



Advanced Mixed Fuel Biomass Waste to Energy Plant

Uttaradit, Thailand



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Introduction

The client, Uttaradit Green Power Co. Ltd is a consortium composed of Thai rice milling companies and the well-established IPP (Independent Power Producer) Phichit Biopower, which owns and operates a similar plant to convert agricultural waste to electricity. The Uttaradit plant is located in the northern part of Thailand and is the first plant in a longer term plan to support the development of renewable energy from locally sourced biomass and other renewable sources for the benefit of the local community and the environment. The use of materials such as rice husks and cane leaves can help minimize the open field burning which is prevalent in this region, significantly improving air pollution levels.



The Solution

The plant was designed to operate under the conditions of the Thai government's VSPP program for plants under 10MWe. The design fuel is either rice husks or wood bark (up to 100% of each) or a mixture of these fuels. DP's MaxMulti HPHT solution was used to meet the requirements for different fuels. This solution has already been proven in over 100 plants worldwide and is particularly suitable for complex, corrosive fuels such as rice husks and straws.

The contract was signed in mid-2019, and construction took place under the extremely difficult circumstances of the COVID-19 pandemic. Nevertheless COD was completed on 4 June 2021.

DP's scope for this project included the boiler island supply (fuel feeding, combustion, boiler and flue gas treatment) on an EPC basis (design, procure and install and commission); and DP also provided the EPCM service for the balance of plant.

Plant Design

- The plant was designed 'from chute to stack', ensuring optimal integration of different components, maximum efficiency and performance.
- Designed for primary feedstock of locally sourced rice husks or woodchip (up to 100% of each) or a mixture of these fuels. The plant design enables simultaneous combustion of different fuel type, sizes and moisture content.
- The advanced boiler design and the use of corrosion resistant materials allows operation at full capacity (>8,300 hr/year) with minimal maintenance downtime.

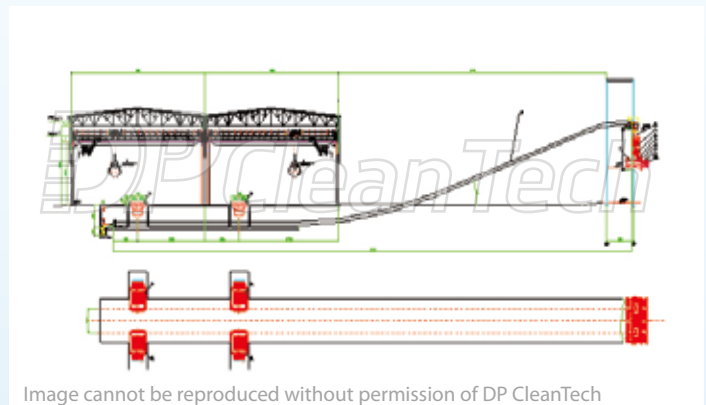
Design Data

Fuel	Rice husk and wood bark
Fuel consumption	8.4t/h with 100% rice husk at 13.19MJ/kg CL VAL
Design fuel mix	100% RH and 100% wood bark
Calorific value (LHV)	10.1-15.0 MJ/KG and 6.8-11.3 MJ/KG
Power output	9.9MWe (gross)
Steam flow	36.62t/h
Steam pressure	96 bar
Steam temperature	520 °C
Boiler efficiency	90%
Gross plant efficiency	31%
Net heat rate	< 13,250kJ/kWh
Availability	>8,300 hours/year

Key Technology

Fuel Handling

The feedstock is stored both outdoors and indoors, which creates different moisture levels that need to be managed. The fuel is transported to the pusher feeder via 2 automatic moving floors and screw and belt conveyors. The pusher feeder allows the combustion of pre-processed feedstock, feeding the fuel into the boiler combustion chamber. There is also an alternative fuel inlet directly onto the belt conveyors.



The 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. Combustion air is fed to the furnace both from beneath and above the grate. The grate is divided into 3 primary air zones. The first zone is subjected to high turbulence to aid the release of volatile matter and moisture. The second stage is the pyrolysis, the third stage is for burning out. The fuel ash and slag are transported along the grate by the vibrating movement into the slag fall, then into a submerged slag conveyor, finally discharging into a slag pit. The grate was designed specifically for biomass combustion and will reliably and effectively accommodate mixtures of woody and herbaceous fuel. The vibration inhibits the formation of large slag particles, common in biomass combustion. This makes the grate suitable for burning fuels with high slagging and sintering propensities. With fewer moving parts than a standard moving grate, less maintenance is needed.



High Pressure, High Temperature (HPHT) Boiler

DP's unique and well proven steam boiler is a water tube boiler with hanging superheaters producing 36.62 tons of steam per hour at 96 bar and 520°C. The steam is used in a conventional steam cycle turbine. The specially selected materials and advanced temperature control counteract the fouling and corrosive effects of the fuel. The flue gas, having been cooled in the boiler, is cleaned in an electric filter before being discharged through the stack.

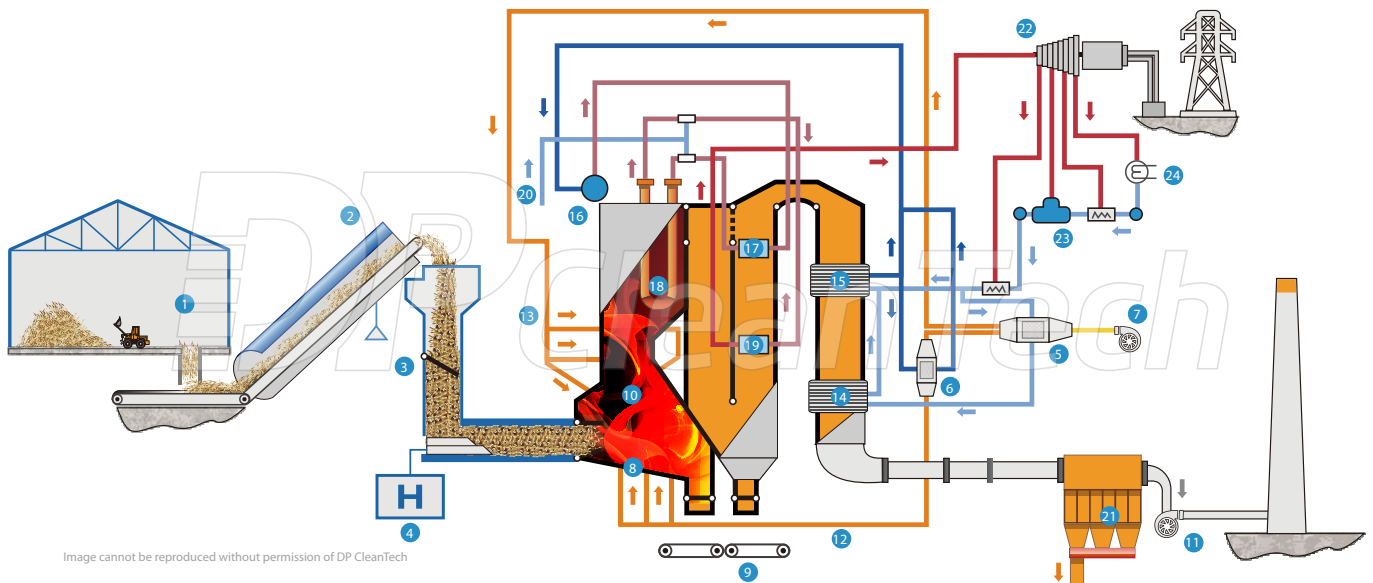


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|----------------------------------|-----------------------|--------------------|------------------------|
| 1 Fuel storage | 7 FD fan | 13 Secondary air | 19 Superheater 3 |
| 2 Belt conveyer | 8 Vibrating grate | 14 Flue gas cooler | 20 Water for atomizers |
| 3 Pusher feeder | 9 Slag conveyor | 15 Economizer | 21 ESP filter |
| 4 Hydraulic station | 10 Combustion chamber | 16 Steam drum | 22 Turbine |
| 5 Low temperature air preheater | 11 ID fan | 17 Superheater 1 | 23 Deaerator |
| 6 High temperature air preheater | 12 Primary air | 18 Superheater 2 | 24 Condenser |

Plant and Boiler Automation

DP developed and programmed the entire advanced boiler control system to support 100% automatic operation in continuous run time. The plant can operate at full capacity for >8,300 hrs/year, with minimal operator assistance. The automation system monitors the combustion process and fuel feeding system using proprietary software and data supplied from field instrumentation, and adjustments can be made automatically for different feedstock combinations. The process is regulated automatically but can also be manually controlled if necessary. Powerful data trend and automatic reporting functions enable fast diagnosis and troubleshooting, minimizing downtime. All boiler protection and plant safety interlock functions are controlled by the system for maximum safety and reliability.

Testimonial

Uttaradit Green Power's Managing Director was one of the key individuals in this project development and commented "DP's team have worked tirelessly to meet the development milestones resulting in this successful outcome. We have been very pleased with the construction process which has been straightforward and demonstrates DP's strengths in design and planning, and their considerable experience in construction and project management".

The project is DP's second plant in Thailand, the first being the pioneering "all-coconut-waste" combustion plant in Mahachai.

