3 PROJECT DESCRIPTION

3.1 CONTEXT

3.1.1 *Overview of the project*

As part of the Ivorian Government's electricity access policy and in response to Côte d'Ivoire's growing electricity needs, ERANOVE, operator of the CIPREL combined-cycle gas-fired power plant in the area Vridi, plans to expand its electricity generation capacity through a new power station. It will be located near the village of Taboth, in the Jacqueville prefecture, about 800 m south of the Ebrié lagoon, about 30 km west of Abidjan.

CIPREL was created in 1995 with the launch in Phase I of a plant comprising three 33 MW turbines. In 1997, Phase 2 follows with 1 GE 9001E turbine of 111 MW. Phase 3 of the project (2009) increased the production capacity of CIPREL to 321 MW. Phase 4 (2014-2016) by adding a 111 MW gas turbine (TAG 10) and a 111MW steam turbine (TAV 1) brings the total power of the plant to 543 MW. All these machines are located on the same site in the Industrial Zone (Z.I.) of Vridi and are able to run on gas, and from back-up fuel.

The project that is the subject of this study, named CIPREL 5, includes the installation of a new gas turbine (TAG), a heat recovery boiler, a steam turbine (TAV), and forced draft cooling towers and associated ancillary equipment. The installed capacity will be 390 MW. The production capacity of ERANOVE, all units combined, will therefore increase from a current total installed capacity of 543 MW (CIPREL) to more than 940 MW (CIPREL and ATINKOU).

The project company in charge of building and operating the plant, ATINKOU, is a new company owned by ERANOVE, a pan-African industrial group, active in the management of public utilities and the production of drinking water and electricity in Africa.

The plant will be put into operation gradually. The commissioning of the TAG in open cycle is scheduled for the third quarter of 2020, the commissioning of the combined cycle TAG-TAV is scheduled for the second quarter of 2021.

The following sections provide a detailed description of the project, including the thermal power plant and its associated infrastructure (1), which will include:

(1) associated infrastructures are infrastructures that have not been built or extended in the absence of the project and without which the project would not be viable (IFC, 2012). Particularly in the context of this project, the associated infrastructure: basic life construction phase workers, upgrading of the loading dock on the island bakre and layout of the site access road .

- An electric substation that will be constructed at the plant site to enable its connection to the electricity distribution network.

- A high-voltage line to connect the power plant to the Akoupé Zeudji substation, currently under construction, will also have to be built. Most of the line that originally planned to connect Vridi to the Akoupé substation was the subject of an ESIA by ERANOVE in 2017. It is therefore not considered as a whole in this study. Only the portion of line connecting the Taboth power station to the 55 pylon of the future Vridi-Akoupé line, over a length of 15.6 km, is taken into account in this study.

- A gas pipeline connecting the plant to the existing Foxtrot pipeline, approximately 3.5 km south of the project site.

3.1.2 ERANOVE's commitment to sustainable development and Corporate Social Responsibility

Sustainable development is an intrinsic issue at the heart of the ERANOVE Group's core business. Through its presence in Africa, the ERANOVE Group aims for a commitment to Africa with the conviction that long-term performance can only be achieved in respect of people and the environment, and by Africa. With 9,000 employees, the Eranove Group embodies the African dynamic by developing talent through training, decentralizing responsibility between the various subsidiaries and pooling experiences.

In September 2015, the adoption of the 2030 Agenda by the United Nations reinforced the imperatives of taking into account sustainable development for the ERANOVE Group: out of 17 promulgated sustainable development objectives, 7 of them are directly linked to its core business and 7 other objectives can benefit from an indirect positive impact on the group's activity.

The seven sustainable development objectives to which the Group contributes directly are illustrated in Figure 3.1.

Figure 3.1 Contribution direct Eranove to sustainable development goals

Source: Sustainability Report 2017, ERANOVE

Since 2015, under the impetus of Eranove SA, all Group companies have implemented CSR indicators monitoring on a range of indicators representative of the footprint of their activities. To guarantee transparency, comprehensiveness and sincerity, Eranove has voluntarily chosen to build and validate its CSR reporting in accordance with the Grenelle II Law.

Since 2016, CSR reporting has been integrated into the management cycle of companies. Thus, the environmental, social and societal indicators of CIE, SODECI, SDE and CIPREL are now presented at the Board of Directors' closing of accounts, prior to the presentation and validation of the consolidated non-financial scope of the Eranove group. In this way, the entire Eranove group participates in the decompartmentalization of management information and environmental, social and societal information. At the same time, in line with the ongoing QSE certification process and in order to support its sustainable development approach, the Eranove Group encourages its operating companies to develop their social responsibility in accordance with the ISO 26000 standard of the International Organization for Standardization (ISO). sets the guidelines and objectives in this regard.

All the actions and objectives of ERANOVE are detailed in the Sustainable Development Report 2017, available on the Group's website[1].

3.1.3 *Context of the energy sector in Ivory Coast*

Since 1984, the decrease in rainfall and the consequent shortage of hydroelectricity in Côte d'Ivoire have highlighted the vulnerability of electricity generation from hydroelectric facilities and alerted the Government to the need to define and to implement a comprehensive and coherent energy policy.

In 1990, the Ivorian government embarked on a major phase of restructuring the electricity sector by awarding a private enterprise the management of the national civil service with respect to production, transmission, distribution, export and export. import of electrical energy. This restructuring aimed at ensuring the self-financing and financial stability of the sector, as well as optimizing the operation of the electricity network. The discovery, at the end of 1993 and 1994 at sea of the associated oil and gas deposit "Lion", and of the "Panthere" offshore gas field, gave the government the opportunity to consider thermal energy in order to install facilities. more important production.

With this in mind, the government signed an agreement in 1994 with a private company, the Ivorian Electricity Production Company (CIPREL), for the construction, operation and transfer of ownership of a thermal power station with a capacity of about 210 MWe (Vridi II, in the Abidjan area). The public-private partnership agreement with CIPREL, the first of its kind in Côte d'Ivoire

[1] https: // www.eranove.com/wp-content/uploads/2018/10/Rapport-DD-Eranove-2017-LD.pdf

and sub-Saharan Africa, demonstrates the government's intention to increase the electricity generation sector through private actors.

Building on this first successful experience in the field of independent power generation, the government intends to continue and intensify its policy of reducing costs and improving the efficiency of the sector, in order to support economic growth in Côte d'Ivoire. Ivory. Achieving these goals must involve the efficient use of oil and gas resources available in the country, as well as the establishment of other independent producers, thus promoting the competitiveness of the sector.

The generation capacity available in 2015 was approximately 1770 MWe, coming from the Azito (430 MWe), CIPREL (540 MWe) and Aggrekko (100 MWe) plants, all located near Abidjan, plus the contribution from hydroelectric power stations located a few hundred kilometers from the centers of consumption. No energy reserves are available and existing plants must operate on a continuous basis at almost full power to meet consumer demand.

In this context, several power plant projects are under development or evaluation, including the Azito thermal power plants (250 MW expansion), Songon (372 MW and the hydroelectric dams, Singrobo (44 MW), Louga (283 MW MW), Boutoubré (156 MW), Tiboto (220 MW) and Tayaboui (100 MW).

To these projects will be added in the short term the development of the CIPREL 5 plant which will result in an increase in the installed capacity of 390 MW, representing a 16% increase in the country's electricity generating capacity. This new increase in capacity will thus contribute significantly to securing the electricity supply of the Republic of Côte d'Ivoire. This project was the subject of a Memorandum of Understanding with the State of Côte d'Ivoire in September 2016. The agreement was signed on December 19, 2018.

3.1.4 Project Location

The project site is located near the village of Taboth, in Jacqueville prefecture, about 30 km west of Abidjan,

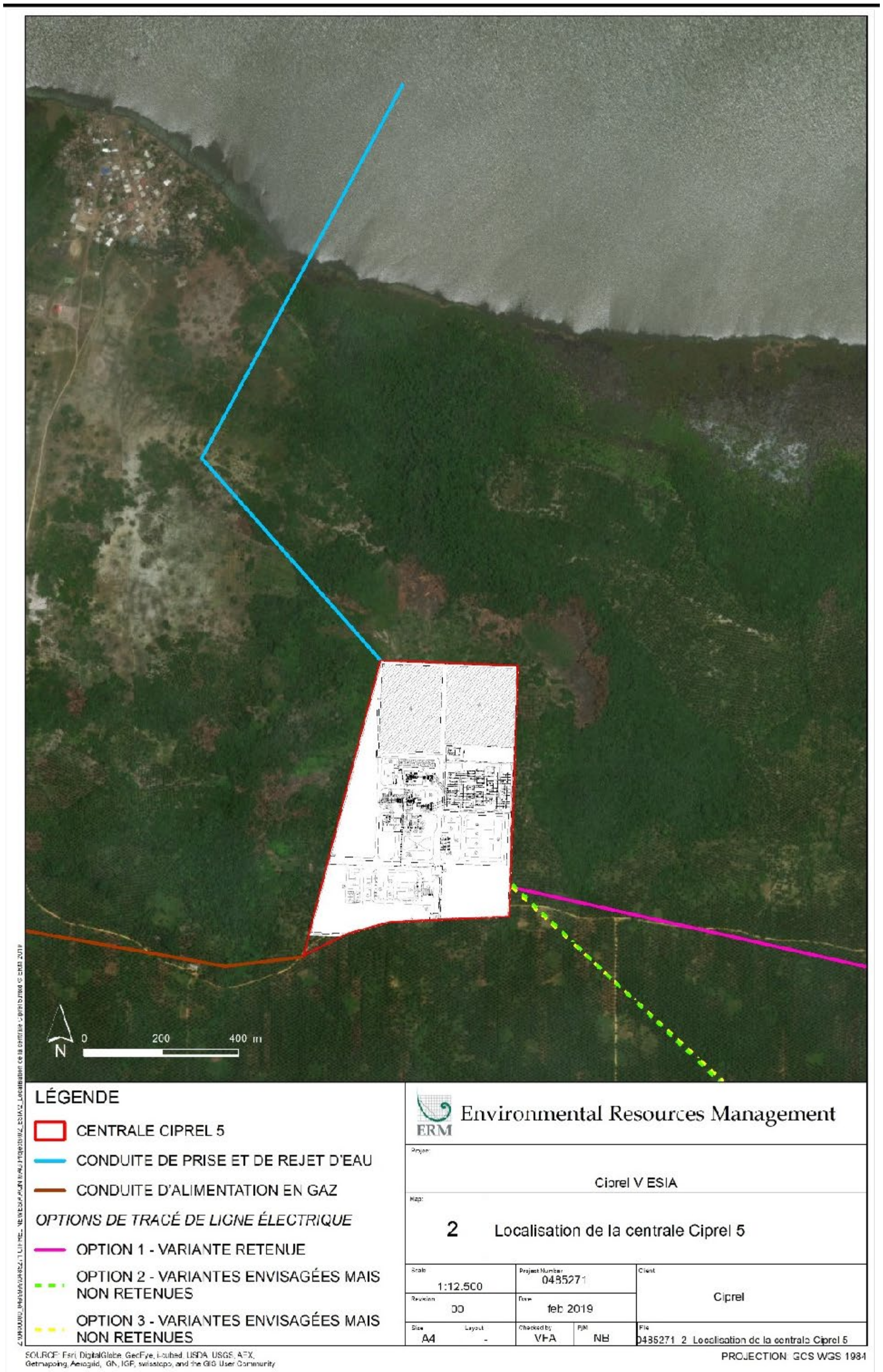
It is 1 km southeast of the village of Taboth, in the town of the same name, about 12 km east of Jacqueville. The 30-hectare site allocated to the project is located in a rural area, currently occupied by coconut plantations and bordered by forest islands. The site is located about 800m south of the Ebrié lagoon. The residential areas closest to the project activities are located approximately 700 m from the northwestern boundary of the property.

The land is currently owned by the village of Taboth. The plant will occupy an area of approximately 10 ha inland.

The overall location of the Project is illustrated in Figure 3.2. The location of the CIPREL 5 plant is shown in Figure 3.3. The locations of the different transmission line options under study at the time of this report are presented in Figure 3.2. Note that the option preferred by CIPREL is option 1 (in purple on the maps).

Figure 3.2 General Project Location

Figure 3.3 Location Central CIPREL 5



3.1.5 *Selecting the plant site*

Site selection is justified by the following elements:

- Site-wide riparian populations generally favorable to the Project, based on initial CIPREL consultations, as well as those conducted as part of the ESIA;
- Proximity of gas supply;
- Near the lagoon for cooling water supply;
- Construction of undeveloped land;
- Avoidance of populated areas to minimize the risk of physical movement;
- Natural habitats on the site of the plant, which are unlikely to be sensitive; avoidance approach to define the line layout, to avoid directly impacting potentially sensitive natural habitats (see Chapter 6, Initial State Study, Chapter 7, Impact Assessment, and Chapter 8, Management Plan) environmental and social issues).

3.1.6 *Power Line Route Selection*

As noted in Section 3.1.4, ATINKOU considered three different routes for the power line connecting the transformer substation at the power plant site and the Azito-Akoupé Zeudji line.

Of these three options, Option 1 through the northern part of the Project Area is currently favored by ATINKOU because it allows for the best balance between avoiding environmental impacts, limiting land acquisition and displacement needs, and cost of ownership. construction.

As such, this study will consider this route for the description of the initial environmental and social condition, and the impact assessment of the Project. A more detailed discussion of alternatives considered and sensitivities associated with the plots of Options 1, 2, and 3 is presented in Section 3.6, Project Variants.

3.1.7 *Connection to Foxtrot Pipeline*

The project involves the connection to the Foxtrot pipeline through Avagou, the gas from the Foxtrot offshore gas field.

Over time, it is possible that the design of the two Foxtrot gas lines will not be sufficient to meet the needs of the project and the various consumers, including the existing CIPREL plant and the Azito plant, which is expected to expand in the near future. Foxtrot's ability to meet gas demand will depend on the resource and future electricity consumption in Abidjan and the electricity supply of the various power plant projects under development. However, improving the energy efficiency of combined cycle gas plants will reduce the gas consumption per kW / h produced.

Other sources of gas supply may also be available, in particular by connecting to existing PetroCI pipelines or to the future Liquefied Natural Gas (LNG) terminal which could be developed by TOTAL in the Vridi area.

3.2 *COMPONENTS AND FACILITIES OF THE PROJECT*

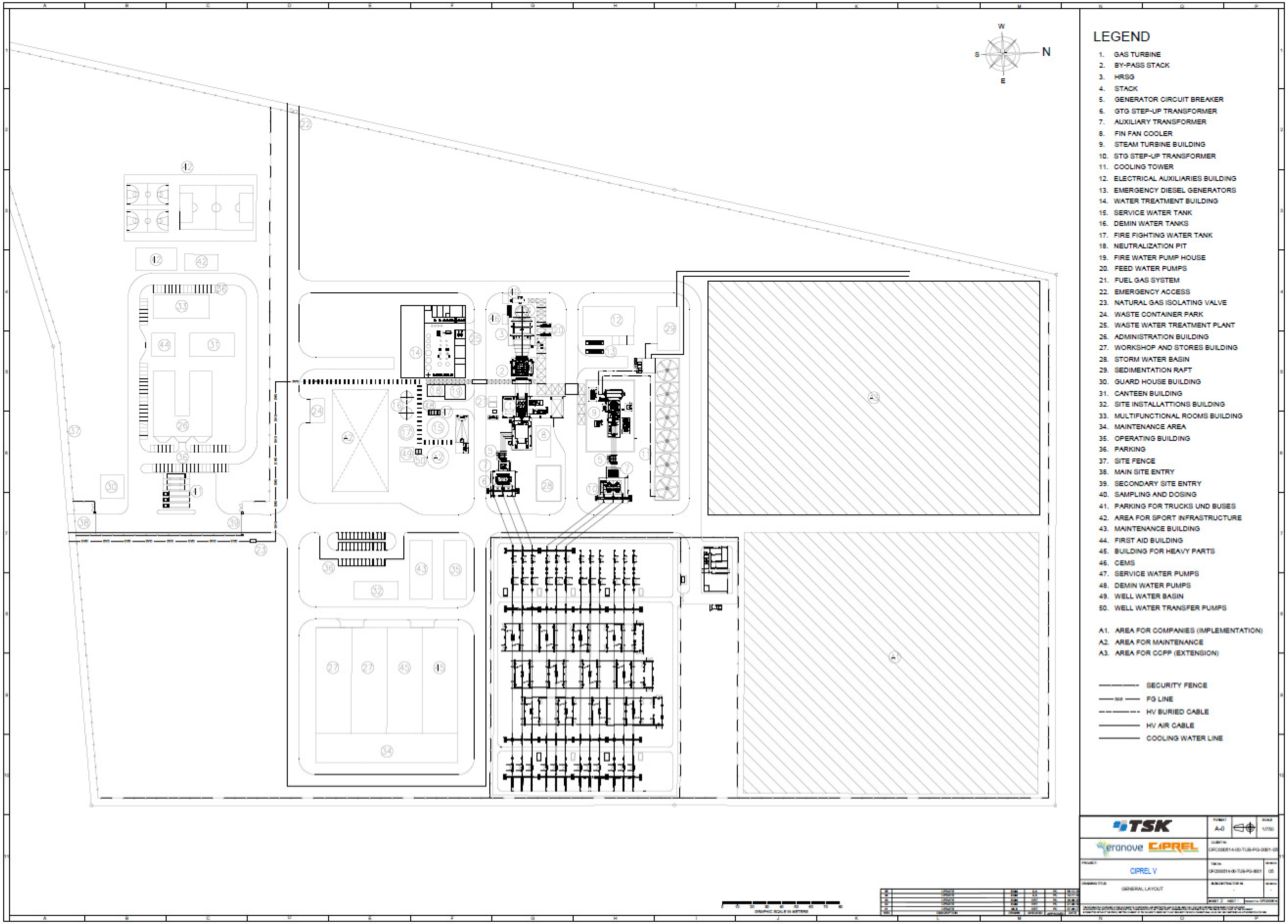
The main components and systems of thermal combined cycle plant are outlined in Table 3.1 and shown in the detailed map in Figure 3.4.

Table 3.1 Main components of the central

components	Description
Gas turbine (TAG)	A high-efficiency class F gas turbine of the "heavy duty" type, which can also operate with liquid fuel in the event of a gas supply failure (otherwise no oil exploitation).
Recovery boiler	AN exhaust gas recovery boiler (Heat Recovery Steam Generator - HRSG) will produce high pressure steam. The boiler will have 2 or 3 levels of vapor pressure, with reheat and without afterburner.
Steam turbine (TAV)	The steam produced by the recovery boiler will be sent to a steam turbine.
exhaust system of the gas turbine	The gas turbine exhaust may also be vented to the atmosphere through a bypass chimney, allowing the plant to operate in an open cycle when necessary. The chimney will have a height of 40 m and will be equipped with control equipment (silencers, filters and gas monitoring) to minimize the potential impacts of the plant.as turbine exhaust gases can also be discharged to the atmosphere through a bypass chimney allowing the plant to operate in open cycle when necessary. The chimney has a height of 40 m and will be equipped with monitoring equipment (silencers, filters and monitoring of gas) to minimize the potential impacts of the plant.
Cooling system	The cooling of the vapors at the outlet of the gas turbine will be done by means of closed-loop force cooling towers. Forced draft allows the circulation of warm, moist air through the tower through the action of a fan. The closed cycle cooling water provides recovery of water sprayed in the towers and its return to the condenser to condense the steam output TAV.
closed cooling water system	A closed water cooling circuit will cool the various equipment of the plant.

components	Description
Water Treatment Systems	Various independent systems of water treatment will be installed, including: •purification of ground water consumption; •cooling water chlorination; •demineralizing water service; and •treatment plant waste water.
compressed air system	The air compression system will distribute air service and instrumentation. The compressed air is produced in a centralized compressor which produces two air quality levels. The instrument air is filtered and dried, and the air service is only filtered.
chemical laboratory	The laboratory has all the equipment to ensure the water analysis. The water quality of the condenser, cooling system and discharged water can be analyzed.
Buildings of the power plant	The plant equipment (TAG, TAV, lab, etc.) will be installed in buildings partially opened or closed as appropriate. Administrative buildings (offices), dormitory, showers, kitchen and dining room are also provided to the staff.
electrical system of the plant	TAG and TAV will be connected to the boost converters via circuit breakers and conductors insulated phase sheath (a separate system for each turbine).
Command and control system of the plant	A control system and integrated control will be installed in a control room. It will monitor the facilities of the plant, including the recovery boiler, water supply, exhaust gas open cycle system, water and water treatment, storage of water service, liquid fuel supply and electrical systems. TAG and TAV will be monitored and controlled via independent systems but the combined cycle control will be integrated into the main central control system. The monitoring system will include an environmental monitoring system.

Figure 3.4 Detailed Plan of the Plant



3.2.1 *Overview of the thermal plant*

The gas thermal power plant will be able to operate in open cycle or combined cycle. In open cycle, only the gas turbine (TAG) produces energy and rejects combustion fumes via a bypass chimney. In the combined cycle, these fumes are recovered and sent to the recovery boiler to operate the steam turbine (TAV).

The TAG will be installed first and it is expected that the plant will operate in open cycle around the third quarter of 2020. The TAV will then be built and the plant will operate in combined cycle from the second quarter of 2021.

The unit can operate in open cycle if the combined cycle is not working (eg maintenance of the TAV, etc.).

The plant will consist of a single TAG, a recovery boiler and a TAV. The plant will be operational 24 hours a day, 7 days a week except during stops.

A description of these different operating modes and the main facilities and components of the plant is given in the sections below.

3.2.2 *Gas turbine*

The gas turbine selected for the Project is the Siemmens SGT-4000F model. The characteristics of the turbine are presented in Table 3.2.

Table 3.2 Characteristics of the gas turbine in combined cycle and open cycle

Characteristics	Siemens SGT-4000F gas combined cycle	Siemens SGT-4000F open cycle
gross total installed power (MW)	420	278
net installed power (MW)	411	275
Stack diameter (m)	7	7
Flue gas temperature (° C)	98.7	606
Speed of the fumes (m / s)	20	40
Smoke flow (m^3/ S)	705.1	1 583.7
Volume flow of the fumes at the dry state (Nm^3 / s)	524.5	524.5

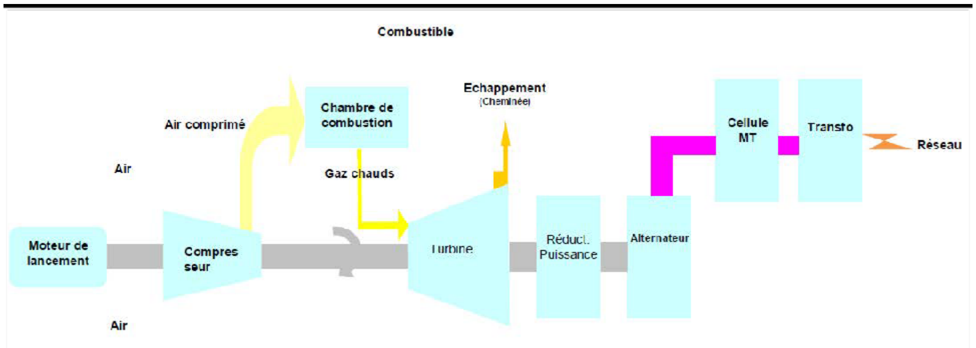
Source: CIPREL 2016

The TAG bypass chimney and the TAV main chimney will be 40 m and 60 m high respectively. The combustion chamber of the gas turbine will be of "dry low NOx" type, without water injection. In gas operation, the flue gas concentration in the dry state will be less than 25 mg / Nm^3 for NOx and 15 mg / Nm^3 for CO.

3.2.3 *Open Cycle operation*

Open cycle operation consists of the operation of a gas turbine and a generator. The gas turbine includes a compressor, a combustion system and an electricity generating turbine. The compressor of the TAG compresses the outside air. The fuel is added to the compressed air in the combustion chamber and then ignited. The expansion linked to the combustion activates the turbine connected to an electricity generator. The graphical representation of open cycle operation is shown in Figure 3.5.

Figure 3.5 Visual schematic of open cycle operation (source: ERANOVE)



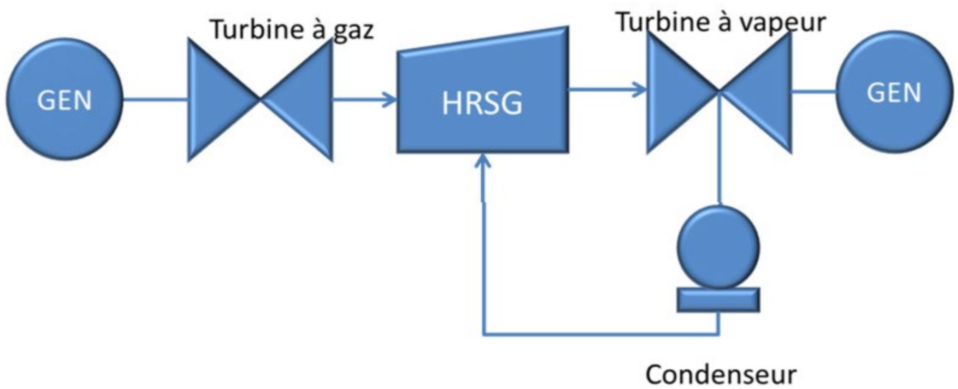
3.2.4 *Combined Cycle*

In addition to the equipment required for the open cycle, the combined cycle includes a heat recovery boiler, a steam turbine and a steam condenser. This system makes it possible to significantly increase energy production per unit of fuel consumed (yield increase of more than 50%).

In the combined cycle, the exhaust fumes from the TAG are recovered in a steam recovery boiler (HRSG). The generated steam is fed to the steam turbine through the steam pipes. The steam drives the steam turbine which in turn drives the alternator to produce electricity. Electricity is produced by TAG and TAV.

The steam at the turbine outlet is then condensed in water in a condenser before being returned to the boiler via pumps. However, injections of demineralized water are provided in the steam system to compensate for water and vapor losses (see Section 3.2.7). The condenser will condense the steam through a forced draft cooling tower (see Section 3.2.6). A flow diagram of the combined cycle is shown in Figure 3.6.

Figure 3.6 *Visual schematic of the combined cycle*



3.2.5 *Gas*

The project involves connecting the Foxtrot gas line to Avagou, the gas from the Foxtrot offshore gas field. The properties and chemical composition of Foxtrot gas are shown in Table 3.3.

Table 3.3 *Properties Foxtrot gas*

properties	Unit	Minimum	Maximum
Pressure	bar	23	25
Temperature	° C	-	55
Superior heat value	kJ / kg	46804	46918
Sulfur	mg / Nm^3	-	-
Higher Heat Value	kJ / kg	52535	52 632
Lower Heat Value	kJ / kg	47495	47558
Methane	mol%	91.9147	92.4343
Ethane	mol%	2.8037	2.7794
Propane	mol%	1.2986	1.2323
N-butane	mol%	.3791	.3597

properties	Unit	Minimum	Maximum
I-butane	mol%	.3214	.3060
N-pentane	mol%	0.1296	.1256
I-pentane	mol%	.1444	.1369
N-hexane	mol%	.7953	.4017
Nitrogen	mol%	1.5910	1.5985
Carbon dioxide	mol%	.6181	.6205
Total	mol%	99.9959	99.9949

Source: CIPREL 2016.

table 3.4 *Indicative gas consumption in existing CIPREL plant (source CIPREL)*

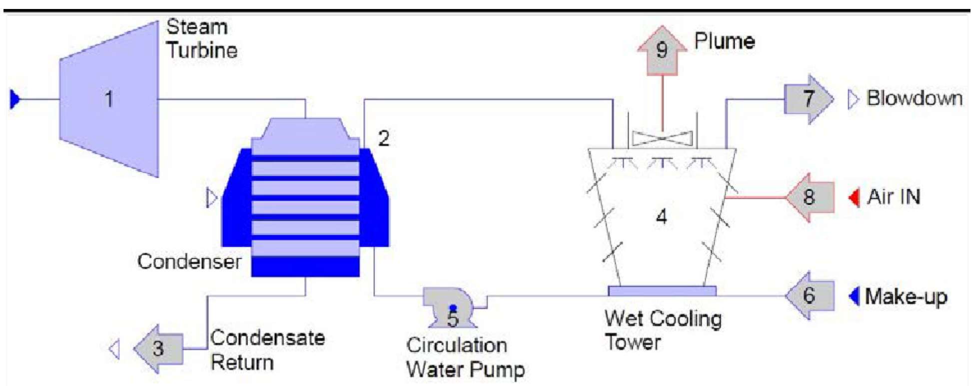
	2012	2013	2014	2015
Annual gas consumption (m^3)	581 884 498	638785560	749071706	633882159

3.2.6 *Cooling of water vapor*

Water vapor operating the steam turbine will be condensed in a condenser. The condenser will itself be cooled by the circulation of cooled water in a forced draft cooling tower in a closed cycle.

Figure 3.7 illustrates the operation of the cooling system.

Figure 3.7 *Diagram of the cooling system*



Note: 1 = TAV; 2 = condenser; 3 = Back condensed water; 4 = water cooling tower; 5 = Circulating pump; 6 = up water; 7 = Purge; 8 = air inlet; 9 = vapor plume. Source: CIPREL, 2016

The cooling system will therefore include:

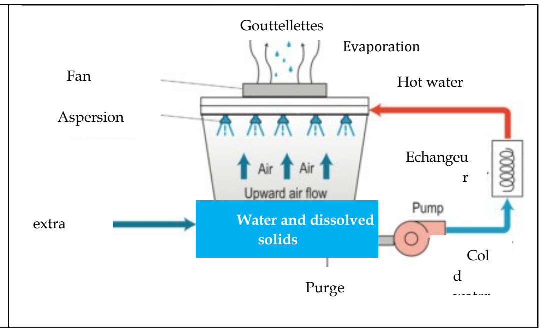
- a surface condenser with titanium tubes;
- cooling towers;
- a pumping station, located next to the basin, equipped with pumps and filters and to circulate the cooling water between the basin, the condenser and the spraying booms of the towers;
- the pipes connecting the circulation pump to the condenser and the condenser outlet to the cooling tower (total length 300 m);
- an injection system of chemicals for controlling biological fouling and limestone;
- a a water backup system including a water intake in Ebrié Lagoon; and
- a deconcentration purge with discharge in the Ebrié lagoon, including (on the site of the power station) a buffer basin allowing the cooling of the purge water before their rejection in lagoon.

The hot water is sprinkled in the upper part of the tower. Falling water transfers heat to the surrounding air. A part evaporates causing under certain atmospheric conditions a white plume escaping from the top of the tower. The sprayed water is collected in a basin and is then returned to the condenser by the circulation pumps.

Water droplets are carried by the air stream and emitted into the atmosphere. This training will be limited to less than 5 ‰ of circulating water flow through the use of drift eliminators to minimize droplet deposition in the surrounding area. The discharge of droplets by the plant will be about 0.1 m^3 / h.

To limit the content of dissolved solids and suspended in the circulating water, a continuous purge is performed. Depending on the quality of the water, this purge will be higher or lower. A booster is necessary to compensate for the purge, the evaporation and the water droplets entrained by the current of air. The forced draft cooling tower will be supplied with brackish water from the Ebrié Lagoon. The location of the water intake is shown in Figure 3.4. The expected water consumption will be around 2170m^3 / h (in the upper scenario, according to the Tractebel thermal rejection modeling study carried out for CIPREL in 2018). The cooling water will circulate in a closed cycle, however, continuous purges will be carried out (approximately 1680 m^3 / h, major scenario, Tractebel study for CIPREL, 2018). The maximum expected temperature of the purge water is 33.55 ° C.

The circulation of hot, humid air in the forced draft tower is facilitated by the action of a fan located either at the entrance or at the top of the tower (an example is shown below). Forced draft towers are smaller than natural draft towers. They are composed of prefabricated cells assembled on site. For the project, eight towers (cells) would be installed online for a footprint of about 125 x 15 m and 15 m high. Figure 3.8 shows a photograph of a forced draft tower and its schematic operation.Figure 3.8 illustration of cooling tower with forced draft



Source: CIPREL 2016

In order to limit corrosion, limestone deposit and biological development, chemicals will be injected into the cooling water system. Table 3.5 gives the characteristics of typical products used on a similar cooling system. TSK, the EPC, may choose products other than Hydrex H2869 and H7211. The deconcentration purges will be rejected without pre-treatment in the Ebrié lagoon, the quality of the purge water will be similar to that drawn from the lagoon with a higher salt concentration and the decomposition products of the injected treatment agents. The chlorine content will be controlled to not exceed 0.2 mg / l, the pH will be maintained between 6 and 9 and the difference between the incoming and outgoing water temperature will be kept below 3 ° C.

Table 3.5 Type of chemicals injected into the cooling system

Typical product	Hydrex H2869	Hydrex H7211	Sodium hypochlorite
Function	Liquid corrosive organic liquid: anticorrosive, dispersing and stabilizing limestone, sulfate deposits, metal oxides and dross.	Oxidizing biocide, bromine donor which enhances the effect of chlorine.	NaOCl, disinfectant.
Composition and decomposition products	1-hydroxy ethylidene-1,1-diphosphonic acid, phosphorous acid.	hypobromous acid and hydrobromic acid.	Reacts with metals giving the hydroxide or oxide of this metal, also reacts with other acids and dismutation in case of heat.

product Type	Hydrex H2869	Hydrex H7211	Sodium hypochlorite
			Possible decomposition: NaCl, Cl 2, NaClO 3, HClO.
pH	<2	6-8	11- 13
Content in water	5 ppm at the cooling towers.	6 ppm in the makeup water.	See monitored parameters.
Controlled settings	View content in the water.	View content in the water.	Free chlorine 0.2 - 0.5 ppm.
Amount injected	Depending on the content in the water.	4.3kg / h for 1 h.	Depending on the content in the water.
Harmfulness / toxicity	Harmful if swallowed. Causes burns and injuries from contact with skin and eyes.	Ranked pollutant in water according to the Clean Water Act (US). Toxicity LC50: Daphnia: 9.3 g / 48h, perch sun and blue rainbow trout:> 1 g / l 96h.	Corrosive and danger to the aquatic environment. GHS. Hazard: H314, H400, EUH031, P260, P301, P303, P305, P330, P331, P338, P351, P353, P361, P405, P501.

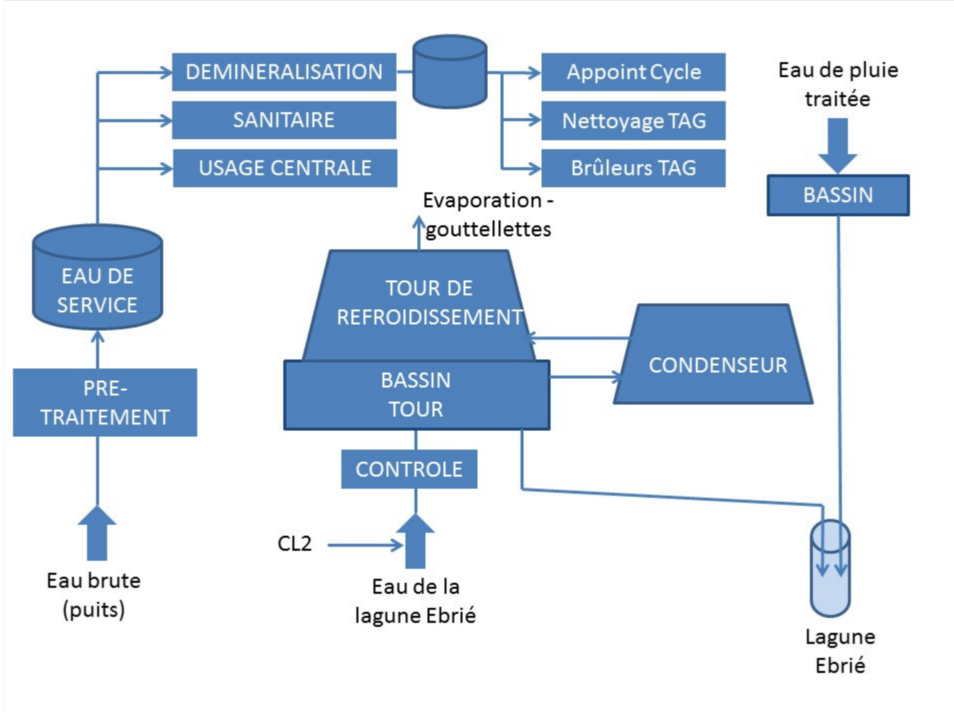
Source: Veolia

3.2.7 *Service Water*

The water will be extracted via boreholes (about three wells) and filtered. The number, exact location and depth of these wells are still under study. These wells are likely to be located within the boundaries of the site if flow and water quality meet the needs of the project.

The water will be discharged into a covered basin on the site. From this pool, water will be pumped into a treatment unit that will supply the service water. The service water will be stored in a dedicated tank and distributed through the plant to produce demineralized water, sanitary water, fire water, etc. The service water requirement will be approximately 20 m^3 / h in stabilized mode. Drinking water will be supplied in commercial bottles. The service water will not be used for the cooling system. Figure 3.9 illustrates the water cycle for the plant. The following sections detail the different uses and discharges of water from the plant.

Figure 3.9 Diagram of the water cycle



Source: CIPREL 2016, adapted by ERM

Demineralization of Water

Only demineralized water is consumed continuously, consumption will be intermittent for other systems. The demineralized water is used to supply the recovery boiler and to compensate for the losses of the condenser water vapor cycle, and for the cleaning of the TAG compressor at or off the compressor.

The demineralization unit will consist of two ion exchange production lines, an ion exchange resin regeneration system, an acid-base neutralization system (possibly combined with the water purification system), demineralized water and a system for analyzing the service water supplying the demineralization unit.

Drinking and Sanitary Water

Drinking water will be supplied in commercial bottles. The sanitary water will be produced by a chlorination system and distributed in the sanitary water circuit mainly supplying showers, toilets and rinsing systems where chemicals are handled.

3.2.8 Waste water management and rainwater service

Wherever possible, all wastewater service produced by the plant will be recycled.

- Non-recycled water will be treated on site and discharged into the Ebrié lagoon after treatment, via a collection basin.

- The cleaning water of the TAG will be collected in a dedicated pit and treated externally.

- The water collected at the bottom of the chimney during the shutdown of the plant will be collected in a dedicated pit and sent to the treatment plant.

- In case of fire fighting, the fire water will be sent to the deoiling unit before being directed to the storm basin.

- If the fight against fire, fire water will be sent to the de-oiling unit before being directed to the storm basin.

- Domestic wastewater will be collected separately and sent to septic tanks.

- Industrial water will be treated in a neutralization unit before being sent to the buffer pond. The quality and flow of water from each discharge source will be monitored continuously and must comply with applicable local and international standards.

The water treatment plant will be supplied by a collection network for each type of effluent and will consist in particular of:

- a neutralizing unit for process water;
- a pool of oil-laden water and a de-oiling unit;
- a sanitary water treatment unit;
- a collection basin for treated water of 200 m^3;
- a storm basin (possibly common to the treated water collection basin);
- a buffer pond for purge water from the cooling system; and
- ways to load trucks with contaminated TAG cleaning water and chimney water.

3.2.9 *Handling and storage of chemicals*

Chemical dosing and water analysis system

The chemical injection system will be located on the site and covered. It will ensure the dosing of the products to be injected into the water circuit of the recovery boiler and into the cooling water circuit. Pressure injection pumps will be connected to tanks of 1 m^3 per chemical. Dilution tanks for each chemical and oxygen cylinders will be installed. A sampling and water analysis system will also be installed. Both systems will be fully automated and connected to the centralized monitoring and control system

Storage of products

Construction activities will require fuel, oils, paint and miscellaneous maintenance products. These products will be stored in covered covered areas if necessary and with retention system. The fuel and oils will be stored in their original container or in a dedicated air tank. Liquid chemical waste (used oils, paints, bottoms, etc.) will be disposed of and treated in approved sectors locally or abroad.

During operation of the plant, chemicals will be stored on site. The list of liquid products, their storage mode and the quantity stored are shown in Table 3.6.

Table 3.6 List of goods and liquids stored onsite and storage mode

Chemical product	Mode of storage	Volume / autonomy
Raw water	1 basin	Undefined
Water service	1 tank	5000 m^3
Demineralized Water	2 tanks	2 x 500 m^3
Chemicals concentrate the injection unit and demineralization	1 tank by product	1 month of autonomy by product
Other particular chemical sodium hypochlorite	not defined	7 days autonomy at full capacity of the plant
DDO for emergency generators	1 tank	2 days of autonomy for base load
DDO for the fire pump diesel	According to standards	According to standards
Holding tank	1 tank	1000 m^3
Bottles H2 (if necessary)	several bottles	For 2 weeks of operation
CO2 cylinders (if necessary)	several bottles	For 3-dump generator

Chemical product	Middle storage	Volume / autonomy
N2 bottles	several bottles	1.5 x the recovery boiler + volume of steam lines

Source: CIPREL, 2016

3.3 AUXIALLARY FACILITIES

3.3.1 Temporary storage area of construction equipment

The temporary storage area for construction equipment will be located within the boundaries of the project site. Its exact location is still under study.

3.3.2 Access paths

To access the CIPREL 5 site, two access roads will be used: the road via the Jacqueville bridge and the Vridi waterway.

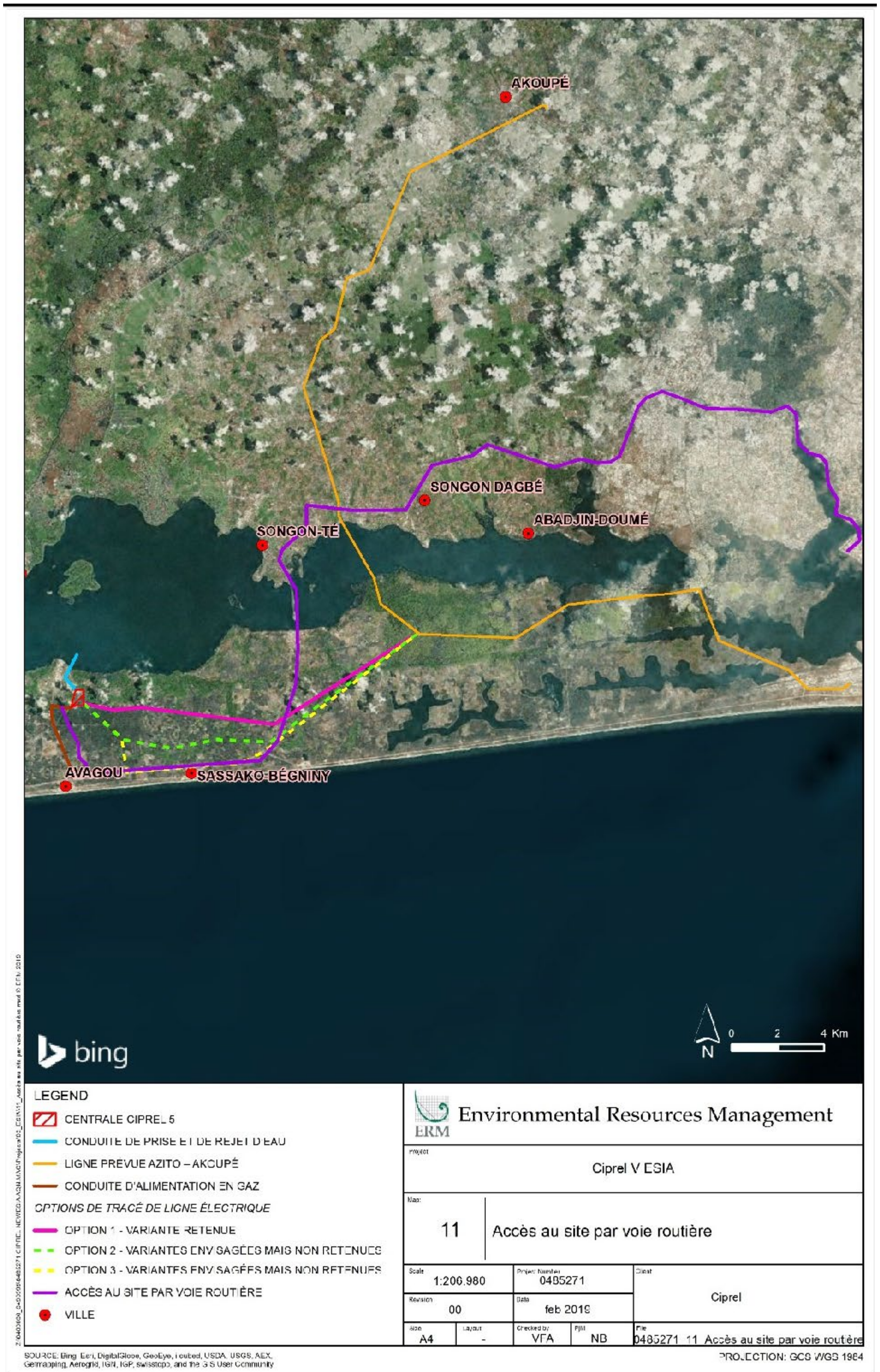
Roadway by the bridge Jacqueville

The road from the port of Abidjan passes through Yopougon and Songon, then crosses the Ebrié Lagoon by the Jacqueville bridge and then follows the seaside (south side) to the site of the plant. This road access represents approximately 57 km mainly on paved roads. The portion of the access road between the village of Avagou and the site of the plant will have to be arranged to allow the passage of vehicles carrying equipment.

The Jacqueville Bridge roadway will be used for the transportation of conventional equipment and for the transportation of local supplies.

These transports will have adjusted schedules to circulate in off-peak hours, so as not to aggravate the traffic difficulties while allowing to limit the loss of time and the risks of deterioration of the equipment to be transported.

Figure 3.10 Access to the site by road



River Access

The access by river will be favored for the transport of heavy parcels. Inland waterway access involves crossing the lagoon to the unloading bay operated by the CHEC, from which an existing runway runs along the

Vridi canal to the south of the canal. The transport will then be transported by the road along the seaside to the site of the power station.

The most suitable type of barge that will be used to ensure safe and efficient handling of equipment is a barge without self-propulsion1.

This will be possible through close cooperation with the port and maritime affairs to take account of port requirements (existing traffic). This will ensure the safety of the transport and the users of the port.

Port authorities, customs and offshore companies have been consulted. The possibility of unloading directly from the ship on the barge in the bay, not far from the jetty of the site has been confirmed. This implies that the work for this project will not disturb the river traffic of the port or canal at any time.

Ships will not need to return to the port or dock to unload their cargo as customs formalities can be done directly on the barge, as is done for other projects in the Abidjan Lagoon. The choice of a large barge will also make it possible to use it as a "stand-by yard", this having the effect of reducing the constraints of planning of loading and unloading.

In order to allow the transport of the heaviest equipment (total load up to 200-250 T), the track between the Vridi canal and the village of Avagou will probably have to be developed (laterite or asphalt).

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[1] *A large barge without self-propulsion is preferred since Abidjan has a tug center Importance whose machines are largely sufficient to carry out the barge conduction we would need. A large (eg 91 x 32 m) will be preferred in order to optimize and maximize the best possible travel to / from the barge. Moreover, this kind of barge provides a cargo capacity of approximately 11,000 tons on an area of 2700 m² with a ground pressure of 20 m tonnes². Because of its large size and weight, work ballast and reduce the risk for equipment and the environment.*

Figure 3.11 Existing track along the Vridi channel

3.3.3 Transport-related project activities

The construction of the project will require the transport of construction materials and equipment from the plant. The sand required for the concrete will be provided by a quarry in operation and will not be subject to dredging under the project. Materials will be transported by barge from the port of Abidjan to an equipped wharf and then by road to the project site. Figure 3.12 illustrates the possible points of passage for construction equipment and materials.

Figure 3.12 Loading/unloading zones and transportation routes

Note: Following the order routing (A: unloading dock boats import / export, B dock for loading via barge, C: smaller boats loading dock, D: unloading dock on the island bakre) .
Source: CIPREL 2016

equipment will be unloaded in zone A. It will then be transported by road to point B or C. Point B is accessible by the service roads of the port, point C requires to use the public road through points 1 at 6. The public road is partially degraded and regularly congested, the bridge at point 2 is not designed for the heaviest loads (eg generators). Wharf B has lifting facilities for loading and can accommodate larger vessels than Wharf C. A barge will provide return trips between the port and the unloading wharf on Bakré Island.

Table 3.7 Identification of heavy packages

Object	Q	Weight (T)	Length (Mm)	Width (mm)	Height (mm)
Steam turbine HP	1	52	4550	2600	2500
Steam turbine IP / LP	1	46	8000	4220	4720
Generator	1	200	1000	5000	4000
Gas turbine (unit)	1	306.68	10930	5200	4860
Generator	1	328	12300	4000	3800
Recovery boiler					
Module 1	2	148	29170	5230	4300
Module 2	2	258	29170	5230	4730
Module 3	2	274	29030	5270	4360
Module 4	2	245	29000	5240	3850
Module 5	2	220	29000	5240	3630
HP Drum	1	114	15180	2820	3280
Transformermain	1	148	7500	3500	4600

Planning for transportation equipment at the site (estimated)

This means of transport will be present on the water for a period of approximately 6 months (cumulative) and the estimated number of round trips is approximately 13 trips.

Turbines and Generators
For items that arrive in the same boat at the same time:

- 10 days of work for gas turbine and generator; and
- 10 days of work for steam turbine and generator.

For items arrive separately:

- One week installation for each heavy item.

Recovery Boiler Modules

- 10 days for setting up the 10 units;
- 5 days lifting modules (first set), if connections modules managed I per day;
- 4 days to remove all units (second set);
- 5 days lifting modules (second set);
- 4 days to remove all units (third set);
- 5 days lifting modules (third set);

- 2 days to collect two units of HP drum;
- 1 day for the lifting drum; and
- 6 days to dismantle and set up in the container to the discharge.

Other

- Mobile Crane: 3 months (loading / unloading equipment for transport, all the preparation of the site and the entire installation) and 1 mobile crane of 150 tons of capacity;
- SPMT: 2 month site; and
- Barge: 2 month site for unloading.

3.3.4 Loading dock

The dock located to the northeast of the site (see Area D in Figure 3.12), developed by China Harbor Engineering Company (CHEC), may be used for the unloading of material and equipment. The unloading dock in its current state is shown in Figure 3.13. It is not equipped with a lifting device and its load capacity must be checked by the EPC. Work on the extension and redevelopment of this wharf will be necessary, it will probably have to be reinforced and equipped with a floating dock and a lifting device. The unloading can also be done by the technique Roll on-Roll off1.

Three recognitions were made on the northern area of Vridi West to verify the functionality of this wharf. This one appeared repeatedly degraded (presence of earth, sand and rocks). Although the wharf seems to have a high resistance (currently machines of very large tonnage circulate there), a study of resistance will be carried out in order to know its capacity per square meter and to envisage work if necessary (maintenance, repair, reinforcement or improvement). Possible reinforcement works include the addition of an additional armored or reinforced screed of twenty centimeters, or distribution beams.

[1] Roll on / Roll off, also called abbreviated Ro / Ro, is an English term used in logistics to designate the ro-ro traffic, ie transport trucks or trailers by special boats called "ro-ro". It refers to the technique of handling: packages are loaded and unloaded by rolling from the harbor ferry ramp (when it exists) to the mobile ramp of the ship.

Figure 3.13 Existing CHEC unloading dock near the project site

An alternative is also envisaged for the transport of building materials. The transport would be carried out by ballast barges via the lagoon from the Port of Abidjan, would be unloaded on a wharf at the level of Jacqueville in N'djem, then transported by road to the site of the plant.

An existing wharf west of the Jacqueville Bridge will be renovated, provided that the largest equipment can transit under the bridge. Otherwise, a wharf will be built east of the bridge on a vacant lot.

This option would probably require dredging in the lagoon at the wharf level and potentially in the lagoon. Due to these potential impacts in the lagoon, this alternative has not been favored.

Figure 3.14 Alternative unloading dock at N'djem - Location

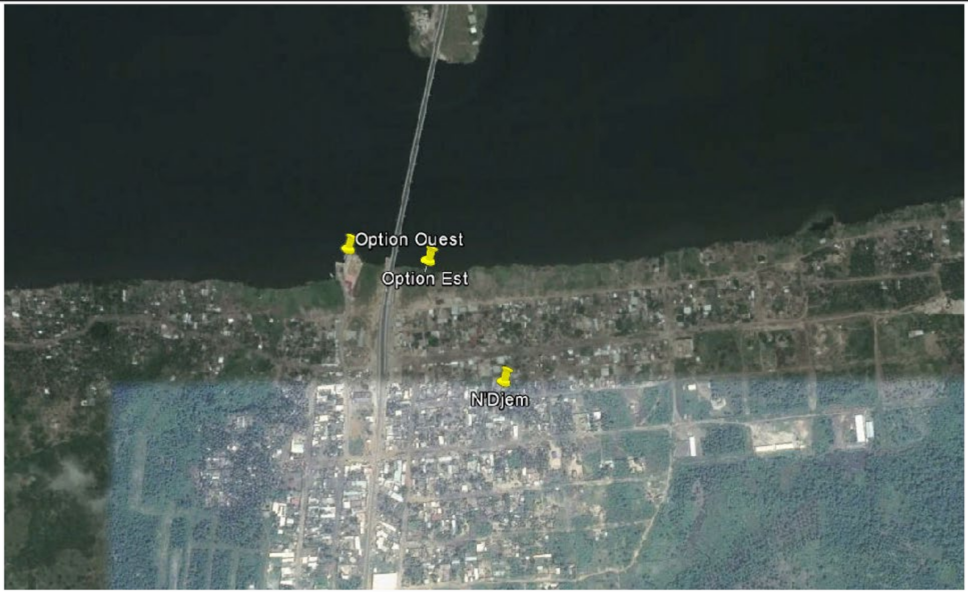


Figure 3.15 Alternative unloading dock at N'djem - illustration


Alternative N'djem - West Option


Alternative N'djem - Is Option

3.3.5 *Temporary Home Base*

The Project is studying the possibility of transporting staff from the construction phase by bus from Abidjan on a daily basis. If this option is not deemed satisfactory, the workers will be housed in a home base in Jaqueville. This base will be located in the former boarding school of Jaqueville which will be rehabilitated for the reception of the workers.

3.3.6 *Operating City*

The project will employ about 100 people in the operational phase. ERANOVE plans to build a residential estate for households on an area of approximately 5-6 ha. The location of this city is not defined at this stage. If this should be outside the project site, the necessary additional studies will be carried out by ERANOVE and any requests for authorization required will be made.

3.3.7 *Security*

The project site will be secured by a permanent barrier from the beginning of the construction phase. Security personnel will monitor site and site access 24/7. All vehicles entering and exiting the plant will be inspected. All staff members will have to display their ID badge and all visitors will need to check in at the entrance. The EPC will be responsible for site security during the construction phase.

3.3.8 *Gas supply pipeline*

The gas supply for the CIPREL 5 plant is planned from the Foxtrot pipeline. The gas line will run along a medium-voltage power line and existing tracks lined with rural and agricultural land, including an industrial coconut grove, on a corridor 5m wide and 4.2km long. This pipeline is at the expense of the State of Côte d'Ivoire.

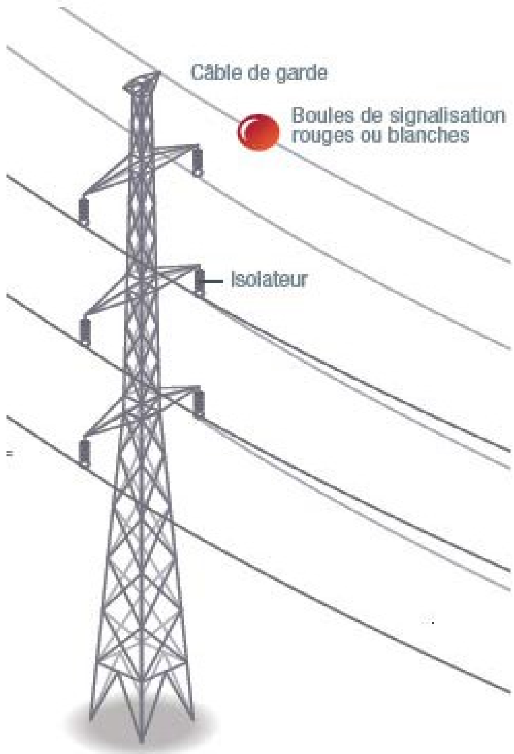
3.2 *ELECTRIAL TRANSMISSION LINE*

The Project's power distribution line will carry 400kV high-voltage power by dual-circuit overhead conductors. The arrangement of the phases of the double circuits will be vertical according to the illustration given in Figure 3.16. The line will be supported by pylons at more or less regular intervals, for a distance of 15.6 km until connecting to pylon 55 of the line Azito Akoupé Zeudji.

It will be equipped with:

- 2 circuits, three phases with three conductors per phase
- type AAAC conductors 570 (ASTER);
- 2 fiber optic guard cables;
- composite or tempered glass insulators; and
- a grounding system.

Figure 3.16 Components of a high voltage line



3.4.1 *Distance and safety corridor*

Minimum distances are imposed between the different elements of the line and the elements external to the Project (eg dwellings, ground, etc.) as well as between the elements of the line itself. The safety distances taken into account in the design of the Project are described in Table 3.8.

Finally a 25 m safety corridor on either side of the line will be defined and restrictions of use of land under the line will be put in place. The following measures will be observed:

- prohibition of construction of dwellings or structures; and
- Prohibition of planting perennial crops.

Table 3.8 Minimum safety distances (without wind)

Description	terms
Between conductors and the tower	3.1 m
Between conductors	3.7 m
Above ground	8m
Above the roads	9m
Over power lines	4.5m
antennas	5m

Above non residential roofs fireproof	13m (7m if fire resistant)
Horizontal distance to the roofs of houses and buildings	5m

Source: Tractebel, Technical Specification for the Project

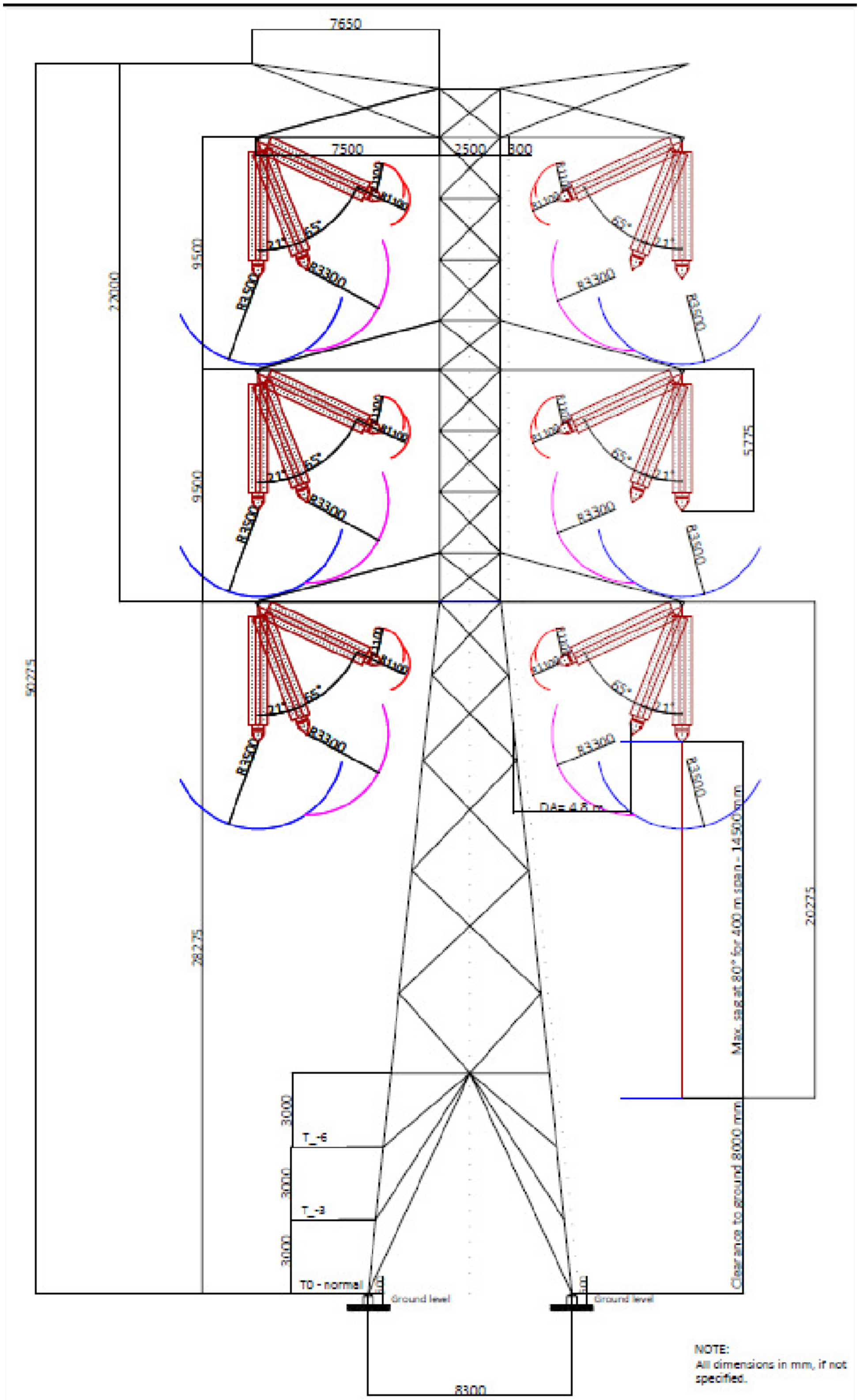
3.4.2 *Pylons*

Overview

The number of pylons is being determined. They will support the drivers and will be installed approximately every 400m.

They will be equipped with an anti-climbing device and their silhouette will probably be in double flags. Figure 3.17 illustrates the tower diagram. The majority of pylons will reach a height varying between 50 and 60m.

Figure 3.17 Pylon double type flag, three-phase double circuits



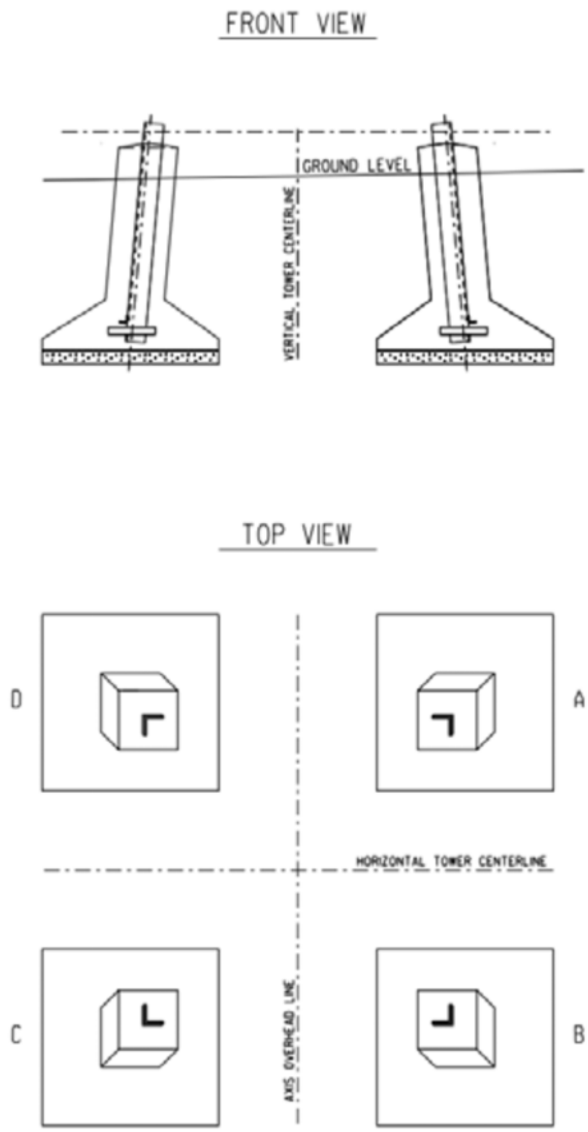
Source: CIPREL

Foundations

The foundation of pylons will generally be reinforced concrete, in more unstable and wet areas the foundations will be on feet beaten or drilled (for example in swampy areas).

The study of soils at the foundation sites will allow the choice of the appropriate type of foundation. It will consider the nature of the soil and the capacity of the soil to support the load involved.

Figure 3.18 Typical profile support foundations



3.5 *PHASES of the PROJECT*

The project will be implemented in three phases, each detailed below.

3.5.1 Construction phase

Planning

As the project is still in the design stage to date, the official date of construction has not yet been confirmed, but it is likely that work will begin in April 2019, subject to validation of the ESIA by the Ivorian authorities. . The construction phase is expected to last about 40 months with progressive turbine operation.

Construction activities

The preliminary construction activities at the commissioning of the power plant include:

- the demarcation of the area to be cleared and the establishment of a fence and gates to control access to the site;
- clearing of vegetation on the site;
- development of the dock north of the Vridi Canal;
- leveling, compacting and dressing floors to create flat surfaces;
- Rehabilitation of the Jacqueville boarding school to serve as a living base for the workers;
- the development of hard surfaces to accommodate storage areas, roads, tracks, etc. ,
- metallurgical works, platform and lining installation, masonry work;
- the establishment of foundations and implementation of foundation piles;
- the development of a drainage system for the site;
- setting up support facilities, particularly for waste management, wastewater, electricity supply, fuel reserves and storage areas;
- he construction of the water intake in the Ebrié lagoon and the discharge pipe;
- he construction of buildings and structures; and
- installations of equipment.

After clearing activities, the soil should be leveled over the entire surface of the site. The EPC will have to dispose of all waste associated with clearing, sand excavation and soil disposal activities in approved landfills. Embankments will ensure leveling and compaction of the soil. These embankments must be inert and unpolluted.

The necessary backfill (aggregate, sand, soil) will be provided by an approved supplier and will not be dredged under the project.

The temporary tracks necessary for the construction will be arranged in order to then be kept as road of the project site, with finishing at the end of the construction phase. They will be at least 6 m wide. Some routes can then be paved or concreted at the end of the construction phase after the installation of the rainwater drainage system. The runway from the wharf to the site will also be converted to accommodate the heaviest equipment.

Given the loose nature of the soil, the foundations will probably have to be deep. They will have to rest on pillars driven into the ground at the places of the heaviest buildings and equipment.

The buildings will then be built. The building of the TAG aims to soundproof and protect it from the vagaries of the weather. The foundations of the turbine and the generator will be reinforced. The recovery boiler will be installed outside but covered while its outdoor equipment will be inside. The support columns of the boiler will be supported by concrete bases. A reinforced concrete foundation will be built under the boiler and the fuel pump building. A 60x40 m building made of steel structure serving as hangar and workshop will be built. Table 3.9 details the different buildings and structures that will be built on the site.

table 3.9 ***Buildings and structures of the plant***

Building / structure	Super Structure	elevated slabs	Facade	roofing	Platforms / stairs
TAV construction	steel structure	composite slab / wire rack	coatingmetallic	steel roof	steel structure
TAG building	steel structure	n / A	n / A	steel roof	steel structure
Boiler	steel structure	composite slab / wire rack	uncoated	steel roofing	steel structure
Electrical and control building	reinforc ed concrete	reinforced concrete	Masonry	reinforc ed concrete	reinforced concrete
Administrative building	reinforc ed concrete	reinforced concrete	Masonry	reinforc ed concrete	reinforced concrete
Workshop & warehouse	steel structure	composite slab / wire rack	metal coating	steel roofing	steel structure
Building at the entrance	reinforc ed concrete	reinforced concrete	Masonry	reinforc ed concrete	
N Building déminéralisati o	steel structure	composite slab / wire rack	metal coating	steel roofing	steel structure
pipe Support	steel structure	n / A	n / A	n / A	n / A
Trench cables and pipelines	reinforc ed concrete	n / A	n / A	n / A	n / A

Building / structure	Super Structure	elevated slabs	Facade	roofing	Platforms / stairs
(Underground Work)					
pump room fire fighting	steel structure	composite slab / wire rack	metal coating	steel roofing	steel structure
compressed air vessel	steel structure	n / A	metal coating	steel roofing	steel structure
air intake structure	reinforc ed concrete	n / A	reinforced concrete	n / A	n / A
TAV Foundation	reinforc ed concrete	reinforced concrete	n / A	n / A	n / A

Note: NA: Not applicable

A complete sanitation of wastewater collection will be installed on site for the use of staff during the construction phase. The waste water will be collected in a tank and treated before discharge. An area for sorting and storage of construction waste will also be built. Hard surfaces will be drained and the water treated by an oil separator before being discharged.

Construction activities will create direct and indirect jobs. Between 1,000 and 1,500 employees (up to a period of one year), mechanical and electrical engineering. The local employment will be encouraged wherever possible.

3.5.2 *Operation phase*

Planning

The commissioning of the first unit (TAG) of the plant is scheduled for the third quarter of 2020 for the open cycle and the second quarter of 2021 for the combined cycle.

Operations in the operating phase will consist primarily of operating the new combined cycle power plant.

Operating activities

The thermal power plant will be operated 24 hours a day, 7 days a week by a new entity owned by ERANOVE. This company will employ about 100 people. The staff will consist of qualified managers and operators who will be responsible for the operation and maintenance of the plant. It is expected that the majority of employees will be of national origin.

The majority of activities during this phase will be related to monitoring the operation of the plant and periodic maintenance work. The property necessary for the operation of the plant and the employees will be transported from the port of Abidjan. On-site activities and transportation of goods will increase during shutdown and maintenance periods.

3.5.3 *Dismantling phase*

The plant will be designed for a minimum service life of 250,000 hours of operation which corresponds to 30 years of operation under normal conditions. Beyond these 30 years, the plant can be maintained in operation following maintenance and replacement of equipment as needed.

In accordance with the concession between the Ivorian State and ERANOVE, the operation of the plant will be the subject of a new concession agreement, the term of which should be between 2040 and 2045. It can operate beyond this date, either as part of a concession renewal or as a retrocession to the state.

Should the plant be dismantled, decommissioning activities will include securing the site, cleaning equipment, dismantling equipment and structures, and clearing the surface of the site, in accordance with applicable regulatory requirements, with international standards. and at the concession agreement with the state.

3.3 *VARIANTS PROJECT*

The potential variants of the project are analyzed on the basis of the most essential components of the project, namely:

- location of project;
- the configuration of the ground plan and the location of the various components of the project; and
- technological choices for electricity generation and cooling.

The main identified potential alternatives are described and briefly discussed below.

"Without project" Option

From an environmental point of view, the absence of a project presents no quantifiable modification of the current biological and physical characteristics (pre-project).

On the socio-economic level, this option would represent a shortfall in terms of employment, investment, energy security and economic growth. It would be in contradiction with the national strategy aimed at increasing electricity generation capacity, increasing energy production performance and reducing consumption costs.

"Other location" Option

The project could be carried out on another site in the periphery of the district of Abidjan. This option would have other impacts, although similar in nature, in another location. Initially, the project site was planned along the Vridi canal opposite the current CPIREL station. This option was not retained due to land conflicts. As such, the location of the project in Taboth has the following advantages (see also Section 3.1.5):

- local riparian populations generally favorable to the Project site;
- proximity to gas supply;
- virgin construction land;
- avoidance of populated areas to minimize the risk of physical movement.

"Different line route" Options

As discussed in Section 3.1.4, Ciprel considered three different routes for the power line. The choice of Option 1 as the preferred route was based on the results of the field studies conducted as part of the ESIA.

The route of Option 1 passes through lowland areas, generally considered sensitive habitats, and therefore has potential for environmental impact. However, the impact on these sensitive habitats can be minimized by technical means that are presented in Chapter 7 - Environmental and Social Impact Assessment and Chapter 8 - Impact Management and Monitoring. In all cases, this routing option avoids the most sensitive areas, including swamp forests identified as suitable habitats for the presence of chimpanzees (which the line bypasses by the south).

The route of option 2 passes through sensitive habitats (lowlands and swamp forests) over distances greater than option 1. On the other hand, it presents less social sensitivity by avoiding the areas of settlement and the agricultural areas present. more to the south. Because of its greater length, it also has a higher financial cost than Option 1.

The route of option 3 avoids the lowland areas, therefore the most sensitive habitats and therefore has a lower environmental impact than options 1 and 2. In contrast, this route crosses the village of Sassako and therefore presents a strong challenge related to social aspects. In addition, this route has a significantly higher financial cost than Option 1.

Option 1 was therefore selected because of its lower potential environmental impact compared to option 2 and its lower potential social impact compared to option 3.

Figure 3.19 General location of the Project and plot lines options considered in the analysis of variation (copy of Figure 3.2)

table 3.10 Summary of justification for chosen line route

Option considered	Natural habitats and biodiversity	populated areas / need for displacement of stakeholders	Length / construction costs (excluding E & S measures)
Option 1 rather straight, northernmost	Bypass the swampy lagoon edge forests, identified as a chimpanzee refuge. Crossing of lowland areas.	Very limited - especially plantations	-
Option 2, plant	Further away from swamp forests to the north, but through more lowland areas than Option 1.	Numerous plantations and food crop fields north of Sassako.	More important than option 1 460 million FCFA
Option 3, from the south and the village of Sassako	Along the road, little crossing of natural habitats	Very important land impact (security corridor under the line) and direct impact on the populated area of the village of Sassako.	More important than option 1 to 1.2 billion FCFA

"Without combined cycle" Option

The choice to produce in a combined cycle has the effect of reducing the gas consumption per kWh produced, and thus minimizing the operating costs and the contribution of the project to global warming. For an installed capacity of 400 MW, the evaluation of the impact of the project on global warming (see Chapter 7) has made it possible to evaluate a reduction of 31% of CO2 emissions, ie the equivalent of 490 122 tonnes a year thanks to the combined cycle. Overall, this has the effect of increasing the environmental performance of electricity production by equivalent KW. For these reasons, production without a combined cycle was not considered.

Option "other fossil fuel"

The plant could produce energy based on heavy fuel (HVO) or diesel (DDO). This would increase the potential impacts of the project on the environment and local populations, including greater degradation of ambient air quality and long-term risk of soil pollution, or 'accident. Gas, widely available locally and being the cleanest fossil fuel (GHG reduced by KWe compared to liquid fuels, minimum impact on ambient air quality, volatile therefore no risk of soil pollution) has been option chosen for this project.

A comparison of greenhouse gas (GHG) emissions per kWh and fuel type is presented in the table below.

Table 3.11 GHG emissions by fuel type per kWh

Fuel	kg CO_2e emitted per kWh	kg of CO_2 emitted per kWh	kg of CH_4 released per kWh	kg N_2O emitted per kWh
Natural gas	0.20444	0, 20405	0.00028	0.00011
HVO	0.28492	0.28390	0.00037	0.00064
DDO	0.26756	0.26540	0.00006	0.00210

"Renewable energy" Option

The technologies for generating energy from renewable sources (in particular wind, solar, biomass, hydropower) present alternatives to the production of energy from natural gas, without significant emissions of greenhouse gases.

However, the project is part of a national policy of securing and diversifying the energy supply. Côte d'Ivoire is also implementing a renewable energy development program, complementary to its existing or planned gas-fired power plants.

A thermal project allows a constant supply of the electricity network, without the intermittent phenomena associated with solar and wind energy.

Also, the project uses a combined cycle technology that allows a good performance in terms of greenhouse gas emissions per MWh produced. The project is facilitated by the availability of gas supply near the site (presence of gas fields off Côte d'Ivoire and existing infrastructure for gas transportation).

Finally, to achieve an electricity production capacity comparable to that of the Project (390 MW), a solar or wind project would require a significantly larger area of land than the project site right-of-way, incompatible with the development needs of Greater Abidjan. , constraints of land use in the area, and objectives of preservation of natural areas.

"Other cooling technology" Option

The following technologies help ensure the water vapor cycle cooling:
- air condenser (as CIPREL IV);
- cooling towers with natural or mechanical draft; and
- direct cooling with seawater.

The choice between these three modes of cooling was made on the basis of technical criteria (yield, reliability, risks), economic and environmental.

Open-cycle seawater cooling (direct cooling) is usually used in plants where large volumes of water are available. In such systems, a large amount of water is pumped into the water source, passes through the condenser and is returned, warmer, to the environment. The cooling water flow for the plant would have been 23,000 m^3 / h. Although it offers the best cooling performance, it requires significant investment. The impact on the aquatic environment is greater because of the large quantities of water pumped and discharged at higher temperatures.

Cooling towers are mainly of two types:

- natural draft tower: the warm, moist air naturally rises in the tower through a chimney effect; the tower is a very high structure with a hyperbolic shape. For CIPREL 5, a single tower of more than 100 meters in height would be necessary; and; and
- turn forced draft: Hot, moist air flows through the tower through the action of a fan. Forced draft towers are smaller in size and are a combination of prefabricated cells assembled on site. For the project, eight towers (cells) would be installed in line for a footprint of about 125 x 15 m 15 m high.

The natural draft tower solution was rejected as it has the least favorable return on investment given the significant investment in tower construction, and does not bring any specific environmental benefits compared to other technologies

The air condenser is also penalized by its high investment cost and its low performance. It is a technology generally chosen in the absence of water source.

The solution with forced draft towers and extra water from the lagoon provides a limited investment cost, low risk construction and low environmental impact. It was therefore selected for this project.

"Other cooling water supply source" Option

The sources of water supply available for the cooling system are: Lake Labion located 13.5 km east of the site, the aquifer underlying the site, and the sea 3.6 km to the south . The choice of feed from the Ebrié lagoon meets technical, economic and environmental optimization criteria. From an environmental point of view, it is best not to draw fresh water from the aquifer or Labion Lake. From a technical point of view, it is also the closest source of surface water, it makes it possible to limit the installations related to the installation of the pipes and the pumping system, to reduce the footprint of the project to soil and thus minimize disturbance of biodiversity and surrounding socio-economic activities.