

Load Flow Analysis in Seven Bus Power System

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering.

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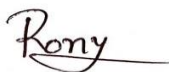
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JANUARY, 2023

Declaration

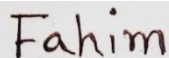
I hereby declare that this project “**Load Flow Analysis in Seven Bus Power System**” represents my own work which has been done in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

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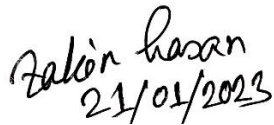
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Approval

The project entitled “**Load Flow Analysis in Seven Bus Power System**” submitted by **Rony Sikder (ID: 191-33-5018) & Md. Fahim Sakib Khan (ID: 191-33-5035)** has been done under my supervision and accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** in **January, 2023**.

Signed



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Dedicated
To
OUR
Mother's

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List of Abbreviations

PU	Per Unit
PSAT	Power System Analysis Toolbox
PSAF	Power System Analysis Framework
PSCAD	Power System Computer Aided Design
PSPICE	Personal Simulation Program with Integrated Circuit Emphasis
SVC	Static Var Compensator
GUI	Graphical User Interface

Acknowledgement

First of all, we want to give thanks to **Almighty Allah**. With his blessing we are able to complete our work with best effort.

We want to pay our utmost respect to our Supervisor **Zakir Hasan**, Lecturer of the **Department of EEE, Daffodil International University** for who has given us the chance to work on an impactful idea and taken care of every issue of development of this concept. Then we would like to take this opportunity to express gratitude to our supervisor for being dedicated in supporting, motivating and guiding us throughout this project. This project can't be done without his useful advice and help. Also thank him very much for giving us the opportunity to work with this project.

Abstract

Load flow analysis may be defined as computations that define the characteristics of a power system's steady-state operating environment. The load flow analysis of a power distribution system under fault and no fault situations is proposed in this paper. Three phase-to-phase faults are used on distinct locations of an IEEE 7-bus system created with the MATLAB/Simulink platform. The obtained findings are compared to normal operating circumstances to assess the system's behavior during transient operating conditions. For comparison, the IEEE 7-BUS 3-Machine test feeder models are utilized since they encompass all conceivable realistic configurations and load profiles, such as three-phase asymmetry, single-phase lateral and dispersed loads, and so on. The results indicate the voltage and current on loaded buses with the least amount of loss.

Keywords: Load flow, MATLAB Simulink, Feeder, Power system, Asymmetry, Fault.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this thesis book, we have analyzed about 7 bus 3 machine load flow by using MATLAB simulink. In MATLAB Simulink, we have collected our main components from the library browser. We used three phase source, load flow bus, three phase V-I measurement, three phase transformer (Two winding) also three phase RLC load. And then we have execute this simulink design. Basically, based on this simulink there are two types of conditions. During operating the MATLAB simulink we have found without fault and with fault condition. As we have analysed several thesis paper, we have got some knowledge on power flow analysis based on the Gauss seidel method, Newton raphson method. By implementing our MATLAB system design, we can create a new power system network. By which system loss minimization and transformer tap setting for economic operation can be held. Also, it will help to decide the best operation of existing system and for planning the future expansion of the system.

1.2 Problem Statement

As it is analysis based thesis paper, during normal load condition in 230 KV transmission line there is no problem on our load. But whenever a fault occurs on this network, a huge level of surge voltage create on the load side. Also this surge voltage is detrimental for our household equipments and the circuit may be destroyed. After some time, not any voltage found on the load side. In the mean time, whole current passes through the fault path. Because of the fault occurrence it creates a very low impedance path for the current flow. This results in a very high current being drawn from the supply, damaging insulation and components of the equipments.

1.3 Objectives

Many times, various types of faults occur in our system. This type of fault is common, especially during natural disasters. In our research, we have analyzed the state of the system before the fault and the state of the system after the fault.

1.4 Technologies

The computations used in load flow analysis may be thought of as defining the steady-state operational parameters of an energy system. This study suggests an investigation of the power flow across a power distribution system when there is a failure. Three phase-to-ground faults per network are employed. In the modern era, we can perform this load flow analysis using a variety of software programs such as PSAT, PSAF, CYME, PSCAD, and others. But we have done the analysis in our study using MATLAB Simulink. We obtained the expected results in under-fault and no-fault conditions using MATLAB Simulink, which indicates our output of voltage and current.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Load flow analysis is the most significant segment in power system analysis. On this load flow analysis, we can measure voltage (pu), current (pu), phase angle, transient stability, fault condition, and no fault condition on a power system. In that case, we can use a variety of methods, including the Newton-Raphson method, the Gauss-Seidel equation, steady-state analysis, and power flow. MATLAB, PSAT, Cyme, PSAT, and other toolboxes are available today. With this type of toolbox, we can see the load flow of any power system.

2.2 Related Research

Authors of [1] The analysis of load flow is performed by power companies. Analysis of load flow is often carried out by power companies using rather complicated software. PSAT is just one of many open-source software packages that can be used to investigate load flow analysis. Other applications include In this panel paper, the steady-state analysis of the IEEE-6 bus system is investigated utilizing a variety of load-level flow strategies. These methodologies include the Newton-Raphson method and the fast-decoupled method. The process of applying numerical analysis to a power system requires the use of an instrument known as power flow analysis. This paper details a brand new power system analysis tool (PSAT) that can be downloaded for free from the internet and is based on Matlab. Small-signal stability analysis, time-domain simulation, power flow, continuation power flow, and optimum power flow are all aspects of the PSAT that are covered. Within the scope of this research is the presentation of the steady-state analysis of the IEEE-6 bus system. The result indicates how rapidly and correctly the power flow calculation can meet the demanding requirements of power simulation. The investigation and implementation of new power system operating arrangements will be the primary focus of research in the future. Es makes use of some extremely complicated software. PSAT is just one of many open-source software packages that can be used to investigate load flow

analysis. Other applications include In this panel paper, the steady-state analysis of the IEEE-6 bus system is investigated utilizing a variety of load-level flow strategies. These methodologies include the Newton-Raphson method and the fast-decoupled method. The process of applying numerical analysis to a power system requires the use of an instrument known as power flow analysis. This paper details a brand new power system analysis tool (PSAT) that can be downloaded for free from the internet and is based on Matlab. Small-signal stability analysis, time-domain simulation, power flow, continuation power flow, and optimum power flow are all aspects of the PSAT that are covered. Within the scope of this research is the presentation of the steady-state analysis of the IEEE-6 bus system. The result indicates how rapidly and correctly the power flow calculation can meet the demanding requirements of power simulation. The investigation and implementation of new power system operating arrangements will be the primary focus of research in the future.

Authors of [2] The power flow study is the first stage, and it is responsible for providing the voltage magnitudes, phase angles, active power flows, and reactive power flows at each separate bus under normal operating circumstances. The calculation of breaches of parameters is accomplished through the use of contingency analysis. Using the PSAT toolbox in MATLAB, this article calculates the maximum loading parameter and determines the contingency status of the Western System Coordinating Council's 3 machine and 9 bus test systems. The anticipation of a voltage collapse is an important part of both the design and management of power systems. This is because voltage collapse is one of the primary causes of voltage instability, which may be prevented by doing an adequate risk assessment. Line outage contingencies are rated in order to find the line that has the greatest impact on the voltage stability of the system. If an outage were to occur in that specific line, it would be possible to spot it and immediately give protection to the system. PSAT also has a comprehensive collection of graphical interfaces that are simple to use, in addition to a Simulink-based editor for creating one-line network diagrams. With the assistance of contingency analysis, the operator is able to discover the most crucial component of the system. This component is the one that has to be recognized in order to prevent future discrepancies that might lead to a blackout of the system. Within the scope of this study, power flow analysis was carried out to determine the line power losses and bus voltages of the remaining system, and CPF analysis was

carried out to determine the maximum loading factor. Here, an analysis of potential outcomes for a failure of transmission lines is carried out. This enhances the essential system's dependability as well as its efficiency in its linked architecture.

Authors of [3] The load flow study for a 9-bus electrical system has been completed as part of the inquiry into the most effective distribution of SVC throughout the system. After doing research on load flow for a typical, uncompensated system first, researchers turned their attention to SVC-compensated systems. A comparison of these uncompensated systems with these compensated systems leads to the conclusion that the SVC-compensated system is superior in terms of voltage stability and reduces the amount of total loss in the system. On the other hand, it was once again seen that the stability of the SVC was substantially improved at one position of installation compared to any other location of installation and that losses were greatly reduced. By capturing various system circumstances, the load flow study provides a visual representation of the overall performance of the electrical system as well as the total power flow (P & Q) in steady state. In addition to this, it offers a comprehensive analysis of line and transformer losses, in addition to system losses and voltage at a variety of electrical buses. In this article, a shunt-connected controller known as SVC is used for the purposes of conducting a load flow analysis, enhancing voltage stability, and reducing loss in an electrical system that consists of nine buses. The load flow of an uncompensated nine-bus system and an SVC-compensated system is compared and examined in terms of maintaining voltage stability and minimizing loss to determine the best way to use SVC resources.

Authors of [4] This paper presented a summary of the findings from a load flow analysis case study that was carried out using the PFASYM software (a Matlab-based computational tool for three-phase power system analysis). This work was completed as part of a larger energy systems modeling and analysis effort aimed at providing a validated power flow study that aids comprehension of power flow ideas for existing distribution networks operating in asymmetric situations. The technique of analysis that was employed in this illustrative case study, as well as the lessons that were learned from the research, might be of use to the grid operator in the process of performing power flow analyses of operating regions of interest. PFASYM does not have a graphical user interface (GUI), but it does enable modeling of unbalanced loads and offers methods that are both resilient and efficient for solving problems

involving three-phase load flow. In order to verify a power flow case study that is appropriate for simulation and evaluation, the three-phase power flow model PFASYM was applied to a representative electric power system. This was done in order to accomplish the goal of validating the model. The section of the network was chosen because of its technical complexity, which made it possible to address all of the major concepts pertaining to power flow studies, and because of its proximity to our research center, which made it easier to visit the site and get access to the data. Both of these factors were important in the decision. In this work, we provide a summary of the findings from a load flow analysis case study that was carried out using the PFASYM software (a Matlab-based computational tool for three-phase power system analysis).

Authors of [5] This paper presents Inverter-interfaced distributed generators, often known as DGs, are used in microgrids. These DGs have unique features and models that are not supported by the typical power flow analytic tools that are currently in use. This article proposes a static modeling technique for inverter-interfaced DGs that may be used for time-spread load flow analysis and fault analysis of microgrids, including droop-based voltage-regulated DGs. The approach was developed by the authors of this article. A unique electrical network idea known as MICROGRID offers flexibility in terms of both control and operation to distribution networks that include a significant number of distributed generators (DGs). As a result of this research, it has been shown that the static equations of an island-based microgrid, which include droop-based DG inverters, have sufficient restrictions to be solved by numerical techniques. Then, using the phasor simulation method, it was demonstrated that developed static models for DG inverters, which are based on the constraints of droop control and current limiting, can be used to perform power flow analysis of small to medium-scale microgrids, including faults. This was achieved by using the phasor simulation method. On the other hand, the detection of current limiting requires a unique consideration since the power controller of voltage-controlled DGs does not include any current reference information. This complicates the detection of current limiting. It has been proposed that grid-based voltage-based current-limiting detection might be used as a solution to the problem. With this technique, the threshold voltage could be computed using a two-step process. It has been shown that the procedure that was suggested is suitable for use in the event that symmetrical flaws occur.

Authors of [6] The use of load flow, a tool that is both crucial and fundamental, is essential to the investigation of any power system. This tool is used throughout the planning phase of the system as well as the operational phase. This procedure is carried out in order to investigate the magnitude and phase angle of the voltage at each bus as well as the actual and reactive power flows that take place inside the system components. In this article, we explore how Matlab may be used to analyze and resolve steady-state and transient problems that arise in power systems. Research on power flow, short circuit analysis, and stability analysis are some of the subjects covered in this section. When investigating the aforementioned conditions, the Gauss–Seidel method, the Newton–Raphson method, and the Decouple method are the methodologies that are used the majority of the time. After that, the output of it is used for determining whether or not there was a short circuit and the system's overall stability.

Authors of [7] Power flow analysis can be described as calculations on defining characteristic properties of steady state operating situation of energy systems. This study proposes the power flow analysis of a power distribution system, under fault conditions. Three phase-to-ground faults are applied on various points of IEEE 9-bus system, which is designed under MATLAB/Simulink platform. Power flow studies provide mathematical calculations to determine the bus voltages, phase angles, active and reactive power flows through power system components. The study gives steady state solutions of the voltages at all the buses, for a particular load condition (Kaur, G.). The main information obtained from the load flow or power flow analysis comprises magnitudes and phase angles of load bus voltages, reactive powers and voltage phase angles at generator buses, real and reactive power flows on transmission lines together with power at the reference bus In this study, effects of faults on power flow analysis parameters, which are voltage amplitude and phase angle, of a distribution system is investigated. IEEE 9-bus system is designed under MATLAB/Simulink platform. Three faults, which are placed at slack bus, PV bus and load bus are applied on system and results are obtained from two measurement points out of these buses, to determine the effects of faults on power flow analysis parameters. It is clear from graphs that it is necessary to take faults into account when performing power flow calculations for accurate results.

2.3 Compare and Contrast

We can learn about various load flow analyses from the above research paper. They have done all this load analysis in various ways. They used some toolboxes like PSAT, PSAF, CYME, etc. Through this process, they demonstrated phase angle, small signal stability, transient stability, system losses and voltage, and fault analysis. We used Matlab simulation to perform a 7 bus 3 machine load flow analysis. Our analysis shows current and voltage output in normal operating conditions and under fault conditions.

2.4 Summary

PSAT is just one of many open-source software packages that can be used to investigate load flow analysis. Within the scope of this research, the steady-state analysis of the IEEE-6 bus system is investigated. Using the PSAT toolbox in MATLAB, this article calculates the maximum loading parameter and determines the contingency status of the Western System Coordinating Council's 3 machine and 9 bus test systems. The anticipation of a voltage collapse is an important part of both the design and management of power systems. A shunt-connected controller known as SVC is used for a load flow analysis, enhancing voltage stability, and reducing loss in an electrical system that consists of nine buses. Inverter-interfaced distributed generators, often known as DGs, are used in microgrids. These DGs have unique features and models that are not supported by current power flow analytic tools. Phasor simulation was used to develop static models for DG inverters that can be used to perform power flow analysis. In this article, we explore how MATLAB may be used to analyze power systems. Power flow analysis might be thought of as a set of calculations used to determine typical characteristics of steady-state operating scenarios for energy systems. The IEEE 9-bus system is designed in MATLAB/Simulink, and three phase-to-ground failures are introduced at strategic locations throughout the system. This study examines the effects of faults on the voltage amplitude and phase angle used in the power flow analysis of a distribution system. The MATLAB/Simulink environment is used to develop the IEEE 9-bus system. Results are gathered from two independent measuring sites away from these buses.

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

In this materials and methods chapter, we have discussed the 7 bus 3 machine components and its MATLAB Simulink implementation method. We have arranged different types of components in the Simulink library browser. The three-phase RLC load has been explained in the same way as the three-phase source, three-phase transformer, and load flow bus. In the method for load flow analysis, we have designed a 7-bus, 3-machine diagram for a single load. Also based on an online diagram of a 230KV transmission line for load flow analysis, a MATLAB Simulink has been designed. The ultimate outcome depends on the normal and fault conditions that were designed in the Simulink block diagram. Also, the outcome shows the magnitude of voltage and current for this load flow analysis.

3.2 Methods and Materials

Three phase source: The Three-Phase Source block functions as a three-phase voltage source and has an R-L impedance as part of its design. By using a connection in the form of a Y with a neutral that may either be grounded internally or made externally accessible, it is possible to unite three separate voltage sources into a single circuit. [Citation needed] Indicating the source's internal resistance and inductance may be done in one of two ways: either by entering values for R and L, or by supplying the source's inductive short-circuit level and X/R ratio. Both of these methods are feasible [9].

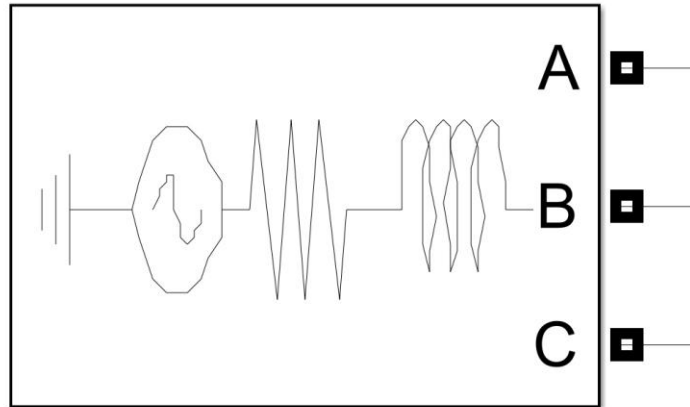


Fig.3. 1 Three phase sources

Three phase vi measurement: V_i measurement over all three phases the instantaneous voltages and currents of all three phases of a circuit may be measured with the help of the Three-Phase V-I Measurement block. It returns the three phase-to-ground or phase-to-phase peak voltages and currents when it is linked in series with three-phase components. Alternatively, it may also return the phase-to-phase peak voltages and currents [8].

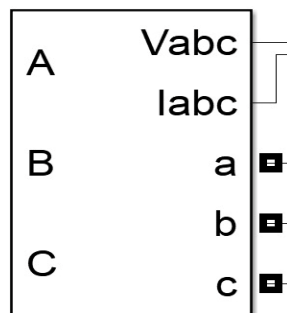


Fig.3. 2 Three phase VI measurement

Three phase transformer (Two windings) :

The functionality of a three-phase transformer is represented by this block as a combination of three single-phase transformers. Check out the Linear Transformer block for a comprehensive breakdown of the electrical representation of a single-phase transformer.

When active, the saturation characteristic exhibits the exact same behavior as that which is outlined for the Saturable Transformer block. The beginning values will be automatically changed to ensure that the simulation begins in a steady state if the fluxes are not given.

The transformer's nominal power P_n and the winding's nominal voltage are used to calculate the leakage inductance and resistance of each winding. These values are expressed in pu (V_1 or V_2). You may get an explanation of per units by looking at the Linear Transformer or the Saturable Transformer[11].

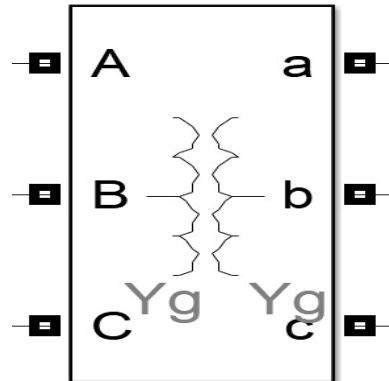


Fig.3. 3 Three phase transformer

Three-Phase PI Section Line

A balanced three-phase transmission line model that has its parameters grouped together in a PI section may be created with the help of the Three-Phase PI Section Line block.

In contrast to the Spread Properties Line model, which assumes that the line's resistance, inductance, and capacitance are evenly distributed throughout the line, the Three-Phase PI Section Line block combines all of the line's parameters into a single PI section[13].

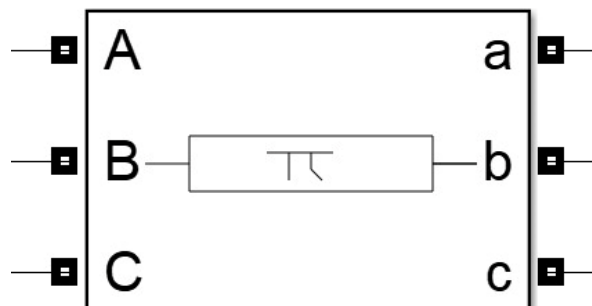


Fig.3. 4 Three-Phase PI section line block

Load flow bus: In order to solve a load flow, you may use the Load Flow Bus block in models to provide the bus locations as well as the parameters for those sites. The problem of load flow may be solved with the help of the Powergui Load Flow tool.

The Simscape™ Electrical™ Specialized Power Systems provide you the ability to execute both of the following kinds of load flows:

The load flow was performed in a positive sequence on a three-phase system. At each three-phase bus, we calculate the positive-sequence voltages in addition to the active power (P) and reactive power (Q) flows.

Unbalanced load flow that is being applied to a combination of three-phase, two-phase, and single-phase systems. Calculations are done for each phase to determine the individual phase voltage and PQ flow. Only for the purpose of initializing the model are the Load Flow Bus parameters utilized. They do not have any effect whatsoever on the performance of the simulation[10].

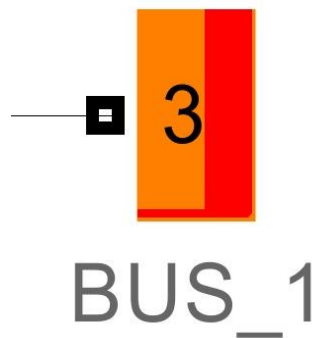


Fig.3. 5 Load flow bus

Three-Phase Parallel RLC Load: This three-phase balanced load is implemented as a parallel combination of RLC components by the Three-Phase Parallel RLC Load block. The load demonstrates a consistent impedance at the frequency that has been set. Both the load's active and reactive powers are proportional to the square of the applied voltage when it comes to being absorbed[14].

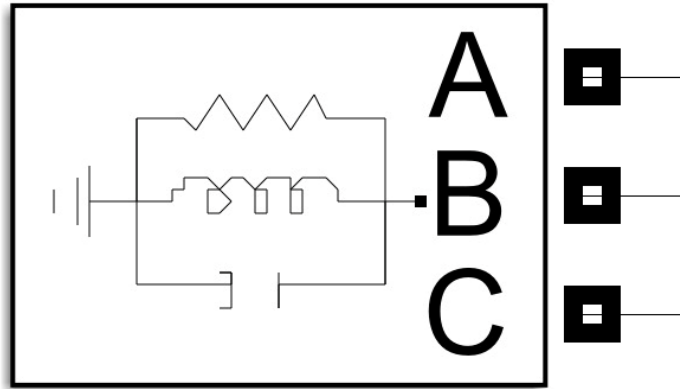


Fig.3. 6 Three-Phase Parallel RLC Load

Three-phase Fault: The Three-Phase Fault block is an implementation of a three-phase circuit breaker, and it allows the opening and shutting timings of the circuit breaker to be controlled either by an external Simulink signal or by an internal control timer (internal control mode).

In order to program phase-to-phase faults, phase-to-ground faults, or a mix of phase-to-phase and ground faults, the Three-Phase Fault block makes use of three Breaker blocks that may be separately turned on and off. The arc extinguishing procedure for the Three-Phase Fault block is identical to the one used for the Breaker block[15].

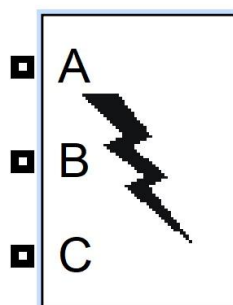


Fig.3. 7 Three-Phase Fault

Scope: The DSP System Toolbox as well as the Simulink Scope block Signals in the time domain are shown via the Time Scope block. The functionality and look of a scope block may be modified by modifying the scope configuration parameters. detailed instructions for doing routine operations associated with the scope, such as recording data, exchanging photos, and manipulating the display.[12]

winding) transformer. We have also used a step-up transformer between bus no. 3 and bus no. 4, and lastly, we have a step-up transformer connection between bus no. 6 and 7.

3.4 System Analysis or Design Analysis

In this system, we see that generator 1 is connected to load flow bus 1, and this generator is producing 18 kV and supplying it to bus 1. Here, the three phase step-up transformer connection between No. 1 and No. 2 load flow buses is being converted to 18 KV/230 KV. Next, we see that Bus No. 2 is connected to Bus No. 3 and Bus No. 7. We also see that generator 2 is connected to bus no. 6, which generates 13.8 kV and is converted from 13.8 kV to 230 kV by the three phase step up transformer between buses no. 6 and 7. Generator 3 generates 16.5 kV and converts it to 16.5 kV / 230 kV in a step-up transformer between bus no. 3 and 4. Here, Bus No. 2, Bus No. 3, Bus No. 5, and Bus No. 7 make an interconnection, and next we see that a load of 80 MW is connected to Bus No. 5.

3.5 Simulation

Using MATLAB Simulink, we performed load flow analysis on 7 bus 3 machines for a single zone. Then gathered the necessary tools from the MATLAB Simulink library browser, including the Three phase source, Load flow bus, Three phase two winding transformer, three phase V-I measurement, PI section transmission line, three phase RLC load, Scope, and Powerful. The system design in MATLAB Simulink without fault condition is given bellow:

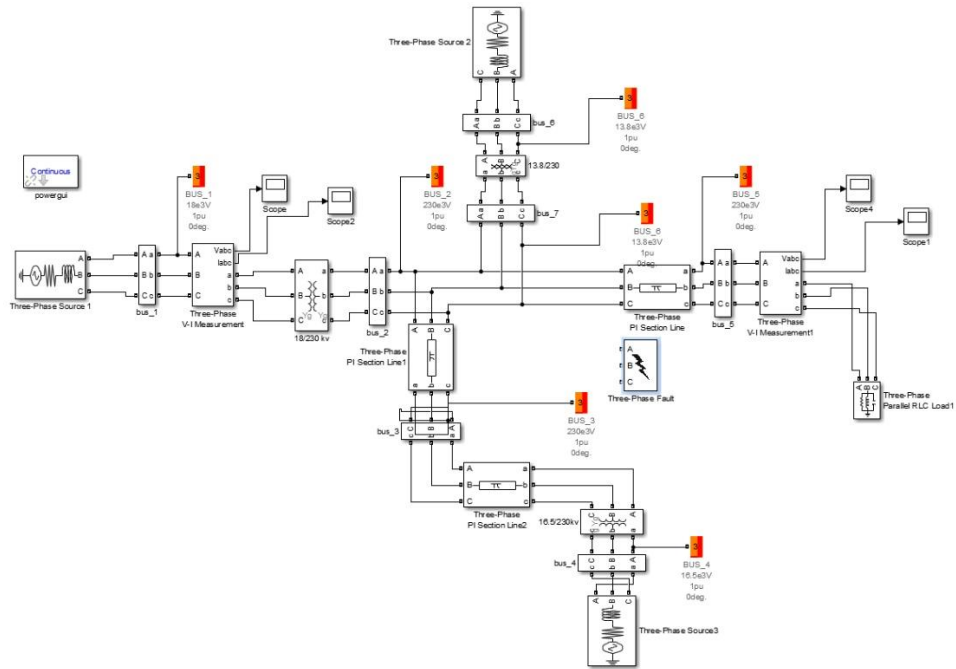


Fig.3. 10 Simulink Design of No Fault Condition

Here, a three-phase source is used as a generator in the Simulink design. The three-phase line from source 1 is connected to the three-phase VI measurement through busbar 1. Here, the three-phase VI measurement is mainly used to measure the voltage and current produced by source 1. The 18 kV generated from source 1 is converted to 230 kV by an 18/230 kV generator to connect to the grid. Similarly, the power produced from source 2 is connected to a generator through bus 6. The generator converts the 13.8 KV power produced by Source 2 to 230 KV and sends it to Bus 7. On the other hand, the 16 kV power generated from source 3 is connected to the generator through busbar 4. The 16.5 kV produced by the generator is converted to 230 kV and connected to the pi section line. The improved end-stable voltage from the pi section line is connected to bus 3. The voltage from bus 3 is connected directly to the grid through another pi section line. On the load side, another PI section line is used so that we get a stable voltage. A three-phase line emerges from the pi section line and connects to bus bar 5. From bus bar 5, we use this as our required power load. In this case, we've assumed a load of 80 MW.

The following describes the MATLAB Simulink system architecture with a fault condition:

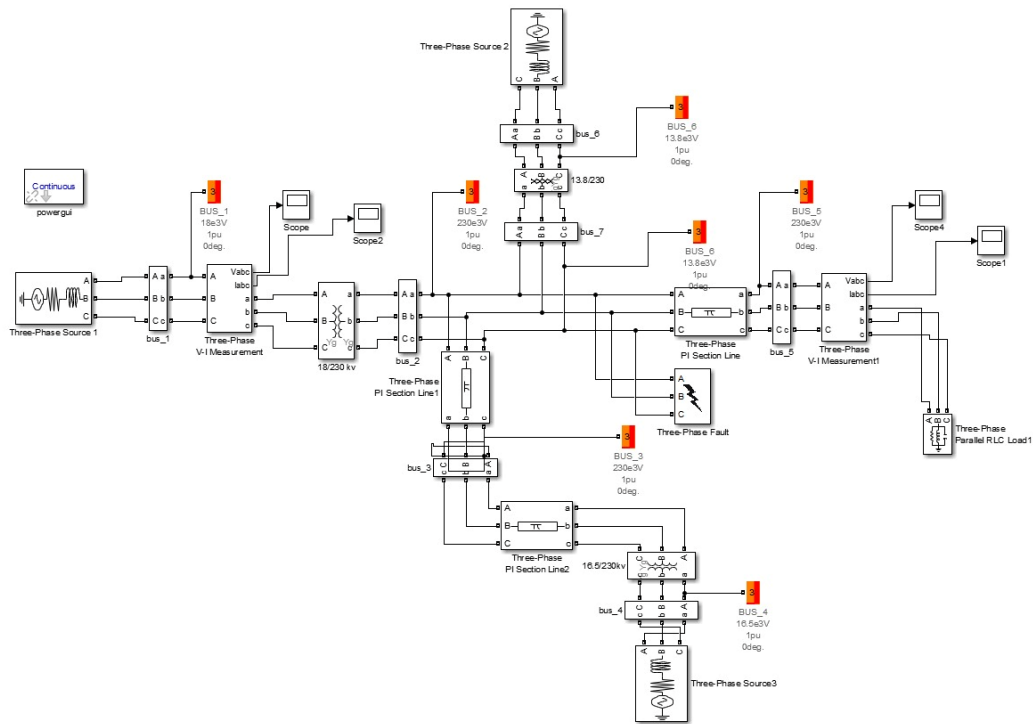


Fig.3. 11 Simulink Design Under Fault Condition

The MATLAB Simulink diagram in this instance is identical to one with no faults; the only fault exhibited is a three-phase fault (Phase-to-Phase) between bus numbers 2 and 5.

3.6 Summary

By using a connection in the form of a Y with a neutral, it is possible to unite three separate voltage sources into a single circuit. Indicating the source's internal resistance and inductance may be done in one of two ways. The functionality of a three-phase transformer is represented by this block as a combination of three single-phase transformers. The Simscape TM Electrical TM Specialized Power Systems provide you the ability to execute the following kinds of load flows. The Three-Phase Fault block is an implementation of a three-phase circuit breaker.

The DSP System Toolbox as well as the Simulink Scope block show signals in the time domain via the Time Scope block. Using MATLAB Simulink, we performed load flow analysis on seven bus 3 machines for a single zone. The diagram shows an

online diagram of three generators and seven buses. We also see that generator 1 is connected to load flow bus 1, and this generator is producing 18 kV. The power produced from source 1 is connected to a generator through bus 6.

The generator converts the 13.8 KV power produced by Source 2 to 230 KV and sends it to Bus 7. On the load side, another PI section line is used so that we get a stable voltage.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Results

Current output waveshape in without fault condition is given below:

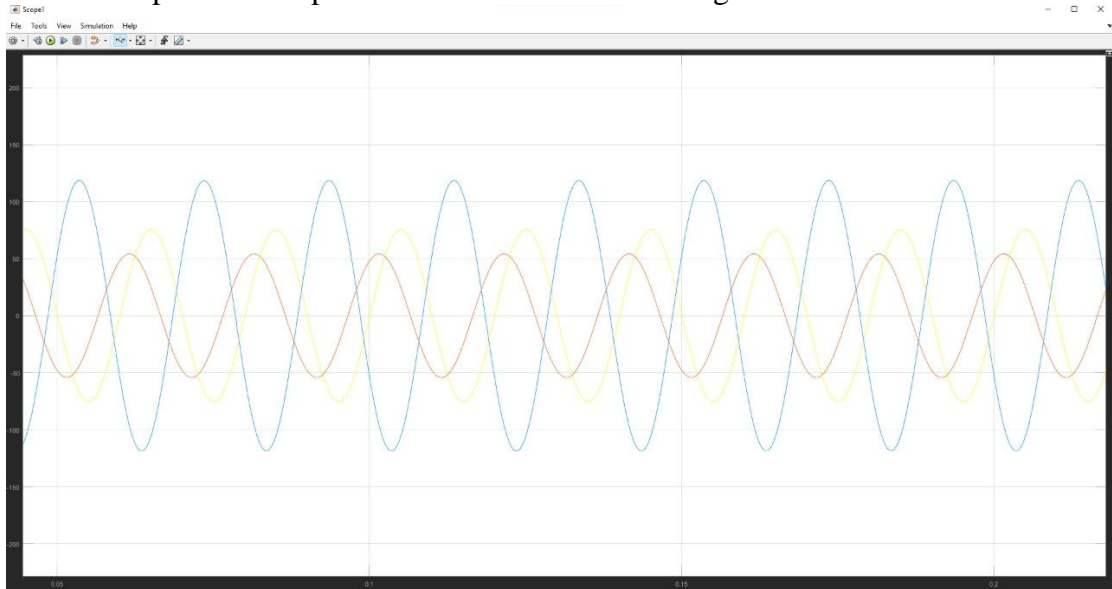


Fig.4. 1 Current Waveshape in Without Fault Condition

In figure 4.1 we see that the current output waveshape without fault condition. In this figure we see that the waveshape is stable and without fault condition there don't have any distortion.

Voltage output waveshape in without fault condition is given below:

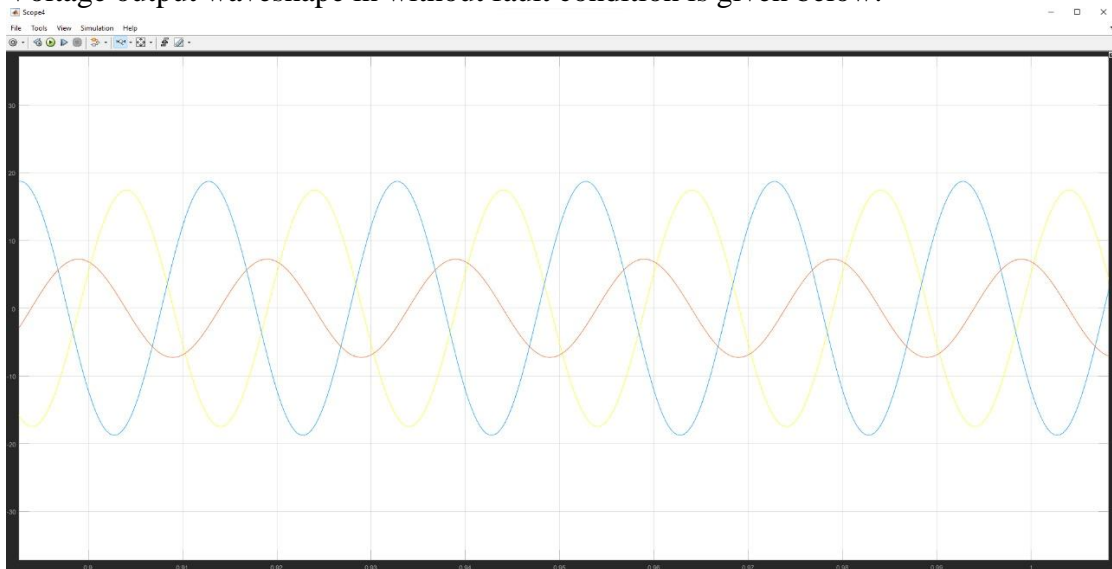


Fig.4. 2 Voltage Waveshape in Without Fault Condition

Figure 4.2 shows that there is no fault condition in the voltage output waveshape. This graphic demonstrates that the waveshape is stable and distortion-free in the absence of fault conditions.

Current output waveshape under fault condition is given below:

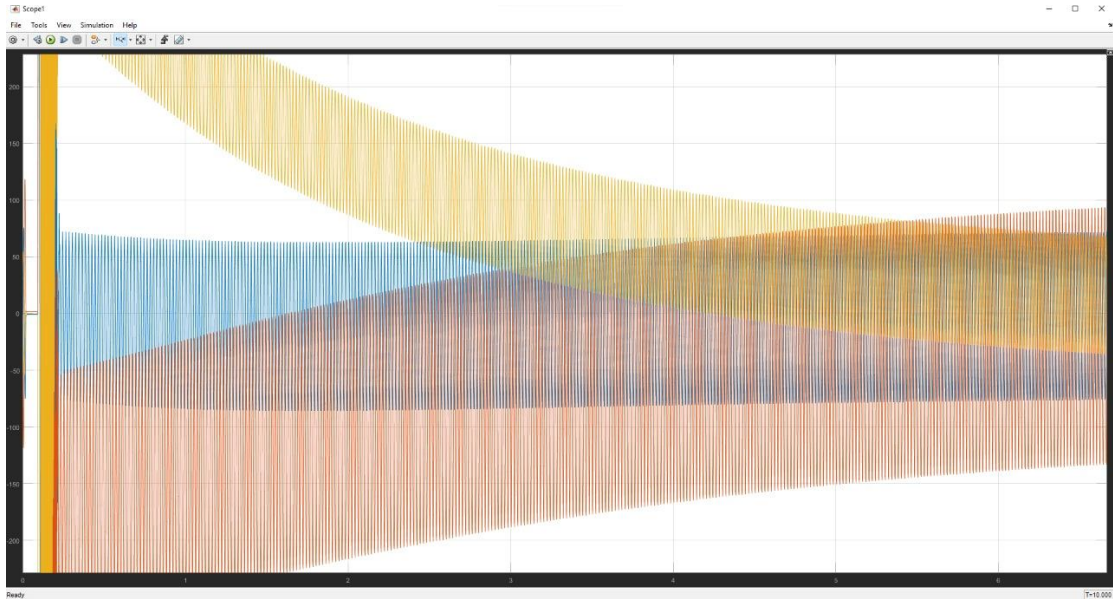


Fig.4. 3 Current Waveshape Under Fault Condition

In figure 4.3 we see the output voltage waveshape under fault condition. Under fault condition there is huge amount of surge voltage and the whole system is unstable.

Voltage output waveshape under fault condition is given below:

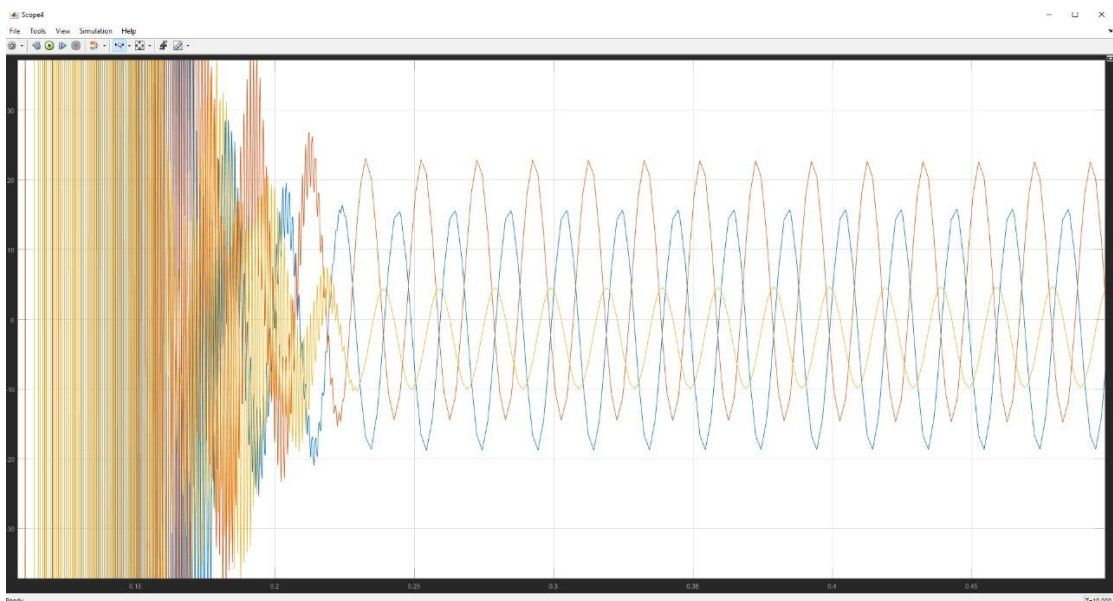


Fig.4. 4 Voltage Waveshape Under Fault Condition

The output voltage waveform under a fault state is shown in figure 4.3. Huge amounts of surge voltage are present when there is a malfunction, and the entire system is unstable.

4.2 Discussions

In Figures 4.1 and 4.2, we can see the current and voltage waveshapes without fault conditions, and the waveshape is stable and there is no distortion. The current rating is 250 amps and the voltage rating is 40 kV when no fault condition exists. If any fault doesn't occur in the system, then we will get stable voltage and current all the time. Under a fault condition, we see that in Figure 4.3, there is a huge amount of surge current; at the initial stage, it is around 600 amps. This huge amount of current can damage our electrical equipment and even burn it. In figure 4.4, we see the output voltage waveform under a fault condition. Initially, we see a vast amount of surge voltage, which is around 80KV. We get a nominal voltage at the load side after a short time. We see that here, without fault, this system was stable and there wasn't any distortion. However, when a fault condition occurs, the waveshape of this system changes and there is no stability.

CHAPTER 5

IMPACT ASSESMENT OF THE PROJECT

5.1 Economical, Societal and Global Impact

One of the most crucial elements of power system design and operation is load flow studies. In a power system, the load side typically has minimal impact under normal circumstances. Because in this instance, the load side is experiencing a steady flow of current, voltage, and phase angle. However, when a defect occurs in the system, high voltage and current temporarily flow on the load side. As a result, the system might severely harm any loads that are connected to it. It is possible to utterly damage even sizable industrial motors and generators. Our financial situation is impacted since these businesses need a lot of money to recover. When these issues arise, both the productivity of the industrial sector and people's daily lives are interrupted. Bangladesh is a middle-income nation, so if such occurrences persist, it will be harder for Bangladesh to improve.

5.2 Environmental and Ethical Issues

We have arranged several types of components in the Simulink library browser. For a single load, we constructed a 7-bus, 3-machine diagram using the load flow analysis technique. The outcome also shows how much voltage and current were used in this load flow analysis. In essence, the system we created has no direct impact on the environment. Thus, this system is beneficial to the environment.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

For comparison, the IEEE 7-BUS 3-Machine test feeder models are utilized since they encompass all conceivable realistic configurations and load profiles, such as three phase asymmetry, single-phase lateral and dispersed loads, and so on. The results indicate the voltage and current on loaded buses with the least amount of distortion. Our primary components have been gathered via the library browser. After that, we must put this Simulink concept into action. Basically, there are two different sorts of situations based on this simulation. While running the MATLAB simulator, we discovered both faultless and faulted conditions. We have gained some understanding about power flow analysis based on the Gauss-Seidel and Newton-Raphson methods as a result of our examination of various thesis. We are able to build a new power system network by putting our MATLAB system design into practice.

6.2 New Skills and Experiences Learned

Discovering new information is the process of research. When new concepts are developed or current information and theories are advanced, it results in previously undiscovered knowledge. In this study, we learn how to gather materials, such as similar articles from multiple sources, how to use MATLAB Simulink, and how to create a thesis paper.

6.3 Future Recommendations

Load flow analysis is one of the most important part of power system. There are many opportunities to work in this sector. In this continuity we have done load flow analysis with a 7 bus 3 machine. Later, if anyone wants to work in this sector, our recommendations are given below:

- ❖ In the future, a multiple zone can be developed by increasing the number of bus machines and loads.

- ❖ Besides voltage and current, they can also work with frequency and phase angle.
- ❖ In this system, analysis is done only for no-fault and under-fault conditions. They can work on how to stabilize the system after future faults.
- ❖ Here only MATLAB Simulink has been worked with; in the future, one can work with any other software like CYME, PSPICE, PSCAD, etc.

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