ProEcoPolyNet
Best practice Sheet
”OMES”

RTD Project Identification

RTD Project Name: OMES

RTD Contract No.: EU NNE5-1999-20128

Programme: EU 5th Frame Working Programme

Description of technology

The T100 unit is composed by one high-speed generator and turbine wheels that are on the same rotating shaft, the only moving part in the engine.

Operating principle

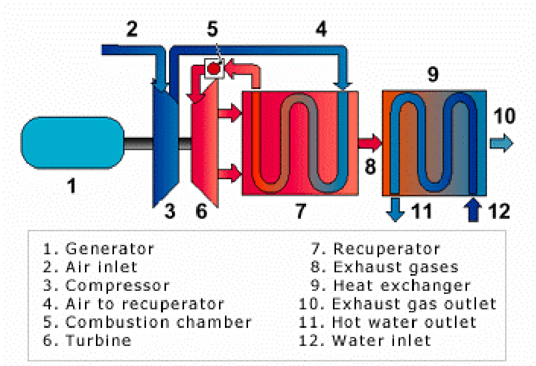
The microturbine is a power generation system that is based on a combination of a small gas turbine and a directly driven high-speed generator. In many cases, the gas turbine includes an exhaust gas recuperator that improves the efficiency of the system.

The design of Turbec's gas turbine is very simple and the pressure ratio is low. The turbo machinery design can be compared to that of a turbo charger used in piston engines. The high-speed generator is on the same shaft as the compressor and the turbine. No gearbox is needed and the system uses only two bearings.

The electricity created by the high-speed generator is converted into useful voltage and frequency by a power converter that is also part of the system.

The microturbine uses a combustor that can run on various fuels such as natural gas, diesel, ethanol, and biogas. The level of harmful emissions is very low.

Inspired by developments in the automotive industry, the design of the microturbine is the key to its reliability and competitive price.



Technical characteristics of installation

- *Type:* Turbec 100 PH Microturbine

Engine data

- *Compressor type:* Centrifugal
- *Turbine type:* Radial
- *Type of combustion chamber:* Lean pre-mix
- *Number of combustion chamber:* 1
- *Pressure in combustion chamber:* 4.5 bar
- *Turbine inlet temperature:* 950ºC
- *Nominal speed:* 70,000

Electrical data

- *Voltage output:* 400/230V AC, 3 phases
- *Frequency output:* 50 Hz (60 Hz)

Fuel requirements

- *Pressure min/max:* 0.02/1.0 bar
- *Temperature min/max:* 0/60ºC
- *Lower heating value:* 38-50MJ/kg

Hot water installation

- *Thermal output (hot water):* 155kW @70-90ºC
- *Total efficiency:* 77% @70-90ºC
- *Min. water inlet temperature:* 50ºC
- *Max. water outlet temperature:* 150ºC
- *Max. water pressure:* 25 bar
- *Exhaust gas temperature:* 90ºC @70-90ºC

Performance data

- *Fuel:* Natural gas, other fuels as biogas, diesel, kerosene, methanol or LPC
- *Electrical output capacity:* 100 (kW)
- *Electrical efficiency:* 30 (%)
- *Thermal output capacity:* 155 (kW)
- *Fuel consumption:* 333 (kW)
- *Exhaust gas flow:* 0.80 kg/s
- *Power to heat ratio:* 1:1.55
- *Noise emissions:* 70 (dBA) at 1 meter

External dimensions

- *Weight:* 2770 (kg)
- *Width:* 900 mm,
  Height: 1810 mm,
  Lenght: 2770 mm

Location and use

- *Private Buildings:* Yes
- *Residential Buildings:* Yes
- *Commercial Buildings:* Yes
- *Public Buildings:* Yes
- *Others:*

hotels, schools, hospitals, office buildings, apartment houses, sports centres, swimming baths, super markets and shopping centres (combined heat, power and cooling (CHPC) for satisfying heating and cooling demands), greenhouses (CHP and CO2-fertilization), industrial laundries, sewage treatment plants, small and medium sized enterprises (SME)'s with a certain profile of heat demand or some special process integrated industrial applications.

Capital investment and maintenance costs

- *Capital investment*
  Specific cost of unit (€/kWe): 800 - 860
  Installation cost (€/kWe): 200
- *Maintenance*
  Specific maintenance costs (€/MWhe): 13-15

State of Development/Market implementation

- *Serial production:* Yes
- Full market implementation with sales organisations in several European countries.
- The Turbec 100 may be rebuild to fit different application and fuel type's even hot air from concentrating solar systems.

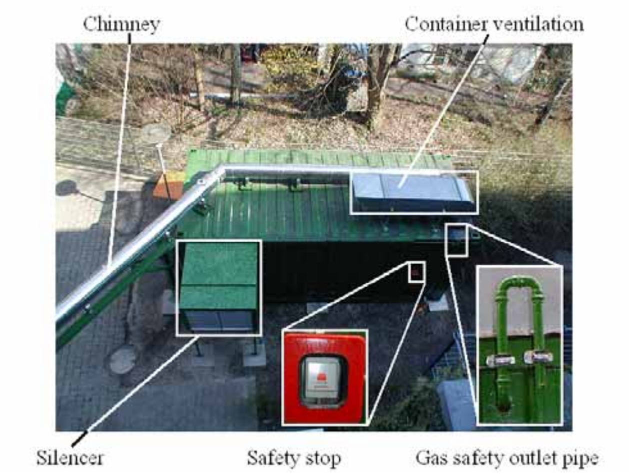
The OMES project

In 2001 the OMES (Optimised Microturbine Energy System) project was started - a European demonstration project for the demonstration of the turbine technology at small scale CHP.

The OMES Project [1] has partly been financed through the EU 5th Frame Working Programme. Participants in the project were Gasum, Finland, Vattenfall/SGC and the microturbine manufacturer Turbec from Sweden, Statoil, Norway, and DONG and Energi E2 from Denmark. DONG was overall project leader, assisted by the Danish Gas Technology Centre (DGC).

The installations, spread over six countries (Finland, Sweden, Norway, Denmark, Germany and Ireland), are a mix of industrial, commercial and domestic installations. The installations (18 units) cover a number of different applications and fuels:

- Traditional small scale CHP (schools, business centres, etc.)
- Flexible steam generation
- CO2 fertilization in greenhouses
- Cooling
- Cluster installation of micro turbine CHP units
- Natural gas, biogas and methanol



Microturbine Housing in a Container at Hamburg

Data on energy efficiency, availability, emission, O/M costs etc. were recorded and reported over the operation period from 2002, when most of the installations were made, to April 2004.

Operational data

- Total hours of operation (h) >100,000
- Success Criteria:
  ☑ Power efficiency ≥ 30% (full load)
  ☐ Overall efficiency ≥ 80% (ref. LCV)
  ☑ Availability ≥ 90%
  ☐ O/M costs < 10 €/MWh_e
  ☑ Unit costs < 800 €/kW_e
  ☑ Emission levels < 15 ppm NO_x at 15% O_2

CO2 and primary energy savings

Volumetric exhaust gas emission at 15% O_2 and 100% load:

- *NOx: <15ppm/v= 32 mg / MJ fuel*
- *CO: <15ppm/v= 18 mg / MJ fuel*

Benefits and obstacles

Integration of a micro gas turbine in some industrial processes can lead to very high-energy efficiency (i.e. direct drying or with supplementary firing, also giving very high marginal electrical efficiency, or when exhaust gas is used directly for heating and CO2-fertilization in greenhouses). In such applications, the economics can be attractive given the present and predominantly levels in cost for gas and electricity.

However, the market potential in such “special applications” is expected to be rather limited.

Areas with no or poor supply of electricity or where the electricity grid needs reinforcement are very potential markets.

Areas with a long heating season and dense population are also potential markets. However, if district heating already is implemented, then district heating based on relatively large CHP plants with high electrical efficiencies are most likely both technically and economically more competitive.

In order to pay back within reasonable time, an micro gas turbine for CHP has to operate intensively. Three thousand hours of full-load operation per year is considered as absolute minimum. This fact sets up restrictions on heat demands in terms of base load and heat storage capacity and limits the number of locations suited.

Two T-100 CHP Units installed in Heating Station West at Copenhagen Airport

However, the present levels in specific cost for installation and cost related to over-haul & maintenance for this rather new and still maturing technology have to be reduced and/or the predominantly gap between cost of electricity and gas has to be increased, to make it economically attractive substituting existing energy systems with CHP based on micro turbine units.

For the time being, support for promoting the further development and reduce installed cost of this new technology is necessary.

The Microturbine and Chiller Installation at Statoil, Stavanger

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