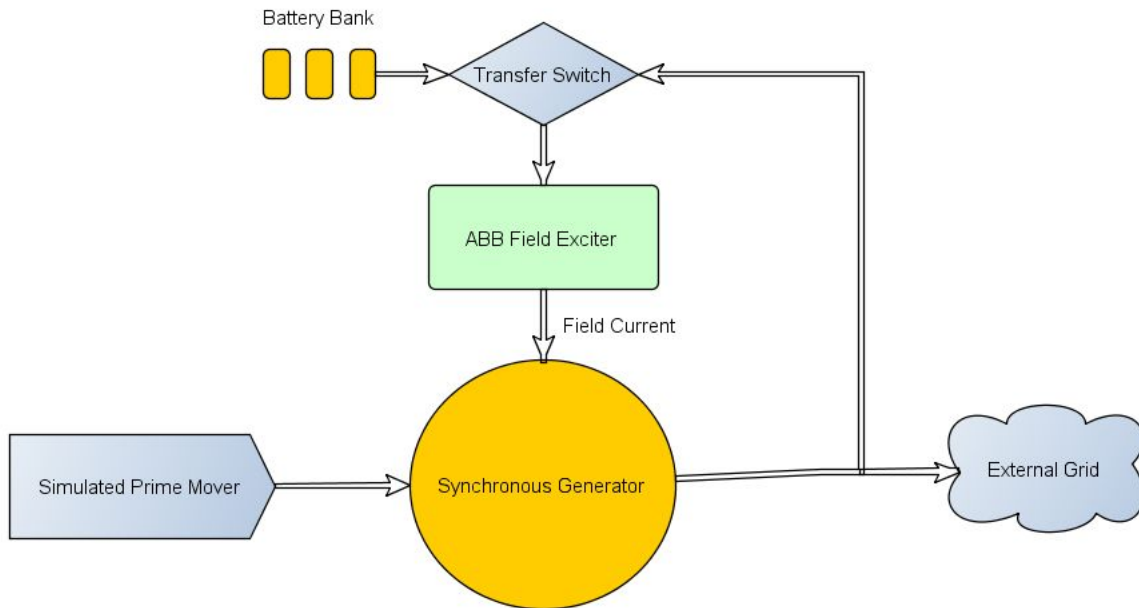


Synchronous Generator Black Start Field Exciter System



Specifications:

System Process:

1. Initiate black start - .no synchronization - no starting line voltage
2. Battery bank powers ABB exciter (AVR) until sufficient power is provided from synchronous generator to run the AVR.
3. Black start system controls transfer of exciter power supply from batteries to generator power.
4. Generator terminal voltage achieves desired voltage
5. AVR controls excitation in steady state operation

Tasks:

- Validate/improve existing RTDS model
 - Modeling governor is not needed
- Model black start on RTDS simulation
- Determine battery to generator switch point
- Design/program controller to control transfer from battery to generator power
- Size battery bank - energy storage capacity and battery connections
- Size/select/design transfer switch - SSR or mechanical switch

- Operate and test black start scenario on the generator
- Document black start system operating procedures for future work
- Optional: Protection and SCADA integration
 - Exciter currently has built in protection schemes to work with

Portability:

- Not needed - Will remain in the BEL lab

Testing Specifics:

- Main goal of project is black start operation
- Start with only battery power
- No need for synchronization
 - Test Parameters to measure:
 - Transfer from battery to generator power at predicted time
 - Sufficient battery bank capacity
 - Amount of startup time needed