NAME: Erik Kilander
COUNTRY: Sweden
REGISTRATION NUMBER: 6282

GROUP REF.: B4
PREF. SUBJECT: PS 1
QUESTION N°: 13

Open code is not a requirement and maybe not an option since the control performance responsibility still lies with the manufacturer. Part of the code can be open and/or parametrized but making a bigger part of the control system open will remove most of the R&D incentive in the market. Focus should instead be on dealing with the various compiler dependencies in the different industry tools and keeping models up to date. Software models, like any other software, are built for a certain program version, operating system, compiler set, etc. and therefore requires maintenance, especially considering it needs to be valid and used for 30-40 years. If your normal PC software is not kept updated, you would have the same problem. HVDC vendors do have model update services in place to support this, either as part of warranty contracts or small orders. Model upgrades can also be ordered with new functionality, e.g. added protection functions. If this service is not provided by the vendor, escrow agreements can be used to store the model source code in a safe place for the lifetime of the HVDC system.

Successfully commissioned multi-vendor HVDC systems exists already today. Some examples are Dogger Bank A&B (Hitachi Energy) + offshore wind farm (GE Renewable Energy), Dogger Bank C (Hitachi Energy) + Sofia (GE Renewable Energy), DolWin5 (Hitachi Energy) + offshore wind farm (Siemens Energy), ÅL-link (Hitachi Energy) + onshore wind farm (Vestas) and most recently Johan Sverdrup 1 (Hitachi Energy) + Johan Sverdrup 2 (Siemens Energy).

These multi-vendor projects have been solved through either vendor-vendor model exchange and/or combining the use of generic models with vendor-vendor model validation by third-party. The latter requires close collaboration and frequent communication between vendor(s) and client/third-party.

Not all vendors agree to vendor-vendor model exchange. In those cases, a more legally strict, controlled, supervised/monitored simulation environment could be organized by client/third-party. Models could then be shared with limited IP exposure since access is very limited. The solution could be web/server based.

Another novel approach is to use a co-simulation environment organized by client/third-party where detailed models can be used by all vendors but with incorporated model interfaces so that each vendor only sees the connection point and not beyond. This approach has already been demonstrated and published. The solution could also be web/server based. CIGRÉ efforts could be made to validate how model performance is affected by the newly introduced model interfaces.

Complementary to above, frequency domain methods such as impedance-, passivity and eigenvalue-based stability analysis should be further utilized as complement. They also do not require the same IP exposure. In this area, there are rich experiences from the railway industry, where near identical problems were faced almost a decade ago. This combined with above mentioned model sharing and collaboration approaches will pave a smooth way for realizing interoperability.

Through commissioned projects, it has already been proven that multi-vendor interoperability is possible. The key factor has been to enable analysis of system performance before commissioning using accurate models and tools and finding relevant control solutions. Going forward the solutions must, in addition to being accurate, also be flexible and scalable. Having a software-based environment enables this. HIL is a less viable option since it will (eventually) require huge amounts of equipment and should preferably be limited to actual hardware tests.

To achieve fully meshed multi-vendor DC grid interoperability, i.e. where each converter is connected to a DC network, similar to equipment in an AC system, above methods must be complemented with new performance requirements applicable for both AC and DC connection points (PCC). In this way the interfaces are standardized, not the solution. It allows for vendor optimization based on functional (performance) specification and further development to preserve innovation and competitive differentiation. Simulation and analysis tools already established for studying AC side interoperability can be adopted for DC side.

This would also change the responsibilities in the industry and require a new role, a DC system operator (TSO) responsible for design, rating, performance, master control and governance of the DC system. The required concept and technology have already been realized for a single-vendor system in the CMS multi-terminal HVDC project. CIGRÉ guidelines for DC grids also exists from earlier and should be used as a reference.