RECP Best Practice Catalogue

Upgrade in-house electricity supply and steam system with co-generation

Developed within the framework of MED TEST II

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

The SwitchMed Programme is funded by the European Union

Best Practice - Upgrade in-house electricity supply and steam system with co-generation

SECTOR:	**Food & Beverage**
SUBSECTOR:	Manufacture of other food products
PRODUCTS	Mayonnaise/Ketchup/Tomato paste
CATEGORY	Technology upgrade/Eco-innovation
APPLICABILITY	Utilities

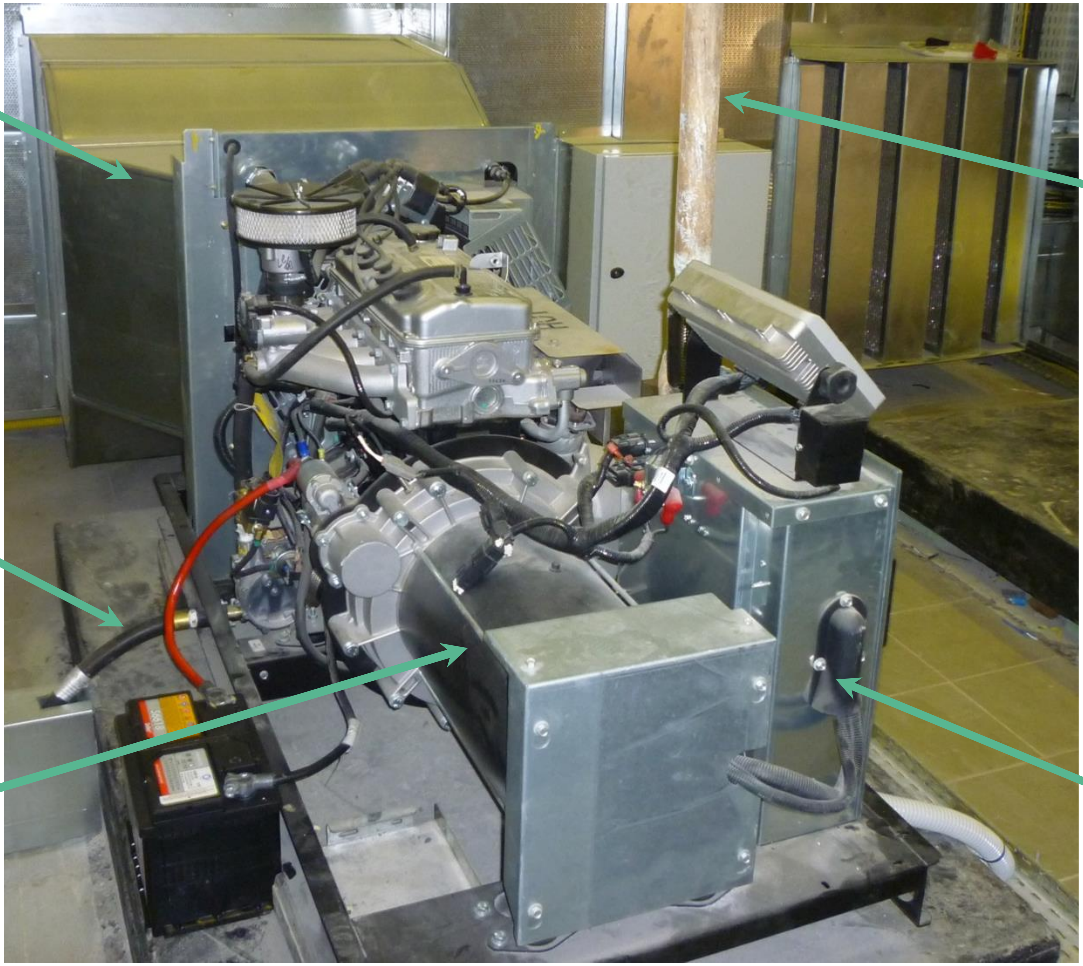
COMPANY NAME	NOT DISCLOSED
COMPANY SIZE	SME

Best Practice - Upgrade in-house electricity supply and steam system with co-generation

Description of the problem (Base scenario):	This plant is not connected to the electricity grid, it relies completely on an in-house electricity supply consisting of electric generators (2x550 KVA + 1x110 KVA + 30 KVA) The main 550 KVA generators are used during day time operation while the smaller ones are for night time and week ends. The 550 KVA generators are old and not properly sized to the plant load, the supply demand mismatch is so high that the generators operate for at least 50% of the time at 25% load factor or less. Furthermore, the radiators of the generators jacket cooling systems need to be constantly sprayed with water during summer to evacuate the heat buildup. The consequence is that the main generators average operating efficiency does not exceed 27% knowing that during some periods of the day it drops as low as 7% !! This leads to considerable waste in fuel and water. The generators diesel consumption amounted to 146,000 liters for the year 2015 while the water needed to spray cool the radiators is estimated at 300 m^3/year. Furthermore, the issue of load mismatch is also found in the steam system where the steam boiler operates most of the time at less than 25% load factor leading to an average operating efficiency of less than 60%. The steam boiler consumption amounted to 162,000 liters of diesel fuel in 2015. steam is used in the cooker for ketch-up production and for water heating for Cleaning in Place (CIP) unit. The steam boiler and generators represent 100% of final energy use in this plant.

Best Practice - Upgrade in-house electricity supply and steam system with co-generation

Description of the solution	Generators are inherently inefficient (see figure 1 below), wasted heat from generators operation could be put to good use in generating steam and hot water instead of burning fuel in boiler. Consequently the oversized boiler could be removed and a much smaller one installed. The proposal is as follows: - Replace the 2x550 KVA generators with 2x400 KVA prime rated duty-standby generators with synchronizer load management unit. Calculated average load factor: 75%. The target average generation efficiency for the in-house system is 34%. - Install a 60 KW Heat Recovery Steam Generator (HRSG) on the exhaust of each generator to deliver 75 kg/hr of steam at 6 bars. (See figure 2 below) - Install a 40 KW Heat Recovery Exchanger (HRE) on the jacket cooling system of each generator to deliver hot water at 85°C. This hot water is partly used for CIP and partly as make up water for the steam system. (See figure 2 below) - Replace the existing oversized diesel fired 2.8 MW boiler with a 1.5 MW boiler. It is not advised to divide this capacity between two smaller boilers because of the sudden surge in steam demand typical of ketchup cooker operation. The target average steam generation efficiency is 85%. This proposal aims to reduce energy consumption and GHG emissions by 30%. It also aims to save some 300 m³ of soft water per year.

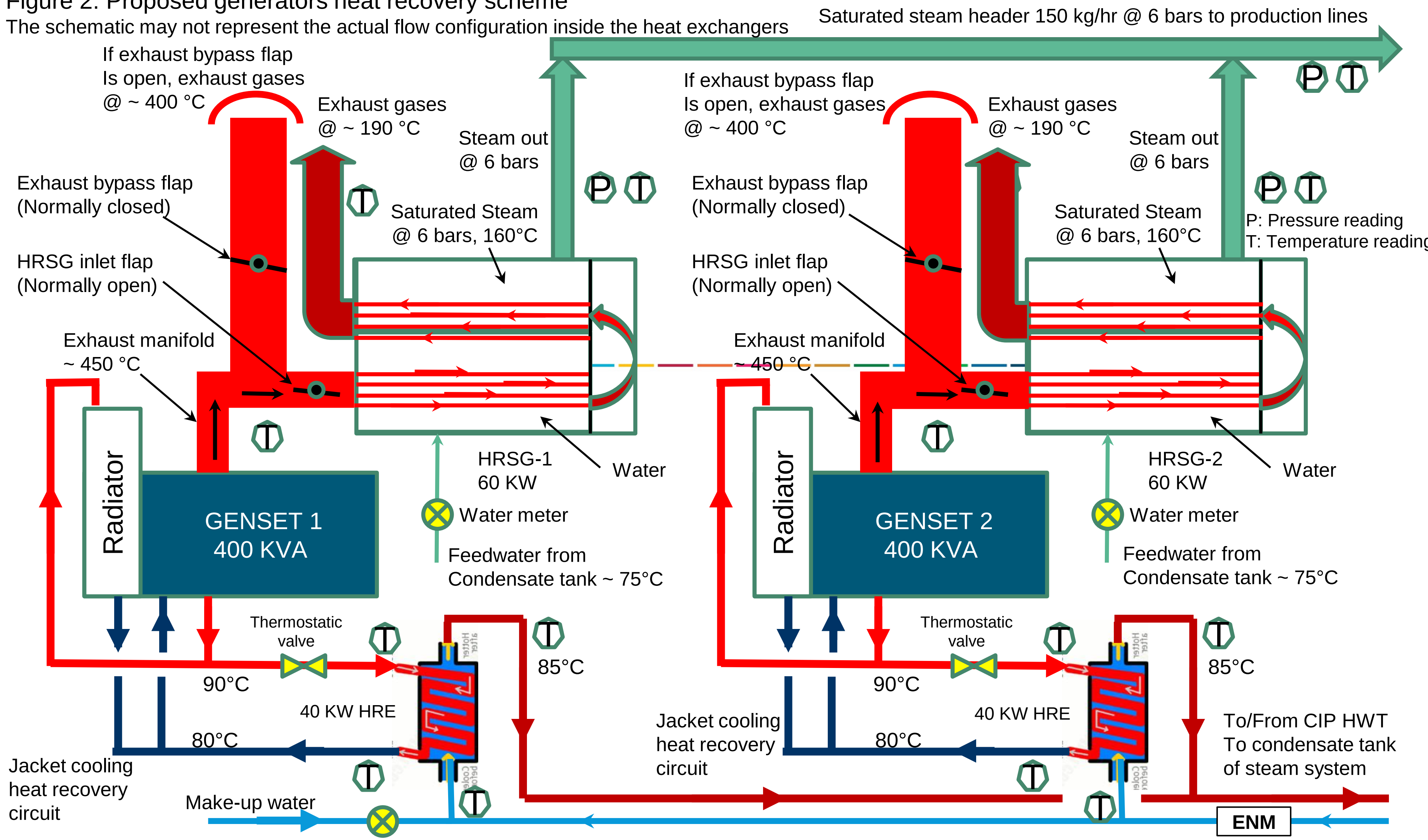


This balance does not represent the case at hand where the losses are even higher

Figure1: Typical energy balance for a medium size electricity Generator

Figure 2: Proposed generators heat recovery scheme

The schematic may not represent the actual flow configuration inside the heat exchangers



Best Practice - Upgrade in-house electricity supply and steam system with co-generation

Economic Benefits	Base case diesel fuel consumption to produce electricity: 120 Tonnes/year Estimated diesel fuel savings after gensets upgrade: 37 Tonnes/year (31% savings) Base case diesel fuel consumption to produce steam: 133 Tonnes/year Estimated fuel savings for implementing HRSG: 18 Tonnes/year (13% savings) Estimated fuel savings for implementing jacket heat recovery: 15 Tonnes/year (11% savings) Estimated fuel savings from replacing boiler for load matching: 6 Tonnes/year (4% savings) Overall fuel savings on steam system: 39 Tonnes/year (29% savings) Market price of Diesel : 600 EUR/Tonne Expected savings resulting for gensets upgrade: 37*600 = 22,000 EUR/year Expected savings from heat recovery system and boiler upgrade: 39*600 = 23,000 EUR/year Expected total savings: 22,000 + 23,000 = 43,000 EUR/year The savings represent 30% of the overall final energy use in the plant, thus they will have a significant impact on specific energy use of the different products manufactured
Environmental Benefits	Expected diesel fuel savings: 76 Tonnes/year (30% of overall plant energy use) Specific CO_2 emissions of diesel: 3200 kgCO_2/Tonne Avoided CO_2 emissions: 76*3200 = 243,000 kgCO_2/year (30% of overall plant CO_2 emissions)
Other benefits	Not applicable
Health and safety impact	Not applicable

Best Practice - Upgrade in-house electricity supply and steam system with co-generation

Capital investments & financial indicators	Cost of intervention: 140,000 EUR Return on investment (simple payback): 3.2 years
Suppliers	Generators: Imported Heat recovery: Local manufacture Steam boiler: Local manufacture
Other aspects	- The cost of intervention shown above includes the cost of the information system to implement a Performance Monitoring and Verification Plan for that intervention. - Above calculations are based on 2015 data supplied by company complemented by 6 month of measurements between September 2016 and April 2017. - This best practice combines three separate measures in the action plan of the company concerned.
Implementation	Measure is currently on hold, expected implementation 2019 – 2020.