DP CleanTech
Creating value from waste

Nongkhai RDF Power Plant Project

Nongkhai, Thailand

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Introduction

The 8MWe Nongkhai RDF Power Plant began commercial operation in 2022.

Owner: Nongkhainayu Co., Ltd. (Super Energy)

Operator: A2 Technologies Co., Ltd.

Plant Location: Thailand, Nongkhai Province

Project Name: NKNY 8MWe RDF

DP Scope: Full Engineering, Procurement, Construction and Commissioning (EPC) for Boiler and FGT.

Scope of Work

WTE Boiler

- Boiler Pressure Part
- Refractory's Boiler Part special design for WTE Plant
- Feed Water System
- Main Steam Piping from Boiler to Steam Turbine
- Fan System (FD, EGR and ID Fan)
- Boiler Cleaning System (Water Jet Cleaning and Soot Blow)
- Ducting and Damper System
- Steel Structure and Platform (Included Pipe Rack between Boiler and Steam Turbine Building)
- Bottom Ash Transfer System
- Boiler Chemical Dosing Unit
- Sampling Water System
- Insulation and Cladding
- Stack
- Manual Valve and Control Valve
- Electrical and Instrumentation

FGT (Flue Gas Treatment)

- Quenching System
- Reactor Tower
- Bag Filter Unit
- Lime Dosing System
- Activated Carbon dosing System
- Lime Recirculation System
- Residue Transportation and Storage System
- Insulation and Cladding
- Heat Tracing System
- FGT Control System (PLC)
- Ducting and Damper System
- Steel Structure and Platform
- Manual Valve and Control Valve
- Electrical and Instrumentation

Situation

The Thai government has a roadmap for energy security and sustainability, which includes renewable energy options. Biomass fuel is abundant in Thailand and DP has already built several plants using waste biomass resources. However, increasing volumes of waste, and stringent environmental regulations were informing the need for a sustainable waste to energy infrastructure. For Super Energy, the preferred fuel source in this situation and location was RDF (Refuse Derived Fuel). RDF is the separated, combustible component of MSW, industrial or commercial waste. The composition of RDF fuel is a critical element in the design and operation of a thermal power plant, and establishing the specific characteristics of the RDF is a crucial first task.

The Importance of Fuel Analysis and Technology Selection

Waste fuel varies significantly in composition and thermal degradation. These characteristics directly affect the formation of ash and emissions, and the physical and chemical properties must be properly understood. Technology options for energy conversion include both thermal combustion and thermal gasification - each has merits depending on the nature of the fuel, the emissions requirement and the volume of fuel.

From the initial fuel analysis, DP's experts were able to model the design and operation of various thermal conversion systems to determine the best technology from DP's portfolio.

Design Fuel Analysis

	Nominal	Dimensioning
Carbon	36.2%	25 - 43%
Hydrogen	5.0%	3.8 - 6.0%
Oxygen	26.0%	18 -38%
Nitrogen	1.15%	1 - 1.3%
Sulfur	0.24%	≤0.3%
Chloramine	1.75%	≤3.0%
Other	29.66%	20 - 40%

Elementary analysis on dry basis

DP Solution

Following the fuel analysis, DP proposed various options for discussion. The final recommendation was a comprehensive, end-to-end solution for the design, manufacturing, and installation of the RDF boiler and Flue Gas Treatment (FGT) system. The scope included boiler pressure parts for efficient RDF combustion, a robust FGT system with bag filters, lime, and PAC injection to meet emissions standards, and a feed water system to ensure consistent steam quality.

The solution also included air and flue gas ducts for optimal combustion; refractory lining and insulation for protection and efficiency; and comprehensive valves, armatures, and instrumentation for safe and efficient operation.

A Selective Non-Catalytic Reduction (SNCR) system was also recommended to reduce nitrogen oxide emissions, alongside an ash and slag removal system for efficient by-product management. DP's design and engineering teams in Denmark and Poland headed the design effort, with the FGT design and engineering being conducted in the UK.

Fuel Capacity Design @ MCR

LHV (Low Heating Value) ..... 8,374 kj/kg
2,000 kCal/kg
Fuel Capacity ..... 15,833 kg
Thermal Load ..... 33.92 MW Fired
Fuel Capacity ..... 380 Tons per day

Pit Volumetric Capacities

Fuel Pit ..... Approx. 5,000 m^3
Approx. 15mW x 40.2mL x 6.0mH

Fuel Charging System

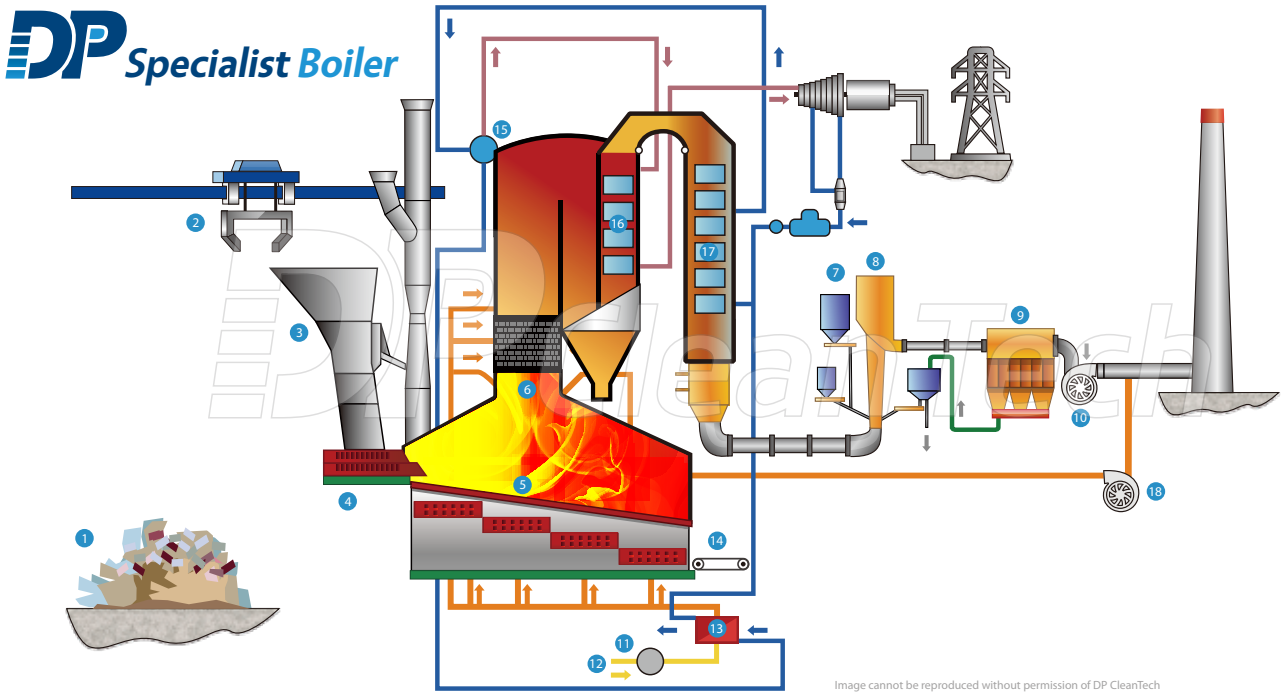
Fuel Crane ..... 1 Set
Crane Type ..... Electric Overhead Travelling Crane (Grab Crane)
Feeding Amount ..... 15.83 tph
Fuel Dumping Gate ..... 5 Units

Key Elements of the Solution:

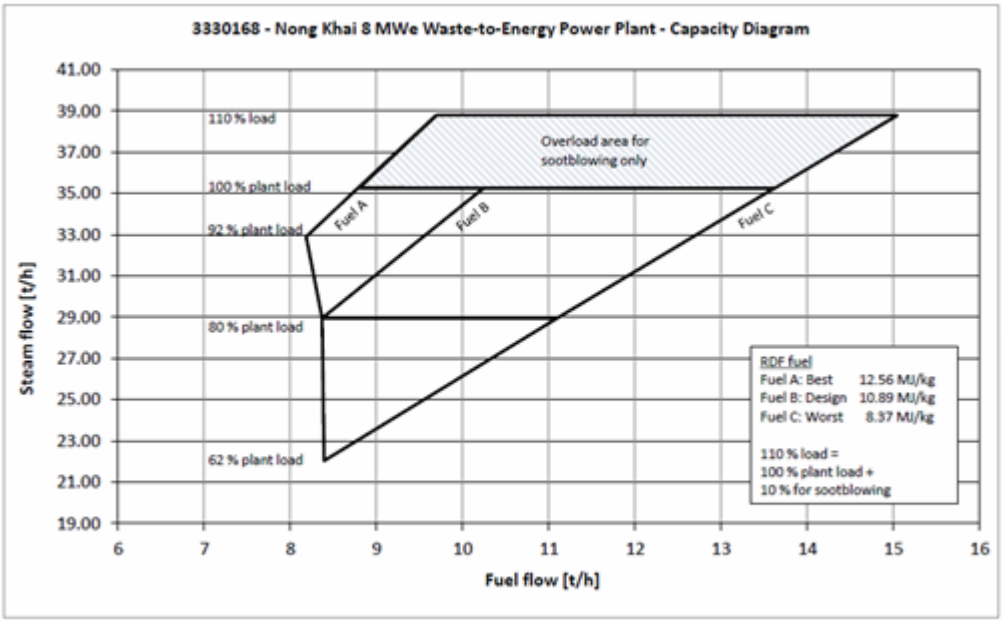
Boiler Island

From deaerator to the main steam pipe of steam turbine.

Incorporates Feed Water System and Flue Gas Treatment (FGT).



1 Waste bunker
2 Crane
3 Feeding hopper
4 Pusher
5 Step grate
6 Combustion chamber
7 Reagent storage
8 Venturi reactor
9 Bag filter
10 ID fan
11 FD fan
12 Combustion air intake
13 Air preheater
14 Slag conveyor
15 Steam drum
16 Superheater
17 Economizer and flue gas cooler
18 Flue gas recirculation fan



Technical Design Data

- Maximum Continuous Rate (MCR) of Steam Flow: 38.78 tph
- Main Steam Temperature: 465°C
- Main Steam Pressure: 61 bar (g)
- Boiler Efficiency on LHV or NCV basis
- Emissions to be less than 90% of Thailand's regulations

Boiler Operation Data

Position	Dim.	Boiler Output
Boiler Load	%	100
Steam Output, Boiler Outlet	t/h	38.78
Steam Pressure, Boiler Outlet	Bar (g)	61
Steam Temperature, Boiler Outlet	°C	465
Corresponding Terminal Power, Gross	MWe	8.0

Position	Dim.	Load Range
Boiler Load Range	%	62-100
Boiler Load Range with Full Superheating	%	80-100

Emissions Data

Position	Dim.	Thai Emission Standard
Particulate Matter (PM)	mg/Nm^3	≤70
SO_2	ppm	≤30
HCl	ppm	≤25
Hg	mg/Nm^3	≤0.05
Cd	mg/Nm^3	≤0.05
Pb	mg/Nm^3	≤0.5
Dioxin	ng/Nm^3	≤0.1
Opacity	%	≤10

Emission guarantees are typically the daily average values at a reference of 7%-vol. O2 in dry Flue gas at Normal conditions 1 atm and 25 °C.

Engineering and Fabrication

Utilization of state-of-the-art engineering processes from Europe (Poland, Denmark, UK) and fabrication in China to ensure cost-effectiveness and compliance with international standards.

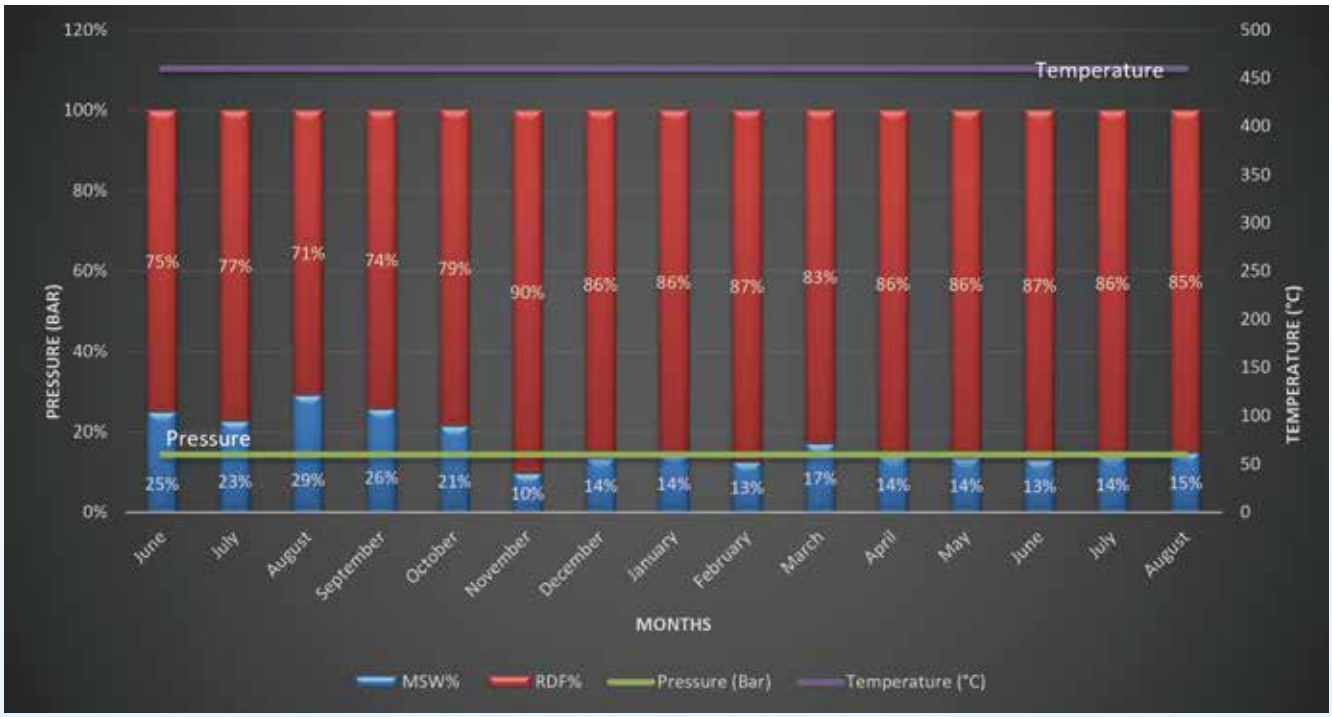
Plant Performance

Commissioned (First Fire) on 9 October 2022.

Commercial Operation Date (COD) on 30 November 2022.

The plant has achieved its designed output levels of 8 MWe gross and 6 MWe net, optimized fuel consumption, and reduced emissions to well below regulatory limits.

Operational reliability also increased, with guaranteed availability of at least 8,000 hours p/a ensuring consistent performance. These improvements underscore the project's impact on energy efficiency and environmental sustainability in Thailand.



Year: 2023-2024

Conclusion

The successful completion of the Nongkhai RDF Power Plant Project highlights DP CleanTech's expertise in delivering advanced waste-to-energy solutions through its international design and engineering team and experienced supply chain.

By integrating state-of-the-art technology and adhering to rigorous environmental standards, DP CleanTech has ensured the long-term operational efficiency and sustainability of the Nongkhai RDF Power Plant. This project contributes significantly to Thailand's ambitious renewable energy targets, aiming for carbon neutrality by 2050 and net-zero greenhouse gas emissions by 2065. The successful implementation of this project not only supports national goals but also sets a benchmark for future waste-to-energy initiatives in the region.