

Proposed VHVDC3 model

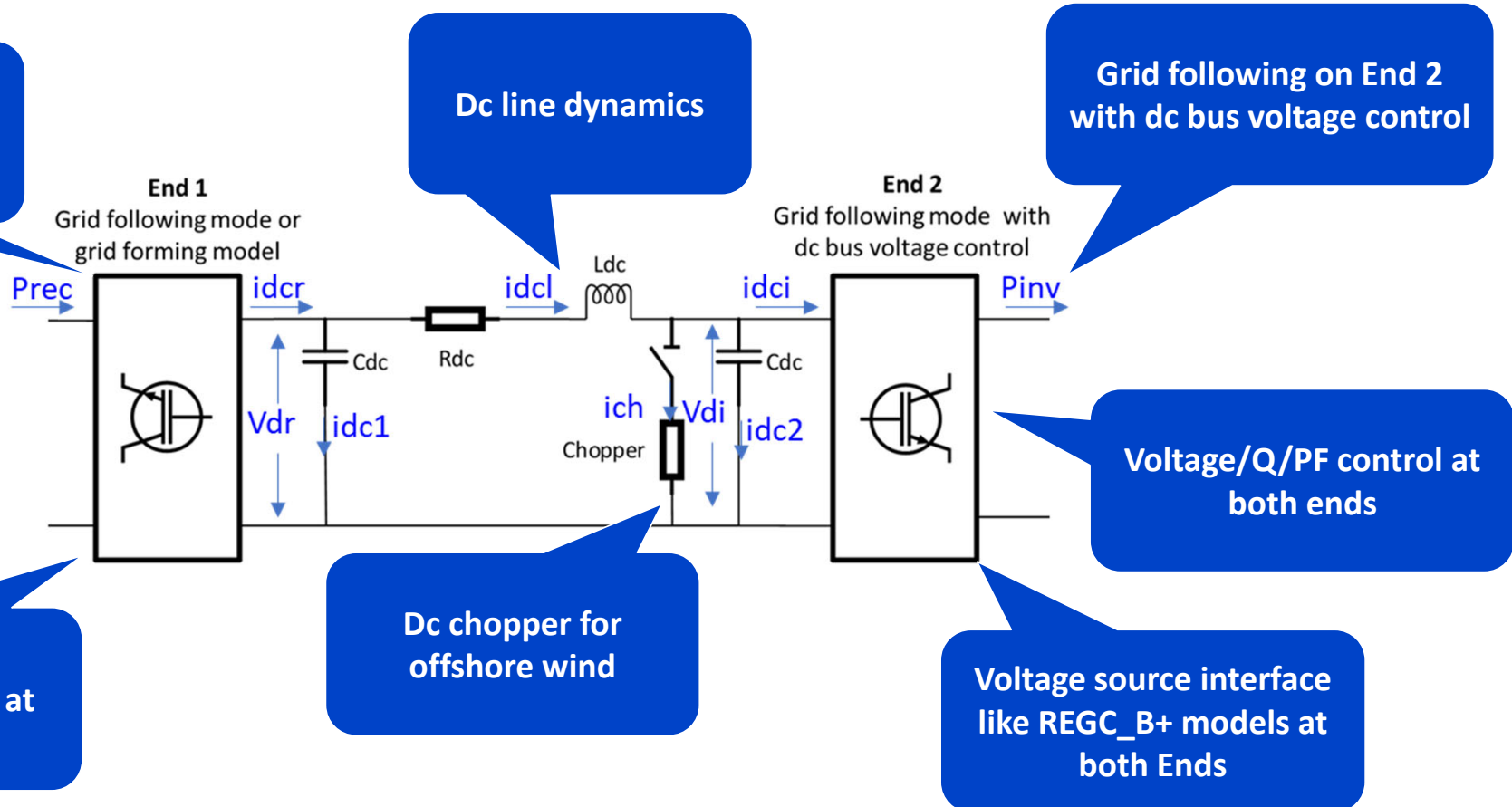
WECC MVS Meeting – Jan 2024

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Pouyan Pourbeik (PEACE®)

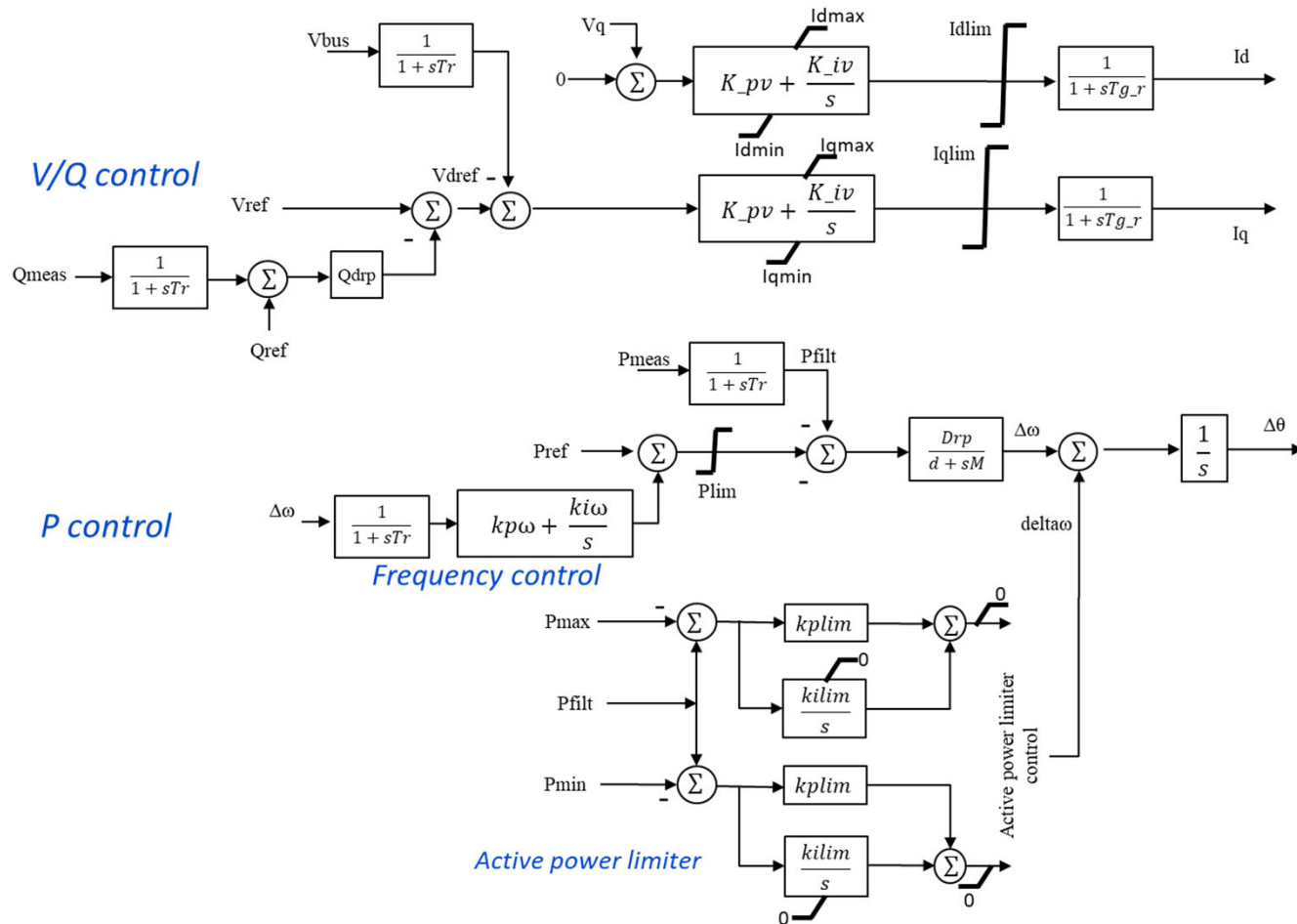


New VSC HVDC model development - VHVDCx

Grid following and
Grid forming at End
1

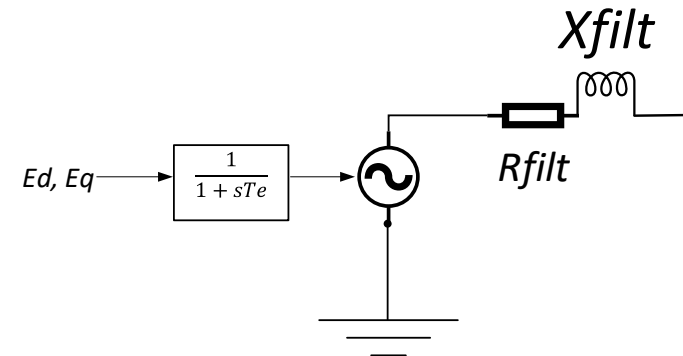


GFM control on converter with active power control

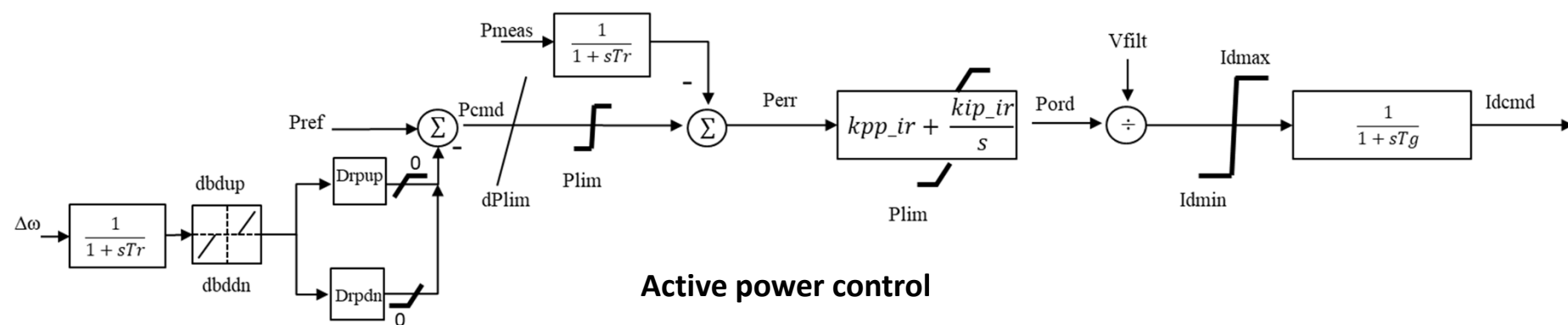


$$E_d = V_d + I_d * R_{filt} - I_q * X_{filt}$$

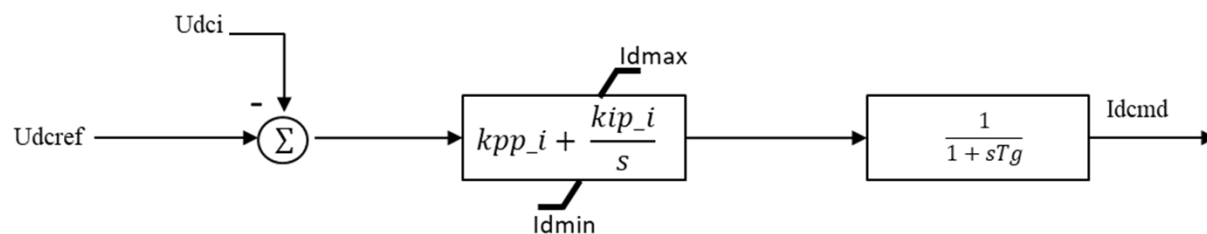
$$E_q = V_q + I_q * R_{filt} + I_d * X_{filt}$$



GFL control on converter with active power control



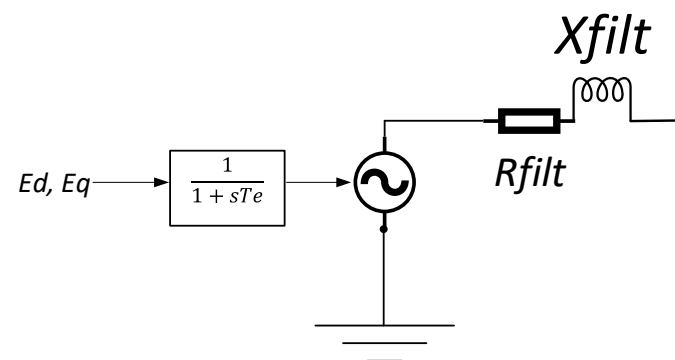
Active power control



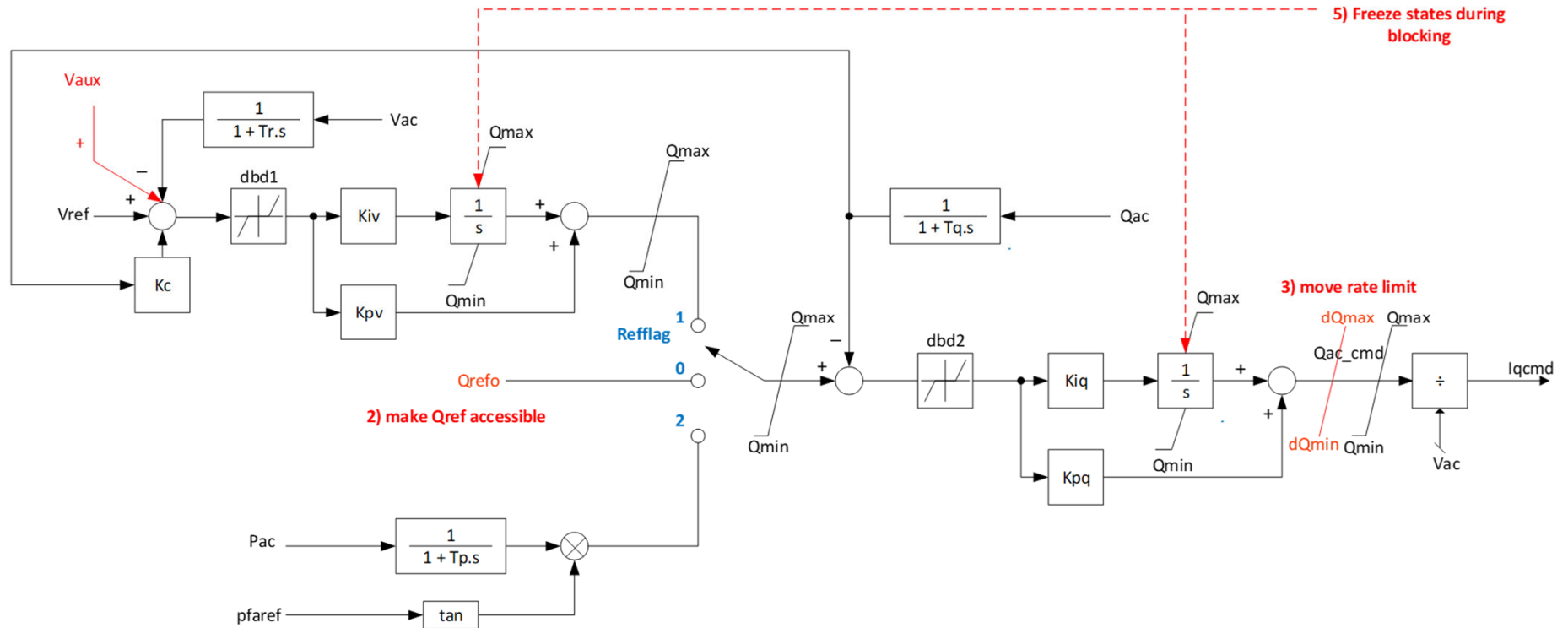
Dc bus voltage control

$$E_d = V_t + I_{dcmd} * R_{filt} - I_{qcmd} * X_{filt}$$

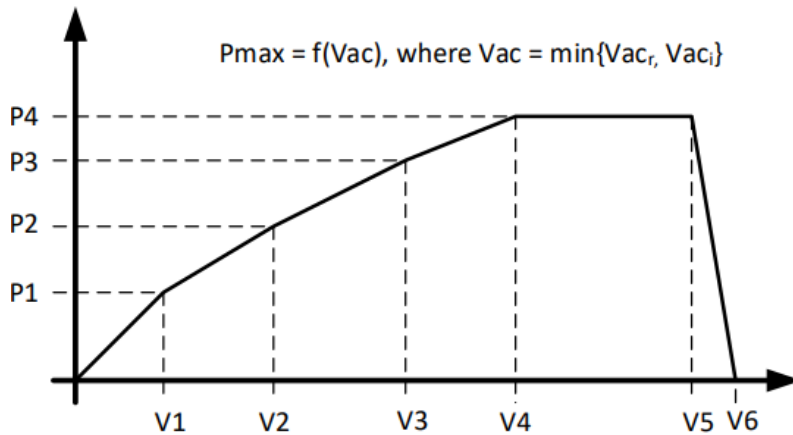
$$E_q = 0 + I_{qcmd} * R_{filt} + I_{dcmd} * X_{filt}$$



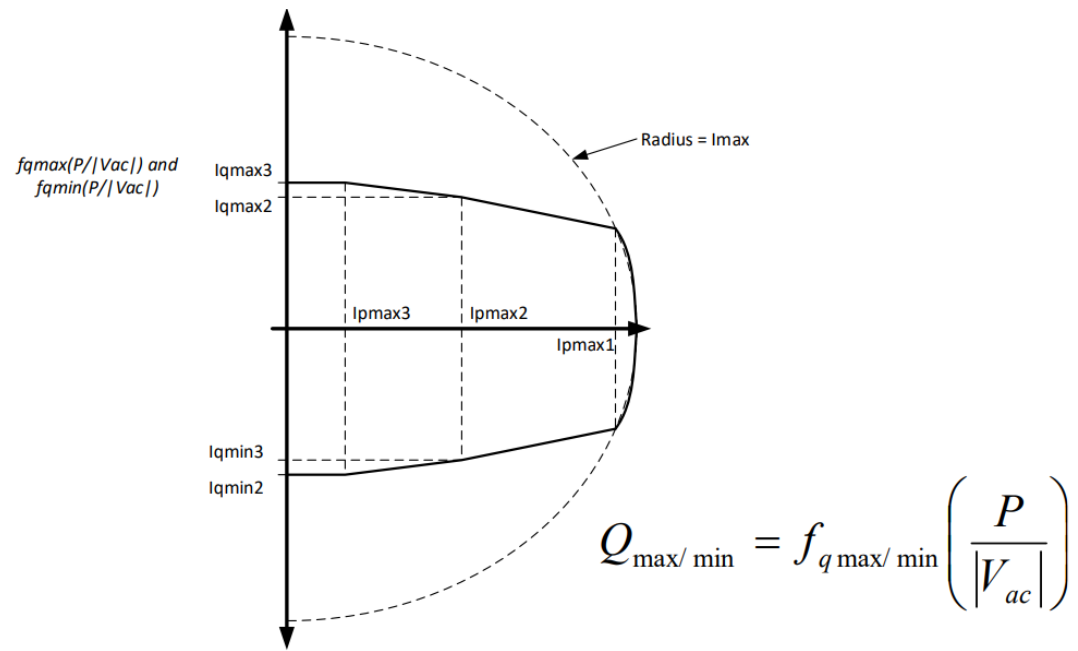
GFL reactive power control



Active and reactive power limiters

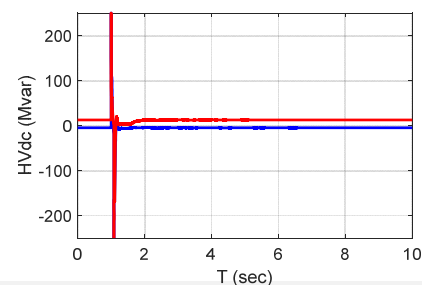
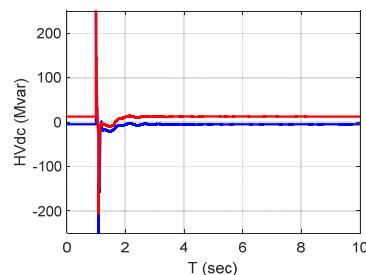
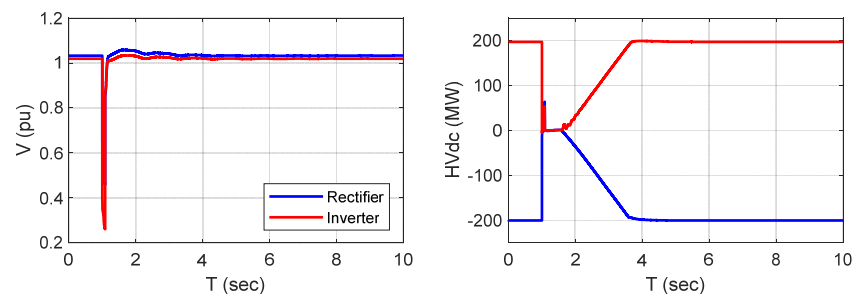
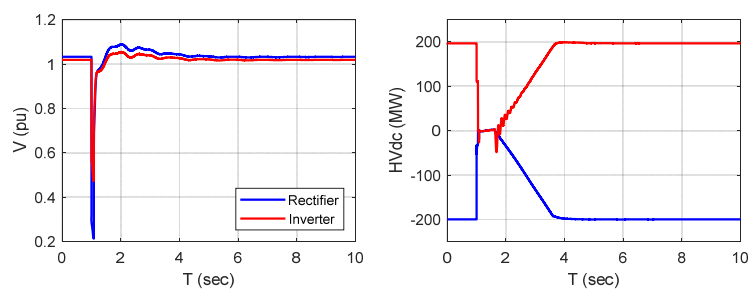
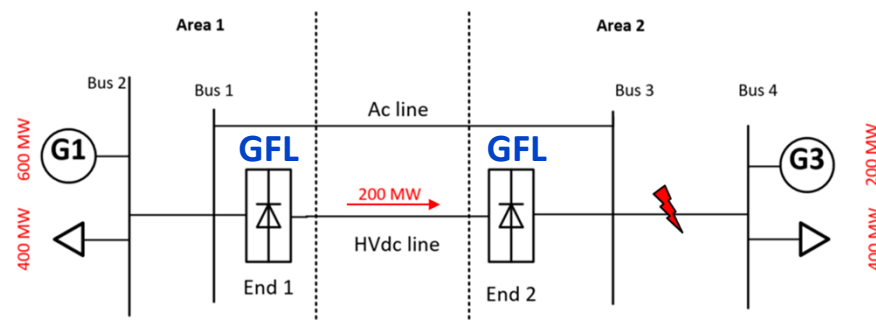
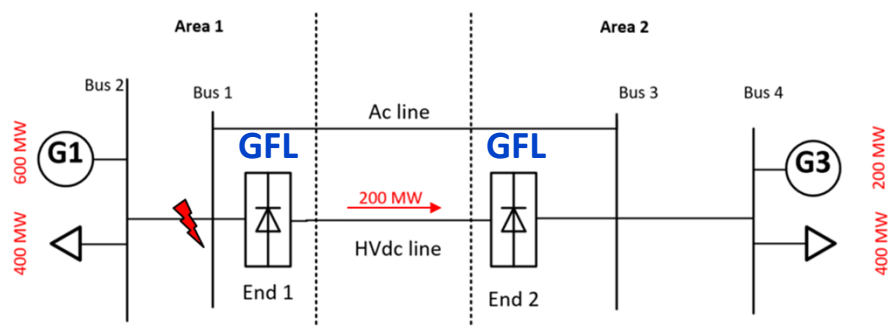


Voltage dependent active power limiter

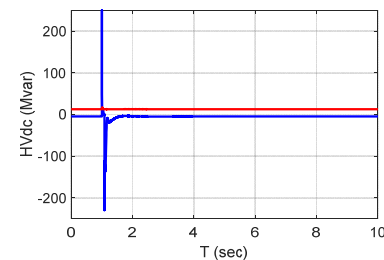
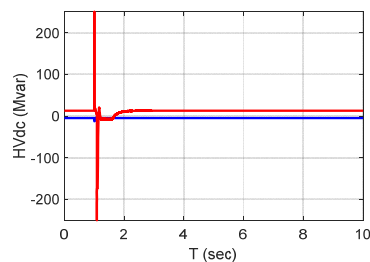
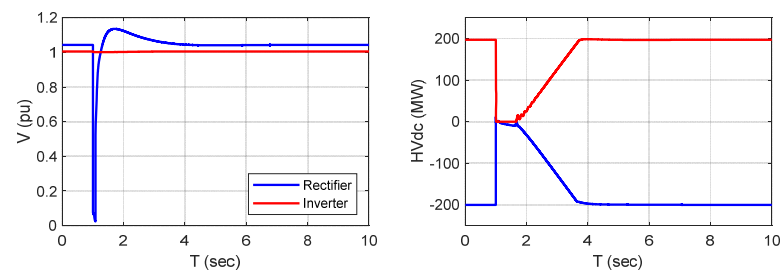
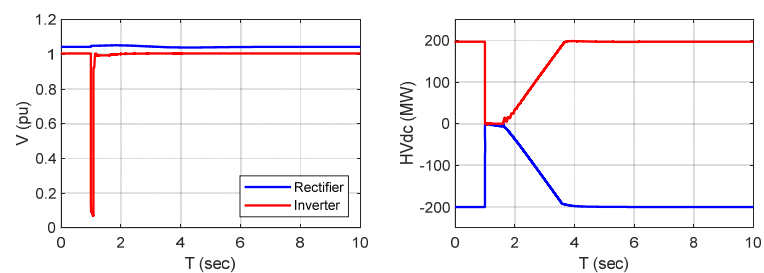
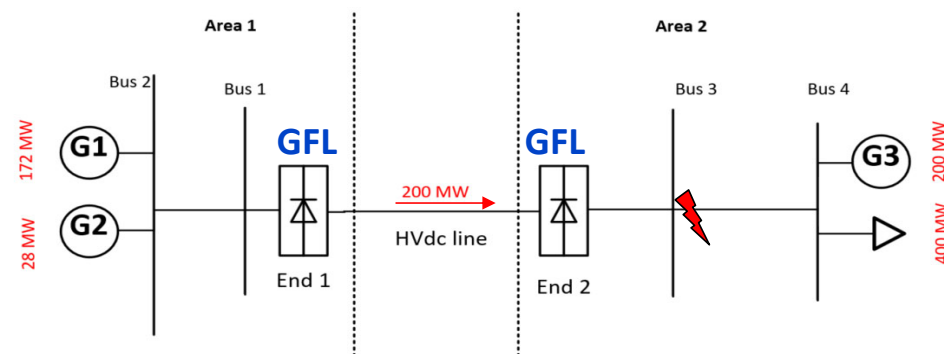
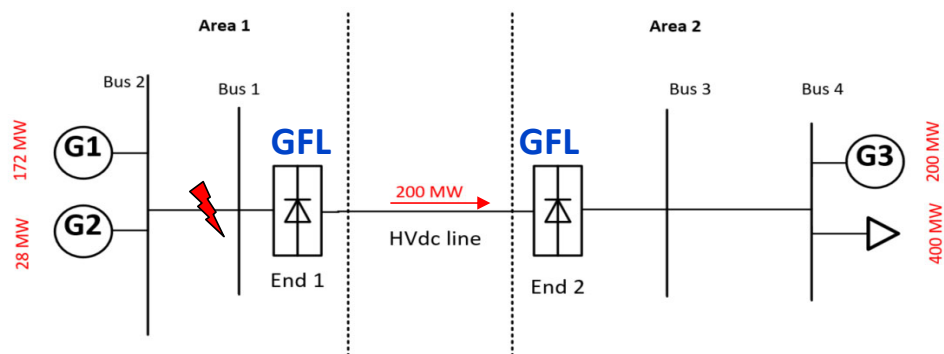


D-curve based reactive current limits

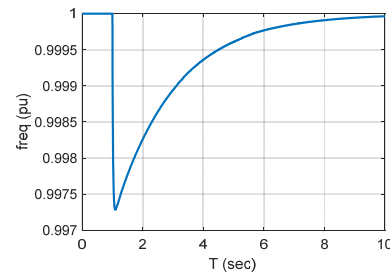
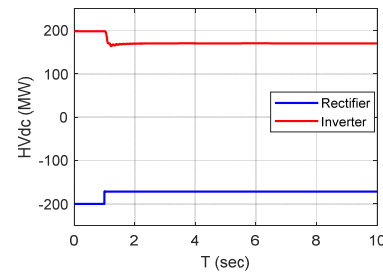
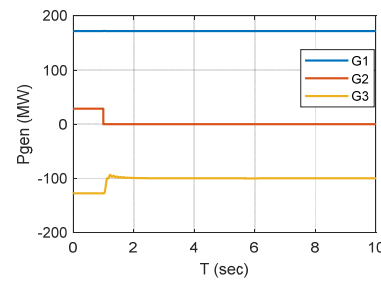
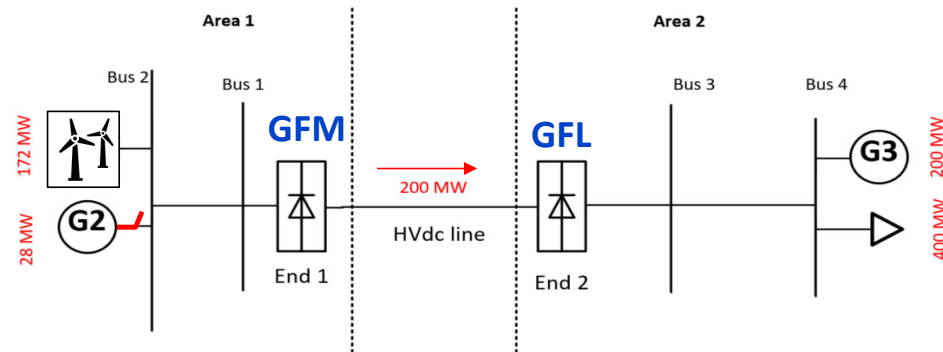
Fault close to HVDC terminal of the embedded HVDC (GFL/GFL)



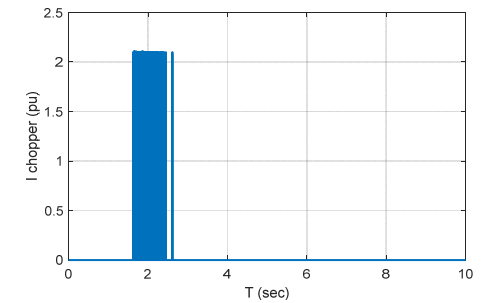
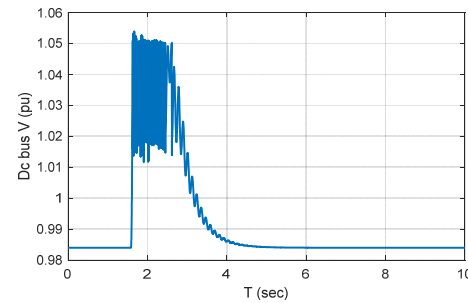
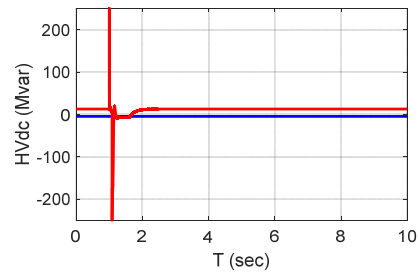
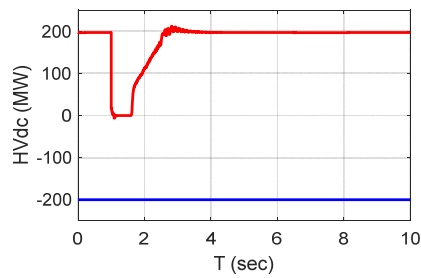
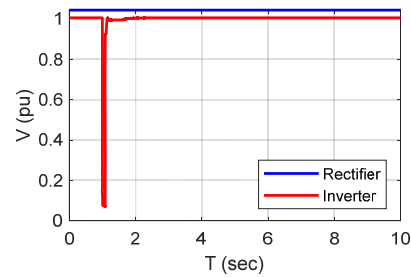
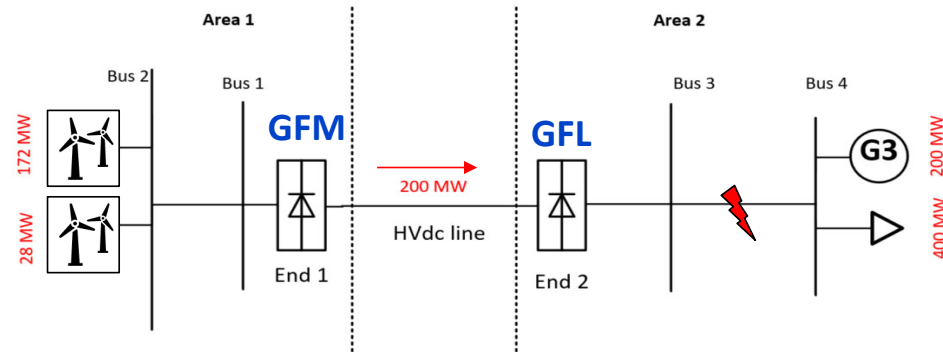
Fault close to HVDC terminal for non-embedded HVDC (GFL/GFL)



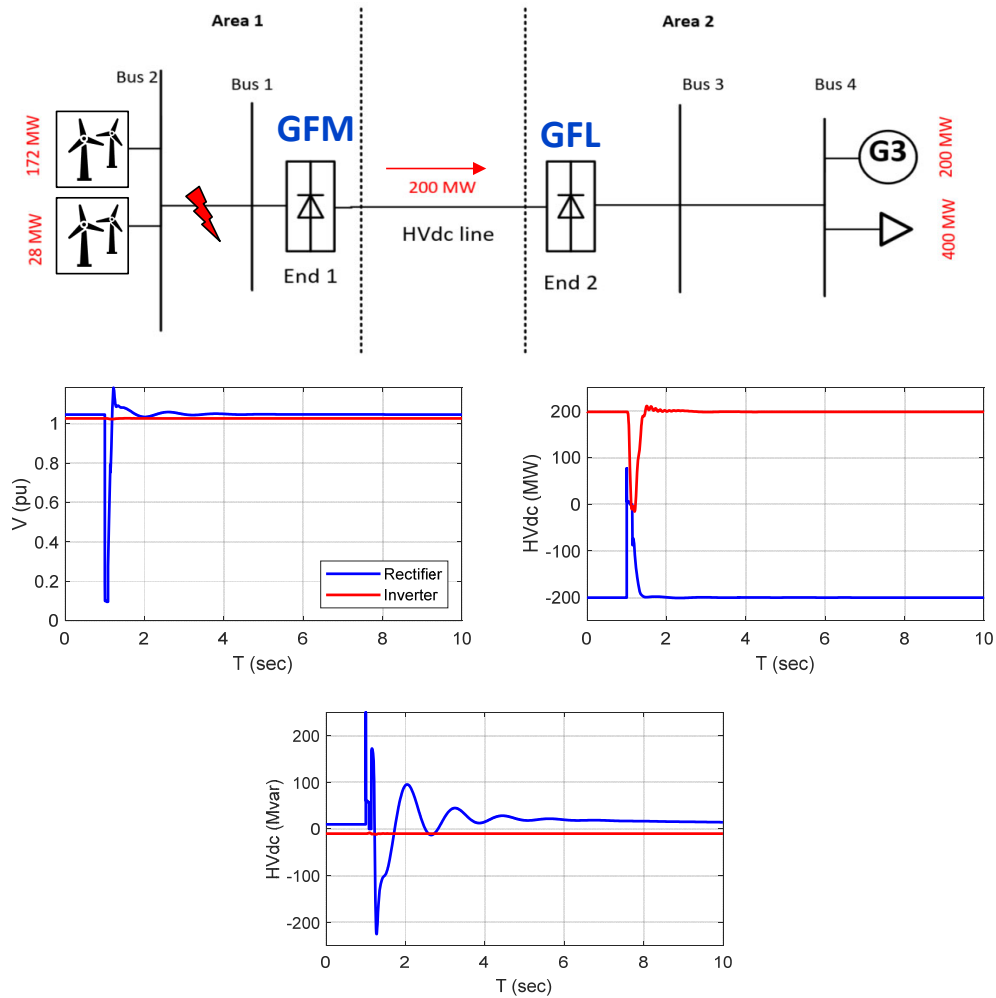
Loss of last synchronous generation in remote system with HVDC (GFM/GFL)



Offshore wind with HVDC (GFM/GFL) inverter side fault



Offshore wind with HVDC (GFM/GFL) inverter side fault



Open Items

- Current limiter for GFM mode of operations: Need to finalize whether we use circular limiter, virtual impedance or D-curve similar to GFL
- Dc chopper: Chopper has been implemented but an energy dissipation-based tripping is not yet implemented
- VSCDC1 issues with current clamping to 0 during HVDC blocking in the absence of at least one classical generator model needs to be addressed



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