LCRI LOW-CARBON RESOURCES INITIATIVE

EPRI GTI ENERGY

EXECUTIVE SUMMARY

CONVERSION OF EXISTING NATURAL-GAS-FIRED DUCT BURNERS TO HYDROGEN

State of Knowledge and Issues Assessment

Large-scale, combined-cycle gas turbines (CCGT) for industrial or power generation applications often use duct burners upstream of the heat recovery steam generator (HRSG) to increase peak load production or steam production. Also known as supplemental firing systems, these burners typically fire natural gas (NG) and thereby contribute to the overall greenhouse gas footprint generated by the greater CCGT unit. Accordingly, there is a need to investigate potential pathways for converting NG duct burners to low-carbon fuels such as hydrogen. This report addresses the state of knowledge, issues, and resource requirements for converting existing NG-fired duct burners to hydrogen in a safe, reliable, and economical manner.

Key findings from the full report are summarized as follows:

- Although most duct burner applications use NG as the primary fuel, duct burners designed specifically for hydrogen have been successfully operated for both HRSG and air heater applications at heat inputs of over 300 MBtu/hr.
- Original equipment manufacturer (OEM) interviews and a recently conducted literature search have not revealed information on applications where the original NG duct burner system was converted to hydrogen as a fuel (pure hydrogen or blended with NG). Demonstration projects are needed to define resource requirements and resolve key issues for these conversions.
- Limited information is available from OEMs regarding existing duct burner units designed to fire both NG and hydrogen. As a result, general conclusions are not currently known regarding reliability, emissions, and performance of these burner designs.
- Numerous combustion-related duct burner components, including stabilizers and gas manifold drillings, differ for hydrogen applications compared to NG. However, blend ratios not exceeding 25 to 30% hydrogen content (by volume) may be achieved with only minor system modifications.
- Based on available data, NOx emissions from duct burners were found to be substantially higher for hydrogen units compared to NG units—this being attributed to increased peak flame temperatures (readers may reference the Zeldovich mechanism for further information).

The report focuses on technical issues and needs associated with the combustion of hydrogen in duct burners for CCGT applications. Gas turbines are mentioned only to address upstream turbine exhaust gas impacts on duct burner performance, and HRSGs are mentioned only to address how their performance is impacted by duct burners. In addition, as the report is limited to combustion-related issues, topics pertaining to production, storage, and transport of hydrogen are not included.

The Low-Carbon Resources Initiative

This report was published under the Low-Carbon Resources Initiative (LCRI), a joint effort of EPRI and GTI Energy addressing the need to accelerate development and deployment of low- and zero-carbon energy technologies. The LCRI is targeting advances in the production, distribution, and application of low-carbon energy carriers and the cross-cutting technologies that enable their integration at scale. These energy carriers, which include hydrogen, ammonia, synthetic fuels, and biofuels, are needed to enable affordable pathways to economy-wide decarbonization by mid-century. For more information, visit www.LowCarbonLCRI.com.

Technical Contact: Tony Facchiano, Sr. Program Manager, 650.799.7640, afacchia@epri.com

3002025560 December 2022

EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com