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QUESTION N° : 1.11

Question 1.11:

VSC-MMC MTDC systems have been studied and are now starting to be developed for bulk power offshore and onshore interconnection all over the world.

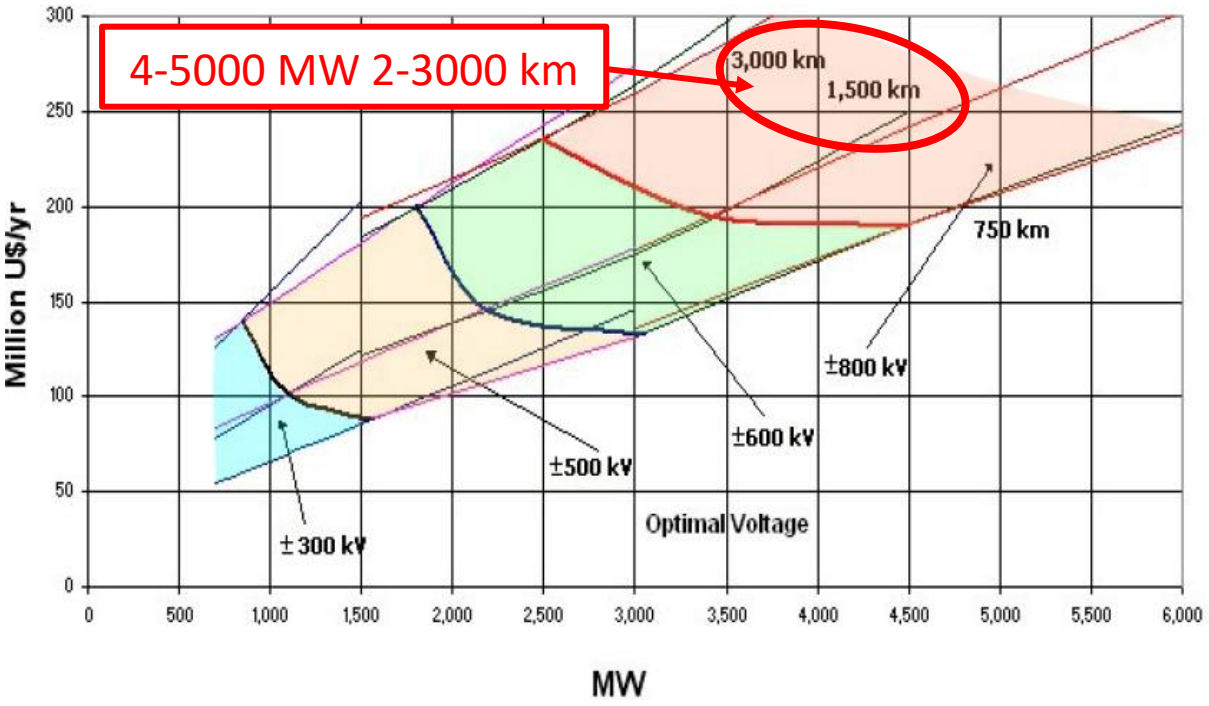
- What is the preferred DC voltage rating foreseen for the multiterminal schemes? Are there any special concerns with applying the VSC-MMC technology at greatly increased power and voltage ratings?

Application of VSC-MMC technology on UHVDC overhead lines

Choice of Voltage

Choice of voltage is a function of the transmission distance and the power to be transmitted. Brazil has major loads concentrated in the SE region, while the new generation expansion in renewable energy, mainly wind and solar is concentrated in the NE region. The geographical characteristics of Brazil indicate that distances of 2-3000 km should be considered when integrating new resources. There are six existing LCC links, four ±600 kV, 3150 MW and two ±800 kV, 4000 MW, with ±800 kV, 5000 MW, link in planning.

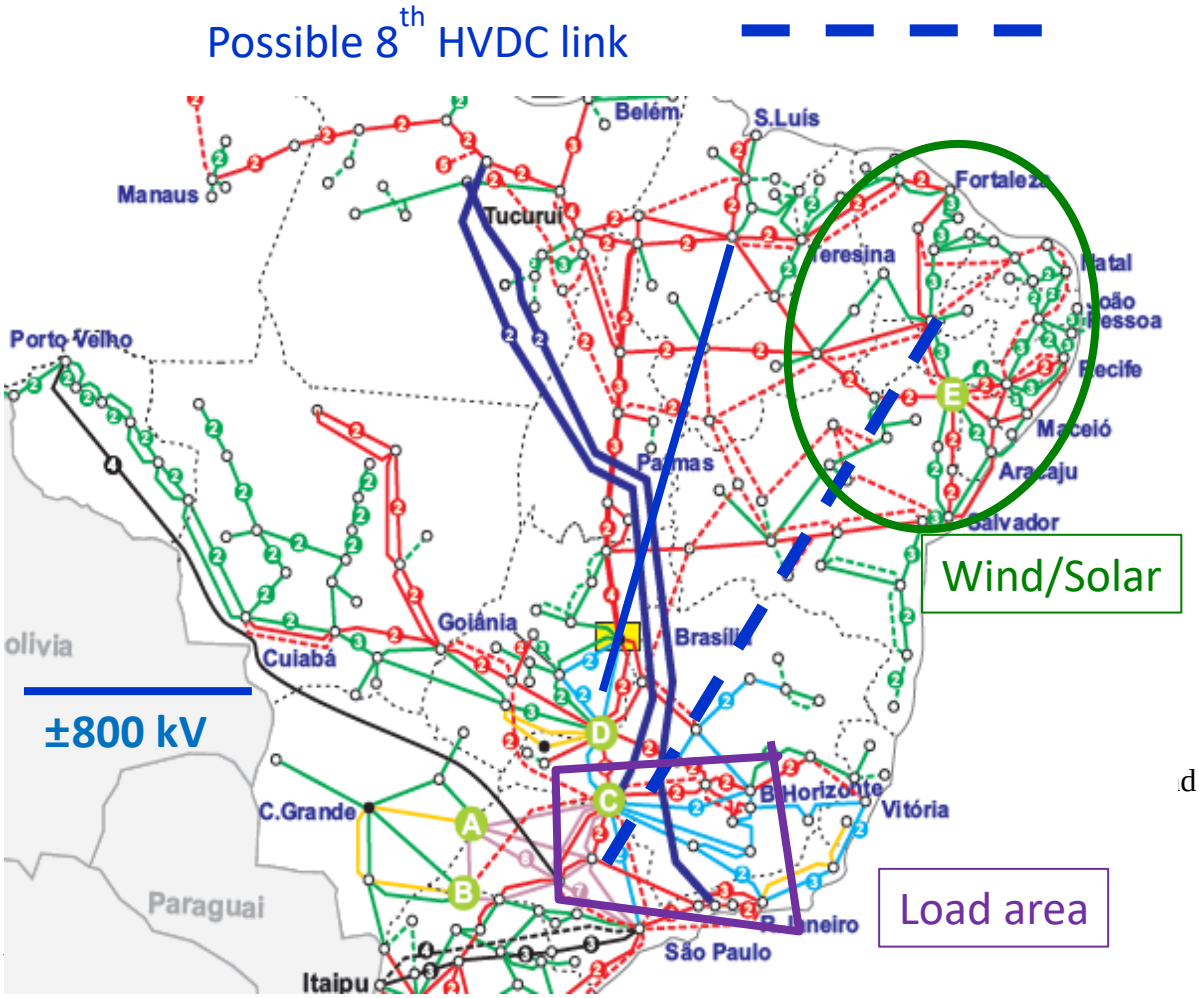
Cigre TB 388 Impacts of HVDC LINES on the Economics of HVDC Projects (2009) would indicate ±800 kV for LCC and gives a good indication today, even with the higher cost of VSC systems.



This indication, together with the successful implementation of ±800 kV LCC links in Brazil, implies the use of ±800 kV for VSC systems.

Why use VSC-MMC systems?

There are six HVDC-LCC bipoles in SE load area, plus one more to be auctioned in 2023, and an eighth under study, probably to be auctioned in 2024. While dynamic performance is good, multi-infeed interaction is a serious concern and mitigation measures are already in place.

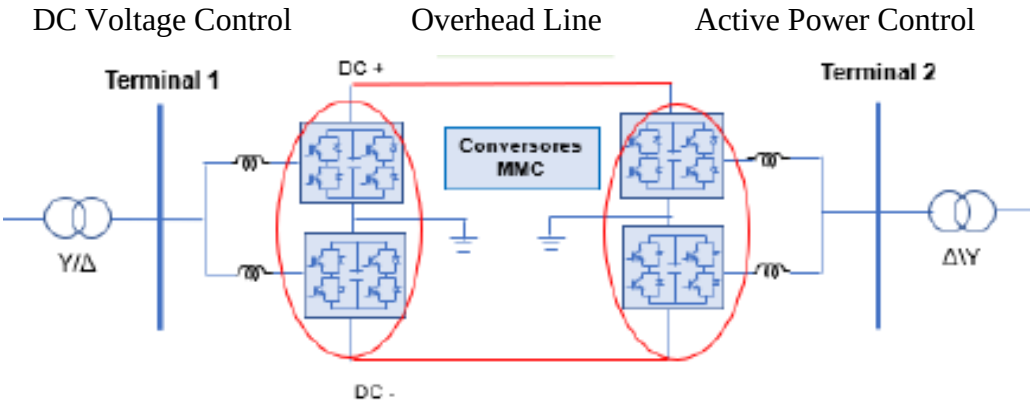


VSC-MMC technology can improve dynamic performance as it is immune to commutation failure and can provide independent reactive power support. Unfortunately, this improvement comes at an additional cost. This additional cost is offset by avoiding additional mitigation measures such as synchronous compensators, as well as reduced land area.

Challenges

When applied with overhead lines, the technology employed needs to ensure arc extinction on the OHL, as well as satisfactory power recovery.

The R&D project has started with modelling full-bridge MMC as this is most conservative approach and allows good verification of deenergization of the DC overhead line, as well as best performance when recovering from both AC and DC faults. The R&D base case is 4000 MW at ±800 kV.



Further studies to be included are Hybrid LLC/MMC configuration as more economical and three terminal as a possible solution for better load flow control. Line lengths of 2000 to 3000 km are considered necessary given the dimensions of Brazil.

Digital EMT models for system planning have been developed for the base case and are under development for the cases to be investigated.

Conclusion

In reply to question 1.11:

- What is the preferred DC voltage rating foreseen for the multiterminal schemes?

For Brazil, with long overhead lines, the preferred voltage is ±800 kV.

- Are there any special concerns with applying the VSC-MMC technology at greatly increased power and voltage ratings?

Yes, there are concerns, both economical and technical. They are being addressed and for the technical concerns, it is considered feasible do meet them. The economical concerns are a matter of development and comparison of the VSC solution with LCC plus mitigation. The resolution of these issues makes the possibility of applying VSC-MMC technology a natural outcome for the 8th bipole mentioned above.