Concept Design of Modular NDDCT Solutions for the CSG Industry

Research Team: Hugh Russell, Kamel Hooman, Zhiqiang Guan, Yuanshen Lu

School of Mechanical and Mining Engineering, UQ

Opportunity

How can Natural Draft Dry Cooling Tower (NDDCT) technology best deliver value in the context of the CSG industry?

Premise 1) activities related to process gas cooling are currently a significant cost in CSG production – **NDDCTs can reduce Operating Expenses (OPEX)**

Premise 2) Future technology developments in the CSG production chain will increase the reliance on equipment powered by grid power – **NDDCTs can eliminate the need for electric fans and the exposure to electricity prices**

Premise 3) Fan noise from cooling systems restricts plant deployment in some situations – **NDDCTs are silent and can improve deployment flexibility**

Premise 4) Reduced power consumption for cooling will make power available for other uses – **for sites with limited power, the elimination of fans can make power available for for other uses**

Methodology

1) Identify technology applications

2) Concept Design – implement NDDCT design workflow to create a viable concept, including assessment of crosswind performance

3) Numerical modelling

4) Techno-economic Analysis – capital cost estimation, estimation of savings[2], Discounted Payback Period[1,2]

Applications

Application 01 – Low-pressure cooler (46 kWt)

Application 02 - High-pressure compressor station cooler (single stream, 4.6 Mwt)

Application 03 - High-pressure compressor station cooler (multiple streams, 3 MWt)

Concept Design

- rectangular footprint with flat / V-arrangement of heat exchangers **simplifies transport and layout**
- stacks made from **lightweight, flexible membrane material** as demonstrated at UQ Gatton Campus
- porous crosswind barriers limit formation of deleterious vortices in **strong crosswinds**

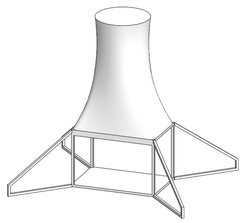

Fig 1) 50 kWt Module

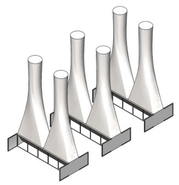

Fig 2) Three 1.5 MWt Modules

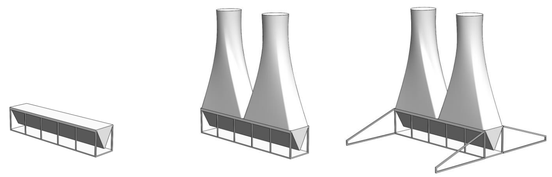

Fig 3) Deployment of 1.5 MWt Module

Results

- Application 01 concept is estimated to have a discounted payback period in excess of **10 years[1,2]**, based on the **cost savings due to elimination of fans ($9,600 annually per site)**
- Application 02 concept is estimated to have a discounted payback period of **8.3 years[1,2]** , based on the **cost savings due to elimination of fans ($195,000 annually per site)**
- Application 02 concept presents an opportunity for the elimination of **32 hours of annual maintenance[3]** related to fans
- All module types are shown to be **resistant to crosswind effects** when barriers are used

Fig 4) Natural Draft Dry Cooling Tower (NDDCT) Test Facility, UQ Gatton

[1]Capital costs estimation based on quotes for one-off supply of major components. It is likely that capital cost would reduce with volume, improving payback period.
[2]Cost savings due to reduced maintenance are not included in DPP calculations, but represent a further opportunity for OPEX savings.
[3]Information provided by Arrow Energy.