GéoTherWal
Optimisation des sondes géothermiques en système fermé

No 1117492 (01/01/2012-30/06/2016)

ULg, ULB, OREX, Geolys

Wallonie

Experimental site in Sart-Tilman

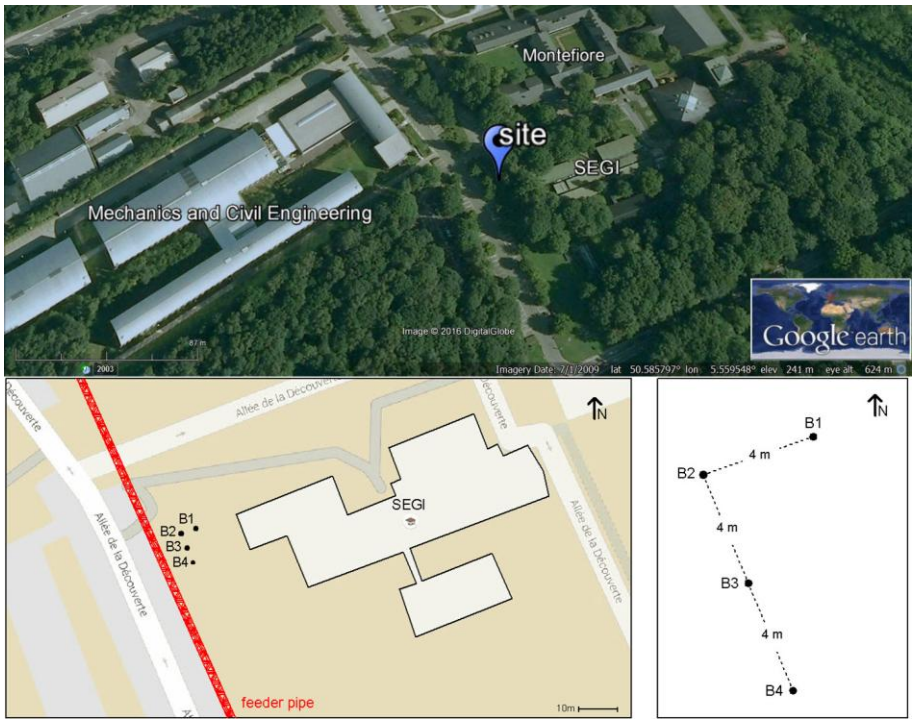

Figure 1 - Site location on the campus of the University of Liege (retrieved from Google Earth©)

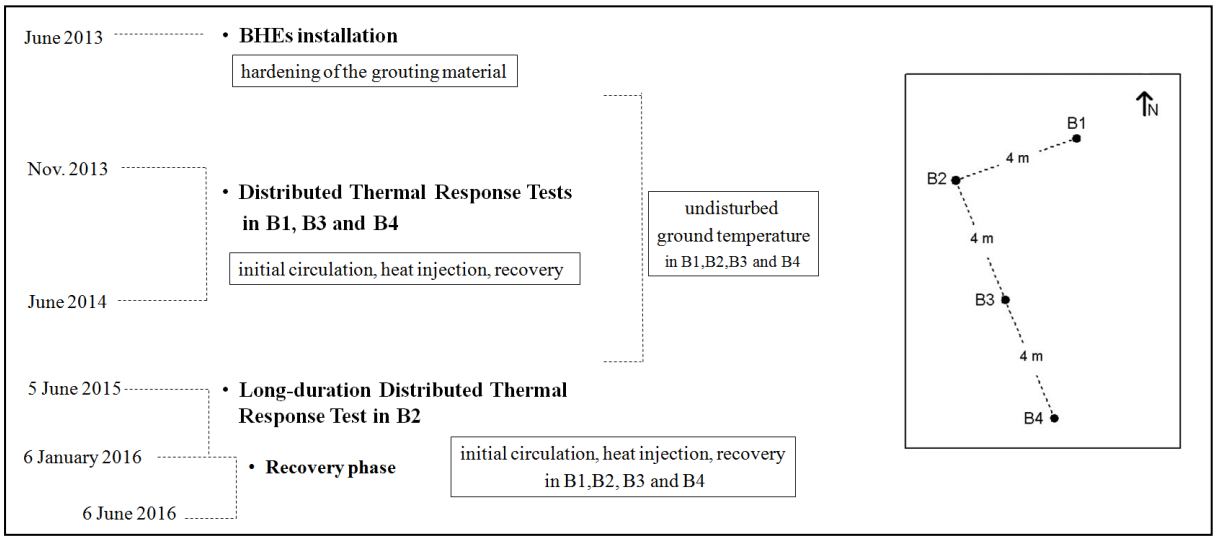

Figure 2 - In-situ temperature measurements in the four BHEs (B1-B4) (June 2013 - June 2016)

Table 1- Duration of in-situ Distributed Thermal Response Tests

BHE			**B1**	**B2**	**B3**		**B4**	
DTRT			B1 *18/06/2014-09/07/2014*	B2 *05/06/2015-06/06/2016*	B3.1 *26/03/2014-31/03/2014*	B3.2 *31/03/2014-19/04/2014*	B4.1 *13/11/2013-22/11/2013*	B4.2 *23/04/2014-01/05/2014*
	Water circulation	Heat injection						
Phase 1	√	-	24 h	39 h	16 h	29h	22 h	22 h
Phase 2	√	√	177 h	216 d	10 h	160 h	168 h	91 h
Phase 3a	√	-	-	-	-	35 h	34 h	-
Phase 3b	-	-	302 h	153 d	94 h	240 h	-	67 h

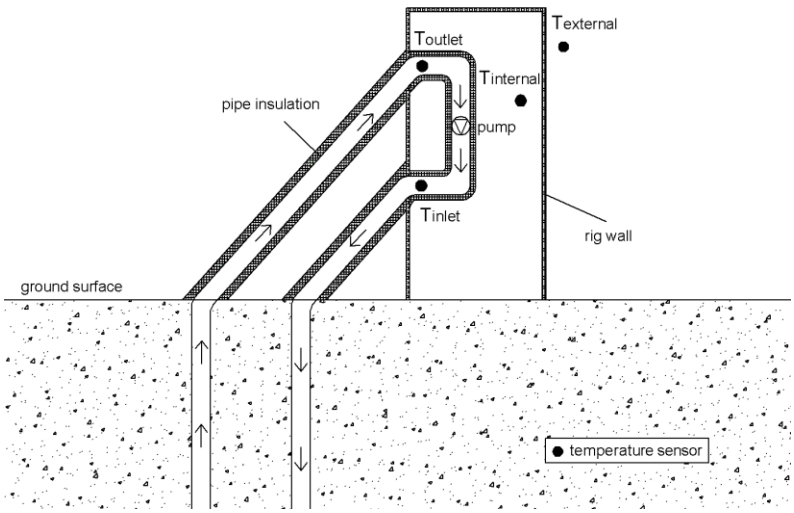

Figure 3 - Temperature sensors location during the DTRTs

Data files description:

1. **Borehole televiewer**: measurements in B1-B4, *Chapter 2 (Radioti, 2016), (Radioti et al., 2016)*

2. **A few days after installation:** calibrated fiber optic profiles in B1 and B4 a few days after injecting the grouting material, mean of downward and upward pipe leg, *Figures 5.24 and 5.2 (Radioti, 2016), (Radioti et al., 2016)*

3. Undisturbed temperature: before the TRTs, calibrated fiber optic profiles (mean of downward and upward pipe leg) + lowering RTD probe, B1-B4 and in two wells in Sart-Tilman (B52 and B77), *Figures 4.2 and 4.3 (Radioti, 2016), (Radioti et al., 2017)*

4. TRTs in B1,B3,B4

- **typical TRT measurements**: water and air temperature measurements, flow rate, electr. power, Geolys, *Figures 4.10, 4.11, 5.1... (Radioti, 2016)*
- **RTD measurements for B1**: RTD probes attached at the outlet connecting pipe (outer pipe surface underneath the insulation layer): RTD1 at module entrance, RTD2 at ground level, t=0: start of heating phase, *Figure 5.4 (Radioti, 2016)*
- **Phase1 - fiber optics**: calibrated fiber optic profiles during water circulation in the pipe loops, mean of downward and upward pipe leg, t=0: start of the test, *Figures 4.13, 4.14... (Radioti, 2016), (Radioti et al., 2017)*
- **Phase2 - fiber optics**: calibrated fiber optic profiles during the heating phase, t=0: start of the heating phase, *Figures 5.19, 5.21.. . (Radioti, 2016)*
- **Phase3 - fiber optics**: calibrated fiber optic profiles during the recovery phase, t=0: start of the recovery phase, *Figures 5.22, 5.21... (Radioti, 2016), (Radioti et al., 2016)*
- **B4_2 fiber optics**: NOT calibrated fiber optic measurements along the cable during the TRT, cable loop inside the ground: points 162-636, 636-1110

5. Long-duration TRT in B2

- **Geolys-B2**: typical TRT measurements (water and air temperature measurements, flow rate, electr. power), Geolys, *Figure 5.1, Section 6.1... (Radioti, 2016)*
- **B1_fiber optics, B3_fiber optics, B4_fiber optics**: calibrated fiber optic profiles in B1, B3 and B4, mean of downward and upward pipe leg, t=0: start of the heating phase (07/06/2015), *Section 6.5 (Radioti, 2016)*
- **B2_fiber optics**:
  - NOT calibrated fiber optic measurements along the cable for phase 1 and phase 2, ph1->t=0: start of the test, ph2 -> t=0: start of the heating phase, cable loop inside the ground: points 175-650, 650-1125
  - Calibrated fiber optics profiles during the recovery phase, ph3 -> t=0: start of the heating phase

References

Radioti, G. (2016). *Shallow geothermal energy: effect of in-situ conditions on borehole heat exchanger design and performance*. Doctoral dissertation, University of Liege, Belgium

Radioti, G., Delvoie, S., Charlier, R., Dumont, G. and Nguyen, F. (2016). Heterogeneous bedrock investigation for a closed-loop geothermal system: A case study. *Geothermics*, 62, 79-92

Radioti, G., Sartor, K., Charlier, R., Dewallef, P. and Nguyen, F. (2017). Effect of undisturbed ground temperature on the design of closed-loop geothermal systems: A case study in a semi-urban environment. *Applied Energy*, 200, 89-105