Ultra Super Critical Boilers

Clean Coal Technology

The USC boiler with a PF combustion system will still be the simplest and most efficient way of using coal for power generation.

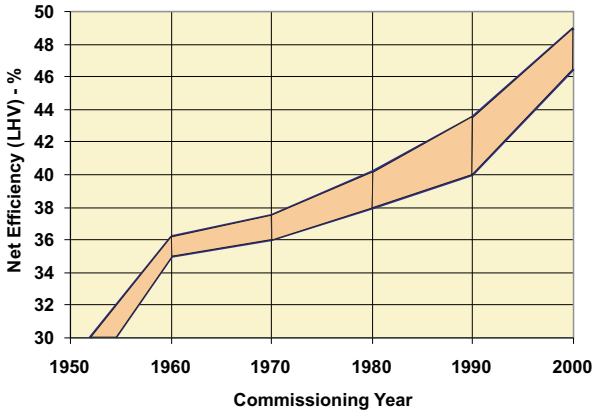
A substantial part of the world's growth in power generation will be based on coal for at least the next 20-30 years. At the same time there is a requirement for reduction of harmful emission from coal fired units and also an increasing demand for limiting greenhouse (CO_2) emission.

The current approach for facing these requirements is called "Clean Coal Technology". This is a frame containing various solutions which all have the same basic idea: Reduce or limit the formation of harmful substances and thereby reduce the amount of necessary secondary measures. One of the most favoured solutions is the Ultra Super Critical (USC) power cycle which has demonstrated in several plants that it is a fully commercially developed process with excellent performance and availability records.

The background for the USC process is the well known Rankine steam cycle which was developed during the 1980's and 90's in the form of the Benson, once through principle, from the subcritical through the supercritical to the ultra supercritical design with the first two units in commercial operation in 1997 and 1998 - Skærbækværket Unit 3 and Nordjyllandsværket Unit 3, and the third unit, Avedøreværket Unit 2, in 2001 - all three located in Denmark.

The USC Cycle

During the transition period from sub-critical to USC, the net electrical efficiency has increased from 42 to 49%.



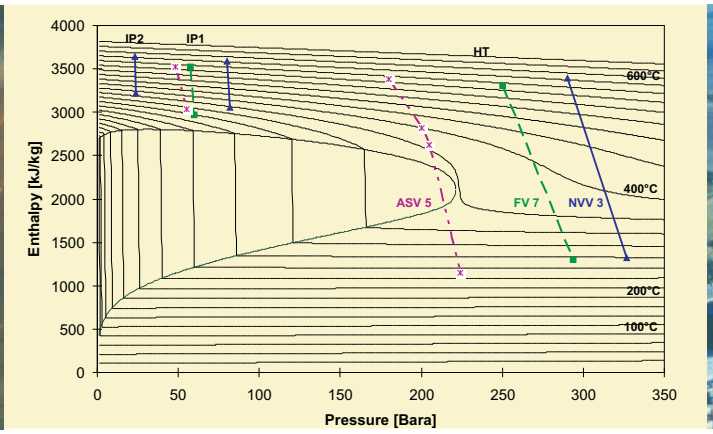
This transition process itself has been a step-wise progress and the outcome is now a success on all major technical features, i.e. the water/steam process, pulverized fuel combustion and heat transfer.

During the period the steam temperature has increased from 540 °C to 600 °C and the pressure from 200 bar to 305 bar.

Apart from the improvements in the steam cycle and the related development of new materials, there have also been major improvements in the design of boilers, turbines and other main components of the power plant.

Material Development

The main design challenge in USC boilers can be found in the thick walled steam headers, the superheaters and the furnace walls.



The problems are connected with the selection of materials and manufacturing methods. In drum boilers, it is possible to make the whole boiler pressure system in normal ferritic materials. For the higher pressures and temperatures in the USC boiler, new ferritic/ martensitic high-temperature steels like the P91 and P92 have been developed for commercial use. For the final stages in the superheaters, an austenitic material like Super304 has been selected as having the necessary creep rupture strength and high temperature corrosion resistance. By only using the austenitic materials in the relatively thin walled tubes, the problem with thermal fatigue is minimized.

USC Boiler System

The main design features of the Ultra Supercritical boiler are:

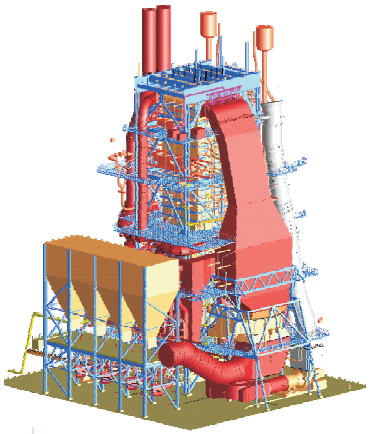
- One pass tower type design
- Superheaters and economizers in horizontal tubing
- Tangential firing system with circular burners

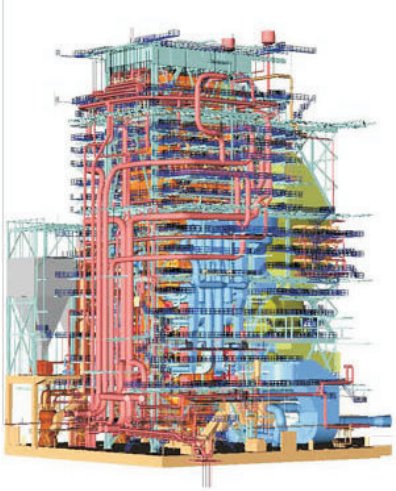
This design is chosen because it gives the most compact, material-saving design. Process and operational wise, it also gives the advantage of a symmetrical and well defined flue gas flow, which will bring about a more homogeneous temperature profile of the flue gas and of the water/steam.

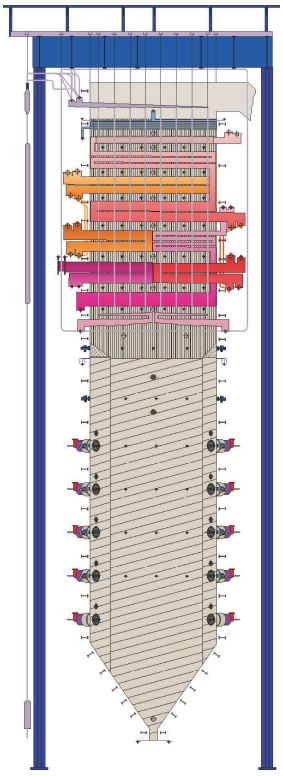
In order to control the steam outlet temperatures in an economical way, an FGR (Flue Gas Recirculation) system can be installed.

The Firing System

The design idea of the combustion system is to establish the best possible conditions for Low NOx combustion. The circular burners are placed in the corner of the furnace. Above each burner are OBA (Over Burner Air) openings, and at the top of the furnace OFA (Over Furnace Air) openings, which together with the air split in the burners establish the air staging.







World leader in steam power technology

Burmeister & Wain Energy A/S has specialized in the development and design of advanced steam boiler plants for utility and biomass fired power stations.

Furthermore, BWE designs a wide range of auxiliary power station equipment such as the BWE Low-NOx coal/oil/N-gas/biomass burners, Air Preheaters and Gas-Gas Heaters.

BWE is part of the Italian STF S.p.A. Group.

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