PhD proposal

Study of solar mirrors ageing and its correlation with environmental stress factors

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 main objective of this thesis is understanding the degradation phenomena due to environmental stress factors of solar mirrors used in different technologies. The definition of ageing law and the determination of the lifetime prediction of tested mirrors constitute other objectives.

Research Activities and Tasks:

The candidate will be define the adapted tools to measure the environmental parameters and analysis the level of stress factors. In the same time mirrors samples will be exposed on site. The analysis of the degradation over the time and the correlation between the stress levels will be study. The analysis of field data related to the stress level will be used to define the degradation law. An extended materials analysis will be perform to identified and understand the degradation mechanisms. The objective is to determine the lifetime of mirrors related to the site specification. This experimental works was systematically compared to a bibliographic analysis. The candidate will participate to the conception and the implantation of outdoor test bench for sample exposition and environmental measurement. The observation of outdoor degradation will be compare to the accelerate test performing in CEA INES.

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 ageing phenomena in relation with environmental stresses, with focus on CSP power plants conditions and components.
- Identification of relevant environmental stress factors of MASEN's ageing sites and conception of specific measurement tools to determine their levels and frequencies. This work will be conduct on two different representative sites for CSP deployment (Ouarzazate and another site).
- modelling of ageing to determine the life time prediction and gives inputs parameters for performance's model
- Contribution to designing experimental setup to characterize solar components' durability in accordance with the modelling efforts
- Carrying out of real-like-condition testing campaigns of mirrors ageing.
- Analysis of the experimental results.

- Conclusions' drawing and recommendations.
- 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 Material Science.
- Skills/wiliness in carrying scientific experimental work
- Scientific modelling skills
- Software proficiency:
    - Advanced skills in: Scilab/Matlab, MS Office, etc.
    - Literacy in : Data processing/analysis,
    - Proven written and spoken skills: English and French.
- Location: Ouarzazate/Rabat
- Mobility: 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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