

ORC RECOVERING HEAT OF A CONDENSATION PROCESS

E-RATIONAL ORC 20FT – 1.5MW_{TH} – 160kWe

Hamyang Recycling Centre, South Korea is a waste incineration plant for municipal solid waste (MSW) located 350km south of Seoul.

The plant processes municipal waste from Hamyang and neighbouring cities. The heat from the incineration process is recovered in a steam-condensate circuit, producing 2.4 tonnes/hour of saturated steam at approximately 150°C. Apart from the ORC, the plant has three other consumers of steam, using 0.9 tonnes/hour - rather less than half the total.

Before installation of the E-RATIONAL ORC, the 1.5 tonnes/hour of surplus steam was vented to atmosphere. The steam fed to the ORC machine adjusts according to the steam demand of the other three minor steam consumers. The ORC machine is cooled using a cooling tower.

Installation of the E-RATIONAL ORC has brought several benefits to the project. Besides recovering the heat of the steam through condensation, the pre-treated demineralized water recovered by the ORC is returned as boiler feed water. The residual heat in the condensate is used for drying and preheating the MSW, as a pre-treatment, important for the optimization of the efficiency of the incineration process. The produced electricity is sold and injected to the public grid.



On average the ORC machine consumes 1.5 tonnes/hour of steam at 143°C which is condensed and subcooled to 80°C by the E-RATIONAL HT-ORC, recovering 1000kW of heat. Under these conditions, the machine is operating at part load capacity. At full load capacity (of 1500kW of heat) the machine is producing around 135kWe.



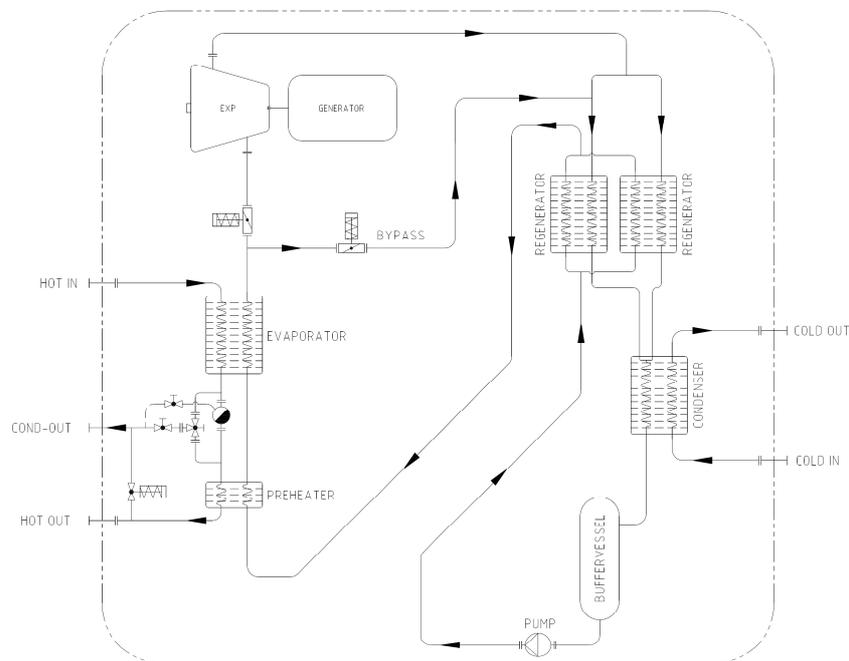
Left: Wet cooling tower for ORC cooling – Top Right: Complete ORC installation Hamyang – Bottom Right: Vented surplus steam

As energy-efficiency upgrade measure, the ORC is equipped with extra heat exchangers for regeneration of heat of the internal process.

The E-RATIONAL ORC machine generates a double win: producing electricity for injection to the public grid while recovering pre-treated water by condensing the surplus steam.

Heat to be recovered	143°C → 80°C
Working temperature hot side	± 1500kWth
Thermal load at hot side	30° C → 40°C
Condenser	± 1400kWth
Cooling capacity	Cooling Tower
Cooling	160kWe
Total installed generator capacity	135kWe
Average net power production	December 2016
In operation since	± 8000h
Running hours per year	

Machine definition Hamyang Recycling Centre



P&ID ORC Hamyang Recycling Centre with internal heat regeneration and steam condensation

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.