

A Benefit of STATCOM + SMES in Transmission network

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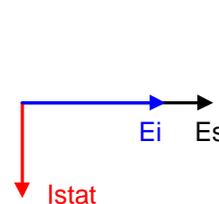
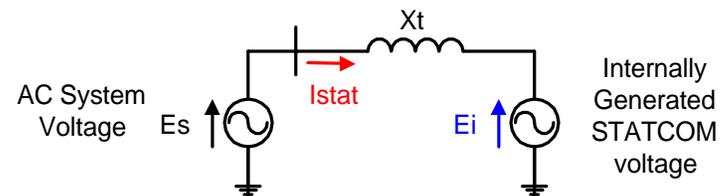
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Outline of Presentation

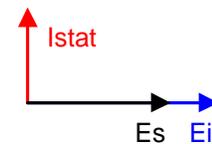
- Brief overview of STATCOM operation
- Test AC system with under-damped generator swing mode (0.5 Hz)
- Example of how STATCOM with POD may stabilize oscillation mode
- Example of how STATCOM + SMES may stabilize oscillation mode

Features of STATCOM operation

- Internal STATCOM voltage controlled to draw leading/lagging current from AC system
- Fast control allows rapid regulation of AC bus voltage
- Common DC bus structure (if employed) allows flexibility: may be interfaced to other inverters/devices
- Four quadrant operation of inverter allows real power exchange to/from DC bus

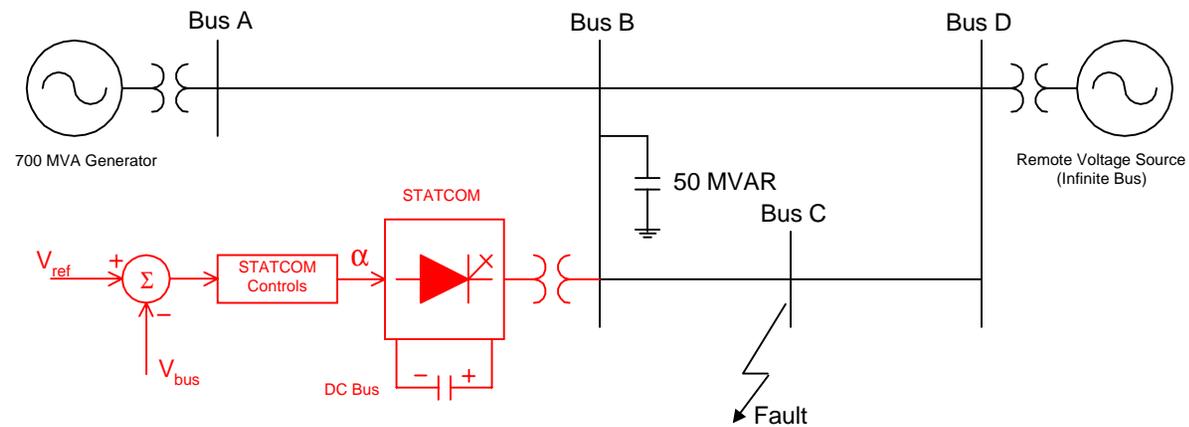


a) $E_i < E_s$, I_{stat} is inductive



b) $E_i > E_s$, I_{stat} is capacitive

Connection of STATCOM to AC system



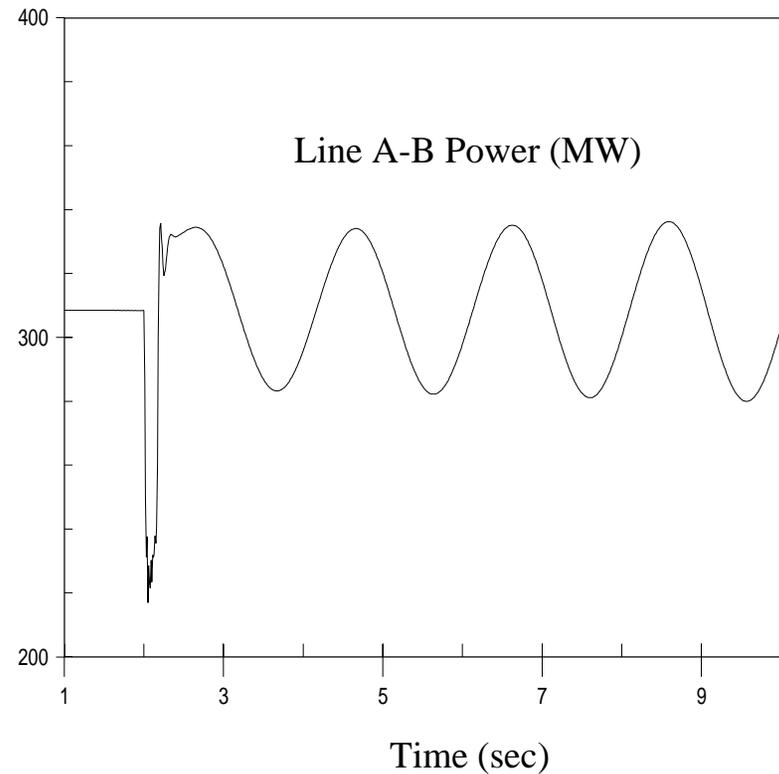
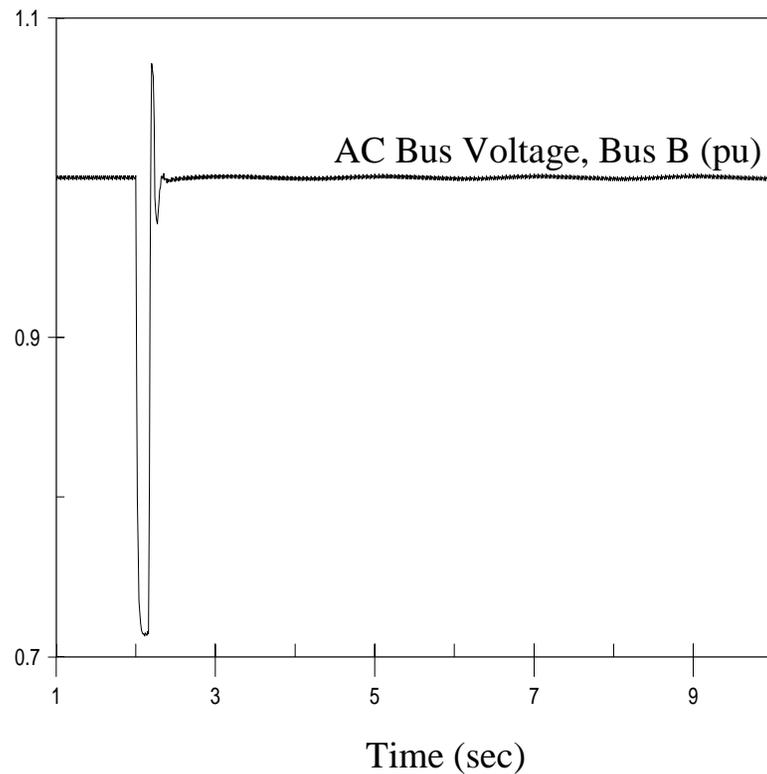
Generator (with inertia) at Bus A, connected through transmission lines to strong system at Bus D.

Lightly damped swing mode between generator and strong system source.

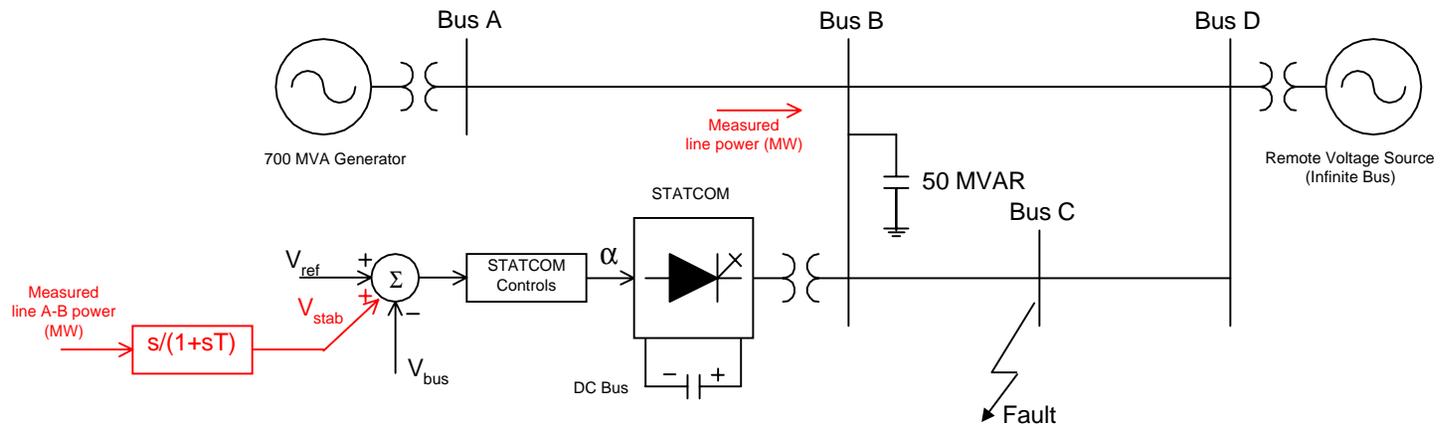
STATCOM provides voltage regulation and dynamic voltage support at Bus B.

PSCAD-EMTDC used to perform simulations, 100msec fault applied at 2 seconds.

Characteristics of AC system (with STATCOM), under-damped generator swing mode at 0.5 Hz

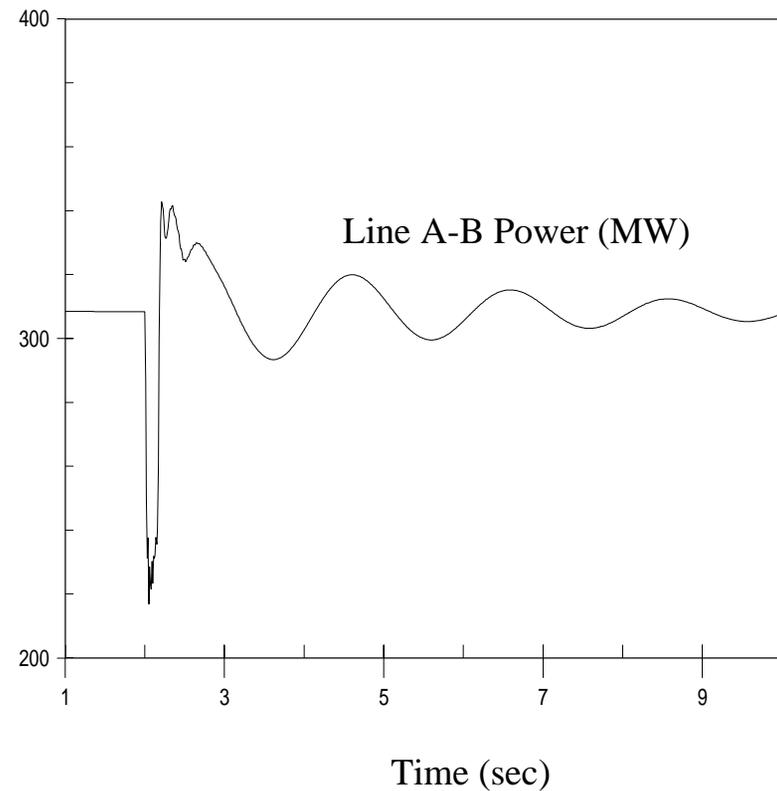
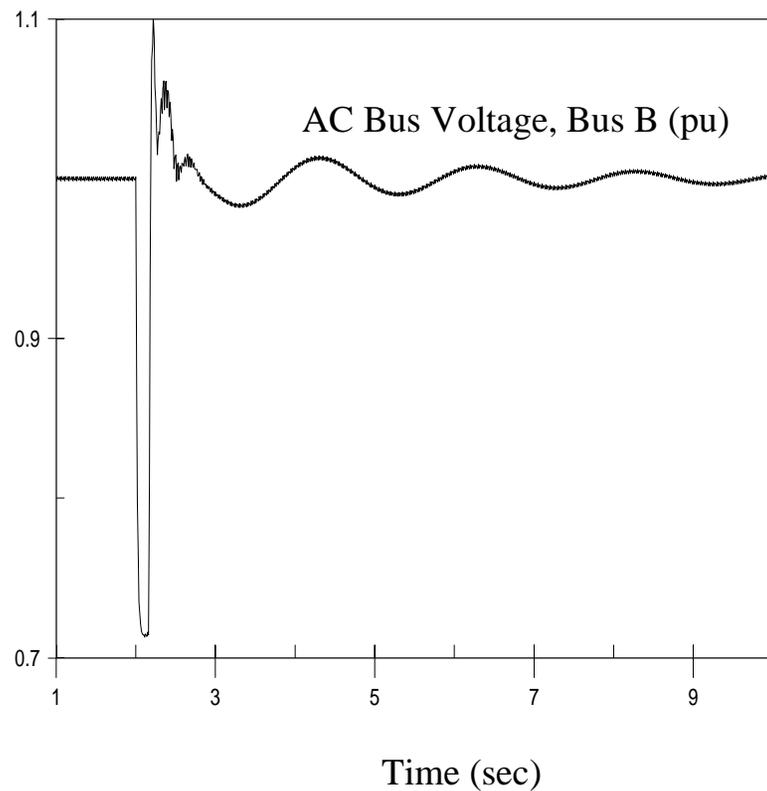


Arrangement with STATCOM + Power Oscillation Damper (POD)

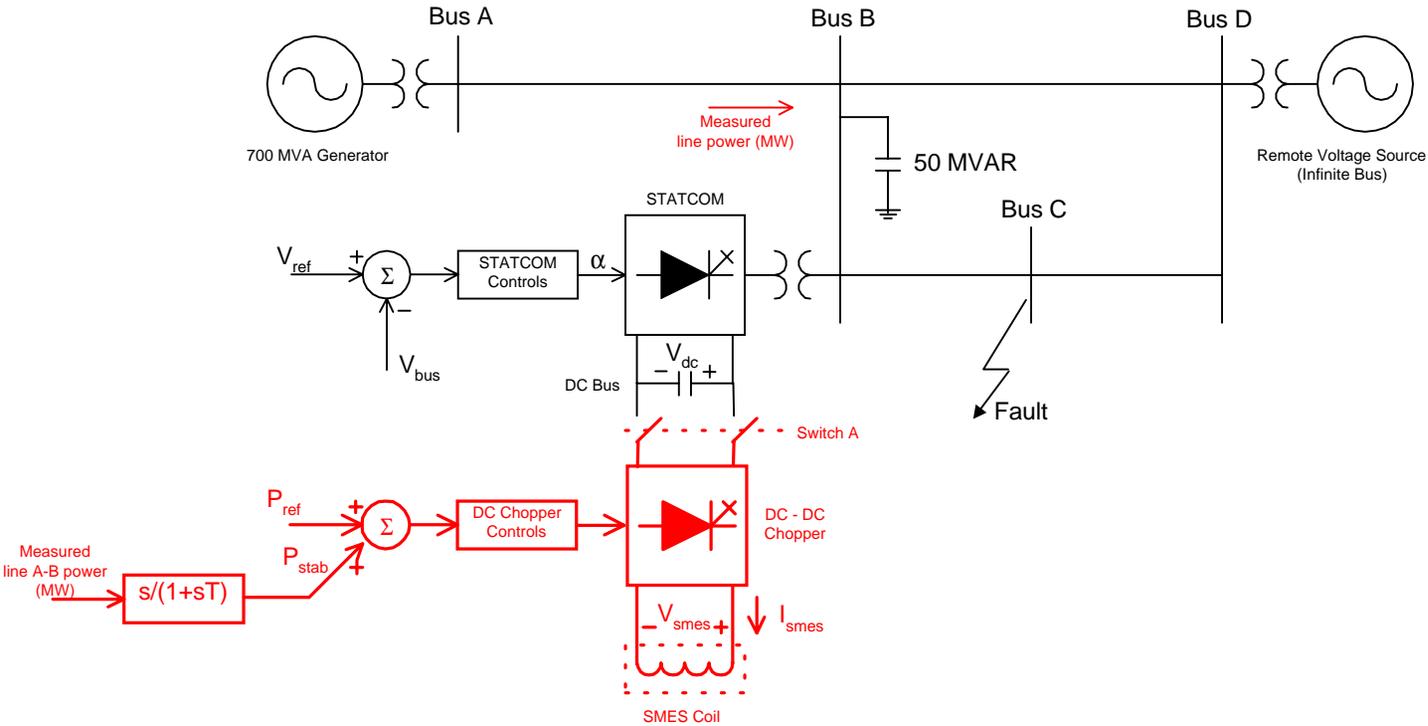


Line A-B power fed as stabilizer signal to voltage control loop of STATCOM

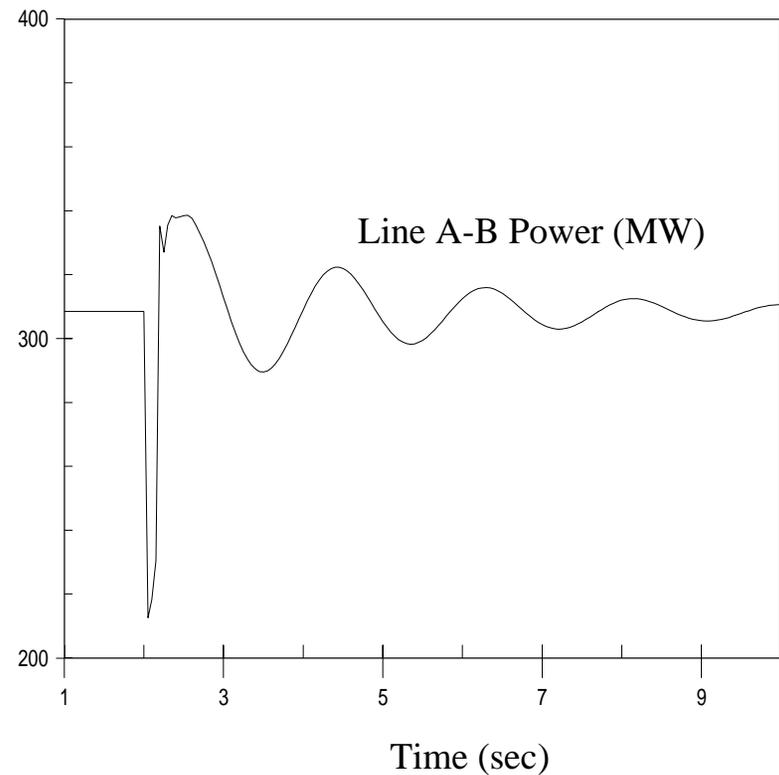
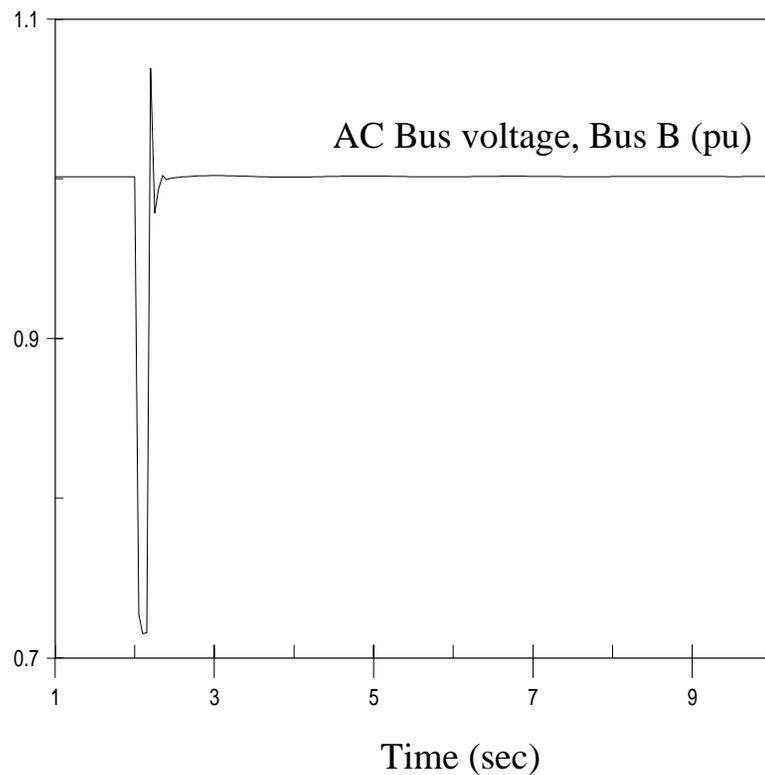
Results with STATCOM + POD, modulation adds damping at expense of voltage regulation at Bus B



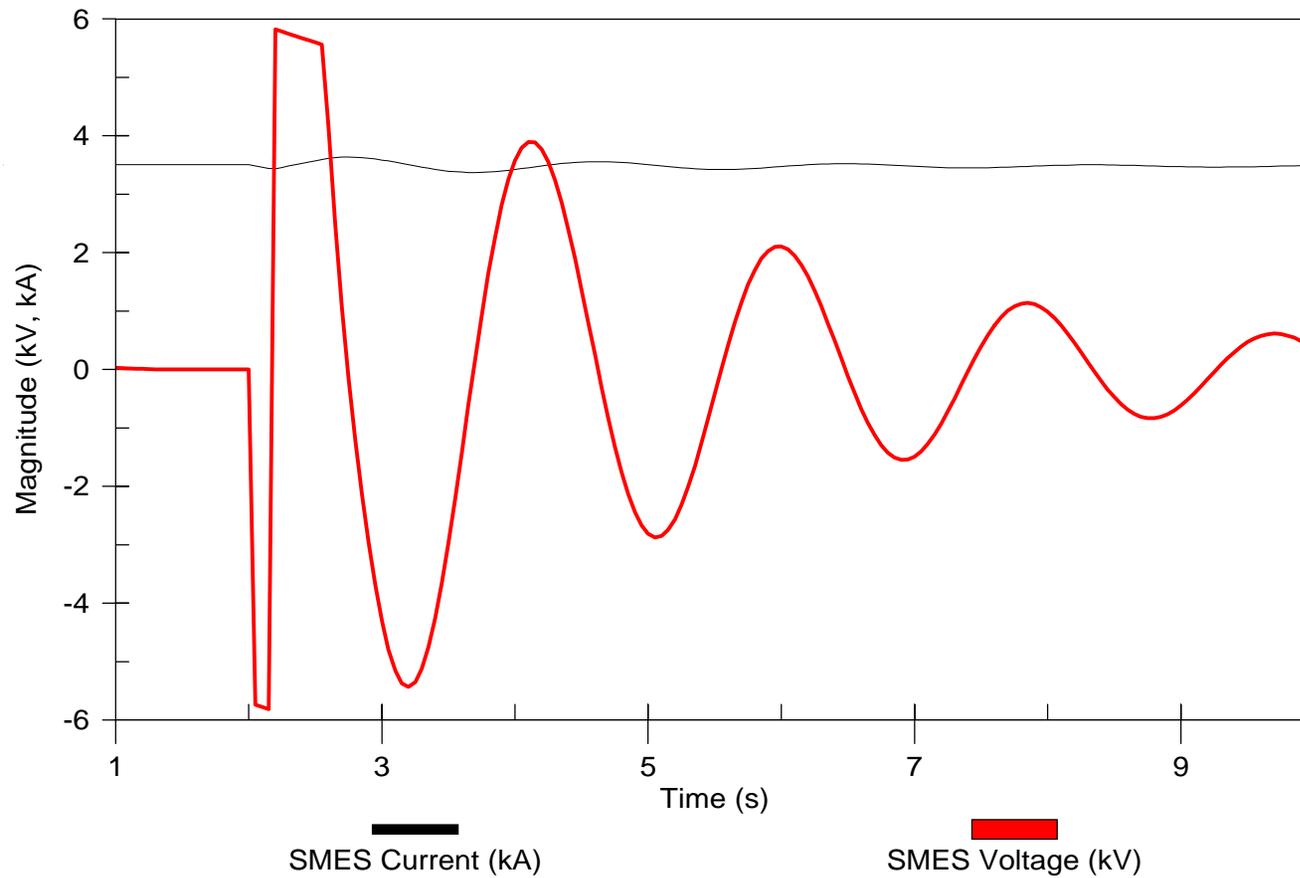
Interface of SMES system to DC bus of STATCOM



Results with STATCOM and SMES + POD, oscillation damped and bus voltage regulated



Power Flow to SMES via STATCOM DC Bus



Summary

- STATCOM by itself can provide power oscillation damping to network, but at the expense of voltage regulation
- STATCOM+SMES combination allows simultaneous voltage regulation and power oscillation damping
- Amount of SMES power required may be relatively small (20 MW) to achieve desired damping