Postdoc Position

Numerical optimization of thermal storage by sensible heat

Context

The integration of Thermal Energy Storage (TES) is perfectly suited to industrial sites where heat demand and production are not synchronized, giving flexibility to heat supply. TES can be charged by available residual heat, renewable energy but excess electricity can also be stored in the form of heat. The stored energy is then used when the industrial site's heat demand requires it.

The Thermal Energy and Processes Laboratory (LaTEP) is working with industrial partners on the development of a numerical tool to optimize specific storage technologies.

Project start date: December 2024

PostDoc duration: 12 months

PostDoc start date: as soon as possible.

Location

Pau, France - ENSGTI – LaTEP

Salary

Approximately 2900 euros gross per month

Research Program

The storage unit behaves dynamically, and its behavior can be adjusted by managing operating and design conditions to fulfil heat needs. Multiple phenomena play important role in the evolution of the dynamic thermal profile within a storage. To better understand their behavior and to assess the effect of operating and design conditions on the TES response, the first step is to develop a dynamic 1 or 2D detailed model.

TES modelling faces multiple challenges. Depending on the project goal one can adopt a coarse or fine modelling. The latter implies a good description of the system's features such as topology, storage material, heat transfer fluid and mass and heat transfer phenomena so that the thermocline and the available energy in the system are known.

In this context, our final aim is to develop an optimization tool that uses the fine dynamic modelling and evaluates, for a given case study, the optimal operating and design conditions. We will focus on the development of a robust, fast and detailed TES model of a solid sensible TES technology. We will also evaluate over a small timespan (24h), the optimal operating conditions for a given load. Herein, the load corresponds to a seasonal heat load from an industrial site that we intend to decarbonize with an electric heater and a TES. The system will co-participate on the grid market. You can find below the different provisional tasks of the research program as well as the deliverables.

Tasks

01 Collect data on the solid thermal storage via a literature review such as, thermal properties, design and operating features, charging and discharging modes using heat transfer fluid, experimental data.

Define and implement the system equations considering the topology of the storage system and validate the model with experimental data from the literature.

02 Add a simplified model of an electric heater in view of the case study.

Sensitivity analysis on operating conditions (inlet flow and temperature) for charging and discharging steps, efficiency, etc.

Sensitivity on design features: capacity, number of modules in series and in parallel, efficiency, etc.

03 Define an applicable optimization algorithm on the TES operation considering the case study over a timespan (24h, 240h).

Development of the optimization tool.

Preliminary results on operation management optimization.

04 Investigate the need to increase the optimization timespan, improve model and optimization tools upon results.

Final results on optimization.

The Post-Doctoral fellow shall provide frequent reporting that will take the form of scientific article for future valorizations.

Candidate profile

The candidate (Dr) will have solid skills in numerical optimization, programming and modelling, as well as in energy and heat transfer. Writing skills are essential as well as A good level of English.

The laboratory:

The Laboratoire de Thermique, Energétique et Procédés, LaTEP EA 1932, works on the issue of the energy transition by carrying out research in energy engineering and environmental processes. LaTEP is a host team comprising 24 teaching researchers and around twenty doctoral and post-doctoral students. The research carried out in our laboratory, whether fundamental or technological, aims to propose solutions adapted to the sober, safe and efficient management of energy and the development of innovative tools to improve the quality of the environment and the treatment of waste, always under the constraint of energy efficiency, which is essential today. The LaTEP's research activities focus on three main themes:

- Thermodynamics and characterization of electrolytic systems
- Environmental process engineering
- Experimentation and numerical optimization of energy systems

This project is part of the activities linked to the last theme.

Contact

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Applications (CV, covering letter, letters of recommendation) should be sent by e-mail to the above addresses.