Strategies to cope with obsolete populations of MV switchgear

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Abstract

Résumé:
The electricity grid in Western Europe was mainly constructed during the period 1945 to 1980, so ageing of assets is a major concern for electrical network operators. At Stedin DSO, about 60% of the switchgear in major substations was designed more than 50 years ago, and the techniques used are archaic. Manufacturers cease support of old and some less successful medium aged designs. To secure continued operation of existing switchgear populations Stedin and (the successors of) three main switchgear manufacturers (Eaton, ABB and Alstom) concluded long term contracts. They enable Stedin to make a smooth out phasing plan for obsolete switchgear designs and support the conservation of knowledge, skills and production of spare parts by the manufacturers. The main characteristics of the long term agreements are discussed. Some arguments relating to larger and smaller populations are mentioned. An example of a 20 year replacement plan is shown. Long term agreements must have a certain flexibility dealing with external changes. The consequences of enhanced regulation of Dutch network operators to an existing agreement are treated.
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Strategies to cope with obsolete populations of MV switchgear. DIRK van HOUWELINGEN Asset management Stedin BV Rotterdam, the Netherlands
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Abstract— The electricity grid in Western Europe was mainly constructed during the period 1945 to 1980, so ageing of assets is a major concern for electrical network operators. At Stedin DSO, about 60 % of the switchgear in major substations was designed more than 50 years ago, and the techniques used are archaic. Manufacturers cease support of old and some less successful medium aged designs. To secure continued operation of existing switchgear populations Stedin and (the successors of) three main switchgear manufacturers (Eaton, ABB and Alstom) concluded long term contracts. They enable Stedin to make a smooth out phasing plan for obsolete switchgear designs and support the conservation of knowledge, skills and production of spare parts by the manufacturers. The main characteristics of the long term agreements are discussed. Some arguments relating to larger and smaller populations are mentioned. An example of a 20 year replacement plan is shown. Long term agreements must have a certain flexibility dealing with external changes. The consequences of enhanced regulation of Dutch network operators to an existing agreement are treated. Keywords— Switchgear, Obsolete, Population, Long Term Agreement, Ageing Assets I. INTRODUCTION Ageing of materials and constructions has been described in many papers [1,2,3]. In most switchgear, this can be countered by proper maintenance and overhauls. But in the long run, the support by manufacturers will be less, and technological development in production will make old types of spare parts difficult to produce. In the end the switchgear will become obsolete. As a network operator in the Netherlands, Stedin faces this problem in its switchgear in 10 – 25 kV substations. About 60 % of the switchgear in major substations was designed more than 50 years ago, and the techniques used are archaic. The problem is aggravated by the fact that Stedin is formed from around 15 municipal energy boards with their own preferences for network lay out and manufacturers. Thus, a multitude of old types of switchgear exists in the grid. Manufacturers of switchgear have merged as well. They have to support a diversity of switchgear types from their predecessors. As a means of rationalization, manufacturers cease support of some less successful designs. They declare those types “obsolete” and wish to stop support of maintenance and delivery of spare parts. Medium aged types may be declared “obsolete”, many years before the inherent ageing of major components decreases their abilities. Due to specific Dutch conditions (e.g. the old 25 kV system voltage, which is replaced by the 36 kV IEC standard voltage), no direct relation exists between worldwide populations and share in the Stedin grid. Large worldwide population with continued support from the original manufacturer may be small within Stedin. On the other hand, Stedin may have a large share in a comparative small population worldwide. So, Stedin has to cope with: old populations forming a large share in its grid with conclusion of support announced within a few years, medium aged small populations being declared “obsolete” very old small populations with continued support. Some of the problems and solutions associated with operation of ageing assets will be discussed in this paper. II. POPULATIONS WITH A LARGE SHARE IN STEDIN’S SUBSTATIONS In 2011 manufacturer Eaton announced its plan to cease support for maintenance of COQ-type of switchgear. This was the first time a large family of high voltage switchgear became obsolete before capacity requirements forced its replacement. Stedin realized that support for maintenance of old types of switchgear was not assured, and had a closer look at the age of its switchgear populations. In 2013, three families old switchgear from traditional manufacturers accounted for over 60 % of all bays in the (sub)transport substations of Stedin. Their shares are shown in figure 1. The COQ-family is the largest population, old BBC and AEG populations are substantial as well. Both Stedin and Eaton realized they would benefit from a long term agreement on continued maintenance and planned phase out of COQ switchgear, and started negotiations. In the prelude to the finally agreed long term agreement, they state that, “STEDIN…decided to safeguard the preservation of its COQ, Conel and HH Reyrolle switchgear by making, for at least 20 years, an agreement with EATON regarding revision, modification, repair, maintenance, inspection and withdrawal Fig. 1. shares of old types of switchgear of COQ, Conel and HH Reyrolle switchgear, …., and apart from that, STEDIN has the intention of replacing or amortizing the said switchgear in the said period.” In 2012 a long term agreement was signed by Stedin and Eaton. In 2015 similar long term contracts were concluded with ABB as the original equipment manufacturer (OEM) of DB switchgear and Alstom Grid as successor of AEG, the OEM of CP switchgear. A fourth contract has been signed with Siemens as successor of the OEM of COQ 50 kV. We will not discuss the Siemens contract here, but it is mentioned as part of the “ageing asset”-contracts by Stedin. More on the Siemens ageing asset contract can be found in [4]. III. STEDIN-EATON LONG TERM AGREEMENT The aim of the long term agreement between Eaton and Stedin is: “To secure the preservation of the COQ-family of switchgear during the agreed period (20 years), thus assuring the continuity of energy supply by Stedin. It concerns the revision, modification, repair, maintenance, inspection and withdrawal of switchgear of Eaton. By signing of the agreement Eaton also declares: To use and preserve all knowledge, expertise and workmanship with regard to the activities during the term of the
The agreement with Stedin ensures Eaton funding for the conservations of knowledge and skills in support of COQ switchgear. It also ensures a base level of work and continued experience on maintaining COQ switchgear. The agreement with Eaton provides Stedin a reasonable time span to out phase COQ switchgear. The long-term agreement only concerns the two parties Eaton and Stedin. Eaton is free to organize the work with any service provider needed, e.g. for measurements, switchgear operations and surveillance of safe work operations. The agreement includes many details to ensure a yearly planning cycle. The duration of the long term agreement is 20 years (up to 2032), but it can be increased by common agreement to 2037 or 2042. Provisions are made when either of the parties has to end the agreement prematurely due to external circumstances like bankruptcy or losing the license to operate. These provisions include an exit plan and placing in an escrow depot of all major documents, drawings and technical specifications.

After concluding a long term agreement with Eaton, Stedin recognized the risk posed by the (lack of) support for DB switchgear (original supplier BBC) and CP (original supplier AEG). Though support was still available, both families of switchgear had a long history and no long term support was agreed on. To ensure long term support, Stedin started negotiations with ABB and Alstom Grid (now GE) for long term support of old switchgear types. In 2015 agreements were reached with both parties. The aim of the agreements is stated as: “to ensure the preservation of switchgear during the term of the agreement, to secure the continuity of energy supply by Stedin. Stedin and supplier strive for a long term partnership.” The objective is “to reach or continuously improve: Recording verifiable results of done maintenance activities, including found deviations and unfinished work, and follow-up of deviations; High reliability of switchgear during the expected life time of at least 40 years; High availability by i) small amount of necessary preventive maintenance and inspection; ii) quick repair in case of failure or deviations (found during maintenance and inspection)” Both agreements span a period of 10 years, with the possibility to add another 10 years. The scope of the long term agreements includes all switchgear of ABB and Alstom Grid and their predecessors. Most emphasis is on the large DB and CP populations, but other smaller populations are included. As no announcement was made by ABB or Alstom Grid to cease support for old populations, no time schedule for out phasing of equipment is included in the agreements. In the ABB and Alstom agreements a third party, called the Representative, is included, who will execute operations on behalf of Stedin. It is a service provider called Joulz, who is part of the ENECO holding, which owned Stedin. Figure 2 shows the relations between parts of the ENECO Holding at the time the contracts were concluded. Joulz acted as a service provider for both production and transport & distribution. It was the preferred service provider for Stedin and as such it was included in the contracts. Joulz also was the preferred supplier for other services needed when performing maintenance, e.g. measurements, switchgear operations and surveillance of safe work operations. In an addendum to the contracts Stedin and suppliers recognize Joulz as the service provider and Joulz Fig. 2. ENECO holding structure in 2014 accepts responsibility as Representative under the contracts. The ABB-Stedin agreement does include a clause how to proceed if any population should be declared “obsolete”, i.e. maintenance no longer supported and spare parts no longer produced. It was expected that the DB population would be out of support soon. Provisions are made for Stedin to be able to procure a last supply of DB spare parts before production is stopped. ABB will stock the last spare parts for Stedin and support maintenance while stocks last. The Alstom agreement does not contain a similar clause. V. SMALL POPULATIONS For smaller populations different strategies can be chosen. The obvious solution, when no preventive action is taken, will be to dismantle switchgear when it is obsolete. This is a good solutions when only a few bays of a type exist in the grid. It’s also a good solutions, when the switch gear no longer meets the present and future requirements like safe work regulations, environmental impact or increased fault levels. As an example, Stedin decided to replace its sole EIB/BStt 107-K CRR 30 system in Zoetermeer-9 25 kV-substation, because of its high SF6 leakage rate. In fact, even old switch gear for which maintenance and spare parts are still supported, may be replaced if it no longer meets future requirements. In the main industrial and harbor area of Rotterdam, several substations have no possibility to connect with modern control systems. Thus, several sections of COQ and DB switchgear (built in 1949) will be replaced, as remote control is an essential need in this area. The same happened with F&G and AEG switchgear in substation Gruttostraat after 61 year of service. A medium term option for all systems, applicable to large and small populations, is to try to synchronize an “obsolete” declaration with refurbishment or 10-year maintenance. It couples internal and external planning, easing the financial and operational decisions for replacement. Major maintenance, planned at 10 year intervals at Stedin, can be advanced to e.g. 8 years when an “obsolete” declaration is imminent. Thus, the switchgear enters another 10 year period without major maintenance and replacement is postponed. On the other hand, major maintenance may be postponed or replaced by minor maintenance, when replacement is expected in a few years. An interesting option for a small population is to piggyback on a long term contract concerning a larger population by the same OEM. In the ABB-Stedin long term agreement, the main focus is on the DB-population, consisting of ca 600 bays originally supplied by BBC. But it also includes other medium aged and old populations, e.g.: 50 bays of HB12 switchgear, originally supplied by Calor Emag 40 bays of OD3 switchgear, originally supplied by Calor Emag 30 bays of SD12 switchgear, originally supplied by BBC Stedin and ABB would not invest in each of these populations to continue operation and support, but together with the large DB-population they form an interesting business case. VI. FIVE YEAR EXPERIENCE WITH LONG TERM AGREEMENTS Stedin and its main switchgear suppliers have been working with the long term agreements for about 5 years now, and some experience has been gained. In the first years, it took some time to fit the planning systems of the parties. The agreements call for a planning in a phasing forecast for 36 month, longer than either party was used to. But this was build up, and works well now. Continuous effort is needed to update the forecast when switchgear is replaced, either for reasons of capacity or to realize the out phasing of switch gear populations in 20 years (for Eaton switchgear). This is realized by yearly
meetings between the Asset Management department of Stedin with Eaton (for COQ) and the Representative Joulz (for ABB and Alstom). The planning to provide an exit plan within 6 month of signing a contract has proven to be very optimistic. It took about 3 years to write and implement the exit plan with Eaton and finally place the COQ documentation in escrow. For ABB with multiple types of switchgear the exit plan is more complex and may take even longer. It seems likely that only the major populations of ABB will be treated in the exit plan and included in the escrow of documents. It seems easy to start a 20 year replacement program. But a major change in the allocations of financial resources must be included in the financial forecast of the company. A plan has to be developed to avoid working on many stations in the same time in one region. Finally, it takes about three years to execute a switchgear replacement project from start of engineering to dismantling of the last old switchgear bay. It took Stedin 5 years to accelerate its replacement rate of COQ-switchgear to achieve out phasing in 20 years. In 2017 more than 5 % of the original number of bays was replaced in one year for the first time. This is shown in figure 3. Some other interesting planning details are included in figure 3. In the middle of the graph a high number of bays will be replaced per year. This is due to risk considerations. At the start of a program one would start with some smaller Fig. 3. Realised and planned replacement of Coq bays substations to avoid project risks. As more experience is gained, larger substations can be done. With those large substations many old bays are replacement and most of the risk to the business is mitigated. In the end, some small substations are done with low risk to the business. In this case with Stedin, over 50 % of all substations are situated in one small geographical area, the harbor area of Rotterdam. Less than 25 % of all bays is in these substations, who each serve only a few large customers. Those account for the long tail in the graph from 2025 with only few bays. Due to the focus on DB type of switch gear, no last buy notice was issued by ABB when the HB switchgear was declared obsolete. Stedin had no spare parts to conduct major 10-year maintenance and will have to replace its switchgear in Schiedam-Noord and Roca substations. In conjunction with ABB a solution was worked out, which only involves the replacement of the circuit breakers on the removable parts of the bays. All other primary parts of the switchgear will remain in service. VII. REGULATION AND CONTRACT MANAGEMENT In 2016 a final decision was reached on the enhanced regulation by the Dutch regulator of the energy market, concerning the independent operation of grid operators. It meant that Stedin could no longer be owned by a company that was also involved in energy production and supply, like ENeco. Ownership of Stedin was transferred to the owners of ENeco, a number of municipalities in the west of the Netherlands. The new regulation stated also, that Stedin had to take control over most of the activities done by service provider Joulz. So, Joulz became a subsidiary of Stedin. This is shown in fig. 4. The new structure had minor impact on the ABB and Alstom agreements. Joulz, now being a part of Stedin, could still represent Stedin on operational aspects. The new structure had a profound influence on the Eaton agreement. Earlier Eaton had chosen to hire Joulz for switchgear operations and surveillance of safe work operations. A logical choice, as Joulz is familiar with Stedin’s assets and procedures. But now Eaton hired the same organization as it was hired by, creating a circle of responsibilities. This is a legal loophole, making the contract illegal according to Dutch law. Fig. 4. Stedin and ENeco structure in 2017 From a financial perspective, Stedin paid overhead to Eaton for Joulz people working on the contract, which were now Stedin’s own employees. Thus, the Eaton-Stedin agreement had to be renegotiated. To prevent the legal loophole, Stedin’s operational program manager now hires Joulz-personnel directly. And to compensate Eaton for the missed revenues the contract is expanded with a wider range of switchgear types. Like the ABB and Alstom contracts, the Eaton agreement now covers most old populations from Eaton (and its predecessors) used by Stedin. VIII. CONCLUSION To optimize the continued operation of “experienced” assets, long term agreements between grid operators and the original equipment manufacturer are necessary. They provide grid operators with a time space to replace (large) populations of switch gear in an orderly way without compromising the security of supply. And they allow manufacturers to maintain knowledge and operational experience, as a minimal turnover is guaranteed. Long term agreements work best for large populations, but smaller populations may piggy-back on the larger ones in the same contract or several smaller populations may be combined. Long term agreements in the energy transport- and distribution sector must have enough flexibility, as legal and regulatory circumstances and concern structures will change over time.


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