1 Introduction

The purpose of this article is to shortly describe and provide basic information of the logistic processes in a coal power plant covering electricity demand in the described region.

2 General project description

Vung Ang 1 thermal power plant with capacity of 1,200 MWe is owned by PVN (PetroVietnam – Vietnam National Oil and Gas group).

Main fuel used by the boiler is dust coal- No.5 from Cam Pha, auxiliary fuel (for start-up and firing support in case of low load), is heavy fuel oil (FO) - No.5B in compliance with the Vietnamese standard 6239-2002. Coal and FO will be transported to the plant by sea. Coal is loaded / unloaded at the coal jetty, FO loaded/unloaded via Vung Ang Port and transported by road.

Fig. 1 Location of VA1 coal fired power plant
The construction location of the power plant is on the east side of Hai Phong village, Ky Loi commune, Ky Anh district, Ha Tinh province, within Vung Ang Port – industrial zone, 8 to 9 km far from the National Highway (Fig. 1) with geological coordinates: N: 18°05'-18°05', E: 106°22'-106°30'. Site elevation (to top of soil platform) is 8.00 m (MSL).

3 Configuration and logistic processes

There are 2 units each rated 600 MWe each, with common stack, coal handling, ash handling, seawater cooling system [1].

- Turbine generator gross output: 600 MWe (at MCR),
- Main steam parameters: 24.2 MPa and 566 °C,
- Main steam flow rate: 1995 t.h\(^{-1}\) (at MCR),
- Reheat steam parameters: 4.263 MPa and 566 °C,
- Reheat steam flow rate: 1624 t.h\(^{-1}\) (at MCR),
- Exhaust steam flow: 1151.8 t.h\(^{-1}\),
- Exhaust steam pressure: (back-pressure): 10.2 kPa,
- Feedwater temperature: 280 °C,
- Stack emissions (at 6% \(O_2\)): \(SO_2\) 200 mg.(Nm)\(^{-3}\)
  – \(NO_x\) 400 mg.(Nm)\(^{-3}\)
  – CO 1000 mg.(Nm)\(^{-3}\)
  – Particulates 50 mg.(Nm)\(^{-3}\)
- Coal consumption: @ 85% capacity for both units 4200000 t per year,
- Number of ships: 40 to 50 per year,
- Cooling water (sea water) for both units: 61 m\(^3\).h\(^{-1}\),
- Generator voltage: 22 kV,
- Main step-up transformer outlet: 500 kV.

Vung Ang 1 power plant, 2x600 MWe is now in the early stages of main equipment installation. Located in the middle of Vietnam, it also plays an important role in the growing infrastructure of the area and country itself (Fig. 2).
Fig. 2 Vietnam's 1200 MW Vung Ang 1 coal fired power plant is one of the largest infrastructure project currently under development.

Power plant layout (Fig. 3) based on basic layer of description can be described as follows [2]:

**Fig. 3 Layout of VA1 coal fired power plant**

1 – Administration, Workshop, Canteen, Warehouse buildings,

2 – Sea water Flue gas desulfurization FGD, Electro static precipitator ESP, stack,
3 – Ammonia storage system, auxiliary boiler system, ash handling temporary store and system,
4 – Steam generator structure,
5 – Steam turbine structure,
6 – Heavy fuel oil system HFO, water treatment plant,
7 – Switchyard area,
8 – Coal storage area and handling system,
9 – Coal jetty,
10 – Sea water discharge,
11 – Sea water intake structure and wave block,
12 – Sea water pump house and sea water intake basin,
13 – Hydraulic ash disposal system.

Underlying the power plant design, there are the following major considerations:

• a layout to accommodate a wide range of coal, including possibility for blending two types of coals,

• the use of well proven components and suppliers,

• redundancy concept to avoid plant outages and minimize operation risk by supplying n+1 components for all but the largest plant components.

3.1 Coal handling and heavy fuel oil storage

As the coal supply will be by ship, the plant is equipped with a coal jetty for receiving the coal, which will be unloaded by means of two continuous ship unloaders and delivered to the coal jetty yard by the receiving conveyors.

The capacity of the stock yard is about 45 days supply of coal. The two covered coal sheds are equipped with two combined stacker/reclaimers which allow simultaneous unloading from the ships with one machine and reclaiming with the other two machines for blending of two coal types. The reclaimed coal is brought via reclaiming conveyors to coal bunkers of two units.
For start-up, the plant is using light oil as fuel for auxiliary steam system, which is filled by auxiliary steam boiler. For stabilization of fire and for 30% of load the heavy fuel oil is used.

3.2 Steam generator

Each steam generator is of subcritical drum type design with single reheat. The facility is capable of operating in fixed and sliding steam pressure mode. The steam generator is two pass type, top supported with all water cooled membrane walls. The heating surface consists of three stage super heaters, single stage re heater and economiser. Superheater steam temperature control is achieved by two stage spray type desuperheaters. Reheater steam temperature control is achieved by gas dumpers, as the second pass super heater and reheater is located at in parallel flue gas paths. The economiser is located at the bottom of the second pass and consists of a horizontal tube with fins. The coal firing system is of direct, pressurised type for pulverised coal.

The coal is fed from coal bunkers via gravimetric coal feeders into the five coal mills, which are of the vertical-spindle medium-speed type. Cold and hot primary air dries the coal and transports it to the burners via pulverised coal piping. The burners are of dual flow, low NOx type with a swirled air flow, and are arranged in opposed firing configuration. The draft system is of balance-draft type and consists of two primary air fans, forced-draft fans, regenerative air preheaters and Induced-draft fans, plus all connecting ducts up to the chimney.

3.3 Steam turbine

The tandem-compound turbine has a single-flow High-pressure cylinder, double flow intermitted cylinders and four-flow low-pressure cylinders. Reheated steam is admitted to the intermitted section at through two combined-reheat stop and intercepts valves. The steam exhausts from the intermitted part and low-pressure part at the generator and via a crossover pipe. The low-pressure section is of two double-flow construction. It exhausts downward to the condenser.

3.4 Cooling water

Two circulating water pumps supply the condenser with circulating water from the sea. The circulating water system is unitised, with individual travelling band screens and circulating water pumps, with interconnecting discharge valves and piping. The system is equipped with cathodic protection for the purpose of corrosion protection.

After passing through the titanium condenser tubes, the circulating seawater is routed to the seal pit and later discharged into the sea. For auxiliary cooling, additional cooling water is taken from the condenser cooling water inlet to closed-loop cooling water heat exchangers. A portion of the seawater is supplied to the flue gas desulphurisation plant.
3.5 Flue gas treatment

The emission limits for Vung Ang 1 are equal to or significantly lower than World Bank guideline. The flue gas is treated in electrostatic precipitators (ESP) and a flue gas desulphurisation plant (FGD), while the emissions limits for CO and NO are met by the advanced low NO burners.

The FGD process uses sea water's inherent ability to absorb and neutralise the sulphur dioxide of the flue gas. The flue gas is routed to the absorber where flue gas and seawater are brought into contact with a counter current flow. After reaction with the seawater, the desulfurized clean flue gas exhaust is emitted to the atmosphere via the stack. The seawater used in the FGD will be treated before it is discharged, first in a mixing chamber-process where acidic absorber effluent and additional seawater are mixed to neutralise the pH and then in an aeration basin process where oxidation of S0₂ to sulphate, pH neutralisation on and oxygen saturation of the liquid are carried out.

3.6 Ash handling

The ash-handling system consists of submerged scraper conveyors (SSCs), which are used to remove ash from the boiler bottom hopper and transport it via crushers to the bottom-ash silo. From this silo the ash will be transported by ash slurry systems with a recirculating- water system to the ash pond. The fly-ash handling system carries fly ash pneumatically from the other boiler hoppers and the ESP to the fly-ash silo. From the fly-ash silo, the fly-ash will be loaded into dump trucks for reuse or brought to the ash pond.

3.7 Water and waste water

An ion exchange system provides the demineralised water for power plant operations.

The waste water treatment plant is designed to treat all effluents produced from the plant to comply with the environmental regulations.

3.8 Instrumentation and control

The human/machine interface will be centralised in the central control room (CCR) to provide the overall plant control, monitoring, alarm and event functions [1]. The operator will be able to control and monitor all plant equipment except for the coal handling system, which has a separate control room. A distributed control system will be used for the main plant control while PLCs will be used for the balance of plant control such as water treatment, main cooling water, etc. An interface will be provided between DCS and PLC to enable the operator in the CCR to monitor the whole plant process areas. The control systems are designed on a hierarchical basis: unit, group, sub-group and drive level.

3.9 Electrical systems

Each generator which is equipped with static isolation system, is completely enclosed and uses hydrogen as the cooling medium for the rotor section [2].
directly cooled by demineralised water. Power from each generator is fed through the generator transformer to a 500/275 kV substation. The facility will be connected to the national grid system via a 500 kV transmission line.

Part of the output from each generator provides the auxiliary power supply to the power plant through the unit auxiliary transformer, for internal consumption. Each unit has an interconnection to the common facilities supply. These connections can also be used to start one unit from another without having to draw power from the public grid.

4 Conclusion

As described in the article, the power plant layout consists of many systems to meet electricity power generation and environmental requirements. Generally, it can be concluded that such a plant involves main equipment steam generator, steam turbine, fuel handling, main cooling system and balance of plant that is supporting the main equipment creating required power ration and meet performance guaranties.

References


Resume

The article describes basic logistic systems and processes in a coal fired power plant and brings a view of energy source concept in later mentioned production of electricity rate. The article includes the steam generator, steam turbine, fuel handling, water treatment and also ash disposal system short description.

Key words

Coal, power plant, performance, logistic, process

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