PART B-01

TITLE: **MAINTENANCE STRATEGIES**

SPECIFICATION NO: **B-01**

INCEPTION DATE: **AFTER GAZETTING (WORKING DOCUMENT FOR A 2 YEAR PERIOD)**

AMENDMENTS/REVISIONS

DATE	PAGE	PARAGRAPH	DESCRIPTION	ORIGINATOR	APPROVED

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1. SCOPE

This document provides a guideline which aims to sustain the “as-designed” performance of distribution equipment over their intended life cycle, thus ensuring that the licensee meets the statutory requirements contributing to safe network operations by identifying failure in the early stages and finally sustaining the value of the asset over its life cycle through sound maintenance strategies.

2. MAINTENANCE PLANNING

The objectives of maintenance planning are to:

a) Prepare an optimal work execution plan to meet safety, cost and quality targets.

b) Ensure materials, personnel, tools, permits and process equipment are available for execution required by the plan.

The number of planners required depends on the state of the licensee/organisation, including the:

a) Availability of maintenance history

b) Library of standard plans

c) Experience of planners

d) Effectiveness of the maintenance system (CMMS)

3. MAINTENANCE STRATEGIES

3.1 Reliability Centred Maintenance

The RCM method has been developed as a result of the experience from application studies and its approach is to focus on a defined system using a multidisciplinary team of people including a facilitator, technician, a craftsperson and other specialist as required. The team:

a) Defines the operating parameters of the system, including a description of what the system does and a list of the equipment within the system;

b) Defines all functions of the system including primary functions, secondary functions (e.g., protection, economy, efficiency, support, appearance, environment), and protective functions (e.g., alarms, interlocks, device for relieving abnormal conditions);

c) Lists all failure modes and effects for each function;

d) Uses a decision diagram to guide the decisions on how to maintain the function of the equipment in the most sensible manner to minimize the risk of equipment failure or process malfunction.

For equipment failures which cannot be prevented from failing, appropriate strategies are developed to minimize the impact of failure.

3.1.1 Typical RCM Outputs

The typical outputs of a Reliability Centred Maintenance analysis include:

a) Listing of the functions the system and subsystems must perform;

b) Identification of the failed states (such as ‘too much’, too little’ and ‘not at all’);

c) Identification of possible causes of failed states including failures which have occurred before, failures which are the subject of the current maintenance regime and those failures which are thought to be possible under the operating context;

d) Probable worst case effect of the failure;

e) Allocation of the failure into the grouping of Hidden, Safety or Environmental Operational and non-operational;

f) Determination of the most appropriate failure management strategy if the failure cannot be prevented;

g) Determination of process, plant, operational or maintenance redesigns to reduce risks, costs or consequences.

3.2 Reactive Maintenance

Reactive maintenance is also referred to as breakdown, repair, fix-when-fail, or run-to-failure (RTF) maintenance.

When applying this maintenance technique, maintenance, equipment repair, or replacement occurs only when the deterioration in the equipment’s condition causes a functional failure or is obviously near to functional failure.

This type of maintenance assumes that failure is equally likely to occur in any part, component, or network.

3.3 Preventative Maintenance (PM)

PM consists of regularly scheduled inspection, adjustments, cleaning, lubrication, part replacement, calibration, and repair of components and equipment.

PM is also referred to as time-driven or interval-based maintenance. It is performed without regard to equipment condition.

PM schedules periodic inspections and maintenance at pre-defined intervals (time, operating hours, or cycles) in an attempt to reduce equipment failures for susceptible equipment.

3.4 Predictive Maintenance

Predictive maintenance is any inspection that uses technology to predict when failures are likely to occur. Maintenance is carried out based on knowledge or prediction of the “actual” condition of items.

By monitoring key parameters of operating conditions such as temperature, vibration, oil quality, leaks etc. one may be able to predict failures before they occur.

A distribution network being of complex composition requires a robust mix of the three above mentioned maintenance strategies. These are not the only strategies, but are the most widely used maintenance strategies.

3.4.1 Condition Monitoring

Predictive Maintenance is also referred to as **“Condition-Based Maintenance”** because the need to conduct maintenance is based on the actual condition of the item. This means:

a) Maintenance is not done until it is needed

b) Doing only that what is required

c) Monitoring and trending

d) Identifying impending failure

e) Repairs are cheaper

f) Repairs are scheduled to optimize availability and use of resources

It is recommended that measurements be done on a regular basis to build up a historic database. Some of the technologies/methods used include:

3.4.1.1 Oil analysis for Predictive Maintenance (PdM)

The purposes for oil analysis for predictive maintenance include:

a) Anticipating or predicting the remaining resistance to failure of individual components in the equipment by analysing the wear material in the oil, and;

b) Regular analysis used to determine timing of next oil change.

3.4.1.1.1 Taking oil samples

In taking oil samples one should do the following:

a) Ensure that the samples are representative of the oil circulating in the system;

b) Consult with OEM regarding the best methods for drawing samples;

c) Ensure that the sample point area is clean to prevent contaminants falling into the reservoir or the sample container.

3.4.1.1.2 Sampling intervals

In order to determine the sampling intervals, one should do the following:

a) Determine what is to be sampled;

b) Understand how frequency is determined (history, OEM recommendation, oil supplier recommendation, etc);

c) Ensure that sampling is done at regular intervals in order to gain maximum potential output value of oil analysis, i.e. showing what occurs over time;

d) Compare with OEM requirements, at least during the warranty period;

e) Review the process for sample interval (load, potential contaminants);

f) Vary sample interval based on the analysis information.

3.4.1.1.3 Oil analysis key requirements

The key requirements for oil analysis include:

a) Knowledge of the equipment being monitored;

b) Metallurgy of the components of the equipment being monitored;

c) Awareness of the likely contaminants;

d) Monitoring of trends;

e) View current results and compare them to historic results;

f) View calculated wear rates and compare them with historic values;

g) Establishing relevant alarm levels.

3.4.1.2 Thermography

Equipment to be subjected to Thermographic monitoring include:

a) Electrical switches

b) Medium voltage lines

c) Motor control centres

d) Electrical substations

e) Transformers