SCADA PROJECT: Electric Power System – Electric Power Generation Plants, Transmission Areas, and Distribution Systems.

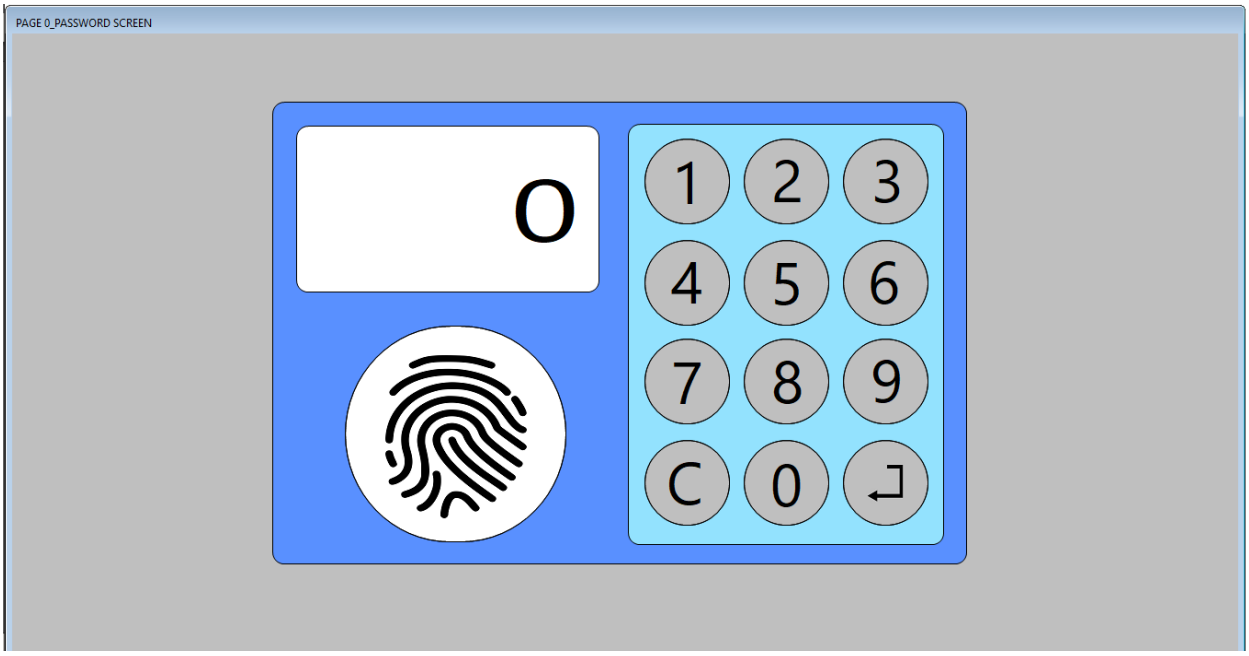
1. **Description and Scope**

The SCADA system project will be based on the Electric Power System in the Philippines. The various power generation plants will be presented by source: coal, oil-based, natural gas, hydro, geothermal, and other renewable energy sources such as wind, solar, and biomass.

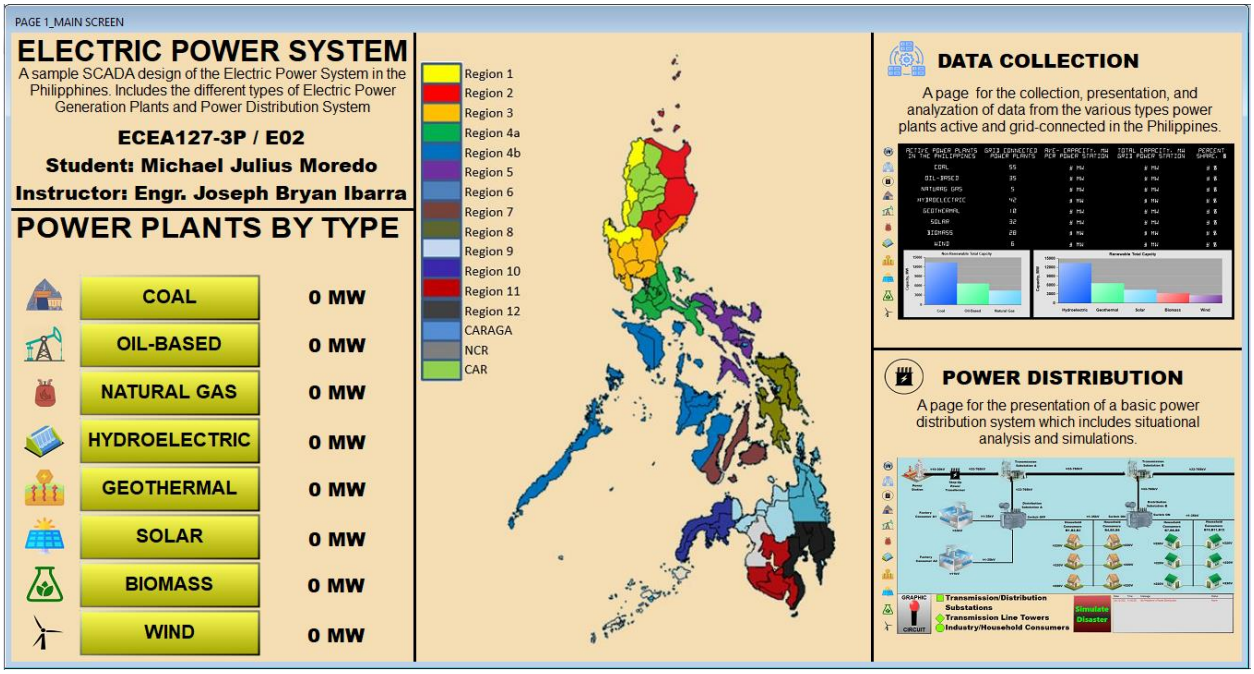
The SCADA project will include the following: (1) the power generation procedures based on the type of power plant, (2) a sample power transmission and distribution that could be controlled remotely in case of emergencies which will be simulated for the user, and (3) the collective data (only based on the simulation and not real data) for power generation capacity and power consumption.

2. **Project Design**

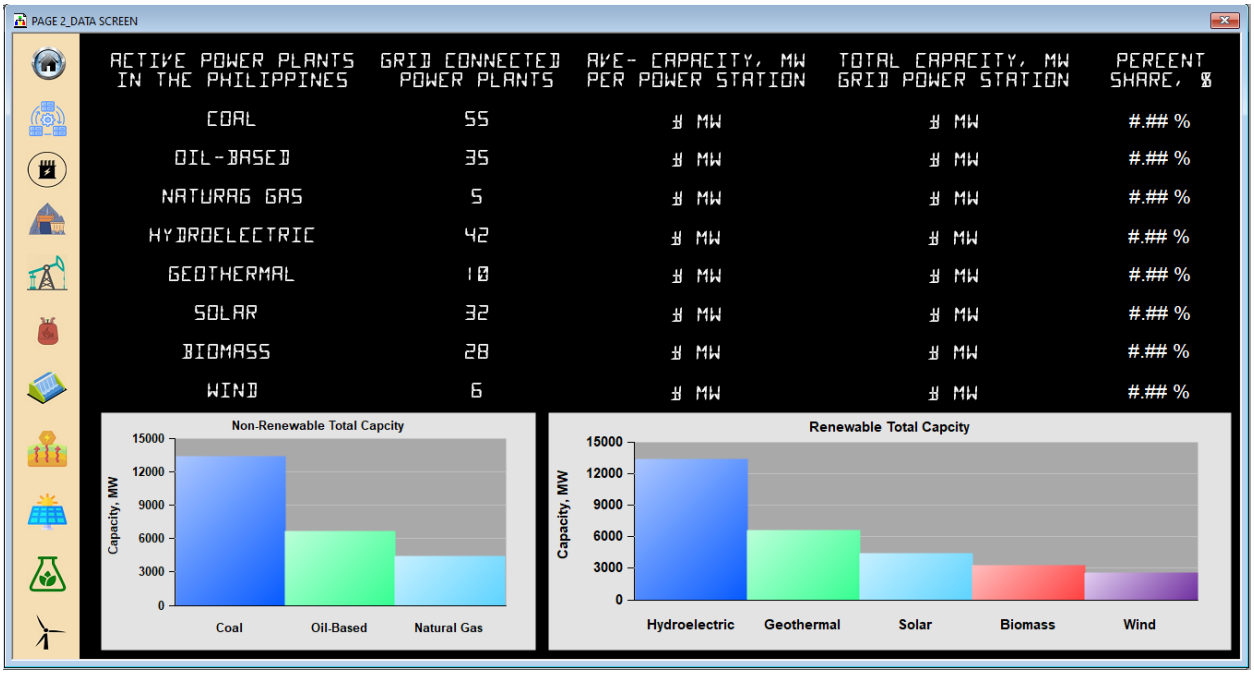
The SCADA design will be composed of multiple screen designs wherein each screen will have its corresponding function to display.



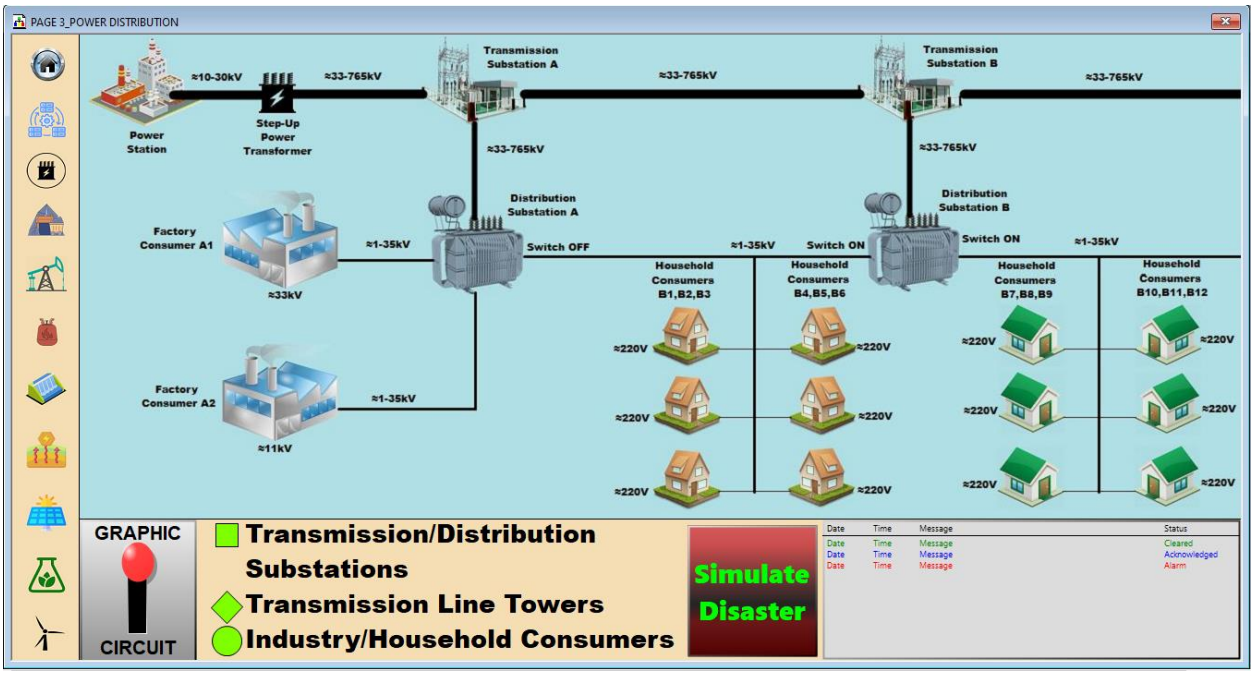
The first screen or the start-up page will be the password screen. Only when the correct password submitted by the user will the program proceed to the Home/Main/Menu screen. The initialized password is “1234”. Additional feature is the thumb print recognitions but, as the project does not apply actual sensors, this button is used as bypass to the password.



At the home screen, the data monitoring screen, electric power distribution system screen, and the different power plant screens will have a corresponding button to redirect to the designated screens. The main screen only display the Philippine map with symbols corresponding to a specific type of power plant as well as the major grid lines. Each yellow buttons displays some of the actual grid-connected power plants in the Philippines by power plant type.



The data screen will display the collective data for the presented power stations by average capacity per power station, by the total capacity of each type of grid-connected power station, and its percent share in providing power in the distribution system connected to the grid. There will also be a graphical representation of the total capacity being generated by each power station which is further categorized into renewable and non-renewable sources.

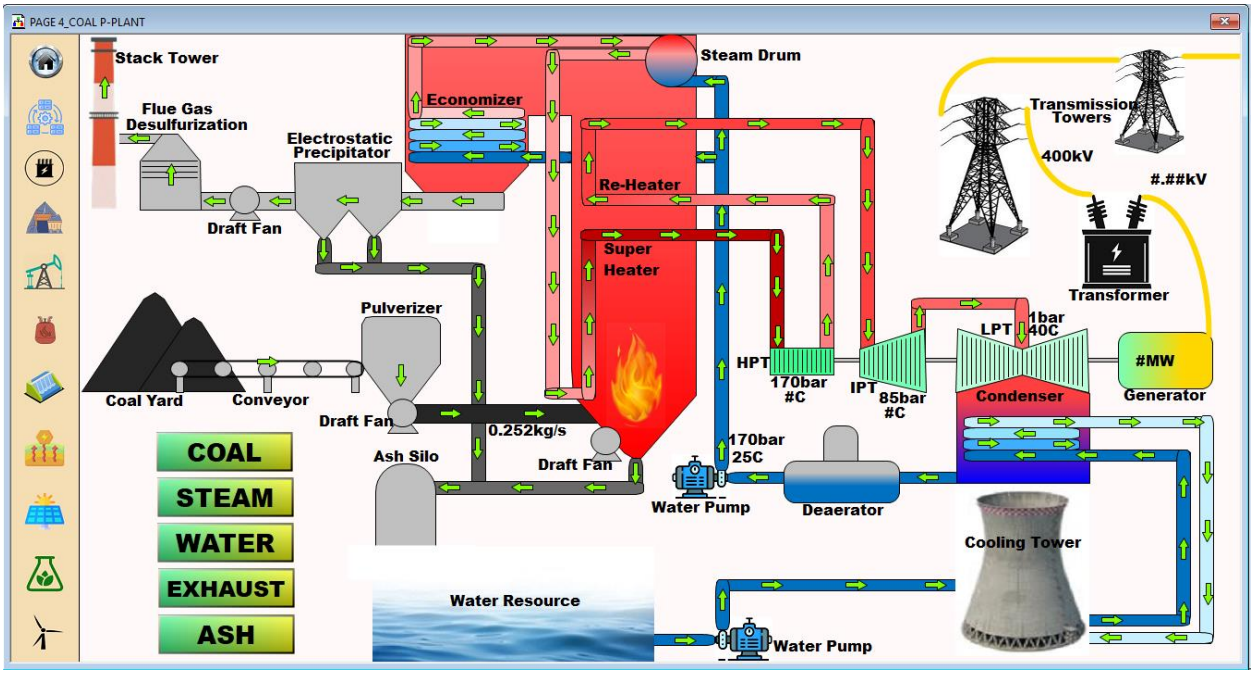


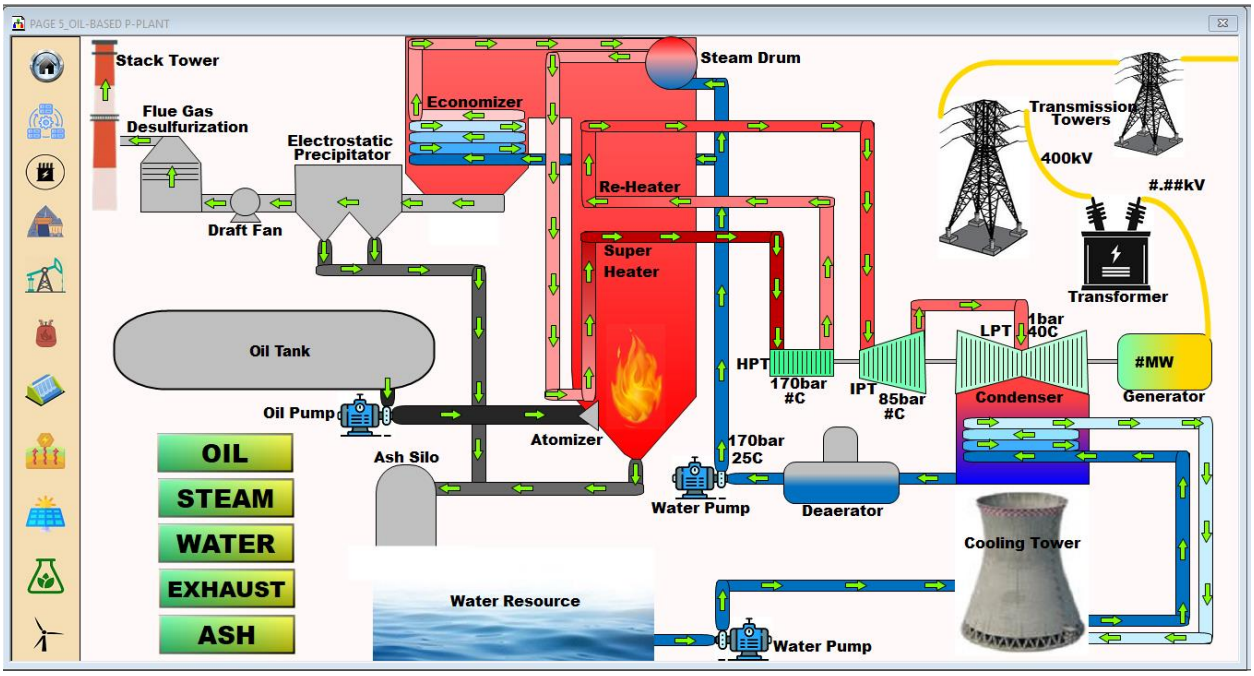
For the power distribution, a single page was dedicated to demonstrate a simple line switching in a grid. The user can show the graphical and circuit diagram design of the sample grid at any time. Each consumer, substation, and transmission towers are categorized by a specific symbol. Simulating a disaster can randomly choose from the following scenarios:

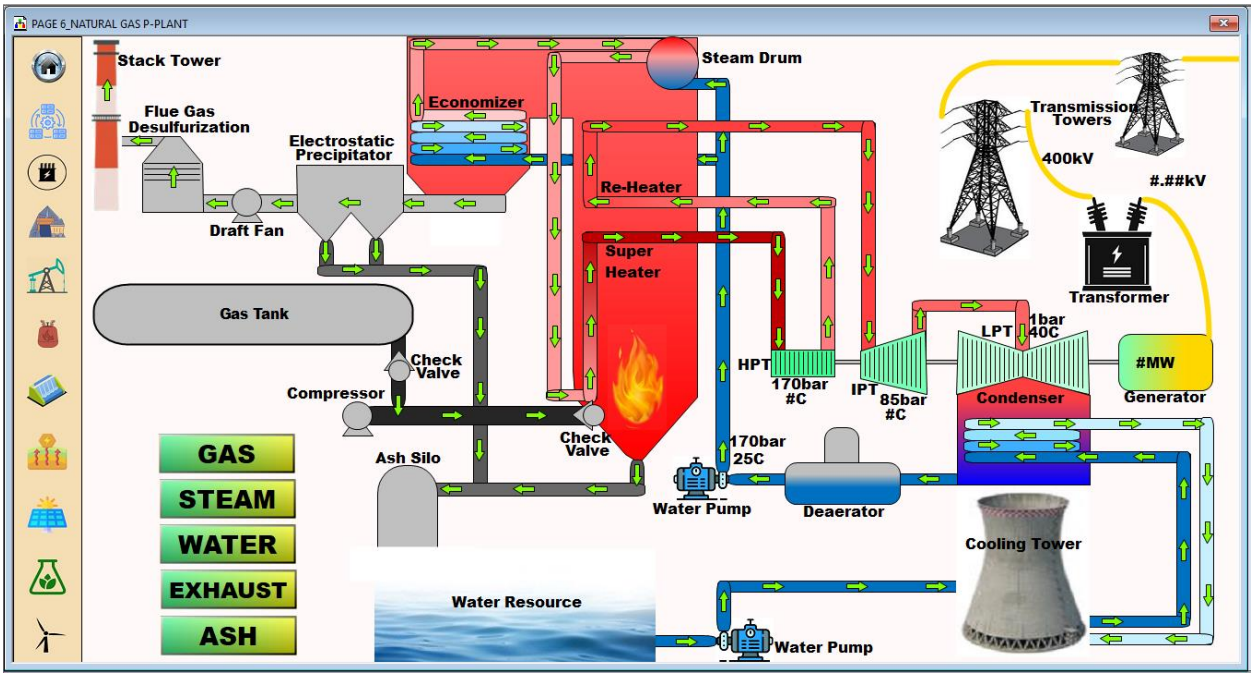
(1) Lack of power to Distribution Substation A due to fault in transmission tower from the Transmission Substation A to Distribution Substation A.

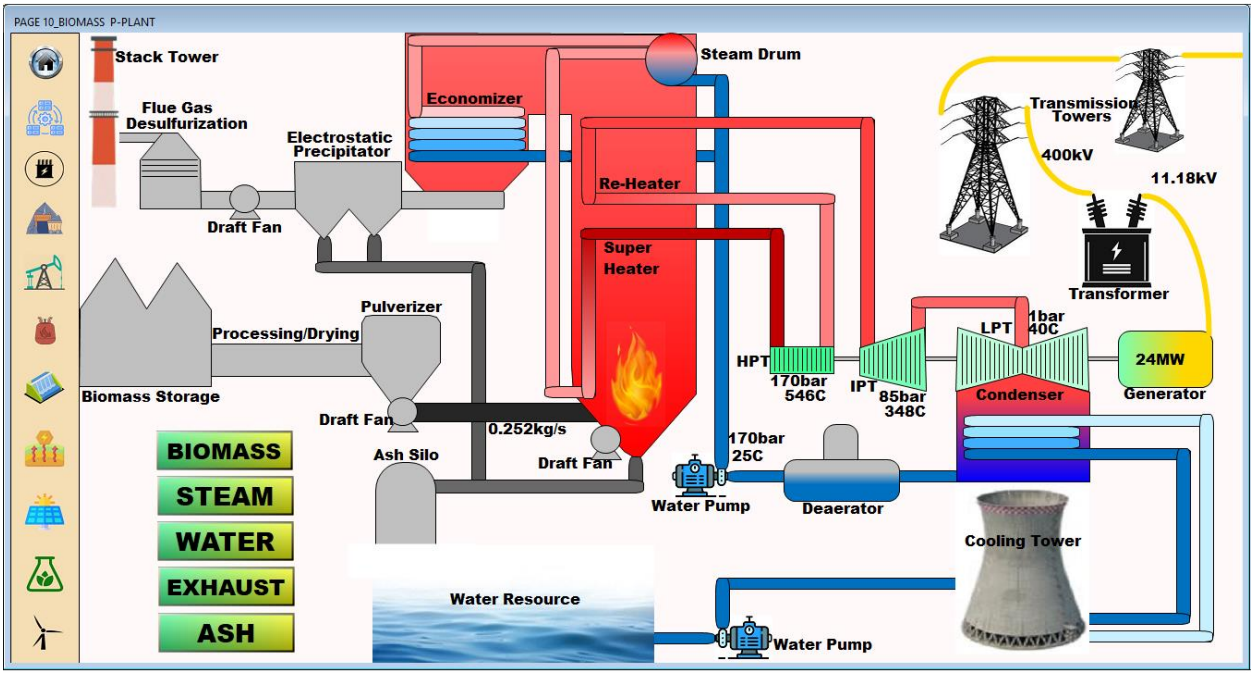
(2) Lack of power to Distribution Substation B due to fault in transmission tower from the Transmission Substation B to Distribution Substation B.

(3) Lack of power to Area B1-B6 due to fault in transmission tower nearest to Distribution Substation B from the left.


PAGE 4_COAL P-PLANT
Stack Tower
Flue Gas Desulfurization
Electrostatic Precipitator
Draft Fan
Economizer
Steam Drum
Re-Heater
Super Heater
Pulverizer
Coal Yard
Conveyor
Draft Fan
0.252kg/s
Ash Silo
Draft Fan
COAL
STEAM
WATER
EXHAUST
ASH
Water Resource
Water Pump
170bar 25C
Deaerator
Water Pump
Cooling Tower
HPT
170bar #C
IPT
85bar #C
LPT
1bar 40C
Condenser
#MW
Generator
Transmission Towers
400kV
#.##kV
Transformer


PAGE 5_OIL-BASED P-PLANT
Stack Tower
Flue Gas Desulfurization
Electrostatic Precipitator
Draft Fan
Economizer
Steam Drum
Re-Heater
Super Heater
Oil Tank
Oil Pump
Atomizer
Ash Silo
OIL
STEAM
WATER
EXHAUST
ASH
Water Resource
Water Pump
170bar 25C
Deaerator
Water Pump
Cooling Tower
HPT
170bar #C
IPT
85bar #C
LPT
1bar 40C
Condenser
#MW
Generator
Transmission Towers
400kV
#.##kV
Transformer





The Coal, Oil-Based, Natural Gas, and Biomass power plants have been configured to use the water tube boiler process but differs only in the fuel used. A button can be pressed to show the flow of that system or substance. For all three power plants the process is as follows:

(1) Fuel is injected to the burner in its smallest size possible and its rate will determine the strength of the fire or heat in the boiler.

(2) The boiler will pre-heat, superheat, and re-heat the water in the water tubes to flow to the high, intermediate, and low turbines.

(3) The turbines are connected to the generator which will convert the kinetic to electrical energy and will further be processed by transformer before going to the grid.

(4) The steam from the turbines will pass through the condenser and will be pumped to the cooling tower.

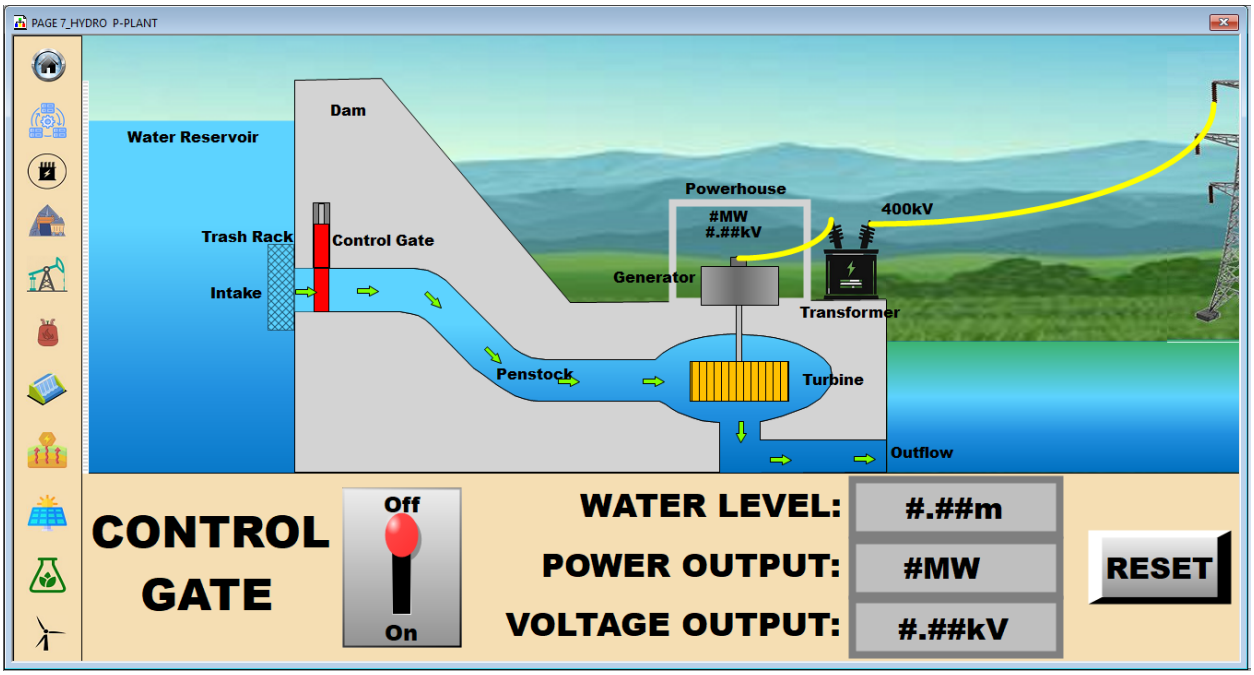
(5) Coming back from the cooling tower will be the cooled off condensed water as well as additional make-up water from a nearby water body.

(6) This will pass through to the deaerator to remove dissolved gasses before being pump back to the boiler at high pressure.

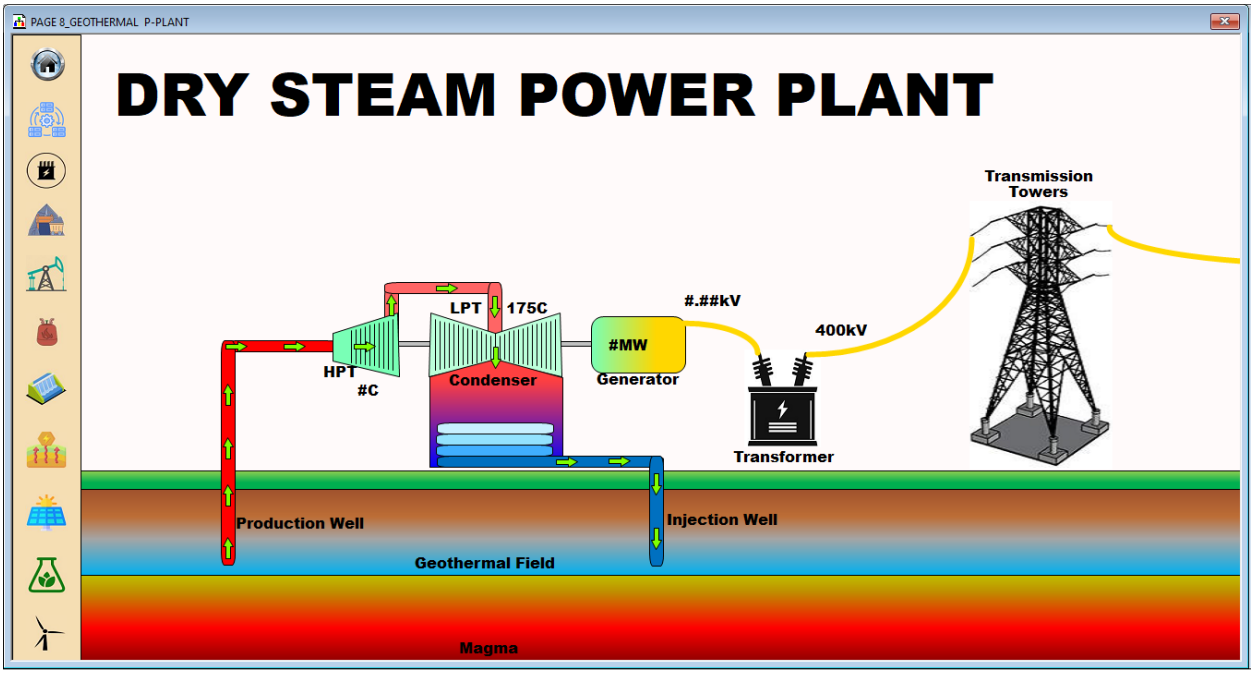
(7) Aside from the heat output of the boiler, the gas substances will be filtered by the electrostatic precipitator which will collect these substances such as ash to be sent to the ash silo.

(8) Continuing with the exhaust system, the gas will pass through a flue gas desulfurization to remove sulfur compounds.

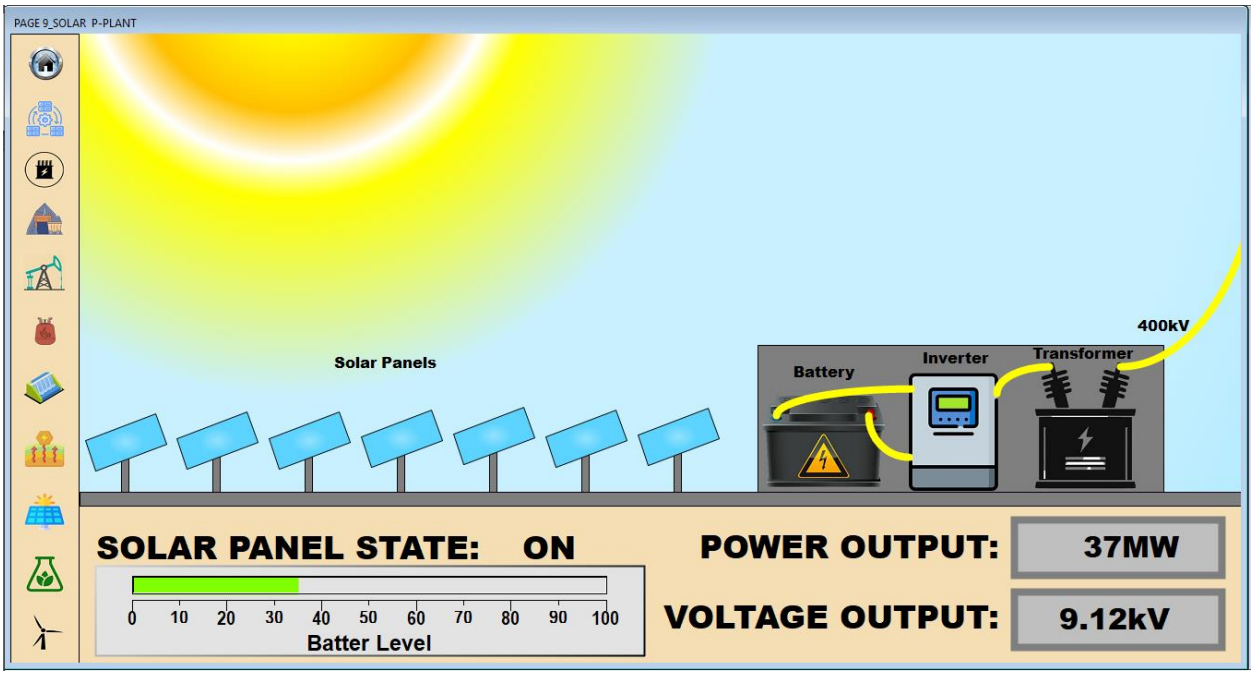
(9) Lastly, the gas will exit the stack tower as smoke.



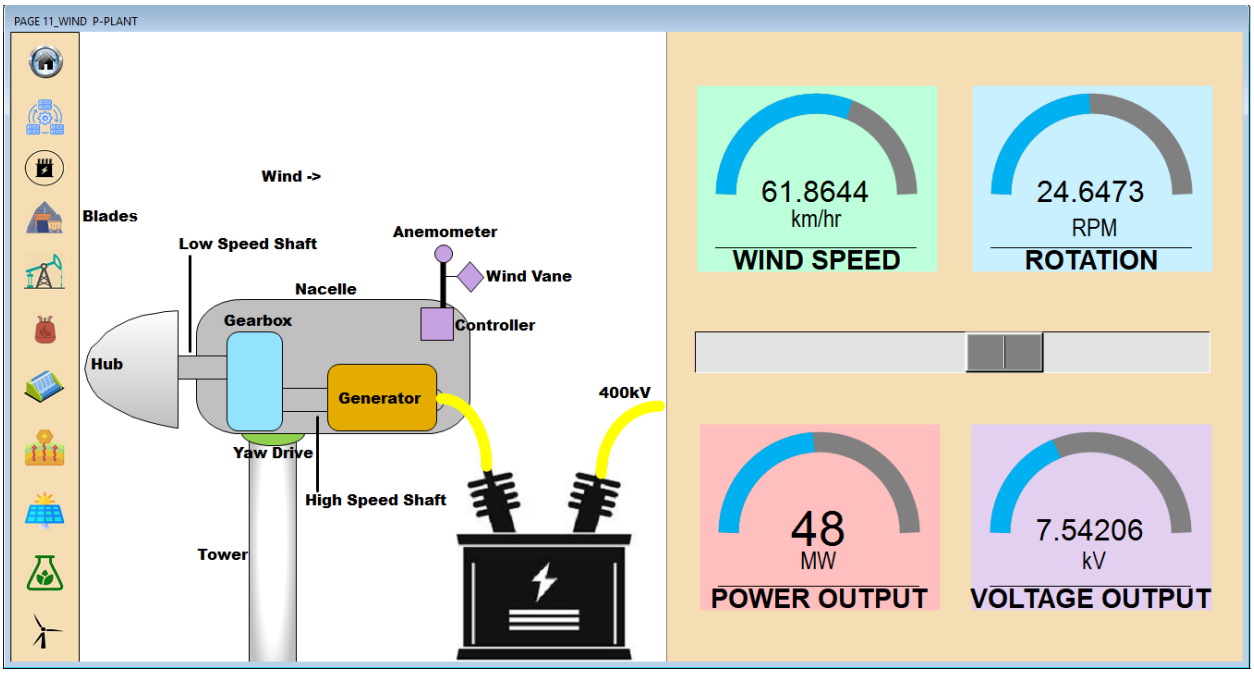
Aside from coal, oil, and gas power generation, the Philippines also incorporates typical hydroelectric power generation by Dams. In this design, the user can start and stop the power generation by controlling the gate which lets the water pass through to spin the turbine connected to the generator to convert kinetic to electrical energy. A reset button is available to reset the water level in the Dam.



The geothermal power plant presented in this project is a simple dry steam power plant. The steam comes from the geothermal field below the earth that is heated by the nearby magma. This steam passes through the high then low pressure turbines connected to the generator to convert kinetic to electrical energy. The steam will be condensed and sent back to the geothermal field for re-heating. The process is somewhat similar to a water tube boiler.



For the solar power generation, it is designed to simulate day and night rotation from left to right. The solar panels also rotate based on the sun position. These panels are all connected to the inverter which is also connected to both the battery and transformer. The battery charges during day time while it discharges at night time to compensate the power as solar panels does not receive power at night.



The last power generation is by wind. The sample design is based on a typical wind turbine power generation. Each important parts of the wind turbine is labeled as well as the important data to be monitored such as wind speed, blade rotation, power output, and voltage output. The wind speed can be manually controlled by the user for this designed SCADA simulation.