FY21 CROSSCUTTING (WATER MANAGEMENT) PEER REVIEW OVERVIEW REPORT

April 2, 2021

U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

DISCLAIMER

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INTRODUCTION AND BACKGROUND

The Water Management Program within the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Crosscutting Research Portfolio aims to reduce the amount of freshwater used by fossil-fueled power plants and minimize the potential impacts of plant operations on water quality. The vision for this program is to develop a 21st-century America that can count on the nation's abundant, sustainable fossil energy and water resources to achieve the flexibility, efficiency, reliability, and environmental quality essential to continued economic health and national security. Thermoelectric power generation accounts for more than 40% of freshwater withdrawals (i.e., 143 billion gallons of water per day) and more than 3% of freshwater consumption (i.e., 4 billion gallons per day) in the United States. As the cost associated with water consumption increases, so will the need for water treatment, recovery, and reuse.

The Crosscutting (Water Management) Program addresses the competing needs for water consumption through research in three dynamic platforms:

- Increasing Water Efficiency and Reuse—There is an inextricable link between water and energy; it is increasingly important to use water effectively throughout the power generation sector. This area aims to advance concepts for both new and existing plants to minimize water intake and use. Examining plant cycles and testing new efficient processes can not only reduce water intake, but also lower overall operating costs.
- Treatment of Alternative Sources of Water—Identifying and treating alternative sources of water, such as brackish and effluent streams, offers opportunities for scientists to address energy-water system challenges. This area focuses on furthering technology to utilize alternative water resources that span multiple facets of research and development (R&D), including consideration of capital costs, operating costs, and system integration.
- Energy Water Analysis—The complex relationship between energy and water is constantly developing. The multiple components that impact the system can be modeled and analyzed to better inform decision-makers and scientists alike. This area helps prioritize research objectives through analyses of water-energy system behavior.

Office of Management and Budget and U.S. Department of Energy Requirements

In compliance with requirements from the Office of Management and Budget and in accordance with the DOE Strategic Plan, DOE and NETL are fully committed to improving the quality of research projects in their programs by conducting rigorous peer reviews. DOE and NETL conducted a Fiscal Year 2021 (FY21) Crosscutting (Water Management) Peer Review Meeting with independent technical experts to offer recommendations to strengthen projects during the period of performance and assess the projects' Technology Readiness Level (TRL) progression. KeyLogic, an NETL site-support contractor, convened a panel of four academic and industry experts[*] on March 9-12, 2021, to conduct a peer review of four Crosscutting (Water Management) Program research projects.

[*] Please see "Appendix D: Peer Review Panel Members" for detailed panel member biographies.

TABLE 1. CROSSCUTTING (WATER MANAGEMENT) PEER REVIEW – PROJECTS REVIEWED

Project Number	Title	Lead Organization	Total Funding		Project Duration	
			DOE	Cost Share	From	To
FE0031810	Wastewater Recycling Using a Hygroscopic Cooling System	Energy and Environmental Research Center (EERC)	$655,675	$165,000	10/1/2019	9/30/2022
FE0031886	Improvement of Coal Power Plant Dry Cooling Technology Through Application of Cold Thermal Energy Storage	University of North Carolina Charlotte	$1,453,179	$363,484	7/1/2020	6/30/2023
FE0031828	Water Recovery from Cooling Tower Plumes	Infinite Cooling, Inc.	$1,500,000	$375,000	10/1/2019	9/30/2022
FE0031833	Enhanced Cooling Tower Technology for Power Plant Efficiency Increase and Operating Flexibility	Gas Technology Institute (GTI)	$1,230,043	$307,755	10/1/2019	9/30/2022
Peer Review Evaluation: During TRL-based evaluations, the independent panel offers recommendations and assesses the projects' technology readiness for work at the current TRL and the planned work to attain the next TRL.			$4,838,897	$1,211,239		
			$6,050,136			

OVERVIEW OF THE PEER REVIEW PROCESS

Peer reviews are conducted to help ensure that the Office of Fossil Energy's (FE) research program, implemented by NETL, is in compliance with requirements from the Office of Management and Budget and in accordance with the DOE Strategic Plan and DOE guidance. Peer reviews improve the overall quality of the technical aspects of R&D activities, as well as overall project-related activities, such as utilization of resources, project and financial management, and commercialization.

KeyLogic convened a panel of four academic and industry experts to conduct a peer review of four research projects supported by the Crosscutting (Water Management) Program. Throughout the peer review meeting, these recognized technical experts offered recommendations to strengthen the projects during the remaining period of performance and provided feedback on the projects' technology readiness for work at the current TRL and the planned work to attain the next TRL. KeyLogic selected an independent Peer Review Panel, facilitated the peer review meeting, and prepared this report to summarize the results.

Pre-Meeting Preparation

Before the peer review, each project team submitted a Project Technical Summary (PTS), project presentation, and a Technology Maturation Plan (TMP) to facilitate TRL evaluation. The Federal Project Manager (FPM) provided the Project Management Plan (PMP), the latest quarterly report, and supplemental technical papers as additional resources for the panel. The panel received these materials prior to the peer review meeting, which enabled the panel members to fully prepare for the meeting with the necessary background information to thoroughly evaluate the projects.

To increase the efficiency of the peer review meeting, multiple pre-meeting orientation teleconference calls were held with NETL, the Peer Review Panel, and KeyLogic staff to review the peer review process and procedures, evaluation criteria, and project documentation, as well as to allow for the Technology Manager to provide an overview of the program goals and objectives.

Peer Review Meeting Proceedings

At the meeting, each project performer gave a presentation discussing all aspects of the project. The presentation was followed by a question-and-answer session with the panel and a closed panel discussion and evaluation. The time allotted for the presentation, the question-and-answer session, and the closed panel discussion was dependent on the project's complexity, duration, and breadth of scope.

During the closed sessions of the peer review meeting, the panel discussed each project to identify strengths, weaknesses, and recommendations in accordance with the Peer Review Evaluation Criteria. The panel offered a series of prioritized recommendations to strengthen the projects during the remaining period of performance and offered an evaluation of TRL progression.

SUMMARY OF KEY FINDINGS

This section summarizes the overall key findings of the projects evaluated at the FY21 Crosscutting (Water Management) Peer Review Meeting. The panel concluded that the peer review provided an excellent opportunity to comment on the relative strengths and weaknesses of each project. The presentations and question-and-answer sessions provided additional clarity to complement the pre-meeting documentation. The peer review also provided an insight into the range of technology development and the relative progress that has been made by the project teams. The technical discussion enabled the panel to contribute to each project's development by identifying core issues and by making constructive, actionable recommendations to improve project outcomes. The panel generated 26 recommendations for NETL management to review and consider.

The panel indicated that the projects are researching technologies that have the potential for commercial impact. The teams are employing unique, innovative, and creative means for achieving their respective project goals and objectives. The panel noted that the projects are aligned with DOE's near- and/or long-term goals and have sufficient resources (e.g., budget, personnel, facilities) to execute the work scope.

The panel expects that the project teams will continue to face challenges with their technologies, with some projects demonstrating more progress than the others (based on the information shared during the peer review). Despite the challenges, the panel stated that these projects have strong teams that can troubleshoot issues and/or problems as they arise. The panel expressed concern that each project revealed a lack of consideration and/or evaluation of markets and commercialization (e.g., how fast can the technology penetrate the marketplace?). Specifically, the panel was expecting that the project teams would have given more consideration to their intended markets and subsequently direct/tailor their commercialization plan to those markets. Finally, the panel offered that the projects used different values for the cost of water and the cost of power, which made it challenging to evaluate. It was suggested that DOE and NETL establish a standard or baseline for consistent numbers and metrics for projects to include in their analyses (the projects could also use their own numbers and metrics as well, because the panel acknowledged that prices and data differ across the United States).

Evaluation of Technology Readiness Level Progression

At the meeting, the panel assessed the projects' readiness to start work towards the next TRL based on a project's strengths, weaknesses, recommendations, issues, and concerns. For the various projects subject to review, the panel found that the projects were on track to attaining their respective planned end-of-project TRL based on achievement of the project goals as planned and addressing the panel recommendations.

- Project FE0031810 has attained TRL 4. Upon completing the model for optimal system design, validating materials of construction, and selecting a solid separation device, Project FE0031810 will attain TRL 5. Upon verifying effluent limitation guidelines (ELG) compliance using the pilot system, Project FE0031810 will attain TRL 6.
- Project FE0031886 has attained TRL 3. Upon finalizing the orientation/shape configurations of the modules and selecting and integrating materials, Project FE0031886

will attain TRL 4. Upon completing laboratory testing and lifecycle and cost analysis, Project FE0031886 will attain TRL 5.

- Project FE0031828 has attained TRL 4. Upon testing the shroud, winter operations, different scale water chemistry, and corrosion, and incorporating these findings into the design, Project FE0031828 will attain TRL 5.
- Project FE0031833 has attained TRL 3. Upon achievement of a finalized and established process approach and design, and the integration of the design components for validation of the design model through data collection, Project FE0031833 will attain TRL 4. Following a determination of the electrical infrastructure size at full-scale and evaluating the impact(s) of the potential range of water chemistry on material selection, Project FE0031833 will attain TRL 5.

PROJECT SYNOPSES

For more information on the Crosscutting (Water Management) Program and project portfolio, please visit the NETL website: https://netl.doe.gov/coal/water-management.

FE0031810

WASTEWATER RECYCLING USING A HYGROSCOPIC COOLING SYSTEM

ENERGY AND ENVIRONMENTAL RESEARCH CENTER

Project Description: The overall objective of this project is to test the feasibility of using the Energy and Environmental Research Center's (EERC) hygroscopic cooling technology to eliminate power plant wastewater by recycling the water fraction to augment the plant's cooling load. Key benefits of this approach are to improve the plant's overall water use efficiency while allowing it to conform with zero-liquid-discharge (ZLD) requirements. To achieve the overall objective of this work, the project will begin with a survey of candidate wastewaters at a partnering power plant followed by laboratory analysis of their properties. Based on that evaluation, a targeted wastewater stream will be identified, and the optimal conditions for using it as makeup for the hygroscopic cooling system will be determined. The project will then transition to the design, fabrication, and testing of a small pilot system for recycling plant wastewater. Results from these activities will inform a summary techno-economic analysis, which will compute cost metrics that can be compared to other approaches for achieving ZLD.

FE0031886

IMPROVEMENT OF COAL POWER PLANT DRY COOLING TECHNOLOGY THROUGH APPLICATION OF COLD THERMAL ENERGY STORAGE

UNIVERSITY OF NORTH CAROLINA CHARLOTTE

Project Description: The proposed air pre-cooling system is focused on the air side of a mechanical draft dry cooling tower/air-cooled condenser (ACC). The system is based on "cold energy" storage, which involves storing low-temperature heat ("cold" thermal energy) during the night when the temperature of the ambient air is low and using it to pre-cool the air entering a dry cooling tower/ACC during the hot period of the day. A pervious concrete (PC) material with embedded, encapsulated phase-change material (PCM) will be fabricated, tested with air flow by an induced draft (ID) or forced draft (FD) fan, and integrated into a direct contact heat exchanger. The combined system is referred to as the Cold Thermal Energy Storage System (CTESS). The CTESS heat storage modules will be designed by considering trade-offs between air pressure drop and heat storage capacity. The PC mix designs without PCM will be developed to optimize porosity, thermal conductivity, and specific heat while meeting mechanical requirements of compressive and tensile strength and stiffness. The PC mixes will be fabricated and examined at the Advanced Technology for Large Structural Systems (ATLSS) Research Center at Lehigh University. After the baseline PC characterization, PCM will be characterized and three techniques will be examined for integrating this material into the PC matrix: micro-encapsulation, macro-encapsulation, and containment in embedded pipes.

FE0031828

WATER RECOVERY FROM COOLING TOWER PLUMES

INFINITE COOLING, INC.

Project Description: This project consists of the study of plume formation and collection on mechanical (induced) draft cooling towers, partly in a high-fidelity controlled environment and partly on a full-scale industrial cooling tower. It will start by building the needed laboratory setup and installing various sensors on the lab cooling tower. At the same time, a computational fluid dynamics (CFD) model will be implemented to get precise full-scale plume models. Using the insights into power plant plume characteristics, Infinite Cooling Inc. will iterate on and experimentally test electrodes and collectors, which make up modular panels, on the lab cooling tower. What has been learned from the full-scale plume modeling and sensor data analysis will then be applied to develop a design model to build the optimal collection apparatus for given working conditions of the industrial cooling tower.

FE0031833

ENHANCED COOLING TOWER TECHNOLOGY FOR POWER PLANT EFFICIENCY INCREASE AND OPERATING FLEXIBILITY

GAS TECHNOLOGY INSTITUTE

Project Description: The objective of the project is to develop a technology that enhances flexibility and improves the efficiency of existing recirculating cooling towers by precooling and dehumidifying air prior to entering the cooling tower fill while controlling parameters of the air under cyclic and part-load operation. It is proposed to demonstrate and model a sub-dew-point cooling tower technology (patent pending) that increases coal-fueled power plant efficiency under cyclic and part-load operation. The technology employs an innovative flow arrangement called a pressure dehumidifying system (PDHS) coupled with effective heat and mass transfer so air is cooled and dehumidified prior to entering the cooling tower fill. The air cooling and dehumidification is accomplished by a near-atmospheric pressure regeneration technique and efficient heat exchange components with ultra-low energy requirements. The main components of the PDHS are an air heat exchanger, blower, heat-mass exchanger, and expander. The blower in the system slightly pressurizes the incoming air and increases the air dew point, thus making it easier to remove moisture from the air using the heat-mass exchanger. The expander is used to offset the power consumed by the blower, thus making this an ultra-low energy system. Preheating the ambient air in the heat exchanger by using waste heat from the coal-fired boiler or other heat sources would allow deeper cooling of air and water in the cooling tower.

APPENDIX A: PEER REVIEW EVALUATION CRITERIA

Peer reviews are conducted to ensure that the Office of Fossil Energy's (FE) research program, implemented by the National Energy Technology Laboratory (NETL), is compliant with the U.S. Department of Energy (DOE) Strategic Plan and DOE guidance. Peer reviews improve the overall quality of the technical aspects of research and development (R&D) activities, as well as overall project-related activities, such as utilization of resources, project and financial management, and commercialization.

In the upcoming NETL peer review, a significant amount of information about the projects is covered in a short period. For that reason, NETL has established a set of guidelines for governing the meeting.

The following pages contain the criteria used to evaluate each project. Each criterion is accompanied by multiple characteristics to further define the topic. Each reviewer is expected to independently assess all the provided material for each project prior to the meeting and engage in discussion to generate feedback for each project during the meeting.

NETL Peer Review – Technology Readiness Level-Based Evaluation

At the meeting, the Facilitator leads the Peer Review Panel in assessing a project's readiness to start work towards the next Technology Readiness Level (TRL) based on a project's strengths†, weaknesses‡, recommendations, issues, and concerns.

NETL Peer Review – Recommendations-Based Evaluation

At the meeting, the Facilitator leads the Peer Review Panel in identifying strengths, weaknesses, prioritized recommendations, and overall score for each project. The strengths and weaknesses serve as a basis for the determination of the overall project score in accordance with the Rating Definitions and Scoring Plan.

Under a recommendation-based evaluation, strengths and weaknesses are characterized as either "major" or "minor" during the Review Panel's discussion at the meeting. For example, a weakness that presents a significant threat to the likelihood of achieving the project's stated technical goal(s) and supporting objectives is considered "major," whereas relatively less significant opportunities for improvement are considered "minor."

A recommendation emphasizes an action that is considered by the project team and/or DOE to correct or mitigate the impact of weaknesses, expand upon a project's strengths, or progress along

† A strength is an aspect of the project that, when compared to the evaluation criterion, reflects positively on the probability of successful accomplishment of the project's goal(s) and objectives.

‡ A weakness is an aspect of the project that, when compared to the evaluation criterion, reflects negatively on the probability of successful accomplishment of the project's goal(s) and objectives.

the technology maturation path (TRL-based evaluation). A recommendation has as its basis one or more strengths or weaknesses. Recommendations are ranked from most important to least, based on the major/minor strengths/weaknesses.

NETL Peer Review Evaluation Criteria
1. Degree to which the project, if successful, supports the U.S. Department of Energy (DOE) Program's near- and/or long-term goals.
• Program goals are clearly and accurately stated. • Performance requirements[1] support the program goals. • The intended commercial application is clearly defined. • The technology is ultimately technically and economically viable for the intended commercial application.
2. Degree to which the project demonstrates alignment with a commercially relevant challenge or opportunity.
• The intended commercial application is clearly defined. • The technology value proposition has been validated by potential end-users. • The technology development plan and associated metrics and milestones meaningfully reduce the risk of market adoption. • The technology is ultimately technically and economically viable for the intended commercial application.
3. Degree to which there are sufficient resources to successfully complete the project.
• There is adequate funding, facilities, and equipment. • Project team includes personnel with the needed technical and project management expertise. • The project team is engaged in effective teaming and collaborative efforts, as appropriate.
4. Degree of project plan technical feasibility.
• Technical gaps, barriers, and risks to achieving the performance requirements are clearly identified. • Scientific/engineering approaches have been designed to overcome the identified technical gaps, barriers, and risks to achieve the performance requirements. • Remaining technical work planned is appropriate considering progress to date and remaining schedule and budget. • Appropriate risk mitigation plans exist, including Decision Points when applicable.
5. Degree to which progress has been made towards achieving the stated performance requirements.
• The project has tested (or is testing) those attributes appropriate for the next Technology Readiness Level (TRL). The level of technology integration and nature of the test environment are consistent with the aforementioned TRL definition. • Project progress, with emphasis on experimental results, shows that the technology has, or is likely to, achieve the stated performance requirements for the next TRL (including those pertaining to capital cost, if applicable). • Milestones and reports effectively enable progress to be tracked. • Reasonable progress has been made relative to the established project schedule and budget.
6. Degree to which an appropriate basis exists for the technology's performance attributes and requirements.
• The TRL to be achieved by the end of the project is clearly stated[2]. • Performance attributes for the technology are defined[2]. • Performance requirements for each performance attribute are, to the maximum extent practical, quantitative, clearly defined, and appropriate for and consistent with the DOE goals as well as technical and economic viability in the intended commercial application.
7. The project Technology Maturation Plan (TMP) represents a viable path for technology development beyond the end of the current project, with respect to scope, timeline, and cost.
[1] If it is appropriate for a project to not have cost/economic-related performance requirements, then the project is evaluated on technical performance requirements only. [2] Supported by systems analyses appropriate to the targeted TRL.

NETL Peer Review – Rating Definitions and Scoring Plan

The Review Panel assigns an overall score to the project after strengths, weaknesses, and prioritized recommendations are generated at the meeting. Intermediate whole number scores are acceptable if the Review Panel feels it is appropriate. The overall project score must be justified by, and consistent with, the identified strengths and weaknesses.

NETL Peer Review Rating Definitions and Scoring Plan	
10	**Excellent -** Several major strengths; no major weaknesses; few, if any, minor weaknesses. Strengths are apparent and documented.
8	**Highly Successful -** Some major strengths; few (if any) major weaknesses; few minor weaknesses. Strengths are apparent and documented, and outweigh identified weaknesses.
5	**Adequate -** Strengths and weaknesses are about equal in significance.
2	**Weak -** Some major weaknesses; many minor weaknesses; few (if any) major strengths; few minor strengths. Weaknesses are apparent and documented, and outweigh strengths identified.
0	**Unacceptable -** No major strengths; many major weaknesses. Significant weaknesses/deficiencies exist that are largely insurmountable.

APPENDIX B: DOE TECHNOLOGY READINESS LEVELS

The following is a description of U.S. Department of Energy (DOE) Technology Readiness Levels (TRLs).

Relative Level of Technology Development	Technology Readiness Level	TRL Definition	Description
System Operations	TRL 9	Actual system operated over the full range of expected mission conditions	The technology is in its final form and operated under the full range of operating mission conditions. Examples include using the actual system with the full range of wastes in hot operations.
System Commissioning	TRL 8	Actual system completed and qualified through test and demonstration	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this Technology Readiness Level (TRL) represents the end of true system development. Examples include developmental testing and evaluation of the system with actual waste in hot commissioning. Supporting information includes operational procedures that are virtually complete. An Operational Readiness Review (ORR) has been successfully completed prior to the start of hot testing.
	TRL 7	Full-scale, similar (prototypical) system demonstrated in relevant environment	This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing full-scale prototype in the field with a range of simulants in cold commissioning (1). Supporting information includes results from the full-scale testing and analysis of the differences between the test environment, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.
Technology Demonstration	TRL 6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering-scale prototypical system with a range of simulants (1). Supporting information includes results from the engineering-scale testing and analysis of the differences between the engineering-scale, prototypical system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. TRL 6 begins true engineering development of the technology as an operational system. The major difference between TRL 5 and 6 is the step-up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the operating system. The prototype should be capable of performing all the functions that will be required of the operational system. The operating environment for the testing should closely represent the actual operating environment.

Technology Development	**TRL 5**	Laboratory-scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment with a range of simulants (1) and actual waste (2). Supporting information includes results from the laboratory scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical.
Technology Development	**TRL 4**	Component and/or system validation in laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of ad hoc hardware in a laboratory and testing with a range of simulants and small-scale tests on actual waste (2). Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRL 4–6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system. The laboratory system will probably be a mix of on hand equipment and a few special purpose components that may require special handling, calibration, or alignment to get them to function.

Research to Prove Feasibility	**TRL 3**	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development (R&D) is initiated. This includes analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants (1). Supporting information includes results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. At TRL 3 the work has moved beyond the paper phase to experimental work that verifies that the concept works as expected on simulants. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
	TRL 2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept. The step up from TRL 1 to TRL 2 moves the ideas from pure to applied research. Most of the work is analytical or paper studies with the emphasis on understanding the science better. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work.
Basic Technology Research	**TRL 1**	Basic principles observed and reported	This is the lowest level of technology readiness. Scientific research begins to be translated into applied R&D. Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world. Supporting Information includes published research or other references that identify the principles that underlie the technology.

1 Simulants should match relevant chemical and physical properties.

2 Testing with as wide a range of actual waste as practicable and consistent with waste availability, safety, as low as reasonably achievable (ALARA), cost, and project risk is highly desirable.

APPENDIX C: MEETING AGENDA

FY21 Crosscutting (Water Management) Peer Review
March 9-12, 2021
Virtual Meeting

**** All times Eastern ****

Day 1 – Tuesday, March 9, 2021

12:00 – 12:30 p.m.	Peer Review Panel Kickoff Session *DOE HQ/NETL, KeyLogic Peer Review Support Staff, and Panel Members Attend* - Facilitator Opening, Review Panel Introductions, NETL Welcome, Peer Review Process and Meeting Logistics
12:30 – 1:15 p.m.	Project FE0031810 – Wastewater Recycling Using a Hygroscopic Cooling System *Christopher Martin* – Energy and Environmental Research Center (EERC)
1:15 – 2:00 p.m.	Question-and-Answer Session
2:00 – 2:15 p.m.	BREAK
2:15 – 4:00 p.m.	Closed Discussion (Peer Review Panel Evaluation) *DOE HQ/NETL and KeyLogic Peer Review Support Staff Attend as Observers*
4:00 p.m.	Adjourn

**** All times Eastern ****

Day 2 – Wednesday, March 10, 2021

12:00 – 12:10 p.m.	Kickoff Session
12:10 – 12:55 p.m.	Project FE0031886 – Improvement of Coal Power Plant Dry Cooling Technology Through Application of Cold Thermal Energy Storage *Nenad Sarunac* – University of North Carolina Charlotte
12:55 – 1:40 p.m.	Question-and-Answer Session
1:40 – 2:00 p.m.	BREAK
2:00 – 3:45 p.m.	Closed Discussion (Peer Review Panel Evaluation) *DOE HQ/NETL and KeyLogic Peer Review Support Staff Attend as Observers*
3:45 p.m.	Adjourn

**** All times Eastern ****

Day 3 – Thursday, March 11, 2021

12:00 – 12:10 p.m.	Kickoff Session
12:10 – 12:55 p.m.	Project FE0031828 – Water Recovery from Cooling Tower Plumes *Karim Khalil* – Infinite Cooling, Inc.
12:55 – 1:40 p.m.	Question-and-Answer Session
1:40 – 2:00 p.m.	BREAK
2:00 – 3:45 p.m.	Closed Discussion (Peer Review Panel Evaluation) *DOE HQ/NETL and KeyLogic Peer Review Support Staff Attend as Observers*
3:45 – 4:30 p.m.	Peer Review Panel Discussion *DOE/NETL and KeyLogic Peer Review Staff Attend*
4:30 p.m.	Adjourn

**** All times Eastern ****

Day 4 – Friday, March 12, 2021

12:00 – 12:10 p.m.	Kickoff Session
12:10 – 12:55 p.m.	Project FE0031833 – Enhanced Cooling Tower Technology for Power Plant Efficiency Increase and Operating Flexibility *Yaroslav Chudnovsky* – Gas Technology Institute (GTI)
12:55 – 1:40 p.m.	Question-and-Answer Session
1:40 – 2:00 p.m.	BREAK
2:00 – 3:45 p.m.	Closed Discussion (Peer Review Panel Evaluation) *DOE HQ/NETL and KeyLogic Peer Review Support Staff Attend as Observers*
3:45 – 4:15 p.m.	Peer Review Panel Wrap-Up Session (Common Themes & Logistics/Process Feedback) *DOE HQ/NETL, KeyLogic Peer Review Support Staff, and Panel Members Attend*
4:15 p.m.	Adjourn

APPENDIX D: PEER REVIEW PANEL MEMBERS

FY21 Crosscutting (Water Management) Peer Review
March 9-12, 2021
Virtual Meeting

Amy Childress, Ph.D.

Dr. Amy Childress is the Gabilan Distinguished Professor of Science and Engineering and Director of Environmental Engineering in the Department of Civil and Environmental Engineering at the University of Southern California (USC). Dr. Childress' research interests include membrane contactor processes, pressure-driven membrane processes, membrane bioreactor technology, colloidal and interfacial aspects of membrane processes, and solar ponds for brine reduction and energy recovery. She has also directed research projects funded by the U.S. Bureau of Reclamation, the National Science Foundation, the National Aeronautics and Space Administration (NASA), the Office of Naval Research, the U.S. Department of Energy (DOE), the California Energy Commission, the California Department of Water Resources, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Defense's Strategic Environmental Research and Development Program (SERDP), as well as local and private agencies.

Dr. Childress' research addresses the global challenge of freshwater scarcity and pursues fundamental research, process development, and field applications to evaluate the energy, recovery, and water quality advantages that will lead to further development of advanced systems to reduce energy consumption in clean water production, to reuse water during energy production, and to leverage uncommon sources to produce energy. Dr. Childress was previously professor and chair of the Civil and Environmental Engineering Department at the University of Nevada, Reno. She earned a B.S. in civil engineering from the University of Maryland and an M.S. and Ph.D. in civil and environmental engineering from the University of California, Los Angeles.

Paula Guletsky, PE

Paula Guletsky is the vice president and project director (Energy and Industrial Group) at Sargent & Lundy. Ms. Guletsky has more than 35 years of power plant design experience and is a chemical engineer with an extensive background in environmental control technology, including both retrofit and greenfield projects. She has managed scopes spanning site selection, permit application, conceptual design, detailed design, construction, commissioning, performance testing, and project closeout, and is an active member of several Community of Practice (COP) groups established by Sargent & Lundy to foster development and information sharing.

In addition to her extensive air pollution control background, Ms. Guletsky has direct experience with material handling and storage, heat cycle analysis and optimization, and water treatment and permitting. Through her work on varied projects, she has successfully managed the design and construction of greenfield site preparation, transmission tie-in, water acquisition and delivery, and environmental retrofit projects. Ms. Guletsky serves as project director for the concept and cost development of capital projects; strategic planning studies; and plant service projects for reliability, life extension, process optimization. Ms. Guletsky has also provided consulting services and expert testimony for several clients, including Basin Electric Power Cooperative, FirstEnergy, Panda Energy, Tampa Electric Company, Dominion Energy, Wisconsin Electric, and Indianapolis Power and Light. The National Association of Professional Women (NAPW) honored Ms. Guletsky as a 2013/2014 Professional Woman of the Year for leadership in power engineering. Ms. Guletsky earned a B.S. in chemical engineering from the University of Kentucky and is certified as a professional engineer (PE) in Wisconsin.

Bryan Hansen, PE

Bryan Hansen is a chemical engineer specializing in air pollution control, water and wastewater treatment systems, and water chemistry studies. Throughout his 25-year career, Mr. Hansen has provided various engineering services, including consulting, studies, reports, conceptual design, detailed design, procurement, and construction. Mr. Hansen has also functioned as the project manager on numerous studies, reports, and projects.

In his current role at Burns & McDonnell, Mr. Hansen works primarily on projects involving water and wastewater treatment process design and air pollution control equipment process design for electric utilities and industrial clients. Mr. Hansen also conducts studies to evaluate technologies for regulatory compliance and has extensive experience related to effluent limitation guidelines (ELG) compliance. Mr. Hansen regularly writes papers and delivers presentations at technical conferences such as Electric-Power, Coal-Gen, Power-Gen, the International Water Conference, and the MEGA Symposium. Mr. Hansen earned a B.S. degree in chemical engineering from the University of Missouri-Columbia and is a certified PE in New Mexico, Nevada, and Kansas.

H.G. Sanjay, Ph.D., PE

Dr. H.G. Sanjay is an engineering and business development professional with experience in project and technical management, market development, design, fabrication, installation, commissioning, and startup. He is currently a senior engineer (water treatment) at Bechtel Corporation, responsible for technology evaluation and assessment, water balance, and specification and process development for multiple projects and proposals; reviewing overall water management processes and designs for multiple projects and power plant configurations; and supporting and working with various functions, including startup and commissioning to ensure system turnover on schedule. Dr. Sanjay has experience in power, mining, food, oil and gas industry process water, and produced and frac water treatment and management.

His skills and interests include business and client development; strategy development and execution; operations and project management; process design and engineering; process flow diagrams, process and instrument drawings, and heat and mass balance; equipment and material specification; tertiary water treatment; sea water desalination; produced and frac water treatment; zero liquid discharge systems; membrane and ion-exchange systems; advanced oxidation and disinfection; clarification and flotation systems; filtration and dewatering systems; controls and instrumentation specification; hazard and operability studies; and upset condition analysis. Dr. Sanjay earned a B.S. in chemical engineering from Osmania University (India), an M.S. in chemical engineering with petroleum and coal refining and processing option from the Indian Institute of Technology (India), and a Ph.D. from Auburn University.