A standardised industry approach towards asset management

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A sustainable approach to the management of an electrical supply network can only be found in organisations that fully embrace all the principles of Asset Management. It is the author’s opinion the no amount of investment, or the application of systems or technology can resolve the current problems associated with poor design, construction and maintenance. Asset centric organisations understand and implement these principles while reaping the long term benefits from such an approach.

NRS 093 – another industry standard?

The ESLC decided in 2007 to develop NRS 093: Asset Management for Electrical Infrastructure. The need has been identified due to the lack of “proudly South African” standards. Several international documents exist, most notably PAS55 [1] and The International Infrastructure Management Manual (IIMM) [2]. These documents are however written for application in all industries and ignore the maturity and specific asset portfolio of industries. NSR 093 therefore tends to become a prescriptive minimum standard for application in the South African Electrical Supply Industry.

Asset Management Concepts

Life Cycle Stages

Asset life cycle stages are seen as discreet phases of and asset throughout its whole life, form conception to final retirement and disposal. Most engineers are familiar with this concept, but are reluctant to define these stages. NRS 093 set out six such stages as follows:

Life Cycle stage – Plan: In this stage assets planning focus on the integration of organisational objectives with all asset plans. Network planning is responsible for ensuring that the expansion of the power system is optimally planned to sustain the demand placed on the power system. The network should be expanded at just the right time to ensure optimal investment of capital while avoiding network overloading. The power network should continue to meet power quality, reliability, statutory, safety and environmental requirements. The planning philosophy prescribed by the South Africa Grid Code and the Distribution Code is that of least economic, i.e. life cycle, cost.

Life Cycle stage – Design: Design activities include research and application of new technologies, equipment design specifications and standards, network design and application guides and the application of all such specifications, standards and guides.

Life cycle stage – Acquire: This life cycle stage includes the procurement of new plant and equipment (based on specifications developed during the Design stage), as well as the procurement of construction services from contractors. This is followed by the activities of contract management, construction and/or installation of the asset, and finally quality assurance. The Acquire life cycle stage is supported by the utility’s commercial services and supply chain processes.

Life cycle stage – Commission: In an asset management context, the commission phase starts when the contractor has completed the design implementation and indicates that the asset or system is ready for utilisation. Final testing of the installation is carried out, the as-built data is recorded and captured, and the maintenance and operating staff are informed about the maintenance and operating requirements of the new plant. The phase ends when the new asset is put into commercial operation.

Life cycle stage – Operate and Maintain: During the Operate and Maintain lifecycle stage, the physical asset is expected to perform its designed function at, or above, the specified performance and reliability. The manner in which the asset is operated and maintained directly determines the performance, reliability and life expectancy of the asset. When the operators and maintainers work in harmony then the best performance, at the optimum cost, of the asset will be experienced. If either operations or maintenance work in isolation of each other then deterioration and poor performance will result. The effect of good management of assets during the operate and maintain phase will extend life expectancy, reduce overall life cycle costs and ensure good availability and reliability.

Life cycle stage - Retire: This life cycle stage includes the following possible actions:

- Replacement – The planned replacement of assets for reasons other than system expansion e.g. degraded performance experienced at the end of its useful life.
- Retirement – The removal of equipment from service due to system expansion, but retention of the asset for strategic reasons such as spares.
• Disposal – The complete removal and disposal of an asset when it is no longer required.

**Critical assets**

Items of plant, that whilst power delivery is still possible without such items, supply quality, legal and safety considerations are compromised to varying extents. Utilities should define all critical assets using a criticality matrix.

These items include but are not limited to:

- Power Transformers with a power rating of 1 MVA and above (irrespective of the voltage ratios),
- HV cables with associated accessories (joints and terminations),
- Mini Substations with/without ring main units,
- Distribution transformers below 1 MVA,
- Reticulation transformers,
- Reclosers and sectionalisers,
- Switchgear, isolators and links,
- Control plant such as feeder protection relays, unit protection relays and metering units for LPU’s,
- DC systems,
- Static VAR compensators,
- Capacitor banks,
- Transformer bushings,
- Distribution type surge arrestors.

Life cycle plans and activities shall be defined for all critical assets.

**Expected useful life of assets**

It is the extent of life of an asset over which it can be expected to meet the required performance given its operational environment (including design parameters such as climate, soil conditions, topography, utilisation, and operations and maintenance regime), and over which it will be productively used. This is a probabilistic life, based on the normal distribution and is defined as the time at which at least 95% of equipment are still in active service or able to produce their designed performance.

Utilities should define the useful life of all critical assets, depending on their current asset base (age profile and technology), operational conditions and care of assets.

In absence such determination the following table shall be used [3]:

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Expected Useful Life (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV Transformers</td>
<td>50</td>
</tr>
<tr>
<td>HV Lines</td>
<td>50</td>
</tr>
<tr>
<td>HV Cables</td>
<td>50</td>
</tr>
<tr>
<td>HV Substation Equipment</td>
<td>50</td>
</tr>
<tr>
<td>MV Transformers (Transformers &amp; Mini- Subs)</td>
<td>45</td>
</tr>
<tr>
<td>MV Cables and Lines</td>
<td>50</td>
</tr>
<tr>
<td>MV Substations Switch Gear</td>
<td>45 (see note 1)</td>
</tr>
<tr>
<td>LV Network (overhead)</td>
<td>45 (see note 1)</td>
</tr>
<tr>
<td>Network Management</td>
<td>20</td>
</tr>
<tr>
<td>Consumer Electricity Meters (credit type)</td>
<td>30 (see note 2)</td>
</tr>
<tr>
<td>Telemetry</td>
<td>20</td>
</tr>
</tbody>
</table>

*Table: 1 Expected useful life of assets.*

Notes:
1. 60 years if underground cables.
2. 10 years if pre-paid meters.
3. Technical and Financial Asset life should be linked.
4. One asset register to be maintained

Asset managers, suppliers, design engineers and maintenance staff should all ensure that these lifetimes are achieved while optimising costs, risk and performance of the assets.
Minimum requirements of an asset management system

Asset health requirements
Performance monitoring, assessment and reporting shall be done in accordance with NRS 047 [4] & NRS048 [5].

The utility shall assess the condition of all critical assets. This assessment shall form the basis of a complete asset class risk assessment. The utility shall document a systematic approach, which should include a measure of impact and probability and total risk.

The approach is as follows:
• identify risk events;
• determine the utility’s exposure to each risk event; and
• determine an appropriate response to each risk event.

All non-conformances and critical incident and failures shall be investigated. Typical critical failures include the following:
• Outages affecting > 10% of customer base
• Rogue feeders (Worst performing feeders)
• Power trfs > 10 MVA
• Recurring failures or under-guarantee failures
• Management system non-conformance
• Audit results

A proper root cause analysis technique should be applied, related to the criticality of the asset. The utility shall identify further actions to perform the following:
• Corrective action
• Preventive action
• Improvement and optimization of the Asset Management System
• Monitor (Assess and evaluate/follow-up) preventive and improvement initiatives

Asset organisational activities

Establishing Asset performance targets and customer requirements.

The utility shall develop, implement and demonstrate effective processes to determine asset performance target and customer requirements. These targets shall be reviewed regularly to determine its suitability and needs for change.

Asset management strategy and policy

Top management shall determine the Utility’s Asset Management policy and strategy. This policy and strategy shall be communicated and understood by all staff and consultants/contractors working on the utility’s assets.

Asset management processes

The utility shall develop, implement and demonstrate effective processes to perform the necessary Asset Management activities. These processes, includes, but is not limited to:
• Network Asset Establishment
• Maintain Network
• Manage availability of supply

Investment and planning

Asset investments and expansion planning decisions shall consider whole life costing, asset risks and performance targets.

Resources and skills requirements

The utility shall match its resources and to assets activity plans and location. This includes staffing and contracting resources, requirements for tools, mobile and computing equipment and financial resources.

General requirements

The utility shall develop and document its management system.
Refer NRS 082: 2004 [6].
References


[4] NRS 047: Quality of Service

[5] NRS 048: Quality of Supply

[6] NRS 082: Recommended Maintenance Policy For Electricity Networks

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