EXPERIMENTAL MEASUREMENTS AT THE STEAM GENERATOR OF THE 330 MW POWER PLANT

Cristinel Racoceanu, *Professor,"Constantin Brâncuşi" University of Târgu Jiu*

ABSTRACT. This paper presents a case study on experimental measurements performed on the steam generator of power unit no. 5 at the Rovinari thermoelectric power plant. The 1035 t/h Benson steam generator operates with coal, and natural gas is used for ignition and flame stability.

KEY WORDS. Calorific power, air fan, flue gas fan, coal mill, live steam, intermediate superheated steam.

1. INTRODUCTION

The latest negotiations with the European Commission regarding the postponement of the deadlines assumed by Romania regarding the renunciation of coal-based electricity production have allowed the continuation of the operation of the energy groups at the Oltenia Energy Complex, until 20230. 2 330 MW energy groups at the Rovinari thermal power plant, a 330 MW energy group at the Turceni thermal power plant will remain in operation and a 330 MW energy group at the Rovinari thermal power plant and a 330 MW energy group at the Turceni thermal power plant will be in reserve capacity. The Craiova II thermal power plant, which provides electricity and technological steam for industrial consumers in the municipality of Craiova, will also continue to operate. The heat exchange surfaces of the Benson steam generator, in the order of their passage by water and steam, are the following:

* for superheated steam:

- water economizer
- evaporator
- steam superheater 1
- steam superheater 2
- steam superheater 3

* for intermediate superheated steam:

- intermediate steam superheater1 (SI
- intermediate steam superheater2 (SI 2)

The regulation of the live steam temperature is done with two injections of feed water taken from the discharge of the feed pumps before the high pressure preheaters, and to regulate the temperature of the intermediate superheated steam, an injection of feed water taken from the body of the feed pump is made. The air necessary for combustion is provided by two axial fans that suck air from the atmosphere. Before entering the boiler, the air is preheated with the help of combustion gases in two rotating Lyngstrom type preheaters. Before the rotating preheaters, to avoid the acid dew point, the air is preheated by recirculation of hot air from the PAR in the suction of the fans. The combustion gases are sucked from the furnace by two axial gas fans.

The basic fuel is lignite, fuel oil and natural gas being used at start-up and for flame stabilization.

For the preparation and combustion of lignite, the boiler is equipped with 6

DGS-100 coal mills, with hammers and a fan, and 2x6 slotted coal burners. Figure 1 shows the technological flow diagram for the preparation and combustion of coal. Figure 2 shows the combustion air installation diagram.

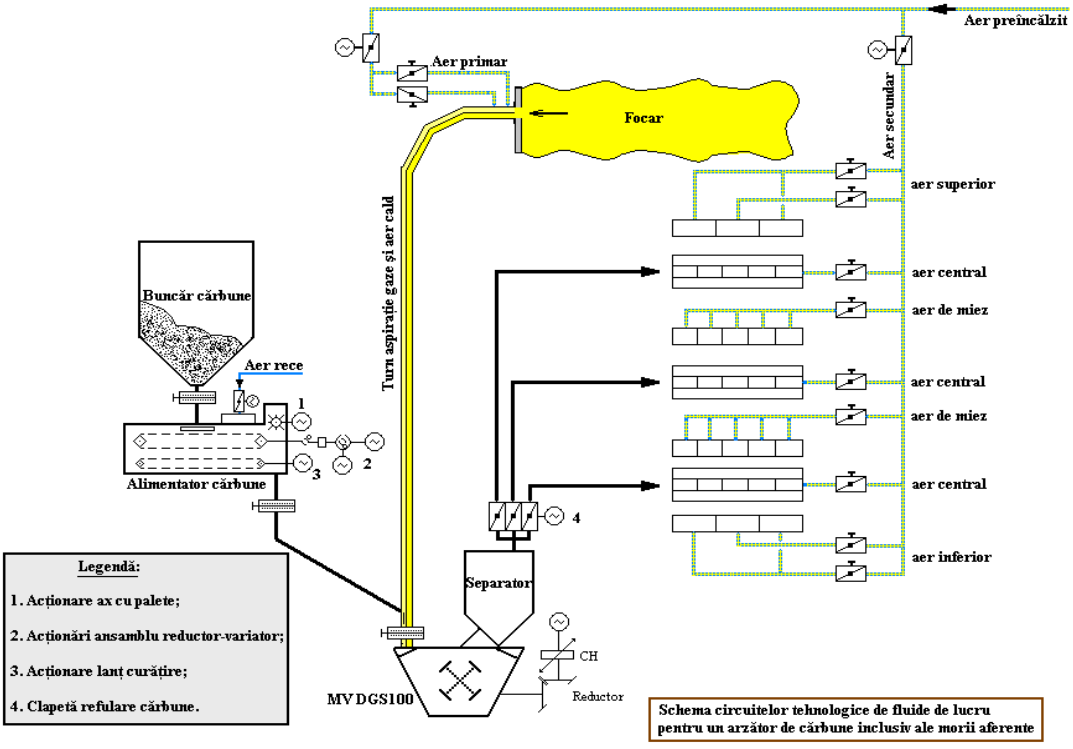

Figure 1 Diagram of technological working fluid circuits for a coal burner

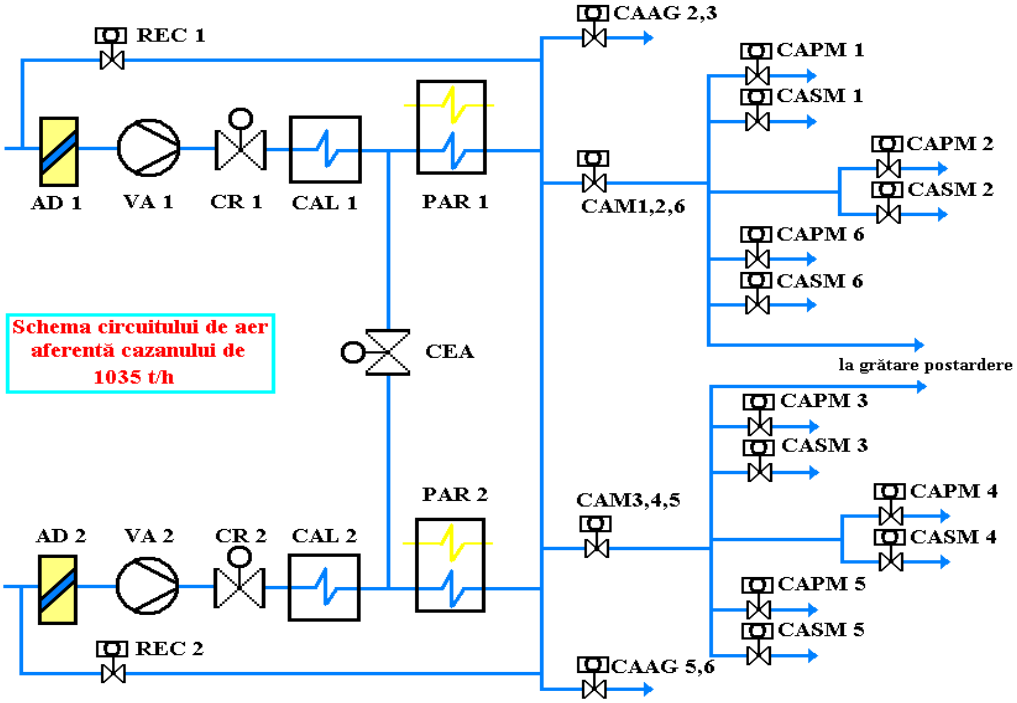

Figure 2 Combustion air circuit diagram

2. EXPERIMENTAL RESULTS

To perform the measurements, the following additional measurement scheme was created:
- measurement points for measuring the flow rates of live steam, feed water and injection water in the intermediate steam. The flow rates (differential pressures) were measured with SPRIANO transducers
- measurement points for determining the static pressures of the fluids (live steam, feed water and injection water in the intermediate steam). The measurement was performed with SPRIANO transducers
- measuring points for determining static pressures on the air and flue gas circuits. The measurement was carried out with "U" tube manometers
- measuring points for determining temperatures on the air and flue gas circuits. The measurement was carried out with K-type thermocouples. Table no. 1 presents the results of measurements on the water-steam circuit.

Table no. 2 presents the results of measurements on the fuel circuit. Table no. 3 presents the results of measurements for air fans.

Table no.1 Measurement results on the water-steam circuit

Nr Crt	SIZE	U.M	SAMPLE NO.		
			1 – 304 MW	2 – 273 MW	3 – 216 MW
1.	Superheated steam flow rate	t/h	955	862	688
2.	Superheated steam pressure	bar	178	175	176
3.	SI steam temperature	ºC	532	535	524
4.	Feed water flow rate	t/h	914	850	682
5.	Feed water pressure	at bar	262	253	226
6.	Feed water temperature	ºC	250	247	240
7.	SII steam flow rate (intermediate)	t/h	904	825	656
8.	Cold intermediate steam pressure	at bar	46	42	33
9.	Cold intermediate steam temperature	ºC	345	339	318
10.	Hot intermediate steam pressure	at bar	46	41	32
11.	Hot intermediate steam temperature	ºC	521	523	519
12.	Ratio W2/W n 2x100	%	90	85	68
13.	Useful heat produced by the boiler	Gcal/ h	648	596	479
14.	Ratio (Qu/Qun)x100	%	94	86	69

Table no.2 Fuel circuit measurement results

Nr Crt	SIZE	U.M	SAMPLE NO.		
			1 – 304 MW	2 – 273 MW	3 – 216 MW
COMBUSTIBIL SOLID					
1.	Solid fuel flow	t/h	358	352	268
2.	Lower calorific value	kJ/kg	8514	8038	8667
3.	Initial moisture	%	46	44	43
4.	Initial ash	%	16	19	18
5.	Number of mills in operation	-	5	5	4
6.	Average mill discharge temperature	°C	176	168	163
7.	Average mill flow	t/h	72	71	67
8.	Gas fuel flow	Nm^3/h	1320	1320	1240
9.	Lower calorific value of combustible gases under normal conditions (0ºC and 760 mm Hg)	kJ/ Nm^3	35990	35987	35987
10.	Natural gas pressure after VR	bar	0,3	0,28	0,35
11.	Gas fuel calorific input	%	1,55	1,65	1,85

Table no.3 Air fan measurement results

Nr Crt	SIZE	U.M	SAMPLE NO.		
			1 – 304 MW	2 – 273 MW	3 – 216 MW
1.	Steam flow SI	t/h	953	869	695
2.	Flow rate of VA 2	m^3/h	438114	442329	397246
3.	Total pressure achieved by VA 2	mmca	328	318	253
4.	Electric power consumed by VA 2	kW	1130	1086	878
5.	Opening of the director device VA 2	%	52	52	41
6.	Motor load VA 2	%	42	41	37
7.	Operating efficiency VA 2	%	38	39	34

3. CONCLUSIONS

The boiler was loaded at loads between 688 t/h and 955 t/h

The maximum boiler load was obtained at test no. 1 and had the value of 955 t/h .

The high-pressure regenerative preheating installation was in operation, the temperature of the feed water at the boiler inlet being, at the maximum boiler load, 250 0C.

The superheated steam parameters had values in the following variation ranges: temperatures 524 □ 535 ºC, and pressures 175 □ 178 bar, lower pressure values than the design ones.

During the measurements, the boiler operation was stable in terms of the variation of the parameters in the water-steam and air-gas circuits.

The block operated with automatic regulation during the tests.
The quality of the solid fuel used during the measurements was located in terms of lower calorific value (8514-8667 kJ/kg) above the coal in the design band.
All tests were performed with a minimum calorific input of natural gas (below 2%).
Coal mills were available. The boiler operated with 5 mills at maximum and intermediate boiler load (without mill 2), and at minimum load with 4 mills (without mills 1 and 5).
The air flows entering in an orderly manner through the air fans had values of about 66% of the total air flow entering the boiler, the rest up to 100% representing the total air infiltrations that occur in the boiler, especially through leaks in the solid fuel feeding and grinding installation.
The unburned content in the slag varied between 38% and 47%, very high values that depend mainly on the combustion and the fineness of grinding of the mills. A fairly high degree of wear of the grinding elements and a number of operating hours are found that may explain the situation. The use of a fuel with a high calorific value above the design band reduced the negative influence on yields through the lower amount of ash contained in it.

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