

Green power needs the **green fluid.**

Take your wind turbines to a higher level by using FR3® fluid by Cargill to help make your transformers more compact and sustainable*, all at a lower cost than synthetic fluid filled and dry-type transformers.



More sustainable

- Global Warming Potential (GWP) of zero and carbon neutral
- Biodegradable in as little as 10 days



Higher loading capacity

- More compact transformers with up to 20% more loading capacity



Cost savings

- Save up to 50% compared to the cost of synthetics



Maintenance free

- No maintenance needed under normal operating conditions
- Easily handles high heat with 140°C¹ top fluid temperature limit



Superior fire safety

- Up to 50°C higher flash and fire points*
- Zero reported fires in 25+ years

*Compared to a synthetic fluid filled transformer.

¹According to IEC 60076-14 and IEEE C57-154.

FR3
a Cargill brand

Wind Power FAQs

Do I need to worry about oxidation when using FR3® fluid?

No. FR3® fluid is designed to be a robust solution for use in non-free breathing transformers where it will last the complete lifespan of the transformer without the need of any maintenance. If there is a breach in the sealing system, FR3® fluid's oxidation is expected to require over 10 years to lead to a 10% increase in viscosity, and this will not negatively impact any characteristics of the fluid. The only effect will be the transformer running approximately 2°C hotter.

Under free breathing conditions for both natural and synthetic esters, the first maintenance limit to be surpassed is the allowable moisture content of the fluid. This may lead to a decrease in the breakdown voltage, which happens faster in synthetic fluids due to its higher moisture absorption and the lack of "self-drying" properties inherent to FR3® fluid. Also, acid content and dissipation factor maintenance limits will be reached in approximately 5 years, many years before any impact on viscosity due to oxidation is detected.

Can I retrofit existing transformers with FR3 fluid?

Yes, FR3 fluid can be used to retrofit both synthetic and mineral oil filled transformers. In fact, many wind turbine farm operators have been retrofitting synthetic-filled transformers with FR3 fluid in order to improve reliability and reduce maintenance. Both synthetic fluid and mineral oil have issues handling the difficult harmonics and varying load capacities in wind generation, which causes accelerated aging of the insulating fluid. FR3 fluid is specially formulated to handle high heat and challenging harmonics without accelerated aging of the fluid.

Is FR3 fluid miscible with synthetic fluid?

Yes, FR3 fluid is fully miscible with synthetic fluid. In a typical retrofit, Cargill would expect to see 3-5% residual fluid remaining, which does not impact FR3 fluid's performance.

Are there diagnostic tools available for FR3® fluid?

Yes. There is a complete set of standards from both the IEC and IEEE with guidelines for maintenance based on physical-chemical analysis. All the traditional DGA tools such as basic ratios, simplified ratios, and CO₂/CO can be used. Specific Duval Triangles and Pentagons for FR3 fluid are also available to perform a more accurate analysis of generated gases.

Can FR3 fluid be used in cold weather?

Yes, FR3® fluid is recommended for all non-free-breathing transformers, **regardless of ambient temperature.** FR3 fluid maintains breakdown voltage and the transformer's dielectric capacity down to -50°C (-58°F) and is qualified to be energized under normal operating conditions defined by IEC down to -25°C and IEEE down to -20°C.

For very cold climates, Cargill recommends using the same cold start procedures already defined by turbine manufacturers - start with a reduced load for a certain period of time and after, use a linear increase up to full load. This will allow for a smooth temperature increase on the transformer and will guarantee suitable fluid flow inside it.

How are larger wind turbines impacting transformer specifications?

As turbine blades grow well over 100 meters in length, more powerful transformers are needed to transmit all the power being generated. As transformers become larger, more insulating liquid is needed, and the insulating liquid becomes a larger portion of the overall cost of the project. FR3 fluid filled transformers can be built more compact while still maintaining a high loading capacity, all at a lower cost than synthetic fluids.

Dry-type transformers are becoming too large to fit in the nacelle or are already past the limits of how much capacity they can provide, making them a poor fit for today's large wind turbines.

Learn more about how FR3® fluid can make your transformers more compact, sustainable and higher performing at FR3fluid.com.

© 2022, Cargill, Incorporated. All rights reserved.

