



## FR3 FLUID PROVIDES SUSTAINABLE ALTERNATIVE FOR REDUCING CARBON FOOTPRINT

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With the mounting evidence of global warming and the growing recognition that increasing atmospheric levels of carbon dioxide (CO<sub>2</sub>) are a key contributing factor, regulatory pressure to reduce CO<sub>2</sub> emissions has been gaining momentum. As the global community is focused on mitigating the effects of global warming by reducing greenhouse gases, there is an increased demand for products and solutions that would limit and/or offset a company's carbon footprint.

### FR3 Fluid Information

Envirotemp FR3 transformer fluid is a soy-based, biodegradable, fire-resistant dielectric coolant used to insulate electric transformers. Because FR3 fluid is derived from 100% edible seed oils and uses safe additives, it has a superior environmental and safety profile when compared to mineral oil.

Among the many notable environmental advantages FR3 fluid has over mineral oil, there is one in particular that is gaining awareness in the industry. Studies show that using FR3 fluid instead of conventional petroleum-based mineral oil will reduce a company's carbon footprint. The primary material for FR3 fluid is derived exclusively from soybean plants, which sequester carbon dioxide from the atmosphere.

### A Comparison

The U.S. National Institute of Standards and Technologies (NIST) developed software—Building for Environmental and Economic Sustainability (BEES)—that provides a life-cycle assessment of building materials at every stage in the production life that includes initial investment, replacement, operation, maintenance and repair, and disposal. Using the BEES software, NIST performed an analysis on transformer oil,

juxtaposing conventional mineral oil and its environmental performance to that of the soy-based biodegradable FR3 fluid.

The results indicate that petroleum-based mineral oil has a significantly higher environmental impact in comparison to Envirotemp FR3 fluid. The primary component of FR3 fluid is derived from soybean plants, which act as a carbon sink. This CO<sub>2</sub> absorption during the growing period for soy plants contributes to the sequestering of carbon emissions and assists in reducing a facility's carbon footprint.<sup>1</sup> FR3 fluid, manufactured from domestically grown soybeans, performs considerably better as it has a significantly smaller carbon footprint than mineral oil. According to the latest BEES report (4.0e), a 1000 kVA rated transformer containing 500 gallons of Envirotemp FR3 fluid lasting 30 years has an estimated carbon footprint of roughly 34,260 g CO<sub>2</sub>e/unit, whereas a transformer with the same specifications containing mineral oil has a carbon footprint of 1,899,973 g CO<sub>2</sub>e/unit. In other words, mineral oil produces 56 times more carbon emissions than that of the FR3 transformer fluid.

Another benefit of using FR3 fluid is that it extends the lifespan of the transformer, providing longer utilization. Cooper Power Systems has done extensive studies showing FR3 fluid extends the life of the insulating paper by 5 to 8 times—which directly extends the expected thermal life of a transformer. From testing, this life-extending property of soy-based FR3 fluid has been conservatively estimated to double the lifespan of the transformer. By deferring the need for replacement, the longer lifespan also delays the amount of carbon emitted from manufacturing and installing a new transformer and disposing the old units. In addition to having a significantly larger carbon footprint, mineral oil, which

is a derivative of crude oil, is a finite resource. World demand of petroleum is expected to increase over 40% by 2030, which will contribute to the depletion of our increasingly limited supplies of oil.<sup>2</sup> As supplies are limited, FR3 fluid provides a sustainable alternative to traditional mineral oil as its main ingredient is from a renewable resource.

### Utilities Commitment

Utilities across the United States are becoming aware of the exceptional environmental performance FR3 fluid has over conventional mineral oil. Xcel Energy was one of the first major utilities to make the switch and plans to install as many as 15,000 new single-phase transformers filled with FR3 fluid. Based on their annual purchasing history of distribution transformers, Xcel Energy would avoid the use of approximately 336,000 gallons of mineral oil by specifying FR3 fluid, ultimately reducing their CO<sub>2</sub> emission by nearly 16,000 tons annually.

Other utilities have also committed to using FR3 fluid in their distribution transformers, in attempts to reduce their carbon footprint. It has been estimated that ComEd will reduce annual carbon dioxide emissions by more than 1,400 tons of carbon dioxide per year by using overhead transformers with soy oil insulation fluid. Alliant Energy has also made the switch to FR3 fluid—reducing its carbon footprint by 7,280 tons annually. “That's the equivalent of taking 1,210 cars off the road each year. Those numbers include eliminating the need for about 168,000 gallons of petroleum-based mineral oil annually.”<sup>3</sup>

Continued on page 17

## FR3 FLUID PROVIDES SUSTAINABLE ALTERNATIVE FOR REDUCING CARBON FOOTPRINT

From page 7.

By utilizing a soy-based dielectric fluid, utilities across the nation are able to deliver reliable service to their customers and participate in the global effort of reducing atmospheric levels of CO<sub>2</sub>. Public owned utilities are also using FR3 fluid in their distribution transformers, including the California-based electrical utility Sacramento Municipal Utility District.

### Regulation

In the current political climate, FR3 fluid has the potential to do more than just reduce a company's carbon footprint. The volume of domestic and international carbon regulatory bodies, such as the Regional Greenhouse Gas Initiative, the Carbon Climax Exchange, and the European Union Emission Trading Scheme, has been increasing substantially in recent years. In many cases, these institutions place limits to the amount of carbon that can be emitted into the environment—allowing for companies to purchase carbon offsets to reduce their carbon footprint. Examples of carbon offset projects include those which incorporate wind generation, contain methane generated by farm animals and landfills, include planting trees, or enhance energy efficiency.

Carbon regulation has also manifested

into policy at the local level. California, Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont are taking the first steps to limit carbon emissions, while Massachusetts and Kansas are in the process of developing CO<sub>2</sub> regulatory legislation. Oregon and Washington have already mandated that power plants are required to offset a certain percentage of anticipated carbon emissions.<sup>4</sup> Considering the carbon political activity at the local level, a national policy that implements a carbon cap and trade system is likely to occur within the next presidential administration. If a national cap and trade policy were to be passed, the value of a carbon credit has been estimated to reach or exceed \$40 USD per carbon ton. Under these circumstances, a utility making annual distribution transformer purchases of \$1,000,000 would yield a potential carbon credit value of \$19,000. Companies would be gaining roughly a two percent rebate on their transformer purchase.

### FR3 Fluid and the Future

There are many environmental and economic benefits to be gained by using a biobased fluid in distribution transformers. Using FR3 fluid would allow for a

significant reduction in greenhouse gases as compared to mineral oil. From reducing the harmful effects of transformer spills and avoiding fires to reducing a company's carbon output, it is evident that FR3 fluid not only enhances safety and reliability for the electrical grid but assists utilities in implementing sustainable business practices. ■

1. "Building for Environmental and Economic Sustainability Technical Manual and User Guide" National Institute of Standards and Technology. August 2007.
2. "International Energy Outlook 2007" Energy Information Agency. (May 2007) <<http://www.eia.doe.gov/oiaf/ieo/oil.html>>
3. "Alliant Energy makes the move to FR3 fluid for its distribution transformers." 26 February 2008. <<http://www.alliantenergy.com/docs/groups/public/documents/pub/p016407.hcsp>>
4. "States with a Carbon Cap or Offset Requirement for Power Plants" PEW Center on Global Climate Change. (2 April 2001) <[http://www.pewclimate.org/what\\_s\\_being\\_done/in\\_the\\_states/cap\\_and\\_offset\\_map.cfm](http://www.pewclimate.org/what_s_being_done/in_the_states/cap_and_offset_map.cfm)>

## DEMAND RESPONSE: A GOOD THING FOR EVERYBODY

From page 12.

- The residential sector delivered 32% or 3,600 MW.
- These results are encouraging because:
  - DR has risen steadily since 2004.
  - 2007 results may well exceed 13,000 MW.
  - DR in Canada is increasing.
- These results indicate that the residential sector's market potential for DR is primarily untapped.
- 46 million of them have central electric air conditioning.
- 24 million have electric water heating.
- 18 million have central electric heating systems.
- Assuming that 25% of these candidates could be persuaded to participate in summer peak-period demand response programs:
  - 11.5 million families having more than 12.5 million central air conditioning units would provide over 12,500 MW of summer peak-demand relief.
  - The U.S. has yet to tap over 70% of the air conditioning load control potential.

### The Residential Demand Response Potential

- The U.S. has about 66 million families living in single-family, owner-occupied housing units.
- These 66 million families are the primary candidates for participation in utility-sponsored residential demand response programs.

### The Emerging Demand Response Market—Cooper Power Systems' Role

Numerous utilities across the United

States have made large investments in load management systems. Cooper is supporting these existing systems with its Cannon Yukon software platform alongside its newest technologies—allowing utilities to migrate smoothly from older to new technology without needing to replace the entire investment immediately.

Secure hosted Web access through the Yukon advanced energy services platform supports our entire suite of intelligent devices. The widely used Yukon DR platform fully supports thermostat programming, meter data integration for dynamic pricing, consumer access, and much more.

Cooper Power Systems looks forward to building on its history for innovation while solidifying its position as a leading demand response solutions provider in North America. ■