**Sudan University of Science & Technology**

**College of Graduate Studies**

**Preparing a Computer Program to Evaluate the Performance of Garri Combined Cycle Power Plant**

إعداد برنامج حاسوبي لتقويم أداء محطة قري ذات الدورة المشتركة

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**Master of science Degree (M.Sc) in Mechanical Engineering**

**Prepared by :**

   **Mugtaba Nour Eldaim Mohammed Ahmed**

**Supervised by :**

   **Dr. Eihab Abd Alrouf Mustafa**

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بِسْمِ اللهِ الرَّحْمَنِ الرَّحِيمِ

قال تعالى :

﴿ اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَن يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ ﴾

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# DEDICATION

To my dear father

To my dear mother

To my brothers and sister

To all my family

To all my friends

To all my supervisor and  teachers

To my family M.R.F (LIEBHERR)

To my family Garri combined Cycle Power Plants

# Abstract

This study looking for benefit possibility of computer device in Garri Combined Cycle 1&2 thermal power generation to improve performance of plants . The researcher developed the program by MATLAB using GUI to evaluate performance and status of the plants . It is content main interface and status interface .

Main interface content empty texts boxes to enter the data . Primary data must be entered at first time (primary value selection) and daily data then press calculate . After first time daily data just should be entered by user . when calculate has been pressed some tables should be appeared . Station power generation table , it's content power generated , power factor generation , power auxiliary consumption , planned energy losses , unplanned energy losses and availability for each machine . Also resources consumption and supply table , it's content LDO and HCGO fuel consumption for each machine , total pump able fuel stock in tanks , total fuel stock ,river side supply water , and demin water quantity for each plant . Also units availability and remarks table , it's content availability , status and last power generated recorded . Also specific fuel consumption table and efficiency table for each machine .

Status interface content empty texts boxes for plant one and plant two to enter daily power generated in each hour to get graphics show user status of each machine .

# مُـــــستخلص

هذه الدراسة تبحث إمكانية الاستفادة من جهاز الحاسوب في مجمع محطتي الدورة المركبة قري 1 و 2 للتوليد الحراري لتحسين اداء هاتين المحطتين . فقد قام الباحث بتطوير برنامج بواسطة برنامج الماتلاب باستخدام واجهات المستخدم الرسومية  لإيجاد أداء و حالة المحطتين . اذ يحتوي البرنامج على واجهتين الواجهة الرئيسية و واجهة حالة المحطتين .

الواجهة الرئيسية تحتوي علي أماكن فارغة لإدخال البيانات يقول المستخدم بإدخال القيم الأولية إذا كانت هذه المرة الأول التي يُدخل فيها البيانات و إذا لم تكن المرة الأولى فيقوم بإدخال البيانات اليومية فقط و عند ضغط علي ذر حساب يقوم البرنامج بعرض جدول قدرة المحطتين المنتجة  الذي يحتوي على القدرة المنتجة لكل ماكينة و معامل القدرة المنتج لكل ماكينة و القدرة المستهلكة بواسطة الأجهزة المساعدة و الطاقة المخطط لفقدانها لكل ماكينة و الطاقة الغير مخطط لفقدانها لكل ماكينة و نسبة توفر الماكينة) . و أيضا يعرض أيضا البرنامج جدول الإمدادات و الوقود المستهلك الذي يحتوي على الوقود المستهلك لكل ماكينة و كمية إمدادات الوقود و مخزون الوقود في مخازن الوقود و كمية المياه المستهلكة سواء مياه معالجة أو غير معالجه . و أيضا يعرض جدول الماكينات المتاحة و آخرة قدرة منتجة في اليوم و نسبة توفر الماكينة في اليوم . و يعرض جدول يحتوي على الوقود النوعي المستهلك لكل ماكينة و جدول لعرض كفاءة كل ماكينة .

أما الواجهة الثانية فتحتوي علي واجهة لإدخال بيانات القدرة المنتجة لكل ماكينة على مدار ساعة و تكون نتيجة هذه الواجهة مخططات توضح حالة إنتاج كل ماكينة على مدار ساعات اليوم .

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# List of Abbreviations

| Symbol | Description | Page No . |
|--------|-------------|-----------|
| HCGO | Heavy Cock Gas Oil | 4 |
| LDO | Light Diesel Oil | 4 |
| HRSG | Heat Recovery System Generating | 4 |
| GUI | Graphical User Interface | 7 |
| GT1 | Gas Turbine No 1 | 28 |
| GT2 | Gas Turbine No 2 | 28 |
| GT3 | Gas Turbine No 3 | 28 |
| GT4 | Gas Turbine No 4 | 28 |
| GT5 | Gas Turbine No 5 | 28 |
| GT6 | Gas Turbine No 6 | 28 |
| GT7 | Gas Turbine No 7 | 28 |
| GT8 | Gas Turbine No 8 | 28 |
| ST1 | Steam Turbine No 1 | 28 |
| ST2 | Steam Turbine No 2 | 28 |
| ST3 | Steam Turbine No 3 | 28 |
| ST4 | Steam Turbine No 4 | 28 |

# CHAPTER ONE

# INTRODUTION

# 1. Introduction

A power station, also referred to as a power plant or powerhouse and sometimes generating station or generating plant, is an industrial facility for the generation of electric power. Most power stations contain one or more generators, a rotating machine that converts mechanical power into electrical power. The relative motion between a magnetic field and a conductor creates an electrical current. The energy source harnessed to turn the generator varies widely. Most power stations in the world burn fossil fuels such as coal, oil, and natural gas to generate electricity. Others use nuclear power, but there is an increasing use of cleaner renewable sources such as solar, wind, wave and hydroelectric .

## 1.1. Thermal power station

In thermal power stations, mechanical power is produced by a heat engine that transforms thermal energy, often from combustion of a fuel, into rotational energy. Most thermal power stations produce steam, so they are sometimes called steam power stations. Not all thermal energy can be transformed into mechanical power, according to the second law of thermodynamics; therefore, there is always heat lost to the environment. If this loss is employed as useful heat, for industrial processes or district heating, the power plant is referred to as a cogeneration power plant or CHP (combined heat-and-power) plant [1] . In countries where district heating is common, there are dedicated heat plants called heat-only boiler stations. An important class of power stations in the Middle East uses by-product heat for the desalination of water. The efficiency of a thermal

power cycle is limited by the maximum working fluid temperature produced. The efficiency is not directly a function of the fuel used. For the same steam conditions, coal-, nuclear- and gas power plants all have the same theoretical efficiency. Overall, if a system is on constantly (base load) it will be more efficient than one that is used intermittently (peak load). Steam turbines generally operate at higher efficiency when operated at full capacity.

Besides use of reject heat for process or district heating, one way to improve overall efficiency of a power plant is to combine two different thermodynamic cycles in a combined cycle plant. Most commonly, exhaust gases from a gas turbine are used to generate steam for a boiler and a steam turbine. The combination of a "top" cycle and a "bottom" cycle produces higher overall efficiency than either cycle can attain alone [2] .

Sudan has hydroelectric power station, diesel engine station ,steam turbine , gas turbine , combined cycle station . steam turbine is steam-driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankine cycle [3] . A gas turbine, also called a combustion turbine, is a type of internal combustion engine. It has an upstream rotating compressor coupled to a downstream turbine, and a combustion chamber or area, called a combustor, in between . The basic operation of the gas turbine is similar to that of the steam power plant except that the working fluid is air instead of water. Fresh atmospheric air flows through a compressor that brings it to higher pressure.

Energy is then added by spraying fuel into the air and igniting it so the combustion generates a high-temperature flow. This high-temperature high-pressure gas enters a turbine, where it expands down to the exhaust pressure, producing a shaft work output in the process. The turbine shaft work is used to drive the compressor and other devices such as an electric generator that may be coupled to the shaft. The energy that is not used for shaft work comes out in the exhaust gases, so these have either a high temperature or a high velocity. The purpose of the gas turbine determines the design so that the most desirable energy form is maximized . but combined cycle station consists gas turbine with steam turbine . it uses waste heat from a gas turbine, in the form of hot exhaust gas to raise steam, by passing this gas through a Heat Recovery Steam Generator (HRSG) the steam is then used to drive a steam turbine in a combined cycle plant that improves overall efficiency. Combined heat and power plants (CH&P plants), often called co-generation plants, produce both electric power and heat for process heat or space heating. Steam and hot water. Power plants burning coal, fuel oil, or natural gas are often called fossil-fuel power plants. Some biomass-fueled thermal power plants have appeared [1] .but here in Sudan has thermal power generating company contents diesel generators , steam turbine , gas turbine and combined cycle plant . garri combined cycle power plant one of these plants and is consists eight gas turbines and four steam turbines . gas turbines use LDO (light diesel oil) and HCGO (heavy cock gas oil) as fuel [4] . And this research about this plant and is Actually daily live depends on calculation specially at company and businesses to calculate profits , losses ,

work efficiency , products quality , workers evaluation  , expectations and analyzes .

so it's necessary to evaluate performance and statues of  this plant and it can only be found by calculation . At the past old calculator was used to find it . After development computer  became meager way to find and calculate performance and statues of power plants. The computer uses programming language  to evaluate them  . A programming language is a formal computer language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs to control the behavior of a machine or to express algorithms. The earliest known programmable machine preceded the invention of the digital computer and is the automatic flute player described in the 9th century by the brothers Musa in Baghdad, "during the Islamic Golden Age".From the early 1800s, "programs" were used to direct the behavior of machines such as Jacquard looms and player pianos.Thousands of different programming languages have been created, mainly in the computer field, and many more still are being created every year [7] . Many programming languages require computation to be specified in an imperative form (i.e., as a sequence of operations to perform) while other languages use other forms of program specification such as the declarative form (i.e. the desired result is specified, not how to achieve it). The description of a programming language is usually split into the two components of syntax (form) and semantics (meaning). Some languages are defined by a specification document (for example, the C programming language is specified by an ISO Standard) while other languages (such as Perl) have a dominant implementation that is treated as a reference.

Some languages have both, with the basic language defined by a standard and extensions taken from the dominant implementation being common [5] .

Array programming (also known as vector or multidimensional) languages generalize operations on scalars to apply transparently to vectors, matrices, and higher−dimensional arrays . and MATLAB one of them . MATLAB will be used in this research . MATLAB (matrix laboratory) is a multi−paradigm numerical computing environment and fourth−generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python [6] . Figure (1.1) bellow show MATLAB R2014a [7] which used in research
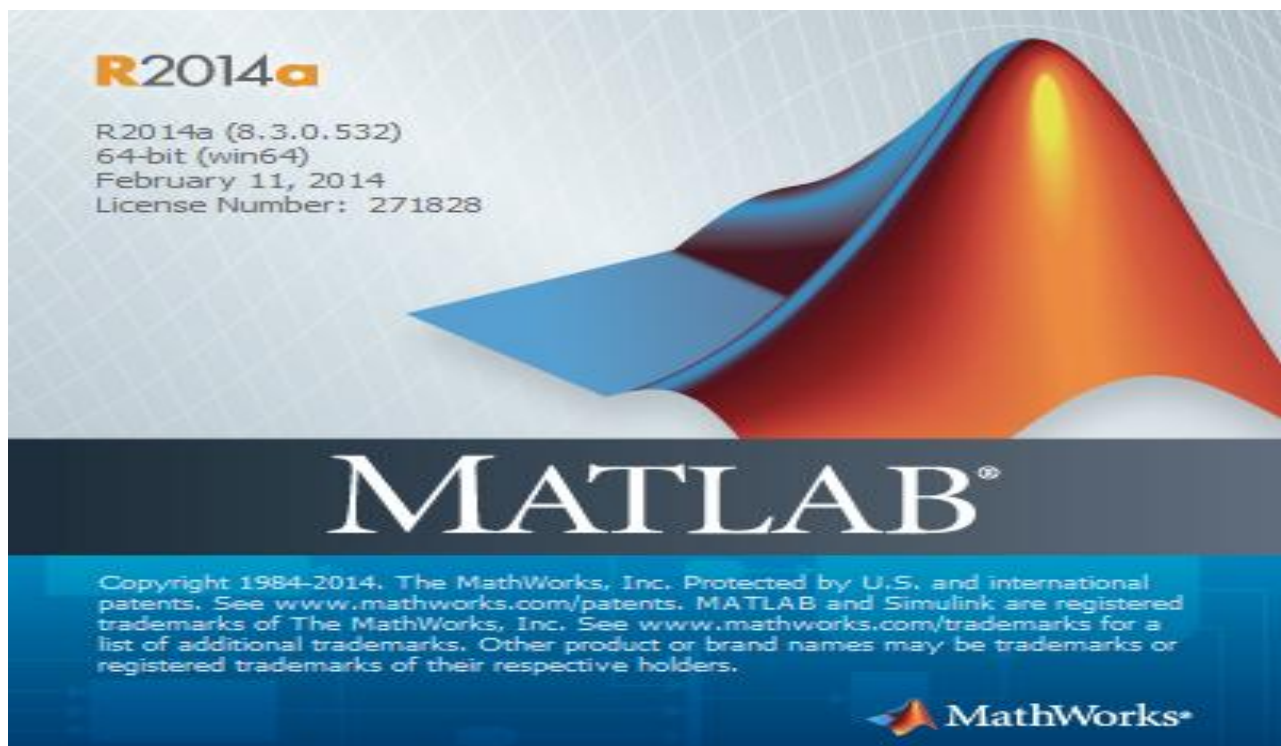


Figure (1.1)   MATLAB R2014a

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems [7].

MATLAB had a lot of  users across industry and academia . MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB has many of libraries like Simulink library and GUI library . And GUI library will be used in this research .so what is GUI ?!

GUI (graphical user interface) is a graphical display in one or more windows containing controls, called components, that enable a user to perform interactive tasks. The user of the GUI does not have to create a script or type commands at the command line to accomplish the tasks. Unlike coding programs to accomplish tasks, the user of a GUI need not understand the details of how the tasks are performed . GUI components can include menus, toolbars, push buttons, radio buttons, list boxes, and sliders—just to name a few. GUIs created using MATLAB  tools can also perform any type of computation, read and write data files, communicate with other GUIs, and display data as tables or as plots [7] . Figure  bellow is window of GUI figure by GUIDE library :
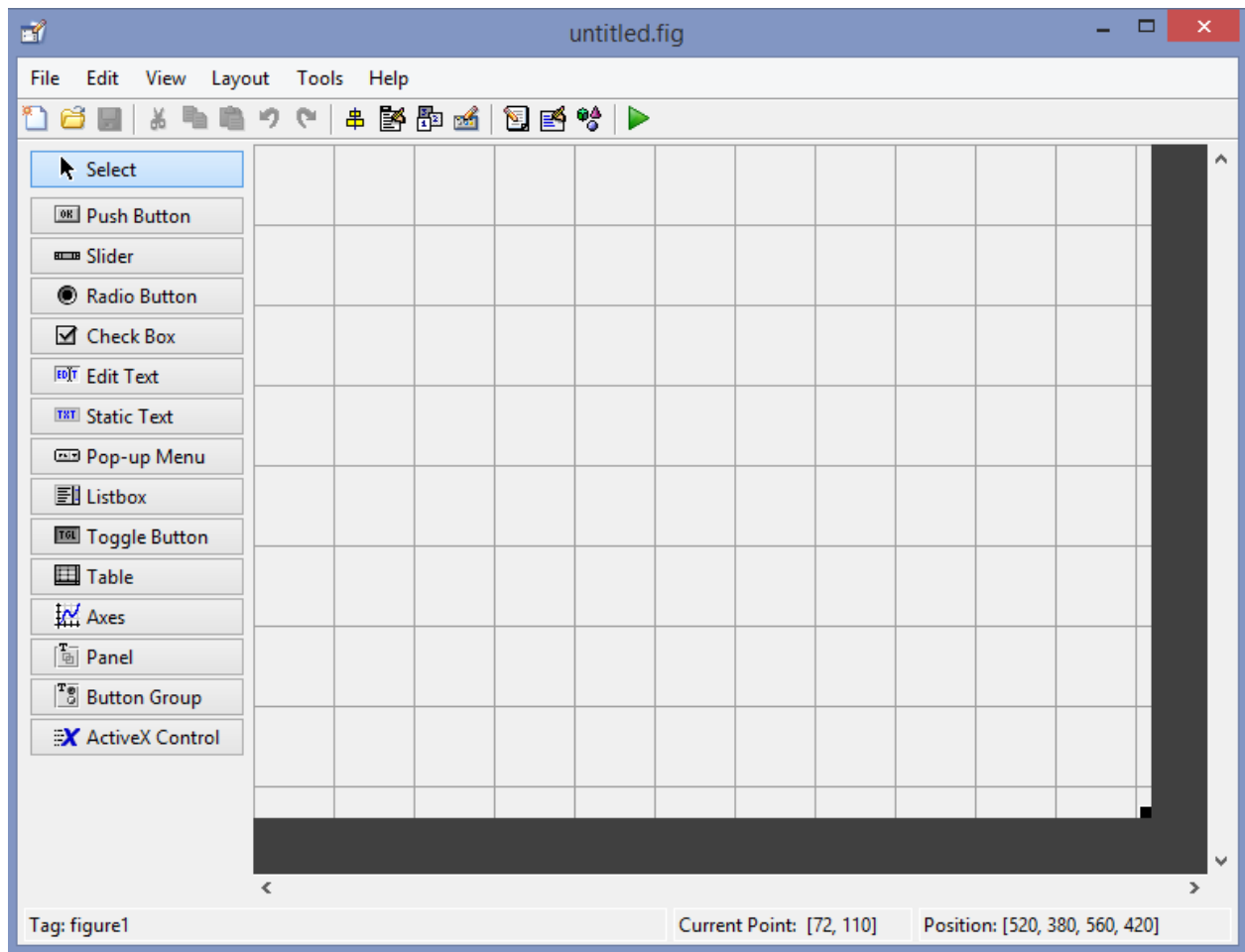
Figure (1.2)  GUI figure

## 1.2. Problem statement

The problem that engineers of Garri Combined Cycle Power Plant suffer and waste long time to calculate and evaluate performance , statues specific fuel consumption efficiency of plant because they use old and difficult programs . if anyone do any mistake in the constants or equations the results will be wrong . Picture figure (1.3)[4] and figure (1.4)[4] bellow from the complicated way of calculation :

Figure (1.3)  Excel Data sheet

Figure (1.4) Excel data sheet

## 1.3. Objectives

1- Facilitate the process of data entry and extraction results to get perfect performance and statues reports and gain the time.
2- Get rid of mistakes of old ways and programs.

## 1.4. Methodology

The primary research method for this study is literature review and create program using matlab to find power plants performance and statues .

- First step : Review concepts of power plants performance and statues.

- Second step : Study programs

  Matlap to create code of a program.

  Microsoft office excel to use as data base for variable value


- Third step : Get all equations and constants needed for calculations.

- Fourth step : The program code.

- Fifth step : Discuses program's results.

## 1.5. Time Table

Table (1.1) : Time table

| Activities | First month | | | | second month | | | | third month | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review and concepts | ■ | | | | | | | | | | | |
| Study programs(matlab&excel) | | ■ | | | | | | | | | | |
| Get equations and constants | | | ■ | | | | | | | | | |
| Create the code | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | |
| Discuses program's results | | | | | | | | | | | | ■ |

# CHAPTER TWO

# LITERATURE REVIEW

# 2. LITERATURE REVIEW

Actually daily live depends on calculation specially at company and businesses to calculate profits , losses , work efficiency , products quality , workers evaluation , expectations and analyzes . As example in power plants it's necessary to evaluate performance , efficiency , simulation and statues of plant and it can only be found by calculation . At the past old calculator was used to find it . After development computer became meager way to find and calculate performance and statues of power plants . Here we have some previous studies and programs .

## 2.1. Previous Studies

Yasin Aöhret [8] (et.ed) have written Analysis of Combustion Efficiency for Turbofan Engine Combustor Using MATLAB . In this study, the combustion efficiency of a turbofan engine combustor is analyzed by MATLAB . The thermal efficiency of an aircraft turbofan engine is related to combustion efficiency . It is net output thrust power to total input fuel energy of the combustor . However , net heat effects on thermal efficiency and net heat is related to combustion efficiency . Furthermore , specifying combustion efficiency has a key role in estimating emission indices. In the program codes , the basic combustion equilibrium is analyzed for carbon , hydrogen, oxygen, nitrogen, sulfur, carbon dioxide, carbon monoxide, hydrocarbon, nitrogen oxide, nitric oxide and water . As a conclusion, researchers examine the relationship between combustion efficiency and exhaust gas emissions . The figure (2.1) bellow a screen capture of this program :

ANALYSER PROPERTIES | INLET AIR PROPERTIES | FUEL PROPERTIES | EXHAUST GAS PROPERTIES | DATASHEET PROPERTIES   Encoded and scripted by Yasin Şöhret at the request of TUSAS Engine Ind. (TEI). ®

ANALYSER PROPERTIES

| | |
|---|---|
| Interference coefficient for effect of oxygen on the measurement of carbondioxide | 0.09 |
| Interference coefficient for effect of carbondioxide on the measurement of carbonmonoxide | -0.0001 |
| Interference coefficient for effect of carbondioxide on the measurement of nitrogenoxides | 0.14 |
| Interference coefficient for effect of water on the measurement of nitrogenoxides | 0.28 |
| Interference coefficient for effect of water on the measurement of carbonmonoxide | -0.00045 |
| Nitrogenoxide converter efficiency | 0.93 |
| Water content of the semi-dry exhaust sample leaving the dryer | 0.000001 |

FUEL PROPERTIES

| | |
|---|---|
| Molar constant of carbon for selected fuel | 10.9 |
| Molar constant of hydrogen for selected fuel | 20.9 |
| Molar constant of oxygen for selected fuel | 0 |
| Molar constant of nitrogen for selected fuel | 0 |
| Molar constant of sulfur for selected fuel | 0 |
| Molecular weight of selected fuel | 152 |
| Net heat of combustion of fuel at constant pressure (J/kg) | 43370.59 |

EXHAUST GAS PROPERTIES

| | |
|---|---|
| Molar constant of carbon for selected unburned hydrocarbon in exhaust gas | 1 |
| Molar constant of hydrogen for selected unburned hydrocarbon in exhaust gas | 4 |

DATASHEET PROPERTIES

| | |
|---|---|
| Number of datas | 800 |

Measurement datas will be read from imported excel (*.xls, *.xlsx) file. Use import button to import datas.

INLET AIR PROPERTIES

| | |
|---|---|
| Mole fraction of oxygen in dry inlet air | 0.20948 |
| Total mole fraction of nitrogen and argon in dry inlet air | 0.79018 |
| Mole fraction of carbondioxide in dry inlet air | 0.00034 |
| Mole fraction of methane in dry inlet air | 0 |
| Water content of the inlet air (moles of water vapour/mole of dry inlet air) | 0 |

SAVE INPUTS
IMPORT
CALCULATE
EXPORT
PLOT

Figure (2.1) A screen capture for Analysis of Combustion Efficiency for Turbofan Engine Combustor program

Falah Alobaid (et .. ed)[9] have written in dynamic simulation of thermal power plants software code in CCPP dynamic simulation . While the conventional design of thermal power plants is mainly focused on high process efficiency , Market requirements increasingly target operating flexibility due to the continuing shift towards renewable . Dynamic simulation is a cost−efficient tool for improving the flexibility of dispatch able power generation in transient operation such as load changes and start – up procedures. Specific applications include the optimization of control structures , stress assessment for critical component sand plant safety analysis in malfunction cases. This work is a comprehensive review of dynamic simulation , its development and application to various thermal power plants . The required mathematical models and various components for description the basic process , automation and electrical systems of thermal power plants are explained with the support of practical example models . The underlying flow models and their fundamental assumptions are discussed , complemented by an overview of commonly used simulation codes . Relevant studies are summarized and placed in context for different thermal

power plant technologies : combined –cycle power , coal fired power desalination . Particular attention is given to those studies that include measurement validation in order to analyze the influence of model simplifications on simulation results .In conclusion ,the study high lights current research efforts and future development potential of dynamic simulation in the field of thermal power generation .

STEAG Energy Services [10] created Professional as diagnostic software to help Power Plants to identify poor performance of plant components, sub-systems or the plant as a whole . Finds the gap between the operating condition and achieved parameters of the plant based on the design and operating model with the subsystem analysis. In addition, Ebsilon application also brings out in efficiencies , consistencies , operation and maintenance procedures and help in deciding remedial measures. Calculation of current Key Performance Indicators .

- Boiler efficiency
- Fouling Factor
- Heat Rate
- Calculation of expected efficiencies

Also figure ($2.2$) explain how it does work :
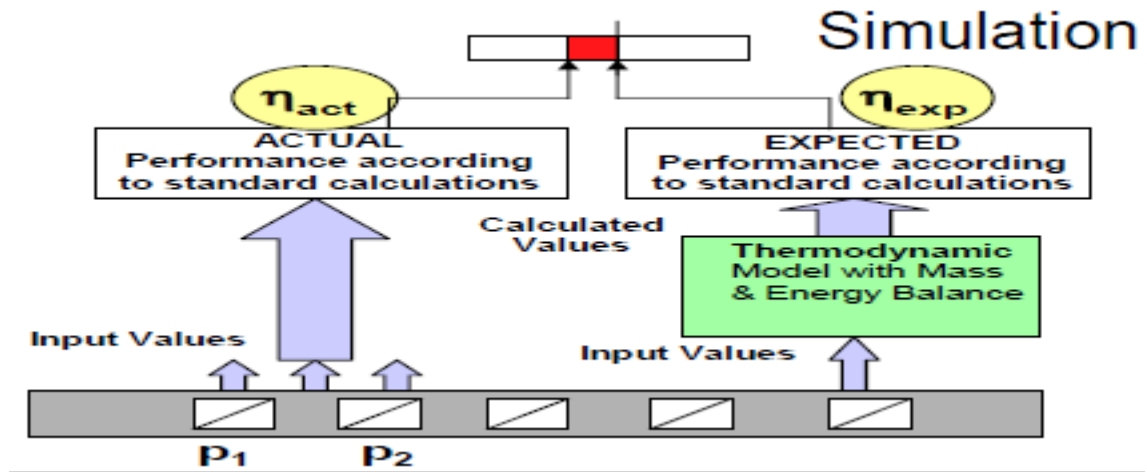


Figure(2.2) simulation explain

Naimul Hasan [11] (et . ed ) have written Optimization of CCGT power plant and performance analysis using MATLAB/Simulink with actual operational data [(4)] . In the Modern scenario, the naturally available resources for power generation are being depleted at an alarming rate; firstly due to wastage of power at consumer end, secondly due to inefficiency of various power system components. A Combined Cycle Gas Turbine (CCGT) integrates two cycles− Brayton cycle (Gas Turbine) and Rankine cycle (Steam Turbine) with the objective of increasing overall plant efficiency. This is accomplished by utilizing the exhaust of Gas Turbine through a waste−heat recovery boiler to run a Steam Turbine. The efficiency of a gas turbine which ranges from $28\%$ to $33\%$ can hence be raised to about $60\%$ by recovering some of the low grade thermal energy from the exhaust gas for steam turbine process. This paper is a study for the modeling of CCGT and comparing it with actual operational data. The performance model for CCGT plant was developed in MATLAB/Simulink.

Ahmed Noaman [12] ( et . ed )have written  In February 2017 Computer –
Aided Evaluation of Steam Power Plants Performance Based on Energy and
Exergy Analysis paper. Abdel–Aziz create This paper aims to solve the power
consumption problem using computer software by analyzing the steam power
plants from the energetic and exergetic viewpoint using computer application
method[5]. Most of the previous applications have some specificities which cannot
be applied to any steam power plant . Moreover , they neglect the volumetric
analysis of the hydrocarbon fuel which has a considerable effect on the boiler and
power plant efficiencies. So, the first build a new computer program   Which
covers the shortage and over comes the problems of the previous programs. We
used it to analyze the increment problem of the fuel consumption occurred in the
Cairo West Thermal Power Plant (Units 7 & 8). The results presented by it show
that the boiler is the main source of exergy destruction due to combustion, boiling
and super heating  processes as show in figure (2.3),(2.4) and (2.5)  :
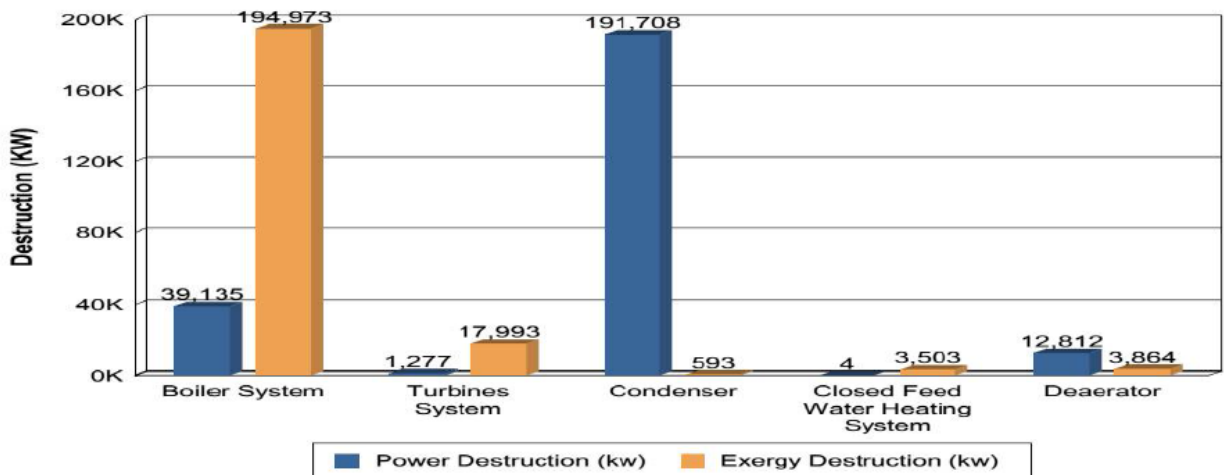


Figure (2.3) Power and exergy destruction

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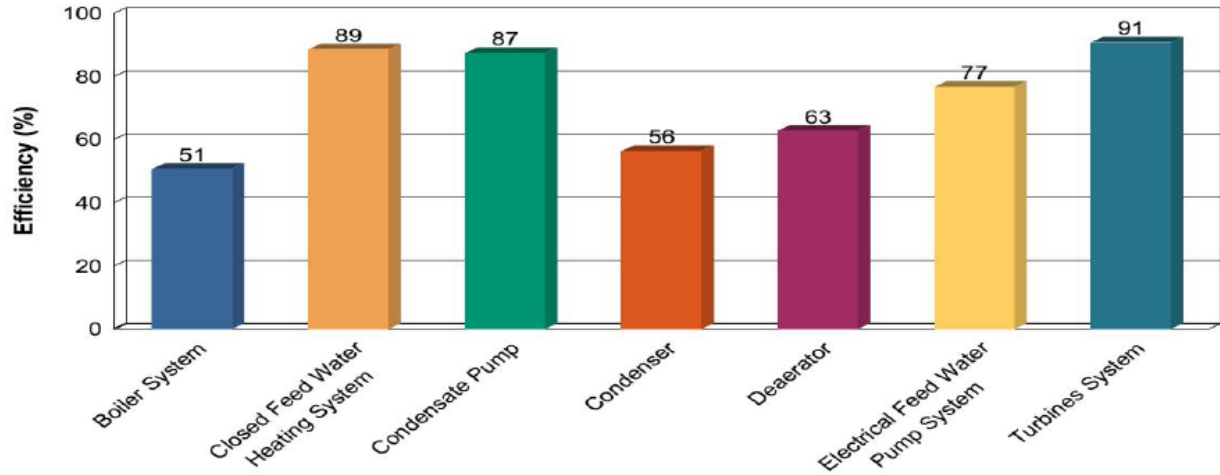
Figure (2.4) Exergetic efficiency of main systems



| | | |
|---|---|---|
| Boiler System | 194,973.25 | 87.9% |
| Closed Feed Water Heating System | 3,502.85 | 1.6% |
| Condensate Pump | 62.08 | 0.0% |
| Condenser | 592.72 | 0.3% |
| Deaerator | 3,864.25 | 1.7% |
| Electrical Feed Water Pump System | 933.45 | 0.4% |
| Turbines System | 17,992.90 | 8.1% |
| Total: | 221,921.48 | 100.0% |

Figure (2.5) Exergy destruction pie chart of main systems

Garri combined cycle power plants Department of Efficiency and Planning [4] has created Daily Performance  and Status Report reports Excel datasheet . It's to evaluate station power generation , Recourses consumption and supply  , Units availability and remarks and Units availability and remarks . figures bellow show outputs :

- station power generation

| 1. STATION POWER GENERATION | | | | | | |
|---|---|---|---|---|---|---|
| Unit No. | | Generated (MW.hr) | Generated (MVAr.hr) | Consumption of Auxiliaries(kW.hr) | Planned Energy Losses | Unplanned Energy Losses | Availability (%) |
| Garri (1) | GT1 | 656.727 | 152.73 | 3,000.00 | 0.00 | 0.00 | 100.00 |
| | GT2 | 0.000 | 0.00 | 6,000.00 | 758.40 | 0.00 | 0.00 |
| | ST1 | 224.700 | 74.10 | | 0.00 | 0.00 | 100.00 |
| | GT3 | 656.727 | 146.62 | 2,000.00 | 0.00 | 0.00 | 100.00 |
| | GT4 | 767.455 | 137.45 | 14,000.00 | 0.00 | 0.00 | 100.00 |
| | ST2 | 0.000 | 0.00 | | 0.00 | 768.00 | 0.00 |
| Garri (2) | GT5 | 0.000 | 0.00 | 0.00 | 758.40 | 0.00 | 0.00 |
| | GT6 | 640.700 | 273.40 | 58,000.00 | 0.00 | 0.00 | 100.00 |
| | ST3 | 275.000 | 140.00 | | 0.00 | 0.00 | 100.00 |
| | GT7 | 0.000 | 0.00 | 36,000.00 | 0.00 | 758.40 | 0.00 |
| | GT8 | 748.000 | 397.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| | ST4 | 331.000 | 195.00 | | 0.00 | 0.00 | 100.00 |
| Total | | 4,300.309 | 1,516.30 | 119,000.00 | 1,516.80 | 1,526.40 | 66.67 |

Figure (2.6)station power generation

- Recourses consumption and supply

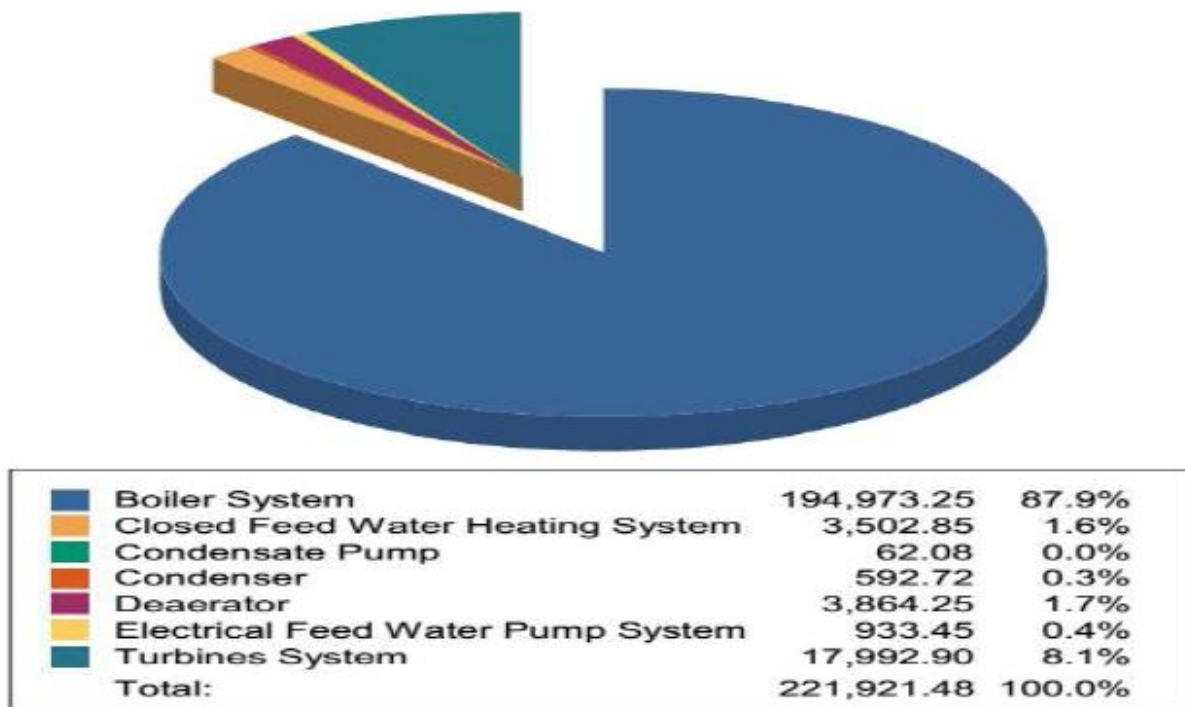| 2. RESOURCES CONSUMPTION & SUPPLY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **THERMAL & DIESEL & GAS TURBINES** | | | | | | | |
| Unit No. | | | | Total Fuel Supply: Tank 1-3 | | River side supply water(ton) | |
| | | LDO | HCGO | | | | |
| Garri (1) | GT1 | 199.40 | 0.00 | 0.000 | | 12193.00 | |
| | GT2 | 0.00 | 0.00 | Pumpable Fuel Stock: Tank 1-3 | | Demin water  quantity(tons) | |
| | GT3 | 3.29 | 195.86 | 2,212.285 | | Plant 1 | Plant 2 |
| | GT4 | 230.24 | 0.00 | Total Fuel Supply: Tank 5-8 | | 120.8 | 130.16 |
| | Aux. Boiler | 0.00 | | 0.000 | tons | Total | 250.96 |
| Garri (2) | GT5 | 0.00 | | Pumpable Fuel Stock: Tank 5-8 | | Total HCGO Stock: Tank 4 | |
| | GT6 | 219.10 | | 11,600.680 | | 131.700 | |
| | GT7 | 0.00 | | Total Fuel Supply: Tank 1-8 | | Total HCGO Supply: Tank 4 | |
| | GT8 | 199.60 | | | | | |
| Total | | 851.63 | 195.86 | 1,970.812 | | 0.00 | tons |
| | | | | Total Pumpable Fuel Stock | | Total Pumpable HCGO :Tank 4 | |
| | | | | 13,812.966 | tons | 7160.581 | tons |

Figure (2.7) Recourses consumption and supply

19

- Units availability and remarks

| Unit No. | | Availability (%) | | MW |
|---|---|---|---|---|
| Garri (1) | GT1 | 100.00 | Normal Operation by LDO. | 27 |
| | GT2 | 0.00 | Planned Outage Due To Clean Lube Oil Cooleres. | 0 |
| | ST1 | 100.00 | Normal Operation by HRSG(1). | 10 |
| | GT3 | 100.00 | Normal Operation by HCGO. | 26 |
| | GT4 | 100.00 | Normal Operation by LDO. | 32 |
| | ST2 | 0.00 | Forced Outage Due To HRSG(3) Internal Lekage. | 0 |
| Garri (2) | GT5 | 0.00 | Planned Outage Due To M.O. | 0 |
| | GT6 | 100.00 | Normal Operation . | 26 |
| | ST3 | 100.00 | Normal Operation by HRSG(6). | 12 |
| | GT7 | 0.00 | Forced Outage Due To Bearing Metal Temperature High. | 0 |
| | GT8 | 100.00 | Normal Operation. | 31 |
| | ST4 | 100.00 | Normal Operation by HRSG(8). | 14 |
| | Total | 66.67 | | 178 |

Figure(2.8)Units availability and remarks

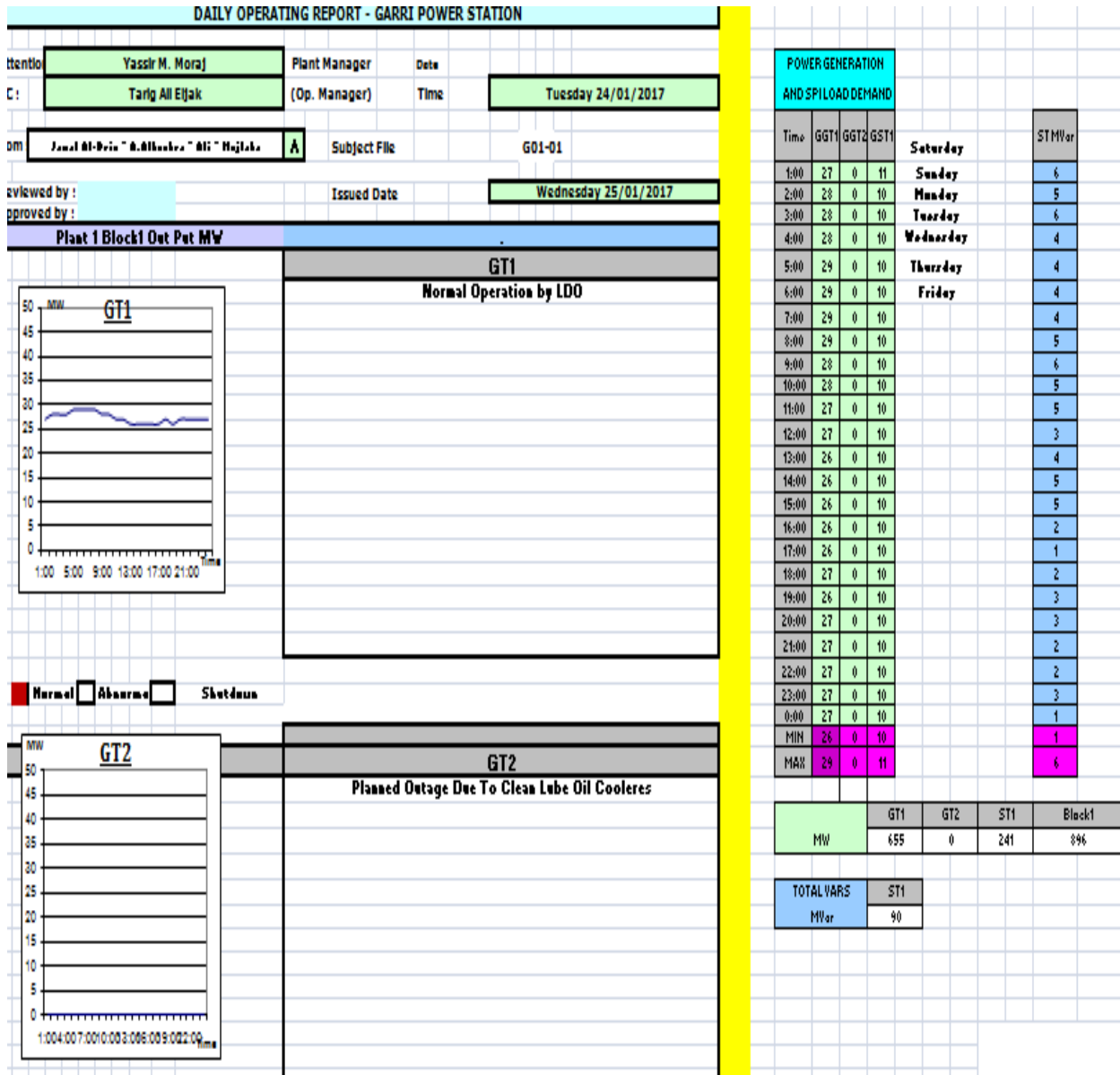- Statues of gas turbines and steam turbines



Figure (2.9) Statues of gas turbines and steam turbines

- By using Watts ,VAr and fuel tank levels recorded by hour for (status report) figure (2.10) , unit data (Watts , VAr , Auxiliary , Totalize and number of start) , Fuel tank levels and water data as data inputs for (performance report) figure (2.11) as data inputs .

الشركة السودانية للتوليد الحراري

الإدارة العامة للتوليد

مجمع محطات كهرباء قري ـ محطة قري (1)

قسم التشغيل

Midnight Data Sheet – Plant

Date : / / 2017        Shift ( ) Operator Name : ...................................................

| Unit | Time | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq | Hz | | | | | | | | | | | | | | | | | | | | | | | | |
| GT(1) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| GT(2) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| ST(1) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| GT(3) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| GT(4) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| ST(2) | MW | | | | | | | | | | | | | | | | | | | | | | | | |
| | MVAr | | | | | | | | | | | | | | | | | | | | | | | | |
| LDO Tank No1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| LDO Tank No2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| LDO Tank No3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| LDO Tank No4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Tank Level | | | | | | | | | | | | | | | | | | | | | | | | | |

GEN-06/F-11        issued Date 1/11/2012        3 years Valid

Figure (2.10) Watts ,VAr and fuel tank levels recorded by hour data

Figure (2.11) units data

## 2.2. About research :

In this research program code will be created by researcher to evaluate Daily Performance , Status Report reports and efficiency of Garri combined cycle power plants by simple program using MATLAB (GUI library ) it's results are accurate results . It's include station power generation , Recourses consumption and supply, Specific fuel consumptions of gas turbines , Units availability , remarks and Units availability , remarks and efficiency . Also it will use same formula of pervious study inputs data figure (2.10) and figure (2.11) . previous study Garri combined cycle power plants Department did not evaluate

efficiency and specific fuel consumption  of Garri combined cycle power plants but this program will evaluate it .

# CHAPTER THREE

# Methodology

# 3. Methodology

The  previous program was created by Microsoft  Excel .It is Software developed and manufactured by Microsoft Corporation that allows users to organize, format, and calculate data with formulas using a spreadsheet system broken up by rows and columns. Microsoft Excel usually comes bundled with Microsoft Office and is compatible with other applications offered in the suite of products. The first software program similar to Excel was released and was called Multiplan . Figure $(3.1)$ below show the interface of entering data :



Figure (3.1) Enter facing of the previous program

But this program was created by MATLAB .  It's the Language of Technical Computing , Also it is a high−level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The

language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java . You can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing. Key Features of MATLAB are High-level language for numerical computation, visualization, and application development , Interactive environment for iterative exploration, design, and problem solving , Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration, and solving ordinary differential equations , Built-in graphics for visualizing data and tools for creating custom plots , Development tools for improving code quality and maintainability and maximizing performance , Tools for building applications with custom graphical interfaces and Functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET, and Microsoft Excel . MATLAB program can create GUI (Graphical User Interfaces) using GUIDE (GUI development environment) provides tools to design user interfaces for custom apps. Using the GUIDE Layout Editor, it can graphically design UI. GUIDE then automatically generates the MATLAB code for constructing the UI, which it can modify to program the behavior of application [7] .

Before entering to the code of the program we must know equations of performance , specific fuel consumption and efficiency of the plant . Also define factors and constants .As researcher mention Garri combined cycle power plant

is consists eight gas turbines each gas turbine connected with HRSG also each two HRSGs connected with each other to operate steam turbine that means it has eight gas turbines (GT1,GT2,GT3,GT4,GT5,GT6,GT7,GT8) and four (ST1,ST2,ST3,ST4) steam turbines . gas turbines use LDO (light diesel oil) and HCGO (heavy cock gas oil) as fuel . GT1 and GT2 support ST1 ,GT3 and GT4 support ST2 , GT5 and GT6 support ST3 finally GT7 and GT8 support ST4 [4] . Also it's necessary to know and understand the equations and constants which create the code according them .

## 3.1. Equations of the program

### 3.1.1. Station power generation [4]

- For [GT1,GT2,GT3,GT4] Power generated (MW.hr)=((today MW.hr read − Yesterday MW.hr read)*10500*800/110)/1000         (3.1)

- For [ST1,ST2,GT5,GT6,GT7,GT8,ST3,ST4] Power generated (MW.hr)=((today MW.hr read − Yesterday MW.hr read)* 1000)/1000 (3.2)

- For [GT1,GT2,GT3,GT4] Power Factor generated (KVAr.hr)=((today VAr.hr read − Yesterday VAr.hr read)*10500*800/110)/1000     (3.3)

- For [ST1,ST2,GT5,GT6,GT7,GT8,ST3,ST4]Power Factor generated (MW.hr) =((today MW.hr readVAr.hr − Yesterday VAr.hr read)*1000)/1000 

           (3.4)

- Consumption of Auxiliaries (KW.hr)=(Today MW.hr Consumption of Auxiliaries read− MW.hr Consumption of Auxiliaries read)*1000     (3.5)

- Planned Energy Losses =(31.6)(planned outage 1(hour)+ planned outage 2(hour)) $\qquad$ (3.6)

- Unplanned Energy Losses= (31.6)( Forced Outage 1+ Forced Outage 2)

- Availability=(24−planned outage 1− planned outage2−forced outage1− forced outage2)/24 *100 $\qquad$ (3.7)

## 3.1.2. Resources consumption and supply [4]

- LDO consumption =totalize read today −totalize read yesterday $\qquad$ (3.8)

- HCGO consumption =totalize read today −totalize read yesterday $\quad$ (3.9)

- LDO Pump able fuel stock in Tank1_3=((LDO tank 1 level*3.14*D12*density )−300)+ ((LDO tank 3 level*3.14*D32*density )−300) $\qquad$ (3.10)

D1−3=11.25 m

Density of LDO=0.82 kg/m3

- LDO Pump able Fuel Stock in Tank 5−8=(( LDO tank 5 level*3.14*D52*density )−265)+ (( LDO tank 6 level*3.14*D62*density )−265)+( (LDO tank 7 level*3.14*D72*density )−300)−(( LDO tank 8 level*3.14*D82*density) −300) $\qquad$ (3.11)

D5−6   = 11.85 m

Density of LDO=0.82 kg/m3

- Total LDO Pump able Fuel Stock= LDO Pump able fuel stock in Tank1_3+ LDO Pump able Fuel Stock in Tank 5−8                         (3.12)

- Total HCGO  Pump able in Tank 2−4 = ( (HCGO Tank 2 level*3.14*D22*density )−300)− ( (HCGO Tank 4 level*3.14*D42*density )−300)                         (3.13)

D2−4  =11.25 m

Density of HCGO=0.858 kg/m3

- LDO fuel supply =Total present fuel stock –( previews LDO fuel stock –total LDO consumption)                         (3.14)

- HCGO  fuel supply =Total present fuel stock –( previews HCGO fuel stock –total HCGO consumption)                         (3.15)

- Efficiency =(3600*100)/(heat rate)

  Heat rate =(LDO consumption *1000*LDO heating value + HCGO consumption *1000* HCGO heating value)/power generation        (3.15)

HCGO heating value= 45125

LDO heating value= 45859

## 3.2. How dose performance and status program work ?

Here researcher will use data of 18-05-2017 for calculation with primary value selection and 19-05-2017 for calculation without primary value selection .

### 3.3.1. Main interface

there are two chooise :

- Calculation with primary value selection:

That means you have to enter primary values as shown at figure (3.2) bellow then press done to keep primary values .
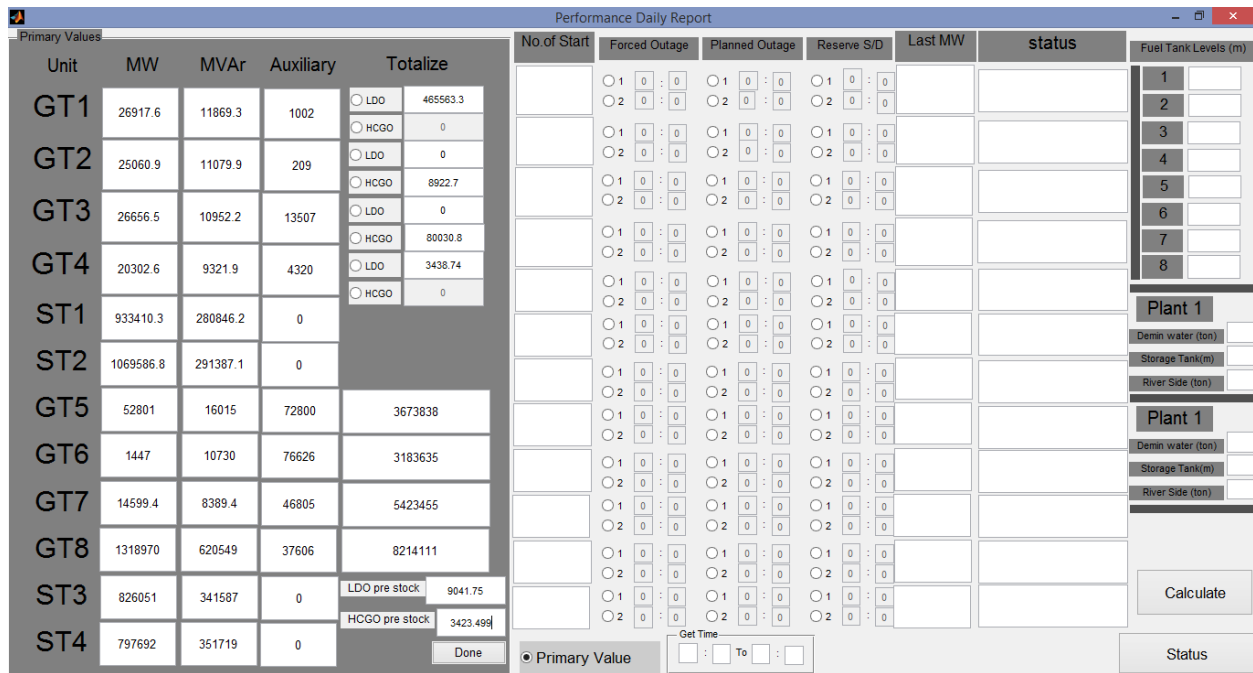


Figure (3.2)  Main  interface with primary values

After pressing done the primary values will be saved and the value of today will appear as shown in figure (3.3) bellow . after that enter another values as shown in figure bellow :
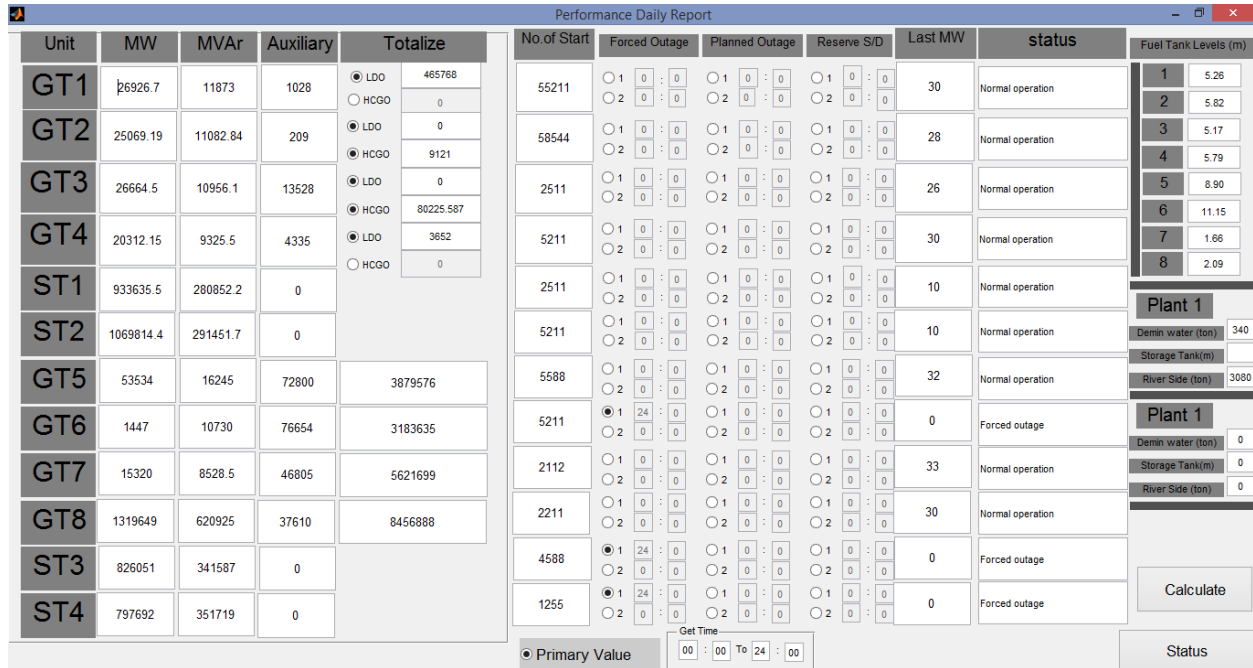


Figure (3.3) Main interface with primary selection

When user press calculate the program will use primary and today values to give result as shown in figure (3.4) :
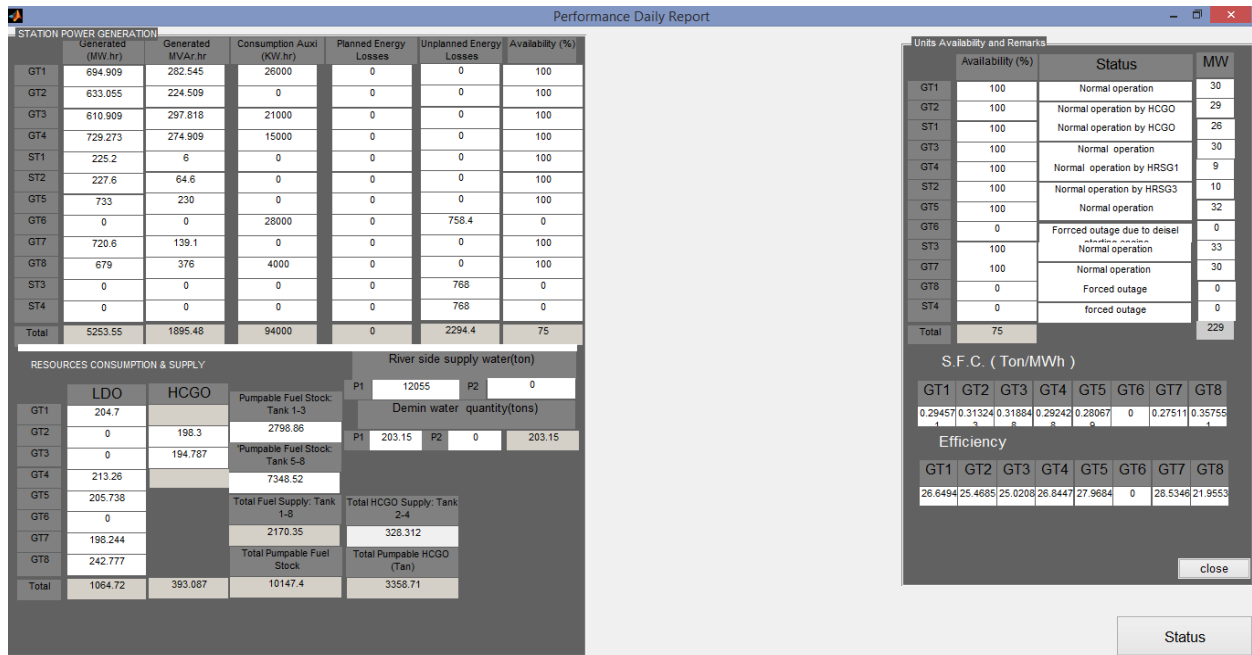
Figure (3.4)  results interface with primary selection

- Calculation without primary value selection:

After first time user don't need to enter primary values . program need just today valuse . also its necessary to make primary value radio button unactive then enter the values as shown bellow :
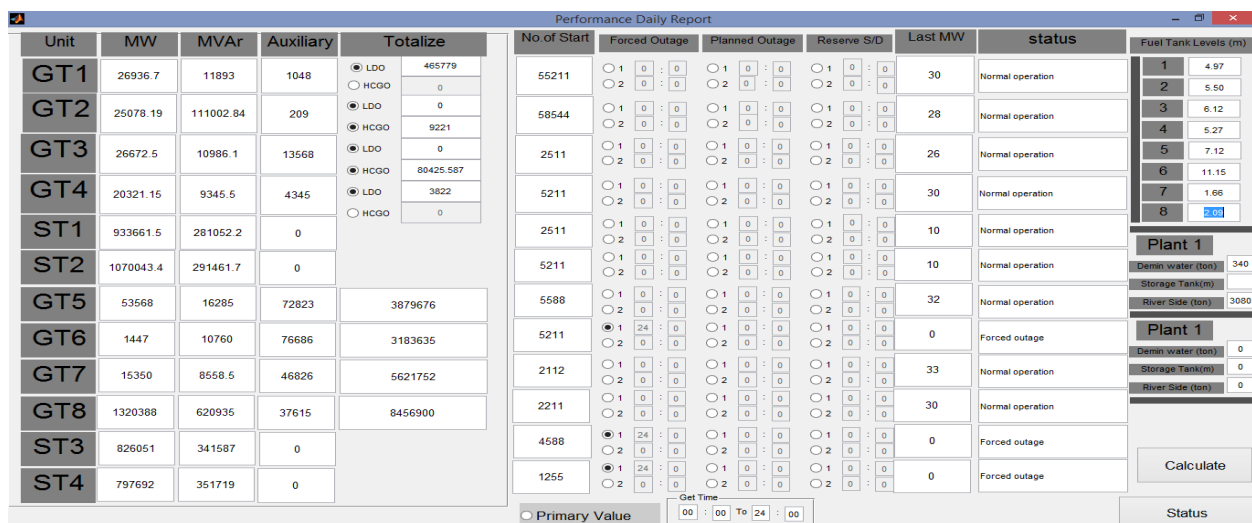


Figure (3.5)  Main  interface without primary selection

After press calculate results will appear as shown in figure (3.6) bellow:
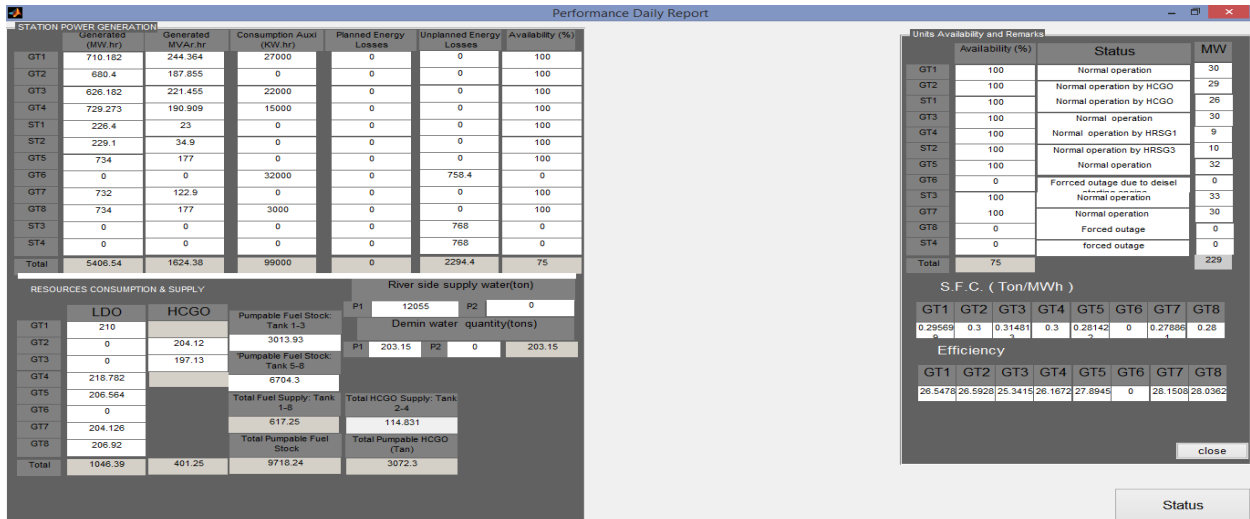


Figure (3.6) results interface without primary selection

### 3.3.2. Status interface :

When user press status pushbutton a status interface will appear as shown in figure (3.7) bellow :
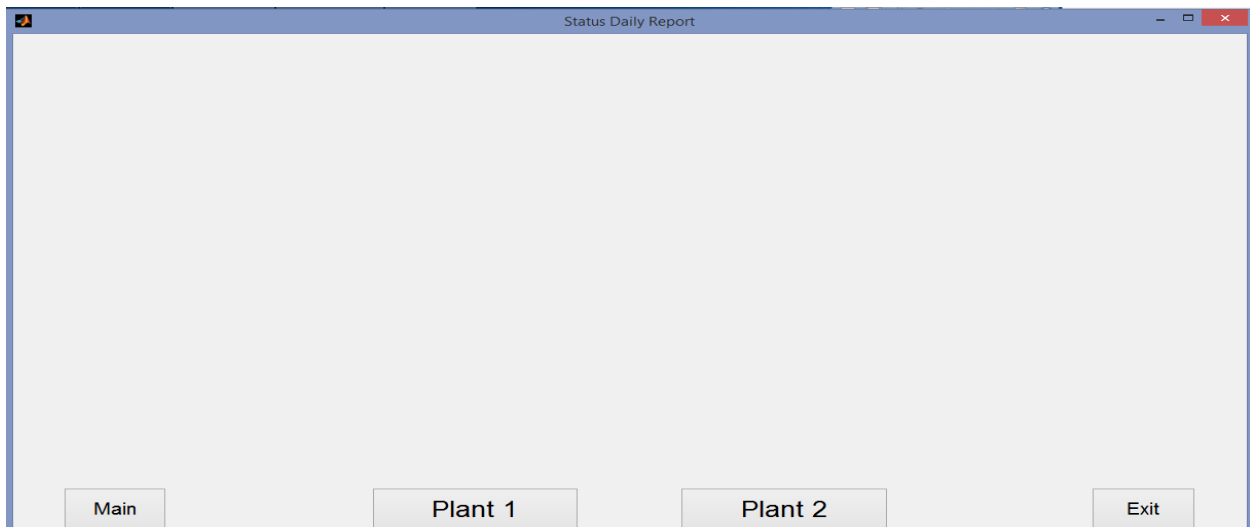


Figure (3.7) Status interface

When user choose plant 1 status values will appear to entring as shown in figure (3.8) bellow :
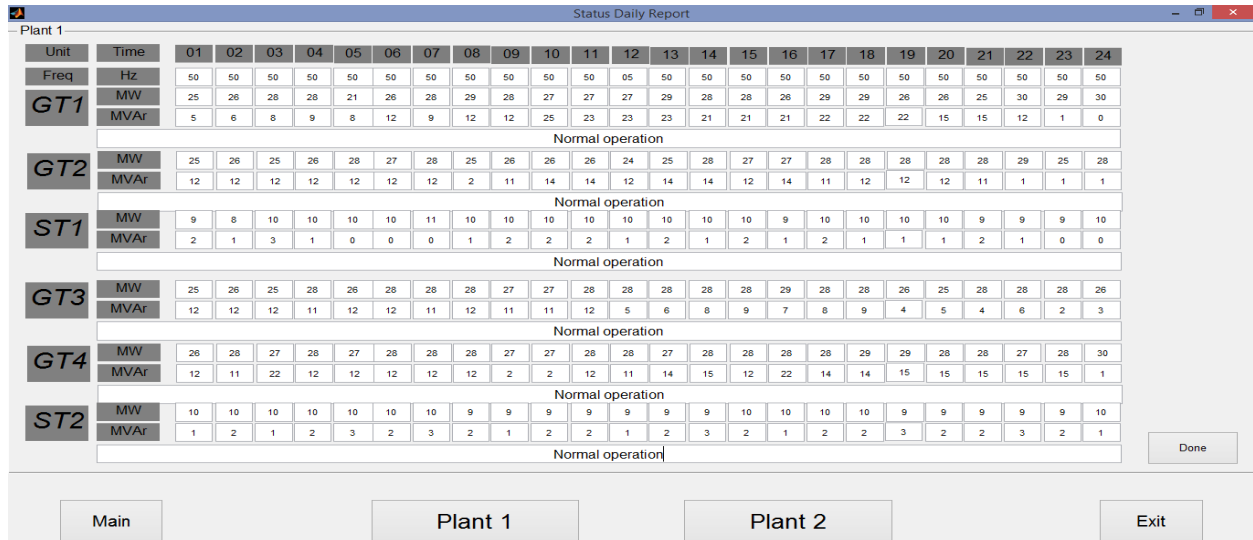


Figure (3.8)  Entering values of plant 1

After enter values and press done the charts of status will appear as shown in figure (3.9)  bellow :
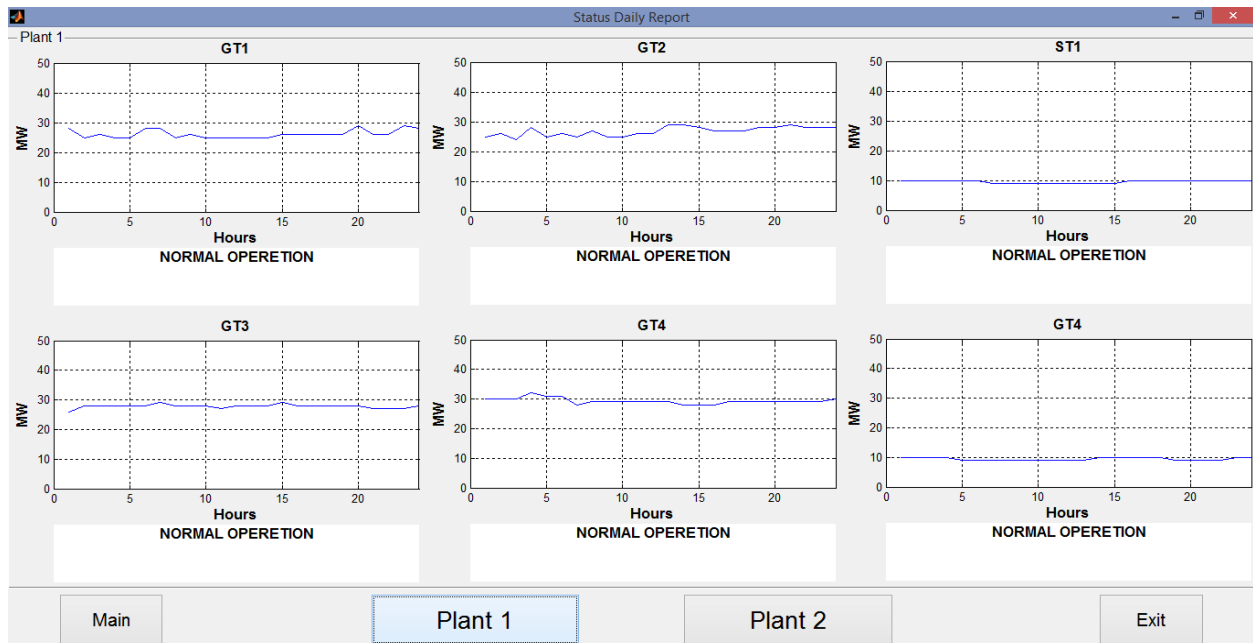


Figure (3.9)  status charts of plant 1

Also in plant 2 values as shown in figure (3.9) and charts of status in figure (3.10) :

| Unit | Time | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Freq | Hz | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| GT5 | MW | 30 | 29 | 30 | 30 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 29 | 29 | 28 | 29 | 31 | 31 | 30 | |
| | MVAr | 8 | 8 | 8 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 8 | 9 | 8 | 9 | 8 | 5 | 5 | 5 | 5 | 2 | 2 | 2 |
| | | | | | | | | | | | Normal operation | | | | | | | | | | | | | | |
| GT6 | MW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | MVAr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | Forced outage | | | | | | | | | | | | | | |
| ST3 | MW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | MVAr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | Forced outage | | | | | | | | | | | | | | |
| GT7 | MW | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 30 | 30 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 33 |
| | MVAr | 7 | 8 | 9 | 8 | 7 | 4 | 6 | 5 | 6 | 5 | 5 | 5 | 2 | 1 | 10 | 10 | 10 | 12 | 12 | 12 | 5 | 5 | 6 | 5 |
| | | | | | | | | | | | Normal operation | | | | | | | | | | | | | | |
| GT8 | MW | 31 | 32 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 28 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 29 | 29 | 31 | 30 | |
| | MVAr | 8 | 6 | 5 | 8 | 5 | 6 | 5 | 8 | 5 | 6 | 5 | 6 | 5 | 6 | 5 | 6 | 5 | 4 | 5 | 6 | 5 | 6 | 6 | 5 |
| | | | | | | | | | | | Normal operation | | | | | | | | | | | | | | |
| ST4 | MW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | MVAr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | Forced outage | | | | | | | | | | | | | | |

Main   Plant 1   Plant 2   Exit

Figure (3.9) Entering values of plant 2
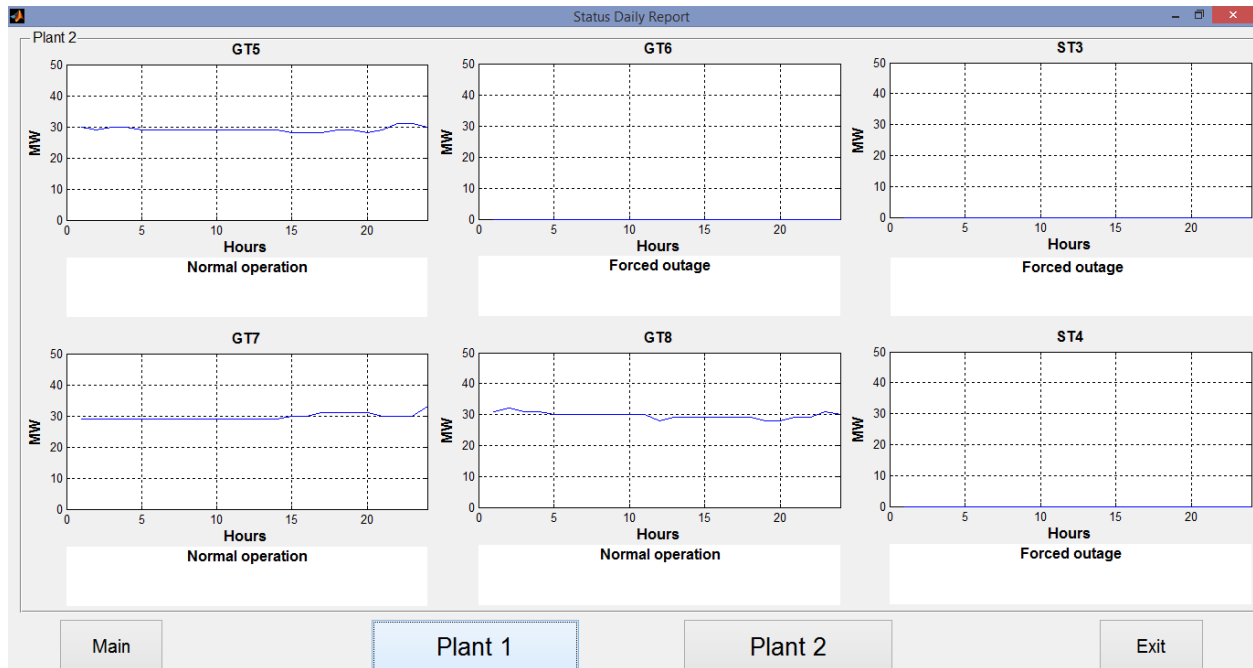
Figure (3.10) status charts of plant 2

# CHAPTER FOUR

# Results and Discussion

# 4 . Results and Discussion

As researcher mention this research create performance and status of Garri Combined Cycle Power Plants (plant 1 and plant 2 ) also this report consist station power generation (MW.hr generated , MVAr.hr generated , KW.hr auxiliary consumption , planned energy losses , unplanned energy losses and availability ) , resource consumption and supply , units availability and remarks , S.F.C and efficiency . After creating  program and operate we found :

## 4 .1. Results :

Data of 18−05−2017 with primary values and status data in figure (3.15) and figure (3.17) shown tables  below :

Table (4.1)   primary values

| No | MW | MVAr | Auxilliary | Totalize |
|------|-----------|----------|------------|-----------|
| GT 1 | 26917.6 | 11869.3 | 1002 | 465563.3 |
| GT 2 | 25060.9 | 11079.9 | 209 | 8922.7 |
| GT 3 | 26656.5 | 10952.2 | 13507 | 80030.8 |
| GT 4 | 20302.6 | 9321.9 | 4320 | 3438.74 |
| ST 1 | 933410.3 | 280846.2 | | |
| ST 2 | 1069586.8 | 291387.1 | | |
| GT 5 | 52801 | 16015 | 72800 | 3673838 |
| GT 6 | 1447 | 10730 | 76626 | 3183635 |
| GT 7 | 14599.4 | 8389.4 | 46805 | 5423455 |
| GT 8 | 1318970 | 620549 | 37606 | 8214111 |
| ST 3 | 826051 | 341587 | | |
| ST 4 | 797692 | 351719 | | |

Table (4.2)  Data of 18−05−2017

|  | MW generated | MVAr generated | Auxilliary | Totalize | No .of start | Tank | Level |
|---|---|---|---|---|---|---|---|
| GT 1 | 26926.7 | 11873 | 1028 | 465768 | 498 | Tank (1) | 5.26 |
| GT 2 | 25069.19 | 11082.84 | 209 | 9121 | 1308 | Tank (2) | 5.82 |
| GT 3 | 26664.5 | 10956.1 | 13528 | 80225.587 | 288 | Tank (3) | 5.17 |
| GT 4 | 20312.15 | 9325.5 | 4335 | 3652 | 950 | Tank (4) | 5.79 |
| ST 1 | 933635.5 | 280852.2 |  |  | 197 | Tank (5) | 8.9 |
| ST 2 | 1069814.4 | 291451.7 |  |  | 183 | Tank (6) | 11.15 |
| GT 5 | 52801 | 16245 | 72800 | 3879576 | 1884 | Tank (7) | 1.66 |
| GT 6 | 53534 | 10730 | 76654 | 3183635 | 40 | Tank (8) | 2.09 |
| GT 7 | 1447 | 8528.5 | 46805 | 5621699 | 1896 |  |  |
| GT 8 | 1319649 | 620925 | 37610 | 8456888 | 686 |  |  |
| ST 3 | 826051 | 341587 |  |  | 98 |  |  |
| ST 4 | 797692 | 351719 |  |  | 114 |  |  |

Table (4.3)  : Data of river and demin water

| Demin water  quantity(tons) plant (1) | 344.1 |
|---|---|
| Demin water  quantity(tons) plant (2) | 0 |
| River side supply water(ton)   plant (1) | 81920 |
| River side supply water(ton)   plant (2) | 0 |

The results of performance for these data and status data were shown in figures
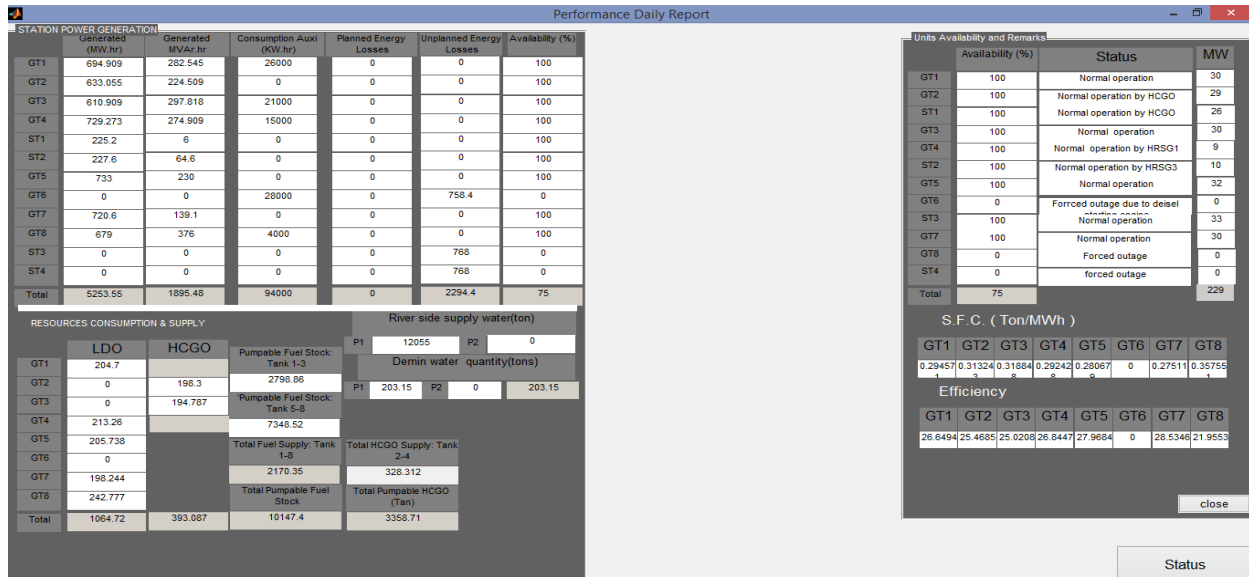
below :



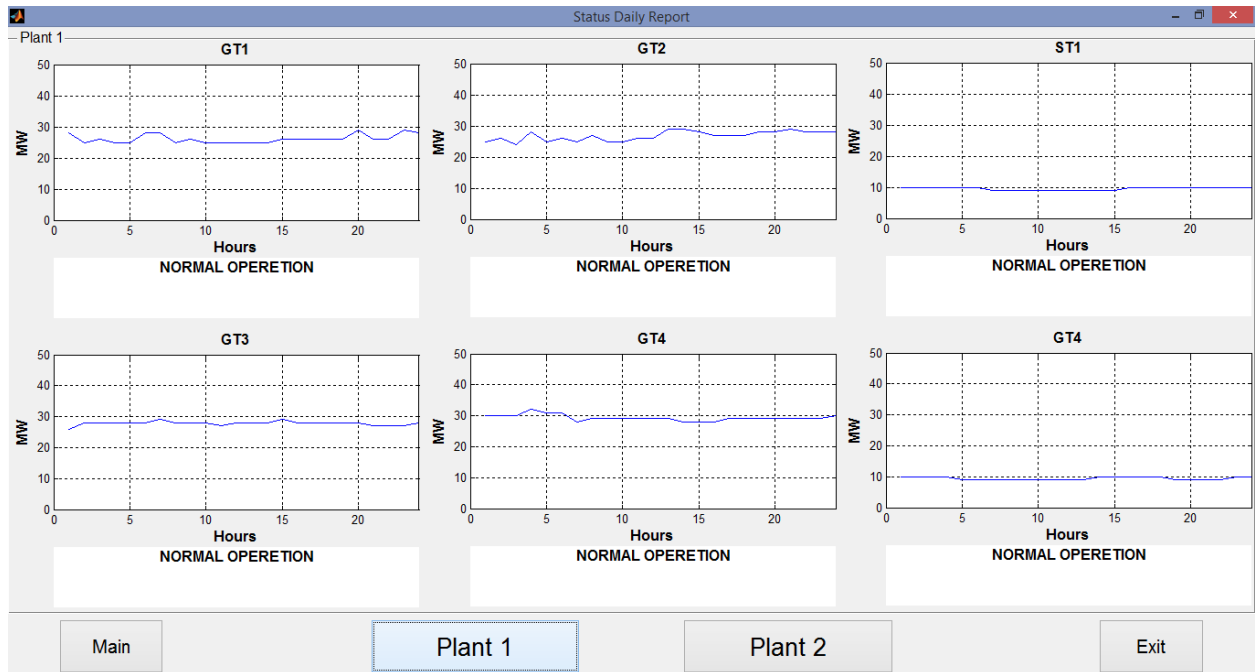Figure (4.1) results of 18-05-2017 Data

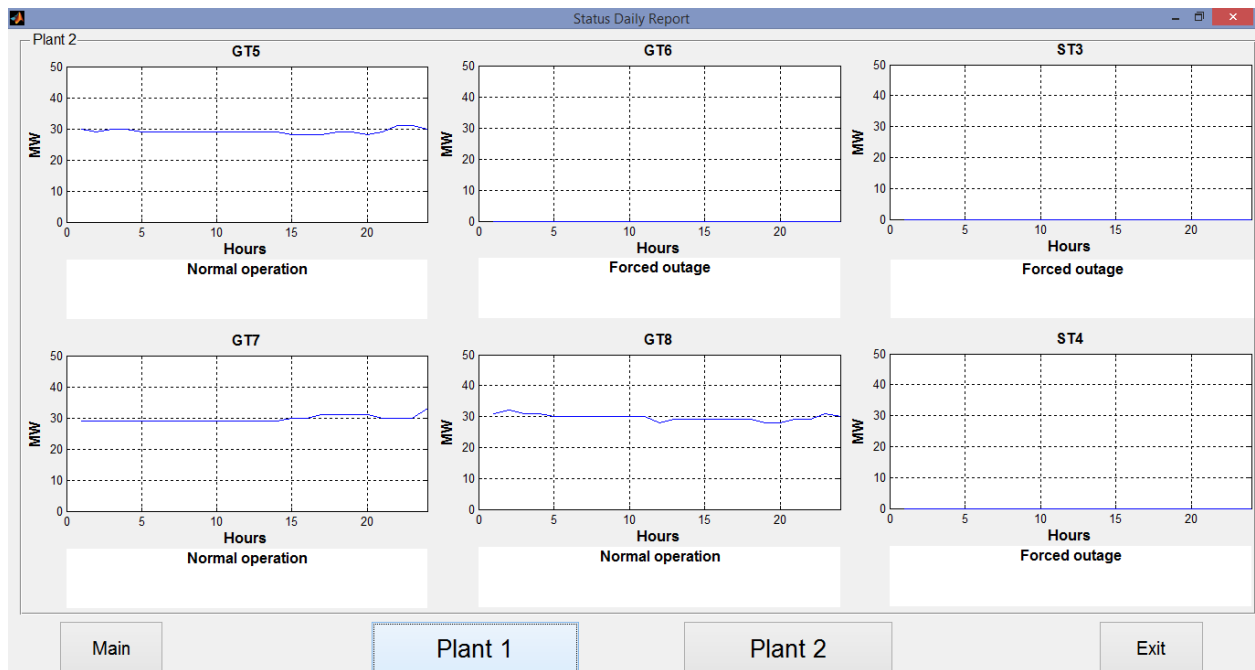Figure (4.2) status graphic of 18-05-2017 Data for plant (1)



Figure (4.3) status graphic of 18-05-2017 Data for plant (2)

Also data of 19−05−2017 without primary values as shown in tables below :

Table (4.4)  : Data of 19−05−2017

|  | MW generated | MVAr generated | Auxilliary | Totalize | No .of start | Tank | Level |
|---|---|---|---|---|---|---|---|
| GT 1 | 26926.7 | 11873 | 1028 | 465768 | 498 | Tank (1) | 5.26 |
| GT 2 | 25069.19 | 11082.84 | 209 | 9121 | 1308 | Tank (2) | 5.82 |
| GT 3 | 26664.5 | 10956.1 | 13528 | 80225.587 | 288 | Tank (3) | 5.17 |
| GT 4 | 20312.15 | 9325.5 | 4335 | 3652 | 950 | Tank (4) | 5.79 |
| ST 1 | 933635.5 | 280852.2 |  |  | 197 | Tank (5) | 8.9 |
| ST 2 | 1069814.4 | 291451.7 |  |  | 183 | Tank (6) | 11.15 |
| GT 5 | 52801 | 16245 | 72800 | 3879576 | 1884 | Tank (7) | 1.66 |
| GT 6 | 53534 | 10730 | 76654 | 3183635 | 40 | Tank (8) | 2.09 |
| GT 7 | 1447 | 8528.5 | 46805 | 5621699 | 1896 |  |  |
| GT 8 | 1319649 | 620925 | 37610 | 8456888 | 686 |  |  |
| ST 3 | 826051 | 341587 |  |  | 98 |  |  |
| ST 4 | 797692 | 351719 |  |  | 114 |  |  |

Table (4.5)  : Data of river and demin water

| Demin water  quantity(tons) plant (1) | 203.15 |
|---|---|
| Demin water  quantity(tons) plant (2) | 0 |
| River side supply water(ton)   plant (1) | 12055 |
| River side supply water(ton)   plant (2) | 0 |

The results of performance for these data and status data were shown in figures and figure bellow :
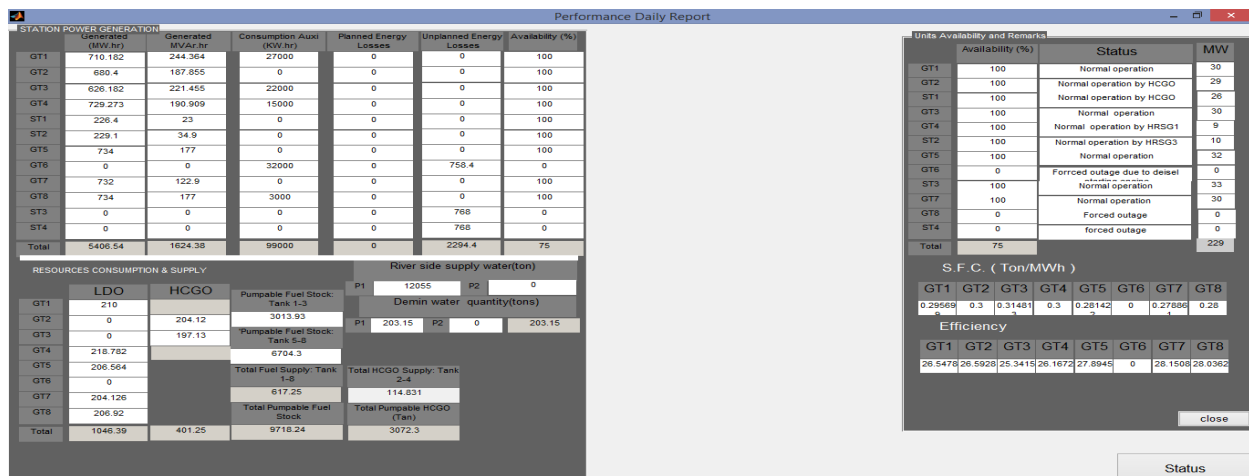


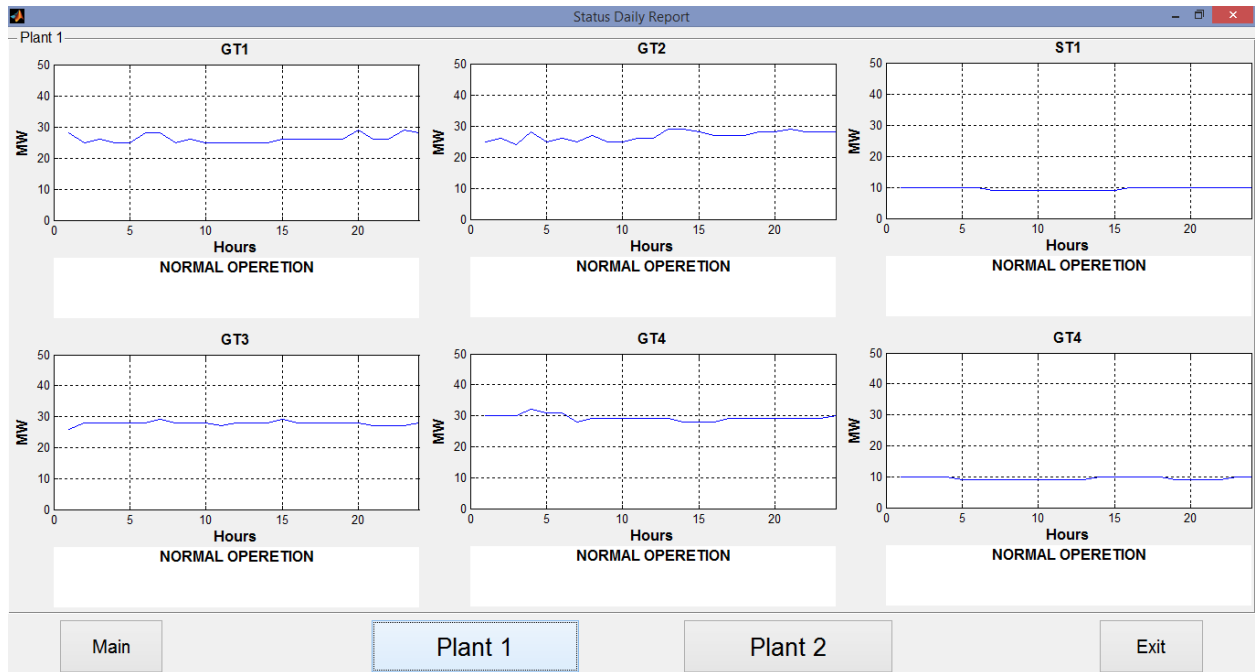Figure (4.4) results of 18-05-2017 Data

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Figure (4.5) status graphic of 19-05-2017 Data for plant (1)
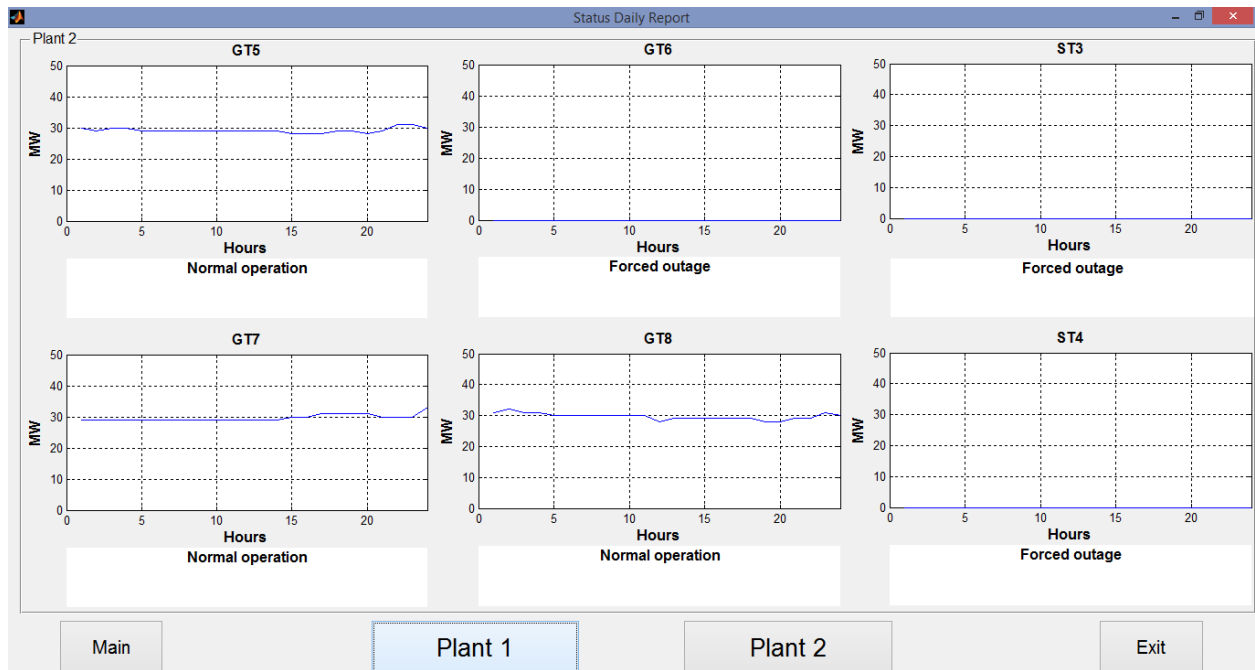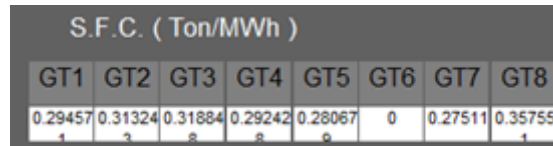


Figure (4.6) status graphic of 19-05-2017 Data for plant (2)

## 4.2. Discussions

1-It's results are same  in comparison with previous program results and results of this program .

2- It's  easy to use more than author programs    because it has graphical user interface that makes data entering so easy for engineers .
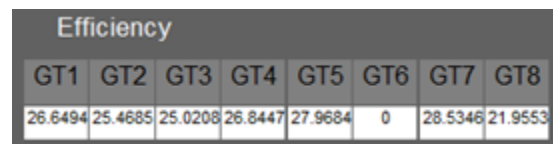
3- It can calculate   specific fuel consumption report   for each gas turbine    in comparison with previous programs   .as shown in figure below :

| S.F.C. ( Ton/MWh ) | | | | | | | |
|---|---|---|---|---|---|---|---|
| GT1 | GT2 | GT3 | GT4 | GT5 | GT6 | GT7 | GT8 |
| 0.294571 | 0.313243 | 0.318846 | 0.292428 | 0.280679 | 0 | 0.27511 | 0.357551 |

Figure (4.7) S.F.C

4- It can find and calculate efficiency report for each gas turbine   in comparison with previous programs . as shown in figure below :

| Efficiency | | | | | | | |
|---|---|---|---|---|---|---|---|
| GT1 | GT2 | GT3 | GT4 | GT5 | GT6 | GT7 | GT8 |
| 26.6494 | 25.4685 | 25.0208 | 26.8447 | 27.9684 | 0 | 28.5346 | 21.9553 |

Figure (4.8) Efficiency

5- It doesn't need mush time to enter the data because interface of this program is not complicate and it is arranged according to data sheet in the plant . in comparison with previous programs it takes few minutes to prepare daily report .

# CHAPTER FIVE

# Conclusion and Recommendations

## 5.1. Conclusion

In this study a program was built using MATLAB (GUI) to improve performance of Garri Combined Cycle Power Plants . So the program was useful it can content two interface with their results . First on Main interface interface that show performance of plants and second interface show status of plants .

A data of date $18-5-2017$ was used in primary value selection and data of date $19-5-2017$ was used also for without primary value selection . Results were very accurate Station power generation table figure$(4.1)$ for data of date $18-5-2017$ and figure $(4.4)$ for data of date $19-5-2017$ , It's content power generated , power factor generation , power auxiliary consumption , planned energy losses , unplanned energy losses and availability for each machine . Also resources consumption and supply table , It's content LDO and HCGO fuel consumption for each machine , total pump able fuel stock in tanks , total fuel stock ,river side supply water , and demin water quantity for each plant . Also units availability and remarks table , it's content availability , status and last power generated recorded . Also specific fuel consumption table and efficiency table for each machine .

Also used in status interface data of date $18-5-2017$ and its results were graphics in figure $(4.1)$ and figure $(4.2)$ and data of date $19-5-2017$ also its results were graphics in figure $(4.5)$ and figure $(4.6)$ .

This program was so easy to use all engineers didn't found any difficult to deal with its interface and get results . Also it doesn't waste time to prepare

reports just fill data and press calculate . when it used in Garri Combined Cycle

Power Plants it just took ten minutes to fill data and get results

## 5.2.Recommendations

1- Develop this program to calculate gross heat rate .

2- Also get net gross heat rate , specific heat rate and net efficiency.

3- Make this program calculate gross generation cost .

4- Develop this program to calculate time maintenance using operating hours.

5- Develop this program to calculate capacity factor.

6- Develop this program to connect with internet to evaluate performance and status of other plants .

7- Convert this program into android application to calculate performance and status by mobile phone .

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# 5.4.Appendices

## 5.4.1 Appendix A: Main figure code

After we know and understand the equation and constants it's necessary moving to the code . A GUI program consist two files m.file and figure file . figure file for interfacing and m.file to write codes . This program consist two figures main figure and status figure .

Main content edit text to write the values ,primary value , calculate pushbutton and status shown in figure bellow figure (5.1) :



Figure (5.1) Main interface

- Primary value radio button :

If user select  this Primary value radio button activated  value s that means make its value one that makes a new panel appear to enter primary values .

Code of primary value radio button :

```
function radiobutton294_Callback(hObject, eventdata, handles)
a=get(hObject,'value');
if a==1
    set(handles.uipanel4,'visible','on')
    set(handles.uipanel5,'visible','off')
else
    set(handles.uipanel5,'visible','on')
    set(handles.uipanel4,'visible','off')
end
```
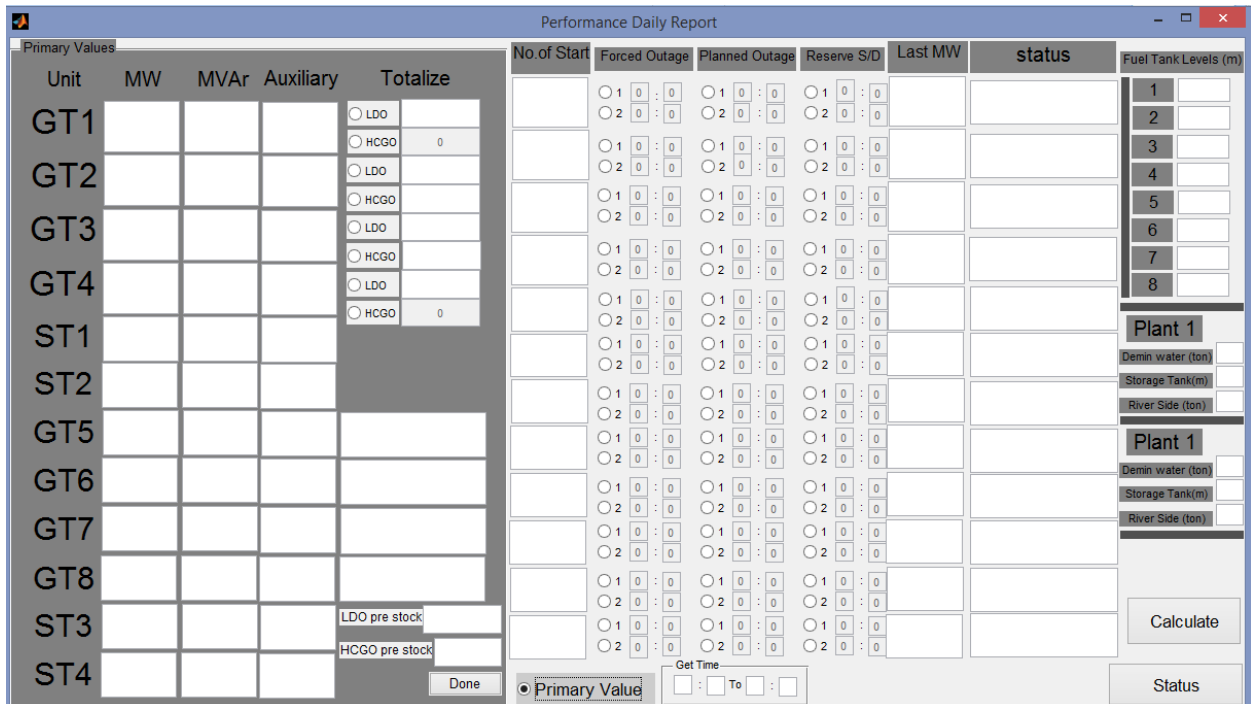


Figure (5.2) Primary interface

After user enter primary values then press done to save the values .

Code of  Done :

```
function pushbutton11_Callback(hObject, eventdata, handles)
 set(handles.uipanel4,'visible','off')
 set(handles.uipanel5,'visible','on')
```

after pressing Done and the primary value radio button activated as shown bellow

in figure (5.3)  :
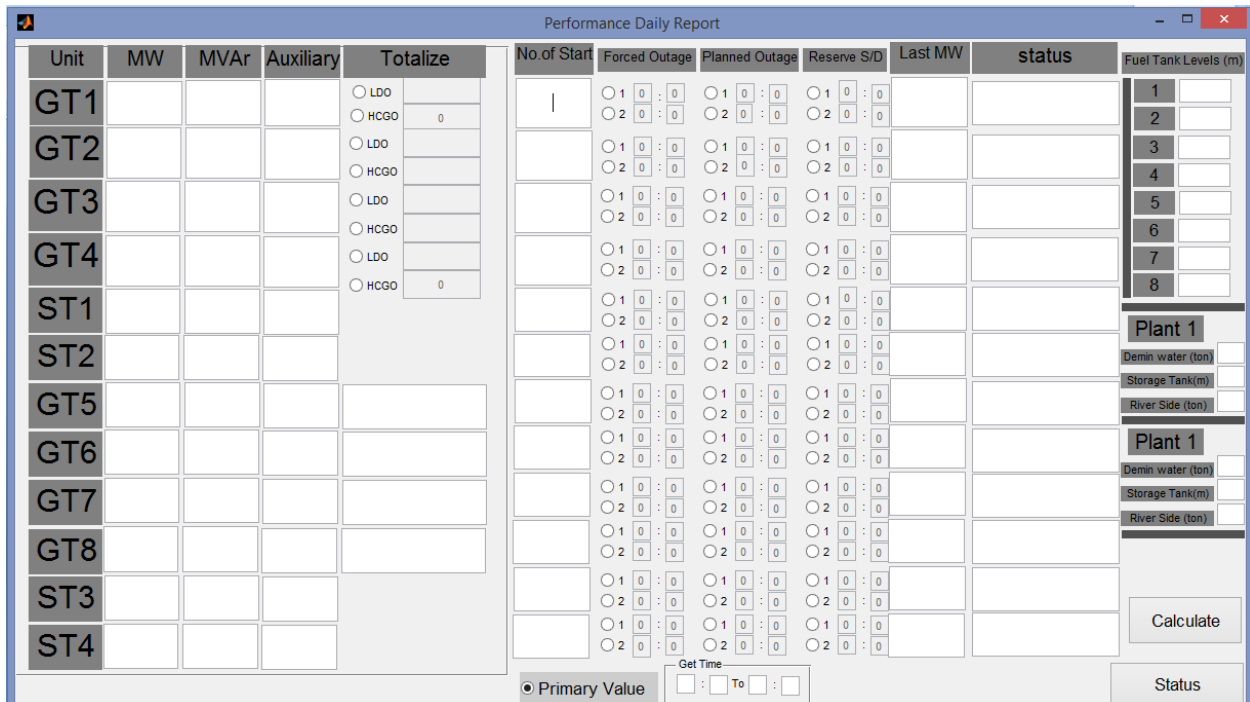


Figure (5.3)  Calculate with primary interface

- After enter all values then press calculate pushbutton

Code of calculate :

```
function pushbutton6_Callback(hObject, eventdata, handles)
%visible on generation
 set(handles.uipanel6,'visible','on')
 set(handles.uipanel7,'visible','on')
```

```matlab
set(handles.text837,'visible','on')


%visible  off texts
set(handles.radiobutton294,'visible','off')
set(handles.edit49,'visible','off')
set(handles.edit50,'visible','off')
set(handles.edit51,'visible','off')
set(handles.edit52,'visible','off')
set(handles.edit53,'visible','off')
set(handles.edit54,'visible','off')
set(handles.edit55,'visible','off')
set(handles.edit56,'visible','off')
set(handles.edit57,'visible','off')
set(handles.edit58,'visible','off')
set(handles.edit59,'visible','off')
set(handles.edit60,'visible','off')
set(handles.text6,'visible','off')
set(handles.uipanel5,'visible','off')
%visible off status
set(handles.edit685,'visible','off')
set(handles.edit684,'visible','off')
set(handles.edit686,'visible','off')
set(handles.edit687,'visible','off')
set(handles.edit688,'visible','off')
set(handles.edit689,'visible','off')
set(handles.edit690,'visible','off')
set(handles.edit691,'visible','off')
set(handles.edit692,'visible','off')
set(handles.edit693,'visible','off')
set(handles.edit694,'visible','off')
set(handles.edit695,'visible','off')
set(handles.edit696,'visible','off')
set(handles.edit697,'visible','off')
set(handles.edit698,'visible','off')
set(handles.edit699,'visible','off')
set(handles.edit700,'visible','off')
set(handles.edit701,'visible','off')
set(handles.edit702,'visible','off')
set(handles.edit703,'visible','off')
set(handles.edit704,'visible','off')
set(handles.edit705,'visible','off')
set(handles.edit706,'visible','off')
set(handles.edit707,'visible','off')
set(handles.edit716,'visible','off')
set(handles.edit717,'visible','off')
set(handles.edit718,'visible','off')
set(handles.edit719,'visible','off')
set(handles.edit720,'visible','off')
set(handles.edit721,'visible','off')
set(handles.edit722,'visible','off')
set(handles.edit723,'visible','off')
set(handles.edit724,'visible','off')
set(handles.edit725,'visible','off')
set(handles.edit726,'visible','off')
set(handles.edit727,'visible','off')
```

```matlab
 set(handles.edit728,'visible','off')
 set(handles.edit729,'visible','off')

 set(handles.text401,'visible','off')
 set(handles.text420,'visible','off')
 set(handles.text411,'visible','off')
 set(handles.text412,'visible','off')
 set(handles.text413,'visible','off')
 set(handles.text414,'visible','off')
 set(handles.text415,'visible','off')
 set(handles.text416,'visible','off')
 set(handles.text417,'visible','off')
 set(handles.text418,'visible','off')
 set(handles.text419,'visible','off')
 set(handles.text432,'visible','off')
 set(handles.text425,'visible','off')
 set(handles.text421,'visible','off')
 set(handles.text422,'visible','off')
 set(handles.text423,'visible','off')
 set(handles.text424,'visible','off')
 set(handles.text426,'visible','off')
 set(handles.text427,'visible','off')
 set(handles.text428,'visible','off')
 set(handles.text429,'visible','off')
 set(handles.text430,'visible','off')
 set(handles.text431,'visible','off')
 set(handles.pushbutton6,'visible','off')
%with primary values selection
pri=get(handles.radiobutton294,'value')
if pri==1
prgt1w=str2double(get(handles.edit826,'string'));
prgt2w=str2double(get(handles.edit827,'string'));
prgt3w=str2double(get(handles.edit828,'string'));
prgt4w=str2double(get(handles.edit829,'string'));
prst1w=str2double(get(handles.edit830,'string'));
prst2w=str2double(get(handles.edit831,'string'));
prgt5w=str2double(get(handles.edit832,'string'));
prgt6w=str2double(get(handles.edit833,'string'));
prgt7w=str2double(get(handles.edit834,'string'));
prgt8w=str2double(get(handles.edit835,'string'));
prst3w=str2double(get(handles.edit836,'string'));
prst4w=str2double(get(handles.edit837,'string'));
prgt1v=str2double(get(handles.edit838,'string'));
prgt2v=str2double(get(handles.edit839,'string'));
prgt3v=str2double(get(handles.edit840,'string'));
prgt4v=str2double(get(handles.edit841,'string'));
prst1v=str2double(get(handles.edit842,'string'));
prst2v=str2double(get(handles.edit843,'string'));
prgt5v=str2double(get(handles.edit844,'string'));
prgt6v=str2double(get(handles.edit845,'string'));
prgt7v=str2double(get(handles.edit846,'string'));
prgt8v=str2double(get(handles.edit847,'string'));
prst3v=str2double(get(handles.edit848,'string'));
prst4v=str2double(get(handles.edit849,'string'));
prgt1a=str2double(get(handles.edit850,'string'));
prgt2a=str2double(get(handles.edit851,'string'));
prgt3a=str2double(get(handles.edit852,'string'));
```

```matlab
prgt4a=str2double(get(handles.edit853,'string'));
prst1a=str2double(get(handles.edit854,'string'));
prst2a=str2double(get(handles.edit855,'string'));
prgt5a=str2double(get(handles.edit856,'string'));
prgt6a=str2double(get(handles.edit857,'string'));
prgt7a=str2double(get(handles.edit858,'string'));
prgt8a=str2double(get(handles.edit859,'string'));
prst3a=str2double(get(handles.edit860,'string'));
prst4a=str2double(get(handles.edit861,'string'));
prgt1tl=str2double(get(handles.edit862,'string'));
prgt1th=str2double(get(handles.edit863,'string'));
prgt2tl=str2double(get(handles.edit864,'string'));
prgt2th=str2double(get(handles.edit865,'string'));
prgt3tl=str2double(get(handles.edit866,'string'));
prgt3th=str2double(get(handles.edit867,'string'));
prgt4tl=str2double(get(handles.edit868,'string'));
prgt4th=str2double(get(handles.edit869,'string'));
prgt5t=str2double(get(handles.edit870,'string'));
prgt6t=str2double(get(handles.edit871,'string'));
prgt7t=str2double(get(handles.edit872,'string'));
prgt8t=str2double(get(handles.edit873,'string'));

%Value Entered

gt1w=str2double(get(handles.edit874,'string'));
gt2w=str2double(get(handles.edit875,'string'));
gt3w=str2double(get(handles.edit876,'string'));
gt4w=str2double(get(handles.edit877,'string'));
st1w=str2double(get(handles.edit878,'string'));
st2w=str2double(get(handles.edit879,'string'));
gt5w=str2double(get(handles.edit880,'string'));
gt6w=str2double(get(handles.edit881,'string'));
gt7w=str2double(get(handles.edit882,'string'));
gt8w=str2double(get(handles.edit883,'string'));
st3w=str2double(get(handles.edit884,'string'));
st4w=str2double(get(handles.edit885,'string'));
gt1v=str2double(get(handles.edit886,'string'));
gt2v=str2double(get(handles.edit887,'string'));
gt3v=str2double(get(handles.edit888,'string'));
gt4v=str2double(get(handles.edit889,'string'));
st1v=str2double(get(handles.edit890,'string'));
st2v=str2double(get(handles.edit891,'string'));
gt5v=str2double(get(handles.edit892,'string'));
gt6v=str2double(get(handles.edit893,'string'));
gt7v=str2double(get(handles.edit894,'string'));
gt8v=str2double(get(handles.edit895,'string'));
st3v=str2double(get(handles.edit896,'string'));
st4v=str2double(get(handles.edit897,'string'));
gt1a=str2double(get(handles.edit898,'string'));
gt2a=str2double(get(handles.edit899,'string'));
gt3a=str2double(get(handles.edit900,'string'));
gt4a=str2double(get(handles.edit901,'string'));
st1a=str2double(get(handles.edit902,'string'));
st2a=str2double(get(handles.edit903,'string'));
gt5a=str2double(get(handles.edit904,'string'));
gt6a=str2double(get(handles.edit905,'string'));
```

```matlab
gt7a=str2double(get(handles.edit906,'string'));
gt8a=str2double(get(handles.edit907,'string'));
st3a=str2double(get(handles.edit908,'string'));
st4a=str2double(get(handles.edit909,'string'));
gt1tl=str2double(get(handles.edit910,'string'));
gt1th=str2double(get(handles.edit911,'string'));
gt2tl=str2double(get(handles.edit912,'string'));
gt2th=str2double(get(handles.edit913,'string'));
gt3tl=str2double(get(handles.edit914,'string'));
gt3th=str2double(get(handles.edit915,'string'));
gt4tl=str2double(get(handles.edit916,'string'));
gt4th=str2double(get(handles.edit917,'string'));
gt5t=str2double(get(handles.edit918,'string'));
gt6t=str2double(get(handles.edit919,'string'));
gt7t=str2double(get(handles.edit920,'string'));
gt8t=str2double(get(handles.edit921,'string'));
%calculation
%watt
rgt1w=(((gt1w-prgt1w)*10500*800)/110)/1000;
set(handles.text542,'string',rgt1w)
rgt2w=(((gt2w-prgt2w)*10500*800)/110)/1000;
set(handles.text543,'string',rgt2w)
rgt3w=(((gt3w-prgt3w)*10500*800)/110)/1000;
set(handles.text544,'string',rgt3w)
rgt4w=(((gt4w-prgt4w)*10500*800)/110)/1000;
set(handles.text545,'string',rgt4w)
rst1w=((st1w-prst1w)* 1000)/1000;
set(handles.text546,'string',rst1w)
rst2w=((st2w-prst2w)* 1000)/1000;
set(handles.text547,'string',rst2w)
rgt5w=((gt5w-prgt5w)* 1000)/1000;
set(handles.text548,'string',rgt5w)
rgt6w=((gt6w-prgt6w)* 1000)/1000;
set(handles.text549,'string',rgt6w)
rgt7w=((gt7w-prgt7w)* 1000)/1000;
set(handles.text550,'string',rgt7w)
rgt8w=((gt8w-prgt8w)* 1000)/1000;
set(handles.text551,'string',rgt8w)
rst3w=((st3w-prst3w)* 1000)/1000;
set(handles.text552,'string',rst3w)
rst4w=((st4w-prst4w)* 1000)/1000;
set(handles.text553,'string',rst4w)
totalw=rgt1w+rgt2w+rgt3w+rgt4w+rst1w+rst2w+rgt5w+rgt6w+rgt7w+rgt8w+rst3w+rst4w;
set(handles.text554,'string',totalw)
%var
rgt1v=(((gt1v-prgt1v)*10500*800)/110)/1000;
set(handles.text555,'string',rgt1v)
rgt2v=(((gt2v-prgt2v)*10500*800)/110)/1000;
set(handles.text556,'string',rgt2v)
rgt3v=(((gt3v-prgt3v)*10500*800)/110)/1000;
set(handles.text557,'string',rgt3v)
rgt4v=(((gt4v-prgt4v)*10500*800)/110)/1000;
set(handles.text558,'string',rgt4v)
rst1v=((st1v-prst1v)* 1000)/1000;
set(handles.text559,'string',rst1v)
rst2v=((st2v-prst2v)* 1000)/1000;
```

```
set(handles.text560,'string',rst2v)
rgt5v=((gt5v-prgt5v)* 1000)/1000;
set(handles.text561,'string',rgt5v)
rgt6v=((gt6v-prgt6v)* 1000)/1000;
set(handles.text562,'string',rgt6v)
rgt7v=((gt7v-prgt7v)* 1000)/1000;
set(handles.text563,'string',rgt7v)
rgt8v=((gt8v-prgt8v)* 1000)/1000;
set(handles.text564,'string',rgt8v)
rst3v=((st3v-prst3v)* 1000)/1000;
set(handles.text565,'string',rst3v)
rst4v=((st4v-prst4v)* 1000)/1000;
set(handles.text566,'string',rst4v)
totalv=rgt1v+rgt2v+rgt3v+rgt4v+rgt5v+rgt6v+rgt7v+rgt8v+rst1v+rst2v+rst3v+rst4
v;
set(handles.text567,'string',totalv)
%auxiliary
rgt1a=(gt1a-prgt1a)*1000;
set(handles.text568,'string',rgt1a)
rgt2a=(gt2a-prgt2a)*1000;
set(handles.text569,'string',rgt2a)
rgt3a=(gt3a-prgt3a)*1000;
set(handles.text570,'string',rgt3a)
rgt4a=(gt4a-prgt4a)*1000;
set(handles.text571,'string',rgt4a)
rst1a=(st1a-prst1a)*1000;
set(handles.text572,'string',rst1a)
rst2a=(st2a-prst2a)*1000;
set(handles.text573,'string',rst2a)
rgt5a=(gt5a-prgt5a)* 1000;
set(handles.text574,'string',rgt5a)
rgt6a=(gt6a-prgt6a)* 1000;
set(handles.text575,'string',rgt6a)
rgt7a=(gt7a-prgt7a)* 1000;
set(handles.text576,'string',rgt7a)
rgt8a=(gt8a-prgt8a)* 1000;
set(handles.text577,'string',rgt8a)
rst3a= (st3a-prst3a)* 1000 ;
set(handles.text578,'string',rst3a)
rst4a= (st4a-prst4a)* 1000 ;
set(handles.text579,'string',rst4a)
totala=rgt1a+rgt2a+rgt3a+rgt4a+rst1a+rst2a+rgt5a+rgt6a+rgt7a+rgt8a+rst3a+rst4
a;
set(handles.text580,'string',totala)
%totalizer
gt1ldo=gt1tl-prgt1tl;
set(handles.text661,'string',gt1ldo)
%s.f.c
if rgt1w==0
 sfcgt1=0;
 gegt1=0;
else
 sfcgt1=gt1ldo/rgt1w;
 ghr1=(gt1ldo*1000*45859)/rgt1w;
 gegt1=(3600*100*1000)/ghr1;
end
set(handles.text787,'string',sfcgt1)
```

```matlab
set(handles.text804,'string',gegt1)
gt2ldo=gt2tl-prgt2tl;
set(handles.text662,'string',gt2ldo)
gt3ldo=gt3tl-prgt3tl;
set(handles.text663,'string',gt3ldo)
gt2hcgo=gt2th-prgt2th;
set(handles.text672,'string',gt2hcgo)
gt3hcgo=gt3th-prgt3th;
set(handles.text673,'string',gt3hcgo)
%s.f.c
if rgt2w==0
 sfcgt2=0;
 gegt2=0;
else
sfcgt2=(gt2ldo+gt2hcgo)/rgt2w;
ghr2=(gt2ldo*1000*45859+gt2hcgo*1000*45125)/rgt2w;
gegt2=(3600*100*1000)/ghr2;
end
set(handles.text789,'string',sfcgt2)
set(handles.text806,'string',gegt2)
%s.f.c
if rgt3w==0
 sfcgt3=0;
 gegt3=0;
else
sfcgt3=(gt3ldo+gt3hcgo)/rgt3w;
ghr3=(gt3ldo*1000*45859+gt3hcgo*1000*45125)/rgt3w;
gegt3=(3600*100*1000)/ghr3;
end
set(handles.text791,'string',sfcgt3)
set(handles.text808,'string',gegt3)
gt4ldo=gt4tl-prgt4tl;
set(handles.text664,'string',gt4ldo)
%s.f.c
if rgt4w==0
 sfcgt4=0;
 gegt4=0;
else
sfcgt4=gt4ldo/rgt4w;
ghr4=(gt4ldo*1000*45859)/rgt4w;
gegt4=(3600*100*1000)/ghr4;
end
set(handles.text793,'string',sfcgt4)
set(handles.text810,'string',gegt4)
gt5ldo=(gt5t-prgt5t)/1000;
set(handles.text665,'string',gt5ldo)
%s.f.c
if rgt5w==0
 sfcgt5=0;
 gegt5=0;
else
sfcgt5=gt5ldo/rgt5w;
ghr5=(gt5ldo*1000*45859)/rgt5w;
gegt5=(3600*100*1000)/ghr5;
end
set(handles.text795,'string',sfcgt5)
set(handles.text812,'string',gegt5)
```

```matlab
gt6ldo=(gt6t-prgt6t)/1000;
set(handles.text666,'string',gt6ldo)
%s.f.c
if rgt6w==0
 sfcgt6=0;
 gegt6=0;
else
sfcgt6=gt6ldo/rgt6w;
ghr6=(gt6ldo*1000*45859)/rgt6w;
gegt6=(3600*100*1000)/ghr6;
end
set(handles.text797,'string',sfcgt6)
set(handles.text814,'string',gegt6)

gt7ldo=(gt7t-prgt7t)/1000;
set(handles.text667,'string',gt7ldo)
%s.f.c
if rgt7w==0
 sfcgt7=0;
 gegt7=0;
else
sfcgt7=gt7ldo/rgt7w;
ghr7=(gt7ldo*1000*45859)/rgt7w;
gegt7=(3600*100*1000)/ghr7;
end
set(handles.text799,'string',sfcgt7)
set(handles.text816,'string',gegt7)

gt8ldo=(gt8t-prgt8t)/1000;
set(handles.text668,'string',gt8ldo)
%s.f.c
if rgt8w==0
 sfcgt8=0;
 gegt8=0;
else
sfcgt8=gt8ldo/rgt8w;
ghr8=(gt8ldo*1000*45859)/rgt8w;
gegt8=(3600*100*1000)/ghr8;
end
set(handles.text801,'string',sfcgt8)
set(handles.text818,'string',gegt8)
totalgtldo=gt1ldo+gt2ldo+gt3ldo+gt4ldo+gt5ldo+gt6ldo+gt7ldo+gt8ldo;
totalgthcgo=gt2hcgo+gt3hcgo;
set(handles.text669,'string',totalgtldo)
set(handles.text679,'string',totalgthcgo)
%level of fuel tank
t1=str2double(get(handles.edit716,'string'));
t2=str2double(get(handles.edit717,'string'));
t3=str2double(get(handles.edit718,'string'));
t4=str2double(get(handles.edit719,'string'));
t5=str2double(get(handles.edit720,'string'));
t6=str2double(get(handles.edit721,'string'));
t7=str2double(get(handles.edit722,'string'));
t8=str2double(get(handles.edit723,'string'));
%calculation of fuel
%pumpable fuel stock tank 1-3
```

```matlab
e32=(t1*3.14*11.25^2*0.82)-300;
e34=(t3*3.14*11.25^2*0.82)-300;
pfst1_3=e32+e34;
set(handles.text683,'string',pfst1_3)
%'Pumpable Fuel Stock: Tank 5-8
e36=(t5*361.92)-265;
e37=(t6*361.92)-265;
e38=(t7*3.14*0.82*11.25^2)-300;
e39=(t8*3.14*0.82*11.25^2)-300;
pfst5_8=e36+e37+e38+e39;
set(handles.text687,'string',pfst5_8)
%Total Pumpable ldo Fuel Stock
tpfs=pfst1_3+pfst5_8;
set(handles.text691,'string',tpfs)
%Total Pumpable HCGO (Tan)
g33=(t2*3.14*0.858*11.25^2)-300;
g35=(t4*3.14*0.858*11.25^2)-300;
tphcgo=g33+g35;
set(handles.text701,'string',tphcgo)
lodps=str2double(get(handles.edit922,'string'));
hcgops=str2double(get(handles.edit923,'string'));
totldo=lodps-totalgtldo;
ldosupply=tpfs-totldo;
tothcgo=hcgops-totalgthcgo;
hcgosupply=tphcgo-tothcgo;
set(handles.text689,'string',ldosupply)
set(handles.text699,'string',hcgosupply)
save('pre.mat','gt1w','gt2w','gt3w','gt4w','st1w','st2w','gt5w','gt6w','gt7w'
,'gt8w','st3w','st4w','gt1v','gt2v','gt3v','gt4v','st1v','st2v','gt5v','gt6v'
,'gt7v','gt8v','st3v','st4v','gt1a','gt2a','gt3a','gt4a','st1a','st2a','gt5a'
,'gt6a','gt7a','gt8a','st3a','st4a','gt1tl','gt2tl','gt3tl','gt4tl','gt5t','g
t6t','gt7t','gt8t','gt2th','gt3th','tpfs','tphcgo')

else

 %without primary values selection
load('pre.mat','gt1w','gt2w','gt3w','gt4w','st1w','st2w','gt5w','gt6w','gt7w'
,'gt8w','st3w','st4w','gt1v','gt2v','gt3v','gt4v','st1v','st2v','gt5v','gt6v'
,'gt7v','gt8v','st3v','st4v','gt1a','gt2a','gt3a','gt4a','st1a','st2a','gt5a'
,'gt6a','gt7a','gt8a','st3a','st4a','gt1tl','gt2tl','gt3tl','gt4tl','gt5t','g
t6t','gt7t','gt8t','gt2th','gt3th','tpfs','tphcgo')

    %watt
    gt1w1=str2double(get(handles.edit874,'string'));
    rgt1w=(((gt1w1-gt1w)*10500*800)/110)/1000;
    set(handles.text542,'string',rgt1w)
    gt1w=gt1w1;
    gt2w1=str2double(get(handles.edit875,'string'));
    rgt2w=(((gt2w1-gt2w)*10500*800)/110)/1000;
    set(handles.text543,'string',rgt2w)
    gt2w=gt2w1;
    gt3w1=str2double(get(handles.edit876,'string'));
    rgt3w=(((gt3w1-gt3w)*10500*800)/110)/1000;
    set(handles.text544,'string',rgt3w)
    gt3w=gt3w1;
    gt4w1=str2double(get(handles.edit877,'string'));
```

```matlab
    rgt4w=(((gt4w1-gt4w)*10500*800)/110)/1000;
    set(handles.text545,'string',rgt4w)
    gt4w=gt4w1;
    st1w1=str2double(get(handles.edit878,'string'));
    rst1w=((st1w1-st1w)* 1000)/1000;
    set(handles.text546,'string',rst1w)
    st1w=st1w1;
    st2w1=str2double(get(handles.edit879,'string'));
    rst2w=((st2w1-st2w)* 1000)/1000;
    set(handles.text547,'string',rst2w)
    st2w=st2w1;
    gt5w1=str2double(get(handles.edit880,'string'));
    rgt5w=((gt5w1-gt5w)* 1000)/1000;
    set(handles.text548,'string',rgt5w)
    gt5w=gt5w1;
    gt6w1=str2double(get(handles.edit881,'string'));
    rgt6w=((gt6w1-gt6w)* 1000)/1000;
    set(handles.text549,'string',rgt6w)
    gt6w=gt6w1;
    gt7w1=str2double(get(handles.edit882,'string'));
    rgt7w=((gt7w1-gt7w)* 1000)/1000;
    set(handles.text550,'string',rgt7w)
    gt7w=gt7w1;
    gt8w1=str2double(get(handles.edit883,'string'));
    rgt8w=((gt8w1-gt8w)* 1000)/1000;
    set(handles.text551,'string',rgt5w)
    gt8w=gt8w1;
    st3w1=str2double(get(handles.edit884,'string'));
    rst3w=((st3w1-st3w)* 1000)/1000;
    set(handles.text552,'string',rst3w)
    st3w=st3w1;
    st4w1=str2double(get(handles.edit885,'string'));
    rst4w=((st4w1-st4w)* 1000)/1000;
    set(handles.text553,'string',rst4w)
    st4w=st4w1;

totalw=rgt1w+rgt2w+rgt3w+rgt4w+rst1w+rst2w+rgt5w+rgt6w+rgt7w+rgt8w+rst3w+rst4
w;
set(handles.text554,'string',totalw)
    %var
     gt1v1=str2double(get(handles.edit886,'string'));
    rgt1v=(((gt1v1-gt1v)*10500*800)/110)/1000;
    set(handles.text555,'string',rgt1v)
    gt1v=gt1v1;
    gt2v1=str2double(get(handles.edit887,'string'));
    rgt2v=(((gt2v1-gt2v)*10500*800)/110)/1000;
    set(handles.text556,'string',rgt2v)
    gt2v=gt2v1;
    gt3v1=str2double(get(handles.edit888,'string'));
    rgt3v=(((gt3v1-gt3v)*10500*800)/110)/1000;
    set(handles.text557,'string',rgt3v)
    gt3v=gt3v1;
    gt4v1=str2double(get(handles.edit889,'string'));
    rgt4v=(((gt4v1-gt4v)*10500*800)/110)/1000;
    set(handles.text558,'string',rgt4v)
    gt4v=gt4v1;
    st1v1=str2double(get(handles.edit890,'string'));
```

```matlab
    rst1v=((st1v1-st1v)* 1000)/1000;
    set(handles.text559,'string',rst1v)
    st1v=st1v1;
    st2v1=str2double(get(handles.edit891,'string'));
    rst2v=((st2v1-st2v)* 1000)/1000;
    set(handles.text560,'string',rst2v)
    st2v=st2v1;
    gt5v1=str2double(get(handles.edit892,'string'));
    rgt5v=((gt5v1-gt5v)* 1000)/1000;
    set(handles.text561,'string',rgt5v)
    gt5v=gt5v1;
    gt6v1=str2double(get(handles.edit893,'string'));
    rgt6v=((gt6v1-gt6v)* 1000)/1000;
    set(handles.text562,'string',rgt6v)
    gt6v=gt6v1;
     gt7v1=str2double(get(handles.edit894,'string'));
    rgt7v=((gt7v1-gt7v)* 1000)/1000;
    set(handles.text563,'string',rgt7v)
    gt7v=gt7v1;
    gt8v1=str2double(get(handles.edit895,'string'));
    rgt8v=((gt8v1-gt8v)* 1000)/1000;
    set(handles.text564,'string',rgt5v)
    gt8v=gt8v1;
    st3v1=str2double(get(handles.edit896,'string'));
    rst3v=((st3v1-st3v)* 1000)/1000;
    set(handles.text565,'string',rst3v)
    st3v=st3v1;
     st4v1=str2double(get(handles.edit897,'string'));
    rst4v=((st4v1-st4v)* 1000)/1000;
    set(handles.text566,'string',rst4v)
    st4v=st4v1;
totalv=rgt1v+rgt2v+rgt3v+rgt4v+rgt5v+rgt6v+rgt7v+rgt8v+rst1v+rst2v+rst3v+rst4
v;
set(handles.text567,'string',totalv)
    %auxiliry
    gt1a1=str2double(get(handles.edit898,'string'));
    rgt1a=(gt1a1-gt1a)*1000;
    set(handles.text568,'string',rgt1a)
    gt1a=gt1a1;
    gt2a1=str2double(get(handles.edit899,'string'));
    rgt2a=(gt2a1-gt2a)*1000;
    set(handles.text569,'string',rgt2a)
    gt2a=gt2a1;
    gt3a1=str2double(get(handles.edit900,'string'));
    rgt3a=(gt3a1-gt3a)*1000;
    set(handles.text570,'string',rgt3a)
    gt3a=gt3a1;
    gt4a1=str2double(get(handles.edit901,'string'));
    rgt4a=(gt4a1-gt4a)*1000;
    set(handles.text571,'string',rgt4a)
    gt4a=gt4a1;
    st1a1=str2double(get(handles.edit902,'string'));
    rst1a=(st1a1-st1a)*1000;
    set(handles.text572,'string',rst1a)
    st1a=st1a1;
    st2a1=str2double(get(handles.edit903,'string'));
    rst2a=(st2a1-st2a)*1000;
```

```matlab
    set(handles.text573,'string',rst2a)
    st2a=st2a1;
    gt5a1=str2double(get(handles.edit904,'string'));
    rgt5a=(gt5a1-gt5a)* 1000;
    set(handles.text574,'string',rgt5a)
    gt5a=gt5a1;
    gt6a1=str2double(get(handles.edit905,'string'));
    rgt6a=(gt6a1-gt6a)* 1000;
    set(handles.text575,'string',rgt6a)
    gt6a=gt6a1;
     gt7a1=str2double(get(handles.edit906,'string'));
    rgt7a=(gt7a1-gt7a)* 1000;
    set(handles.text576,'string',rgt7a)
    gt7a=gt7a1;
   gt8a1=str2double(get(handles.edit907,'string'));
    rgt8a=(gt8a1-gt8a)*1000;
    set(handles.text577,'string',rgt8a)
    gt8a=gt8a1;
     st3a1=str2double(get(handles.edit908,'string'));
    rst3a=(st3a1-st3a)*1000;
    set(handles.text578,'string',rst3a)
   st3a=st3a1;
   st4a1=str2double(get(handles.edit909,'string'));
    rst4a=(st4a1-st4a)*1000;
    set(handles.text579,'string',rst4a)
    st4a=st4a1;
totala=rgt1a+rgt2a+rgt3a+rgt4a+rst1a+rst2a+rgt5a+rgt6a+rgt7a+rgt8a+rst3a+rst4
a;
set(handles.text580,'string',totala)
    %totalizer
    gt1tl1=str2double(get(handles.edit910,'string'));
    rgt1tl=gt1tl1-gt1tl;
    set(handles.text661,'string',rgt1tl)
    gt1tl=gt1tl1;
    %s.f.c
    if rgt1w==0
     sfcgt1=0;
     gegt1=0;
    else
    sfcgt1=rgt1tl/rgt1w;
    ghr1=(rgt1tl*1000*45859)/rgt1w;
    gegt1=(3600*100*1000)/ghr1;
    end
    set(handles.text787,'string',sfcgt1)
    set(handles.text804,'string',gegt1)
    gt2tl1=str2double(get(handles.edit912,'string'));
    rgt2tl=gt2tl1-gt2tl;
    set(handles.text662,'string',rgt2tl)
    gt2tl=gt2tl1;
     gt3tl1=str2double(get(handles.edit914,'string'));
    rgt3tl=gt3tl1-gt3tl;
    set(handles.text663,'string',rgt3tl)
    gt3tl=gt3tl1;
    gt4tl1=str2double(get(handles.edit916,'string'));
    rgt4tl=gt4tl1-gt4tl;
    set(handles.text664,'string',rgt4tl)
    gt4tl=gt4tl1;
```

```matlab
    %s.f.c
    if rgt4w==0
     sfcgt4=0;
       gegt4=0;
    else
    sfcgt4=rgt4tl/rgt4w;
    ghr4=(rgt4tl*1000*45859)/rgt4w;
    gegt4=(3600*100*1000)/ghr4;
    end
    set(handles.text793,'string',sfcgt4)
    set(handles.text810,'string',gegt4)

    gt5tl1=str2double(get(handles.edit918,'string'));
    rgt5tl=(gt5tl1-gt5t)/1000;
    set(handles.text665,'string',rgt5tl)
    gt5t=gt5tl1;
    %s.f.c
if rgt5w==0
 sfcgt5=0;
 gegt5=0;
else
sfcgt5=rgt5tl/rgt5w;
ghr5=(rgt5tl*1000*45859)/rgt5w;
    gegt5=(3600*100*1000)/ghr5;
end
set(handles.text795,'string',sfcgt5)
set(handles.text812,'string',gegt5)
    gt6tl1=str2double(get(handles.edit919,'string'));
    rgt6tl=(gt6tl1-gt6t)/1000;
    set(handles.text666,'string',rgt6tl)
    gt6t=gt6tl1;
    %s.f.c
if rgt6w==0
 sfcgt6=0;
 gegt6=0;
else
sfcgt6=rgt6tl/rgt6w;
ghr6=(rgt6tl*1000*45859)/rgt6w;
    gegt6=(3600*100*1000)/ghr6;
end
set(handles.text797,'string',sfcgt6)
set(handles.text814,'string',gegt6)

    gt7tl1=str2double(get(handles.edit920,'string'));
    rgt7tl=(gt7tl1-gt7t)/1000;
    set(handles.text667,'string',rgt7tl)
    gt7t=gt7tl1;
    %s.f.c
if rgt7w==0
 sfcgt7=0;
   gegt7=0;
else
sfcgt7=rgt7tl/rgt7w;
ghr7=(rgt7tl*1000*45859)/rgt7w;
    gegt7=(3600*100*1000)/ghr7;
end
```

```matlab
set(handles.text799,'string',sfcgt7)
set(handles.text816,'string',gegt7)


    gt8tl1=str2double(get(handles.edit921,'string'));
    rgt8tl=(gt8tl1-gt8t)/1000;
    set(handles.text668,'string',rgt8tl)
    gt8t=gt8tl1;
    %s.f.c

if rgt8w==0
 sfcgt8=0;
 gegt8=0;
else
sfcgt8=rgt8tl/rgt8w;
ghr8=(rgt8tl*1000*45859)/rgt8w;
    gegt8=(3600*100*1000)/ghr8;
end
set(handles.text801,'string',sfcgt8)
set(handles.text818,'string',gegt8)


    gt2th1=str2double(get(handles.edit913,'string'));
    rgt2th=gt2th1-gt2th;
    set(handles.text672,'string',rgt2th)
    gt2th=gt2th1;
    gt3th1=str2double(get(handles.edit915,'string'));
   rgt3th=gt3th1-gt3th;
    set(handles.text673,'string',rgt3th)
    gt3th=gt3th1;
    %s.f.c
if rgt2w==0
 sfcgt2=0;
 gegt2=0;
else
sfcgt2=(rgt2tl+rgt2th)/rgt2w;
ghr2=(rgt2tl*1000*45859+rgt2th*1000*45125)/rgt2w;
gegt2=(3600*100*1000)/ghr2;


end
set(handles.text789,'string',sfcgt2)
set(handles.text806,'string',gegt2)
%s.f.c
if rgt3w==0
 sfcgt3=0;
 gegt3=0;
else
sfcgt3=(rgt3tl+rgt3th)/rgt3w;
ghr3=(rgt3tl*1000*45859+rgt3th*1000*45125)/rgt3w;
gegt3=(3600*100*1000)/ghr3;
end
set(handles.text791,'string',sfcgt3)
set(handles.text808,'string',gegt3)


    totalgtldo=rgt1tl+rgt2tl+rgt3tl+rgt4tl+rgt5tl+rgt6tl+rgt7tl+rgt8tl;
    totalgthcgo=rgt2th+rgt3th;
    set(handles.text669,'string',totalgtldo)
```

```matlab
    set(handles.text679,'string',totalgthcgo)


    %level of fuel tank
t1=str2double(get(handles.edit716,'string'));
t2=str2double(get(handles.edit717,'string'));
t3=str2double(get(handles.edit718,'string'));
t4=str2double(get(handles.edit719,'string'));
t5=str2double(get(handles.edit720,'string'));
t6=str2double(get(handles.edit721,'string'));
t7=str2double(get(handles.edit722,'string'));
t8=str2double(get(handles.edit723,'string'));
%calculation of fuel
%pumpable fuel stock tank 1-3
e32=(t1*3.14*11.25^2*0.82)-300;
e34=(t3*3.14*11.25^2*0.82)-300;
pfst1_3=e32+e34;
set(handles.text683,'string',pfst1_3)
%'Pumpable Fuel Stock: Tank 5-8
e36=(t5*361.92)-265;
e37=(t6*361.92)-265;
e38=(t7*3.14*0.82*11.25^2)-300;
e39=(t8*3.14*0.82*11.25^2)-300;
pfst5_8=e36+e37+e38+e39;
set(handles.text687,'string',pfst5_8)
%Total Pumpable ldo Fuel Stock
tpfs1=pfst1_3+pfst5_8;
set(handles.text691,'string',tpfs1)
%Total Pumpable HCGO (Tan)
g33=(t2*3.14*0.858*11.25^2)-300;
g35=(t4*3.14*0.858*11.25^2)-300;
tphcgo1=g33+g35;
set(handles.text701,'string',tphcgo1)
totldo=tpfs-totalgtldo;
ldosupply=tpfs1-totldo;
tothcgo=tphcgo-totalgthcgo;
hcgosupply=tphcgo1-tothcgo;
set(handles.text689,'string',ldosupply)
set(handles.text699,'string',hcgosupply)
tpfs=tpfs1;
tphcgo=tphcgo1;
save('pre.mat','gt1w','gt2w','gt3w','gt4w','st1w','st2w','gt5w','gt6w','gt7w'
,'gt8w','st3w','st4w','gt1v','gt2v','gt3v','gt4v','st1v','st2v','gt5v','gt6v'
,'gt7v','gt8v','st3v','st4v','gt1a','gt2a','gt3a','gt4a','st1a','st2a','gt5a'
,'gt6a','gt7a','gt8a','st3a','st4a','gt1tl','gt2tl','gt3tl','gt4tl','gt5t','g
t6t','gt7t','gt8t','gt2th','gt3th','tpfs','tphcgo')


end
gt1n=str2double(get(handles.edit49,'string'));
gt2n=str2double(get(handles.edit50,'string'));
gt3n=str2double(get(handles.edit51,'string'));
gt4n=str2double(get(handles.edit52,'string'));
st1n=str2double(get(handles.edit53,'string'));
st2n=str2double(get(handles.edit54,'string'));
gt5n=str2double(get(handles.edit55,'string'));
gt6n=str2double(get(handles.edit56,'string'));
gt7n=str2double(get(handles.edit57,'string'));
```

```matlab
gt8n=str2double(get(handles.edit58,'string'));
st3n=str2double(get(handles.edit59,'string'));
st4n=str2double(get(handles.edit60,'string'));
%last MW
gt1=str2double(get(handles.edit684,'string'));
gt2=str2double(get(handles.edit685,'string'));
gt3=str2double(get(handles.edit686,'string'));
gt4=str2double(get(handles.edit687,'string'));
st1=str2double(get(handles.edit688,'string'));
st2=str2double(get(handles.edit689,'string'));
gt5=str2double(get(handles.edit690,'string'));
gt6=str2double(get(handles.edit691,'string'));
gt7=str2double(get(handles.edit692,'string'));
gt8=str2double(get(handles.edit693,'string'));
st3=str2double(get(handles.edit694,'string'));
st4=str2double(get(handles.edit695,'string'));
totalgt=gt1+gt2+gt3+gt4+gt5+gt6+gt7+gt8+st1+st2+st3+st4;
set(handles.text772,'string',totalgt)
set(handles.text759,'string',gt1)
set(handles.text761,'string',gt2)
set(handles.text762,'string',gt3)
set(handles.text763,'string',gt4)
set(handles.text764,'string',st1)
set(handles.text765,'string',st2)
set(handles.text766,'string',gt5)
set(handles.text767,'string',gt6)
set(handles.text768,'string',gt7)
set(handles.text769,'string',gt8)
set(handles.text770,'string',st3)
set(handles.text771,'string',st4)
%status of plant
gt1stat=get(handles.edit696,'string');
gt2stat=get(handles.edit697,'string');
gt3stat=get(handles.edit698,'string');
gt4stat=get(handles.edit699,'string');
st1stat=get(handles.edit700,'string');
st2stat=get(handles.edit701,'string');
gt5stat=get(handles.edit702,'string');
gt6stat=get(handles.edit703,'string');
gt7stat=get(handles.edit704,'string');
gt8stat=get(handles.edit705,'string');
st3stat=get(handles.edit706,'string');
st4stat=get(handles.edit707,'string');
set(handles.text774,'string',gt1stat)
set(handles.text775,'string',gt2stat)
set(handles.text776,'string',gt3stat)
set(handles.text777,'string',gt4stat)
set(handles.text778,'string',st1stat)
set(handles.text779,'string',st2stat)
set(handles.text780,'string',gt5stat)
set(handles.text781,'string',gt6stat)
set(handles.text782,'string',gt7stat)
set(handles.text783,'string',gt8stat)
set(handles.text784,'string',st3stat)
set(handles.text785,'string',st4stat)
```

```matlab
p1d=str2double(get(handles.edit724,'string'));
set(handles.text839,'string',p1d)
p1s=str2double(get(handles.edit725,'string'));
p1r=str2double(get(handles.edit726,'string'));
set(handles.text843,'string',p1r)

p2d=str2double(get(handles.edit727,'string'));
set(handles.text841,'string',p2d)
pd=p1d+p2d;
set(handles.text695,'string',pd)
p2s=str2double(get(handles.edit728,'string'));
p2r=str2double(get(handles.edit729,'string'));
set(handles.text693,'string',p2r)
min1=str2double(get(handles.edit512,'string'));
min2=str2double(get(handles.edit514,'string'));
min3=str2double(get(handles.edit560,'string'));
min4=str2double(get(handles.edit562,'string'));
min5=str2double(get(handles.edit608,'string'));
min6=str2double(get(handles.edit610,'string'));
gt1m=(min1+min2+min3+min4+min5+min6)/60;
h1=str2double(get(handles.edit511,'string'));
h2=str2double(get(handles.edit513,'string'));
h3=str2double(get(handles.edit559,'string'));
h4=str2double(get(handles.edit561,'string'));
h5=str2double(get(handles.edit607,'string'));
h6=str2double(get(handles.edit609,'string'));
gt1h=h1+h2+h3+h4+h5+h6;
pgt1=gt1h+gt1m;
%GT1 planned enregy losses
gt1pelm=(min3+min4)/60;
gt1pelh=(h3+h4);
gt1pel=(gt1pelm+gt1pelh)*(31.6);
set(handles.text581,'string',gt1pel)
%GT1 Unplanned enregy losses
gt1pelm=(min1+min2)/60;
gt1pelh=(h1+h2);
gt1upel=(gt1pelm+gt1pelh)*(31.6);
set(handles.text594,'string',gt1upel)

min7=str2double(get(handles.edit516,'string'));
min8=str2double(get(handles.edit518,'string'));
min9=str2double(get(handles.edit564,'string'));
min10=str2double(get(handles.edit566,'string'));
min11=str2double(get(handles.edit612,'string'));
min12=str2double(get(handles.edit614,'string'));
gt2m=(min7+min8+min9+min10+min11+min12)/60;
h7=str2double(get(handles.edit515,'string'));
h8=str2double(get(handles.edit517,'string'));
h9=str2double(get(handles.edit563,'string'));
h10=str2double(get(handles.edit565,'string'));
h11=str2double(get(handles.edit611,'string'));
h12=str2double(get(handles.edit613,'string'));
gt2h=h7+h8+h9+h10+h11+h12;
pgt2=gt2h+gt2m;
 %GT2 planned enregy losses
```

```matlab
gt2pelm=(min9+min10)/60;
gt2pelh=h9+h10;
gt2pel=(gt2pelm+gt2pelh)*(31.6);
set(handles.text582,'string',gt2pel)
 %GT2 Unplanned enregy losses
gt2pelm=(min7+min8)/60;
gt2pelh=h7+h8;
gt2upel=(gt2pelm+gt2pelh)*(31.6);
set(handles.text595,'string',gt2upel)
min13=str2double(get(handles.edit520,'string'));
min14=str2double(get(handles.edit522,'string'));
min15=str2double(get(handles.edit568,'string'));
min16=str2double(get(handles.edit570,'string'));
min17=str2double(get(handles.edit616,'string'));
min18=str2double(get(handles.edit618,'string'));
gt3m=(min13+min14+min15+min16+min17+min18)/60;
h13=str2double(get(handles.edit519,'string'));
h14=str2double(get(handles.edit521,'string'));
h15=str2double(get(handles.edit567,'string'));
h16=str2double(get(handles.edit569,'string'));
h17=str2double(get(handles.edit615,'string'));
h18=str2double(get(handles.edit617,'string'));
gt3h=h13+h14+h15+h16+h17+h18;
pgt3=gt3h+gt3m;
 %GT3 planned enregy losses
gt3pelm=(min15+min16)/60;
gt3pelh=h15+h16;
gt3pel=(gt3pelm+gt3pelh)*(31.6);
set(handles.text583,'string',gt3pel)
%GT3 planned enregy losses
gt3pelm=(min13+min14)/60;
gt3pelh=h13+h15;
gt3upel=(gt3pelm+gt3pelh)*(31.6);
set(handles.text596,'string',gt3upel)

min19=str2double(get(handles.edit524,'string'));
min20=str2double(get(handles.edit526,'string'));
min21=str2double(get(handles.edit572,'string'));
min22=str2double(get(handles.edit574,'string'));
min23=str2double(get(handles.edit620,'string'));
min24=str2double(get(handles.edit622,'string'));
gt4m=(min19+min20+min21+min22+min23+min24)/60;
h19=str2double(get(handles.edit523,'string'));
h20=str2double(get(handles.edit525,'string'));
h21=str2double(get(handles.edit571,'string'));
h22=str2double(get(handles.edit573,'string'));
h23=str2double(get(handles.edit619,'string'));
h24=str2double(get(handles.edit621,'string'));
gt4h=h19+h20+h21+h22+h23+h24;
pgt4=gt4h+gt4m;
%GT4 planned enregy losses
gt4pelm=(min21+min22)/60;
gt4pelh=h21+h22;
gt4pel=(gt4pelm+gt4pelh)*(31.6);
set(handles.text584,'string',gt4pel)
%GT4 Unplanned enregy losses
gt4pelm=(min19+min20)/60;
```

```matlab
gt4pelh=h19+h20;
gt4upel=(gt4pelm+gt4pelh)*(31.6);
set(handles.text597,'string',gt4upel)
min25=str2double(get(handles.edit528,'string'));
min26=str2double(get(handles.edit530,'string'));
min27=str2double(get(handles.edit576,'string'));
min28=str2double(get(handles.edit578,'string'));
min29=str2double(get(handles.edit624,'string'));
min30=str2double(get(handles.edit626,'string'));
st1m=(min25+min26+min27+min28+min29+min30)/60;
h25=str2double(get(handles.edit527,'string'));
h26=str2double(get(handles.edit529,'string'));
h27=str2double(get(handles.edit575,'string'));
h28=str2double(get(handles.edit577,'string'));
h29=str2double(get(handles.edit623,'string'));
h30=str2double(get(handles.edit625,'string'));
st1h=h25+h26+h27+h28+h29+h30;
pst1=st1h+st1m;
%ST1 planned enregy losses
st1pelm=(min25+min26)/60;
st1pelh=h25+h26;
st1pel=(st1pelm+st1pelh)*(32);
set(handles.text585,'string',st1pel)


%ST1 Unplanned enregy losses
st1pelm=(min25+min26)/60;
st1pelh=h27+h28;
st1upel=(st1pelm+st1pelh)*(32);
set(handles.text598,'string',st1upel)


min31=str2double(get(handles.edit532,'string'));
min32=str2double(get(handles.edit534,'string'));
min33=str2double(get(handles.edit580,'string'));
min34=str2double(get(handles.edit582,'string'));
min35=str2double(get(handles.edit628,'string'));
min36=str2double(get(handles.edit630,'string'));
st2m=(min31+min32+min33+min34+min35+min36)/60;
h31=str2double(get(handles.edit531,'string'));
h32=str2double(get(handles.edit533,'string'));
h33=str2double(get(handles.edit579,'string'));
h34=str2double(get(handles.edit581,'string'));
h35=str2double(get(handles.edit627,'string'));
h36=str2double(get(handles.edit629,'string'));
st2h=h31+h32+h33+h34+h35+h36;
pst2=st2h+st2m;
 %ST2 planned enregy losses
st2pelm=(min33+min34)/60;
st2pelh=h33+h34;
st2pel=(st2pelm+st2pelh)*(32);
set(handles.text586,'string',st2pel)
%ST2 Unplanned enregy losses
st2pelm=(min31+min32)/60;
st2pelh=h31+h32;
st2upel=(st2pelm+st2pelh)*(32);
set(handles.text599,'string',st2upel)
```

```matlab
min37=str2double(get(handles.edit536,'string'));
min38=str2double(get(handles.edit538,'string'));
min39=str2double(get(handles.edit584,'string'));
min40=str2double(get(handles.edit586,'string'));
min41=str2double(get(handles.edit632,'string'));
min42=str2double(get(handles.edit634,'string'));
gt5m=(min37+min38+min39+min40+min41+min42)/60;
h37=str2double(get(handles.edit535,'string'));
h38=str2double(get(handles.edit537,'string'));
h39=str2double(get(handles.edit583,'string'));
h40=str2double(get(handles.edit585,'string'));
h41=str2double(get(handles.edit631,'string'));
h42=str2double(get(handles.edit633,'string'));
gt5h=h37+h38+h39+h40+h41+h42;
pgt5=gt5h+gt5m;
 %GT5 planned enregy losses
gt5pelm=(min39+min40)/60;
gt5pelh=h39+h40;
gt5pel=(gt5pelm+gt5pelh)*(31.6);
set(handles.text587,'string',gt5pel)
%GT5 Unplanned enregy losses
gt5pelm=(min37+min38)/60;
gt5pelh=h37+h38;
gt5upel=(gt5pelm+gt5pelh)*(31.6);
set(handles.text600,'string',gt5upel)


min7=str2double(get(handles.edit540,'string'));
min8=str2double(get(handles.edit542,'string'));
min9=str2double(get(handles.edit588,'string'));
min10=str2double(get(handles.edit590,'string'));
min11=str2double(get(handles.edit636,'string'));
min12=str2double(get(handles.edit638,'string'));
gt6m=(min7+min8+min9+min10+min11+min12)/60;
h7=str2double(get(handles.edit539,'string'));
h8=str2double(get(handles.edit541,'string'));
h9=str2double(get(handles.edit587,'string'));
h10=str2double(get(handles.edit589,'string'));
h11=str2double(get(handles.edit635,'string'));
h12=str2double(get(handles.edit637,'string'));
gt6h=h7+h8+h9+h10+h11+h12;
pgt6=gt6h+gt6m;
%GT6 planned enregy losses
gt6pelm=(min9+min10)/60;
gt6pelh=h9+h10;
gt6pel=(gt6pelm+gt6pelh)*(31.6);
set(handles.text588,'string',gt6pel)
%GT6 planned enregy losses
gt6pelm=(min7+min8)/60;
gt6pelh=h7+h8;
gt6upel=(gt6pelm+gt6pelh)*(31.6);
set(handles.text601,'string',gt6upel)


min13=str2double(get(handles.edit544,'string'));
min14=str2double(get(handles.edit546,'string'));
min15=str2double(get(handles.edit592,'string'));
min16=str2double(get(handles.edit594,'string'));
```

```matlab
min17=str2double(get(handles.edit640,'string'));
min18=str2double(get(handles.edit642,'string'));
gt7m=(min13+min14+min15+min16+min17+min18)/60;
h13=str2double(get(handles.edit543,'string'));
h14=str2double(get(handles.edit545,'string'));
h15=str2double(get(handles.edit591,'string'));
h16=str2double(get(handles.edit593,'string'));
h17=str2double(get(handles.edit639,'string'));
h18=str2double(get(handles.edit641,'string'));
gt7h=h13+h14+h15+h16+h17+h18;
pgt7=gt7h+gt7m;
%GT7 planned enregy losses
gt7pelm=(min15+min16)/60;
gt7pelh=h15+h16;
gt7pel=(gt7pelm+gt7pelh)*(31.6);
set(handles.text589,'string',gt7pel)
%GT7 planned enregy losses
gt7pelm=(min13+min14)/60;
gt7pelh=h13+h14;
gt7upel=(gt7pelm+gt7pelh)*(31.6);
set(handles.text602,'string',gt7upel)
min19=str2double(get(handles.edit548,'string'));
min20=str2double(get(handles.edit550,'string'));
min21=str2double(get(handles.edit596,'string'));
min22=str2double(get(handles.edit598,'string'));
min23=str2double(get(handles.edit644,'string'));
min24=str2double(get(handles.edit646,'string'));
gt8m=(min19+min20+min21+min22+min23+min24)/60;
h19=str2double(get(handles.edit547,'string'));
h20=str2double(get(handles.edit549,'string'));
h21=str2double(get(handles.edit595,'string'));
h22=str2double(get(handles.edit597,'string'));
h23=str2double(get(handles.edit643,'string'));
h24=str2double(get(handles.edit645,'string'));
gt8h=h19+h20+h21+h22+h23+h24;
pgt8=gt8h+gt8m;
%GT8 planned enregy losses
gt8pelm=(min21+min22)/60;
gt8pelh=h21+h22;
gt8pel=(gt8pelm+gt8pelh)*(31.6);
set(handles.text590,'string',gt8pel)
%GT8 Unplanned enregy losses
gt8pelm=(min19+min20)/60;
gt8pelh=h19+h20;
gt8upel=(gt8pelm+gt8pelh)*(31.6);
set(handles.text603,'string',gt8upel)

min25=str2double(get(handles.edit552,'string'));
min26=str2double(get(handles.edit554,'string'));
min27=str2double(get(handles.edit600,'string'));
min28=str2double(get(handles.edit602,'string'));
min29=str2double(get(handles.edit648,'string'));
min30=str2double(get(handles.edit650,'string'));
st3m=(min25+min26+min27+min28+min29+min30)/60;
h25=str2double(get(handles.edit551,'string'));
h26=str2double(get(handles.edit553,'string'));
h27=str2double(get(handles.edit599,'string'));
```

```matlab
h28=str2double(get(handles.edit601,'string'));
h29=str2double(get(handles.edit647,'string'));
h30=str2double(get(handles.edit647,'string'));
st3h=h25+h26+h27+h28+h29+h30;
pst3=st3h+st3m;
%ST3 planned enregy losses
st3pelm=(min27+min28)/60;
st3pelh=h27+h28;
st3pel=(st3pelm+st3pelh)*(32);
set(handles.text591,'string',st3pel)
%ST3 Unplanned enregy losses
st3pelm=(min25+min26)/60;
st3pelh=h25+h26;
st3upel=(st3pelm+st3pelh)*(32);
set(handles.text604,'string',st3upel)

min31=str2double(get(handles.edit556,'string'));
min32=str2double(get(handles.edit558,'string'));
min33=str2double(get(handles.edit604,'string'));
min34=str2double(get(handles.edit606,'string'));
min35=str2double(get(handles.edit652,'string'));
min36=str2double(get(handles.edit654,'string'));
st4m=(min31+min32+min33+min34+min35+min36)/60;
h31=str2double(get(handles.edit555,'string'));
h32=str2double(get(handles.edit557,'string'));
h33=str2double(get(handles.edit603,'string'));
h34=str2double(get(handles.edit605,'string'));
h35=str2double(get(handles.edit651,'string'));
h36=str2double(get(handles.edit653,'string'));
st4h=h31+h32+h33+h34+h35+h36;
pst4=st4h+st4m;

%ST4 planned enregy losses
st4pelm=(min33+min34)/60;
st4pelh=(h33+h34);
st4pel=(st4pelm+st4pelh)*(32);
set(handles.text592,'string',st4pel)
%ST4 force enregy losses
st4pelm=(min31+min32)/60;
st4pelh=(h32+h31);
st4upel=(st4pelm+st4pelh)*(32);
set(handles.text605,'string',st4upel)

totalplannedlosses=gt1pel+gt2pel+gt3pel+gt4pel+gt5pel+gt6pel+gt7pel+gt8pel+st
1pel+st2pel+st3pel+st4pel;
set(handles.text593,'string',totalplannedlosses)
totalunplannedlosses=gt1upel+gt2upel+gt3upel+gt4upel+gt5upel+gt6upel+gt7upel+
gt8upel+st1upel+st2upel+st3upel+st4upel;
set(handles.text606,'string',totalunplannedlosses)
%Availability (%)
gt1ava=((24-pgt1)/24)*100
set(handles.text607,'string',gt1ava)
set(handles.text745,'string',gt1ava)
gt2ava=((24-pgt2)/24)*100
set(handles.text608,'string',gt2ava)
set(handles.text746,'string',gt2ava)
```

```
gt3ava=((24-pgt3)/24)*100
set(handles.text609,'string',gt3ava)
set(handles.text747,'string',gt3ava)
gt4ava=((24-pgt4)/24)*100
set(handles.text610,'string',gt4ava)
set(handles.text748,'string',gt4ava)
st1ava=((24-pst1)/24)*100
set(handles.text611,'string',st1ava)
set(handles.text749,'string',st1ava)
st2ava=((24-pst2)/24)*100
set(handles.text612,'string',st2ava)
set(handles.text750,'string',st2ava)
gt5ava=((24-pgt5)/24)*100
set(handles.text613,'string',gt5ava)
set(handles.text751,'string',gt5ava)
gt6ava=((24-pgt6)/24)*100
set(handles.text614,'string',gt6ava)
set(handles.text752,'string',gt6ava)
gt7ava=((24-pgt7)/24)*100
set(handles.text615,'string',gt7ava)
set(handles.text753,'string',gt7ava)
gt8ava=((24-pgt8)/24)*100
set(handles.text616,'string',gt8ava)
set(handles.text754,'string',gt8ava)
st3ava=((24-pst3)/24)*100
set(handles.text617,'string',st3ava)
set(handles.text755,'string',st3ava)
st4ava=((24-pst4)/24)*100
set(handles.text618,'string',st4ava)
set(handles.text756,'string',st4ava)
totalava=(gt1ava+gt2ava+gt3ava+gt4ava+gt5ava+gt6ava+gt7ava+gt8ava+st1ava+st2a
va+st3ava+st4ava)/12;
set(handles.text619,'string',totalava)
set(handles.text757,'string',totalava)
```

after pressing calculate the results will appear as in figure (5.4) bellow
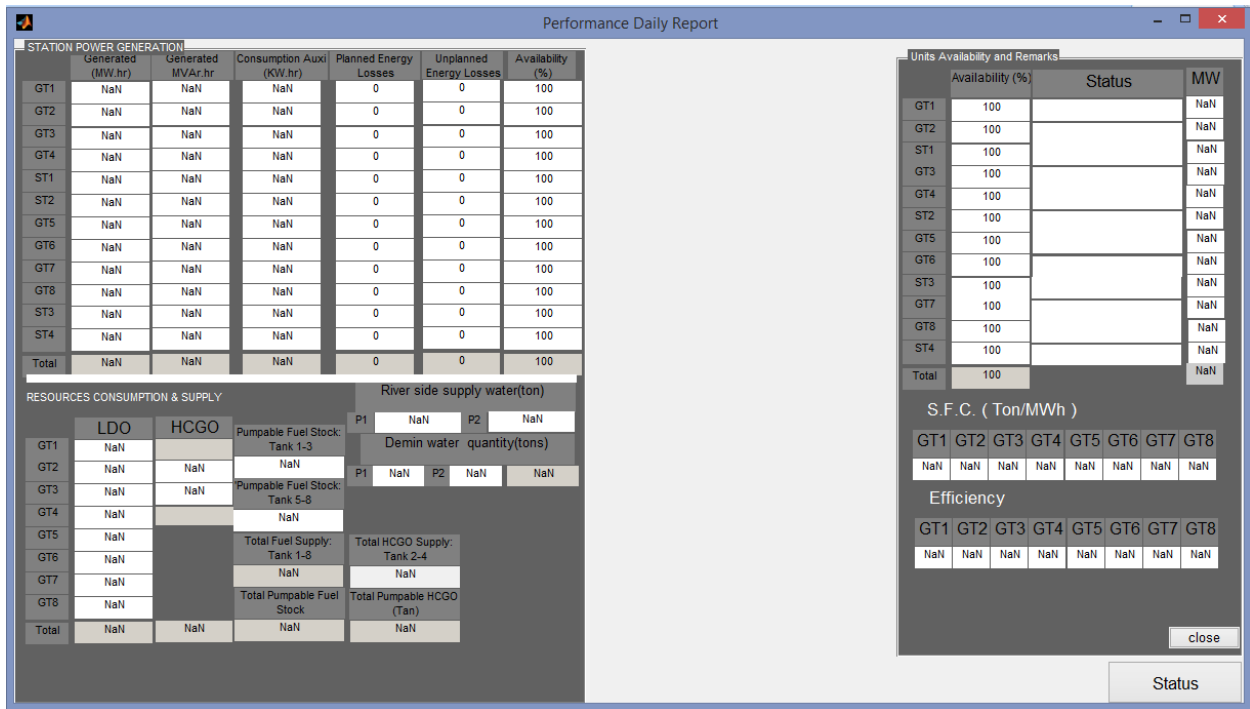


Figure (5.4) Results interface

Its content station power generation , resources consumption and supply , units availability and remarks ,S.F.C and efficiency .

- Close pushbutton to close results panel code

```
function pushbutton10_Callback(hObject, eventdata, handles)
set(handles.uipanel5,'visible','on')
set(handles.uipanel6,'visible','off')
set(handles.radiobutton294,'visible','on')
set(handles.pushbutton6,'visible','on')
set(handles.uipanel7,'visible','off')
```

- Status pushbutton convey user to status enter facing code

```
function next_Callback(hObject, eventdata, handles)
set(handles.figure1,'visible','on')
set(handles.output,'visible','off')
```

## 5.4.2 Appendix B: Status figure code

status interfacing content  main , plant $1$ , plant $2$ and Exit pushbutton  as shown in figure $(5.5)$   bellow :
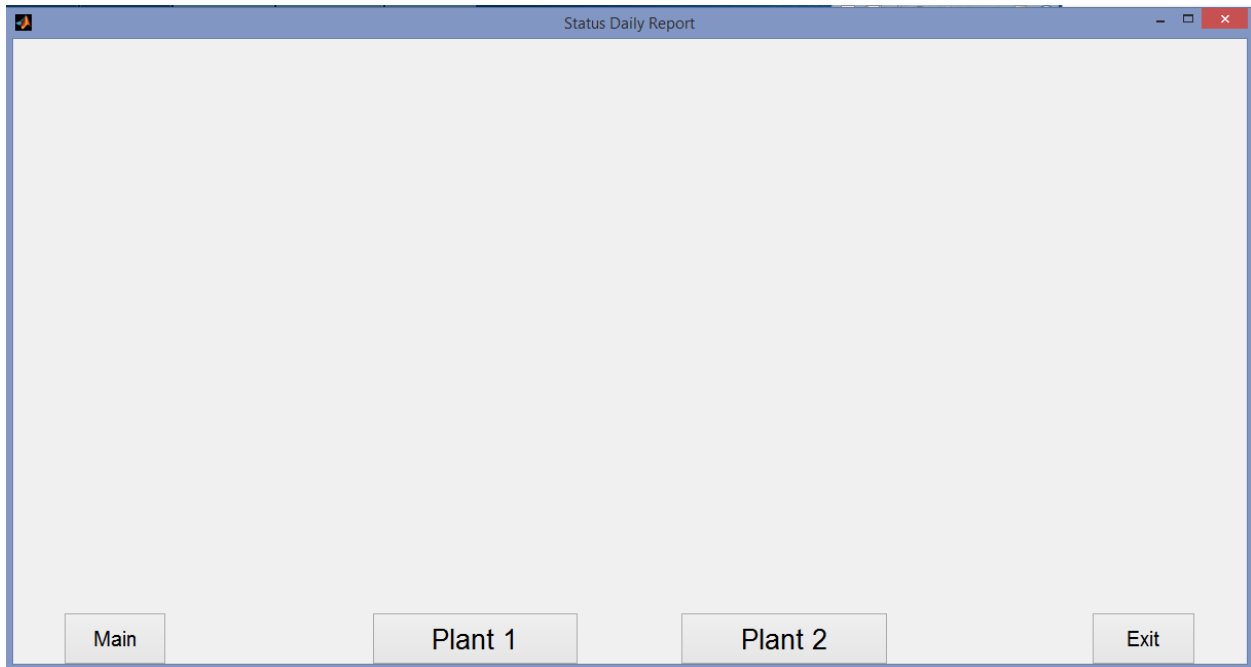


Figure (5.5)  Status interface

- Main push button to back to main interfacing of the program

Code of main :

```matlab
function prev_Callback(hObject, eventdata, handles)
% hObject    handle to prev (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.prev,'visible','on')
set(handles.output,'visible','off')
```

- When plant 1 pressed by user a figure (5.6) bellow will appeared . its values to gets status of plant 1

Code of plant 1 :

```matlab
function pushbutton3_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel1,'Visible','on')

set(handles.uipanel3,'Visible','off')
set(handles.uipanel5,'Visible','off')
set(handles.uipanel6,'Visible','off')
```
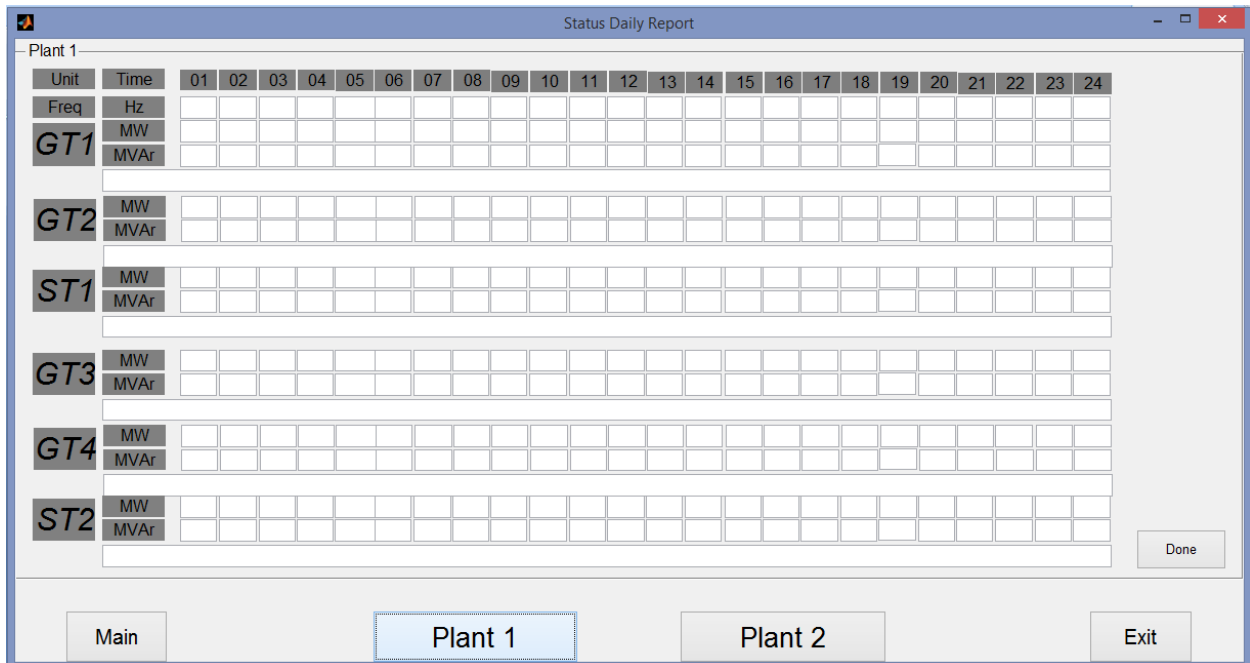


Figure (5.6)  Plant 1 Status interface

- Done pushbutton to calculate status graphs of gas turbine as show bellow :
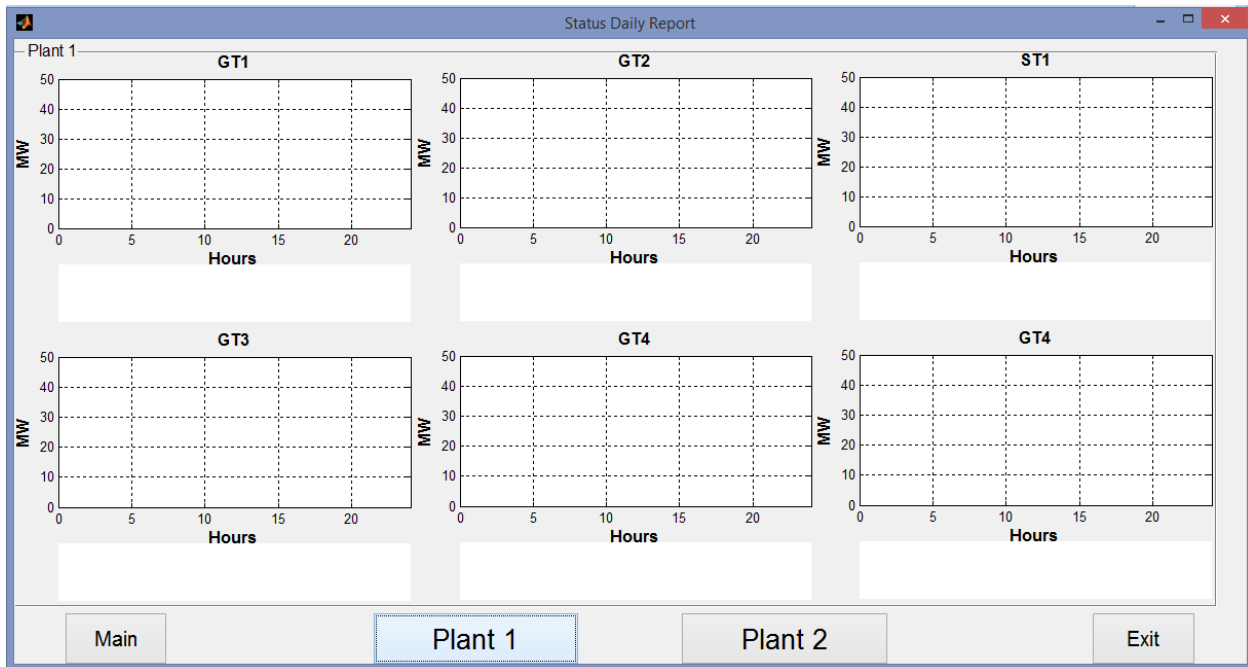


Figure (5.7)  Plant 1 Status graph  interface

Code of done :

```
function pushbutton8_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton8 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
x49=str2double(get(handles.edit49,'string'));
x50=str2double(get(handles.edit50,'string'));
x51=str2double(get(handles.edit51,'string'));
x52=str2double(get(handles.edit52,'string'));
x53=str2double(get(handles.edit53,'string'));
x54=str2double(get(handles.edit54,'string'));
x55=str2double(get(handles.edit55,'string'));
x56=str2double(get(handles.edit56,'string'));
x57=str2double(get(handles.edit57,'string'));
x58=str2double(get(handles.edit58,'string'));
x59=str2double(get(handles.edit59,'string'));
x60=str2double(get(handles.edit60,'string'));
x61=str2double(get(handles.edit61,'string'));
x62=str2double(get(handles.edit62,'string'));
x63=str2double(get(handles.edit63,'string'));
x64=str2double(get(handles.edit64,'string'));
x65=str2double(get(handles.edit65,'string'));
x66=str2double(get(handles.edit66,'string'));
x67=str2double(get(handles.edit67,'string'));
x68=str2double(get(handles.edit68,'string'));
```

```
x69=str2double(get(handles.edit69,'string'));
x70=str2double(get(handles.edit70,'string'));
x71=str2double(get(handles.edit71,'string'));
x72=str2double(get(handles.edit72,'string'));
xs=get(handles.edit97,'string');
a11=[x49 x50 x51 x52 x53 x54 x55 x56 x57 x58 x59 x60 x61 x62 x63 x64 x65 x66
x67 x68 x69 x70 x71 x72];
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.uipanel1,'visible','off')
set(handles.uipanel3,'Visible','on')
set(handles.text83,'string',xs,'FontWeight','bold','FontSize',12);
axes(handles.axes18)
plot(a2,a11)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT1','FontWeight','bold','FontSize',12)
grid on

x98=str2double(get(handles.edit98,'string'));
x99=str2double(get(handles.edit99,'string'));
x100=str2double(get(handles.edit100,'string'));
x101=str2double(get(handles.edit101,'string'));
x102=str2double(get(handles.edit102,'string'));
x103=str2double(get(handles.edit103,'string'));
x104=str2double(get(handles.edit104,'string'));
x105=str2double(get(handles.edit105,'string'));
x106=str2double(get(handles.edit106,'string'));
x107=str2double(get(handles.edit107,'string'));
x108=str2double(get(handles.edit108,'string'));
x109=str2double(get(handles.edit109,'string'));
x110=str2double(get(handles.edit110,'string'));
x111=str2double(get(handles.edit111,'string'));
x112=str2double(get(handles.edit112,'string'));
x113=str2double(get(handles.edit113,'string'));
x114=str2double(get(handles.edit114,'string'));
x115=str2double(get(handles.edit115,'string'));
x116=str2double(get(handles.edit116,'string'));
x117=str2double(get(handles.edit117,'string'));
x118=str2double(get(handles.edit118,'string'));
x119=str2double(get(handles.edit119,'string'));
x120=str2double(get(handles.edit120,'string'));
x121=str2double(get(handles.edit121,'string'));
xs1=get(handles.edit146,'string');
a12=[x98 x99 x100 x101 x102 x103 x104 x105 x106 x107 x108 x109 x110 x111 x112
x113 x114 x115 x116 x117 x118 x119 x120 x121];
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text82,'string',xs1,'FontWeight','bold','FontSize',12);
axes(handles.axes19)
plot(a2,a12)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
```

```matlab
title('GT2','FontWeight','bold','FontSize',12)
grid on
x147=str2double(get(handles.edit147,'string'));
x148=str2double(get(handles.edit148,'string'));
x149=str2double(get(handles.edit149,'string'));
x150=str2double(get(handles.edit150,'string'));
x151=str2double(get(handles.edit151,'string'));
x152=str2double(get(handles.edit152,'string'));
x153=str2double(get(handles.edit153,'string'));
x154=str2double(get(handles.edit154,'string'));
x155=str2double(get(handles.edit155,'string'));
x156=str2double(get(handles.edit156,'string'));
x157=str2double(get(handles.edit157,'string'));
x158=str2double(get(handles.edit158,'string'));
x159=str2double(get(handles.edit159,'string'));
x160=str2double(get(handles.edit160,'string'));
x161=str2double(get(handles.edit161,'string'));
x162=str2double(get(handles.edit162,'string'));
x163=str2double(get(handles.edit163,'string'));
x164=str2double(get(handles.edit164,'string'));
x165=str2double(get(handles.edit165,'string'));
x166=str2double(get(handles.edit166,'string'));
x167=str2double(get(handles.edit167,'string'));
x168=str2double(get(handles.edit168,'string'));
x169=str2double(get(handles.edit169,'string'));
x170=str2double(get(handles.edit170,'string'));
xs2=get(handles.edit195,'string');
a13=[x147 x148 x149 x150 x151 x152 x153 x154 x155 x156 x157 x158 x159 x160
x161 x162 x163 x164 x165 x166 x167 x168 x169 x170];
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text81,'string',xs2,'FontWeight','bold','FontSize',12);
axes(handles.axes20)
plot(a2,a13)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('ST1','FontWeight','bold','FontSize',12)
grid on
x294=str2double(get(handles.edit294,'string'));
x295=str2double(get(handles.edit295,'string'));
x296=str2double(get(handles.edit296,'string'));
x297=str2double(get(handles.edit297,'string'));
x298=str2double(get(handles.edit298,'string'));
x299=str2double(get(handles.edit299,'string'));
x300=str2double(get(handles.edit300,'string'));
x301=str2double(get(handles.edit301,'string'));
x302=str2double(get(handles.edit302,'string'));
x303=get(handles.edit303,'string'));
x304=str2double(get(handles.edit304,'string'));
x305=str2double(get(handles.edit305,'string'));
x306=str2double(get(handles.edit306,'string'));
x307=str2double(get(handles.edit307,'string'));
x308=str2double(get(handles.edit308,'string'));
x309=str2double(get(handles.edit309,'string'));
x310=str2double(get(handles.edit310,'string'));
```

```matlab
x311=str2double(get(handles.edit311,'string'));
x312=str2double(get(handles.edit312,'string'));
x313=str2double(get(handles.edit313,'string'));
x314=str2double(get(handles.edit314,'string'));
x315=str2double(get(handles.edit315,'string'));
x316=str2double(get(handles.edit316,'string'));
x317=str2double(get(handles.edit317,'string'));
xs3=get(handles.edit342,'string');
a14=[x294 x295 x296 x297 x298 x299 x300 x301 x302 x303 x304 x305 x306 x307
x308 x309 x310 x311 x312 x313 x314 x315 x316 x317];
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text78,'string',xs3,'FontWeight','bold','FontSize',12);
axes(handles.axes21)
plot(a2,a14)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT3','FontWeight','bold','FontSize',12)
grid on
x343=str2double(get(handles.edit343,'string'));
x344=str2double(get(handles.edit344,'string'));
x345=str2double(get(handles.edit345,'string'));
x346=str2double(get(handles.edit346,'string'));
x347=str2double(get(handles.edit347,'string'));
x348=str2double(get(handles.edit348,'string'));
x349=str2double(get(handles.edit349,'string'));
x350=str2double(get(handles.edit350,'string'));
x351=str2double(get(handles.edit351,'string'));
x352=str2double(get(handles.edit352,'string'));
x353=str2double(get(handles.edit353,'string'));
x354=str2double(get(handles.edit354,'string'));
x355=str2double(get(handles.edit355,'string'));
x356=str2double(get(handles.edit356,'string'));
x357=str2double(get(handles.edit357,'string'));
x358=str2double(get(handles.edit358,'string'));
x359=str2double(get(handles.edit359,'string'));
x360=str2double(get(handles.edit360,'string'));
x361=str2double(get(handles.edit361,'string'));
x362=str2double(get(handles.edit362,'string'));
x363=str2double(get(handles.edit363,'string'));
x559=str2double(get(handles.edit559,'string'));
x364=str2double(get(handles.edit364,'string'));
x365=str2double(get(handles.edit365,'string'));
a16=[x343 x344 x345 x346 x347 x348 x349 x350 x351 x352 x353 x354 x355 x356
x357 x358 x359 x360 x361 x362 x363 x559 x364 x365];
xs5=get(handles.edit390,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text79,'string',xs5,'FontWeight','bold','FontSize',12);
axes(handles.axes22)
plot(a2,a16)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
```

```matlab
title('GT4','FontWeight','bold','FontSize',12)

grid on

x391=str2double(get(handles.edit391,'string'));
x392=str2double(get(handles.edit392,'string'));
x393=str2double(get(handles.edit393,'string'));
x394=str2double(get(handles.edit394,'string'));
x395=str2double(get(handles.edit395,'string'));
x396=str2double(get(handles.edit396,'string'));
x397=str2double(get(handles.edit397,'string'));
x398=str2double(get(handles.edit398,'string'));
x399=str2double(get(handles.edit399,'string'));
x400=str2double(get(handles.edit400,'string'));
x401=str2double(get(handles.edit401,'string'));
x402=str2double(get(handles.edit402,'string'));
x403=str2double(get(handles.edit403,'string'));
x404=str2double(get(handles.edit404,'string'));
x405=str2double(get(handles.edit405,'string'));
x406=str2double(get(handles.edit406,'string'));
x407=str2double(get(handles.edit407,'string'));
x408=str2double(get(handles.edit408,'string'));
x409=str2double(get(handles.edit409,'string'));
x410=str2double(get(handles.edit410,'string'));
x411=str2double(get(handles.edit411,'string'));
x412=str2double(get(handles.edit412,'string'));
x413=str2double(get(handles.edit413,'string'));
x414=str2double(get(handles.edit414,'string'));
a17=[x391 x392 x393 x394 x395 x396 x397 x398 x399 x400 x401 x402 x403 x404
x405 x406 x407 x408 x409 x410 x411 x412 x413 x414];
xs7=get(handles.edit439,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text80,'string',xs7,'FontWeight','bold','FontSize',12);
axes(handles.axes23)
plot(a2,a17)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT4','FontWeight','bold','FontSize',12)

grid on
```

- Also plant 2 by same way

code of plant 2 :

```matlab
function pushbutton4_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton4 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
```

```matlab
set(handles.uipanel1,'Visible','off')
set(handles.uipanel6,'Visible','off')
set(handles.uipanel3,'Visible','off')
set(handles.uipanel5,'Visible','on')
```

- Also the code of done in plant $2$ same like plant $1$

code of done :

```matlab
function pushbutton10_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton10 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
set(handles.uipanel5,'Visible','off')
set(handles.uipanel6,'Visible','on')
xs12=get(handles.edit981,'string');
set(handles.text181,'string',xs12,'FontWeight','bold','FontSize',12);
x934=str2double(get(handles.edit934,'string'));
x935=str2double(get(handles.edit935,'string'));
x936=str2double(get(handles.edit936,'string'));
x937=str2double(get(handles.edit937,'string'));
x938=str2double(get(handles.edit938,'string'));
x939=str2double(get(handles.edit939,'string'));
x940=str2double(get(handles.edit940,'string'));
x941=str2double(get(handles.edit941,'string'));
x942=str2double(get(handles.edit942,'string'));
x943=str2double(get(handles.edit943,'string'));
x944=str2double(get(handles.edit944,'string'));
x945=str2double(get(handles.edit945,'string'));
x946=str2double(get(handles.edit946,'string'));
x947=str2double(get(handles.edit947,'string'));
x948=str2double(get(handles.edit948,'string'));
x949=str2double(get(handles.edit949,'string'));
x950=str2double(get(handles.edit950,'string'));
x951=str2double(get(handles.edit951,'string'));
x952=str2double(get(handles.edit952,'string'));
x953=str2double(get(handles.edit953,'string'));
x954=str2double(get(handles.edit954,'string'));
x955=str2double(get(handles.edit955,'string'));
x956=str2double(get(handles.edit956,'string'));
x957=str2double(get(handles.edit957,'string'));
a21=[x934 x935 x936 x937 x938 x939 x940 x941 x942 x943 x944 x945 x946 x947
x948 x949 x950 x951 x952 x953 x954 x955 x956 x957];

a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];

axes(handles.axes24)
plot(a2,a21)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT5','FontWeight','bold','FontSize',12)
```

```matlab
grid on
x982=str2double(get(handles.edit982,'string'));
x983=str2double(get(handles.edit983,'string'));
x984=str2double(get(handles.edit984,'string'));
x985=str2double(get(handles.edit985,'string'));
x986=str2double(get(handles.edit986,'string'));
x987=str2double(get(handles.edit987,'string'));
x988=str2double(get(handles.edit988,'string'));
x989=str2double(get(handles.edit989,'string'));
x990=str2double(get(handles.edit990,'string'));
x991=str2double(get(handles.edit991,'string'));
x992=str2double(get(handles.edit992,'string'));
x993=str2double(get(handles.edit993,'string'));
x994=str2double(get(handles.edit994,'string'));
x995=str2double(get(handles.edit995,'string'));
x996=str2double(get(handles.edit996,'string'));
x997=str2double(get(handles.edit997,'string'));
x998=str2double(get(handles.edit998,'string'));
x999=str2double(get(handles.edit999,'string'));
x1000=str2double(get(handles.edit1000,'string'));
x1001=str2double(get(handles.edit1001,'string'));
x1002=str2double(get(handles.edit1002,'string'));
x1003=str2double(get(handles.edit1003,'string'));
x1004=str2double(get(handles.edit1004,'string'));
x1005=str2double(get(handles.edit1005,'string'));
a22=[x982 x983 x984 x985 x986 x987 x988 x989 x990 x991 x992 x993 x994 x995
x996 x997 x998 x999 x1000 x1001 x1002 x1003 x1004 x1005];
xs13=get(handles.edit1030,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text180,'string',xs13,'FontWeight','bold','FontSize',12);
axes(handles.axes25)
plot(a2,a22)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT6','FontWeight','bold','FontSize',12)

grid on
x1031=str2double(get(handles.edit1031,'string'));
x1032=str2double(get(handles.edit1032,'string'));
x1033=str2double(get(handles.edit1033,'string'));
x1034=str2double(get(handles.edit1034,'string'));
x1035=str2double(get(handles.edit1035,'string'));
x1036=str2double(get(handles.edit1036,'string'));
x1037=str2double(get(handles.edit1037,'string'));
x1038=str2double(get(handles.edit1038,'string'));
x1039=str2double(get(handles.edit1039,'string'));
x1040=str2double(get(handles.edit1040,'string'));
x1041=str2double(get(handles.edit1041,'string'));
x1042=str2double(get(handles.edit1042,'string'));
x1043=str2double(get(handles.edit1043,'string'));
x1044=str2double(get(handles.edit1044,'string'));
x1045=str2double(get(handles.edit1045,'string'));
```

```matlab
x1046=str2double(get(handles.edit1046,'string'));
x1047=str2double(get(handles.edit1047,'string'));
x1048=str2double(get(handles.edit1048,'string'));
x1049=str2double(get(handles.edit1049,'string'));
x1050=str2double(get(handles.edit1050,'string'));
x1051=str2double(get(handles.edit1051,'string'));
x1052=str2double(get(handles.edit1052,'string'));
x1053=str2double(get(handles.edit1053,'string'));
x1054=str2double(get(handles.edit1054,'string'));
a23=[x1031 x1032 x1033 x1034 x1035 x1036 x1037 x1038 x1039 x1040 x1041 x1042
x1043 x1044 x1045 x1046 x1047 x1048 x1049 x1050 x1051 x1052 x1053 x1054];
xs14=get(handles.edit1079,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text179,'string',xs14,'FontWeight','bold','FontSize',12);
axes(handles.axes26)
plot(a2,a23)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('ST3','FontWeight','bold','FontSize',12)

grid on

x1080=str2double(get(handles.edit1080,'string'));
x1081=str2double(get(handles.edit1081,'string'));
x1082=str2double(get(handles.edit1082,'string'));
x1083=str2double(get(handles.edit1083,'string'));
x1084=str2double(get(handles.edit1084,'string'));
x1085=str2double(get(handles.edit1085,'string'));
x1086=str2double(get(handles.edit1086,'string'));
x1087=str2double(get(handles.edit1087,'string'));
x1088=str2double(get(handles.edit1088,'string'));
x1089=str2double(get(handles.edit1089,'string'));
x1090=str2double(get(handles.edit1090,'string'));
x1091=str2double(get(handles.edit1091,'string'));
x1092=str2double(get(handles.edit1092,'string'));
x1093=str2double(get(handles.edit1093,'string'));
x1094=str2double(get(handles.edit1094,'string'));
x1095=str2double(get(handles.edit1095,'string'));
x1096=str2double(get(handles.edit1096,'string'));
x1097=str2double(get(handles.edit1097,'string'));
x1098=str2double(get(handles.edit1098,'string'));
x1099=str2double(get(handles.edit1099,'string'));
x1100=str2double(get(handles.edit1100,'string'));
x1101=str2double(get(handles.edit1101,'string'));
x1102=str2double(get(handles.edit1102,'string'));
x1103=str2double(get(handles.edit1103,'string'));
a24=[x1080 x1081 x1082 x1083 x1084 x1085 x1086 x1087 x1088 x1089 x1090 x1091
x1092 x1093 x1094 x1095 x1096 x1097 x1098 x1099 x1100 x1101 x1102 x1103];
xs15=get(handles.edit1128,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text176,'string',xs15,'FontWeight','bold','FontSize',12);
axes(handles.axes27)
plot(a2,a24)
```

```matlab
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT7','FontWeight','bold','FontSize',12)

grid on

x1129=str2double(get(handles.edit1129,'string'));
x1130=str2double(get(handles.edit1130,'string'));
x1131=str2double(get(handles.edit1131,'string'));
x1132=str2double(get(handles.edit1132,'string'));
x1133=str2double(get(handles.edit1133,'string'));
x1134=str2double(get(handles.edit1134,'string'));
x1135=str2double(get(handles.edit1135,'string'));
x1136=str2double(get(handles.edit1136,'string'));
x1137=str2double(get(handles.edit1137,'string'));
x1138=str2double(get(handles.edit1138,'string'));
x1139=str2double(get(handles.edit1139,'string'));
x1140=str2double(get(handles.edit1140,'string'));
x1141=str2double(get(handles.edit1141,'string'));
x1142=str2double(get(handles.edit1142,'string'));
x1143=str2double(get(handles.edit1143,'string'));
x1144=str2double(get(handles.edit1144,'string'));
x1145=str2double(get(handles.edit1145,'string'));
x1146=str2double(get(handles.edit1146,'string'));
x1147=str2double(get(handles.edit1147,'string'));
x1148=str2double(get(handles.edit1148,'string'));
x1149=str2double(get(handles.edit1149,'string'));
x1226=str2double(get(handles.edit1226,'string'));
x1150=str2double(get(handles.edit1150,'string'));
x1151=str2double(get(handles.edit1151,'string'));
a25=[x1129 x1130 x1131 x1132 x1133 x1134 x1135 x1136 x1137 x1138 x1139 x1140
x1141 x1142 x1143 x1144 x1145 x1146 x1147 x1148 x1149 x1226 x1150 x1151];
xs16=get(handles.edit1176,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text177,'string',xs16,'FontWeight','bold','FontSize',12);
axes(handles.axes28)
plot(a2,a25)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('GT8','FontWeight','bold','FontSize',12)

grid on

x1177=str2double(get(handles.edit1177,'string'));
x1178=str2double(get(handles.edit1178,'string'));
x1179=str2double(get(handles.edit1179,'string'));
x1180=str2double(get(handles.edit1180,'string'));
x1181=str2double(get(handles.edit1181,'string'));
x1182=str2double(get(handles.edit1182,'string'));
x1183=str2double(get(handles.edit1183,'string'));
```

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```matlab
x1184=str2double(get(handles.edit1184,'string'));
x1185=str2double(get(handles.edit1185,'string'));
x1186=str2double(get(handles.edit1186,'string'));
x1187=str2double(get(handles.edit1187,'string'));
x1188=str2double(get(handles.edit1188,'string'));
x1189=str2double(get(handles.edit1189,'string'));
x1190=str2double(get(handles.edit1190,'string'));
x1191=str2double(get(handles.edit1191,'string'));
x1192=str2double(get(handles.edit1192,'string'));
x1193=str2double(get(handles.edit1193,'string'));
x1194=str2double(get(handles.edit1194,'string'));
x1195=str2double(get(handles.edit1195,'string'));
x1196=str2double(get(handles.edit1196,'string'));
x1197=str2double(get(handles.edit1197,'string'));
x1198=str2double(get(handles.edit1198,'string'));
x1199=str2double(get(handles.edit1199,'string'));
x1200=str2double(get(handles.edit1200,'string'));


a26=[x1177 x1178 x1179 x1180 x1181 x1182 x1183 x1184 x1185 x1186 x1187 x1188
x1189 x1190 x1191 x1192 x1193 x1194 x1195 x1196 x1197 x1198 x1199 x1200];
xs17=get(handles.edit1225,'string');
a2=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24];
set(handles.text178,'string',xs17,'FontWeight','bold','FontSize',12);
axes(handles.axes29)
plot(a2,a26)
xlim([1 24])
ylim([0 50])
axis([0 24 0 50])
xlabel('Hours','FontWeight','bold','FontSize',12)
ylabel('MW','FontWeight','bold','FontSize',12)
title('ST4','FontWeight','bold','FontSize',12)

grid on


exit pushbutton to close the program
code of exit
function pushbutton6_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton6 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
pos_size=get(handles.s1,'Position');

user_response=questdlg('Would you like to exit ?','Confirm Close');
switch user_response
    case {'No'}
        %take no action
    case 'Yes'
        %prepare to clse window
        delete(handles.s1)
end
```