

GeoDH Training

Date
Location



Co-funded by the Intelligent Energy Europe
Programme of the European Union



Promote Geothermal District Heating Systems in Europe

GeoDH

Section A – Geothermal

Part 5:

Production, operation and management of geothermal resource

elaborated by

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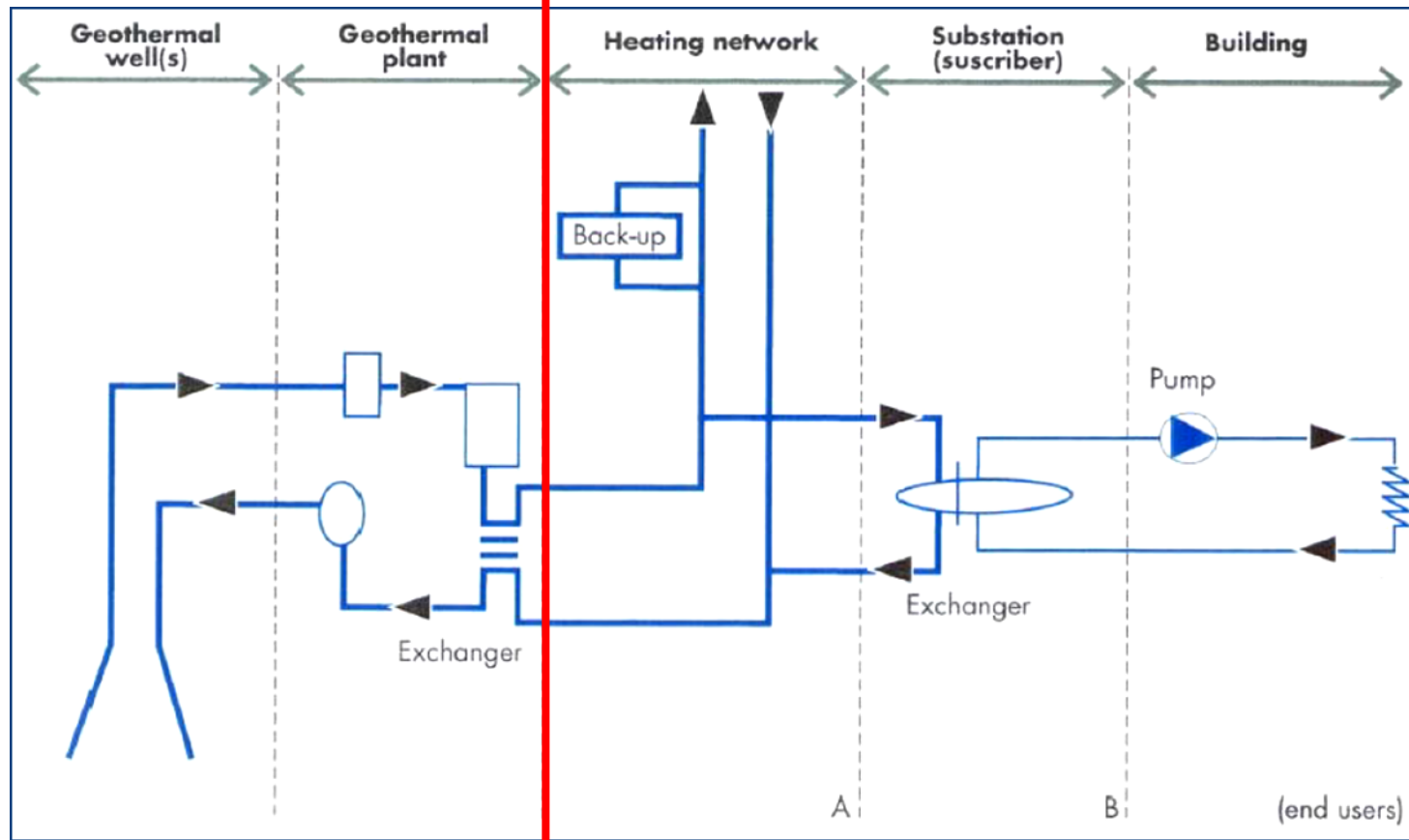
Production, operation and management of geothermal resource



The geothermal wells' doublet was tested at full production and injection flow rate

Geothermal part of the DH
Geothermal loop

Conventional part of the DH
Heating loop



Testing and regulating period

During some months before 1st heating season it is necessary to test geothermal loop in order to regulate the flow rate and speed variation system, water pressure of the wells, behavior of chemical water composition after some months, etc. ...

First year of exploitation

All the parameters in the wells but also pressure in the primary network (circulating geothermal water) and follow up of heat exchanger including upstream and downstream pressure and temperature are of paramount importance. Any deviation from the anticipated value has to be checked to prevent any malfunction in the loop.

The beginning is crucial to permit a 30 years exploitation

Geothermal energy CAPEX are high and a fluent exploitation is the only solution to offer a significant financial advantage during the lifetime of the project.

In this perspective a contract has to be signed with a specialized company in order to supervise the geothermal loop. The service company to be chosen must have a former experience to be sure that the geothermal plant should give its maximum in term of working hours.



Definition of tasks and actions to be performed during exploitation period (P1 – P3)

Operating costs and maintenance				K Euros
Geothermal loop				
P1	Electricity			240
	Corrosion inhibitors			70
	Water			5
P2	Regular maintenance			30
	Electrical Logging			20
P3	Heavy maintenance			88
	Equipment replacement			40
	Work force and 24/24h follow up			15
	Stock ,for repairs			15
P'3	Work over in the wells			55
	Insurance			45
District heating network surface installations				
P1	Electricity			20
	Natural gas			1 100
P2	Work force and 24/24h follow up			420
P3	Equipment replacement			320
P'3	Stocks for repair			50
	Insurance			150
Total				2 683

A typical detailed cost
for a deep
geothermal doublet



Definition of tasks and actions to be performed during exploitation period: External energy (P1)

P1: the consumption of reference energy (electricity, gas, coal...). It is the energy needed to run the DH system for peak production and ancillary equipment when the doublet is working.

This consumption has to be reduced constantly in order to utilize the geothermal potential at 100%.

The contract to be negotiated by the plant manager has to be optimized and it is recommended to have long term contracts with several suppliers in order to choose the best offer depending on the season or the quantity of MWh to be bought.

In some cases the external energy to be bought can be another renewable, such as biomass to be sure to reduce the consumption of fossil energy.



Definition of tasks and actions to be performed during exploitation period: Regular maintenance (P2)

P2: the annual following of the doublet scheme. It includes also careful measurement of the geothermal fluid evolution and the corrosion treatment if any. The filtration system (usually recommended to avoid problems in plate heat exchanger) has to be monitored and particles filtrated to be analyzed.

The service company in charge must maintain well' s head, pumping equipment and the frequency variators driving the production and injection pumps.

If two geothermal wells are not closed on the same platform (10 to 20 m in case of deviated wells), the piping connection which circulates geothermal water in general under pressure (above eth bubble point) has to be also monitored.

P2 will allow to estimate the possible problem arising in the doublet system and consequently to anticipate the repairs and pumps change for example which are usually done out of the heating season.

Electrical logging to inspect well's behavior (diameter, production zones, corrosion or deposition, etc..) has to be carried when heavy maintenance is done, eg. each 5 years which is a good duration life for an electrical submersible pump.



Definition of tasks and actions to be done during the exploitation period: Heavy maintenance (P3)

- P3:** costs which should be planned in order to repair the geothermal loop out of the heating period. It is separated into 2 different contracts: one for the geothermal loop and the other for the set of the surface installation (heating room, piping network, substation, heat pumps if any and all the centralized control system in real time to supervise the full installation).
- P'3 for the geothermal loop** corresponds to the work over provision for the two wells of the doublet. This is to clean the well from the bottom to the surface in case of deposits, to put a new casing to cover a damaged part if any.
- P'3 for the surface equipment** includes the stock for repairs and the insurance to cover all the difficulties that could arise.



Drilling of 2 deviated wells	K Euros
Grant application ADEME	10
Insurance application SAF Environment	10
Geothermal lease and application for permits	95
Civil works (platform, fence, anti-noise , cellars)	700
Cranes works, transportation, storage	60
Drilling rig mob, demob and moving	650
Drilling (energy included)	2 200
Overreaming	250
Drilling mud	520
Drilling tools	170
Deviational including personal	700
Electrical logging	520
Casings	920
Installation of casings (acesories , screwing)	310
Cementing	900
Stimulation and development	85
Acidizing jobs	130
Mud treatment and cuttings removal	960
Well heads and valves	130
Geological follow up	410
Supervision on site 24/24	400
Cleaning of the platform	500
Insurance SAF short and long term	630
Engineering	190
Provision for unexpected	480
Total	11 930

Total costs

- Administrative costs = 105 K€
- Surface works = 1260 K€
- Geological and technical supervision on site: 810 K€
- Engineering & insurance system: 820 K€
- Unexpected : 480 K€
- Operation to drill and equip two wells = 8455 K€ (70% of full cost)



Geothermal loop at the surface	K Euros
Production pump (300 m ³ /h)	215
Pumping tubing (DN 175 coated)	140
Transformer	100
Piezometric tubing	10
Inhibitors line and accessories	180
Injection pump	60
Frequency variators	80
Regulation cos phi	20
Titanium plate heat exchangers	215
Handling of equipments	20
Geothermal water piping at the surface	210
Filters station	25
Monitoring of the loop including instruments	15
Water tank (4m ³)	25
Digital systems	20
Architect, engineering and control	300
Heat station surface piping (DN 200 to 350)	450
Connection to the grid	90
Electric rack	95
Pumps for secondary loop	100
Total	2 370

Sub-surface costs

- Total cost of surface geothermal loop = 2370 K€
and full cost of fully equipped doublet (incl. plate heat exchanger) = 14 300K€
- Drilling of two wells at 8455 K€ represents less than 60% of total cost
- It is important to keep in mind that drilling and cost of the well is the main part but that many other components and investments have to be taken into account to make a good evaluation of the geoDH investment



Maintenance and operation costs

Operating costs and maintenance			K Euros
Geothermal loop			
P1	Electricity		240
	Corrosion inhibitors		70
	Water		5
P2	Regular maintenance		30
	Electrical Logging		20
P3	Heavy maintenance		88
	Equipment replacement		40
	Work force and 24/24h follow up		15
	Stock ,for repairs		15
P'3	Work over in the wells		55
	Insurance		45
District heating network surface installations			
P1	Electricity		20
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P2	Work force and 24/24h follow up		420
P3	Equipment replacement		320
P'3	Stocks for repair		50
	Insurance		150
Total			2 683

Annual costs of exploitation and maintenance of geothermal district scheme:

$$P1 = 1445 \text{ K€}$$

$$P2 = 470 \text{ K€}$$

$$P3 = 478 \text{ K€}$$

$$P'3 = 300 \text{ K€}$$

The sum of P2+P3+P'3 is of the same importance compared to the energy cost for peak heating and back up



Conclusions

- The investment cost for a doublet (2 deviated wells at 2 km depth with a pumping chamber in 18''5/8) and all the sub-surface and surface equipment is estimated at 14 300 K€. This CAPEX comprises everything to exploit and run the geothermal loop for 30 years
- The maintenance and operating cost including everything to run the geothermal and the distribution heating system in the city is of 2 683 K€. This amount covers also energy to be bought out of the geothermal energy production which is for free
- With such high CAPEX and OPEX, the geothermal DH exploitation has to operate 24/24 hrs during the heating season and as much as possible during the summer season, eg. to produce sanitary hot water. The higher the geothermal production of MWh production should be the better the ROI of the installation will be.
- Maintenance and professionalism of the services companies contracted for the exploitation are the keys for a profitable project

