next-CSP

High Temperature concentrated solar thermal power plant with particle receiver and direct thermal storage

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Deliverable D3.1

WP3 – Detailed design of the 4 MWth high temperature solar loop and of the heat conversion loop

Deliverable D3.1 Report on the solar receiver design

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1 Introduction

The solar receiver is the heat exchanger within the solar loop that transfers the concentrated solar radiant heat, emanating from the heliostat field, to the upflow fluidised powder heat transfer/heat storage medium. The solar receiver must internally accommodate the fluidised powder flow process and externally accept the severe radiant heat flux loading. The receiver is part of a complete heat capture, storage and re-use concept where the air-Brayton cycle power generation is the heat-to-electricity part of the project. The complete, albeit tentative layout of the complete solar power plant, excluding the Brayton turbine, is illustrated in Figure 7.1 of the Appendices.

2 Objectives of D3.1

The objective of this deliverable is to define the detailed design of the solar receiver for the Next CSP pilot scale power plant. The major challenge to be addressed by the receiver design is that of durability under the extreme operating conditions, consisting of receiver tube wall temperature in the range 800-1000 °C and delivery of particles in the temperature range 750-800°C. The heat transfer fluid will flow upwards through 40 vertical receiver tubes, exposed to a high solar flux density, with a solid mass flux will vary from 100 to 125 kg/m².s.

Additionally, the instrumentation and controls of the complex receiver concept were studied in detail, and are added separately in Appendix 1 of Section 7.