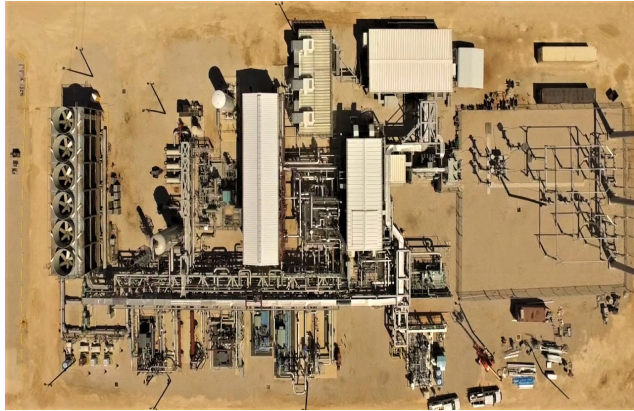


NET Power Cycle Testing and Assessment Study



Background, Objectives, and New Learnings

Today's power markets are evolving with dramatic growth in renewables and a drive towards lower-carbon generation. For fossil power to remain an option in future portfolios, it will likely need carbon capture and storage (CCS) to achieve low-carbon operation. However, CCS remains high cost with a significant energy penalty.

Supercritical CO₂ (sCO₂) power cycles are potentially capable of high-efficiency, low-carbon operation due to the superior thermodynamic characteristics of CO₂ used as the working fluid. The NET Power Cycle is a direct-fired, semi-closed version of sCO₂ power generation in which high-pressure oxy-combustion of a fuel—with high-purity oxygen provided by cryogenic air separation—occurs in a combustor within the cycle itself, producing a high-temperature flue gas of principally CO₂ and water to drive a power turbine. The cycle utilizes significant recuperation from a variety of sources in the cycle to improve efficiency, then condenses out water produced by the combustion before compression, after which the CO₂ is removed at pipeline-ready pressure. The natural gas (NG) version of the direct-fired sCO₂ power cycle is being commercialized by NET Power, LLC, (NET Power) a joint venture between 8 Rivers, McDermott, Oxy, and Exelon.

The NET Power Cycle has the potential for efficiencies as high as NG combined-cycles without CCS, but with near 100% CO₂ capture, while generating potentially sellable byproducts in CO₂, water, argon, and nitrogen. A prior techno-economic study has been performed on these cycles by EPRI, showing costs on the order of \$1500/kW with full capture.

- Insights on the NET Power Cycle technology, which has the potential to provide low-cost, low-carbon power generation from natural gas
- Operational data and performance indicators relevant to the power industry, and lessons learned from field testing
- Ability to provide feedback on test planning
- Provision of a hosted site visit during testing to see operations first-hand
- Access to technology experts

NET Power has built a 50-MWth NG pilot plant located in La Porte, TX, which first operated at the end of 2018 and has run for several hundred hours. However, more operating data and testing are required to provide more confidence in the technology and its operations. NET Power plans to operate the pilot for ~1000 hours in 4Q 2021 and potentially put MWhs on the grid, providing an opportunity for new insights on the technology.

Key questions on this technology include the reliability of its components related to high-temperature and potentially corrosive effects; the performance of the cycle architecture (especially its novel components); plant operational characteristics at full and part load and during ramping; sequence of operations including for startup and shutdown; ability to operate continuously; and impact on the commercial design based on the testing done at La Porte.

Benefits

The results of this project will provide members with real-world experience data on a direct-fired sCO₂ power cycle utilizing NG at pilot scale. Component and cycle designs, operations, lessons learned, and performance assessments will be the focus. The involvement of EPRI and participating companies will contribute to increased relevance of the results to the power industry. In particular, the project will inform project participants and the public about the viability of the concept and its associated technology (turbomachinery, recuperative heat exchangers, and oxy-combustors, in particular) and provide lessons learned about its operation.

The project is expected to provide critical knowledge supporting continuing technology advancement and future commercial deployment of NET Power Cycle power generation.

Key information will be provided on the design of the NET Power Cycle during this project, along with detailed testing data and performance assessments. The project will look to provide insights and lessons learned on the technology and its operations, giving more evidence of its potential viability for low-carbon power generation.

Ultimately, if the NET Power Cycle concept proves to be successful, it could provide a system capable of delivering low-carbon power generation from fossil fuels at high efficiency and low cost, helping to provide synchronous, dispatchable power for a low-carbon future.

Project Approach and Summary

The project entails participation in a testing effort on the pilot at La Porte operating on NG. EPRI will work with project participants and NET Power to review and update the test plan to include additional test runs relevant to the power industry. In parallel, EPRI will develop a testing protocol to assess the accuracy of onsite measurements and calculate essential performance indicators (e.g., net plant heat rate, combustor and turbine efficiency, recuperator effectiveness, and CO₂ purity). EPRI will obtain data from the testing to assess the performance of the cycle and key components. Lessons learned from the testing and a hosted site visit will also be provided. Finally, EPRI will work with NET Power to obtain the sequences of operation for the system, and details on the design of the pilot and the commercial system.

Deliverables

- Quarterly webcasts to recap progress at the site and lessons learned and access to project experts.
- Final report, which includes detailed information on the:
 - Design layout of the 50-MWth pilot site (piping and instrumentation diagram level) and commercial-scale system (process flow diagram level)
 - Operational data from testing at full-load and part-load settings during both steady-state and dynamic (i.e., ramping) operations
 - Calculated performance indicators on key components and the overall system
 - Sequence of operations and insights on operations
 - Lessons learned

- Hosted visit to the La Porte site during operations (pending any travel restrictions)
- Closeout webcast with NET Power to review next steps for the technology.

Price of Project

The price to participate in the project is \$100,000. The price can be paid over two years. The project is eligible for Self-Directed Funding (SDF) and Tailored Collaboration (TC).

Project Status and Schedule

The start date for this project is September 2021 and expected to be completed in 6 months.

Who Should Join

Organizations interested in direct-fired sCO₂ power cycles / transformational fossil power technology that can provide high efficiency with near 100% CO₂ capture, while reducing emissions and water use and potentially providing valuable byproducts, may benefit from participation in this project.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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