next-CSP

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

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Deliverable D3.2

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

Deliverable D3.2 Report on the design of the solar pilot loop component and layout of the assembly atop the Themis tower

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1 Introduction

The complete solar power plant includes a sequence of different unit operations. The key part is the solar receiver which has been dealt with in details in deliverable 3.1. The present deliverable 3.2 treats the remaining components of the complete solar power plant. Receiver discharged powder is collected in a hot storage bin. The storage bin feeds a counter-current fluidised bed air pre-heater. Air from the turbine compressor is fed at 6.8bar and 280°C to be pre-heated to 750°C. The powder is thereafter lifted by bucket elevator to a cold storage bin at 400°C. Powder is fed to the receiver at a fixed and controlled mass flow rate. The layout of the complete solar power plant, including the location of the air Brayton turbine, is illustrated in the figures from the Appendix 1.

2 Objectives of D3.2

The objective of this deliverable is to define the detailed design of the complete solar power plant for the Next CSP project in addition to the deliverable 3.1 that was describing the receiver. The major challenge to be addressed in the over-all design is that of durability under the extreme operating conditions, consisting of a feed powder temperature in the range 400-850 °C.

3 Summary of description and operating conditions

Summary:

The solar power plant consists of 6 zones: Dispenser, Receiver, Hot Storage, Turbine air preheater, Bucket Elevator and Cold Storage.

Materials proposed for the plant are: refractory stainless steel. Concern regarding dilatation with temperature is stated.

The particle mass flowrate through the solar plant is to be 6.8kg/s.

The particle temperature upon entering the dispenser is to be 400°C, exiting at 850°C maximum.

The thermal heat rate to the particles is to be taken as 3.3MW.

Consideration is to be given to the restraint and support of the solar plant components in order to tolerate the significant thermal dilatation.

Air tightness of alll equipment is to be maintained while allowing for thermal dilatation.