LIFE Project Number

LIFE10 ENV/IT/000397

D4 – Test on site report

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Project:	Integrated fumes depuration and heat recovery system in energy intensive industries (EII)			
Acronym:	H-REII DEMO			
Code:	LIFE10 ENV/IT/000397			

GENERAL PROGRESS

In 2010 was launched in Brescia the first national pilot project about the topic: the H-REII - Heat Recovery in Energy Intensive Industries – project (LIFE08 ENV/IT/000422 www.hreii.eu). The project, co-financed by the LIFE+ program, aims to map the potential to recover waste in highly energy-intensive companies (cement, glass industries, steel, aluminium and nonferrous, heat treatments, chemical industry, refineries, oil & gas, agribusiness, textile, paper) using the ORC (Organic Rankine Cycle) technology with power generation sizes between 0.5 MWhel and 10 MWhel.
Thanks to several energy audits carried out in Italy and Europe, and to an analysis of allocations quotes by National Allocation Plans (ETS), at the outset, it was estimated the potential for energy recovery in 3 of the 10 areas of investigation was estimated. The prudential estimate, on Italian cement, glass and steel, highlights a potential saving from 641 GWhel/year to 1025 GWhel/year of electricity, the 5% of the total estimated energy savings for the Italian industry for 2016, and prevents the emission of over 650.000 tons of CO2/year.

The estimated recovery potential has led to the present second project co-financed by the LIFE+ program: the H-REII_DEMO (2012-2013) - Integrated fumes depuration and heat recovery system in energy intensive industries (EII) – project (www.hreii.eu/demo). This project aims to develop and study the first prototype of heat recovery system in EAF (Electric Arc Furnace) of iron and steel industry, completely integrated into a fume extraction plant, by using water in a closed loop for cooling waste fumes, and operating at a higher temperature and pressure than traditional methods. The prototype will be realized in a European leader steel industry: the Feralpi group – ESF-Riesa plant in Germany. This is expected to lead to a significant reduction in total power consumption and to an improvement in the performance of the fume depuration plant in energy intensive industrial applications (iron and steel industries, cement, glass, etc.). Power generation from effluents, currently considered a waste, could drastically reduce, (and in some applications even eliminate), the energy consumption of fume depuration, helping to reduce CO_2 emissions and other environmental damaging impacts.

TEST ON SITE

On December, the 18th 2013, the first heat recovery system to power with ORC technology recovering Electric Arc Furnace exhausts started up.

This document reports the analysis of the first operating hours of the plant.

During this phase, the operation of the two individual blocks - the heat exchange system (Comeca) and the ORC module (Turboden) - have been verified and tested

1. HEAT EXCHANGE

Concerning the heat exchange, a PLC monitors and manages all the system functions, particularly:

Test	*Report*	*Notes*
1. The logical operations during the different phases		
1A. Preliminary test for start up the system	ok	
1B. Lead to steady state	ok	
1C. Monitoring of the steady state condition	ok	
1D. Made safe	ok	
1E. Shut-down	ok	
2. The safety of all phases and of the individual elements		
2A. Made safe the system in any phases	ok	
2B. Targeted safety tests of the main components	ok	
2C. Redundancy of some components	ok	
2D. Operating practices	ok	
3. Monitoring of plant components, of the measured quantities, and of the performances		
3A. Active visualisation of the different quantities (pressures, temperatures, mass flows, tensions) that determinate the heat recovered quantity by the system, afterwards converted in electric energy	ok	

Test	*Report*	*Notes*
3B Diagrams of the monitored quantities, recorded during the time	ok	
3C Display and recording alarms	ok	
3D The system and its performance are continuously monitored during all the operating life of the plant	ok	

2. ORC MODULE

Regarding the ORC module, the activities performed are:

Test	*Report*	*Notes*
A. Automatic start-up and shut-down	ok	
B. emergency shut-down procedures	ok	
C. Automatic operation at different feeding conditions	ok	

The aim of these "Test Run" is to verify the continuous and reliable functioning of the plant, in any guaranteed operating condition.

Successfully completed the "Test Run", a session of analysis, characterized by different phases of start-up test to monitor various system parameters in order to ensure optimum operation have been carried out.

3. RESULTS

Testing continued until the ORC system reached the electric power guaranteed at nominal load. Test would have been considered successful if the nominal electrical power was achieved with a tolerance of 5% on the nominal input thermal power with the given conditions (gas and water temperatures and mass flows).

On December, the 19th 2013, at 4:18 pm the nominal load (2,671 kW) of the ORC unit was achieved, as reported in figure 1.

With inlet steam flow of 20 tons per hour at 225°C and with cooling water flow of 410 m^3/h, the gross electric power generated was 2,671 kW.

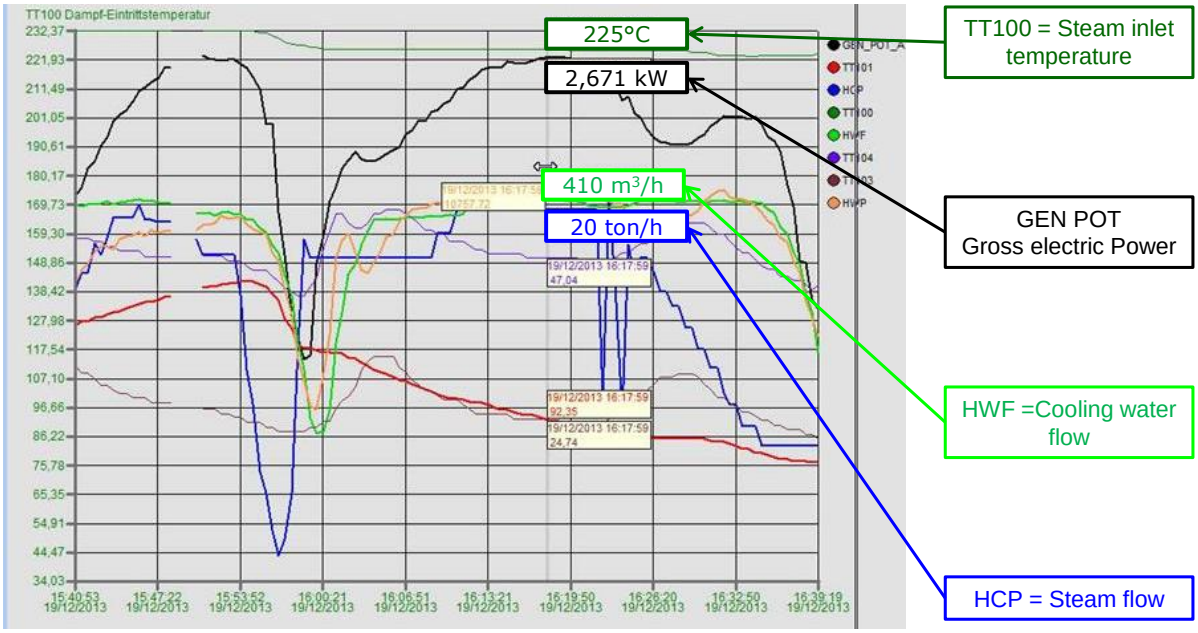

Figure 1: Performance graph of the ORC unit at ESF Riesa on December, the 19th 2013

Final test is positively if guaranteed net electrical power at nominal load is reached with thermal input power not exceeding 105% of nominal input thermal power with the given conditions (saturated steam, cooling water temperatures and mass flows).

A performance analysis will be delivered in following months.