NED University of Engineering & Technology

Electrical Engineering Department

EE-411 POWER GENERATION

COMPLEX ENGINEERING PROBLEM

REPORT

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ABSTRACT

This report discusses and analyzes six different real world load profiles of different cities. MATLAB GUI has been used to give information about the different parameters associated with the load profiles and one load profile has been optimized by making a 3D model of their generating stations on SketchUp and cost analysis done through the MATLAB GUI.

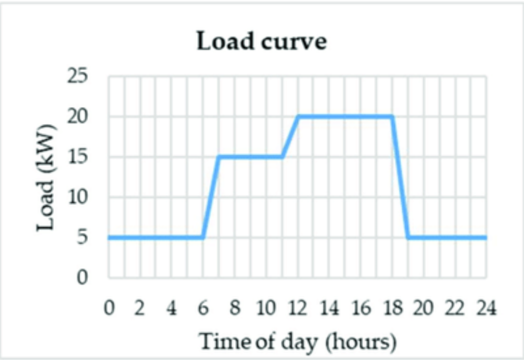
Initially, the report gives a brief overview of efficient power generation and the importance of electricity. It then defines the different technical and economic parameters associated to power generation and consumption. Thereafter, six different load profiles have been discussed with their technical analysis done on MATLAB GUI and the screenshots attached.

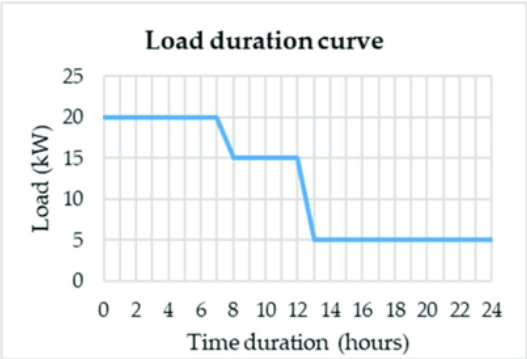
Out of these six load profiles, one load profile with the lowest load factor is chosen and a more efficient design has been proposed for that by doing their cost analysis and a 3D model has been designed for their generating station.

POWER GENERATION & LOAD PROFILE ANALYSIS

In power generation, one form of energy gets converted into electrical energy. We produce electrical energy from various natural sources. We classify these sources into two types renewable sources and non-renewable sources. In present power systems, most of the electrical energy gets generated from non-renewable sources like coal, oil and natural gases. However, these resources are limited. Therefore, we have to use these resources carefully and always have to find an alternate resource or move onto renewable resources. The renewable sources include the solar, wind, water, tidal and biomass. These sources are environment-friendly, free and infinitely available.

In a power system, a load curve or load profile is a chart illustrating the variation in demand/electrical load over a specific time. Generation companies use this information to plan how much power, they will need to generate at any given time. A load duration curve is similar to a load curve. The information is the same but is presented in a different form. These curves are useful in the selection of generator units for supplying electricity.





TECHNICAL PARAMETERS

Maximum Demand
Maximum (or peak) demand is the highest demand recorded over the billing period.

Base Load
The base load on a grid is the minimum level of demand on an electrical grid over a span of time, for example, one week.

Average Load
The Average Load is the average power consumed by the load in a given period, usually, a day or a month.

$$Average\ Load = \frac{Area\ under\ the\ daily\ load\ curve}{24\ hours}$$

Load Factor
Load factor is defined as the average load divided by the peak load in a specified time period.

$$Load\ Factor = \frac{Aeverage\ Load}{Max\ Demand}$$

Units of Energy
The kilowatt-hour is a unit of energy equal to 3600 kilojoules (3.6 mega joules).

Plant Capacity Factor
Capacity factor is the annual generation of a power plant (or fleet of generators) divided by the product of the capacity and the number of hours over a given period.

$$PCF = \frac{Aeverage\ Demand}{Plant\ Capacity}$$

Plant Use Factor
It is ratio of kWh generated to the product of plant capacity and the number of hours for which the plant was in operation

$$PUF = \frac{Station\ output\ in\ kWh}{Plant\ capcaity * hours\ of\ use}$$

ECONOMIC PARAMETERS

Fixed Cost

It includes the capital cost, the annual cost of central organization, the interest on capital cost of land and the salaries of high officials.

Semi-Fixed Cost

It is the cost which depends on maximum demand. It includes the annual interest on capital development, depreciation of building and equipment and the taxes and salaries of management and electrical staff.

Running Cost

It only depends on the number of units generated. It includes maintenance cost, repair cost, lubricating oil costs, cost of water, salaries of operating staff, cost of consumable stores and materials and the annual cost of fuel.

Three-part form

The overall annual cost of electrical energy generated is divided into three parts; fixed cost, semi-fixed cost and running cost.

$$\begin{aligned}&Total\ annual\ cost\ of\ energy\\&\quad = Fixed\ cost + Semi - fixed\ cost + Running\ cost\\&\quad = Constant + Proportional\ to\ max.demand\\&\qquad + Proportional\ to\ kWh\ generated\\&\quad = Rs\,(a + b\,kW + c\,kWh)\end{aligned}$$

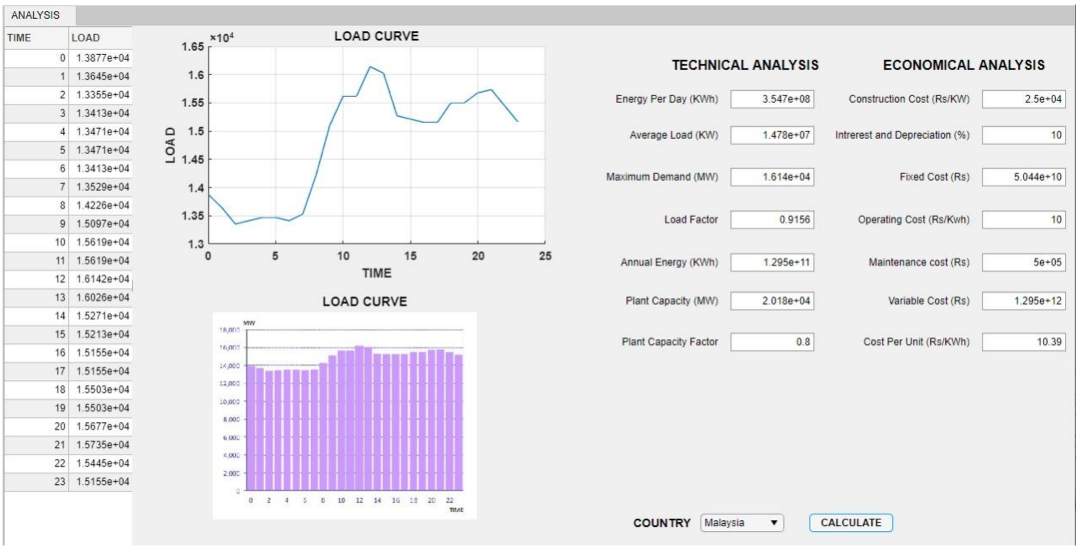
Two-part form

The annual cost of energy is divided into two parts; a fixed sum per kW of maximum demand plus a running charge per unit of energy.
The expression for the annual cost of energy then becomes:

$$Total\ annual\ cost\ of\ energy = Rs.(A\,kW + B\,kWh)$$

LOAD PROFILES

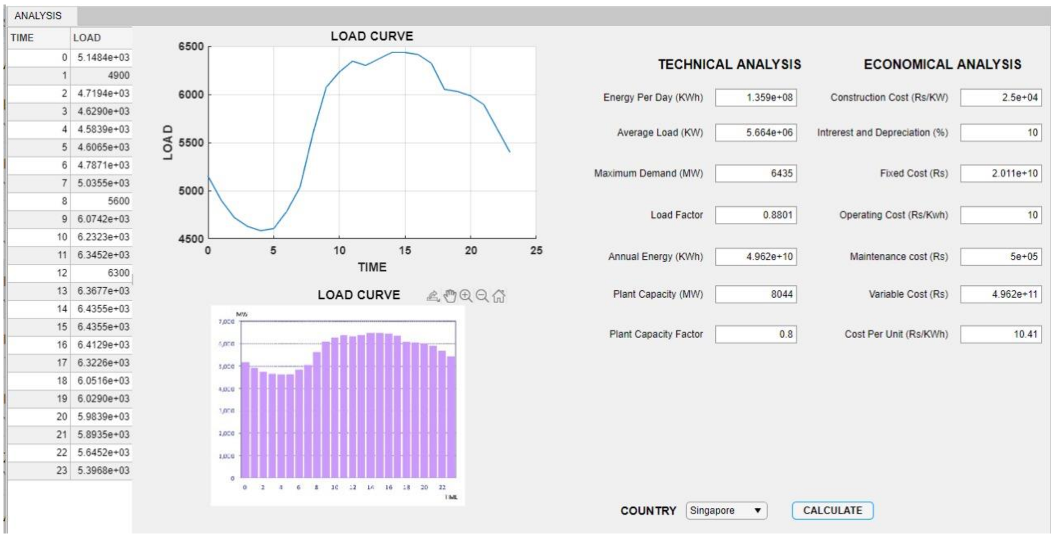
1) Load Profile for a Power System in Malaysia [1]



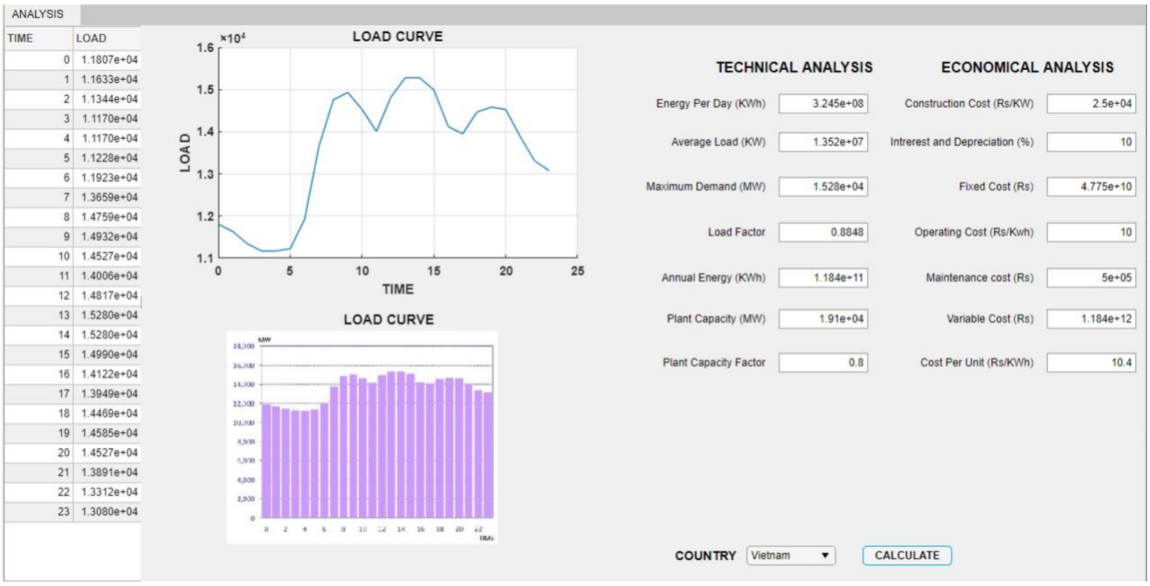
2) Load Profile for a Power System in Philippines [1]

3) Load Profile for a Power System in Thailand [1]

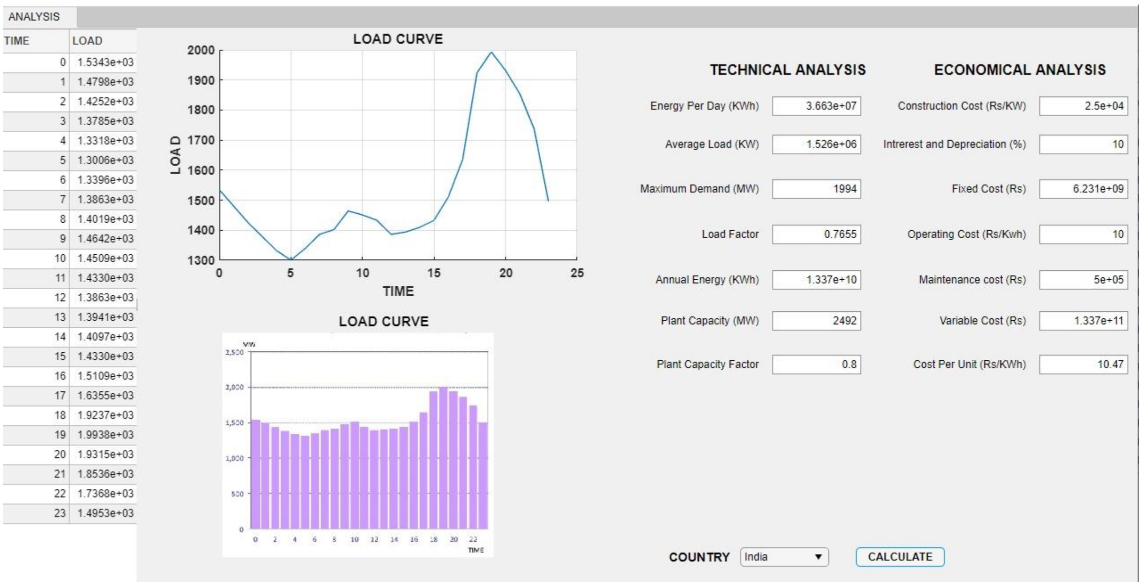
4) Load Profile for a Power System in Singapore [1]



5) Load Profile for a Power System in Vietnam [1]



6) Load Profile for a Power System in India [1]



COMPARISON OF LOAD PROFILES

Load Profile	Country	Maximum Demand	Units/day	Average Load	Load Factor
1	Malaysia	1.614*10^4 MW	3.547*10^8 kWh	1.478*10^7kW	0.9156
2	Philippines	4823 MW	9.417*10^7 kWh	3.924*10^6kW	0.8315
3	Thailand	2.584*10^4 MW	5.515*10^8 kWh	2.298*10^7 kW	0.8894
4	Singapore	6435 MW	1.359*10^8 kWh	5.664*10^6 kW	0.8801
5	Vietnam	1.528*10^4 MW	3.245*10^8 kWh	1.352*10^7 kW	0.8848
6	India	1994 MW	3.663*10^7 kWh	1.526*10^6 kW	0.7655

POWER GENERATING STATION DESIGN

According to our comparative study, the load profile with the worst-case scenario is Load Profile 6 i.e., India with load factor of 76.55%

1st PORPOSED DESIGN FOR LOAD PROFILE 6

For this load profile the power plant selected has to supply uninterrupted power to manufacturing industries, hospitals, stock industries etc. Out of many advantages a diesel power plant has to offer like uninterrupted power supply, great durability and easy maintenance we have decided to select a Diesel operated generating station. Using a diesel power plant will also help reduce transportation costs.

Load factor of Load Profile 6 is 0.7655. For its generating station we have selected:

1. 5 Generators of capacity 300 MW for base
2. 5 Generators of capacity 100 MW for variations
3. 300 MW generator as reserve.

Here is the generators operating schedule:

Time (24 Hour)	MW	Generator Size (MW)	Operating MW
12 to 1 a.m	1534.26791	300/300/300/300/300/100	1600
1 to 2	1479.75078	300/300/300/300/300	1500
2 to 3	1425.23364	300/300/300/300/300	1500
3 to 4	1378.50467	300/300/300/300/300	1500
4 to 5	1331.7757	300/300/300/300/300	1500
5 to 6	1300.62305	300/300/300/300/300	1500
6 to 7	1339.56386	300/300/300/300/300	1500
7 to 8	1386.29283	300/300/300/300/300	1500
8 to 9	1401.86916	300/300/300/300/300	1500
9 to 10	1464.17445	300/300/300/300/300	1500
10 to 11	1450.90343	300/300/300/300/300	1500
11 to 12 p.m	1433.02181	300/300/300/300/300	1500
12 to 1	1386.29283	300/300/300/300/300	1500
1 to 2	1394.081	300/300/300/300/300	1500
2 to 3	1409.65732	300/300/300/300/300	1500
3 to 4	1433.02181	300/300/300/300/300	1500
4 to 5	1490.90343	300/300/300/300/300	1500
5 to 6	1635.51402	300/300/300/300/300	1500
6 to 7	1923.67601	300/300/300/300/300/100/100/100/100/100	2000
7 to 8	1993.76947	300/300/300/300/300/100/100/100/100/100	2000
7 to 9	1931.46417	300/300/300/300/300/100/100/100/100/100	2000
9 to 10	1853.58255	300/300/300/300/300/100/100/100/100	1900
10 to 11	1736.76012	300/300/300/300/300/100/100/100	1800
11 to 12 a.m	1495.3271	300/300/300/300/300	1500
Total:	36610.0312		38300

FURTHER TECHNICAL ANALYSIS

Installed capacity = 2300 MW **Maximum demand** = 1994 MW

Reserve Capacity = 300 MW

Capacity Factor = $Average\ load/\ Installed\ Capacity$

= $1.526 * 10^6\ kW\ /2300\ MW$

= 0.6634

Plant use Factor = $Energy\ demanded/Energy\ produced$

= $36610.0312/38300$

=0.9558

RECOMMENDATION TO IMPROVE LOAD PROFILE

The plant is running at a low portion of its installed capacity from 12 am till 6 pm. By reducing the tariff during the valley regions, the consumption during that time will increase, the problem can be resolved and cost per unit will be decreased.

ECONOMIC ANALYSIS

Energy generated per day = $3.663 * 10^7 kWh$

Energy generated per year = $3.663 * 10^7 \times 365 = 1.339 * 10^{10} kWh$

Capacity of plant = $2300\ MW$

FIXED COSTS

Capital cost per KW installed =
$Rs\ 3000/-$
Initial Capital Cost of plant and Land = $3000 * 2300 * 10^3 = Rs\ 6.9 * 10^9/-$
Fixed cost $= Interest\ (4\ \%) + Depreciation\ (4\ \%) + Taxes\ \&\ Wages\ (2\%)$

$$= 10\ \%\ of\ initial\ cost$$

Fixed cost = $Rs\ 6.9 * 10^8$ & **Fixed Maintenance cost** = $Rs\ 10000000/-$

Total Fixed Cost = Fixed cost + Fixed Maintenance cost = $Rs\ 7 * 10^8/-$

VARIABLE COSTS

Operating cost per kWh = $Rs\ 0.0815/-$

Operating cost = $Operating\ cost\ per\ KWh\ *\ Units\ generated$

$$= 0.0815 * 1.339 * 10^{10}$$

$$= Rs\ 1091285000/-$$

Cost of fuel per kg = $Rs\ 100/-$

Energy per kg produced = $2.4\ kWh$

Annual fuel consumption = $(energy\ produced\ during\ year)/2.4\ KW\ produced\ /\ kg\ of\ oil$

= $1.339 * 10^{10} / 2.4 = 5579166667\ Kg$

Cost of annual fuel consumption = $5579166667 * 100$

$$= Rs\ 5.579166667 * 10^{11}/-$$

Variable maintenance cost = $Rs\ 10000000/-$

Operating cost = $Rs\ 1063166.43/-$

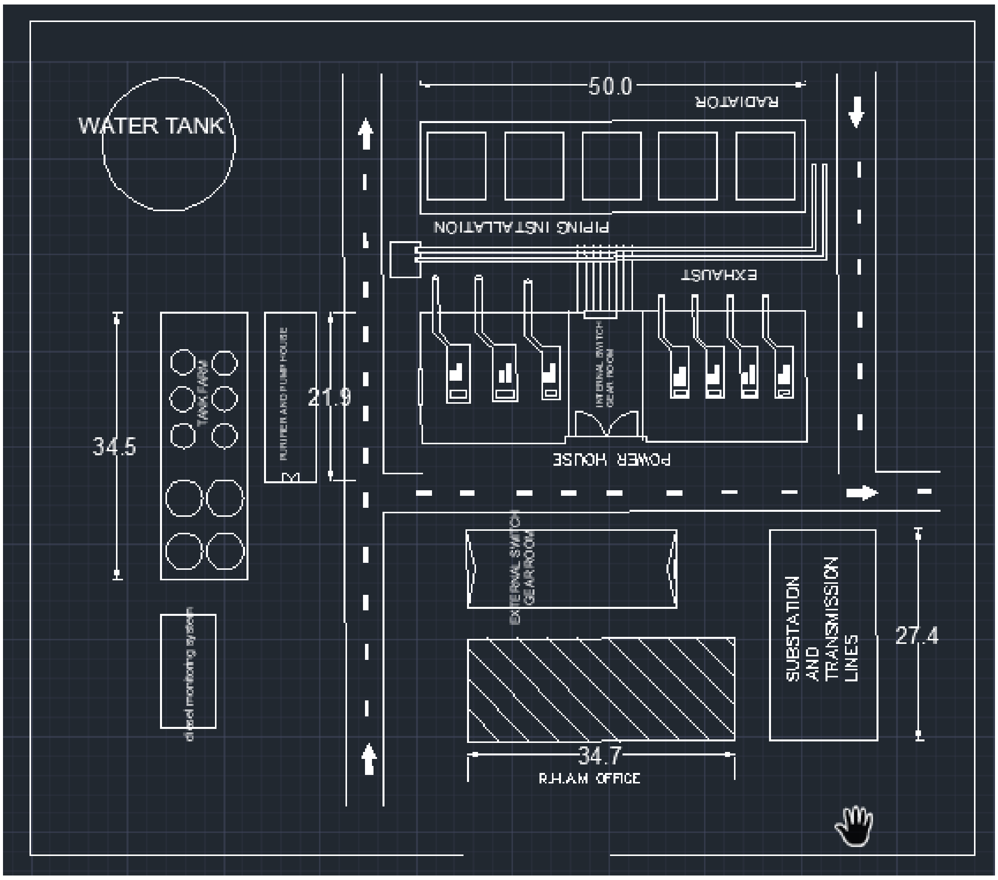
Total running cost = $Cost\ of\ annual\ fuel\ used + Operating\ cost + Var.maintenance\ cost$

= $Rs\ 559017951600/-$
Cost per unit = $(Total\ Fixed + Total\ running\ cost)\ /\ Units\ generated$

$$= (Rs\ 1720000 + Rs\ 218679613.9)/\ 13044986.85$$

= $Rs\ 41.8/-$

2D MODEL ON AUTOCAD



3D MODEL ON SKETCHUP

2nd PROPOSED DESIGN FOR LOAD PROFILE 6

We have decided to select a nuclear power plant as the 2nd design. Firstly, it will help cut down on the operating costs as the running cost per kWh is very low and the maintenance costs are almost negligible. Also, our location is India where pollution is very much high. The advantages of nuclear power plants are that:

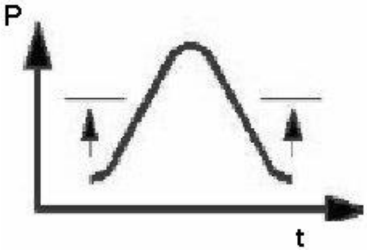
- nuclear-powered plants don't produce greenhouse gases
- nuclear energy is a very efficient form of energy production
- nuclear power plants have a small carbon footprint
- nuclear power is a very versatile form of energy
- nuclear power plants are easy to maintain

Since nuclear power plant is proving more beneficial to this scenario in long term and environment friendly wise hence, we are proposing a nuclear power plant.

Load factor of Load Profile 6 is 0.7655. Nuclear for this load factor can't be proposed directly; first we have to improve this load factor as there are load variations as observed from load profile.

IMPROVEMENT OF LOAD FACTOR FOR PROFILE 6 USING VALLEY FILLING TECHNIQUE

Valley filling is a load management technique used by power utilities to smooth out the demand for electricity throughout the day. The valley filling aims in increasing demand during off-peak hours while maintaining peak load.[3]



To perform valley filling, a power utility will typically offer different tariff charges for electricity consumed during peak and off-peak periods. For example, the utility may charge a lower rate for electricity consumed during off-peak hours. This motivates consumers to increase their usage during off peak periods thereby increasing the overall average load demand.

Power utilities may also use other load management techniques, such as demand response programs, to further smooth out the demand for electricity. In these programs, consumers can choose to reduce their electricity consumption during peak periods in exchange for financial incentives.

Following this convention of valley filling, we lowered the tariff charges to improve overall load factor to 81% so that the proposed nuclear power plant can be employed.

IMPROVED LOAD PROFILE BY CONSUMER VALLEY FILLING

For its generating station we have selected the following generator:

1. Single Generator of capacity 2000 MW

Here is the generators operating schedule:

Time (24 Hour)	After 9% increase	Generator Size (MW)	Operating MW
12 to 1 a.m	1672.352025	2000	2000
1 to 2	1612.928349	2000	2000
2 to 3	1553.504673	2000	2000
3 to 4	1502.570093	2000	2000
4 to 5	1451.635514	2000	2000
5 to 6	1417.679128	2000	2000
6 to 7	1460.124611	2000	2000
7 to 8	1511.05919	2000	2000
8 to 9	1528.037383	2000	2000
9 to 10	1595.950156	2000	2000
10 to 11	1581.484735	2000	2000
11 to 12 p.m	1561.993769	2000	2000
12 to 1	1511.05919	2000	2000
1 to 2	1519.548287	2000	2000
2 to 3	1536.52648	2000	2000
3 to 4	1561.993769	2000	2000
4 to 5	1625.084735	2000	2000
5 to 6	1782.71028	2000	2000
6 to 7	1923.676012	2000	2000
7 to 8	1993.76947	2000	2000
7 to 9	1931.464174	2000	2000
9 to 10	2020.404984	2000	2000
10 to 11	1893.068536	2000	2000
11 to 12 a.m	1629.906542	2000	2000
Total:	39378.53209		48000

FURTHER TECHNICAL ANALYSIS

Installed capacity = $2000\ MW$

Maximum demand = $2000\ MW$

Capacity Factor = $Average\ load/\ Installed\ Capacity$ = $1642\ MW/2000$ = 0.821

Plant use Factor = $Energy\ demanded\ /\ Energy\ produced$ = $39378.5309/48000$ = 0.82

RECOMMENDATION TO IMPROVE LOAD PROFILE

Due to the high average demand, a nuclear power station should be installed as its running cost is lower than other plants. There are still load variations in the profile which can be shaved off by introducing time of use tariff during that period to reduce the maximum demand which will further improve the load factor.

ECONOMIC ANALYSIS

Energy generated per day = $3.94 * 10^7 kWh$

Energy generated per year = $3.94 * 10^7 \times 365 = 1.4381 * 10^{10} kWh$

Capacity of plant = $2000\ MW$

FIXED COSTS

Capital cost per KW installed = $Rs\ 28000/-$

Initial cost of plant = $2000 * 10^3 * 28000 = Rs\ 5.6 * 10^{10}/-$

Interest + Depreciation + Taxes + Wages = $10\%\ of\ capital\ investment$

Total Fixed cost = Interest + Depreciation + Taxes + Wages = **10%** of initial cost

= $Rs\ 5.6 * 10^9/-$

VARIABLE COSTS

Operating cost per kWh = $Rs\ 0.0026/-$

Cost of fuel per KW = $Rs\ 0.63/-$

Cost of annual fuel consumption = $Cost\ of\ fuel\ per\ KW * Units\ generated$

= $0.63 * 1.4381 * 10^{10}$

= $Rs\ 9060030000$ **/-**

Operating cost = $Operating\ cost\ per\ KWh * Units\ generated$

= $0.0026 * 1.43381 * 10^{10}$

= $Rs\ 37390600/-$

Total running cost = $Cost\ of\ annual\ fuel\ consumption + Operating\ cost$

= $Rs\ 37390600 + Rs\ 90600030000$

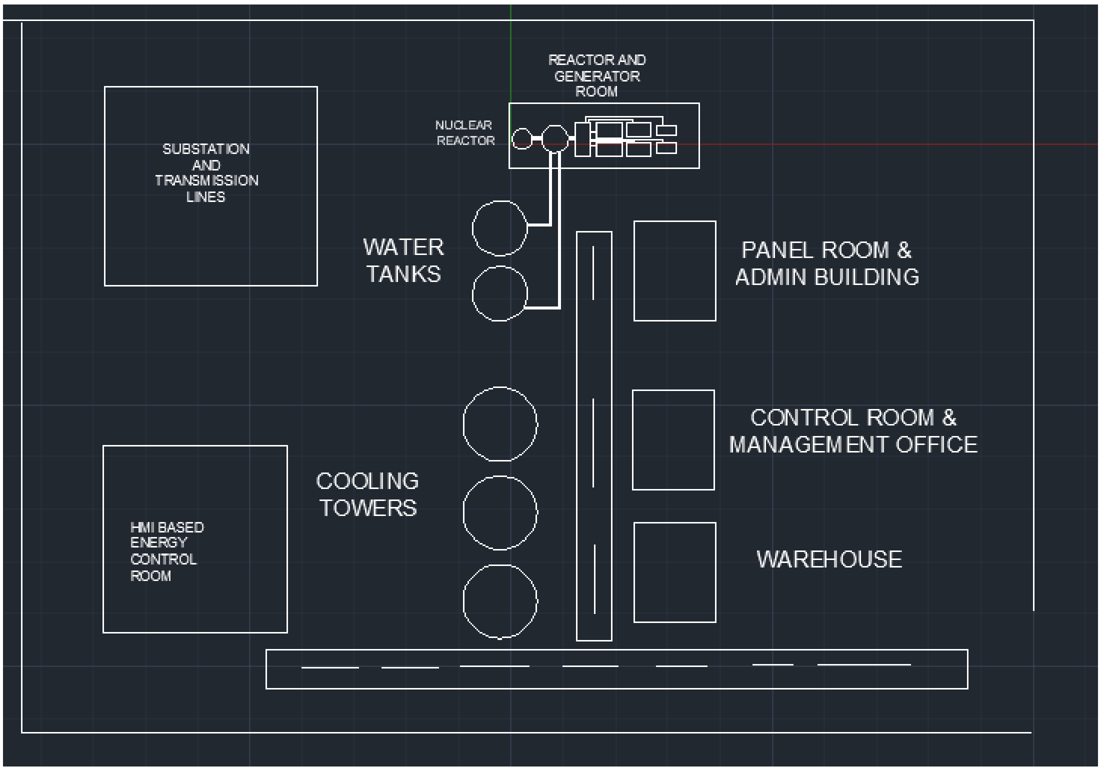
= $Rs\ 9097420600/-$

Cost per unit = $(Total\ Fixed\ cost + Total\ running\ cost)\ /\ Units\ generated$

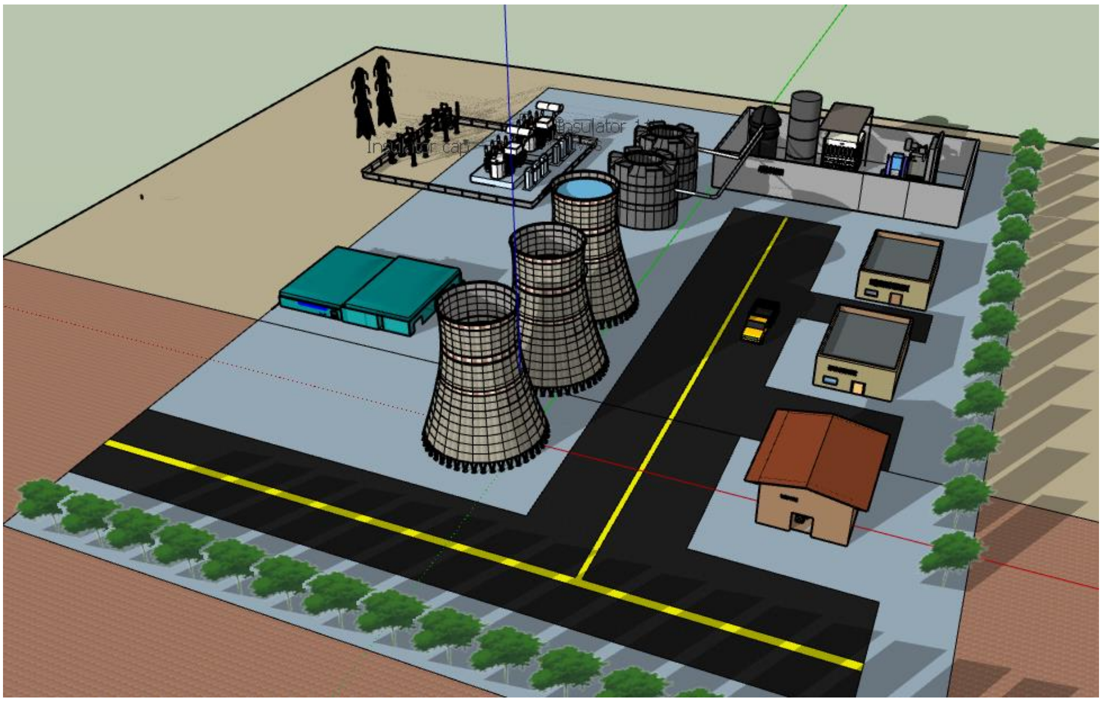
= $(Rs\ 5.6 * 10^9 + Rs\ 9097420600) /\ 1.4381 * 10^{10}$

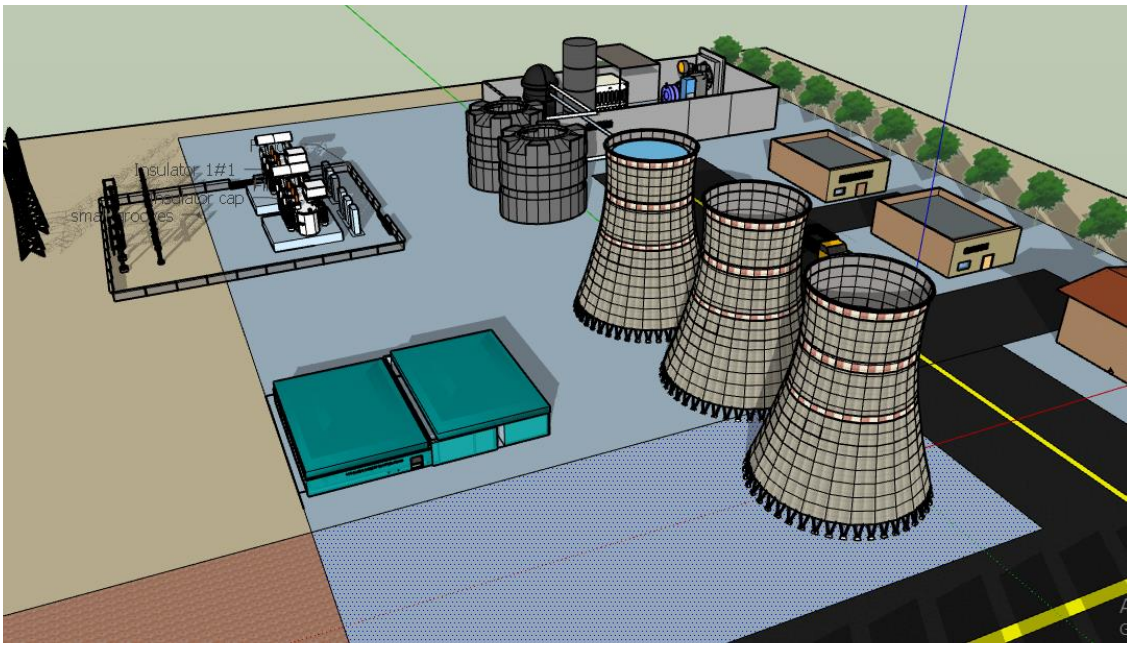
=$Rs\ 1.0220/-$

2D MODEL ON AUTOCAD



3D MODEL ON SKETCHUP





IMPACT OF NUCLEAR AND DIESEL POWER GENERATING STATIONS WITH RESPECT TO MAINTENANCE COST, RUNNING COST, INITIAL COST AND EFFICIENCY

Criteria	Nuclear Power	Diesel Power
Maintenance cost	High	Moderate
Running cost	Low	Moderate
Initial cost	High	Moderate
Efficiency	High	Moderate

The maintenance cost of nuclear power plants is high due to the need for regular safety inspections and the complexity of the systems. Running cost is relatively low because nuclear power plants do not require fuel to generate electricity once they are operational. The initial cost of building a nuclear power plant is also high due to the complex technology and safety requirements. Efficiency is high as nuclear power plants have high-capacity factors.

On the other hand, the maintenance cost of diesel power plants is moderate, running cost is also moderate as diesel fuel is relatively cheaper than other fossil fuels. The initial cost of building a diesel power plant is moderate. Efficiency is moderate as diesel power plants have lower capacity factors than nuclear power plants.

It's worth noting that the costs and efficiencies of both types of power plants can vary widely depending on specific circumstances such as the location, size and age of the power plant.

COMPARISON BETWEEN THE PROPOSED DESIGNS ON THE BASIS OF ENVIRONMENT AND SUSTAINABILITY:

Criteria	Nuclear Power	Diesel Power
Carbon emissions	Low	High
Air pollution	Low	High
Water usage	Low	Moderate
Land usage	Moderate	Low
Waste disposal	High-level radioactive waste	Low-level hazardous waste
Sustainability	Long-term, but concerns about nuclear waste disposal and potential accidents	Not sustainable in the long-term due to finite fossil fuel reserves and environmental impact

Nuclear power plants do not produce carbon emissions or air pollution, but they do produce high-level radioactive waste that requires careful management for thousands of years. They also have the potential for accidents, such as the one that occurred at the Fukushima Daiichi nuclear power plant in Japan in 2011.

Diesel power plants, on the other hand, release carbon emissions and air pollution, and they require a steady supply of fossil fuels. They also produce low-level hazardous waste, but it is not as long-lived as nuclear waste [2].

Overall, while nuclear power may be a low-carbon option, it also poses other environmental risks and sustainability challenges.

On the basis of this comparison and from environment perspective, the advantages of nuclear have more weight than those of diesel. Also, as seen in our analysis or in general the nuclear power plant offers the unit (kwh) cost less than that of diesel. So, a Nuclear Power Generating Station would be more suitable, sustainable and a better option for the subjected location's load profile.

We have designed a MATLAB GUI for the technical and economic analysis for our load profiles. For each individual load profile, their load curve, load consumptions along with their technical and economic analysis have been shown.

CONCLUSION

In this complex engineering problem, first we looked for 6 different load curves. Then we extracted the hourly data from these load curves through online tools and presented them in a table. We evaluated the technical and economic parameters for each load curve and chose the worst load profile with respect to its load factor and proposed a power station design for it along with detailed economic costing and 2D and 3D models.

Finally, a GUI was designed on MATLAB for the presentation of the technical and economic analysis of the different load.

From this CEP, we learned about the different parameters that need to be considered for power generation and what factors need to be considered to design a power plant.

REFERENCES

[1] ERIA (2014), 'Electric Power Supply in EAS Countries', in Kutani, I. and Y. Li (eds.), Investing in Power Grid Interconnection in East Asia, ERIA Research Project Report FY2013, No.23.Jakarta: ERIA, pp.5-26.

[2] B. E. K. Nsafon, et al., "Optimization and sustainability analysis of PV/wind/diesel hybrid energy system for decentralized energy generation", Energy Strategy Reviews Volume 32, November 2020, 100570, Doi: 10.1016/j.esr.2020.100570

[3] Montaser .Atta . kassem , Abdelfatah Ali Elahwil, "POWER LOAD MANAGEMENT: Techniques and Methods in Electric Power System", International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 09, Dec-2015, e-ISSN: 2395-0056

APPENDIX

MATLAB CODE

```
classdef PG < 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
UITable matlab.ui.control.Table
UIAxes matlab.ui.control.UIAxes
CALCULATEButton matlab.ui.control.Button
COUNTRYDropDownLabel matlab.ui.control.Label
COUNTRYDropDown matlab.ui.control.DropDown
TECHNICALANALYSISLabel matlab.ui.control.Label
ECONOMICALANALYSISLabel matlab.ui.control.Label
EnergyPerDayKWhEditFieldLabel matlab.ui.control.Label
EnergyPerDayKWhEditField matlab.ui.control.NumericEditField
AverageLoadKWEditFieldLabel matlab.ui.control.Label
AverageLoadKWEditField matlab.ui.control.NumericEditField
LoadFactorEditFieldLabel matlab.ui.control.Label
LoadFactorEditField matlab.ui.control.NumericEditField
AnnualEnergyKWhEditFieldLabel matlab.ui.control.Label
AnnualEnergyKWhEditField matlab.ui.control.NumericEditField
UIAxes2 matlab.ui.control.UIAxes
MaximumDemandMWEditFieldLabel matlab.ui.control.Label
MaximumDemandMWEditField matlab.ui.control.NumericEditField
PlantCapacityMWEditFieldLabel matlab.ui.control.Label
PlantCapacityMWEditField matlab.ui.control.NumericEditField
PlantCapacityFactorEditFieldLabel matlab.ui.control.Label
PlantCapacityFactorEditField matlab.ui.control.NumericEditField
ConstructionCostRsKWEditFieldLabel matlab.ui.control.Label
ConstructionCostRsKWEditField matlab.ui.control.NumericEditField
OperatingCostRsKwhEditFieldLabel matlab.ui.control.Label
OperatingCostRsKwhEditField matlab.ui.control.NumericEditField
MaintenancecostRsEditFieldLabel matlab.ui.control.Label
MaintenancecostRsEditField matlab.ui.control.NumericEditField
FixedCostRsEditFieldLabel matlab.ui.control.Label
FixedCostRsEditField matlab.ui.control.NumericEditField
IntrerestandDepreciationLabel matlab.ui.control.Label
IntrerestandDepreciationEditField matlab.ui.control.NumericEditField
VariableCostRsEditFieldLabel matlab.ui.control.Label
VariableCostRsEditField matlab.ui.control.NumericEditField
CostPerUnitRsKWhEditFieldLabel matlab.ui.control.Label
CostPerUnitRsKWhEditField matlab.ui.control.NumericEditField
end
```

```
properties (Access = private)
t % Description
end

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

% Code that executes after component creation
function startupFcn(app)
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\India.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\india.jpeg');
imshow(image,'parent',app.UIAxes2);
end

% Value changed function: COUNTRYDropDown
function COUNTRYDropDownValueChanged(app, event)
value = app.COUNTRYDropDown.Value;
switch value
case 'India'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\India.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\india.jpeg');
imshow(image,'parent',app.UIAxes2);
case 'Malaysia'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\Malaysia.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\malaysia.jpeg');
imshow(image,'parent',app.UIAxes2);
case 'Phillipines'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\Phillipines.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\phillipines.jpeg');
imshow(image,'parent',app.UIAxes2);
case 'Singapore'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\Singapore.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\singapore.jpeg');
imshow(image,'parent',app.UIAxes2);
case 'Thailand'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\Thailand.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\thailand.jpeg');
imshow(image,'parent',app.UIAxes2);
case 'Vietnam'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\Vietnam.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\vietnam.jpeg');
imshow(image,'parent',app.UIAxes2);
```

```
case 'India-Updated'
app.t=readtable("C:\Users\hp\Desktop\7th semester\PG CEP\India-
updated.xlsx");
app.UITable.Data=app.t;
image=imread('C:\Users\hp\Desktop\7th semester\PG CEP\india.jpeg');
imshow(image,'parent',app.UIAxes2);
end
end


% Button pushed function: CALCULATEButton
function CALCULATEButtonPushed(app, event)
x = table2array(app.t(:,1));
y = table2array(app.t(:,2));
plot(app.UIAxes,x,y);
a = sum(y)*1000;
app.EnergyPerDayKWhEditField.Value = a;
b = (sum(y)*1000)/24;
app.AverageLoadKWEditField.Value = b;
c = max(y);
app.MaximumDemandMWEditField.Value = c;
d = b/(c*1000);
app.LoadFactorEditField.Value = d;
e = b*8760;
app.AnnualEnergyKWhEditField.Value = e;
plant_cap = 1.25*c;
app.PlantCapacityMWEditField.Value = plant_cap;
plant_cap_factor = (c/plant_cap);
app.PlantCapacityFactorEditField.Value = plant_cap_factor;
const_cost = 25000;
app.ConstructionCostRsKWEditField.Value = const_cost;
int_dep = 10;
app.IntrerestandDepreciationEditField.Value = int_dep;
fixed_cost = (const_cost*int_dep*plant_cap*1000)/100;
app.FixedCostRsEditField.Value = fixed_cost;
op_cost = 10;
app.OperatingCostRsKwhEditField.Value = op_cost;
main_cost = 500000;
app.MaintenancecostRsEditField.Value = main_cost;
var_cost = (op_cost*e)+main_cost;
app.VariableCostRsEditField.Value = var_cost;
cost_per_unit = (fixed_cost+var_cost)/e;
app.CostPerUnitRsKWhEditField.Value = cost_per_unit;
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 UITable
app.UITable = uitable(app.ANALYSISTab);
app.UITable.ColumnName = {'TIME'; 'LOAD'};
app.UITable.RowName = {};
app.UITable.Position = [1 1 154 622];

% 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.FontSize = 14;
app.UIAxes.FontWeight = 'bold';
app.UIAxes.XGrid = 'on';
app.UIAxes.YGrid = 'on';
app.UIAxes.Position = [154 320 556 303];

% Create CALCULATEButton
app.CALCULATEButton = uibutton(app.ANALYSISTab, 'push');
app.CALCULATEButton.ButtonPushedFcn = createCallbackFcn(app,
@CALCULATEButtonPushed, true);
app.CALCULATEButton.FontWeight = 'bold';
app.CALCULATEButton.Position = [1014 19 100 22];
app.CALCULATEButton.Text = 'CALCULATE';

% Create COUNTRYDropDownLabel
app.COUNTRYDropDownLabel = uilabel(app.ANALYSISTab);
app.COUNTRYDropDownLabel.FontSize = 14;
app.COUNTRYDropDownLabel.FontWeight = 'bold';
```

```
app.COUNTRYDropDownLabel.Position = [752 19 74 22];
app.COUNTRYDropDownLabel.Text = 'COUNTRY';

% Create COUNTRYDropDown
app.COUNTRYDropDown = uidropdown(app.ANALYSISTab);
app.COUNTRYDropDown.Items = {'India', 'Malaysia', 'Phillipines',
'Singapore', 'Thailand', 'Vietnam', 'India-Updated'};
app.COUNTRYDropDown.ValueChangedFcn = createCallbackFcn(app,
@COUNTRYDropDownValueChanged, true);
app.COUNTRYDropDown.Position = [832 19 120 22];
app.COUNTRYDropDown.Value = 'India-Updated';

% Create TECHNICALANALYSISLabel
app.TECHNICALANALYSISLabel = uilabel(app.ANALYSISTab);
app.TECHNICALANALYSISLabel.FontSize = 16;
app.TECHNICALANALYSISLabel.FontWeight = 'bold';
app.TECHNICALANALYSISLabel.Position = [797 560 182 32];
app.TECHNICALANALYSISLabel.Text = 'TECHNICAL ANALYSIS';

% Create ECONOMICALANALYSISLabel
app.ECONOMICALANALYSISLabel = uilabel(app.ANALYSISTab);
app.ECONOMICALANALYSISLabel.FontSize = 16;
app.ECONOMICALANALYSISLabel.FontWeight = 'bold';
app.ECONOMICALANALYSISLabel.Position = [1050 560 200 32];
app.ECONOMICALANALYSISLabel.Text = 'ECONOMICAL ANALYSIS';

% Create EnergyPerDayKWhEditFieldLabel
app.EnergyPerDayKWhEditFieldLabel = uilabel(app.ANALYSISTab);
app.EnergyPerDayKWhEditFieldLabel.HorizontalAlignment = 'right';
app.EnergyPerDayKWhEditFieldLabel.Position = [725 525 128 22];
app.EnergyPerDayKWhEditFieldLabel.Text = 'Energy Per Day (KWh)';

% Create EnergyPerDayKWhEditField
app.EnergyPerDayKWhEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.EnergyPerDayKWhEditField.Position = [868 525 100 22];

% Create AverageLoadKWEditFieldLabel
app.AverageLoadKWEditFieldLabel = uilabel(app.ANALYSISTab);
app.AverageLoadKWEditFieldLabel.HorizontalAlignment = 'right';
app.AverageLoadKWEditFieldLabel.Position = [742 482 111 22];
app.AverageLoadKWEditFieldLabel.Text = 'Average Load (KW)';

% Create AverageLoadKWEditField
app.AverageLoadKWEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.AverageLoadKWEditField.Position = [868 482 100 22];
```

```
% Create LoadFactorEditFieldLabel
app.LoadFactorEditFieldLabel = uilabel(app.ANALYSISTab);
app.LoadFactorEditFieldLabel.HorizontalAlignment = 'right';
app.LoadFactorEditFieldLabel.Position = [783 381 70 22];
app.LoadFactorEditFieldLabel.Text = 'Load Factor';

% Create LoadFactorEditField
app.LoadFactorEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.LoadFactorEditField.Position = [868 381 100 22];

% Create AnnualEnergyKWhEditFieldLabel
app.AnnualEnergyKWhEditFieldLabel = uilabel(app.ANALYSISTab);
app.AnnualEnergyKWhEditFieldLabel.HorizontalAlignment = 'right';
app.AnnualEnergyKWhEditFieldLabel.Position = [731 330 122 22];
app.AnnualEnergyKWhEditFieldLabel.Text = 'Annual Energy (KWh)';

% Create AnnualEnergyKWhEditField
app.AnnualEnergyKWhEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.AnnualEnergyKWhEditField.Position = [868 330 100 22];

% Create UIAxes2
app.UIAxes2 = uiaxes(app.ANALYSISTab);
title(app.UIAxes2, 'LOAD CURVE')
xlabel(app.UIAxes2, '')
ylabel(app.UIAxes2, '')
app.UIAxes2.PlotBoxAspectRatio = [2.09787234042553 1 1];
app.UIAxes2.FontSize = 14;
app.UIAxes2.FontWeight = 'bold';
app.UIAxes2.Position = [154 1 555 305];

% Create MaximumDemandMWEditFieldLabel
app.MaximumDemandMWEditFieldLabel = uilabel(app.ANALYSISTab);
app.MaximumDemandMWEditFieldLabel.HorizontalAlignment = 'right';
app.MaximumDemandMWEditFieldLabel.Position = [714 432 139 22];
app.MaximumDemandMWEditFieldLabel.Text = 'Maximum Demand (MW)';

% Create MaximumDemandMWEditField
app.MaximumDemandMWEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.MaximumDemandMWEditField.Position = [868 432 100 22];

% Create PlantCapacityMWEditFieldLabel
app.PlantCapacityMWEditFieldLabel = uilabel(app.ANALYSISTab);
app.PlantCapacityMWEditFieldLabel.HorizontalAlignment = 'right';
```

```
app.PlantCapacityMWEditFieldLabel.Position = [737 284 116 22];
app.PlantCapacityMWEditFieldLabel.Text = 'Plant Capacity (MW)';

% Create PlantCapacityMWEditField
app.PlantCapacityMWEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.PlantCapacityMWEditField.Position = [868 284 100 22];

% Create PlantCapacityFactorEditFieldLabel
app.PlantCapacityFactorEditFieldLabel = uilabel(app.ANALYSISTab);
app.PlantCapacityFactorEditFieldLabel.HorizontalAlignment = 'right';
app.PlantCapacityFactorEditFieldLabel.Position = [733 235 120 22];
app.PlantCapacityFactorEditFieldLabel.Text = 'Plant Capacity Factor';

% Create PlantCapacityFactorEditField
app.PlantCapacityFactorEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.PlantCapacityFactorEditField.Position = [868 235 100 22];

% Create ConstructionCostRsKWEditFieldLabel
app.ConstructionCostRsKWEditFieldLabel = uilabel(app.ANALYSISTab);
app.ConstructionCostRsKWEditFieldLabel.HorizontalAlignment = 'right';
app.ConstructionCostRsKWEditFieldLabel.Position = [1003 525 150 22];
app.ConstructionCostRsKWEditFieldLabel.Text = 'Construction Cost (Rs/KW)';

% Create ConstructionCostRsKWEditField
app.ConstructionCostRsKWEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.ConstructionCostRsKWEditField.Position = [1168 525 100 22];

% Create OperatingCostRsKwhEditFieldLabel
app.OperatingCostRsKwhEditFieldLabel = uilabel(app.ANALYSISTab);
app.OperatingCostRsKwhEditFieldLabel.HorizontalAlignment = 'right';
app.OperatingCostRsKwhEditFieldLabel.Position = [1014 381 139 22];
app.OperatingCostRsKwhEditFieldLabel.Text = 'Operating Cost (Rs/Kwh)';

% Create OperatingCostRsKwhEditField
app.OperatingCostRsKwhEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.OperatingCostRsKwhEditField.Position = [1168 381 100 22];

% Create MaintenancecostRsEditFieldLabel
app.MaintenancecostRsEditFieldLabel = uilabel(app.ANALYSISTab);
app.MaintenancecostRsEditFieldLabel.HorizontalAlignment = 'right';
app.MaintenancecostRsEditFieldLabel.Position = [1027 330 126 22];
app.MaintenancecostRsEditFieldLabel.Text = 'Maintenance cost (Rs)';
```

```
% Create MaintenancecostRsEditField
app.MaintenancecostRsEditField = uieditfield(app.ANALYSISTab, 'numeric');
app.MaintenancecostRsEditField.Position = [1168 330 100 22];

% Create FixedCostRsEditFieldLabel
app.FixedCostRsEditFieldLabel = uilabel(app.ANALYSISTab);
app.FixedCostRsEditFieldLabel.HorizontalAlignment = 'right';
            app.FixedCostRsEditFieldLabel.Position = [1064 432 89 22];
            app.FixedCostRsEditFieldLabel.Text = 'Fixed Cost (Rs)';

            % Create FixedCostRsEditField
            app.FixedCostRsEditField = uieditfield(app.ANALYSISTab,
  'numeric');
            app.FixedCostRsEditField.Position = [1168 432 100 22];

            % Create IntrerestandDepreciationLabel
            app.IntrerestandDepreciationLabel = uilabel(app.ANALYSISTab);
            app.IntrerestandDepreciationLabel.HorizontalAlignment =
  'right';
            app.IntrerestandDepreciationLabel.Position = [987 482 166 22];
            app.IntrerestandDepreciationLabel.Text = 'Intrerest and
  Depreciation (%)';

            % Create IntrerestandDepreciationEditField
            app.IntrerestandDepreciationEditField =
  uieditfield(app.ANALYSISTab, 'numeric');
            app.IntrerestandDepreciationEditField.Position = [1168 482 100
  22];

            % Create VariableCostRsEditFieldLabel
            app.VariableCostRsEditFieldLabel = uilabel(app.ANALYSISTab);
            app.VariableCostRsEditFieldLabel.HorizontalAlignment =
  'right';
            app.VariableCostRsEditFieldLabel.Position = [1050 284 103 22];
            app.VariableCostRsEditFieldLabel.Text = 'Variable Cost (Rs)';

            % Create VariableCostRsEditField
            app.VariableCostRsEditField = uieditfield(app.ANALYSISTab,
  'numeric');
            app.VariableCostRsEditField.Position = [1168 284 100 22];

            % Create CostPerUnitRsKWhEditFieldLabel
            app.CostPerUnitRsKWhEditFieldLabel = uilabel(app.ANALYSISTab);
            app.CostPerUnitRsKWhEditFieldLabel.HorizontalAlignment =
  'right';
```

```
            app.CostPerUnitRsKWhEditFieldLabel.Position = [1021 235 132
22];
            app.CostPerUnitRsKWhEditFieldLabel.Text = 'Cost Per Unit
(Rs/KWh)';

            % Create CostPerUnitRsKWhEditField
            app.CostPerUnitRsKWhEditField = uieditfield(app.ANALYSISTab,
'numeric');
            app.CostPerUnitRsKWhEditField.Position = [1168 235 100 22];

            % 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

            % Create UIFigure and components
            createComponents(app)

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

            % Execute the startup function
            runStartupFcn(app, @startupFcn)

            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
```