CEP Report

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Power Generation

Our electricity comes from converting various natural resources into usable power. These resources fall into two categories: renewable and non-renewable. Currently, most electricity comes from non-renewable sources like coal, oil, and natural gas. However, these resources are finite, meaning they'll eventually run out. To ensure a sustainable future, we need to use them wisely and explore alternative energy sources. Renewable sources like solar, wind, water, tidal, and biomass offer a solution. These eco-friendly resources are free and constantly replenished, making them a promising path for the future of power generation.

Generating Stations

We rely on electricity for everything from keeping our lights on at home to powering factories. This ever-growing demand is met by massive power plants. These plants use various fuels like coal, oil, or natural gas to generate heat. The heat boils water, creating high-pressure steam that spins a turbine connected to a generator. These generators are the workhorses, transforming the power of spinning turbines into electricity that travels through a vast network of transmission lines and distribution systems to reach our homes and businesses. While power plants are the backbone of our current system, it's important to remember they rely on limited resources.

Load Profile Analysis

A load curve or load profile is a graphical representation of the changes in electricity demand over a specific period, helping out generation companies anticipate and plan their power output. Similarly, a load duration curve presents the same information in a different format, aiding in the selection of generator units to meet electricity demands. Both curves are essential tools for power system planning and management [1].

Technical Parameters

Maximum Demand

Maximum demand or peak demand is the Maximum electricity usage recorded over the billing period [2].

Average Load

The Average load represents the average power consumed by the load over a defined period, usually a day or a month

$$Average\ Load = \frac{Total\ load}{total\ hours\ in\ a\ day}$$

Load Factor

Load factor is a measure of how efficiently electricity is being used. It's calculated by dividing the average amount of power used (think: everyday usage) by the highest amount of power used (think: peak demand during a heatwave).

A **high load factor** means the power grid is being used consistently and efficiently.

A **low load factor** suggests there are periods of high demand that put a strain on the system, even though overall usage might be average.

$$Load\ Factor = \frac{Average\ Load}{Maximum\ Demand}$$

Plant Use Factor

Maximum load ratio which could be drawn to the rated capacity of the system.

$$Plant\ Use\ Factor = \frac{Total\ Load}{Total\ Capacity}$$

Plant Capacity Factor

The plant capacity factor represents the actual output of a power plant compared to its theoretical maximum output, typically expressed as a percentage. It measures how efficiently a plant is utilized over a specific period.

$$Plant\ Capacity\ Factor = \frac{Average\ Load}{Plant\ Capacity}$$

Load Curve

A load curve is a graph that shows the changing electricity demand (in kW or MW) over time, typically shown in hourly increments. It visualizes the fluctuations in power consumption over a specific period, such as a day (daily load curve) or a year (annual load curve) [3].

Economical Parameters

Fixed Cost

Capital costs, including expenses for equipment purchase, rent, land acquisition, and senior management salaries, fixed cost remains constant regardless of the installed capacity or the energy output of a generating station.

$$Fixed\ Cost = Interest + Depreciation + Taxes\ \&\ Wages$$

Semi-Fixed Cost

These costs fluctuate based on the installed capacity of a generating station but are unrelated to the quantity of energy produced.

Running Cost

These costs are solely determined by the quantity of units generated. They encompass maintenance expenses, repair costs, lubricating oil expenses, water costs, salaries for

operating staff, expenditures on consumable stores and materials, and the annual fuel cost.

$$Running\ Cost = Operating\ Cost + Maintenance\ Cost$$

Variable Cost

These are costs that are directly proportional to the amount of energy produced by a generating station: fuel, maintenance, transportation, storage, and daily wages [4].

Selection of Load Profile [5]

Time (hr)	Load (MW)
1	1625
2	1700
3	1820
4	1810
5	1800
6	1740
7	1600
8	1525
9	1450
10	1550
11	1625
12	1625
13	1750
14	1750
15	2000
16	2150
17	2000
18	1870
19	1700
20	1475
21	1350
22	1350
23	1280
24	1380
Total	**39925**

Load Analysis

$$Maximum\ Demand\ =\ 2150\ MW$$

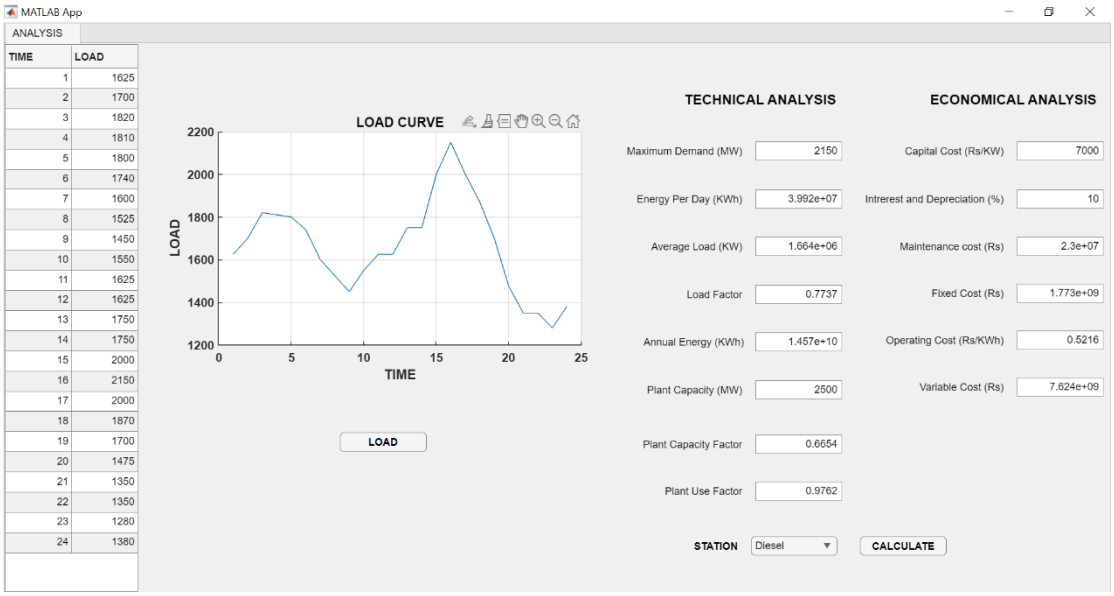
$$Total\ Energy\ per\ day\ =\ 3.9925 \times 10^{7}\ kWh$$

$$Average\ Load\ =\ 1664\ MW$$

$$Load\ Factor = 0.7737$$

$$Annual\ Energy = 1.457 \times 10^{10} kWh$$

Building GUI in MATLAB using App Designer



Selection of Power Plant#1

For this load profile, the power plant selected is a diesel power plant because of its greater durability and easy maintenance [6].

Generator Sizing

Based on the load factor of 0.7737, the generators selected are operating at 300 MW, 100 MW and 300 MW generator as reserve.

Operating Schedule

Time (hr)	Generator Size (MW)
1	300+300+300+300+300+100+100
2	300+300+300+300+300+100+100
3	300+300+300+300+300+300+100
4	300+300+300+300+300+300+100
5	300+300+300+300+300+300
6	300+300+300+300+300+300
7	300+300+300+300+300+100
8	300+300+300+300+300+100
9	300+300+300+300+300
10	300+300+300+300+300+100
11	300+300+300+300+300+100+100
12	300+300+300+300+300+100+100
13	300+300+300+300+300+300
14	300+300+300+300+300+300
15	300+300+300+300+300+300+100+100
16	300+300+300+300+300+300+300+100
17	300+300+300+300+300+300+100+100
18	300+300+300+300+300+300+100
19	300+300+300+300+300+100+100
20	300+300+300+300+300
21	300+300+300+300+100+100
22	300+300+300+300+100+100
23	300+300+300+300+100
24	300+300+300+300+100+100
Total	**40900**

Generating Station Calculation

$$Total\ Capacity\ of\ the\ Plant\ =\ 2500\ MW$$

$$Reserve\ Capacity\ =\ 300\ MW$$

$$Plant\ Capacity\ Factor = \frac{Total\ Load}{Plant\ Capacity \times total\ hours\ in\ a\ day}$$

$$Plant\ Capacity\ Factor = \frac{39925}{2500 \times 24}$$

$$Plant\ Capacity\ Factor = 0.6654$$

$$Plant\ Use\ Factor = \frac{Total\ Load}{Total\ Capacity}$$

$$Plant\ Use\ Factor = \frac{39925}{40900}$$

$$Plant\ Use\ Factor = 0.976$$

Fixed and Variable Cost Calculation

Fixed Cost

$$Capital\ Cost =\ \text{Rs}\ 7{,}000$$

$$Initial\ Cost\ =\ \text{Rs}\ 7{,}000 \times 2500 \times 10^3 = \text{Rs}\ 17{,}50{,}00{,}00{,}000$$

$$Fixed\ Cost = Interest\ (4\%) + Depreciation\ (4\%) + Taxes\ \&\ Wages\ (2\%)$$

$$Fixed\ Cost = 10\%\ of\ Initial\ Cost$$

$$Fixed\ Cost = \text{Rs}\ 1{,}75{,}00{,}00{,}000$$

$$Maintenance\ Cost =\ \text{Rs}\ 2{,}30{,}00{,}000$$

$$Total\ Fixed\ Cost = Fixed\ Cost + Maintenance\ Cost$$

$$Total\ Fixed\ Cost = \text{Rs}\ 1{,}75{,}00{,}00{,}000 + \text{Rs}\ 2{,}30{,}00{,}000$$

$$Total\ Fixed\ Cost = \text{Rs}\ 1{,}77{,}30{,}00{,}00$$

Variable Cost

$$Operating\ Cost\ per\ kWh = \text{Rs } 0.5216$$

$$Operating\ Cost = Operating\ Cost\ per\ kWh \times Annual\ Energy$$

$$Operating\ Cost = \text{Rs } 0.5216 \times 1.457 \times 10^{10}$$

$$Operating\ Cost = \text{Rs } 7,59,97,12,000$$

$$Running\ Cost = Operating\ Cost + Maintenance\ Cost$$

$$Running\ Cost = \text{Rs } 7,46,85,82,000 + \text{Rs } 2,30,00,000$$

$$Running\ Cost = \text{Rs } 7,62,27,12,000$$

Selection of Power Plant#2

The second power plant selected is a nuclear power plant because of it doesn't produce greenhouse gases and it is very efficient [7].

Generator Sizing

Load factor of the load profile is 0.7737, so load factor has to be improved using valley filling technique. The generator selected is operating at 2200 MW.

Operating Schedule

Time (hr)	Generator Size (MW)
1	2200
2	2200
3	2200
4	2200
5	2200
6	2200
7	2200
8	2200
9	2200
10	2200
11	2200
12	2200
13	2200
14	2200
15	2200
16	2200
17	2200
18	2200
19	2200
20	2200
21	2200
22	2200
23	2200
24	2200
Total	**52800**

Generating Station Calculation

$$Total\ Capacity\ of\ the\ Plant\ =\ 2200\ MW$$

$$Plant\ Capacity\ Factor = \frac{Total\ Load}{Plant\ Capacity \times total\ hours\ in\ a\ day}$$

$$Plant\ Capacity\ Factor = \frac{39925}{2200 \times 24}$$

$$Plant\ Capacity\ Factor = 0.756$$

$$Plant\ Use\ Factor = \frac{Total\ Load}{Total\ Capacity}$$

$$Plant\ Use\ Factor = \frac{39925}{52800}$$

$$Plant\ Use\ Factor = 0.756$$

Fixed and Variable Cost Calculation

Fixed Cost

$$Capital\ Cost =\ \text{Rs}\ 63{,}000$$

$$Initial\ Cost\ =\ \text{Rs}\ 63{,}000 \times 2200 \times 10^3 = \text{Rs}\ 1{,}38{,}60{,}00{,}00{,}000$$

$$Fixed\ Cost = Interest\ (4\%) + Depreciation\ (4\%) + Taxes\ \&\ Wages\ (2\%)$$

$$Fixed\ Cost = 10\%\ of\ Initial\ Cost$$

$$Fixed\ Cost = \text{Rs}\ 13{,}86{,}00{,}000$$

Variable Cost

$$Operating\ Cost\ per\ kWh = \text{Rs}\ 0.0163$$

$$Operating\ Cost =\ Operating\ Cost\ per\ kWh \times Annual\ Energy$$

$$Operating\ Cost = \text{Rs}\ 0.0163 \times 1.457 \times 10^{10}$$

$$Operating\ Cost =\ \text{Rs}\ 23{,}74{,}91{,}000$$

Comparison between the proposed designs on the basis of environment and stability

Nuclear power plants offer a low-carbon energy source with no air pollution, but they generate high-level radioactive waste requiring long-term management and carry the risk of accidents. In contrast, diesel power plants emit harmful pollutants, require constant fuel supply, and produce less hazardous waste.

While nuclear power poses environmental risks, its benefits outweigh those of diesel from an environmental perspective. Additionally, nuclear power generally offers a lower cost per unit (kWh) than diesel. Therefore, a Nuclear Power Generating Station is a more suitable and sustainable option for the specific load profile. Our MATLAB GUI provides a comprehensive analysis of load profiles, including load curves, consumption, and economic viability, further supporting this conclusion.

However, the optimal power generation solution for the world is to transition to renewable energy sources like solar, wind, hydro, and geothermal, which offers

- Zero or minimal greenhouse gas emissions
- Abundant and sustainable resources
- Low operating costs
- Minimal waste generation

This transition can be achieved by:

- Implementing energy storage solutions like batteries to address intermittency
- Investing in grid modernization and smart infrastructure for efficient distribution
- Promoting energy efficiency and conservation measures
- Gradually phasing out diesel and nuclear generations, replacing them with renewable energy sources

This solution prioritizes sustainability, mitigates climate change, and ensures a cleaner, healthier environment for future generations.

References

[1] L. N. He L., "Load Profile Analysis for Commercial Buildings Microgrids under demand response," *IEEE,* 2017.

[2] W. J. J. N. Drysdale B., "Flexible Demand in GB domestic electricity sector in 2030," *Elsevier,* 2015.

[3] M. T. Asif M., "Energy Supply, Its Demands and Security Issues for Developed and Emerging Economies," *Elsevier,* 2005.

[4] L. S. J. Theo W. L., "An MILP model for cost-optimal planning of an on-grid hybrid power system for an eco-industrial park," *Elsevier,* 2016.

[5] P. D. Zahir J. Paracha, "Load Management: Techniques and Methods in Electric Power System," *IEEE Catalogue,* 1998.

[6] O. A. Nsafon B., "Optimization and sustainability analysis of PV/Wind/Diesel/Hybrid Energy System for Decentrelized Energy Generation," *Elsevier,* 2020.

[7] A. A. F. Biyanto R. T., "Thermal Energy Storage Optimization in Shopping Center Buildings," *ITJB,* 2015.

Appendix

MATLAB Code

```
classdef PG_CEP < matlab.apps.AppBase

    % Properties that correspond to app components
    properties (Access = public)
        UIFigure                        matlab.ui.Figure
        TabGroup                        matlab.ui.container.TabGroup
        ANALYSISTab                     matlab.ui.container.Tab
        STATIONDropDown                 matlab.ui.control.DropDown
        STATIONDropDownLabel            matlab.ui.control.Label
        PlantUseFactorEditField         matlab.ui.control.NumericEditField
        PlantUseFactorLabel             matlab.ui.control.Label
        LOADButton                      matlab.ui.control.Button
        VariableCostRsEditField         matlab.ui.control.NumericEditField
        VariableCostRsEditFieldLabel    matlab.ui.control.Label
        IntrerestandDepreciationEditField
matlab.ui.control.NumericEditField
        IntrerestandDepreciationLabel   matlab.ui.control.Label
        FixedCostRsEditField            matlab.ui.control.NumericEditField
        FixedCostRsEditFieldLabel       matlab.ui.control.Label
        MaintenancecostRsEditField      matlab.ui.control.NumericEditField
        MaintenancecostRsEditFieldLabel  matlab.ui.control.Label
        OperatingCostRsKWhEditField     matlab.ui.control.NumericEditField
        OperatingCostRsKWhEditFieldLabel  matlab.ui.control.Label
        CapitalCostRsKWEditField        matlab.ui.control.NumericEditField
        CapitalCostRsKWEditFieldLabel   matlab.ui.control.Label
        PlantCapacityFactorEditField    matlab.ui.control.NumericEditField
        PlantCapacityFactorEditFieldLabel  matlab.ui.control.Label
        PlantCapacityMWEditField        matlab.ui.control.NumericEditField
        PlantCapacityMWEditFieldLabel   matlab.ui.control.Label
        MaximumDemandMWEditField        matlab.ui.control.NumericEditField
        MaximumDemandMWEditFieldLabel   matlab.ui.control.Label
        AnnualEnergyKWhEditField        matlab.ui.control.NumericEditField
        AnnualEnergyKWhEditFieldLabel   matlab.ui.control.Label
        LoadFactorEditField             matlab.ui.control.NumericEditField
        LoadFactorEditFieldLabel        matlab.ui.control.Label
        AverageLoadKWEditField          matlab.ui.control.NumericEditField
        AverageLoadKWEditFieldLabel     matlab.ui.control.Label
        EnergyPerDayKWhEditField        matlab.ui.control.NumericEditField
        EnergyPerDayKWhEditFieldLabel   matlab.ui.control.Label
        ECONOMICALANALYSISLabel         matlab.ui.control.Label
        TECHNICALANALYSISLabel          matlab.ui.control.Label
        CALCULATEButton                 matlab.ui.control.Button
        UITable                         matlab.ui.control.Table
        UIAxes                          matlab.ui.control.UIAxes
    end


    properties (Access = private)
        t
        x
        y
    end
```

```
    % Callbacks that handle component events
    methods (Access = private)

        % Button pushed function: LOADButton
        function LOADButtonPushed(app, event)
            app.t=readtable("C:\Users\sajja\Documents\Sajjad's
Archives\last sem\PG_CEP.xlsx");
            app.UITable.Data=app.t;

            app.x = table2array(app.t(:,1));
            app.y = table2array(app.t(:,2));
            plot(app.UIAxes,app.x,app.y);
        end

        % Value changed function: STATIONDropDown
        function STATIONDropDownValueChanged(app, event)

        end

        % Button pushed function: CALCULATEButton
        function CALCULATEButtonPushed(app, event)
            value = app.STATIONDropDown.Value;

            energy = sum(app.y)*1000;
            app.EnergyPerDayKWhEditField.Value = energy;

            avg = (sum(app.y)*1000)/24;
            app.AverageLoadKWEditField.Value = avg;

            maximum = max(app.y);
            app.MaximumDemandMWEditField.Value = maximum;

            load = avg/(maximum*1000);
            app.LoadFactorEditField.Value = load;

            annual = avg*8760;
            app.AnnualEnergyKWhEditField.Value = annual;

            switch value
                case 'Diesel'
                    plant_cap = 2500;
                    capit_cost = 7000;
                    main_cost = 23000000;
                    op_cost = 0.5216;

                case 'Nuclear'
                    plant_cap = 2200;
                    capit_cost = 63000;
                    main_cost = 0;
                    op_cost = 0.0163;

            end

            app.PlantCapacityMWEditField.Value = plant_cap;

            plant_cap_factor = (avg/(plant_cap*1000));
            app.PlantCapacityFactorEditField.Value = plant_cap_factor;

            plant_use_factor = (energy/(40900*1000));
```

```
            app.PlantUseFactorEditField.Value = plant_use_factor;

            app.CapitalCostRsKWEditField.Value = capit_cost;

            int_dep = 10;
            app.IntrerestandDepreciationEditField.Value = int_dep;

            app.MaintenancecostRsEditField.Value = main_cost;

            fixed_cost = (capit_cost*int_dep*plant_cap*1000)/100 +
main_cost;
            app.FixedCostRsEditField.Value = fixed_cost;

            app.OperatingCostRsKWhEditField.Value = op_cost;

            var_cost = (op_cost*annual)+main_cost;
            app.VariableCostRsEditField.Value = var_cost;

        end
    end

    % Component initialization
    methods (Access = private)

        % Create UIFigure and components
        function createComponents(app)

            % Create UIFigure and hide until all components are created
            app.UIFigure = uifigure('Visible', 'off');
            app.UIFigure.Position = [100 100 1280 648];
            app.UIFigure.Name = 'MATLAB App';

            % Create TabGroup
            app.TabGroup = uitabgroup(app.UIFigure);
            app.TabGroup.Position = [2 1 1279 648];

            % Create ANALYSISTab
            app.ANALYSISTab = uitab(app.TabGroup);
            app.ANALYSISTab.Title = 'ANALYSIS';

            % Create UIAxes
            app.UIAxes = uiaxes(app.ANALYSISTab);
            title(app.UIAxes, 'LOAD CURVE')
            xlabel(app.UIAxes, 'TIME')
            ylabel(app.UIAxes, 'LOAD')
            app.UIAxes.PlotBoxAspectRatio = [1.70234113712375 1 1];
            app.UIAxes.FontWeight = 'bold';
            app.UIAxes.XTickLabelRotation = 0;
            app.UIAxes.YTickLabelRotation = 0;
            app.UIAxes.ZTickLabelRotation = 0;
            app.UIAxes.XGrid = 'on';
            app.UIAxes.YGrid = 'on';
            app.UIAxes.FontSize = 14;
            app.UIAxes.Position = [160 243 556 303];

            % Create UITable
            app.UITable = uitable(app.ANALYSISTab);
            app.UITable.ColumnName = {'TIME'; 'LOAD'};
            app.UITable.RowName = {};
```

```
            app.UITable.Position = [1 1 154 622];

            % Create CALCULATEButton
            app.CALCULATEButton = uibutton(app.ANALYSISTab, 'push');
            app.CALCULATEButton.ButtonPushedFcn = createCallbackFcn(app,
@CALCULATEButtonPushed, true);
            app.CALCULATEButton.FontWeight = 'bold';
            app.CALCULATEButton.Position = [989 43 100 22];
            app.CALCULATEButton.Text = 'CALCULATE';

            % Create TECHNICALANALYSISLabel
            app.TECHNICALANALYSISLabel = uilabel(app.ANALYSISTab);
            app.TECHNICALANALYSISLabel.FontSize = 16;
            app.TECHNICALANALYSISLabel.FontWeight = 'bold';
            app.TECHNICALANALYSISLabel.Position = [786 544 182 32];
            app.TECHNICALANALYSISLabel.Text = 'TECHNICAL ANALYSIS';

            % Create ECONOMICALANALYSISLabel
            app.ECONOMICALANALYSISLabel = uilabel(app.ANALYSISTab);
            app.ECONOMICALANALYSISLabel.FontSize = 16;
            app.ECONOMICALANALYSISLabel.FontWeight = 'bold';
            app.ECONOMICALANALYSISLabel.Position = [1070 544 200 32];
            app.ECONOMICALANALYSISLabel.Text = 'ECONOMICAL ANALYSIS';

            % Create EnergyPerDayKWhEditFieldLabel
            app.EnergyPerDayKWhEditFieldLabel = uilabel(app.ANALYSISTab);
            app.EnergyPerDayKWhEditFieldLabel.HorizontalAlignment =
'right';
            app.EnergyPerDayKWhEditFieldLabel.Position = [725 434 128 22];
            app.EnergyPerDayKWhEditFieldLabel.Text = 'Energy Per Day
(KWh)';

            % Create EnergyPerDayKWhEditField
            app.EnergyPerDayKWhEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.EnergyPerDayKWhEditField.Position = [868 434 100 22];

            % Create AverageLoadKWEditFieldLabel
            app.AverageLoadKWEditFieldLabel = uilabel(app.ANALYSISTab);
            app.AverageLoadKWEditFieldLabel.HorizontalAlignment = 'right';
            app.AverageLoadKWEditFieldLabel.Position = [742 379 111 22];
            app.AverageLoadKWEditFieldLabel.Text = 'Average Load (KW)';

            % Create AverageLoadKWEditField
            app.AverageLoadKWEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.AverageLoadKWEditField.Position = [868 379 100 22];

            % Create LoadFactorEditFieldLabel
            app.LoadFactorEditFieldLabel = uilabel(app.ANALYSISTab);
            app.LoadFactorEditFieldLabel.HorizontalAlignment = 'right';
            app.LoadFactorEditFieldLabel.Position = [783 324 70 22];
            app.LoadFactorEditFieldLabel.Text = 'Load Factor';

            % Create LoadFactorEditField
            app.LoadFactorEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.LoadFactorEditField.Position = [868 324 100 22];
```

```
            % Create AnnualEnergyKWhEditFieldLabel
            app.AnnualEnergyKWhEditFieldLabel = uilabel(app.ANALYSISTab);
            app.AnnualEnergyKWhEditFieldLabel.HorizontalAlignment =
'right';
            app.AnnualEnergyKWhEditFieldLabel.Position = [733 269 122 22];
            app.AnnualEnergyKWhEditFieldLabel.Text = 'Annual Energy (KWh)';

            % Create AnnualEnergyKWhEditField
            app.AnnualEnergyKWhEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.AnnualEnergyKWhEditField.Position = [868 269 100 22];

            % Create MaximumDemandMWEditFieldLabel
            app.MaximumDemandMWEditFieldLabel = uilabel(app.ANALYSISTab);
            app.MaximumDemandMWEditFieldLabel.HorizontalAlignment =
'right';
            app.MaximumDemandMWEditFieldLabel.Position = [714 489 139 22];
            app.MaximumDemandMWEditFieldLabel.Text = 'Maximum Demand (MW)';

            % Create MaximumDemandMWEditField
            app.MaximumDemandMWEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.MaximumDemandMWEditField.Position = [868 489 100 22];

            % Create PlantCapacityMWEditFieldLabel
            app.PlantCapacityMWEditFieldLabel = uilabel(app.ANALYSISTab);
            app.PlantCapacityMWEditFieldLabel.HorizontalAlignment =
'right';
            app.PlantCapacityMWEditFieldLabel.Position = [737 214 116 22];
            app.PlantCapacityMWEditFieldLabel.Text = 'Plant Capacity (MW)';

            % Create PlantCapacityMWEditField
            app.PlantCapacityMWEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.PlantCapacityMWEditField.Position = [868 214 100 22];

            % Create PlantCapacityFactorEditFieldLabel
            app.PlantCapacityFactorEditFieldLabel =
uilabel(app.ANALYSISTab);
            app.PlantCapacityFactorEditFieldLabel.HorizontalAlignment =
'right';
            app.PlantCapacityFactorEditFieldLabel.Position = [733 160 120
22];
            app.PlantCapacityFactorEditFieldLabel.Text = 'Plant Capacity
Factor';

            % Create PlantCapacityFactorEditField
            app.PlantCapacityFactorEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.PlantCapacityFactorEditField.Position = [868 160 100 22];

            % Create CapitalCostRsKWEditFieldLabel
            app.CapitalCostRsKWEditFieldLabel = uilabel(app.ANALYSISTab);
            app.CapitalCostRsKWEditFieldLabel.HorizontalAlignment =
'right';
            app.CapitalCostRsKWEditFieldLabel.Position = [1005 489 150 22];
            app.CapitalCostRsKWEditFieldLabel.Text = 'Capital Cost
(Rs/KW)';
```

```
            % Create CapitalCostRsKWEditField
            app.CapitalCostRsKWEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.CapitalCostRsKWEditField.Position = [1170 489 100 22];

            % Create OperatingCostRsKWhEditFieldLabel
            app.OperatingCostRsKWhEditFieldLabel =
uilabel(app.ANALYSISTab);
            app.OperatingCostRsKWhEditFieldLabel.HorizontalAlignment =
'right';
            app.OperatingCostRsKWhEditFieldLabel.Position = [1014 271 141
22];
            app.OperatingCostRsKWhEditFieldLabel.Text = 'Operating Cost
(Rs/KWh)';

            % Create OperatingCostRsKWhEditField
            app.OperatingCostRsKWhEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.OperatingCostRsKWhEditField.Position = [1170 271 100 22];

            % Create MaintenancecostRsEditFieldLabel
            app.MaintenancecostRsEditFieldLabel = uilabel(app.ANALYSISTab);
            app.MaintenancecostRsEditFieldLabel.HorizontalAlignment =
'right';
            app.MaintenancecostRsEditFieldLabel.Position = [1029 379 126
22];
            app.MaintenancecostRsEditFieldLabel.Text = 'Maintenance cost
(Rs)';

            % Create MaintenancecostRsEditField
            app.MaintenancecostRsEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.MaintenancecostRsEditField.Position = [1170 379 100 22];

            % Create FixedCostRsEditFieldLabel
            app.FixedCostRsEditFieldLabel = uilabel(app.ANALYSISTab);
            app.FixedCostRsEditFieldLabel.HorizontalAlignment = 'right';
            app.FixedCostRsEditFieldLabel.Position = [1066 325 89 22];
            app.FixedCostRsEditFieldLabel.Text = 'Fixed Cost (Rs)';

            % Create FixedCostRsEditField
            app.FixedCostRsEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.FixedCostRsEditField.Position = [1170 325 100 22];

            % Create IntrerestandDepreciationLabel
            app.IntrerestandDepreciationLabel = uilabel(app.ANALYSISTab);
            app.IntrerestandDepreciationLabel.HorizontalAlignment =
'right';
            app.IntrerestandDepreciationLabel.Position = [989 434 166 22];
            app.IntrerestandDepreciationLabel.Text = 'Intrerest and
Depreciation (%)';

            % Create IntrerestandDepreciationEditField
            app.IntrerestandDepreciationEditField =
uieditfield(app.ANALYSISTab, 'numeric');
            app.IntrerestandDepreciationEditField.Position = [1170 434 100
22];
```

```
            % Create VariableCostRsEditFieldLabel
            app.VariableCostRsEditFieldLabel = uilabel(app.ANALYSISTab);
            app.VariableCostRsEditFieldLabel.HorizontalAlignment = 'right';
            app.VariableCostRsEditFieldLabel.Position = [1052 217 103 22];
            app.VariableCostRsEditFieldLabel.Text = 'Variable Cost (Rs)';

            % Create VariableCostRsEditField
            app.VariableCostRsEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.VariableCostRsEditField.Position = [1170 217 100 22];

            % Create LOADButton
            app.LOADButton = uibutton(app.ANALYSISTab, 'push');
            app.LOADButton.ButtonPushedFcn = createCallbackFcn(app,
@LOADButtonPushed, true);
            app.LOADButton.FontWeight = 'bold';
            app.LOADButton.Position = [388 162 100 23];
            app.LOADButton.Text = 'LOAD';

            % Create PlantUseFactorLabel
            app.PlantUseFactorLabel = uilabel(app.ANALYSISTab);
            app.PlantUseFactorLabel.HorizontalAlignment = 'right';
            app.PlantUseFactorLabel.Position = [759 106 94 22];
            app.PlantUseFactorLabel.Text = 'Plant Use Factor';

            % Create PlantUseFactorEditField
            app.PlantUseFactorEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.PlantUseFactorEditField.Position = [868 106 100 22];

            % Create STATIONDropDownLabel
            app.STATIONDropDownLabel = uilabel(app.ANALYSISTab);
            app.STATIONDropDownLabel.HorizontalAlignment = 'right';
            app.STATIONDropDownLabel.FontWeight = 'bold';
            app.STATIONDropDownLabel.Position = [792 43 56 22];
            app.STATIONDropDownLabel.Text = 'STATION';

            % Create STATIONDropDown
            app.STATIONDropDown = uidropdown(app.ANALYSISTab);
            app.STATIONDropDown.Items = {'Diesel', 'Nuclear'};
            app.STATIONDropDown.ValueChangedFcn = createCallbackFcn(app,
@STATIONDropDownValueChanged, true);
            app.STATIONDropDown.Position = [863 43 100 22];
            app.STATIONDropDown.Value = 'Diesel';

            % Show the figure after all components are created
            app.UIFigure.Visible = 'on';
        end
    end

    % App creation and deletion
    methods (Access = public)

        % Construct app
        function app = PG_CEP

            % Create UIFigure and components
            createComponents(app)
```

```
            % Register the app with App Designer
            registerApp(app, app.UIFigure)

            if nargout == 0
                clear app
            end
        end

        % Code that executes before app deletion
        function delete(app)

            % Delete UIFigure when app is deleted
            delete(app.UIFigure)
        end
    end
end
```