



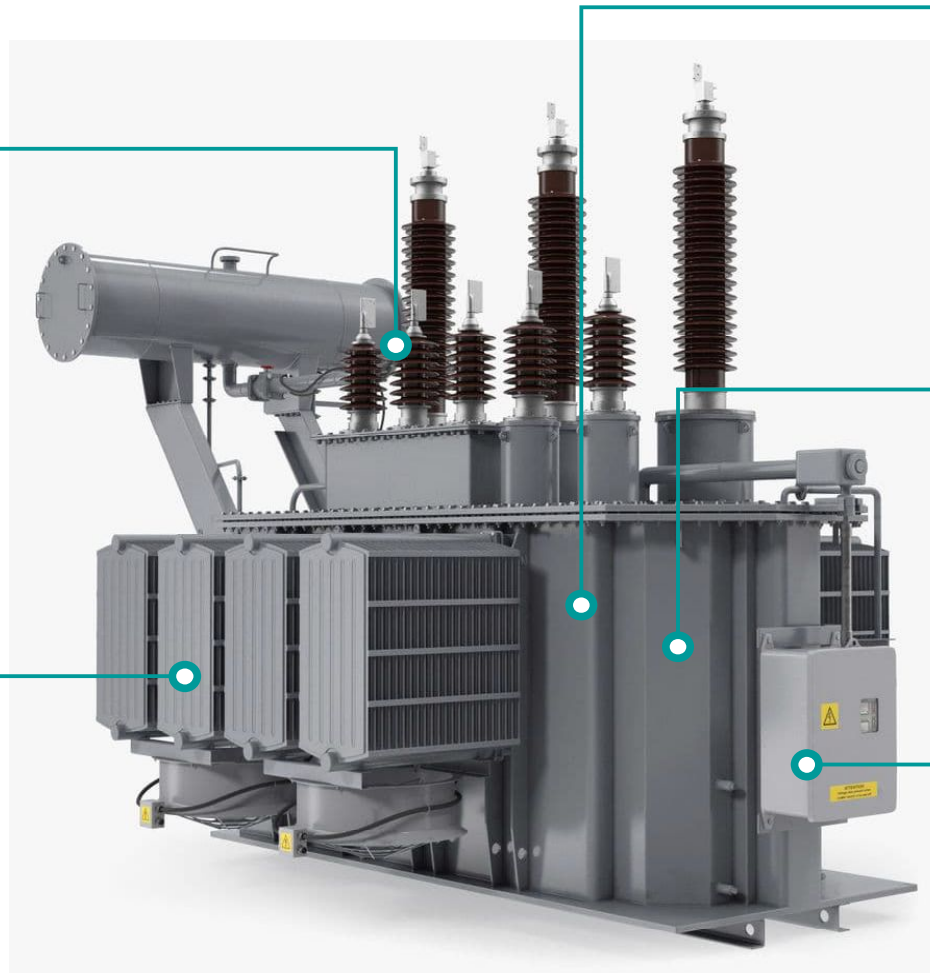
Transformer Condition Monitoring

HV/LV/MV Bushing

- Overheating
- Insulation Aging
- Bad Tap Contact
- Short Circuit in Capacitive Layers
- Moisture Ingress
- Partial Discharge

Cooling System

- Fan/Pump Failure
- Cooling Control Failure
- Pump / Fan Running in Reverse
- Radiator Blockages
- Reduced Efficiency
- Fan/Pump End of Life



Winding and Magnetic Circuit

- Winding / Core Overheating
- Excess Moisture in Insulation
- Generation of Bubbles
- PD in Winding Insulation
- Loose connection with Bushings
- Loss of Core Ground
- Unintentional Core Ground

Main Tank and Oil

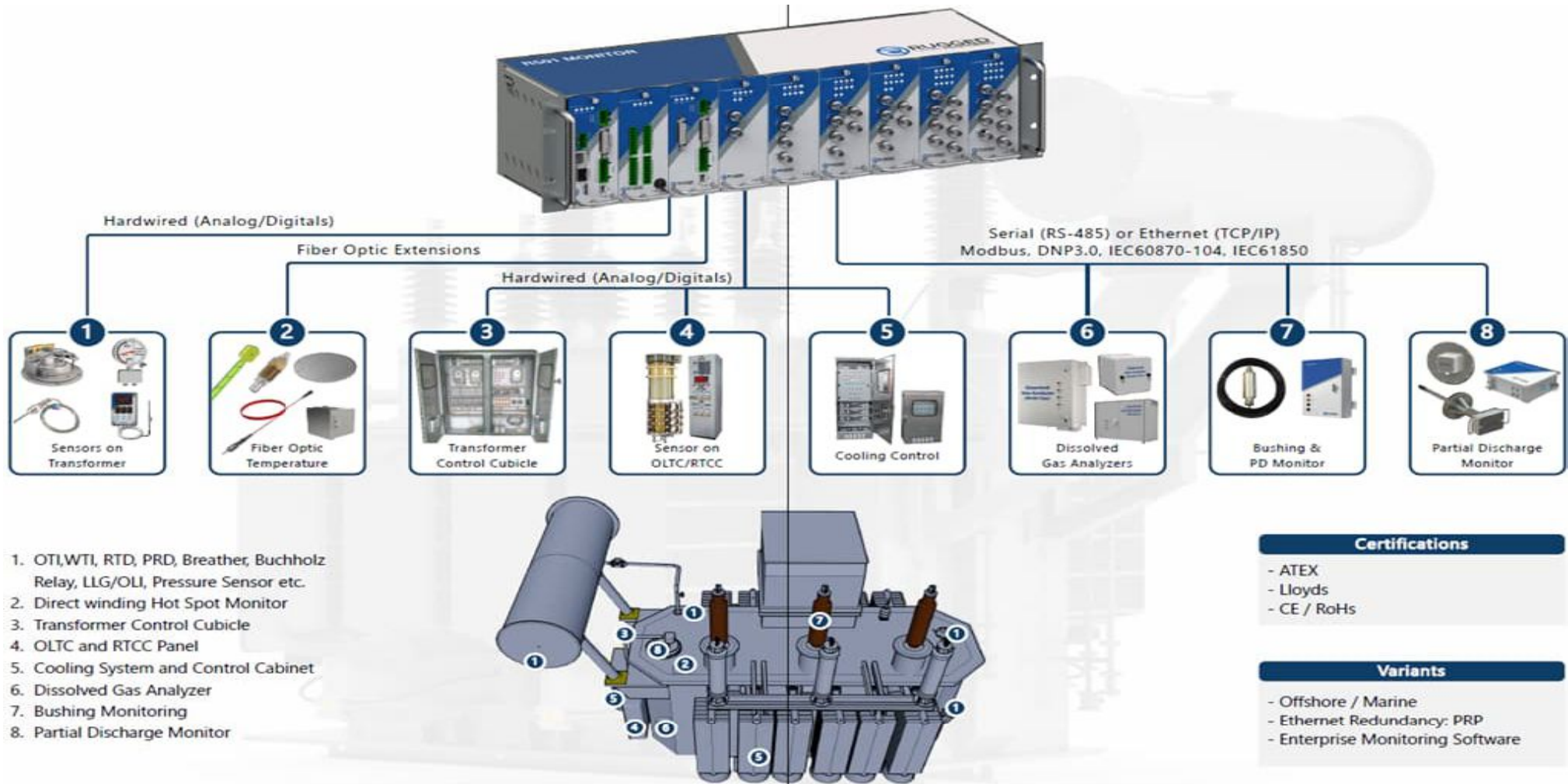
- Excess Moisture in Oil
- Loose Connections
- PD in Oil Insulation
- Oil Level drops
- Sudden Rise in Tank Pressure
- Conservator Bladder Rupture

On Load Tap Changer (OLTC)

- OLTC End of Life
- OLTC Contact Coking
- OLTC Multiple Tap Movement
- OLTC Excess Arcing
- OLTC Motor Drive Issues
- OLTC Oil – Weak Insulation

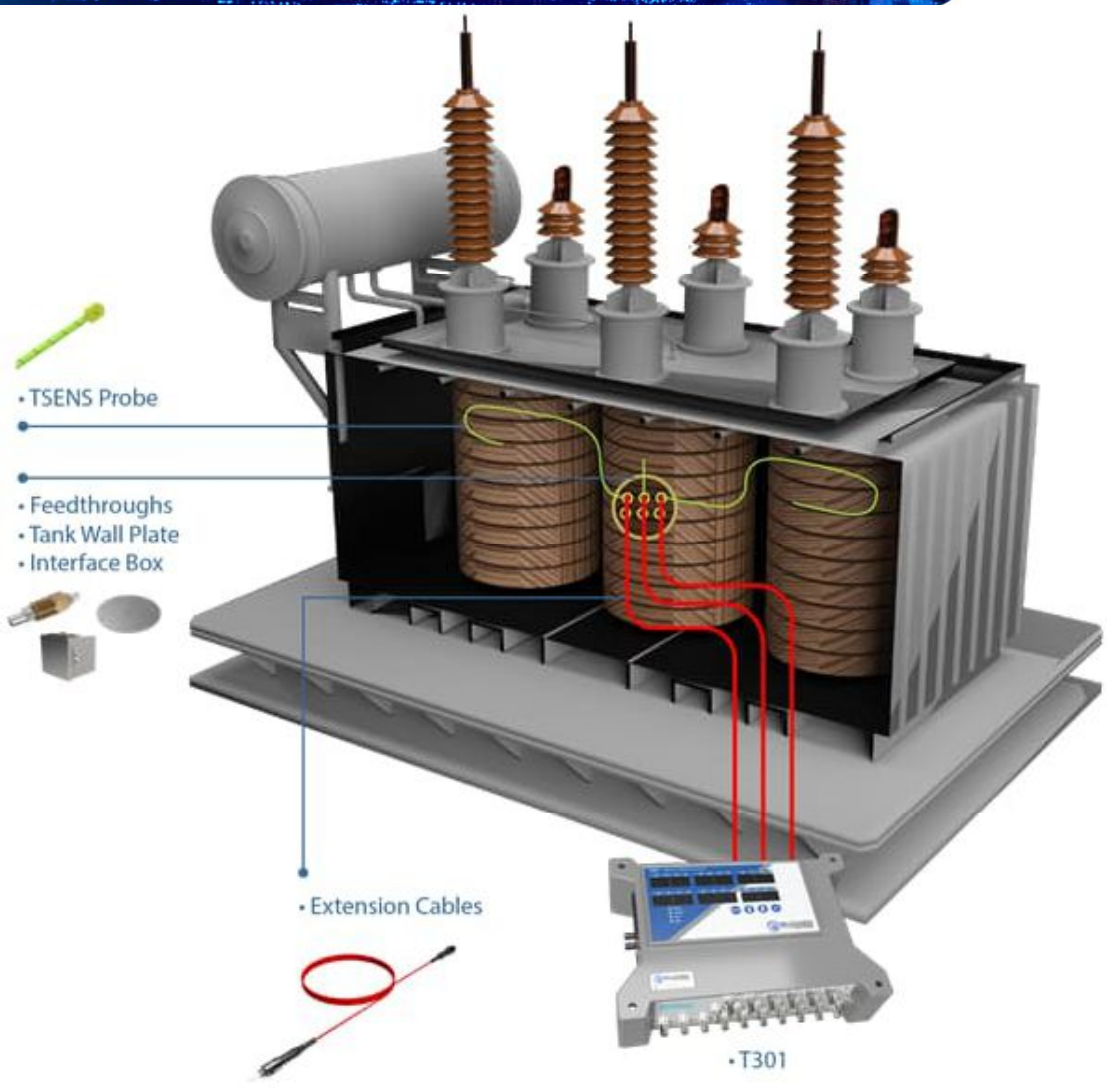


Transformer Condition Monitoring – R501

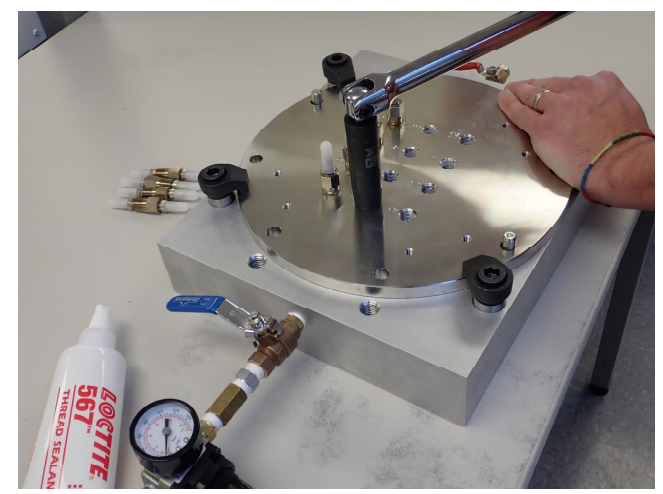




Transformer Condition Monitoring – FOTS



Fiber Optic Temperature Sensors installed on the Spacer



Transformer Tank Wall Plate & Feedthroughs



Transformer Bushing Monitoring System

1. Bushing Monitoring (BMT301)

- System Voltage Range: to 1000kV (50 / 60Hz)
- Standard 06 Bushing Solution (Extendable up to 12 bushings)
- Leakage Current
- Power Factor (Tan Delta)
- Capacitance

2. Safer Bushing Adaptor Design

3. Support for Multiple bushing Monitoring Techniques

- Sum of Current Method
- Adjacent Phase Method
- Comparison Method
- VT Reference Method

4. Partial Discharge Monitoring

- Solution available with Bushing Monitoring
- PD Magnitude
- PD Discharge Rate
- Severity of Partial Discharge

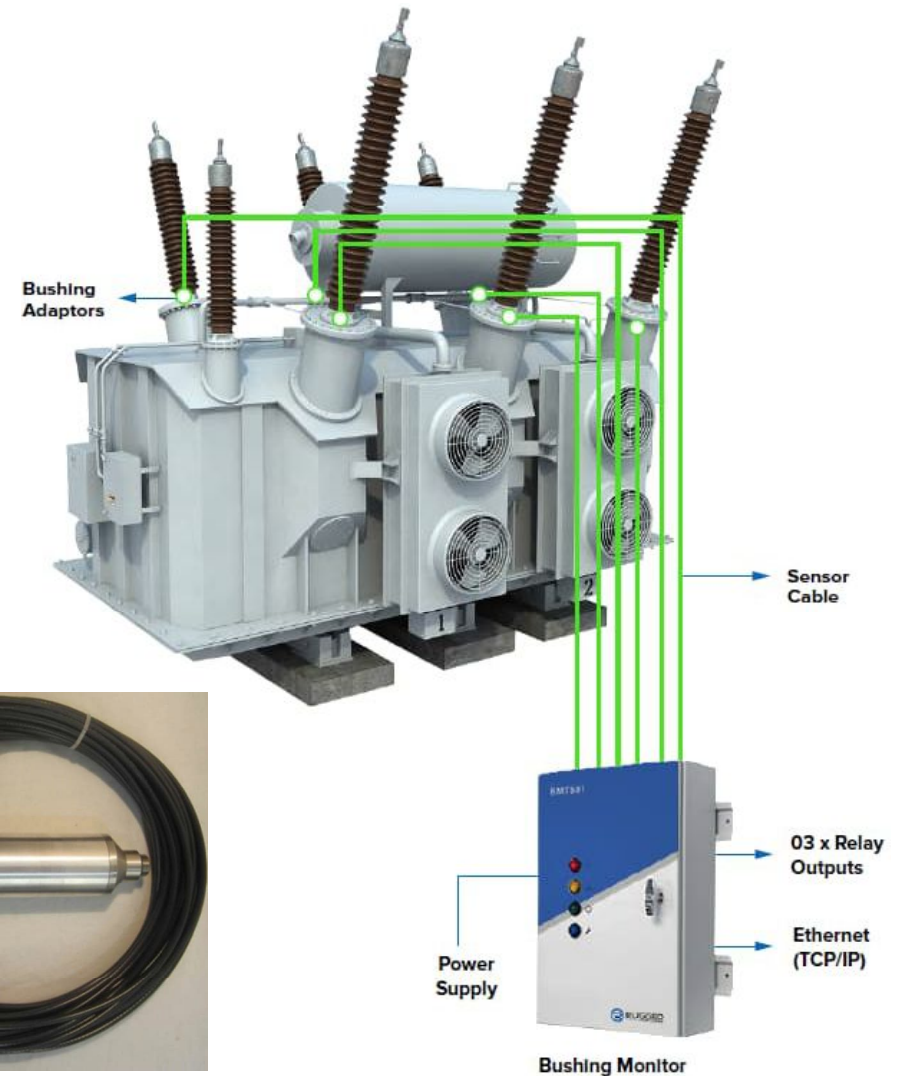
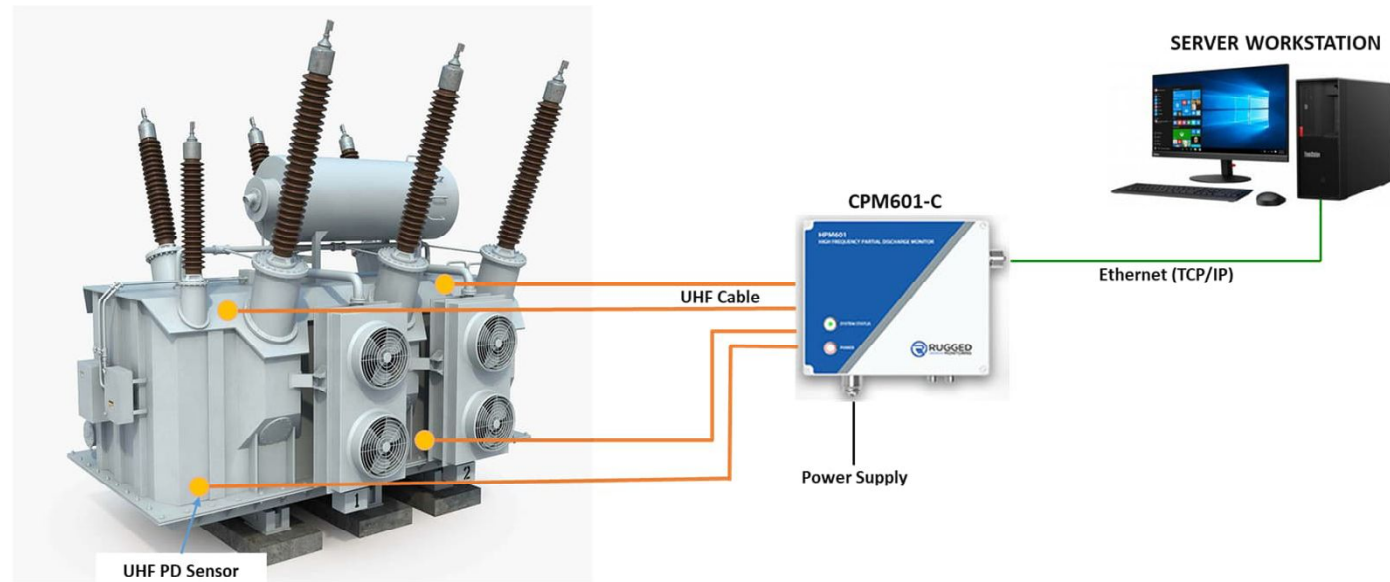


Figure 11: Bushing Tap Adaptors



Transformer Partial Discharge Monitoring System

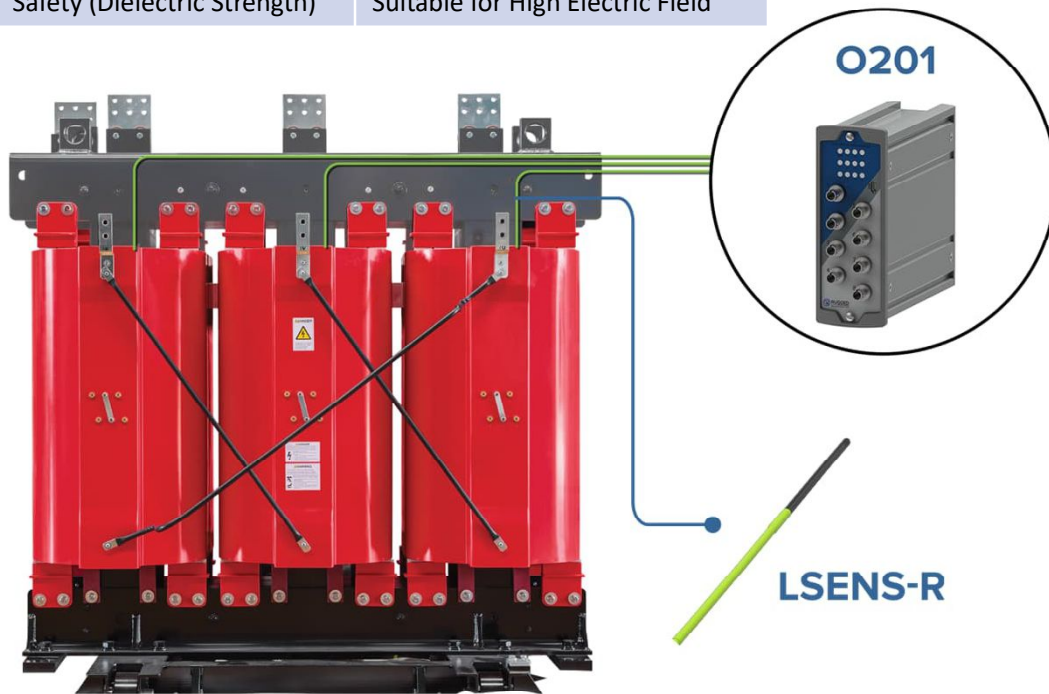
- 1. BMT601: Partial Discharge Monitoring via Bushing Adaptors/Sensors**
 - Integrated with the Bushing Monitoring System
 - Cost Effective and Easy to Retrofit Solution
- 2. CPM601: Advance Partial Discharge Monitoring Using UHF Technology**
 - Most accurate PD Monitoring with Fault Categorization and Localization flexibility
- 3. Key Features of PD Analysis:**
 - Measures all attributes of Partial Discharge: Magnitude (Amplitude), and Discharge Rate
 - Flexibility for PD Severity Analysis





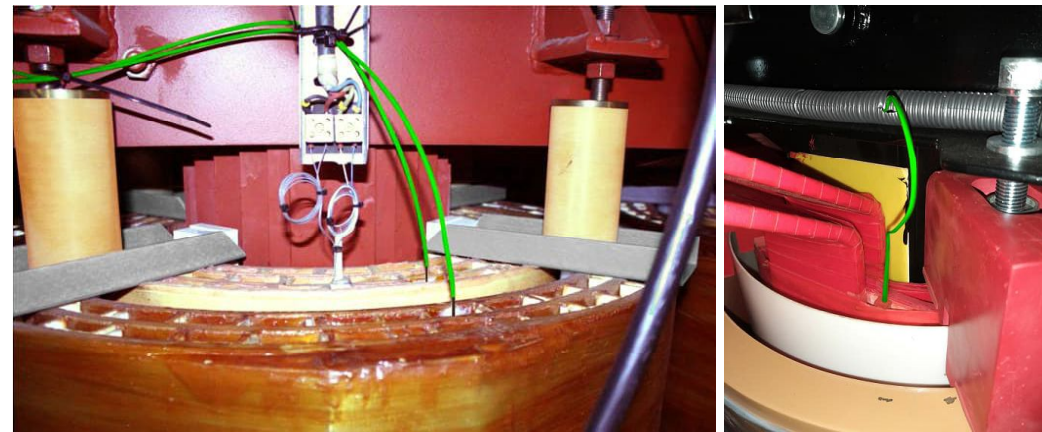
Dry Type Transformers – Winding Temperature Monitoring

FO Sensors/Monitors	Value/Comments
Accuracy	$\pm 1^{\circ}\text{C}$
Temperature Range	-80°C to + 250°C
Sensor Size	0.5mm to 3mm
Response Time	200 ms
Safety (Dielectric Strength)	Suitable for High Electric Field



System Architecture: FO Sensors and Monitors

1. Most accurate hot spot measurement of all Windings and Core temperature
2. Maintenance Free; No Recalibration required
3. Portable PDM System for Partial Discharge Testing and Monitoring
 - IEC 60270 compliant PDM system
 - Suitable for connection with Capacitive Divider / Couplers
 - Advance Filtering and Noise Gating for accurate PD detection
4. Cost effective solution for PD testing in Transformer Factory
5. Most accurate solution for PD testing and monitoring on site.



Fiber Optic Sensors Installed into Dry Type Transformers