Fuji Electric

Innovating Energy Technology

High-precision remaining life assessment services for oil-filled transformers

Winner of PM Excellent Product Award (Development Award) from Japan Institute of Plant Maintenance
Winner of Technical Achievement Award (Development Award) from Japan Electrical Manufacturers' Association

Do you have any transformers in use for more than 25 years?
The service life expectancy of a transformer is 30 years.

"The damage from accidents caused by aging deterioration is huge."
"If it's still usable, that's already a sign of danger."

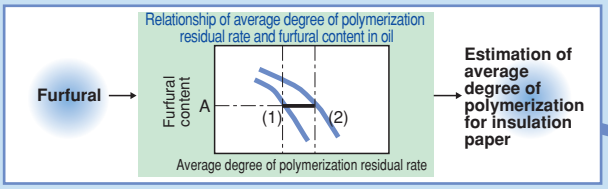
At Fuji Electric
"We can very precisely predict the remaining service life using our own structured neural networks."

Structured neural networks

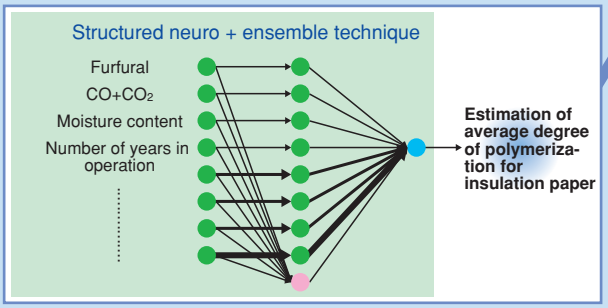
Fuji Electric' s proprietary prediction and diagnosis technology was developed to be more highly precise and uses a modified neural network technique capable of learning complex multivariate relationships and automatically tuning the structure of the model.
We have a proven track record that includes forecasting electricity demand and optimizing energy plant operations.

Predicting remaining service life using structured neural networks

Conventional method (Furfural method)

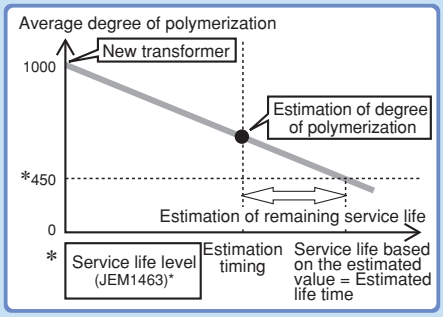


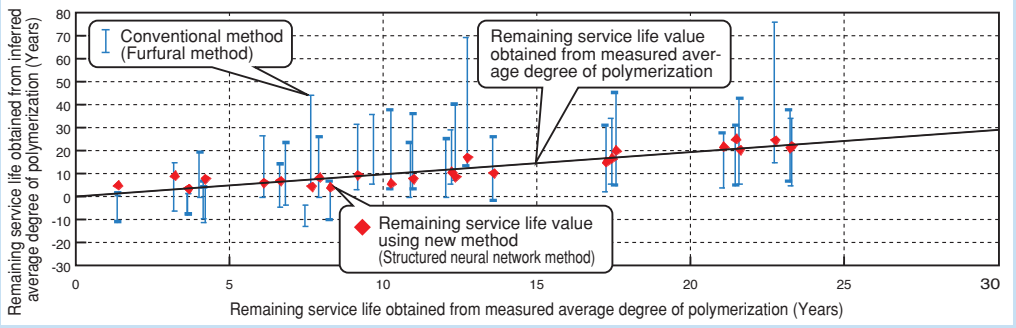
Method using structured neural networks



Problem:
The estimation range of the average degree of polymerization residual rate corresponding to the amount of furfural A is wide [(1) to (2)].

Remaining service life prediction





*JEM1463 is the evaluation criteria for the average degree of polymerization for transformer insulation paper.
(Evaluation criteria for the average degree of polymerization of the insulation paper used for the coil of an oil-filled transformer over 1,000 kVA.)

Conventional method (Average prediction range)	**15 years**
Structured neural network method (Average prediction range)	**3 years**

Flow of remaining service life assessment

Intended mainly for transformers with more than 15 years of operation.

- Extraction of 1 liter of oil from transformer
- Oil analysis
  - 1. Analysis of gas in oil
  - 2. Examination of oil characteristics
  - 3. Furfural analysis
- Estimation of average degree of polymerization using structured neural networks
- Remaining service life prediction

Please tell the **number of years in operation and the load factor.**

Optimal replacements timing

Optimal maintenance plan

We will respond promptly.

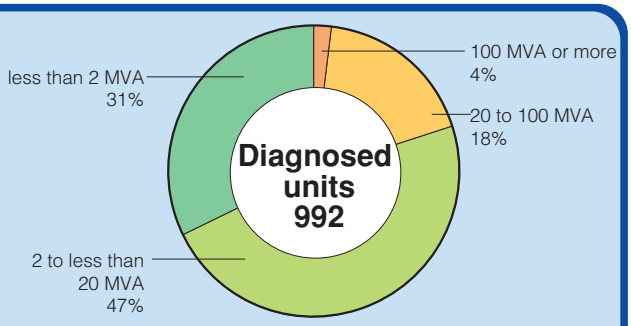
Typical schedule: Oil extraction, oil analysis: 5 days
Remaining service life prediction: 2 days

Inspection cycle and replacements timing

Classification	Part	Inspection cycle and replacements timing	Considerations
Parts in oil	Inside main unit	Consider an internal inspection depending on the results of an oil gas analysis performed once every 1 to 2 years.	There is a service life expectancy of 30 years.
Oil sealed units	Gasket Seal section	Total replacements of gaskets about every 15 years.	Since transformers are generally said to have a service life of 30 years, during that time parts are replaced one time.
Air accessories	Protection relay type parts	Replacements in 15 years.	
Mechanical wear parts	Cooling devices Oil pumps Cooling fans	Total replacements when bearings are worn.	Regularly maintained against wear.
	Load tap changers (LTCs)	Inspect at every switching frequency of 30,000 to 70,000 times. Replace at: switching frequency of 200,000 times (electrical) switching frequency of 800,000 times (mechanical)	

Our diagnosis experience

As of the end of March 2013 we have diagnosed 992 transformers (of which 30% were competitors' products). As a result, the diagnosis results helped our customers to make replacements plans or to review maintenance plans and we won a reputation for our diagnosis services that can be utilized effectively to create optimal maintenance and replacements plans.



Fuji Electric has presented on its structured neural networks and high-precision remaining service life assessment for oil-filled transformers at at various academic conferences.

"Method for optimizing the learning of a neural network" (JP Patent 2008-4226754)
"Deterioration diagnosis method for oil-filled electrical equipment" *
"Remaining service life estimation method for oil-filled electrical equipment" *

*: Patent pending

⚠ Safety precautions

Note: Before using this product, in order to use it correctly, be sure to carefully read the Instruction Manual and Specifications, or contact our company or your dealer for information as necessary.
Note: This product is intended to be handled by persons with specialized technical knowledge.

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