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What is the worldwide experience in refurbishing HVDC assets with manufacturers other than the original manufacturer? What are the obstacles for a vendor to refurbish an HVDC asset from another vendor?

### **Transpower's experience with HVDC Refurbishments**

In many cases as-built documentation and knowledge about existing assets could be a key deciding factor when approaching vendors. If the utility has sufficient plant information, design data, accurate as-built documentation, and in-house expertise, they have more freedom in selecting vendors. On the other hand, if in-house capabilities are limited due to various reasons such as lack of design and as-built information, engagement of the OEM might be necessary. The risk appetite of the utility will also influence the vendor selection as engaging the OEM is a safer option due to original design information available to them. Approaching other vendors will increase the owner's risk exposure.

Some limiting factors in approaching other vendors could be:

- accuracy of original information provided to the owner by the OEM – i.e. availability of project specific manuals
- accuracy of as-built documentation – i.e. capturing any modifications since commissioning
- urgency – i.e. time available for developing a retrofit design
- IP considerations – i.e. some OEM information cannot be shared with third parties
- testing requirements – i.e. it may not be possible to test other vendor products to the required standard without having access to certain information
- in-house expertise – i.e. how much support the owner can provide to other vendors
- availability of original design information – i.e. transformer internal construction details
- risk appetite of the utility – i.e. other vendors' products could cause compatibility issues
- outage availability for gathering additional information – i.e. other vendors may need to gather extra information from in-service plant

There are instances where non-OEM products can be installed where the technical risks are lower. Good documentation such as accurate as-built drawings and in-house expertise is important if other vendors are being approached as technical risks are now carried by the utility. It is also important to ensure that original as-built information is accurate and up to date as this could cause issues along the way even if the OEM is undertaking the work.

Having access to OEM original design information is advantageous in ensuring compatibility. This is very important if the utility has limited information to assist alternative vendors (i.e. lack of transformer internal drawings).

The OEM engagement is recommended on high-risk projects such as replacing Oil Impregnated Paper (OIP) insulated porcelain bushings on converter transformers with modern Resin Impregnated Paper (RIP) insulated composite bushings. This will minimise the risk of interfacing issues both mechanically and electrically (i.e. voltage stresses across internal bushing barriers).

Interfacing should be given careful consideration and identical connections could be specified to minimise interfacing risks and installation times. 3D scans could also assist both vendor and the utility with interfacing and interference fit requirements.

Good technical specifications, test plans and extensive commissioning tests would further reduce the risk exposure. The replacement of the wall bushings, AC/DC yard assets, and auxiliary systems can be carried out by alternative vendors depending on the risk appetite and economic considerations. Additional time should be allowed in the case of other vendors to develop a suitable retrofit design.

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