DEVELOPMENT OF CIRCULATING FLUIDIZED BED TECHNOLOGY IN POLAND

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Introduction

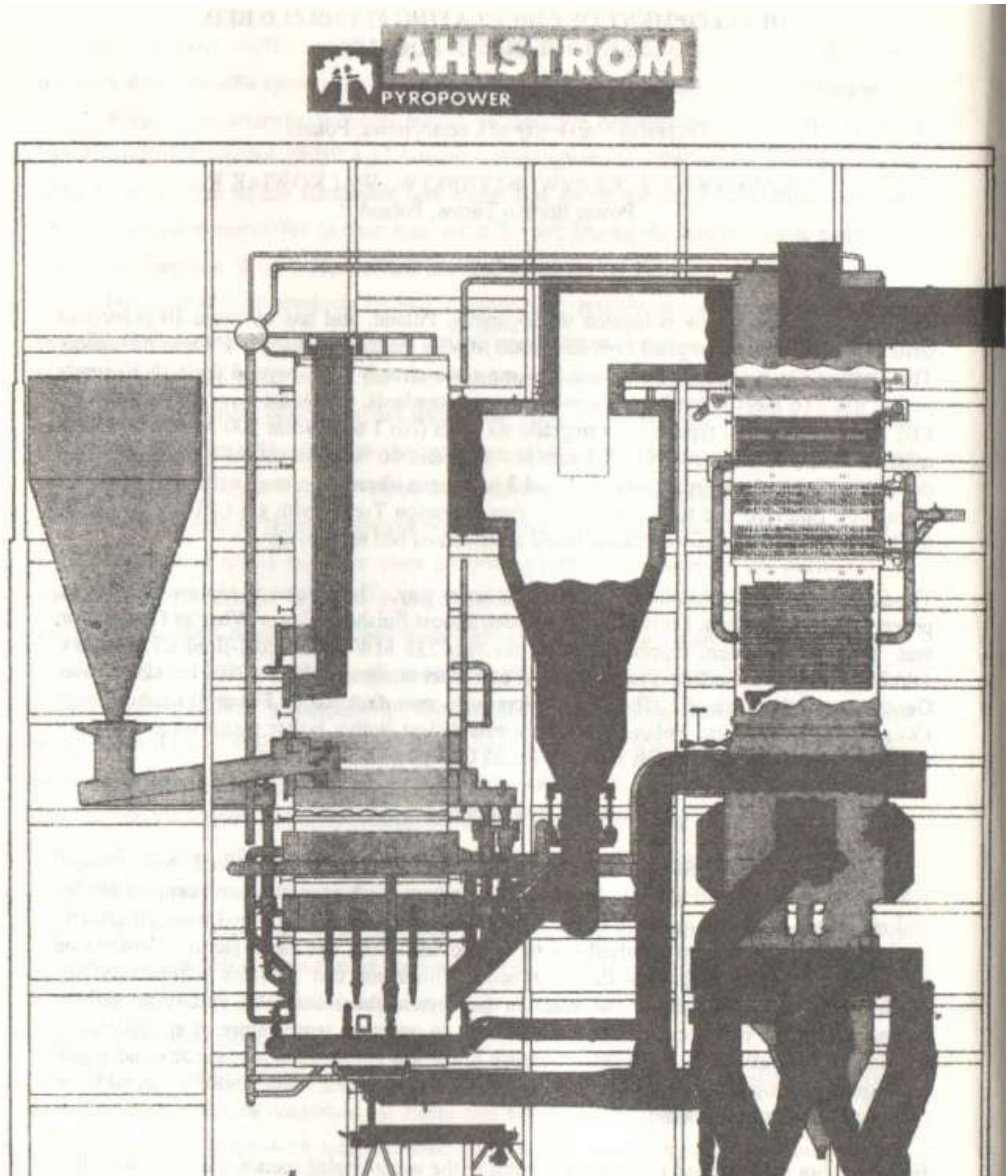
The Power Station Turow is located in Bogatynia, Poland, and has operated 10 pulverised units each 200 MW. The plant provided 2000 MW at the lowest cost per kWh in the nation. The Turow units have approached and in some cases already gone beyond their 25-30 year's design life. To meet Poland's new environmental standards, which are now compatible with EU, Turow decided to replace and upgrade six units (No 1 to 6) from 200 MW to 230 MW units and remove one unit No. 7. Units No 8, 9 and 10 were equipped with dry sorbent desulfurization technology. Units No 1 and 2 have been already replaced with new clean coal circulating fluidized bed technology. The Power Station Turow with six CFB units is to be the largest in the world power station based on fluidized bed technology.

The first phase of the rehabilitation program is under way. The process to replace the existing pulverised coal boilers in Units 1 and 2 has been almost finished. Foster Wheeler Corporation was selected to design, supply and build the two 230 MW reheat coal-fired CFB boilers. Turbine generators, electrical, structure steel and other equipment is provided by ABB Power Generation of Switzerland. The CFB boilers were manufactured by Foster Wheeler Energy Company in Sosnowiec, Poland, the oldest-established Polish boiler manufacturer (former FAKOP) which was acquired by Foster Wheeler Company, USA.

Circulating fluidized bed technology

CFB units at Turow Station utilise the Pyroflow circulating fluidized bed process, schematically shown in Figure 1 [1]. The process uses a water-cooled combustion chamber and refractory-lined hot cyclones to recirculate hot bed material. The bed material (mainly inert ash), fuel and sorbent are fluidized by air provided from two fan systems. Combustion takes place in a hot, vigorous fluidized bed environment that contains a relatively low concentration of combustibles. A reaction between sorbent and SO_2 and other sulphur compounds in the fuel occurs in the combustor at an optimum temperature of approximately 850-888 °C to control SO_2 emissions. Because of the low combustion temperature and staged air supply, nitrogen oxides NO_x are at much lower levels than those achievable in conventional pulverised boilers.

Heat from hot particles and gases is transferred to the water cooled membrane walls and other evaporative superheater surface in the combustor. The larger fraction of the bed material is recirculated to the hot cyclone through a non-mechanical seal back to the combustor. From the outlet of the cyclone, the flue gas enters the convective heat transfer surfaces in the back pass. Hot gas first encounters the final superheat stage then the primary superheat stage and finally the economizer and tubular air heater. Fly ash is removed by electrofilters ahead of the stack.



Modernizacja blokow 1 - 6 - kotly fluidalne

The rate of bottom ash material is controlled to maintain a constant bed inventory. The hot circulating bed of the CFB provides a stable combustion source as long as it is maintained above a certain minimum temperature characteristic of the fuel being fired. Unlike pulverized coal firing, the fuel feed can be interrupted without danger.

Design parameters and fuel

The CFB design parameters are shown in Table 1. Their are fairly typical for a utility plant in the 230 MW size class.

Turow Power Station design parameters of CFB boilers

Table 1

Main Steam:	
Flow	185.4 kg/s
Pressure	131.7 bar
Temperature	540 °C
Cold reheat:	
Flow	165.5 kg/s
Pressure	27.6 bar
Temperature	312.8 °C
Hot reheat:	
Flow	166.1 kg/s
Pressure	24.5 bar
Temperature	540 °C
Feedwater temperature	242.6 °C
Efficiency (on a LHV basis)	>90%

The boilers as design are capable of burning brown coal as shown in Table 2. High heating value of burning coal is 9745 kJ/kg. Mazut oil will be used as a start-up fuel and the start-up burners will be capable of 40% of MCR heat input. The boiler has been designed to reduce emissions of sulphur oxides by the injection of limestone into the furnace.

Fuel analysis

Table 2

Proximate analysis	Performance weight %	Range weight %
Moisture	44	40-48
Volatile Matter	19.8	17.6-22
Fixed Carbon	13.7	12.3-15.1
Ash	22.5	6.5-31.5

Combustion chamber

The combustion chamber is a gas-tight enclosure fabricated from fully water-cooled walls. The lower combustion chamber is a refractory lined, water-cooled enclosure.

Openings are provided in the combustion chamber walls to allow for the connections of solid return inlets, ash outlets, limestone inlets, air inlets, burner inlets, instrument penetration, gas ducts to cyclones and superheat tubes.