DEVELOPMENT OF A PEMFC POWER SYSTEM WITH INTEGRATED BALANCE OF PLANT

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ABSTRACT

Autonomous Underwater Vehicles (AUV's) have received increasing attention in recent years as military and commercial users look for means to maintain a mobile and persistent presence in the undersea world. Compact, neutrally buoyant power systems are needed for both small and large vehicles. Batteries are usually employed in these applications, but the energy density and therefore the mission duration are limited with current battery technology.

At a certain energy or mission duration requirement, other means to get long duration power become feasible. For example, above 10 kW-hrs liquid oxygen and hydrogen have better specific energy than batteries and are preferable for energy storage as long as a compact system of about 100 W/liter is achievable to convert the chemical energy in these reactants into power. Other reactant forms are possible, such as high pressure gas, chemical hydrides or oxygen carriers, but it is essential that the power system be small and light weight.

Recent fuel cell work, primarily focused on NASA applications, has developed power systems that can meet this target power density. Passive flow-through systems, using ejector driven reactant (EDR) flow, integrated into a compact balance of plant have been developed. These systems are thermally and functionally integrated in much the same way as are automotive, air breathing fuel cell systems. These systems fit into the small volumes required for AUV and future NASA applications.

Designs have been developed for both a 21" diameter and a larger diameter (LD) AUV. These fuel cell systems occupy a very small portion of the overall energy system, allowing most of the system volume to be used for the reactants. The fuel cell systems have been optimized to use reactants efficiently with high stack efficiency and low parasitic losses. The resulting compact, highly efficient fuel cell system provides exceptional reactant utilization and energy density. Key design variables and supporting test data are presented. Future development activities are described.