

IMPROVING DISTRIBUTION NETWORK MAINTENANCE PROCESS WITH SELF-DRIVEN MAINTENANCE ACTIONS BY CONTRACTOR PARTNERS

Pauliina SALOVAARA
Elenia Oy – Finland
pauliina.salovaara@elenia.fi

Otso KARHU
Elenia Oy – Finland
otso.karhu@elenia.fi

Turo IHONEN
Elenia Oy – Finland
turo.ihonen@elenia.fi

Harri SALOMÄKI
Elenia Oy – Finland
harri.salomaki@elenia.fi

ABSTRACT

Distribution system operators (DSO's) are nowadays influenced by several factors that affects the development of their business. The whole society is today highly dependent of electricity which leads to increasing demand of reliability of supply and higher customer expectations. There are also ongoing large replacement investments projects of old aerial network with undergrounded weatherproof network in Finland. Most of these actions are done by external service contractors when DSO's having only white-collar project supervision role.

All these arguments drive distribution utilities to optimize their maintenance management process of their physical assets, by developing their maintenance activities more effectively and to fulfil the requirements also in a cost-effective way to allocate limited maintenance resources correctly.

This paper presents self-driven maintenance management actions that Elenia has taken into action during past two years with regional contractor partners to improve distribution network maintenance process as well as to improve network reliability, quality of delivery and safety with optimal costs. This has been one of the first steps towards tactic partnerships between DSO and contractor partners.

To enable fluent self-driven maintenance management process, the used ICT systems in Elenia are also further developed to ensure simple documentation also on the site. The used Network Information System (NIS) has developed maintenance part and the mobile solution for NIS is used for maintenance as well.

INTRODUCTION

An increasing number of DSOs in Finland have outsourced their non-core functions and are purchasing services from external service providers. By using purchased services, they aim at focusing on core-business, cost savings, having better and wider resources and getting the possibility to exploit best practices and know-how in the industry. [1]

Elenia Oy (Elenia) is the second largest DSO in Finland with more than 425 000 customers and over 70 000 kilometres of total network length. Elenia is operating mostly in rural areas in central Finland and have 160m of

network per customer. The underground cabling rate is currently over 41% of total network length and the rest is overhead lines. Target proportion of whole network underground cabling is 75% by the end of 2028.

During the over last ten years Elenia has focused heavily into improving reliability of delivery e.g. with increasing network automation, building new small-scale primary substations and implementing new tree clearance actions for trees outside line corridors. Since 2009 Elenia has constructed all new and reinvested low voltage (LV) and medium voltage (MV) networks with underground cables across the entire network area. Next step is to develop asset management processes with e.g. data-analytics and more advanced maintenance management.

PARTNERSHIP NETWORK

Elenia has developed its partnerships over a long period of time and today over 800 professionals work for us in different positions. Elenia has outsourced all its electricity network construction, maintenance, services and fault repairing into totally open market. These functions and many others are purchased from the partnership network. The new way of organizing distribution business processes together with partners requires new perspectives and tools to manage the whole partnership network. [2]

Elenia's network area is divided into 20 contracting areas with a total of 6 regional contractor partners today. Elenia is committed to long-term partnerships, the current contract period started in 2017 and it will last until February 2020 and after that there will be possibility to option periods. The annual contractor for each of the 20 contracting areas was chosen with tendering process. The contracts are unit-priced including network construction, planning, maintenance, service functions and fault repairing. Elenia orders all these services with unit-prices for each area from the regional contractor of the concerning area.

The improvement of the services providers' operational efficiency can be achieved with a successful partnership management. Together with our current partners we have developed a new model for self-driven maintenance process to integrate the DSO and contractor partners operative processes and further utilize synergies and more engagement partnerships. This has been one of the first steps towards tactic partnerships between Elenia and

regional contract partners. Well-functioning partner guidance has become an established practise for Elenia during the past years with wide partnership network.

Development of partnership network

The operational partnership is mechanical in nature. The goal of cooperation is reducing costs and focusing resources on your core business. Cooperation is based on clear agreements that define each party role, responsibilities and performance. The benefit can be reliably calculated by the parties. The basis for trust is in documents and written agreements. Confidence arises when partners are both able to act on their own in accordance with the agreements. Subcontracting relationships are typical of this form of partnership in the mechanical business environment.

Tactical partnership is characterized by learning together. The goal is to combine parties' processes, eliminate duplication, but also combine operational cultures. It seeks to integrate functions, not just the exchange ratio of performances. As a result, the parties will achieve both savings and new learning. Tactical partnership requires trust and does not work alone on contracts.

Self-driven maintenance process was defined and developed in joint workshops together with all the present regional contractors in the beginning of new contract period. Target was to develop a new fluent operating model for small maintenance actions noticed during other actions in distribution network. At the same time the responsibility of the regional contractor can be grown towards property management of own area.

Increasing the use social interaction with the partnership network has many benefits. The information flow improves, and the objectives of the partnership become clearer. The interaction improves mutual understanding of another's business and at the same time partners can share best practices to improve the whole business. It also improves the comprehension of the whole process, the whole partnership network and the meaning of the mutual end-customer. [2]

MAINTENANCE

The objective of maintenance is ensuring the safety of distribution network and maintain the reliability of supply by optimal costs. The primary goal of maintenance is to avoid or mitigate the consequences of failure of component by preventing the failure before it occurs or repair the defects in reasonable time.

Maintenance can be divided to preventive and corrective maintenance. Preventive maintenance aims to detect failures before they cause malfunctions. Preventive maintenance can be further divided to systematic preventive maintenance actions, called Time Based

Maintenance (TBM) and actions made based on inspection results, called Condition Based Maintenance (CBM). Corrective maintenance is conducted after suddenly unplanned need for repair with-out pre-planning.

Systematic TBM is maintenance which actions are performed regularly by the pre-defined plan. Elenia uses TBM e.g. when planning inspections of all distribution network components. CBM is based on collected maintenance data which guides how to allocate the corrective maintenance actions. CBM is used in Elenia on maintenance actions based of inspection notes and other information received from network components.

All the maintenance inspections and actions are traditionally budgeted, planned and ordered beforehand by Elenia based on the yearly maintenance program. In self-driven maintenance process, the regional contractor partners employee can perform the needed maintenance action already when making the inspections or in other occasions when passing by without previously made order.

SELF-DRIVEN MAINTENANCE

The target for self-driven maintenance development was to improve network reliability, quality of delivery and safety with optimal costs. The other as important as the previous was to develop partnerships towards tactic where the both parties can e.g. achieve savings of costs.

The traditional way of maintenance as well as all the other investment and service actions has been that first there is order from DSO of the maintenance work based on inspections or other notices and after that the contractor partner perform the action in defined time period. Invoicing is based on the unit-priced actions which have existed for a quite long time in construction and maintenance within Elenia.

Self-driven maintenance is limited to individual action to network components that still have remaining service-life. Self-driven maintenance actions can be done to all voltage levels 0,4 – 110 kV and primary substations of Elenia network. These actions have to be single and separate and large entities of maintenance actions should still be planned within Elenia. The same unit-priced actions are used for self-driven maintenance as well for the other planned maintenance. The amount of the unit-priced maintenance action of distribution network is limited so the use of them is easy to instruct to wide range of partners employees.

There are actions for example correcting the markings of one component (Image 1), making small scale correction for distribution cabinet and secondary substation or maintenance of the whole distribution cabinet and secondary substation. Some actions for aerial network are also divided by the need for climbing to the pole or not.

There are different actions for different voltage levels, component types and primary substations. E.g. for 20 kV pole there is 5 different type actions to do all the correction maintenance of which one is straightening the pole (Image 2).



Image 1. Correction of safety markings

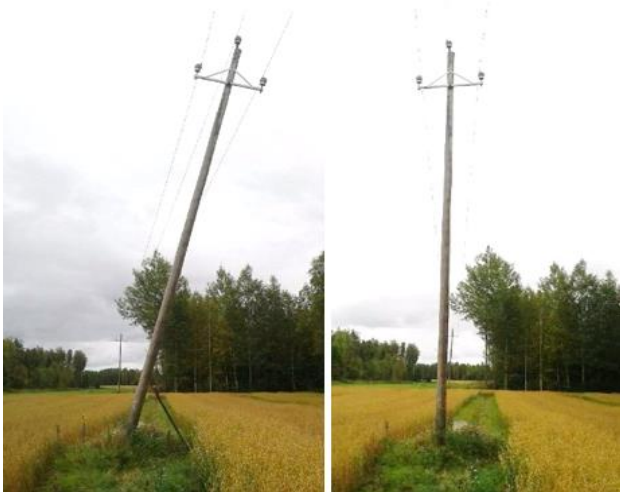


Image 2. Adjustment of tilted 20 kV pole

Part of the self-driven maintenance is also informing of the need for re-investments in distribution network in the cases where the network is already in the end of service-life and maintenance is no longer profitable. In those cases, the regional partner makes a general plan for the reinvestment and send it to Elenia for verification.

Self-driven maintenance process

The normal process for self-driven maintenance goes similarly for every component type and voltage level. First the local contractor employee does the observation of the component condition and document it to Elenia NIS. At the same visit the employee does the needed maintenance action and, in the end, make the documentation of the made action and corrected observation to NIS (Image 3). All the maintenance information is saved immediately to the NIS database and can be seen from the component by every user.

The condition of the component before and after the self-driven maintenance action will be photographed and documented to NIS in to the component's information

sheet in situations where the action is slightly larger. In the beginning of the new process all the actions were photographed to verify the need for maintenance and to see the end result of made action.

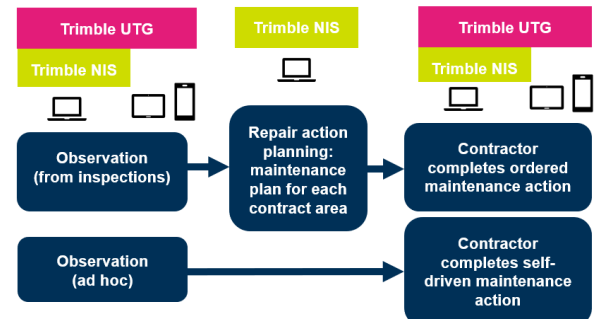


Image 3. NIS UTG maintenance process

Based on the NIS documentation the contractor partners will get weekly order trough Enterprise Resource Planning (ERP) system of the self-driven maintenance actions. So the only difference to traditional maintenance process is that the order of the maintenance action is made after the work is done. In both cases the payment will be done after the work and the documentation is ready.

Because of the large reinvestment process that is going on in Elenia's network, the information of possible demolition of the component is also available to all user from the component data sheet. In this way we can avoid maintenance action to components that will be reinvested in near future. Overall plans for the long-term investments have also been brought visible.

SYSTEM DEVELOPMENT

Attribute information about all the network components are stored in Elenia's NIS by Trimble. In the same system there are also all the collected maintenance data of the components over past years. Maintenance data consists of inspection notifications as well as the actions that has been done to maintain the component condition.

To enable smooth self-driven maintenance process, network information system (NIS) by Trimble has been also developed. All the maintenance executions have been divided into specific named actions that include notifications of the component. The number of NIS maintenance actions is limited, and they are directly linked to unit-priced actions. All the planned and made maintenance actions are linked to specific maintenance plans and with these plans Elenia can follow precisely all the maintenance actions state and direct those to selected partners. All the Elenia contract partners have also granted access to the same NIS system through specific area plans with user rights added by Elenia.

Mobile network information system

Mobile NIS usage possibility Utility To Go (UTG) has also been elaborated, that enables up to date network information to onsite. A mobile solution provides field crews with secure access to network data on different background maps anytime, anywhere, in real-time and with most web browsers. Operative state and electrical network topology in real-time are also available as well as the up-to-date information on network outages (Image 4).



Image 4. Mobile solution UTG by Trimble.

UTG allows field crews to view maintenance data of network elements, pick the nearby planned actions and execute actions in the field. At the same time, it is possible to update network element and operative data, such as estimated repair times for outages directly in the field to maintain maximal data integrity among other things.

New NIS and UTG permits the partners also to document maintenance actions that are unplanned in advance within DSO. For the new self-driven maintenance process to work, this development was very important. These self-driven actions will be directed automatically to specific contracting area maintenance plan and from these plans both Elenia and the regional partners can report the made actions from NIS interface. This way the process is transparent and both parties always have the same information.

REPORTING

In order to manage new self-driven maintenance process, it must be reported continuously as well as all the other purchased services. In joint workshops together with regional partners was decided that all the made self-driven maintenance actions will be reported transparently to all the regional partners regularly. This will increase the understanding of new process and partners can share best practices to improve their efficiency.

Self-driven maintenance process has been in use since 2017 and the developed NIS system since April 2018. The NIS documentation as well as reporting have been slightly different in the beginning of new process with older NIS version and used other solution. Since April 2018 approx.

4 000 separate self-driven maintenance actions have been done. These actions have been fairly evenly distributed throughout the Elenia distribution network, but still there are contracting areas where the process has not been effectively deployed. A great part of the actions done are correction of markings and other actions done in connection with inspection.

In order to manage also the whole maintenance budget of Elenia the cost reporting of self-driven maintenance actions is done within Elenia as a part of overall maintenance management. In the beginning it was also clearly stated to the partners the yearly budget of self-driven maintenance that they can use. These costs will be entirely consisted of unit-priced maintenance actions that are done and documented to NIS/UTG. The total target budget 2018 was achieved but the variation between the contracting areas was quite high, so there is still work to do to have all the partners sufficiently committed to the new process.

CONCLUSIONS

Self-driven maintenance process has been in use almost two years with in total 6 regional partners. In all twenty contracting areas, a certain budget has been available for regional partners to use for maintenance action that they have noticed during other actions or passing by. These actions are documented to NIS system and according to these unit-priced actions, the partner receives an order afterwards. Traditionally all maintenance actions are planned and ordered by Elenia and only after that the actual action has been done. Through this new process model the condition of the network improves as the inspection-based work order inertia decreases.

This is one of the first development action towards tactic partnerships model with partners and the responsibility of the regional contractor can be grown towards property management of own area. Self-driven maintenance process has started well, and it has been decided to continue with regional partners because this model benefits both parties. During the next months, areas where the usage of new process has been small, will be more familiarized to have advantage of the new process.

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