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# Subhorizontal Geothermal doublet Completed at Cachan, A demonstrator for the future

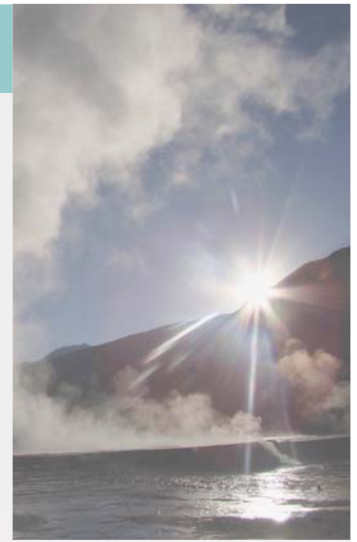


Photo : El Tatio ©P.Ungemach

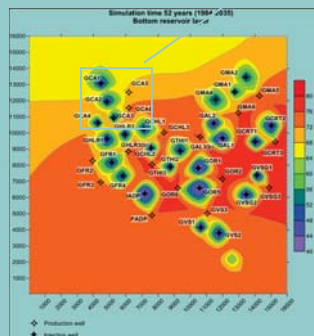


Panoramic view of the Cachan drillsite , 2017

## Major concerns of the Dogger geothermal exploitation in the Paris Basin

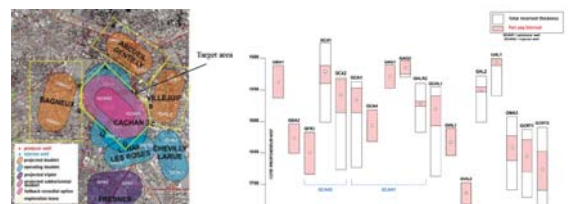
Geothermal District Heating (GDH) doublets in the Central part of the Paris Basin, in particular in the Capital City suburban areas faces two major concerns :

- (i) the replacement of aging and declining, when not damaged, well infrastructures and productive/injective capacities,
- (ii) GDH doublet densities, approaching in some areas overpopulation, which limit well replacement opportunities and cloud new development issues bearing in mind space limitations in urban areas and thermal breakthrough/reservoir cooling shortcomings.



The Cachan site, a relevant candidate for a first implementation of an alternative well architecture design known as the subhorizontal well (SHW) :

- (i) limited space availability,
- (ii) proximity of neighboring, operating and commissioned doublets,
- (iii) a local GDH facility including two, 32 years old first generation doublets
- (iv) locally moderate reservoir properties, saturated production capacities and poor system COP ratios (Produced heat/consumed power < 10 MWth/ MWeI/).



Paris Southern suburbs. Geothermal district heating doublet locations and Offset wells layered reservoir correlations

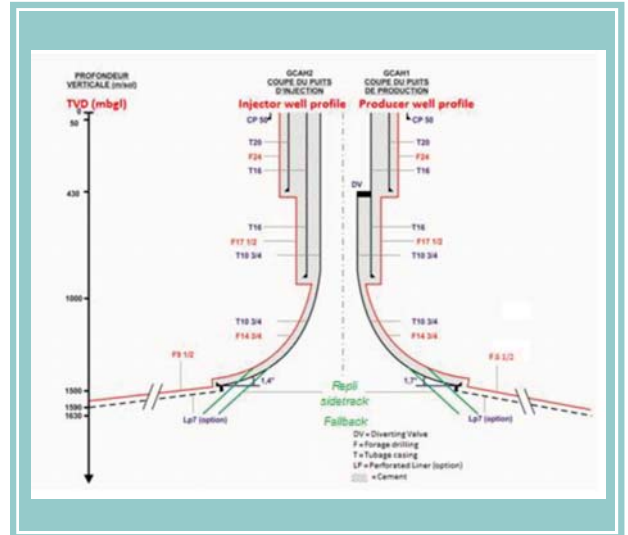
## New Well Architecture — A World Geothermal Première

On March 20, GPC IP successfully tested the second subhorizontal geothermal (injection) well, GCAJ2, at the Paris suburban Cachen site, thus validating this innovative well architecture, initiated on the previously drilled production well, GCAH1, recorded as a World Première.

Well design features two 1001 (GCAH1) / 1 005 m (GCAH2) long, 87 to 93° slanted, 8<sup>m</sup>1/2 openhole drains, drilled in the Dogger (mid Jurassic)/Bathonian oolitic limestone at 1 550 m true vertical (TVD) and 3 000 m drilled (mD) depths.

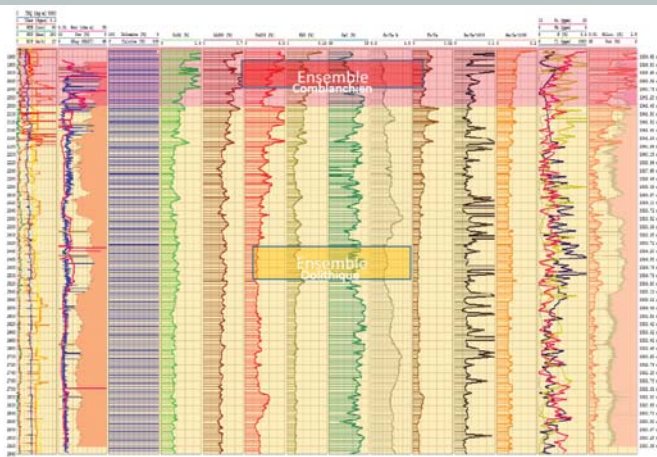
Targeted at 450 (nominal) and 500 m<sup>3</sup>/h (maximum) productive and injective capacities, the new doublet, managed by a DALKIA (EDF Group)/City of Cachen J.J (DALKIA operator), will replace two existing, ageing (33 years) doublets rated 180 and 170 m<sup>3</sup>/h (total 350 m<sup>3</sup>/h) respectively.

The concept pioneered by GPC IP, first published in February 2011 at the Stanford Geothermal Engineering Workshop and later developed at the 2016 European Geothermal Conference (September 2016, Strasbourg), raises considerable interest among geothermal operators reclaiming areas undergoing moderate to poor (by geothermal standards) reservoir performance.



## A substantial technical achievement

### Geosteering drain trajectories



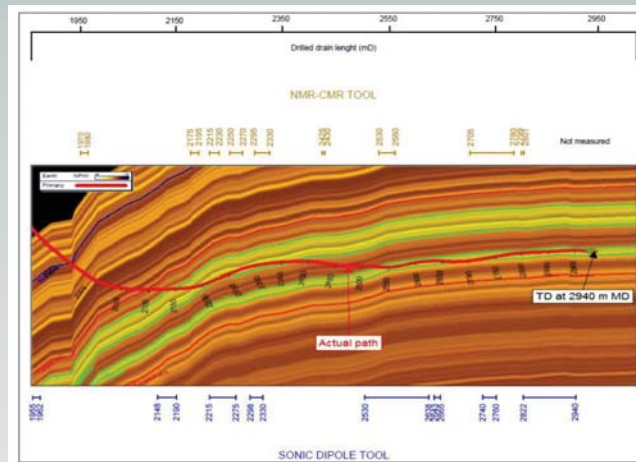
### Geosteering Optimization | Rotary Steerable System, LWD and Real-time Geochemistry

On the Cachen site, Hi-Tech has been deployed to secure optimum project achievement. A 7/24 dedicated team surveyed parameters recorded while drilling. These informations, linked to the conceptual reservoir model, made it possible to (re)adjust in real time well trajectory.

Within the context of the Paris Basin Dogger carbonate platform, geochemical monitoring, based on (XRF, X Ray fluorescence) elemental and (XRD, X Ray diffractometry) mineralogic analyses on cuttings sampled while drilling, was implemented with a view to appraise varying reservoir properties in response to facies changes and diagenetic impacts on porosity/permeability trends.

Real-time Geochemical Monitoring (XRD/XRF)

### Wireline logging



Wireline log (NMR-CMR and Sonic dipole porosity, permeability tools) correlation with drain productive segments

### The ambitious exhaustive wireline logging programme initially contemplated could not be wholly fulfilled.

However, respective to porosity, density and lithology, logging while drilling (LWD) supplied useful clues while geosteering drain trajectories, particularly on well GCAH2 characterised by a thin, metric size, (up) dip varying, bed structure.

On well GCAH1, the successful PLT spinner flow-metering provided invaluable information as to the flow and dynamic temperature profiles along the entire drain path.

On the other hand, the first application on French geothermal projects of nuclear magnetic resonance (NMR/CMR) and dipole sonic logs proved rewarding and of great significance in correlating permeabilities to porosities and VV, along with assessing thin bed porosity layering from P and S wave sources.

### A success story and more...

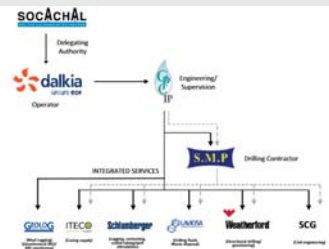
- ... a novel geothermal well architecture standard.
- ... a promising development route for reclaiming heat energy from low permeability deposits.

### A partnership project

#### Supporting parties



#### Project team



### Thanks to them...

The first subhorizontal doublet of Cachen could be achieved thanks to the dedicated commitment of each partner.

Since the 1980s the city of Cachen has been involved in geothermal production, with the support of its public sister company "Socachal". Nowadays, the activity has been handed over to Dalkia. The company, via its equity and public financial support, embarked in this innovative and challenging subhorizontal project.