LIFETIME EXTENSION SERVICES FOR STATIC VAR COMPENSATORS

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1. Abstract

Active power quality improvement solutions such as static var compensators (SVC), static synchronous compensators (STATCOM), battery energy storage systems (BESS) and smart hybrid power systems (SHPS) are critical for electrical grid and installations' stability, reliability and availability.

To properly address factors such as the aging of these solutions and deterioration and wear of parts or devices, operation services like maintenance check-ups and equipment diagnosis should be performed regularly together with remote monitoring and analysis (JEL, 2003).

These operation services may foresee risks of increasing failure rate according to electrical and environmental stress, opening the door to renewal services that will address the needs for life extension, technological enhancement, increasing the electrical ratings of the solutions and manage their obsolescence.

Renewal services for these solutions improve their reliability, add functionality, secure spare part availability and increase overall performance, bringing older systems closer to the functionality supplied by newer systems.

2. Static var compensators (SVCs)

The technological development of thyristor valves in the 1970s made possible the development of the static var compensator concept. Since the 1970s until today a large number of SVCs have been commissioned around the world, making SVCs a well-proven technology.

Fig. 1: Static var compensator at steel mill (MP, 2018)

An SVC is a thyristor-controlled compensator providing fast acting reactive power control to regulate voltage and to stabilize the system. It works as a dynamically variable source of reactive power, that absorbs inductive reactive power when voltage is too high and generates capacitive reactive power when voltage is too low.

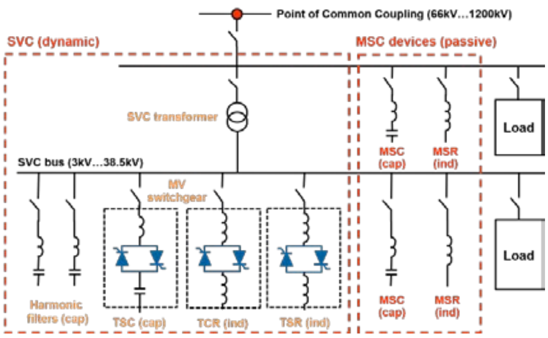

Fig. 2: Typical SVC schema

According to their use and functions, we can identify three types of SVCs:

- Industrial SVCs: Used in electric arc furnaces, rolling mills, mining, manufacturing and railways. Their main functions are to improve power factor, reduce voltage fluctuations, increase production efficiency, reduce harmonic distortion, load balancing and improve installations' voltage profile.
- Renewables SVCs: Used in wind farms and solar power plants. Their main functions are to control reactive power and maintain the voltage level at the point of common coupling, and to reduce the voltage fluctuation caused by power variation during generation, stabilizing the electrical grid.
- Transmission and distribution (or utility) SVCs: Used by electric utilities. They are large size SVCs, up to 765kV and hundreds of Mvar. Their main functions are to improve grid availability and the available active power, improve power factor, suppress voltage fluctuations, control voltage unbalance and reduce the loss of reactive power.

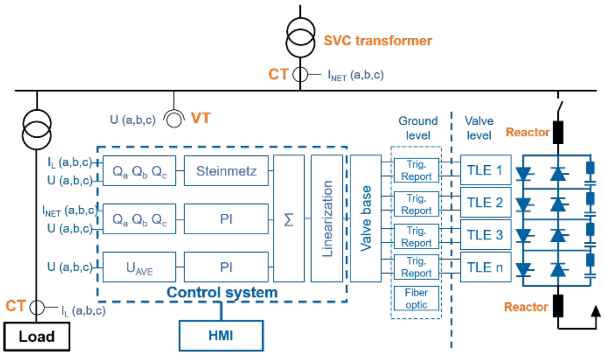

Fig. 3: Typical SVC control block diagram (MP, 2018)

Some of the benefits that SVCs bring are:

- Near-instantaneous response to system changes.
- Transient and steady state stability improvement.
- Voltage control and support.
- Reactive power control / Power factor improvement.
- Flicker and voltage distortion reduction.
- Power oscillation damping.
- Balancing the loads of the system.

2.1. Main components

The components of an SVC can be divided in the ones forming the passive part of the SVC and the ones forming the active part.

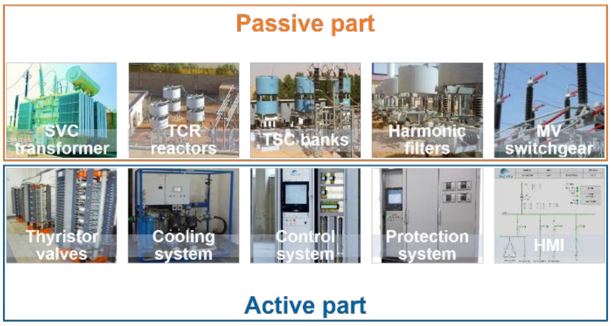

Fig. 4: Main components of an SVC

2.1.1 Passive part

The main components of the passive part are:

- SVC transformer: Connection between medium and high voltage grid. Enables the use of medium voltage thyristor valves.
- TCR reactors: Provide inductive reactive power by point-on-wave control (smooth adjustable output) from minimum current to full rated current. They absorb reactive power to decrease system voltage.
- TSC banks: They provide capacitive reactive power by fast ON/OFF switching (output in blocks), minimum current or full rated current. They generate reactive power to increase system voltage.
- Harmonic filters: They provide fixed capacitive reactive power at fundamental frequency and they absorb harmonic currents generated by the loads and the TCR reactors.
- Medium voltage switchgear: Measurement of currents and voltages (CTs and VTs), allow the maintenance of TCRs, TSCs and harmonic filters (disconnectors and earthing switches), and protect medium voltage components (surge arresters).

2.1.2 Active part

The main components of the active part are:

- Thyristor valves: They take care of switching the TCR reactors and TSC banks.
- Cooling system: Cooling for the thyristor valves.
- Control system: Real-time operation of the SVC ensuring response to system's requirements.
- Protection system: Real-time protection detecting system faults and abnormalities and disconnecting the SVC from the rest of the power system.
- HMI: Monitors SVC condition and communicates with customers' SCADA system. It can also provide remote monitoring and analysis capability.

2.2. SVC components' lifetime

Useful lifetime of the passive part components of the SVC like SVC transformer, medium voltage switchgear, reactors and capacitor banks is longer than the lifetime of active part components like thyristor valves, cooling systems, HMI and control and protection systems.

Active part components face several problems. Spare parts for some components may not be available after a certain period, which makes them impossible or unfeasible to repair in case of failure. For example, thyristor discs must match with other discs in the stack to be able to be replaced. Manufacturer specific electronic components may also become obsolete after few years.

Component	Lifetime (years)
HMI	8-10
Control system	10-15
Cooling system	15-20
Protection system	15-20
Thyristor valves	20-25
TCR reactors	25-35
TSC banks	25-35
Harmonic filters	25-35
Circuit breakers, disconnectors, earthing switches, CTs, VTs and surge arresters	30-35
SVC transformer	30-40
Building for active part	40-50

Table 1: SVC components' lifetime

2.3. Common problems of SVCs

During the lifetime of an SVC, even with proper operation services performed regularly, several components (mainly belonging to the active part of the SVC) can create problems.

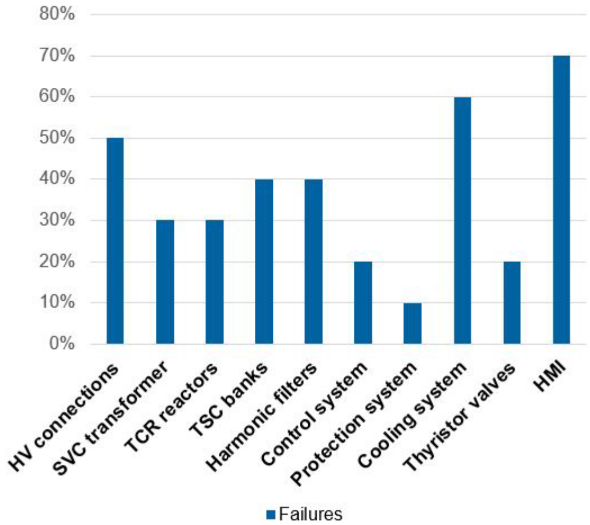

Fig. 5: Common problems of SVCs

3. Services for SVCs

SVCs need a full range of services, from the initial stages of the project until the end of their lifetime.

Fig. 6: Services for SVCs

3.1. Operation and renewal services

Design life of an SVC is typically 30 years, consistent with other high voltage power electronic devices. Even with proper and frequent operation services, after 15-20 years of operation, many SVCs need renewal services to some degree. Often the reasons are lack of spare parts, obsolescence of the electronics and lack of competence and skills from both, owners and suppliers of SVCs.

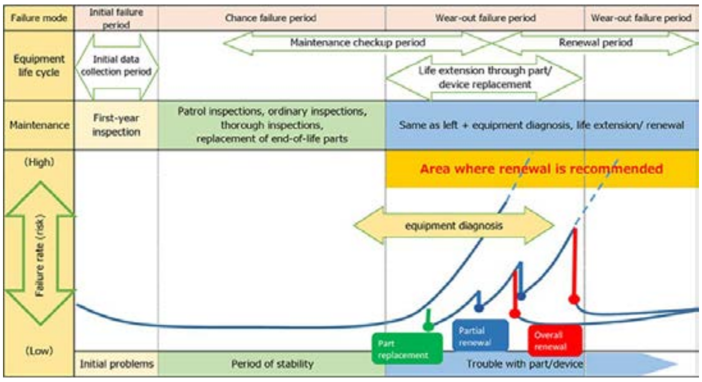

Fig. 7: Operation and renewal services concepts (JEL, 2003)

SVCs are critical equipment at their installations. The need for SVCs to remain in operation, due to system stability, voltage support, or improving power quality, increases in the years following their commissioning. The alternatives to maintain or improve the performance of the installation are either to replace the old SVC with a new one (or with any other active power quality improvement solution) or to apply renewal services to the existing SVC. Renewal services have often the benefits of lower costs, faster implementation times and shorter SVC shutdown needed, limiting the impact on the operation of the whole installation.

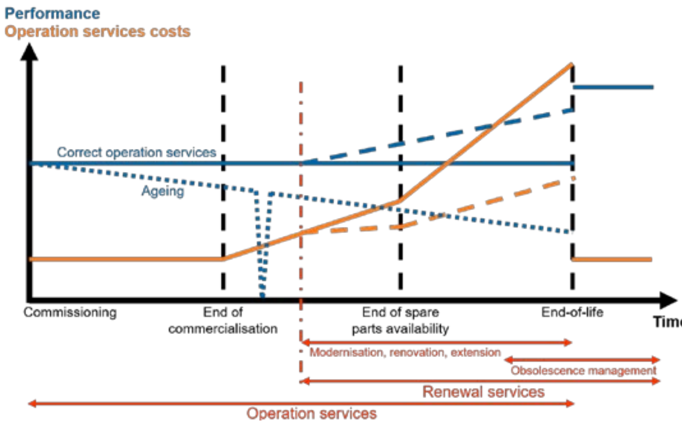

Fig. 8: Operation and renewal services for SVCs

4. Operation services for SVCs

Active power quality improvement solutions like SVCs are designed to provide safe, efficient and reliable operation when properly serviced. But years of continued use and exposure to the elements can adversely affect the reliability of the system, which can result in unplanned outages and associated financial losses.

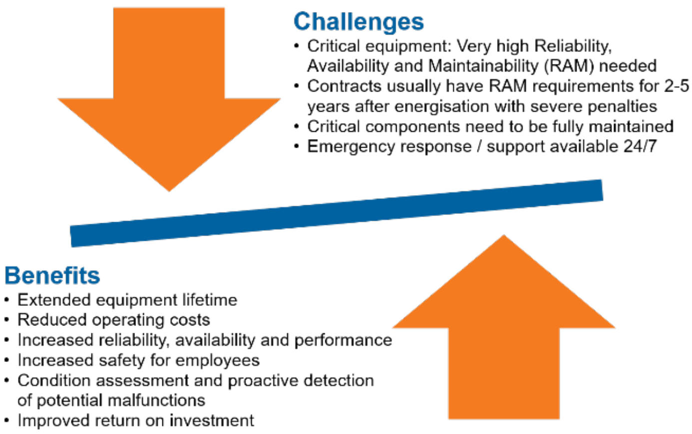

Fig. 9: Challenges and benefits of operation services for SVCs

4.1. Types of operation services

Customers need a broad range of tailored operation services for managing, monitoring, and maintaining their critical assets. Operation services for SVCs include:

- Maintenance.
- Repairs.
- Spare parts management.
- Remote monitoring and analysis.
- Warranty and availability guarantee extensions.
- Qualification and training.

Comprehensive operation services packages would allow customers to design the coverage needed to operate their SVCs efficiently, minimize downtime and manage costs.

4.1.1 Maintenance

Proper maintenance (preventive and corrective) decreases the risk of system failures and unscheduled repairs. Comprehensive maintenance programs define maintenance work and the required spare parts ensuring the best possible usability and performance of the equipment.

Preventive maintenance for SVCs usually includes:

- An onsite examination of the SVC to find possible problems and ensure optimal performance.
- Project management of scheduled outage.
- Maintenance in line with the recommendations of the SVC supplier.
- Coordination and engagement of relevant sub-contractors.
- Supply and replenishment of consumables.

Corrective maintenance for SVCs is carried out after the possible future occurrence of a severe fault is detected. It aims to restore the SVC to a condition in which it can perform its intended function. Timely repair of possible future faults reduces the likelihood of emergency breakdowns and is often mandated by regulations.

4.1.2 Repairs

Repairs concept involves fast response from SVC supplier or local qualified field service personnel. In case of unscheduled failures, fast recovery of the affected components with on-site repair or replacement is necessary.

Usually during warranty period, SVC suppliers or components' suppliers cover the costs of repairs according to the sales contract. Outside warranty period, repairs are often offered case by case.

4.1.3 Spare parts management

The scope of spare parts management includes:

- Ensure correct spare parts availability.
- Implementation of efficient concepts, e.g. regarding the spares' location (centralized vs. decentralized).
- Quantity and quality control.
- Maintain accurate stock inventory and appropriate levels.
- Guarantee status of spare parts through spares maintenance.
- Structured physical arrangement of spare parts to allow rapid location and transportation to site.
- Coordinate repair and/or replacement of parts.

Challenges:

- System availability is a critical operational requirement.
- During a system failure, return to operation will likely require a replacement part.
- Spare parts management is a critical process in maximizing system reliability and hence customer operational performance.

Benefits of this approach:

- Recommended spare parts to minimize shut down risks.
- Commitment to deliver spare parts for a certain amount of years after end of equipment commercialization.
- Stock for emergencies.
- Guarantee that the delivered spare parts meet equipment specifications.

	Option 1 **Delivered from parts supplier**	**Option 2** **Service provider stock delivery**	**Option 3** **Customer's stock delivery**
Pricing	As per separate commercial offer	Monthly fee related to the spare part value	As per separate commercial offer
Spare purchase	Against PO for the needed spare	Against contract agreement	Against PO for the needed spare
Delivery time to location	Manufacturing time	Manufacturing time plus transport to service provider	Manufacturing time plus transport to customer's location

Spare location	Supplier's location	Service provider's location	Customer's location
Availability	Manufacturing time plus transport to site	1-2 days EXW	Immediate

Table 2: Typical spare parts management service model

4.1.4 Remote monitoring and analysis

The ability to remotely access an SVC is a key feature from both a monitoring management and corrective maintenance perspective. The analysis of system data helps customers to foresee any possible problems and ensure system availability and reliability.

SVCs can be connected to service providers' headquarters via a suitable communication channel (subject to functionality being incorporated and customer agreement) allowing SVC performance and components monitoring and fast resolution of any problems. The service provider can supply a 24/7 monitoring service that acts as a primary or secondary support function, helping to diagnose and resolve problems before they become critical. This service includes:

- Immediate technical senior expert support via telephone or instant messaging applications (WhatsApp, Skype, etc.).
- Utilization of internal engineering department.
- Coordination with key sub suppliers.

Benefits of this approach:

- Extraction of the record of events and faults for post incident analysis.
- Condition based maintenance data extracted and reported.
- Monthly report of system status.

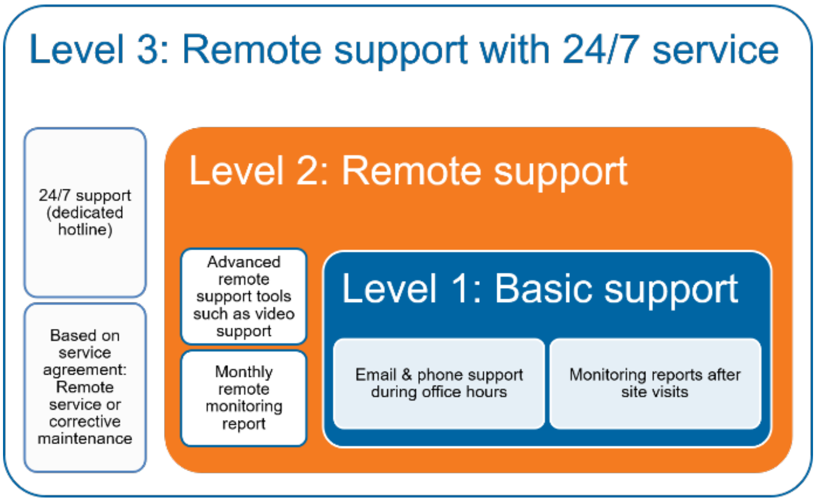

Fig. 10: Typical remote monitoring and analysis service model

4.1.5 Warranty and availability guarantee extensions

It is possible to agree on extended warranty for the complete SVC or for single components. Individually fixed availability ratings can be negotiated with the service provider. The warranty conditions are usually defined in the commercial offer. The service provider monitors warranty status of delivered products and the components' failure rate, and feedback is given to customers and/or suppliers if necessary.

Fig. 11: Example of warranty model

4.1.6 Qualification and training

Training for beginners to experts (managers, designers, installers, operators, maintenance personnel) can be arranged. It will ensure the necessary skills and competencies to properly operate the SVC in safety. Tailored trainings and continuous qualification of service personnel can be arranged. Topics can include:

- General training on power quality.
- Specific training on selected topics (for example harmonics, reactive power, etc.).
- Training on SVCs and qualification of service personnel.

The delivery of the qualification and training modules can be as class room trainings, training on a test field or onsite trainings.

4.2. Case studies: Operation services

4.2.1 Preventive maintenance

Preventive maintenance was carried out for an SVC in an electric arc furnace in Myanmar. The ratings of the SVC are 11kV, 50Hz, -0/+15Mvar. The original commissioning year of the SVC was 2004.

The scope of the project included site survey, condition evaluation and recommendations for further maintenance and upgrades. Main challenge was the climatic conditions at site affecting all the outdoor equipment.

As a result, the customer got recommendations for the needed upgrades of the SVC to be able to keep it in operation. The work was completed in 3 days.

Fig. 12: Harmonic filters and TCR reactors (MP, 2018)

4.2.2 Corrective maintenance

Corrective maintenance was carried out for an SVC in an electric arc furnace in Egypt. The ratings of the SVC are 22kV, 50Hz, -0/+28Mvar. The original commissioning year of the SVC was 2005.

The scope of the project included TCR reactors installation, GAL-circuit refreshment and troubleshooting the control and protection system. The main challenges faced during the project were that there was a long shutdown period, so the electronics were failing after re-energization, and that practically no spares were available anymore for valve electronics and control cards.

The results of the project were that the system started with new TCR reactors performing as expected and customer was given the guidelines for the control system upgrade needed in the near future. The work was completed in 4 days.

Fig. 13: Installation of TCR reactors (MP, 2018)

4.2.3 Remote monitoring and analysis

The SVC is located in Thailand and it is used in an electric arc furnace. The ratings are 22kV, 50Hz, -0/+85Mvar. Original commissioning year was 2011.

The scope of the project was the implementation of a remote monitoring system. The challenges of the project were that the HMI and the control system were very old.

The project allowed that the SVC performance and status could be monitored remotely. The customer can get monthly reports including corrective maintenance recommendations. Also, it allows remote support capability from service provider location.

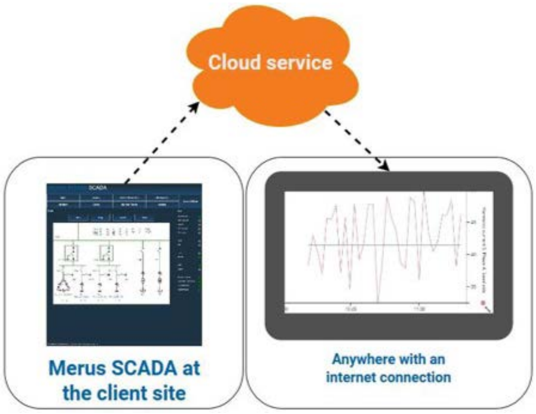

Fig. 14: Remote monitoring and analysis concept (MP, 2018)

5. Renewal services for SVCs

A full set of renewal services can support the decision-making process of customers when extending assets lifetime and increasing their availability. Most original SVC suppliers are not willing to deliver only part of an existing SVC scope. Thus, renewing an SVC (depending of the provider of the service) usually means replacing the whole system or at least several of the main components.

5.1. Types of renewal services

An SVC renewal consists in modernising, renovating, extending and/or managing the obsolescence of the system and its components. This is usually done without affecting the existing foundations, buildings and below-grade trenches, conduits or grounding system.

The first components to be evaluated in priority are the HMI and control system, which typically become obsolete after 8 to 15 years in operation. With obsolescence comes the issue of spare parts availability. The performance of the system, as well as its availability and reliability can be improved by switching to modern digital control systems and carefully designed new electrical equipment. Extensive system studies, testing and commissioning are required to ensure that the new system will meet customers' and/or applications' requirements.

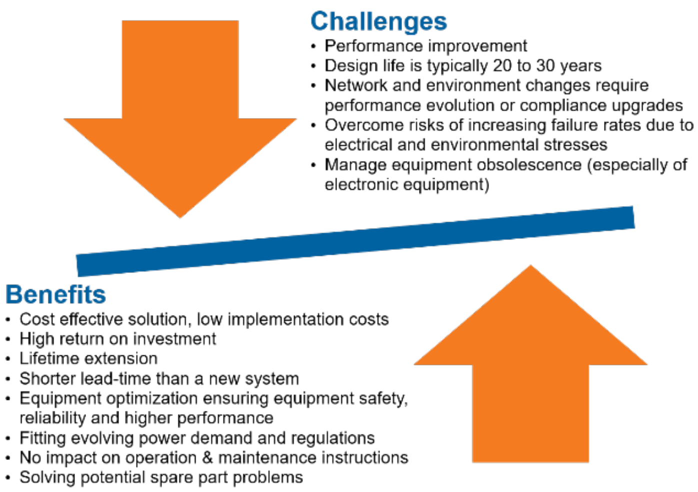

Fig. 15: Challenges and benefits of renewal services for SVCs

5.1.1 Modernisation services

Modernisation refers to the upgrade and update of equipment and components. It is a way of getting benefits of new design and technology on equipment already in operation, maintain installations' high availability and reliability, and it is also a solution for obsolescence challenges caused by old components. Additionally, modernisation will increase the lifetime of the installation.

Some examples of modernisation include:

- Hardware and software update with latest technologies to avoid obsolescence.
- Upgrade from analogue to digital control.
- Add condition monitoring devices.

- Add remote monitoring and analysis capabilities.

Modernisation brings several benefits including:

- Reduced need for maintenance.
- Better availability and higher reliability.
- Meet new regulatory requirements.
- Extended operational lifetime.
- New generation of spare parts can be used.

5.1.2 Renovation services

Renovation refers to the refurbishment and retrofitting of the equipment and components. Proactively renovating the system before a severe outage occurs can save time and money. The need for renovation depends on the general condition of the system and the potential future unavailability of spare parts. Renovation is common after 15–20 years of operations, and it needs to be validated by full testing to original specifications and standards.

It is possible to expand the life of ageing systems by:

- Valve and control system retrofit.
- Replace worn protection equipment.
- SVC transformer, CTs, VTs, circuit breakers, disconnectors, earthing switches and surge arresters' mid-life overhaul.

5.1.3 Extension services

Extension refers to the uprating and expansion of the equipment according to changing customers' demands and needs. These services can include:

- Increase system's electrical ratings such as output power, nominal current or short-circuit current.
- Extension of protection system performance.
- Adding new harmonic filters to the installation.
- Increase the output or the productivity of the installation.

5.1.4 Obsolescence management services

Obsolescence management refers to the decommission and migration or replacement of the equipment. An optimal maintenance strategy for electrical systems is based on detailed knowledge of all used hardware components and the software. Some of the components of active power quality improvement solutions like SVCs are manufactured in low quantities and they might have long supply chains with many part suppliers. Obsolescence management services include:

- Early and proactive information on the obsolescence of the components of the system.
- Planning and recommend actions to guarantee availability.
- At risk components identified and appropriate measures taken.
- End-of-life services and recycling.
- Migration to a complete new SVC.
- Replacement for a different type of active power quality improvement solution (e.g. STATCOM).

5.2. Project scope

By using a modular SVC concept, customers have the flexibility to choose the most appropriate technical and economical scope for their project, adjusting it to their installation service break.

Service providers can usually provide renewal services for any brand and type of SVC (industrial, renewables or utility SVC). The renewal services that can be provided need to be evaluated case by case and depend on the scope of works and the type of original equipment. Service providers can provide the following scopes for renewal services projects:

- Migration to a full new SVC.
- Full active part replacement.
- Partial active part replacement.
- Control & protection system and HMI replacement.
- SVC replacement by STATCOM.

5.2.1 Modular SVC concept

A modular SVC concept allows splitting easily the scope of supply in case of renewal services are needed:

- For the original SVC suppliers, the core technology is the active part of the SVC.
- New or existing passive parts can be integrated into the system to achieve a fully functional SVC system with state-of-the-art reliability, functionality and performance.
- This concept allows replacing the active part alone in case of existing SVC.

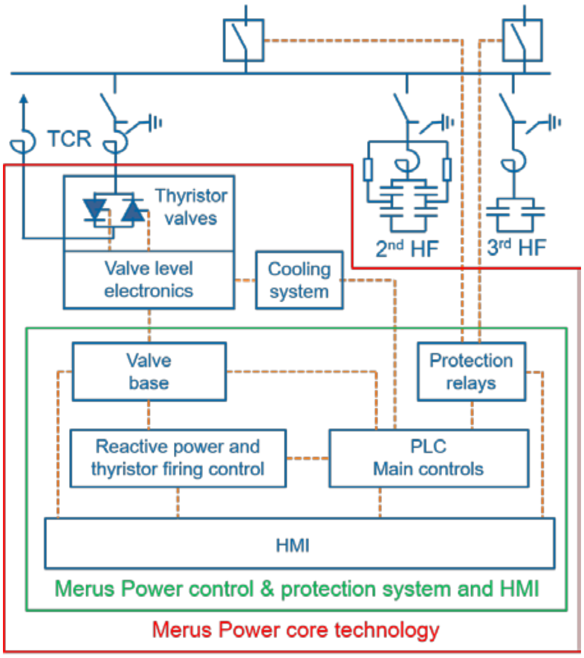

Fig. 16: Modular SVC concept (MP, 2018)

5.2.2 Migration to a full new SVC

Completely replacing both, the passive and active parts of the SVC brings the installation fully up-to-date. This option allows changes of the complete SVC arrangement, layout, power range, harmonic filters configuration, etc.

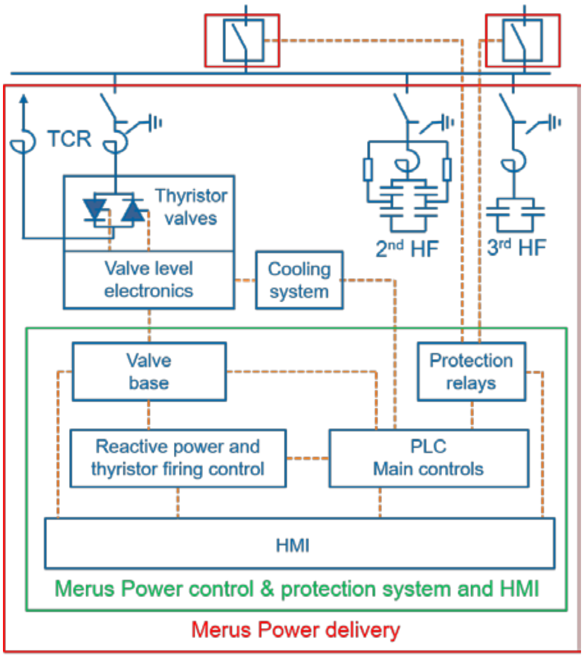

Fig. 17: Migration to a full new SVC (MP, 2018)

Benefits:

- Allows change of power range or harmonic filters configuration.
- Brings the installation fully up-to-date.
- Improvement of performance (response time, flicker reduction, etc.).
- Built from state-of-the-art components with high availability of spare parts.
- Remote monitoring and analysis capabilities.

5.2.3 Full active part replacement

Replacing the active part completely brings the SVC functionality fully up-to-date. Full active part replacement consists of replacing the thyristor valves, the cooling system, the control and protection system, and the HMI.

Benefits:

- Fully updated functionality.

- Improvement of SVC performance (response time, flicker reduction, etc.).
- Built from state-of-the-art components with high availability of spare parts.
- Remote monitoring and analysis capabilities.

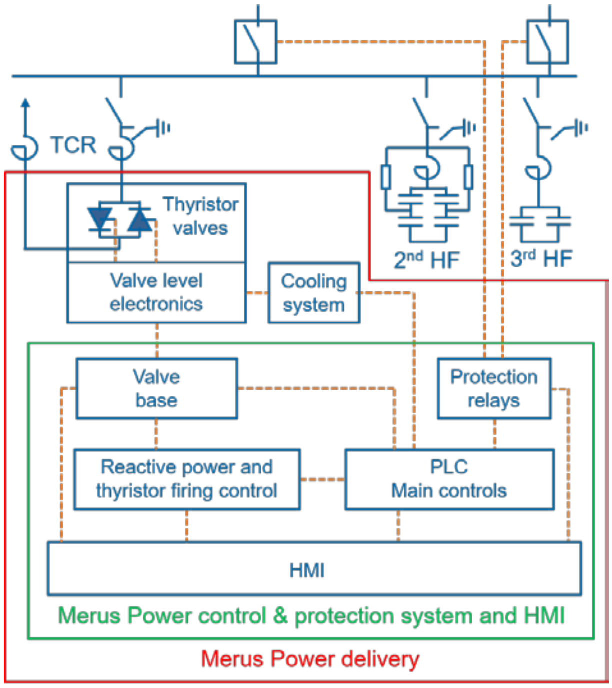

Fig. 18: Full active part replacement (MP, 2018)

5.2.4 Partial active part replacement

Partial active part replacement consists of replacing the thyristor valves, the cooling system and a part of the control and protection system, integrating them with the existing system:

Replacing the active part partially it is possible with certain preconditions. It is especially important to check if the existing control and protection system is compatible with the interface of the new valve base electronics.

Benefits:

- Refurbished power electronics with state-of-the-art reliability, availability of spares and lower losses.
- Complete set of valve protections including forward recovery protection (FRP).
- Temperature measurement of each thyristor valve that improves monitoring.

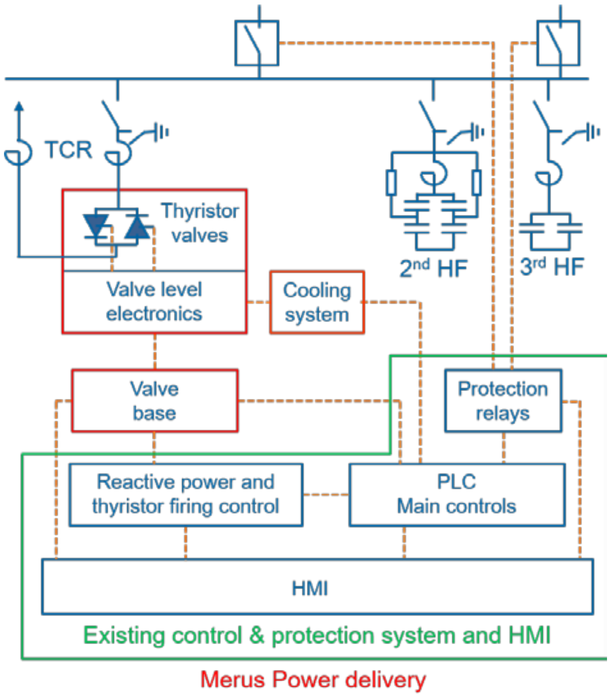

Fig. 19: Partial active part replacement (MP, 2018)

5.2.5 Control & protection system and HMI replacement

Replacing the existing control & protection system and HMI is possible if the existing valve base system is compatible with the interface of the new control & protection system.

Benefits:

- Improvement of SVC performance (response time, flicker reduction, etc.).
- Built from state-of-the-art components with high availability of spare parts.
- Remote monitoring and analysis capabilities.

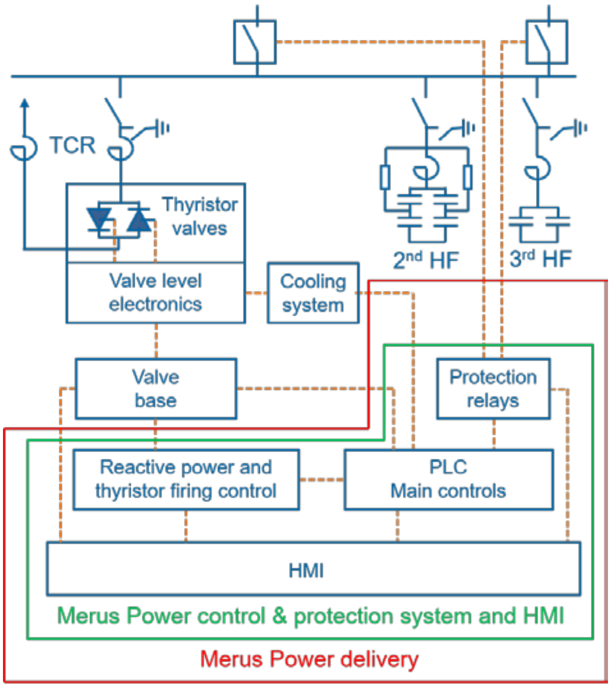

Fig. 20: Control & protection system and HMI replacement (MP, 2018)

5.2.6 SVC replacement by STATCOM

Depending on the requirements of the application, it is possible to replace the SVC for a different type of active power quality improvement solution. The most common situation is replacing the SVC by a STATCOM. This may be the right solution if better performance is required for dynamic response such as flicker reduction capability or if the site has limited space.

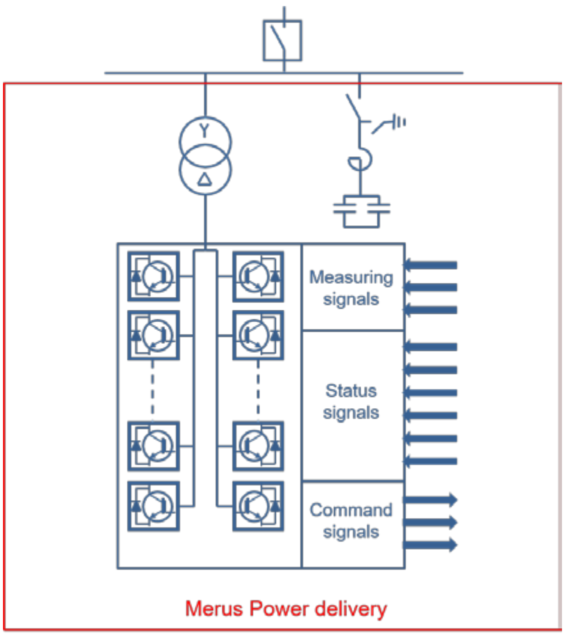

Fig. 21: STATCOM solution (MP, 2018)

Benefits:

- Cost efficient transfer to STATCOM dynamic performance.

- Superior flicker reduction performance.
- Smaller foot print releases space.
- It may be possible to use existing SVC harmonic filter banks to extend the control range of the STATCOM system.
- Availability of spares parts.
- Remote monitoring and analysis capabilities.

5.3. SVC renewal project example

A typical SVC renewal project consists of several stages: tendering, planning and installation. The project starts with a site survey, where the service provider evaluates the current situation of the installed SVC. At this stage, it is important to understand the long and short term operational goals of the customer.

The site survey allows to benchmark the condition of the installed SVC against the desired or optimal SVC operational performance. The site survey leads to recommendations for operation and/or renewal services for the SVC.

5.3.1 Tendering stage

Before contract is signed:

- Site visit if possible.
- Offer review according to the technical and performance requirements: Technical review according to full SVC contract requirements and review of the SVC renewal project check list.
- Renewal plan including the manufacturing and site works.
- Delivery time confirmation: SVCs / STATCOMs have semiconductor parts whose delivery time from suppliers can be long (4-6 months).
- Shutdown and replacement detailed time plan and preparations.

5.3.2 Planning stage

Check list:

- Instruction manuals at site available.
- Mechanical drawings, circuit diagrams, signal lists, cable lists, etc. (usually should be part of the instructions manual of the existing SVC).
- Evaluation of special tools required.
- Investigation of any special programs or programming devices needed.
- Detailed service history (when, who, what).
- Spare part inventory: Used spare parts during service.
- Available spare parts at site.
- Event list from HMI (alarms, trips, etc.).
- Space available for replacement (dimensions of the building, etc.).
- Door dimensions, window locations, etc.
- Cabling connections of control & protection system.
- Cooling unit specification (power, flow, delta T, etc.).
- Air/water or water/water heat exchangers.
- Possible remote monitoring protocol.
- Auxiliary powers available (AC and DC).
- Have there been any changes in the electrical network since original commissioning.
- Any plans for changes in the future.

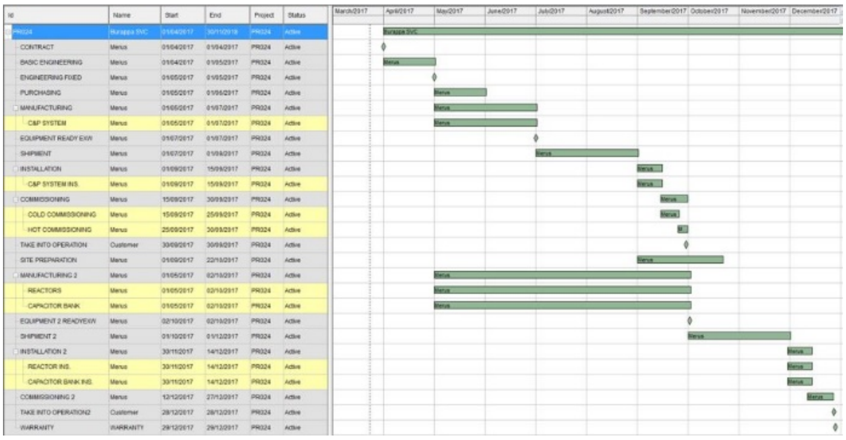

Fig. 22: Typical project schedule (MP, 2018)

5.3.3 Installation stage

Usually the main targets of the installation phase are to minimize the scheduled outage and to cause minimal impact on customers' operations. A preparatory site visit is recommended approximately one month before the planned outage. Customers can perform certain activities before the outage to complete as much of the work as possible before the scheduled outage.

Containerized solutions to reduce installation time needed at site are available. This approach includes all the active part of the SVC inside a container fully assembled and tested already at the factory.

To save time, commissioning work and site testing can be performed in parallel with the installation to the greatest extent possible.

The key to the successful performance of renewal services at site is the cooperation with the customers' team. Preparatory work done prior to the outage makes possible to have full control of the logistics with needed resources, equipment and material supply.

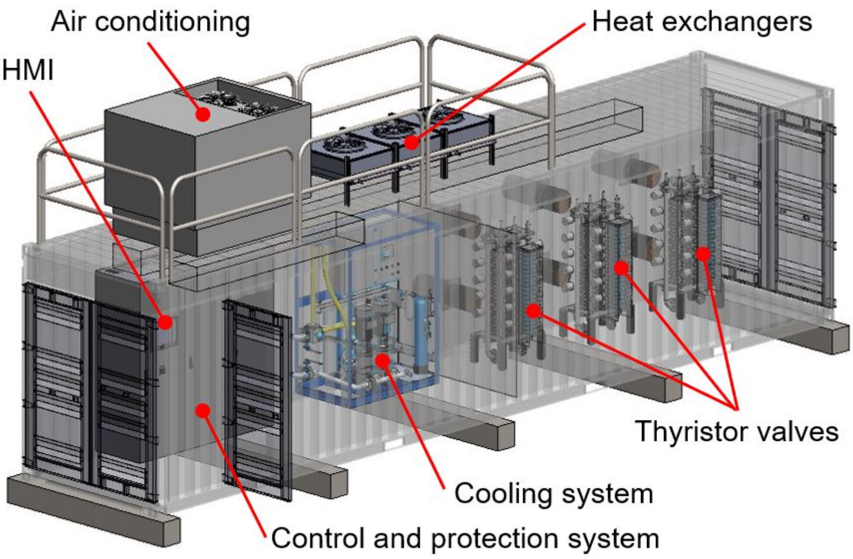

Fig. 23: Containerised active part for an SVC (MP, 2018)

5.3.4 Case study: Modernisation and extension

Modernisation and extension services were carried out for an SVC in an electric arc furnace in Thailand. The ratings of the SVC were 22kV, 50Hz, -0/+85Mvar. The original commissioning year of the SVC was 2011.

The scope of the project included the replacement of the control and protection system and capacity extension to 105Mvar by installing a 5th harmonic filter of 20Mvar. The challenges of the project were that the old control system was larger than the new one, so the cables were not long enough, and new cabling was needed. Also, the components of the passive part of the SVC were in poor condition.

Fig. 24: New SVC control & protection system (MP, 2018)

The results included extended capacity, modern user interface and remote monitoring capability. The whole scope of work was completed in 5 days.

The SVC performance after the renewal services was verified by means of power quality measurements. After analysing the records, it was learnt that the total furnace power was increased by a considerable 63% but the new SVC control system managed to keep the power quality parameters within acceptable limits. The power factor was corrected to unity and the flicker level was considerably lower than what was expected with the performance of the original control system. A statistical analysis of the flicker performance revealed that the recorded maximum flicker was more than 25% lower than predicted based on the performance of the original control system.

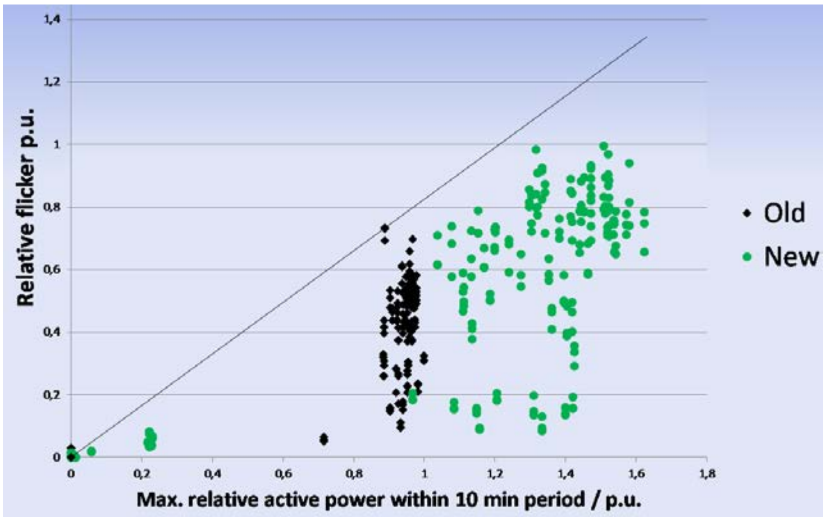

Fig. 25: Flicker Pst and load power correlation new vs. old system (MP, 2018)

6. Conclusions

SVCs are well-proven technology and they have been in the market and in service for almost 50 years. The technology of the suppliers of different SVC systems is all the time surpassed by updated SVC technologies and by the technology of new active power quality improvement solutions like STATCOMs.

Well planned operation and renewal services support customers' decision-making process when deciding on lifetime extension and performance improvement of critical systems in electrical installations like SVCs. The benefits of comprehensive operation and renewal services for SVCs can be summarized as:

- Improvement of reliability, availability and performance of the SVC and the installation.
- Extension of the existing SVC lifetime, migration to a completely new SVC, or replacement for a new active power quality improvement solution.
- Adaptation of the system to current needs and technologies.
- Shutdown time and cost to owner can be minimized by careful project planning.
- Containerized solutions to reduce the installation time needed at site are available.
- Short and long lead time components delivery, and overall project delivery time can be optimized.
- Higher return on investment.
- Remote monitoring and analysis capabilities can be added to the existing SVC.

7. References

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