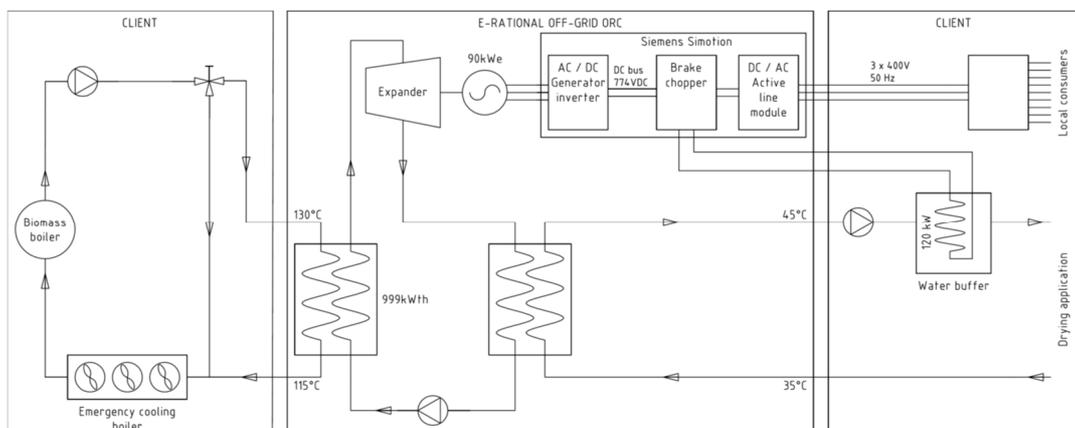
Top Left: Fans for the drying floor – Top Right: Hall with drying bays – Bottom: Top loader for wood chips for incineration

The ORCs are equipped with a G59/3 mains decoupling/protection relay according to requirements from the local power utility company.

The electrical output from the two E-RATIONAL ORC machines powers the fans of the drying floors, while the machine cooling is used to warm the air blown on the drying floors.

Heat to be recovered	Hot water from a biomass boiler
Working temperature hot side	130°C → 115°C
Thermal load at hot side	± 1000kWth
Condenser	35°C → 45°C
Drying capacity	± 925kWth
Cooling	Dry coolers for air heating
Total installed generator capacity	90kWe
Average net power production	75kWe
In operation since	December 2016
Running hours per year	± 8760 hours
Support scheme	UK Renewable Heat Incentives (RHI)

Machine definition Slacks Farm Lochmaben



Principle scheme for the off-grid drying application at Slacks Farm

The ORC asynchronous generator is connected to an AC/DC inverter, generating a DC voltage. The chopper, integrated on the DC circuit, manages excess power on the micro-grid. As the demand of the local consumers is continuously varying and always lower than the electricity produced on the generator, the chopper diverts surplus electricity (around 1% of the total produced power), in this case to submerged heating elements installed in the cooling cycle of the ORC. DC is re-converted to the 3-phase micro-grid AC by the active line module which also manages the micro-grid as the main grid builder. Therefore, no other grid builders can be present on the micro-grid. The local consumers on the micro-grid, fans in this case, can be any 3-phase power demand. Main requirements for the micro-grid are 3-phase power consumers to balance consumption on all phases and isolation of these consumers from the public grid.

E-RATIONAL is delivering a cost-effective solution to convert low temperature waste heat into clean energy without emissions. Our state-of-the-art **Organic Rankine Cycle (ORC)** technology, with in-house development of the expansion part and the use of industrial grade components, makes E-RATIONAL's ORCs user-friendly, robust and economically viable. The E-RATIONAL ORC has been designed to maximize uptime and efficiency with a minimized operational and maintenance cost. This results in a containerized modular machine, CE-compliant, with plug-and-play connections for easy installation.

The ORC machines can convert heat from various sources, such as:

- Industrial processes, e.g. cooling cycles at chemical plants, glass, steel or food industry, power plants, etc.
- District heating networks (unused excess heat)
- Biomass burners or biogas installations with CHP units
- Low temperature geothermal wells

E-RATIONAL's technology is suitable for heat recovery of feeding temperatures at maximum 170°C (338°F) and minimum 85°C (185°F) at the hot side. Typical temperature difference between inlet and outlet is 20°C. Cooling temperature sent to the machine can be maximum 60°C (140°F), depending on the temperatures at the hot side.

info@e-rational.net | www.e-rational.net

E-RATIONAL is a BEP Europe division
E-RATIONAL | Ten Briele 6 | 8200 Brugge | Belgium | ☎ +32 50 40 85 40