

Getting to Know Power World Read-Ahead

*Created by the University of Illinois at Urbana-Champaign
TCIPG PMU Research Group¹*

I. INTRODUCTION:

What is Power World?



Power World is a program that allows a user to gauge and calculate power flow within a power grid. The main benefits of this are the following:

- Can visually see power flow.
- Can visually see a problem in the grid.
- Calculates out all the power flow equations

As you can see from above, the benefit of Power World is the visual aid that it provides and the calculations that are done behind the scene. By using Power World, one can model a power grid with ease.

II. PRE-LAB:

A. Installing Power World

First thing you should do is to install Power World. To install Power World, you must use Windows. If you have an OSX or Linux, you can use Oracle VM Virtual Box or Boot Camp to install Windows. If you have other methods to solve this problem, sharing your method will be much appreciated.

To install Power World, please download Power World from the URL.

<http://www.powerworld.com/simulator-15-glover-sarma-overbye-edition-download>

Before coming to class, please have the simulator running, and have the file, found on the TCIPG reading group page, loaded. **Please do not download the 5 bus model from last week.**

<http://tcipg.org/tcipg-reading-group-fall-2012>

¹ Credit given to Mark Alikpala, Kenta Kiriara, and Bogdan Pinte.

B. Power World Background

The following symbols will be used to reference to voltage magnitude, phase angle, real power and reactive power:

V: Voltage
 δ : Phase Angle
 P: Real Power
 Q: Reactive Power

We should know this from our previous weeks, so if you have difficulties, you may want to refer to the documentation again.

Now moving along, we will examine some basic vocabulary necessary to understand Power World.

Buses are conductors that connect two or more electrical circuits together. There are many definitions for buses, but we will, at least here, refer to a bus as a node on the grid where we can measure voltage, current, or anything related to it. **The difference between transmission lines and buses is that buses are the nodes themselves and transmission lines are the lines connecting to it.** There are three types of buses that are used in an electric grid:

Slack (Swing) Bus:

Only one slack bus exists in an electric grid, which acts as a reference bus. The slack bus will have a voltage, V, as 1.0 per unit, and a phase angle, δ , 0° . Since the Voltage and Phase angle is given on this bus, we can calculate real power, P, and reactive power, Q.

Load (PQ) Bus:


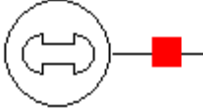
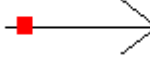

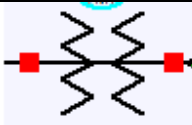
A load bus is a bus where real, P, and reactive, Q, power are given. In an electric grid, most buses are defined as load buses. In a load bus, we calculate the voltage, V and the phase angle, δ .

Voltage Controlled (PV/Generator) Bus:

A voltage controlled bus is a bus where real power, P and voltage magnitude, V are given. These buses are usually connected to generators and shunt capacitors. This type of bus has a defined minimum and maximum value of allowed reactive power, Q. If the reactive power reaches any of these 2 limits, then the bus will be modeled as a Load Bus. In this type of bus, the reactive power, Q, and phase angle, δ , are computed.

Note: Slack bus are sometimes called Swing Bus; Load Bus are sometimes called PQ Bus; Voltage Controlled Bus are sometimes called as PV Bus.

To create our own power network, we will be using the following components:

Device	Description	PowerWorld Image
Bus	Connects two or more electrical circuits together. This would be like the substations in our applet from last week.	
Generator	Provides power to the system. These are essentially the generators in the applet: nuclear, hydroelectric, wind, etc.	
Load	Consumes power. This is actually the consumers such as the residential, commercial, and industrial areas.	
AC Transmission Line	Carries power from one point to another. This is an electric line.	
Transformer	Steps up or steps down voltages from one bus to another. These refer to the small transformers in the neighborhood as well as the big ones in the plants.	

C. Power World Use

The two main parts of Power World that you will be using are going to be the Draw tab and the Tools tab.

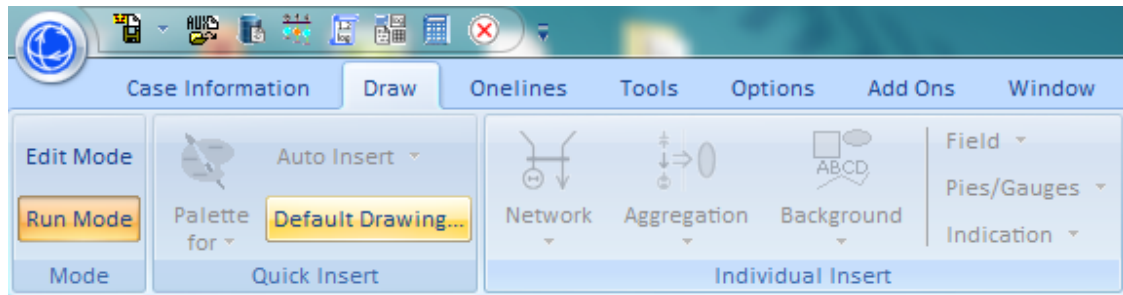


Figure A

In a basic use of this program, you do not have a necessity to use any other tabs besides these two. However, you probably still need to use the ribbon to save the cases.

Under the Draw tab (Figure A) are the necessary things you need to use in our actual seminar this week. Within the network button are the components described above. The field button will pop out a menu that allows fields to be placed. Fields are the measurements that can be made at the transmission line or bus or anything along those lines. Another thing you may want to add is a text that is located in the background pop-down. This will let you keep all the lines labeled and organized.

The other tab, Tools tab (Figure B), has a very useful feature as well. The sole important button that you will use is the solve button (indicated with a green play button). It is the button that we must press in order for us to solve the circuit. To actually use this, click on the Run Mode first, then use the green button under the tools tab. This will solve the circuit and show the actual module running.

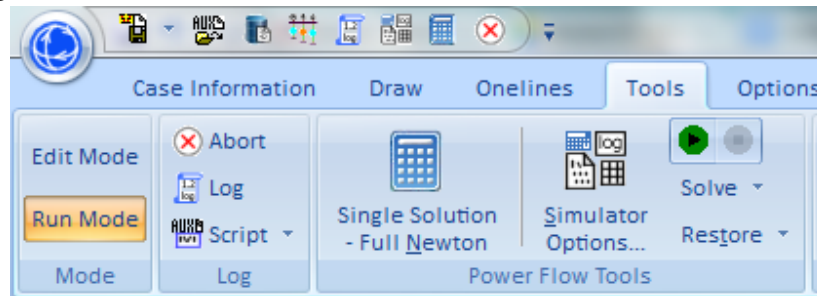


Figure B

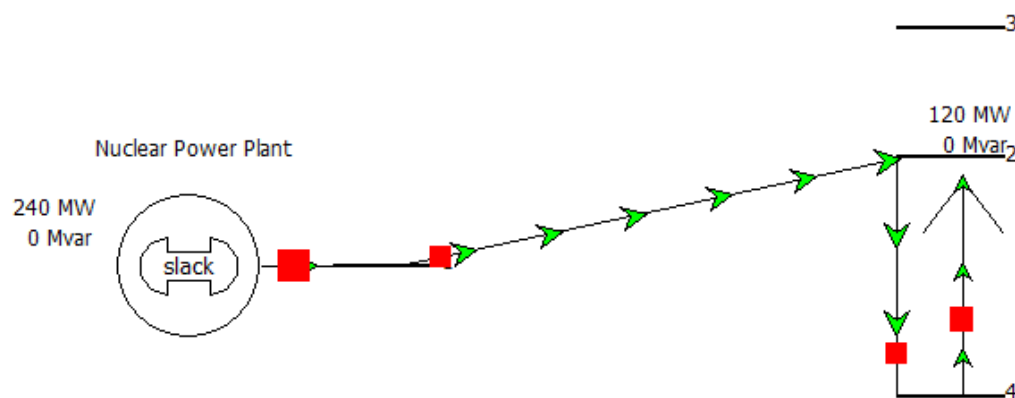


Figure C

The picture of the simulator actually running is shown in Figure C. In actuality, the arrows will be moving, but for the sake of this documentation, we can only snap it while it is not. Again, the tutorials you will load will be different, but this should give you a better idea of how it looks like.

Other features about Power World that you may want to know are about changing the view. Dragging the screen will allow you to navigate across the power grid. Right clicking or double clicking on each component will allow you to edit the options selected for the particular component. Scrolling while pressing control, or in many laptops scrolling on the track pad or mouse, allows the user to zoom in and out. Also, if you want to move around components, you can easily do so by clicking on the component and dragging it to other parts of the grid.

Now, after going through this tutorial, you should have the sufficient background to use Power World.

III. EQUIPMENT LIST

Required:

- Laptop with Power World Version 15 Installed.
- Same laptop with the demo loaded.

Preferred:

- A mouse: this will make this lab easier as you will be right clicking many times.
- The procedure part of this lab printed: as Power World takes up a lot of space on your screen, it is probably best to have it.

When you come to class, please have the demo loaded. We will go through it together first, then add on more to the power grid.