PhD proposal

Outdoor Accelerated ageing of Concentrated Solar Power (CSP) components

Context and Objectives:

Concentrated Solar Power (CSP) consists of the concentration and the use of solar energy in a thermodynamic cycle to produce electricity via a turbine. Compared to other technologies, CSP is grid friendly and dispatchable thanks mainly to its efficient and cost effective energy storage. However, in order to produce a competitive kilowatt-hour, CSP technology still faces some challenges.

Durability of the solar field components in a CSP plant is one of the issues that R&D efforts are undertaking in many research institutions worldwide. In order for such plants to operate fully for more than 20+ years, the ageing phenomena of plant components such as mirrors need to be understood and their lifetime to be improved. Actually there is no model to describe ageing mirrors related to the environmental stress despite the fact that this information is needed to better define standards of accelerate tests used to qualify the durability of these components. This point constitutes the scope of this thesis.

The **M**oroccan **A**gency of **S**ustainable **EN**ergy, **Masen**, has recently initiated an R&D collaboration program with **CEA**, the French Institute for Atomic and Alternative Energies. The idea behind such a partnership is the implementation of a joint lab dedicated to advanced studies and research on durability issues of solar components, systems and subsystems. This joint lab is deployed both on Ouarzazate R&D platform and CEA/Liten R&D at National Institute of Solar Energy (INES).

The objective of this thesis is to carry out accelerated aging tests of solar mirrors and absorbers. These tests will allow degradation phenomena acceleration and tests time saving. The main tasks of this work concern the design, the conception and the realization of experimental equipment's which can be used to study the ageing phenomenon. The R&D platform of NOOR project offers high irradiation and ideal tools to conduct these accelerated tests.

Research Activities and Tasks:

To carry out such research, Masen is looking for PhD candidates willing to tackle those R&D challenges. Research activities include but are not limited to:

- Review and analysis of literature on accelerated ageing "sous flux" , with focus on CSP power plants conditions and components
- Design and realization of experimental setups to carry out accelerated tests of solar components (mirrors and absorbers mainly)
- Implementation of qualification tools and control of test parameters: flow homogeneity, temperature and measurements instrumentation
- Carrying out real-like-condition testing campaigns
- Analysis of experimental results (samples degradation) to identify ageing parameters and its kinetics in relation with tests conditions. Correlation between climatic and accelerated tests conditions. Determination of representative tests parameters of reel conditions of CSP plant
- Elaboration of accelerated ageing tests protocols that could be used to establish new standards in this field.
- Contribution to modeling approaches to help explaining of components' ageing
- Scientific communication on results and research perspectives

The PhD program is financed by Masen and will take place mainly within the R&D Platform of Ouarzazate, Morocco, with some regular stays in Rabat (Morocco) for training or experiments. The candidate may also have to travel to Chambery (France) if needed.

Profile description:

Successful candidates should demonstrate high level academia records as well as strong motivations and abilities to work in international and collaborative R&D projects. They should fulfill also the following requirements:

- Holding or in final year of Master's/Engineering Degree in Physics, Instrumentation, Material Science, Optics, Metrology
- Skills/wiliness in carrying scientific experimental work
- Software proficiency:
    - Advanced skills in: Matlab, Comsol, MS Office, etc.
    - Literacy in: data processing and software control.
- Proven written and spoken skills: English and French
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- Geographic mobility: Ouarzazate, Rabat in Morocco + International

The profile has to exhibit creativity, inventiveness, autonomy and consistent trait of accuracy and rigor. Experience in project management is an advantage

Contacts:

Interested candidates must apply by sending their application: Resume, Cover Letter and 2 references; with the reference *"[PHD_Application_Durability_S1_2016]: First and Family Names of the candidate*" via email to: s.rachidi@masen.ma

References:

(1) Delord, C. and al. (2016), *AIP Conference Proceedings* **1734**, Solarpaces 2015:
(2) Karim, M.; and al. (2015), *Energy Procedia* **69,** Solarpaces 2014, 106-115.
(3) Karim, M.; and al. (2014), Solarpaces 2014', 246-251.
(4) Karim, M.; and al. (2014), *Solar Energy* **108**, 41-50.
(5) Karim, M. and al. (2015), *Solar Energy* **118**, 520-532.
(6) Edfouf, Z.; and al. (2014), *IRSEC 2014*, 125-130.
(7) Edfouf, Z.; and al. (2015), Solarpaces 2014', 1508-1518.
(8) Girard, R.; and al. (2015), Solarpaces 2014', 1519-1528.
(9) Raccurt, O.; and al. (2013), Solarpaces 2013, 1700-1707.

More information on the background publications of this project can be found by consulting relevant literature published by:

Dr. Olivier Raccurt, French Alternative Energies and Atomic Energy Commission (CEA LITEN), National Institute of Solar Energy (INES)
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