



S&T: Closing Gaps



Energy Storage and Power Conversion:

- Develop **NiPEC sections** to capitalize on **PEBB clusters** within power trains.
- Establish and **validate tools for integrating** energy storage to maintain operability and power quality in normal and transient loading.
- Develop ship integration models and assess for **reliability, stability, survivability, and operability.**

Ship Integration & Interfaces:

- Develop electrical, mechanical and thermal **interface technology** for NiPEC connections (e.g. latching mechanism, disconnect).
- Investigate NiPEC impact on ship **construction, testing, and upgrade.**
- Coordinate and develop **higher performing mission systems** afforded by NiPEC.
- Develop **scale-ability** of LRU arrangements, thermal management, EMI mitigation and dielectrics within NiPEC and determine impacts on SWAP-C.

Control:

- Develop **orchestration** techniques for **discretized power routing.**
- Integrate **energy management** concepts leveraged from past RCPC work.
- Develop **stability process/control and protection algorithms** for integrated clusters of PEBBs.
- Develop **agile and secure** programming processes for control code



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Thermal Management:

- Co-design **scalable thermal management solutions** that support PEBB operability, reliability and survivability.
- Develop advanced cooling strategies to accommodate power electronics and high-frequency transformer designs.
- Validate scalable LRU and NiPEC thermal models in relevant environments.

Electro-Magnetic Interference (EMI), and Dielectrics:

- Develop and demonstrate **EMI cancellation and mitigation strategies**.
- Integrate outcomes of **ESARCA** concerning insulation material and partial discharge.
- Add isolation layers and PCB-embedded shielding for **enhanced EMI immunity**.
- Develop and standardize effects of dielectrics on NiPEC composition.

Cyber-Physical Systems and Cyber-Security:

- Leverage outcomes from RCPC FNC and research between Clarkson, FSU, USC and FIU; with respect to analysis methods that differentiate between normal behaviors, natural degradations, and cyber-attacks.