Technical aspects in the development of a large geothermal borehole exchange infrastructure

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Introduction

Renewable energy represents the fundamental of sustainable development from local scale to global scale. Currently, the share of renewable energy in total final energy consumption stands at 18.3%. About one-half of this portion is made up of modern renewable, evenly split between electricity and direct heat applications. The other half consists of traditional biomass used for heating and cooking [1]. A small portion of the potential of geothermal energy yet is explored. The use of geothermal energy will allow a substantial reduction of green-house gases - CO2-emissions [2]. When speaking about geothermal energy, an important and accessible source is represented by the shallow geothermal energy.

Shallow geothermal energy is available everywhere, and it is harnessed typically by ground source heat pump (GSHP) installations, using the heat pump to adjust the temperature of the heat extracted from the ground to the (higher) level needed in the building, or to adjust the temperature of heat coming from building cooling to the (lower) level required to inject it into the ground.

ELI-NP geothermal borehole exchange infrastructure

Extreme Light Infrastructure (ELI) will be the only European and International Centre for high-level research on ultra-high intensity laser, laser-matter interaction and secondary sources with unparalleled possibilities [3]. For this research facility a renewable source of energy (1080 geothermal boreholes) was design to be used in several technological processes (cooling and also heating). During 5 months (April 2015 - October 2015) 1070 boreholes were drilled and equipped in order to construct the largest European system

Due to land ownership and time constrains the drilling process imposed several technical challenges: (1) the boreholes were grouped in 19 plots (Fig. 1) having a distance between them of only 5 m; (2) there were drilled 1070 boreholes in less than 5 months, (3) three drilling subcontractors were used having in total around 15 drilling rigs.

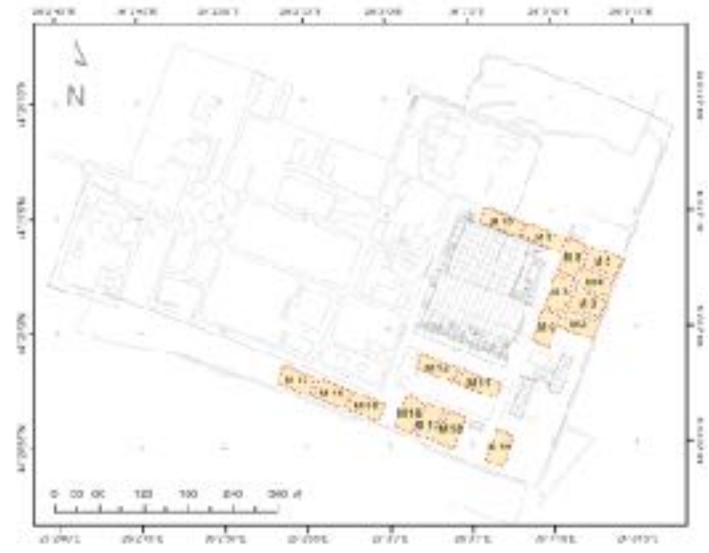

Fig. 1. Position of the plots around the ELI-NP research infrastructure

Each of the boreholes were drilled until 120 m bellow surface, and from geological point of view they intersected 3 major aquifer systems: [A] Shallow aquifer - Colentina Strata (mainly gravel and sand), [B] Medium depth aquifer - Mostistea Strata (mainly sand and silty sand), [C] Deeper aquifer system - Fratesti Strata composed by two layers (mainly sand and gravel), separated by impervious layers of clay and silty clay (Fig. 2).

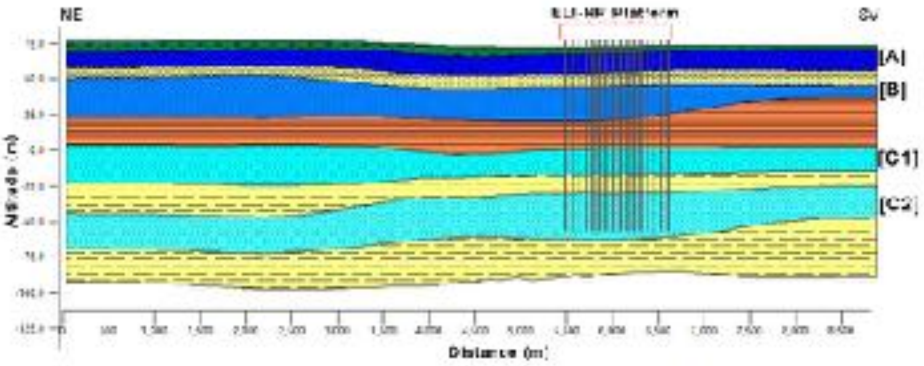

Fig. 2. Geological cross-section for the study area

In order to achieve the objective (finishing in the time frame) all the procedures were supervised by a team of geologist and hydrogeologists. The progress of each individual drilling rig and all the main failure causes were recorded and centralized.

References:

[1] IRENA (2017), REthinking Energy 2017: Accelerating the global energy transformation. International Renewable Energy Agency, Abu Dhabi.
[2] EGEC (2016) - European Geothermal Energy Council: Market Report 2015
[3] http://www.eli-np.ro/about-eli.php