

Developing asset management plans for RE operation and maintenance with ISO 55001

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The global asset management standard, ISO 55001:2014, is finding increasing traction across many industries, in many countries. This is reflected by 164 organisations which have achieved formal ISO certification, of which 35 are in the electrical energy business.

Implementation of an ISO compliant management system follows a top-down approach with strategic level elements being completed first to provide guidance for a rational deployment.

This paper is a case study of the development of asset management plans (AMPs), as called for by clause 6.2.2 of the standard, as it was developed for a local RE IPP asset owner and operator.

Asset management systems

According to ISO 55000 (overview, principles and terminology):

“The organisation shall establish, document and maintain asset management plan(s) to achieve the asset management objectives. An asset management plan is documented information that specifies the activities, resources and timescales required for an individual asset or grouping of assets. It is common practice for such a plan to contain a rationale for AM activities, operational and maintenance plans and capital investment plans (overhaul, renewal, replacement, enhancement and disposal), and financial and resource plans.”

Fig. 1 shows the position of the AM plans as one of the key elements within the larger AM system.

Further to the guidelines and requirements of the ISO standard, the wisdom of global large asset owners was considered during the planning and scoping for the development of AM plans for the project described in more detail in Fig. 1.

Typically, they asserted a need at business unit level to establish asset management plans for critical assets within the context of the long-term business plan for such assets, to optimise the planning and budgeting processes and help to drive down the total cost of ownership over the life of these assets while effectively managing risk contributors.

Asset management plans are documented information specifying the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organisation's asset management objectives. The grouping of assets may be by asset type, asset class, and asset system or asset portfolio.

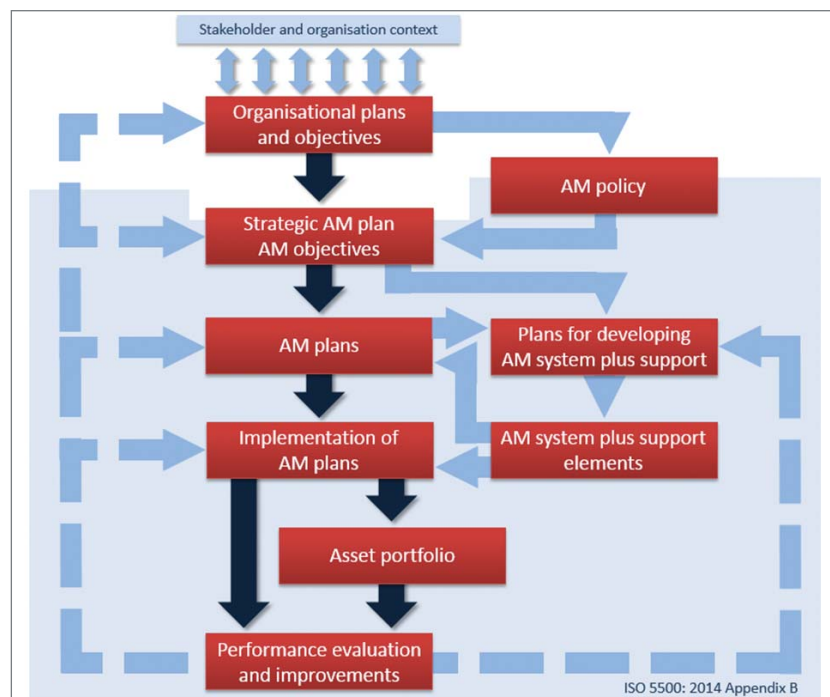


Fig. 1: Key elements of an asset management (AM) system (ISO 55000:2014, Annex B).

Effective management and application of AMPs should support the following business outcomes:

- To provide a clear link between the business service level expectations and the equipment's performance.
- To present an understanding of the present and future demands on the equipment and an estimate of the long term financial commitments.
- To present a clear and up to date status of the equipment's performance, condition and health.
- To support optimal life determination and life cycle budgeting.
- To define risks and contains risk mitigation plans.
- To summarise the appropriate strategies to address issues in relation to both the shorter term operations and maintenance and the longer term strategic planning of the assets.
- To provide an information source capable of spanning organisational changes and the transfer of responsibilities between successive organisational roles.
- To model future costs and asset performance and process to identify future work and staff needs.
- To integrate all the information and processes associated with the equipment in a logical structure.
- To provide a mechanism to introduce discipline to enhance the execution of the intent of the various plans and activities.
- To provide a tool to communicate to stakeholders, customers and other parties about the organisations asset management activities.
- To provide a reference basis for continuous improvement as it is effective in highlighting gaps in information and processes.

Developing AMPs for an SA REIPP

Project background

The authors were the lead asset management consultants in a project for the asset owners and operators in the local renewable energy (RE) industry. The assets under management are located on one wind farm and two solar PV plants, all constructed in the REIPPP

round 1. The plants all went commercial during April 2014. At the time of the project roll-out, all the operational assets (or equipment items) were in their third year of a 20-year lifetime (governed by the duration of the Power Purchase Agreement with the contractual energy buyers). The EPC warranty period of typically two years had expired, thus the asset owners were facing a period of 18 years during which they will be responsible and accountable for asset performance, cost and risk.

The operational equipment items of this type of operation can be divided into three major categories:

- **Generation:** Those equipment items converting energy from renewable sources (wind and sun, in the case of this project) to electrical, typically at 400 to 700 V AC. This includes wind turbine generators, PV modules and inverters.
- **Electrical balance of plant (EBOP):** Those equipment items transporting and transforming the generated energy to a point and form suitable for delivery to the Eskom transmission grid typically at 132 kV. This includes transformers, cabling, protection, monitoring, control and communication systems.
- **Civil balance of plant:** All other equipment items which provide the infrastructure and environment for effective operation, maintenance and management of the generation and EBOP equipment. This includes buildings, roads, fences and water supply.

The project employer opted for an extensive top-down management system development to achieve the dual objectives of short-term enablement and long-term sustainability of their business. With the extremely high asset-intensiveness of the business, ISO 55001 provided the ideal framework for this.

Project roll-out

With reference to Fig. 1, the project roll-out was planned to establish the following deliverables in top-down fashion:

- Customised asset management framework which would serve for gap analysis between “as-is” and “to-be” states of the organisation, and management system design.
- Operational strategic plan (OSP) to clearly formulate and document the inherent business strategy as it developed intuitively during the early period.
- Asset management policy.
- Strategic asset management plans (SAMP), one per plant.
- Asset management plans.

A key mechanism to support change management in the organisation was the establishment of a project steering committee. Where it is relatively easy for a project team, including consultants, to put deliverables on

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Fig. 2: Final AMP table of contents.

the table, the real challenge lies in shaping the culture of the organisation to internalise and apply the proposed wisdom. The harnessed support of the organisation’s top management played a major role to smooth the road.

The first four elements listed above are all strategic in nature. As such, while no one would doubt their place and value, they are fairly removed from the day-to-day operations and thus do not materially contribute to the perceived needs of the organisation’s resources who are held responsible and accountable for asset performance, costs and risks.

The AMPs, in contrast, were expected to address the asset portfolio consideration directly, thereby supporting the O&M resources in their activities and decision-making.

AMP development process

The project stakeholders placed a high premium on the inclusivity of the process to develop the AMPs, and the change management to be obtained by wide participation of the O&M resources. However, the same resources were heavily loaded with O&M responsibilities and their time and availability to participate in the AMP development was constrained.

The nominal process followed was:

- Find agreement on AMP contents and the format of information to be documented and included.
- Consultants would source information from combination of options:
 - Plant as-built information and data (residing mostly on Sharepoint).
 - Organisation’s staff members (plants, operations, commercial, financial).
 - Subject matter experts (SMEs) external to the organisation.
 - Suppliers and OEMs.
 - General technical, engineering and financial literature (public domain, mostly web-based).
- Conduct detailed failure mode and effect analyses (FMEA) for each asset type in scope.
- Conduct structured asset condition assessments for at least pilot samples of the operational equipment in scope.
- Construct and populate life cycle cost (LCC) models for the projected plant life of 20 years.

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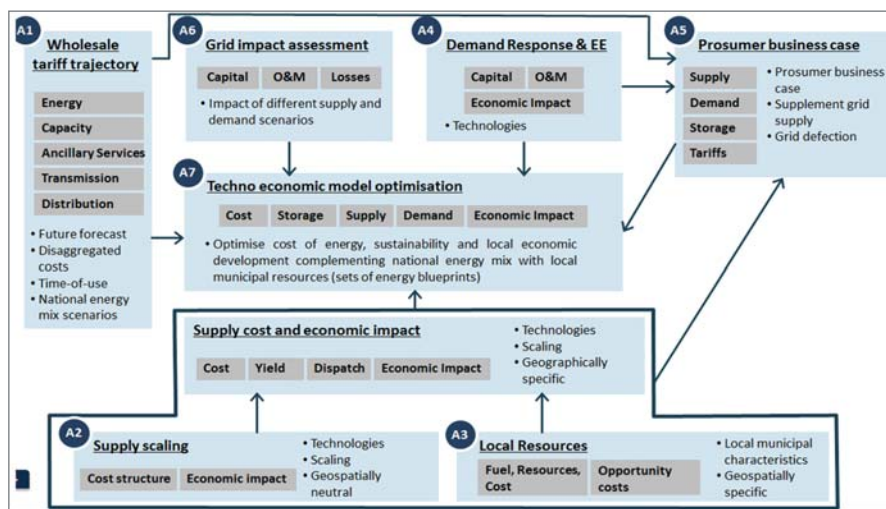


Fig. 6: MEMP activity interdependencies.

- **Prosumer business case and tariff analysis:** Develop models of consumer self-sufficiency, and local optimisation of supply, demand and storage to assess the consumer business case for a range of retail tariffs, feed-in tariffs, cost assumptions and other forecasted parameters.
- **Grid impact assessment:** Assess the costs of municipal distribution grid capex, opex and losses for penetration levels of supply and demand side options as part of scenarios considered.
- **Techno economic model optimisation:** Techno economic optimisation of the municipal electrical energy system considering the wholesale tariff trajectory, supply options, demand options, prosumer business case and grid costs. This will be performed for assumed electricity demand forecasts as understood by municipalities.

Workshops and discussions with municipalities

and broader stakeholders will be held to disseminate the project approach, progress, findings, learnings and recommendations. These will include activities to support municipal resource involvement in modelling activities (for skills transfer) and developing and managing the formal calls for interest in the program envisaged to be run by SALGA and supported by the DoE to select supported municipalities. This will also include the dissemination of municipal electricity supply plans to national government and the proposing of suitable metropolitan/city generation allocations to the national IRP updating process (metropolitan/city determinations).

Conclusion

The procurement of energy from local energy sources is an attractive option for municipalities, and South African municipalities are being approached by potential IPPs looking to enter

into commercial arrangements to buy and sell power, as well as customers looking to install generation for own use. Power generation technologies identified in municipal energy master plans for electricity (MEMPs) can provide a range of transformative, clean and reliable energy solutions to local governments, with lower greenhouse gas emissions and localised pollution effects. The modelling being undertaken will provide deep insights as to an optimal blend of wholesale electricity supply complemented with embedded distributed resources within the municipal electricity grid. The results will create an understanding of the future municipal energy system in South Africa, and can then inform the design of municipal electricity/energy business models, services and tariffs.

Acknowledgements

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- Document high-level information in AMP master document, and reference details stored in underlying folder structure.
- Review progress regularly with as wide an audience as possible to confirm agreement on data included, statements made and conclusions drawn.
- Feature the AMP development process high on the agenda of the project steering committee.

The final AMP master document content is shown in Fig. 2.

Conclusion

A set of five AMPs was completed in December 2017, one for each of the following major asset type/groups: solar PV

inverters; PV modules; solar SCADA system; generation step-up transformer and power transformers

With reference to the contents of the plans, at this early stage in the asset lives, the most valuable parts of the plans from the perspective of the O&M users appears to be:

- Asset type characterisation, and particularly the asset condition assessments as aid to life-cycle planning and decision making.
- Financial, life cycle costing (LCC) as an aid to budgeting.
- Risk management, AM risks, with mitigation plans.
- Asset life cycle management, and particularly the planned actions derived from the condition assessments.

- Resourcing, as an aid to organisation and competency development.

The challenges, after completing the initial versions of the AMPs, will be to keep the documents and underlying information alive, and configuration control.

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