PETROBRAZI COGENERATION PLANT (ROMANIA)
POSTCOMBUSTION WITH HEAVY OIL & NATURAL GAS

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In 2001, HYUNDAI Engineering & Construction Co. Ltd of Korea (HDEC), realized for SNP Petrom SA, Romania, a 50 MWe cogeneration plant comprising 2 identical lines on the PETROBRAZI refinery site (60 km north of BUCHAREST).
4 PILLARD type GRC INDUCT burner heads, firing heavy fuel oil in postcombustion on each line, have been supplied and installed upstream to the HRSG.

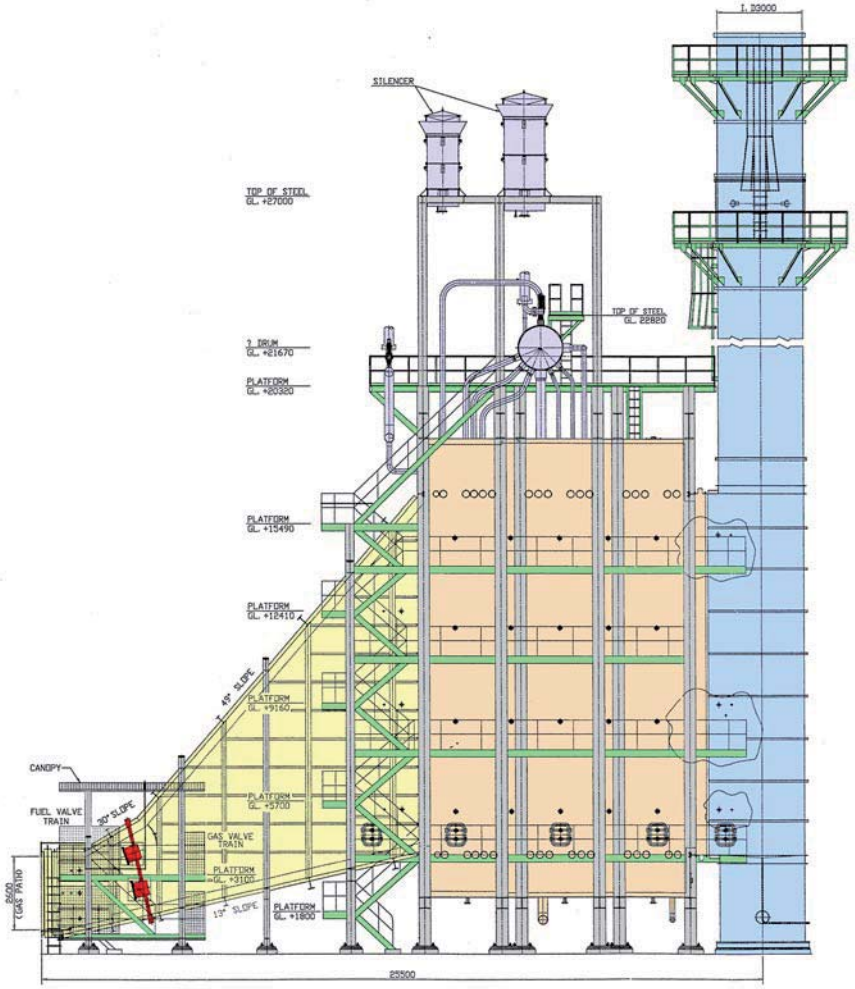

Fig. 1 : View of the HRSG equipped with the PILLARD burner system

Main characteristics :

Gas turbine	:	Nuovo Pignone MS-5001 - 2 x 26,57 MWe
HSRG	:	Hyundai 2 x 134,8 t/hr steam 37,5 bar/340°C (TEG + postcombustion)
TEG	:	Max. flow : 125 kg/s at 487°C
		O_2 % : 15,5 % O_2 (sec, vol)
		Water content : 7,8 % / 11,1 % (with/without steam injection or DeNOx in the gas turbine)
Burners	:	4 PILLARD GRC INDUCT burner heads, 50 MW at nominal load,
		60 MW maxi (no operation with ambient air)
		Fuels : heavy fuel oil, 5 tons/hr per burner,
		or
		natural gas, 3 800 kg/hr per burner

EMISSION TARGETS

For this plant, the main fuel is heavy fuel oil, natural gas being in stand-by. The emissions guaranteed are those measured at stack including those of the Gas Turbine (Fig.2).

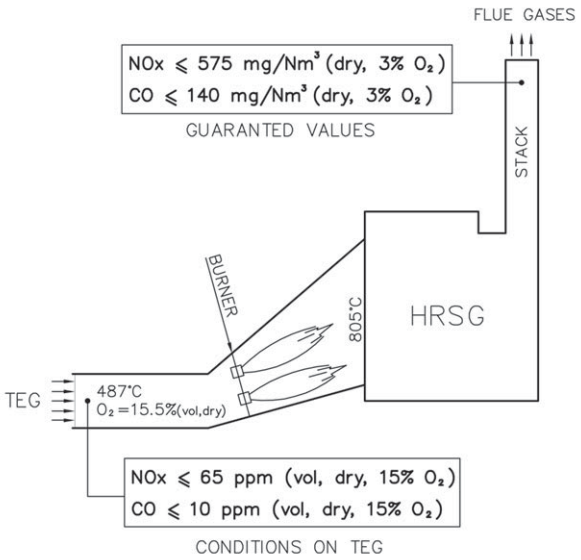

Fig. 2 : Contractually guaranteed emissions of NOx & CO

The limits for emissions generated by the burners are therefore :

$CO \leq 97$ mg/MJ

$NOx \leq 260$ mg/MJ

CHOSEN COMBUSTION TECHNIQUE

4 PILLARD GRC INDUCT burner heads, dual-fuel fired (PILLARD patent 97/02586) are located in the duct (Fig. 3). Each head can be dismantled for maintenance thanks to a (rail + door) system.
Such a burner type allows :
- a high flame stability
- low NOx, CO and dust emissions
- a low pressure drop (10 to 30 mmWG)

The heavy fuel oil is atomized by steam (11 bar, 270°C, flow rate :10 % of the fuel flow). Each burner oil gun can be withdrawn from the side of the duct even in operation (Fig. 4).
When withdrawing the oil gun, the burner head may continue to operate in gas firing mode.

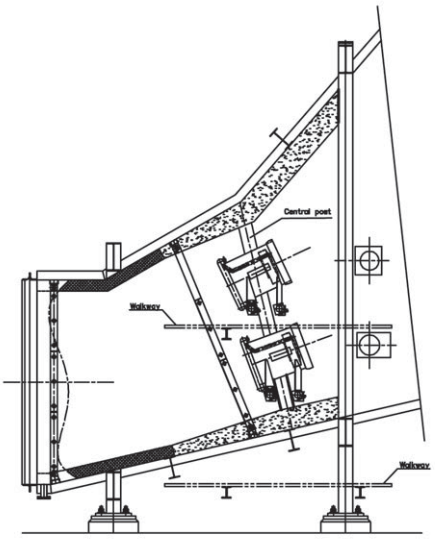

Fig. 3 : Location of the burner heads in the duct

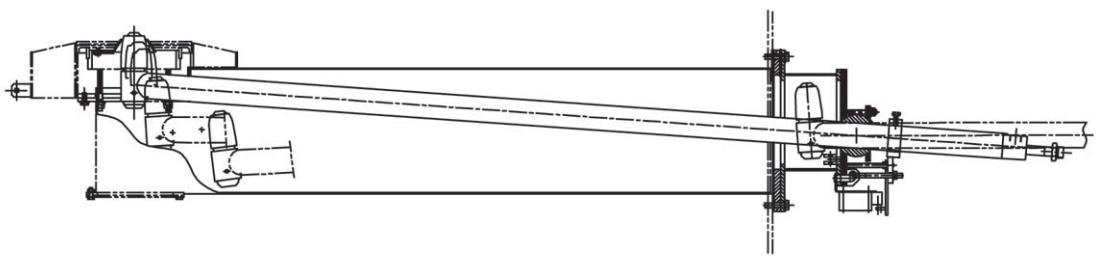

Fig. 4 : Principle of oil gun dismantling

Fig. 5 : External view of a dismantling door

Fig. 6 : Heavy fuel oil flame

STUDY OF COMBUSTIVE FLOWS

A modelization by FLUENT® software (property of FLUENT Inc.) has been utilized to achieve a good TEG distribution across the burner in spite of a limited pressure drop (incl. burner)for a total of 58 mmWG.
Such a study resulted in the addition of 2 perforated plates and a slight modification to the upper part of the duct

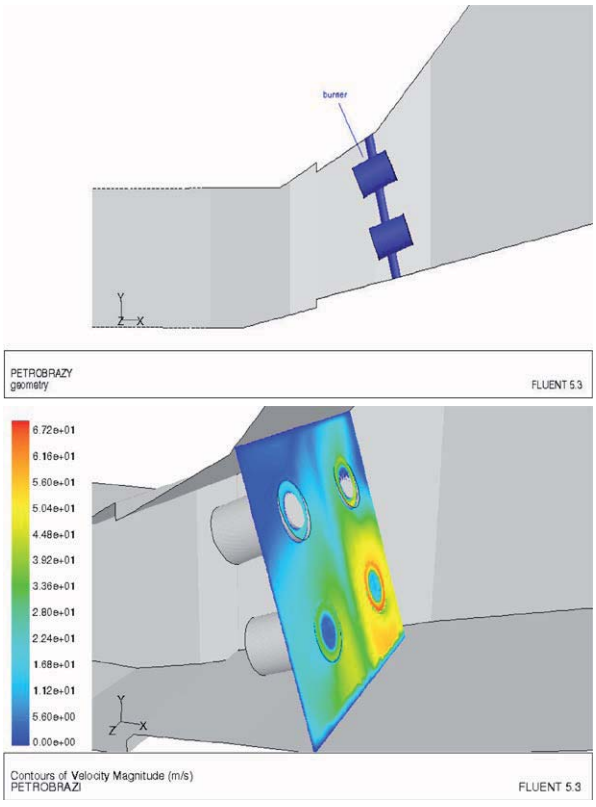

Fig. 7 :Flow before treatment and mod of duct

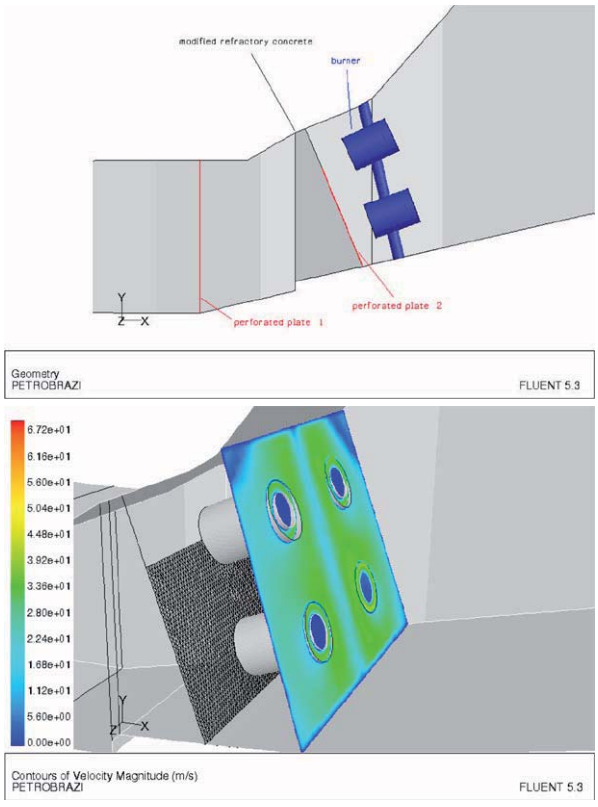

Fig. 8 : Flow after addition of plates

At an average velocity of 28 m/s, the initial dispersion (0 to 60 m/s) becomes (22 to 32 m/s), i.e. -20 /+15 %.
During the burner commissioning, the very homogeneous flame shapes confirmed good combustive distribution.

REAL PERFORMANCES AS MEASURED

The acceptance tests were carried out in April 2003. The 2 lines were in operation (TEG + postcombustion) at the nominal steam production.
The steam injection system of GT (aiming at reducing their NOx emissions) was operating (2.2 to 2.6 kg/s water injection).

PETROBRAZI site Combustion data in TEG+PC mode				
Type of fuel : Heavy fuel oil				
		Measured values		
		Contractual guarantees	1	2
			April 13, 03 (water injection in GT = 2,39-2,50 kg/s)	April 12, 03 (water injection in GT = 2,21 kg/s)
Line number			N° 1	N° 2
GT power	(MW)	31	27,3	27
GT load	(%)	100	88	87
Temperature upstream burner (high/med/low level)	(°C)	487	502/502/500	497/500/497
Postcombustion load	(%)	100	98	97
Steam flow	(t/h)	134,9	132	131
Oil pressure heads 1/2/3/4	(bar)		19,5/20,5	19/19,5
Burner kiln temperature	(°C)		150	160
Ato. steam pressure heads1/2/3/4	(bar)		10/11	11
Total oil flow	(kg/h)	4 089	4 300	4 300
Burner heat release	(MW)	48,27	53,83	46,63
Temperature at HRSG inlet (high/med/low level)	(°C)	805,3	784/783/841	776/823/779
TEG temperature at HRSG outlet (high/med/low level)	(°C)	147,2	154/152/151	154/153/153
O_2 upstream burner	(%)	15,52	15,9	15,6
O_2 downstream burner (stack)	(%)	12,83	12,9	13
CO upstream burner at real O_2	(ppm)		4	7
CO upstream burner at 15% O_2	(ppm)	10	5	8
CO upstream burner at 3% O_2	(mg/Nm^3)		18	30
CO downstream burner at real O_2	(ppm)		51	51
CO downstream burner at 3% O_2 (stack)	(mg/Nm^3)	140	141	145
CO downstream burner (stack)	(mg/MJ)	97	97	106
NOx upstream burner at real O_2	(ppm)		69	73
NOx upstream burner at 15 % O_2	(ppm)	65	81	81
NOx upstream burner at 3% O_2	(mg/Nm^3)		507	506
NOx downstream burner at real O_2 (stack)	(ppm)		125	119
NOx downstream burner at 3% O_2 (stack)	(mg/Nm^3)	575	573	555
NOx downstream burner (stack)	(mg/MJ)	257	189	189

The NOx and CO emissions are confirmed to be in compliance with guaranteed ones in spite of a nitrogen % in the heavy oil (0.39 %) almost double that which was contractually specified (0.2 % and in spite of an NOx content upstream to the burner 25 % higher than contractually specified (81 ppm instead of 65 ppm at 15 % O_2)
The very good combustion quality can be verified by the lack of any visible dust at the stack outlet.

CONCLUSION

This plant proves :
- The efficiency of using FLUENT® software to get a better combustive distribution
- The good suitability of the GRC INDUCT technique with heavy oil firing in postcombustion :
  - easy maintenance of oil guns
  - possibility to adjust the flame shapes just by replacing the atomization multinozzles
  - high flame stability
  - low emission of NOx-CO-dust.