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Feasibility studies are usually conducted at a stage where HVDC control performance requirements are not fully set. Even though base design solutions are well established with manufacturers and even some standardization exists there is still customization done at project integration stage to meet custom specifications and applicable grid codes depending on client and region. Feasibility studies are usually used to assess the feasibility of a project and define the overall requirements and should be kept very simplified and on high level. Generic models can be used for this purpose and RMS tools are fully sufficient. Generic models can be developed based on generic control concepts such as TB 604, 804 and 832. These generic models have come quite far but needs to be kept updated. One solution is to incorporate them officially in simulation tool libraries to let software suppliers handled the maintenance. Some vendors also offer standard library models in tools like PSSE and PowerFactory. Using EMT models in feasibility studies is, however, not necessary since the model accuracy is way higher than what the study requires. Also, the included model details might change after detailed design stage. If there are concerns for certain phenomena that could only be studied in EMT domain, e.g. interaction with nearby equipment, they should be listed as study requirement in the specification of the real project and be executed during project integration stage. In general, the trend of trying to include all details in all models at all stages of a project is neither possible nor beneficial since different models are designed for different study purposes. This is not only to minimize study effort but also to consider the limitations of each simulation tool and thereby avoid introducing unrealistic phenomena caused by over-modelling. Many model requirements today are overlapping in terms of what performance they should include. This redundancy could be eliminated to speed up both project feasibility and integration studies. Using EMT tools in feasibility studies is, for sure, one of those overlaps.

Also, the studied scenarios can also be adapted accordingly. For example, instead of focusing on all possible scenarios it is more efficient to only focus on worst cases. Many times thousands of cases are required where, in reality, only hundreds of them are relevant. This identification not only requires deep knowledge about the power system behavior in general but also how the HVDC system influences it. Extensive collaboration between client and supplier with two-way communication (and understanding) is therefore required in order to narrow down the number of scenarios. CIGRÉ efforts could be made to standardize what test cases should be conducted in each type of simulation tool to unify the industry and avoid waste.

A higher presence of IBR requires models with higher accuracy and bandwidth. The traditional RMS environment is no longer sufficient and EMT simulation shall be applied. However, extensive experience already exists in the industry today ranging from strong to extremely weak to completely passive networks with multiple IBR units. For example, many offshore wind projects with HVDC have been studied and commissioned successfully. However, in these situations it is critical that vendor specific models built from real site code, e.g. see CIGRÉ WG B4.82, are being used to accurately represent the system behavior. Generic models are not sufficient. High IBR scenarios shall not be investigated accurately in feasibility stage but needs to be studied in the project integration stage with real vendor models with close collaboration between all stake holders.

Performance validation of RMS models are usually done against EMT models. Performance of EMT models is best validated against real site measurements. Live tests are usually limited but can and should be utilized whenever possible. Site recordings from faults can also be collected for the same purpose. Some vendors also provide test facilities where a reduced test circuit of the converter can be validated.

HVDC clients sometimes require a performance validation of EMT offline models towards real-time simulators. This makes sense from the viewpoint that control implementation should be validated in the EMT offline model but from a system dynamic performance perspective the real-time simulator is not sufficient since it is built-up using software models of the electrical circuits. Such dynamic benchmarking study should therefore only be seen and treated as a comparison, not a validation of dynamic performance. Adding to this, a real-time model also demands parallel processing and artificial transmission line interfaces to connect different parts in order to achieve real-time. In general, the simulation speed (time step and hardware) will dictate model design whereas in online simulation the model design will dictate simulation speed. Additionally, an online software-based environment gives possibility to run scenarios in parallel (over-night, multi-run), at any time (independent of project stage) and on multiple computers by multiple engineers (parallel studies). All these factors should be considered when choosing simulation strategy for future power systems.