Less Maintenance, More Time

Best Transformer

R&D Center

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BEST TRANSFOMER

by A. Kerem KÖSEOĞLU

Expect more from your transformer

Less Maintenance, More Time is the concept.

With increasing energy demand and complexity of power systems, substation and number of transformer in a grid increases too. The expectations of the users of transformers are simple: long lasting, mistake free operation with as low maintenance cost as it could be.

As Best Transformers; we want to help our valuable customers about this. We aim to minimize the maintenance requirement for transformers that we produce mostly in accordance with the special requests of our customers and to increase the life of the transformer. In line with this goal, we developed the concept of “Less Maintenance, More Time”. With these solutions, you’ll have more time for your transformer in operation and less maintenance with lower costs. Thus this will create you more time…

Below we have listed different solutions to reduce the maintenance of transformers with the concept. Some of them are already in use, some of them are under development but they surely can give you more space for maintenance:

- Ambient Monitoring System
- Use Of Thermal Camera
- VR Glasses
- Using A Vacuum Type Tap Changer
- Use Of Best Transformer Monitoring System
- Automatic Dehydratıng Breather
- Lack Of Supply Voltage
- Oil Filter Unit
- Training

1) Ambient Monitoring Systems

Durability of transformer is very important but if it is designed accordingly. Transformer designs have been made according to customer requirements. But what if there is a change in environment conditions? That will lead even the best transformer to fail or more often maintenance checks.

Temperature: Temperature change is the most important environment variable for many places. It is important for the health of the systems to determine temperature changes in the places where many expensive devices and equipment are constantly in need of cooling. After a deteriorating cooling system, the environment can reach high temperature levels, causing major damage to equipment. This phenomenon is more important with global warming is one of the main climate issue.

It is not possible to control air temperature for transformers but preparing transformer ready for a new ambient condition will increase its performance. Cooling regime could be adapted to new condition and controlling forced cooling with adaptive ambient temperature change could increase transformer performance, decrease ageing.

Humidity: Although it varies according to usage area, high humidity can cause corrosion on electronic parts and low humidity can cause static electricity problems. Therefore, constant monitoring of moisture and keeping it in the desired range of values will allow the equipment to last longer. This is especially important for dry type transformers.

Changing the cabinet of dry type transformer could be a solution. If the humidity changes over time and differ from the order document; it might be a good solution to change the paint class of transformer for more suitable environment condition before it's too late.

Energy consumption: Changes in the amount of energy used and energy parameters can be recorded continuously and both consumption reports and power cuts can be monitored continuously. As you can be instantly aware of all this information, you can receive retrospective reports and make energy analyses when uninterruptible power supplies (UPS) are activated and how long they have worked.

This will guarantee that protection and cooling equipment is ready all the time. According to analyses about energy consumption, it might be advantageous to change to new lower-loss fans to save money in auxiliary power consumption. This could also lead your UPS dimension and lifetime to change.

Fire and smoke alarms: Fire and smoke alarms are also a great risk for every place. The alarm system connected to the extinguishing system can immediately interfere with the event and interrupt the power in the environment. However, if this situation is experienced outside of working hours and there is no extinguishing system, there is a risk that the event will be noticed late. It is possible to make an early intervention by instantly informing the authorized persons with a mobile phone message without noticing the situation and being affected by the current energy system.

Vibration sensors: Transformers can withstand vibrations, they vibrate continuously. That's the main reason for noise! But when unexpected vibration occurs, it is impossible to understand effects of unknown vibrations to transformer. These unexpected vibrations could be from inside; which means a kind of short circuit during operation, or from outside like an earthquake. Both these vibrations could damage windings and core of transformer. It is better to sense these vibrations and give alert to users for a maintenance call or general check-up. Otherwise could be too late to save transformer with minor damages. Risking transformer with "out of service" situation is never effective.

With monitoring this parameters and more could increase lifetime of your transformer and decrease maintenance or failure costs.

2) Thermal Camera Usage

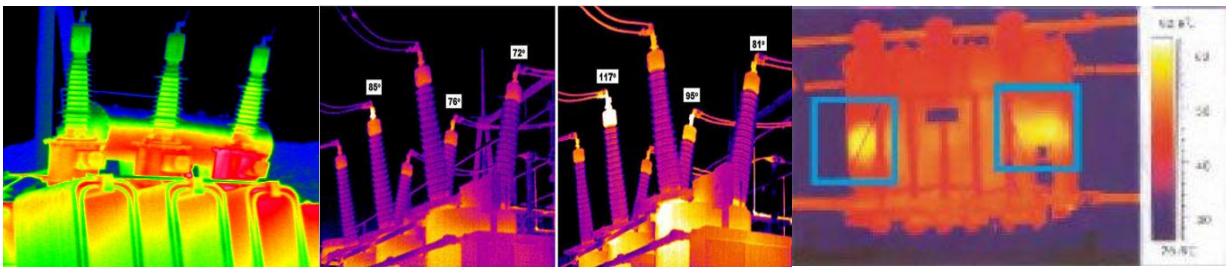
Thermal energy is emitted in the infrared range that our eyes cannot see. Thermal cameras work exactly on this basis. That is, a thermal camera translates infrared wavelengths in the electromagnetic spectrum into a visible picture.

Picture 1 - It is easy to create automated alarm for temperature rise situations.

Temperature measurement and control can be made with the use of thermal cameras in transformers. It can prevent costs that can cause failure or out of service situation. Preventive ordering spare parts could help our customers to save a lot of time.

With new technology, it is easy to monitor 24/7 of your equipment and set alarms for critical levels. This could help to understand a critical situation before it happen.

This will allow you to have control on the effects of ambient over transformer.

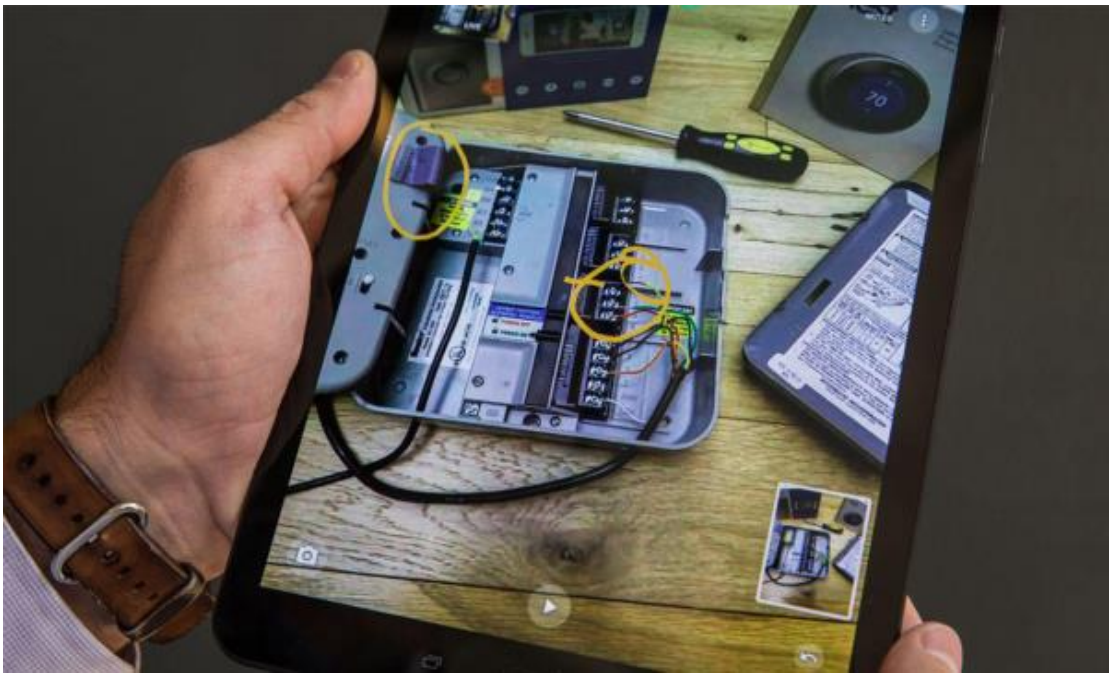


Picture 2- Thermal vision and detection of overheating.

3) AR Glasses or On-Side Communication

Augmented reality (AR), from educational activities to daily living (Entertainment, head-up display on car windshields, etc.) is an innovative human-machine interaction that places virtual components into a real-world environment with many potential applications in areas as diverse as). The ability to provide the user with the necessary information about a process or a procedure directly in the working environment, an important factor for consideration of AR as an effective tool will also be used Through-life engineering services (TES). Many experimental applications have been made by industries and academic institutions in this field of research: applications in remote maintenance, diagnostics, non-destructive inspection, repair and

installation activities represent the most significant examples made in the last few years. These applications include aviation, rail, industrial facilities, Machine Tools, military equipment, underground pipes, civilian structures, etc.it is related to different work environments such as. Maintenance can be done by directing service personnel remotely without going to the site. This could prevent to pay extra costs for service, reduce maintenance costs.



Picture 3 – AR application example

Sometimes direct connection via mobile phone or video chat could also be a solution too. Important thing is to detect failures before they happen. Sometimes a noise, a quick temperature rise or abnormal gas levels could save transformer and prevent failure before happen.

4) Using Vacuum Type Tap Changers

Historically, the idea of vacuum breakers at the California Institute of Technology, where Sorensen and Mendenhall date back to the 1920s, research began on the concept of short circuit current interruption in a vacuum. They experimented by placing two fixed contacts and a C-shaped movable contact in a glass envelope and used a magnetic actuator to drive the movable contact tested at 15kV. However, commercial production began in the 1950s when Spiral Petal Arc Control Contact Vacuum Circuit Breaker developed.

Picture 4 – Vacuum type OLTC

Since then, many studies have been carried out in the field of vacuum cutting to produce low-cost, low maintenance vacuum circuit breakers, switches and reclosing machines for medium and high voltages. In vacuum, switching creates less damage on contacts so changing tap changer or maintenance period extends greatly.

If the OLTC with vacuum breaker is used in the transformer, the contact life can be extended up to 5 times. In this way, a tap changer can be preferred which will work longer with less maintenance.

5) Using Transformer Monitoring System

Transformer monitoring is one of the most exciting topics of today. With monitoring systems; historic information of voltage drops, temperature and power threshold, alarm information of transformer can be taken. Premature wear can be prevented due to overload. Knowing the transformer load may prevent premature replacement. The cause and location of the problem can be known. Transformer, zone or panel based outage and failure reports, compensation reports, access and response reports can be prepared for customer-specific reports, integrated sensors and IED communication protocol provides monitoring and diagnostic system for all vital parts of the transformer.

Transformer Failure Detection, Monitoring and Diagnostic System - Analyzes the moisture in the transformer oil and HYDROGEN (H2) - CARBONMONOXIDE (CO) - METHANE (CH4) - ACETHYLENE (C2H2) - ETHYLENE (C2H4) gases. DGA is a very important test to be informed about the status of the transformer and to be aware of the failures that may affect the duty of the transformers in operation in the early stages. Transformers can be used to inspect oil and reduce maintenance.

Picture 5 – Monitoring system general solutions and remote monitoring and control of transformer.

6) Automatic Dehydrating Breather Usage

Excessive moisture from the atmosphere can deteriorate the oil and insulation system over time. This deterioration causes premature aging, reducing overall life and performance. This may result in future additional maintenance and even premature and unexpected errors.

Excessive moisture from the atmosphere can deteriorate the oil and insulation system over time. This deterioration causes premature aging, reducing overall life and performance. This may result in future maintenance and even premature and unexpected asset errors. In order to prevent this, dehumidifiers are used in transformers.

Picture 6 – Automatic dehydrating breather

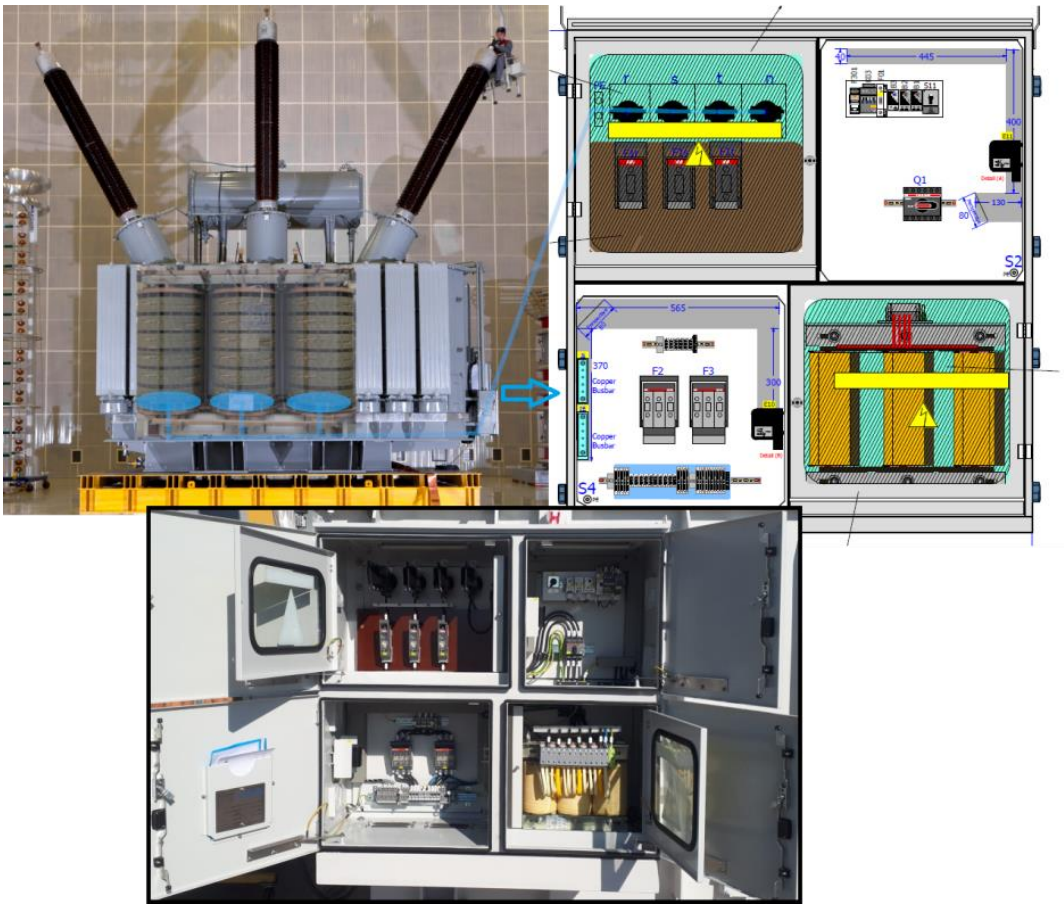
For typical applications (transformers, on-load tap-changers or industrial processes), conventional desiccant air-borers filled with silica gel or similar desiccants are still used in many places today. However, standard dehumidifiers that become old and need to be replaced as they dehumidify can increase the maintenance intervals of the users. State-of-the-art maintenance-free automatic dehumidifiers; this is the perfect solution for the problem.

Table 1- Comparison of breathers

Automatic Dehydrating Breathers	Traditional Breathers
Visual inspections can be reduced to a minimum and can be carried out in conjunction with other inspection and maintenance work.	Regular visual checks to check the humidity of the dryer over the lifetime of the transformer.
Huge cost savings by eliminating the regular replacement of the dryer	Regular replacement of the dryer throughout the life of the transformer
Sensor-controlled “heating S of silica gel Controlled by humidity and temperature sensors	Large costs due to frequent filling with desiccant, especially in areas with high humidity
No environmental pollution and disposal problems from spent desiccant	Environmental pollution and disposal problems from spent desiccant
Higher dehydration efficiency due to wider contact surface and mechanical design	Less efficient dehydration
Maintenance-free system, increased operational reliability	High risk for transformer without maintenance

7) Auxiliary Supply Voltage Outage

Although transformers are electromechanical devices that convert voltage, they need single-phase or three-phase side supply in order to work properly. Because the transformer windings at high voltage (400, 230, 110kV…), fan and so on. The accessory feeds are 400-230Vac. Therefore, 400Vac voltage is needed in the field. Devices that operate with this voltage are also used during maintenance. Since these auxiliary supplied elements are critical, battery solution for power outages is also an additional consideration and cost.



Picture 7 - Layout of auxiliary supply voltage system

At Best we offer a new solution: transformers with auxiliary windings. By transporting a low-winding winding to be added to the middle leg with bushings out of the tank and using a small auxiliary supplying transformer, you can receive the 400Vac voltage directly from your transformer. You can also use this voltage output as equipment during maintenance or as a supply to the field. In addition, your transformer will not be affected by battery storage or power outages and you will be saved from UPS system investment.

8) Oil Filter Unit for OLTC

If vacuum type OLTC is not an option, oil filter unit for oil type tap changers could be offered with oil filter units. The filter unit consists of a filter base, one or two filter housings, an electric motor, a pump, an electric connection box, a sample valve and two threaded connections. These filter units could filter the oil inside the OLTC and circulate clean oil for OLTC. So maintenance could be reduced.

9) Training & Education

Who could be a better protector of transformer than an expert? In nowadays with new technology, it is easier to be an expert. Best Service Team could help you to become one with our educational training and maintenance program. On demand training plan and with active, “see and learn” approach, our training is for the ones aiming the Best.

Picture 8 – In factory and on-site education options are available

As Best Transformers; we believe our customer’s time and money are valuable, so we are offering some simple solutions to save both of them. If you decide to select options from below table, we could gladly make alternative offer with below options. Select the ones that suits you most and we will take the rest.

Price Comparison and Effect to Maintenance

Solutions	Maintenance Reduction	Cost Effect
Remote Environmental Monitoring System		
Thermal Camera Solutions		
AR Glasses		
Using A Vacuum Type Tap Changer		
Best Transformer Monitoring Solutions		
Automatic Dehydrating Breather		
Auxiliary Supply Voltage Outage		
Oil Filter Unit		
Training & Education		

** Higher the maintenance reduction, less maintenance is necessary.*

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Organize San. Bölgesi 7.Cadde No: 1 BALIKESİR / TÜRKİYE
T: 0 266 281 10 70
F: 0 266 281 10 02

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