Impact Study of Value-Added Functionality on Inverters in Energy Storage Systems

Motivation
Power conversion systems (PCS) developers are incorporating value-added functions; little is known about the overall PCS reliability.

Objective
Develop electrical models to gain an understanding of the degradation of a PCS and its internal components due to value-added functionality; primarily VAR generation. Investigation and modeling of frequency support applications may be considered as a secondary objective.

Simulated System
The reliability models will then be leveraged to identify areas of improvement such as revised component selection and advanced control methods.

Preliminary Results (Model Validation)
The junction temperature ($T_j$) of the IGBT and Diode were used as a quantitative indication of reliability of the components. The voltage ripple of the capacitors was used in the same way.

Figure 6: Real and Reactive Power Reference vs. Output

Figure 7: IGBT and Diode Loss from Manufacturer (Fuji)

Figure 8: IGBT and Diode Loss from Simulation

Future Work
- Selection of final converter components/topology
- Improved degradation and reliability analysis
- Assessment of PCS improvement proposals
- Evaluation of the effect of additional value-added functions

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