Technologies for geothermal to enhance competitiveness in smart and flexible operation

Reporting

Project Information

GeoSmart

Grant agreement ID: 818576

Project website

DOI
10.3030/818576

Project closed

EC signature date
3 June 2019

Start date
1 June 2019

End date
30 September 2024

Funded under
SOCIETAL CHALLENGES - Secure, clean and efficient energy

Total cost
€ 18 306 025,25

EU contribution
€ 14 985 759,28

Coordinated by
TWI LIMITED
United Kingdom

Periodic Reporting for period 2 - GeoSmart (Technologies for geothermal to enhance competitiveness in smart and flexible operation)

Reporting period: 2020-06-01 to 2022-11-30

Summary of the context and overall objectives of the project

The GeoSmart project aims to optimise and demonstrate innovations to improve the flexibility and efficiency of geothermal heat and power systems, specifically:
• Energy storage and power block management innovations to provide daily flexibility for "dispatchability''- to ramp up and down to the extent and speed required to fill the gaps between the sporadic and "duck curve" demand curves and the supply curves from solar and wind;
• Integration of more flexible organic Rankine cycle (ORC) systems that can cope with variations in needs in the electricity markets;
• Innovative methods to allow a combined heat and power (CHP) supplier to extract more heat from the post-generator ("waste" heat) brine outflows when required for increased heating supply during colder weather, using aquifer heat storage/re-cooling, and by removing the scale-formation constraints to cooling in high-silicate brines.
The proposed innovations will be implemented and tested at demonstration sites in Insheim (Germany) and KZD2 (Turkey) against four technology pillars:
• Provision of Thermal Energy Storage (TES), tailored to a site's conditions, to provide buffered supply against stochastic and 'duck curve' peak and ramping needs;
• Redesign of ORC generation system to optimise for flexibility of operation and maximise efficiency across the ramp rates and "off-design" operating conditions required to work with TES;
• Increase ORC efficiency during warm days through an aquifer based hybrid cooling system;
• The Carnot efficiency of the exergy extraction will be increased by removing the brine re-injection temperature constraint caused by silica scaling.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The main achievements in the reporting period were as follows:
• Formalisation of end user specifications for the two demonstration sites in Balmatt (Belgium) and Zorlu (Turkey) (WP1);
• User workshops to generate the integration document with site specific data and proposed innovations at the demonstration sites (WP1 & WP10);
• Development of safety and risk register for demonstration sites to include information on equipment safety legislation codes, operational conditions and specification designs (WP1).
• Identification and selection of phase change materials in accordance with the site requirements (WP2);
• Design of thermal storage units for demonstration sites based on input data from the demonstration sites (WP2);
• Development of physical models for the different components of the ORC including the pump, heat exchangers, expander and piping (WP3);
• Work on preliminary design and control strategy for the aquifer-based hybrid cooling of the ORC (WP3);
• Work on production of the individual and overarching energy management and control systems and optimisation of the combined flexible ORC, thermal energy storage and aquifer-based hybrid cooling system for application at the Balmatt demonstration site (WP3 & WP6);

• Design of retention tank unit following the heat exchange unit to allow for silica scale formation prior to re-injection (WP4).

The main achievement in the RP2 were as follows:
• Following the change of demo sites, the key performance indicators (KPIs) were re-evaluated for relevance;
• New site specific (Insheim and KIZILDERE 2) integration documents including Process flow diagrams (PFD) and Piping and Instrumentation diagrams (P&IDs) were formalised to define the integration of the GeoSmart innovations on the demo sites;
• Previously established site specific safety and risk registers were updated to include information on relevant equipment safety legislation codes, operational conditions and specification designs.
Insheim site
• Design of pressurized water thermocline storage (10 MWh) as the TES of choice;
• Development of adiabatic cooling system specifications for air cooled condenser;
• Development in progress for implementation of a flexible energy management of ORC and district heating using a secondary cycle with industrial water.
Kizildere 2 site
• Finalization of design of two types of storage systems:
o Steam accumulator (5 MWh) and a Phase Change Material (PCM) module (2 MWh).
• Decision on final material choice (HITEC salt) for PCM module;
• Design and development of a small scale test module (PCM and HX) for laboratory testing in CEA and Fraunhofer respectivley;
• Design, development and delivery of a scaling reduction system for installation at Kizildere 2 site;
• Formalisation of detailed planning document for procurement of materials (tendering) to fabrication, installation and demonstration of the storage and retention tanks on Kizildere 2 site.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

The GeoSmart technology concept will allow the geothermal plant to be operated in a flexible mode to produce power and heat in a cost competitive way. This will be elaborated via case studies addressing a wide range of geothermal power opportunities.

GeoSmart Logo

Last update: 12 November 2024

Permalink: https://cordis.europa.eu/project/id/818576/reporting