# FISCAL YEAR 2025 ADVANCED TURBINES PEER REVIEW

## OVERVIEW REPORT

March 31, 2025

**Disclaimer**

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# 1 INTRODUCTION AND BACKGROUND

The National Energy Technology Laboratory (NETL) Advanced Turbines Program manages a research, development and demonstration (RD&D) portfolio designed to enable a reliable and efficient electricity sector by developing revolutionary advanced turbines technologies. In response to the nation's increasing power supply challenges, NETL is researching next-generation turbine technology with the goal of producing reliable, affordable, diverse and environmentally friendly energy supplies. NETL is also committed to enabling the use of hydrogen in gas turbines to facilitate a future power industry. Program and project emphasis is on understanding the underlying factors affecting combustion, aerodynamics/heat transfer, and materials for advanced turbines and turbine-based power cycles.

- Advanced Combustion Turbines — Research addresses component development for turbine systems that are powered by various fuels, including hydrogen and natural gas in both simple and combined cycle applications. Topic areas include improved combustor designs to reduce nitrogen oxide ($NO_X$) emissions, novel cooling schemes and thermal barrier coatings to protect first-stage turbine blades from higher turbine inlet temperatures, and sensor development and aerothermal studies to enhance overall thermal efficiency.
- Supercritical $CO_2$ Power Systems — Research is focused on developing high-efficiency, low-cost power generation systems based on supercritical carbon dioxide ($sCO_2$)-based power cycles. This includes new turbine systems for $sCO_2$-based power cycles and development and testing of an $sCO_2$ power cycle-based pilot plant.
- Pressure Gain Combustion — Current research assesses the potential benefit of pressure gain combustion systems when used with gas turbines in both simple and combined cycles. Researchers are focused on combustion control strategies and fundamental understanding of pressure wave-flame interaction and lab-scale testing/component prototyping for integration with gas turbine engines.[a]

## 1.1 OFFICE OF MANAGEMENT AND BUDGET AND U.S. DEPARTMENT OF ENERGY REQUIREMENTS

In compliance with requirements from the Office of Management and Budget (OMB) and in accordance with the U.S. Department of Energy's (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 2025 (FY 2025) Advanced Turbines Peer Review Meeting with independent technical experts to offer recommendations to strengthen projects during the period of performance and assess each project's Technology Readiness Level (TRL) status and progression. KeyLogic, an NETL site-support contractor, convened a panel of academic and industry experts[b] Jan. 21–23 and 29–30, 2025, to conduct a peer review of four projects (Exhibit 1-1).

[a] https://netl.doe.gov/carbon-management/turbines.

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

***Exhibit 1-1. FY 2025 Advanced Turbines Peer Review — projects reviewed***

| Project Number | Title | Lead Organization | Total Funding* | | Project Duration* | |
|---|---|---|---|---|---|---|
| | | | DOE | Cost Share | From | To |
| FE0032075 | Physics-Based Integration of $H_2$-Air Rotating Detonation into Gas Turbine Power Plant (HydrogenGT) | Purdue University | $800,000 | $250,003 | 08/01/2021 | 01/31/2025 |
| FE0032077 | A Robust Methodology To Integrate Rotating Detonation Combustor With Gas Turbines To Maximize Pressure Gain | University of Alabama | $800,000 | $201,341 | 06/30/2021 | 06/29/2025 |
| FE0032170 | Demonstration of a Gas Turbine-Scale Rotating Detonation Combustor Integrated with Compressor and Turbine Components at 7FA Cycle Conditions | General Electric Company | $6,999,923 | $1,749,980 | 10/01/2022 | 09/30/2026 |
| FWP-1022408-02 | Turbines: Pressure Gain Combustion | National Energy Technology Laboratory | $7,900,000* | $0* | 04/01/2022 | 03/31/2025 |
| | | | **$16,499,923** | **$2,201,324** | | |
| | | | **$18,701,247** | | | |

TRL-Based Evaluation: During TRL-based evaluations, the independent Review Panel offers recommendations and assesses the technology readiness for work at the current TRL and the planned work to attain the next TRL.

Data from NETL's Visual User Environment (VUE) unless otherwise noted.

* Data from NETL Peer Review Project Technical Summary (PTS) form.

# 2 OVERVIEW OF THE PEER REVIEW PROCESS

Peer reviews are conducted to help ensure that the Office of Fossil Energy and Carbon Management's (FECM) research program, implemented by NETL, is in compliance with requirements from OMB and in accordance with the 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.

KeyLogic convened a panel of academic and industry experts[c] to conduct a peer review of four projects supported by the Advanced Turbines Program. Throughout the peer review meeting, these recognized technical experts offered recommendations to strengthen the projects during the remaining period of performance and assessed each project's TRL status and progression. KeyLogic selected an independent Review Panel, facilitated the peer review meeting and prepared this report to summarize the results.

## 2.1 PREMEETING PREPARATION

Before the peer review meeting, each project team submitted a Project Technical Summary (PTS), project presentation and Technology Maturation Plan (TMP). The Federal Project Manager (FPM) provided the Field Work Proposal (FWP)/Project Management Plan (PMP), the latest quarterly report, and supplemental technical papers as additional resources for the Review Panel. The Review Panel received these materials prior to the peer review meeting, which enabled the Review Panel to fully prepare for the meeting with the necessary background information.

To increase the efficiency of the peer review meeting, multiple premeeting orientation sessions were held with NETL, the project teams, the Review Panel and KeyLogic to review the peer review process and procedures, roles and responsibilities, peer review evaluation criteria, and project documentation. The Technology Manager also offered an overview presentation of the program goals and objectives, as well as the rationale behind selecting the projects for peer review.

## 2.2 PEER REVIEW MEETING PROCEEDINGS

At the meeting, each project team offered a presentation describing the project. The presentation was followed by a Q&A session with the Review Panel and then a closed discussion and evaluation session for the Review Panel. The time allotted for the presentation, the Q&A session and the closed discussion session was dependent on the project's complexity, duration and breadth of scope.

During the closed discussion sessions of the meeting, the Review Panel discussed each project (Exhibit 1-1) to identify strengths, weaknesses and recommendations in accordance with the

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

peer review evaluation criteria.[d] The Review Panel offered prioritized, actionable recommendations to strengthen the project during the remaining period of performance and an evaluation of current TRL status and progression toward achieving the planned end-of-project TRL.

[d] Please see "Appendix A: Peer Review Evaluation Criteria" for more information.

# 3 Summary of Key Findings

This section summarizes the overall key findings of the projects evaluated at the FY 2025 Advanced Turbines Peer Review Meeting. The Review Panel concluded that the peer review provided an excellent opportunity to comment on the relative strengths and weaknesses of each project. The presentations and Q&A sessions provided additional clarity to complement the premeeting documentation. The peer review also provided insight into the range of technology development and the relative progress that has been made by the project teams. The technical discussion enabled the Review Panel to contribute to each project's development by identifying core issues and making constructive, actionable recommendations to improve project outcomes. The Review Panel generated 19 recommendations for NETL management to review and consider.

The Review Panel offered several observations about the projects reviewed. Overall, the panel members indicated that the future of these projects looks promising. One demonstrated improvement was the teams' work to tie their efforts closely to modeling efforts. Another commonality presented by the teams was the usage of geometry (e.g., most of the conditions were at lower pressure with inlet temperatures at lower values). Another theme evident over the course of the meeting was the turbine class families and the highlighting of representative engines that could serve as targets for the technology. Baseline studies are available that could be used as a starting point for targets; NETL could consider publishing a framing document of the landscape for future applications. The Review Panel suggested that a consortium approach to further research could benefit industry and different universities, because of the input that could be provided toward, for example, a long-term plan for air supply. In addition, the panel noted that the majority of the engines under investigation are natural-gas centric, but some have developments for propane, hydrogen and associated blends. Finally, the cooling aspect was discussed because there appeared to be high heat transfer in the combustion system. If a moderate pressure scheme could be used, that might address issues with cooling, in terms of the rotating detonation combustors (RDCs) and the first-stage nozzles. The panel agreed that the peer review was a beneficial opportunity to share feedback to accelerate technology integration and subsequent commercialization.

**Evaluation of Technology Readiness Level Progression**

The Review Panel assessed each project's current TRL and whether the project was on track to attain the planned end-of-project TRL based on the project strengths, weaknesses, issues, concerns and recommendations identified during the peer review. The panel offered the following assessments:

- Project FE0032075 has attained TRL 2. The conditions tested and designed in this project should be compared to the reference case to help inform a potential follow-on project that matches those conditions.
- Project FE0032077 has attained TRL 2. To reach TRL 3, future work shall need to test under relevant turbine conditions (i.e., temperature and pressure).
- Project FE0032170 has attained TRL 2. Upon completion of testing Rig 4, Project FE0032170 shall attain TRL 3. Successful testing of Rig 5 would result in achieving TRL 4.

- FWP-1022408-02 has attained TRL 2. Upon demonstration of pressure gain combustion, FWP-1022408-02 shall attain TRL 3.

# 4 Project Synopses

More information on the Advanced Turbines Program and project portfolio is available via the NETL website.

## Project Number FE0032075

| | |
|---|---|
| **Project Title** | **Physics-Based Integration of $H_2$-Air Rotating Detonation into Gas Turbine Power Plant (HydrogenGT)** |
| **Lead Organization** | **Purdue University** |
| **Project Description** | Purdue University will develop a novel, compact combustor-diffuser-turbine strategy to transition high-speed, unsteady flow from rotating detonation combustors (RDCs) to industrial turbines. Physics-based models will be developed to scale results to an F-class turbine, culminating in an experimental/numerical methodology to establish a successful architecture and the relevant nondimensional parameters for power plant operation at high thermodynamic cycle efficiency. The specific project objectives are to characterize the influence of various loss mechanisms on the performance metrics of RDC-turbine systems via integration of experimental and computational studies and develop the efficient transition of the high-Mach-number, unsteady RDC outlet into a turbine rotor for reliable work extraction. The research methodology involves three tasks: loss budgeting in a combustor with a downstream transition element and nozzle guide vane (NGV), demonstrating the coupling of the RDC-flow transition and NGV turbine to produce work, and scaling experimental and computational studies to F-class and aero-derivative class rotating detonation engine (RDE) gas turbine integrated systems. The proposed approach will rely on a combined experimental and computational effort. |

# PROJECT NUMBER FE0032077

| | |
|---|---|
| **Project Title** | **A Robust Methodology To Integrate Rotating Detonation Combustor With Gas Turbines To Maximize Pressure Gain** |
| **Lead Organization** | **University of Alabama** |
| **Project Description** | University of Alabama and Virginia Tech will develop a robust methodology to integrate a rotating detonation combustor (RDC) with a gas turbine, and to identify the impact of loss mechanisms on detonation performance in the RDC. Hydrogen and hydrogen-methane fuel mixtures at conditions relevant to F-class gas turbine engines will be used. The research team will minimize flow unsteadiness at the RDC exit and maximize pressure gain by applying computational and experimental techniques to optimize the flow path in an annular RDC channel by strategically constricting the flow area to improve the stability of detonation and to weaken the oblique shock wave(s) for higher performance. In addition, the team will apply computational and experimental techniques to optimize and integrate the RDC with a diffuser for F-class gas turbines. The methodology developed will be applicable to aeroderivative gas turbines. Lastly, computational and experimental techniques will be applied to an optimized RDC-diffuser design to quantify the impact of loss mechanisms in the combustion process associated with nonideal mixing, mixed mode combustion (deflagration/detonation), and wave mode/numbers in the RDC. Computational fluid dynamics (CFD) simulations will be performed and validated against detailed experimental datasets. A Design of Experiments approach will be applied to optimize geometric parameters of the RDC annular flow path and the integrated RDC-diffuser design. In addition, CFD simulations on the fully integrated RDC-diffuser design will be performed at select operating conditions to quantify the impact of loss mechanisms in the combustion process. Experiments will be performed using the RDC and integrated RDC-diffuser system. A plenum with a backpressure plate will be used to simulate the turbine flow path. Pressure probes, ion-probes, dynamic pressure probes, and advanced high-speed diagnostic techniques — including particle image velocimetry and rainbow schlieren deflectometry — will be used to quantify the flow unsteadiness and pressure gain (loss), and to generate a robust validation data. |

# PROJECT NUMBER FE0032170

| | |
|---|---|
| **Project Title** | **Demonstration of a Gas Turbine-Scale Rotating Detonation Combustor Integrated with Compressor and Turbine Components at 7FA Cycle Conditions** |
| **Lead Organization** | **General Electric (GE) Company** |
| **Project Description** | GE Research — in collaboration with GE Aviation, the University of Michigan, the Georgia Institute of Technology, North Carolina State University and the University of Central Florida — will design, fabricate and demonstrate operation of a rotating detonation combustor (RDC) at 7FA cycle conditions while integrated with upstream and downstream turbomachinery components. The project team will study the integrated system performance when operating over a range of natural gas and hydrogen fuel blends. RDC operation has been extensively studied at low-pressure operating conditions and without the presence of representative inlet and exit engine components. Therefore, the impact on performance and operability of the coupled components that represent the integrated gas turbine system is largely unknown. Furthermore, the performance impact of this coupled system at realistic gas turbine cycle conditions is also not well understood. This project will focus on studying the interactions between the RDC and the inlet air compressor/diffuser components and the interaction between the RDC and the downstream turbine inlet section. |

# PROJECT NUMBER FWP-1022408-02

| Project Title | Turbines: Pressure Gain Combustion |
|---|---|
| Lead Organization | National Energy Technology Laboratory |
| Project Description | The objective of this work is to accelerate the deployment of rotating detonation combustors (RDCs) for gas turbine applications and to explore additional power cycles that may benefit from pressure gain attained through near-constant volume combustion associated with detonation. This will be accomplished through a combination of experimental testing of several RDC test rigs, and the development of computational tools for predicting performance in close conjunction with research partners at the National Aeronautics and Space Administration (NASA) and individual agencies within the U.S. Department of Defense (DoD). This effort will conduct research on hydrogen-air-fired RDC that will: (1) demonstrate the development process to reduce pressure loss across the fuel and air injector leading to a system capable of producing pressure gain; (2) develop a methodology for characterizing the pressure gain and associated performance (i.e., combustion efficiency, combustion stability, nonideal parasitic/commensurate deflagration, etc.) with respect to multimodal, multiwave operations; (3) estimate the performance impacts of integrating the unsteady flow associated with RDC with a high-efficiency turbine; (4) improve the fundamental understanding of nitrogen oxide ($NO_X$) formation in detonation versus deflagration environments; (5) characterize the fluid mechanics and unsteady heat transfer in the exhaust diffuser used to transition flow between the combustion channel and the hypothetical turbine inlet; and (6) develop the next generation of sensors capable of the high-speed diagnostics needed for detonation-based combustion applications. The product of this research effort will include experimental data and validated computational models to assist in the design of detonation-based combustion systems for gas turbine engines. |

# Appendix A: Peer Review Evaluation Criteria

Peer reviews consist of a formal evaluation of selected National Energy Technology Laboratory (NETL) projects by an independent panel of subject matter experts (SMEs) and are conducted to ensure that the Office of Fossil Energy and Carbon Management's (FECM) research program, implemented by NETL, is compliant with Office of Management and Budget (OMB) guidance, the U.S. Department of Energy (DOE) Strategic Plan, and DOE guidance. Peer reviews reduce project risk (e.g., cost, schedule, technology development) and 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. NETL uses the peer review findings to guide and redirect projects, as appropriate, underscoring NETL's commitment to funding and managing a portfolio of high-quality research.

## NETL Peer Review — Technology Readiness Level-Based Evaluation

At the meeting, the peer review facilitator leads the Review Panel in assessing a project's readiness to start work toward the next Technology Readiness Level (TRL) based on a project's strengths[e]; weaknesses[f], issues and/or concerns; and recommendations.

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 the technology maturation path. 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.

[e] 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.

[f] 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.

***Exhibit A-1. FY 2025 Advanced Turbines Peer Review evaluation criteria***

| FY 2025 Advanced Turbines Peer Review Evaluation Criteria |
|---|
| **Technology Maturation Plan (TMP)** |
| • The path to commercialization includes precisely defined steps indicating Technology Readiness Level (TRL) stages, a market viability analysis, market acceptance strategy and commercialization timeline.<br>• Key commercialization milestones are included as part of a commercialization timeline.<br>• Stakeholder interest in the technology (and/or a robust plan to generate such an interest) is clearly defined and described.<br>• Estimated likelihood of market adoption.<br>• Aspects of the technology that require testing are presented, and the methods of testing each parameter are clearly and precisely described.<br>• Critical parameters and performance milestones that must be met to achieve commercial readiness/market acceptance are clearly defined and described.<br>• TMP represents a viable path for technology development beyond the end of the current project, with respect to scope, timeline and cost. |
| **Performance Attributes and Requirements** |
| • Performance attributes for the technology are defined (supported by systems analyses appropriate to the targeted TRL).<br>• The project has tested (or is testing) those attributes appropriate for the next TRL. The level of technology integration and the nature of the test environment are consistent with the aforementioned TRL definition.<br>• Performance requirements for each performance attribute are, to the maximum extent practical, quantitative, clearly defined, and appropriate for and consistent with technical and economic viability in the intended commercial application.<br>• 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). Reasonable progress has been made relative to the established project schedule and budget. |
| **Market Penetration and Disruption** |
| • Degree of actual realized or projected pressure gain across the combustor section (rotating detonation engine [RDE] only).<br>• Projected cost metrics (e.g., capital expenditures [CAPEX], operating expenses [OPEX]) compared to the current state-of-the-art are included.<br>• Retrofit capabilities are clearly defined and described.<br>• Overall performance/efficiency compared to the current state-of-the-art is included.<br>• Technical gaps, barriers and risks to achieving the performance requirements are clearly identified.<br>• Potential of the proposed technology to be adopted into the current market is presented, and notable barriers to entry are clearly defined and explained. |
| **Compatibility with Low-Carbon Fuels** |
| • Maximum tolerable limit for hydrogen, ammonia and/or other novel low-carbon fuel (in terms of percent by volume) is included.<br>• Capabilities of the technology for rapid fuel switching is included and described.<br>• Nitrogen oxide ($NO_X$) emissions are acceptably low, ideally comparable to an equivalent natural gas process (in terms of pounds/megawatt-hour based on energy output for turbines). |
| **Transformative Technology** |
| • Key differences in process, structure and/or thermal-flow design compared to the current state-of-the-art are described.<br>• Sufficient past research and experimental results demonstrate a path toward the projected performance results.<br>• The technology provides an opportunity to enhance the thermal efficiency/performance of the current state-of-the-art through improved thermal or material output, reduction of the consumption of raw material, or a combination of both. |

# APPENDIX B: DOE TECHNOLOGY READINESS LEVELS

***Exhibit B-1. Description of DOE 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, as well as 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. |

| Relative Level of Technology Development | Technology Readiness Level | TRL Definition | Description |
|---|---|---|---|
| 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. |

| Relative Level of Technology Development | Technology Readiness Level | TRL Definition | Description |
|---|---|---|---|
| Basic Technology Research | 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 better understanding the science. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work. |
| | 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.

*Source: U.S. Department of Energy, "Technology Readiness Assessment Guide." Office of Management. 2011.*

# Appendix C: Meeting Agenda

| FY 2025 Advanced Turbines Peer Review |
|---|
| January 21–23, 29–30, 2025 |
| Virtual Meeting |

## Day 1 – Tuesday, January 21, 2025

### FE0032075 – Physics-Based Integration of $H_2$-Air Rotating Detonation into Gas Turbine Power Plant (HydrogenGT)

**** All times Eastern ****

| | |
|---|---|
| 12:30–1:00 p.m. | Peer Review Panel Kickoff Session |
| 1:00–1:45 p.m. | **FE0032075 – Physics-Based Integration of $H_2$-Air Rotating Detonation into Gas Turbine Power Plant (HydrogenGT)**<br>*G. Paniagua-Perez* – Purdue University |
| 1:45–2:30 p.m. | Question and Answer Session |
| 2:30–2:45 p.m. | BREAK |
| 2:45–4:15 p.m. | Closed Discussion (Peer Review Panel) |
| 4:15 p.m. | ADJOURN |

## Day 2 – Wednesday, January 22, 2025

### FE0032077 – A Robust Methodology To Integrate Rotating Detonation Combustor With Gas Turbines To Maximize Pressure Gain

**** All times Eastern ****

| | |
|---|---|
| 12:30–12:40 p.m. | Kickoff Session |
| 12:40–1:25 p.m. | **FE0032077 – A Robust Methodology To Integrate Rotating Detonation Combustor With Gas Turbines To Maximize Pressure Gain**<br>*Ajay Agrawal* – University of Alabama |
| 1:25–2:10 p.m. | Question and Answer Session |
| 2:10–2:30 p.m. | BREAK |
| 2:30–4:00 p.m. | Closed Discussion (Peer Review Panel) |
| 4:00 p.m. | ADJOURN |

| FY 2025 Advanced Turbines Peer Review |
|---|
| January 21–23, 29–30, 2025 |
| Virtual Meeting |

## DAY 3 – THURSDAY, JANUARY 23, 2025

## FE0032170 – DEMONSTRATION OF A GAS TURBINE-SCALE ROTATING DETONATION COMBUSTOR INTEGRATED WITH COMPRESSOR AND TURBINE COMPONENTS AT 7FA CYCLE CONDITIONS

**** All times Eastern ****

| | |
|---|---|
| 12:30–12:40 p.m. | Kickoff Session |
| 12:40–1:25 p.m. | **FE0032170 – Demonstration of a Gas Turbine-Scale Rotating Detonation Combustor Integrated with Compressor and Turbine Components at 7FA Cycle Conditions**<br>*Kapil Singh* – General Electric (GE) Company |
| 1:25–2:10 p.m. | Question and Answer Session |
| 2:10–2:30 p.m. | BREAK |
| 2:30–4:00 p.m. | Closed Discussion (Peer Review Panel) |
| 4:00 p.m. | ADJOURN |

## DAY 4 – WEDNESDAY, JANUARY 29, 2025

## FWP-1022408-02 – TURBINES: PRESSURE GAIN COMBUSTION

**** All times Eastern ****

| | |
|---|---|
| 12:30–12:40 p.m. | Kickoff Session |
| 12:40–1:25 p.m. | **FWP-1022408-02 – Turbines: Pressure Gain Combustion**<br>*Don Ferguson* – National Energy Technology Laboratory |
| 1:25–2:10 p.m. | Question and Answer Session |
| 2:10–2:30 p.m. | BREAK |
| 2:30–4:00 p.m. | Closed Discussion (Peer Review Panel) |
| 4:00 p.m. | ADJOURN |

| FY 2025 Advanced Turbines Peer Review |
|---|
| January 21–23, 29–30, 2025 |
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## Day 5 – Thursday, January 30, 2025

## Peer Review Panel Debrief and Next Steps

**** All times Eastern ****

| | |
|---|---|
| 12:30–12:40 p.m. | Welcome |
| 12:40–2:00 p.m. | Peer Review Panel Debrief and Next Steps |
| 2:00 p.m. | ADJOURN |

# APPENDIX D: PEER REVIEW PANEL MEMBERS

| FY 2025 Advanced Turbines Peer Review |
| --- |
| January 21–23, 29–30, 2025 |
| Virtual Meeting |

## Forrest Ames, Ph.D.

Forrest Ames, Ph.D., is professor emeritus (mechanical engineering) at the University of North Dakota (UND). He earned his M.S. and Ph.D. in mechanical engineering at Stanford University. He began his career at the Allison Gas Turbine Division of General Motors, where he conducted research on issues related to gas turbine heat transfer and aerodynamics. Ames began his faculty position at UND in 1997, where he currently teaches thermodynamics, compressible flow, computational fluid dynamics, heat transfer and fluid mechanics. His research has included studies on gas turbine aerodynamics, as well as internal heat transfer methods and external heat transfer and film cooling in gas turbines.

## Mark Fernelius, Ph.D.

Mark Fernelius, Ph.D., graduated from Brigham Young University with a Ph.D. in mechanical engineering. Following graduation, he worked for Innovative Scientific Solutions Inc. as an on-site contractor at Wright-Patterson Air Force Base, developing small gas turbine engines and rotating detonation engines (RDEs). Fernelius then joined the civil service as an Air Force civilian in the Turbine Engine Division at the Air Force Research Laboratory. In this position, he manages research being conducted for small piston and gas turbine engines. (Fernelius participated on days two, four and five.)

## Steve Martens, Ph.D.

Steve Martens, Ph.D., is the Propulsion, Power and Thermal Management Program Officer at the Office of Naval Research, Code 35—Aviation, Force Projection and Integrated Defense. He manages a portfolio of science and technology programs to ready new technologies and capabilities for transition to the U.S. Navy and U.S. Marine Corps. Prior to his current role, Martens spent more than 20 years at GE Aviation and GE Global Research, where he developed a deep technical background in advanced propulsion, inlets and exhausts, unsteady aerodynamics, and aeroacoustics. He holds an M.S. and Ph.D. in aerospace engineering from Penn State.

## Gary Ostdiek, Ph.D.

Gary Ostdiek, Ph.D., is a senior engineer within the Turbines Engine Division (Aerospace Systems Directorate) at the Air Force Research Laboratory. Ostdiek has worked in private industry, providing design, manufacturing and assembly support. In 2001, he joined the Air Force Research Laboratory's gas turbine engine compressor testing team. Ostdiek is currently working on gas turbine engine structures, engine technology demonstrator testing and ceramic composites research. He holds a B.S., M.S. and Ph.D. in mechanical engineering from the University of Dayton. (Ostdiek participated on day two.)

## Alex Schumaker, Ph.D.

Alex Schumaker, Ph.D., is a senior research engineer in the Turbine Engine Division of the Aerospace Systems Directorate of the Air Force Research Laboratory. His primary focus area is the development of

RDEs for Air Force applications and leads an integrated 6.1 to 6.3 RDE development program. Schumaker is currently acting as the Turbine Engine Division Principal Scientist, where he is responsible for in-house research and development activities across the division.

Prior to joining the Turbine Engine Division in February 2019, he spent 10 years with the Rocket Propulsion Division Combustion Branch as branch technical advisor and as a researcher, where he oversaw an in-house research portfolio for both rocket engines and motors, including work in fuels, injectors, combustion stability, rotating detonation rocket engines, carbon-carbon materials, and multifidelity modeling and simulation. Schumaker received a B.S. in aerospace engineering from Ohio State and performed his graduate work in aerospace engineering at the University of Michigan, receiving an M.S. and Ph.D. He is an associate fellow of the American Institute of Aeronautics and Astronautics. (Schumaker participated on days one and three.)

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