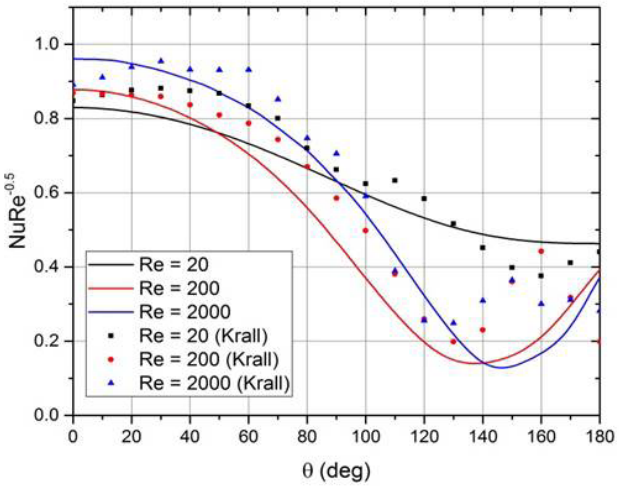
Solar Energy | Water | Environment
Nexus IN NEVADA

Innovative research to achieve water efficient and environmentally friendly solar power

SOLAR ENERGY-WATER-ENVIRONMENT NEXUS PROJECT



Improvements to Dry Cooling Technology

Introduction and goal

Improving dry cooling technology and developing more efficient thermodynamic cycles in solar plants can lead to less water use. Dry cooling for thermal power plants saves considerable water in generating power but degrades plant efficiency. Since dry cooling can ideally result in only small deficits in annual performance compared to wet cooling systems while saving a great deal of water, improvements in current designs can be extremely valuable.

Our goal is to build an advanced dry cooling design that uses forced convection ambient air flowing over finned copper tubes to condense vapor in steam power plants. We estimate that with our advances dry cooling will be nearly as efficient as wet cooling but with no loss of water.

Where does this research fit within the NEXUS project?

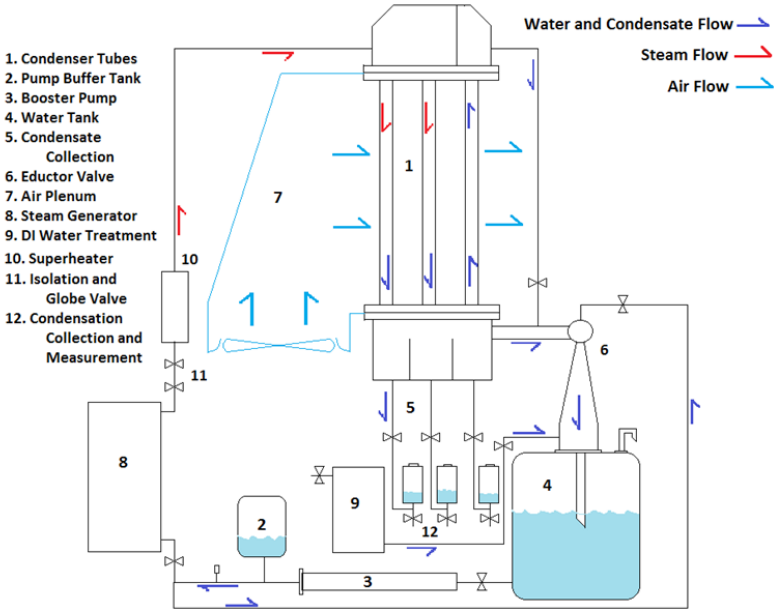
Making efficiency improvements to the solar energy plant and its associated technology as well as developing practices to minimize water use are under Objective 1, Goal 1 and they are at the heart of the NEXUS research. Since wet cooling requires a great deal of water, this development will be extremely valuable for desert research.

Why is this research important and what knowledge gap does it fill?

Development of effective thermal cycles would result directly in less water use and less land area needed for solar development, which would result in less environmental impact and better economics for the system. The research will result in improved solar energy and power generation efficiency, as well as improving the performance of dry cooling systems while saving a great deal water.

What is the originality of the approach?

This is one of the most comprehensive studies of heat transfer in dry cooling that is being carried out, considering a variety of possibilities of improving performance. Application of this new design to new low cost and, separately, high performance, water saving, systems that could lead to a myriad of developments that impact many fields.



How is the new NEXUS equipment being used now and in the future?

It is being used to conduct experiments emulating an air-cooled cycle heat rejection device to understand and improve the performance of dry cooling systems. In the future it will be a good test facility to evaluate possible new potential improvements. The basic system design is a piece of equipment that can be used to evaluate advanced cooling approaches.

Key results to date

We have built the major apparatus and have completed nearly half of the planned experimental evaluations. The development of key computer analysis codes is allowing us to increase our understanding of the steam condensing phenomena both for power cycles as well as other related processes. Modifications to the experimental air-cooled heat exchanger system resulted in an improvement in accumulated condensate in the lower manifold. It was found that complete condensation could be accomplished using a fraction of the original fan power. Mass flow rate measurements demonstrated that heat transfer coefficients were consistent (<2% variation) across multiple tests for identical system parameters.

How is the research and/or equipment fostering collaboration now, and in the future?

Once published we anticipate that other scientists and engineers will build on and extend our work. Plans include attracting power plant cooling companies to add the NEXUS dry cooling developments to their product lines.

Future plans

Future air-cooled condenser research will clearly include evaluation of tubing with a variety of surface treatments. We feel that the air-cooled condenser work taking place in the Nexus project investigating a variety of heat transfer surfaces treatments is quite forward looking, and it will set the stage for a variety of improvements in steam condensing systems. The associated computer code development is breaking new ground in the simulation of steam condensing phenomena. We feel that both the experimental techniques as well as the computer simulation techniques will prove to be very valuable in a variety of applications as well as in dry cooing systems.

Contact us

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