DP CleanTech

Creating value from waste

Advanced Turnkey Straw Fired Power Plant

Sangüesa, Navarra, Spain

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Introduction

In 1999, Energia Hidroelectrica de Navarra (EHN), (Acciona Energia) signed a contract with DP for a turnkey 25MW biomass plant to add to their renewable energy portfolio of wind, solar, hydro and biomass power plants. The plant is located in Sangüesa in the Navarra province of Spain and was expected to supply 200,000 MWh to the Province, the equivalent of 60,000 homes. The primary feedstock is wheat straw, with an auxiliary fuel of maize straw, all of which is supplied by local farmers within a radius of 75 km from the plant. The plant entered service in 2002 and has been operating for over 20 years. As the first biomass plant in Spain, it is an important reference for the renewable energy potential of straw biomass.

Power Plant Specification

Location	Sangüesa, Spain
Power output (Net)	25MW
Fuel	Wheat straw
Max water content in Straw	25%
Fuel consumption	19 tph
Alternative fuel	Maize straw
Steam production	103.5tph
Steam outlet temperature	542°C
Steam pressure	92 bar
Feed water temperature	230°C
Boiler efficiency	>92%
Plant efficiency	>32%
Operating hours	>8000 hrs

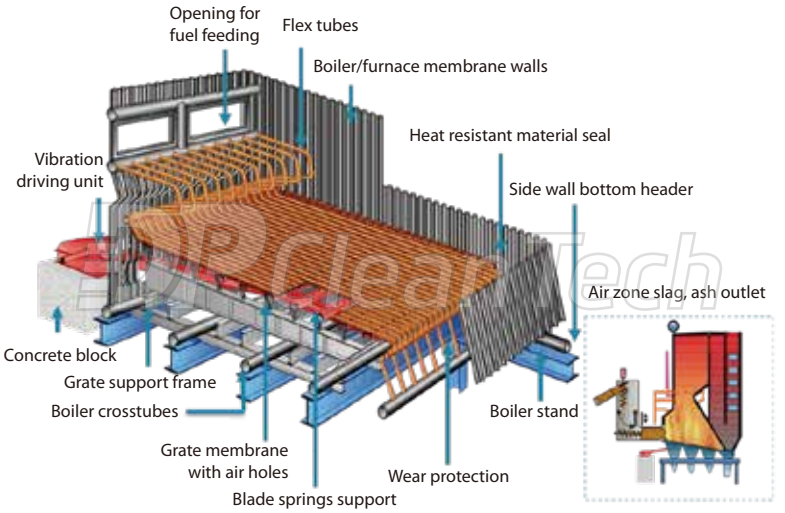
Plant Solution

The proposal was a fully integrated 'chute to stack' solution – to include the fuel handling system, straw-fired boiler island and flue gas cleaning system. A High Temperature, High Pressure boiler would provide the necessary steam parameters of 92 bar and 542°C to achieve the net nominal load of 25 Mwe, with a net peak load performance up to 26.3 MWe.

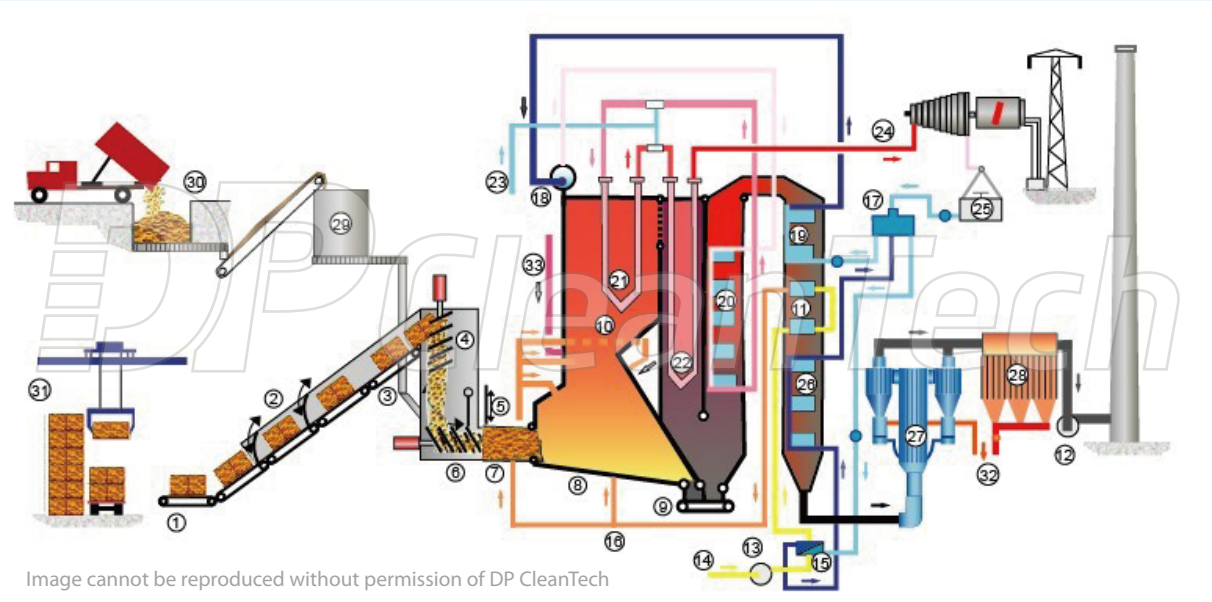
Key Technology

Combustion Grate and Combustion Process

DP's proprietary Water Cooled Vibrating Grate (WCVG) regulates combustion, using an alternating vibration cycle of between 1.5 – 3 minutes for a period of 3 – 5 seconds at a time. The grate was designed specifically for biomass combustion and can accommodate single or multiple fuel types. The vibration inhibits the formation of large slag particles which are common in biomass combustion. This is particularly important for fuels with high slagging and sintering properties. The grate has fewer moving parts and requires less maintenance than standard travelling grates.



Partial combustion air is fed to the furnace from beneath the grate and further combustion air is introduced through nozzles situated above the grate. The stability of the ignition zone is effected through a patented ignition air supply system. The grate is divided into 3 primary air zones. The first zone which receives the straw is subjected to high turbulence in order release volatile matter, which corresponds to 50 - 60% of the straw's energy. The second stage is pyrolysis. In the third stage, the fuel ash and slag are burnt out and transported by the vibrating movement down the grate to the slag fall and finally to the slag pit.



1. Chain conveyor
2. Seal gates
3. Dosing unit
4. Scarifier
5. Fire dampers
6. Stoker
7. Water cooled duct
8. Vibrating grate
9. Slag conveyor
10. Combustion chamber
11. Air preheater
12. Induced draught fan
13. Forced draught fan
14. Combustion air intake
15. Air preheater
16. Preheated combustion air
17. Feedwater tank
18. Steam drum
19. Economizer
20. Superheater 1
21. Superheater 2
22. Superheater 3
23. Water for atemperators
24. High pressure steam to turbine
25. Aircooled condenser
26. Flue gas cooler
27. Gas suspension absorber
28. Fabric filter
29. Wood chip silo
30. Wood chip
31. Straw barns
32. By product and ash handling
33. Natural gas

High Pressure, High Temperature (HPHT) Boiler

DP's unique and well proven boiler design is specially developed for straw firing at high temperature and pressure. The steam boiler is a water tube boiler with hanging superheaters and it produces 103 tons of steam per hour at 92 bar and 542°C, allowing a net overall plant efficiency of 32.4 %. The advanced boiler design and the use of corrosion resistant materials allows optimized operations, with minimal downtime for cleaning and maintenance. The plant operates over 8000 hours pa.

The steam is used in a conventional steam cycle turbine which has a generator output of 29 MWe. The nearby river provides water-cooling.

Fuel Handling

The plant consumes more than 160,000 tons of straw per year with a consumption rate of 19 tonnes per hour. The fuel storage capacity is 4,464 New Holland straw bales (1,875 metric tons). This is a 4-day storage capacity which covers extended holiday periods. Straw bales are assessed for humidity, weight, and fuel value, and then fed onto automatic conveyors to the boiler building, where the bales are loosened and fed into the boiler at the appropriate rate and volume.

Flue Gas Cleaning

After cooling in the boiler, the flue gas is cleaned to remove particulates and prohibited emissions before being discharged through a 60 meter high stack.

Sangüesa Biomass Power Plant development video: https://youtu.be/jbQ1hw7XQ0M?si=5tnYQwOmzw6491hS

Contact Us

DP has 7 offices around the world in 6 countries – China, Denmark, Poland, Thailand, UAE and UK.

To ensure that we can address your needs appropriately, please email info@dpcleantech.com for enquiries or further information.

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