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Concerning scope to refurbish HVDC from another vendor

In Brazil we have two HVDC projects that are due for refurbishment, Furnas (Itaipu) and Garabi (Argentina – Brazil):

- Itaipu 2x 3150 MW ± 600 kV Bipole 1 operation since 1984, Bipole 2 1989
- Garabi 2x 1100MW 70 kV B-t-B Garabi 1 operation since 2000, Garabi 2 2002

Interestingly, both projects are 50/60 Hz frequency converters, although Itaipu has two parallel bipolar lines, each of about 900 km.

Itaipu has maintained a good RAM (Reliability, Availability, Maintainability) record with no significant refurbishment other than an ongoing (on site) program to reform the converter transformers. However, the age of the equipment, now past the limits given in TB 649, endangers future performance.

Garabi, while newer, uses fully digital controls and spares availability is a problem, including for much equipment. Additionally, the original concession is ending.

In Itaipu the age of the equipment indicates that a wide scope for refurbishment is available. In fact, the intention is to replace all controls, but to refurbish only one of the two bipoles. This not only ensures satisfactory performance of Bipole 1, but furnishes spares for the operation of Bipole 2. This division of work essentially removes the obstacles for a third-party supplier of the refurbishment. The work needs to be carried out with a minimum of outage time, as the power plant has a very high utilization factor, as there is not the period of low river flow, common in many hydroelectric plants.

In the case of Garabi, the refurbishment envisages replacement of selected individual pieces of equipment, including new spares, and the full control system. This limited scope of refurbishment not only reduces the volume of work for the supplier, but complicates the interface difficulties, especially in the case of a third party. These interfaces (I/O) with the control equipment include measuring devices, status of switchgear and notably with converter valves. This is further complicated by the use of CCC technology for the converters. In general the utilization factor has been low, but there have been notable occasions when high levels of import have been kept due to poor hydrological conditions in Brazil.

Conclusions

Refurbishment of HVDC links may give a valuable increase in RAM performance of older systems, as well as economic returns from the life extension.

A large scope of refurbishment encourages third party suppliers and simplifies the interface issues. TB 649 gives 25 to 35 years for most equipment, with only digital C&P having a notably shorter time. In addition to age, the utilization factor also needs to be taken into account

Outage time during the implementation and commissioning must be taken into account and a larger scope may help if space is available for construction and testing with the original equipment still operating.

The retention of some equipment will increase the difficulties for a third vendor due to interface protocols, and perhaps guarantees.

Elsewhere, open source HVDC control systems are discussed for multivendor grids, and while this may be a long way away, it would solve many refurbishment issues. However, in the shorter term, open-source interface protocols between major blocks of control and protection hierarchy seems easier, and would greatly facilitate refurbishment.