

Electricity & steam from landfill biogas at Plessis-Gassot (F) and Fresnes-sur-Marne (F)

Feedback from 5 years of operation

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1 - NATURE OF THE PROBLEM

The garbage landfills of Plessis-Gassot (F) and Fresnes-sur-Marne (F) each treat approximately 800 000 tons per year of urban waste from the Paris area.

Early in 1986, the REP Company ("Routière de l'Est Parisien") installed a piping network to recover the biogas formed by the anaerobic decomposition of the garbage.

In 1992, the REP Company developed an energy recovery system from biogas by installing spark ignition gas engines at the Plessis-Gassot site (1.7 MWe delivered to the EDF network from 1992 to 1996).

Operational difficulties appeared leading to high running costs, essentially due to the components of the biogas, in particular :

- water
- silica (deposits on engine valves as well as abrasion problems)
- H_2S (200 ppm, leading to corrosion of the engine cylinder heads)
- variable content of CH_4 , sometimes below 48 %, which is the lowest limit acceptable by engines.

In 1996, the REP Company decided to abandon the use of spark ignition gas engines in favour of a solution with boilers feeding a steam turbine. The choice of CNIM-BABCOCK boilers fitted with PILLARD BIOFLAM[®] burners, was confirmed with orders awarded in 1997. The new plant at Plessis-Gassot (F) started to produce electricity in spring 1998. It was followed by a second, identical to the Fresnes-sur-Marne (F) site. These 2 plants are run by DALKIA Company.

2 - PRINCIPLE OF EACH POWER STATION

Each power station uses 3 boilers (with one as back-up) and one steam turbine of 11 MWe, sized to continuously treat a biogas flow of 9 200 Nm^3/hr .

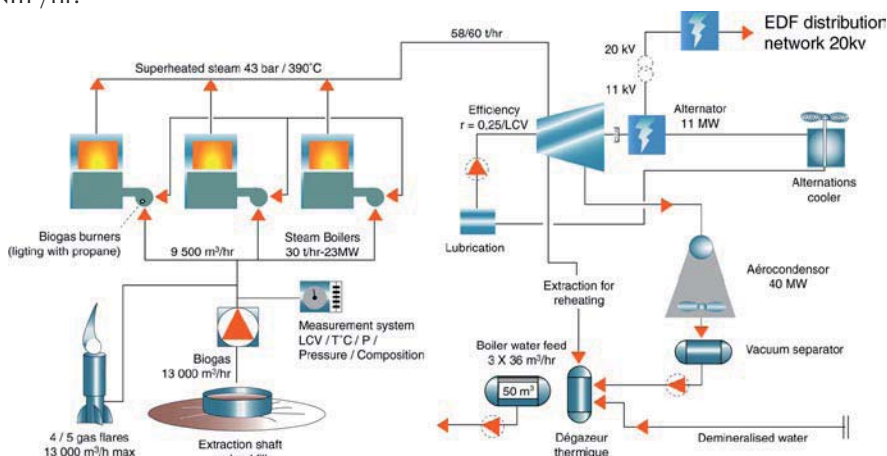


Fig. 1 : Plant general principle

- Turbine and alternator :
 - trademark : DRESSER-RAND
 - power : 11 800 kW
 - stages number : 8
 - flow : 60 t/hr
- Boilers :
 - trademark : CNIM-BABCOCK
 - steam production : 30 t/hr, 390°C/40 bar per unit
 - furnace heat release : 23 MW per unit (on LCV basis)
 - boiler efficiency : 93 % (on LCV basis)

- PILLARD BIOFLAM® burners :

Such burners have been specially developed to fire biogas. They allow to reach to a perfect flame stability without being sustained by a rich fuel within a wide LCV range (even for LCV values lower than 3 000 kcal/Nm³). The possible turn-down ratio is 1 to 6 in spite of a very low gas pressure of only 150 mbar at burner inlet.

In order to resist to corrosion, they are made entirely of stainless steel.

Such burners are also able to operate on heavy fuel-oil in order to ensure electricity production even if the biogas supply is out of operation.



Fig. 2 : PILLARD BIOFLAM® burner fitting one of the three boilers

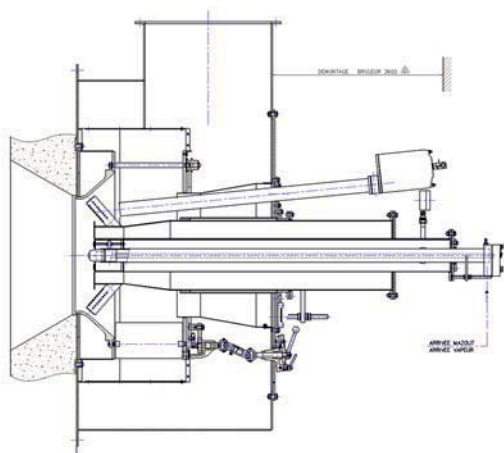


Fig. 3 : Principle of the PILLARD BIOFLAM® burner

- max. heat release : 23 MW
- biogas flow : maxi 9 500 Nm³/hr (LCV variable from 3 200 to 5 200 kcal/Nm³), mini 1 900 Nm³/hr
- biogas pressure : 150 mbar
- combustion air temperature : 20°C

- Combustion control system : Similar to the one of a classical measuring C.C.S., the measured biogas flow being corrected according to the real LCV value, which is continuously measured.

The combustive air flow / biogas flow ratio is corrected thanks to a parameter function of the O₂ content in the flue gas.

3 - FEEDBACK FROM 5 YEARS OF OPERATION

- The burners did not require any particular maintenance. The plant operation appears to be similar to a plant using natural gas as main fuel. No corrosion or clogging of any orifice have been encountered since first start-up.

Combustion performance :

- Excess air at nominal load : 8 %
- NO_x : 50 mg/Nm³ @ 3% O₂ dry basis
- CO : 0

- The boilers have not been subject to any corrosion to date (particular design). The presence of silica as component of the biogas leads to some deposits on the superheater tubes and on the economiser, which need an annual clean.

- Plant operation : The target of electricity production supplied to the EDF network of 80 million kW/hr per year has been easily met.