

Paris Session 2022



A generic 800 kV HVDC bipole model for transmission planning in Brazil

DC systems and power electronics – B4

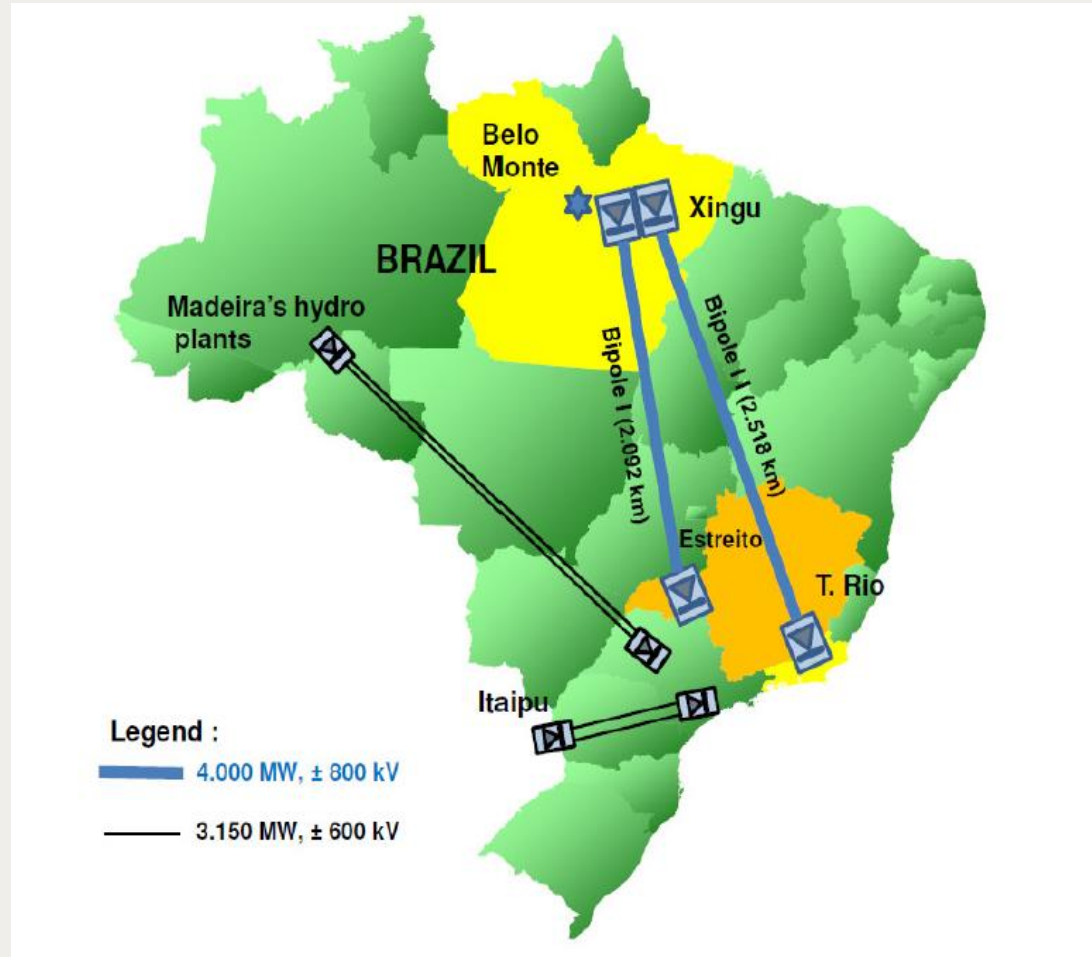
PS 1 - Question 1.1

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Brazilian HVDC links in operation

6 LCC type bipoles, 4 manufacturers



Group Discussion Meeting

Motivation for a generic model

- During Madeira's HVDC studies, planners had the perception that the development of a generic HVDC EMT type model was imperative
- The benchmark or public model available were too simple whereas manufacturer's model were very difficult to access
- The run-time of detailed EMT type HVDC models, to demonstrate adequate converter performance, was very long.

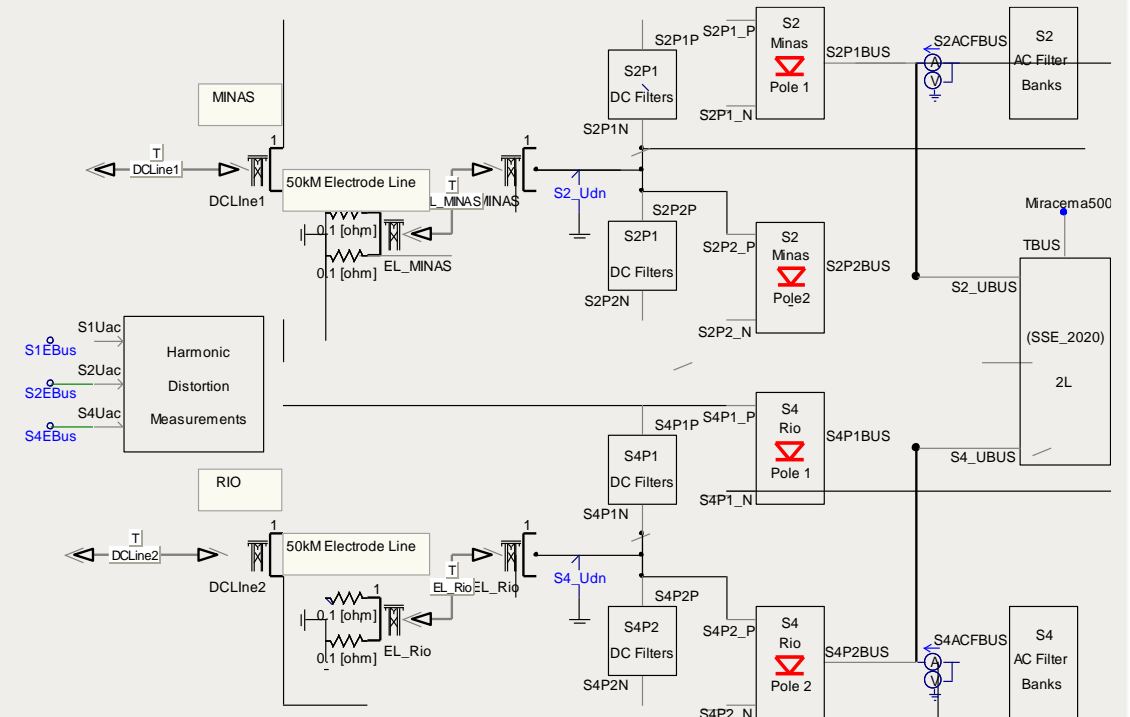
Model development

Some basic concepts

- ✓ Consider only a set of basic controls and elements necessary for the type of simulations involved
- ✓ The model was based on control topology found in existing HVDC projects
- ✓ Higher level controls (pole current control, VDCOL, bipole power controls, etc.)
- ✓ HVDC lines and electrode lines modelled using frequency dependent model
- ✓ AC filter banks were generic double tuned banks and DC filter was a generic triple tuned filter.

Group Discussion Meeting

Example: “top view” of terminals of the two 800 kV bipoles in the software



Digital model performance

- With a conventional engineering personal computer (64 bit operating system, 8 GB RAM)
- AC network modelled with 80 three-phase buses (Belo Monte planning studies)

✓ Typical simulation run-times

Type of simulation	Snapshot (pre-initialized state) simulation		Actual simulation (from a snapshot simulation)	
	Simulation time (s)	Run-time (minute)	Simulation time (s)	Run-time (minute)
Electromagnetic transients	1	4.4	1	4.5
Dynamic performance	4	18.2	1	5.5
Multi-infeed evaluation	1	13.2	1	13.5

acceptable performance, achieving adequate run-times



A new 800 kV bipole is under planning stage in Brazil and the generic model has been applied with success