

PRODUCT SHEET

ENERGY PRODUCTION



ORC MODULE
ZE - 250 - MT

PLANT TECHNOLOGY

The structure of the proposed plant is based on the so-called low-temperature organic Rankine cycle (MT-ORC), and may be summed up by the diagram in **Figure 1**.

A heat source [1] generates heat, which is conveyed through a **vector fluid** circulating into a closed loop to one or more primary heat exchangers, usually a **preheater** and an **evaporator** [2], where said heat is transferred from the vector fluid to the **working fluid**.

The working fluid - a low-boiling, biodegradable, non toxic liquid when at room temperature - **boils** in the evaporator at a temperature far lower than that of water, becoming a high-pressure dry gas which spins through its expansion the impeller of a specifically designed and sized **turbine** [3].

The high-speed rotation (18.000÷24.000 Rpm) of the turbine shaft spins the rotor of a **generator** which is directly connected to it, thus producing **electric power** [4] which, after being synchronized in frequency, phase and voltage by a **power converter**, may be injected into the national power grid or self-consumed, according to local needs and policies.

Downstream the turbine, the working fluid - still in gas phase - is conveyed to another heat exchanger, called a **condenser** [5], where it is cooled, releasing its excess heat and condensing back into a liquid which is collected in a **condensation tank**, ready to be sent back to the primary heat exchanger by a **recirculation pump**, thus closing the loop.

Excess heat released in the condenser is a low-temperature thermal energy source itself, which may be **used for other purposes** such as preheating or desiccating biomass fuel (thus increasing its heating value), building heating, hot water production and so on.

In case that is not possible, residual heat may be dissipated by using an **external cooling system** [6] such as an evaporative cooling tower or a dry cooler.

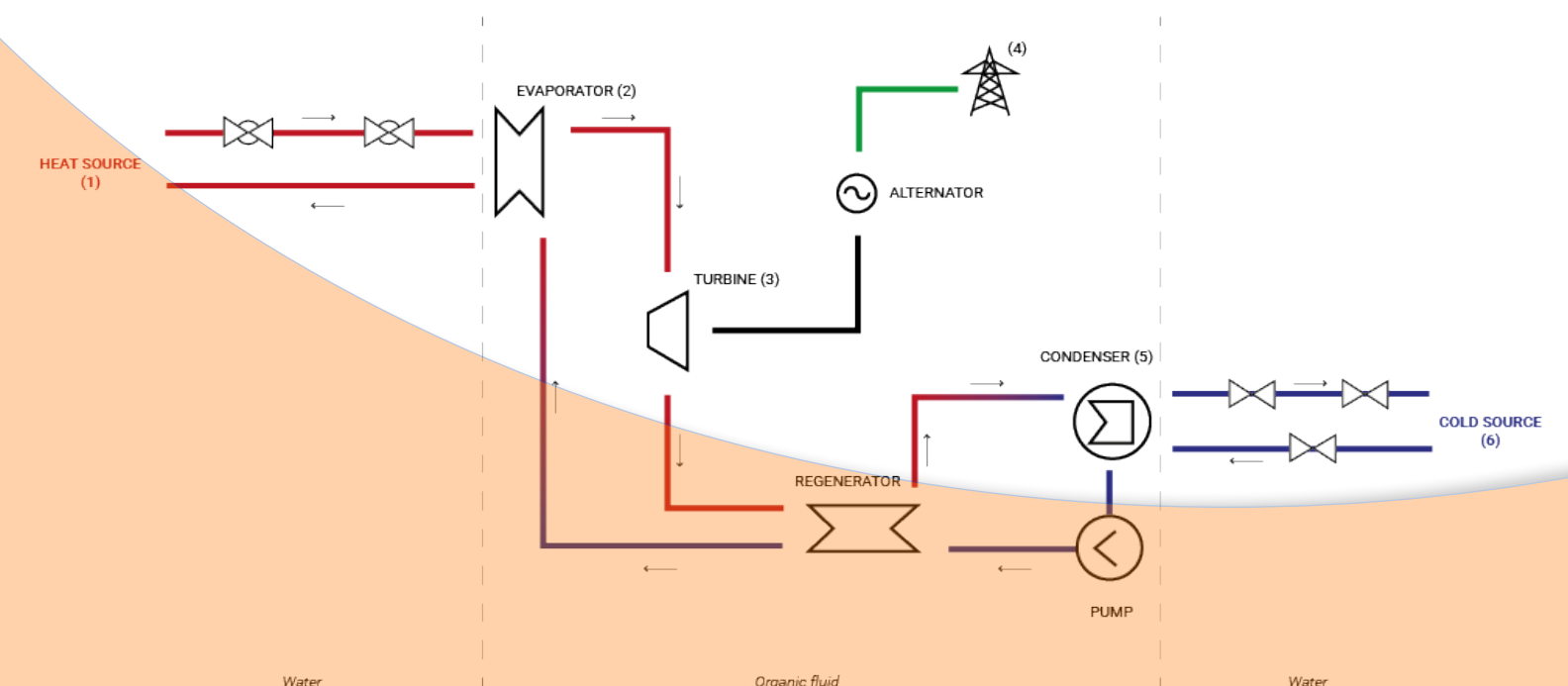
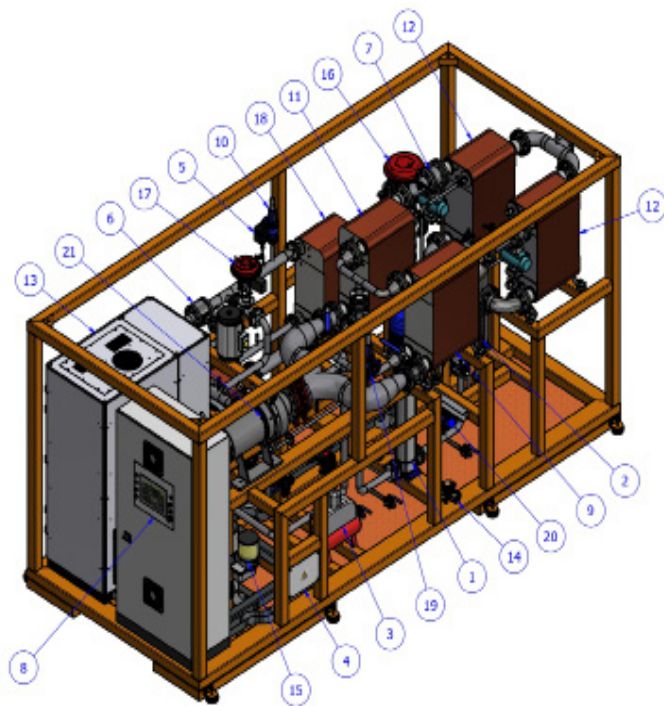


Figure 1 - Plan Diagram

ORC CIRCUIT COMPONENTS



PARTS LIST	
PART	DESCRIPTION
1	HFC FLUID PUMP
2	LEVEL METER
3	COMPRESSOR
4	ELECTRICAL CONNECTION BOX
5	SAFETY PRESSURE SWITCH
6	SAFETY VALVE STEAM
7	ON-OFF CONDENSER VALVE
8	CONTROL PANNEL
9	REGENERATOR
10	SAFETY VALVE TO CONNECT OUTSIDE DN40
11	REGENERATOR
12	CONDENSER
13	INVERTER
14	VACUUM PUMP
15	LUBRIFICATOR
16	THREE-PORT CONTROL VALVES
17	START VALVE
18	VAPORIZER
19	SECURITY VALVE DN20 X 40 FLANG Bar 8.20
20	SECURITY VALVED DN20 X 40 FLANG Bar 5.50
21	TURBINE

PROCESS DATA

WORKING FLUID	
Type	Mixture of non-toxic, non-flammable, environmental-friendly HFO
Operational range	175°C
Condensation temperature	47°C (@3 bar)
Working pressure	32 bar
Organic vapor mass flow	7kg/s

HEAT EXCHANGER	
Type	Brazed plate
Working pressures	30 bar (Nominal) / 39 bar (Test) /225 bar (Burst)
Construction materials	AISI316 S/S & 99,9% copper
Max working temperature	195°C

PREHEATER + EVAPORATOR

Total thermal power input	1560 kWt
Vector fluid	Pressurized water
Vector fluid temperature (input/output)	$\geq 175^{\circ}\text{C}$ / 145°C
Vector fluid flow rate	12 kg/s
Electric power output from turbine	250 kWe

CONDENSER

Thermal power dissipation	1300 kWt
Condenser cooling water temperature (in/out)	28°C / 40°C
Condenser circuit flow	25.91 kg/s

TURBINE

Type	Single-stage radial inflow turbine w/fixed nozzles, directly coupled to generator shaft
Operating Temperature (Input/Output)	$170^{\circ}\text{C}/95^{\circ}\text{C}$
Stage pressure	PS 16 (tested to 24 bar)
Materials	Machined steel (body) / Aluminium alloy (impeller)
Speed control	Multilevel converter
Seals and gaskets	Sealed labyrinth on impeller back and optionally at generator interface. Env. seal : Gaskets / O-rings

GENERATOR

Type	Synchronous, permanent magnet
Power Output	250 kWe
Output Voltage and Frequency	400 V/ 833 Hz
Rotational Speed	24.000 rpm
Rectifier /synchronizer	Built-in / Included
Cooling system	Water jacket
Cooling fluid	Water + glycol (antifreeze) mix @ $\text{TIN} < 40^{\circ}\text{C}$

INVERTER

Type	Drive amplifier based on multilevel technology
Output power	250 kWe
Output voltage / frequency	380 - 480 V 3-phase 50/60Hz
Max operational environmental temperature	40°C
Braking chopper, emergency resistance bank	included, 266 kW for 1 min

ZE-250-MT SKID DIMENSIONS

The power generation module is supplied mounted on a self-supporting compact frame ("skid") which houses all the principal components.

The following drawings show the standard version of the ZE-250-MT ORC power generation module, designed for indoor installation, which weighs about 6.2 tons, and fits inside a standard 40 ft High Cube container for shipping.

Other versions are available, including a closed, weatherproof version for outdoor installation

