

# Promote Geothermal District Heating Systems in Europe

## GeoDH Training

### Sessione sulla geotermia

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## Tecnologie per la perforazione dei pozzi

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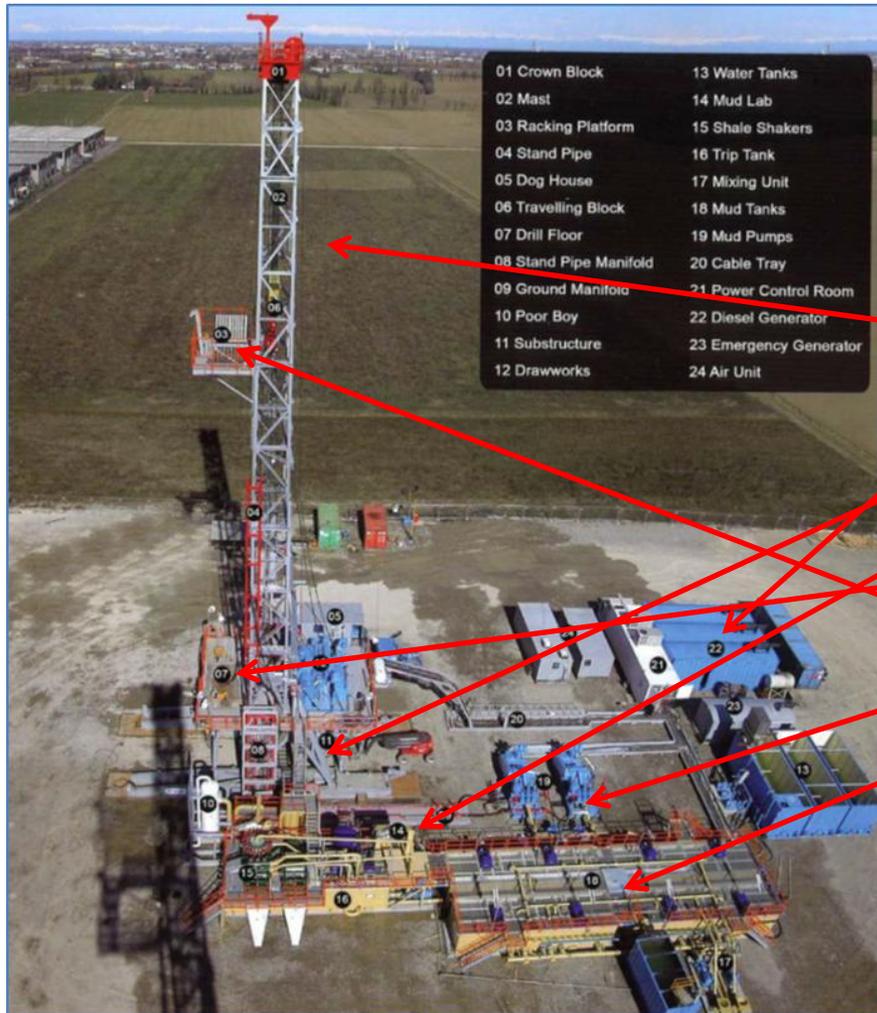


# Geothermal drilling

- Drilling has been developed in the USA on the 19<sup>th</sup> and the first deep geothermal wells has been drilled in the EU beginning of the 20<sup>th</sup>. More than 6 millions oil & gas wells have been drilled.
- Geothermal drilling presents rather important specificities.
- A good productive oil wells is producing 1000 barrels a day ( 5m<sup>3</sup>/h) a reasonable production rate for a geothermal well built for district heating is 200 m<sup>3</sup>/h in fact 40 times more.
- For a production at the surface with acceptable pumping rates for production and injection it is mandatory to get the smallest pressure losses in the well: which oblige to drill in big diameters.
- The drilling of geothermal wells is located in general in urban or suburban area and consequently the environmental concerns are much higher (noise, surface of the platform, trucks traffic, mud and storage pits etc...).
- The cost will be influenced by these parameters and it is reinforced by the fact that if series of 10 to 15 wells are common in oil & gas business, a geothermal doublet is made of only two wells.



# A typical old rig to drill deep wells



The surface need is of one hectare and the main components are:

- Mast
- Diesel generator
- Substructure
- Mud lab and shale shaker
- Drill floor
- Racking platform
- Pumps
- Mud tanks



# Aerial view of Melun platform



# Typical rigs used in geothermal sector



Hydraulic rig very recent

Traditional rig



# Geothermal/oil & gas

Characteristics	Oil and gas	Geothermal (Heat and CHP)
Depth of the reservoir	1000 to 7000m	500 to 4000m
Type of rocks	Sedimentary (carbonate, clastic, shale, source rocks of various type)	Sedimentary (80%carbonate and 20% clastic) In EGS sedimentary +
Drilling site location	Remote, rural, off shore	Urban, sub-urban, sometimes rural
Pressure	Low to high	Low to near hydrostatic
Fluid types	Single, two or three phase	Single phase liquid, dissolved gas
Porosity type of rocks	Matrix, fracture non connected	Matrix and/or fractured
Fluids flow rate	0,1 to 40 m <sup>3</sup> /h	100 to 400 m <sup>3</sup> /h
Temperature	30 to 250°C	30 to 150°C
Well design	Small to medium diameter	Large to very large diameter
Diameter	7" casing and 5" tubing and perforated 7"x 5" cemented	13"3/8 x 9"5/8, reservoir in 7" or 8"1/2 with screens 6"-7"
Completion types	Inner tubing, packer, safety valve completion	Full-bore casing production, open hole, slotted liner or screens
Production	Artificial lift gravity, self-flowing	Artificial lift, possible self-flowing







# Definition of needs and services to be provided

The first step before starting to design a geothermal well is to select a suitable rig: the size of the engine and the mast has to be adapted to the depth and casing diameter to be set in the well, further a lot of items have to be defined such as:

- **Site preparation and rig footprint:** the land needed is often between 5000 and 10000m<sup>2</sup> and usually inside the town special attention has to be paid to day and night works, noise, trucks rotation etc...
- **Drilling**
- **Bits and adapted tools for fishing**
- **Drilling fluids and mud treatment**
- **Directional drilling** (special services companies)
- **Casing and liners**
- **Cementing and products**
- **Waste disposal and processing**



# Definition of needs and services to be provided

- **Geological control and supervision**

quantity of miscellaneous items such as:

- **water consumption and injection,**
- **mining risk insurance,**
- **environmental aspects and administrative constraints**
- **Don't forget possible work-over in exploitation phases,**
- **screens in detrital reservoirs,**
- **mud solid control,**
- **drilling contract follow up,**
- **rig management...**

When the doublet has been successfully drilled and tested at the operational flow rate the engineering company in charge of the doublet construction has to design the surface equipment's which includes:



# Definition of needs and services to be provided

- **geothermal well heads,**
- **electro- submersible pump and variable speed drive,**
- **electrical and piping equipment in the geothermal station,**
- **heat pump selection if any,**
- **anti-corrosion treatment if needed,**
- **filtering systems to avoid plugging in the geothermal loop,**
- **heat exchanger with adapted metallurgy...**

Don't forget additionally that the geothermal doublet is built to be into operation during a minimum period of 30 to 35 years to be extended to 50-60 years after necessary repairs and new casings in smaller diameter.



# Definition of needs and services to be provided

In this perspective a strong attention has to be given to the usual annual maintenance and the heavy repairs which have to be anticipated, planned and carried out during the life time of the plant. A contract has to be put in place from the beginning of the exploitation period to guarantee a full time operation of the plant.

Do not forget that geothermal energy is available 24/24h all the year with energy content fixed and stable, it is of utmost importance to maintain this advantage constantly which will lead to a very cheap energy after passing the payback period.

**Remember that geothermal needs high CAPEX but during the life time of the plant the OPEX are reduced to a minimum and the doublet becomes a cash machine when the break-even is attained.**



# Geothermal drilling in evolution

The first generation of geothermal plants drilled in the sixties have been realised in small diameter and usually vertical because deviation was a recent technology. That is the case of the wells in Melun l'Almont (France) drilled in 1969. The wells drilled since now 10 years are in larger diameter and normally deviated even with big angles up to 50°C. A new generation is coming and horizontal wells have been already drilled in Switzerland for example in 2013 and project are on going in Paris area.

