Asset management strategies to preserve operational equipment

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Deregulation and liberalisation have intensified the efforts of utilities to technically and economically exploit their networks and the associated operational equipment - such as onload tap-changers (OLTCs), generators and transformers - to an optimum. The technical and economical optimisation of the available operational equipment is the particular and main goal of asset management.

The term Asset Management means administration and determination of available operational equipments. Asset management is for utilities and network operators an intelligent, economical and optimal management of the technical assets of the operational network equipment, such as on-load tap-changers (OLTCs), transformers, generators, etc.

The asset management has the task to:

- Determine and evaluate the condition of the equipment
- Evaluate the economic efficiency
- Keep and improve the technical condition of the equipment (high equipment availability)
- Reduce the life cycle costs, including the process optimisation
- Reduce of operation and maintenance costs
- Obtain knowledge of the technical system condition (remaining lifetime)
- Preservation of the environment by respecting and applying health and safety regulations

Asset management is an intelligent tool for the cost/quality balance, and a challenge for modern energy producing and supplying companies.

Tasks and tools

Maintenance

The asset manager should know what are the relevant factors when maintenance needs to be done. Thereby initially the maintenance strategy must be decided.

Maintenance definitions

There is a definition in the European Standard EN 13306 which is described as follows:

Maintenance: Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in or restore it to a state in which it can perform the required function"

Maintenance objectives: Targets assigned and accepted for the maintenance activities. These targets may include for example availability, cost reduction, product quality, environment preservation, safety."

Maintenance strategy: "Maintenance method in order to achieve the maintenance objectives"

Maintenance strategies

Risk or event-based maintenance

A typical maintenance strategy is the risk or event-based maintenance. In such cases maintenance is carried out only after a fault has already occurred and has been detected. This maintenance strategy includes:

- Maintenance performance only after a failure
- Availability of the facility depends on the reliability of the device
- No influence on failure time
- Risk of unplanned outages
- Risk of consequential damage
- Lowest total costs for maintenance, (but without consideration for consequential costs, which are difficult to estimate)

This is not the recommended strategy for operational equipment.

Time-based maintenance

The most common maintenance strategy for operational equipment used to be the time-based maintenance. In that case maintenance is carried out at predetermined intervals or according to specified criteria and intended to reduce the probability of failure. This method is a safe method and is recommended for transformers and on-load tap-changers. This maintenance strategy includes:

- Maintenance in fixed time cycles
- Replacement after a stipulated service life
- High availability
- Cost intensive

This has been the standard strategy for operational equipment up to now.

Condition–based maintenance

The condition-based maintenance is an advanced and up-to-date maintenance strategy as an alternative to time-based maintenance. It is based on performance and/or parameter monitoring and the subsequent actions. In contrast to time-based maintenance it allows extending maintenance intervals to the limit and thus exploit equipment reserves. This maintenance strategy includes:

- Maintenance depends on the technical condition
- Safe maintenance strategy
- Exploiting reserves
- Environment friendly solution
- Life cycle cost optimisation
- Characterisation of the current condition of the asset needs the use of new technology and devices

This is an advanced strategy for operational equipment.

Maintenance-free equipment

The use of maintenance free equipment is a big advantage for the equipment user and offers the following benefits:

- No maintenance necessary
- No maintenance cost
- No cost for logistic and planning
- No shutdown required
- Best life cycle cost consideration
- Best solution for the environment

Modern asset management methods are almost exclusively geared to this maintenance strategy, and this is the preferred strategy for operational equipment.

After the maintenance strategy is determined, the asset manager has to take care that it become accepted. That means, that the asset manager decides if, when and mainly how will be invested and maintained.

Practical example of preservation and evaluation of the condition of the equipment

Criteria for Oiltap OLTC maintenance

There are different criteria for the determination of required inspections and preventive maintenance of on-load tap-changers. For high-speed resistor type tap-changers with arcing contacts under oil (Oiltap), these criteria can be summarised as follows:

In brief the following events occur during the OLTC diverter switch operation:

- Arcing on the diverter switch contacts creates contact wear and carbonisation of diverter switch oil
- Diverter switch operation in 40 - 50 ms
- Mechanical stress to diverter switch components

Online oil filtration with Oil Filter unit

Effects:

- Removal of carbon particles from the tap changer oil
- Keeping the water content to a minimum (in case of combined filter cartridge)

Benefits:

- Improving operational reliability of OLTC and transformer
- Extension of maintenance intervals
- Avoiding of cleaning work during maintenance
- Saving transformer oil (less oil needed for replacement and cleaning)
- Reduction of maintenance costs

This is an active measure for improving tap-changer oil quality.

Equipment condition monitoring for OLTC

The task of the equipment condition monitoring is to identify in time possible operating facts. The equipment condition monitoring should deliver facts and information for an assessment of the error risk. From the result of a measurement and whose interpretation arrangements for further actions (maintenance, replacements of parts, etc.)

The necessary facts for determining and evaluating the condition could be won through permanent monitoring devices.

The most high-value and at the same time most intensive equipment to determine the equipment condition is the permanent equipment monitoring.

Use of maintenance-free equipment

Use of Vacutap OLTCs for new transformers:

The use of a Vacutap instead of an Oiltap tap-changer offers the benefit that – because of the switching arc occurring exclusively in the vacuum interrupter – no carbon particles will

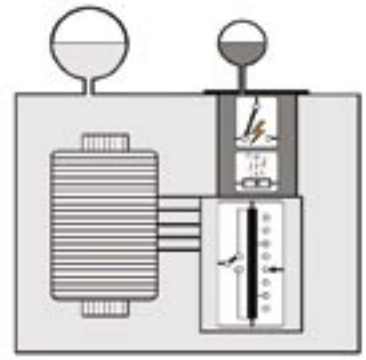

Fig. 1

be produced in the course of tap change-operations. Thus the "carbon formation" is eliminated. With the first maintenance to become due only after 150 000 operations, the Vacutap technology is a step towards the maintenance-free tap-changer for transformers in network application.

Benefits:

- Switching arc in vacuum interrupter
- No oil carbonisation
- Extended contact life
- Suitable for the use with alternative insulating fluids
- Maintenance free up to 150 000 operations
- Reduction of maintenance work
- Reduction of operating cost

Conventional OLTC technology (switching contacts make and break the current under oil) has achieved a very high level and is able to meet transformer application requirements. However, the need to regulate transformers with a reduced maintenance efforts. is increasing. Furthermore, worldwide deregulation of the electricity supply industry is still a concern. As a result, increased cost pressure on utilities as well as on the industry has led to increased performance expectations placed on the transformer equipment and OLTCs in particular.

Maintenance free dehydrating breather:

Conservator tanks of transformers and tapchangers are usually equipped with dehydrating breathers. The drying agent of those breathers absorbs the moisture from the air passing through the breather. The moisture-absorbing capacity of the drying agent is gradually reduced until finally the dehydrating breather is no longer efficient.

Drying agents have to be replaced prior to having reached their saturation. The use of a maintenance-free breather eliminates the need for periodic inspections and replacement of the drying agent.

Benefits:

- No permanent inspection frequency
- No permanent replacement frequency of drying agents
- Reduction of maintenance costs
- No disposal of drying agents necessary

Lifespan assessment

The basis for a qualified lifespan appraisal is a reliable determining and evaluation of the condition. Beyond it knowledge about the basic ageing action and about the essential constructive feature of the respective assets are needed.

Evaluation of the economic efficiency

For a macroeconomic evaluation of the asset the asset-management needs operating figures, which give a packed view about revenue and expense and about the interacting factors. They should provide information about:

- asset effectiveness
- efficiency of rationing
- asset profitability

Expansion and modernisation

The Asset Manager is also instructed to acquire modernisation strategies and to deal with the expansion of the network. During modernisations or expansion projects new technologies will be considered. In this connection it must be kept in mind that these investments should be made only under the consideration of the reduction of the operating costs (life cycle costs).

Appraisal of reliability

To be able to make corroborated statements about the reliability, the Asset Manager must achieve information about the reliability of the single network components. Therefore the basis is to analyse the operating

facts, which gives information about single network components.

From these analyses the reliability of the single components and of the whole system can be deduced. Additionally these dates can be used as a basis for the development of

- long-term strategies for the single assets and
- tools for determining and evaluating the condition

Observance of environmental compatibility

The increased public environmental consciousness leads partly to intensified environmental constrains. These could cause considerable operating costs and additional investment costs. However these cost must often be accepted. The Asset Manager has to consider these when making decisions.

IT asset management

To implement the listed functions of assetmanagement, a suitable IT system can be used. When making the choice of this system, the chosen strategies for maintenance, determining and evaluating the condition and other factors, for example the size of the company, are essential.

Asset management software should basically give a detailed summary about the possible cost-saving within the scope of the life cycle of an asset.

The following list shows some examples of software product solutions, whereby asset management is possible:

- SAP
- Office-Asset XP
- Enterprise Asset-Management

Situation abroad

Since about 1990, liberalisation of the energy market has occurred all over the world - in some countries earlier, in some later. Due to this global liberalisation, some consulting companies have expanded their offerings, and consult to network operators, especially in the field of asset management. They often supervise this activity on behalf of their clients, and/or are are seconded to perform this function for the client.

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