PEM Water Electrolysis for Enhanced Water Detritiation at ITER

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The focus of the international ITER experiment is the development of the next generation fusion reactor. The goal of the ITER project is to advance the state of fusion reactor development to a larger scale and assist in the transition to future fusion power plants for electricity production. One of the programmatic goals of ITER is to implement and test the key technologies and processes needed for future tritium-based fusion power plants, including the handling and processing of radioactive waste streams. A key element of the confinement systems of ITER is the atmospheric tritium containment system. Several such systems will be deployed within the nuclear buildings of ITER. These systems will collect tritium in the form of tritiated water which will then be processed in the ITER Water Detritiation System (WDS).

The design of the WDS is based upon Combined Electrolysis Catalytic Exchange (CECE). CECE uses water electrolysis to convert tritiated water to gaseous hydrogen. The gaseous hydrogen is then passed through a Liquid Phase Catalytic Exchange (LPCE) column to remove tritium from the hydrogen so that the pure hydrogen can be safely discharged. The WDS water electrolysis baseline concept design is composed of multiple proton exchange membrane (PEM)-based systems arrayed to convert an estimated 120 kg/h of water to almost 150 Nm^3/h of hydrogen.

Under contract to the ITER Organization, Proton Energy Systems evaluated the availability of commercial water electrolysis equipment for use in an enhanced water detritiation system being developed for the next generation fusion reactor machine. The technology basis for the study was Proton Energy Systems' commercial HOGEN® PEM electrolysis system H and C-series platforms, examining modifications required to meet the design intent of the detritiation system. Areas of study included definition of the "ideal" system requirements, characterization of Proton's systems inputs, outputs, maintenance requirements, and impact on the surrounding ITER environment. The study concluded with the development of an overall conceptual system design package. Results of this study will be summarized and presented.