

Procedure for PSS/E model validation

Unité Programme et stratégies du réseau principal
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1. Purpose

The document *Transmission provider technical requirements for the connection of power plants to the Hydro-Quebec Transmission system* specifies that the power producer must provide a complete PSS/E model for each type of wind turbine, including the relevant technical documentation, data and parameters. In the case where the voltage regulation of the wind power plant is achieved by means of additional compensation equipment in the switchyard, the power producer must also provide the complete PSS/E model for the compensation equipment including the technical documentation, data and parameters.

In order to accelerate the validation process of each new model and release, we ask the power producer to provide a report for each wind turbine model to demonstrate that the PSS/E model:

- Initializes correctly
- Represents a realistic behavior of the wind power plant during voltage and frequency deviations

When the voltage regulation of the wind power plant is achieved through additional compensation equipment, the PSS/E model for the compensation equipment must also be taken into account in the simulations of the wind power plant.

To assist the power producer in its task, a base case scenario is provided with a list of simulations and variables to be plotted. The power producer has also the flexibility to work with his own base case scenario but will have to transfer all the files required to perform simulations along with the report.

2. Base case scenario

The base case scenario *windtest.sav* is a simplified network based on the one available in PTI documentation *savnw.sav* (figure 1). A 100 MW wind plant is integrated in the *windtest.sav* base case at bus 3006 through a collector bus system and a step-up transformer (figure 2). The power producer must update the base case scenario according to the wind plant parameters and models and add the compensation equipment if required.

The following files are available to the power producer in PSS/E version 32 to perform the simulations:

- Load flow base case: *Windtest32.sav*
- Dynamic files: *Windtest32.dyr*
- Slider: *Windtest32.sld*, *WTGxx.sld*
- Channel file: *Windtest32.idv*

3. Simulations

Below is a list of the simulations to be performed in the base case scenario to validate the wind turbine model and its compensation equipment when required.

List of simulations:

- 1) No fault for 20 s
- 2) Capacitor switching to get a 5 % voltage step change at the point of interconnection (POI) for 60 s (capacitor of 290 Mvar)
- 3) Reactor switching to get a 5 % voltage drop at the POI for 60 s (reactor of 290 Mvar)
- 4) Three phase fault ($V = 0.8$ pu) at POI cleared in 45 cycles for 20 s ($Z: 0 + 55j$ ohms)
- 5) Three phase fault ($V = 0.25$ pu) at POI cleared in 45 cycles for 20 s ($Z: 0 + 5j$ ohms)
- 6) Three phase to ground fault at POI cleared in 9 cycles for 20 s ($Z: 0$ ohms)
- 7) Drop plant bus 3011 for 100 s
- 8) Drop load number 2 bus 154 for 100 s

The simulations must be performed in PSS/E version 32. The following dynamic settings are suggested:

Acceleration: 0.5
Network solution iterations: 200
Tolerance: 0.0001
Island frequency acceleration: 0.66
Island frequency tolerance: 0.0005
Time step: 4.16 ms
Frequency filter: 0.01667
Delta threshold intermediate: 0.04
Delta threshold island frequency: 0.06
Network frequency dependance ON

For each simulation, the following variables must be plotted:

- a) Wind plant real power
- b) Wind plant reactive power
- c) Voltage regulation equipment reactive power
- d) Real and reactive power flow at the POI (High voltage side)
- e) Voltage at bus
 - a. Low voltage side of the wind plant
 - b. Low voltage side of the voltage regulation equipment
 - c. POI (High voltage side)
- f) Frequency at bus 152

The power producer is invited if required, to perform more simulations, add variables or give additional information to help the comprehension of the wind plant behavior.

Along with the report, all the files required to perform the simulations must be transferred.

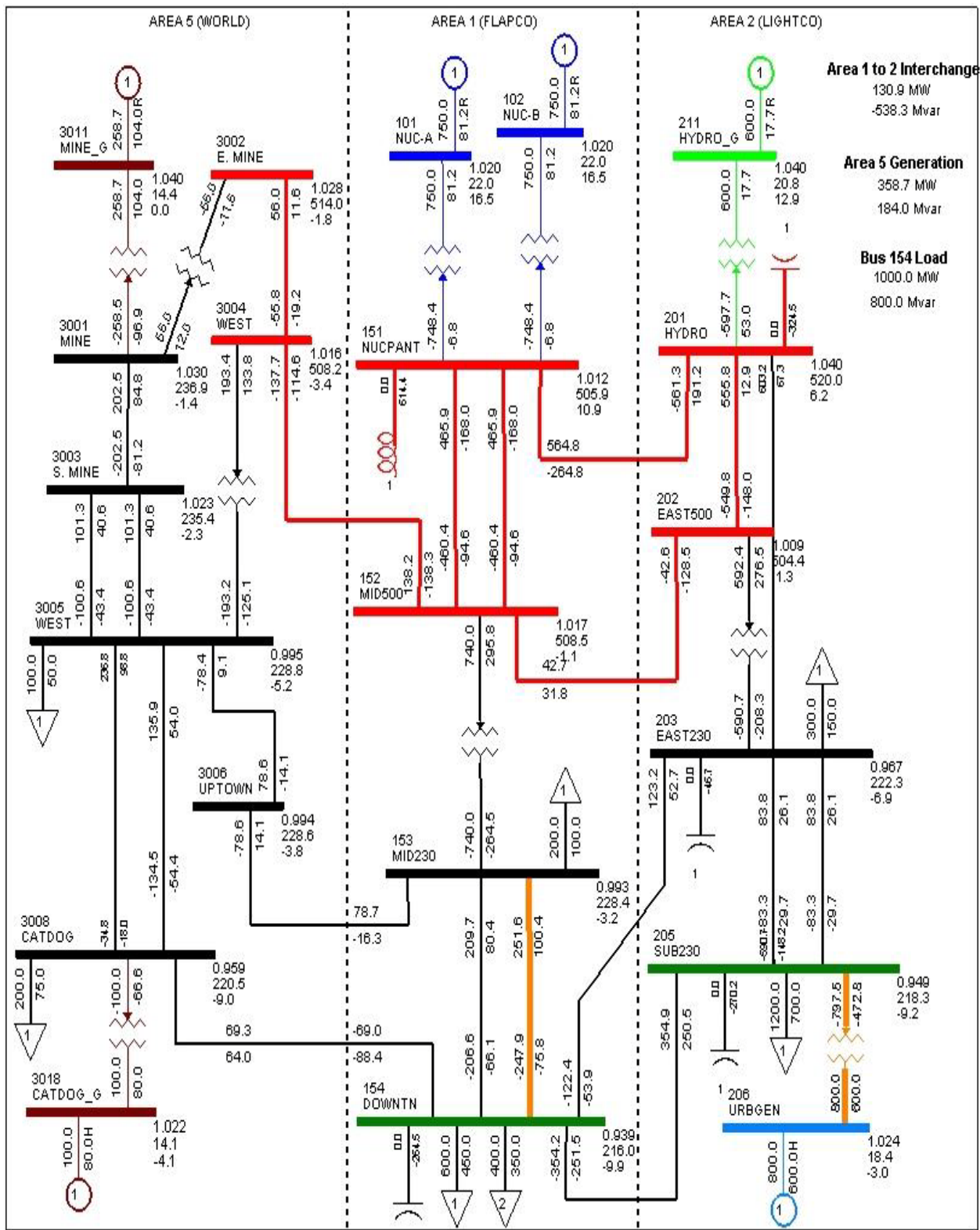


Figure 1 (Windtestxx.sld)

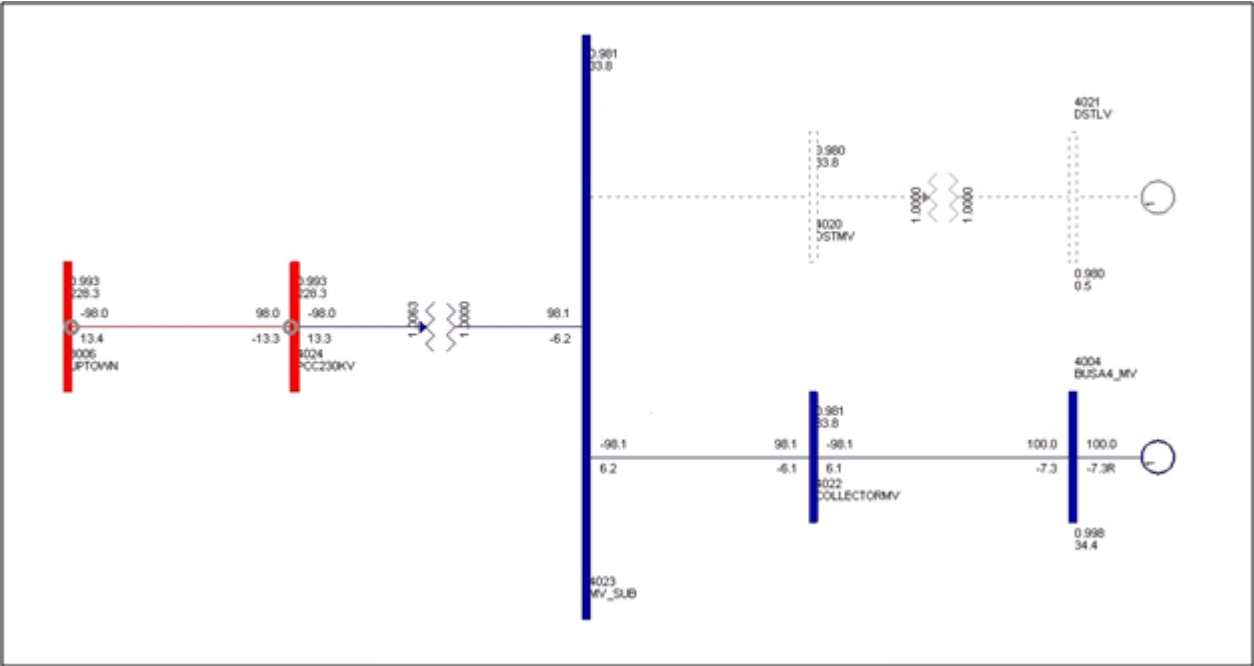


Figure 2 (wtgxx.sld)

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