Advanced Research In Dry cooling – ARID

PROJECT DESCRIPTIONS

Advanced Cooling Technologies, Inc. – Lancaster, PA

Heat-Pipe PCM Based Cool Storage for Air-Cooled Systems- $3,202,009

Advanced Cooling Technologies, Inc. (ACT), University of Missouri, Lehigh University, and Evapco, Inc. will develop a novel storage system that collects and stores heat rejected from a power plant condenser during the day until the heat waste can be more efficiently rejected during the night at lower ambient temperatures. This technology will utilize an array of heat pipes to transfer heat to the thermal storage unit, and will incorporate self (flow-induced) agitated fins to increase air-side heat transfer by 230%. The team will also tailor the thermal properties of the thermal storage media, which will allow the system to be optimized for use in climates with different daytime and nighttime temperatures.

Applied Research Associates, Inc. – Panama City, FL

Active Cooling Thermally Induced Vapor-Polymerization Effect (ACTIVE) - $2,224,292

Applied Research Associates, Inc. (ARA) will develop a dry cooling system that overcomes the inherent thermodynamic performance penalty of air-cooled systems, particularly under high ambient temperatures. ARA's ACTIVE cooling technology will use a depolymerization thermochemical cycle to provide supplemental cooling and cool energy storage that can work as a standalone system or be synchronized with air-cooled units in order to cool below the ambient dry bulb temperature. This technology will provide power plant condensers with return water at necessary temperature levels to maintain power production thermal efficiencies at their optimum levels.

Colorado State University – Fort Collins, CO

Ultra-Efficient Turbo-Compression Cooling - $1,914,401

Colorado State University (CSU) will develop a waste heat driven cooling system with team members Barber-Nichols and Modine, which utilizes an ultra-efficient turbo-compressor powered by exhaust flue gas. The high speed turbo-compressor cooling system will enable dry power plant cooling in regions where water resources are severely limited, and allow highly efficient cooling both day and night.

Electric Power Research Institute, Inc. – Palo Alto, CA

Indirect Dry Cooling Using Recirculating Encapsulated Phase-Change Materials - $3,000,000

The Electric Power Research Institute, Inc. (EPRI) and its partners – Drexel University, University of Memphis, Evapco, WorleyParsons, and Maulbetsch Consulting - will develop, manufacture, and demonstrate a cost-effective, 50 kW indirect dry cooling system that utilizes a recirculating mesh heat exchanger with encapsulated phase-change materials (EPCMs). By continuously circulating the EPCM meshes between the air and water sides, EPRI's innovation will create a short-duration thermal storage system that effectively rejects heat at the PCM melting temperature. The proposed design is compact, can be optimized for various geographic and weather conditions, and can be integrated into existing power plants through relatively cost-effective retrofitting options.

These projects have been selected for negotiation of awards; final award amounts may vary. Last updated: 5/13/2015

General Electric Company – GE Global Research – Niskayuna, NY

A Low-Cost Heat Pump with Advanced Refrigerant/Absorbent Separation - $1,100,000

General Electric Company (GE) and its partners will develop and design a low-cost, high performance absorption heat pump enabling supplemental dry cooling for a combined cycle power plant. The proposed heat pump has two key innovations: a new absorbent enabled regenerator that directly separates liquid water refrigerant from a novel liquid absorbent and a tubeless evaporator that directly evaporates a portion of the cooling water through flash atomization. The integration of these two innovations will result in a heat pump system with enhanced performance at a regeneration temperature of 80^{o}C and a system cost of less than $150 per kilowatt of thermal power.

PARC, a Xerox Company – Palo Alto, CA

Metamaterials-Enhanced Passive Radiative Cooling Panels - $1,000,000

PARC will develop a scalable, low-cost passive radiative cooling structure that can eliminate power plant water consumption while increasing the efficiency by providing supplementary cooling below ambient temperature. PARC's cooling technology utilizes modules with a two-layer structure of a reflective film atop an ultra-black metamaterial-based emitter. This low-cost structure, which would sit atop water channels, can reflect solar light while simultaneously dissipating heat to the atmosphere and cooling water below ambient temperatures, even in broad daylight.

SRI International – Menlo Park, CA

Spectrally-Tuned All-Polymer Technology for Inducing Cooling (STATIC) Radiative Cooling for Cold Storage - $674,852

SRI International will adapt its proprietary spectrally tuned polymer technology for radiative cooling during daytime and nighttime. The polymer structure will cover power plant condenser discharge water and will thus provide cooling while preventing evaporation. The technology is designed to reflect solar energy while allowing the thermal energy in the discharge water to radiate to the cold sky. SRI will produce its STATIC cover using low-cost, scalable processing technologies.

Stony Brook University – Stony Brook, NY

Condensing Flue Gas Water Vapor for Cool Storage - $2,500,000

Stony Brook University will develop a thermosyphon system that condenses water vapor from power plant flue gas by using highly efficient phase-change heat transfer. Heat is rejected to the ambient using an innovative air-cooled polymer heat exchanger with high thermal conductivity. The polymer construction will diminish corrosion effects from the flue gas. The resulting condensate can be stored and used for subsequent evaporative cooling when the ambient temperature exceeds acceptable operating limits.

TDA Research, Inc. – Wheat Ridge, CO

Novel Desiccant Cycle for Flue Gas Water Recovery and Cool Storage- $1,717,995

TDA Research, Inc. (TDA) and its partners will develop a novel direct contact condensation and liquid desiccant system for extracting 64% of the water vapor from natural gas combined cycle (NGCC) power plant flue gas. This water can be used to provide supplemental evaporative cooling to improve the efficiency of power plants that otherwise use dry cooling. The process has been specifically designed to allow the use of low-cost materials of construction, which greatly reduces the capital cost and improves the economic viability.

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University of Cincinnati – Cincinnati, OH

Enhanced Air-Cooling System with Optimized Asynchronously Cooled Thermal Energy Storage - $3,425,448

The University of Cincinnati will develop a dry-cooling system that includes two primary components: an ultra-enhanced air-cooled condenser (ACC), and a novel daytime peak-load shifting system that utilizes thermal energy storage (TES). The ultra-enhanced ACC will use a novel swirl-producing and boundary-layer disrupting surface on the air-side that substantially increases the heat transfer coefficients. The ACC is coupled to the daytime peak-load shifting system (PLSS), which reduces the ambient air inlet temperature for air cooling. The PLSS consists of a highly compact, low-cost air pre-cooler that transfers the heat load to a TES system. The TES system will utilize phase change materials that operate over a range of temperatures, and the system will recharge at night by an asynchronous air-cooled enhanced heat exchanger.

University of Colorado at Boulder – Boulder, CO

Radiative Cooled-Cold Storage Modules and Systems (RadiCold) - $2,998,642

The University of Colorado at Boulder will develop radiative cool storage modules and a system called RadiCold to enable efficient, low-cost supplementary cooling for power plants. A metal-coated micro-structured thermoplastic polymethylpentene (TPX) surface reflects sunlight and allows radiative cooling for both day- and night-time operation. A passive, single-phase thermosyphon will collect cool water in a local storage unit beneath the RadiCold surface, and a low power-consumption pipe network will collect the cool water from local storage modules into a central storage system. Roll-to-roll manufacturing technology for the micro-structured TPX thin film will enable effective radiative cooling at a low cost.

University of Maryland – College Park, MD

Novel Microemulsion Absorption Systems for Supplemental Power Plant Cooling - $3,039,310

The University of Maryland (UMD) and its partners will utilize a novel microemulsion liquid absorbent, recently invented by researchers at UMD, for use in absorption cooling systems for power plants. These microemulsion absorbents can absorb water vapor (refrigerant), and release the water as liquid during desorption, thus achieving a high coefficient of performance. Waste heat from the power plant flue gas will drive the microemulsion cooling system to provide supplemental cooling below the ambient temperature.

University of Maryland – College Park, MD

Novel Polymer Composite Heat Exchanger for Dry Cooling of Power Plants - $1,993,425

The University of Maryland (UMD) and its partners will develop novel polymer composite heat exchangers for indirect air cooling of power plants that are superior to state-of-the-art metallic heat exchangers in terms of cost, performance, lifetime, and corrosion resistance. The heat exchangers will utilize a UMD proprietary technology in which a low-cost, high-conductivity medium (e.g. aluminum) is encapsulated in a polymeric material with high durability, low cost, and high resistance to corrosion (e.g. polypropylene). Further, onsite production of the developed heat exchangers will be possible via additive manufacturing (3-D printing), allowing for low-cost production and assembly.

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University of Wisconsin – Madison, WI

Optimized Air-Side Heat Transfer Surfaces Via Advanced Additive Manufacturing- $1,162,054

The University of Wisconsin and Oak Ridge National Laboratory will develop advanced high thermal conductivity polymer air-cooled heat exchangers with enhanced air-side heat transfer. The team will develop a cost-effective, polymer composite material that is suitable for the Fused Layer Modeling (FLM) additive manufacturing (3-D printing) technique. The optimization of the heat transfer surface structures and the overall design will be achieved by combining dimensional analysis, computational fluid dynamics (CFD), and topology optimization with the design freedom enabled by FLM, leading to a substantial improvement in the heat transfer coefficient.