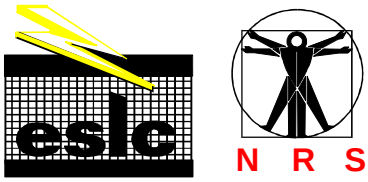
NRS 082:2014

Edition 1.1
Reaffirmed (September 2018)

RECOMMENDED MAINTENANCE POLICY FOR ELECTRICITY NETWORKS

This document does not have the status of a South African National Standard.



This rationalized user specification is issued by
the Technical Governance Department, Eskom,
on behalf of the
User Group given in the foreword
and is not a standard as contemplated in the Standards Act, 1993 (Act No. 29 of 1993).

Table of changes

Change No.	Date	Text affected
Amdt 1	2014	Amended to update referenced standards, to include routine tests, to explain referenced legislation in the foreword, and to include NRS 089 to serve as a guide when maintenance work is carried out.

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Foreword

This specification was prepared on behalf of the Electricity Suppliers Liaison Committee (ESLC).

The working group comprised the following members:

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This document supersedes NRS 082:2004 (edition 1).

Reference is made in 4.1.5(a) to "legal requirements". In South Africa this is the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Introduction

This specification was prepared to provide guidelines to supply authorities in the South African Electricity Supply Industry (ESI) on developing an acceptable maintenance policy. It is believed that an acceptable maintenance policy is the first step in implementing a maintenance programme that will improve the quality of electricity supply in this country.

Keywords

electricity delivery, maintenance, networks, policy.

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1 Scope

The objective of this document is to set out guidelines for the development of a policy in order to optimize maintenance. The recommended policy is presented in such a manner that the requirements of customers, internal stakeholders and legal authorities related to such networks are met at minimum life cycle cost.

This document applies to the maintenance of electricity networks operated at voltages up to and including 132 kV (including all associated control and protection systems).

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this specification. At the time of publication, the references indicated were valid. Compilers of documents are encouraged to apply the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from the SABS Standards Division.

NER Power Quality Directive; The NER Power Quality Directive was developed by the National Electricity Regulator and is available on their website www.nersa.org.za.

NRS 047-1, *Electricity supply – Quality of service. – Part 1: Minimum standards.* **Amdt 1**

NRS 047-2, *Electricity supply – Quality of service. – Part 2: Reporting guidelines.* **Amdt 1**

NRS 048-2, *Electricity supply – Quality of supply – Part 2: Voltage characteristics, compatibility levels, limits and assessment methods.* **Amdt 1**

NRS 048-4, *Electricity supply – Quality of supply – Part 4: Application practices for licensees.* **Amdt 1**

NRS 048-6, *Electricity supply – Quality of supply – Part 6: Measurement and reporting of medium-voltage network interruption performance.* **Amdt 1**

NRS 048-7, *Electricity supply – Quality of supply – Part 7: Application practices for end-customers.* **Amdt 1**

NRS 048-8, *Electricity supply – Quality of supply – Part 8: Measurement and reporting of extra high voltage (EHV) and high voltage (HV) network interruption performance.* **Amdt 1**

NRS 048-9, *Electricity supply – Quality of supply – Part 9: Load reduction practices, system restoration practices, and critical load and essential load requirements under system emergencies.* **Amdt 1**

NRS 089-1, *Maintenance of electricity networks – Part 1: Underground distribution systems.* **Amdt 1**

NRS 089-2-1, *Maintenance of electricity networks – Part 2: Overhead distribution systems – Section 1: Overhead power lines.* **Amdt 1**

NRS 089-2-2, *Maintenance of electricity networks – Part 2: Overhead distribution systems – Section 2: Inspection and supplemental treatment of treated wood utility poles.* **Amdt 1**

NRS 089-2-3, *Maintenance of electricity networks – Part 2: Overhead distribution systems – Section 3: The manual replacement of a rotten wooden pole structure.* **Amdt 1**

NRS 089-2-4, *Maintenance of electricity networks – Part 2: Overhead distribution systems – Section 4: Clearing and maintenance of servitude roads.* **Amdt 1**

NRS 089-2-5, *Maintenance of electricity networks – Part 2: Overhead distribution systems – Section 5: Insulators.* **Amdt 1**

NRS 089-3-1, *Maintenance of electricity networks – Part 3: Substations – Section 1: General.* **Amdt 1**

NRS 089-3-2, *Maintenance of electricity networks – Part 3: Substations – Section 2: Power transformers, circuit-breakers, isolators and instrument transformers.* **Amdt 1**

NRS 089-3-3, *Maintenance of electricity networks – Part 3: Substations – Section 3: Miniature substations, distribution transformers and electrical enclosures.* **Amdt 1**

NRS 089-4, *Maintenance of electricity networks – Part 4: Control technology.* **Amdt 1**

NRS 089-5-1, *Maintenance of electricity networks – Part 5: Street lighting and high masts – Section 1: Maintenance of street lighting and high masts.* **Amdt 1**

SANS 14001, Environmental *management systems – Specification with guidance for use.*

3 Terms, definitions and abbreviations

For the purposes of this specification, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

competent person
person who is able to carry out the designated functions

condition-based maintenance
maintenance done based on information from tests which predict when maintenance is necessary, rather than on time in service or number of operations

corrective maintenance
maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function (IEC)

inspection
visual or audible (or both) examinations that can be assisted by mechanical or electrical (or both) means, that will detect obvious unsatisfactory conditions or discrepancies (IEC modified)

item
any part, component, device, subsystem, functional unit, equipment or system that can be individually considered (IEC)

life cycle cost
net present value of the sum of all the direct and indirect costs incurred to acquire, install, commission, operate, maintain, decommission and dispose an item throughout its life

NOTE The maintenance component of the life cycle cost should include the costs of risk, spares, labour, maintenance facilities and equipment, transport, site establishment and any special training.

life cycle items
primary items and all other network items which together account for 80 % of the sum of all life cycle costs

maintenance
combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function (IEC)

maintenance philosophy
system of principles for the organization and execution of the maintenance (IEC)

maintenance policy
general approach to the provision of maintenance and maintenance support based on the objectives and policies of owners, users and customers (IEC)

modifications from manufacturers
changes made to an item to incorporate developments after manufacture

overhaul
work done with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, tests, examination, or as required by the manufacturer's maintenance manual, in order to restore the item to an acceptable condition

preventive maintenance
maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item (IEC)

pure risk
risk which results only in loss, damage, disruption or injury with no potential for gain, profit or other advantage

redundancy
existence of more than one means for performing a required function (IEC)

refurbishing
reinstatement of items to their original condition and intended performance with consideration for cost and current technology for the purpose of extending the plants useful life expectancy

repair
that part of corrective maintenance in which manual actions are performed on the item

retrofit
modifications done to an item to incorporate improvements in design to ensure enhanced operating performance

risk
chance of loss, or the probability that an undesired event may occur, multiplied by the cost of that event if it does occur

risk management
managerial function which has the objective of protecting people, assets and profits of a business, by eliminating or minimizing the potential for loss from pure risk and the provision of funds to recover from losses that do occur

run-to-failure
failure of an item, which has intentionally not been subject to preventive maintenance

routine test
activity to determine the status, calibration and functionality of an asset or component of an asset
Amdt 1

3.2 Abbreviations

KPI key performance indicator

MTBF mean time between failures (for a particular type of item)

MTTR mean time to repair (for a particular type of item)

QA quality assurance

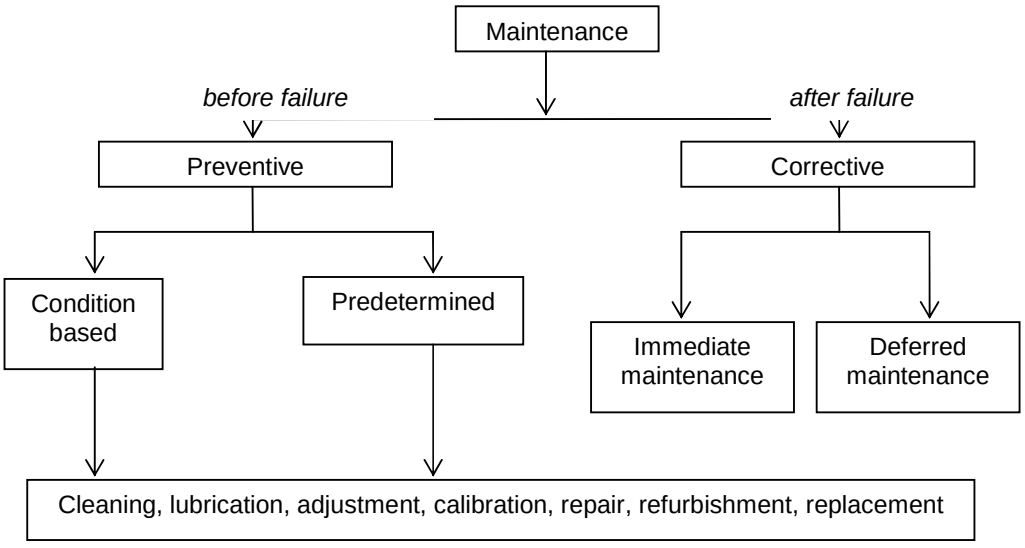
RCM reliability centred maintenance

4 Requirements

4.1 Maintenance philosophy

4.1.1 Each utility shall have a maintenance policy based on the philosophy covered in this specification. The relevant part of NRS 089 can also be used as a guide during maintenance.
Amdt 1

4.1.2 Figure 1 shows the various maintenance practices and actions.



Source IEC

Figure 1 — Maintenance practices and actions

4.1.3 The maintenance philosophy shall contain at least the following actions for dealing with items:

a) repair,

b) overhaul,

c) replace,

d) retrofit,

e) refurbish,

f) modifications by manufacturers, and

g) run-to-failure (items to be run-to-failure shall be listed and risk shall be managed).

4.1.4 The above actions can be achieved through the following maintenance practices:

a) corrective maintenance;

b) condition based maintenance;

c) preventive maintenance;

d) visual and audible routine inspections;

e) routine tests; and **Amdt 1**

f) any other acceptable international practice.

The maintenance practice adopted for each plant item shall have been determined by a structured process such as RCM or similar and the results documented.

4.1.5 The maintenance philosophy and practices to be used in each application shall be selected in such a way that the following minimum requirements are met:

a) all legal requirements (see foreword), including those pertaining to the health and safety of persons and the environment; **Amdt 1**

b) customer requirements (see 4.5);

c) the sum of the life costs of all life cycle items shall be minimized (see 4.6);

d) the requirements of environmental management policy (see 4.7);

e) the requirements of risk management policy (see 4.8); and

f) the requirements of quality management policy (see 4.9).

4.1.6 The following factors should be taken into account in determining maintenance philosophies:

a) historical or estimated MTBF and MTTR of the items to be maintained,

b) differences between the environmental and operating conditions under which the historical MTBF and MTTR were achieved, and the conditions under which items will need to operate in future,

c) the criticality of items to safety and to meeting the stated maintenance objective, and

d) whether redundancy is present in the configuration of the items.

4.2 Maintenance planning

Maintenance plans shall be prepared to meet all the requirements in 4.1 (maintenance philosophy). Each maintenance plan shall detail which items will be maintained within a specific timeframe. Maintenance plans shall be developed, documented, approved and updated as necessary.

4.3 Maintenance work

Maintenance of electricity delivery networks and associated control systems shall be carried out by competent persons and according to the maintenance plans and all maintenance work shall meet the requirements of 4.2. The relevant part of NRS 089 shall be used as a guide during maintenance. **Amdt 1**

4.4 Legal requirements

Maintenance shall comply with all other relevant legislation of the state or local authorities. requirements

4.5 Customer requirements

The customer requirements to be met shall be the NER Power Quality Directive as negotiated with the customers that are served by that part of the network for which the maintenance plan is being prepared, as well as the quality of service (see the relevant part of NRS 047) and the quality of supply (see the relevant part of NRS 048) specifications. **Amdt 1**

4.6 Life cycle costing

Before a maintenance planning decision is made for any particular type of item, a life cycle cost forecast shall be made for that type of item, for each of the maintenance options under consideration. Such forecasts shall comprise all costs included in the definition of life cycle cost, not just maintenance costs.

4.7 Environmental management

Maintenance philosophies, work, equipment and materials shall conform to the environmental policy, as stated in SANS 14001.

4.8 Risk management

Each utility shall have a risk management policy for maintenance work, equipment and materials. Risk assessment shall take into account the extent to which formal quality assurance is or will be applied to the methods, equipment or materials under consideration.

4.9 Quality management

All aspects of maintenance planning and maintenance work, which are critical to safety and the stated maintenance objective, shall be covered by a documented QA system. If a documented QA system is not in place, SANS 9004 should be used as a guideline.

NOTE Certification to SANS 9004 is not required.

4.10 Modifications and retrofits

Where substitutes are manufactured for items of a critical nature, recognized reverse engineering techniques can be used to ensure that the substitutes are at least equal to in all essential respects to the originals.

In using reverse-engineering to manufacture replacement items, the legal rights of others regarding patents, copyright and registered designs shall be respected.

Before departing from the designs and maintenance instructions of equipment suppliers, consideration shall be given to the possibility that warranties and type test certificates may be invalidated. If warranties are to be invalidated, the risk management implications shall be re-assessed. If type test certificates are to be invalidated, steps shall be taken to ensure that the relevant legal and risk requirements are still complied with, for example, by obtaining new type test certificates.

4.11 Auditing

The maintenance management system shall make provision for regular internal audits.

5 Maintenance management system

5.1 A proper information system to support the maintenance policy shall be developed. The system can be a paper or computerized auditable system and shall include the following:

a) register of plant assets;

b) maintenance planning;

c) resources planning;

d) costing (down to equipment level); and

e) performance measurement systems.

5.2 Maintenance KPIs should be set in accordance with the maintenance policy and be continuously monitored at council or board level.

Bibliography

Standards

IEC 60300-3-14, *Dependability management – Part 3-14: Application guide – Maintenance and maintenance support*.

SANS 9004/ISO 9004, *Managing for the sustained success of an organization – A quality management approach*.