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How deployment ready is CST supercritical CO_2 power generation technology

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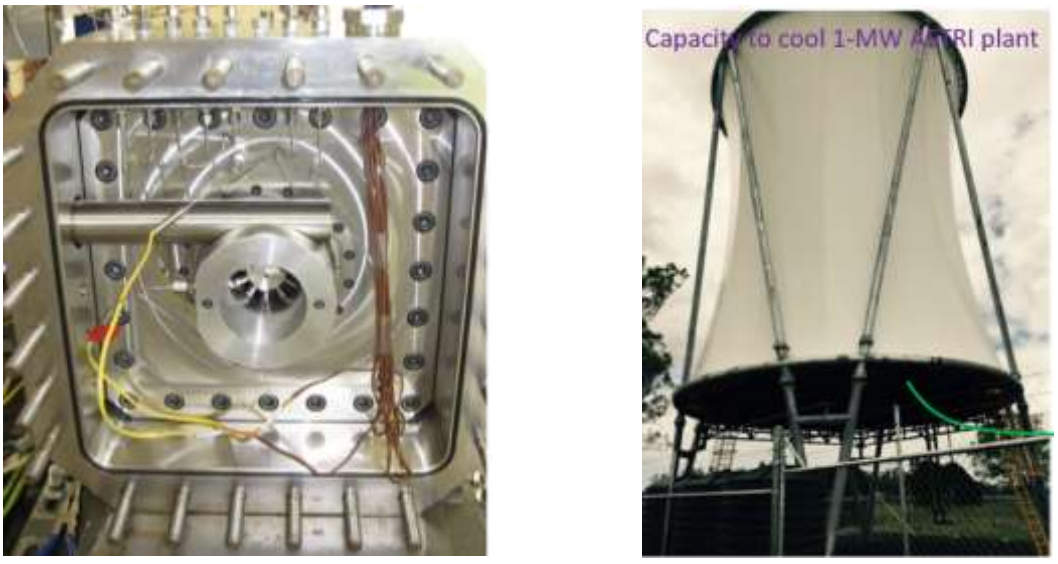
Solar power towers using supercritical CO_2 Brayton cycles were proposed as the next-generation Concentrating Solar Thermal (CST) technology six years ago by a US Department of Energy(DoE) study[1]. Around the same time, in Australia, we foreshadowed the attraction of the sCO_2 power block technology for Australian remote area power generation[2].

One of the challenges was identified as the power block and the lack of a reliable supercritical CO_2 turbine technology in particular. A number of projects were initiated in USA[3, 4], Korea[5], Australia[6, 7] and China[8] to address this challenge. The Australian Solar Thermal Research Institute (ASTRI)[1] has been working for over five years towards modular scaleable CST using sCO_2 cycles. Significant progress has been achieved over this period: the optimum configuration for a CST plant with a sCO2 power cycle was established[9]; a sCO2 turbine design methodology has been developed and a refrigerant turbine was built to test/validate the methodology[7]; and a fully-instrumented prototype natural draft hybrid cooling tower was built to test efficient and low-maintenance cooling options for 1-30 MWe CST power generators[10, 11].



(a) (b)

Figure 1. ASTRI-built lab-scale refrigerant turbine(a) and natural draft dry cooling tower test rig(b)

[1] http://www.astri.org.au/

While the ASTRI focus is on power block technology with air cooling for small- to medium-scale CST plants, elsewhere in the world the focus has been on technology that will suit utility-scale power plants not necessarily limited to CST.

Where are we now after six years? While there has been substantial advances, there are still significant challenges in materials selection, the turbo-generator components such as bearings and seals, and turbine control and operability. This paper will provide highlights of the sCO_2 Brayton cycle power block technology over the past decade with a particular focus on the Australian context.

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