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### **Question 1.5**

Today liquid-filled and dry type transformers are used for GSUs in photovoltaic and wind parks and also for reactors. Which insulation system should be recommended under which circumstances?

### **Answer**

Larger and larger transformers for renewable energy with higher and higher voltage levels promote liquid-filled insulation systems. Keeping in mind special installation sites and special operational conditions for GSU transformers, advanced insulation systems should be recommended, like robust insulation systems based on aramid insulation. If dry-type equipment is used, e.g. for inductive components, the high-performance insulation systems in thermal class 180 (H) may be used.

#### Aramid-based insulation for liquid-filled transformers

- Historically, offering maximum compactness for best utilizing tight space in wind turbine constructions, both onshore and offshore.
- Weight saving of transformer and nacelle translates in cost saving on supporting structure to hold the nacelle.
- In PV installations, allowing best use of tight space in containerized PV inverter installations, or allowing maximizing the power output within the given size limits of the container.
- Excellent overloading capability allows for design optimization for best fit to the expected loading patterns – especially important for optimizing design for repetitive loading pattern in PV installations, where high peak load can be assumed without compromising the transformer life.
- Ensuring long lifetime based on limited thermal degradation.
- Advanced insulation systems developed for power transformer that cover all range of insulation components needed.
- First aramid-based insulation system has been recently certified by UL for liquid-filled transformer that proves the recognized performance.

#### Class H insulation for dry-type transformers

- Offering the best temperature handling for dry-type transformers,
- Insensitive to overheating in case of high current harmonics,
- Insensitive to malfunctioning cooling systems,
- Most compact inductive components allowing minimizing power converters for wind or PV applications,
- Fire safety proven in multiple industrial applications and in railways.