



# Grid Simulator

Grid Simulator replicates response of a typical transmission grid having different types of power plants - coal, gas, solar, wind, hydro, pump storage, battery storage & biomass.

## Operator Training and Analysis

Beneficial for Operator training and response analysis for various scenarios such as:

- Changes in breaker status, load/generation schedule, wind speed/radiation profile
- Automatic startup, shutdown, synchronization of power plants
- Black start during grid failure
- Response during frequency fluctuations
- Voltage regulation and reactive power control
- Sudden addition/disconnection of Load

## DigSILENT PowerFactory Software

The model is developed using DigSILENT PowerFactory software. HMI screens are designed in Wonderware Intouch for providing operator commands and visualizing results.

## Types of Power Plant

Different power plants with controllers: wind, solar, biomass, coal, gas, hydro, pump storage & battery storage.

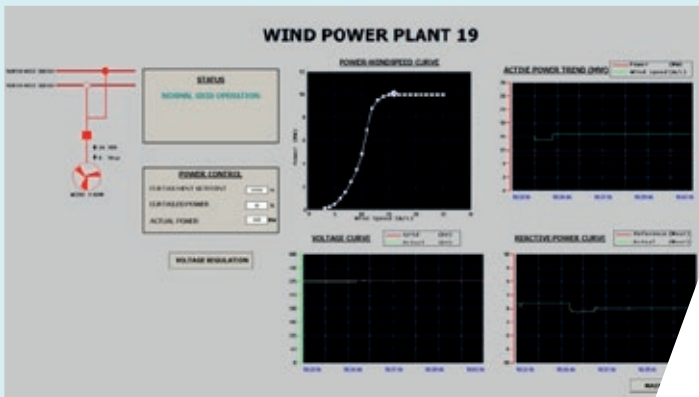
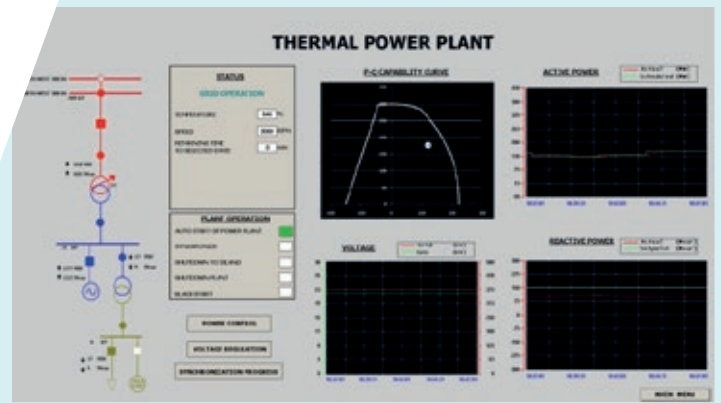
## Renewable Plants – Wind/PV/Biomass

- Represented by a single unit connected in parallel by using a multiplication factor for active power
- Various applicable operating states: Switch on/switch off (based on radiation/wind speed, etc), grid operation
- Provision for frequency-dependent power reduction
- Reactive power control based on various characteristics – Q(U), Q(P), Fixed reactive power, power factor regulation



## Thermal – Coal/Gas Power Plant

- Various applicable operating states: startup from cold, hot & warm condition, automatic turbine startup, synchronization, grid operation (Load following, primary/secondary control), shutdown
- Black start operation
- Inclusion of protection functions for the generator or turbine
- 3 control modes for AVR - voltage regulation, power factor control, reactive power control



## Frequency Control

- Provision to analyse response during frequency fluctuations.
- Primary Control
- Controlled by turbine valves and works according to droop stated in grid operation
- Automatic Secondary Control
- Control error is based on combination of difference between actual exchange power and planned exchange power and the frequency deviation
- Based on lookup table in which (roughly) the available control power in relation to the merit order is stored
- Expensive power plants have a high merit order

## Instructor Functions

Instructor console features: Start/Stop, Study cases, Event initiation, Snapshots, Fast/Slow time operation, etc

## Hydro/Pumped Storage Power Plant

- Various applicable operating states:
  - a) Turbine Operation: Startup operation from standstill or any residual speed, Synchronization, Grid operation (Load following, primary/secondary control), shutdown to plant standstill
  - b) Pump Operation for pumped hydro plant: starting from standstill, pumping operation, shutdown operation into plant standstill.
- 3 control modes for AVR - voltage regulation, power factor control, reactive power control

## Battery Storage Plant

- Various applicable operating states: Storage system out of order, Storage system charged (operation as load), Storage system discharged (operation as generator)
- Simulation of charging/discharging process
- Provision for frequency-dependent power reduction and reactive power control



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