

Complex HV installations require specialist skills and infrastructure

by Dale Pudney, High Voltage Technology SA

High Voltage Technology SA (HVT) has been involved in a number of high voltage labour and erection contracts over the years for complex installations for Eskom and international OEMs, demonstrating and developing the specialist skills required for these contracts.

These installation contracts include the upgrade of the Apollo HVDC converter station, the installation of series capacitor banks up to 765 kV and the installation of 765 kV tubular busbar systems. The lesson that HVT has learnt, through performing these contracts, is that only when the specialist skills are supported by proper safety and quality systems, does the "site services" business become sustainable.

The "site services" business involves application engineering of OEM technology and comprises mainly project management, labour and erection of OEM equipment. It is therefore skills and infrastructure dependent. As such it is inherently a risky business, with the market plagued by a lack of skills, low work ethic, lack of pride, etc. Most labour and erection businesses have struggled during the recent economic crisis, while the company's site services division is growing at a rapid rate. This article considers the complexities of the application of world class high voltage technology and the organisational characteristics required to be successful in that business.

Evolutionary services

The erection contracts are often "first of a kind" or evolutionary installations, requiring innovative techniques, developed to suit the project objectives. These projects are often characterised by the fact that the technical design and installation procedures have not been 100% finalised by the time that work commences on site. Often these can't always be planned properly prior to the start of the contract and therefore require site management skills and experience on the ground with the appropriate aptitude.

The refurbishment of the Apollo HVDC converter substation was such a project (see "Upgrade of the Apollo HVDC converter station", p 35, Energize, October 2009); being one of a kind in the country a repeat of the work is not expected for decades. To complete the project, ABB sent about 20 engineers from Sweden to co-ordinate and plan the project, with the work being done by about 70 semi-skilled labourers from the company.

This introduces a number of issues that need to be carefully managed, such as the cultural, language and technical understanding divide between the site

workers and international engineers. The site management of these projects therefore has the added burden of providing the interface between these groups and translating the needs to overcome the wide gaps. This involves the "Africanising" of first world technology.

Often it is the simple solutions that work

best. Such as building as much as possible of a series capacitor bank on the ground and then lifting the whole platform and equipment up to its operating height.

This makes lifting significantly more difficult, but is quicker and safer than lifting the platform and then the capacitor racks individually.



Fig. 1: Working at heights provides an additional challenge.



Fig. 2: Correct sized cranes makes work safer and faster.



Fig. 3: Lifting a pre-assembled capacitor bank into place.



Fig. 4: Capacitor bank in place.

heights, making it difficult to control the 25 m long busbars while lifting them. An immediate solution was required on site that included additional harnesses, guide ropes and the use of wind meters to determine when it is unsafe to work.

SHEQ systems capture learning

Without a foundation of safe work procedures and robust technical methodology, to support site performance, the impact of the additional risks associated with these complex installations could make the business unsustainable. The SHEQ system is what captures the newly developed techniques and methodologies into repeatable business processes. Learning as you go, and capturing the improvements into the work instructions and procedures. The result of an effective SHEQ system is a learning organisation.

While SHEQ systems cost extra, does the learning organisation become more efficient, effective and competitive? Are these extra costs counteracted by economies of scale, economies of scope, productivity from additional resources, etc.? In practice, the organisation does not become more efficient, because extra resources on site require additional management to supervise and control them. The learning organisation is however better able to manage the risks that could put less prepared companies out of business. This sustainability also ensures that companies like HVT are the first choice for complex installations, providing the differentiation required to compete effectively in the market.

When large organisations with the necessary infrastructure compete with "bakkie builders" (who do the minimum to be compliant with the specifications and take shortcuts on the tools and equipment) there is always price pressure from competitors who theoretically shouldn't qualify from a technical or SHEQ perspective. The only time customers value a fully compliant company is when things go wrong.

A culture of "living safety" is required, which must be continually emphasised and supervised. Without this, the workforce is forgetful of the rules and procedures – until complacency results in injuries. Ensuring that the workforce respect and understand the value of the safety is a continuous challenge that cannot be achieved through compliance to paperwork – it requires pride of place, continuous emphasis and innovative techniques. Repetitive work is its own worst enemy.

Investment in people

The requirements for getting workers into high voltage yards has been ever increasing over the years. Workers need a host of qualifications, depending on their responsibilities, from HV Regulations to fire fighting to safe lifting to legal liability. Many of the qualifications the workers need are

Additional challenges

These evolutionary projects often involve additional challenges from a technical and safety point of view – such as working next to live chambers, working at heights, heavy lifting, tight spaces, time sensitive deadlines, etc. The risks are therefore very high and need to be managed carefully.

The Apollo project was done over the Christmas period taking out portions of the system at a time to minimise the disruption in the power supply. Large teams are required to complete the tasks within the deadline, with each person working on their specific tasks. The installation of a GE series capacitor bank included the challenge of working with both imperial and metric units of measure.

This introduced unexpected delays to translate things like the threads, profiles, etc. of the American equipment to fit the locally supplied goods with metric dimensions. The solution is to add additional resources to the site to ensure that the deadline is met, but that requires a pool of qualified and experienced site

workers to draw from. It is almost impossible to bring casual labour onto Eskom high voltage sites these days because of the safety, health, environment and quality (SHEQ) requirements.

Infrastructure costs (cranes, trucks, etc.) normally outweigh the labour costs, so there is no incentive to cut the labour force; and a bigger team can often reduce the time the infrastructure is required on site. Contractors who don't have the right tools and equipment on site risk damaging the primary equipment by taking short cuts that negate any planning and design work that has gone into the project. In a series capacitor bank project, which the company was not involved in, the capacitors were removed from the racks to enable a smaller crane to lift the racks onto the platform, but then the capacitors were returned to the wrong position and manhandled to get them into the racks at height; negating the careful balancing calculations and damaging many of the capacitors.

Installing 765 kV tubular busbars introduces the additional problem of wind at those



Fig. 5: Installing tubular busbars.

life skills courses that have application beyond the workplace as well. Complex installations requires a properly equipped worker, which doesn't only mean the right tools, but also the right training and pride in his work. This creates the new breed of artisan required to work on Eskom sites.

HVT maintains a matrix of skills and resources to ensure that we are able to resource all projects, whether small or big, simple or complex, with the appropriate

level of skills. The matrix ensures depth of skills and succession planning for all levels of the organisation. The pool of skills is what allows the company to add extra resources to problem sites quickly – to avoid delays which cause additional costs and holding up teams from progressing.

Having worked on many high voltage sites throughout South Africa, many of the staff can tell stories of their projects with pride. The fact that the company has not had a

serious injury on site during its 16 years of existence can be attributed to this pride in their work. The documentation and systems alone are not sufficient – the right attitude among the workforce is critical to a sustainable organisation.

The investment made into its people is important for building responsibility among its staff and therefore as a corporate citizen to ensure that the company is here to stay – for much longer than the 20 to 30 year lifetime of the equipment it installs.

Conclusion

Working at the leading edge of complex high voltage installations requires a learning organisation that is able to learn, capture and entrench that learning into its workforce, methodologies, processes, procedures, etc., through its SHEQ systems. The learning is therefore translated into tangible intellectual property that can be used to expand the value proposition and hence grow the business horizontally (extra products and services) while improving efficiency and effectiveness to improve sustainability... and hence competitiveness.

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