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PTTL – A life-size test loop for parabolic trough collectors

J. León[a]*, J. Clavero[a], L. Valenzuela[a], E. Zarza[a], G. García[a]

a CIEMAT - Plataforma Solar de Almería, Carretera de Senés, km 4, E04200 Tabernas, Spain

Abstract

The Plataforma Solar de Almería (PSA), belonging to the Spanish Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), built in 1996 a parabolic trough test loop for testing a 50m long LS-3 collector under different operating conditions. After finishing the test campaign, the test loop continued its operation up to date. During the last fifteen years it was enlarged several times holding up to three different collectors connected in parallel. Along that time, it has been operating for testing 75m long half collectors prototypes as well as individual modules and the main components that conform a real loop, i.e. absorber tubes, mirrors, support structures, mobile connections or sun-tracking systems. Due to the technology development, the technical requirements and the increasing number of manufacturers, the test loop reached its maximum capacity. As a consequence it was decided to build a new test facility able to handle four complete collectors of commonly used dimensions, i.e. length of 150 m, or even bigger in an East – West oriented field as well as up to four real size collectors loops, as they are in a conventional power plant, in a second field North – South oriented. Both fields will be connected to a Balance Of Plant (BOP) where two independent pumping and cooling systems will feed the respective fields.

A collaboration agreement named SolarNOVA was signed between the Spanish Administration and CIEMAT (Contract No. ICT-CEPU2009-0002) and, under its umbrella and the European Union FEDER program, some funds were devoted to the present project, called Parabolic Trough Test loop (PTTL).

Earthworks and land preparations started early this year while the procurement already started in 2012. Since the mechanical works will start by the end of May it is expected that at the Conference time the BOP erection must be very advanced. The mounting end is foreseen by December 2013.

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Keywords: Parabolic Trough Collector; qualification, testing, Balance Of Plant

* Corresponding author. Tel.: +34 950 387937; fax: +34 950 365015.
E-mail address: javier.leon@psa.es

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1. Introduction

The fast development that happened during the last years in the transition from experimental and demonstration solar plants to the implantation of commercial solar power plants connected to the grid, presented the real problems of components mass production and the construction of huge solar fields in the range of 300000 m^2 to more than 510000 m^2 for 50 MWe plants, depending on the thermal energy storage existence or not, or 2200000 m^2 for 250 MWe size plant. Such sizes imply a considerable amount of parabolic-trough collectors loops per field, each of them formed for, at least, four collectors. Considering the collector parts, i.e. reflectors, heat collecting elements, interconnections, structures, driving mechanisms and other parts, it is clear that there is a necessity of raising the innovation in every component which forms part of the solar collector field. All those new components need to be checked prior to their installation in a commercial plant without having the risk of failures or lower efficiencies. Always with the main goal of increasing the efficiency and reducing the cost either in the components themselves or in the way they are mounted on-site, the PSA has several laboratories and test facilities devoted to test them [1]. Due to the huge experience gained along the years in the already existing installations assessing parabolic-trough collectors and their components, many international companies and institutions showed a growing interest in the last years. As consequence the Spanish Government supported the erection of a new test facility able to stand the new existing collectors either as independent units or forming complete loops as currently mounted in the different solar power plants.

2. Background

Since 1996 the so called HTF test loop (see Fig. 1) has been in operation up to date for testing parabolic-trough collectors as a whole as well as their own and associated components. At that time the test facility had only one 50 m long Solel LS-3 collector which was very useful to handle all related items associated to it from the mounting procedure to the new control installed. A half collector was developed and installed later, the first EuroTrough prototype followed, as an extension, by a second improved prototype [2]. Additional collectors were installed later either as individual modules adapted to the existing collectors as SenerTrough [3] or with a new half collector as AlbiasaTrough. The lack of ground obliged us to replace the former LS-3 collector by a new one named UrssaTrough.

Fig. 1. General view of HTF test facility at the PSA

The PSA HTF test stand consists of a closed loop in which a pump makes a silicon oil, DOW Syltherm 800, to flow through the system while it is heated and cooled; the gained energy is rejected to the atmosphere in an air-cooled heat exchanger, keeping constant the main operation parameters all along the test duration. The increasing oil