

# **IEEE Transformer Committee Task Force on Power Transformer Tank Rupture and Mitigation**

## **Natural Ester Based Fluid Evaluation**

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One of the natural ester based fluid was evaluated to determine if the liquid is helpful in transformer tank rupture prevention and mitigation.

Based on the information available to the reviewer, here are the findings.

1. Natural ester based fluid is considered less flammable with much higher fire point as compared with mineral oil, 360°C (typ.) vs 165°C. Because of that a fire is more difficult to be ignited and if ignition does happen, it is easier to be extinguished.

2. Natural ester based fluid is considered biodegradable so the impact of a spill is much smaller.
3. On one of the fluid vendor's technical bulletin it is stated that "Previous high fault primary and secondary testing has shown that it is essentially not possible to ignite liquid less-flammable fluids by arcing as the ignition source."
4. This vendor's arcing tests were performed with an arcing source of 480 volts, 3,000 amps for 600 cycles. This works out to an arc energy of 14.4 MJ (based on 600 cycles).
5. Large power transformers are normally protected by breakers and the fault is normally interrupted in 2-5 cycles. Arc energy, often of tens of MJ, can be as high as >100 MJ for a period of a few cycles.

6. The lab test arc energy, if lasted only for 5 cycles, will be less than 1/8 MJ when ignoring asymmetry.
7. The test does not quite represent the actual arcing situation for large power transformers with much higher arcing voltage and current.
8. So far the largest unit filled with this brand fluid is a retrofill, 200 MVA, 161 kV put in service in 2004.

### **Conclusions:**

1. The higher fire point of natural ester fluid might be helpful in tank rupture and fire.
2. Testing conducted at the vendor's lab does not quite represent actual arcing condition of a large power transformer, namely the energy level is too low.

3. More tests with much higher energy level are needed to properly evaluate the fluid.

4. Field experience regarding failure of large units filled with natural ester fluid will definitely help in determining the usefulness of the fluid in tank rupture and subsequent fire prevention.