

The image features three overlapping orange banners with black outlines, set against a solid blue background. The banners are arranged horizontally, with the middle one being the largest and containing text. The left and right banners are smaller and positioned behind the central one, with their pointed ends facing left and right respectively. The text is in a bold, red, sans-serif font.

Session 4b
Staines II

High-Megawatt Converter Technology Workshop

Capacitor Technology for High- Megawatt Power Conversion

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Film Capacitors for Power Conversion

- Depending on frequency, capacitors can be the largest component in the system
- Requirements are
 - Low inductance
 - High rms current capability
 - Low loss
 - 100% reversal
 - High energy density
 - GA-ESI paper/polypropylene capacitors developed for SNS



IGBT switch plate assembly
(LANL SNS modulator)



GA-ESI Research Objectives

- **Long DC life at high energy density**
- **High-temperature Polymers**
- **Novel construction technique for high current and high energy density**
- **Improved metallized electrodes for self-healing and low ESR**
- **Packaging for high temperature and thermal management**
- **Thin film winding for low voltage applications**

High Temperature Polymers

- **Polypropylene film capacitors have highest energy density at low temperature**
- **Performance degrades rapidly above 40°C**
- **Investigating high-temperature films including**
 - Polyphenyl sulfide (PPS)
 - Polyetheretherketone (PEEK)
 - Polyetherketoneketone (PEKK)

Improved Metallization

- **Self-healing capacitors use thin metallization deposited on dielectric films instead of foil**
- **Fault current causes vaporization of metallized layer, quenching the fault discharge**
- **Thin ($\sim 300\text{\AA}$) metallization limits current and thermal dissipation**
- **Challenge is to improve thermal conductivity without sacrificing self-healing properties**
- **Self-healing allows operation up to limit of film breakdown voltage for higher energy density**

Impact on Converter Costs

- **High energy density passive components reduce the need for high frequency switching**
- **Reduces switching loss and switch stress**
- **Could use cheaper, more mature switch technology without prohibitive size, weight**
- **Metallized film capacitors fail gracefully**
- **Capacitor monitoring could identify when maintenance required to avoid failures**

Summary

- **Depending on frequency, capacitors can be the largest components in power converters**
- **Future development to focus on**
 - Increasing energy density
 - Reducing loss
 - Improving thermal management
- **Significant improvements in fast capacitor technology expected from improved engineering using proven film technology**
- **Smaller passive components may reduce requirement for high switching speeds**