

BUILDINGS ENERGY EFFICIENCY CONSORTIUM

U.S. - CHINA CLEAN ENERGY RESEARCH CENTER (CERC-BEE)



Sub Wet Bulb Evaporative Chiller

Laboratory Testing and Demonstration

Western Cooling Efficiency Center, UC Davis

Tsinghua University

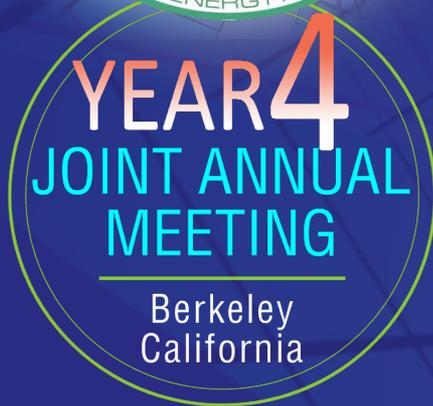
Nexajoule, Inc., LLC

Xinjiang Refreshing Angle Air Environment and
Technology Company

Presented By

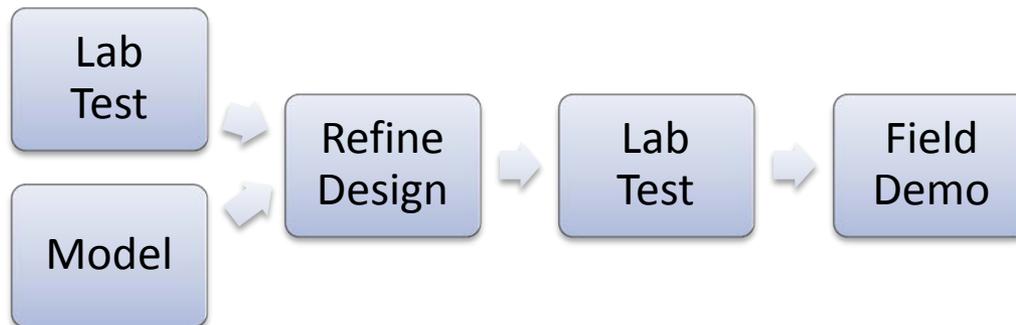
Western Cooling Efficiency Center

08-12-2014



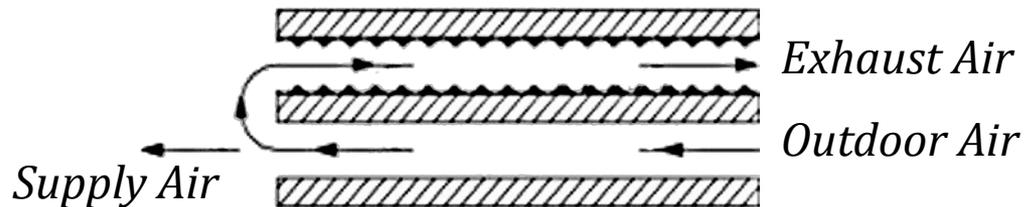
Objective and Milestones

- Objective
 - To further sub wet bulb evaporative chiller technology through laboratory testing, modeling, revision, and demonstration.
- 2014 Milestones (Year 1)
 - Complete laboratory testing on two existing chiller designs
 - Develop final chiller design
 - Select field test site
- Project start date May 15, 2014

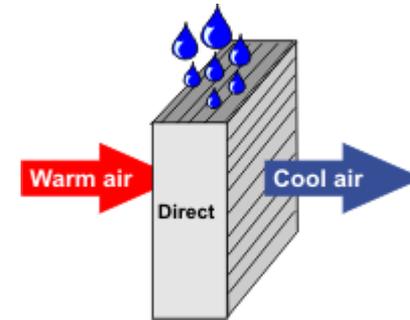


Overview of Sub Wet Bulb Chillers

- Produce chilled water using a combination of *indirect* and *direct* evaporative cooling



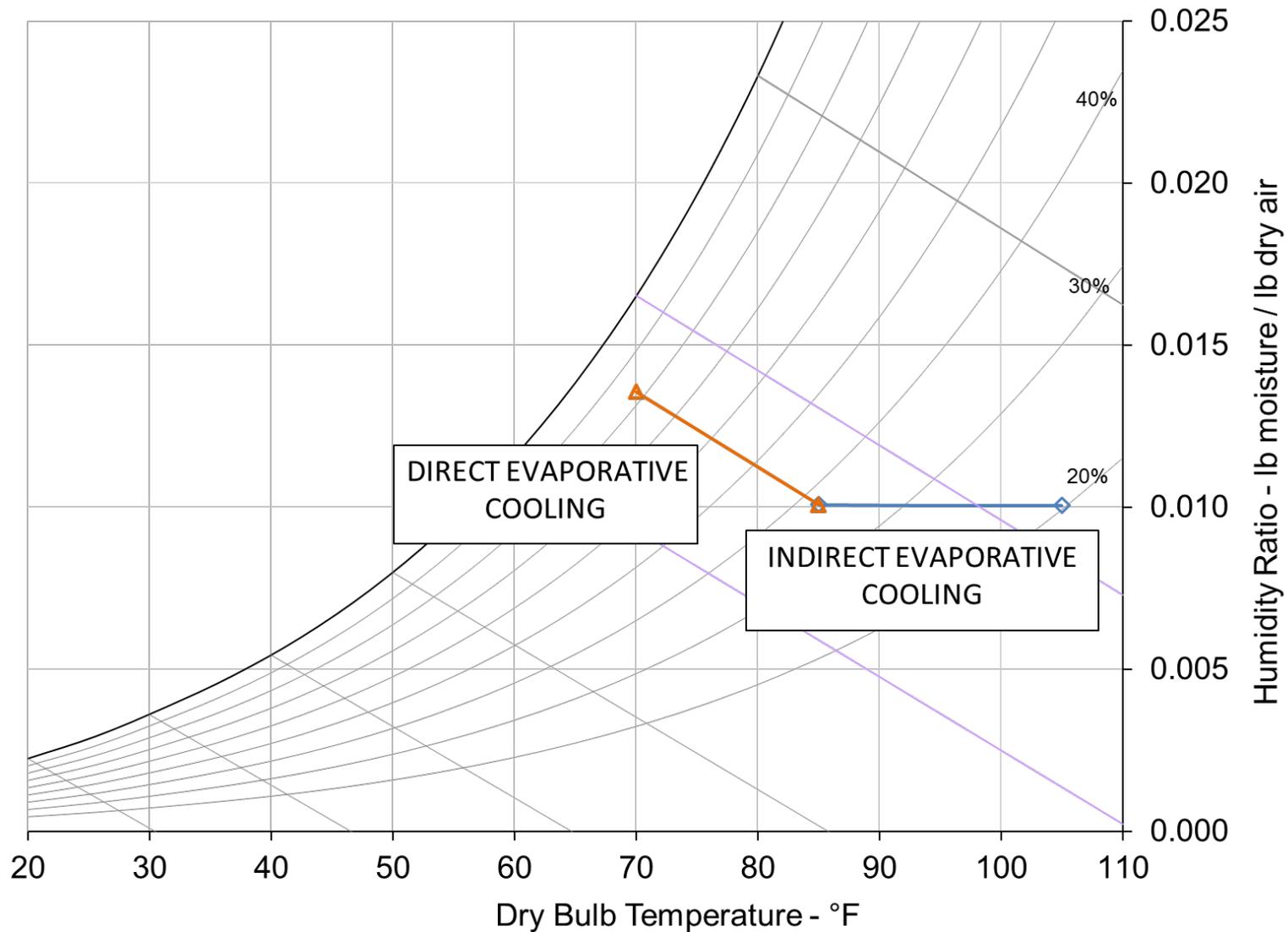
Indirect Evaporative Cooling



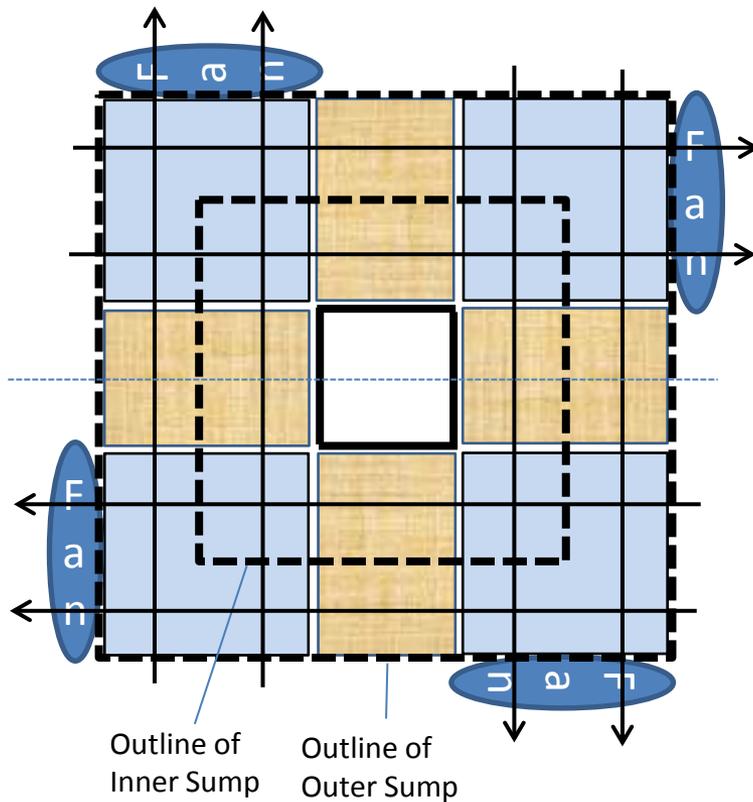
Direct Evaporative Cooling

- Many configurations of indirect evaporative cooling
- Combining indirect and direct evaporative cooling can produce chilled water *below* the wet bulb temperature
- Theoretical limit for chilled water temperature is the dew point
- Use chilled water in building fan coils and radiant cooling systems

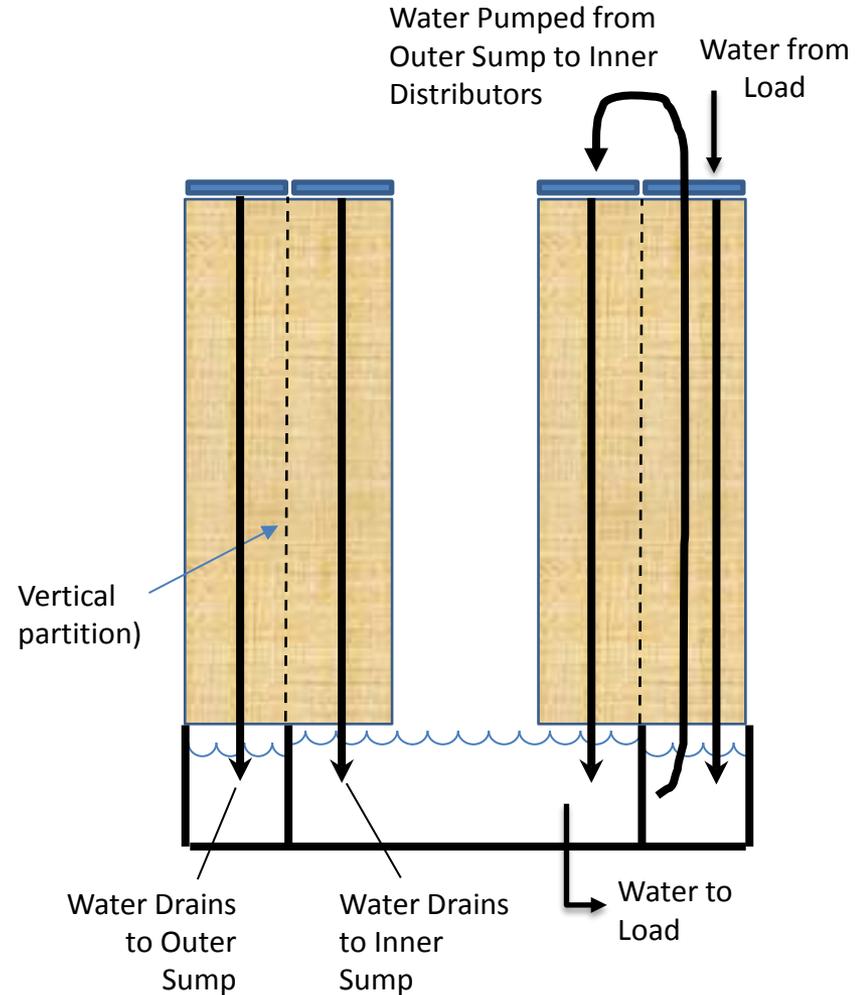
Overview of Sub Wet Bulb Chillers



Chiller Design - Nexajoule



Top View

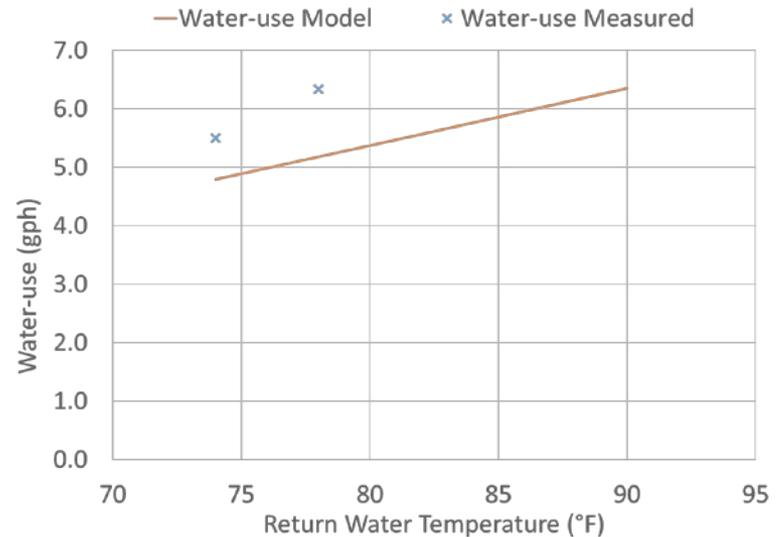
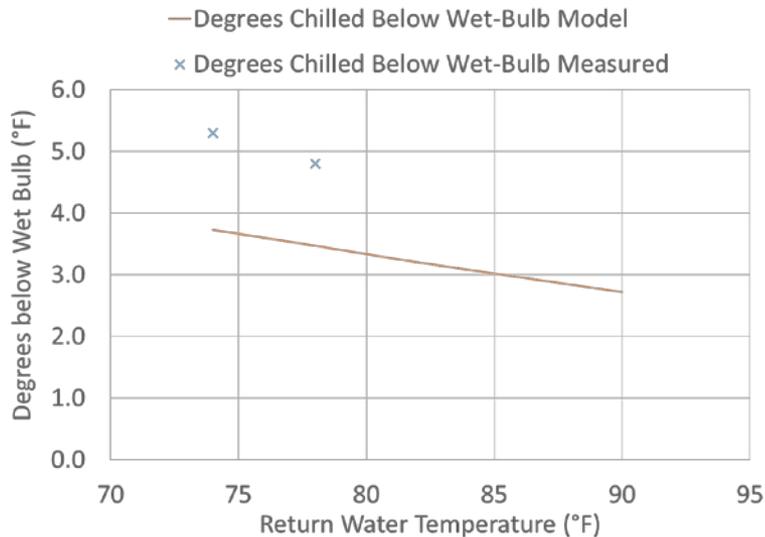
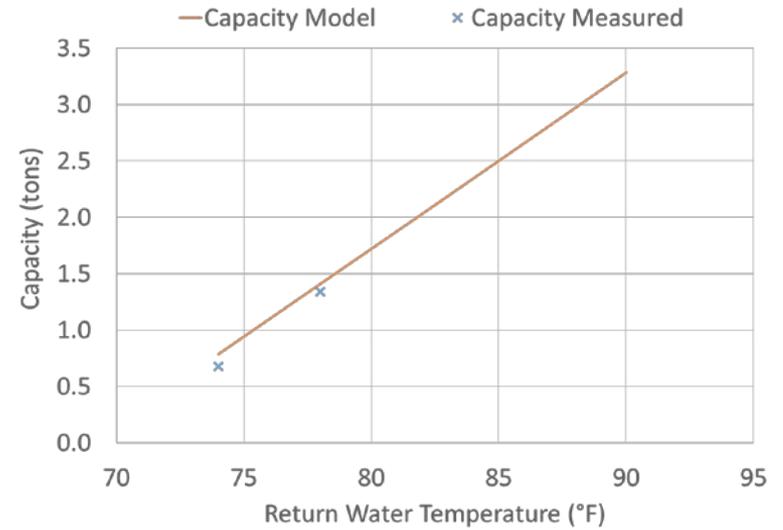
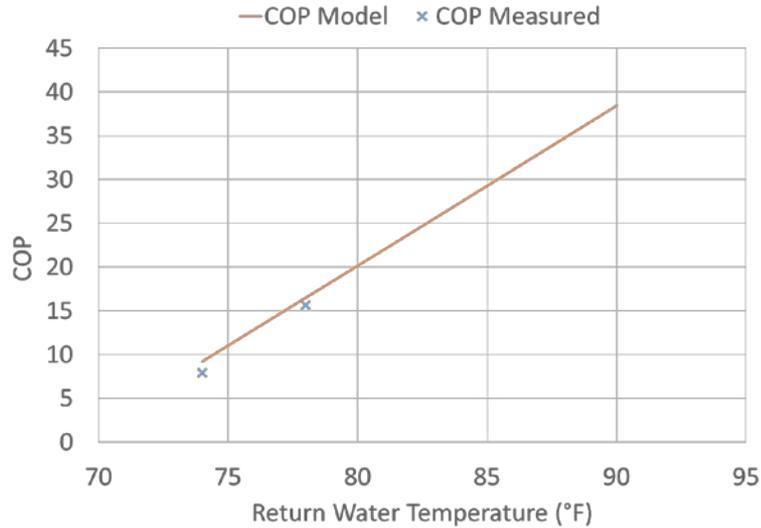


Cross-Sectional Side View

Nexajoule – Testing at WCEC lab

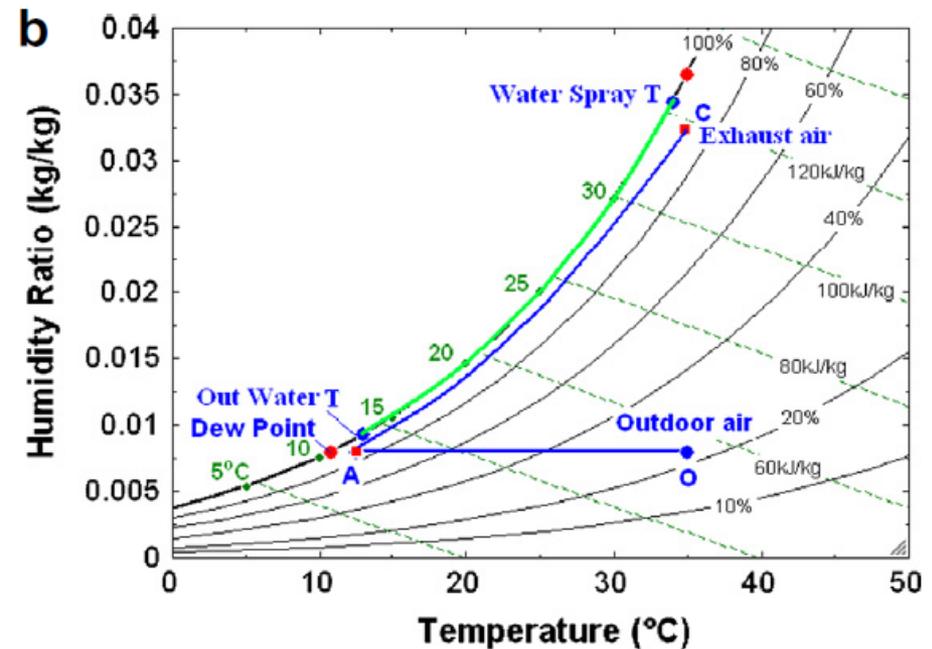
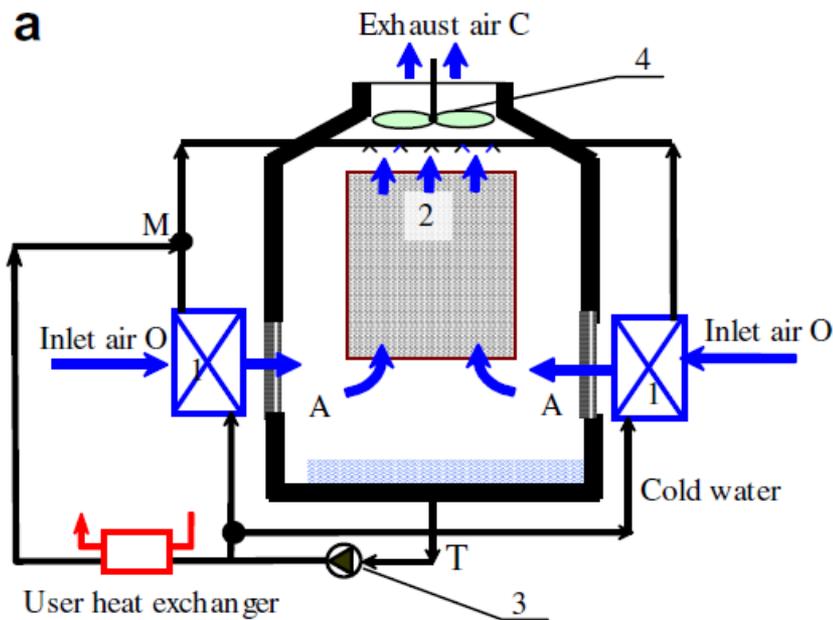


Testing and Modeling of Nexajoule



Chiller Design - Xinjiang

Y. Jiang, X. Xie / Solar Energy 84 (2010) 2041–2055



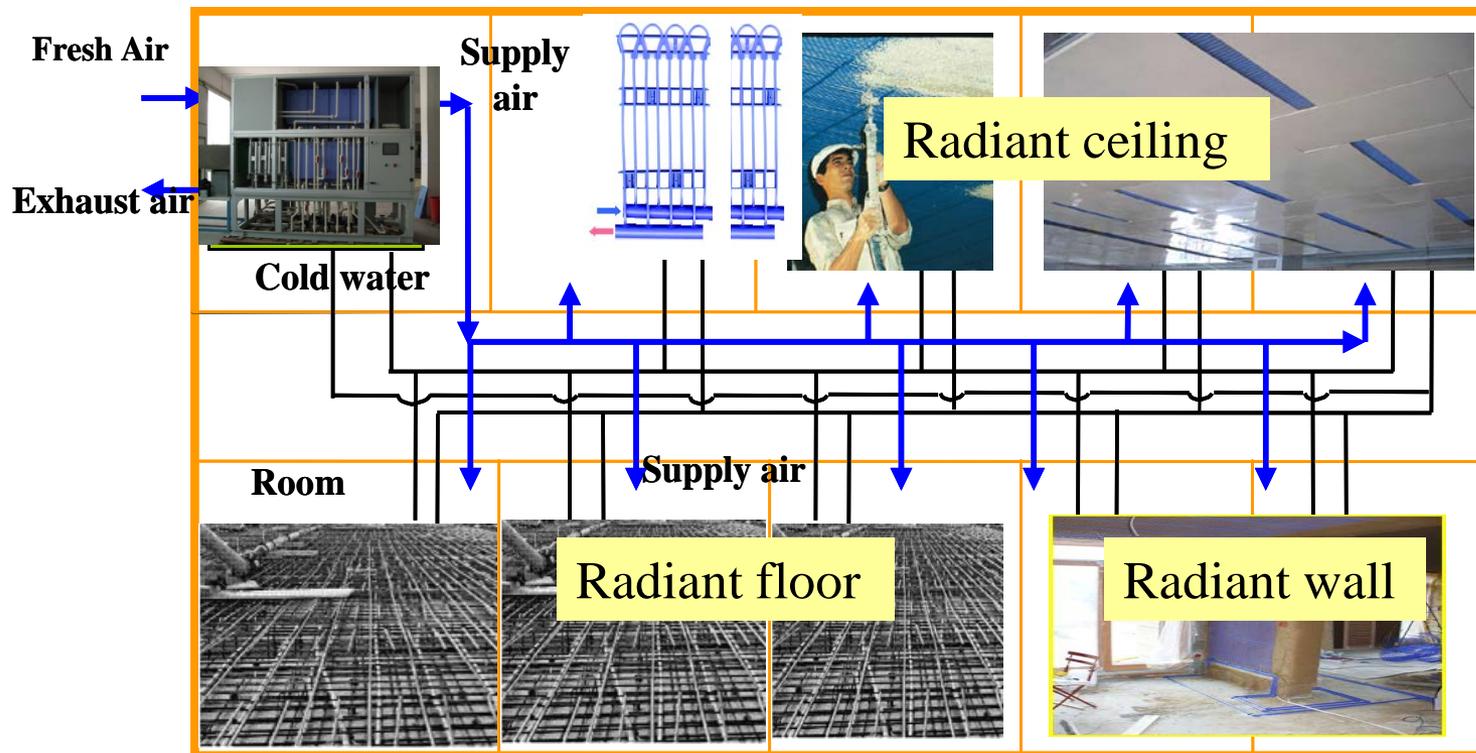
Xinjiang - Applications in China

- Manufacturer is the largest company in China to produce indirect evaporative cooling devices.
- Application building area is now over 200,000m² in west China. The location of the manufacture is in Xinjiang province.



Plan of the demo in the USA

- Produce one indirect evaporative water and air cooling device for about 200~300m² building, and ship it into the USA.
- Install the chiller in the demo building, install the terminals such as radiant floor. System commissioning and testing.



Milestones

- Unspent Year 4 Funds – 97% (late contract execution)

Task	Progress	Schedule	Issues/Risks	Abatement
Lab characterization of two chillers with published results	Nexajoule tested Xinjiang planned	12-2014	Xinjiang Chiller design height is taller than laboratory test chamber	Manufacture custom model, locate alternate test facility, skip lab test (field test only)
Improved cooler re-design	Model of Nexajoule built, Xinjiang existing	10-2014	Design changes may be difficult to implement	Quantify impacts of potential design changes
File one invention disclosure	None	NA	Improvements may not be intellectual property, this may not be needed	
Secure industrial partner	Xinjiang (exists) Nexajoule prototype only	12-2014	Technology is not typical for US buildings	WCEC to work with manufacturing partners/utilities

Project Continuation - 2015

- Demonstrate technology in field test
 - Option 1 – Residential radiant cooling application (retrofit chiller only)
 - Option 2 – Radiant cooling application at UC Davis (retrofit chiller only)
 - Option 3 – Install chiller and radiant system in new demonstration location
 - Option 4 – Replace small RTU on commercial building with chiller and fan coil.
- Outcomes
 - Document long term performance in actual climate conditions and study equipment longevity.
 - Measure before and after energy consumption and performance in demonstration building.
 - Further validate and refine model built from laboratory testing.

Project Continuation - 2015

- **Project Budget**
 - CERC \$50,000
 - Southern California Edison \$100,000 (through 03/2015)
 - Tsinghua/Nexajoule (chiller donation)