

Evaluation of Hydrogen Production Feasibility Utilizing System Integrated Modular Advanced Reactor (SMART) in Saudi Arabia

Monday, 13 November 2023 14:10 (20 minutes)

Worldwide, the demand of hydrogen has grown by threefold since 1975. Hydrogen is mainly produced from fossil fuels, due to lower costs compared to other production alternatives. Consequently, this industry resulted in the emission of about 830 million tons of carbon dioxide per year. In its effort to tackle this global issue, Saudi Arabia is considering the utilization of nuclear energy to power the production of hydrogen as part of a push by the world's largest exporter of crude to diversify its economy away from hydrocarbons and fulfill its net-zero target. Hence, this paper presents a Techno-Economic model for hydrogen production using System-Integrated Modular Advanced Reactor (SMART) as a clean alternative to reduce dependence on fossil fuels and mitigate its carbon footprint in Saudi Arabia. SMART is an advanced pressurized water reactor that has been developed on the basis of proven technologies, with a 365 MW thermal capacity co-owned by the Kingdom. The reactor has integral steam generators and advanced safety features designed for electricity generation and thermal applications. The paper identifies the key factors that could affect the competitiveness of SMART for hydrogen production, by estimating the associated capital and operational expenses while considering the impact of various factors such as electricity prices, fuel costs, and carbon prices. The tool used for this analysis is "Hydrogen Economic Evaluation Program (HEEP)" developed by International Atomic Energy Agency (IAEA), which includes numerous options for hydrogen generation. The Discounted Cash Flow (DCF) approach is the foundation of the mathematical modeling used in HEEP to determine the levelized cost of hydrogen at a certain discount rate. The findings of this paper identify the key factors that could affect the competitiveness of small nuclear reactors for hydrogen production, providing valuable insights for future research and development in this area.

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Session Classification: Day 1- Parallel Session - III : Fusion and Advanced Reactors

Track Classification: Fusion and Advanced Reactors