
TERNA ENERGY
GEK TERNA GROUP
“Developing Albania’s Hydroelectric Potential”
Workshop - Tirana, 3rd June 2016

TERNA AND TERNA ENERGY S.A

“A LONG EXPERIENCE IN HYDOELECTRIC AND HYDRAULIC PROJECTS”

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GROUP
STRUCTRURE

TERNA ENERGY
GEK TERNA GROUP
RES & Waste Management

70 RES SPVs

TERNA
GEK TERNA GROUP
Construction

Backlog : €3 billion

TERNA MAG
GEK TERNA GROUP
Magnesia Mining

100% Exports Oriented

HERON
CCGT Electricity Production

Major shareholder along with GAZ DE FRANCE SUEZ και QATAR PETROLEUM

GEK TERNA GROUP is one of the leading business Groups in Greece with operations also in **Central and Southeastern Europe, USA, North Africa and Middle East**.

- **Two listed companies (GEK TERNA, TERNA ENERGY), both in ATHEX/LARGECAP 25**
- 5,000 employees in **16** countries

COMPANY HISTORY

COMPANY **OVERVIEW**

TERNA ENERGY expertise lies with:

- Green Field Development of Projects in:
  - Wind
  - Hydro
  - Biomass
  - Solar
  - Waste Management
- Construction & Commissioning (EPC)
- Operation & Maintenance
- Procurement
- Project Financing

COMPANY **HIGHLIGTS**

A pioneer player in the development of **RES** Industry in Europe, with a strong portfolio of technologies and a total pipeline of more than **5.8GW** in various projects, which are characterized by long term Power Purchase Agreements **(PPAs)**

Strong operating assets in RES with geographical exposure across **Europe, USA and MENA region**

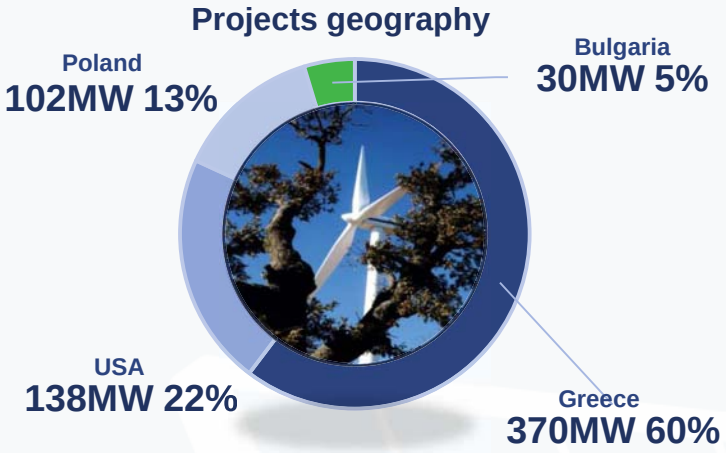
High technological profile and **EPC** international experience

Vertical integration business model with a wide portfolio of know-how in RES technologies including engineering, development, design, procurement, construction, operation and maintenance.






OUR ASSETS AND DEVELOPMENT PLANS



	In operation (MW)	Under construction or ready to build (MW)	Pipeline (MW)
Wind Energy	640	238	4858
Hydroelectric Projects	18	-	183
Hybrid Projects	-	-	165
Solar Energy	8.5		33
Biomass	-	5	14
Pumped Storage Projects	-	-	680
Total: Capacity in MW	666.5	243	5933

Highlights:

- **40% of our wind assets are based abroad.**
- **On track with our goal to become a diversified renewable energy producer targeting 1 GW installed.**

Dafnozonara SHE Project on Achellos R. – 11,20 MW

Dafnozonara SHEP – Operation in 2011

- Main Technical Characteristics

The "Dafnozonara - Sanidi" SHPP is developed on Acheloos River, the largest river in Greece.

- Overflow Concrete Dam – Spillway. Height (above the foundation): ~25m
- Spillway capacity (MPF) :3.200 m^3/sec – Three radial gates and self-tipping fusegates

Associated constructions : Bridge, Stilling Basin, Fish-ladder, Canoe-kayak

- Power Station in the dam body at the right abutment.

Two Turbines: Kaplan S-type, horizontal shaft

Rated flow 40m^3/sec, each

Estimated annual production: 45GWh

- Substation 20/150kV and 15 km HV line
- Total Investment cost 42.000.000 €

Dafnozonara in a snowy day

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Eleoussa SHEP on Axios R. – 6,6 MW

Eleoussa SHEP – Operation in 2009
Main Technical Characteristics

Owner: PPC RENEWABLES – TERNA ENERGY S.A
Located at the right abutment of Axios river aside to an existing irrigation dam, belonging to the Ministry of Public Works.
Type of Turbine: Two double regulated Kaplan, Compact PIT-type
Rated flow: 70m^3/sec, each
Rated Power: 3,4 MW each
Estimated annual production: 30 GWh
Total Investment cost 18.000.000 €

Eleoussa SHEP

KEY HYDRO - PROJECTS IN PROGRESS -1

1. Amari Hybrid Scheme in Crete Island

- "Design, Financing, Construction, Management, Exploitation of a Hybrid Power Station for Electrical Power Production"
- The system combines effectively Wind energy (Lassithi prefecture) and Pumped Storage technology (Rethymno prefecture).
- Upper reservoir volume 1,2 mio m3.
- Lower reservoir existing (Amari – Potamoi Dam)

Installed capacity:

Wind Farms: 27 W/G , (3.30 MW each) = 89.1 MW

Two reversible Hydro Units of 25/36 MW each + one spare (turbine/pump mode), of constant speed.

Guaranteed capacity to the grid: 50 MW

Eleven pumps +one spare: 3.2 MW each, of variable speed with VFDs

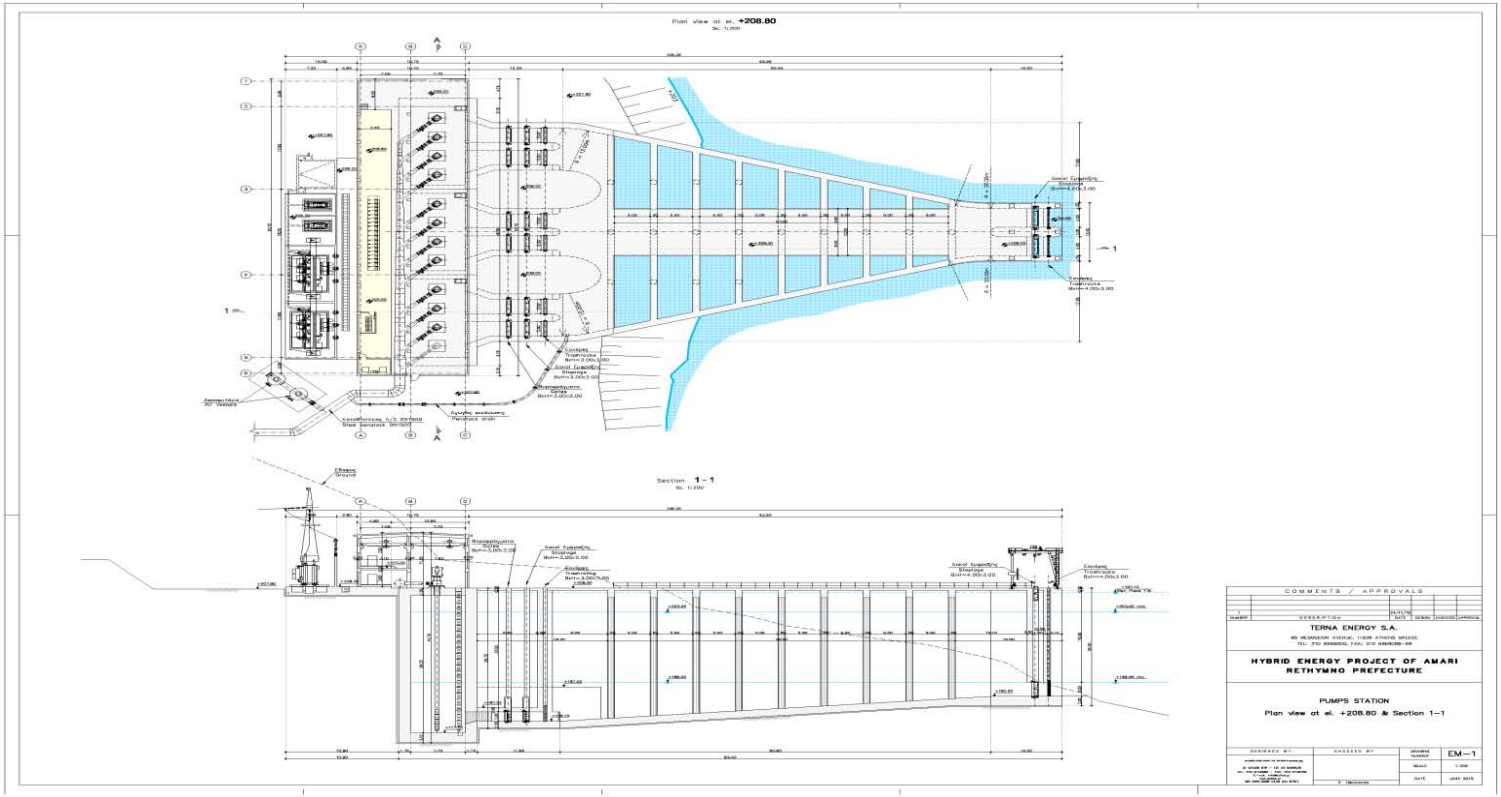
Total Investment cost: 277.000.000 €

AMARI PROJECT LOCATION – 1.1

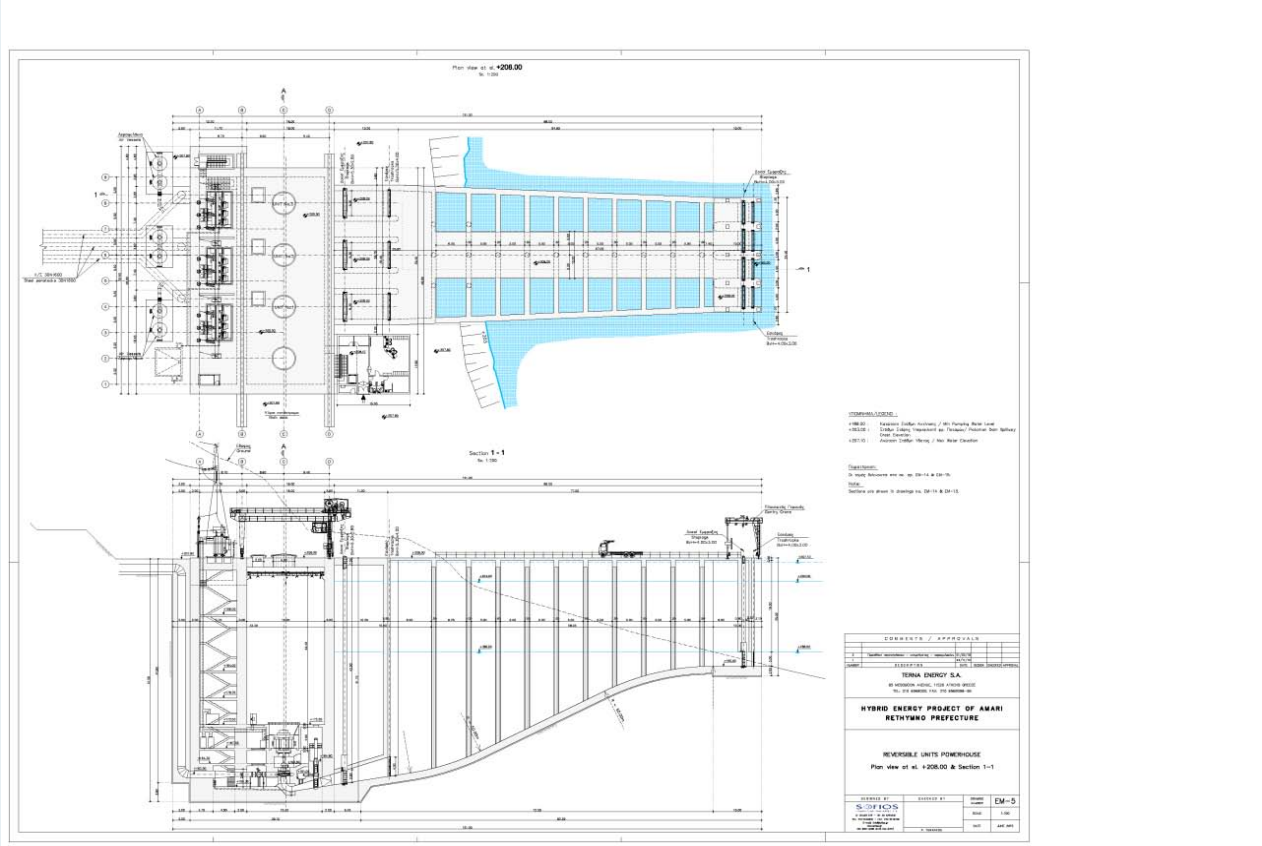
PUMPED STORAGE POWER PLANT (50MW)

WIND FARMS (TOTAL 89,1MW)

Amari Pump Station (12 pumps of 3,20 MW each)



Amari Power House (three reversible Units)



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Annual Simulation Results in relation to W/F Production

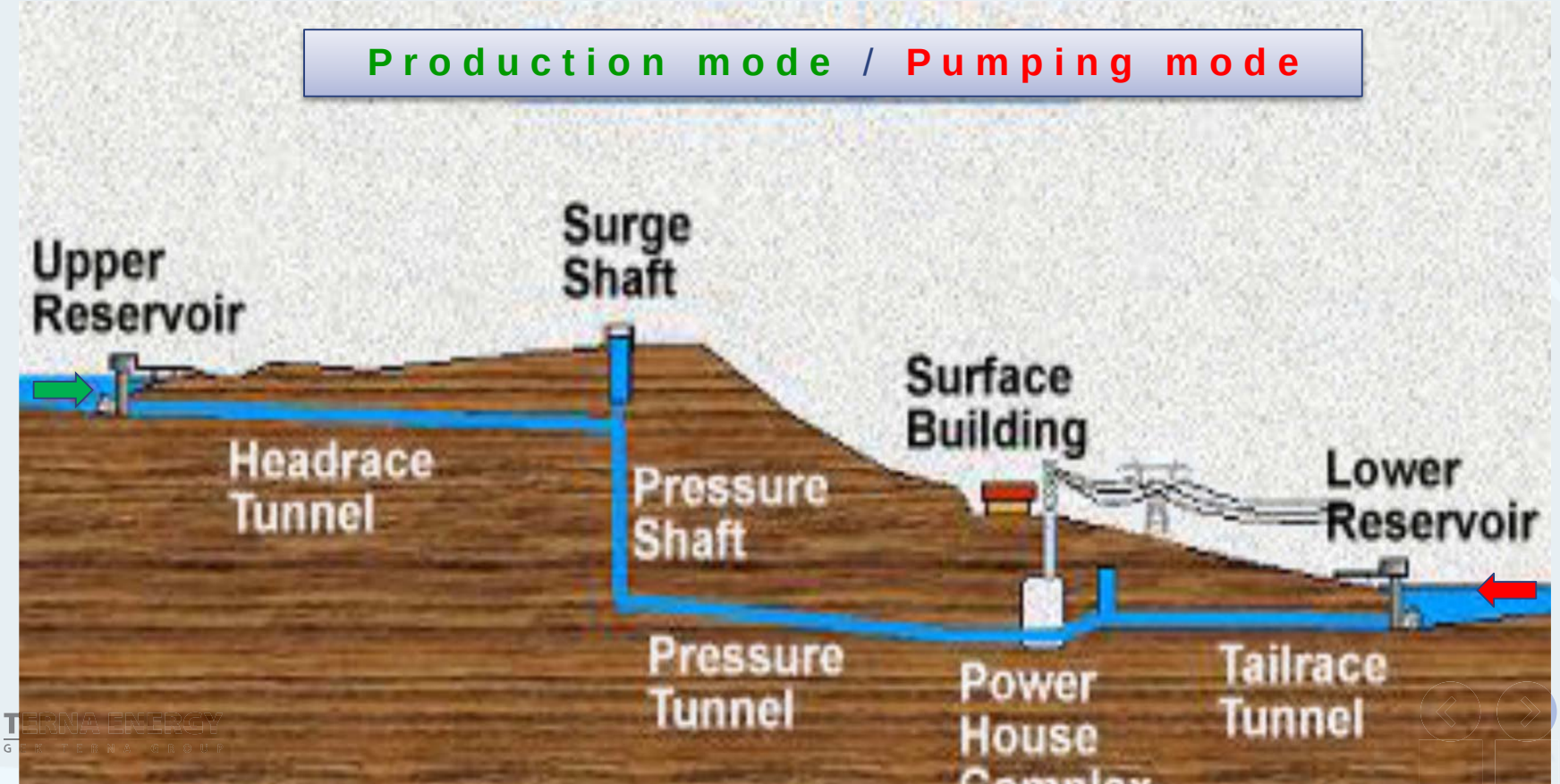
Hydro turbines production	**GWh**	226.56
Available W/F energy	**GWh**	362.04
Total W/F energy produced	**GWh**	352.95
Wind energy to pumping	**GWh**	352.65
Wind energy to wind-hydro	**GWh**	0.29
Wind energy to set-point	**GWh**	0.00
Rejected wing energy	**GWh**	9.10
Capacity Factor	**%**	45.22

• KEY HYDRO - PROJECTS IN PROGRESS -2

2. Pumped Storage Complex 680 MW

- The complex consists of two independent pumped storage projects, located in Western Greece (Municipality of Amfilochia).
- The purpose of the complex is to use excess of wind or photovoltaic energy, as well as thermal energy in low prices for pumping from the low to the upper reservoir and subsequently recover it via turbine mode, during the peak demand.
- Both Projects have been evaluated by European Commission as eligible Projects of Common Interest (PCI) in the framework of Regulation for trans-European energy infrastructure
- **Estimated CAPEX :EUR 502ml**

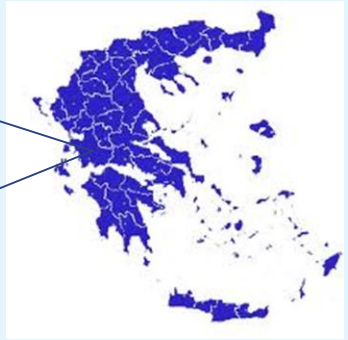
Design concept - PSP



Project Location - PSP

AITOLOAKARNANIA
PREFECTURE

Amfilochia municipality



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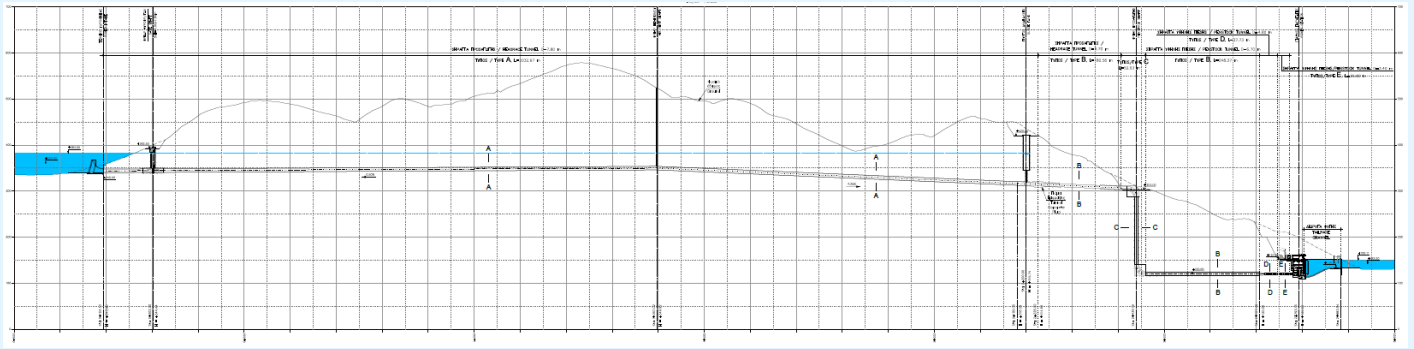
General layout & Technical characteristics – PSP

- Total Installed capacity: **680 MW** (production mode) & **730 MW** (pumping mode)
- Annual production: **~ 816.00 GWh**

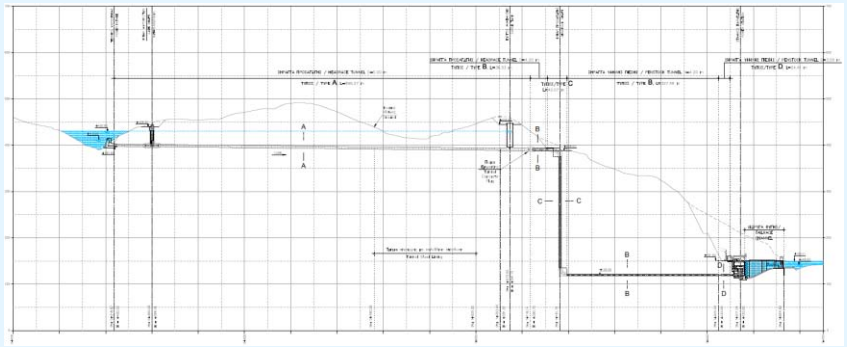
- **Two independent upper reservoirs**:
  a) Agios Georgios: net volume ~ **5 hm^3**
  b) Pyrgos: Net volume ~ **2 hm^3**
- **Lower reservoir**: Existing "Kastraki" lake. Owner PPC
- Two independent powerhouses:
  a) Agios Georgios : **4 reversible units**
  b) Pyrgos : **2 reversible units**
- Both powerhouses are to be connected to the Interconnected Grid at the existing "Acheloos" Ultra High Voltage Centre (**400kV), by a HV line of 400 kV.**

Water conveyance system Longitudinal section (hydraulic tunnel) - PSP



"Agios Georgios"

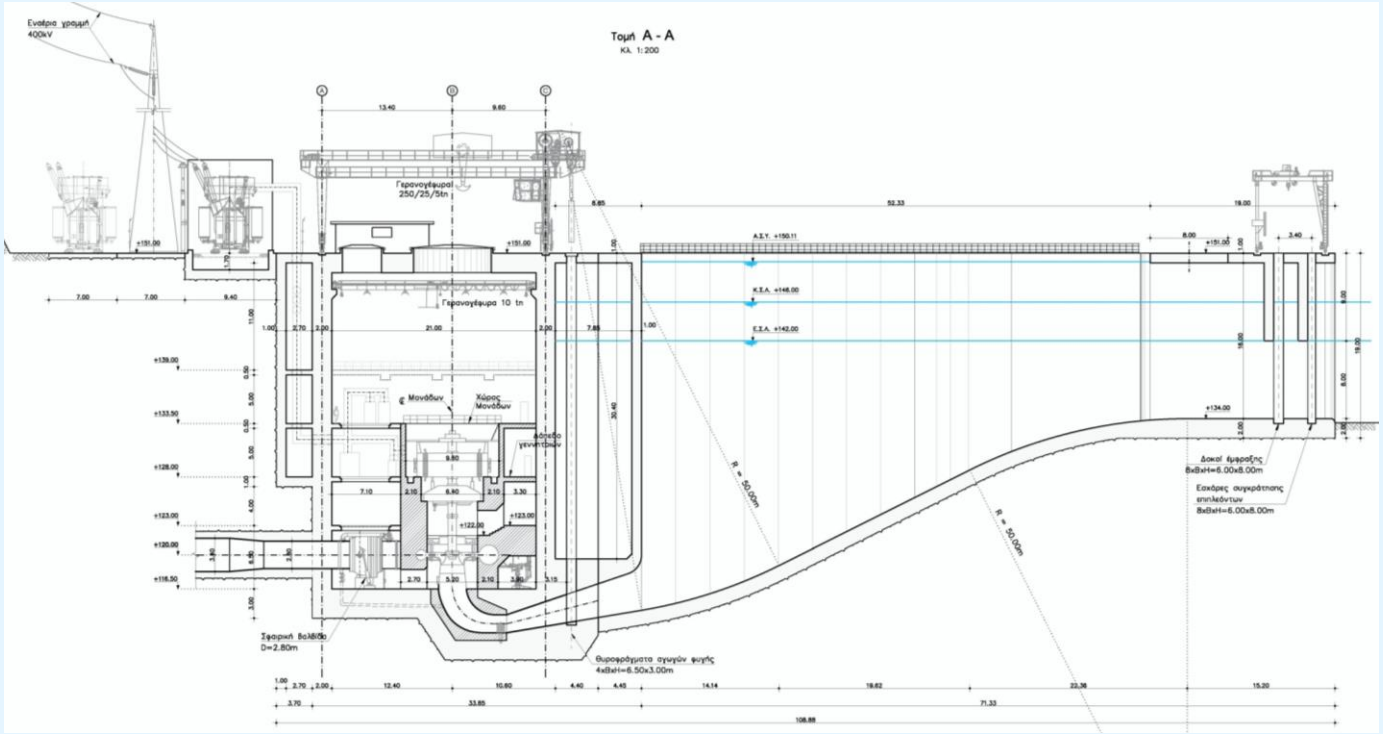
(~2.800,0 m)



"Pyrgos"

(~1.600,0 m)

Power station: indicative section along water flow - PSP



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TERNA S.A as Hydro Projects Contractor

1. Gratini Dam
(cooling water for the CCGT of Komotini Project)

Gratini Dam

Gratini Dam – Main technical characteristics

- Owner: PPC
- TERNA was in J/V.
- Contract Amount: 27.000.000 €

Rock fill dam with a central impervious clay core, 42.50 m high. The project also included the construction of a concrete spillway, an overflow canal, a steel pipe transferring cooling water to Komotini Thermal Plant (CCGT).

- Completion in 2001.

2. POURNARI II - Arachthos River

Pournari II – Technical Characteristics

- Owner: PPC
- The project is very close to Arta city and 2,5km downstream of the HEP Pournari I. It reregulates the river flow, to satisfy the irrigation demands of the area and to produce additional electric energy, exploiting furthermore the water of Arachthos river.
- The project is composed of an earth dam of approximately 2km long, a concrete dam - spillway 130m long and a Power Station with two bulb type units (horizontal shaft) 2x15=30MW + 1.5MW for irrigation purposes. The annual energy production is about 45 GWH.
- Contract amount 31.000.000 €. Operation in 2001.

3. AMARI DAM AT CRETE ISLAND – (RETHYMNO PREFECTURE)

AMARI DAM

- Owner: Organization of Crete Development
- Earthfil Dam, 55 m high.
- Contract amount 11mio €
- The dam was initially constructed for irrigation purposes.
- It will constitute the “lower” reservoir for Amari Hybrid Scheme.

Construction of an earth fill dam of total volume of 1,600,000 m^3, the sill height being +154.00 m and the spillway sill level being +193.50 m. This project was completed at this level.

Thank you for your attention