# 2008 Summary of Research Reports

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**Project:** Bi-directional DC/DC Converters for the Next Generation Integrated Power System
**Sponsor:** NAVSEA

**Statement of Work:**

The work will be broken up into four distinct phases. The initial segment of work will consist of a literature survey that will identify converter architectures that offer bidirectional capability, modular design, and high power density. In this part of the effort, the Principle Investigator (PI) will focus primarily on DC/DC converters. The main sources of information will be derived from automotive and locomotive applications and will emphasize topologies that offer isolation and high power density. As stated above, the topologies will be assessed based on complexity, part count, waveform fidelity, controllability, power capacity, and fault tolerance. The next phase of the effort will focus on modeling and simulating the most attractive candidate DC/DC converter architectures. The simulations will be performed using the Advanced Continuous Simulation Language (ACSL) and will clearly document modeling assumptions and approximations where appropriate. The models will be exercised sufficiently as to confirm predicted output waveforms and to perform a first-cut local control, where the local control is responsible for specifying the switching signals to establish a desired output voltage. The requirements of the outer system control will be specified at this point but a detailed implementation will be accomplished in the next phase of the effort. The third phase will involve developing a system-level representation in order to design the system-level controls and assess the transient performance of the converter. This portion of the work will leverage power system models available through the Navy and may employ some level of system aggregation that trades off simulation efficiency versus the number of possible transient events. The goal of this effort will be to consider the transient performance of the DC/DC converter specifically focusing on the waveform fidelity (power quality), bidirectional power flow speed of response, and any component interaction (stability). Since the last item is very parameter dependent, the PI will at least outline a procedure that might be utilized to effectively sweep the parameter space to evaluate this question. This approach might utilize simulation, the DC Stability Toolbox, or some combination of both. The final phase of this work will consist of writing a report that summarizes the above findings. The report will (1) document the approach used to "score" the converter topologies, (2) describe the methodology used to model the converter, (3) explain the structure and design of the "local" control, (4) illustrate some validation waveforms, (5) set forth the assumptions used to assemble a system-level simulation, (6) document the implementation of the "system-level" controls, (7) show representative transient studies that assess waveform fidelity, fault performance, dynamic interaction, and transient response, and (8) summarize recommendations regarding the "best" converter candidate topologies.