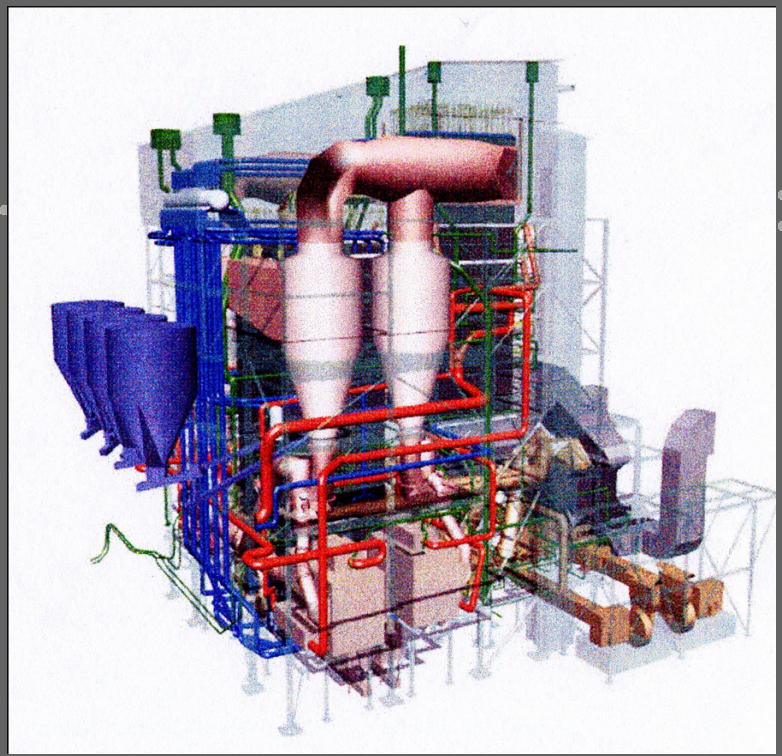

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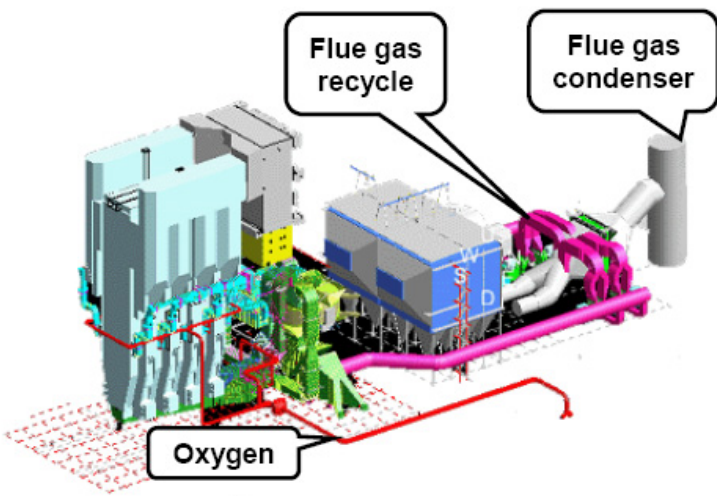
« Oxy-CFB studies »

Philippe Jaud

IEA-FBC, Xi'an, May 19th 2009

A few Oxy-CFB projects are already underway



Source : Foster Wheeler

- **Spanish Government has decided to invest for the CIUDEN 30 MWth class pilot oxy-PC and oxy-CFB facility, which will provides a full experimental platform for the demonstration and validation of oxygen/air fuel combustion,**

- **Jamestown Board of Public Utilities is engaged in the development of a 50 MWe oxy-CFB demonstration at Jamestown plant in New York State in collaboration with Foster Wheeler and Praxair,**

- **Endesa Generacion plans to demonstrate a 500 MWe scale Oxy-CFB for CCS and will apply participation in EU's flagship CCS demonstration program.**

Advanced coal power plants with CO_2 capture

A study has been performed in France (1) to compare various advanced coal power designs with CO_2 capture :

- **High pressure coal gasification (GE-Texaco) integrated with GE « H type » combined cycle, with CO_2 capture,**
- **Oxycombustion with supercritical PC and CFB boilers (1200 MWe, 290b/615°C and 54b/635°C) producing flue gas with very high CO_2 content,**
- **Capture of CO_2 in the flue gas with the possibility of enriched air PC combustion.**

I will discuss the oxy CFB design in the following slides.

(1) Study performed in 2006 by Alstom, EDF and the Technical University of Compiègne (UTC) with the financial support of Ademe (French Agency for Environment and Energy Management)

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Selection of design criteria for oxy-CFB

The first step for an oxy-CFB will be a furnace using an oxygen concentration of about 30 % in order to be able to performed full power on air if needed. This will also permit retrofitting of small scale existing CFB.

But on the medium to long term, the design of oxy-CFB could be improved by reducing the flue gas recycling, thus reducing the size of the furnace and the auxiliaries consumption. In our study, we choose to made an evaluation of a supercritical 600 MW CFB unit using an oxygen concentration of 70 % which has been tested on several small scale pilots. Thus the design data were as follows:

OXY-CFB	600 MWe Gross Power
Steam parameters	main steam : 1476 t/h at 290 b/615 °C reheat steam : 1260 t/h at 54 b/635 °C efficiency : 44,4 % LHV (air) ⇒ 35 % LHV (oxy)
ASU	8500 t/day at 95 % O_2 purity , 70 % O_2 for combustion + 23 % CO_2 + 7 % (N_2, Ar, H_2O)
CO_2 recycled to the furnace	170 t/h (but 620 t/h needed for FBHEs ⇒ use of Nitrogen instead)
Flue Gas after CO_2 recycling	432 t/h with 90 % CO_2 (dry basis)

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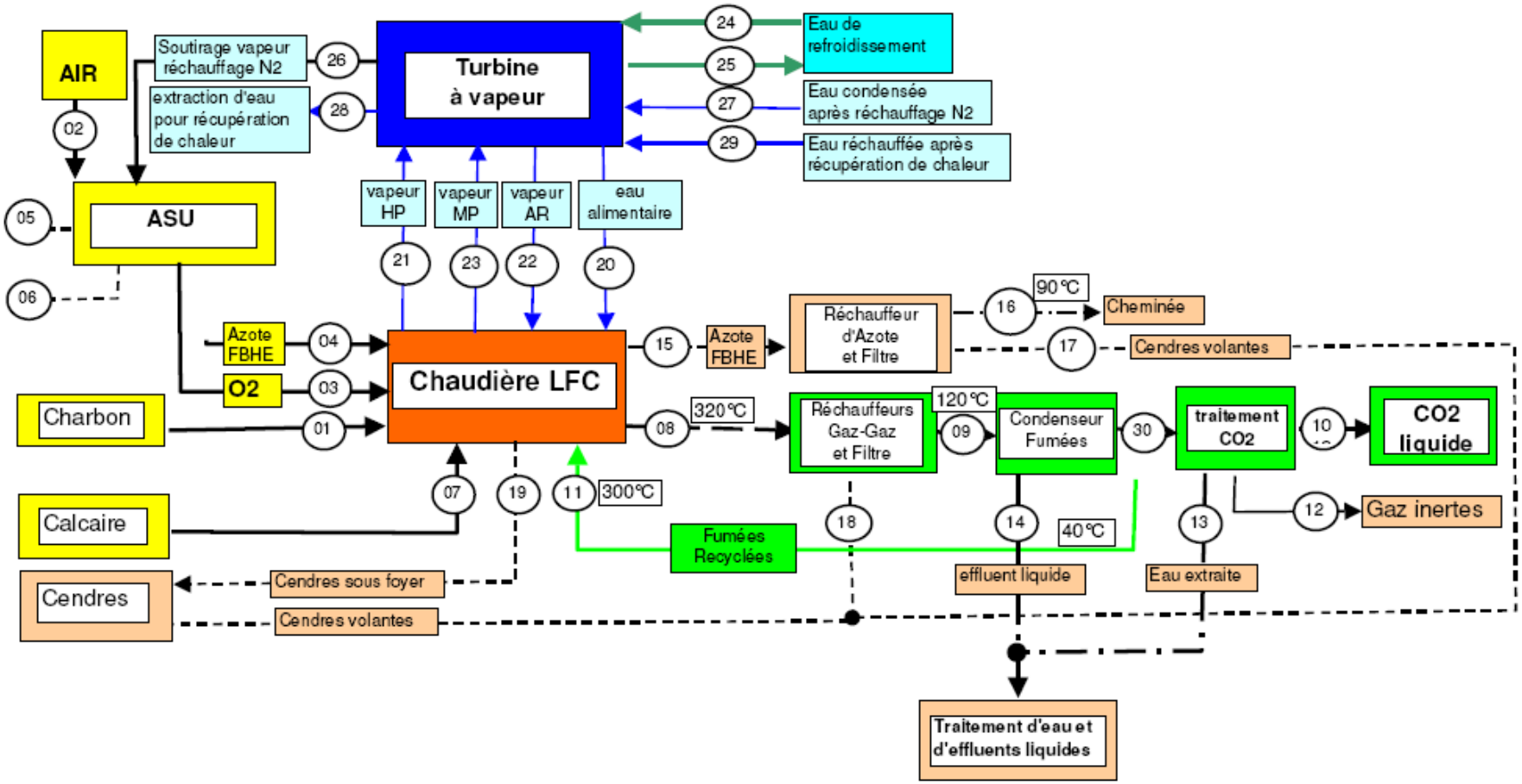
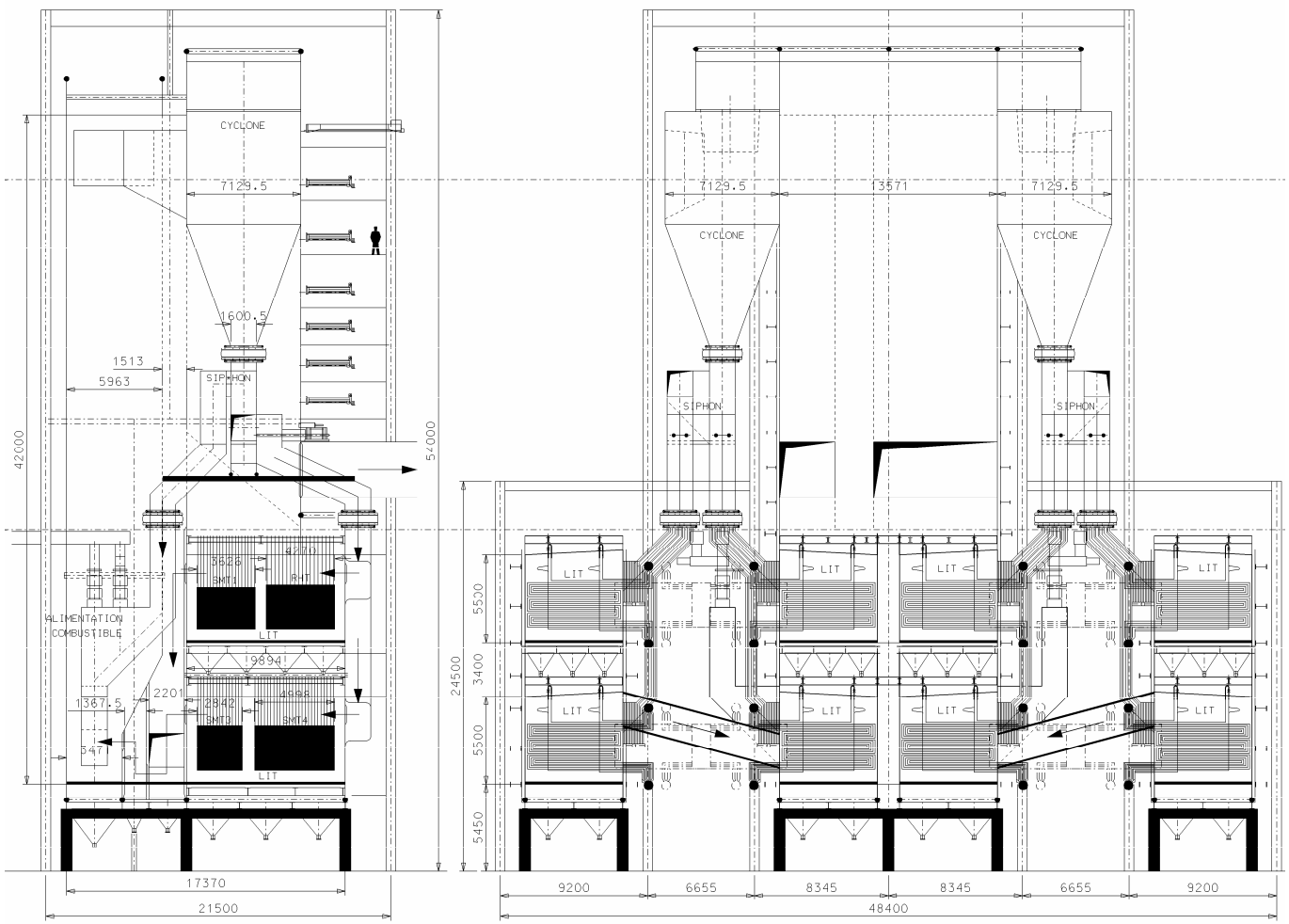
Main configuration of a 600 MW oxy-CFB plant



Source : Alstom

View of a 600 MW oxy-CFB with 2 cyclones and 8 FBHEs



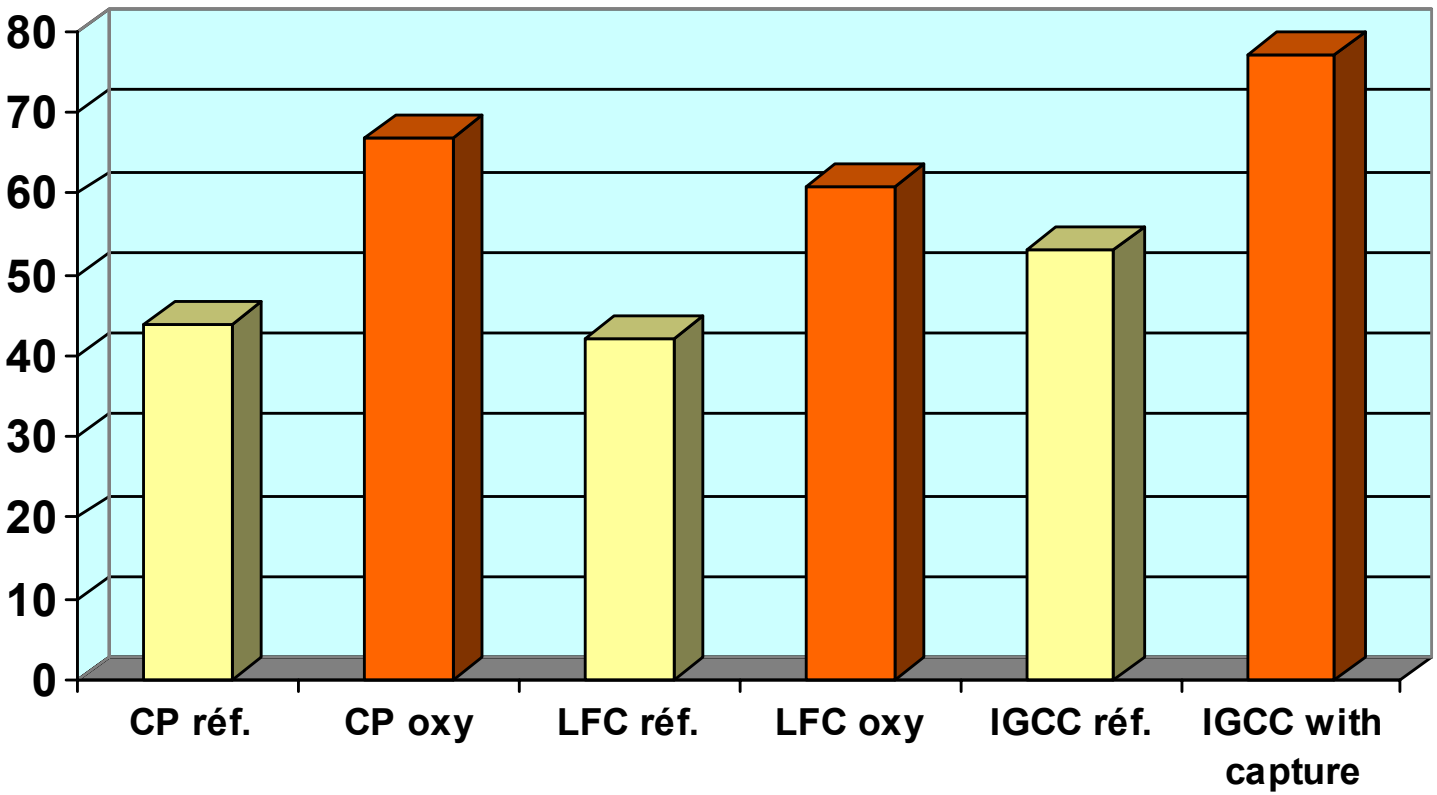
Source : Alstom

Main challenges for a 600 MWe oxy-CFB with 70 % O_2 and large FBHEs

- To be able to design large FBHEs (twice the size of existing ones) with good fluidization and hydrodynamic to avoid local overheating of tube bundles,
- To be able to provide enough solids to the FBHEs in particular at part load,
- Necessity to cool down the nitrogen used for fluidization in FBHEs (for energy recovery in dedicated heat exchangers) and clean it (dedusting, CO, SO_2 ?) before discharge to atmosphere,
- To be able to calcine the limestone in the furnace under high CO_2 concentration (T > 900 °C) in particular at part load,
- To avoid risk of recalcination and agglomeration in areas where T < 900°C and CO_2 concentration is high (loop seals ?),
- If ASU is not operating, full load cannot be reached with air only if the furnace is design for high O_2 concentration.

Economical evaluation

Euros/MWh (without CO_2 transport & storage ~ 20 €/MWh in France)



If successful, large oxy-CFBs have the potential to be 10 % cheaper than oxy-PC

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