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ESIG

Modeling and Simulation for Synchronous Condenser Applications – A Case Study

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Got a problem on the grid? Any problem at all? Try……

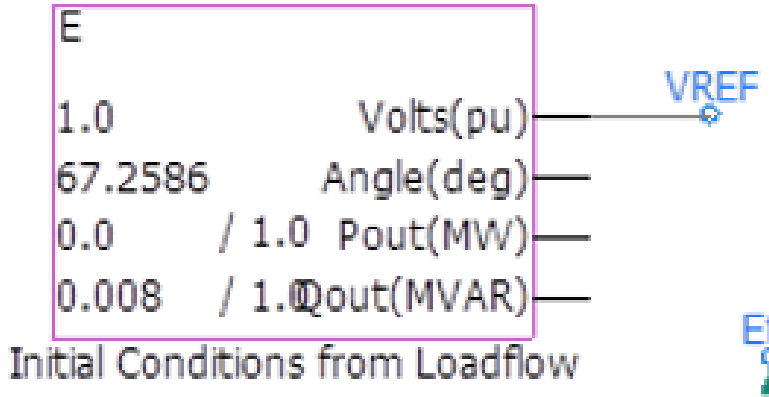
…Synchronous Condensers!! Silver bullet of the power grid!

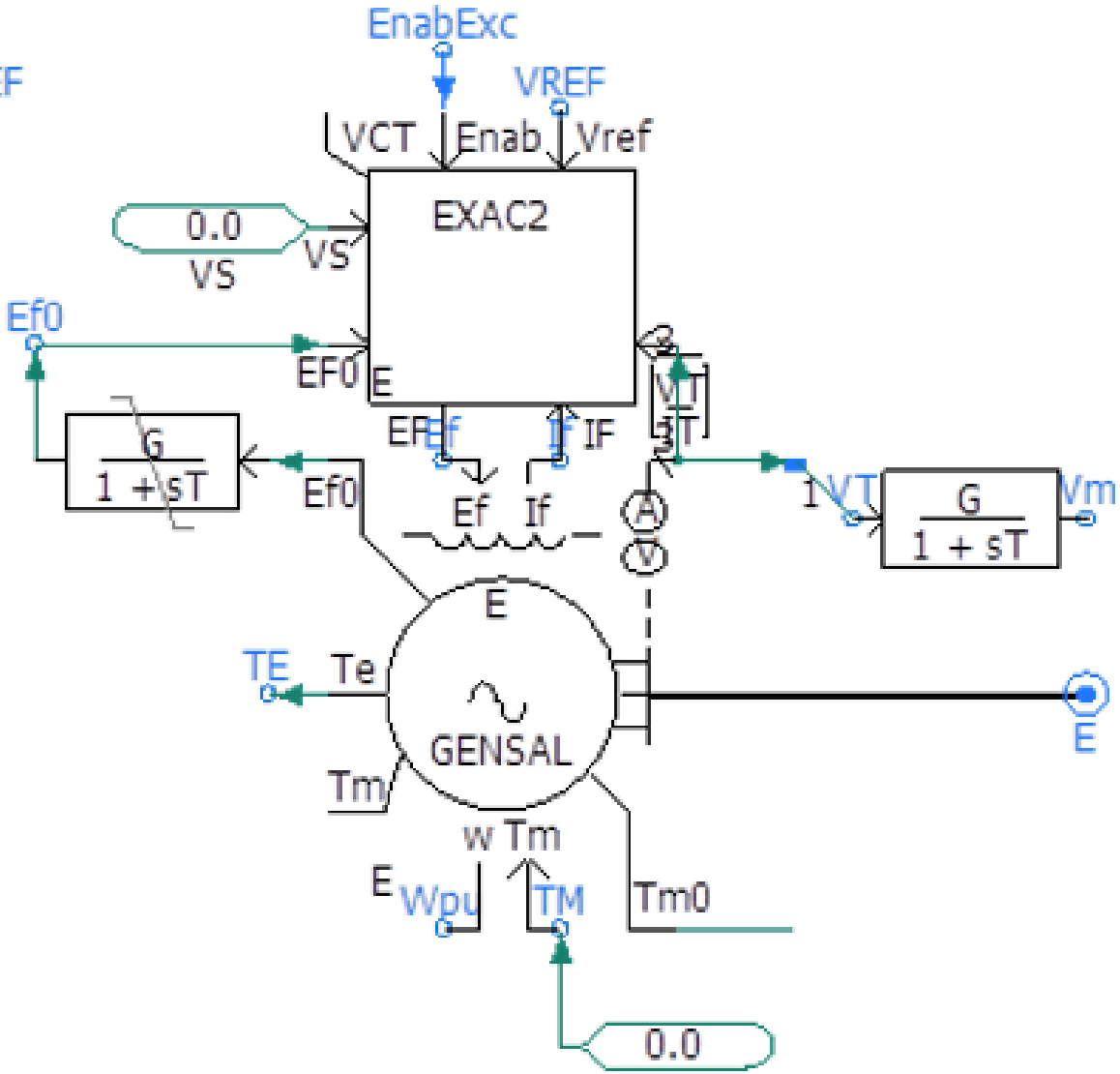
It is kind of true… additional inertia, resistance to frequency changes can solve a lot of power systems problems. **But:**

The other side of synchronous condensers

- High maintenance
- Can interact with variable generation voltage control
- Where best to locate?

What a synchronous condenser looks like in a study:





This synchronous condenser model is automatically translated into electromagnetic transients (EMT – PSCAD) by E-Tran from a solved power flow and associated dynamics file

Modelling large renewable based systems:

- EMT – PSCAD large grids translated from power flow & transient stability (PSS/E and now PSCAD models can be added to PSLF (but not yet released commercially)

- Detailed models – transmission lines, wind & solar plant, Sync. Cons, SVCs, STATCOMs, BESS, DERs are maintained in “Substitution Libraries” and automatically inserted into a new EMT case and initialized with the EMT grid model from the power flow. For simplicity, we use separate Substitute Libraries for each OEM’s equipment

Parallel processing large grids:

- EMT – PSCAD large grids inherently slow due to detailed inverters with calculation time steps from 1 – 5 Ωsec to 50 Ωsec with co-simulation transient stability at 5 – 10 msec

- Compiling/linking issues and supplier models with different compilers

- Confidentiality problems

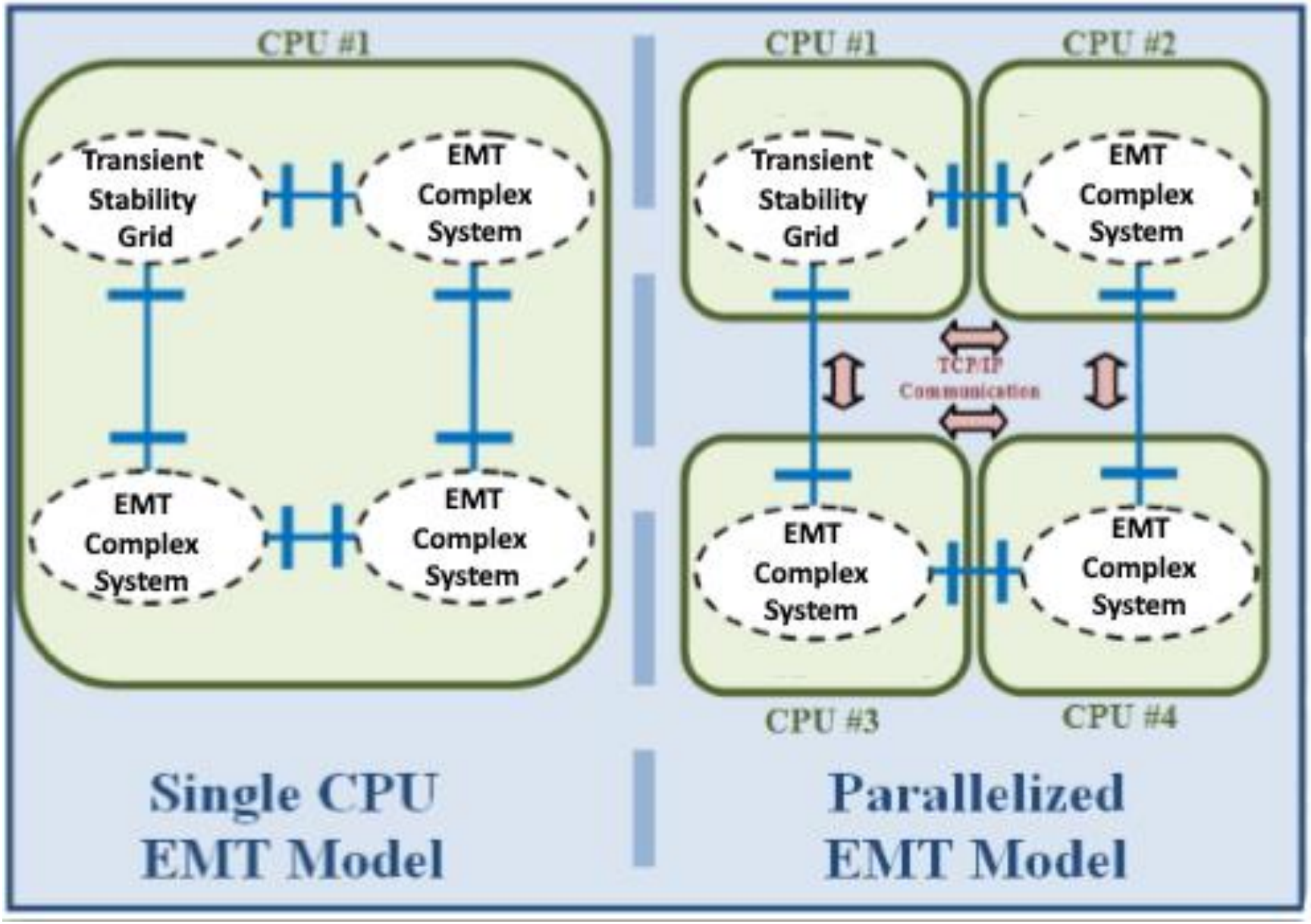
Parallel processing large grids - solution:

- These issues solved with each facility on its own CPU/CORE using a PSCAD add-on program "E-Tran Plus for PSCAD" and each CORE model compiled with different time step, different Fortran/C compilers

- Be completely "Black Boxed" to solve confidentiality matters

- Simulations accurate because all fully initialized from a standard power flow solution

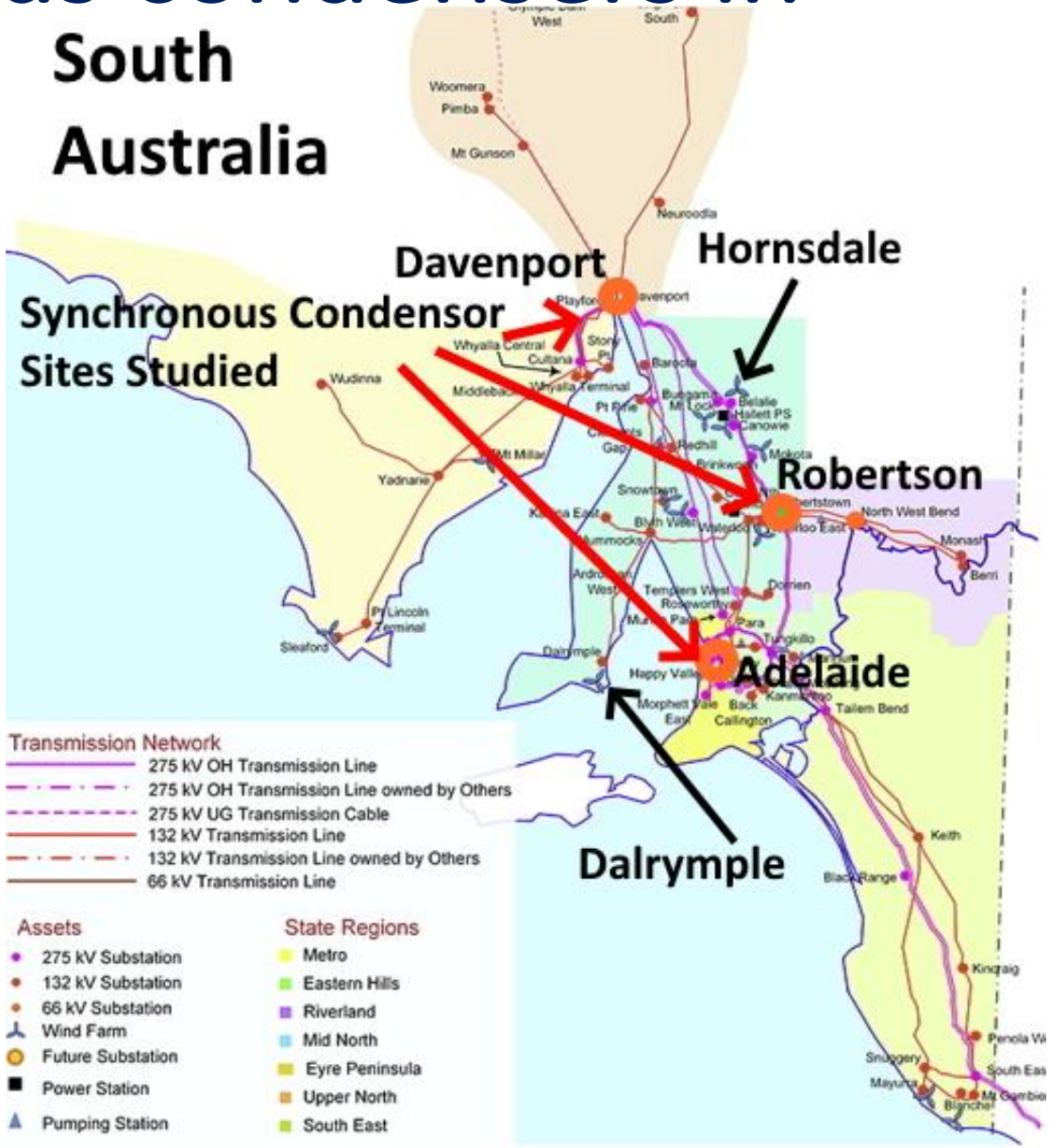
Parallel processing large grids - solution:



Example: Three synchronous condensers in South Australia

- Synchronous Condensers planned in central network location to provide inertia as wind penetration rises

- Study completely undertaken with PSCAD (no co-simulation) or transient stability



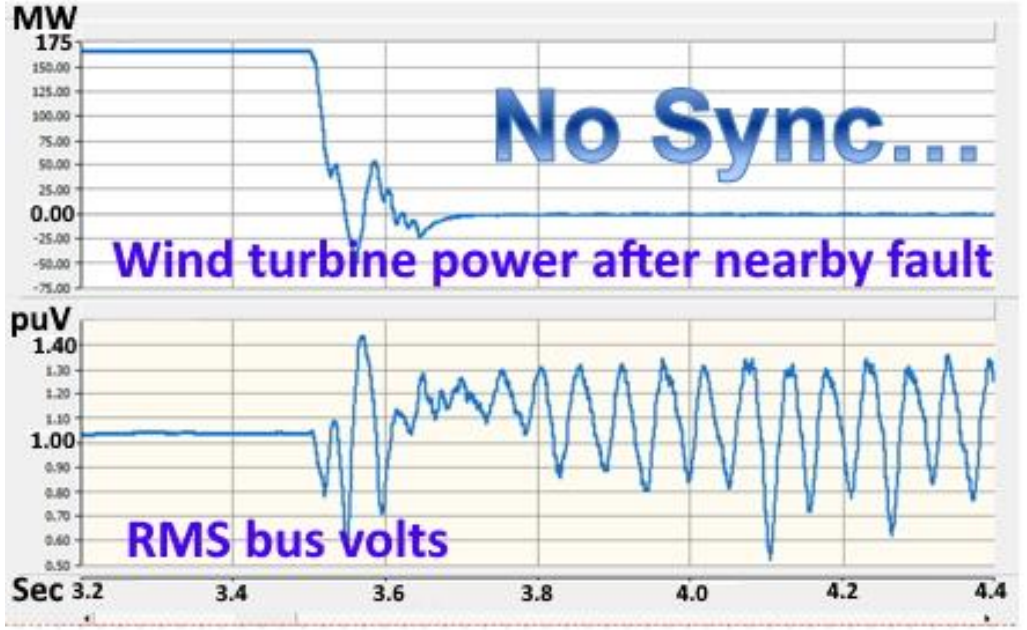
"South Australia transmission company ElectraNet says it has found a cheaper solution than using the state's gas plants to provide system strength to the local grid, which is now dominated by wind and solar.

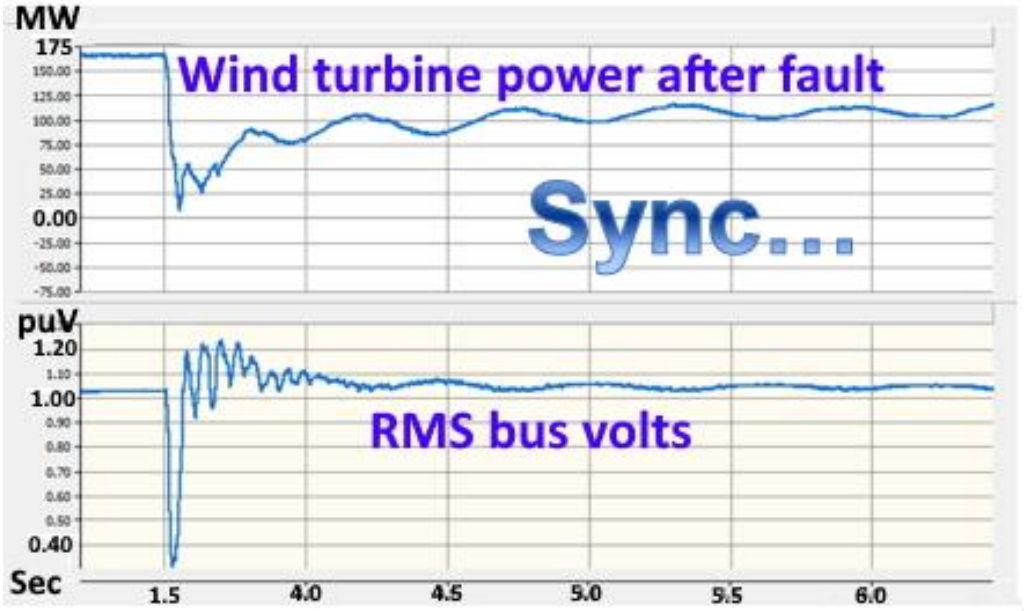
ElectraNet says it proposes to install three "synchronous condensers" in key areas of the state – at a cost of around $80 million – to ensure that gas-fired generators will no longer need to be switched on just to ensure the grid remains stable…South Australia has the highest penetration of wind, compared to the size of its grid, than anywhere else in the world"

Impact of Synchronous Condensers

Synchronous condenser being proposed to assist wind turbines riding through faults in extremely low short circuit ratios (SCRs).

Marginal gains… SCs provide a damping influence to assist plants in riding through, but they are an expensive alternative to control fixes





…Thanks!!

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