



# On-Line Transformer Dehydration

**DRYER TRANSFORMERS = LONGER ASSET LIFE**

Situations exist where transformers consistently support an existing customer load and simply cannot be taken out of service. SPX Transformer Solutions' on-line dehydration system solves this problem. On-line dehydration equipment is monitored and controlled remotely through a satellite communication system. While oil can be dehumidified quickly, diffusion of moisture from the insulation system through the oil may take several weeks—or months. This remote monitoring and tracking capability serves to validate the achievement of desired results prior to finalizing the drying process and moving the equipment to another transformer or site.



## WATER IN TRANSFORMERS IS A PROBLEM

- Water lowers the dielectric strength of oil and paper insulation, increasing the risk of dielectric failure
- Water increases the aging rate of cellulose, limiting the useful life of the asset
- Water limits the ability to overload the transformer and could restrict the capacity to operate the utility system under emergency conditions

## ON-LINE DRYING

To remedy high water content, SPX Waukesha offers an on-line dryout option that provides many advantages over alternate dryout methods:

- Elimination of the need to take a service outage for field drying
- Reduction in labor requirements
- Reduction in capital requirements
- Unattended operation with ability to remotely monitor progress
- Less power consumption

## EQUIPMENT SPECIFICATIONS AND ADVANTAGES

- Portable equipment can be easily relocated for use on multiple units
- Satellite communication system allows for drying process to be remotely controlled and monitored
- Switching system from "active drying" to "monitoring" mode allows for distinguishing when transformer dryout is complete
- Continuous monitoring provides real-time information on flow rates, moisture content, oil temperatures and operating pressures while periodically reporting on the dryout process
- Drying media can absorb up to six gallons of water before cartridge change is required; filter media is recycled—no disposal or environmental requirements
- Dual moisture content monitors for inlet and outlet oil
- 0.5 micron particle filter helps improve oil quality by catching suspended fragments
- System is fully purged with oil—no concerns with low oil levels
- Oil pump is seal-less and leak-proof
- Oil flow rate: 300 GPH
- 240 V, 20A single phase power required

## DRYING PROCESS

The on-line drying process is accomplished by removing water from mineral oil by passing it through an external drying media. By reducing the saturation point of water in oil, the water is transferred from the solid cellulose insulation to the oil where moisture can be removed.

Because 99% of the available water in a transformer's insulation system is in the solid cellulose insulation, the drying process is typically slower than off-line drying methods. This process is best accomplished when the oil temperatures are above 40°C to allow for the highest moisture equilibrium in the oil and highest rate of moisture transfer. The chart at right gives an approximation of the drying time required to reduce transformer moisture content to less than 1% based upon the initial relative saturation of the moisture in oil, the insulation weight of the transformer and an average oil temperature of 40°C.

Since the drying is accomplished by drying media, there is no effect on dissolved gas in the transformer. Therefore, no operating abnormalities that might produce dissolved gasses would go undetected in routine sampling and analysis.

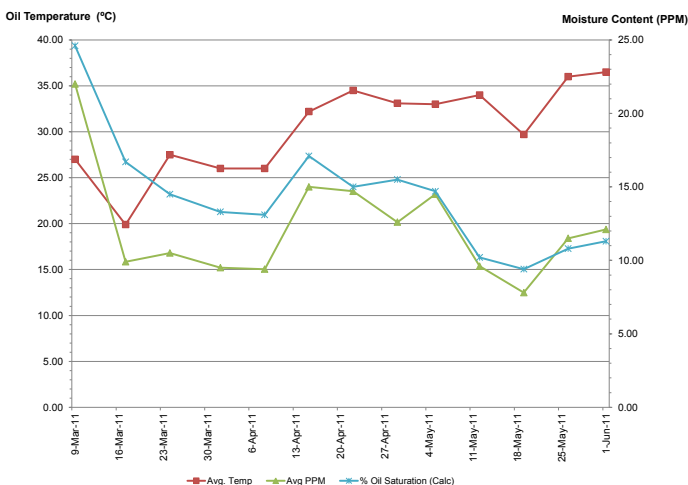
## TYPICAL RESULTS

During a short drying process for an electric utility in the south-eastern United States, SPX Waukesha equipment was used to monitor and perform on-line drying of a 69kV-13.8kV power distribution transformer:

### Key Facts

Gallons of Oil:	3525
Drying Time:	12 weeks
Initial Water Saturation:	30%
Water Removed:	96 oz.
Final Water Saturation:	10%
CH Power Factor:	Reduced 15%
CHL Power Factor:	Reduced 37%
CL Power Factor:	Reduced 15%

## ON-LINE DEHYDRATION RESULTS



## TYPICAL DRYING TIMES

INSULATION WEIGHT	MOISTURE CONTENT					
	< 2%	2-3%	3-4%	4-5%	5-6%	> 6%
< 1500 lbs	15 Days	30 Days	45 Days	60 Days	90 Days	120 Days
1500 - 2500 lbs	20 Days	40 Days	60 Days	80 Days	120 Days	160 Days
2501 - 3500 lbs	30 Days	60 Days	90 Days	120 Days	180 Days	240 Days
> 3500 lbs	40 Days	80 Days	120 Days	160 Days	240 Days	320 Days

NOTE: If the average winding temperature is less than 40°C, increase processing time by 15 days for every 5°C decrease in temperature.

## SAFETY CONSIDERATIONS

Because the process is ongoing with live equipment, SPX Waukesha has designed a number of safety features into the system and drying process:

- Low oil level detection
- Loss of flow detection
- Double wall hoses with leak detection monitoring
- Solenoid valves at inlet and outlet ports of transformer to provide safe shutdown on any alarm event or power failure
- Oil leak detection in drying unit sump
- Visual monitoring through web camera and automated alarm notifications to monitoring center



Contact us for additional information or quotation on our extensive range of services:

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