Information Summary

Company	Quintero Energía SpA
Site Designation	Ventanas Thermal Power Plant
Operation Type	Coal-fired thermal power plant (Unit 3: 267 MW; Unit 4: 270 MW)
Address or Physical Location	Route F-30-E, Puchuncaví, Valparaíso Region, Chile.

1.1 LOCATION SUMMARY

History and Current Status

The Ventanas Thermal Power Plant, located in Puchuncaví, Valparaíso Region, Chile, was conceived in the late 1950s to meet the increasing energy demands of a planned industrial complex in the Quintero Bay. This complex included a refinery and a smelter operated by the National Mining Company (ENAMI). Initially managed by Compañía Chilena de Electricidad (CHILECTRA), the plant, which lies at the shoreline of Quintero Bay, began operations in 1964 with an installed capacity of 120 MW (Unit V1), using pulverized coal-fired technology and cooling water from the sea. In 1977, Unit V2 was inaugurated, adding 220 MW to the plant's capacity. In 2010, Unit V3 (officially named Nueva Ventanas) commenced operations, featuring an advanced pulverized coal system, and was followed by the commissioning of Unit V4 (officially named Campiche) in 2013.

The plant has undergone significant changes in recent years due to Chile's decarbonization strategy. Unit V1 ceased operations in December 2020, and Unit V2 followed at the end of 2022. Both units are out of service with no plans for reintegration, however their fire protection systems remain operative. Currently, Units V3 and V4 are operational, delivering a gross capacity of 537 MW. These two units operate independently, each with their own water systems, coal supply, control room, auxiliary services, and other essential infrastructure.

Units V3 & V4 were built by POSCO E&C (Korean EPC Contractor) as an EPC turn-key project and comprises an Ansaldo Energia (Genova-Italy) steam turbine and a Doosan Heavy Industry & Construction coal-fired boiler.
These units are identical in design (boiler, turbine, and generator), each with a gross capacity of 272 MW. However, due to the Environmental Qualification Resolution, Unit V3 is limited to a gross capacity of 267 MW, while Unit V4 operates at a gross capacity of 270 MW. The minimum loads of V3 and V4 are 82 and 84 MW, respectively.

In December 2024, AES Andes completed the sale of Empresa Eléctrica Ventanas SpA, the operator of Units V3 and V4, to Quintero Energía SpA. This acquisition aligns with AES Andes' transition towards a renewable energy portfolio while maintaining the strategic importance of Ventanas as a key energy supplier for Chile's electrical grid.

Operational Summary

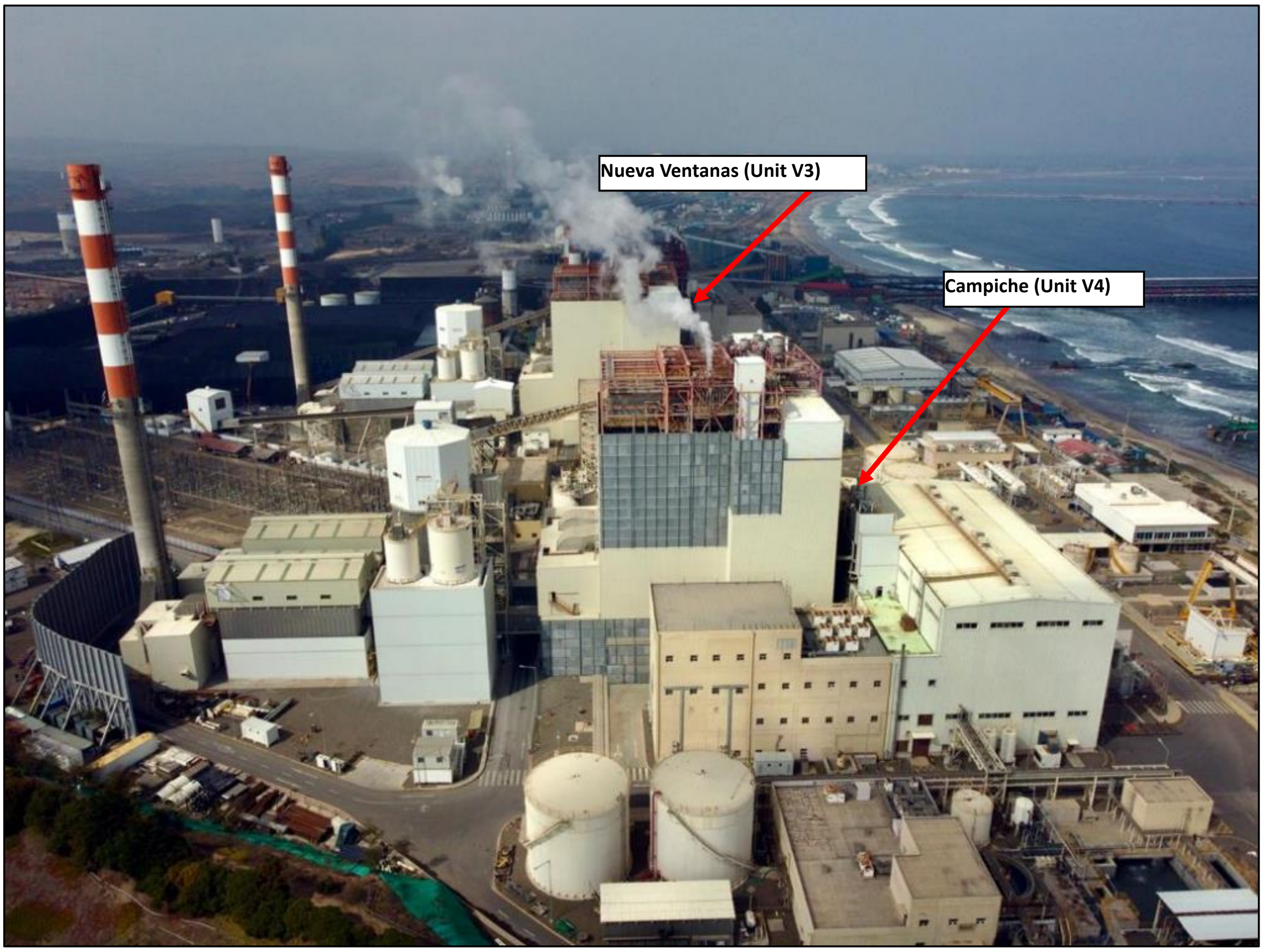
Ventanas Thermal Power Plant is strategically located on a 30-hectare industrial site, adjacent to Puerto Ventanas, leveraging its proximity to seawater for cooling and optimizing coal supply logistics through long-term contracts. The plant's coal yard has a storage capacity of 256,000 tons, while the ash deposit site, located 8 km from the plant, has a total capacity of 8.75 million cubic meters, with 70% still available.

A GIS substation receives the generated energy from Units V3 and V4 and transmits it in 220 kV via the Ventanas–Nogales double-circuit transmission line, which spans approximately 30 km to the Nogales substation where is injected to the SEN. Additionally, these units are connected to a 220/110-kV autotransformer, providing an alternative evacuation route through the Ventanas substation at 110 kV, utilizing the Ventanas–Torquemada and Ventanas–San Pedro transmission lines.

The operation follows an output-regulated base load strategy, where Units V3 and/or V4 are started as required by the National Electric Coordinator (CEN). One planned outage is scheduled per year. The workforce is structured into five crews covering two 12-hour shifts.

Company Profile
Quintero Energía SpA is a Chilean energy company established in September 2024 by Chilean investors lead by Eduardo Escaffi and Fernando Gardeweg long term players in the Chilean electricity sector. The company was formed to acquire the operational generating units of the Ventanas Thermal Power Plant from AES Andes, a transaction involving the transfer of Empresa Eléctrica Ventanas SpA, which operates Nueva Ventanas (Unit V3) and Campiche (Unit V4) with a combined installed capacity of 537 MW. The agreement also includes technical support from AES during the first operational year of Quintero Energía, and over 90% of AES's key workers who have operated the complex for the past 10 years were hired by Quintero Energía and will remain in their positions.

Quintero Energía has expressed its commitment to maintaining high operational standards and aligning its operations with the Chilean government's decarbonization plan. The company has pledged to honor existing agreements with workers and the community, ensuring that the Ventanas facility continues to operate efficiently and safely until the National Energy Commission authorizes its definitive retirement.



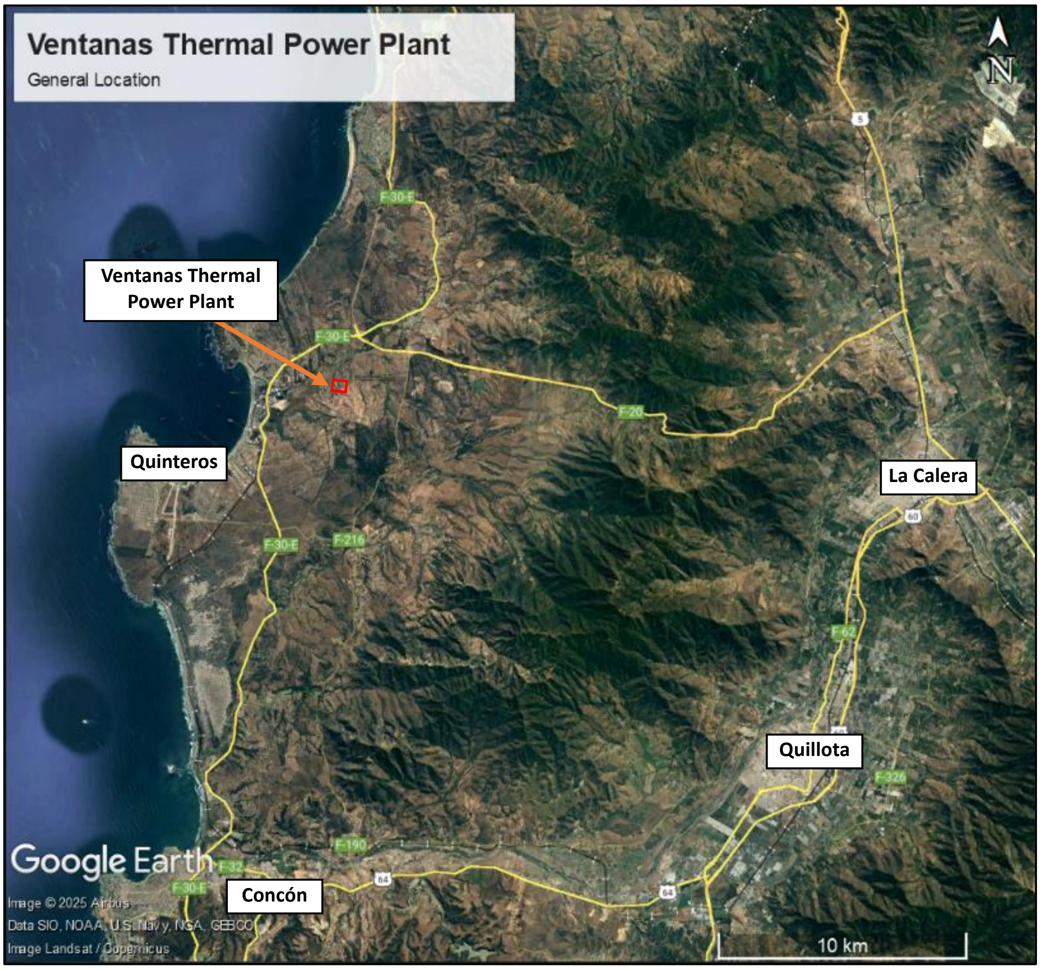
Ventanas Thermal Power Plant

1.2 LOCATION CHARACTERISTICS

1.2.1 Location and Access

The Ventanas Thermal Power Plant is located in Puchuncaví, in the Valparaíso Region, adjacent to Quintero Bay. The plant occupies a 23-hectare industrial site strategically positioned near Puerto Ventanas, enabling efficient coal delivery via long-term contract. The bay area provides an ideal location for the plant, benefiting from proximity to key energy and industrial infrastructure.

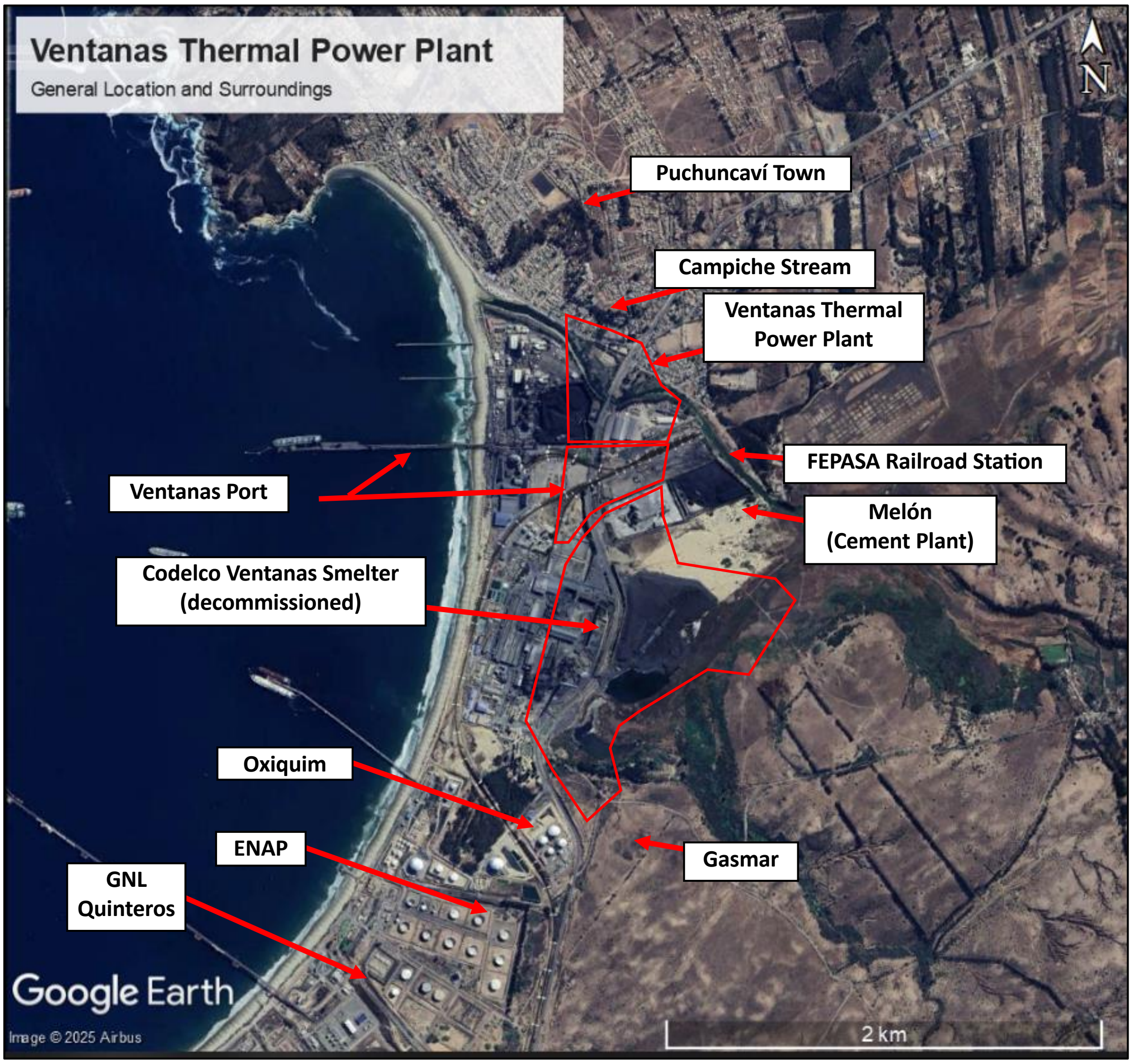
Access to the property is through Route F-30-E, which connects the towns of Concón and Puchuncaví. This route links to Route 60-CH, a major highway connecting to Valparaíso, Viña del Mar, and Santiago, located approximately 150 kilometers to the southeast. The roads are paved and well-maintained, facilitating the transport of heavy equipment and any operational needs. The plant's location also benefits from its proximity to urban centers such as Quintero and Viña del Mar, ensuring access to workforce and services.



Ventanas Thermal Power Plant General Location

1.2.2 Surroundings

The following satellite image shows the location of Ventanas Thermal Power Plant and the main surrounding industries:



Ventanas Thermal Power Plant Location and Main Surroundings*

**The boundaries shown on the satellite image above are approximate and do not represent the exact limits of the respective properties.*

1.3 CONSTRUCTION, OCCUPANCY, AND LAYOUT

The Ventanas Thermal Power Plant is strategically located on Quintero Bay in central Chile, designed to maximize operational efficiency by utilizing its proximity to the Pacific Ocean for coal delivery and cooling purposes. The property covers an approximate area of 230,000 m², with a perimeter of about 2,000 m, and extends along the coastline for approximately 640 m. Access to the premises is via its eastern side, in the southern sector, through Route F-30-E, which is controlled by a guard post and vehicle barriers. To the north and east of the access control point, there are parking areas for light vehicles and buses. Entry is through a paved internal road that begins east of the coal yard and then leads to multiple internal roads surrounding the various buildings and facilities of the plant. Internal roads have an approximate width of 10 m.

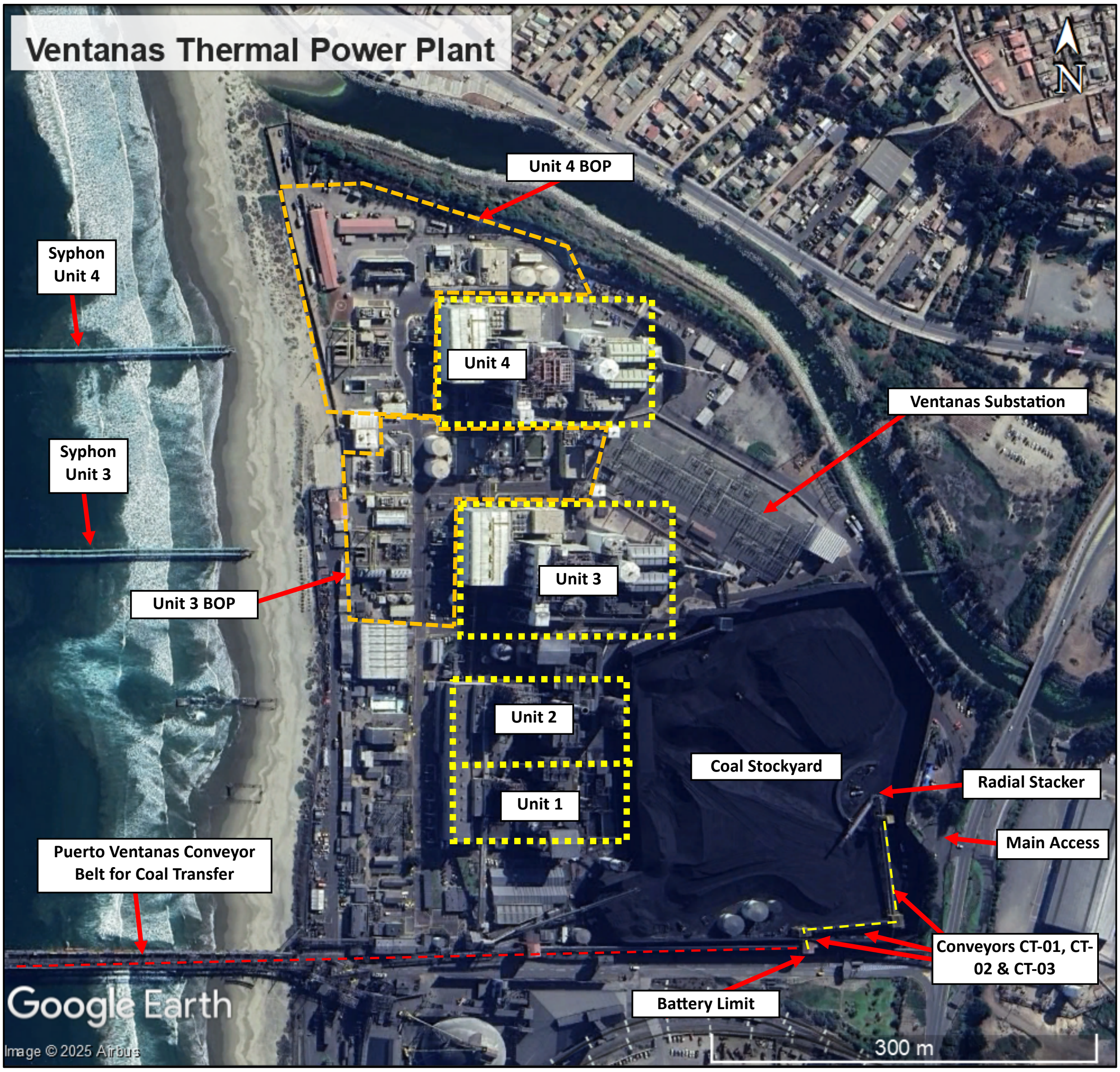
The main buildings and facilities correspond to the power blocks of Units V1 through V4, which are aligned along a single line from south to north, parallel to the coastline. The coal yard covers an approximate area of 57,000 m² and is in the southeastern corner of the site. The Ventanas Substation covers approximately 12,000 m² and is situated north of the coal yard, east of Unit 3, and southeast of Unit 4. The auxiliary services (BOP) for each Unit are located near their respective facilities, following the coastline from south to north and separated from the MCB buildings and powerhouses by an internal road. Warehouse 16, designated for the storage of materials and spare parts, is in the southern section of the site and covers approximately 2,000 m². The location of other buildings and facilities is detailed in the satellite image below (next page).

The Powerhouse and MCB buildings for Unit V3 and Unit V4 are identical. Each Powerhouse consists of a reinforced concrete building up to the top floor where the upper section of the turbine is located. This upper floor is made up of a concrete slab and steel structure for facades and roof (columns, beams, bracing, and trusses), with polyurethane sandwich cladding. The MCB Buildings for Unit V3 and Unit V4 are made of reinforced concrete. Most important electrical rooms and battery rooms are on different floors of the MCB Buildings, such as the 220 V and 440 V rooms, 6.9 kV rooms, switchgear rooms, control rooms and relay rooms.

The boilers structure and construction are non-combustible and made of steel structure, metal panels, and gridded metal flooring/walkways/platform surfaces. There are acoustic panels insulated with rock wool installed around the boilers. All electrical room walls are constructed of concrete block on reinforced concrete, and reinforced concrete slab floor and ceiling.

The total constructed area is approximately 18,000 m^2 for Unit V3, based on an approximate 4,124 m^2 ground area, including all floors. For Unit 4, the total constructed area is about 16,500 m^2. This estimate includes Power Houses, MCB Buildings, Boiler Structures, and attached equipment, resulting in a total constructed area of approximately 34,500 m^2.

The distance between buildings and facilities within the plant is appropriate, with internal streets creating clear distances of some 15 m. The Powerhouses of Units V3 and V4 are separated by more than 90 m. Diesel oil tanks are located more than 25 m away from their respective units, and likewise for the storage warehouses for hazardous substances and waste.



Main Buildings and Facilities of Ventanas Thermal Power Plant

Unit V3 Powerhouse and GSU Transformer

Unit V4 Power Block

1.4 ENERGY GENERATION EQUIPMENT AND PROCESSES

1.4.1 Process Overview

The processes and systems described apply equally to Units V3 and V4, which operate as completely independent facilities. Each unit includes separate water treatment facilities, fuel oil and diesel tanks, control rooms, output transformers, fire protection systems, and other auxiliary systems.

Main cooling water for both units is supplied from the sea. Intake and discharge pipes connect the facilities to the ocean, including circulating water pump stations, intake structures, and discharge structures. The raw water required for operations is stored in an 1,800 m³ (475,500 gallons) tank, processed at a demineralization plant, and then stored in a demineralized water tank of equal capacity. These tanks also reserve 900 m³ of water for fire protection. The heated water is discharged into the sea by two 1.9-m diameter, 200-m-long high-density polyethylene (HDPE) pipes with a combined capacity of 34,000 m³/h, connected to the sealing well and ending in a common diffuser. Ventilation pipes are installed on each discharge pipe approximately 70 m from the sealing well, within the intertidal zone.

Each unit's power block consists of a pulverized coal-fired boiler and a reheat condensing extraction steam turbine generator (STG). Steam is generated by the boilers, which burn pulverized coal as the primary fuel, using a blend of 46% sub-bituminous coal (N°9) and 54% bituminous coal (N°4), with a maximum volatile content of 34%. The boilers are equipped with five levels of burners and can use heavy fuel oil (HFO) for operation at 10% to 40% of TMCR during start-up. Diesel oil is used for ignition and start-up up to 30% TMCR. In emergencies, HFO can also be used as a secondary fuel at 100% BMCR, though its higher cost limits its use to exceptional cases.

Turbine start-up follows one of three modes—Cold Start, Warm Start, or Hot Start—depending on the rotor temperature and the required start-up time to ensure safe and efficient operation. Before being placed into service, turbines must undergo a minimum turning period, requiring a continuous turning process to ensure a minimum of 12 hours of rotation before synchronization. All start-ups in 2024 were successfully completed.

Coal is delivered in bulk to Ventanas Port, located adjacent to the south of the site, and transported directly to the plant's stockyard via conveyor systems, with no coal stockpiles at Puerto Ventanas. From the plant's stockyard, each unit is fed by its own independent conveyor belt system.

Emission control for each unit includes a dedicated flue gas desulfurization system (FGD) that uses lime and water to wash sulfur from combustion gases through an exothermic reaction. The washed gases are filtered through bag filters, which collect ash for storage in silos and later proper disposal at an environmentally approved landfill. Ash, along with lime slurry, is removed from the bottom of the bag filter system, which uses periodic air pulses to clean the bags. Part of the slurry is recirculated into the FGD system to regulate reaction temperature, maintaining it at 80°C (176°F). Collected ash is transported by truck to landfills that are reforested after use. Any disruptions to ash removal due to landfill issues would result in operational shutdowns in compliance with Chilean environmental regulations.

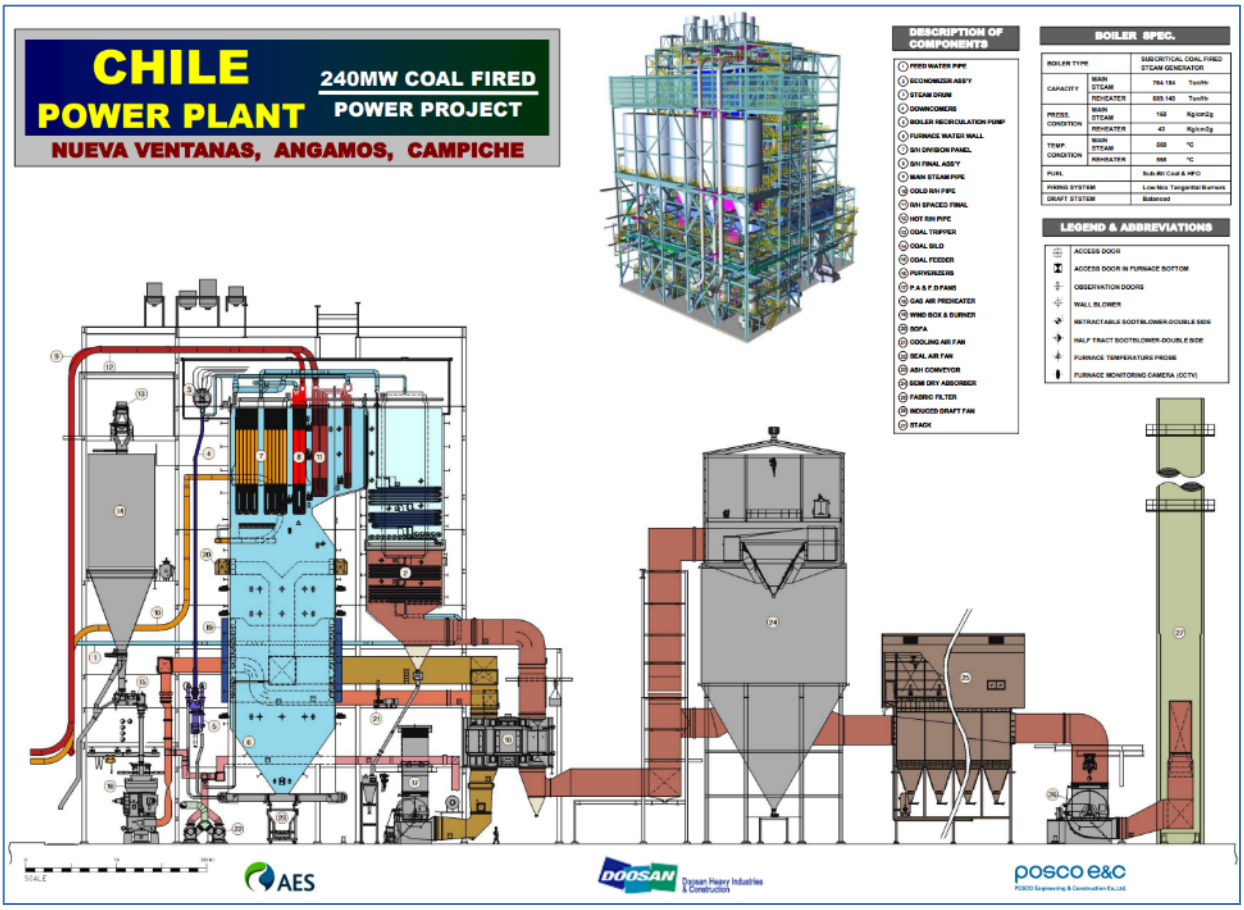
Emission controls are critical due to strict Chilean regulations, especially given the proximity of neighboring communities. A partial loss of emission control capacity requires power output reduction, while complete failure prohibits operation entirely. Dust handled in the facility consists of lime and ash, and coal dust would only appear due to incomplete combustion, which is monitored and controlled by boiler systems. Cleaned gases are released into the atmosphere through stacks.

The steam cycle operates with a nominal pressure of at least 160 bar(a) and a temperature of 565°C or higher. The exhaust from the steam turbine is condensed in a vacuum condenser. Each unit outputs power at 18 kV, which is stepped up to 231 kV by generator step-up (GSU) transformers rated at 320 MVA. Auxiliary systems receive power at 6.9 kV through auxiliary transformers.

A GIS substation receives the generated energy from Units V3 and V4 and transmits it in 220 kV via the Ventanas–Nogales double-circuit transmission line, which spans approximately 30 km to the Nogales substation where is injected to the SEN. Additionally, these units are connected to a 220/110-kV autotransformer, providing an alternative evacuation route through the Ventanas substation at 110 kV, utilizing the Ventanas–Torquemada and Ventanas–San Pedro transmission lines.

There is a control room for Unit V3 located in its MCB Building, as well as an independent control room for Unit V4, also located in its respective MCB Building. Additionally, Unit V4 can be monitored and controlled from the control room of Unit V3, but the reverse is not possible. Both V3 and V4 units can also be controlled from the Santa María Building in Santiago. Furthermore, fuel management, including coal and diesel oil, is controlled from a separate control room located in a building outside the coal stockyard.

The plants operate in regulated base load mode with one planned outage per year. Emission limits are closely monitored, and operational adjustments are made as necessary to ensure compliance. Staffing includes five 12-hour shifts, with three personnel in the control room of Unit 3 and six field staff for both plants.



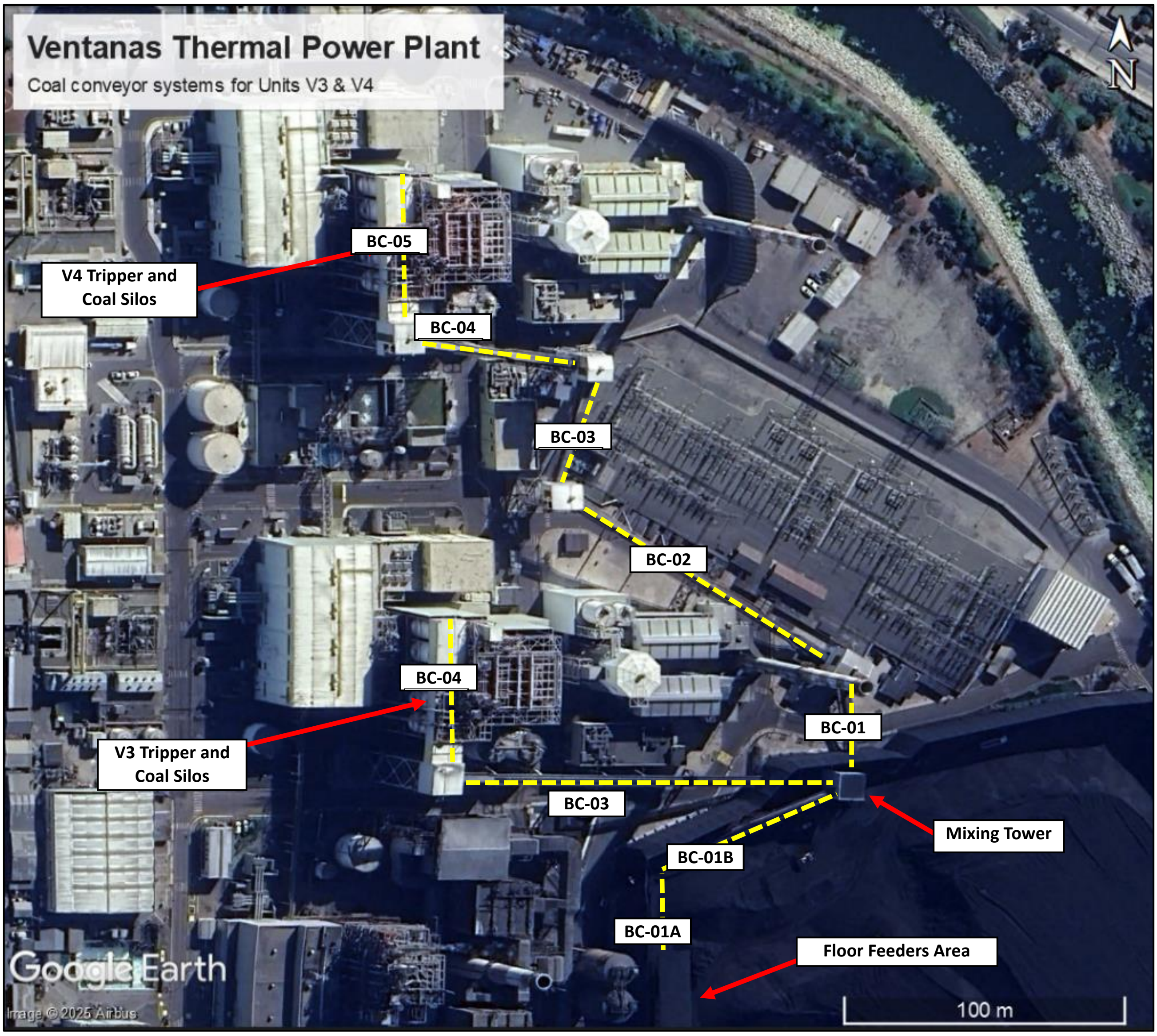
240 MW Coal-Fired Power Plant Schematic for Units V3 and V4 - Ventanas Thermal Power Plant

1.4.2 Coal Stockyard and Conveyors

The coal is partially national and partially imported from countries such as Canada, Colombia, Thailand, etc., depending on the spot market price. Coal received at Ventanas Port (Panamax vessels of 75,000 tons) is unloaded at a rate of 1,500 tons per hour. Ventanas Port delivers the coal to the Ventanas Thermal Power Plant via a single conveyor belt. The battery limit (see satellite image in section 3.2) is located at the transfer station within the premises of Ventanas Port, where it is unloaded in CT-01 which connects to a transfer station within the coal stockyard of Ventanas Thermal Power Plant. The stockyard is equipped with a radial stacker for unloading coal onto the yard.

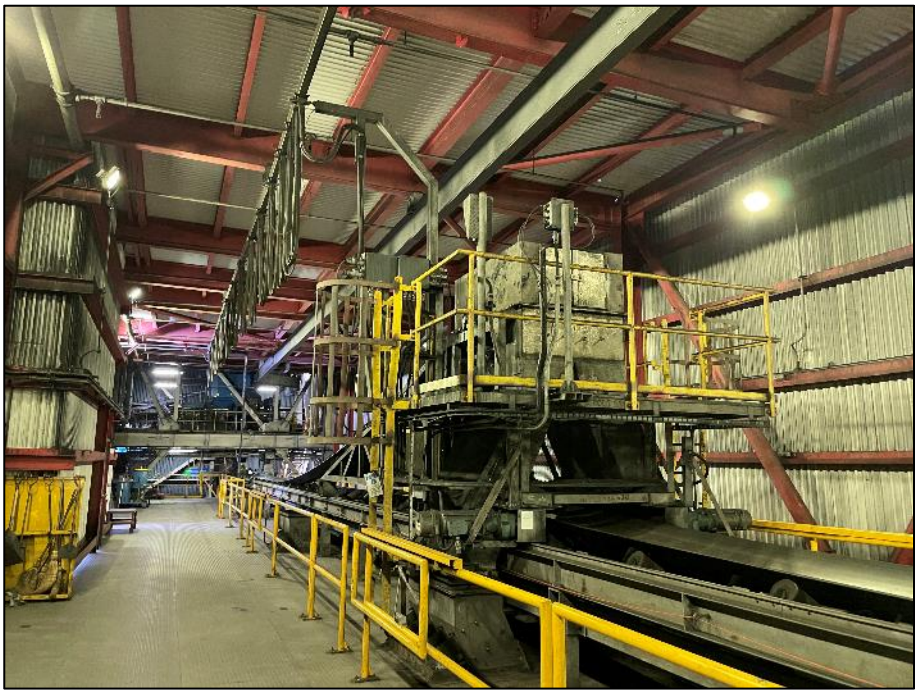
Coal is distributed into piles within the coal stockyard, with a maximum height of 11.5 m, based on its origin and characteristics, using the radial stacker and front loaders. Front loaders feed two chain drag conveyors (arranged in series) for Units V3 and V4 by forming piles over them. The two chain drag conveyors are located under a metal overhang on the western side of the coal stockyard. These floor feeders supply conveyor BC-01A, which is equipped with an electromagnet and a metal detector. Conveyor BC-01A then transfers the coal to conveyor BC-01B, which is equipped with a belt scale and ends at a mixing tower. From this mixing tower emerges the independent conveyor systems feeding Units V3 and V4. The table below details the main characteristics of all conveyors related to the coal handling system.

The coal stockyard has a maximum capacity of 256,000 tons. Each unit consumes 2,500 tons of coal per day at full load. When both units (V3 & V4) operate at full capacity and the coal yard is at its maximum capacity, the theoretical autonomy is 51 days. In practice, turbines do not operate continuously. During the Lockton Risk Consulting (LRC) survey (January 2025), the coal stock was 216,000 tons. Given the consumption patterns and inventory, it is reasonable to anticipate a minimum of two months of operational autonomy.



Conveyor Systems for Units V3 & V4

Coal Stockyard (view from top of Unit V3 boiler)



Unit V3 Coal Tripper

Coal Pulverizers, Unit V3

Coal Silos, Unit V3

1.4.3 Liquid Fuel Storage

Units V3 and V4 each have their own independent diesel oil reserve, consisting of two steel tanks of 100 m³ each. The tanks are located more than 25 meters away from the respective power block, equipped with a parapet for spill containment and fire protection systems (water-foam deluge).

Diesel oil is primary used during ignition and start-up operations, where it is utilized to ignite the boiler and support the system until the plant reaches up to 30% of its Turbine Maximum Continuous Rating (TMCR).

Additionally, diesel oil serves as a backup fuel during emergencies. In situations where there is a disruption in the coal supply or other unexpected events, diesel oil provides the necessary fuel to maintain boiler operations, safeguarding the continuity of the plant's functions. The diesel oil system is also used for powering the emergency diesel generators (one for each unit).

Diesel Tanks (Unit V3)

Diesel Tanks (Unit V4)

1.4.4 Boilers

The boilers of Units V3 and V4 are identical high-pressure, subcritical, water-tube, pulverized coal-fired boilers designed for balanced draft combustion. They were supplied by POSCO Engineering & Construction with technology from DOOSAN. These boilers operate with a design pressure of 185 bar(a) and a steam pressure of 160 bar(a) at a superheated steam temperature of 540°C. Each boiler has a heating surface area of 8,760 m^2.

Function

The primary function of the boiler is to generate high-pressure steam from coal combustion. The steam is used to:

1. Power the steam turbine, which drives the generator to produce electricity.
2. Supply auxiliary systems, including soot blowers and auxiliary steam systems, during start-up and low-load operation.
3. Support plant operations by maintaining steam temperatures and pressure under various fuel and load scenarios.

Design Criteria

1. Type: Outdoor installation, balanced draft, controlled circulation type.
2. Capacity:
    - Maximum Continuous Rating (BMCR): 763,684 kg/h at 103% of TMCR.
    - Minimum stable load: 40% TMCR using blended coal without supplementary fuel.
3. Fuel Options:
    - Primary fuel: Bituminous and sub-bituminous coal blends.
    - Backup/emergency fuel: Heavy fuel oil.
    - Start-up fuel: Diesel oil for ignition and low-load operation up to 30% TMCR.

Key Components

1. Combustion System:
    - Equipped with low NOx coal burners to meet emission limits.
    - Supports fuel flexibility, allowing operation with different coal blends or heavy fuel oil.
2. Pulverizers:
    - Five pulverizers (5 × 25% capacity) are installed, with four required for operation under degraded conditions.
    - Pulverizers are designed to handle coal blends and ensure proper grinding for efficient combustion.
3. Steam Cycle:
    - Main steam temperature: 565 ± 5°C.
    - Reheat steam temperature: 568 ± 5°C.
    - Operates at nominal pressure ≥ 160 bar.
4. Air and Gas Systems:
    - Forced draft (FD), primary air (PA), and induced draft (ID) fans, all rated at 2 × 50% capacity.
    - Regenerative air preheaters and steam-heated air preheaters ensure optimal combustion air temperature and minimize acid dew point issues.
5. Flue Gas Handling:
    - Flue gas exits through a 95 m high chimney, equipped with a continuous emissions monitoring system (CEMS).
    - Includes provisions for dust-proof cladding and lagging of ductwork and equipment.

Auxiliary Systems

1. Soot Blowers: Steam-driven, installed in key areas (economizers, superheaters, reheaters, and air heaters) to remove ash deposits.
2. Water and Blowdown Systems:
    - Continuous blowdown tank and intermittent blowdown tank for efficient water management and system cleaning.
    - Deaerators and feedwater heaters optimize feedwater quality and temperature.

Structural and Environmental Considerations

1. Structural Design:
    - Includes steel framework for the boiler, coal silos, and auxiliary equipment.
    - Designed to accommodate outdoor conditions without a roof.

- Design according to local seismic codes.

2. Environmental Compliance:
   - Meets NOx and SO_2 emission standards through combustion design and Flue Gas Desulfurization (FGD) systems.
   - Equipped with dust-proof and weather-protective enclosures for coal handling and ductwork.

<u>Safety and Reliability</u>

1. Safety Features:
   - Automatic control systems are integrated with the Distributed Control System (DCS).
   - Backup systems for critical operations, including dual fuel support.
2. Flexibility:
   - Seamless transition between coal, oil, and mixed fuel operation without load reduction.
   - Designed for long-term reliability and minimal maintenance downtime.

Fuel Injector for Boiler Startup, Unit V3

Elbow with Internal Wear Plate, Boiler Unit V3

1.4.5 Steam Turbines

Units V3 and V4 operate on a Rankine cycle with reheating and regeneration, featuring identical condensing steam turbines and generators manufactured by ANSALDO ENERGÍA. The turbine model is RH-TCDF 43, and the generator model is TRX-L56. These units, constructed in 2007 and 2008 respectively, have a maximum apparent power capacity of 330,000 kVA and operate with an admission steam pressure of 160 bar and an admission steam temperature of 565°C. The turbines run at a rotational speed of 3,000 rpm (or 3,600 rpm in specific configurations). The generators utilize air cooling.

General Information

- Manufacturer: Ansaldo Energia.
- Turbine Model: RH TCDF 43/0369 TT.
- Generator Model: TRX-L56.
- Year Built:
    - Turbine: 2008.
    - Generator: 2007.
- Service Status: Base load.

Ratings

- Turbine:
    - Power: 272 MW @ 160 bar (2,230 psi).
    - Rotational Speed: 3,000 rpm.
- Generator:
    - Synchronization: 3-phase, 330 MVA, 3,000 rpm.
    - Voltage/Frequency: 18 kV, 50 Hz.

Controls/Trips

- Steam Failure:
    - Turbine: 272 MW @ 160 bar, 3,000 rpm.
- Overtemperature: Base load operation.

Generator Protection

V3 and V4 synchronous generators is provided with micro-processed based relays with the following protections: 46 (negative phase sequence relay), 87G (generator differential relay), 87U (unit generator/transformer differential relay), 59 (over-voltage relay), 40 (loss of field relay), 64S & 64R (stator & rotor ground relay), 51V (voltage restrained or controlled over-current relay), 21 (distance relay – minimum impedance), 60 (voltage unbalance relay), 81< & 81> (under & over frequency relay), 27 (under-voltage relay), 78 (loss of synchronism or out of step relay), 32R (reverse power relay), 32F (minimum power relay), 59/81 (over-fluxing relay), 50BF (break fail relay), 59N (neutral over-voltage relay), 49 (over-load relay), and 87REF/HV (restricted earth fault relay). The 25 protection (synchronization check relay) is in a separate unit.

Turbines Protection

Both V3 and V4 steam turbines are equipped with two overspeed protection devices:

- One device set at 110% of nominal speed, located within the Turbine Trip System.
- A second device set at 112%, located in the Steam Turbine Control System.

The 112% overspeed protection device was last tested using a real overspeed test on:

- V3 Unit steam turbine: January 29, 2022, at 3,213.5 rpm (after the first major overhaul).
- V4 Unit steam turbine: March 23, 2021, at 3,239 rpm (during the annual planned outage).

The emergency trip mechanism for both V3 and V4 steam turbines operates through three solenoid valves, which control the hydraulic 2-out-of-3 tripping unit. For a trip to be initiated, at least two of the three solenoid valves must be de-energized, following a fail-safe principle. Once this occurs, the hydraulic safety system depressurizes. These solenoid valves are grouped into three blocks (A, B, and C), and each block is tested weekly via the 110% overspeed online test.

The high-pressure (HP) steam turbine protection system includes several critical valves, which are subject to routine testing:

- Main Stop Valves (MSV).
- Governor Valves (GV).
- Intermediate-Pressure (IP) steam turbine combined with reheat stop valves, specifically:
    - Reheat Stop Valve (RSV).
    - Intercepting Control Valve (ICV).

These valves undergo a full stroke test every month for both V3 and V4 Units.

Additionally, both V3 and V4 steam turbines feature seven non-return (NR) valves installed along the extraction lines of HP (cold steam), IP, and LP sections. These NR valves are tested every two weeks, as per the maintenance schedule. The test procedure involves both system supervisory indications and direct visual confirmation by an operator to ensure proper valve operation.

Unit 3 Powerhouse, Upper Floor

Unit V3

1.4.6 Water

The plant's water system involves two main stages: desalination and treatment.

For Unit V3, seawater is drawn in, processed through the MVC (Mechanical Vapor Compression) system, and stored as desalinated water. A portion of this water undergoes EDI (Electro deionization) filtration to produce high-purity water for boilers, closed-loop cooling of engines, and other equipment.

For Unit V4, the process is similar but utilizes TVC (Thermal Vapor Compression) technology instead of MVC.

Large circulation pumps, located in the wells, direct water to the condenser via siphons. The inlet temperature ranges between 15-17°C, and the outlet temperature reaches 22-24°C.

Desalinated and demineralized water tanks for Units V3 and V4 are interconnected, allowing water recovery when Unit V4 is offline by utilizing reserves from Unit V3. Similarly, when Unit V4 is started up, it is initially supplied with water from Unit V3 until the plant reaches operational stability, at which point the TVC system is activated.

Operational Considerations:

- During overhauls, at least one MVC unit must remain operational.
- Each siphon discharges into a well, and the system is designed to operate with a single well at minimum technical flow.
- Each unit has two pipelines and two wells, which are interconnected, housing two circulation pumps per well.

Syphons (view from the top floor of Unit V3 Boiler)

Unit V4, MCB Building (left) and Water Treatment Plant and Tanks (right)

Water Desalinization

Sea water is desalinated in two desalination process lines (one for each unit). Desalinated water is demineralized and stored in an 1,800 m^3 tank of the respective unit.

The desalination plant for Unit 3 uses a Mechanical Vapor Compression (MVC) system with two units manufactured by IDE, model MVC-1200. Each unit has a production capacity of 50 tons per hour and operates with a maximum feedwater salinity of 4 ppm. The system processes 113 tons of seawater per hour, producing 63 tons of brine. The feedwater temperature is maintained at 12°C. The system was commissioned in 2008.

In contrast, the desalination plant for Unit 4 employs a Thermal Vapor Compression (TVC) system with a single unit manufactured by SWS. This plant has a production capacity of 100 tons per hour, handling seawater with a maximum salinity of 4 ppm. It processes 550 tons of seawater per hour, generating 170 tons of brine. The feedwater temperature ranges between 12°C and 21°C, with a main steam pressure of 14 bar(g) at 260°C and a low-pressure steam of 3.5 bar(g) at 160°C. This unit was commissioned in 2011.

Cooling Water

The plant features a cooling demineralized water system. Seawater is used to cool a closed-loop demineralized water circuit, which includes a head tank with high- and low-level alarms and two redundant seawater-returning heat exchangers. This system supplies demineralized water to various components, such as coal pulverizers, boiler water recirculation pumps, boiler furnace access doors, primary air fans, FD fans, ID fans, the generator air cooler, feedwater pumps, condenser circulating water pumps, and air compressors. The demineralized water system is also equipped with protections to address high temperature conditions, including alarms for water temperatures exceeding 32°C and automatic trips if both pumps detect temperatures above this threshold.

The condenser cooling water system uses circulating water pumps to maintain effective cooling. Each unit (V3 and V4) is supported by two pumps operating at 50% capacity each. These pumps, manufactured by HHI, are rated at 18,000 m^3/h with a head of 15.6 meters, running at 370 RPM and powered by 899 kW AC induction motors. The motors have a frame designation of HRQ3 713-764Y, operating at 1,050 kW with a frequency of 50 Hz and a speed of 375 RPM. The pumps and motors are equipped with continuous vibration monitoring systems, providing alarms and trip functions.

Cooling Water Recirculation Pumps, Unit V3

The condenser system for the thermal power plant is equipped with condensers manufactured by BUMWOOENG CO Ltd. Each condenser unit has an effective heat transfer area of 11,986 m^2 and can handle a seawater flow of 36,000 m^3 per hour. The system is designed to operate within a thermal gradient limit of 9.68°C and can withstand a maximum water-side pressure of 5.0 bar(g). The condenser consists of 13,178 titanium tubes conforming to ASTM B338 Gr.2 standards, ensuring high resistance to corrosion and durability in a seawater environment.

Boiler Water Supply

Each boiler has a make-up consumption of 8 m^3/h. Boiler water treatment consists of a congruent phosphate program. Grab samples are obtained every 4 hours, 7-days per week and analyzed for conductivity, pH, phosphates, silica, iron, copper, & chlorides. Online monitoring is provided for conductivity and PH and also set to alarm. Both Unit V3 and V4 turbine condensers are provided with online sodium analyzers. The program is managed by in-house chemists.

1.4.7 Transformers

V3 and V4 units are connected to the 220-kV electrical system by two transmission lines (Ventanas-Nogales 1 & 2) and to the 220/110-kV autotransformer. For each V3 and V4 units, there is a generator circuit breaker (245 kV, 1,600 A, 40 kA) for the main unit transformer (320 MVA, 231/18 kV) and for the steam turbine generator (330 MVA, 18 kV), which are interconnected by an isolated phase bus (24 kV, 120,000 A, 80 kA). Either the auxiliary transformer (40 MVA, 18/6.9/6.9 kV) or the start-up transformer (44 MVA, 220/6.9/6.9 kV) can supply power to the 6.9-kV electrical system.

Unit V4 GSU Transformer (right) and Auxiliary Transformer (left)

Unit V4 Electric Room

1.4.8 Flue Gas System

The Flue Gas Desulfurization (FGD) system employed in Units V3 and V4 is a Semi-Dry Absorber (SDA) system designed to reduce sulfur dioxide (SO_2) emissions from the flue gases downstream of the air heater. The primary function of this system is to capture SO_2 through a semi-dry process that utilizes lime absorbent and advanced filtration technology.

The system uses lime absorbent (sorbent) which is introduced into the reactor via a semi-dry process.

Key components of the system are the following:

1. Semi-Dry Absorber (SDA):

- The SDA unit uses a rotating spray atomizer to introduce lime slurry into the reactor for SO_2 capture.
- It can maintain emissions at levels below 450 mg/Nm^3 at 6% O_2 (dry basis).
- The absorption efficiency exceeds 74.5% for design coal and 65.6% for heavy fuel oil (HFO).
- The system consumes less than 2.63 tons of lime per hour at full capacity.
- Each unit includes one atomizer, manufactured by GEA NIRO (Denmark), with a model designation of AX12-350/F800. The atomizer is powered by a 500 kW, 6.6 kV, three-phase motor.

2. Fabric Filter System:
   - This system is equipped with pulse-jet filter collectors for efficient particulate removal.
   - Each unit has 16 modules and 252 filter bags, providing an effective particle capture area of 10,866 m^2.
   - The filter bags, made of polyacrylonitrile (PAN), measure 8 meters in length with a diameter of 200 mm.
   - The nominal pressure drop across the system is 18 mmBar, with a particulate concentration at the outlet of less than 20 mg/Nm^3.
   - Collected ash is stored in hoppers for disposal.
3. Ash Handling and Disposal:
   - Ash is stored in two collection silos before being transported by trucks to a dedicated landfill site approximately 7 km from the plant. At the disposal site, the ash is compacted and moistened to minimize dust dispersion. The landfill is then sealed with a vegetative cover and subjected to reforestation efforts to promote environmental restoration.
   - The system includes mechanisms to regulate reaction temperatures and ensure operational stability. Lime slurry is recirculated within the FGD system to maintain a reaction temperature of 80°C (176°F).

There is an emergency cooling (quenching – water spray) system at the absorber, upstream of the bag filters. In case of high temperature at the bag filter inlet, an alarm is triggered at 95°C, and the quenching system for Unit 3 is automatically activated at 130°C for 5 minutes or at 140°C for 5 seconds. The emergency cooling system for Unit 4 is manually activated from the control room. The quenching systems are supplied by AC electric pumps, with backup power provided by an emergency generator.

1.4.9 Power Transmission

A GIS substation receives the generated energy from Units V3 and V4 and transmits it in 220 kV via the Ventanas–Nogales double-circuit transmission line, which spans approximately 30 km to the Nogales substation where is injected to the SEN. Additionally, these units are connected to a 220/110-kV autotransformer, providing an alternative evacuation route through the Ventanas substation at 110 kV, utilizing the Ventanas–Torquemada and Ventanas–San Pedro transmission lines.

Autotransformer

GIS

1.5 SITE UTILITIES AND AUXILIARY SYSTEMS

1.5.1 Power Supply

The internal power supply system of the Nueva Ventanas Thermal Power Plant relies on its own power generation to meet internal energy needs. However, during start-ups or low-load operations, the plant draws electricity from the national grid via the 220 kV interconnection with the Nogales substation to support auxiliary equipment and initial operations.

Each unit (V3 & V4) consumes around 20-24 MW for its internal processes, including the operation of boiler feedwater pumps, cooling systems, fuel handling systems, and control equipment. During the synchronization process, as the unit gradually increases generation, transition occurs when reaching approximately 50 MW of generated power, switching from the respective startup transformer to self-supply mode, allowing the unit to sustain its internal loads.

1.5.2 Emergency Generators

The plant does not have black start capability.

For Unit 3, an emergency diesel generator rated at 1,250 kVA ensures a safe shutdown, supplying essential loads such as the DCS system, cooling system, and lube oil system, but only for this purpose. The diesel generator room is equipped with automatic sprinkler protection.

For Unit 4, an emergency diesel generator rated at 1,000 kVA, serves the same function, supporting a safe shutdown by powering the DCS system, cooling system, and lube oil system. Its room is also protected by an automatic sprinkler system.

The emergency generators are tested weekly, running unloaded for 30 minutes, while load tests are conducted at least annually to ensure reliability.

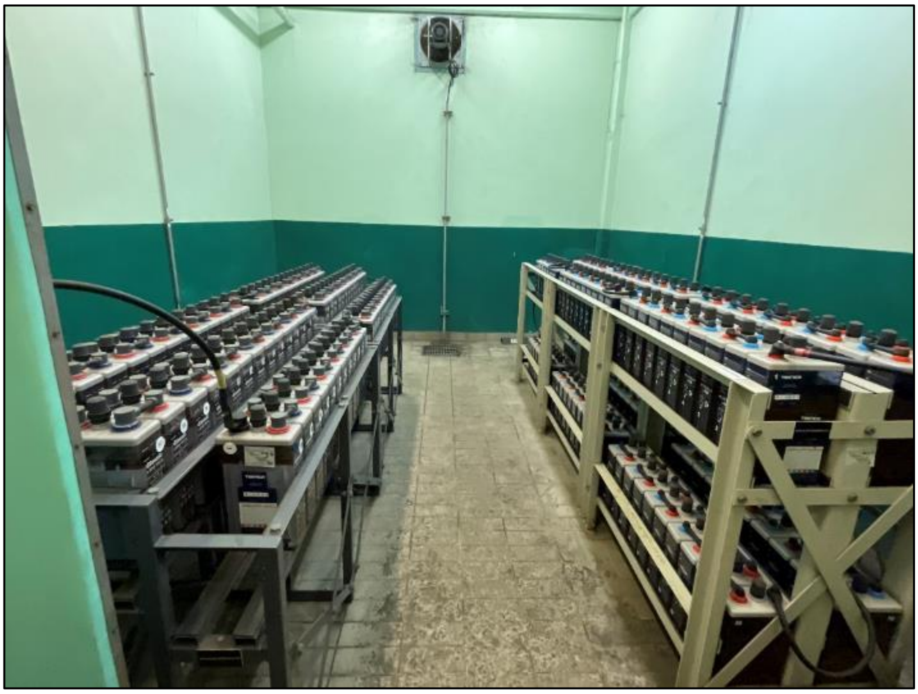
1.5.3 DC Emergency Batteries

The battery systems of Units V3 and V4 at the plant utilize HOPPECKE 9 OPZS 900 Vented Lead-Acid (VLA) batteries, providing reliable backup power for critical operations. Each unit features two battery banks (one active and one hot standby), each comprising 110 batteries per bank with a nominal voltage of 2V per battery. The batteries have a nominal capacity of 900 Ah at 10 hours at 20°C, a nominal density of 1.24 Kg/l at 20°C, and each weigh 140 kg, with dimensions of 330 x 270 x 590 mm.

The battery chargers for Units V3 and V4 are manufactured by CEG. The charger for Unit V3 (I-4064) and Unit V4 (I-4160) share the same specifications: a nominal float voltage of 245 Vdc, a maximum current of 600 A, a float current of 1 A, a boost charge voltage of 264 Vdc, and a maximum boost current of 135 A for up to 16 hours.

Testing activities were conducted in 2020, 2022, and 2024, while preventive cell replacements are scheduled every five years, with the last replacements completed in 2020 and the next planned for 2025. Quarterly inspections are carried out by a contractor for both units, including visual inspections, cleaning, voltage measurement for each cell, tightness checks, and specific gravity determination for 10% of the cells.

Capacity testing is performed every three to five years to monitor battery aging and determine replacement timing. For Unit V3, the last capacity test in October 2023 used a two-step performance test: the first step applied 479 A for one minute, and the second step discharged at 261 A for 180 minutes, with an end voltage of 1.8 V per cell, yielding satisfactory results. For Unit V4, the last capacity test in February 2024 used a constant current discharge test of 254 A for 180 minutes, with an end voltage of at least 1.8 V per cell, also yielding satisfactory results.



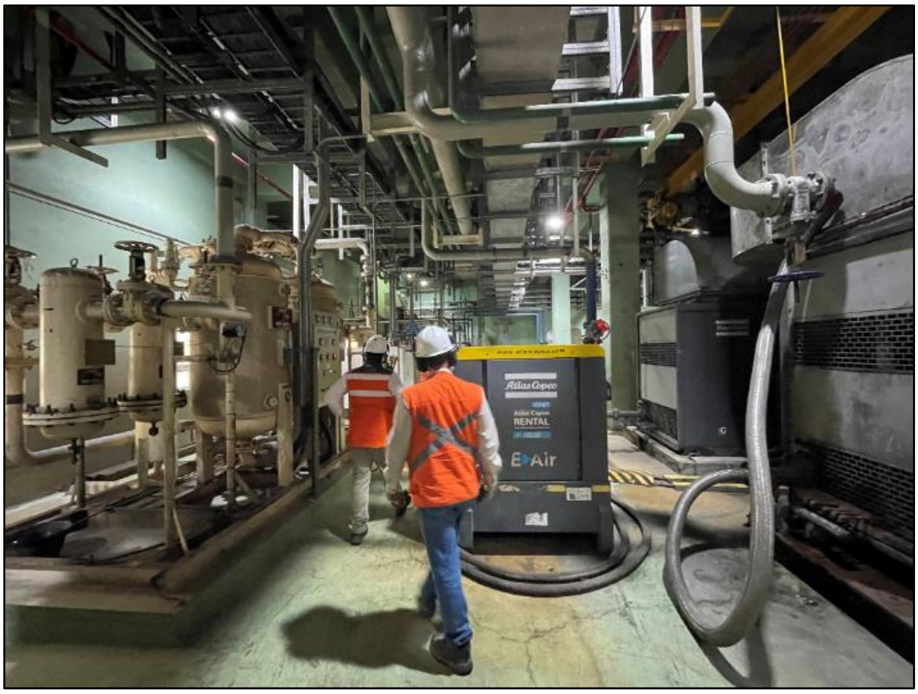
Battery Room with Forced Extraction and Hydrogen Sensor

1.5.4 Compressed Air

The compressed air systems of Unit V3 consist of three rotary screw Atlas Copco compressors (ZR 275-10-50), each rated at 315 kW, providing 34 Nm^3/min at 9.5 bar. Unit V4 features a single rotary screw Atlas Copco compressor (model ZT 160FF, 168 kW, 8.6 bar) manufactured in 2018, alongside two piston compressors. Typically, the rotary screw compressor operates together with one piston compressor, while the second piston compressor remains on standby. The combination of any two compressors (piston or rotary screw) is adequate to meet plant demands.

The compressed air system serves various functions, including providing service air for the operation of mechanical equipment, air tools, wrenches, and maintenance activities. Additionally, it supplies high-purity, oil-free, and moisture-free instrument air for pneumatically operated plant instrumentation and control devices. It also supports the cleaning of bag filters within the emission treatment system.

The instrument air is processed through an instrument air receiver, a pre-filter, an air dryer, and an after-filter, ensuring high purity. Similarly, service air is distributed via a service air receiver and pre-filter. The compressors' discharge air pressure is regulated through a dedicated microprocessor (Elektronikon MKIV), which manages loading and unloading operations based on programmed logic.



Compressors Room

1.5.5 Water Supply

Potable water is supplied through an agreement with ESVAL and is used as a backup for slurry preparation systems, preventing the use of desalinated process water in case any equipment becomes unavailable.

The facility also includes a chlorine storage and dosing plant, utilizing 10% sodium hypochlorite for treatment.

1.5.6 Diesel Fuel and Other Hazardous Substances

Hazardous substances and waste are stored in concrete-wall buildings with light non-combustible roof, located safely detached from the power blocks.

Hazardous Waste Warehouse

Storage of Compressed Cylinder Gases

Main Access to the Site

Maintenance Workshop