FIRST CROATIAN GEOTHERMAL POWER PLANT MARIJA 1 , 4.71 MW

Example of cascade use of geothermal energy

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North Eastern part of Croatia is a part of Pannonian Basin
Pannonian Basin has recognized geothermal potential for low to medium enthalpy resources temperatures raging from 80-180 °C
geothermal fields with temperatures above 120 °C
- In the 90's while researching for oil and gas, "INA" Croatian Oil and Gas Company discovered numerous GT fields with low temperature and 5 GT fields with temperature ranging from 120-175°C.

- In 2007, legal framework for RES was adopted, which enabled GEOEN as a private company to start development on GT field Velika Ciglena.

- GT field of Velika Ciglena is considered one of the most prospective geothermal opportunities in the CEE region.
3D TOP STRUCTURE IMAGE OF GEOTHERMAL FIELD VELIKA CIGLENA

EXISTING WELLBORES:

1 DEDICATED PRODUCTION GEOTHERMAL WELL (VC-1A)
3 HYDROCARBON EXPLORATION WELLS (VC-1, VC-2, PTK-1)
VC-1A AND VC-1 ARE COMMUNICATING WELL PAIR (PRODUCTION AND INJECTION)
RESEARCH METHODS USED TO ESTABLISH RESERVES ON GEOTHERMAL FIELD VELIKA CI GLENA

• According to Croatian law, geothermal water as a source of energy is in same category with other energy raw materials (Oil & Gas) and the same standards of procedure are applied. Results of these procedures are understood as transparent to European and World standards by international independent experts.

• The reserves feasibility study in Velika Ciglena is based on the following integrated studies:
  - geological
  - hydrodynamic
  - technological
  - economical
  - environmental

• Integrated geological and geophysical surface measurements and investigations were carried out, finally interpreted including oil field development grid of 2D seismic and related information from four deep wells, all of them penetrating carbonate production formation.

• Hydrodynamic testing aimed at geothermal production, performed in two major cycles, reaching critical parameters for establishing sound reservoir production model, including reservoir limit test and interferential testing including both wells.

• Subsurface production equipment was completed on wells, including production and injection wells and their surface equipment.

Results of the study of reserves were accepted by Croatian National commitee for establishing mineral reserves and revisioned by independent experts.
Top carbonate formation
Super permeable zones
(Relalacted fractures)

Bedrock Formation

Surface

3 D GEOLOGICAL MODEL OF GEOTHERMAL RESERVOIR

VC-1  4790m
VC-1A 2956m
VC-2  2526m
Ptk-1 2602m
POTENTIAL OF GEOTHERMAL FIELD VELIKA CI GLENA

Characteristics of GT fluid at wellbore VC-1A Velika Ciglena are:

- surface operating temperature 175°C;
- surface operating pressure 20 bar;
- geothermal water flow of 83 l/s;
- it is expected to maintain the temperature at the wellhead constant during 20 years

- 4,71 MWe installed electric capacity will be achieved based on one well pair geothermal system (ORC)

- Additional 10 MW heating capacity that will be used for heating greenhouses, industrial zone...

- After implementation of first 4,71 MWe Geoen will proceed with development of 2nd GTPP (5-10 MWe) on the same field
WELLBORES POSITION IN RELATION TO THE GEOTHERMAL POWER PLANT
WIDER AREA OF DEVELOPMENT INTENDED FOR ACCOMODATION OF THE BUSINESS ZONE VELIKA CI GLENA

INDUSTRIAL ZONE
(10ha)
CURRENT STATUS OF THE PROJECT

• Geoen owns land on the site where the GTPP is going to be constructed and additional 14 ha of land for wider area of development
• Geoen has Location permit to build GTPP
• Energy approval signed by Ministry of economy-Energy Department
• Exploitation rights approved to Geoen for 20 years period
• Signed contract for grid connection
• Official support from Government of Croatia and local community as this represents demonstration project that is aiming to raise awareness of geothermal energy potential in Croatia
• Construction permit will be obtained in 2 months, after securing financing we are ready to order equipment

Expected end of construction and commissioning end of 2012.
FINANCIAL ASPECT OF THE PROJECT

- Feed in Tariff for power generation from GT sources for 2010 in Croatia is **191 €/MWh** (one of highest incentives in EU)
- Guaranteed Power Purchase Agreement for 12 years with HROTE (Croatian energy market operator)
- Expected additional incentives for heat energy

- Significant part of CapEx is already invested (50% of total investment)
- Remaining capital required for implementation and finalisation of project is 13 mil/€
- Time ROI is 4.6 years
GEOEN NEW DEVELOPMENT ON LOCATION BABINA GREDA IN EAST SLAVONIA, GTPP1,1 MW
THANK YOU FOR YOUR ATTENTION