HV Insulation
NIST/DOE Workshop on Enabling Technologies for Next Generation Electric Machines

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GE Global Research
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Imagination at work.
GE businesses

Aviation
$20B

Power & Water
$28B

Energy Management
$7B

Appliances & Lighting
$8B

Oil & Gas
$15B

Transportation
$6B

Healthcare
$18B

R&D Spending = $5+B/year
Main factors affecting insulation life

Sinusoidally fed:

- Voltage
- Frequency
- Temperature
Industry trends

Power density
Torque density
Temperature
Industry trends

Higher speed

Variable speed
Industry trends

Converter fed

Higher voltage
Main factors affecting insulation life

Converter fed:

- Voltage ramp rate
- Voltage overshoot
- Converter architecture
- Switching frequency
- Fundamental frequency
- Duty cycle
- Temperature

Interactions among the factors generate additional complexity
Do we need to do something? Yes!

**CIGRE Study Committee A1**

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

<table>
<thead>
<tr>
<th>WG* N° A1.53</th>
<th>Name of Convener: A. K. GUPTA (IN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E-mail address: <a href="mailto:akgupta07@ntpc.co.in">akgupta07@ntpc.co.in</a></td>
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Technical Issues # (2): XXXX  Strategic Directions #(3): 2

The WG applies to distribution networks (4): Yes

Title of the Group: Guide on Design Requirements of Motors for Variable Speed Drive Application

Fans, condensate extraction pumps, compressors, coal conveyors, coal feeders and ventilation system equipment. As the penetration of VFDs in industry and in power stations has increased, several motor failures have been reported worldwide and it has become clear that manufacturers don’t have common design criteria for inverter grade motors. The variety of VFD technologies available stresses the motor insulation differently. Thyristor based
What do we need to do?

• Could just add more insulation build…
What do we need to do?

• Need to understand fundamentals of aging & life

\[
\text{Remaining Life} = \int dt \, f(\text{main factors})
\]
What do we need to do?

• Use fundamental knowledge to innovate high-voltage insulation systems
  – Turn, phase, ground, grading, and armor
  – Computational materials discover
  – Temperature, thermal conductivity, breakdown strength, endurance, PD/corona resistance

• Materials
  – New polymers/epoxies/resins and inorganics
  – Nano…

• Processes
  – New ways of using old materials
  – Materials conversion
  – Manufacturing