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Fuel Cell Systems

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In addition to the activities conducted using individual fuel cells and stacks at the Hawaii Fuel Cell Test Facility [1] (HFCTF), research and development efforts are also carried out on complete fuel cell systems. This work encompasses both computer simulations and extensive laboratory studies utilizing actual hardware. The areas of interest are fuel cell energy/power systems (FCEPS) for unmanned underwater vehicles (UUVs), unmanned aerial vehicles (UAVs) and automotive electric hybrid vehicles. For example, for UUVs, an initial technology assessment has included attention to polymer electrolyte membrane fuel cells and hydrogen and oxygen storage systems. Click here [2] to see a draft technical report presenting the results of this assessment. In the future, consideration will be given to hardware experiments directed at the vital arena of how to quickly one can move from laboratory testing to production of prototype units (rapid system prototyping). HNEI will eventually develop all the elements required for system prototyping. The following paragraphs outline expected elements that will be part of overall fuel cell systems R&D efforts at HNEI.

- Simulation [3]: Computer simulation is a powerful tool for assisting in the development of any technology and its use in the fuel cell arena is mandatory, especially for achieving accelerated advancement within the field. Modeling will be done at several levels of development, including simulation of individual cells and cell stacks, fuel cell vehicles, and complete fuel cell systems. For more details on specific activities within Simulation, click here [3].
- Hardware-in-the-Loop [4]: (HiL) testing: HFCTF has one test stand specific for high speed HiL testing. The HiL test stand is used to characterize the dynamic performance of cell, stack, other system components, including a simulated fuel cell system for a particular dynamic application or load profile. For more details on Hardware-in-Loop, click here [4].
- Rapid System Prototyping: In development of new fuel cell systems, time and cost are vital elements. Due to the complexity of such systems, it is always necessary to perform integrated overall system testing in addition to testing of individual components, in order to manifest a new prototype system. When sufficiently capable HiL systems are available, they can be used for such overall system testing to achieve rapid system prototyping.

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