Solar Facilities for the European Research Area

SFERA-III

Solar Facilities for the European Research Area

Implementation of reactor and system control Tools

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VALIDATION

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Disclaimer

Executive Summary

This report outlines several initiatives within the SFERA III consortium aimed at automating the operation of solar fuel production reactor systems. Section 1 describes a collaborative work between CEA and CNRS on the automation of a hybrid solar biomass gasification reactor. The automation used a DNI forecast to predict solar flux, and a model based predicative control (MPC) strategy to adjust the oxygen feed to achieve optimal syngas production under intermittent solar flux. The control strategy compensated for drops in solar DNI using the oxygen flow to adjust the extent of autothermal operation. The results were very promising, with the MPC strategy outperforming a reference PID rule based algorithm. Section 2 describes the SCADA heliostat control system implemented by IMDEA. This method was used to provide varying solar flux to a solar thermochemical methane reforming reactor tested in collaboration with ETH Zurich. The SCADA system provided flexible solar flux control for the two-step process. Section 3 describes a feedback linearization algorithm implemented by CIEMAT for the control of a 100 kW solar reactor under transient solar flux conditions. Section 4 described the automation of a dual reactor system operated at ETH Zurich, for two-step solar thermochemical syngas production, as part of a mini solar refinery. The operation was automated, and a successful performance optimisation algorithm also implemented based on the results of large parametric study and using the performance indicators of task 8.3.

The development of automation, control, and optimization strategies within SFERA III WP8 have broken new ground and built upon the consortiums know-how for the complex engineering challenge that is solar reactor operation and optimization.