Vasilikos Power Station

Electricity
Authority
of Cyprus

General

Vasilikos Power Station constitutes the biggest work of infrastructure ever undertaken in Cyprus.

Phase I of the station is in commercial operation since the year 2000. Phase II is expected to go into commercial operation early 2007. The first two phases of the station consist of three steam units of total power 390MW and one 38MW open cycle gas turbine. The total installed power generation capability is 428MW as shown on the table below.

Type of unit	Fuel	Generating capacity
Steam unit no 1	Heavy Fuel Oil (HFO)	130 MW
Steam unit no 2	Heavy Fuel Oil (HFO)	130 MW
Steam unit no 3	Heavy Fuel Oil (HFO)	130 MW
Gas turbine	Distillate Fuel oil	38 MW
	Total	428 MW

The investment for phase I (units 1 & 2), which includes infrastructure work for the future extension phases, amounted to CY £ 160.000.000. The final investment for phase II (unit 3) is expected to reach CY £ 85.000.000.

According to the present electricity demand rate and demand prediction studies of the Transmission System Operator (TSO), it is expected that the next generating units (units 4 and 5 & 6) will gradually go in service in 2008 and 2011 respectively. These units will be combined cycle gas turbine units (CCGT) and will operate on Liquefied Natural Gas.
Unit No4 will initially operate on distillate fuel oil and at a later stage when LNG will be available in Cyprus it will be converted to operate on this fuel .

Their generating capacity will be 180 - 220 MW each.
With the addition of these units the generating capability of the Station will exceed 1000 MW.

Boilers

Phase I boilers have been supplied and installed by Austrian Energy and Environment of Austria. Boiler No3 (Phase II) has been supplied and installed by Ansaldo Caldaie of Italy. Each boiler is capable of producing up to 390 tons of superheated steam per hour at a temperature of 540°C and a pressure of 140bar. The fuel used by all three boilers is heavy fuel oil and the thermal efficiency of the boilers is approximately 90%.

Steam Turbines

Phase I turbines have been supplied and installed by Asea Brown Boveri of Germany while the third one by Alstom Power Generation of Germany. The efficiency of the installed steam turbines is 45%. The rotor of the turbine rotates at 3 000rpm and is coupled directly to the rotor of the generator. The generator produces electricity at 15 750 Volts, 50Hz. The thermal efficiency of each Unit is approximately 39%.

Gas Turbine

This frame 6 gas turbine was manufactured, under a licence from General Electric, by European Gas Turbines SA of France. The main parts of the unit are the compressor, the combustion chamber the turbine and the generator. The hot gases (1000°C) generated by burning distillate fuel oil in the combustion chamber are used as the motive force of the turbine and eventually the

generator which is coupled to it. The generator produces electricity at 11 000 Volts, 50Hz. The thermal efficiency of the unit is around 29%. This gas turbine can also be used to supply power to the auxiliary equipment of the Power Station in the event of a total shutdown of the generating system.

Water Treatment Plant

The water used in the boilers and the steam produced is of very high purity in order to protect the boiler pipework and the turbine blades from harmful deposits. Two desalination plants each capable of producing 900 tons of desalinated water per day are available for this purpose. Before using this water in the boilers feed water system it is further treated in the Demineralisation Units where harmful substances like salts of magnesium, copper, iron etc are chemically removed.

Sea Water System

Sea water is used mainly for condensing steam in the condenser located at the turbine exhaust. It is also used at the desalination plants for the production of distillate water and in various other cooling systems. It is transferred to the pumping station by gravity by three submarine pipes. Each pipe is 700m long and has a diameter of 2,7m. The sea water is then passed through two drum screens installed in parallel. These screens remove seaweeds and other debris /solid objects found in

the water. Each screen can filter up to 12m^3 of sea water per second. The filtered water is then ready to be pumped to the station and used as required.

Fuel Oil Tanks

Heavy fuel oil is supplied to the station by Tankers. Fuel oil tankers approach the unloading facilities of the station and unload their cargo via two submarine pipes. The heavy fuel oil is stored in four heavy fuel oil tanks of 30 000 metric tons storage capacity each. Each heavy fuel oil tank is equipped with appropriate steam heaters to maintain the heavy fuel oil in the desired storage and transfer temperature.

Road tankers supply distillate fuel oil to the Station. This is stored in two 3 000 tons tanks. One of these tanks, the “Dirty Distillate Oil Tank” is used to store distillate fuel oil that is used to clean the pipework of the heavy fuel oil unloading piping system of the Station.

Heavy Fuel Oil Unloading Facility

As mentioned above heavy fuel oil is supplied to the station by sea. Fuel oil tankers of up to 80 000 tons capacity can be accommodated by the unloading facilities. Mooring of the fuel oil tankers takes place about 2km offshore at the single point mooring (SPM) facility of the Station. From that point two submarine pipes of 0,5m in diameter are used to transfer the heavy fuel oil to the shore.

A system that employs diesel is used to clean the underwater pipes of the unloading system. With this method we avoid using sea water for the cleaning of the unloading pipes thus reducing the risk of sea pollution.

Power Transformers

The generators of the steam units produce electricity at a voltage of 15 750V and the one of the gas turbine at 11 000V. For transmission purposes the voltage is increased to 132 000V using the generator transformers. By increasing the voltage the losses over the transmission system are reduced.

Other transformers present in the station lower the voltage to 6 600V, 400V and 230V so it can be used for the needs of the station.

Central Control Room

The central control room is the heart of the station. In this room the control and monitoring of the various equipment of the station takes place. The control and monitoring is carried out by computers and software programs.

Protecting the Environment

Protection of the environment is of primary importance for EAC. Every effort is made to operate the generating stations in an environmentally friendly manner and within the preconditions set by European and Cypriot Legislation.

Regarding Vasilikos Power Station, EAC received advise from specialised consultants for an in depth study of the negative/positive repercussions on the environment. Based on this study the design of the station was modified accordingly. As a result the heavy fuel oil used is of low sulphur content (1%), low NOx burners are used, Units 1&2 are equipped with multicyclones and Unit 3 with an electrostatic precipitator (ESP) to restrict flue gas dust (particulates) emissions within permissible limits and finally unit 3 is equipped with a Flue Gas Desulphurisation Plant (FGD) to restrict the SOx levels within permissible limits. Sound proofing materials were also used in the erection of the plant and a sewage treatment plant is in operation. As a result the noise levels and the flue gas emissions comply with the environmental legislation set by the government and the European Union.

Units 4, 5 and 6 will be Combined Cycle Gas Turbines Units (CCGT). Unit No4 capacity will be 220 MW and will operate initially on distillate fuel oil and on Liquefied Natural Gas (LNG) when this will be available on the island beginning of 2011. Units No5 & No6 will be of similar size (180- 220 MW) and will operate on LNG.

Two mobile Air Quality Monitoring Stations are available for monitoring the quality of the atmospheric air at ground level around Vasilikos Power Station. These units have equipment for the measurement of NOX, CO2, ozone ,dust as well as recording meteorological data like wind speed , temperature and humidity. These measurements are automatically transmitted to computers in the station and EAC Head Office. They are also available to the inspectors of the Ministry of Labour and the public in general.

Technical Data

Steam Turbine Units:

Unit rated power	130 MW
Unit efficiency	39%
Fuel	Heavy fuel oil
Fuel sulphur content	1%
Steam pressure	140bar
Steam temperature	540°C
Flue gas temperature	130°C
Cooling water flow	$6m^3/s$

Gas Turbine Unit:

Unit power	38 MW
Unit efficiency	29%
Fuel	Distillate fuel oil
Fuel sulphur content	0,2%
Air flow	$480Nm^3/h$
Flue gas temperature	543°C

Electricity in Cyprus

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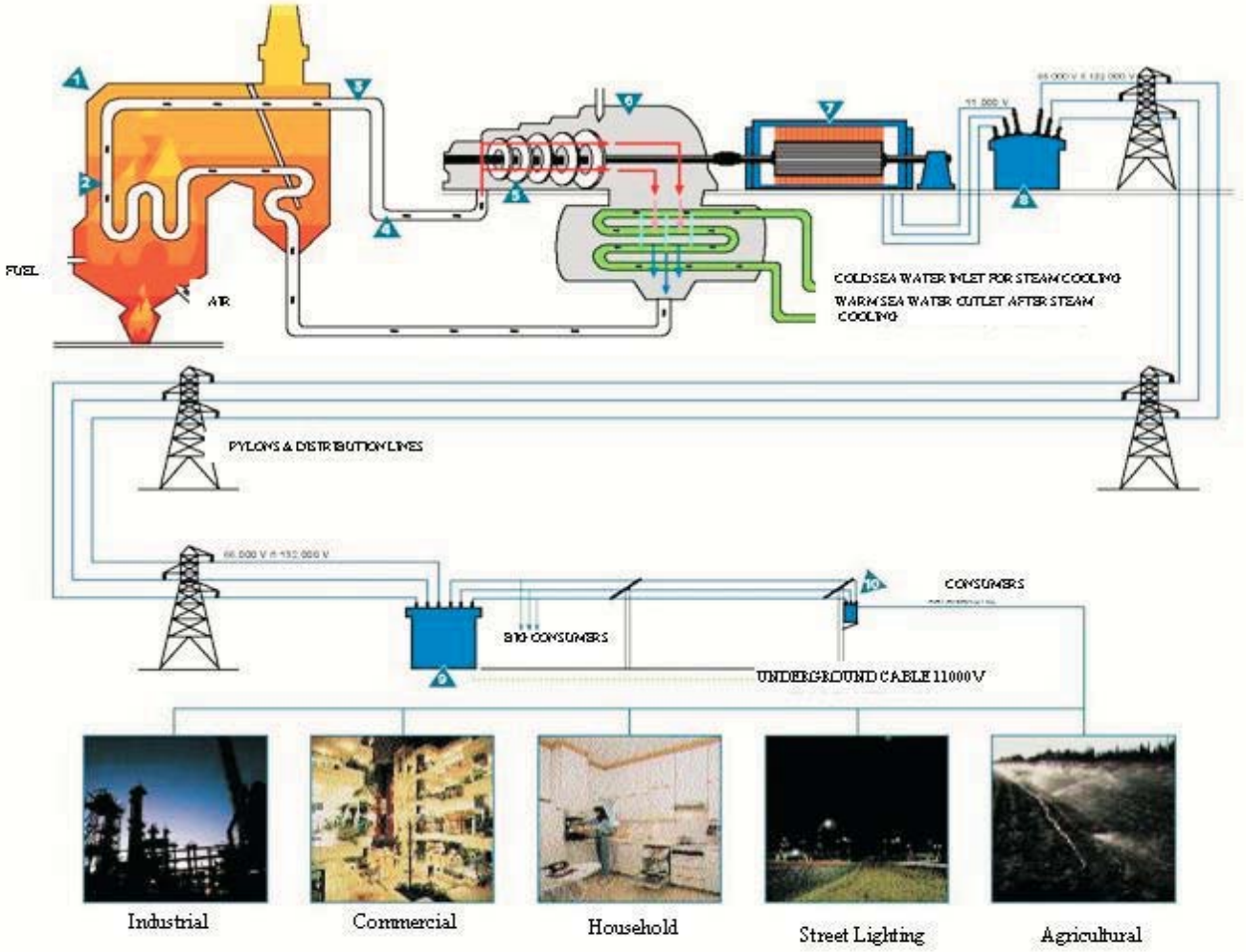
FROM GENERATION TO CONSUMPTION



HEAVY FUEL OILS IS BURNT IN THE FURNACE. 1 AND FROM THE HEAT PRODUDED THE CIRCULATING WATER WHICH IS IN THE INTERNAL PIPING 2 OF THE BOILER IS CONVERTED INTO HIGH PRESSURE STEAM 3 WHICH IN TURN 4 IS DIRECTED AT HIGH SPEED AND PRESSURE TO THE TURBINE 5 BLADES 6 THUS ROTATING IT. THE TURBINE IS CO-AXIALLY 7 CONNECTED TO THE GENERATOR THUS FORCING THE GENERATOR TO ROTATE ALSO. THIS ROTATION GENERATES ELECTRICITY AT A VOLTAGE OF 11000V (CYPRUS) WHICH IN TURN IS STEEPED UP TO 66000V OR 132000V 8 BY MEANS OF TRANSFORMERS. THE ELECTRICITY IS TRANSMITED TO LONG DISTANCES AND TO BIG SUBSTATIONS WHERE TRANSFORMERS 9 STEP DOWN THE VOLTAGE BACK TO 11000V AND EVEN MORE DOWN 10 TO 240/415V WHICH IS USED FOR DISTRIBUTION TO HOUSEHOLD COMMECRCIAL, INDUSTRIAL AND OTHER CONSUEMRS

Electricity Authority of Cyprus

Public Relations Department,
P.O.Box 24506, 1399 Nicosia, Cyprus.
Tel. 22 201000, Fax 22 201315

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