

## **PREVENTIVE, PREDICTIVE MAINTENANCE BY USING VISUAL DIAGNOSTIC METHODS**

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### Abstract

Preventive maintenance of equipment can easily be ignored by assuming that every thing is fine as long as the equipment is operating. Ignoring original equipment manufacturer (OEM) recommended maintenance schedules can create problems that are not apparent from just looking at the system.

Keywords: Visual diagnostics maintenance

### 1. Introduction

The preventive maintenance inspection depends on the periodic check of condition and of the aging behavior of diagnostic objects.

This subject is very important for the industrial fields to fulfill the following Advantages:

- a maximum of possible availability of the equipment in operation
- a full using of wear reserves
- a minimum of stop times (set out of operation) of the equipment
- the best coordination for schedules of maintenance and investments necessary in future
- minimum of risk of accidents
- Low maintenance and life time costs.

### 2. Importance, objectives in electrical power supply

The observation, control and maintenance by visual procedures and methods get an increasing importance in the Technical Diagnostics of equipment in electrical power supply, The detection of visible changes of Diagnostics objects caused by stressing and aging processes during the operation is the mainly task of the visual diagnostics.

The modern visual diagnostics based on technical methods goes essential beyond on the classical visual inspection without technical devices. The visual registration, description and assessment of diagnostic objects are realized by its two-dimensional display in a long range of technical wavelength by using different devices as follows:

a. Devices for registration / display in the normal visual range of the human perception that means in the range of wavelength from = 400 nm up to 780 nm (e.g. analog and digital photo and video cameras)

b. Devices for display and image processing in a further range of technical interesting wavelengths (e.g. optical and visual infrared cameras )

c-Devices for observation and registration of areas in equipment by difficult accessibility (Technoscopes in different types).

d. Devices for registration by sampling of moving parts of electrical rotating machines (stroboscopes in different types)

e. Devices to detect the sparks (day light corona camera)

f. Devices for time lapse and time dilatation as specific programmed video cameras (high-speed cameras) or devices by variable shutter times from 1/100s up to 1/50000s to record of transient processes or fast motions.

g. Devices to capture of pictures and video sequences, realized by video and graphic computers by modern processing programs.

### 3. Some Applications and Utilization

This method of visual diagnostics can be used by a great variety of applications and investigations in industry, especially by the Technical Diagnostics in electrical power supply such as :

\* Diagnostics on power transmission lines (industrial partners: supply power companies, operators, producers and erectors of appliances and equipment for transmission lines):  
- Corona discharges, partial discharges on the standards conductor and on the insulator, detecting of the intensity and the location.

- Over temperatures on connecting elements and contacts. Caused by over currents or bad contact.

- Creep currents erosion and pollution phenomena on the outdoor insulators.

\* Cables and cable equipment (industrial partners: power supply companies, manufactures of energy cable equipment).

- Partial Discharges (PD) on cable termination.

-Thermal stressed cables insulation, bushings, terminations and cable joints (e.g. bad contact resistances, hot-spots, defects by over currents, inner PD).

\* Power transformers (industrial partners: electrical power plants, power supply companies, manufacturer of power transformers and transformers equipment, maintenance companies – visual inspection of inner components and parts by endoscopes

- Detection of Impurity of the insulation oil (transparency of the oil)
  - Detection of Impurity and pollution on the surface of the transformer board/paper component (Creep current traces and discharge channels)
  - Detection of Loose or moving parts (switch mechanism, contacts, and connecting elements, bolted joints)
  - Detection of Partial discharge on bushings.
  - Detection of Partial or local heating of the transformer board.
- General thermal view of transformers, registered by thermos cameras.

\* Power generators and motors (industrial partner: electrical power plants, power supply companies, manufacturers of power generators, operators, and maintenance companies)

OFFLINE- diagnostics by video techniques and different endoscopes :

- Detection of loosing and moving parts in stator and rotor-component.
- Discoloration by overheating.

ONLINE- diagnostics by thermo-visional techniques and stroboscopes:

- Detection of temperature allocation.
- Detection of mechanical oscillation and vibrations.

\* Electrical switchgears (industrial partners: electrical power plants, power supply companies, manufacturers of switchgears, operators, maintenance companies)

- Bad contact systems loosing connections, hotspots, detected by thermovisional techniques.
- Mechanical switch analysis, registered by slow motion and video techniques.
- Flashover and discharges.

#### 4- Examples

The examples will be given during the presentation.

#### 5- Conclusions

Visual diagnostics is very important method to achieve easy and fast method to detect and observe the variations due to the effect of degradation and aging in the different parts of equipment and devices .

#### 6-References

[1] Prof.Dr.Eng.Hab.Porzel, “ Visualisierung diagnostischer Prozeduren in der Energietechnik”, 46<sup>th</sup> Internationales Wissenschaftliches Kolloquium der TU Ilmenau, 2001 .

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