DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

A THESIS SUBMITTED TO THE GRADUATE SCHOOL OF APPLIED SCIENCES OF NEAR EAST UNIVERSITY

By SAND MUSTAFA AL-REFAI

In Partial Fulfilment of the Requirements for The Degree of Master of Science in Electrical and Electronic Engineering

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To my parents and family....

ABSTRACT

Electrical energy is very important for sustainability and quality of life on this planet. Solar photovoltaic (PV) is one of the most adequate technologies used to convert the energy of the sun to electrical energy. Suitable exploitation of solar energy implies important diminution of the emissions of greenhouse gases.

In Libya, due to environmental, economic and development perspectives the Renewable Energy Authority of Libya (REAOL) is planning to implement a grid connected 14 MW photovoltaic (PV) power plant near the Houn city in the Jufra District in Libya. The implementation of such large scale solar project may affect the normal parameters of the existing power station. These parameters are mainly voltage control, stability, protection equipment, and harmonic distortion levels. Therefore, this thesis develops a study of the design of PV system to be implemented in Houn substation 220 kV. The study aims to find the optimal parameters of the PV system such that it can function correctly. In addition, it investigates the impact of integrating PV directly with the existing grid. Different analysis tools will be used to perform load flow analysis to ascertain the effect on the PV to the grid. Analysis of the voltage variations and voltage stability after the integration of the PV system will also be assessed. Harmonic distortion analysis of the system is also going to be experimented after the connection of the PV plant to ensure the conformity of the resulting system with the international power quality standards.

In order to prove the design validity of the proposed system, models and simulations in MATLAB/SIMULINK and ETAP program will be established for a practical distribution grid. Real loads and solar energy data will be used in the simulation models for more realistic design. The results obtained from the analysis will be presented, tabulated, and discussed throughout this work.

Keywords: Solar energy; photovoltaic (PV); Houn city; Houn substation 220kV; MATLAB/Simulink; ETAP

ÖZET

Elektrik enerjisi gezegenimizdeki yaşamın sürdürülebilirliği ve kalitesi için çok önemlidir. Güneş enerjisini elektrik enerjisine dönüştürmek için kullanılan en uygun teknolojilerden biri fotovoltaik panellerdir. Güneş enerjisinden uygun biçimde yararlanarak sera etkisi yapan gazların yayımı azaltılabilir.

Libya Yenilenebilir Enerji Kurumu (REAOL) çevresel, ekonomik ve gelişim perspektifleri ile Jufra bölgesinin Houn şehri yakınlarında şebeke bağlantılı 14 MW gücünde fotovoltaik enerji tesisinin kurulumunu planlamaktadır. Bu ölçekte bir güneş enerjisi sisteminin kurulumu, mevcut enerji santralinin normal parametrelerini etkileyebilir. Bu parametrelerin başlıcaları gerilim kontrolü, kararlılık, koruma cihazları ve harmonik bozunum seviyeleridir. Bu tezde 220 kV gerilimli Houn şalt merkezinde kurulacak PV sistemin tasarımına yönelik bir çalışma gerçekleştirilmektedir. Çalışmanın amacı, PV sistemin işlevini doğru biçimde yerine getirebilmek için gerekli optimum parametrelerin bulunmasıdır. Ayrıca, PV sistemin mevcut şebekeye doğrudan bağlanmasının etkileri incelenmektedir. PV sistemin şebekeye etkisini değerlendirmek amacıyla yük akışı analizini yapmak için farklı analiz araçları kullanılmaktadır. PV sistemin entegrasyonunun bağlantısından sonra gerilimdeki değişimlerin ve gerilim kararlılığının analizi de gerçekleştirilmektedir. Sistemin uluslararası güç kalitesi standartlarına uygun davrandığını görmek için harmonik bozunum analizi de yapılmaktadır.

Önerilen sistemin tasarımının doğruluğunu göstermek için gerçek sistemin ve dağıtım şebekesinin MATLAB/SIMULINK ve ETAP programları ile modellemesi ve benzetimi gerçekleştirilmiştir. Daha gerçekçi bir tasarım için gerçek yük ve güneş enerjisi verileri kullanılmıştır. Çalışmada, analizlerden elde edilen veriler sunulmakta ve tartışılmaktadır.

Anahtar Kelimeler: Güneş enerjisi; Photovoltaik (PV) enerji; Houn şehri; Houn 220 kV şaltmerkezi; MATLAB/Simulink; ETAP

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
ABSTRACT	iv
ÖZET	V
TABLE OF CONTENTS	vi
LIST OF ABBREVIATIONS	xiii

CHAPTER 1: INTRODUCTION

1.1 Introduction	1
1.2 Aim of the Thesis	5
1.3 Overview of the Thesis	6

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction	.7
2.2 Literature Review	.7

CHAPTER 3: DISTRIBUTED GENERATION SYSTEMS

3.1 Introduction	9
3.2 Electric Power Networks vs. Distributed Generation	9
3.2.1 History of distributed generation	11
3.2.2 Types of distributed generation technologies	13
3.2.2.1 Gas turbines	13
3.2.2.2 Micro turbines	13
3.2.2.3 Engines	13
3.2.2.4 Fuel cells	14
3.2.2.5 Wind turbines	14
3.2.2.6 Photovoltaic solar cell	15
3.3 Photovoltaic Systems	15
3.3.1 Advantages and drawbacks of solar energy	16

17
20
20
21
21
22
23
24
24
24

CHAPTER 4: DESIGN AND SIMULATION OF GRID CONNECTED PV SYSTEM FOR LIBYAN NATIONAL GRID

4.1 Introduction
4.2 Design Procedure of the PV Station
4.2.1 Design and selection of grid tied inverter
4.2.1.1 Design of the central inverter
4.2.2 Layout of grid connected PV system with the central inverters
4.2.3 Cable sizing
4.2.3.1 Sizing cables between PV modules
4.2.3.2 Sizing of cable from PV array bus-bar to inverter
4.2.3.3 Sizing of cable from inverter to main junction
4.2.4 Sizing of circuit breakers
4.2.4.1 Sizing of circuit protection between PV array and inverter
4.2.4.2 Sizing of circuit protection on every phase output of inverter
4.2.5 Synchronization with the system
4.3 PV Modelling Using SIMULINK
4.3.1 Electrical circuit models of PV modules
4.3.2 Simulink modelling for PV module
4.3.3 PV Simulation results and discussions

CHAPTER 5: POWER SYSTEM STUDIES FOR PV INTEGRATION

5.1 Introduction	45
5.2 Load Flow Study and Analysis Using ETAP	45
5.2.1 Load flow simulation using ETAP	46
5.3 Short Circuit Study and Analysis Using ETAP	48
5.3.1 Short circuit simulation using ETAP	48
5.4 Harmonics Study and Analysis Using ETAP	49
5.5 Transient Stability Study and Analysis Using ETAP	50

CHAPTER 6: RESULTS ANALYSIS OF POWER SYSTEM STUDIES

6.1 Introduction	
6.2 Load Flow Analysis	51
6.3 Short Circuit Analysis	51
6.4 Harmonics Analysis	
6.5 Transient Stability Analysis	

CHAPTER 7: CONCLUSION AND FUTURE WORK

7.1 Conclusion	
7.2 Future Work	

REFERENCES	5	60

APPENDICES	64
Appendix 1: Houn Substation Loads	65
Appendix 2: Module Datasheet	66
Appendix 3: ABB Central Inverter	67
Appendix 4: Load Flow Analysis Without PV	68
Appendix 5: Load Flow Analysis With PV	

Appendix 6: Short Circuit Analysis Without PV	. 100
Appendix 7: Short Circuit Analysis With PV	.114
Appendix 8: Harmonics Analysis Without PV	. 131
Appendix 9: Harmonic Analysis With PV	. 153
Appendix 10: Harmonic Analysis With Filters and No PV Connection	. 186
Appendix 11: Harmonic Analysis With Filters and PV	. 208
Appendix 12: Transient Stability Analysis Without PV	. 243
Appendix 13: Transient Stability Analysis With PV	. 265

LIST OF FIGURES

Figure 1.1: General power system topology	2
Figure 1.2: The location of the proposed project activity near the town of Houn, Jufra .	4
Figure 1.3: Schematic diagram of the connection of the solar station	5
Figure 3.1: Structure of the electric power grid	10
Figure 3.2: A power system with distributed generation	11
Figure 3.3: Solar map in Libya	18
Figure 3.4: Load growth in Libya 2003-2012	19
Figure 3.5: Electricity production growth in Libya between 2003 and 2012	19
Figure 3.6: PV and diesel stations in the communication network	20
Figure 3.7: Flow chart of the station design and analysis process	24
Figure 4.1: (a)- String inverter a vs. (b)- central inverter	28
Figure 4.2: The array configuration of the central inverter	31
Figure 4.3: General structure of the arrays with the inverters	32
Figure 4.4: Wiring diagram of connection of inverters output to main combiner box	33
Figure 4.5: Solar cell's model using single diode	38
Figure 4.6: Solar cell model using single diode with R_s and R_p	39
Figure 4.7: Block diagram of the model based upon the equations of PV model	41
Figure 4.8: Masked PV module in Simulink	42
Figure 4.9: The final model of PV system	42
Figure 4.10: Simulink model of solar panel (160 strings) V-I characteristic curves	43
Figure 4.11: Simulink model of solar panel (160 strings) P-V characteristic curves	43
Figure 4.12: Simulink model of solar panel (160 strings) V-I characteristic curves	44
Figure 4.13: Simulink model of solar panel (160 strings) P-V characteristic curves	44
Figure 5.1: Electrical power system study methodology flow chart	45
Figure 5.2: Load flow simulation with PV disconnected	47
Figure 5.3: Load flow simulation with PV connected	47
Figure 5.4: Short circuit simulation with PV disconnected	48
Figure 5.5: Short circuit simulation with PV connected	49
Figure 6.1: Voltage waveform at bus 1 with PV disconnected	53
Figure 6.2: Analysis results of harmonic with PV connected	53
Figure 6.3: Waveform and spectrum of bus1 voltage after using PV plant	54

Figure 6.4: Harmonic study with filters and PV connection	55
Figure 6.5: Bus 1 voltage waveform and spectrum with filters and PV connection	55
Figure 6.6: Percentage of bus nominal (kV) without PV connection	57
Figure 6.7: Percentage of bus nominal (kV) with PV connection	57

LIST OF TABLES

Table 1.1: Technical specifications of PV modules to be used in Houn project	4
Table 3.1: The total installed PV capacity in Libya	
Table 4.1: Basic features of the discussed PV modules	
Table 4.2: Features of the ABB 1 MW central inverter used	
Table 4.3: Cable sizing for the PV system	

LIST OF ABBREVIATIONS

AC	Alternative Current
СВ	Circuit Breaker
СНР	Combined Heat and Power
СР	Cathodic Protection
CPV	Concentrated Photovoltaic
CSA	Cross Sectional Area
CSES	Center of Solar Energy Studies
DC	Direct Current
DG	Distributed Generation
EIA	Energy Information Administration
ЕТАР	Electrical Transient Analyzer Program
FACTS	Flexible Alternative Current Transmission Systems
FC	Fuel Cell
GECOL	General Electrical Company of Libya
MATLAB	Matrix Laboratory
MPPT	Maximum Power Point Tracking
PCC	Point of Common Coupling
PU	Per Unit
PV	Photovoltaic
REAOL	Renewable Energy Authority of Libya
SCADA	Supervisory Control and Data Acquisition
STC	Standard Test Conditions
THD	Total Harmonic Distortion
UPS	Uninterruptible Power Supplies
VTs	Voltage Transformers

CHAPTER 1 INTRODUCTION

This work is an introduction of the Photovoltaic (PV) solar energy in the Libyan national electrical network. It represents a study of the implementation of 14 MW solar power station into Houn sub-station in Libya.

1.1 Introduction

Electrical energy is one of the most central human needs. Life without electrical energy is not imaginable. Nowadays Libya, similar to the other countries of the Middle East, uses oil and natural gas to produce its electrical energy needs. However, as these types of nonrenewable energy sources will exhaust one day, it is very important to find alternative electrical energy sources like wind, sea waves, and solar energy. One of the great wealth that Libya has is the incredible distribution and amount of solar energy incident. Therefore, the significance of the investment in this source for the production of electrical energy by using the high efficiency photovoltaic generators becomes evident.

Normally power systems meet load growth demands through installation of centralized large generation plants, transmission lines and substations as well as distribution infrastructure. Figure 1.1 shows the traditional power delivery structure, from centralized generation to long distance transmission distribution. The generation station generates electricity at lower voltage level, generally 11 kV. This voltage is stepped up through a generation step up station. Stepped up voltage at the level of 220 kV or 400 kV is transmitted for long distances until the destination consumption areas. This power is then stepped down to different distribution levels according to consumers' needs. Solar generation is generally a small source of electric power generation ranging in size from less than a kW to tens of MW. PV sources are not generally part of the central power generation and are more suited to be installed near to the load, as shown, in the green distribution area in Figure 1.1.

Photovoltaic systems are widely used in different applications, from small cells in calculators that consume small amount of power to large scale PV plants that produce power in the range of many MW. Although there is a broad variety of PV applications, the main applications for PV systems are in the power generation on-board craft and in

standalone systems in rural areas. In the last decades an important revolution in the use of grid-connected solar generators has been witnessed. The newly developed technologies encouraged consumers to start shifting toward the use of distributed energy resources like PV systems. Prices and initial installation costs of the PV systems have noticeably been decreased in the last 10 years especially with the exclusion of back-up batteries.



Figure 1.1: General power system topology (Condon, 2004)

Photovoltaic energy is one of the cleanest sources of renewable energy. The recent observations of the climatic alterations have encouraged the humanity for more investigation in the renewable resources of energy like solar. Although the technology was very costly in its beginnings, it has spread and has become very familiar and most used especially with the introduction of programs to encourage people to investigate in this technology. The use of distributed resources and especially PV systems in connection with power systems has many advantages such as (Steffel, et al., 2012):

- Voltage profile improvement.
- Voltage stability improvement for the whole system.
- Reactive power flow reduction.
- Power loss reduction.
- Pollution reduction.
- Maintenance cost reduction.

However, the use of individual solar applications or large scale PV generators can affect power systems and cause serious problems that need to be taken in consideration. For that reason, the penetration of distributed generation systems in the power systems has become one of the hottest topics of electrical power engineering. The variable nature of PV sources may cause serious power quality issues in the distribution systems. Such problems must be studied and mentioned preliminary to the installation of distributed generation system to avoid the failure of the systems. These problems or disadvantages can be summarized in the next few points (Coster et al., 2011; Steffel et al., 2012):

- Injection of harmonics due to the use of power inverters.
- The interruption of solar generation during night.
- The challenges of protection because of the bidirectional power flow.
- Over voltage of the systems.

In this work, the use of solar energy power station with a total capacity of 14 MW in the Libyan distribution station of Houn is studied. The study will include the effect of the solar power station on the stability of the distribution station. It will include the analysis of load flow, short circuit faults, system stability, and harmonics of the system after the installation of the solar station. The project was proposed by the Renewable Energy Authority of Libya (REAOL) to build a photovoltaic (PV) power plant. The power rating of this first gridconnected plant of Libya which will be near the city of Houn in the Jufra District is 14 MW. The project is expected to produce an annual net electricity of approximately 23,140 MWh. High technology PV modules, power electronic systems, transformers and protection devices will be employed in this plant. Measurement and communication equipment will also be used to ensure reliability and surveillance of the system. The geographical location of the proposed project activity is as shown in Figure 1.2. The town of Houn situates at the latitude of 29° 08' 52" N, and longitude of 16° 00' 57" E, at a distance of about 250 km from the coastal line and 700 km from the capital city of Libya. The total available area for the project is approximately 10 hectare. The plant is planned to be connected to the distribution substation of 66/11 kV near Houn station of 220 kV as explained in Appendix 1. The specifications of the solar panels that must be used as sited by the REAOL are shown in Table 1.1. The substation has 2 step down transformers 66/11 kV of 20 MVA each. The connection between the solar field and the 11 kV bus bar will be established through 7 step-up transformers of 3 MVA each. The voltage rating of these transformers is 0.4/11 kV and situated 100 m away from the field (UNFCCC, 2012). Figure 1.3 presents the schematic diagram of the connection between the solar system and the distribution grid through step-up transformers.



Figure 1.2: The location of the proposed project activity near the town of Houn, Jufra

Parameter	Value
Cell type	Crystalline PV module
Power	Different power ratings: 230 – 245 Wp
Number of modules	~ 57,140 - 60,870
Module efficiency	14.1 – 15.1 %
Maximum rated current series	15 A
Power tolerance	+ / - 3 %
Maximum power voltage	29.4 – 30.7 V
Plant load factor	18.87 %

Table 1.1: Technical specifications of PV modules to be used in Houn project



Figure 1.3: Schematic diagram of the connection of the solar station

1.2 Aim of the Thesis

Voltage control and stability are very critical for safe and reliable operation of power systems. They need to be taken in consideration during the generation, transmission and distribution levels of electric power. Voltage control for traditional power systems is well established. However, voltage control for distributed power systems is a rather new concept. Several researchers have been proposing new control algorithms to overcome the problems related to voltage regulation and stability so that renewable energy plants can be safely connected to national grids.

Libya is a country rich in solar energy and needs new power plants. Therefore it is expected that new solar energy projects will be carried out in near future, which means voltage stability and regulation problems should be studied before connecting these plants to existing networks.

The purpose of this work is to establish the analysis of the distributed solar generation that is planned in Houn in Libya. The analysis has the aim of determining the effect of installing 14 MW solar station connected to the distribution station of Houn. This analysis will focus on studying the voltage profile, voltage stability; short circuit faults, reactive power flow, and harmonic distortions due to the connection of the solar station to the distribution system at Houn. The study will discuss the general structure of the solar generation station and its components. The connection between the solar system and the power distribution station of Houn will also be discussed. A load flow and short circuit analysis of the studied systems will be performed in an attempt to obtain the optimal levels of voltage quality and stability of the system. In order to verify the feasibility and validity of the studied system, model of the distribution station combined and connected with the solar PV station will be built in ETAP software. Different analysis methods of load flow, short circuit, voltage stability, and harmonics are going to be analysed. Separately, modelling of the solar system will be discussed and studied to show the different parameters that affect the function of the solar cells. The model will be carried out using Matlab software and different operating conditions will be studied and discussed.

As a conclusion, the objectives of this study can be resumed in the next few points:

- To study the capability of solar generation systems in the load demand and power flow reduction at the distribution station level in Libya.
- To study the effect of connecting large scale commercial solar sources directly with the public grid. And to open the opportunity for future analysis of the technoeconomic benefits of connecting large or small size solar projects to the Libyan National Grid.
- To inspect the consequences of grid connected solar systems on the voltage regulation levels in the public network in Libya and its participation in load reduction and stabilization of transmission systems.

1.3 Overview of the Thesis

In Chapter 2, a review of the existing literature on the topic is presented. In Chapter 3, discussion on the distributed generation systems is presented, the methodology followed in the thesis is described and the two simulation and analysis software programs are presented. In Chapter 4, the design and simulation of the grid connected plant are given. In Chapter 5, load flow, short circuit analysis, harmonic analysis and voltage profile studies are explained. In Chapter 6, results are discussed. In Chapter 7, the thesis is concluded and future work is discussed.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The Energy is defined conventionally as the capability of work production. The origin of the word energy comes from the ancient Greek. It is a compound term from the two Greek word "en" and "ergon". The terms mean something that can work in the body. Scientists define the energy as the ability or capacity to perform work. The famous physician Max Planck has given a more accurate and scientific definition of the energy. He defined the energy as: "The ability of a system to produce outside activity" (Tzanakis, 2006).

Electrical energy has been the main source of energy for humanity during the last two hundred years. However, this energy is produced based on the burn of fossil fuels like gas and petrol oil. These fuels suffer from two disadvantages that pushed toward the investigation in new natural resources; these are the environment pollution and the nonrenewable nature of these fuels. Scientists have focused on the investigation of renewable energy resource for electrical energy production. In the last decades, different technologies were developed to produce green energy. One of the main developed technologies was the solar energy technology. Throughout the course of its development, renewable solar energy has witnessed different revolutions in terms of power production, back-up and efficiency. Recently, solar or renewable energy systems became able to be connected directly to the electric grids. This allowed these systems to support the existing power generation systems directly with the minimum costs. They share now in a great amount of power production all around the world. However, these advantages were combined with some drawbacks concerning the effects of distributed generation systems which a term is describing all power sources that are connected to the main sources at any point- connected to the existing power systems. These drawbacks concern mainly the lack of stability, voltage regulation, and harmonic distortions caused by distributed generation systems.

2.2 Literature Review

Different researches were pointed toward the study and analysis of these drawbacks and different solutions to overcome their effects. (Coster, Myrzik, Kruimer, & Kling, 2011) Has discussed the effects of the Distributed Generation (DG) systems on the power grid stability as reported by Dutch distribution system operators. The authors discussed the

different opportunities to handle network planning challenges in the existence of distributed sources. Paper demonstrated that voltage control issues and protection errors are rarely happening in compact power systems. A study of the issues combined with the use of distributed generation systems on the power grids was presented in (Therien, 2010). The author discussed different issues like voltage regulation, protection system faults, harmonics, power flow, and intermittency of power systems with DG. A case study of a grid connected solar system was presented to address the different issues related to the DG. In (Nazari & Ilic, 2008) different problems related to the use of distributed generation system.

The effects of the location of DG and technology on the stability of the power system voltage were discussed in (Angelim & Affonso, 2016). In the paper, three distributed generation technologies were discussed and experimented. In addition, different DG locations were used and the effects on the stability of the power systems were discussed. An analysing method of the financial value of the DG systems was proposed and discussed in (Ault, McDonald, & Burt, 2003). The authors discussed different factors and issues concerning the DG systems. The developed function is helpful in determining the DG impact on the network, business, and the penetration of system. A case study of the United Kingdom distributed generation system was also discussed in this work. Line losses reduction due to the use of DG systems was discussed by (Dang, Yu, Dang, & Han, 2011). The work presented the study of radial feeder and distributed generator system under various load conditions. Results of losses reduction were presented and discussed. Impact of distributed generation on the dispatch of power systems was discussed in (Liu, Zhang, Zhou, & Zhong, 2012). Different renewable energy distributed generators were discussed and their impact was studied.

A study of the investigation of hybrid distributed generation system of wind, PV, and hydro power sources was presented by (Liu, Zhang, Zhou, & Zhong, 2012). The dynamic impact of these DG systems was analysed and presented (Olulope, Folly, & Venayagamoorthy, 2013). Different issues related to the placement of distributed generators into power grid were discussed in (Yadav & Srivastava, 2014). Review of the most DG technologies also was presented in this paper work. The work in (Zhao, Li, & Liu, 2014) discussed the analysis of distributed generators and the optimal design techniques of these generators.

CHAPTER 3 DISTRIBUTED GENERATION SYSTEMS

3.1 Introduction

Life cannot be imagined to have the same quality it is having without electricity. It is so important for life and human civilization. It is the source of light that clear the darkness, it is the way how we keep our foods in fridges, and it is the mean we use to operate our air conditioners, electricity is the invention that gives our life its comfort. None of our basic needs for comfort life can be achieved without electricity. TV's, cameras, personal computers, digital processors, phones, cellular phones, radio, modern cars, home appliances, and many other electronic devices could not happen to work without electricity. Based on reports of the Energy Information Administration (EIA); until 2030, the electrical energy is expected to remain the fastest developing form of energy worldwide (Dorian, Franssen, & Simbeck, 2006). The traditional resources used for electrical energy production have dangerous consequences on the environment especially under the actual and predicted electrical consumption rates.

The nature and sources of electricity is well known and understood. This knowledge allows various uses of electrical energy to be useful. Nowadays, the integration of clean electrical energy sources into the actual infrastructures is growing quickly; governments as well as environment organizations are paying more attention for the subject. However, governments need to do more efforts to increase the chances of renewable resources to be more competitive.

New policies and technologies aim to decrease environment pollution due to energy production by finding new clean, renewable, and low cost resources. Renewable resources like solar, wind, sea waves, and many other energy sources are nowadays more and more investigated. The use and development of these renewable clean free energy sources has led to the use of Distributed Generation systems DG.

3.2 Electric Power Networks vs. Distributed Generation

An electrical grid is an interrelated network of electrical components distributing electrical power between producers and clients. Power systems in our days are very complex grids that can be essentially categorized into four main groups: generation system, transmission

system, distribution system, and different loads (Paolone & Cherkaoui). Figure 3.1 shows a general structure of the electric power grid. In the generation system, electricity is mostly produced by huge centrifuged alternators located in generation stations. The electrical power is usually generated under the level of 11 kV or 30 kV.



Figure 3.1: Structure of the electric power grid (Paolone & Cherkaoui)

Overhead transmission networks are responsible for the transmission of electrical power between different parts of the system. They transfer energy from main stations to distribution stations and between generation stations as well. The distribution grid can be either low or medium voltage distribution network. It uses transformers to step down high or extra high voltages to low level or medium level voltages. Transformers in the distribution unit feed electrical power to a number of secondary feeders whom consumer is connected to. Customers are connected to feeders either directly or through transformers to step down the voltage to a suitable level.

Distributed generation (DG) term is used to describe the use of group of interconnected small size power generators. These generators produce low voltage level electricity by usually using alternative fuel. The distributed generators are constructed such that they can

be connected directly to the nearest available network and loads. A general description of a power system including distributed generation systems is present in Figure 3.2. Distributed generation is still used and considered as spare or emergency endorsement source of power and restricted to a limited part of grid tied sources.



Figure 3.2: A power system with distributed generation (The grid as it is today, 2016)

DG systems are less used in many countries where prices of oil and natural gas are low, or where regulatory batteries are used. However, widespread of DG is being reconsidered due to the changes in relation between centralized and distributed power generation; in addition to the excessive use of natural gas and restrictions on the new transmission lines, and the new technologies that are implemented in the DG systems (The grid as it is today, 2016).

3.2.1 History of distributed generation

In 80s of the 19th century, the Pearl Street electric system that was created by Edison and served Wall Street and the near buildings can be considered as a distributed generation system. The same generation structure continued until the end of nineteenth century in the United State of America (USA) and around the world. Such systems served few small areas by direct current sources. Over more, individual factories were served individually by systems that supplied electric power with heating in Combined Heat and Power (CHP)

systems (Hughes, 1993). The main struggle of the distributed Direct Current (DC) system was the huge amount of losses under low voltages. The transmission of electricity under low voltages for long distance causes a lot of power losses. As a result, other competitors supported the use of alternating current based systems. In the Alternative Current (AC) systems larger and spread out areas can be served easily. This was possible thanks for the invention of power transformers.

With technological developments in alternating current systems, more economical investments in large and centralized power systems were required. These centralized high load systems were built in huge networks. They have the ability to spread out in wide areas providing consistent services. Unfortunately, storage of large amounts of electrical power is very difficult; this implies the requirement that that demand and supply are balanced all the time. For more efficient use of the transmission and generation systems, different customers need to stabilize their consumption through days and seasons. The grouping of different industrial, commercial, and residential loads helps achieving smooth demand profile the maximum possible. This goal implies the service to be extended over larger areas and the interconnection of multiple areas together. Another motivation for the use of extended electrical services network was the availability of resources of energy. Mines and water hydraulic energy resources are mostly located far from centres of industrial and residential zones. The two possible choices were to transport fuel to the distributed power stations or to transmit the electrical energy from the places of energy resources using high voltage systems. By the 1930s, industrial states had established huge electrical grids, joining together around the steam turbine generation system. Smaller generation systems were then naturally melted and shut down. An increase from 80 MW generation station in 1920 to 600 MW unit in 1960 and then to 1400 MW in 1980 have been witnessed. The idea to return back to the distributed generation in the 20th century came after the petrol shocks in the 1970s and the need to increase the systems efficiencies. The efficiency of large scale economic generation system was limited to 33 % of the used energy (Nishida, et al., 2003).

Evolution of small scale distributed generation has led to important reduction in cost, increased reliability, and less pollution emissions of different turbines, fuel cells, engines, and solar panels. On another side, particularly in the past two decades; a great evolution in

the management, monitoring, surveillance, and control systems has happened (Hamlyn, Cheung, Lin, Cungang, & Cheung, 2008) & (Lin, et al., 2009).

3.2.2 Types of distributed generation technologies

Actually, types of distributed generators extend to cover all types of power generation methods. These types include the traditional generators like oil and gas generators in addition to recently developed technologies like micro turbines, solar plants, wind farms and other sources of electrical energy.

3.2.2.1 Gas turbines

Gas turbines or power generation based on gas turbine technologies is common with very large generation capacities. Sizes of gas turbines vary from small gas turbines of 500 kW and reaching the capacity of huge gas stations of 50 MW. Gas turbines are very common due to low costs of their maintenance in addition to higher efficiency achieved due to the high ability for heat recovery. Gas turbines are the most favourite type for almost all distributed generation requirements (Davis, 2002).

3.2.2.2 Micro turbines

The same functional cycle of conventional turbines is implemented in micro turbines. However, micro turbines are commercially less developed compared to the mentioned conventional turbines. The development of micro turbine has started from the design of fast and small turbines. These turbines rotate at high speeds of up to 100000 cycles per minute. Their components like nozzles and burners are more and more compressed. Generally, the sizes of micro turbines range between 30 and 250 kW (Pilavachi, 2002). Micro turbines require less maintenance costs and use an air cooling system. However, micro turbines are a little bit less efficient than their conventional large sized gas turbines because of low functional temperatures.

3.2.2.3 Engines

The technology of internal combustion engines is a well-known and conventional engines structure. These engines are fed by natural or diesel oil. Natural gas engines are using spark ignition while diesel oil engines implement a compression ignition technology to fire. The energy of combustion is divided into three main parts; the first part is the mechanical energy that is converted into electricity with the ratio of 26-39 %; the second

part is a useful heat that can be used for different goals and represent 46-60 %; the last part represents different losses of the engine due to radiations and exhaust gas losses in addition to gear box losses.

Power production engines are of the size of 1 MW typically. They are more and more used in distributed generation systems. They are increasingly being used in combined heat power for peak load or standby needs in different applications (Daley, ASCO Power Technol., & Siciliano, 2003).

3.2.2.4 Fuel cells

Fuel cells (FC) produce electromechanical energy out of chemical energy without the need for any thermal energy phase. Fuel cells have very high efficiency compared to other engines. In the fuel cell the hydrogen and the oxygen are fed to the cell. Chemical reactions combining hydrogen and oxygen molecules producing water and energy take place in the fuel cell. The oxidation of hydrogen to produce water creates equilibrium where electrons flow through an external electric structure providing energy. Unlike normal batteries, fuel cells can provide continuous energy provided with the two main functional elements which are oxygen and hydrogen. However, the direct oxidation of natural gas is still impossible which implies the conversion between different materials. This conversion is less efficient and still need more scientific researches and investigations.

Fuel cells have their own advantages including high power efficiency and performance under variable loading values. Their emissions are very small and they cause no noise. The main disadvantage of the use of fuel cells is as mentioned above the high initial costs.

3.2.2.5 Wind turbines

Wind power generation existed since long time and it can be considered as distributed generation sources if it is located near the demand source. Generally, areas with high and stable wind speed over the year can have wind turbine farms. The annual capacity factor of a good wind turbine area is 20-40 %. Typical wind turbine can provide its services for more than 20 years with six month interval maintenance. Rotating axe of the wind turbine transfer the mechanical energy from the wind to a gear box connected to an electrical generator. Normal wind turbine sizes range from few hundreds of watts for residential needs to huge turbines with the power of over 5 MW (Spera, 2009). The main

disadvantages of wind power reside in the initial costs in addition to the intermittent nature of the energy source.

3.2.2.6 Photovoltaic solar cell

Solar cells have the ability to produce electricity directly from the sunlight by taking advantage of photovoltaic effect (Williams & Ogden, 1989). Solar cells are constructed totally of fixed parts; there are no rotating or moving parts within the solar cell. Typical photovoltaic cell can produce a maximum of 2 W and about 1.5 V. For commercial and technical reasons, multiple cells are normally grouped in series and parallel combinations to produce more power and higher voltage levels suitable to be used in different applications. The group of multiple series and parallel combined cells is called PV module.

3.3 Photovoltaic Systems

PV system is a system able to convert energy from the sun directly into electrical energy. The main part of the solar system is the solar cell combined in groups to produce solar modules and arrays. Solar systems are used to produce energy to be used in feeding different electrical loads. Solar cells produce DC electrical energy that can be used directly in feeding some types of DC loads; or converted through different converter types to feed other DC and AC loads. Solar systems can be connected together to form larger systems or even can be combined with public grids to exchange their power with. The general structure of the solar system is composed of a DC-DC converter, DC-AC inverter, battery system, controllers, protection devices, in addition to some auxiliary power sources and the loads. Recently, batteries in solar systems became an optional part in the grid tied solar systems; these systems exchange the energy directly with the electric grid with the need to locally stock it. By consequence, costs of grid tied solar systems have reduced to half the initial costs.

Solar systems can be found in different forms and sizes from residential application size of less than 10 kW to medium size of 10-100 kW, and other large systems with production capacity of more than 100 kW. These systems are either used as standalone systems, hybrid systems in combination with other energy sources, or connected directly to the power grid to exchange energy interactively.

Commercial solar modules produce the energy from the sun with an approximate energy efficiency of 10-20 %. This means that 10-20 % of the solar energy falling on the module is being captured and converted to electricity. Scientists and research laboratories are making huge efforts to increase these efficiency ratios and decrease the costs of solar applications. As a result for these efforts appeared the solar cells or Concentrated Photovoltaic Cells (CPV). These systems focus solar energy on multi-junction solar cell to increase cell's efficiency. In CPV systems, the solar cells are fit in concentrating collectors. Concentrating collectors use mirrors or lens to concentrate the light of the sun on the solar cells. Some special tracking systems are used with CPV systems is the very high efficiency achieved. Some references concluded that CPV can produce an energy efficiency of up to 50 % (Luque, 2011). However, the need for special sophisticated tracking systems is one of CPV's costs.

3.3.1 Advantages and drawbacks of solar energy

Solar energy has its own advantages and disadvantages, the advantages of solar energy systems can be resumed by (Deendayal, 2012):

- 1- Solar energy is available mostly everywhere and solar systems are flexible; they can be used in different manners and can be easily implemented.
- 2- Solar energy is available when its need is maximum, the peak demand happens in midday when the solar energy produces its maximum energy.
- 3- Solar structures can work for long periods of time with the minimum maintenance and operating costs.
- 4- Solar energy is clean and environment friend, it is safe and cause minimal pollution.
- 5- Solar systems are modular; any extra power generation can be added easily with no extra needs or expenses.
- 6- Solar systems are the perfect choice to be implemented in remote areas as they are cheap and reliable compared to the creation of public grids infrastructures.
- 7- The main and most important advantage of solar systems is that their source of energy is infinite, charge free, and accessible all the time.

Although solar energy is clean and cheap source of power, it still presents some disadvantages. The main disadvantages of solar energy are:

- 1- Solar energy needs to be stocked in batteries especially in remote areas; that amplify the expenses and imply extra maintenance costs.
- 2- The most important drawback of solar energy resides in its initial costs if compared to other large scale electrical power sources. However, in the last 10 years the costs of the solar energy have decreased to about 50 % due to the use of new technologies in their production and development.
- 3- Another drawback of solar systems is the variable output power that is a function of the solar irradiation and temperature. Areas that have short day times or covered by clouds for long periods will produce very low amounts of energy. Over more, the efficiency of solar arrays is less than 20 %; this means more and more reduction in power generation.

3.4 Energy Potential in Libya

Libya is one of the main exporting countries in Africa and the world with 6 million populations spread over its area of 1.75 million square kilometres. Weather in Libya is Middle Eastern hot in summer and warm in winter. Like most of Middle East countries, Libya has high average solar irradiation that makes it a great solar energy potential. The daily average irradiation varies between 7.1 kWp and 8.1 kWp (Mondal & Denich, 2009). Figure 3.3 presents the solar map of Libya showing the solar energy distribution in the Libyan territories. Until 2011, Libya had a large electric grid with big and well-arranged infrastructures. 12000 km of high voltage networks combined with 12500 km of medium voltage grid in addition to 7000 km of low voltage grid constructed the main nerves of the Libyan national grid (Hassan, Nafeh, H.Fahmy, & El-Sayed, 2010). However, after the war in 2011 the situation in Libya has changed and national electric grid became unable to feed the country with the required energy. Many high and medium voltage transmission lines were destroyed during and after the war and couldn't serve the distribution stations. Power consumption in Libya is in continuous growth. Load profile in Libya during the years 2003-2012 is presented in Figure 3.4. It shows a constant annual increase in the consumption during this period except for 2011 where political and civil was events have affected all the fields of the life including the energy consumption and production. Many generation and distribution station went off service during the war that has a great effect on the overall energy sector. Figure 3.5 demonstrates the growth in Libyan electricity generation during the period extending from 2003 until the year 2012. The figure shows that the energy production was growing in a fixed rate of approximately 7.6 % between 2003 and 2010. However, the energy production sector has faced some troubles during the year 2011 as a result of the political and security instability. However, during the year 2012 the energy production sector has recovered its normal growth rate and the annual production reached the value of 35000 GWh.



Figure 3.3: Solar map in Libya (Solargis, 2016)



Figure 3.4: Load growth in Libya 2003-2012 (Ibrahim & Khalifa, 2003)



Figure 3.5: Electricity production growth in Libya between 2003 and 2012 (Ibrahim & Khalifa, 2003)

3.4.1 Photovoltaic applications in Libya

The investigation in solar potential in Libya is still weak and need more plans and governmental support. There exist four main applications of solar energy sector in Libya; these are solar energy for communication systems, cathodic protection, rural electrification and water pumping.

3.4.1.1 PV system for Libyan microwave communication networks

The Libyan communication networks consist of about five hundred stations of repeaters. In the end of the year 1997, 9 rural stations were driven using solar systems. The approximate total peak power demand was about 10.5 kW peak. Among the 9 solar energy powered communication stations, four stations solar systems are still working after more than 30 years of service. The batteries of the system were replaced many times with an average life time of 8 years. On the other hand, the other stations that use diesel generators have faced many struggles due to the lack of diesel and maintenance. Problems include continuous interruption in the communication services and stolen fuel and engine parts. One of the most famous cases was in Zalaf station that went of service for 17 days during the year 1997 (saleh, 2006). Nowadays, more than 80 communication stations in Libya are using solar energy to obtain their power needs. This increase in the number of solar energy powered stations is due to the success of solar energy applications and the reductions in the costs of solar applications. Figure 3.6 shows the relation between the number of diesel based communication stations compared to those powered using solar energy sources between the years 1980 and 2003 (Ibrahim & Khalifa, 2003).



Figure 3.6: PV and diesel stations in the communication network (Ibrahim & Khalifa, 2003)
3.4.1.2 Solar energy for cathodic protection

The Cathodic Protection (CP) stations are usually situated at large distances from public networks; this signifies that it's impossible practically to use the public grids in feeding these stations with their power requirements. A cathodic protection station requires up to 15 kWh daily. Solar systems offer a perfect and reliable source of energy for CP stations. Solar systems must be chosen to fit best the load profile of a CP station. Solar systems for CP stations can be set up in any place near to the station to convert directly the sun energy to the required type of energy need by the station. For reasons related to maintenance of diesel generators, the need for continuous supply of fuel. In addition to the lack of power grids that solar resources were chosen as the best alternative for CP stations in Libya was set up into service in 1976, CP stations comes the next in the total accumulated solar power in Libya after communication systems. By the year 2005 over than 300 CP stations were powered using solar energy systems in Libya. The total set up systems produced about 450kW peak (Al-Jadi, EKhlat, & Krema, 2012).

3.4.1.3 Rural electrification with PV systems

The main problems that face the planners of power distribution systems in different countries can be concluded in low population, and distance from the existing networks. The extension of high voltage lines to cover rural areas through the desert is a very costly process and needs special budgets. In the less populated countries of the developing countries, just main cities are empowered through the public network. The electrification of rural areas is accomplished by the use of other resources available within the possibilities of the governments.

As an example, in a 200 citizen's village located at a distance of fifteen kilometres from the distribution station in Libya, and considering an average annual individual consumption of 1000 kWh, the village will need 200 MWh per year. A price of 0.75 \$/kWh will be charged to be able to provide such a village with electricity from this station without loss which is 10 times the actual national tariff in Libya. For such reason, a rural area was accepted to be a place having 200 citizens and situated at a distance more than 5 km from the low voltage grid (Al-Jadi, EKhlat, & Krema, 2012).

The Libyan national plan to cover all the cover all the remote areas by electricity is to electrify all distributed houses and villages in addition to water pumping units. A project for the electrification of 10 villages was presented earlier to be established as a first step in this plan (Al-Jadi, EKhlat, & Krema, 2012). Some of these villages are:

- a) Mrair Gabis village.
- b) Swaihat village.
- c) Intlat village.
- d) Beer al-Merhan village.
- e) Wadi Marsit village.
- f) Intlat village.

The first works of installation of solar systems in this project was initiated in 2003. The total number of installed projects by the General Electrical Company of Libya (GECOL) was 340 with capacity of 220 kW peak. Projects that are installed by the Center of Solar Energy Studies (CSES) and the Saharian Center is about 125 kW peak divided on 150 individual projects. The applications were as following:

- 380 projects for isolated houses.
- 30 projects for police stations.
- 100 projects for street lighting.

3.4.1.4 PV systems for water pumping

Water pumping is one of the most suitable applications of solar energy systems. The variable nature of the produced solar power is acceptable in water pumping applications. The project of water pumping included the installation of 35 individual solar projects. The total power generated by these projects is 96 kWp. Table 3.1 shows the total solar power generation for different applications in Libya until the year 2014 (Al-Jadi, EKhlat, & Krema, 2012).

APPLICATIONS	NUMBER OF SYSTEMS	TOTAL POWER [KWP]
COMMUNICATION	100	420
CATHODIC PROTECTION	300	540
RURAL ELECTRIFICATION	510	345
WATER PUMPING	40	110
TOTAL	950	1415

Table 3.1: The total installed PV capacity in Libya

3.5 Methodology of the Work

In this research, a large scale grid connected photovoltaic system is designed with 14 MW installed capacity. Details of the design include the total number of PV modules, inverter, cables and circuit breakers. In this study, the main system design is undertaken based on the amount of generated power. The generated output power from the PV system is at 0.4 kV voltage level. It is stepped up through 0.4 kV to 11 kV bus-bars by 7 step-up distribution transformers with 3 MVA rating each. The output of the power transformer is synchronized to the national grid at Houn substation less than 100 m of the supply point. To achieve the power ratings, 7 arrays with 2 MW for each array resulting at 14 MW generated power were adopted.

Results and objectives of this study presented in three main areas. Detailed design section, Matlab/Simulink PV Simulation, and power analysis studies using ETAP. Design section starts with considering the methods of connection of solar arrays and their connection with the inverter and power transformers, cables selection, inverter selection, and protective devices selection. Load flow, short circuit, harmonics and voltage stability studies were carried out. The results of power flow, busses voltages, busses angles and line losses were compared. Flow chart of the methodology is depicted below in Figure 3.7.



Figure 3.7: Flow chart of the station design and analysis process

3.6 Modelling and Analysis Software

In this work, two software packages have been used which are:

3.6.1 MATLAB / SIMULINK (version 7.8.0.347 (R2009a))

The Matlab is a high level powerful programming language dedicated for technical processing and mathematics purposes, it has an easy to use and manipulate user interface. Matlab environment presents mathematical problems and solutions simple and familiar mathematical notation. Matlab has a very powerful graphical user interface called Simulink. Simulink is used to build easily models for different systems. The interactive graphical environment of Simulink simplified the process of modelling processes or systems, removing all necessity of writing differential equations in programming languages (MathWorks, 2016).

3.6.2 ETAP (version 12.6.0H)

ETAP is the most wide-ranging analysis software that is designed especially to design and apply tests of power systems. ETAP program can use real data obtained from normal operation of the systems to perform offline data analysis, simulation, energy management, and load control. The name ETAP stands for (Electrical Transient Analyzer Program). It is designed to be used by engineers to perform different tasks of power systems analysis for different areas of industries in a one package.

CHAPTER 4 DESIGN AND SIMULATION OF GRID CONNECTED PV SYSTEM FOR LIBYAN NATIONAL GRID

4.1 Introduction

In this chapter, the details of the design and calculations of 14 MW PV integrated to the Libyan national grid at Houn city which is the capital of the Jufra District in Libya will be presented. Also, mathematical modelling of the PV panels used in the design will be discussed and presented; Matlab simulations of the panels will also be discussed and presented in this chapter.

4.2 Design Procedure of the PV Station

This section introduces the design procedure before the integration of solar PV power system into an existing grid with power generation of 14 MW. The main system design is undertaken based on the amount of generated power (14 MW). The generated voltage is 0.4 kV and it will be stepped up to 66 kV. It is stepped up through two stages:

- First stage: voltage step-up from 0.4 kV to 11 kV by seven step-up distribution transformers with 3 MVA rating each.
- Second stage: voltage step-up from 11 kV to 66 kV by two step-up power transformers with 12.5 MVA rating.

The output voltage of the power transformer is synchronized to the national grid at Houn main substation. To achieve the power ratings, 7 PV arrays with 2 MW for each array resulting at 14 MW generated power will be used.

PV modules must be selected based on some criterions related to their efficiency, price, warranty, life period, and atmospheric conditions. The selection must take these considerations in account in order to guarantee the best performance, highest benefit, reliability, at suitable prices. The first decision is to choose between mono-crystalline and poly-crystalline modules. The choice must consider the price and efficiency as the first criterions as the other criterions are approximately the same. Generally, the prices of poly-crystalline are more expensive than the mono-crystalline panels. However, the efficiency

in poly crystalline modules is a little better than mono crystalline panels. Due to the high costs of the project as the project needs a huge number of PV panels to generate the required power of 14 MW. The Renewable Energy Authority of Libya "REAOL" decided to use mono crystalline panels. Suniva ART245-60 modules of 240 Wp solar panels are going to be used in the project. ART245-60 module is a well-known robust solar cell's type that is designed to be used in grid tied solar projects and power stations. The characteristics of the ART245-60 are taken under STC "Standard Test Conditions" in laboratory environment. The standard conditions are 1000W/m² irradiation, 25°C, and 1.5 solar spectrum air mass. Basic features of the used modules are presented in Table 4.1 while the detailed data sheet of the module is presented in Appendix 2 (Suniva, 2010).

Maximum power	240 W
Voltage @ maximum power point	30.9 V
Current @ maximum power point	7.95
Open circuit voltage	37.4
Short circuit current	8.44
Cells per module	60
β (Voltage de-rating factor (V_{oc} % / ^C))	-0.332
α (Current de-rating factor (Isc % / °C))	0.035
γ (Power de-rating factor (P _{max} % / °C))	-0.465

Table 4.1: Basic features of the discussed PV modules

4.2.1 Design and selection of grid tied inverter

Inverter is a power electronic device used to invert/convert electrical energy from DC to AC. The inverter is actually bi-directional device; the power conversion is achieved from AC to DC or from DC to AC. However, it is mainly used as an AC generator (Rashid, 2001). The DC side of the inverter is fed from a battery or a group of batteries while the AC side can be connected directly or via a special transformer to increase the voltage level and improve the quality of the generated voltage. Inverters are used in UPS systems, static compensators, active filters, flexible alternative current transmission systems (FACTS), and many other applications (Rashid, 2001). The development of power electronic

technologies has led to a great evolution in the voltage source inverters topologies and control schemes. Recently, synchronised or grid connected inverters are widely spread and used in renewable energy applications. Such inverters has the ability to synchronise there output voltage and current with the grid's voltage. They can be directly connected to existing power grid and interchange energy with the latter. Grid connected inverters have greatly decreased the costs of solar and wind energy systems as they reduced the need for batteries to backup generated energy. Instead, generated energy is being fed directly to the grid that is considered as a huge battery for the power system.

Two types of inverters can be used in large scale projects; these are multiple string inverter and central inverter. Multi string inverter topology is presented in Figure 4.1-a. Each group of panels or strings are connected together and fed to a suitable DC-AC inverter. The group of inverters are then connected individually and separately to the grid. The main advantage of this topology is the use of small size and rating inverters instead of using one large inverter in central topology. It also requires less maintenance in general than the other topology. The failure of one inverter in a string system causes the failure of a part of the system and not the whole system. Over more, the maintenance required will be considered for that one inverter and not for the whole system. However, the initial cost of string inverter based system is higher than the central inverter. String inverters are still new topologies and not used too much in large scale stations. One more advantage of the string inverter is that it can be connected with strings with different angles and different voltage levels. Central inverters are the most used in power stations. Figure 4.1-b shows the topology of the central inverter. Multiple PV strings are combined in a one DC box out of which one connection is fed to a high rated inverter. The DC connection of multiple strings implies that their tilt angle and generated power are exactly the same. Central inverter requires less space and less initial costs compared to string inverters. However, the failure of the inverter causes the failure of the whole system (Cenergypower, 2014).



(b) Central inverter

Figure 4.1: (a) - String inverter a vs. (b) - Central inverter (Cenergypower, 2014)

Due to the low initial costs and the familiarity of central inverter in similar applications as it is used widely all over the world in similar applications, central inverter has been chosen to be implemented in this work. Details of the design and sizing of the system are going to be discussed in the next sections of this chapter.

4.2.1.1 Design of the central inverter

The aim of the present study is to design a large scale grid connected PV generator. The design must take different rating and power calculations in consideration to avoid future failures and problems as much as possible. The system is going to be connected to the Houn station in the Jufra district. The capacity of the solar system is decided to be 14 MW of mono crystalline solar panels. The design needs to consider the maximum input voltage for the inverter to find the maximum series strings or modules. Also, the maximum current rating of the inverter is used to decide the parallel strings that are going to be fed. Cables

sizes also must consider the current rating of the strings. Central inverters of 1 MW rating from ABB were chosen to be used in the project. Total of 14 inverters are going to be connected and used in the system. Central inverter PVS800-57-1000 kW-C model is used. Main features of this inverter's model are presented in Table 4.2 while the documentation is provided in Appendix 3 (ABB, 2014). To accomplish the design task of the project, the total power was divided on seven fields. Each field has a power capacity of 2 MW. The design considers the calculations for one field and then generalized for the rest of the fields of project. Given that the maximum power of each module is 240 Wp, the total number of modules to be used in each field can be found easily by:

Number of modules per field = $\frac{2000 \text{ kW}}{240 \text{ W}}$ = 8333 PV module

PVS800-57-1000kW-C	
1000 kW	
1200 kW	
600-850 V	
1100 V	
1710 A	
8-20	
400 V	
1445 A	

Table 4.2: Features of the ABB 1 MW central inverter us	ed
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The total number of the PV modules in the project is then given by:

Total number of modules = $8333 \times 7 = 58,331$ PV module.

It is important to remember here that the power ratings given in the datasheet of the solar modules are measured under standard test conditions that are difficult to be achieved in real life. The real maximum power obtained from the module is mostly less than this value due to high temperature and low irradiation levels. The open circuit voltage values given in Table 4.1 were given at standard temperature of 25 degrees. However, the temperature is variable that can decrease to less than zero or more than 60 at the cell's surface. For this

reason, open circuit voltage values are going to be calculated at the highest and lowest temperature limits of the modules that are -40 and 90 degrees. The next relation can be used to give an approximation of the open circuit voltage.

$$V(T) = V_{@25^{\circ}C} \times (1 + \beta \times \Delta T)$$
(4.1)

Where β is the temperature de-rating factor shown in table 4.1. The maximum and minimum voltages of the system can be given as:

$$(V_{OC})_{@-40 \circ C} = 37.4 \times [1 + (-0.332) \times (-40 - 25)/100] = 45.6 V$$
$$(V_{OC})_{@90 \circ C} = 37.4 \times [1 + (-0.332) \times (90 - 25)/100] = 29.32 V$$

$$(V_{MPP})_{@-40\,°C} = 30.9 + (-0.332\,\%) \times \Delta T = 20.9 + (-0.00332) \times (-65) \times 29.8$$

= 36.2V

$$(V_{MPP})_{@+90\,°C} = 30.90 - 0.00332 \times \Delta T \times 30.9 = 30.90 - 65 \times 0.00332 = 24.32V$$

From Table 4.2, the maximum permissible DC input voltage is 1100 V, and the maximum power point voltage ranges between 600 and 850 V. It is important to notice that both the open circuit and maximum power point voltages are maximal at the minimum temperature -40°C and minimum at 90°C. These values are important to find the number of series connected modules per each string that can be connected to the inverter. These values are going to be calculated at the minimum acceptable temperature that is -40°C.

Number of modules per string =
$$\frac{V_{MPPinverter}}{V_{MPP@-40^{\circ}C}} = \frac{850}{36.2} = 23.4$$
 (4.2)

The optimum number of modules per string is found to be 23 modules per string. Now it is important to find the maximum possible number of modules per string as follows:

modules per string_{max} =
$$\frac{V_{\text{maxinverter}}}{V_{OC\,@-40^{\circ}C}} = \frac{1100}{37.4} = 29.4$$
 (4.3)

That means the maximum allowed number of series modules is 29 modules. The optimal design implies that the number of series module will be between 23 and 29 modules as maximum. In order to find the maximum number of parallel strings, it is important to

consider the short circuit and maximum power point currents. The number of strings is found as follows:

$$String_{number \max/inverter} = \frac{I_{\max inverter}}{I_{SC \mod ule}} = \frac{1710}{8.49} = 201.4 strings$$
(4.4)

This means that a maximum of 201 parallel strings can be connected at the input of the inverter. For each inverter, taking in consideration the total number of modules per field found previously to be 8333 modules that will be distributed on two inverters. That means each inverter will be connected to a total of 4167 modules. If we accept that each string will contain 26 series modules for better performance and security, the number of parallel string is then given by:

$$String_{number/inverter} = \frac{Strings \ per \ inverter}{Modules \ per \ string} = \frac{4167}{26} = 160 < 201$$
(4.5)

From the previous calculation it was found that the design must use 160 strings of 26 modules each respecting the inverter and modules specifications. Figure 4.2 shows the connection of the strings and modules as calculated previously.



Figure 4.2: The array configuration of the central inverter

4.2.2 Layout of grid connected PV system with the central inverters

Since there exist 7 distribution transformers with 3 MVA rating each, the modules were distributed on 14 arrays. Each two arrays were connected to 1 transformer through two separate central inverters. The seven transformers primary sides are connected to the 11 kV grid bus bar. Inverters are connected to the panels such that each inverter is connected with 160 parallel strings, and 26 modules per string in series. Figure 4.3 below presents the connection scheme of the arrays, inverters, transformers and bus bars.



Figure 4.3: General structure of the arrays with the inverters

The wiring diagram connection of the inverters output to the main AC combiner box is shown in Figure 4.4. It must be mentioned here that the output of the main combiner box was connected to a step-down distribution transformer from the secondary side. This transformer is selected to be (11/0.4) kV, since it is connected to the inverter from the 0.4 kV level side. The 11 kV voltage level is selected because the Houn station has an 11 kV bus-bars. The connection between each two elements is done through special AC protection and disconnection circuits to ensure the total safety of equipments and persons against any faults or electric hazards as shown in Figure 4.4. These protection circuits in addition to the suitable cable sizing calculations are going to be discussed in the next parts of this work gradually.



Figure 4.4: Wiring diagram of connection of inverters output to main combiner box

4.2.3 Cable sizing

Cable sizing is one of the most important issues in electrical works and installations. It is a very vital measure of security to ensure the capability of connection wires to handle all types of electrical and electromagnetic stresses under the different possible atmospheric conditions. In addition, the wiring must not affect the performance of the designed system due to extra losses caused by wrong sizing of cables. Cables must be sized to withstand the current flowing through it, to support short circuit fault levels for short periods until the tripping of protection circuits, to handle changes in temperature and moisture, to be able to withstand the voltage levels they are carrying, and to ensure the minimum possible voltage drop. The voltage drop in a wire can be given by:

$$V_d = \frac{\rho \times l}{A} \times 2 \times I \tag{4.6}$$

Where:

 ρ : is the resistivity of used wire which is normally taken to be 0.0183 Ω mm²/m for copper.

l = the length of cables in meters.

I = the current through the cables in amperes.

A is the cross sectional area (CSA) in mm².

The multiplication by 2 accounts for total circuit wire length. We can rearrange the above equation to obtain the following equation:

$$A = \frac{2 \times \rho \times l \times I}{V_{d \max}} \tag{4.7}$$

In the design of the system, a maximum cable voltage drop of 5 % was used and this is the maximum allowable voltage drop in the international standards.

4.2.3.1 Sizing cables between PV modules

The cable is sized based on the following information:

Length of cable is 1.5 m, while the maximum current that can flow through the wire is given by:

$$I_{\max} = 1.25 \times I_{SC \mod ule} = 1.25 \times 8.44 = 10.55A \tag{4.8}$$

Where, the factor of 1.25 was considered for reason of security. The maximum allowable voltage drop is given by:

$$V_{MPP \, \text{mod}\,ule} \times 5\% = 30.4 \times 5\% = 1.52V \tag{4.9}$$

The wires are considered copper wires that have resistivity of 0.0183 Ω mm²/m, from which the cross sectional area is found as:

$$A = \frac{2 \times \rho \times l \times I}{V_{d_{\text{max}}}} = \frac{2 \times 0.0183 \times 1.5 \times 10.55}{1.52} = 0.38 mm^2$$
(4.10)

This means that any cable of cross-sectional area above 0.38 mm^2 can be used for the wiring between PV modules. However, this value is suitable to ensure the minimum voltage drop, but it is not enough to ensure that the wires can handle the maximum current flowing through it. By referring to the NEC tables for cable sizing it is found that a wire of 1.5 mm^2 is needed to withstand a current of 9A while a wire of 2.5 mm^2 is needed to withstand a current with safety factor is 10.55, then the best choice is a 2.5 mm^2 wire. It is important to notice that special insulated DC wires with PVC cover are used. This insulation is suitable to be used under ultraviolet rays without need for any extra covering.

4.2.3.2 Sizing of cable from PV array bus-bar to inverter

The cable is sized based on the following information:

Length of cable is 20 m, the maximum current from array is $8.44 \times 160 \times 1.25 = 1688$ A. The maximum voltage drop is given by:

$$V_d = 5\% \times V_{DC\min} = 5\% \times 600 = 30V \tag{4.11}$$

The minimum cross sectional area is found by:

$$A = \frac{2 \times \rho \times l \times I}{V_d} = \frac{2 \times 0.0183 \times 20 \times 1688}{30} = 41.2 mm^2$$
(4.12)

That means the minimum cable cross sectional area needed to ensure acceptable voltage drop is 41.2 mm², however; the design must consider the cables' ampacity. As the wires need to handle an amount of current of 1688A, by referring to the cable tables it is found that the maximum cable size is 240 mm² and can handle a maximum of 400A. A good choice of cables was found to be 6 wires of 150 mm² that can handle a maximum of 1722A.

4.2.3.3 Sizing of cable from inverter to main junction (inverter / distribution panel)

The cable is sized based on the following information:

Maximum length of cable is 30 m; the maximum current from inverter at full load on each phase (line) is given by:

$$I_{phase} = \frac{Inverter VA_{max}}{V_{LL} \times \sqrt{3}} = \frac{1200}{400 \times \sqrt{3}} = 1.73kA$$
(4.13)

The maximum allowable voltage drop is given by:

$$V_{d\max} = 5\% \times 400 / \sqrt{3} = 11.5V \tag{4.14}$$

The minimum cross sectional area correspondent to voltage drop can be calculated by:

$$A = \frac{2 \times \rho \times l \times I}{V_{d \max}} = \frac{2 \times 0.0183 \times 30 \times 1730}{11.5} = 165.2 mm^2$$
(4.15)

By considering the cable ampacity, 6 cables of 185 mm² should be used to connect each inverter to the bus bar.

4.2.4 Sizing of circuit breakers

Circuit breakers are installed in the system to protect against over current of the circuits and sized to not be below 125 % of the current flowing through the wiring. The circuit breakers used in this installation must be bi-directional. However, the sizing of circuit breakers should be less than the maximum ampacity of the protected cables in the circuit.

4.2.4.1 Sizing of circuit protection between PV array and inverter

There are generally two ways of undertaking the circuit protection between PV array and Inverter.

- 1- Each parallel string of modules can be fused before entering DC collection point.
- 2- The total output of the PV array is fused before being joined to the inverter.

In this study installation, the first option is used because that makes it easier to find suitable DC circuit breakers at suitable prices.

The maximum current is $1.25 \times$ short circuit current of modules (8.44 amperes) = $1.25 \times$ 8.44 = 10.55A Therefore the minimum rate of DC circuit protection is $\frac{125}{100} \times 10.55 = 13.18 A$ per parallel string.

4.2.4.2 Sizing of circuit protection on every phase output of inverter

The maximum current from inverter at full load on each phase (line) was found earlier in this chapter, the current was 1730A per phase. During the cable sizing calculations it was found that we need to use 6 cables of 185mm². The best circuit breaker value for this cable size is 300A circuit breaker. That means 6 circuit breakers with capacity of 300A are going to be used at the output of the inverter.

4.2.5 Synchronization with the system

In a grid tied system, the synchronisation is a very important notion to take care of. The connection between two power sources needs to take in consideration that the two sources have the same variables. The variables that must be equal are the voltage, the phase, and the frequency. The connection between sources is done just when these three variables are equal in both sources. There are two connection points between the grid and the solar system; these are the 0.4 kV level bus-bar and the 11 kV level bus-bar. Synchronization must be achieved when there is a closed loop system; this is implemented by using Synchro-check relay. Two voltage transformers (VT_s) on phase measure the voltages, one on the system circuit side and the other on the bus-bar. The Synchro-check relay compares the line voltage and the bus-voltage, and then a closing pulse command comes from the SCADA centre, and closes a normally open contactor if the synchronization conditions are achieved, then the circuit breaker closes. The synchronisation is very important to protect the systems from being short circuit connected to each other and it is used in all stations to connect multiple sources of power. Table 4.3 resumes the cable and circuit breaker sizing of the designed system as per calculation.

Table 4.3: (Cable sizir	ig for the	PV	system
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Cable	Cable Length (m)	Cable size (mm ²)	CB rating
Sizing cables between PV modules	1.5	2.5	No
Cables from PV array to the inverter	20	6×150	No
Sizing of AC wires	30	6×185	300

4.3 PV Modelling Using SIMULINK

4.3.1 Electrical circuit models of PV modules

Models of photovoltaic cell provide a comprehensive description of the behaviour of photovoltaic cell for scientists to be able to study it. A well-known model commonly used in the electrical engineering is the so called single diode PV cell model. The ideal photovoltaic cells model consists of a single diode connected in parallel with a light generated current source (I_{sc}) as shown in Figure 4.5. The equation for the output current is given by:

$$I = I_{sc} - I_D \tag{4.16}$$

While the diode's current is given by:

$$I_D = I_0 \left[e^{\frac{qV}{KaT}} - 1 \right]$$
(4.17)



Figure 4.5: Solar cell's model using single diode

The light generated electric current depends on both temperature of the cell and irradiance. It is measured under laboratory special conditions. Thus:

$$I_{sc} = I_{scref} + k_i (T_k - T_{ref}) \times \sigma / 1000$$

$$(4.18)$$

Where:

 I_{sc} : is the light generated current at the STC (25°C and 1000W/m²).

 K_i : is the short circuit current/temperature coefficient at I_{SCref} (0.0017 A/K).

 T_k and T_{ref} : are the actual and reference temperature in Kelvin.

 σ : is the irradiation on the device surface, and 1000W/m² is the STC value.

The model presented in Figure 4.5 cannot describe the total behaviour of the cell under all environmental variations. Some extra losses need to be considered in a more practical model as shown in Figure 4.6; R_s and R_p are the series and parallel resistance losses.



Figure 4.6: Solar cell model using single diode with R_s and R_p

In this model, a photo electric current source I_{sc} depending on the solar radiation, cell temperature and voltage, a diode whose inverse saturation current is a function of temperature, and two series and shunt resistances to represent different losses in the cell are used. The formula that describes the *I-V* characteristic of the cell in Figure 4.6 is given by:

$$I = I_{sc} - I_D - \frac{V_D}{R_p}$$

$$\tag{4.19}$$

The reverse saturation current I_{rs} is given as:

$$I_{rs} = I_{sc ref} \left[\exp\left(\frac{qV_{oc}}{N_s K AT}\right) - 1 \right]$$
(4.20)

The module's saturation current I_Q changes with the cell temperature and is given by:

$$I_{Q} = I_{rs} \left[\left(\frac{T}{T_{ref}} \right)^{3} e^{\frac{qcg}{AK}} \times \left(\frac{1}{T_{ref}} - \frac{1}{T} \right) \right]$$
(4.21)

Where, I_Q is the diode saturation current (A). The formula describing the output current of a PV cell or module of the single diode equivalent circuit is given by:

$$I_{pv} = N_p I_{sc} - N_s I_o \left\{ \exp\left(\frac{q\left(V_{pv} + I_{pv} R_s\right)}{N_s A K T}\right) - 1 \right\} - V_{pv} + \left(\frac{I_{pv} R_s}{R_p}\right)$$
(4.22)

Where:

K: is Boltzmann's constant $(1.38 \times 10^{-23} \text{ J K}^{-1})$.

q: is the electronic charge $(1.602 \times 10^{-19} \text{ C})$.

T: is the cell temperature (K).

A: is the diode ideality factor.

 R_s : the series resistance (Ω).

 R_p : is the shunt resistance (Ω).

 N_s : is the number of cells connected in series = 26.

 N_p : is the number of cells connected in parallel = 160.

$$V_{pv} = V_{oc} = 37.30 \text{ V}.$$

The formula described by equation 4.22 depends on the solar irradiance, and the cell temperature (Abdulkadir, Samosir, & Yatim, 2012). Nameplate values of solar arrays are given under STC conditions. Real operation conditions differ from the STC. The use of the simple model of solar cell in our work simplifies the work without affecting the accuracy or generalization of the theory. It makes it easier for power electronic engineers to consider this model while working with power converters. The value of the shunt resistance R_p is

typically high such that it can be neglected (Abdulkadir, Samosir, & Yatim, 2012) (Yusof, 2004).

4.3.2 Simulink modelling for PV module

Mono-crystalline 240W PV Module is taken as the reference module for simulation and the data sheet details are given in Table 4.1. In addition the simulation for one array of 2 MW is conducted and then the simulation is generalized to all arrays in a similar way. A block diagram of the model based upon the equations of PV model is represented in Simulink environment as given in Figures 4.7, 4.8 and 4.9.

These models are developed in moderate complexity to include the temperature dependence of the photo current source, the saturation current through the diode, and a series resistance is considered based upon the shackle diode equations described previously. Since the main objective is to develop a functional PV model for the Simulink environment, the system is modelled to supply power to the load.



Figure 4.7: Block diagram of the model based upon the equations of PV model



Figure 4.8: Masked PV module in Simulink



Figure 4.9: The final model of PV system

4.3.3 PV Simulation results and discussions

The model discussed previously and shown in Figures 4.7, 4.8 and 4.9 was simulated under different conditions to evaluate the different characteristics of the PV modules. Figure 4.10 presents the V-I curve of the system simulated in Matlab environment. The simulation has considered 160 strings of 26 series modules parallel connected. The curves show the variations in voltage and current under different irradiation levels and fixed temperature of 25°C. Figure 4.11 presents the P-V curve of the same system under same conditions of temperature and irradiation. These two figures show that the system has one peak at which the system can provide the maximum power.



Figure 4.10: Simulink model of solar panel (160 strings) V-I characteristic curves



Figure 4.11: Simulink model of solar panel (160 strings) P-V characteristic curves

Figures 4.12 and 4.13 present the variations in the I-V and P-V curves under variable temperature and a solar irradiation of $1000W/m^2$. The figures show that the higher the

temperature the lower generated power becomes. Also, the figures show that the generated voltage decreases slightly with the increase in temperature of the cells.



Figure 4.12: Simulink model of solar panel (160 strings) V-I characteristic curves



Figure 4.13: Simulink model of solar panel (160 strings) P-V characteristic curves

CHAPTER 5

POWER SYSTEM STUDIES FOR PV INTEGRATION

5.1 Introduction

This chapter introduces the electrical power system studies for the project using ETAP software. The used methodology is as shown in the flow chart of Figure 5.1 below:



Figure 5.1: Electrical power system study methodology flow chart

5.2 Load Flow Study and Analysis Using ETAP

ETAP software uses the buses voltages, flow of current and power in the system, and branches power factor to perform load flow analysis. It is a very powerful software that can analyse the load flow for loop or radial electrical systems. Furthermore, ETAP software is designed to be able to perform different types of load flow analysis based on the custom choices and purposes of the specific case.

The purpose of load flow analysis in ETAP is to build an extensive idea about the behaviour of the power system under different supply and load conditions. It helps electrical power systems planners to design and test the performance of their systems prior to their installation and during their real time operation. It is also used to detect and forecast possible faults or power flow problems to propose the suitable solutions. The load flow Study is capable to define and adjust the parameters of the system for each case separately. ETAP has multiple choices to define the display options based on the user's needs and requirements from load flow analysis.

Load flow analysis in ETAP is based mainly on numerical solutions of systems of differential equations.

5.2.1 Load flow simulation using ETAP

This section discusses the implementation of Houn substation project simulation with the 14 MW PV plant as presented in Figure 5.2. Figure 5.2 shows the components of the Houn substation in addition to the PV Plant model in ETAP. As discussed earlier in chapter 4, PV arrays are connected through 7 transformers to the 11 kV bus-bars. The latter are connected through 2 step-up transformers to buses 11 and 12 as shown in the figure. The figure shows the load flow results for each one of the buses and branches.

On the figure buses voltages can be seen in per unit (PU). It is important to mention that in Figure 5.2 the PV plant is disconnected. The voltage on the 66 kV bus 1 is 99.12 % while the power of the PV plant is zero. Figure 5.3 shows the system load flow after the connection of PV plant. The voltage at bus 1 has increased to 99.39 % while a total of 11641 kW is flowing from the PV plant to the system. Power factor of the PV plant is approximately 1.



One-Line Diagram - HOUN SUBSTATION 220 kV (Load Flow Analysis With Out PV)

Figure 5.2: Load flow simulation with PV disconnected



One-Line Diagram - HOUN SUBSTATION 220 kV (Load Flow Analysis With PV)

Figure 5.3: Load flow simulation with PV connected

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5.3 Short Circuit Study and Analysis Using ETAP

The ETAP has the functionality of Short Circuit analysis in electrical distribution systems. It can find the short circuit currents and the contributions of each load in the short circuit. Fault duties are based on the new editions issued by IEC and ANSI/IEEE standards (ETAP, 2016). ETAP presents a very powerful short circuit detection and calculation ability. It is one of the main short circuit analysis software used in power systems by power engineers to estimate the effects of short circuit consequences in power systems.

5.3.1 Short circuit simulation using ETAP

Short circuit analysis was performed on the substation of Houn without PV plant as shown in Figure 5.4 and with the PV plant connected as shown in Figure 5.5. The figures show the short circuit currents at all buses and branches. It is obvious that the existence of PV plant in Figure 5.5 has increased the short circuit currents slightly at most of buses. However, the increase in short circuit current levels is very small and doesn't introduce extra problems.



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Figure 5.4: Short circuit simulation with PV disconnected



One-Line Diagram - HOUN SUBSTATION 220 kV (Short-Circuit Analysis With PV)

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Figure 5.5: Short circuit simulation with PV connected

5.4 Harmonics Study and Analysis Using ETAP

As a result of the continuously increasing uses of power electronic equipment like variable speed motor drives, UPS systems, power converters, rectifiers, and different power electronic devices, power quality of system's voltage and current is strictly affected in different areas. Components of higher frequencies start to circulate in power systems causing the wave forms of voltage and current to be distorted. Such higher frequency components are integer multipliers of the fundamental frequency which are known by the term harmonics. The harmonic emitting devices are called nonlinear loads and include power electronic switching devices, transformers, motors, fluorescent lights, arc furnaces and many other different devices. Such devices cause very serious problems affecting the power quality of power systems.

The existence of harmonics in any power system causes different problems and effects that include but not limited to over temperature of equipment, low power factor of devices, low performance of electrical components, unexpected behaviours of protective devices, interferences with communication systems, resonance with other equipment that cause failure of these equipment, noise, vibration of electrical motors, and other effects. Over more, harmonic currents don't stay near to their source; instead, they penetrate the electrical distribution networks and start circulating throughout the electric systems. The circulation of harmonic currents in the electric systems distorts electric voltages fed to the other users and the harmonic problem is accumulated. This phenomenon has become a main hot topic for power quality as a result of the increasing spread of electronic devices and equipment in power systems.

Using computer simulation, the problem of power system harmonics can be modelled and analysed. The ETAP harmonic analysis module offers a great tool to model different power system elements and equipment accurately to study their frequency dependency, nonlinear behaviour, and other effects of the presence of harmonic currents and voltages.

5.5 Transient Stability Study and Analysis Using ETAP

The ETAP is constructed to study the system's dynamic behaviour and steady state limits of a power system. This study or analysis is implemented before, throughout, and following changes or disturbances in the electric systems. The program implements the events and activities defined by the user to analyse the system. It then determines the response of the system to these events. These analyses are important to determine the protective and design parameters of the system.

Voltage profile is the numerical description of the system voltages at a given point, generally a bus or a node of the electric system at some determined circumstances. Examples of voltage profile are: no load profile, light load profile, full load profile, and finally overload profile. In the most of power systems, voltage is limited to predefined values that shouldn't be exceeded. Some variations in the voltage profile parameters can lead the system to instability. Voltage stability is a description of the ability of the system to preserve steady state parameters and voltages at their state values after different faults or occurrences (Cutsem & Vournas, 1998).

CHAPTER 6 RESULTS ANALYSIS OF POWER SYSTEM STUDIES

6.1 Introduction

To simulate a real system, models of each element have to be built and incorporated in the power system simulation software ETAP. This provides the ability to simulate load flow, short circuit, harmonics and stability analysis work in the same software environment. This chapter introduces the results and analysis for electrical power system studies for the project using ETAP software.

6.2 Load Flow Analysis

Load flow analysis is a great tool that produces essential computation practice in order to establish the characteristics of power system under steady state conditions. In this thesis load flow analysis for Houn substation which consists of 42 buses, 14 transmission lines and 26 transformers in addition to switches and circuit breakers as shown in the single line diagram Figure 5.2 and Figure 5.3. Modelling and simulation are carried out by using ETAP simulation software for two cases; first case without PV connection and the second case with PV connection. The results are tabulated as shown in Appendixes 4 and 5.

Tabulated reports show that integrating a PV system into Houn distribution network improves the system voltage profile as can be observed in most of the busses and particularly bus 10 which became normal after it was critical before connecting the PV system. The importance of the load flow analysis is to make sure that the distribution network is safe enough to be connected with PV generators. The results obtained from the load flow study of Houn substation show that the use of PV generators at Houn power station is safe, feasible, and advantageous. It can noticeably improve the voltage stability at each bus of the system, and increase the voltage profile.

6.3 Short Circuit Analysis

The short circuit of power system under consideration is performed to identify the strong and weak buses in the power system under disturbance. The possibilities for a short circuit in three phase system are as follows:

- 1- Symmetrical three phase fault.
- 2- Single Line to Ground fault.
- 3- Line to Line fault.
- 4- Double Line to Ground fault.

Short circuit analysis basically based on finding the steady state solution of the power system under study. This information is needed to determine the required interrupting capacity of the circuit breakers and to design proper relaying system (Saadat, 2010). To get enough information, different types of faults are simulated at different locations and the study is carried out for two cases; first case, without PV connection to Houn network, and the second case when the PV plant is connected to Houn network. In this thesis the ETAP report results of short circuit studies is tabulated as shown in Appendixes 6 and 7. The reports include the following information:

- 1- Short circuit contributions from all buses connected to the faulted buses or between any other two buses specified in the input, or both.
- 2- Voltage at the remote buses where fault contributions are specified by (1).
- 3- System X/R ratio at the fault point for medium voltage circuit breaker interrupting duty with its associated multiplying factor.
- 4- Symmetrical and asymmetrical current for breaker momentary duty.
- 5- Local and remote fault contributions.

The report includes input data, total fault level at each faulted bus, and also contributions from all connecting buses. Short circuit studied diagrams for Houn network as depicted in Figure 5.4 and Figure 5.5 showing all system faulted busses results.

6.4 Harmonics Analysis

Harmonics were presented earlier in this work and they present one of the most important problems in power systems. PV systems can represent a source of harmonics to the grid under some conditions; produced harmonics can be the effect of the solar panels instable functionality due to variable irradiations or from the power electronic elements used as interface. However, it is important to notice here that modern power inverters provide high power quality factors. The injected harmonics by such inverters are mostly high order harmonics that can be filtered easily.

In this research work simulations were carried out for the system under consideration, to obtain the voltage and current waveforms at bus bars 1 and 2 which are the Point of Common Coupling (PCC), where the study were performed for two cases one without PV connection, and the other with PV connection. Figure 6.1 shows the waveforms of the bus 1 voltage before the connection of PV plant. Figure 6.2 presents the Total Harmonic Distortion (THD) amounts of all buses after connecting the PV plant.



Figure 6.1: Voltage waveform at bus 1 with PV disconnected



One-Line Diagram - HOUN SUBSTATION 220 kV (Harmonic Analysis with PV and No Filters)

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Figure 6.2: Analysis results of harmonic with PV connected

Figure 6.3 presents the waveform and spectrum of the bus 1 voltage after the connection of the PV plant.



Figure 6.3: Waveform and spectrum of bus1 voltage after using PV plant

From Figure 6.2 it can be noticed that THD values of voltages at buses 1 and 2 are 2.33 % and 1.15 % respectively. The results show that the injection of solar power through solar inverters causes the injection of voltage harmonics into the power system. However, the THD values after the use of PV plant are still less than 5 % and don't cause any problems according to different international standards like IEC.

To improve the stability condition such as reducing the 5th and higher orders harmonics and reduce the harmonic content in the waveforms, passive filters can be connected at the common coupling busses as shown in Figure 6.4. The figure shows that the use of harmonic passive filters has reduced the THD value of voltage to 0.63 % at bus 1 and 0.41 % at bus 2. It is important to mention here that the filter was tuned specifically to cancel the 11th harmonic as it was the dominant harmonic as shown in Figure 6.3. It is important to notice that the 11th harmonic was cancelled as shown in Figure 6.5. Another filter tuned at the 13th harmonic could reduce more the THD and increase the power quality at bus 1 and bus 2.



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Figure 6.4: Harmonic study with filters and PV connection



Figure 6.5: Bus 1 voltage waveform and spectrum with filters and PV connection

The complete reports of the study including THDV value with filters are depicted in the Appendixes 8, 9, 10 and 11.

6.5 Transient Stability Analysis

Stability of power system is the criterion that guarantees it to keep in equilibrium point under normal conditions; also to return to its initial stable conditions after the occurrence of different disturbances. Unacceptable voltage profiles can be the main consequence of the incapability of the system to feed the required reactive power to the load. Under normal operating conditions, the magnitude of the bus voltage boosts proportional to the increase in the injected reactive power on the same bus. However, unstable system occurs when the voltage of the bus decrease with the increase of reactive power injection. The voltage instability is a local problem; however, its effects can spread all over the system due to the relation between active power, reactive power, and bus voltage.

Solar systems are nonlinear configurations because of the discrete operation and existence of the sunlight, in addition to the switching scheme of the power electronic converters and DC-AC inverter devices. The output voltage in a solar system, the generated current, and the produced power are subject to dynamic variations at real time basis. The connection of such type of systems has its side effects on the other different components of the power system and its stability especially the power factor and voltage profile. In this thesis PV plant is integrated at bus 1 and bus 2 as shown previously.

Dynamic voltage stability simulations were carried out using the ETAP software. Simulation results demonstrate that connecting the PV to Houn substation increases the voltage profile at the particular bus bar. Thus, integrating of a PV system into a distribution network improves the system voltage stability.

In transient stability we studied about the behavior of the system under consideration during the disturbance for large interval in both cases. The results are shown in Figure 6.6 and Figure 6.7. The complete reports of the study for both cases are depicted in the Appendixes 12 and 13. Figure 6.6 shows the transient voltage that follows a three phase fault applied to bus 1 and bus 5 with PV disconnected. It demonstrates a voltage change of up to 200 % in bus 1 voltage. After the connection of PV plant, the same fault was executed and results were shown in Figure 6.7. The transient voltage has decreased to 140
% and the time of transient was also decreased. These two figures show that the connection of PV plant help stabilizing the power system and reducing the transient effects.



Figure 6.6: Percentage of bus nominal (kV) without PV connection



Figure 6.7: Percentage of bus nominal (kV) with PV connection

CHAPTER 7 CONCLUSION AND FUTURE WORK

7.1 Conclusion

Libya is very wealthy in the solar energy and gains a huge prospective for solar power generation plants. Solar energy is variable in the nature and depends on the site. The unpredictable nature of this energy source has its great impact on the power system operation and planning. The aim of this specific work is to evaluate the effect of the integration of solar power generator in the city of Houn distribution station in Libya. This aim was achieved by developing the design of PV system to be implemented in Houn substation 220 kV. Sizing of PV system, inverters and cables were obtained.

In order to verify the design validity, different simulation models using MATLAB and ETAP programs have been built and carried out. Real load and solar energy data were used in the simulation to achieve more realistic results that can help for future analysis and planning processes.

Investigation of the impact of 14 MW PV plant on Houn distribution power system in this thesis was carried out and some analyses were established. The first study was concerned by the slow variations in the common coupling point's voltage. The second study was concentrated on the study of short circuit faults at the coupling point of Houn power station. These studies were performed in order to verify whether the Houn substation is capable to hold the planned generation plant. After those studies were performed, another analysis of the voltage stability on Houn station before and after the consideration of the solar plant was carried out. Finally, the effect of PV system on the power quality at the coupling point was studied by using the harmonic analysis tools.

The obtained results from the load flow analysis show that the implementation of PV solar generation station at Houn power distribution station develops the voltage profile and increase the stability of the system. Distribution lines' losses are found to be decreased as an effect of the implementation of the solar system. The applied analyses have shown that the power station of Houn is in good status and its voltage profile is healthy before and after the use of PV generation system.

The implementation of PV plant connected to the station of Houn has shown capability of decreasing the transient effects of buses faults. This means an increased stability compared with the high transient when the PV plant is not connected. The connection of the PV plant has caused the injection of some voltage harmonics that started to spread over the network. However, the amount of generated harmonics was within the international limits stated by different standards. Tuned filters for the dominant harmonics were installed on the connection buses to cancel these harmonics. Analyses have shown that these filters were able to reduce the harmonics significantly.

From the work done in this thesis it can be concluded that the addition of support PV power generation of 14 MW increases the efficiency of the Houn power station and improves the voltage profile of all station buses. After applying a fault at 66 kV and 11 kV busses, it's found that the PV system is capable to develop the voltage steady and dynamic state stability of Houn power distribution station. The PV system responded to the faults by sharing in the voltage recovery during the fault and after it. No system tripping was detected throughout or after the disturbance.

7.2 Future Work

Any scientific research can't cover all aspects and investigates all important points at once; some points need to be reinvestigated and studied in future works. Separately from the studies applied in the course of this thesis work; that seems to be of the highest importance, further studies of the impact of the solar systems on the connected power systems and distribution stations needs to be penetrated. After the integration of DG stations, power flow becomes bi-directional. In this case, different protection and interruption systems need to be studied and introduced into the stations. Future works that are recommended in other stages of this work are:

- The reliability analysis on the distribution station of the security and adequacy of the proposed system especially keeping in mind the intermittent function of PV stations.
- 2- Further studies on the protection profile after the injection of PV generators.
- 3- The frequency stability of the power station under the effects of PV systems.

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APPENDICES

APPENDIX 1 HOUN SUBSTATION LOADS

MEDIUM VOLTAGE NETWORK MANAGEMENT CONSOLE

	SUB STATION	NUMBER	VOLTAGE	CAPACITY MVA	MW	TOTAL
,	HOIN	1	66/11	20	7	0
1	HOUN	2	66/11	20	2	У
•		1	66/11	20	5	16
2		2	66/11	20	11	10
2	WEDDAN	1	66/11	20	3.5	0
э		2	66/11	20	5.5	у
4	4 ALFORJAN	1	66/11	15	6	12
4		2	66/11	15	б	12
-	AT WASEED	1	66/11	20	3	2
2	5 ALKASEER	2	66/11	20	0	3
4	7411.4	1	66/11	10	5	-
0	0 LALLA	2	66/11	10	2	
7	ZALLA ROAD TRANSFORMER	1	66/11	10	6	б
8	HOUN 220	1	66/11	10	0	0

DETECTING LOADS TRANSFORMERS (66/30/11 kV)

APPENDIX 2 MODULE DATASHEET

Suniva* ART245-60 Monocrystalline Solar Modules

ELECTRICAL DATA (NOMINAL)

The electrical data apply to standard test con-	ábora (STC): Imadiance of 100	10 With? with AM 1.5 spectra at	25°C.	
Power Classification (Max.)	Pmax (W)	235	240	245
Voltage at Max. Power Point	Vmp (V)	30.00	30.40	30.90
Current at Max. Power Point	Imp (A)	7.84	7.89	7.95
Open Circuit Voltage	Voc (V)	37.30	37.30	37.40
Short Circuit Current	Isc (A)	8.38	8.44	8.49

The rated power may only vary by -D/+4.99 Wp and all other electrical parameters by $\pm\,5\%$

DIMENSIONS AND WEIGHTS

Cells / Module	60	
Module Dimensions	1657 x 987 mm; 65.24 x 38.86 in.	
Module Thickness (Depth)	42 mm; 1.65 in.	
Approximate Weight	19 kg, 42 lbs.	_

CHARACTERISTIC DATA

Type of Solar Cell	High-efficiency Suniva® 3 busbar monocrystalline cells of 156 x 156 mm
Frame	Silver anodized aluminum alloy
Glass	Anti-reflective coating, tempered & low-iron
Junction Box	IP67 rated; IEC & UL listed; with internal bypass diodes
Cable & Connectors	4 mm ² cable with MC4 connectors; cable length approximately 1 m

TEMPERATURE COEFFICIENTS

Voltage	8, Voc (%/°C)	-0.332
Current	a, lsc (%/°C)	+0.036
Power	y, Pmax (%/*C)	-0.460

LIMITS

Max. System Voltage	1000 VDC
Operating Module Temperature	-40°C to +90°C
Storm Resistance	Tested to IEC 61215 for wind loads of 5400 Pa (204 mph)

Sunivat[®] reserves the right to change the data at any time.







10/06/10

APPENDIX 3 ABB CENTRAL INVERTER

ABB central inverters PVS800 100 to 1000 kW



Technical data and types

Type designation	-0100kW-A	-0250kW-A	-0315KW-B	-0500kW-A	-0630kW-B	-0875kW-B	-1000kW-C
PVS800-57	100 kW	250 KW	315 KW	500 KW	630 KW	875 kW	1000 KW
Input (DC)		NE		<i>16</i> - 3	3	89	
Maximum Input power (Pro, ras) *	120 KWp	300 KWp	378 kWp	600 kWp	756 KWp	1050 KWp	1200 kWp
DC voltage range, mpp (U _{sc.})	450 to 825 V	450 to 825 V	525 to 825 V	450 to 825 V	525 to 825 V	525 to 825 V	600 to 850 V
Maximum DC voltage (University)	1000 V	1000 V	1000 V	1100 V	1100 V	1100 V	1100 V
Maximum DC current (Imaginci)	245 A	600 A	615 A	1145 A	1230 A	1710 A	1710 A
Number of protected DC inputs	1 (+/-) /4 7	2, 4, 8 (+/-)	2, 4, 8 (+/-)	4 to 15 (+/-)	4 to 15 (+/-)	8 to 20 (+/-)	8 to 20 (+/-)
Output (AC)	-	12 × 2		10 U		0) 2	
Nominal power (Physa) 3	100 kW	250 KW	315 kW	500 kW	630 KW	875 KW	1000 KW
Maximum output power 4	100 kW	250 KW	345 KW	600 kW	700 kW	1050 KW	1200 KW
Power at cose = 0.95 ^a	96 kW	240 KW	300 KW	475.kW	600 kW	830 KW	950 KW
Nominal AC current (hoso)	195 A	485 A	520 A	965 A	1040 A	1445 A	1445 A
Nominal output voltage (U _{NPC)}) ¹⁰	300 V	300 V	350 V	300 V	350 V	350 V	400 V
Output frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Harmonic distortion, current 9	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%	< 3%
Distribution network type ¹¹	TN and IT	TN and iT	TN and IT	TN and IT	TN and IT	TN and IT	TN and IT
Efficiency	Contraction of the second second						10000 million
Maximum ^{ap}	98.0%	98.0%	90.6%	98.6%	98.6%	98.7%	98.8%
Euro-eta*0	97.5%	97.6%	98.3%	98.2%	B8.4%	98.5%	98.6%
Power consumption		N	8	20 2			
Own consumption in operation	310 W	310 W	310 W	490 W	490 W	650 W	650 W
Standby operation consumption	60 W	60 W.	60 W	65 W.	65 W	65 W	65 W
External auxiliary voltage *	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz
Dimensions and weight							
Width/Height/Depth, mm (WiH/D)	1030/2130/690	1830/2130/680	1830/2130/680	2630/2130/708	2630/2130/708	3630/2130/708	3630/2130/708
Weight appr. 10	550	1100	1100	1800	1800	2320	2320

1) Recommended maximum input power

Recommended maximum input power
Optional MCB inputs, 80 A inputs
Optional MCB inputs, 80 A inputs
Optional MCB inputs, 80 A inputs
Optional Power
At 25 °C. See the user manual for details.
At 25 °C. See the user manual for details.

¹⁴ For the smallest number of protected inputs. See the user manual for details.

Product flyer for PVS800 | ABB solar Inverters

¹¹ +/- 10%

APPENDIX 4

LOAD FLOW ANALYSIS WITHOUT PV

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Electrical Transient Analyzer Program

Load Flow Analysis (Without PV)

Loading Category (1): Design Generation Category (1): Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total	
Number of Buses:	3	0	26	29	

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	15	0	0	14	0	0	29

Method of Solution:	Adaptive Newton-Raphson Method
Maximum No. of Iteration:	99
Precision of Solution:	0.0001000
System Frequency:	50.00 Hz
Unit System:	Metric

Project:	MASTER THESIS	ETAP		Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: 1	LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV			Config:	Normal

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Ves	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yet	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP	Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

								Lo	ad			
1	Bus		Initial V	oltage	Centa	ut kVA	Const	aut Z	Coun	tant I	Gen	erše
D	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Myar	MW	Mvar	MW	Myar
Bunl	66.009	1	99.4	-4.2			-					
Bus2	66,000	2	99.1	-1.2								
Jus3	220.000	1	100.0	0.0								
Bus4	220.009	3	100.9	0.0								
Buss	220.008	2	100.0	0.0								
Busti	11,000	1	98.3	-4.2	0.000	0.995	0.000	0.249				
Bus7	66.000		99.0	-1.2								
Buss	66.608	1	99.3	-4.3								
Bus9	11.000	2	98.4	-1.8	1.600	0.992	0.410	0.248				
Bus10	11.000	1	98.0	-6.3	5,600	3.471	1.400	0,958				
Bus13	66.000	1	98.6	-4.7								
Bus14	66.000	2	98.2	-1.7								
Bun15	11.009	1	99.0	-7.6	4.800	2.975	1.299	0,744				
Bus16	11.000	2	98.6	-4.7	4,500	2.975	1.200	0.744				
Busl7	66.000	1	99.2	-5.9								
Bus18	66.000	2	99.0	-1.6								
Bus19	11.009	1	99.0	-7.5	4,400	0.000	1.199	0.000				
Bun20	11.000	2	98.9	-2.6	2.500	0.000	0.700	0,000				
Bus21	66.000	1	99.2	-6.5								
Bus22	11.000	1	98.7	.9.4	4,800	0.000	1.200	0.000				
Bus23	66.800	1	99.5	-6.9								
Bux25	11.000	1	98.4	-7.9	1.600	0.991	0.400	0.248				
Bus27	66.000	1	99.1	-4.9								
Bun28	11.009	1	98.7	-5.8	2.400	1,487	0.600	0.372				
Bus29	11.009	1	98.7	-5.8	2,400	1.487	0.600	0.372				
Bus30	66.009	1	98.8	-4,6								
Bus31	66.000	2	98.5	-1.4								
Bux32	11.009	1	98.3	-7.8	5,500	5.455	2.290	1.364				
Bus33	11.000	:	100.7	-2.8	4.000	2.479	1.000	0.620				
Total Number of Bases:	29				17,998	23.507	12,000	5.827	0.000	0.000	0.000	0.00

Buy Input Data

Project:	MASTER THESIS	ETAP	Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and a second second	Config:	Normal

	Generation B	as -		Voltz	120		Generation	97.	Mvar	Limits
Ð	kV	Type	Sub-sys	% Mag.	Angle	MW	Myar	% PF	Max	Min
Buch	220.000	Swing	1	100.0	0.0			-		
les-4	220.000	Swing	3	100.0	0.0					
Bus5	220,000	Swing	2	100.0	0.0					
						0.000	0.000			

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract;	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and a second second second	Coufig:	Normal

Line/Cable Input Data

	Ohms or Siemens/1000 m per Conductor (Cable) or per Phase (Line)											
Line/Cable			Lengt	h								
ID	Libeary	Size	Adj. (m)	96 Tol.	#Phase	T (°C)	R	X	Y			
Linel	-	674	19500.0	0.0	1	75	0.056003	0.374255	0.0000031			
Line2		674	19300.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line3		674	23000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line4		674	15000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line5		674	8000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Linró		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line7		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line8		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line9		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Line10		674	8000.0	0.0	1	75	0.056001	0.342069	0.0000034			
Linell		674	8000.0	0.0	1	75	0.056001	0.342869	0.0000034			
Line12		674	21000.0	0.0	1	75	0.056001	0.342069	0.0000834			
Line13		674	161000.0	0.0	1	75	0.056001	0.342969	0.0000034			
Line14		674	140000.0	0.0	1	75	0.056001	0.342069	0.0000034			

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	U	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	10000	E	Config:	Normal

2-Winding Transformer Input Data

Transformer	r			Rating				Variatio	m	% Tap	Setting	Adjusted	Phase	Shift
ID	Phote	MVA	Prim kV	Sec. kV	% Z1	X1/RI	+ 5%	- 554	%5 Tol.	Prim.	Sec.	96 Z	Type	Aught
n	3-Phase	63.000	129.000	66.900	12.50	45.00	0	0	0	0	3.750	12,5000	Dya	0.000
T5	3-Phase	63.000	120.000	66,000	12.50	45.00	0	ø	0	0	0.625	12.5000	Dyn	0.000
T4	3-Plane	10.000	65.909	11.009	8.35	15.00			0	0	0	8.3500	Dyu	6.005
T5	3-Phate	20.000	65,000	11.000	10.00	20.00	0		0		0	10.0000	Dya	0.008
Té	J-Phase	20.000	65.000	11.000	10.00	20.00	0	0	0	0	1.250	10.0000	Dyn	0.000
T9	3-Phase	10.000	65.009	11.000	8.35	13.00		0	.0	0	4.375	8,3500	Dyn	0.000
T10	3-Phase	10.000	66.000	11,000	8.35	13.00		0	0	0	4.375	8,3500	Dyu	8.008
TII	3-Phane	20.000	55.000	11.009	10.00	26.00		0	.0	0		10.0000	Dyn	8.008
T12	3-Phote	20.000	65.009	11.000	10.00	20.00	0		0	0	8	10.0000	Dyn	9.009
T13	3-Phone	10.000	65.000	11.000	8.35	13.00		0	0	0	0	8,3500	Dyn	0.000
T14	3-Plane	10.000	65.000	11,000	8,35	13.00	0	0	0	0		8.3500	Dyn	0.000
T16	3-Phone	20.000	65,000	11,900	10.00	29.09			0	0	9.625	10.0000	Dyu	0.008
T17	3-Phase	20,000	65.000	11.000	10.00	28.09	0	0	0	0	0.625	10.0000	Dya	0.000
T18	3-Phase	20.000	65.009	11.000	10.00	20.00		0	0	0	3,750	10.0000	Dyn	0.000
T15	3-Plane	28.000	66.000	11,000	10.00	20.00	0	0	0	0	3,750	10,0000	Dyn	0.000

Project:	MASTER THESIS	ETAP	Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 2204A	and a second second	Config:	Normal

CKT	Branch	Con	mected Bus ID	% Impe	dance, Pos.	Seq., 100 3	dVA Base
ID	Type	From Bus	To Bus	R	X	z	Y
TI	2W XFMR	Bas3	Butl	0.46	20.58	38.59	
T3	2W XFMR	Bus5	But2	0.44	19.96	19.97	
T4	2W XFMR	Bus1	Buid	6.40	83.25	85.50	
15	2W XFMR	Bas7	But9	2.50	49.94	\$0.00	
16	2W XFMR	Bus\$	Bun10	2.53	50.56	\$0.63	
19	2W XFMR	Bail3	Bm15	6.68	56.90	87.15	
T10	2W XFMR	Buil4	Bm16	6.68	\$6.90	87.15	
TIL	2W XFMR	Bus17	But19	2.50	49.94	\$0.00	
T12	2W XFMR	Bus18	Bas20	2.50	49.94	\$0.00	
T13	2W XFMR	Bus21	Bm22	6.40	83.25	83.50	
T14	2W XFMR	Bas23	Bu:25	6.40	83.25	\$3.50	
T16	2W XFMR	Bus27	But28	2.51	50.25	50.31	
T17	2W XFMR	Bus27	Ban29	2.51	50.25	50.31	
T18	2W XFMR	Bun30	But32	2.59	51.81	51.88	
T19	2W XFMR	Bus31	Bun33	2,59	51.81	51.88	
Linel	Line	Bus2	Buil4	2.48	16.58	16.77	0.2607629
Line2	Line	Busl	But15	2.48	15.16	15.36	0.2842267
Line3	Line	Bas2	Bun18	2.96	18.66	18.30	0.3387157
Line4	Line	Bas27	Bm17	1.93	11.78	11.94	0.2209015
Line5	Line	Busl	But27	1.03	6.28	6.37	0.1178142
Lineó	Line	Bus1	Bus?	0.51	3.34	3.18	0.0589071
Line?	Line	Bus1	ButS	0.51	3.14	3.18	0.0589071
Line8	Line	Bus2	Bun7	0.51	3.14	5.18	0.0589071
Line9	Line	Butl	Build	0.51	3.14	3.18	0.0589071
Line10	Line	Bus2	Ban31	1.03	6.28	6.37	0.1178142
Line11	Line	Busl	Ban30	1.03	6.28	6.37	0.1178142
Line12	Line	Bun17	Bm21	2.70	16.49	16.71	0.3092622
Line13	Line	Bas17	Bun23	20.70	126.43	128.11	2.3710100
Line14	Line	Bus21	Bui23	18.00	109.94	111.40	2.0617480

Branch Connections

Project:	MASTER THESIS	ETAP		Page:	8
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	LF.	Revision:	Base
Filename:	HOUN SUBSTATION 220KV		æ	Config:	Normal

LOAD FLOW REPORT (Without PV)

	Bus		Volt	age	Gene	ration	Lo	ad		Load Flow	N			XFMR
	ID	kV	% Mag.	Aug.	MW	Mvar	MW	Myar	ID	MW	Myar	Amp	%P7	%Tap
Busl		66.000	99.118	-5.1		0			Buil3	6.017	3.963	63.6	\$3.5	
									Bus27	19.518	1.155	172.6	99.8	
									Buth	3.479	1,276	36.7	\$3.7	
									Buck	3,479	2.276	36.7	83.7	
									Bas30	10.979	7.688	118,3	B1.9	
									Bud	-43,474	-18.606	417.3	91.9	3,750
									Bund	0.001	1.247	11.0	0.1	
Bas2		66.000	98.852	-1.9		0		0	Busl4	6.909	3.992	63.8	\$3,3	
									Bet18	3.485	-0.245	59.9	.99.5	
									But7	0.994	0.572	10.1	\$6.7	
									Bus?	0.994	0.572	19.1	\$6.7	
									Bus51	5.022	3.198	52.T	84.4	
									Bush	-16.907	-\$.089	162.7	\$9.5	0.625
Bun3		220.000	109.000	0.0	43,582	23.466			Buil	43.582	23.466	129.9	88.0	
Ben5		220.000	100.900	0.0	16.522	8.783			But2	16.522	8.783	49.3	\$8.3	
Bur6		11.000	98.071	-8.1			0.000	1.254	Butl	0.009	-1.234	66.0	0.0	
But7		56.000	98.828	-1.9					Ber1	0.994	-0.629	10.4	\$4.5	
									Bet2	-0.994	-0.629	10.4	84.5	
									Betf	1.987	1.259	20.8	84.5	
Benß		66.000	99.027	-5.2					Buil	-3.478	-2.329	37.0	83.1	
									Busl	-3,478	-2.329	37,0	\$3.1	
									Bur10	6.956	4.657	73.9	\$3.1	
Bas9		11.006	95.146	-2.5			1.986	1.231	Bei7	-1.986	-1.231	124.9	85.0	
Basi10		11.000	97,770	-7.2			6.938	4.391	Buck	-6.938	-4.301	438.2	\$5.0	1.250
Bur13		66.000	98.344	-5.6					Busl	-6.004	-4.158	65.0	\$2.2	
									Bus15	6.004	4.158	65.9	\$2.2	
Bas14		66.000	95.015	-2.4					Ber2	-5.996	-4.155	65.1	\$2.2	
									Bas16	5.996	4.155	65.1	82.2	
Bus15		11.000	95.692	-8.5			5.968	3,699	But13	-5,968	_3.699	375.4	\$5.0	4.375
Builé		11.000	98,339	-5.4			5.960	3.694	Busl4	-5.960	-3.694	\$74.2	\$5.0	4,375
Bas17		66.010	98.917	-65					Bus27	-33,472	2.510	121.7	-97.9	
									Ber11	6.602	-1.319	59.5	-98.1	
									But23	1.390	-1.644	19,0	-64.6	
									Bus29	5.490	0.153	48.5	100.0	
Bm18		66.000	98.765	.2.3					Bus2	-3.484	-0.062	30.9	160.0	
									Ban20	3.484	0.962	30.5	100.0	

Project:	MASTER THESIS	ETAP		Page:	9
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	UF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	-1000 CO.	रहे.	Config:	Normal

But		Volt	age	Gene	ration	Lo	ad		Load Flow	ni -			XFMR
Ð	¥7.	W Mag.	Ang.	MW	Muar	MW	Muar	ID	MW	Muar	Amp	16PF	*sTap
Bus19	11.000	95,748	-8.4			5,472	0.000	Busl7	-5,472	0.000	290.9	100.0	
Bus20	11.000	98.661	-3.5	0		3.481	0.000	Bus18	-3.481	0.000	185.2	190.0	
Bus21	66.000	95,938	-7,5	0			0	Busl?	.6,590	1.092	59.1	.98.7	
								But23	0.604	-1.598	15.5	-39.6	
								Bus22	5.986	0.306	\$3.0	99.9	
Bus23	11.000	95.422	-16.4	.0		5.962	0.000	Bur21	-5.962	0.000	518.0	100.0	
Bus23	66.000	99.263	-7.9	0				Bus17	-1.385	-0.656	13.5	90.4	
								Bus21	.0.603	-0.621	7.6	69.6	
								Bus25	1.988	1.277	20.8	\$4.1	
Bus25	11.000	95,077	-5.8	0		1.984	1.230	Bus23	-1.984	-1.230	124.9	\$5.0	
But27	66.000	98.547	-5.8	0			0	Busl7	13.509	-2.797	122.1	.97.9	
								Buil	-19.478	-1.026	172.6	99.9	
								Bus28	2.984	1.912	31.4	842	
								Bus29	3.984	1.912	51.4	\$4.2	
Bur28	11.000	95.428	-6.7			2,981	1.848	Bui27	-2.981	-1.848	187.0	\$5.0	0.625
Bus29	11.000	98.428	-6.7	0		1.981	1.848	Bus27	-1.981	-1.848	187.0	\$5.0	0.625
Bun30	66.000	95.515	-8.5	.0			.0	Busl	-10.961	-7.688	118.9	81.9	
								Bus52	10.961	7.688	118.9	\$1.9	
But31	66.000	98,594	-2.1	0			0	Bus2	-5.019	-3.290	53.2	\$3.6	
								Bus33	5.019	3,290	53.2	\$3.6	
But52	11.000	98.055	-8.7			10.914	6.765	Bas50	-10.914	-6,765	687.5	\$5.0	3.750
Bus33	11.000	100.463	-3.5			5.009	5.195	Bus31	-5.009	-3.105	307.9	\$5.0	3.750

* Indicates a valtage regulated bus (voltage controlled or uning type machine connected to it)

indicates a buy with a load minmatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP	Page:	10	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV		Config	Normal	

Bus Loading Summary Report

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Directly Connected Load Total Bus Load Constant kVA Constant I Genevic Bai Cunitant Z Percent ID kV Rated Amp MW Myar MW Myar MW Mun MW Muar MYA. 46 PF Loading Amp 220.000 Bas4 0 0.0 8,8 Busl 66,000 è . 0 6 ö 0 47.288 91.9 417.3 ò ٠ 66.000 e 8 .0 . 18,492 163.6 Bus2 6 0 . 0 89.5 Bass 220.000 ÷ 0 0 a 0 0 9 49,495 \$5.0 129.9 0 Bus5 220.000 0 0 . 0 18.712 88.5 49.1 11.000 0.995 1.234 65.0 Bash . 0 0.239 0 0 . n 0.0 \$6.010 2.352 29.8 Ber7 0 84.5 0 0 . 0 0 . Ð Bush 66.000 ï ä . 8.371 85.1 73.9 ń 6 ò Rect 11.000 1.600 8.992 0.385 0.239 6 0 ٠ 6 2,336 85.0 124.9 Ban10 11.000 5.600 3.171 1.338 6.830 0 0 0 8.163 \$5.0 438.2 . Bas15 66.000 . 0 0 8 0 7.305 82.2 65.0 0 ٠ 0 66,000 7.794 Berlá . 6 0 . 0 0 ٠ 6 82.2 65.1 Bus15 11.000 4.800 2.975 1.169 0.724 7.022 85.0 373.4 0 0 . ú Bus16 11.000 4.800 2.975 1.160 9,719 7.012 85.0 374.2 D 0 . ò Bat17 66.000 6 . . ٠ в 'n. ٠ ú 13,794 97.7 122.6 Bus18 66.000 . 0 6 0 0 3.485 100.0 38.9 ٠ ٠ 0 Bun19 11.000 4.400 0 1,072 0 0 0 8 0 5.472 100.0 295.9 Ber10 11,000 2,500 0 0.691 4 0 0 . 0 3.481 100.0 185.1 97.8 Bus21 65.000 6.736 59.6 . 0 . . 0 0 ٠ ú Ban22 11.000 4.800 0 1.162 . 0 0 5.962 100.0 318.0 . ń Bat23 66.000 a 0 0 • 6 0 . n 2.365 84.1 29.8 11.000 0 2.334 124.9 1,600 0.991 0.355 0 ġ 35.0 Bat25 0.238 ٠ Bus27 66.000 0 0 0 19,850 981 175.7 ė 0 0 . 0 Ban28 11.000 2.400 1.487 0.581 \$360 0 0 3.597 85.0 187.0 . 0 11.000 3,507 Ban29 85.0 187.0 2,400 1.487 0.591 0.360 0 0 . 0 Bas30 66.000 13.588 81.9 118.9 6 0 0 ė Bas31 66.000 ä . 0 ŵ. 6 à 'n 6.001 83.6 53.2 16 11.000 12.841 687.5 Ban32 3,800 5.455 2.114 1.311 0 0 . 0 85.0 Bas33 11.000 4.000 2.479 1.009 9.626 8 ú ٠ ó 5.895 35.0 307.9

* Indicates operating load of a but exceeds the but critical limit (100.8% of the Continuous Ampere rating).

indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

Project:	MASTER THESIS	ETAP	Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Contraction of the second second second second second second second second second second second second second s	Coufig:	Normal

100		C.M. A.D.			Transformer					
	l / Branch	Ampacity	Loading		Capability	Loading (input)		Loading ((heqtwo	
ID	Type	(Amp)	Amp	56	OUL Y	MVA	56	MVA	14	
TI	Transformer				63.000	49.498	78.6	47.288	75.1	
T3	Transformer				63.000	18.712	29.7	18.382	29.2	
T4	Transformer				10.000	1.247	12.5	1.234	12.3	
TS	Transformer				29,000	2.552	11.8	2.536	11.7	
T6	Transformer				29.000	8.371	41.9	8,165	40.8	
T9	Transformer				10.000	7.303	73.0	7.022	70.2	
T10	Transformer				16.000	7.294	72.9	7.012	78.1	
ти	Transformer				29,000	5.482	27.4	5.472	27.4	
TI2	Transformer				29.000	3.485	17.4	3.481	17.4	
T13	Transformer				10.000	5.994	9.92	5.962	\$9.6	
T14	Transformer				10.000	2.563	23.6	2.534	23.3	
T16	Transformer				28,000	3.544	17.7	3.507	17.5	
T17	Transformer				29,000	3.544	17.7	3.507	17.5	
T18	Transformer				28.000	13.388	66.9	12.841	64.2	
T19	Transformer				20,000	6.001	30.0	5.893	29.5	

Branch Loading Summary Report

* Indicates a branch with operating load exceeding the branch capability.

Project:	MASTER THESIS	ETAP		Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV			Config:	Normal

CKT / Branch	From-To	Bus Flow	To-From	Bus Flow	Los	ises	% Bus	Voltage	Vd % Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
Line2	6.017	3.963	-6.004	-4.158	13.4	-195.2	99.1	98.3	0.77
Line5	19.518	1.155	-19.478	-1.026	40.0	129.1	99.1	98.8	0.27
Line7	3.479	2.276	-3.478	-2.329	0.9	-52.3	99.1	99.0	0.09
Line9	3.479	2.276	-3.478	-2.329	0.9	-52.3	99.1	99.0	0.09
Linell	10.979	7.688	-10.961	-7.688	18.9	0.4	99.1	98.5	0.60
T1	-43.474	-18.606	43.582	23.466	108.0	4859.9	99.1	100.0	0.88
T4	0.001	1.247	0.000	-1.234	1.0	13.2	99.1	98.1	1.05
Linel	6.009	3.992	-5.996	-4.155	13.5	-162.6	98.9	98.0	0.84
Line3	3.488	-0.246	-3.484	-0.062	3.7	-308.2	98.9	98.8	0.09
Line6	0.994	0.572	-0.994	-0.629	0.1	-57.1	98.9	98.8	0.02
Line8	0.994	0.572	-0.994	-0.629	0.1	-57.1	98.9	98.8	0.02
Line10	5.022	3.198	-5.019	-3.290	3.8	-91.8	98.9	98.6	0.26
T3	-16.507	-8.089	16.522	8.783	15.4	694.5	98.9	100.0	1.15
T5	1.987	1.259	-1.986	-1.231	1.4	28.3	98.8	98.1	0.68
T 6	6.956	4.657	-6.938	-4.301	17.8	356.9	99.0	97.8	1.26
Т9	6.004	4.158	-5.968	-3.699	35.3	459.1	98.3	98.7	0.35
T10	5.996	4.155	-5.960	-3.694	35.5	461.1	98.0	98.3	0.32
Line4	-13.472	2.810	13.509	-2.797	37.4	12.8	98.9	98.8	0.07
Linel2	6.602	-1.319	-6.590	1.092	12.4	-226.9	98.9	98.9	0.02
Line13	1.390	-1.644	-1.385	-0.656	4.6	-2300.1	98.9	99.3	0.35
T11	5.480	0.153	-5.472	0.000	7.7	153.4	98.9	98.7	0.18
T12	3.484	0.062	-3.481	0.000	3.1	62.2	98.8	98.7	0.10
Linel4	0.604	-1.398	-0.603	-0.621	0.9	-2019.1	98.9	99.3	0.32
T13	5.986	0.306	-5.962	0.000	23.5	305.5	98.9	98.4	0.52
T14	1.988	1.277	-1.984	-1.230	3.6	47.2	99.3	98.1	1.19
T16	2.984	1.912	-2.981	-1.848	3.2	64.2	98.8	98.4	0.42
T17	2.984	1.912	-2.981	-1.848	3.2	64.2	98.8	98.4	0.42
T18	10.961	7.688	-10.914	-6.765	46.1	922.2	98.5	98.0	0.48
T19	5.019	3.290	-5.009	-3.105	9.2	185.0	98.6	100.5	1.87
					464.8	3296.6			

Branch Losses Summary Report

Project:	MASTER THESIS	ETAP	Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

		Alert Sum	mary Report				
			% Al	ert Setti	ngs		
			Critical	1	Marginal		
	Loading						
	Bus		100.0		95.0		
	Cable		100.0		95.0		
	Reactor		100.0		95.0		
	Line		100.0		95.0		
	Transformer		100.0		95.0		
	Panel		100.0		95.0		
	Protective Device		100.0		95.0		
	Generator		100.0		95.0		
	Inverter/Charger		100.0		95.0		
	Bus Voltage						
	OverVoltage		105.0		102.0		
	UnderVoltage		95.0		98.0		
	Generator Excitation						
	OverExcited (Q Max.)	pi -	100.0		95.0		
	UnderExcited (Q Min	.)	100.0				
		Margin	al Report				
Device ID	Туре	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
Bus10	Bes	Under Voltage	11.00	kV	10.75	97.5	3-Phase

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

SUMMARY OF TOTAL GENERATION, LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	60.104	32.249	68.209	88.12 Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	
Total Demand:	60.104	32.249	68.209	88.12 Lagging
Total Motor Load:	47.999	23.307	53.358	89.96 Lagging
Total Static Load:	11.640	5.646	12.937	89.97 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.465	3.297		
System Mismatch:	0.000	0.000		

Number of Iterations: 2

APPENDIX 5

LOAD FLOW ANALYSIS WITH PV

Project:	MASTER THESIS	ETAP		Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cata-	15	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	stady cases		Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Electrical Transient Analyzer Program

Load Flow Analysis (With PV)

Loading Category (1): Design

Generation Category (1): Design

Load Divertity Factor: None

	Swing	V-Control	Load	Total			
Number of Buses:	3	7	30	40			
	NFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	24	0	0	16	0	0	40

Method of Solution:	Adaptive Newton-Raphson Method			
Maximum No. of Iteration:	99			
Precision of Solution:	0.0001000			
System Frequency:	50.00 Hz			
Unit System:	Metric			

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yet	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	LF.	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Cast.	10-2	Config:	Normal

								Lo	ađ			
1	Bas		Initial Voltage		Centita	ut kVA	Ceast	ant Z	Cut	I funite	Ge	noric
ID	ŁV	Sub-sys	% Mag.	Ang.	MW	Myar	MW	Mvar	MW	Maar	MW	Myar
Bail	66.000	1	99.1	-5.1								
Bm2	65.000	2	98.9	-1.9								
Bun3	220.000	1	100.0	0.0								
Bus4	220.000	3	100.0	0.0								
Bat5	220.000	1	100.0	0.0								
Ben6	11.000	1	98.1	-5.1	0.000	0.995	0.000	0.349				
Bm7	66.909	2	98.8	-1.9								
Bes8	65.000	1	99.0	-5.2								
Bat9	11,000	2	98.1	-2.5	1,609	0.992	0.400	0.248				
Ber19	11.000	1	97.8	-7.2	5.600	3.471	1.400	0.868				
Bm11	65.000	2	99.1	-1.2								
Ban12	66.000	1	99.4	-4.2								
Bm13	66.000	1	98.3	-5.6								
Bm14	66.000	1	98.0	-2.4								
Bei15	11.000	1	98.7	-8.5	4,509	2.975	1.200	0.744				
Ber16	11.000	1	98.3	-5.4	4.509	2.975	1,200	0.744				
Bm17	65.000	1	98.9	-6.8								
Bm18	65.000	1	98.8	-2.5								
Bur19	11.000	1	98.7	-8.4	4.400	0.000	1.109	0.000				
Bar20	11.000	2	98.7	44	2.809	0.000	0.700	0.000				
Ber21	66.000	1	98.9	-7.5								
Ben22	11.000	1	98.4	-10.4	4.500	0.000	1.200	0.000				
Ber23	66.000	1	99,3	-7.9								
Ber25	11.000	1	98.1	-8.8	1,609	0.991	0,100	0.248				
Ber27	65.000	1	98.8	-5.8								
Bas28	11.909	1	98.4	-6.7	2.409	1.487	9.600	0.572				
Bm2#	11.000	1	98.4	-6.7	2.400	1.487	0.600	0.372				
Ben30	65.000	1	98.5	-5.5								
Bur31	65.000	2	98.6	-2.1								
Bm32	11.000	1	98.0	-8.7	8.500	5.455	2,200	1.364				
Bur33	11,000	1	100.5	35	4.000	2.479	1.000	0.620				
Bar.34	0,490	1	100.0	11								
Bm35	0,490	1	100.0	11								

Bus Input Data

Project:	MASTER THESIS	ETAP	1	Paget	4
Location:	HOUN CITY - LIBYA	12.6.0H	1	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SIN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case 11	, I	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Staty Case. La		Config:	Normal

								Lo	ad			
Bus		Initial Voltage		Constant kVA		Ceast	Countant Z		Constant I		Generic	
m	83	Sub-sys	% Mag.	Ang.	MW	Myar	MW	Myar	MW	Mvar	MW	Mvir
Bus36	0.400	1	100.0	1.1	_							
Bas37	0.400	1	100.0	1.1								
Bus38	0.400	2	100.0	3.3								
Bus39	0.400	2	100.0	3.5								
Bas40	0.400	2	100.0	3.3								
Bus41	11.000	1	98.9	-1.2								
But+2	11.009	2	95.6	1.0								
Total Number of Buret: 40					47,999	23.307	12.000	5.827	0.000	0.000	0.000	0.000

Total loumost of bullet: 40	Total	Number	of Barer:	40
-----------------------------	-------	--------	-----------	----

Generation Bus				Voltage		Generation			Myar Limits	
ID	kV [*]	Type	Sub-sys	% Mag.	Aagle	MW	Myar	% PF	Max	Min
Bust	220.000	Soing	1	100.0	0.0					
Bus4	220.000	Swing	3	190.0	0.0					
Bus5	220.000	Soing	2	100.0	0.0					
Bus34	0.400	Voltage Control	1	100.0	11	1.960			0.899	0.009
Bus35	0.400	Voltage Control	1	100.0	1.1	1.960			0.899	0.000
Bus36	0,400	Voltage Control	1	100.0	1.1	1.960			0.899	0.000
Bus37	0.406	Voltage Control	1	100.0	1.1	1.960			0.899	0.000
Bus38	0.400	Voltage Control	2	100.0	3.3	1.960			0.899	0.000
Bus39	0.400	Voltage Control	2	100.0	3.3	1.960			0.899	0.000
Bus40	0.400	Voltage Control	2	106.0	3.3	1.960			0.899	0.000
							-			

13.719 0.000

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	one care a	Coufig:	Normal

Time/Cable			Lenet				<u> </u>	x	
ID		66m	Adl (m)	No. Tel	***	Tata	P		v
μ,	Labrary	Sue	with (m)	74 1 OL	#CF BASE	1(-C)			1
Cablel	11MCUS3	300	190.0	0.0	1	75	0.076302	0.087400	0.0001646
Cahle2	11MCU53	300	190.0	0.0	1	75	0.076302	0.087400	0.0001646
Line1		674	19300.0	0.0	1	75	0.056003	0.374255	0.0000031
Line2		674	19300.0	0.0	1	75	0.056001	0.342069	0.0000034
Line3		674	23000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line4		674	15000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line5		674	\$900.0	0.0	1	75	0.056001	0.342069	0.0000034
Line6		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line?		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line8		674	4000.0	0.0	1	75	6.056001	0.342069	0.0000034
Line ⁹		674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line10		674	\$000.0	0.0	1	75	0.056001	0.342069	0.0000034
Linell		674	8000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line12		674	21000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line13		674	161000.0	0.0	1	75	0.056001	0.342069	0.0000034
Line14		674	140000.0	0.0	1	75	6.056001	0.342069	0.0000034

Line/Cable Input Data

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP	Page:	6	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV		Config:	Normal	

2-Winding Transformer Input Data

Transformer	÷			Rating			2	Variatio		% Tap	Setting	Adjusted	Phase	Shift
ID	Phase	MVA	Prim. kV	Sec. kV	% Z1	XI/R1	+ 599	- 590	45 Tol.	Prim.	Sec.	46 Z	Type	Angle
п	3-Phote	65.000	220.000	66.900	12.50	45.00		0	0	0	3,750	12.5000	Dyn	0.000
13	3-Phase	63.000	229,909	66.000	12.50	45.00		0	0	0	0.625	12.5000	Dyn	0.090
T4	3-Phase	10.000	66.000	11.000	8.35	13.00						8.3500	Dyn	6.000
TS	3-Phase	20.000	65.900	11.000	19.90	20.00				0		10,0000	Dyn	0.000
16	3-Phate	20.000	65,000	11,000	10.00	20.00		0	0	0	1.250	10.0000	Dyn	0.000
17	3-Phase	12.500	11,000	66.000	8,35	13.00		D	0	-1.250	0	8.3500	visit	0.000
T8	3-Phane	12.500	11,900	66.000	8.35	13.00			0	-1.259	0	8.3500	YNd	6.000
19	3-Phase	10.000	66.009	11.000	8.35	13.00		0		0	4,875	8.3500	Dyn	0.000
T10	3-Phane	10.000	65.000	11.000	8.35	13.00				0	4.375	8.3580	Dyn	0.000
TH	3-Phase	20.000	66.000	11,000	19.60	20.00		0	0	0	0	10.0000	Dyn	0.000
T12	3-Phate	20.000	66,000	11.000	10.00	20.00		0	0	0	0	19.0000	Dyn	0.000
TIS	3-Phane	10.000	66.900	11,909	8.35	13.00				0	0	\$.3500	Dyn	0.000
T14	3-Phase	10.000	65,000	11,809	8.35	13.00		0	0	0	0	8.3500	Dyn	0.000
T16	A-Phate	20.000	65.000	11,809	10.00	20.00			0	0	0.625	10.0000	Dyu	0.000
T17	3-Phate	20.000	66.999	11,000	19,00	20.00		0	0	0	0.625	19,0000	Dyn	0.000
T18	3-Phase	20.000	66.000	11.000	19.00	20.00		0	0	0	3.750	10.0000	Dyn	0.090
T19	3-Phase	20.090	65,000	11,909	10.00	20.00		Ð	0	0	3.750	10.0000	Dyu	0.090
T29	3-Phase	3,000	4.400	11,000	6.25	6.00		0	0	0		6.2500	¥Nd	0.000
T21	3-Phase	3.000	0.400	11.809	6.25	6.00		0	0	0	.0	6.2500	YNd	0.000
T22	3-Phote	5.000	0.400	11,000	6.25	6.00		0	0	0	0	6.2500	YNd	0.000
T23	3-Phase	3.000	0.499	11.000	6.25	6.00		0	0	0	0	6.2500	YNd	0.000
T24	3-Plane	3.000	0.400	11.009	6.25	6.00	٠			0		6.2500	VNd.	0.000
TB	3.Phase	3.000	6.400	11.000	6.25	6.00	6		0	ė	0	6,2580	YNd	0.000
T26	3-Phase	3.000	0.400	11,009	6.25	6.00		0	0	0	0	6.2500	YNd	0.000

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	IF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	bruny cuse.		Config:	Normal

CKT	Branch	Con	mected Bus ID	% Impe	dance, Pos.	Seq., 100 3	IVA Base
ID	Type	From But	To.Bm	R	х	Z	Y
TI	2W XFMR	Bus3	Busl	0.46	20.58	20.59	
T3	2W XFMR	Bus5	Ban2	0.44	19.96	19.97	
T4	2W XFMR	Bust	Bust	6.40	83.25	83.50	
T5	2W XFMR	Bus7	Bus9	2.50	49.94	50.00	
T6	2W XEMR	Bus5	Bas10	2.53	50.56	50.63	
17	2W XFMR	Bus42	Buill	5,05	65.77	65.97	
TS	2W XFMR	Bus4I	Bus12	5.06	65.77	65.97	
19	2W XFMR	Buil3	Bus15	6.65	86.90	87.15	
T10	2W XFMR	Buil4	Buil6	6.65	86,90	87.15	
TII	2W XFMR	Bus17	Bus19	2,50	19.94	50.00	
712	2W XFMR	Bus18	Bus20	2.50	19.94	50.00	
T13	2W XFMR	Bus21	Bus22	6,40	83.25	83.50	
T14	2W XFMR	Bus23	Bus25	6.40	83.25	83.50	
T16	2W XFMR	Bus27	Bas25	2.51	50.25	50.51	
T17	2W XFMR	Bus27	Bus29	2.51	50.25	58.31	
T18	2W XFMR	Bus30	Bus32	2.59	51,81	51.89	
T19	2W XFMR	Bus31	Bus33	2.59	51.81	51.88	
T20	2W XFMR	Bm34	But41	34.25	205.50	268.33	
T21	2W XFMR	Bus35	Bus41	34.25	205.50	208.33	
T22	2W XFMR	Bus36	Bus41	34,25	205.50	205.53	
T23	2W XFMR	Bus37	Bun41	34.25	205.50	205.33	
T24	2W XFMR	Bus38	Bus42	34.25	205.50	208.33	
T25	2W XFMR	Bus39	Bus42	34.25	205.50	208.33	
T26	2W XFMR	Bus40	Bas42	34.25	205.50	201.33	
Cable1	Cable	BuslI	Bas2	0.02	0.02	0.03	0.0716998
Cable2	Cable	Buil2	Baul	0.02	0.02	6.03	0.0716998
Linel	Line	Bui2	Bus14	2.48	16.58	16.77	0.2697629
Line2	Line	Busl	Bus13	2.45	15.16	15.36	0.2842267
Line3	Line	Bus2	Bus15	2.95	18.06	18.30	0.3387157
Line4	Line	But27	Bas17	1.93	11.78	11.94	0.2209015
Line5	Line	Busl	Bus27	1.03	6.28	6.37	0.1178142
Line6	Line	Bus2	Bun7	0.51	3.14	3.18	0.0589071
Line7	Line	Buil	Bass	0.51	3.14	3.18	0.0589071
Line8	Line	Bus2	Bus7	0.51	3.14	3.18	0.0589071
Line9	Line	Busl	Bush	0.51	3.14	3.18	0.0589071
Line10	Line	Bus2	Bus31	1.03	6.28	6.37	0.1178142
Linell	Line	Busl	Bus30	1.03	6.28	6.37	0.1178142

Branch Connections

Project:	MASTER THESIS	ETAP		Page:	8
Location:	HOUN CITY - LIBYA	12.6.0H		Page: Date: SN: Revision: Config:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	15	Revision:	Base
Filenamet	HOUN SUBSTATION 220kV	thing care.		Page: Date: SN: Revision: Config:	Normal

CKT/	Branch	Con	% Impedance, Pos. Seq., 100 MVA Base				
ID	Type	From Bus	To But	R	х	Z	Y
Line12	Line	Bus17	Buy21	2.70	16.49	16.71	0.3092622
Line13	Line	Bm17	Bus23	20.76	126.43	128.11	2.3710100
Line14	Line	Bus21	Bus23	18.00	109.94	111.40	2.0617480

Project:	MASTER THESIS	ETAP	Page:	9
Location:	HOUN CITY-LIBYA	12.6.0H	Date:	18-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	orany care, and	Config:	Normal

LOAD FLOW REPORT (With PV)

	Bas		Voltage		Generation		Lo	ba	Load Flow				XFMR	
1	m	kV.	% Mag.	Aag.	MW	Myar	MW	Myar	ID	MW	Myar	Amp	%PF	49Tap
Busl		66.000	99.388	-4.2			0	0	Bus12	-7.754	-0.376	68.3	99.9	
									Bus13	6.924	3.964	63.5	83.5	
									Bas27	19.539	1,129	172.3	99.8	
									Bus\$	3.483	2.278	36.6	\$3.7	
									Bus8	3.483	2.278	36.6	83.7	
									Ban30	10.992	7.691	118.1	81.9	
									Ban3	-35.767	-18.211	353.3	89.1	3.750
									Buy6	0.001	1.248	11.0	0.1	
Burt2		66.000	99.961	-1.2	0	W	0	0	Bus11	-5.821	-0.725	51.8	99.2	
									Butl4	6.014	3,993	63.7	83.3	
									Bus18	3.491	0.248	38.9	.99.7	
									Bux7	0.994	0.575	10.1	\$6.7	
									Bax?	0.994	0.573	10.1	86.7	
									Bus31	5.027	3.200	52.6	84.4	
									Bas5	-10.700	-7.365	114.7	82.4	9.625
BmJ		226.600	100.000	0.0	35.844	21,694	0	0	Buil	35.844	21.694	110.0	\$5.6	
Bes5		220,000	100.009	0.0	10.705	7.711	0	0	Bus2	10,788	7.711	34.6	81.1	
Bush		11.000	98.343	-4,2	0		0.080	1.235	But1	0.000	-1.235	65.9	0.0	
Bus7		66.000	99.035	-1.2			0	0	Bas2	-0.994	-0.630	10.4	84.5	
									Ban2	-0.994	-0.630	10.4	84.5	
									Bart9	1,999	1,260	29.5	84.5	
Bus8		66.000	99.297	-4.5	0		0	0	Bus1	-3.482	-2.350	36.9	\$3.1	
									BusI	-3.482	-2.338	36.9	\$3.1	
									Bus10	6.964	4.661	73.8	83.1	
Bus9		11.000	98.355	-1.8	0		1.957	1,252	Bast7	-1.987	-1.232	124.5	85.0	
Bur10		11.000	95.648	-6.3	0		6.946	4.305	Bush	-6.946	-4.305	437.5	\$5.0	1.250
Bin11		66,000	99.062	-1.2	0	•	0	0	Bas2	5.821	0.654	51.7	99.4	
									Ban42	-5.821	-0.654	51.7	99.4	
Bus12		66.000	99,390	-4.2			.0		Busi	7.754	0.306	68.3	99.9	
									Bus41	-7.754	-0.306	68.5	99.9	
Buil3		66.000	98.615	-4.7	0		0	0	Buil	-6.911	-4.161	64.8	82.2	
									Bas15	6.011	4.161	64.5	82.2	
Bm14		66.000	98.224	-1.7	0		0	0	Bus2	-6.001	-4.157	65.0	82.2	
									Bus16	6.001	4.157	65.0	82.2	
Bus15		11.000	98.985	-7.6			5,975	3.703	Bas15	-5.975	-3.703	572.8	85.0	4.375
Bus16		11.000	98.564	.4.7			5.965	3.697	Bux14	.8.965	-3.697	373.7	\$5.0	4.375

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H		Page: Date:	10 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	LF.	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and the second	Nation in the second second second second second second second second second second second second second second	Config:	Normal

	Bus		Volt	age	Gene	ration	La	ad			Load Flow	t i i			XFMR
	ID	kV	% Mag.	Ang.	MW	Myar	MW	Myar		ID	MW	Mvar	Amp	%PF	%Tap
Busl7		66.000	99,192	.5.9	0	0	0	0	But?7		-13.487	2.837	121.5	.97.9	
									Bus21		6.609	-1.333	59.5	.98.0	
									Bm23		1.391	1.657	19.1	-64.3	
									Bm19		5.486	0.153	48.4	100.0	
Buill		66.000	98.973	-1.6	0	0	0	0	Bud2		-3.487	-0.062	30.8	100.0	
									But20		3.487	0.062	30.8	100.0	
Buil#		11.000	99.816	-7.5	0		5.478	0.000	Buil7		-5.478	0.005	290.4	100.0	
Bus20		11.000	98.570	-2.6		8	3.484	0.000	Bm18		-3.484	0.000	185.0	100.0	
Bus21		66.000	99.215	-6.5	0	0	0		Buil7		-6.597	1.194	59.0	.98.6	
									Bur23		0.604	-1.409	13.5	-39.4	
									Bus22		5,992	0.504	52.9	99.9	
Bus22		11.000	98,700	.8.4	0	0	5.969	0.000	But21		-5.969	0.000	317.4	100.0	
Bus23		66.000	99.545	-6.9	0	0	.0	0	Bm17		-1.387	4,656	13.5	90.4	
									Bur21		-0.603	-8.622	7.6	69.6	
									Bur25		1.990	1.278	20.8	54.1	
Bun25		11.000	95,360	-7.9	0	0	1.987	1.231	Bur23		-1.987	-1.231	124.7	\$5.0	
Bus27		66.000	99.119	-4.9	0	0		0	Buil7		13.524	-2.826	171.9	.97,9	
									Busl		-19,499	-1.001	172.5	99.9	
									But28		2,998	1.914	31.3	\$4.2	
									But29		2,968	1.914	31.3	84.2	
Bus28		11,000	95.703	-5.8	0	0	2,984	1.850	Bm27		-2.984	-1.850	186.7	\$5.0	9.625
Bui(29		11.000	98.703	-5.8	0	0	2.984	1.850	But27		-2.984	-1.850	156.7	85.0	0.625
But30		66.090	98.787	-4.6	0	0	0	0	Binl		-10.973	-7,692	118.7	81.9	
									Bmi52		10.973	7.692	118.7	81.9	
BuiJ1		66.000	95.502	-1.4	0	0	0		Buil2		-5.013	-3.292	53.2	83.6	
									Bui33		5,023	3.292	53.2	83.6	
Bus31		11.090	98.326	-7.8	0	0	10.927	6.773	But30		-10.927	-6.773	696.3	85.0	3.750
Bus33		11.000	100.682	-2.8	0	0	5.014	3.105	Bu31		-5.914	-3.108	597.5	85.0	3.758
Bus34		0.400	100.000	ш	1,960	0.258	0	0	Ber41		1,560	0.258	2853.2	99.1	
Bus35		0.400	100.000	11	1.960	9,258	0	0	Bm41		1.960	0.258	2853.2	99.1	
Bur36		0.400	105.009	11	1.960	0,258		.0	Bur41		1.960	0.258	2853.2	99.1	
Bush7		0.400	100.009	11	1.960	0.258	0		Bm41		1.960	0.258	2853.2	99.1	
Bus38		0.400	100.000	3.3	1.969	0.378	0	0	Bur42		1.960	0.378	2590.8	98.2	
Bur39		0.400	100.000	3.3	1.960	0.378	0		Bur42		1.960	0.378	2699.8	98.2	
Bus40		0.400	100,000	3.3	1.969	0.378	0		Bur42		1.960	0.378	2880.8	98.2	
Bus41		11.000	98.877	-1.2	0	0	0	0	Bm12		7,786	0.712	415.0	99.6	-1.250
									Bui34		-1.946	-0.178	103.8	99.6	
									Bui35		-1.946	-0.178	103.8	99.6	
									Bus56		-1.946	-0.178	103.8	99.6	

Project:	MASTER THESIS	ETAP		Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	LF.	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	orang cases	11. A	Config:	Normal

Bus		Voltage		Generation		Load		Load Flow					XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Myar	Анр	16PF	чотар
								But37	-1.946	-0.178	103.8	99.6	
Bm42	11.000	98.630	1.0	0				Buill	5.838	9.887	314.3	98.9	-1.25
								But38	-1.946	-0.296	194.5	98.9	
								Bm.39	-1.946	-0.296	104.8	98.9	
								Bus 40	-1.946	-0.296	184.8	98.9	

assucates a younge regulated our (voltage controlled or swing type machine connected to it)
indicates a but with a load mirmatch of more than 0.1 MVA
Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	12 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineert	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	State Carlo 14	Config:	Normal

Bus Loading Summary Report

			Directly Connected Load						Total Buy Load					
	Buy		Centra	at kVA	Count	sut Z	Cour	taut 1	Ge	netic				Percent
D	kV	Rated Amp	MW	Myar	MW	Mvar	MW	Myar	MW	Mear	MVA	16 PF	Amp	Londing
Bui4	220.000											0,0	0.0	
Buil	66.000	,		0						0	47.324	92.0	416.5	
But2	66.00		0	0	0				0		18.506	89.3	163.4	
Bus3	220.000	,	0	0	0	.0			0	0	41.898	85.6	110.0	
Burs	220.000	,	0	0	0				0	0	13.195	81.1	34.6	
Butó	11.000			0.995	0	0.248				0	1.235	0.0	65.9	
But7	66.000	,	0	0	0				0	0	1.554	84.5	20.8	
Bus8	66.00	,	0	.0	0		0.1		. 0	0	8,350	83.1	73.8	
Bur9	11.000		1.600	0.992	0.387	0.248				0	2.538	85.0	124.8	
Bus10	11.000	,	5.600	3.471	1.346	0.834			0	0	8.172	85.0	437.5	
Bus11	66.00		0	0	0				0	0	5.857	99.4	51.7	
Buil2	66.00	,	0	0					0	0	7.760	99.9	68.3	
Burls	\$6.00	,	ė.	0	0				0	0	7.310	\$2.2	64.8	
Bus14	\$6.00	6	0	0	0				0	0	7.300	82.2	65.0	
Buil5	11.000)	4,300	1.975	1.176	0.729	0.1		0	0	7.030	85.0	372.8	
Buil6	11.000	,	4.800	2.975	1.166	0,722				0	7.018	85.0	373.7	
Buil7	66.00		0	0	0				0	0	13.814	97.6	121.8	
Buil8	66.000	,	0	0	0		0		0	0	3.458	100.0	30.8	
Bun19	11.00	,	4.400	0	1.978				0	0	5.478	100.0	290.4	
Bui20	11.000	,	2,800	0	8.684	8			0		3.484	100.0	185.0	
Bus21	66.000		0	0	0				0	0	6.745	97.8	\$9.5	
Bus22	11.000		4.800	0	1.169				0	0	5.968	100.0	317.4	
Bun25	66.00		0		0				0	0	2.565	84.1	20.8	
Bus25	11.000	,	1.600	0.991	0.387	0,240			0	0	2,337	85.0	124.7	
Bus27	66.00		0	0	.0				0	0	19,871	98.1	175.4	
Bui28	11.000	,	2.400	1.487	0.585	0.362			0	6	3.511	85.0	186.7	
Bui29	11.00		2.400	1.487	0.585	6.362			0	0	3.511	85.0	186.7	
Bur.30	\$6.00		0	0	0	0			0	0	13,400	81.9	118.7	
But31	\$6.00		0	0					0	0	6.006	83.6	53.2	
Bui32	11.00	,	8.900	5.455	2.127	1.318			0	0	12.856	85.0	686.2	
Bus53	11.000		4.000	1.479	1.014	0.625			0	0	5.899	85.0	397.5	
Bui34	0.40	,	0	0	0		0.		0	0	1.977	99.1	2853.2	
But35	0.40	,	0							0	1.977	99.1	2853.2	
Bus36	0.40		0	0	0				0	0	1.977	99.1	2853.2	
Bus37	0.40	,	0	0	0				0	0	1.977	99.1	2853.2	
Bus38	0.40	,	0	0	0				0	0	1.996	98.2	2850.8	

Project:	MASTER THESIS	ETAP	Paget	13
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LE	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

					Directly Connected Load					Total Bes Load					
	Bes		25	Consta	nt kVA	Caust	taut Z	Com	T ALLE Y	Ges	uectic .				Provent
	D	F2.	Rated Amp	MW	Mvar	MW	Myar	MW	Muar	MW	Mear	MVA	96 PF	Amp	Loading
Bu:39		0.400			0	0		0	9	0	0	1.996	98.2	2880.8	
Bus40		0.400			0	0		0	0	0	0	1,996	98.2	2880.8	
Bus41		11.000			0	0		0	0	0	0	7.818	99.6	415.0	
Bun42		11.000			0	0		0	0		0	5.906	98.9	314.3	

* Indicates operating load of a bus exceeds the bus critical limit (100.0% of the Continuous Ampere rating).

indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

Project:	MASTER THESIS	ETAP		Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		2220	Config:	Normal

Transformer CKT/Branch Cable & Reactor Loading Amp Loading (input) Loading (output) Ampacity (Amp) Capability (MIVA) 56 MVA MVA m Type 44 44 Cable1 Cable 423.67 51.80 12.23 Cable2 Cable 423.67 68.33 16.13 TI 63.000 41.898 66.5 40.136 63.7 Transformer 13.195 28.9 12,990 26.6 T3 Transformer 63,000 Transformer **T**4 10,000 1.248 12.5 1.235 12.4 T5 Transformer 20.000 2.354 11.8 2.538 11.7 **T**6 Transformer 20.000 8.380 41.9 8.172 40.9 12.500 5.906 47.2 17 Transformer 5.857 46.9 12.500 7.818 7.768 **T**8 62.5 62.1 Transformer **T9** 10.005 7.310 7.030 Transformer 73.1 78.4 T10 Transformer 10.000 7.300 73.0 7.018 70.2 T11 Transformer 20.000 5.488 27.4 5.478 27.4 20.000 T12 Transformer 3.488 5.484 17.4 17.4 10.000 TB Transformer 6.000 68.0 5.969 69.7 T14 Transformer 10.000 2.365 23,7 2.337 23.4 T16 Transformer 20.000 3.548 17.7 3.511 17.6 T17 Transformer 20.000 3.548 17.7 3.511 17.6 20,000 T18 Transformer 13,400 67.0 12.856 64.3 T19 Transformer 20.000 6.006 30.0 5,899 29.5 T20 Transformer 3,000 1.977 65.9 1.955 65.2 T21 Transformer 1.977 65.2 3.000 65.0 1.064 T22 Transformer 3,000 1.977 65.0 1.055 65.2 T23 Transformer 3,000 1.977 65.9 1.955 65.2 T24 Transformer 3.000 1.996 66.5 1.969 65.6 T25 Transformer 3,000 1.996 66.5 1.969 65.6 1.969 Transformer 3.000 1,096 T26 66.5 65.6

Branch Loading Summary Report

* Indicates a branch with operating load exceeding the branch capability.

Project:	MASTER THESIS	ETAP		Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	IF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stary Saids	-	Config:	Normal

CKT / Branch	Fram-To	Bus Flow	To-From	Bus Flow	Los	ses	96 Bus	Voltage	the Drop
ID	MW	Mvar	MW	Mvar	ŁW	kvar	From	To	in Vmag
Cable2	-7,754	-0.376	7,754	0_306	0.1	-70.7	99.4	99.4	0.00
Line2	6.024	3.964	-6.011	-4.161	13.5	-197.1	99.4	95.6	0.77
Line5	19,539	1.129	-19,499	-L.001	39.9	127.6	99.4	99.1	0.27
Line7	3.483	2.278	-3.482	-2.330	0.9	-52.6	99.4	99.5	0.09
Line9	3.483	1.278	-3.482	-2.330	0.9	.52.6	99.4	99.5	0.09
Linell	10.992	7.691	-10.973	-7.692	18.8	-0.6	99.4	98.8	0.60
n	-35.767	-18.211	35.844	21.694	77.4	3482.1	99.4	160.0	0.61
T4	0,001	1.245	0.000	-1.235	1.0	13.1	99.4	98.3	1.05
Cablel	-5.821	-0.725	5.821	0.654	0.1	-70.3	99.1	99.1	0.90
Linel	6.014	3.993	-6.001	-4.157	13.4	-163.9	99.1	98.2	0.84
Line3	3,491	-0.248	-3.487	-0.062	3.7	-309.6	99.1	99.0	0.09
Line6	0.994	0.573	-0.994	-0.650	0.1	-57.4	99.1	\$9.0	0.02
LineS	0,994	0.573	-0.994	-0.630	0.1	.57.4	99.I	99.0	0.02
Line10	5.027	3.260	-5.023	3.292	3.8	.92.3	99.1	98.8	0.26
13	-10,700	-7.365	10.708	7.711	377	345.4	99.1	100.0	0.94
15	1.989	1.260	-1.987	-1.232	1.4	28.2	99.0	98.4	0.65
16	6.964	4.661	-6.946	-4.305	17.8	355.6	99.3	98.0	1.25
17	-5.821	-0.654	5.838	0.887	17.9	232.8	99.1	98.6	0.43
TS	-7.754	-0.306	7.786	0.712	31.2	406.1	99.4	98.9	0.51
T9	6.011	4.161	-5.975	-3.703	35.2	457.5	98.6	99.0	0.37
T10	6.001	4.157	-5.965	-3.697	35.4	459.8	98.2	98.6	0.34
Line4	-13.487	2.837	13.524	-2.826	37.3	11.0	99.2	99.1	0.07
Line12	6.609	-1.333	-6.597	1.104	12.4	-228.8	99.2	99.2	0.02
Line13	1.591	-1.657	-1.387	-0.656	4.6	-2313.2	99.2	99.5	0.35
711	5.486	0.153	-5.478	0.000	7.6	152.9	99.2	99.0	0.15
Т12	3.487	0.062	-3.484	0.000	3.1	62.0	99.0	98.9	0.10
Line14	0.684	-1.409	-0.603	-0.622	1.0	-2030.5	99.2	99.5	0.33
T13	5.993	0.304	-5.969	0.000	23.4	304.5	99.2	98.7	0.52
T14	1.990	1.278	-1.987	-1.231	3.6	47.0	99.5	98.4	1.18
T16	2.988	1.914	-2.984	-1.850	3.2	64.0	99.1	98.7	0.42
117	2.985	1.914	-2.984	-1.850	3.2	64.0	99.1	98.7	0.42
TIS	10.973	7.692	-10.927	-6.773	45.9	918.9	98.8	98.3	0.46
T19	5.023	3.292	-5.014	-3.108	9.2	184.5	95.8	100.7	1.55
T20	1.960	0.258	-1.946	-0.178	13.4	80.3	100.0	98.9	1.12
T21	1.960	0.258	-1.946	-0.178	15.4	\$0.3	100.0	98.9	1.12

Branch Losses Summary Report

Project:	MASTER THESIS	ETAP	Page:	16
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Contract Contract	Config:	Normal

CKT / Branch	From-To	Bus Flow	To-From	Bus Flow	Los	ses	% Bus 7	oltage	Vd
ID	MW	Mvar	MW	Mvar	kW.	kvar	From	To	in Vinag
122	1.960	0.258	-1.946	-0.178	13.4	\$0.3	100.0	98.9	1.12
T23	1.960	0.258	-1.946	-0.175	13.4	\$0.3	100.0	98.9	1.12
T24	1.960	0.378	-1.946	-0.296	13.6	\$1.9	160.0	98.6	1.37
T25	1.960	0.378	-1.946	-0.296	13.6	\$1.9	160.0	98.6	1.37
T26	1.960	0.378	-1.946	-0.296	13.6	\$1.9	160.0	98.6	1.37
					569.1	2586.8			

Project:	MASTER THESIS	ETAP	Page:	17
Location: Contract:	HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department	11.0.012	Date: SN:	28-06-2016
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

Alert St	ummary Report	
	% Alert S	ettings
	Critical	Marginal
Loading		
Bus	100.0	95.0
Cable	100.0	95.0
Reactor	100.0	95.0
Line	100.0	95.0
Transformer	100.0	95.0
Panel	100.0	95.0
Protective Device	100.0	95.0
Generator	100.0	95.0
Inverter/Charger	100.0	95.0
Bus Voltage		
OverVoltage	105.0	102.0
UnderVoltage	95.0	98.0
Generator Excitation		
OverExcited (Q Max.)	100.0	95.0
UnderExcited (Q Min.)	100.0	

98

Project:	MASTER THESIS	ETAP	Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: LF	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and a start and	Config:	Normal

SUMMARY OF TOTAL GENERATION, LOADING & DEMAND

	MW	Mvar	MVA	% PF
Source (Swing Buses):	46.552	29.404	55.061	84.55 Lagging
Source (Non-Swing Buses):	13.719	2.166	13.889	98.78 Lagging
Total Demand:	60.271	31.570	68.039	88.58 Lagging
Total Motor Load:	47,999	23.307	53.358	89.96 Lagging
Total Static Load:	11.703	5.677	13.007	89.97 Lagging
Total Constant I Load:	0.000	0.000	0.000	
Total Generic Load:	0.000	0.000	0.000	
Apparent Losses:	0.569	2.587		
System Mismatch:	0.000	0.000		

Number of Iterations: 3

APPENDIX 6

SHORT CIRCUIT ANALYSIS WITHOUT PV

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.6H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineers	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	study cute. Se	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Electrical Transient Analyzer Program

Short-Circuit Analysis (Without PV)

IEC 60909 Standard 3-Phase Fault Currents

	Swing	V-Control	Load	Total
Number of Buses:	3	0	26	29

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	15	0	0	14	0	0	29
	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total	
Number of Machines:	0	3	0	0	13	16	

System Frequency:	50.00 Hz
Unit System:	Metric

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Carter Sec	Config:	Normal

Adir	astments		
Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	1
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP	Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Second Second Second	Config:	Normal

Bus Input Data

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

	Bu		Initial Voltage			
ID	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang
Bus1	Load	66.000	68.475	1	99.12	-5.13
Bus1	Load	66.000	66.413	2	98,85	-1.89
Bus3	SWNG	220.000	220.000	1	100.00	0.00
Bus4	SWNG	220.000	220.000	3	100.00	6.00
Bun5	SWNG	220.000	220.000	2	100.00	0.0
Buső	Load	11,000	11.413	1	98.97	-5.68
Bun7	Load	66.000	66.413	2	98.83	-1.91
BusS	Load	66.000	68.475	1	99.83	-5.19
Bur9	Load	11.000	11.069	2	98.15	-2.47
Bus10	Load	11.000	11.555	1	97.77	-7.2
Bur13	Load	66.000	68.475	1	95.34	-5.6
Bus14	Load	66.000	66.413	2	98.01	-2.4
Bus15	Load	11.000	11.912	1	98.69	-8.5
Busló	Load	11.000	11.553	2	98.34	-5.30
Bun17	Load	65.900	68.475	1	98.92	-6.8
Bus18	Load	66.000	66.413	2	98.76	-2.2
Bun19	Load	11.000	11.413	1	98.74	-8,4
Bus20	Load	11.000	11.069	2	98.66	-3.2
Bus21	Load	66.000	68.475	1	98.94	-7.4
Bus22	Load	11.000	11.413	1	98,42	-10.3
Bur23	Load	66.000	68.475	1	99.26	-7.85
Bus25	Load	11.000	11.413	1	98.05	-8.8
Burt7	Load	66.000	68.475	1	98.85	-5.8
Bus29	Load	11.990	11.484	1	98.43	-6.6
Bun29	Load	11.990	11.484	1	98.43	6.67
Bus30	Load	66.000	68.475	1	98.52	-5.4
Bus31	Load	66.000	66.413	2	95.59	-2.0
Bus32	Load	11.000	11.840	1	98.04	-8.7
Bus33	Lord	11.000	11.484		100.46	3.5

29 Burer Total

All voltages reported by ETAP are in % of bus Nominal kV. Base kV values of buses are calculated and used internally by ETAP.

Project:	MASTER THESIS	ETAP	Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

Line/Cable Input Data

	Ohms or Siemens/1000 m per Conductor (Cable) or per Phase (Line)						ine)		
Line/Cable			Len	gsh					
D	Library	Size	Adj. (m)	% Tol.	#/Plane	T (°C)	R	X	Y
Liael		674	19500.0		1	75	0.05600	0.37425	0.0000031
Line2		674	19300.0		1	75	0.05600	0.34297	0.0000034
Line3		674	23000.0		1	75	0.05600	0.34207	0.0000034
Line4		674	15000.0		1	75	0.05600	0.34207	0.0000034
Line5		674	8000.0		1	75	0.05600	0.34207	0.0000034
Line6		674	4000.0		1	75	0.05600	0.34207	0.0000034
Line?		674	4000.0		1	75	0.05600	0.34207	0.0000034
Line3		674	4000.0		1	75	0.05600	0.34207	0.0000034
Line9		674	4000.0		1	75	0.05600	0.34207	0.0000034
Line10		674	8000.0		1	75	0.05600	0.34207	0.0000034
Line11		674	\$000.0		1	75	0.05600	0.34207	0.0000034
Line12		674	21000.0		1	75	0.05600	0.34207	0.0000034
Line13		674	161000.0		1	75	0.05600	0.54207	0.0000034
Line14		674	140000.0		1	75	0.05600	0.34297	0.0000034

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0日	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Coufig:	Normal

Transformer			Rating			7	. Variatio	a	% Tap	Setting	Adjusted
D	MVA	Prim. kV	Sec. kV	96 Z	X/R	+ 5%6	- 516	99 Tol.	Prim.	Sec.	96 Z
π	63.000	220.000	66.000	12.50	45.00	0	0	0	0	3.750	12.5000
T5	63.000	220,000	66.000	12.50	45.00	0	0	0	0	0.625	12.5000
T4	10.000	66,000	11.000	8.35	13.00	0	0	0	0		8.3509
T5	28.008	66.000	11.000	10.00	20.00	0	8	0	0		10.0000
T 6	20.000	66,990	11.000	10.00	28.00	0	0	0	0	1.250	10.0000
T9	10.000	66.000	11.000	8.35	13.00	0	0	0	0	4.375	8,3500
T10	10.000	66.000	11.000	8.35	13.00	0	0	0	0	4.375	8.3500
TH	20.000	66.000	11.000	10.00	20.00	0	0	0	0		10,0000
T12	20.000	66,000	11.000	10.00	20.00	0	0	0	0		10,0000
T13	10.000	66.000	11.000	8.35	13.00	0	0	0	0		8.3500
T14	10.000	66.000	11.000	8.35	13.00	0	0	0	0	.0	8,3500
T16	20.000	66.000	11.000	10.00	20.00	0	0	0	0	0.625	10.0000
T17	20.009	66.000	11.000	10,00	20.00	0	0	0	0	0.625	10.0000
T18	20.000	66.090	11.000	10.00	20.00	0	0	0	0	3.750	10.0000
T19	20,000	66.000	11.000	10.00	20.00	0	0	0	0	3.750	10.0000

2-Winding Transformer Input Data

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Contraction of the		Config:	Normal

CKT	/Branch	Cot	mected Bus ID	% Impedance, Pos. Seq., 100 MVAb			
ID	Туря	From But	To But	R	x	z	Y
TI	2W XFMR	Bush	Buil	0.43	19.28	19.29	
T3	1W XFMR	But	Bet2	0.45	19.28	19.29	
T4	1W XFMR	Buil	Bat6	5.92	76.98	77.21	
T5	2W XFMR	Bus7	But9	2.43	48.62	48.69	
T6	2W XFMR	Buss	Bus10	2.29	45.74	45.80	
Т9	2W XFMR	But13	Bur15	5.92	76.98	77.21	
T10	2W XFMR	But14	Ban16	6.30	81.84	82.08	
тн	2W XFMR	Buil7	Bas19	2.29	45.74	45.80	
TI2	2W XFMR	Buils	Bus20	1.43	48.62	48.69	
T13	2W XFMR	But21	Bes22	5.92	76.98	77.21	
T14	2W XFMR	Bas23	Bat25	5.92	76.98	77.21	
T16	2W XFMR	Bun27	Bur28	2.29	45.74	45.80	
117	2W XFMR	Bus27	Bun29	3.29	45.74	45.80	
T18	2W XFMR	Bas30	Bard2	2.29	45.74	45.80	
T19	2W XFMR	Bus31	Bun33	1.43	48.62	48.69	
Linel	Line	Bus2	Burl4	2.45	16,38	16.56	
Line2	Line	Butl.	Ben13	2.31	14.08	14.27	
Line3	Line	Bus2	Bw18	2.92	17.84	15.05	
Line4	Line	Bus27	Bus17	1,79	10.94	11.09	
Line5	Line	Busl	Bun27	0.96	5.84	5.91	
Line6	Line	Bus2	Bus7	0.51	3.10	3.14	
Line?	Line	Busl	Bur8	0.48	2.92	2.96	
Line8	Line	Bus2	Bus7	0.51	3.10	3.14	
Line9	Line	Butl	Bwt8	0.45	2.92	2.96	
Line10	Line	Bus2	Bar31	1.02	6.20	6.29	
Line11	Line	Busl	Bur30	0.96	5.84	5.91	
Line11	Line	Bus17	Burt21	2.51	15.32	15.52	
Line13	Line	Bus17	Bus23	19.23	117.46	119.02	
Line14	Line	Buy21	Bun25	16.72	102.14	103.50	

Branch Connections

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Cart.		Config:	Normal

Power Grid Input Data

Connected Bus	Ra	ting	% Impedance 100 MVA Base			
ID	MVAsc.	kV	R	X"	R/X	
Bush	22.101	220.000	45.02233	450.22330	0.10	
Bus4	22,101	220.000	45.02233	450.22330	0.10	
Bus5	22.101	220.000	45.02233	459.22330	0.10	
	Connected Bus ID Bus3 Bus4 Bus5	Connected Bus Rat ID MVAsc Bus3 22.101 Bus4 22.101 Bus5 22.101	Connected Bus Rating ID MVAsc kV Bus3 22.101 220.000 Bus4 22.101 220.000 Bus5 22.101 220.000	Connected Bus Rating I ID MVAsc kV R But3 22,101 220,000 45,02233 But4 22,101 220,000 45,02233 But5 22,101 220,000 45,02233	Connected Bus Rating % Impedance 100 MVA Base ID MVAsc kV R X" But3 22.101 220.000 45.02233 450.22330 But4 22.101 220.000 45.02233 450.22330 But5 22.101 220.000 45.02233 450.22330	

Total Connected Power Grids (= 3): 66.303 MVA

Project:	MASTER THESIS	ETAP		Paget	8
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	SC	Revision:	Base
Filename:	HOUN SUBSTATION 2201/V	2000 B 2000 B-	325	Config:	Normal

Lumped Load Input Data

	1	11						_		Motor	Loads		
Lumped Load	Connected Bus	d Load	Rati	ng	-	961	Load	Loading		% Impedance Machine Base		in Fact.	
ID	ID	kVA	W.	Amp	% PF	MTR	STAT	hW.	kvar	R	X"	R/X^+	MW/PP
Lump1	Busi	1240.2	11.600	65.25	0.01	80	20	0.1	994.6	2.28	15.21	0.15	6.00
Lump2	Bur9	2353.5	11.600	123.53	\$5.00	50	20	1600.4	991.8	1.53	15.31	0.10	1.69
Lump3	But10	8235.7	11.800	432.26	85.00	80	20	\$600.0	3471.1	1.53	15.31	0.10	5,60
Lump4	Buil5	7058.4	11.000	370.47	85.00	80	20	4799.7	2974.6	1.53	15.31	0.10	4.90
Lump5	Bun16	7058.4	11.000	370.47	85.00	30	20	4799.7	2974.6	1.53	15.31	0.10	4.80
Lamps	Bas19	5500.0	11.000	258.68	105.00	80	20	4400.0	0.9	1.53	15.31	0.10	4.40
Lump7	Bus20	3500.0	11.000	183.70	100.00	80	20	2500.0	0.0	1.53	15.31	6.10	2.80
Lump8	But22	6000.0	11.000	314.92	100.00	80	20	4800.0	0.0	1.53	15.31	0.10	4.80
Lump®	Buit25	2352.4	11.600	123.47	85.00	80	20	1599.6	991.4	1.53	15.31	0.10	1.60
Lampl1	Bu:28	3529.2	11.000	185.23	85.00	50	20	2399.8	1487.3	1.53	15.31	0.10	2.40
Lump12	Bur29	3529.2	11.000	185.23	85.00	30	20	2399.8	1487.3	1.53	15.31	0.10	2,40
Lump13	But32	12941.9	11.600	679.27	\$5.00	80	20	8500.0	5454.8	1.53	15.31	0.10	\$.89
Lump14	Bus55	5882.5	11.000	308.75	\$5,00	80	20	4000.0	2479.2	1.53	15.31	0.10	4.00

Total Connected Lumped Loads (= 13): 69184.3 kVA

Project:	MASTER THESIS	ETAP	Page:	9
Location:	HOUN CITY - LIBYA	12.6.6H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	olady canal oc	Config:	Normal

SHORT-CIRCUTT REPORT (Without PV)

3-Phase fault at bus: Bus1

Nominal KV		66.000	
Voltage c Factor	-	1.10	(User-Defined)
Peak Value	-	5.352	kA Method C
Steady State	-	0.173	kA runs

	Contribution			Voltage & Initial Symmetrical Current (rms)						
From Bus ID	To Bus ID	96 V From Bus	kA Real	kA Imaginary	X/R Ratio	kA Magaitude				
Bastl	Total	0.00	0.211	-2.151	10.2	2.161				
Bus13	Basl	4.41	0.027	-0.275	10.5	0.276				
Bas27	Basl	5.37	0.083	-0.507	9.7	0.811				
Bus8	Basl	0.57	0.016	-0.172	10.9	0.173				
Bust	Butl	0.57	0.016	-0.172	10.9	0.173				
Bus30	Busl	3.29	0.044	-0.495	11.2	0.497				
Bur3	Bust	3.60	0.017	-0.172	10.3	0.173				
Bus6	Busl	5,10	0.009	-0.058	6.8	0.059				
Bus15	Bus1.3	29.48	0.027	-0.275	10.3	0.276				
Bus17	Bas27	11.58	0.052	-0.498	9.5	8.501				
Bus28	Bu:27	13.37	0.015	-0.154	10.1	0.155				
Bast29	Bas27	13.37	0.015	-0.154	10.1	0.155				
Bus10	Bus\$	18.49	0.031	-0.344	10.9	0.345				
Bus32	Buc30	29.80	0,844	-0.495	11.2	0.497				
U1	But3	96.39	0.005	-0.054	10.3	0.054				
Lamp1	Butt	100.00	0.051	-0.351	6.8	0.354				

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	Ib sym	Ib atym	Ide
0.61	2.029	3.029	2.249
0.02	1.996	2.595	1.658
0.03	1.960	2.509	1.221
0.04	1.911	2.112	0.900
0.05	1.857	1.954	0.665
0.06	1.784	1.850	0.491
0.07	1.721	1.759	0.362
0.08	1.657	1.678	0.267

Project:	MASTER THESIS	ETAP	Page:	10
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Cart. Sc	Config:	Normal

(Cont.)

3-Phase fault at bus: Bus1

Nominal kV	-	66.000		
Voltage c Factor	-	1.10	(Use	r-Defined)
Peak Value		5.352	kA	Method C
Steady State	-	0.173	kA r	ms

Breaking and DC Fault Current (kA)

Based on Total But Fault Current

TD (S)	Ib sym	Ib aiym	Idc
0.09	1.594	1.606	0.197
0.10	1.532	1.539	0.147
0.15	1.388	1.389	0.032
0.20	1.250	1.250	0.007
0.25	1.118	1.118	0.002
0.30	1.106	1.106	0.000

Project:	MASTER THESIS	ETAP	Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Shilly care. Se	Config:	Normal

3-Phase fault at bus: Bus2

Something is a		66.000	
Voltage c Factor	-	1.10	(User Defined)
Peak Value	-	2.464	kA Method C
Steady State	-	0.184	kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)					
From Bus ID	To Bus ID	% V From But	EA Real	kA Imaginary	X/R Ratio	kA Magnitude	
But2	Total	0.00	0.095	-0.959	19.4	0.993	
Burl4	Bur2	4.79	0.027	-0.274	10.3	0.275	
Buil5	But2	2.97	0.015	-0.155	10.2	0.156	
Bus7	Bus2	0.15	0.005	-0.055	10.5	0.055	
Bus7	Bun2	0.15	0.005	-0.055	10.3	0.055	
But31	Ber2	1.77	0.025	-9.267	10.6	0.268	
Bu:5	Bar2	3.71	0.018	-0.185	16.5	0.184	
Builó	But14	29.78	0.027	-0.274	10.3	0.275	
Bus20	Bur18	10.94	0.015	-0.155	10.2	0.156	
Bat9	Bus7	5.86	0.011	-0.110	10.3	0.111	
Bus33	Bun31	16.06	0.025	-0.267	10.6	0.268	
U3	But5	99.58	0.005	-0.055	10.5	0.055	

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	Th sym	Ib arym	Ide
0.01	0.952	1.405	1.038
0.02	0.937	1.211	0.767
0.03	0.920	1.099	0.566
0.04	0.994	0.987	0.415
0.05	0.548	0.902	0.309
0.06	0,817	0.849	0.228
0.07	0.788	0.806	0.169
0.05	0.759	0,769	0.125
0.09	0.750	0.736	0.092
0.10	0.702	0.705	0,068
0.15	0.635	9.638	0.015
0.20	0.577	9.577	0.003
0.25	0.518	0.518	0.001
0.30	0.512	0.512	0.000

Project:	MASTER THESIS	ETAP	Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	one contraction	Config:	Normal

3-Phase fault at bus: Bus9

 Nominal kV
 = 11.000

 Voltage c Factor
 = 1.10
 (User-Defined)

 Peak Value
 = 10.860
 kA
 Method C

 Steady State
 = 1.005
 kA rms

Contribution		Voltage & Initial Symmetrical Current (rms)						
From Bas ID	To But ID	% V From But	hA Real	kA Imaginary	X/R Ratio	hA Magnirude		
Bus9	Total	0.00	0.368	-4.392	11.7	4.515		
Bus7	Bas9	30.83	0.297	-3.599	12.1	3.611		
Lump2	Bus9	100,00	0,070	-0.703	16.0	0.707		
Bus2	But7	31.82	0.025	-0.300	12.1	0.301		
Bun2	Bm7	31.82	0.025	-0.300	12.1	0.301		

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	Ib sym	Ib asym	Ide
0.01	4.209	6.256	4.669
0.02	4.173	5.494	3.674
0.03	4.131	4354	1.734
0.04	4.038	4.548	2.092
0.05	3.589	4.199	1.605
0.06	3.780	3,975	1.229
0.07	3.682	3.500	0.941
0.08	3.584	3,655	0.720
0.09	3.487	3.530	0.551
0.10	5.392	3.418	0.424
0.15	3.167	3.169	0.112
0.20	2.945	2.948	0.629
0.25	2.736	2.736	0.008
0.50	2,720	2.720	0.902

Project:	MASTER THESIS	ETAP	Page:	13
Location:	HOUN CITY - LIBYA	12.0.9H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

3-Phase fault at bus: Bus10

Nominal kV	=	11.000		
Voltage c Factor	-	1.10	(Use	r-Defined)
Peak Value	-	19.898	kA	Method C
Steady State	\sim	0.927	kA r	TRS

Contribution		Voltage & Initial Symmetrical Current (rms)					
From Bas ID	To Bus ID	% V From But	kA Real	kA Imaginary	X/R Ratie	kA Magnitude	
Bus10	Total	0.00	0.661	-7.868	11.9	7.896	
Bus8	Buil0	46.89	0.415	-5.408	13.0	8.424	
Lump3	Buil0	100.00	0.246	-2,460	10.0	2.473	
Basi	Bui5	48.59	0.035	-0.456	13.0	0.458	
Basl	Bush	48.59	0.035	-0.456	13.0	0.458	

Breaking and DC Fault Current (kA) Based on Total Bas Fault Current

TD (S)	Ib sym	Ib asym	Ide
0.01	7.621	11.480	8.584
0.02	7.552	19.044	6.622
0.03	7.472	9.046	5.899
6.04	7,367	8.348	3.926
0.05	7.210	7.831	3.056
0.06	7.047	7.432	2.359
0.07	6.859	7.125	1.820
0.05	6.716	6.861	1.405
0.09	6.544	6.633	1.684
0.10	6.375	6.432	0.855
0.15	5,975	5.980	0.237
0.29	5.586	5.586	0.965
0.25	5.208	5.208	0.018
0.30	5.180	5.190	0.005

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

Short-Circuit Summary Report (Without PV)

3-Phase Fault Currents

1.27				D	evice Cap	acity (kA)	-		1.270.00	-			
Bu	5	2	Dettice	Making					Short	Circuit C	urrent (kA)		
ID	kV.	ID	Type	Peak.	Ib sym	Ib atym	Ide	I'h	ip .	Bergm	Ib arym	14c	R.
Busl	66.000	Basl	But					2.161	5.351			-	0.173
Bur 2	66.000	Bus2	But					0.995	2.464				0.184
Bmt9	11.000	Ban9	Bus					4.318	10.560				1.005
Bm10	11.000	Bun10	Bus					7.896	19.898				0.927

ip is calculated using method C Ib does not include decay of non-terminal faulted indunction motory Ik is the maximum resolv state fault current Ick is based on X/R from Method C and Ib at specified above

LV CB duty determined based on invice vating. Total through current is used for device duty. * Indicates a device with calculated duty exceeding the device capability.

indicates a device with calculated duty exceeding the device marginal limit. (95.%) times device capability)

APPENDIX 7

SHORT CIRCUIT ANALYSIS WITH PV

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H	Dase:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Start Se	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Electrical Transient Analyzer Program

Short-Circuit Analysis (With PV)

IEC 60909 Standard 3-Phase Fault Currents

Number of Buses:	Swing 3	V-Control 7	Load 30	Total 40			
Number of Branches:	NFMR2 24	XFMR30	Reactor	Line/Cable	Impedance0	Tie PD 0	Total 40

	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total
Number of Machines:	0	3	0	0	13	16

System Frequency:	50.00 Hz
Unit System:	Metric

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Guay care, oc	Coufig:	Normal

Adia	astments		
Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP	Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename: HOUN SUBSTATION 220kV			Config:	Normal

	Bu	5			Initial V	oltage
ID	Type	Nom. EV	Base kV	Sub-sys	%Mag.	Ang.
Basl	Load	66.000	68.475	1	99.39	-4.20
Bus2	Load	66.000	66.413	1	99,86	-1.22
Bus3	SWNG	220.000	220.000	1	100.00	0.00
Bes4	SWNG	220.090	220.000	3	100.00	0.00
Bus5	SWNG	220.000	220.000	2	100.90	0.00
Bust	Load	11.000	11.413	1	98.34	-4.15
But?	Load	66.000	66.413	2	99.04	-1.23
Buiß	Load	66.000	68.475	1	99.30	-4.26
But9	Load	11.090	11.069	2	98.36	-1.80
Buil0	Load	11.000	11.555	1	98.05	-6.26
Bail1	Load	66.000	66.413	2	99,06	-1.22
Bus12	Load	66.000	68.475	1	99.39	-4.20
Buil3	Load	66.990	68.475	1	98.62	-4.67
Busl4	Load	66.000	66.413	2	98.22	-1.74
Bus15	Load	11.000	11.912	1	98.98	-7.58
Bus16	Load	11.000	11.553	2	98.56	-4.67
Busl7	Load	66.000	68.475	1	99.19	-5.86
Bus18	Load	66.000	66.413	2	98.97	-1.59
Bes19	Load	11,000	11.413	1	99.02	-7.46
Bus20	Load	11,000	11.069	2	98.87	-2.61
Bus21	Load	66.000	68,475	1	99.22	-6.52
Bus22	Load	11.000	11.413	1	98.70	.9.43
Bm23	Load	66.000	68.475	1	99.54	-6.94
Bus25	Load	11.000	11.413	1	98.36	.7.87
Bus27	Load	66.000	68.475	1	99.12	-4.91
But28	Load	11.000	11.484	1	98,70	-5.76
Bas29	Load	11.000	11.484	1	98,70	-5.76
But30	Load	66.000	68.475	1	98,79	-4.56
Bus31	Load	66.000	66.413	2	98.80	-1.38
Bus32	Load	11.000	11.840	1	98.33	-7.79
Bus33	Load	11.000	11.484	2	100.68	-2.83
Bus54	Gen.	0.400	0.410	1	0.90	1.05
Bus35	Gen.	0.400	0.410	1	0.00	1.05
But36	Gen.	8.400	0.410	1	0.00	1.05
Ber37	Gen	0.400	0.410	13	0.00	1.05

Bus Input Data

Project:	MASTER THESIS	ETAP		Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H	Date		28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	100000		Config:	Normal

	Ba	15			Initial V	oltage
D	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang
Bur38	Gen.	8,200	0.397	2	0.00	3.28
But39	Gen.	0.400	0.397	2	0.00	3.28
Bus40	Gen.	0.400	0.397	2	0.00	3.28
Bun4I	Load	11.000	11.270	1	95.88	-1.23
Bm42	Load	11.000	10.950	2	98.65	1.01

40 Buses Total

All valtages reported by ETAP are in % of bus Nominal EV. Bate kV values of buses are calculated and used internally by ETAP.

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	start start	Config:	Normal

Line/Cable Input Data

		0	uns or Siemer	ns/1000 m	per Condu	ctor (Cable)	or per Phase (L	ine)	
Line/Cable			Len	çıh					
ID	Library	Size	Adj. (m)	16 Tol.	#/Phase	T (°C)	R	Х	Y
Cable1	11MCUS3	.300	100.0	0	1	75	0.07630	0.08740	0.0001646
Cable2	11MCUS5	300	108.0	0	1	75	0.07630	0.08749	0.0001646
Linel		674	19300,0	0	1	75	0.05600	0.57425	0.0000031
Line2		674	19300.0	0	1	75	0.05600	0.34207	0.0000034
Line3		674	23000.0	0	1	75	0.05600	0.34207	6.9000034
Line4		674	15000.0	0	1	75	0.05600	0.34207	0.0000534
Line5		674	\$000.0	0	1	75	0.05600	0.34207	0.0000034
Line6		674	4000.0	0	1	75	0.05600	0.34207	0.0000034
Line7		674	4000.0	0	1	75	0.05600	0.34207	0.0000034
Line8		674	4000.0	0	1	75	0.05600	0.34207	0.0000934
Line9		674	4000.0	0	1	75	0.05600	0.34207	0.0000034
Line10		674	\$000.0	0	I	75	0.05600	0.34207	0.0000034
Linell		674	\$000.0	0	1	75	0.05600	0.34207	0.0000034
Line12		674	21000.0	0	1	75	0.05600	0.34207	0.0000034
Line13		674	161000.0	0	1	75	0.05600	0.34207	0.0000834
Line14		674	140000.0	0	1	75	0.05600	0.34207	0.0000034

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP	Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAL	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	crait caret ore	Config:	Normal

Transformer			Rating			13	Z Variatio	en.	% Tap Setting		Adjusted
ID	MVA	Prim. kV	Sec. kV	% Z	X/R	+ 5%	- 559	96 Tol.	Prim.	Sec.	96 Z
n	63.000	220.000	66.000	12.50	45.00	0	0	0	0	3.750	12,5000
T3	63.000	220.000	66.000	12.50	45.00	0	0	0		0.625	12,5000
T4	10.000	66,000	11.000	8.35	13.00		0	0	6		8.3500
15	20.000	66.000	11.000	10.00	20.00		0	0			10,0000
16	20.000	66.000	11.000	10.00	20.00	8	0	0	0	1.250	10.0000
17	12.590	11.000	66.000	8.35	13.00	0	0	0	-1.250	0	8.3500
18	12.590	11.000	66.000	8.35	13.00	0	0	0	-1.250		8.3500
19	10.000	66.000	11.009	8,35	13.00	0	0	0	0	4.378	8,3500
T10	10.000	66.000	11.000	8.35	13.00	0	0	0	0	4.375	8,3500
TIL	20.000	66.000	11.009	18.00	29.00	0	0	0	0		10.0000
712	20.000	66.000	11.000	10.00	20.00	0	0	0	0		10.0000
TIJ	10.000	66.000	11.000	8.35	13.00		0	0	0	0	8.3500
T14	10.000	66.000	11.000	8.35	13.00	0	0	0	0		8.3500
T16	20.000	66,000	11,000	10.00	20.00			0		0,625	19,0000
117	20.000	66.000	11.000	10.00	20.00	0	0	0	8	0.625	10.0000
T18	20.000	66.000	11.000	10.00	20.00	0	0	0	0	3.750	10.0000
T19	20.000	66,000	11.000	10.00	20.00	0	0	0	0	3.750	10,0000
129	3.009	0.400	11.000	6.25	6.00	.0	0	0	0	0	6.2500
721	3.000	0.400	11.000	6.25	6.00	0	0	0	0		6.2500
T22	3,000	0.400	11.000	6.25	6.00	0	0	0	0	•	6.2500
T23	3.000	0,400	11.000	6.25	6.00		0	0	0		6.2500
T34	3.000	0,400	11.000	6.25	6.00		0	0	0		6.2500
T25	3.000	9,490	11.000	6.25	6.00	0	0	0	0		6.2500
T26	3.000	0.400	11.000	6.25	6.00	0	0	0	0		6.2500

2-Winding Transformer Input Data

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract;	NEAR EAST UNIVERSITY - EEE Department			5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV			Config:	Normal

CKT/Branch		Con	% Impedance, Pos. Seq., 100 MVAb				
ID	Type	From Bus	To Bun	R	X	Z	Y
11	2W XFMR	Bus3	Burl .	0,43	19.28	19.29	
13	2W XFMR	But5	But2	0.45	19.28	19.29	
E4	2W NFMR	Buil	Bartó	5.92	76.98	77.21	
15	2W XFMR	Bus7	But9	2.43	48.62	48.69	
16	1W XFMR	Buss	Burl0	2.29	45.74	45.80	
17	TW XFMR	Bui42	Burl1	5.04	65.47	65.66	
18	2W XFMR	But41	But12	4.74	61.58	61.77	
19	2W XFMR	Buil3	But15	5.92	76.98	77.21	
110	2W XFMR	Buil4	Burl6	6.30	\$1.84	\$2.65	
T11	2W XFMR	Bm17	Bur19	2.29	45.74	45.80	
F12	IW NFMR	But18	Bur20	2.43	48.62	48.69	
T13	2W XFMR	Bus21	Bun22	5.92	76,98	77,21	
T14	2W XFMR	Bui23	Bat25	5.92	76.98	77.21	
T16	2W XFMR	But27	Bur28	2.29	45.74	45.80	
117	2W XFMR	Bm27	Bwt29	2.29	45.74	45.80	
F18	2W XFMR	Bm30	Bur32	2.29	45.74	45.80	
119	1W XFMR	Bus31	Bun53	2.43	48.62	48.69	
129	1W XFMR	Bm34	Bur41	31.39	198.32	190.92	
121	1W XFMR	Bus35	Bur4I	51.59	188.32	196,92	
[22	2W XFMR	Bu:36	Bur41	31.39	188.32	190.92	
123	2W XFMR	But37	Bun41	51.59	188.52	190.92	
124	1W XFMR	Bus38	Bur42	\$5.37	200.20	202.96	
125	1W XFMR	Bm39	Burt42	33.37	200.20	202.96	
126	1W XFMR	Bus40	Bur42	33.37	200.20	292.96	
Cable 1	Cable	Bus11	Bas2	0.02	0.02	0.03	
Cable2	Cable	Buill	Burl	0.02	6.02	0.02	
Linel	Line	But2	But14	2.45	16.38	16.56	
Line2	Line	Busl	Burl3	2.31	14.08	14.27	
Line5	Line	Bus2	Burl8	2.92	17.84	15.08	
Line4	Line	Bui27	Bun17	1.79	16.94	11.09	
Line5	Line	Busl	But27	0.96	5.84	5.91	
Line6	Line	Bus2	Bur7	0.51	3.10	3.14	
Line?	Line	Buil	Bunß	0.48	2.92	2.96	
Line8	Line	Bus2	Bar7	0.51	3.10	3.14	
Line9	Line	But	Butil	0.48	2.92	2.96	
Line10	Line	Bus2	Burt31	1.02	6.20	6.29	
Line11	Line	Buil	Bur.30	0.96	5.84	5.91	

Branch Connections

Project:	MASTER THESIS	ETAP	Page:	8
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220EV	isting char. See	Config:	Normal

CKT/Branch		Cot	Connected Bus ID		% Impedance, Pos. Seq., 100 MVAb		
ID	Type	From Bus	To But	R	X	Z	Y
Line12	Line	Buil7	Bus21	2.51	15.32	15.52	
Line13	Line	Buti7	Bus23	19.23	117,46	119.02	
Line14	Line	Bus21	But23	16.72	102.14	103.50	

Project:	MASTER THESIS	ETAP		Page:	9
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV			Config:	Normal

Power Grid Input Data

Power Grid	Power Grid Connected Bus		ting	1	% Impedance 100 MVA Base		
ID	ID	MVAsc	kV	R	Χ"	R/X	
^{tu}	Bus3	22.101	220.000	45.02233	450.22330	0.10	
U2	But4	22.101	220.000	45.02233	450.22330	0.10	
03	Bus5	22.101	220.000	45.02233	450.22330	0.10	

Total Connected Power Grids (= 3): 66.303 MVA

Project:	MASTER THESIS	ETAP		Page:	10
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	STATE STATES	Tert.s	Config:	Normal

Lumped Load Input Data

	ş									Motor	Loads		
Lumped Load	Connected Bus	d Load	Rati	ng		56	Load	Loading		% Impedance Machine Base		m Fact.	
ID	ID	ŁVA.	1.V	Amp	% PF	MTR	5TAT	kW	kvar	R	Ζ.,	R/X"	MW/PP
Lumpl	But6	1243:2	11,009	65,25	0.01	80	20	0,1	994.6	2,28	15.21	0.15	0.00
Lump3	Ber9	2353.5	11.000	123.53	\$5.00	50	20	1600.4	991.5	1.53	15.31	0.10	1.60
Lump3	Butl0	8235.7	11,000	432.26	\$5.60	50	20	5600,0	3471.1	1.53	15.31	0.10	5.68
Lump4	Bet15	7058.4	11.000	370.47	\$5.00	80	20	4799,7	2974.6	1.53	15.31	0.10	4.80
Lump5	Bat16	7058.4	11.999	378,47	\$5.00	88	20	4799.7	2974.6	1.53	15.51	0.10	4.59
Lump6	Berl9	5500.0	11.000	188.68	100.00	80	20	4400.0	0.0	1.53	15.31	0.16	4.48
Lump7	Bat20	3500.0	11.009	183.70	100.00	80	20	2800.0	0.0	1.53	15.31	0.16	1.80
Lump8	Ber22	6000.0	11,000	314.92	190.00	89	20	4500.0	0.0	1.53	15.31	0.10	4.80
Lump9	Bet25	\$352.4	11.000	123.47	\$5.60	\$0	20	1599.6	991.4	1.53	15.31	0.10	1.69
Lump11	Bed28	3529.2	11.000	185.23	\$5.80	88	20	2399.8	1487.3	1.53	15.31	0.10	1.40
Lump12	Bes29	3529.2	11.000	185.23	\$5.60	80	20	2399.8	1487.3	1.53	15.31	0.10	2.40
Lump13	Bat32	12941.9	11.009	679.27	85.00	80	20	8300.0	5454.8	1.53	1531	0.10	8.39
Lump14	But53	5882.5	11.000	308.75	85.00	50	20	4000.0	2479.3	1.53	15.31	0.10	4.00

Total Connected Lamped Loads (= 13): 69184.3 kVA

Project:	MASTER THESIS	ETAP	Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 2204V		Config:	Normal

SHORT-CIRCUIT REPORT (With PV)

3-Phase fault at bus: Bus1

Nominal kV	-	66.000	
Voltage c Factor	-	1.10	(User-Defined)
Peak Value	-	5.368	kA Method C
Steady State	-	0.232	kA runs

	Contribution	Voltag	e & Initia	I Symmetric	al Currei	(rms)
From But ID	To Bus ID	% V From Bur	kA Real	kA Imagiaary	X/R Ratio	kA Magnitude
Banl	Total	0.00	0.327	-2.168	6.6	2.193
Burl2	Busl	0.00	0.117	-0.017	0.1	0.138
Bur13	Buil	4.41	0.027	-0.275	10.5	9.276
Bas27	Busl.	5.37	0.083	-0.807	9.7	0.811
Bur8	Bus1	0.57	0.016	-0.172	10.9	0.173
Bas8	Benl	0.57	0.016	-0.172	10.9	0.175
Bas30	Bun1	3.29	0.044	-0.495	11.2	0.497
Bun3	Busl	3.60	0.017	-0.172	10.3	0.173
Bus6	Buil	5.30	0.009	-0.058	6.8	0.059
Bus41	Buil2	8.06	0.117	-0.017	0.1	0.118
Bas15	Bun15	29.48	0.027	-0.275	10.5	0.276
Bas17	Bur27	11.58	0.052	-0.498	9.5	0.501
Bur 28	Bur 27	13.37	0.015	-9.154	10.1	0.155
Bas29	Bui27	13.37	0.015	-0.154	10.1	0.155
Bus10	Bus8	18.49	0.031	.0.344	10.9	0.345
Bus32	Bus30	29.85	0.044	-0.495	11.2	0,497
UI	But3	96.39	0.005	-0.054	10.3	0.054
Lonpl	Bunð	100.00	0.051	-0.351	6.8	0.354

Breaking and DC Fault Current (kA)

Based on Total Bas Fault Current

TD (5)	Ib sym	Ib asym	Ide
0.01	2.059	3.050	2.250
0.02	2.026	2.622	1.664
0.05	1.990	2.334	1.219
0.04	1.941	2,137	0.893
0.05	1.567	1.982	0.666
0.06	1.813	1.878	0.459

Project:	MASTER THESIS	ETAP	Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case, SC	Config:	Normal

(Cont.) 3-Phase fault at bus: Busl

Nominal kV	-	66.000		
Voltage c Factor	-	1.10	(Use	r-Defined)
Peak Value	-	5,368	kA	Method C
Steady State	-	0.232	kA r	ms

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	1b tym	Ib asym	Ide
0.07	1.750	1.786	0.360
0.08	1,685	1.706	0.264
0.09	1.622	1.633	0,194
0.10	1.559	1.566	0.146
0.15	1.415	1.415	0.032
0.20	1.275	1.275	0.007
0.25	1.141	1.141	0.001
0.50	1.129	1.129	0.000

Project:	MASTER THESIS	ETAP	Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Study Case. SC	Config:	Normal

3-Phase fault at bus: Bus2

Nominal kV	-	66.000	
Voltage c Factor	-	1.10	(User-Defined)
Peak Value	-	2.475	kA Method C
Steady State	-	0.221	kA runs

(Voltage & Initial Symmetrical Current (rms)					
From Bus ID	To But ID	% V From Bus	kA Real	kA Imagiaary	X/R Ratio	kA Magnitude
Bur2	Total	0.00	0.184	-1.000	5.4	1.017
Burl1	But2	0.00	0.088	-0.011	0.1	0.059
Bus14	Bus2	4,79	0.027	-8,274	10.3	0.275
Bus18	Bus2	2.97	0.015	-0.155	10.2	0.156
Ban7	Bur2	0.18	0.005	-0.055	10.3	0.055
Bun7	Bm2	0.18	0.005	-0.055	10.5	0.055
Ban31	But2	1.77	0.025	-0.267	10.6	0.268
Bat5	But2	3.71	0.015	-0.183	10.5	0.184
Bus42	Busll	6.07	0.088	-0.011	0.1	0.059
But16	Bus14	29.78	0.027	-6.274	10.3	0.275
But20	Bm18	10.94	0.015	-0,155	10.2	0.156
Bun9	Bun7	5.86	0.011	-0.110	10.3	0.111
Buri33	Bur31	16.06	0.025	-0.267	10.6	0,268
U3	But5	99.38	0.005	-0.055	10.3	0.055

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	Ib sym	Ib anym	Ide
0.01	0.975	1.424	1.035
0.02	0.960	1.231	0.771
0.05	0.945	1.099	0.564
0.04	0.917	1.006	0.413
0.05	0.570	0.925	0.309
0.06	0.540	0.870	0.227
0.07	0.810	0.827	0.167
0.05	0.750	0.790	0.123
0.09	0.752	0.757	0.090
0.10	0.725	6.726	0.067
0.15	0.659	0.659	0.015
0.20	0.696	0.596	0.003

Project:	MASTER THESIS	ETAP	Page:	14
Location: HOUN CITY - LIBYA		12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	and care ac	Config:	Normal

(Cont.)

3-Phase fault	at bus: Bus2

Nominal kV	-	66.000	
Voltage c Factor	-	1.10	(Uter-Defined)
Peak Value	-	2.475	ItA Method C
Steady State	-	0.221	kA russ
and a state			

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (5)	Ib sym	Ib asym	Ide	
0.25	0.537	0.537	0.001	
0.30	0.531	0.531	0.000	

Project;	MASTER THESIS	ETAP	Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: SC	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Cart. Sc	Coufig:	Normal

3-Phase fault at bus: Bus9

Nominal kV	-	11.000	
Voltage c Factor	-	1.10	(User-Defined)
Peak Value	-	10.909	kA Method C
Steady State	-	1.199	kA rms

Contribution		Voltage & Initial Symmetrical Curvent (rms)				ut (runs)
From Bus ID	To Bus ID	% V From But	kA Real	kA Imaginary	X/R Ratio	kA Magaitude
Bur9	Total	0.00	0.610	-4.347	7.1	4.390
Bus7	Bus9	31.45	0.540	-3.644	6.7	3.684
Lump2	Bar9	100.00	9,979	-0,703	10.0	0,707
Bus2	But7	32.46	0.045	-0.304	6,7	0.307
Bus2	Bus7	32.46	0.045	-0.304	6.7	0.307

Breaking and DC Fault Current (kA)

Based on Total Bus Fault Current

TD (S)	Ib sym	Ib asym	Ide		
0.01	4.282	6.343	4.680		
0.02	4.246	5.564	3.596		
0.03	4.204	5.016	2.736		
6.04	4.112	4,609	2.053		
0.05	3.954	4.269	1.610		
0.06	3.855	4.046	1.229		
0.07	3.757	5.872	0.938		
0.08	3.660	5.729	0.716		
0.09	3.563	3,605	0.547		
0.10	3.468	3.494	0.424		
0.15	3.244	3.246	0.111		
0.20	3.025	3.025	0.029		
0.25	2.813	2.813	0,008		
0.30	2,798	2.798	0.002		
Project:	MASTER THESIS	ETAP		Page:	16
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Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cater S	c	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Call. 5		Config:	Normal

3-Phase fault at bus: Bus10

Nominal kV	-	11.000	
Voltage c Factor	-	1.10	(User-Defined)
Peak Value	-	19.943	kA Method C
Steady State	-	1.226	kA rms

(ontribution	Voltag	e & Initia	d Symmetric	al Currer	ut (runs)
From Bas ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	X/R Ratio	EA Magnitude
Bur10	Total	0.00	0.835	-7.907	9,5	7.951
Bus8	Bus10	47.36	0.589	-5,447	9.2	5.479
Lump3	Bus10	100.00	0.246	-2.460	10.0	2.473
Burl	Bus8	48.88	0.050	-0.460	9.2	0.462
Bur1	Bus8	45.38	0.050	-0.460	9.2	0.462

Breaking and DC Fault Current (kA) Based on Total Bus Fault Current

TD (5)	Ib sym	Ib atym	Ide
0.01	7.678	11.526	8,597
0.02	7.608	10.099	6.64]
0.03	7.529	9.096	5.104
0.04	7.424	8.397	3,922
0.05	7.267	7.886	3.062
0.05	7.118	7.499	2.361
0.07	6.947	7.181	1.820
0.05	6.774	6.918	1.403
0.09	6.603	6.691	1.082
0.10	6.434	6.491	0.856
0.15	6.035	6.040	0.236
0.20	5.646	5.646	0.065
0.25	5.268	5.268	0.018
0.30	5.240	5.240	0.005

Project:	MASTER THESIS	ETAP		Page:	17
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	sc	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	onady cases		Config:	Normal

Short-Circuit Summary Report (With PV)

3-Phase Fault Currents

Bus			Sector All	D	evice Cap	acity (kA)				-			
		Device		Making				_	20011	-Circini C	urrent (kA)		
ID	kV	ID	Type	Peak	Ib sym	Do anyon	Ide	t"k	ip	Th 13m	Ib arym	Ide	IL.
Busl	66.000	Buil	Bes					2,193	5.368			_	0.232
Bus2	66.000	Buil	Basi					1.017	2.475				0.221
But?	11.000	Burt9	Bas					4.390	10.909				1.199
Bas10	11.600	Buil@	Ban					7.951	19.945				1.226

ip is calculated using method C Ib does not include decay of son-terminal faulted indunction motors Ik is the maximum steady state fault current Ick is based on X/R from Method C and Ib as specified above

LV CB duty determined based on vervice rating. Total through current is used for device duty. * <mark>Indicates a device with calculated duty exceeding the device capability.</mark> # indicates a device with calculated duty exceeding the device marginal limit. (95 % times device capability)

APPENDIX 8

HARMONICS ANALYSIS WITHOUT PV

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cause HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and the second	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

Electrical Transient Analyzer Program

Harmonic Load Flow (Without PV)

Loading: Operating P, Q

Generation: Operating P, Q, V

	Swing	V-Centrol	Load	Total			
Number of Buses:	3	0	26	29			
	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	15	0	0	14	0	0	29
	Current	Voltage					
Number of Harm. Sources:	3	0					
Number of Filters:	0						
Method of Solution:		Adap	tive Newton-Rap	dison			
Maximum No. of Iteration:		99					
Precision of Solution:		0.000	1000000				
System Frequency:		50.00	Hz				
Unit System:		Metr	ic				

Project:	MASTER THESIS	ETAP	P	age:	2
Location:	HOUN CITY - LIBYA	12.6.0H	D	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		s	N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	R	tevision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case. His	c	onfig:	Normal

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Ves	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Transmission Line Length: Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineert	SAND MUSTAFA AL-REFAI	Study Case!	НА	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	and care		Config:	Normal

								L	ad					
Bu			Initial V	olinge	Canata	at kVA	Cunt	ant Z	Court	tant I	Gen	eric	96 L	imits
ID	kV	Sub-131	% Mag.	Asg	MW	Mvar	MW	Mrar	MW	Myar	MW	Myar	VTHD	VTHE
Benl	66.000	1	99.1	-30.0							_	_	10.00	10.0
Beri 2	65.000	1	98.9	36.0									10.00	10.0
Ban.3	220.000	1	200,0	6.0									16.90	10.0
Ban-4	220.000	3	100.0	0.0									10.00	10.0
Bun5	220,000	1	100.0	0.0									10.60	10.0
Bunh	11.000	1	98.I.	-60.0	8.000	6,995	0.000	0.249					2.50	1.5
Bes7	65.000	1	93.5	30.0									10.90	10.0
Ben 8	66.000	1	99.0	-36.0									16.00	10.0
Ben9	11.000	2	98.1	-2.5	1.600	0.992	0,400	0.248					10.00	10.00
Bus10	11.999	1	97.4	-68.0	5.600	3.471	1.409	0.868					10.00	10.0
Bus13	66.000	1	98.3	-30.0									19.00	20.0
Beil4	65.000	2	98.0	36.0									19.90	10.0
Burl5	11.000	1	98.7	-66.0	4.500	2.975	1.290	0.744					10.00	10.0
Ban16	11.000	3	95.J	-54	4,990	2.975	1.200	0,744					10.00	10.0
Ben17	66.000	1	98.9	-30.0									10.00	10.0
Ben18	66.000	2	98.8	36.0									10.00	10.0
Bes19	11.000	1	98,7	-60.0	4.400	0.000	1.100	9,000					10.00	10.0
Ben20	11.000	1	98.7	-3.3	2.890	0.000	0.798	0.000					10.00	10.0
Ber21	66.000	1	98.9	-30.0									10.00	10.0
Bm32	11.000	1	98.4	-60.0	4.890	0.000	1.200	0.600					10.00	10.0
Ban23	66.000	1	99.3	-30.0									19.00	18.0
Ber 25	11.900	1	98.1	-60.0	1.600	8,991	0.400	0.248					10.00	10.0
Bun27	66.000	1	98.8	.30.0									10.00	10.0
Ban28	11.000	1	98.4	-60.0	2,400	1.487	0.600	0.372					10.00	10.0
Ban 29	11.000	1	98.4	-60.0	2,400	1.487	0.690	0.372					10.00	10.0
Bun30	66.000	1	98.5	-30.0									10.00	10.0
Ben 51	65.000	2	98.6	38.0									10.00	10.0
Bas32	11.000	1	95.0	-60.0	\$.500	5.455	2.200	1.364					10.00	10.0
Bert33	11.000	2	100.5	4.5	4.000	2.479	1.000	0.620					10.00	10.0
Total Number of Baset: 25	0				47,999	23.307	12,008	5.827	6.099	6.006	0.000	0.000		
	Ceneration P				10	Irana		Canar	ation		Moor 1	imits		

Bus Input Data

Project:	MASTER THESIS	ETAP		Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	1171	Config:	Normal

	Generation B	485		Volta	eg#		Generation		Myar	Limits
ID	kV	Туре	5ub-ays	% Mag-	Angle	MW	Myar	% PF	Max	Min
Buri-4	220,000	Swing	3	190.0	0.0					-
Burt?	220.000	Swing	2	100.0	0.0					
						0.000	0.000			

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	order control and	Coufig:	Normal

Cable Input Data

Cable	a.		Length							
ID	Library	Size	% Tal. #Phate	T (*C)	RI	XI	YI	R0	X0	70

Cable resistances are listed at the specified temperatures

Transmission Line Input Data

		~~~	Ohms or Mhos / 1000 m per Phase											
	Line			Length	F			1.						
	ID	Library	Size	Adj. (m)	% Tal.	#Phase	T (*C)	R1	XI	31	R0	X#	7.6	
Linel			674	19300.0	0.0	1	75	0.056003	6.374255	.0008031	0.200077	1.360791	.0000017	
Line2			674	19360.0	9.0	1	75	0.056001	0.342069	,0000034	0.200437	1.424941	.0000016	
Linel			674	25900.0	0.0	3	78	0.056001	0.342969	,6008034	0.200637	1.424041	.0096016	
Line4			674	15900.0	0,0	- 13	75	0.056001	0.342069	,0000034	0.200637	1.424641	.0090016	
Line5			674	\$900.0	0.0	1	75	0.056001	6.342069	.0000034	9.200637	1.424041	.0000016	
Linei			674	4900.0	0.0	1	75	9.056001	8.342969	.0008034	8.209637	1.424841	.0000016	
Line?			674	4900.0	9.0	1	78	0.056001	8.342869	.0000034	8.200637	1.424041	,0000016	
Line5			674	4000.0	8.8	1	75	0.056001	8.342869	.0000034	0.200637	1.424041	.0000015	
Line9			674	4900.0	8.8	1	75	0.956901	8.342969	.0008034	0.280637	1.424041	.0000016	
Line10			674	8000.0	0.0	1	75	0.056001	0.342969	.0000034	8.200637	1.424041	.0000016	
Line11			674	8000.0	8,8	1	75	0.056061	6.342969	,8008034	8,200637	1.424041	.0000016	
Line12			674	21900.0	0.0	1	75	0.056001	0.342069	,0000034	9.200637	1.424041	.0000016	
Line15			674	161000.0	9,9	1	75	0.056001	0.342069	,0000034	0.200637	1.424041	.0000016	
Linel4			674	140000.0	8.0	- 3	75	0.056001	8.342069	,0008034	0.200637	1.454941	.0000016	

Line resistances are listed at the specified temperatures

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H	L	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revition:	Bate
Filename:	HOUN SUBSTATION 220kV	Stany Cart	1000	Config:	Normal

#### 2-Winding Transformer Input Data

Transformer			Rating			1	Z Variatio	m	% Set	Tap ing	Adjusted	Phase	Shift
ID	MVA	Prim. kV	Sec. EV	% Z	XR	+ 555	- 5%	16 Tol.	Prim.	Sec.	96 Z	Type	Angle
TI	63,000	220.000	66.000	12.69	45.00	0	0	.0	.0	0	12.5000	Dyn	30.000
13	63.000	220.000	66.000	12.50	45.00	0	0	0	•	0	12,5000	Dyn	-30.090
T4	19.000	66.000	11.000	8.35	13.00	0	0	.0		0	8.3500	Dyn	30.000
TS	28.009	65.000	11.000	10.00	20.00	0	0	0		0	10.0000	Dyn	30.000
<b>T6</b>	20.000	65.000	11.000	10.08	20.00	0	0	0		0	18.0000	Dyn	30.000
19	10.000	65.000	11.000	8.35	13.00	0	0	.0		.0	8.3500	Dyn	30.000
<b>T10</b>	10.009	66.000	11.000	8.35	13.00	0	0	0		0	8,3500	Dyu	30.000
TH	28.009	66.000	11.000	10.00	20.00	0	0	0		0	10.0000	Dyn	30.000
T12	28.009	65.000	11.000	10.00	26.00	0	0	ø		0	10.0009	Dyn	30.090
T13	18.009	65.000	11.000	8.35	15.00		8	8		0	8.3500	Dyn	30.000
T14	10,000	65.000	11.000	8.35	13.00	0	0	0		0	8.3500	Dyn	30.000
T16	29,090	65.000	11.000	10.00	26.60	0	0	0		0	18.9000	Dyn	30.090
T17	29.000	65.000	11.000	10.00	20.00	0	0			0	10.0000	Dyn	30.000
TIS	28.009	65.000	11.000	10.00	20.00	0	0	0		0	10.0000	Dyn	30.000
T19	20.009	65.000	11.000	10.00	20.00	0	0	0		0	18.9009	Dyn	30.000

#### 2-Winding Transformer Grounding Input Data

						ug						
Transformer		Rating		Conn.		Primary			Secondary			
D	MVA	Prim. kV	Sec. kV	Туре	Type	kV	Amp	Ohm	Type	kV	Amp	Ohm
т1	63.000	220.000	66.000	D/V				2	Solid		_	_
13	63.000	220.000	66.008	D/S					Solid			
T4	10.000	66.000	11.000	DVY					Solid			
15	30,000	66.000	11,000	D/Y					Solid			
Té	20.000	66.000	11.000	D/Y					Solid			
19	10.000	66.000	11.000	D/Y					Solid			
T10	10.000	66.000	11.000	DY					Solid			
TIL	20,000	66.000	11.000	DA					Solid			
T12	20.000	66.000	11.099	D/Y					Solid			
T15	10.000	66.000	11.000	DIY					Selbit			
T14	10.000	66.000	11.000	DAV					Solid			
T16	26,000	66.090	11.008	DY					Solid			

Project:	MASTER THESIS	ETAP	Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	5500 CT	Config:	Normal

#### 2-Winding Transformer Grounding Input Data

								Groundi	er in the second se			
Transformer	-	Rating		Conn.		Primary	ý.			Seconda	ry	
ID	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	Ohm	Type	kV	Amp	Ohm
T17	20.000	66.000	11.000	D/Y					Selid	-		
TIS	26.000	66.000	11.000	D/Y					Selid			
T19	20.000	66.000	11.000	D/Y					Solid			

Project:	MASTER THESIS	ETAP		Paget	8
Location:	HOUN CITY - LIBYA	12.6.0H	1	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	на	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	the second second		Config:	Normal

			12.12	- % P	ositive Sequ	ience Impe	dance
CKI	Branch	Los	Te Res		(100 M)	A Base)	
	- ijp	- Deal			18.81	16.64	
11	AW APAIR	Buch	Dent.	0,44	15,54	19.84	
15	AW APAR	But	Perio	6.60	27,04	19.84	
14	AN ALME	Bust	Deca	0.40	43.42	85.76	
15	TO APAR	Dus/	Deny Denia	2.59	49.94	50.00	
10	2W AFMR	BROD	Buily	2.50	49,94	50.00	
19	TW AFMR	Build	Buils	0,40	83.25	83,50	
110	TW APAR	Buil4	Buil6	0.40	83.25	83.50	
111	IW AFMR	Bas17	Bat17	2.99	49.94	50.00	
112	TW AFMIR	Buil8	894120	2.59	49.94	50,00	
113	IW AFMR	But21	But12	5.49	83.25	83.50	
T14	TW XFMR	Bus23	Bat25	6.40	\$3.25	83.50	
116	2W XFMR	Bas27	Bes25	2.90	49,94	50.00	
117	2W XFMR	Bun27	But29	2.50	49.94	50.00	
T18	2W XEMR	Bux30	Bur32	2.50	49.94	50.00	
T19	2W XFMR	Bur31	But33	2.50	49.94	50.00	
Linel	Line	But2	Bart14	2.48	16.58	16.77	0.2607629
Line2	Line	Bail	Ban13	2.48	15.16	15.36	0.2842266
Line3	Line	Ban2	Buil3	2.96	15.06	18.50	0.3387157
Line4	Line	But27	Bat17	1.93	11.78	11.94	0.2209015
Lines	Line	Butl	Bus27	1.03	6.28	6.37	0.1178142
Line6	Line	But2	Bet7	0.51	3.14	3.18	0.0589071
Line7	Line	Baul	Benß	0.51	3.14	3.18	0.0589071
Line8	Line	Bus2	Ben7	0.51	3,14	1.18	0.0589071
Line9	Line	Busl	But8	0.51	3.14	3.18	6.0589071
Line10	Line	Bus2	Bur31	1.03	6.28	6.37	0.1175142
Linel1	Line	Buil	Bar30	1.03	6.28	6.37	0.1178142
Linel2	Line	Buil7	Bm21	2.79	16.49	16.71	6.3992622
Line13	Line	Baul7	Ban23	20.79	126.43	128.11	2.3710100
Line14	Line	Bus21	Bei13	18.00	109.94	111.40	2.0617480

## Branch Connections

Project:	MASTER THESIS	ETAP		Page:	9
Location:	HOUN CITY - LIBYA	12.6.9H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stany Cases		Config:	Normal

#### CKT/Branch Connected Bus ID % Impedance, Zero Seq., 100 MVAb X9 _____ TD. From Bus Type To But Ro Z.0 10 TI 2W Xfmr Basl But3 T3 2W Xfmr Buch Bus2 T4 2W Xfue BusL Bush T5 1W Xfmr Bus? Bus9 2W.Xfmr Bus10 Té Buis? Bus15 19 2W Xfmr Ber15 T19 2W Xfmr Bus14 Bus16 TH 2W Xfmr But17 Ban19 T12 2W Xfmr Buil5 Bus20 1W Xfmr 84422 TIS Ber21 т14 2W Xfmr Bur23 Bus25 T16 2WXfmr Bes27 Bus28 T17 2W Xfmr Bes27 Bus29 2W Xfmr Bus32 T15 But30 T19 2W Xfmr But31 Bus33 Linel Line Ber12 Bus14 8.86 60.29 60.94 0.1410145 Line2 Line But1 Buil3 8.89 65.09 63.72 0.1341983 Line3 Line Bert2 But18 10.59 75.19 75.93 0.1599255 Line4 Line Bui27 Buil7 6.91 49.04 49.52 0.1042992 Line5 Line Barl But27 3.68 26.15 26.41 0.0556262 Line6 Line Bui2 Bus7 1.84 13.68 13.21 0.0278131 0.0278131 Line 15.08 13.21 1.54 Line? Betl Bus8 LineS Lint Bus2 Bus7 1.84 13.08 13.21 0.0278131 Line9 Line Bat1 Bush 1.54 13.68 13.21 0.02781.51 0.0556262 Line10 Line Bari2 Bun31 3.68 26.15 16.41 0.0556262 Linell Line Berl Bur 10 3.68 26.15 26.41 0.1460189 Line12 Line Buil7 Bus21 9.67 68.65 69.33 Line13 Line Ben17 Bus23 74.16 526.33 531.53 1.1194780 Line14 Line Ber21 Bun25 51.48 457.68 462.20 0,9734595

#### Branch Connections Zero Sequence Impedance

Project:	MASTER THESIS	ETAP		Page:	10
Location:	HOUN CITY - LIBYA	12.6.6H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Carry	(1997)	Config:	Normal

# Machines Machines Nachines <th colspan="

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	11 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

-

#### Harmonic Library

Current Harmonic Source in %

Manufac	turer:	ABB															
Model:		AC\$600	12P														
Order	Freq. Hz	Mag.	Order	Ereq. Hr	Mag	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Hz Hz	Mag. 96	Order	Freq. Hz	Mag.
1.00	58,60	108.00	5.00	250.00	2.60	7,00	.550.00	1.50	11.00	550.00	3.70	13.00	650.00	3.70	17.00	\$50.00	0,50
19.00	950.00	6.30	23.00	1150.00	0.10	25.00	1150.00	0.50									

Manufac	turer:	ABB															
Model:		AC\$600	12P														
Order	Freq.	Mag.	Order	Freq.	Mag.	Onler	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.
	Hz	16		Ha			Ha	- 56		Ha	19		Ha	- 19		Hz	
1,80	58.80	106.86	\$,00	250.00	2.60	7.00	350.00	1.50	11.00	550.09	3.70	13.00	450,00	3.70	17.00	858.00	8.58
19.00	959,00	0.30	23.00	1150.00	9.10	25.00	1255.00	0.59									

Manufas Model:	turer:	ABB ACS600	12P														
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Ordez	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
1,00	50.00	100.00	5.00	250.00	2.60	7.00	350.00	1.50	11.00	550.08	3.78	13.00	650.00	3,70	17.00	859.00	\$,58
19.00	950.00	0.30	23.00	1150.00	0.10	25.00	1250.00	0.50									

Project:	MASTER THESIS	ETAP		Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stand Canada		Config:	

#### Harmonic Source from Library

		Harmonic Source Information										
Bus ID	Device ID	Type	Manufacturer	Model	Fund. Freq.	Mod. Freq.						
But3	tu	Current	ABB	ACS600 12P	0.00	0.00						
Ban4	U2	Current	ABB	AC5600 12P	0.00	0.00						
Bus5	U3	Current	ABB	ACS600 12P	0.00	0.00						

Project:	MASTER THESIS	ETAP	15	Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2916
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	me: BOUN SUBSTATION 220kV	stating care	1.1.1.2.2	Coufig:	Normal

Bus		Volt	age	Generation		Load		Load Flow				XEMB	
ID	kV	%Mag.	Asg.	MW	Mvar	MW	Myar	ID	MW	Mvar	Amp	% PF	86 Taj
Busl	66.000	95.550	-35.0	8	0		0	Bm13	5.542	3.883	64.2	83.3	
								Bur27	19.234	1.494	176.6	99,7	
								Bun8	3.415	2.248	37,4	83.5	
								Buiß	3.415	2.248	37.4	83.5	
								Bm.50	10.683	7.536	119.7	81.7	
								But3	-42.589	-18.638	425.6	91.6	
								Beilő	0.001	1.250	11.3	0.1	
Bus2	65.000	98.267	28.1			.0	0	Bm14	5.901	3.915	63.0	\$3.3	
								Burl8	3.489	-0.241	31.1	.99.8	
								Ban7	0.991	9.572	10,2	\$5.5	
								Bas7	0.991	0.572	10.2	\$5.6	
								Bur31	4,939	3.144	52.1	84.4	
								But5	-16.303	-7.961	161.5	89.9	
Bus5	220.000	100.000	0.0	42.694	25.334	0	0	Burl	42.694	25.334	327.7	87.7	
Bus5	229.000	100.000	0.0	16.318	8.637	0	0	But2	16.318	8.637	48.5	88.4	
Bush	11.000	94.478	-65.0			0.000	1.217	Burl	0.800	-1.217	67.6	0.0	
Bies7	66.999	98.242	28.1		0	0		Bart2	.0.991	-8.628	10.4	84.5	
								Bur2	-0.991	-8.628	10.4	84.5	
								Ban9	1.983	1.256	20.9	84.5	
Bu:5	66.000	95.457	-35.1		.0		0	Bart1	-3.414	-2.296	37.7	83.0	
								Burl	-3.414	2.296	37.7	\$3.0	
								Ban10	6.828	4.592	75.4	83.0	
Bus9	11.000	97,558	-2.5	0		1.981	1.228	Bas?	-1.981	-1.228	325.4	85,0	
Bus10	11.000	92.940	-67.2			6.819	4.221	Bun8	-5,509	-4.221	452.4	85.0	
Bus15	65.000	94.766	-35.5				0	Burl.	-5.828	-4.857	65.5	82,1	
								Bm15	5.828	4.057	65.5	82.1	
Bus14	66.000	97.440	27.6			0	0	Ber1	-5.888	-4.077	64.3	82.2	
								Builf	F.888	4.077	64.3	82.2	
Bus15	11.000	98.937	-68.6	0	0	5.792	3.590	Burl3	-5.792	-3.590	393.5	85.8	
Basil 6	11.000	93.691	-5.3			5.853	3.627	Ban14	-5.853	-3.627	.385.8	85.8	
Bies17	66.000	95.282	-36.8		۰	6	0	Ban27	-13.282	2.461	124.0	-88.3	
								But21	6.510	-1.140	60.7	-98.5	
								Bus23	1,370	-1.481	18.5	-67.9	
								Ban19	5.403	0.161	49.6	100.0	
Busl8	66.000	98.179	27.8	0	0	0	0	Bun?	-3.476	-0.063	31.0	100,0	
								Bat20	3.476	0.063	51.0	199.9	
Rusl9	11,000	85,099	68.8			6.396	0.000	Buel 7	8 106	0.000	107.7	100.0	

#### Fundamental Load Flow Report (Without PV)

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	strange states and all a	Config:	Normal

Bas		Volt	age	Gene	ration	La	ad			Load Flow	6			XFMR
ID	kV	%Mag.	Ang.	MW	Myar	MW	Myar		m	MW	Muar	Amp	96 PŦ	% Tap
Ber20	11.000	98,074	33		0	3,475	0.000	Bur11		-5.473	0.000	185.9	100.0	
Sm21	66.000	95.278	-37.5			0	.0	Bm17		-6.497	0.938	69.3	-99.0	
								Bur23		0.595	-1.259	12.8	-42.7	
								Bus22		5.902	8.329	54.3	99.9	
Bur32	11.000	94.741	-70.6		0	5.877	0.000	Butll		-5.877	0.000	325.6	100.0	
Bur23	65.000	98.841	.37.9		0			Buil?		-1.365	.0.649	13.8	90.5	
								Bur21		-0.594	-0.613	7.8	69.6	
								Bas25		1.959	1.261	21.3	84.1	
But25	11.000	94.324	-68.9		0	1.955	1.212	Bar23		-1.955	-1.212	128.0	85.0	
But27	\$6.000	95.258	-35.8					Bus17		13.321	-2.424	124.4	-98.4	
								Batl		-19.192	-1.345	176.7	99.8	
								Bus28		2.936	1.884	32.0	84.2	
								Box29		2.936	1.884	32.0	84.2	
Ben28	11.000	94.197	-66.7			2.932	1.817	Bus27		-2.932	-1.817	192.2	85.0	
Bm29	11.000	94,197	-66.7		0	2.952	1.817	But27		-2.932	-1.817	192.2	85.0	
But30	66.000	94.935	-35.4			0	0	Buil		-10.663	-7.524	129,5	61.7	
								Bun32		10.663	7.524	120.3	83.7	
Buill	66.000	98.011	28.0		0	D	0	But1		-4.936	-3.235	52.7	\$3.6	
								Ban33		4.936	3.255	\$2,7	\$3.6	
Bur32	11.000	90.861	-65.5			10.616	6.581	But30		-10.616	-6.581	721.5	65.0	
Bar33	11.000	96.268	-3.5		0	4.927	3,054	Burd1		-4.927	-3.954	316.0	\$5.0	

 6  Indicates a voltage regulated bus (voltage controlled or string type machine connected to it) # indicates a bus with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H	Li	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Sound Service	11.5	Config:	Normal

Bus					Volt	age Distorti	IOB			
в	ŁV	Fund.	RMS	ASUM	THD %	TUF	TIHD %	TSHD %	THDG	THDS %
Bat1	66.000	95.55	95.83	109.35	7.71	147.90	0.90	0.00	7.71	7.73
Bus2	66.000	98.27	95,55	115.95	7.66	131.63	0.00	0.00	7.66	7.66
* Bas3	220,000	100,00	100.61	121.75	11.08	129.91	0.00	0.00	11.05	11,05
Barf	220.000	100.00	100.27	115.06	7.52	121.88	0.00	0.00	7.32	7.32
* Ban6	11.000	94.48	94.76	108.14	7.71	148.04	0.00	0.00	7.71	7.73
Ber7	66.000	98.24	95,53	113.91	7.67	151.77	0.00	0.00	7.67	7.67
Bus8	66,000	95.46	95,74	109.22	7.69	147.52	0.00	0.00	7.69	7.65
Bady	11.900	97.56	97.85	112.81	7.53	128.35	9.00	9.00	7.53	7.53
Bier10	11.000	92.94	93.16	104.87	6.88	126.99	0.00	6.00	6.85	6.85
Bas13	66,000	94.77	95.84	108.45	7.67	148.38	0.00	0.00	7.67	7.67
Barl4	66.900	97.44	97.71	112.89	7.60	131.01	0.00	0.00	7.60	7.68
Ban15	11.000	90.94	91.11	101.60	6.26	113.48	0.00	0.00	6.26	6.26
Busid	11.000	93,69	93.88	105.01	6.36	101.97	9.00	0.00	6.36	6.30
Bas17	66.000	95.28	95.52	108.29	7,84	131.44	0.00	0.60	7.04	7.04
But18	66.000	98.18	98.48	114.22	7.83	136.15	0.00	0.00	7.83	7.85
Bas19	11.000	95.10	95,30	107.11	6.50	118.89	0.60	0.00	6.50	6.50
Biet20	11,000	98.07	95.35	113.42	7.53	128.54	8.60	0.00	7.53	7.53
Bun21	66.000	95.28	95.49	105.85	6.70	136.14	8.90	0.80	6.79	6.70
Bas22	11.000	94.74	94.88	105.56	5.48	99.22	9.60	9.00	5.48	5.48
Bac25	66.000	95.54	95.99	115.85	9.70	149.73	0.00	0.00	9.70	9.70
Ban25	11,000	94.32	94.73	111.68	9.32	141.77	8.60	0.00	9.32	9.33
Ban27	66.000	95.25	95.51	108.42	7.39	138.25	0.00	0.00	7.59	7.35
Bat28	11.000	94.20	94.44	106.78	7.35	132.37	0.00	0.00	7.15	7.15
Bas:29	11.000	94.20	94.44	106.78	7.15	132.37	0.00	0.00	7.15	7.15
Bias.30	66.000	94.94	95.21	105.35	7.54	144.58	0.00	0.00	7.54	7.54
Bar.31	66,000	98.01	98.30	113.58	7.64	131.13	0.00	0.00	7.64	7.64
Bus31	11.000	90.86	91.03	101.33	6.16	110.97	0.00	0.00	6.16	6.16
Bat 33	11.800	96.27	96.52	118.59	7.19	120.08	0.00	0.00	7.19	7.15

* IndicatesTHD (Total Harmonic Distortion) Exceeds the Limit. # Indicates IHD (Individual Harmonic Distortion) Exceeds the Limit.

Project:	MASTER THESIS	ETAP		Page:	16
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	НА	Revision:	Base
Filename:	HOUN SUBSTATION 2200V		3707	Config:	Normal

Buy						Current	Distortion						
From Bus ID	To Bus ID	Fund. Amp	RMS Amp	ASUM Amp	THD 55	TIF	IT Апр	ІТв Анар	ETR Amp	TIHD	TSHD %	THDG	THDS
Baul	Bun13	64.22	64.27	69.43	4.15	80.84	\$195.61	5195.61	0.09	9.00	0.00	4.15	4.15
	Ban27	176.62	177.29	211.58	8,70	143.72	25488.07	25480.07	0.00	0.09	0.09	8.70	8.70
	Bund	37.43	37.47	40.83	4,88	88.47	3315.23	3315.23	0.00	0.00	0.00	4.88	4.85
	Burd	37.43	37.47	48.83	4.88	88.47	3315.23	3315.23	0.00	0.00	0.09	4.88	4.88
	Bun30	119.69	119,79	128.95	4.15	72.87	\$728.96	\$728.96	0.09	0.00	0.00	4.15	4.15
	Bus3	425.61	426.32	477.79	5,76	97.57	41595.09	41595.09	0.00	0.09	0.09	5.76	5.76
	Burté	11.26	11,26	11.41	0.69	10.37	116.81	116.61	0.00	9.09	0.00	0.69	0.69
Bax2	Bun14	63.04	63.10	65.91	4.38	70.90	4473.93	4473.93	0.00	0.09	0.09	4.38	4.38
	Bur18	31.05	32.20	37,41	9,70	185.34	\$776.52	\$776.52	0.00	0.00	0.00	9.70	9.70
	Bus?	10.19	10.21	11.69	7.03	127.52	1362.28	1302.28	0.09	0.00	0.00	7.03	7.63
	Bas7	10.19	10.21	11.69	7.03	127.53	1302.28	1302.28	0.09	0.00	0.00	7,03	7.83
	Bus31	52.12	52,20	58,08	5.53	91.14	4757.71	4757.71	0.09	0.09	0.00	5,53	5.53
	Bard	161.51	161.79	181,75	5.93	102.60	16600.14	16600.14	0.00	9.09	0.00	5.93	5.93
Buti	Bun1	127.68	127.90	143.34	5,76	97.57	12478.53	12478.53	0.00	0.09	0.09	5.76	5.76
Bush	Bas2	48.45	48.54	\$4.52	5.93	102.60	4990.04	4980.04	0.09	0.00	0.00	5.93	\$.93
Busó	Basl	67.58	67.58	68.47	0.69	10.37	708.87	700.87	0.09	0.00	0.00	0.69	8.69
Bus?	Bar2	10.45	10.47	11.79	6.17	105.07	1106.07	1100.07	0.00	0.00	0.00	6.17	6.17
	Bus2	10.45	10.47	11.79	6.17	105.07	1100.07	1100.07	0.09	0.09	0.00	6.17	6.17
	Bur?	20.90	20.94	23.58	6.17	105.07	2200.14	2200.34	0.00	0.00	0.00	6.17	6.17
Bush	Bun1	37.70	37.75	41.36	5.21	96.06	3626.42	3626.42	0.00	0.09	0.09	5.21	5.21
	Busl	37.70	37.75	41.36	5.11	96.06	3626.42	3626.42	0.08	0.00	0.00	5.21	\$.21
	Bus10	75,40	75.51	82.73	5.21	96.06	7252.84	7252.84	0.09	0.00	0.00	5.21	5.21
Bar9	Ben?	125.40	125.65	141.46	6.17	105.07	13298.84	13206.84	0.00	0.00	0.00	6.17	6.17
Bus10	Buth	452.42	453.04	496.35	5.21	96.06	43517.02	43517.00	0.00	0.09	0.09	5.21	5.21
Bax13	Burl	65.55	65.62	71.16	4.57	82.80	\$433,09	\$433.09	0.00	0.00	0.00	4.57	4.57
	Burl5	65.55	65.62	71.16	4.57	\$2.80	5433,89	5433.69	0.00	0.00	0.08	4.57	4.57
Busl4	Bus2	64.29	64.37	70.78	4.87	78.15	\$859.68	5038.68	0.08	0.00	0.00	4.87	4.87
	Busló	64.29	64.37	76.78	4.87	78.15	5030.68	5030.68	0.00	0.00	0.00	4.87	4.87
Baul5	Bun13	393.29	393.70	426.94	4.57	82.80	32598.53	32598.53	0.00	0.00	0.00	4.57	4.57
Busló	Bus14	385.75	386.21	424.66	4.87	78.15	30184.05	30184.05	0.00	0.09	0.09	4.87	4.57
Buil7	Bas27	124.02	124.75	354.73	10.86	177.19	22103.41	22103.41	0.00	0.00	0.08	10.86	10.86
	Buri21	68.67	61.69	77,48	11.75	239.40	14625.48	14625.48	0.00	0.00	0.08	11.75	11.75
	Bus25	18.52	19.23	29.66	37.97	329.45	\$163.35	6163,35	0.00	0.00	0.00	27.97	27.97
	Bus19	49.62	49.71	55.40	8.99	109.65	5451.03	\$451.83	0.00	0.00	0.08	5.99	5.99
Bus18	Bus2	30.98	31,96	35.68	7.30	124.61	3870.57	3876.57	0.00	0.00	0.00	7.30	7.30
	Bies20	30.98	31.06	55,68	7.30	124.61	3879,57	3678.57	0.00	0.09	0.09	7.38	7.30
Bus19	Busl7	297.75	298.28	332.41	5.99	109.65	32706.16	32706.16	0.00	0.00	0.00	5.99	5.99
Bus20	Bus18	185.88	186.57	214.08	7,30	124.61	23223.44	23223.44	0.09	0.00	0.08	7.38	7.36
Bus21	Bus17	60.27	69.74	77.14	12.55	139.64	14009.68	14009.68	0.00	0.00	0.00	12.55	12.55
	Bus25	12.78	14.26	27.33	49.54	879.24	12542.29	12542.29	0.00	0.09	0.00	49.54	49.54
	Bus22	54.27	54.15	59.95	5.02	90.05	1941.45	24, 11,91	0.00	0.00	0.00	5.02	5.02

#### System Harmonics Branch Information

Project:	MASTER THESIS	ETAP		Page:	17
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: 1	HA	Revisiou:	Base
Filename:	HOUN SUBSTATION 220kV	Shady Case -		Config:	Normal

Bus						Current	Distortion						
From Bus ID	To Bes ID	Fund. Amp	RMS Amp	ASUM Amp	THD %	TIF	П Амр	IТв Амр	ITn. Autp	TIHD %	TSHD %	THDG %	THDS 44
But22	Bur21	325.59	326.00	359.67	5.82	90.95	29645.68	29645.68	0.00	6.00	0.60	\$.02	5.02
Bus23	Bush7	13.84	13.90	16.61	9.58	183.74	2554.54	2554.54	0.00	0.00	0.00	9.58	9.58
	Bu:21	7.81	7.91	10.27	15.81	316.99	2506.68	2506.68	90.0	8.89	0.00	15.81	15.81
	Bax25	11.34	21.39	24.38	7.22	109.95	2352.16	2352.16	0.00	0.00	0.00	7.22	7.22
Bon15	Bus23	128.01	128.34	146.28	7.22	109.96	14112.98	14112.98	90.6	0.00	0.00	7.22	7.22
Buil7	Buil7	124,35	125.05	154.78	18.62	172.21	11535.02	21535.02	0.00	0.00	0.00	10.62	10.62
	Buil	176.69	177.38	212.16	8.82	148.16	26288,37	26280.37	0.00	0.00	0.00	8.82	8.82
	Bun28	32.64	32.08	35.35	5.53	102.36	3284.20	3284.20	0.00	0.00	0.00	5.53	5.53
	Bus29	32.04	32.06	35.35	5.53	102.36	3284.20	3284.20	0.00	0.00	9,00	5.53	5,53
Bus28	Bus27	192.21	192.51	212.07	5.53	102.36	19705.18	19705.18	0.00	0.00	0.00	5.53	5.53
Bus19	Bus27	192.21	192.51	212.07	5.53	102.36	19705.18	19705.18	0.00	0.00	0.00	5.53	5,53
Bux30	Busl	120.25	120.37	130.55	4.49	\$0.85	9732.70	9732.70	0.00	0.00	0.00	4.49	4.49
	Bus31	120.25	120.37	130.35	4,49	80.85	9732.70	9732.70	0.00	0.00	0.00	4.49	4.49
Bur31	Bur2	52.67	52.76	58.95	5.76	96.21	5075.57	5075.57	0.00	0.00	0.00	\$.76	5.76
	But55	52.67	51.76	58.95	5.76	96.21	5075.57	5975.57	0.00	0.00	0.00	5.76	5.76
Bas32	Bas30	721.51	722.24	782.10	4.49	80.85	58396.22	58396.22	0.00	9,00	9.00	4.49	4.49
But33	Bas31	316.02	316.55	353.71	5.76	96.21	30453.45	30453.45	0.00	0.09	0.90	5.76	5.76

Project:	MASTER THESIS	ETAP		Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	-nauly care.		Config:	Normal

								Bus Ta	bulation								
						Harr	nonic Vol	tages (%	of Funda	mental Ve	dtage)						
Bui ID: Fund. kV)	Bunl 63.063																
Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 10	Order	Freq. Hz	Mag.
5.00	250.00	1.15	7.00	350.00	0.54	11.00	558.00	4.71	13.00	650.00	5.55	17.00	850.00	0.25	19.00	950.00	0.14
23.00	1150.00	0.12	25.00	1250.00	0.85												
But ID: Fund. kV:	Ban10 10.223																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 10	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 19	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 94
5.00	250.00	2.19	7.00	358.00	0.52	11.00	558.00	4.26	13.90	650.00	4.87	17.00	850.00	0.22	19.00	\$55,00	9.11
23.00	1150.00	6.69	25.00	1259.00	0.58												
Bet ID: Fund. kV:	Ban2 64.856																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 56	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
5.00	250.00	2.94	7.00	350.00	1.80	11.00	550.00	4.77	15.00	650.00	4.83	17.00	\$50.00	0.63	19.09	950.00	0.36
23.00	1150.00	0.11	25.00	1259.00	0.50												
But ID: Fund. kV:	Bat0 10.731																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.	Order	Freg. Hz	Mag. 94
5.00	250.00	2.85	7.00	350.00	1.79	11.00	\$50.00	4.69	13.00	650.00	4.72	17.00	\$50.00	0.61	19.00	950.00	8.35
23.00	1150.00	0.10	25.00	1258.80	0.46												

Project:	MASTER THESIS	ETAP		Paget	19
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SIN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	На	Revision:	Bate
Filename:	HOUN SUBSTATION 229kV	construction.		Config:	Normal

								Bus Ta	bulation								
						Ha	armonic V	oltages (	% of Nom	inal Volta	age)						
Bus ID: Nom. kV	Busl : 66.000	0															
Order	Freq. Ha	Mag. %	Order	Freq. Hz	Mag. 16	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 94
5.00 23.00	259.60 1150.00	2.15	7.00	350.00	0.51	11.00	550.00	4.50	13.00	6590.00	\$.53	17.90	\$59.00	9.27	19.00	950.00	0.13
Bus ID: Nom. kV	Busl0																
Order	Freq. Ha	Mag. %	Order	Freq. Hz	Mag. No	Order	Freq. Ha	Mag. 46	Order	Freq. Ha	Mag. 54	Order	Freq. Hz	Mag. 56	Order	Freq. Hz	Mag.
5.80	256.00	2.83	7.00	350.00	0.48	11.00	\$50.00	3.96	13.00	650.00	4.83	17.60	\$58.00	0.21	19.00	956.00	0.10
23.00	1159.00	0.05	25.00	1250.00	8,54												
Bus ID: Nom. kV	Bus2 66.000	i)															
Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 16	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 56
5.90	156.80	1.89	7,00	350.00	1,77	11.00	550.00	4.69	13.00	650.00	4.74	17.60	\$58.00	0.62	19.90	950.00	0.36
23.00	1150.00	0.11	25.00	1250.00	9.49												
Bus ID: Nom. kV	Burs9	19															
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. H2	Mag. 96
5.00	259.00	2.86	7.00	350.00	1,75	11.00	550.00	4.58	15.00	\$50.00	4.60	17,60	\$59,80	0.59	19.00	950.09	0.54
23.00	1150.00	0.19	25.00	1250.00	0.45												

Project:	MASTER THESIS	ETAP		Page:	20
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.		Config:	Normal

#### VIHD (Individual Harmonic Distortion) Report

Bus				
ŁV	Fund. %	VIHD %	Order	
11.000	94.48	2.23	5,00	
11.000	94.48	4.72	11.00	
11.000	94.48	5.58	13.00	
	EV 11.000 11.000 11.000	Volt EV % 11.000 94.48 11.000 94.48 11.000 94.48	Voltage Distor   Fund. VIHD   EV % %   11.000 94.48 2.23   11.000 94.48 4.71   11.000 94.48 5.58	

Project: MASTER THESIS		ETAP		Page:	
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	На	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stany Cases	463	Config:	Normal

#### VTHD (Total Harmonic Distortion) Report

Bu	15	Vol Diste	tage ortion
D	kV	Fund. 96	VTHD %
Berð	220.000	100.00	11.68
Ban6	11.000	94.45	7.71

Indicates buyes with THD (Total Harmonic Distortion) exceeding the limit

Project:	MASTER THESIS	ETAP		Page:	22
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	НА	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	onally care.		Config:	Normal

A	dert Summary Rep	ort					
	% Alert Settings						
	Critical	Marginal					
Bus							
Individual Bus VTE	ID / VIHD values are	used.					
Transformer							
Total I	100.0	95.0					
Filter							
Capacitor kV	100.0	95.0					
Inductor Amp	100.0	95.0					
Capacitor							
Max kV	100.0	95.0					
Cable							
Ampacity	100.0	95.0					

#### **APPENDIX 9**

#### HARMONICS ANALYSIS WITH PV

Project;	Project: MASTER THESIS			Page:	
Location:	HOUN CITY - LIBYA	12.6.0H	1	Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Cart Cart	12008	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### **Electrical Transient Analyzer Program** Harmonic Load Flow (With PV) Loading: Operating P. Q Generation: Operating P. Q. V Swing V-Control Load Total Number of Buses: 7 3 30 40 XFMR2 XFMR3 Reactor Line/Cable Impedance Tie PD Total .0 Number of Branches: 24 .0 16 0 0 40 Number of Harm. Sources: 4 0 Number of Filters: 0 Method of Solution: Adaptive Newton-Raphson Maximum No. of Iteration: 99 Precision of Solution: 0.0001000000 System Frequency: 50.00 Hz Unit System: Metric

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	oned) carry tare	Config:	Normal

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yet	Individual	

Project:	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case!	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Sindy Case.		Config:	Normal

Im Imital Vitage Cuertant VXA Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T Cuertant T NU NU VIIID <tht< th=""><th></th><th></th><th></th><th colspan="4">Load</th><th></th><th></th></tht<>				Load											
ID W 964-50 94-56 94-56 MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW MW		Bm		Initial V	eltage	Court	ant kVA	Coas	rant Z	Cen	taut I	Generic		% L	imits
Ball 66.00 1 95.8 360 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 </th <th>ID</th> <th>ky</th> <th>Sub-aya</th> <th>16 Mag.</th> <th>Aug.</th> <th>MW</th> <th>Myar</th> <th>MW</th> <th>Myar</th> <th>MW</th> <th>Myat</th> <th>MW</th> <th>Myar</th> <th>VTHD</th> <th>VIHD</th>	ID	ky	Sub-aya	16 Mag.	Aug.	MW	Myar	MW	Myar	MW	Myat	MW	Myar	VTHD	VIHD
Back66.00216.06.010.010.0010.00Back220.00310.000.010.0010.0010.00Back220.00210.04.010.0010.0010.00Back11.0019.1146.010.0010.0010.00Back11.0019.8146.010.0010.0010.00Back11.00298.146.010.0010.0010.00Back11.00197.546.010.0010.0010.00Back11.00298.146.010.0010.0010.00Back11.00298.546.010.0010.0010.00Back11.00298.546.010.0010.0010.00Back11.00298.546.010.0010.0010.00Back11.00298.546.010.0010.0010.00Back11.00298.546.010.0010.0010.00Back11.00198.546.010.0010.0010.00Back11.00198.546.010.0010.0010.00Back11.00198.646.010.0010.0010.00Back11.00198.646.010.0010.0010.00Back11.00198.646.010.0010.00<	Busl	66.000	1	98.8	-50.0									10.00	10.00
Back 120,00 1 100,0 0.0 5.00   Back 220,000 3 1060 6.0 10.00 10.00   Back 110,00 1 65,0 10.00 10.00 10.00   Back 110,00 1 65,0 5.00 10.00 10.00   Back 66,000 1 97,0 3.0.0 10.00 10.00 10.00   Back 110,00 1 97,0 66,0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 <td>Bus2</td> <td>66.000</td> <td>2</td> <td>100.0</td> <td>30.0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>10.00</td> <td>10.00</td>	Bus2	66.000	2	100.0	30.0									10.00	10.00
Bari 220.00 3 104 0.00   Bari 220.00 2 10.00 6.0 10.00 10.00 10.00   Bari 11.00 2 9.01 6.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0	Bun3	226.000	1	100.0	0.0									5.04	5.00
Bes 22.000 2 10.0 6.0   Bes 11.00 1 91.1 6.0 5.0   Bes 6.00 2 98.0 3.0 10.00 10.00 10.00   Bes 11.00 2 95.1 6.0 10.00 10.00 10.00   Bes 11.00 2 95.1 6.0 10.00 10.00 10.00   Bes1 10.00 10.00 3.0 10.00 10.00 10.00   Bes1 66.00 2 95.0 3.0 10.00 10.00 10.00   Bes1 66.00 1 95.3 35.0 10.00 10.00 10.00   Bes14 66.00 1 95.3 35.0 10.00 10.00 10.00 10.00   Bes15 11.00 1 95.3 36.0 10.00 10.00 10.00 10.00   Bes14 66.00 1 95.3 36.0 10.00 10.00 10.00 </td <td>Bas4</td> <td>220.000</td> <td>3</td> <td>100.0</td> <td>0,0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>10.06</td> <td>10.00</td>	Bas4	220.000	3	100.0	0,0									10.06	10.00
Basi 11.00 1 91.1 46.0 5.00 5.00 5.00   Bar7 66.00 2 95.8 3.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 <t< td=""><td>Bust</td><td>220.000</td><td>2</td><td>100.0</td><td>0.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>10.00</td><td>10.00</td></t<>	Bust	220.000	2	100.0	0.0									10.00	10.00
Bar?64.00298.83.010.0010.0010.00Bar811.00298.03.010.0010.0010.00Bar911.00298.060.010.0010.0010.00Bar1066.00210.003.010.0010.0010.00Bar1266.00198.358.010.0010.0010.00Bar1366.00198.358.010.0010.0010.00Bar1466.00298.03.010.0010.0010.00Bar1566.00198.558.010.0010.0010.00Bar1611.00298.53.010.0010.0010.00Bar1766.00198.53.010.0010.0010.00Bar2011.00198.53.010.0010.0010.00Bar2166.00198.53.010.0010.0010.00Bar2511.00198.53.010.0010.0010.00Bar2611.00198.53.010.0010.0010.00Bar3110.00198.53.010.0010.0010.00Bar3110.00198.53.010.0010.0010.00Bar3110.00198.53.010.0010.0010.00Bar3110.00198.53.010.0010.00 <td< td=""><td>Bun6</td><td>11.000</td><td>1</td><td>98.1</td><td>-60.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5.00</td><td>5.00</td></td<>	Bun6	11.000	1	98.1	-60.0									5.00	5.00
Barl 64.00 1 99.0 38.0 10.00 10.00 10.00 10.00   Barl 11.00 2 98.1 60.0 10.00 10.00 10.00 10.00   Barl 10.00 1 97.8 60.0 10.00 10.00 10.00 10.00   Barl 66.00 1 98.2 58.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00	Bus?	66.000	2	98.8	30.0									10.00	10.00
Back 11,00 2 98,1 0.0   Bacl 11,00 1 97,5 66,0 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00 10,00	Banß	66.000	1	99.0	-30.0									10.00	10.00
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Burl2 66.09 1 100 3.63   Burl3 66.00 1 96.3 -56.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00	Bus11	65.000	2	100.0	30.0									10.00	10.00
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Ban18 66.00 2 96.8 36.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00	Bun17	66.000	1	95.9	-30,0									10.08	10.00
Bas19 11.000 1 95,7 -00,0   Bas20 11.000 2 95,7 0,0 10.00 10.00 10.00 10.00   Bas21 66,000 1 95,9 -36,0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 <t< td=""><td>Bun18</td><td>66.000</td><td>2</td><td>95.8</td><td>30.0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>10.00</td><td>10.00</td></t<>	Bun18	66.000	2	95.8	30.0									10.00	10.00
Bar20 11.00 2 96,7 0.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00<	Bun19	11.000	1	95.7	-69.0									10.00	10.00
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Bus31 66.00 2 98.6 36.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00	Bus30	66.000	1	98.5	-50.0									10.00	10.00
Bux32 11.000 1 98.0 -60.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.	Bus31	66.000	2	95.6	30.0									10.00	10.00
Bas33 II.000 2 106.5 0.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.0	Bus32	11.000	1	98.0	-60.0									10.00	10.00
Bur34 0.496 1 106.0 -59.0 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.00 50.	Bus33	11.000	2	106.5	0.0									10.00	10.00
Bar35 0.400 1 100.0 30.0 5.00 5.00 5.00 5.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 10.00 <td>Bun34</td> <td>0.490</td> <td>1</td> <td>100.0</td> <td>-50.0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>10.00</td> <td>10.00</td>	Bun34	0.490	1	100.0	-50.0									10.00	10.00
Buché 0.400 1 100.0 -30.0 10.00 10.00	Bun35	6.000	1	100.0	-30.0									5.00	5.60
	But36	0.400	1	106.0	-30.0									10.00	10.00

#### Bus Input Data

Project:	MASTER THESIS	ETAP		Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	and the second	10	Config:	Normal

				Load										
Bes		Initial Voltage		Countant kVA		Constant Z		Comtant I		Generic		% Limits		
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Muar	MW	Mvar	MW	Mvar	VTHD	VIHD
Bus37	0.400	1	100.0	-30.0									10.00	10.00
Bus38	0.400	2	100.0	30.8									5.09	5.00
Bar39	0.400	2	100.0	30.0									5.00	5.00
Bus40	0.400	2	100.0	30.0									5.00	5.00
Bus41	11.000	1	120.5	-60.0									10.00	10.00
Bus42	11.000	3	98.9	0.9									10.00	10.00
Total Number of Buter: 40					0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.000		

	Generation Bus						Generation		Myar Limits	
ID	EV	Type	Sub-sys	ti Mag-	Angle	MW	Myar	% PF	Max	Min
Bu:3	220.000	Swing	1	180.0	8.8					
Bus4	228,000	Swing	3	100.0	0.0					
Bas5	228.000	Swing	2	100.0	0.0					
But34	0.400	Veltage Control	1	100.0	-30.0	1.952			0.000	0.000
Bus35	0.400	Voltage Control	1	100.0	-30.0	1.952			0.005	0.000
Bus36	0.400	Voltage Control	1	100.0	-30.0	1.952			0.000	0.000
Bus37	0.400	Voltage Control	E.	100.0	-39.0	1.952			0.000	0.000
But38	0.400	Voltage Control	2	100.0	30.0	1.952			0.000	0.000
Bus39	0.400	Voltage Control	2	100.0	39.0	1.952			0.000	0.000
Bus40	0.400	Voltage Control	2	100.0	38.8	1.952			0.005	0.000

13.662 0.000

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SIN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename	HOUN SUBSTATION 220kV	and the second second	Coufig:	Normal

#### Cable Input Data

					Hums or	Mhos / 1	000 m per 6	Conductor				
Cable		17	Leagth									
D	Library	Size	Adj. (m)	14 Tol	#Phate	T (*C)	RI	XI	¥1.	<b>R</b> (9	X0	7.0
Cable1	11MCUS3	300	106.0	0.0	1	75	6,976302	0.057400	0.0001646	0.240351	0.215000	
Cable1	11MCUS3	308	109.0	0.0	1	75	0.076302	0.057480	0.0001646	0.240351	0.215000	

Cable resistances are listed at the specified temperatures

#### Transmission Line Input Data

						Oh	ms or Mi	ues / 1000 m	per Phase				
1	ine			Length	6								-
1	m	Library	Size	Adj. (m)	% Tol.	#Phate	T (%C)	RI	XI	VI	RØ	X0	2.0
Linel			674	19300.0	0.0	1	75	0.056003	0.374255	.0000031	0.209077	1.360791	.8009017
Line?			674	19300.0	0.0	1	75	0.056001	0.342069	.009(034	0.200637	142464	.0009016
Line3			674	23900.0	9.9	1	75	0.056001	0.342069	.0090034	0.200637	1.424041	.0009016
Line4			674	15990.0	9,9	1	75	0.056001	0.542069	.0090034	0,209637	1.424941	.0000016
Line5			674	\$900.0	9.9	1	75	0.056001	0.342069	.0090034	0.200637	1.424041	.0000016
Line6			674	4000.0	0.0	1	75	0.056001	0.542069	.0000034	0.200637	1.424041	.0000016
Line7			674	4000.0	0,0	1	75	0.056001	0.542069	.0000034	0.200637	1.424041	.0000016
Line8			674	4000.0	0.0	1	75	0.056001	0.542069	.0090034	0.209637	1.424041	.0000016
Line9			674	4000.0	9.9	1	75	0.056001	9.342059	.0000034	0.200637	1.424041	.0008016
Line10			674	\$900.0	0.9	1	75	0.056001	0.542069	.0000034	0.200637	1.424841	.0000016
Linell			674	\$900.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424048	.0000016
Line12			674	21000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424941	.0000016
Line13			874	161000.0	9.8	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line14			674	140000.0	8.9	1	75	0.056001	9.342069	.0000034	0.200637	1.424941	.0000016

Line resistances are listed at the specified temperatures

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Contract of the second	1.11110	Config:	Normal

Transformer			Rating			z	Variatio	in a	96 Set	Tap ting	Adjusted	Phase	Shift
D	MVA	Prim kV	Sec. kV	% Z	XR	+ 5%	. 544	% Tol.	Prim.	Sec.	16 Z	Type	Angle
n	63.000	229,000	66.000	12.50	45.90	0	0	0	0	0	12.5000	Dyn	30.000
T3	63.000	229,009	66.008	12.59	45.00		0	0	0	0	11.5000	Dyn	-30.000
T4	10.000	65.000	11.000	8.35	13.00	0	0	0	0	0	\$.3500	Dyn	30.000
15	20.000	66.000	11,009	10.00	20.00		0	0	8	0	10.0000	Dyn	30.009
<b>T6</b>	20.000	66,800	11.000	10.00	20.00	0	0	0	0	0	10,0000	Dyn	30.000
17	12.500	11.000	66.000	8,35	13.00	0	0	0	0	0	8.3500	YNd.	30.000
78	12.509	11.009	66.008	8.55	13.00		0	9	0	0	8.3500	YN4	30.000
T9	10.000	66.000	11.000	8.55	13.00			0	0	0	8.3500	Dyn	30.000
T10	10.000	66.000	11.000	8.35	13.00	0	0	0	0	0	8,3500	Dyn	30.000
TII	20.000	66.000	11.000	10.00	20.00	0	0	0	0	0	10,0000	Dyu	30.000
T12	20.000	66.009	11.000	10.00	20.00		0	0	0	0	10.0000	Dyn	30.000
T13	10.000	66.000	11.009	8.35	13.00	0	0	0	0	0	8.5500	Dyn	30.000
T14	10.000	66.000	11.000	8.35	13.00		0	0		0	8.3500	Dyn	30.009
T16	29.000	65.000	11.000	10.00	20.00	0	0	0	0	0	10.0000	Dyn	30.000
117	29.000	66.000	11.000	10.00	20.00	0	0	0	0	0	10.0000	Dyn	50.000
T18	20.000	66.000	11.000	10.09	20.00		0	0	.0	0	10.0000	Dyn	30.000
T19	20.000	66.000	11.009	10.00	20.00		0	0		0	10.0000	Dyn	30.000
T20	3.000	0.400	11.000	6.25	6.00	0	0	0	0	0	6.2500	3284	-30.000
121	3.000	0.400	11.000	6.25	6.00	0	0	0	0	0	6.2500	YNd	-39.099
722	3.000	0.409	11.000	6.25	6.00		0	0	0	0	6.2500	YNd	-30.000
T25	3.009	0.400	11.009	6.25	6.00		0	0	0	0	6.2500	YNd	-30.000
T24	3.000	0.400	11.000	6.25	6.00	0	0	0	0	0	6.2500	YNd	-30.000
T25	3,000	0.400	11.000	6.25	6.00	0	0	0	0	0	6.2500	YNd	-30.000
T26	3.000	0.400	11.009	6.25	6.00	0	0	0	0	0	6.2500	XNd.	-30.000

#### 2-Winding Transformer Input Data

#### 2-Winding Transformer Grounding Input Data

Transformer								Groundi	4			
Transformer	Rating		Conn.		Primary			Secondary				
D	MVA	Prim kV	Sec. kV	Type	Type	45.	Amp	Ohm	Type	FL.	Amp	Ohm
n	63.000	220.000	65.900	D/Y	_				Solid		_	
T3	63.090	220,060	66.990	D/Y					Solid			
T4	10,090	66.000	11.000	D/Y					Salid			
75	20.000	66.060	11.000	D/Y					Solid			

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	study care.		Config:	Normal

								Groundis	ag .			
Transformer		Rating		Conn.		Primar	¥ .			Seconda	iy	
ID	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	Ohm	Туре	kV	Amp	Ohm
16	20.000	66.090	11.000	D/Y					Solid			-
17	12.500	11.000	66.000	D/V					Selid			
T8	12.500	11.000	66,000	D/Y					Selid			
19	10.000	66.000	11.000	DA					Selid			
T10	10.000	66.090	11.000	DA					Solid			
T11	20.000	66.000	11.000	DAY					Selid			
T12	20.000	66.000	11.000	D/Y					Selid			
T13	10.000	66.000	11,000	D/Y					Solid			
T14	20.000	66.000	11.000	D/Y					Selid			
T16	20.000	66.000	11.000	D/Y					Selid			
117	20.000	66.090	11.000	D/Y					Solid			
T18	20.000	66.000	11.000	D/Y					Solid			
T19	28.000	66.000	11.000	DAA					Selid			
T29	5.000	0.400	11,000	D/Y					Selid			
721	3.000	0.400	11.000	DA					Selid			
722	3.000	0.400	11.000	D/Y					Solid			
T23	3.000	0.400	11.000	D/Y					Selid			
T24	3.000	0.400	11.000	D/Y					Solid			
125	3,000	0.400	11,000	D/Y					Solid			
726	3.900	0.400	11,000	D/Y					Solid			

#### 2-Winding Transformer Grounding Input Data

Project:	MASTER THESIS	ETAP	Page:	8
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN;	
Engineer:	SAND MUSTAFA AL-REFAI	Study Casa- HA	Revision:	Base
Filename:	HOUN SUBSTATION 226kV	county conservation	Config:	Normal

CKT	Branch	Con	metted Bus ID	% P	ositive Sequ (100 MV	ience Impe VA Base)	dance
ID	Type	Frem But	To Bas	R	x	Z	Y
TI	2W XFMR	Bush	Butl	0.44	19.84	19.84	
T3	1W XFMR	Bus5	Ber2	0.44	19.84	19.84	
T4	IW XFMR	Butl	Bető	6.40	83.25	83.50	
T5	2W XFMR	Bus7	But9	2.50	49.94	50.00	
T6	2W XFMR	Bard	Bur10	2.59	49.94	50.00	
T7	2W XFMR	Bus42	Butll	5.12	66.69	66.90	
TS	2W XFMR	Bus41	Burl2	5.12	66.60	66.50	
T9	2W XFMR	Buil3	Buil5	6.40	83.25	83.50	
T10	2W XFMR	Burl4	Bun16	6.40	83.25	83.50	
ти	2W XFMR	Bus17	Ban19	1.50	49.94	50.00	
T12	2W XFMR	Burl8	Ben20	2.50	49.94	58.00	
T13	2W XFMR	Bur21	Ben22	6.40	83.25	83.50	
T14	2W XFMR	Bart23	Ber25	6.49	83,25	\$3.50	
T16	2W XFMR	Bus27	Ben28	1.90	49,94	50.00	
T17	2W XFMR	Ban27	Bun29	2.50	49.94	50.00	
T18	2W XFMR	Bur30	Bun32	2.50	49.94	56.00	
T19	2W XFMR	Bus31	Bur33	2.59	49,94	50.00	
T29	IW XFMR	Bax34	Ber41	34.25	205.50	286.53	
T21	2W XEMR	Bar35	Bas41	34.25	205.50	265.33	
T22	2W XFMR	But36	Bm41	34.25	205.50	288.33	
T23	2W XFMR	But37	Ban41	34.25	205.59	288.33	
T24	2W XFMR	Bus38	Bun42	34.25	205.50	205.33	
T25	1W XFMR	Bun39	Ban42	34.25	205.50	208.33	
T26	2W XFMR	Bun40	Ban42	34.25	205.50	208.33	
Cable1	Cable	Busl1	Bun2	0.02	0.02	0.03	0.0716998
Cable2	Cable	Bud2	Beil	0.02	0.02	0.63	0.0716998
Linel	Line	Bus2	Burl4	2.48	16.58	16,77	0.2607629
Line)	Line	Burl	Burl3	2.45	15.16	15.36	0.2842266
Line3	Line	Bun2	Bus18	2.96	18.06	18.50	6.3387157
Line4	Line	Bus27	Bas17	1.93	11.78	11.94	0.2209015
Line5	Line	Buil	Bui27	1.03	6.28	6.37	0.1178142
Line6	Line	But1	Bas?	0.51	3.14	3.18	0.0589071
Line?	Line	Barl	Bur3	0.51	3.14	3.18	0.0589071
Line8	Line	Bus2	Ben7	0.51	3.14	3.18	0.0589071
Line9	Line	Burl.	But5	0.51	3.14	3.18	0.0589071
Line10	Line	Bus2	Bun31	L.03	6.28	6,37	0.1178142
Linell	Line	Buyl	Bas:30	1.03	6.28	6.37	0.1178142

#### Branch Connections

Project:	MASTER THESIS	ETAP	Page:	9
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	ionaly case. and	Config:	Normal

CI	T/Branch	Con	anected Bus ID	%6 P	ositive Sequ (100 MV	ence Impe 'A Base)	dance
ID	Туре	From Bus	Te Bus	R	х	Z	r
Line12	Line	Bus17	Bus21	2.70	16.49	16.71	0.3092622
Line15	Line	Buil7	Bus25	20.70	126.43	128.11	2.3710100
Line14	Line	Bus21	Bus23	18.00	109.94	111.40	2.0617490

Project:	MASTER THESIS	ETAP		Page:	
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 2204/V	Stady Care		Config:	

#### CKT/Branch Connected Bus ID % Impedance, Zero Seq., 100 MVAb ID Type From Bus To Bus RØ X0 **Z**0 7.0 τ1 2WXfmr Bus3 Busl Τ3 2W Xfmr Bun5 Bus2 2W Xfmr Busl Buch T4 T5 2W Xfmr Bas7 Bus9 IW Xfmr 16 Bash Ben18 11 1WXfmr Bus42 Busli TS 2W Xfmr Bas41 Bus11 2W Vine Buil3 Bus15 19 2W Xfmr Burl4 Bas16 T10 TH 2W Xfmr Bas17 But19 T12 2W Xfinr Ban18 But20 T13 2W Xfmr Bes21 Bur22 T14 2W Xfur Bus23 Bus24 2W Xfmr But27 Bus28 T16 2W Xfmr T17 But27 Ber29 T18 2W Xfmr Bus30 Bun32 T19 2W Xfmr Bas51 But53 T20 2W Xfmr Bus34 But41 2W Xfmr Bus35 T21 Bun41 2W Xfmr 722 Bas36 Bus41 T23 2W Xfmr Bien 57 Bus41 T24 TW Xfmr Bux38 Bur42 T25 2W Xfmr Bas 59 Bus42 2W Xfmr T26 But40 Ban-12 Cable1 Bus11 0.05 0.07 Cable But! 0.06 Cable2 Cable Buş12 Bus1 0.05 0.05 9,97 Line1 Line Bun2 But14 8.86 60.29 60.94 0.1410145 63.72 0.1341983 Line2 Line Bun1 Bus13 8.89 63.89 0.1599255 Line3 Line Bus1 Bus18 10.59 75.19 75.93 Line4 Line Bus27 Bus17 6.91 49.04 49.52 0.1042992 Line5 Line Buil Ban27 3.68 26.15 26,41 0.0556262 Line6 Line Bus2 Bas7 1.84 13.08 15.21 0.0278151 0.0278131 Line? Line Basl Bus8 1.84 13.08 13.21 0.0278131 Line8 But7 13.21 Line Bas2 1.84 13.08 15.08 0.0278151 Line9 Line Busl Bus8 1.84 13.21 Line10 Lise Bun2 But31 3.68 26.15 26.41 0.0556262

#### Branch Connections Zero Sequence Impedance

Project:	MASTER THESIS	ETAP		Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cata:	HA.	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case:	115	Config:	Normal

CKT	Branch	Cor	mected But ID	% Impedance, Zero Seq., 100 MVAb					
ID	Type	From Bus	To But	RØ	X0	2.0	7.0		
Lizell	Line	Besl	Ban30	3.68	26.15	26.41	0.0556262		
Line12	Line	Bus17	But21	9.67	68.65	69.33	0.1460189		
Line13	Line	Buil7	Bun23	74.16	526.33	531.53	1.1194780		
Line14	Line	But21	Bas23	64.48	457.68	462.20	0.9734595		

Project:	MASTER THESIS	ETAP		Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H	1	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineert	SAND MUSTAFA AL-REFAI	Snady Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	II.S.	Config:	Normal

#### Machine Input Data

Machine		Connected Buy	Rating (Base)		% Negative Seq. Imp.			Grounding			% Zero Seq. Imp.				
	ID	Type	ID	MVA	kV	RPM	X/R	RI	X2	Conn.	Type	Amp	X/R	R9	X0
Ul		Grid	Bm3	22.101	220.000		16.00	9.950	99.50	Wise	Solid		10.00	35.648	356.48
U2		Geid	Ben4	22.101	220.000		18.88	9.950	99.50	Wye	Solid		10.00	17.738	177.38
U3		Griel	Bus5	22.101	220.000		16.00	9,950	99.50	Wye	Solid		10.00	17.738	177.38
Project:	MASTER THESIS	ETAP	Paget	13											
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Location:	HOUN CITY - LIBYA	12.6.9H	Date:	28-06-2016											
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:												
Engineert	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base											
Filename:	HOUN SUBSTATION 220kV	and serves and	Config:	Normal											

#### Harmonic Library

Current Harmonic Source in %

Manufae	turer:	Typical-I	EEE														
Order	Freq. Hz	Mag.	Onler	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
1.00	59.00	100.00	11.60	550.00	\$.30	13.00	650.00	6.70	23.00	1159.00	2.80	25.00	1250.00	2.38	35.00	1750.00	0.88
37,00	1850.00	0.60	47.00	2350.00	0.20	49.00	2450.00	0.20									

Manufa	charker:	Typical-I	EEE														
Model: Order	Freq. Hz	12 Pulse2 Mag. %	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96
1.00	50.00	100.00	11.00	550.00	\$.30	13.00	650.00	6,70	23.00	1159.00	2.80	25.00	1250.00	2.38	35.90	1758.00	0.80
37.00	1850.00	0.60	47.00	2350.00	6.20	49,00	1450.00	0.20									

Manufae Model:	charter:	Typical-I 12 Palse	EEE 2														
Order	Freq. Bz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
1.00	58,60	100.00	11.00	\$\$0.00	\$.30	13.00	650.00	6.70	23.00	1150.00	2.80	25.00	1250.00	2,30	35.80	1759.00	0.80
37.00	1359.00	0.60	47,60	2350.00	0.20	49,00	2450.00	0.20									

Manufa	cturer:	Typical-D	EEE														
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
1.00	59.00	100.00	11.00	550.00	\$.30	13.00	658.80	6.70	23.00	1159.00	2.80	25.00	1259.00	2.39	35.00	1750.00	0.88
37,00	1350.00	0.60	47.00	2350.00	0.20	49.00	2450.00	0.20									

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case- HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stary Cars. 144	Config:	Normal

	1	Harmonic Sour	ce from Library			
			Harm	onic Source Informa	tion	
Bas ID	Device ID	Type	Manufacturer	Model	Fund. Freq.	Mod. Freq.
Bur34	Inv11	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus36	Inv15	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus37	Inv18	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus39	Inv21	Current	Typical-IEEE	12 Pulse2	0.00	0.00

166

Project:	MASTER THESIS	ETAP		Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	State state	W. ARCOV	Config:	Normal

Bu	5	Volt	age	Gener	ation	Lo	ad		1	Load Flow	t			XFMR
m	ŁV	98Mag.	Ang.	MW	Mvar	MW	Mvar	n	D	MW	Myar	Авр	96 PF	46 Tap
Basi	65,000	101.039	-29.1					Bart12		-7,726	0.632	67.1	.99.7	
								Buil3		0.000	-0.290	15	0.0	
								Bes27		0.014	-5.271	45.6	-0.5	
								Bent		0.000	-0.060	0.5	0.0	
								Bet8		0.000	-8.668	0.5	0.0	
								Bat30		0.000	0.120	1.0	0.0	
								Ben3		7.712	5.190	80.4	\$3.0	
								Beth		0.000	0.000	0.0	0.0	
Bas2	65.000	166.169	30.7					Buill		-5.799	0.364	50.8	-99.8	
								Bail4		0.000	-0.261	2.5	0.0	
								Bar18		6.000	-0.540	3.0	0.0	
								Bas7		0.090	-0.059	0.5	0.0	
								Bas7		0.000	0.059	0.5	0.0	
								Bas31		0.000	-0.118	1.0	0.0	
								Bes5		5.799	0.453	50.8	99.7	
Ben3	229.909	100.000	0.0	.7.708	-5.012			Banl		-7.798	-5.012	24.1	83.8	
Bar5	229,909	100.000	0.0	-5.798	-0.386			Ber2		-5.798	-0.386	15.2	99.8	
Buth	11.909	101.039	-59.1					Burl		0.000	0.000	0.0	0.0	
Bes7	66.809	100.110	30.7			0		Ban2		0.000	0.000	0.0	0.0	
								Bes2		0.000	0.000	0.0	0.0	
								Bec9		0.000	0.000	0.0	0.0	
Bast	65,800	101.040	-29.1					Banl		0.090	0.000	6.0	8.0	
								Berl		0.000	0.000	0.0	0.0	
								Ben19		0.000	0.000	0.0	0.0	
Bast9	11.000	100.110	0.7					Bus7		0.000	0.000	0.0	0.0	
Bus10	11,000	101.040	-59.1					Bes8		0.000	0.000	0.0	0.0	
Buill	66,909	100.110	30.7					Bus2		5.799	-0.456	50.8	-99.7	
								Basi42		.8.799	0.456	50.5	-99.7	
Ben12	66.000	101.041	-29.1					Bunl		7.726	-0.695	67.2	.99.6	
								Bas41		-7.726	0.695	67.2	.99.6	
Bus13	65,909	101.061	-29.1	0				Banl		0.000	0.000	0.0	0.0	
								Bes15		6.000	0.000	0.0	0.0	
Bus14	65,999	100.130	30.7					Ber2		0.000	0.000	0.0	0.0	
								Buslé		0.000	0.000	0.0	0.0	
Burl 5	11.000	101.061	.59.1					Ben13		0.000	0.000	0.0	0.0	
Bas16	11,000	160.130	0.7				0	Berl4		0.000	0.000	0.0	0.0	
Ruel?	65.909	101.950	29.2			1.0		Sec27		-0.007	4.968	12.6	-0.1	

#### Fundamental Load Flow Report

Project:	MASTER THESIS	ETAP	Pager	16
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SNr	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and the second	Config:	Normal

Bus		Volt	age	Gene	ation	Lo	ad			Load Flow	5		_	XFMF
ID	av.	16Ming-	Aug.	MW	Myer	MW	Mose		ID	MW	Myar.	Ang	% PF	No Tap
								Bes21		0.004	-2,486	21.3	-0.1	
								Ban23		0.003	-2.482	21.3	-0.1	
								Ban19		0.000	0,000	0.6	0.0	
as18	66.900	100.159	30.7		0		0	Bar2		0.000	0.000	0.0	0.0	
								Bert20		0.000	0.000	0.0	0.0	
lui19	11.000	101.950	-59.1	8	0		0	Ban17		0.000	0.000	0.6	0.0	
las20	11.000	100,159	0.7		0		0	Bar18		0.000	0.000	0.0	0.0	
lun21	66.000	102.326	-29.3		.0			Bet17		-0.002	2.172	18.6	-0.1	
								Bas23		0.002	-2.172	18.6	-0.1	
								Bas22		0.000	0.000	0.0	0.0	
an22	11,000	102.326	-59.3					Bet21		0.000	0.000	0.0	0.0	
4423	65.000	103,500	-29.4	8	0		8	Bes17		0.000	-9.801	0.6	-16.2	
								Ben21		0.000	6.601	0.6	-16.2	
								Bet25		0.000	0.000	0.0	0.0	
u:25	11,000	103.500	.60.4		0			Ban23		0.000	0,000	0.0	0.0	
un27	66,900	101.363	-29.2		0		0	Bat17		0.011	-5.167	44.6	-0.2	
								Beil		-0.011	5.167	44.6	-0.2	
								Bas28		0.000	0,000	0.0	0.0	
								Ban29		0.000	0.600	0.6	8.8	
us28	11,000	101.363	-59.1		0			Bes27		0.000	0.005	0.0	0.0	
4129	11,000	101.363	.60.2					Bas27		0.000	0,000	0.0	0.0	
41.30	65.000	101.043	-29.1	0	0	. 0	0	Barl		0.000	0.600	0.6	0.0	
								Ben32		0.000	0.800	0.0	0.0	
4531	65.000	109.112	30.7					Bas2		0.000	0.000	0.0	0.0	
								Ban33		0.000	0.600	0.0	0.0	
4532	11.000	101.043	-59.1		.0	0	0	Bas30		0.000	0.800	0.0	0.0	
4035	11.909	100.112	0.7		0			Bet31		0.000	0.008	0.0	0.0	
u134	0,400	101.685	-24.0	1.952	0.000		0	BaidI		1.952	0.600	1778.4	100.0	
us35	0,400	101.685	-24.0	1.952	0.000	.0	0	Ber41		1.952	0.800	1779.4	100.0	
4:36	8,409	101.685	-24.0	1.952	0.000			Bar41		1.952	0.008	2778.4	100.0	
us37	0.400	101.485	-24.0	1.952	0.000		0	Bm41		1.952	0.000	2778.4	100.0	
us38	0,400	109,762	36.2	1.952	0.000		0	Ber42		1.952	0.000	2795.7	100.0	
4:39	0,400	100,762	35.2	1.952	0.000			Ben42		1.952	0.008	1795.7	100.0	
un40	0,400	108.762	35.2	1.952	0.000		0	Ber42		1.952	0.000	1795.7	100.0	
an41	11,000	101.104	-56.2		0			Beil2		7.756	-0.303	403.0	.99.9	
	1.000		1.10	(75)		1.1	1.11	But.34		-1.030	9.876	100.7	-99.9	
								Bas35		-1.939	0.076	100.7	.99.9	
								Bat36		-1.939	0.076	100.7	.99.9	
								B-17		1.030		100.7		

Project:	MASTER THESIS	ETAP		Page:	17
Location:	HOUN CITY - LIBYA	12.6.0H	t i i i i i i i i i i i i i i i i i i i	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Juney Caller		Config:	Normal

Bu	1	Volt	tage	Gener	ration	Lo	ad			Load Flow				XFMR
ID	kV	%Mag.	Ang.	MW	Myar	MW	Myar	_	ID	MW	Myar	Авр	% PF	% Tap
Bus42	11.000	100.178	2.9	0	0		0	Buill		5.817	-0.231	305.0	-99.9	
								Bu:38		-1.939	0.077	101.7	-99.9	
								Bur.39		-1.939	6.677	101.7	-99.9	
								But40		-1.939	0.077	101.7	-99.9	

 o  Indicates a voltage regulated bus (voltage controlled as wring type machine connected to it) # indicates a bus with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	На	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	County south		Config:	Normal

Bu	1				Volt	tage Distort	iou			
ID	ŁV	Fund.	RMS 94	ASUM 56	THD %	ш	TIHD to	TSHD 16	THDG	THDS
Bunl	66.909	101.04	101.07	105.13	2.32	53,04	0.00	0.00	2.32	2.32
Bus2	66.000	100.11	100.12	101.91	1.14	20.54	0.00	0.09	1.14	1.14
Bus3	220.000	100.00	100.03	163.92	2.25	51.33	0.00	0.00	2.25	2.25
Bust	220.000	100.00	100.01	101.72	1.09	19,70	0.00	6.09	1.09	1.09
Bush	11.000	101.04	101.07	105.13	2.32	53,04	0.00	0.00	2.32	2.32
But7	66.000	100.11	100.12	101.91	1.14	20.58	0.00	0.00	1.14	1.14
Buss	66.000	101.04	101.07	105.14	2.52	53.21	0.00	0.00	2.32	2.32
Barth	11.000	100.11	100.12	101.91	1.14	20.58	0.00	8.00	1.14	1.14
Bus10	11.000	101.04	101.07	105.14	2.32	53.21	0.00	0.00	2.32	2.32
Bun11	66.909	100.11	100.32	101.91	1.14	20.54	0.00	0.00	1.14	1.14
Bas12	66.000	101.04	101.97	105.13	2.32	53.05	0.00	0.09	2.32	2.32
But15	66.900	101.06	101.09	105.40	2.40	57.58	0.00	0.00	2.40	2.40
Bus14	66.000	100.13	100,14	102.03	1.17	21.51	0.00	0.00	1.17	1.17
But15	11.000	101.06	101.09	105.40	2.40	57,58	0.00	0.00	2.40	2.40
Bus16	11.009	100.13	100.14	102.01	1.17	21.51	0.00	0.00	1.17	1.17
Bun17	66.000	101.95	101.97	105.01	1.89	36.15	0.00	6.09	1.89	1.89
Bus18	\$6.009	108.14	100.15	102.06	1.19	21.99	0.00	0.00	1,19	1.19
Bun19	11,000	101.95	101.97	105.01	1.89	36.15	0.00	0.00	1.59	1.59
Bus20	11.000	100.14	100.15	102.06	1.19	21.99	0.00	0.00	1.19	1.19
But21	66.000	102.35	102.34	195.84	1.79	52.33	0.00	0.09	1.79	1.79
Bus22	11.000	102.33	102.34	105.84	1.79	52.33	0.00	0.00	1.79	1.79
Bun25	66.000	103.50	103.55	107.72	2.96	47.16	0.00	0.00	2.96	2.96
Bus25	11.909	103.50	103.55	107.72	2.96	47.16	0.00	0.00	2.96	2.96
Bus27	66.909	101.36	101.39	105.02	2.15	43.49	0.00	0.00	2.15	2.15
Bus28	11.000	101.56	161.59	105.02	2.15	43.49	0.00	0.00	2.15	2.15
Bun29	11.000	101.36	101.39	105.02	2.15	43.49	0.00	0.00	2.15	2.15
Ban30	66.000	101.04	161.67	105.17	2.39	\$3.75	0.00	0.09	2.33	2.35
Bur.31	66.000	100.11	100.12	101.92	1.15	26.70	0.00	0.00	1.15	1.15
Bus31	11.000	101.04	101.07	105.17	2.33	\$3.73	0.00	0.00	2.33	2.33
Bun33	11.000	100.11	100.12	101.92	1.15	20.70	0.00	0.00	1.15	1.15
Bun34	0.400	101.68	101.91	117.50	6.73	273.30	0.00	0.00	6.73	6.73
Bus35	0.400	101.68	101.75	109.24	3.69	130.71	0.00	6.00	3.69	3.69
Bus.36	0.400	101.68	101.91	117.59	6.73	273.30	0.00	0.00	6.73	6.73
Bus37	0.400	101.68	161.91	117.50	6.73	273.36	0.00	0.09	6,73	6.73
Bus38	0.400	100.76	100.76	102.19	0.58	28.34	0.00	0.00	0.58	0.58
Bus39	0.400	100.76	100.53	110.01	3.61	181.76	0.00	0.00	3.61	3.61
Bus40	0.400	100.76	100.76	102.19	0.58	28.54	0.00	0.00	0.58	0.58
Bus41	11,000	101.10	101.18	109.18	3.97	140.58	0.00	0.00	3.97	3.97
Bus42	11.000	100.15	100.18	101.70	0.62	30.46	0.00	0.00	0.63	0.63

### System Harmonics Bus Information

* IndicatesTHD (Total Harmonic Distortion) Exceeds the Limit, # Indicates IHD (Individual Harmonic Distortion) Exceeds the Limit.

Project:	MASTER THESIS	ETAP		Page:	19
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Siddy Class	7777-F	Config:	Normal

Bus	12					Current	Distortion						
From But ID	To But ID	Fund. Aup	RMS Amp	ASUM Amp	THD %	TIF	IT Amp	ITs Amp	ITR Amp	TIHD %	TSHD %	THDG	THDS %
Besl	Ber12	67.11	67.15	71.91	3.66	98.65	6624.56	6624.56	0.00	0.00	0.00	3.66	3.64
	Bun1.5	2.51	2.63	4.13	31.18	1067.19	2808.61	2898.61	0.00	0.00	0.00	31.18	51.10
	Bias27	45.64	45.74	51.39	6.57	215.97	9877.82	9877.82	0.00	0.00	0.00	6.57	6.51
	Bust	0.52	8.54	0.54	38.34	1005.48	547,08	547.88	0.00	0.00	0.00	30.54	50.54
	Bas8	0.52	8.54	0.54	30.34	1005.48	547,88	547.06	0.00	0.08	9.00	30.34	30.34
	Ban30	1.64	1.69	1.69	30.44	1012.47	1102.09	1102.69	0.00	0.00	0.00	30.44	30.44
	Ban3	89.43	80.43	\$1.00	6.46	8.15	\$55.68	655.68	0.00	0.00	0.00	0.46	0.4
	Buth	.0	0		0		0.00	655,68	0.00	0.00	0.00	0.08	0.00
Bus2	Beil1	50.79	58.79	52.38	1.64	41.16	2090.84	2090.84	9.09	0.08	9.00	1.64	1.64
	Bas14	2.28	1.31	1.56	13.81	316.96	758.51	750.51	0.00	0.00	0.00	15.81	13.81
	Bas18	2.97	3.00	3.73	13.92	323.86	970.03	978.83	0.00	0.08	9.00	13.92	13.92
	Bas7	0.52	8.52	0.64	13.58	304.59	158.57	158.57	0.00	0.00	0.00	13.58	13.58
	Ben7	0.52	0.52	0.64	13.58	304.59	158.57	158.57	0.00	0.00	0.00	13.58	13.58
	Bes31	1.03	1.04	1.29	13.61	306.03	318.66	318.66	0.00	0.00	0.00	13.61	13.61
	Bur5	50.83	58.83	51.09	0.36	5.95	302.37	392.37	8.09	0.08	9.00	0.36	0.34
Bes3	Besl	24.13	24.13	34.30	0.46	8.15	196.70	196.70	0.00	0.00	0.00	0.46	0.46
Bies5	Bas2	15.25	15.25	15.33	0.36	5.95	90.72	90.71	0.00	0.08	0.00	0,36	6,34
Busi	Bas1	0	0		0		0.60	90.71	0.00	0.00	0.00	0.08	0.01
Bus7	Biet2	0			0		0.00	90.71	0.00	0.00	0.00	0.00	0.04
	Bas2	0			.0		0.00	90.71	0.00	0.00	0.00	0.08	0.01
	Ban9				0		0.00	90.71	9.00	0.08	9.00	9.09	0.04
BatS	Bas1		0		0		0.60	90.71	0.00	0.00	0.00	0.08	0.90
	Basl				. 0		0.00	90.71	0.00	0.08	0.00	0.08	0.04
	Bas10	0			0		0.00	90.71	0.00	0.00	0.00	0.08	0.00
Bur9	Bus7				0		0.00	90.71	9.09	0.08	9.00	0.00	0.04
Basto	Barti				0		0.00	90.71	0.00	0.00	0.00	0.09	0.01
Busl1	Bur2	50.83	58.54	52.58	1.80	44.59	2282.37	2282.37	0.00	0.08	9.00	1.88	1.8
	Bus42	50.83	59.84	52.58	1.80	44.59	2282.37	2282.37	0.00	0.00	0.00	1.80	1.84
Bus12	Bail	67.16	67.20	71.82	3.57	93.57	6288.25	6288.25	0.00	0.09	0.00	3.57	3.57
	Bus41	67.16	67.20	71.82	3.57	93.57	6288.25	6288.25	0.00	0.00	0.00	3.57	3.57
Bus1.3	Banl				0		0.60	6288.25	9.09	0.08	9,00	0.00	0.04
	Bas15						0.00	6288.25	0.00	0.00	0.09	0.08	0.01
Bus14	Bun2				.0		0.00	6288.25	0.00	0.08	0.00	0.08	0.01
	Ban16		0		0		0.80	6288.25	0.00	0.00	0.00	0.08	0.01
Bus15	Bas13				.0		0.00	6288.25	0.00	0.08	0.00	0.08	0.04
Busló	Burl 4	.0			.0		0.00	6288.25	0.00	0.09	0.00	0.08	0.01
Bus17	Ben27	#2.63	42.77	48.61	8.67	258.04	11036.00	11036.00	9.00	0.08	9.00	8.07	8.07
	Bus21	21.33	21.45	25.79	10.66	445,69	9625.84	9625.84	0.09	0.09	0.09	10.66	10.64
	Bun23	21.30	23.34	23.58	6.56	181.12	3865.78	3865.78	0.00	0.08	0.00	6.56	6.54
	Bux19						0.00	3865.78	0.00	0.00	0.00	0.08	0.01

#### System Harmonics Branch Information

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H		Page: Date:	20 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	НА	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	State Care.		Config:	Normal

Bas						Curren	Distortion	1					
From Bar ID	Te Bus ID	Fund. Amp	RM5 Amp	ASUM Amp	THD	ш	IT Amp	ITs Amp	ITR Amp	TIHD %	TSHD 4h	THDG	THDS %
Ber18	Bei2	0	0	0	0	0	0.00	3865.78	0.00	0.00	0.00	0.00	0.00
	Bart20	0	0	0		0	0.06	3565.75	0.00	8.00	0.00	0.08	0.08
Beilf	Berl7	0	0	0		0	0.90	3865.78	0.90	0.06	0.90	0.08	0.00
Bat20	Bar18		0	0		0	0.06	3865.78	0.05	0.00	0.05	0.08	0.00
Bm21	Bun17	18.87	18.72	23.08	12.90	445.83	8347.30	8347.30	0.00	0.00	0.00	12.90	12.99
	Bar23	18.57	18.72	25.05	12.90	445.83	8347.30	8547.58	0.05	0.00	0.05	12.90	12.98
	Bes22	0	0	0		0	0.00	8347,50	0.00	0.00	0.00	0.00	0.00
But22	Bar(21	0	0	0		0	0.00	8347.50	0.00	0.00	0.00	0.08	0.08
Bui23	Bes17	0.01	0.39	0.75	4859.20	2615.09	1019.95	1019.93	0.00	0.05	0.00	4850.20	4850.20
	Bar21	0.01	6,39	0.75	4550.20	2613.05	1019.93	1019.93	0.08	0.00	0.06	4350.28	4550.20
	Ban25	0	0	0	0	0	0.00	1019.93	0.00	0.00	0.00	0.00	0.00
Bat25	Bar23		.0	0		0	0.06	1019.93	0.08	0.00	0.05	0.08	0.00
Bus27	Bud7	44.59	44.71	50.56	7.15	237.32	10610.25	10610.28	0.00	0.00	0.00	7.15	7.15
	Burl.	44.59	44.71	50.56	7.15	237.52	10610.28	10610.25	0.08	0.00	0.00	7.15	7.15
	Bas28	0	0	0		0	0.90	10610.28	0.00	0.00	0.00	0.08	0.08
	Burt29	0 D	0	0		0	0.08	10610.25	0.00	0.00	0.00	0.08	0.08
Bm28	Bar27	0	0	0		0	0.00	19610.28	0.00	0.00	0.00	0.00	0.00
Bet29	Bar27		0	0		0	0.06	10610.25	0.08	0.00	0.06	0.08	0.08
But30	Banl	0	0	0	0	0	0.00	10610.28	0.00	0.00	0.00	0.00	6.00
	Bur32	0	. 0	0		0	0.00	10610.28	0.08	0.00	0.08	0.08	0.09
Bet51	Bas2	0	0	0		0	0.00	10610.29	0.00	0.00	0.00	0.00	0.00
	Bur33	0.0	0	0		0	0.08	10610.25	0.00	0.00	0.00	0.08	0.08
Build	Bm30	0	0	0		0	0.00	19610.28	0.00	0.00	0.05	0.00	0.00
Bet55	Bar31		0	0		0	0.08	10610.25	0.08	0.00	0.05	0.08	0.00
But34	Bm41	2770.37	2775.68	5933.78	4.89	127.69	354180.40	354180.40	0.00	0.00	0.00	4.89	4.89
But35	Bm41	2770.37	2770.48	2792.15	0.50	10.76	29881.97	29881.97	0.00	0.00	0.08	0.58	0.50
But56	Bus11	2770.37	2773.68	5933.78	4.89	127.69	354180.40	354180.40	0.00	0.00	0.00	4.89	4.89
But37	Bur41	2770.37	2773.65	3033.78	4.89	127.69	354150.40	354150.48	0.00	0.00	0.00	4.89	4.89
But38	Bm42	2795.72	2795.72	2799.27	0,07	1.98	5530.49	5530.49	0.00	0.00	0.05	0.07	0.07
But39	Bur42	2795.72	2799,78	5052.91	5.34	136.04	380561.50	380861.59	0.00	0.00	0.00	5.34	5.34
Buri40	Bm42	2795.72	1798.72	2799.27	0.07	1.99	5530.49	5530.40	0.00	0.00	0.00	0.07	0.07
Bui41	Ben12	402.96	403.22	430.94	3.57	93,57	37729,53	37729.53	0.00	0.00	0.08	3.51	3.57
	Ber34	100.74	100.86	110.32	4.89	127.69	12879.29	12879.29	0.00	0.00	0.00	4.89	4.89
	Bec35	100.74	100.74	101.55	0.50	10.76	1065.71	1065.71	0.08	0.00	0.08	0.58	0.50
	Ban36	108.74	100.86	110.32	4.59	127.69	12879.29	12879.29	0.00	0.00	0.00	4.89	4.89
	Bur.37	100.74	109.56	110.32	4.59	127.69	12879.29	12879.29	0.00	0.00	0.00	4.59	4.89
Ben#2	Berl1	304.99	365.04	315.46	1.30	44.89	13694.22	13694.22	0.09	0.00	0.00	1.80	1.80
	Bui38	101.66	101.66	101.79	0.07	1.98	201.11	201.11	0.00	0.00	0.00	0.07	0.07
	Bm39	101.66	101.81	112.11	5.34	136.04	13849.50	13849.50	0.00	0.00	0.00	\$34	5.34
	Bun40	101.66	101.66	101.79	0.07	1.98	201.11	201.11	0.08	0.00	0.08	0.01	0.07

Project:	MASTER THESIS	ETAP		Page:	21
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		107003	Config:	Normal

								Bus Tal	bulation								
						Han	monác Vol	tages (%)	of Funda	mental Vo	sltage)						
Ber ID: Fund kV:	Beil 66.686																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	\$59.00	1.89	13.00	650.00	1.18	23.00	1158.00	6.35	25.00	1250.00	0.85	35.00	1790.00	0.05	37.60	1958.00	0.00
47,00	2350.00	0.05	49.00	1450.00	0.02												
Buy ID: Fund. kV:	Bun10 13.114																
Order	Freq. Hz	Mag.	Ordez	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	558.00	1.89	13.00	650.00	1.18	23.00	1150.00	0.33	25,80	1250.00	0.55	35.00	1750.00	8.05	37,80	1350,00	6.69
47.00	2350.00	0.03	49.00	1450.00	0.02												
Bus ID: Fund. kV	Bus11 66.072																
Order	Freq. Hz	Mag. 96	Order	Freg. Hr	Mag. No	Order	Freq. Hr	Mag. No.	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag. 96	Order	Freq. Hr	Mag. 96
11.00	550,00	0.96	13.00	650.00	0.59	23.00	1150.00	0.12	25.80	1250.09	0.09	35.00	1758.00	0.02	37,00	1850.00	0.01
47.00	1358.60	0.00	49.00	2450.00	0.00												
Bus ID: Fund. kV:	Bas12 \$6.657																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Ha	Mag. 96	Order	Freg. Hr	Mag. 16
11.00	550,00	1.89	13.00	650.00	1.15	23.80	1150.00	0.33	25.00	1250.00	0.55	35.00	1750.00	0.05	37.60	1850.00	0.00
47.00	2359,80	0.03	49.00	2450.00	0.02												
Bus ID: Fund. kV:	Bas13 \$6.700																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag.
11.00	559,80	1.94	13.00	650.00	1.22	23.00	1150.00	0.37	25.80	1250.00	0.62	35.00	1750.00	0.06	57.00	1859,00	0.00
47,00	2356.00	0.05	49.00	2450.00	0.04												
But ID: Fund. kV:	Bar14 \$6.036																
Order	Freq. Hz	Mag.	Order	Freq. Hs	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag. Na	Order	Freq. Hz	Mag.
11.66	558,80	0.99	13.00	650.00	0.61	23.00	1150.00	0.15	25.00	1250.00	0.18	35.00	1750.00	0.05	57,00	1558.00	6.02
47,00	2350.00	0.00	49.00	2456.00	0.00												
Bu; ID; Fund. kV:	Ban15 11.117																
Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550,00	1.94	13.00	650.00	1.22	23.00	1150.00	0.37	15.80	1250.00	0.62	35.00	1750.00	0.66	57.00	1556.00	0.00
47.66	2358.80	0.05	49.00	1450.00	0.04												
Buy ID: Fund. kV:	Ben16 11.614																
Order	Freq. Ha	Mag.	Order	Freq. Hi	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Ha	Mag. %	Order	Freq. Hz	Mag. %
11.00	558.00	0.99	13.00	658.00	0.61	23.00	1158.00	0.15	25.00	1250.00	0.10	35.00	1750.00	0.83	37,80	1858.00	0.02

173

Project:	MASTER THESIS	ETAP	Page:	22	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV		Config:	Normal	

								Bus Ta	bulation	8							
						Har	monic Vol	tages (%)	of Funda	unental Ve	oltage)						
Bus ID: Fund, kV:	Buc16 11.614																
Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 96	Order	Freg. Hz	Mag. 98	Order	Freq. Ha	Mag. 96	Order	Ereq. Hz	Mag. 96
47.00	1350.60	0.00	49.00	2450.00	0.00												
Bus ID: Fund, kV:	Bus17 67.287																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq. Ha	Mag. 96
11.00	559.90	1.33	13.00	650.00	1.55	23.00	1150.00	0.11	25.00	1259.00	0.05	35,00	1750.00	0.05	37.00	1850.00	0.65
47.09	2358.00	0.01	49,00	2450.00	0.01												
But ID: Fand, kV:	Bas18 66.092																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Bz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.09	559.80	1.00	13.00	650.09	8.62	23.00	1158.00	0.14	25.00	1259.00	0.10	35.00	1750.00	0.05	37.00	1850.00	0.02
47.00	2359.00	0.01	49.00	1450.00	0.01												
Bun ID: Fund. kV:	Bus19 11.215																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 54	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.
11.00	550,00	1.33	13.00	650.09	1.33	23.00	1150.00	9.11	25.00	1250.00	0.05	35.00	1750.00	0.05	37,00	1850.00	9.68
47.00	1350.00	0.01	49.00	2450.00	0.61												
But ID: Fund. kV:	Ban2 66.072																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hi	Mag.	Order	Ereq. Hz	Mag. 96
11.00	559.60	0.96	13.00	650.00	0.59	23.00	1150.00	0.11	25.00	1259.00	0.09	35.00	1750.00	0.02	37,00	1850.00	0.61
47.00	2359.60	0.00	49.00	2459.00	0.00												
Bui ID: Fund. kV:	Ban20 11.015																
Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 84	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.
11.09	\$58.00	1.00	13.00	650.00	0.62	23.00	1150.00	9.14	25.09	1259.00	0.10	35.00	1750.00	0.05	37,00	1850.00	9.02
47.00	2358.80	0.01	49.00	2458.00	0.01												
Bun ID: Fund. kV:	Bun21 67.536																
Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96	Order	Freq. Hr	Mag.	Ordez	Freq. Hr	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.
11.00	559.00	0.99	13.00	#50.00	1.32	23.00	1156.00	0.41	25.00	1259.00	0.55	35.00	1750.00	0.09	37.00	1850.00	0.07
47.00	2350.00	0.01	49.00	2450.00	8.00												
Bus ID: Fund. kV:	Ban22 11.256																
Order	Freq. Hz	Mag. 96	Order	Freq. He	Mag. 69	Order	Freq. Hz	Mag. 16	Order	Freq. Hr	Mag. 95	Order	Freq. Ha	Mag.	Order	Freq. Hr	Mag.
11.00	550.00	0.99	13.00	450.00	1.32	23.80	1158.00	0.41	25.00	1250.00	0.55	35.00	1750.08	0.09	37.00	1850.00	0.67
47.00	2350.00	0.01	49,98	2450.00	0.00												

Project:	MASTER THESIS	ETAP		Page:	23
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and souther	000000	Config:	Normal

#### Bus Tabulation

Harmonic Voltages (% of Fundamental Voltage) Bus ID: Ban23 Fund, hV: 68.310 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Hz % Hz % Hz % Hz % Hz % Order Freq. Mag. Mag. He 14 Ha 44 0.90 46 13.00 0.05 25.00 Hz 23.00 1150.00 0.05 35.60 1750.00 37.09 11.90 550.00 2,65 650.08 1.55 1850.00 0,90 47.00 2350.00 0.00 49.00 2458.00 0.00 But ID: But 25 Fund. kV: 11.385 Order Trees Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. He -Ha 14 H 64 Ha -Hr H 14 94 11.86 23,00 \$50.00 2.65 15.00 450.00 1.33 1150.00 0.05 25.08 1250.08 0.05 35.00 1758.00 0.00 37.00 1850.00 0.00 47.80 2350.00 0.08 49.00 2450.00 0.00 Bat27 Bin ID: Ban27 Fund. kV: 66.900 Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, 
 %
 Hz
 %
 Hz
 %
 Hz

 1.25
 23.00
 1156.00
 0.18
 25.00
 1250.00
 0.35
 35.00
 1750.00
 0.06 37.00 Hr He ** Hr 144 -----13.00 650.00 - -11.00 555.00 1.71 1850.00 0.65 47,00 2350,00 0.02 49.00 2450.00 0.01 Bus ID: Fund. kVi Bes18 
 Mag. *%
 Order Hz
 Freq. %
 Mag. %
 Order Hz
 Freq. %
 Mag. Hz
 Order %
 Freq. Hz
 Mag. %
 Order Hz
 Freq. Hz

 1.25
 23.00
 1150.00
 0.18
 25.00
 1250.00
 0.35
 355.00
 1750.00
 Mag. Order Freq. Mag. Order Freq. % Hz Order Freq. Mag. Hr 16 Ha 96 13.00 650.00 0.06 37.00 1856.00 11.00 550.00 1.71 9,93 47.60 2150.00 10.00 2150.00 0.02 0.01 Bus ID: Bus 29 Fund. kV: 11.150 Mag. Order Freq. % Hz Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. He 164 H 100 H H. H 1.25 0.18 25.00 1250.00 11.00 \$\$0.00 15.00 650.00 23.00 1150.00 0.35 35.00 1750.00 37.00 1850.00 1.71 0.05 0.05 47.00 2350.00 0.02 49.00 2450.00 0.61 But ID: But J Fund, kV: 220,000 Free, Mag. Freq Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Mag Order Order Free. Hr Hr 44 44 Hz .84 H -Hr 44 H .94 13.00 11.00 550.00 1.85 650.08 1.14 23.00 1155.00 0.32 25.00 1250.00 0.53 55.00 1750.00 0.04 37.00 1850.00 0.00 47.00 2350.00 0.03 49.00 2450.00 0.02 But ID: Bat.30 Fand, kV: 66.633 Order Freq. Mag. Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, Order Freq. Mag, Order Freq. Mag. Hr ** Hr 1.19 16 Ha 86 HT ** Hz 16 Hr .84 13.00 23.00 1156.00 0.34 25.00 1250.00 37.00 11.00 35.00 650.00 \$55.00 1.96 0.56 1750.00 0.05 1850.00 0.00 47.00 2350.00 0.03 49.00 2450.00 0.02 Bui ID: Bui 31 Fund. kV: 66.074 Order Free, Mag. Order Free, Mag. Order Free, Mag. Order Free, Mag. Order Free, Mag. Order Free, Mag. Ha 0.60 23.00 1150.00 
 Note:
 Other
 Prep.

 94
 Hz
 Hz

 0.12
 25.00
 1250.00
 16 Hz 0.97 13.00 650.08 Hz Hz 46 96 0.02 0.09 35.00 1750.00 11.00 550.00 \$7.00 1850.00 0.61

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	24 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

								Bus Ta	bulation								
						Harr	monic Vol	tages (%)	of Funda	mental Vo	altage)						
Bot ID: Fand. hV:	Sm31 66.074																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag. 96	Order	Freij. Hz	Mag. 96
47.00	2350.00	0.00	49.00	3450.00	0.09	-				_	_	_		-			
But ID: Fund. hV:	But32 11.115																
Order	Freq. Hi	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag. 16	Order	Freq. Hi	Mag. 96
11.00	550.00	1.90	13.00	650.00	1.19	23.00	1150.00	0.54	25.00	1250.00	0.56	35.00	1750.00	0.05	\$7.00	1850.00	0.00
47.00	2350.00	0.03	49.00	2450.00	0.02												
But ID: Fund. kV:	But35 11.012																
Order	Freq. Hz	Mag. 56	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 76	Order	Freq. He	Mag.	Order	Freq. Ht	Mag. No.	Order	Free Hz	Mag. 96
11.00	\$50.00	0.97	13.00	658.80	0.69	23,60	1158.00	0.12	25.00	1250.00	0.09	.55.00	1750.00	0.02	37.00	1356.00	0.01
47,00	2350.00	0.00	49,00	2450.00	0.00												
But ID: Fund. kV:	Bet34 6.407																
Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq Hi	Mag. No	Order	Freq. Hz	Mag. 96
11.00	550.00	4.79	13.90	650.00	2.20	23.00	1158.00	2.72	25.00	1150.00	2.67	35,00	1750.00	L.21	37.00	1550.00	1.00
47,80	2350.00	6.46	49.00	3458,80	0.50												
But ID: Fund. kV:	Ben38 8-407																
Order	Freq. Ha	Mag. %	Order	Freq. Ha	Mag. 96	Order	Freq. H#	Mag.	Order	Freq. Hr	Mag. 99	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.
11.00	550.00	3.05	13.90	650.00	0.50	23,60	1150.00	1.32	25.00	1250.00	1.39	35.00	1750.00	0.45	37.00	1850.00	6,39
47,00	2350.00	0.16	49,00	2450.00	0.17												
But ID: Fund. hV:	Bat36 0.407																
Order	Freq. Hz	Mag. 96	Order	Freq. Ht	Mag. 96	Order	Freq. Hz	Mag.	Order	Freg. Hz	Mag. 95	Order	Freq. Hz	Mag. No	Order	Free. Hz	Mag. 96
11.00	\$50.00	4,79	13.00	658,80	2.28	23.00	1158.00	2.72	25.00	1250.00	2.67	35,90	1750.00	1.21	37.60	1859.00	1.00
47,80	2356,00	0.46	49,00	3459.00	0.50												
But ID: Fund. kV;	Bes37 6.407																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 89	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 96
11.00	550.00	4,79	13.00	650.00	2.20	23.80	1156.60	2.72	25.00	1250.00	2.67	35.00	1750.00	1.21	37.90	1858,60	1.00
47.00	2550.00	0.46	49,00	2458.00	0.50												
Bus ID: Fund. hV:	Bas38 0.405																
Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 99	Order	Freq. Hr	Mag.	Order	Freq. Hr	Mag. 16
11.00	550.00	0.37	15.00	658.00	0.12	23.60	1150.00	0.27	25.00	1250.00	0.26	35.00	1750.00	0.15	37.00	1850.00	0.12
47.00	2350.00	0.06	49,00	2459.00	0.05												

Project:	MASTER THESIS	ETAP		Page:	25
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 229kV	and care	9.3 Ch	Config:	Normal

								Bus Ta	bulation	5							
-						Har	monic Vol	tages (%	of Funda	mental Vo	dtage)						
Bus ID: Fund. kV:	Bes39 0.403																
Order	Freq. Hr	Mag.	Order	Freq. Ha	Mag. 96	Order	Freq.	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hr	Mag. 96
11.00	550.00	1.53	13.00	659.00	1.76	23.00	1159.00	1.77	25,00	1256,60	1.64	35,00	1758.00	0.94	37.00	1858.00	0.77
47,00	2350.00	0.38	49,00	2459.00	0.40												
But ID: Fund, kV:	Bies4 220.000																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Örder	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 56	Order	Freq. Hr	Mag. 56	Order	Freq. Hz	Mag.
But ID: Fund hV	Bus40 0.403				-		_					-					
Order	Freq. Hr	Mag.	Order	Freq. Ha	Mag- 94	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. He	Mag. No
11.00	550.00	0.37	13.00	659.90	0.12	23.00	1150.00	0.27	25.90	1256.00	0.26	35,00	1758,00	0.15	37.00	1858.00	0.12
47,80	2350.00	0.06	49.00	3450.00	0.05												
But ID: Fund. kV:	Bm41 11.121																
Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	550.00	3.27	13.00	659.90	0.54	23.60	1159.00	1.41	25.00	1250.00	1.50	35,00	1750,00	0.49	37.00	1850.00	0.42
47.00	2350.00	9.17	49.00	3450.00	0.15												
But ID: Fund. kV:	Bui42 11.020																
Ordes	Freq. Hz	Mag.	Order	Freep. Hz	Mag. 96	Order	First- Hz	Mag.	Order	Freq. Hz	Mag. 94	Order	Ereq. Hr	Mag. 56	Order	Freq. Hz	Mag. No
11.00	550.00	6.40	13.00	659.00	0.15	23.80	1159.00	0.29	25.90	1250.00	0.28	35.00	1750.00	0.36	37.00	1858.00	0.13
47,00	2350.00	0.06	49.00	2458.00	0.07												
But ID: Fund kV:	Bet5 220.000																
Order	Eveq. Hz	Mag. Na	Order	Freq. Hz	Mag. 14	Ocder	Ereg. He	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hi	Mag. 96	Ordez	Freq. Hz	Mag. He
11.00	550.00	0.92	15.00	650.00	0.57	23,60	1150,00	0.11	25.00	1256.00	0.05	35.00	1758.00	6.02	37.00	1558.00	0.01
47.80	2359.00	0.00	49.00	2459.00	0.08												
But ID: Fund. kV:	Bes6 11,114																
Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	1.59	13.00	659.00	1.18	23.00	1158.00	0.53	25.00	1258.00	0.55	35,00	1750.00	0.05	37,00	1850.00	0.03
47.00	2350.00	0.05	49,00	2450.00	0.02												
But ID: Fund. kV:	Bus7 66.072																
Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. No	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hi	Mag. 19	Order	Freq. Hz	Mag. 96
11.00	550.00	0.96	15.00	659.80	0.59	23.60	1150.00	0.12	25.00	1250.00	0.09	35.00	1750.00	0.02	37,00	1850.00	0.01
47.00	2350.00	0.00	49.00	2459.00	0.00												

## 177

Project;	MASTER THESIS	ETAP	P	age:	26
Location:	HOUN CITY - LIBYA	12.6.0H	D	atet	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		st	N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: H	R	evition:	Base
Filename:	HOUN SUBSTATION 220kV	study cars. 14		onfig:	Normal

								Bus Tal	bulation	ev.							
	Harmonic Voltages (% of Fundamental Voltage)																
Bes ID: Fund. kV:	Bas8 66.687																
Order	Ereq. Hr	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 44	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
11.00	550.00	1.89	13.00	659.00	1.18	23.00	1159.00	0.33	25.90	1259.00	0.55	35,80	1750.00	0.05	37.00	1850.00	0,00
47.00	2350.09	6,63	49.00	2458.00	0.02												
But ID: Fund hV:	Bers 11.012																
Order	Freq. Hr	Mag. 16	Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96
11.09	550.00	8.96	15.00	659.00	0.59	23.00	1159.00	9.12	25.00	1250.00	0.09	35,00	1750.00	0.02	37.90	1850.00	9.01
47,00	2350.00	0.00	49.00	2458.00	0.00												

Project:	MASTER THESIS	ETAP	Page:	27
Location:	HOUN CITY - LIBYA	12.0.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and the second	Config:	Normal

								Bus Ta	bulation								
						H	armonic V	'oltages (	% of Non	inal Volta	age)						
Bus ID: Nom. kV	Buil 66.000																
Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 94	Order	Freq. Ha	Mag. 76	Onler	Freq. Ht	Mag. 94
11.00	\$59.00	1.91	11.00	650.00	1.19	23.09	1150,00	0.13	25.00	1250.00	0.65	35.00	1750.00	8.05	37.00	1850.00	9.60
47,00	2358.00	0.03	49.00	2450.00	0.02												
Bus ID: Nom, kV	Bus10 11.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Ha	Mag.	Order	Freq. Ht	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag. %6
11.00	559.00	1.91	13.00	650.00	1.19	25.99	1150.00	0.35	25,00	1258.00	0.55	35.00	1750.00	0.05	37.00	1850.00	9,60
\$7.00	2350.00	8.63	49.00	2450.00	0.02												
Bus ID: Nom. kV	Bus11 66.000																
Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 56	Order	Freq. Hz	Mag. 16	Order	Freq. Ht	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	0.96	13.00	650.00	0.59	13.00	1150,00	0.12	15.00	1250.00	0.09	35.60	1750.00	0.02	37.00	1850.00	9.91
47.00	2359.00	0.09	49.00	2450.00	8.00												
Bus ID: Nom. kV	Bus12 66.000																
Order	Freq. Ha	Məş. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Ming. 94	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 94
11.00	550.00	1.91	13.00	650.00	1.19	23.08	1150,00	0.55	25.00	1250.00	0.55	35.00	1750.00	0.05	37.00	1850.00	9,60
47.00	2359.00	0.65	49.00	2450.00	0.02												
Bus ID: Nom, kV	Buil3 66.000																
Order	Freq. Ha	Mag. 96	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag. 96
11.00	\$59.00	1.96	13.00	650.00	1.25	13.00	1150.00	8.37	25.00	1250.00	0.63	35.00	1750.00	0.66	37.00	1850.00	0.00
47,00	2350.00	0.05	49.00	2450.00	0.04												
Bus ID: Nom, kV	Bus14 : 66.000																
Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 16	Order	Freq. Hr	Mag. 56	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	\$50.00	0.99	15.00	650.00	0.61	23.06	1150,00	0.13	25,60	1259.00	8.10	35.00	1750.00	0.03	37.00	1850.00	0.02
47.00	2358.00	10,01	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus15 11.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 95	Order	Freq. Hz	Mag. 56
11.00	550.00	1.96	13.00	650.00	1.23	23.00	1150.00	0,37	25,00	1250.00	9.63	35.00	1750.00	0.06	37.00	1850.00	0.00
47,00	2350.00	0.05	49.00	2450.00	0.64												

Project:	MASTER THESIS	ETAP		Page:	25
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	на	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	Sinny Contro	1008a)	Config:	Normal

								Bus Ta	bulation								
						н	urmonic V	oltages (	% of Non	inal Volta	age)						
Bus ID: Nom, kV	Bus16 11.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Ereş. Hz	Mag.	Order	Freq. Hz	Mag. 46
11.00	\$59.60	0.99	13.00	659.00	0.61	23.00	1159.00	0.13	25.00	1258.00	0.10	35.00	1750.00	0.03	37.00	1858.00	0.02
47.00	2359.00	0.01	49.00	2459.00	0.00												
Bus ID: Nom. kV	Bus17 : 66.000																
Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94
11.00	559,60	1.36	13.00	650.00	1.35	23.00	1150.00	0.11	25.00	1259.00	0.05	35.00	1750.00	0.08	37.00	1850.00	8.68
47.00	2350,80	0.01	49,88	3450.00	0.61												
Bus ID: Nom. RV	Bus18																
Order	Freq. Hz	Mag. 96	Ordez	Freq. Ha	Mag. 94	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mig. Ni	Order	Freq. Hz	Mag. No	Order	Freq. Ha	Mag. %
11.00	550,80	1.00	13.00	650,99	9.62	25.00	1150.00	0.14	25.00	1250.00	0.19	35,00	1759.00	0.03	37.00	1850.00	0.02
47.00	2359.60	0.01	49.00	3458.00	0.01												
Bus ID: Nom. kV	Bus10 11.000																
Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 94	Onler	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. Na	Order	Freq. Hz	Mag.
11.00	550,00	1.56	15.00	659.00	1.35	25.00	1150.00	0.11	25.00	1250.00	0.05	35.00	1750.00	0,95	37.00	1850.00	0.68
47.00	2350.00	0.01	49.00	2450.00	0.01												
Bus ID: Nom, kV	Bus2 : 66.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Ereq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
11.00	\$50,80	8.96	13.08	650.00	0.59	23.00	1150.00	0.12	25.00	1259.00	0.09	35.00	1750.00	0.02	\$7.00	1850.00	0.01
47.00	2359.00	0.00	49.00	2450.00	0.00												
Bus ID: Nom, kV	Bus20 ; 11.000																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
11.00	\$50.00	1.00	13.00	659.00	0.62	23.00	1159.00	0.14	25.00	1255.00	0.10	35.00	1756.00	0.05	37.00	1850.00	0.02
47,00	2350.00	0.01	49.04	3459.00	9.01												
Bus ID: Nom, kV	Bus21 ; 66.000																
Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.
11.00	559.60	1.01	15.00	659.00	1.35	23.00	1150.00	0.42	25.00	1250.00	0.57	35.00	1759.00	0.09	37,00	1850.00	0.07
47.00	2350.00	0.01	49.00	3450.00	0.00												

MASTER THESIS	ETAP		Paget	29
HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department			SN:	
SAND MUSTAFA AL-REFAI	Study Care	HA	Revision:	Base
HOUN SUBSTATION 220kV	course carac		Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 229kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: HA   HOUN SUBSTATION 220kV Config:

								Bus Ta	bulation	62							
						н	armonic V	oltages (	% of Non	inal Volt	ege)						
Bus ID: Nom. kV	Bus22 11.000																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 9k	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00 47,00	550.00 2350.00	1.01	13.00 49.00	658.00 2458.00	1.35	23.00	1159.00	0.42	25.00	1250.00	6.57	35,00	1750.00	6.09	37,00	1850.00	0.07
Bus ID: Nom. kV	Bus23																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hr	Mag. No	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 95	Order	Freq. Hz	Mag. 86
11.00	\$50,00	2.74	13.00	659.00	1.37	23.00	1159.00	0.05	25.00	1250.00	0.05	35.00	1750.00	0.00	37.00	1850.00	0.09
47.00	2359.00	8,80	49.00	2459.00	0.00												
Bus ID: Nom. kV	Bus25 11.000																
Order	Freq. Hz	Mag. 55	Order	Freq. Hz	Mag.	Onler	Freg. Hz	Mag. 44	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 99	Qråer	Freq. Ha	Mag. 86
11.06	559,00	2.74	13.06	659.00	1.37	23.00	1159.00	0.05	25.00	1250.00	0.05	35.00	1750,00	0.00	37,00	1850.00	0.09
47.00	2350.00	0.00	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus27																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. M
11.00	559.00	1.73	13.00	659.00	1.26	25.00	1159.00	0.19	25.00	1250.00	0.35	.35.00	1750.00	0.06	.57,80	1350.00	0.03
47.00	2358.00	0.02	49.00	2459.00	0.01												
Bus ID: Nom. kV	Bus28																
Order	Freq. Hz	Mag. 59	Order	Freq. Ha	Mag. No	Order	Freq. Hi	Mag. 96	Order	Freq. Ha	Mag. 94	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 86
11.00	550.00	1.73	15.09	650.00	1.26	23.00	1150.00	0.19	25.00	1250.00	0.35	35.00	1750.00	0.06	37.00	1850.00	0.03
47.09	2350.00	0.02	49.09	2458.00	0,01												
Bus ID: Nom. kV	Bus29																
Ordez	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 19	Order	Freq. Hz	Mag. 96	Onler	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag.
11.00	559.00	1.73	13.00	654.00	1.36	23.00	1159.00	0.19	25.00	1259.00	0.35	35.00	1750.00	0.06	37.00	1850.00	0.03
47.00	2350.00	0.92	49.00	2459.00	0.01												
Bus ID: Nom. kV	Bus3	9															
Order	Freq. Hz	Mag. 9h	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 46
11.00	550.00	1.83	15.00	650.00	1.14	23.00	1150.00	0.32	25.00	1250.00	0.53	35.00	1750.00	0.04	37,00	1850.00	0.00
47.00	2359.00	0.95	49.00	2459.00	9.02												

MASTER THESIS	ETAP	Paget	30
HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department		SN:	
SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
HOUN SUBSTATION 220kV	Contract Contract	Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 220kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 126.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: HA   HOUN SUBSTATION 220kV Config:

								Bus Ta	hulation								
						н	armonic V	oltages (	% of Non	inal Volt	age)						
Bus ID: Nom. kV	Bus30	į															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96
11.00	558.00	1.92	13.00	650.00	1.29	23.00	1150.00	0.34	25.00	1258.00	0.56	35.00	1758.08	0.05	37.00	1850.00	0.00
47.80	2350.00	0.05	49.00	2450.00	0.92												
Bus ID: Nom. kV	Bus31 66.000																
Order	Freq. Hz	Mag. 46	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag- %	Order	Freq. Ha	Mag- %	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag.
11.00	550.00	0.97	15.00	650.00	0.69	23.60	1150.00	0.12	25.00	1250.00	0.09	35.00	1750.00	0.02	37.00	1850.00	0.01
47,80	2359.00	0.09	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus32 11.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 95	Order	Freq. Ha	Mag.
11.00	550.00	1.92	13.00	650.00	1.20	23.00	1150.00	0.54	25.00	1250.00	0.56	35,00	1750.00	0.05	37.00	1850.00	0.05
47.00	2358,80	0.03	49.00	2450.00	0.02												
Bus ID: Nom. kV	Bus33 11.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. Ni	Order	Freq. Hz	Mag- %	Order	Freq. Hz	Mag. Mi	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. %
11.00	558.00	0.97	13.00	650.80	0.68	23.00	1150.00	0.12	25.00	1250.00	0.09	35.00	1758.00	0.02	37.00	1850.00	0.01
47,00	2359.00	0.00	49.00	2450.00	0.00												
Buy ID: Nom. kV	Bus34																
Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. He	35ag. 96	Order	Freq. Hz	Mag. Vis	Order	Freq. Ha	Mag. 96
11.60	559.00	4.87	13.00	650.00	1.24	23.60	1150.00	2.77	25.00	1250.00	2.71	35.00	1750.00	1.25	37.00	1850.00	1.62
47.00	2358.00	0.47	49.00	2450.00	0.51												
Bus ID: Nom. kV	Bus35 0.400																
Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86
11.60	550.00	5.10	13.80	650.00	0.51	23.00	1150,00	1.34	25.00	1250.00	1.42	35.00	1758.00	8.46	37,99	1850.00	0.39
47,00	2358.00	0.16	49.00	2450.00	0.17												
Bus ID: Nom. kV	Bus36 0.400																
Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. Ni	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Ha	Mag. 94
11.00	559.00	4.87	13.00	650.00	2.24	23.00	1150.00	2.77	25.00	1256.00	2.71	35.00	1758.00	1.25	37.00	1850.09	1.02
47.00	2358.00	0.47	49.00	2450.00	0.51												

Project:	MASTER THESIS	ETAP		Page:	31
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: H	IA.	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and east. It		Config:	Normal

								Bus Ta	bulation								
						н	armonic \	oltages (	% of Non	ninal Volt	age)						
Bus ID: Nom. kV	Bus37 0.400																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 55	Order	Freq. Hz	Mag. 90	Order	Freq. Hz	Mag. 98	Onler	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 99
11.99	550.00	4.87	13.00	659.00	2.24	23.00	1150.00	2.77	25.00	1250.00	2.71	35.00	1750.00	1.23	37.00	1850.00	1.02
47.00	2350.00	8.47	49.00	2456.00	0.51												
Bus ID: Nom. kV	Bus38 0.400																
Onlar	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Onler	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.
11.66	550.00	0.58	13.00	658.00	0.12	25.00	1159.00	0.27	25.08	1250.00	0.26	35.08	1750.00	0.15	37.00	1850.00	0.13
47,80	2359.00	0.06	49.00	3450.00	0.05												
Bus ID: Nom. kV	Bus39																
Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 94
11.00	\$59.80	1.54	13.00	650.00	1.77	23.00	1159.00	1.78	25.00	1250.00	1.65	35.00	1750.00	0.95	37.09	1850.00	0.77
47,99	2350.00	0.38	29.00	2450.00	0.41												
Bus ID: Nom. kV	Bus4 220.00	0															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
Bus ID: Nom. kV	Bus40											_	-				
Order	Freq. Ha	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 46	Order	Ereq. Hz	Mag. 94
11.00	550.00	0.35	13.00	658.00	10.12	23.00	1159.00	0.27	25.00	1250.00	0.26	35.06	1750.00	0.15	37.00	1850.00	0.13
47.60	2359.60	0.05	49.00	3459.00	0.06												
But ID: Nom. kV	Bus41 11.000																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 96	Onler	Freq. Hr	Mag. 16	Order	Ereq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	559.00	3.31	13.00	650.00	0.55	25.00	1150.00	1.43	25.00	1250.00	1.51	35.00	1750.00	0.45	37.00	1850.00	0.42
47.00	2359.80	0.17	49.00	2450.00	0.19												
Bus ID: Nom. kV	Bus42 11.000																
Order	Freq. Hz	Mag. 79	Order	Freq. Hz	Mag.	Order	Freq. He	Mag. %6	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 56
11.00	550.00	0.40	13.00	650.00	0.15	23.00	1150.00	0.29	25.00	1250.00	0.28	35.00	1750.00	0.17	37.09	1850.00	0.13
47.00	2350.00	0.05	49.00	2459.00	8.07												
Bus ID: Nom. kV	Bun5 220.00	0															
Order	Freq. Hz	Mag. Na	Order	Freq. Hz	Mag. %	Order	Freq. Bz	Mag. 96	Order	Freq. Hz	Mag. 96	Onlar	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.
11.00	\$50.00	0.92	13.00	655.00	0.57	23.00	1159.00	0,11	25.00	1250.00	0.05	35.00	1750.00	6.02	37.00	1850.00	0.01

Project:	MASTER THESIS	ETAP		Page:	32
Location:	HOUN CITY - LIBYA	12.6.0H	E .	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	thing out		Coufig:	Normal

								Bus Ta	bulation								
						н	armonic V	oltages (	% of Non	unal Volta	nge)						
Bus ID: Nom. kV	Bus5 220.00																
Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freg. Ha	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96
47.00 Bus ID: Nom. kV	2350.00 Bas6 : 11.000	0.09	49.60	1450.00	0.09												
Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag.
11.00 47.00	558.00 2350.00	1.91 9.03	13.00 49.00	650.00 2450.00	1.19 0.02	23.00	1150,00	0.33	25.00	1250,00	0.55	35.00	1750.00	0.05	37.00	1850.00	0.00
Nom. kV	(; 66.000																
Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.
11.00 47.00	550.00 2350.00	0.97 0.00	13.60 49.00	650.00 2450.00	0.59	23.60	1150.00	0.12	25.00	1250.00	0.09	35.00	1750.00	0.02	57.00	1850.09	0.01
Bus ID: Nom. kV	Bus8 66.000																
Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96
11.09 47.00	550.00 2350.00	1.91 0.03	13.00 49.90	650.00 2450.00	1.19	23.00	1150.00	0.33	25.00	1250.00	0.55	35.00	1750.00	0.05	37.98	1850.00	0,90
Bus ID: Nom. kV	But9 11.000																
Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Hr	Mag. 96
11.00	550.00 2350.00	0.97	13.00	650.00 2450.00	0.59	23.00	1150.00	0.12	25,00	1250.00	0.89	35.00	1750.00	0.82	37.00	1850.00	0.01

Project:	MASTER THESIS	ETAP		Page:	33
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		a	SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA		Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Sinny Calif. Hits		Config:	Normal

#### Alert Summary Report % Alert Settings Marginal Critical Bus Individual Bus VTHD / VIHD values are used. Transformer 100.0 95.0 Total I Filter 100.0 95.0 Capacitor kV 100.0 95.0 Inductor Amp Capacitor Max kV 100.0 95.0 Cable 100.0 95.0 Ampacity

## **APPENDIX 10**

# HARMONICS ANALYSIS WITH FILTERS AND NO PV CONNECTION

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and const. And	Config:	Normal



Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	course and	Config:	Normal

Adjus	tments		
Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Tes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Project	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	НА	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	in the second	00000	Config:	Normal

								L	ad					
B	lun		Initial V	oltage	Counts	ant kVA	Cour	tant Z	Court	faot I	Gen	uetic .	% L	lunits
ID	EV	Sub-sys	% Mag.	Aag	MW	Mvar	MW	Mvar	MW	Myat	MW	Mvar	VTHD	VIHD
Ser 1	66.000	1	98.8	-30.0									10.00	10.0
len2	66,090	2	100.5	30,0									10.09	10.00
Janes.3	228.099	1	100.0	0.0									10.09	10.00
Sun-A	220.000	3	100.0	0.0									10.00	10.00
lun5	220.000	3	100.0	0.0									10.00	10.0
lucă	11.000	1	98.1	-60.0									2.58	1.5
ken 7	66.090	2	98.8	36.0									10.00	10.0
barc S	66.000	1	99,8	-30.0									10.00	10.00
Bas 19	11.000	3	98.1	0.0									10.00	10.0
bar10	11.000	1	97.8	-60.0									10.00	10.0
Am13	66.000	1	98.3	-30.0									10.09	10.0
8m14	66.090	2	98.0	30.0									10.00	18.00
han15	11.000	1	98.7	.00.0									10.00	10.0
Bur16	11.000	3	98.3	0.0									10.09	10.0
Sec17	66.090	1	96.9	-50.0									10.00	10.00
laril8	66.090	3	98.8	.90.0									10.09	10.0
lat19	11.000	1	98.7	-60.0									10.00	18.0
Sec 20	11.000	2	98.7	0.0									10.00	10.0
Sun II	66.000	1	98.9	-30.0									10.09	10.0
Ben 22	11.000	1	98.4	-60.0									10.00	10.0
Bass 2.5	66.090	1	99.3	-30.0									18.00	19.0
Bur 25	11.000	1	98.1	-60.0									10.00	10.00
han27	66.000	1	98.5	-30.0									10.09	10.0
Ban 28	11.000	1	98.4	-60.0									10.09	10.00
Bur 29	11.000	1	98.4	-60.0									10.00	10.0
bac.50	66,000	1	98.5	-30.0									10.09	10.0
Sur.51	66.000	2	98.6	30.0									10.00	10.00
Burt.32	11.000	1	98.0	-60.0									10.00	10.0
Suri33	11.000	1	100.5	0.0									10.00	10.00
Total Number of Buses:	29				0.000	0.000	0.000	9.009	0.000	0.000	8.000	8,000		

#### Bus Input Data

	Generation Buy					rge	Generation			Myar Limits	
	ID	kV.	Type	Sub-sys	% Mag.	Angle	MW	Mvar	46 PF	Max	Min
Bui.5		220.000	Saing	1	100.0	0.0					

Project:	MASTER THESIS	ETAP		Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	study case.	na	Config:	Normal

	Generation B	415		Voltz	ige	- 3)	Generation		Myar	Limits
ID	kV	Type	Sub-sys	% Mag.	Augle	MW	Myar	% PF	Max	Min
Buri-4	220.000	Sning	3	100.0	0.0					
Bus5	220.000	Swing	2	100.0	0.0					
						0.000	0.000			

189

MASTER THESIS	ETAP	Page:	3
HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department		SN:	
SAND MUSTAFA AL-REFAI	Study Care: HA	Revision:	Base
HOUN SUBSTATION 220kV	state the	Config:	Normal
	MASTER THESES HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 220kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: HA   HOUN SUBSTATION 220kV Config:

#### Cable Input Data

Cable			Length								
ID	Library	Size	th Tal.	#/Phote	TCO	RI	XI	- 11	RØ	X0	10

Cable resistances are listed at the specified temperatures

#### Transmission Line Input Data

						Ob	ma or Mi	tos / 1000 m	per Phase				
	Line			Length		2							
	ID	Library	Size	Adj. (m)	% Tol.	#Phate	T (*C)	RI	XI	11	RO	X0	2.0
Linel			674	19366.0	0.9	1	75	0.056803	0.374255	.0000031	0.200077	1.360791	.0000017
Line2			674	19300.0	0,0	1	75	0.056001	0.342069	.0000034	0.260637	1.424941	.0000016
Line3			674	23000.0	0.0	1	75	0.056001	0.342869	.0000034	0.200637	1.424041	.0000015
Line4			674	15000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424941	.0000016
Line#			674	5000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line6			674	4000.0	0.0	1	75	0.05600I	0.342069	.0000034	0.200637	1.424041	.0000016
Line7			674	4000.0	0.0	I	75	0.056001	0.542069	.0000034	0.260637	1.424041	.0000016
Line5			674	4000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line9			674	4000.0	0.0	1	75	0,056001	0.342069	.0000034	0.280637	1.424041	.0000016
Line10			674	\$900.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line11			674	8000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line12			674	21000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424941	.0000016
Line15			674	161000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016
Line14			674	140000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016

Line resistances are listed at the specified temperatures

Project:	MASTER THESIS	ETAP	Page:	6
Location:	HOUN CITY-LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

2-Winding Transformer Input Data

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### % Tap Setting Transformer Rating Z Variation Adjusted Phase Shift ID - 544 96 Z MVA Prim. kV X/R Sec. LV 16 Z. + 516 % Tol. Prim Sec. Type Augle 12,5000 30.000 TI 63,000 226,000 66.000 12.50 45.00 0 0 0 0 . Dyn **T**3 63,000 66,000 12.50 45.00 × 12,5000 -50.000 229,000 0 0 . 0 Den Τ4 10.000 66,000 11.000 8.35 13.00 0 ٠ 0 . \$.3590 Dyn 36.000 0 75 . 10.0000 59,000 20,000 65.000 11.000 10.00 20.00 0 . Dyn 0 0 **T6** 29,000 66.900 11.000 . 0 10.0000 39,000 10,00 20.00 0 . Din 0 **T9** 10.000 65,909 11.000 8.35 13.00 0 ٠ 0 . 8,3500 Dyn 30.000 0 T10 10.000 65.000 11.000 8.35 13.00 0 0 . 0 ٠ 8,3500 38.000 Den TH 20,000 65.000 11.000 10.00 28,00 0 0 . 0 . 10.0000 Dyn 58.000 TI 20,000 66.000 11.000 10.00 20.00 0 0 . 0 . 10.0000 Dyn 36.000 T13 10.000 66,000 11.000 8.35 15.00 0 0 . 0 . 8.3500 Dyn .58.000 T14 10.000 65,900 11,000 1.55 13.00 0 0 0 0 . 8.3500 Dya 39,000 T16 20.000 65,009 11,000 10.00 20.00 0 0 4 0 ٠ 10.0000 Dyn 30,000 T17 20,000 65,000 11.000 10.00 20.00 0 0 0 Û. . 18.0000 Dyu 35,000 T18 20.000 10.0000 Dyn 38.000 65.000 11.000 10.00 20.00 0 0 . 0 . 20.000 65.000 11.000 18,0000 Dyn 30,000 T19 10.00 20.00 0 0 . 0 6

#### 2-Winding Transformer Grounding Input Data

								Groundi	ng			
Transformer		Rating		Conn.		Primar	ý.		~	Seconda	ry	
D	MVA	Prim, kV	Sec. hV	Type	Type	kV	Amp	Ohm	Type	kV	Amp	Ohm
11	63.000	220.009	66.000	D/Y				-	Salid			_
T3	63.000	220,000	66,000	D/Y					Sabid			
T4	10.000	66.000	11.000	D/Y					Selid			
T5	20.000	66.000	11.000	DA					Solid			
<b>T6</b>	20.000	66,000	11.000	D/Y					Solid			
19	10.000	66.000	11.000	DA					Solid			
T10	10.000	66.000	11.000	DA.					Solid			
TII	20.000	66.000	11.000	D/Y					Solid			
T12	20.000	66.900	11,000	D/Y					Salid			
T13	10.000	\$6.009	11.000	DA					Selid			
T14	10.000	66,000	11.000	D/Y					Solid			
T16	29.000	66.000	11,000	DA					Salid			

Project:	MASTER THESIS	ETAP	Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	one case. Ha	Config:	Normal

#### 2-Winding Transformer Grounding Input Data

							Grounding						
Transformer	Rating		Coun.		Primary	¥	2.3		Secondary				
ш	MVA	Prim. kV	Sec. kV	Туре	Type	£V.	Анр	Ohm	Type	kV	Ашр	Ohm	
T17	28.000	66.000	11.000	D/Y				3	Solid				
T18	26.000	66.000	11.000	DY				23	Solid				
T19	20.000	66.000	11.000	D/Y				3	Solid				

Project:	MASTER THESIS	ETAP		Page:	8
Location:	HOUN CITY-LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 2201V	Stady Case.	ша	Config:	Normal

CKT	Branch	Con	nected Bus ID	THE P	(100 M)	A Base)	dance
ID	Type	From Bus	To Bar	R	X	Z	Y
ті	1W XFMR	Bust	Bus1	0.44	19.84	19,84	
T3	2W XEMR	Bar5	Bas2	0.44	19.84	19.84	
T4	2W XFMR	Batl	Basi6	6.40	83.25	83.59	
T5	2W XFMR	Ber7	Bat9	2.50	49,94	50.00	
T6	2W XFMR	Bus5	Bus10	2.50	49.94	50.00	
T9	2W XFMR	Bet13	Bui15	6.40	83.25	83.50	
T10	TW XEMR	Buil4	Bail6	6.40	83.25	83.50	
TIL	2W XFMR	Ban17	Buil9	2.50	49.94	50.00	
T12	2W XFMR	Bus18	Bun20	2.50	49.94	50.00	
T13	2W XFMR	Bet21	Bett22	6.40	83.25	83.50	
T14	1W XFMR	Bert23	Bur25	6.40	83.25	83.50	
T16	2W XFMR	Bes27	Bas28	2.50	49.94	50.00	
T17	2W XFMR	Bei27	Ban29	2.50	49.94	50.00	
TIS	2W XFMR	Bat30	Ben32	2.50	49.94	50.00	
T19	IW XFMR	Bard1	Bus33	2.50	49.94	59.00	
Linel	Line	Bas2	Bus14	2.48	16.58	16.77	0.2607629
Line2	Line	Batl	Ban13	2.48	15.16	15.36	0.2842266
Line3	Line	But2	Ben15	2.96	18.06	18.30	0.3387157
Line4	Line	Buil?	Bus17	1.95	11.78	11.94	0.2209015
Line5	Line	Betl	Bar27	1.03	6.28	6.57	0.1176142
Line6	Line	Bas2	Bas7	0.51	3.14	5.18	0.0589071
Line7	Line	Beni	Busð	0.51	3,14	3,18	0.0589071
Line3	Line	Bes2	Bas7	0.51	3.14	3.18	0.0589071
Lins9	Line	Baul	BetS	0.51	3.14	3.18	0.0589071
Line10	Line	Ben2	Bus31	1.03	6.28	6.37	0.1178142
Linell	Line	Batl	Bas30	1.03	6.28	6.37	0.1178142
Line12	Line	Bet17	Ben21	2.70	16.49	16.71	0.5092622
Line13	Line	Bet17	Bui23	20.70	126.43	125.11	2.3710100
Line14	Line	Ber21	Bun2.5	18.00	109.94	111.40	2.0617480

Project:	MASTER THESIS	ETAP		Page:	9
Location:	HOUN CITY - LIBYA	12.6.0H	E ,	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Study Case.	in a	Config:	Normal

#### Branch Connections Zero Sequence Impedance

CKT	/Branch	Con	% Impedance, Zero Seq., 100 MVAb				
ID	Type	From But	Te But	R0	X0	Zð	2.0
TI	2W Xfmr	Bus3	Busl				
T3	2W Xfmr	Bur5	Bus2				
T4	2W Xfmr	Butl	Bust				
TS	2W Xfuor	But7	Bur5				
<b>T6</b>	2W Sfmr	But5	Bus10				
<b>T9</b>	2W Minu	Bus13	Buil5				
T19	2W Mine	But14	Bun16				
T11	2W Xfmr	Buil7	Bun19				
T12	2W Xfmr	Buil8	Bus20				
тв	2W Xfmr	Bart21	Bun22				
T14	2W Xfmr	Bar23	Bus25				
T16	2W Mine	Bui27	Bus28				
T17	2W Xfmr	Bet27	Bus29				
TIS	2W Minr	Bari30	But32				
T19	2W Xfmr	Ban31	Bus33				
Line1	Line	Ben2	Bunl-4	8.56	60.29	60,94	0.1410145
Line2	Line	Burl	Bus13	8.89	63.09	63.72	0.1341983
Line3	Line	Bes2	Bus18	10.59	78.19	75.93	0.1599255
Line4	Line	Bas27	Bust?	6.91	49.04	49.52	0.1042992
Line5	Line	Berl	Bas27	3.68	26.15	26.41	0.0556263
Line6	Line	Bes1	Bus7	1.54	13.08	13.21	0.0276131
Line7	Line	Ber1	Bust	1.84	13.08	15.21	0.0278131
Line8	Line	Bas2	Bus?	1.84	13.08	13.21	0.0278131
Line9	Line	Betl	Bus5	1.84	13.05	13.21	0.0278131
Line10	Line	Bus2	Bus31	3.68	26.15	26.41	0.0556262
Linell	Line	Bail	Bus30	3.68	26.15	26,41	0.0556262
Line12	Line	Buil7	Bus21	9.67	68.65	69.33	0.1469189
Line 13	Line	Bet17	Bus23	74.16	526.55	531.53	1.1194780
Line14	Line	Bat21	Bus23	64.48	457.68	462.20	0.9734595

Project:	MASTER THESIS	ETAP		Page:	10
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	на	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	and carry		Config:	Normal

#### Machine Input Data Connected Bus Type ID Geid Bus) Rating (Base) % Negative Seq. Imp. Grounding MVA EV RPM X/R R2 X2 Cum. Type 22.101 220.000 10.00 9.950 \$9.50 Wyw Solid Grounding % Zero Seq. Imp. Amp X/R R0 X0 Machine . ID -100 10.00 35.648 356.48 UI Wyw U2 Grid Bur4 22.101 220.000 10.00 9.950 99.50 Wys Solid 10.06 17.738 177.38 U3 Grid Burð 22.101 220.000 10.00 9.950 99.50 Wye Solid 10.00 17.738 177.38

Project:	MASTER THESIS	ETAP		Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineers	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV			Config:	Normal

### Harmonic Library

Current Harmonic Source in %

Manufac	turer:	ABB															
Model: Order	Freq.	ACS600 1 Mag.	1P Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.
1.00	50.00	100.00	5.00	250.00	2.60	7.00	350.00	1.50	11.00	550.00	3.70	13.00	659.00	3,70	17.00	\$50.00	0.50
19.00	950.00	0.30	25.00	1150.00	0.10	25.00	1250.00	9,50									

Manufa	turer:	ABB	1														
Model: Order	Freq. Hz	ACS600 1 Mag. %	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 16	Order	Freq. Hz	Mag.
1.00	50.00	100.00	5,80	250.00	2.69	7.00	350,00	1.50	11.00	550.00	3.70	13.00	658.00	3,70	17.00	850.00	0.50
19.00	950.00	0.30	23.60	1159,00	0.10	25.00	1250.00	8,50									

Manufa	turer:	ABB															
Model:	1.1.1.1.	AC5660 1	IP	BARRIER	Sector	2.9275	Sec.	1000	11 10 111	120000	Sec. 1	144.975	Contraction Inc.	Constanting of the	Summer Live	in the second	1.000
Order	Freq. Hr	Mag. 84	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Hz	Mag.
1.00	59.00	100.00	\$.00	258.00	2.69	7.00	350.00	1,50	11.00	550.00	3.79	13.00	659.80	3.70	17.00	850.00	0.50
10.00	958.00	0.30	23.00	1150.00	0.10	25.00	1250.00	0.50									

Project:	MASTER THESIS	ETAP	Page:	12
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Control Line	Config:	Normal

### Harmonic Source from Library

			Harmonic Source Information							
But ID	Device ID	Type	Manufacturer	Model	Fund. Freq.	Mod. Freq.				
Bus3	UI	Current	ABB	ACS600 12P	0.00	0.00				
Bus4	U2	Current	ABB	ACS600 12P	0.00	0.00				
But5	U3	Current	ABB	AC5600 12P	0.00	0.00				

Project:	MASTER THESIS	ETAP		Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	lia lia	Config:	Normal

Filter Input Data

Filter	Connected Bus	C	apacitor	ci	Ь	aductor I	1	R
ID	ID	kV	Max kV	kvar	XI	Q Fact.	Max I	Ohm
HF2	Bwt2	66.000	0.000	62000.0	0.0000	0.00	0.0	0.0000
HF1	Bunl	66.000	0.000	62000.0	0.0000	0.00	0.0	0.0000

Project:	MASTER THESIS	ETAP		Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cate	HA	Revision:	Base
Filename:	HOUN SUBSTATION 2200V	Stant Carte		Config:	Normal

#### Fundamental Load Flow Report study with filters and no PV connection

	Bus		Volt	tage	Gene	ration	n Lo	ad		Load Flow	K			XFMR
	ID	RA.	%Mag.	Aug.	MW	Myzer	MW	Myar	10	MW	Mrar	Amp	% PF	% Tap
Busl		66.009	115.507	-30.2		0	0.080	-\$2.720	Bet13	6,000	-8.379	2.9	0.0	
									Ber27	0.018	-6.539	52.2	-0.3	
									Basi9	9.999	-9,979	0.6	0.0	
									But8	0.000	4,979	0.6	0.0	
									Bat.30	0.009	4.157	1.2	0.0	
									But3	-0.018	99,303	683.9	0.0	
									Banti	0.000	0.000	0.0	0.0	
Bus2		66,000	114,258	29.8	0	.0	0.000	-80.913	Bm14	0.000	.0.549	2.6	0.0	
									Ben18	0.000	0.442	3.4	0.0	
									Bes?	0.000	-8.877	0.6	0.0	
									Bun7	0.000	4,877	0.6	0.0	
									Butt	0.000	-0.154	1.2	0.0	
									Bes5	9,000	82,803	627.9	0.0	
* Bens		229,009	106.000	0.0	0.285	-78.179	0		Beil	0.288	-78,179	205.2	-0.4	
Bus5		220,009	100.000	0.0	8.227	-71.782	0		Ber2	0.327	-71.782	188.4	.0.3	
Basé		11,000	115.507	-60.2	0	0	0	0	Berl	0.000	0.000	0.0	0.0	
Bus/7		66,000	114.240	29.8	0	0	0		Bar2	0.000	0.000	0.0	0.0	
			apreses.			675			Ben2	0.009	0.000	0.0	0.0	
									Bact9	0,000	0.000	0.0	0.0	
Bus5		65,000	115.508	-30.2	0	0	0		Busl	6,999	0.000	0.0	0.0	
									Barl	0.000	0.000	8.0	0.0	
									San10	0.000	0.000	0.0	0.0	
Bur9		11,000	114.240	0.2		0	0	0	Bat7	0.000	0.000	0.0	0.0	
Bas10		11,009	115.508	-40.2		0	0		Butil	0.000	0.006	8.8	0.0	
Buel.3		66.000	115.532	-30.2	0	0	0	0	Bml	0.000	0.000	0.0	0.0	
									Bei15	0.000	0.000	0.0	0.0	
Busl4		65,000	114.263	29.8		0	0		Barr2	0.000	0.000	0.0	0.0	
		1000 L 100	10000		33	1.2	1250		Banló	0.000	6.006	0.0	0.0	
Busis		11.000	116.632	-60.2	0	0	0	0	Bar13	0.000	0.000	0.0	0.0	
Busló		11,000	114.263	-0.2	0	0	0		Bun14	0.000	0.000	0.0	0.0	
Bas17		65,000	116 549	-30.3		0	0		Bes27	0.009	6.493	48.7	.0.1	
				100	- C	10			Bas21	0.005	5.249	14.4	.01	
									Bart 7.5	0.004	3.244	24.5	.0.1	
									Barl9	0.000	0.000	8.0	0.0	
Busl8		65.000	114.223	20.8					Ben1	0.000	0.000		0.0	
David						2			Bas 20	0.000	0.000	0.0	0.0	
Res10		11.005	116 649	AD F					Red 7	5 000	8.005		0.0	
Ban19		11.009	110.549	-80.5	0	0	0	0	Beil7	0.009	0.000	0.0	0.0	

Project:	MASTER THESIS	ETAP		Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H		Datec	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	Stady Case.		Config:	Normal

Bus	Voltage		Generation		Load		Load Flow					_	XFMR	
ID	kV	MAGag.	Ang.	MW	Myar	MW	Myar		ID	MW	Mvar	Amp	% PF	% Tap
Ban20	11.000	114.273	-0.2		0		0	Bus18		0.800	6.000	0.0	0.8	
Ban21	66.000	116.979	-30.3		0	0	0	Bas17		-0.065	2.839	21.2	-0.1	
								Bus23		0.905	-2.539	21.2	-0.1	
								Bus22		9.000	6.000	0.0	0.0	
Bas22	11.000	116.979	-60.3	0	0	0	0	Bus21		0.000	0.000	0.0	0.0	
Basi23	66.000	118,320	-30.4	0	0	0	0	Bes17		0.000	-0.001	0.0	-16.2	
								Ber21		0.800	6.001	0.0	-16.2	
								Bus25		0.800	6.000	6.0	0.0	
Bus25	11.000	118.320	-60.4	0	0	0	0	Bus23		0.000	0.000	0.0	0.0	
Bas 27	66.000	115.878	.39.2	0	0		0	Buil7		0.015	-6.753	51.0	-0.2	
								Bus1		-0.015	6.755	51.0	-0.I	
								Bus28		0.600	0.000	0.0	0.0	
								Bus29		0.000	0.000	0.0	0.0	
dus28	11.000	115.878	-60.2		0	0	0	Bes27		0.800	6.000	0.0	0.0	
Bar29	11.000	115,878	-69.2	8	0		Ú	Bus27		0.800	6.000	0.0	0.0	
Bus30	66.000	115.511	30.2	.0	0	0	0	Busl		0.000	0.000	0.0	0.0	
								But32		9.900	6,000	0.0	0.0	
dur.51	66,000	114,243	29.8		.0		.0	Bus2		9.900	6.000	0.0	0.0	
								Bus33		0.000	0.000	0.0	0.0	
dan32	11.000	115.511	-69.2	0	0	0	0	Bus30		0.000	0.000	0.0	0.0	
Bas53	11.000	114.245	-0.2		0	Ð		Bet51		0.800	0.000	0.0	0.0	

* Indicates a voltage regulated but (voltage controlled or using type machine connected to it) # indicates a bus with a load minimich of more than 0.1 MVA
| Project:  | MASTER THESIS                         | ETAP        | 1. C | Page:     | 16         |
|-----------|---------------------------------------|-------------|------|-----------|------------|
| Location: | HOUN CITY - LIBYA                     | 12.6.0E     |      | Date:     | 28-06-2016 |
| Contract: | NEAR EAST UNIVERSITY - EEE Department |             |      | SN:       |            |
| Engineer: | SAND MUSTAFA AL-REFAI                 | Study Case  | HA   | Revision: | Base       |
| Filename: | HOUN SUBSTATION 220kV                 | orang cases | 11.3 | Config:   | Normal     |

		System	Harmoni	es Bus Info	rpation					
Bus					Volt	age Distort	ion			
ID	kV	Fund.	RMS %	ASUM	THD %	TUF	TIHD %	TSHD %	THDG	THDS %
Burl	66.000	115.51	115.51	117.04	0.68	8.34	0.00	0.00	0.68	9.68
Bus2	66.000	114.24	114.24	115.81	0.69	7.76	0.00	0.00	0.69	0.69
Bun3	220.000	100.00	100.44	119,56	9.40	211.39	0.00	0.00	9.40	9.40
Bus5	220,000	100.00	100.37	117.81	8.62	194.19	0.00	0.00	8,62	8,62
Bush	11.000	115.51	115.51	117.04	0.68	8.34	0.00	0.00	0.68	0.68
But7	66.000	114.24	114.24	115.81	0.69	7,77	0.00	0.00	0.69	0.69
Bust	66.000	115.51	115.51	117.05	0.68	8.35	0.00	0.00	0.68	0.68
Bust	11.000	114.24	114.24	115.81	0.69	2,77	0.00	0.00	0.69	0.69
Bun10	11.600	115.51	115.51	117.05	0.68	8.35	0.00	0.00	0.68	0.68
Bus13	66.000	115.53	115.53	117.10	0.69	8.61	0.00	0.00	0.69	0.69
Bus14	66.000	114.26	114.27	115.86	0.70	5.01	0.00	0.00	0,70	0.70
But15	11.000	115.53	115.53	117.10	0.69	8.61	0.00	0.90	0.69	0.69
Buil6	11.000	114.26	114.27	115.86	0.70	8.01	0.00	0.00	0,70	0,70
Bus27	66.000	116.55	116.55	119.03	1.00	14.26	0.00	0.00	1.00	1.00
Bus18	66.000	114.27	114.28	115.89	0.71	8.1.5	0.00	0.00	0.71	0.71
Bus19	11.000	116.55	116.55	119.83	1.00	14.26	0.00	0.00	1.90	1.00
Bux20	11.000	114.27	114,28	115.89	0.71	8.15	0.00	0.00	0,71	0.71
But21	66.000	116.98	116.99	119.91	1.19	15.49	0.00	0.00	1.19	1.19
Bui22	11.008	116.98	116.99	119.91	1.19	15.49	0.00	0.00	1.19	1.19
Bus23	66.000	118.32	118.34	122.58	2,00	13.18	0.00	0.00	2.00	2.00
But25	11.000	118.32	138.34	122.58	2.00	13.18	0.08	0.00	2.00	2.00
But27	66.000	115.88	115.88	117.72	0.77	9.45	0.00	9.90	0.77	0,77
Bus28	11.000	115.58	115.88	117.72	0.77	9.45	0.00	0.00	0.77	0.77
But29	11.000	115.88	115.88	117.72	0.77	9.45	6.80	0.00	0.77	0.77
Bas30	66.000	115.51	115.51	117.05	8.68	8.38	0.00	0.00	0.68	0.68
Bun31	66.000	114.24	114.25	115.82	0.69	7.50	0.00	0.00	0.69	0.69
Bun32	11.000	115.51	115.51	117.95	0.68	\$.38	0.00	0.00	0.68	0.65
Bur33	11.000	114.24	114.25	115.82	0.69	7.50	0.00	0.00	0.69	0.69
* Indicate: THD (Tetal Harmon	nic Distortion) Exc	eeds the Limit.								

# Indicates 1 HD (Individual Harmonic Distortion) Exceeds the Limit.

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	17 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	totally server and	Config:	Normal

#### System Harmonics Branch Information

Bus	Current Distortion													
Fran Bus ID	To But ID	Fund. Amp	RMS Amp	ASUM Amp	THD %	THE	IT Amp	ITB Amp	ЕТв. Амр	TIHD %	TSHD %	THDG %	THDS 96	
Basi	Bas13	2,87	2.88	3.25	6.17	108.88	313.51	513.31	0.00	9.00	0.00	6.17	6.17	
	Bas27	52.17	\$2.37	60.24	8.81	\$6.43	4526.66	4526.66	0,00	0.09	0.00	8.81	8.81	
	Buts	0.60	0.68	0.67	6.09	106.75	63.66	63.66	0.00	0.00	0.00	6.09	6.05	
	Bush	0.60	0.68	0.67	6.09	106.75	63.66	63.66	0.00	0.09	0.00	6.09	6.05	
	Bar.30	1.19	1.19	1.34	6.10	107.02	127.64	127.64	0.00	0.00	0.00	6.10	6.10	
	Bus3	683.89	685.05	768.76	5.85	99.34	68957.16	68057.16	0,00	0.09	0.00	5.85	5.85	
	Bart		0	0	0	0	6.00	68057.16	0.00	0.00	0,00	0.00	0.00	
Bert .	Buel4	2.61	2.61	2.93	5.92	101.39	264.70	264.70	6.00	0.00	8.90	5.92	5.92	
	Beil8	3,39	3.59	3.81	5.95	192.54	347.06	347.06	6.00	0.00	6,00	5.95	5.95	
	Bas7	0.59	0.59	0.66	5.85	99.40	58.62	58.62	9.90	0.00	0.90	5.85	5,85	
	Ber7	0.59	0,59	0.66	5.85	\$9.40	58.62	58.62	0.00	0.00	0.00	5.85	5.85	
	Ban31	1.18	1.18	1.32	5.86	99.66	117.53	117.55	0.00	0.08	0.00	5.86	5.86	
	Bar5	627.93	629.00	705.90	5.85	99.35	62488.71	62488.71	9,99	0.09	9,00	5.85	5.85	
Berd	Baul	205.17	105.52	230.65	5.85	99.34	10417.15	20417.15	9.80	0.00	0.00	5.85	5.55	
Blas5	Bas2	188.38	188.79	231.77	5.85	99.35	18746.62	18746.62	9.90	9.00	0.00	5.85	5.85	
Batt	But1		0	0	0	0	0.00	19746.62	0.00	0.00	0.00	0.00	0.00	
Bas7	Ban2		0	.0	0	0	0.00	18746.62	9.90	0.00	0.00	0.00	0.00	
	Bes2		0	0	0	0	0.00	18746.62	0.00	0.09	0.00	0.00	0.00	
	Biat/9		0	0	0	0	0.00	11746.62	0.00	9.00	0.00	0.00	0.00	
BevS	Berl		0	0	0	0	0.00	18746.62	0.00	0.00	0.00	0.00	0.00	
	Barl		0	0	0	0	0.00	18746.62	0.00	0.00	0.00	0.00	0.00	
	Bus10		0	0	0	0	0.00	18746.62	0.00	0.00	0.90	0.09	0.00	
Burl	Bay?		0	0	0	0	0.00	18746.62	0.00	0.00	0.00	0.00	0.00	
Buil0	Bat5		0	0	0	0	8,80	18746.62	0.00	0.00	0.00	8.00	0.00	
Busi 3	Basl		0	0	0	0	0.00	18746.62	0.00	0.09	0,00	0.00	0.00	
	Ban15		0		0	0	0.00	18746.62	9.00	0.00	0.00	0.00	0.00	
Bas14	Bax2		0	.0	0	0	0.00	18746.62	0.00	0.09	0.00	0.00	0.00	
	Ban16		0	0	0	0	0.00	18746.62	0.00	0.00	0.00	0.00	0.00	
Beil5	Ben13		0	0	0	0	9,00	18746.62	9.90	0.09	0.00	0.00	0.00	
Bas16	Bus14			0	0	0	0.00	13746.62	9.90	0.00	0.00	0.00	0.00	
Busl?	Ber17	48.75	48.94	56.50	\$.17	\$5.66	4192.34	4192.34	0.00	0.09	0.00	9.17	9.17	
	Bas21	24.39	14.50	28.57	9.59	104.05	2548.96	2548.96	0.00	8.08	0.90	9.59	9.55	
	Bes25	24.35	34.44	17.93	8.77	67.97	1661.37	1661.37	0.00	0.00	0,00	8,77	8.77	
	Bas19		0		0	0	0.00	1661.37	0.00	9.00	0.00	0.00	0.00	
Bet18	But2		0	0	0	0	0.00	1661.37	0.00	0.00	0.00	0.00	0.00	
	Bier20		0	0	0	0	0.00	1661.37	0.00	0.00	8,90	0.00	0.00	
Ban19	Burl7		0	0	0	0	0.00	1661.37	0.00	0.00	0.00	0.00	0.00	
Bas20	Bes18		0	0	0	0	6.00	1661.57	8,50	0.00	0,00	6.09	0.00	
Bas21	Bat17	21.25	21.34	25.02	10.06	\$7.86	1874.45	1874.45	0.00	0.00	0.00	16.05	10.00	
	Ber23	21.25	21.54	25.02	10.06	\$7.56	1874.45	1874.45	8,90	0.09	0,00	10.06	16.90	
	Bay21		0	0	0	0	0.60	1874.43	8.80	0.68	0.00	0.00	0.00	

Project:	MASTER THESIS	ETAP		Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Casa-	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Case.		Config:	Normal

Current Distortion														
To Bus ID	Fund. Amp	RMS Amp	ASUM Amp	THD %	TIF	П Апр	Пъ Атр	ITR Amp	TIHD 16	TSHD %	THDG	THDS %		
Ber21	0	0	0	0	0	0.00	1874.43	8.00	0.00	0.00	0.00	0.00		
Burl7	0.01	0.13	0.29	1404.38	2762.48	549.97	349.97	8,90	0.00	0.00	1404.38	1404.38		
Ber11	0.61	0.13	0,29	1404.38	2702.48	349.97	349.97	0.90	0.00	0.00	1404.38	1404.38		
Bes25		0			0	0.00	349.97	0.00	0.00	0.00	0.00	0.00		
Ben13	0	0	0	0	0	0.00	349.97	0.80	0.00	0.50	0.00	0.00		
Bet17	50,98	51.18	58.99	8.96	\$7.49	4478.34	4478.34	8,90	0.00	0.00	8.96	8.96		
Ben1	50.98	51.18	58.99	8.96	87.49	4478.34	4478.34	0.00	0.90	0.00	8.96	8.96		
Ber25	0	0			9	0.00	4478.34	8,90	0.00	0.00	0.00	0.00		
Bas29	0	0		8	0	0.00	4478.34	8,00	0.00	0.00	0.00	0.00		
Bes27	0	0	0	0	0	0.99	4478.34	0.00	0.00	0.00	0.00	0.00		
Bas27	0	0	0	0	0	0.00	4478.34	8,00	0.00	0.00	0.00	0.00		
Busl	0	0	0	0	0	0.00	4478.34	0.00	0.00	0.00	9,90	0.00		
Bas32		0		0	0	0.00	4478.34	0.00	0.00	0,90	0.00	0.00		
Bas2	0	0	0	0	0	0,00	4478.34	0.00	0.90	0.00	0.00	0.00		
Bus33	0	0		0	0	0.00	4478.34	8,90	0.00	0.00	0.00	0.00		
Bax30	0	0	0	0	0	0.00	4478.34	8.00	00:00	0.00	0.00	0.00		
Bas31	0	0		8	0	0.00	4478.34	0.00	0.00	0.00	0.00	0.00		
	To Das ID Ben11 Ben17 Ben17 Ben21 Ben25 Ben23 Ben17 Ben1 Ben28 Ben29 Ben27 Ben17 Ben27 Ben17 Ben27 Ben12 Ben33 Ben33 Ben30 Ben31	To Bas ID     Fund. Amp       Bas 21     0       Bas 21     0.01       Bas 25     0       Bas 25     0       Bas 17     50.98       Bas 25     0       Bas 25     0       Bas 17     50.98       Bas 25     0       Bas 25     0       Bas 25     0       Bas 27     0       Bas 1     0       Bas 1     0       Bas 2     0       Bas 3     0       Bas 3     0       Bas 34     0       Bas 35     0	To Bas ID     Fund. Amp     RMS Amp       But21     0     0       But21     0.01     0.13       But21     0.61     0.13       But21     0.61     0.13       But21     0.61     0.13       But21     0.61     0.13       But23     0     0       But1     50.95     51.18       But2     0     0       But3     0     0       But3     0     0	To Bas ID     Fund. Amp     EMS Amp     ASUM Amp       Burl1     0     0     0       Burl21     0     0.01     0.15     0.29       Burl25     0     0     0     0       Burl25     0     0     0     0       Burl25     0     0     0     0       Burl3     0.01     0.13     0.29       Burl4     56.96     51.18     58.59       Burl5     0     0     0       Burl2     0     0     0       Burl3     0     0     0       Burl3     0     0     0	To Bus ID     Fund. Amp     RMS Amp     ASUM Amp     THD Mode       But21     0     0     0     0     0       But17     0.01     0.13     0.29     1404.38       But21     0.61     0.13     0.29     1404.38       But25     0     0     0     0       But25     0     0     0     0       But17     50.95     51.18     58.59     8.66       But1     50.95     51.18     58.59     8.56       But25     0     0     0     0       But26     0     0     0     0       But27     0     0     0     0       But27     0     0     0     0       But21     0     0     0     0     0       But21     0     0     0     0     0       But27     0     0     0     0     0       But31     0     0     0     0	To Bus ID     Fund. Amp     RMS Amp     ASUM Amp     THD 55     THE 55       Bar21     0     0     0     0     0     0     0     0       Bar21     0     0     0     0     0     0     0     0     0       Bar21     0.01     0.13     0.29     1404.38     2702.48       Bar25     0     0     0     0     0     0       Bar23     0     0     0     0     0     0     0       Bar25     0     0     0     0     0     0     0     0       Bar17     50.96     51.15     55.99     8.96     87.49       Bar29     0     0     0     0     0     0       Bar27     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0	To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD Sec     THF Amp     THF Amp     THF Amp     THF Amp       Bar21     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0 </td <td>Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 5+     THF 0     HT Amp     Amp Amp       Bu:21     0     0     0     0     0     0     0     0     11F     Amp     Amp       Bu:17     0.01     0.13     8.29     1404.36     2702.48     549.97     349.97       Bu:12     0.01     0.13     8.29     1404.38     2702.48     349.97     349.97       Bu:12     0.01     0.13     8.29     1404.38     2702.48     349.97       Bu:12     0.0     0     0     0     0     0.00     349.97       Bu:13     50.95     51.15     58.99     8.56     87.49     4478.34     4478.34       Bu:14     50.95     51.15     58.99     8.56     87.49     4478.34     4478.34       Bu:25     0     0     0     0     0.00     4478.34       Bu:27     0     0     0     0     0.00     44</td> <td>Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF Amp     TT Amp     TTs Amp     Amp     Amp       Bur21     0     0     0     0     0     0     0.00     1874.43     0.00       Bur21     0     0     0     0     0     0.00     1874.43     0.00       Bur21     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00       Bur25     0     0     0     0     0.00     340.97     0.00       Bur17     50.98     51.18     58.99     8.56     87.49     4478.34     0.90       Bur17     50.98     51.15     58.99     8.56     87.49     4478.34     4.00       Bur25     0     0     0     0     0.00     4478.34     0.90       Bur27     0     0     0     0     0     0.00     4478.34     0.90       Bur32     0     0</td> <td>To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF 56     IT Amp     HT9 Amp     HT9 Amp     HT9 Amp     HT8 Amp     THE 56       Bus 21     0     0     0     0     0     0     0.00     1874.43     0.00     0.00       Bus 21     0     0.01     0.13     0.29     1404.35     2762.48     349.97     349.97     0.00     0.00       Bus 21     0.01     0.13     0.29     1404.35     2762.48     349.97     349.97     0.00     0.00       Bus 25     0     0     0     0     0     0.00     349.97     0.00     0.00       Bus 17     50.95     51.15     58.99     8.96     \$7.49     4478.34     4478.34     0.90     0.00       Bus 17     50.95     51.15     58.99     8.96     \$7.49     4478.34     4478.34     0.90     0.90       Bus 25     0     0     0     0     0     0.00     0.90     0.90     0.90     &lt;</td> <td>Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 5+     THF 0     HT Amp     THS Amp     HTB Amp     THB Amp     THB Amp     THB Amp     THB Amp     THB 5+     TSHD 5+       Bu:21     0     0     0     0     0     0     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00</td> <td>Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF     IT Amp     TH9 Amp     ITR Amp     THR Amp     THB 56     THD6 56       Bu:21     0     0     0     0     0     0     0     0.00     1374.43     0.00     0.00     1404.36       Bu:17     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00     0.00     0.00     1404.38       Bu:12     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00     0.00     0.00     1404.38       Bu:12     0     0     0     0     0.00     349.97     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00</td>	Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 5+     THF 0     HT Amp     Amp Amp       Bu:21     0     0     0     0     0     0     0     0     11F     Amp     Amp       Bu:17     0.01     0.13     8.29     1404.36     2702.48     549.97     349.97       Bu:12     0.01     0.13     8.29     1404.38     2702.48     349.97     349.97       Bu:12     0.01     0.13     8.29     1404.38     2702.48     349.97       Bu:12     0.0     0     0     0     0     0.00     349.97       Bu:13     50.95     51.15     58.99     8.56     87.49     4478.34     4478.34       Bu:14     50.95     51.15     58.99     8.56     87.49     4478.34     4478.34       Bu:25     0     0     0     0     0.00     4478.34       Bu:27     0     0     0     0     0.00     44	Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF Amp     TT Amp     TTs Amp     Amp     Amp       Bur21     0     0     0     0     0     0     0.00     1874.43     0.00       Bur21     0     0     0     0     0     0.00     1874.43     0.00       Bur21     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00       Bur25     0     0     0     0     0.00     340.97     0.00       Bur17     50.98     51.18     58.99     8.56     87.49     4478.34     0.90       Bur17     50.98     51.15     58.99     8.56     87.49     4478.34     4.00       Bur25     0     0     0     0     0.00     4478.34     0.90       Bur27     0     0     0     0     0     0.00     4478.34     0.90       Bur32     0     0	To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF 56     IT Amp     HT9 Amp     HT9 Amp     HT9 Amp     HT8 Amp     THE 56       Bus 21     0     0     0     0     0     0     0.00     1874.43     0.00     0.00       Bus 21     0     0.01     0.13     0.29     1404.35     2762.48     349.97     349.97     0.00     0.00       Bus 21     0.01     0.13     0.29     1404.35     2762.48     349.97     349.97     0.00     0.00       Bus 25     0     0     0     0     0     0.00     349.97     0.00     0.00       Bus 17     50.95     51.15     58.99     8.96     \$7.49     4478.34     4478.34     0.90     0.00       Bus 17     50.95     51.15     58.99     8.96     \$7.49     4478.34     4478.34     0.90     0.90       Bus 25     0     0     0     0     0     0.00     0.90     0.90     0.90     <	Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 5+     THF 0     HT Amp     THS Amp     HTB Amp     THB Amp     THB Amp     THB Amp     THB Amp     THB 5+     TSHD 5+       Bu:21     0     0     0     0     0     0     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00	Current Distortion       To Bus ID     Fund, Amp     RMS Amp     ASUM Amp     THD 56     THF     IT Amp     TH9 Amp     ITR Amp     THR Amp     THB 56     THD6 56       Bu:21     0     0     0     0     0     0     0     0.00     1374.43     0.00     0.00     1404.36       Bu:17     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00     0.00     0.00     1404.38       Bu:12     0.01     0.13     0.29     1404.38     2702.48     349.97     349.97     0.00     0.00     0.00     1404.38       Bu:12     0     0     0     0     0.00     349.97     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00		

Project:	MASTER THESIS	ETAP		Page:	19
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stand Carter		Config:	Normal

								Bus Ta	bulation								
						Harr	nutir Vol	tages (%	of Funda	mental Vo	dtage)						
Bas ID: Fund. kV:	Bus1 76,235																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Ming- 94
5.00 23.00	259.00 1159.00	0.45	7.00	350.00 1250.00	0.14	11.00	550.00	0.36	15.00	650.00	8.29	17.00	\$50.00	0.02	19.00	958,00	0.02
Fund. kV:	12.706																
Order	Freq. Hz	Mag. 94	Order	Freq. Hr	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
5.00	259.00	8.48	7.00	350.00	0.14	11.00	550.00	0.36	13.00	650.00	8.29	17.00	850.00	0.02	19.00	950,00	0.82
23,00	1150.00	6.00	25.00	1250.00	0.02												
Bus ID: Fund. kV:	Bas2 75,397																
Order	Freq. Hz	Mag. 56	Onler	Freq. Hi	Mag. %	Order	Freq. Ha	Mag. 46	Order	Freq. Hz	Mag. 84	Order	Freq. Ha	Mag. 16	Order	Freq. Hs	Mag. 94
5.00	250.00	0.50	7.00	350.00	0.21	11.00	559.00	0.32	13.00	650.00	0.27	17.00	858.00	6.93	19.00	950.00	0.02
23.80	1159.00	0.00	25.00	1250.00	0.02												
Bas ID: Fund. kV:	Bus9 12.566																
Order	Freq. Ha	Mag. 16	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag.	Order	Freq. He	Mag. 56	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
5.90	259.00	0.50	7.00	358.00	0.21	11.00	550.00	0.32	15.00	650.00	0.27	17.00	\$58.00	0.03	19,00	950.80	0.02
23.00	1150.00	0.00	25.00	1250.00	0.02												

Project:	MASTER THESIS	ETAP		Page:	20
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	на	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	stady call.		Config:	Normal

								Bus Ta	bulation								
						Ha	ermonic V	oltages (	% of Nom	inal Volta	ige)						
Bus ID: Nom. kV	Bus1 66.000	,															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 84	Order	Freq. Hz	Mag.
5.00 23.00	250.00 1150.00	0.55	7.00	350.00 1250.00	0.16	11.00	556.00	0.41	13.00	650.00	0.34	17.00	850.00	0.02	19.00	950.00	0.92
Bus ID: Nom. kV	Bus10																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 49	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. Na	Order	Freq. Hz	Mag. 99
5.00	250.00	0.55	7.00	350.00	0.16	11.00	556.00	0.41	13.00	650.00	0.34	17.00	850.00	0.02	19.06	950.06	0.02
23.00 Bus ID: Nom. kV	But2 66.000	0.01	25.00	1250.00	0.02												
Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 19	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
5.00	250.00	0.58	7.00	350.00	0.24	11.00	\$\$9.99	0.37	13.00	650.00	0.31	17.00	850.00	0.03	19.00	950.00	0.02
23.00	1150.00	0.00	25.00	1250.00	0.02												
Bus ID: Nom. kV	Bus9 11.000	,															
Order	Freq. Ht	Mag. 14	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag.
5.00	250.00	0.58	7.00	350.00	0.24	11.00	550.00	0.57	13.00	659.00	0.31	17,00	850.00	0.03	19.00	950.00	0.02
23.00	1150.00	0.00	25.00	1250.00	0.02												

Project:	MASTER THESIS	ETAP		Page:	21
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Standy Carter		Config:	Normal

#### Filter Overloading

	Filter				Capacitor C1			Inductor L1			apacito	r C2	Inductor L2			
				Max.	Opr.		Max.	Opr.	*6	Max.	Opr.	16	Max.	Opr.	16	
	ID	Type	Connection	kV	kV [*]	OverVolt	Amp	Antp	Overload	LV	kV	OverValt	Ашр	Атр	Overload	
HF1		3	Wye	0.000	63.074	N/A	0.00	627.63	N/A							
HF2		3	Wye	0.000	62.488	N/A	0.00	620.64	N/A							

Filter Types: 0 = By-Pass, -1 = High-Pass (Damped), 2 = High-Pass (Undamped), 3 = Single Tuned, 4 = 3rd Order Damped, 5 = 3rd Order C-Type

Project:	MASTER THESIS	ETAP	Page:	22
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	Starty Conternation	Coufig:	Normal

#### Alert Summary Report % Alert Settings Critical Marginal Bus Individual Bus VTHD / VIHD values are used. Transformer 100.0 95.0 Total I Filter Capacitor kV 100.0 95.0 Inductor Amp 100.0 95.0 Capacitor Max kV 100.0 95.0 Cable 100.0 95.0 Ampacity

## **APPENDIX 11**

# HARMONICS ANALYSIS WITH FILTERS AND PV

Project:	MASTER THESIS	ETAP		Page:	1
Location:	BOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Cant	10.1	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### Electrical Transient Analyzer Program Harmonic study with filters and PV connection Loading: Operating P. Q. Generation: Operating P, Q, V V-Control Total Swing Load Number of Buses: 3 7 30 40 Reactor Line/Cable XFMR2 XFMR3 Impedance Tie PD Total Number of Branches: 24 0 16 0 40 0 0 Voltage Current Number of Harm. Sources: 4 0 Number of Filters: 2 Method of Solution: Adaptive Newton-Raphson Maximum No. of Iteration: 00 Precision of Solution: 0.0001000000 System Frequency: 50.00 Hz Unit System: Metric

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	stany case. the	Config:	Normal

	Apply	Individual	
Tolerance	Adjustments	/Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Catar	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	stand canter	17721	Config:	Normal

Load							_							
-	Bas		Initial V	altage	Canat	aut kVA	Court	itaut Z	Cont	tant I	Ge	write	96 L	imits
ID	kV	Sab-191	% Mag.	Ang.	MW	Myar	MW	Mvar	MW	Myay	MW	Mrar	VTHD	VTHD
Buil	66.000	1	98.8	-30.0	-		_					-	10.00	10.00
Bus2	66.000	1	100.0	36.0									10.00	10.00
Bur.3	226.096	1	100.0	0.0									5.00	5.00
Bun4	220.000	3	100.0	0.0									10.00	10.00
But5	228.000	2	100.0	0.0									10.00	10.00
Bund	11.000	1	96.1	-60.0									5.00	5.00
Bus?	66.000	2	98.8	50.0									10.00	10.00
Buið	66.000	1	99.0	-30.0									10.00	18.09
Bur9	11.000	2	98.1	6.0									10.00	10.00
Bus10	11.000	1	97.8	-60.0									19.00	10.09
Bus11	\$6.000	1	100.0	30.0									19.00	10.00
Buil2	66.000	1	100.0	-30,8									10.00	10.00
Hur.13	66.000	1	98.5	-30.0									10.00	10.00
Burl4	66.000	2	98.0	30.0									10.00	10.00
Buil5	11.000	1	98.7	-60,0									10.00	10.00
Buil6	11.000	2	98.3	0.0									10.00	10.00
Buil7	66.000	1	98.9	-50.0									10.00	10.00
Burl8	66.000	2	98.8	50.0									10.00	10.00
But19	11.000	1	98.7	-60.0									10.00	10.06
But20	11.000	20	98.7	0.0									10.00	16.00
Bus21	\$6.000	1	98.9	-30.0									10.00	10.00
Bui22	11.000	1	98.4	-60,0									10.00	10.00
Bur23	66.000	1	99.5	-30.0									10.00	10.00
Bus25	11.000	1	98.1	-60.0									10.00	10.00
Bus27	66.090	1	98.8	-30.0									19.00	18.09
Bun28	11.000	1	98.4	-60.0									10.00	10.00
Bus29	11.000	1	98.4	-60.0									19.00	10.00
Bus.30	66.000	1	98.5	30.0									19.00	10.00
But33	66.009	2	98.6	30.0									10.00	18.06
Bus32	11.000	1	98.0	-68.0									10.00	10.00
Bus33	11.000	:	100.5	0.0									10.00	10.00
But54	0.400	1	100.0	-30.0									10.00	10.00
Ban35	0.400	1	190.0	-30.0									5.00	5.00
Bus36	0.400	1	100.0	-30.0									10.00	10.00

## Bus Input Data

Project: M	MASTER THESIS	ETAP		Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	115	Config:	Normal

					Load									
	But		Initial V	oltage	Counta	nt kVA	at kVA Constant Z		Constant I		Generic		% Limits	
ID	kV	Sub-191	% Mag.	Aug.	MW	Myar	MW	Mvar	MW	Mvar	MW	Mvar	VTHD	VIHD
Bat37	0.400	1	100.0	-30.0									16.00	10.00
But38	0.400	2	100.0	30.0									5.00	5.00
But.39	0.400	2	100.0	30.0									5.00	5,00
Bas40	0.400	2	100.0	30.0									5.00	5.00
Bur41	11.000	1	120.5	-60.0									10.09	16.00
Bus42	11.000	:	98.9	0.0									10.00	10.00
Total Number of Buses:	40				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0,000		

	Generation B	ues -		Volt	Nge .	3	Generation	12	Myar I	imits
ID	kV	Type	Sub-sys	% Mag	Angle	MW	Mvar	% PF	Max	Min
Bet5	220.000	Swing	1	100.0	0.0					
Bet4	220,000	Swing	3	100.0	0.0					
Buif	220.000	Swing	2	100.0	0.0					
Bus34	0.400	Voltage Control	I	100.0	-30.0	1.952			0.000	0.000
But.55	0.400	Voltage Control	1	100.0	-30.0	1.952			9.900	0.000
Bu:56	0.400	Voltage Control	1	109.0	-30.0	1.952			0.000	0.000
But37	0.400	Voltage Control	1	199.0	-30.0	1.952			0.000	0.909
Bu:35	0.400	Voltage Control	2	100.0	30.0	1.952			6.000	0.000
Bus39	0.400	Voltage Control	2	100.0	30.0	1.952			0.000	0.000
Bus40	0.400	Voltage Control	2	100.0	30.0	1.952			0.000	0.000
						13.662	0.000			

Project:	MASTER THESIS	ETAP	Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	in the second second	Coufig:	Normal

#### Cable Input Data

	22	Ohms or Mhot / 1000 m per Conductor										
Cable			Lengt	b								
ID	Library	Size	Adj. (m)	9s Tol.	#Phate	T (*C)	RI	XI	YI	RØ	X0	10
Cable1	HMCU83	300	196,0	0.0	1	75	0.076302	8.867400	0.0001646	0.240351	0.115000	
Cable2	11MCU83	300	109.0	0.0	1	75	0.076302	0.087400	0.0001646	0.240351	0,215000	

Cable resistances are listed at the specified temperatures

## Transmission Line Input Data

					Ob	ms or MI	as / 1000 m	per Phase				
Line			Length									
D	Library	Size	Adj. (m)	% Tol.	#Phase	T (*C)	RI	XI	¥1	RØ	X0	2.0
Linel		674	19300.0	0.0	1	75	0.056003	0.374255	.0000831	0.200077	1.360791	.0900017
Line2		674	19300.0	9.0	1	75	0.056001	0.342069	.0060034	0.200637	1.424041	.0000016
Line3		674	23000.0	0.0	1	75	0.056001	0.342069	,0000034	0.208637	1.424941	.0000016
Line4		674	15000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1,424041	.0000016
LineS		674	8000.0	0.0	1	75	0.056001	0.342069	.0000934	0.200637	1.424041	.0000016
Line6		674	4608.0	0,0	1	75	0.056093	0.342069		6.200637	1.424043	.0000016
Line7		674	4600.9	9.0	1	75	0.056001	9.342069	.0000034	0.200637	L-42-49-41	.0000016
LineS		674	4000.0	6.0	1	75	0.056091	0.542069	,0000034	0.200637	1.424843	,0000016
Line9		674	4000.0	6.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424841	.0000016
Line10		674	\$800.0	0.0	1	75	0.056001	0.342069	.0000034	0.206637	1.424041	.0000016
Linell		674	8800,0	0,0	1	75	0.056001	0.342069	.0000034	0.208637	L424041	.0900016
Line12		674	21000.0	0.0	1	75	0.056001	0.342069	.0000934	0.200637	1.424941	.0000016
Line13		674	161000.0	6.0	1	75	0.056001	0.542069	,0000034	0.200637	1.424041	,0000016
Line14		674	140000.0	0.0	1	75	0.056001	0.342069	.0000034	0.200637	1.424041	.0000016

Line resistances are listed at the specified temperatures

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		elos:	Config:	Normal

Transformer			Rating			7	Variatio	-	% Set	Tap ting	Adjusted	Phase	Shift
ID	MVA	Prim, kV	Sec. kV	% Z	X/R	+ 5%6	- 596	% Tel.	Prin.	Sec	%Z	Type	Angle
n	63.009	220.000	66.000	12.58	45.00	8	0	Û			12,5000	Dys	30.000
T	63.608	228.909	66.000	12.50	45.00	0	0	0			12.5000	Dym	-30.000
T4	10.009	66.999	11.600	8.35	13.00	0	0	0			8.3500	Dya	30.000
T5	29.009	66.000	11.000	10.00	29.00	0	0	9			10.0000	Dyn	30.000
T6	20.009	65.000	11.000	10.08	20.00		0	0			10.0000	Dya	58.090
17	12.509	11.000	66.000	8.35	13.00	8	0	0			8.3500	YN4	30.000
T8	12.500	11.000	66.000	8.35	13.00	0	0	0			8,3500	YNd	30.000
T9	10.000	65.000	11,000	8.35	15.00	0	0	0		0	8.3500	Dyn	38.000
T10	10.009	66.000	11.000	8.35	13.00	0	0	0			8.3500	Dyn	58.000
TII	28.009	65.000	11.000	10.00	20.00	0	0	0			18.9999	Dyn	30.000
T12	20.000	65.000	11.000	16.08	20.00		0	0			10.0000	Dyn	30.000
113	10,000	65.000	11.000	8.35	13.00	8	0	0			8.3500	Dym	30.000
T14	10,668	65,800	11.000	8.35	13.00	0	0	0		0	8.3500	Dyn	36.680
T16	29,099	66.909	11.000	10,09	20.00	0	0	0			10.0000	Dya	30.000
T17	29.009	66.000	11.000	10.00	20.00	0	0	9			10.0000	Dyn	30.000
TIS	29.009	65.000	11.000	10.08	20.00		0				10.0000	Dyn	38.090
T19	20.000	65.000	11.000	10.00	20.00	0	0				10.0000	Dyn	30.000
T20	3.000	0.400	11.000	6.25	6.00	0	0	0			6.2500	YNd	-38.000
T21	3,000	0.400	11.600	6.25	6.00	0	0	0		0	6.2508	YNd	-30.000
T22	3.000	0.400	11.000	6.25	6.00	0	0	0		- 82	6.2500	7.84	-38.000
T25	5.000	9.499	11.000	6.25	6.00	0	0	0			6.2500	VNd	-30.000
T24	3.000	0.400	11.000	6.25	6.00		0	0			6.2500	YNd	-30.000
T25	5.000	0.400	11.000	6.25	6.00	8	0	0			6.2500	YN4	-38.090
T26	3,000	0,400	11.000	6.25	6.00	0	0	0		0	6.2500	VNd	-30.000

## 2-Winding Transformer Input Data

## 2-Winding Transformer Grounding Input Data

							34	Groundi	ug			
Transformer	Rating		Conn. Primary				Secondary					
ID	MVA	Prim. kV	Sec. kV	Туре	Type	kV	Amp	Ohm	Туре	kV	Amp	Ohm
TI	63.000	220.000	66.000	DA				-	Selid		<u> </u>	
T3	65.000	220.000	66.900	DA					Salid			
T4	10.000	66.000	11.900	DA					Solid			
T5	20.000	66.000	11.000	D/Y					Salid			

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	county Calars	55/3	Config:	Normal

			2				1	Groundi	ng			
Transformer		Rating		Conn. Primary				Secondary				
m	MVA	Prim. kV	Sec. kV	Туре	Type	kV	Amp	Ohm	Type	kV.	Ang	Ohm
T6	20.000	66.000	11.000	DIV					Solid	-		-
17	12.500	11.000	66.000	DA					Solid			
T8	12.500	11.600	66.000	D/Y					Solid			
T9	10.000	66.000	11.000	DA					Solid			
T10	10.000	66.000	11.000	DA					Solid			
TII	20.000	66.000	11.000	DA					Solid			
T12	20.000	66.000	11.000	DA					Solid			
T13	10,000	65,090	11.000	DA					Solid			
T14	10.000	66,000	11,000	DAY					Solid			
T16	20.000	66.000	11.000	DA					Solid			
117	20.000	65.000	11.000	DA					Solid			
T15	20,000	66.000	11.090	DA					Solid			
T19	20.000	66.000	11.000	D/Y					Solid			
T20	3.000	0,400	11.000	DOV					Solid			
T21	3.000	0.400	11.000	DA					Solid			
T22	3.000	0.400	11.000	D/Y					Solid			
T23	3.000	0,000	11.000	DA					Solid			
T24	3.000	0.400	11.000	DA					Solid			
T25	3.000	0.400	11.000	DA					Solid			
T26	3.000	0.400	11.000	DA					Solid			

#### 2-Winding Transformer Grounding Input Data

Project:	MASTER THESIS	ETAP	Page:	8
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

CKT/Branch		Cor	unected Bus ID	% Positive Sequence I (100 MVA Ba			Impedance ase)	
ID	Type	From Bm	Te But	R	X	Z	Y	
п	2W XFMR	But3	Bed	9.44	19.84	19.84	-	
<b>T</b> 3	2W XFMR	But5	Bur2	0.44	19.84	19.84		
T4	2W XFMR	Busl	Butő	6.40	83.25	83.50		
T5	2W XFMR	Bus7	But9	2.50	49.94	50,00		
16	2W XFMR	Burll	Bes10	2.50	49,94	50.00		
17	2W XFMR	Bun42	Bet11	5.12	66.69	66.80		
T8	2W XFMR	Bur41	Bus12	5.12	66.60	66.50		
19	2W XFMR	Bus13	But15	6.40	83.25	83.50		
T10	2W XFMR	Butl4	Bas16	6.40	83.25	83.50		
TII	2W XFMR	Bus17	Bat19	2.50	49,94	50.00		
T12	2W XFMR	Buil8	Ber20	2.50	49.94	50.00		
T13	2W XFMR	Bus21	Beill	6.40	83.25	83.50		
T14	2W XFMR	Bur23	But25	6.40	83.25	83.50		
T16	2W XFMR	Bus27	Bes28	2.50	49,94	50.00		
T17	2W NFMR	Bus27	Ber29	2.50	49.94	50.00		
T18	2W NFMR	Bus30	Bet32	2.50	49,94	50.00		
T19	2W XFMR	Bas31	Bur33	2.50	49.94	50.00		
T29	2W XFMR	Bus34	Bus41	34.25	205.50	205.33		
T21	2W XFMR	Bun35	Bu:41	34.25	205.50	205.53		
T22	2W XFMR	Bu136	Ban41	34.25	205.50	208.33		
T23	2W XFMR	Bun37	Ben41	34.25	205,50	208.33		
T24	2W XFMR	Bus38	Bus42	34.25	205.50	205.33		
T25	2W XFMR	Bun39	Bes42	34.25	205.50	208.33		
T26	2W XFMR	Bus40	Bus42	34.25	205.50	208.35		
Cable1	Cable	Bus11	Bei2	0.02	0.02	0.03	0.0716998	
Cable2	Cable	But12	Beil	0.02	0.02	0.03	0.0716998	
Linel	Line	Bun2	Bunl4	2.48	16.58	16.77	0.2607629	
Line1	Line	Burl	Bus13	2.48	15.16	15.36	0.2542266	
Line3	Line	Bas2	Bus18	2.96	18.06	18.30	0.3387157	
Line4	Line	Bux27	Birt17	1.93	11.78	11.94	0.2209015	
Line5	Line	Burl	But27	1.63	6.28	6.37	0.1178142	
Line6	Line	Bus2	Bes7	0.51	3,14	3,18	0.0589071	
Line7	Line	Buck	ButS	0.51	3.14	3.18	0.0589071	
Line8	Line	Bun2	Bur7	0.51	3.14	3.18	0,0589071	
Line9	Line	Busl	But8	0.51	3,14	3.18	0.0589071	
Linel®	Line	Bus2	Bet31	1.03	6.28	6.37	0.1178142	
Linell	Line	Butl	Bet30	1.63	6.28	6.37	0.1178142	

# Branch Connections

Project:	MASTER THESIS	ETAP		Page:	9
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SNI	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220EV	Study Case.	83	Config:	Normal

CKT	anected Bus ID	96 Pe	sitive Sequ (100 MV	ence Imped 'A Base)	fance		
ID	Type	From Bus	To But	R	х	Z	Y
Line12	Line	Bet17	Ber21	2.70	16.49	16.71	0.3092622
Line13	Line	Bus17	Ban23	20.78	126.43	128.11	2.3710100
Line14	Line	But21	Ben23	18.00	109.94	111.40	2.0617480

Project:	MASTER THESIS	ETAP		Paget	10
Location:	HOUN CITY - LIBYA	11.0.01	1	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cate	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	trinity case.		Config:	Normal

CKT	Branch	Con	Connected Bus ID			o Seq., 100	MVAb
ID	Туре	Frem But	Te Bus	R0	X9	Z.9	2.0
TI	2W Xfmr	Bet3	Buil				
T3	2W Xfmr	Bet5	Bm2				
T4	2W Xfmr	Ban1	Butő				
T5	2W Xfmr	Bun7	Bur9				
T6	2W Xfmr	BarS	Buil0				
17	2W Xfinr	But42	Buill				
T8	2W Xfmr	Ban41	Buil2				
T9	2W Xfmr	Bunl.3	Buil5				
T10	2W Xfmr	Bun14	Buil6				
ти	2W Xfmr	Beil7	Buil9				
T12	2W Xfmr	Burl8	Bur20				
T13	2W Xfmr	But21	Bur22				
T14	2W Xftor	Ber23	Bui25				
T16	2W Xfmr	Ban27	Bm28				
T17	2W Xfmr	But27	Bur29				
T18	2W Mfmr	Bur:N0	Bur32				
T19	2W Xfmr	Buri32	Bun33				
T20	2W Xfor	But34	Bm41				
T21	1W Xfmr	Ben35	Bm41				
T22	2W Mine	But36	Ban41				
T23	2W Xfmr	But37	Bus41				
T24	2W Xfmr	Bar.38	Bu:42				
T25	1W Xfmr	Bun39	But41				
T26	2W Xfmr	Bas:40	But42				
Cablel	Cable	Buill	Bui2	0.06	0.05	8.97	
Cable2	Cable	Bun12	Sul	0.06	0.05	0.97	
Linel	Line	Ben2	Bml4	8.86	60.29	60,94	0.1410145
Line2	Line	Bun1	Burl3	8.89	63.09	63.72	0.1341983
Line3	Line	Beil	Bar18	10.59	75.19	75.95	0.1599255
Line4	Line	Bas27	Buil7	6.91	49.94	49.52	0.1042992
Line5	Line	Bunl	Bur27	3.68	26.15	26.41	0.0556262
Line	Line	Bes2	Bus7	1.84	13.68	13.21	0.02783.51
Line7	Line	Batl	Butt	1.84	13.08	15.21	0.0278131
Line8	Line	Burt2	Bus?	1.84	13.68	13.21	0.0278131
Line9	Line	Bunl	Bun8	1.84	13.68	13.21	0.0278131
Line10	Line	Bes2	But31	3.68	26,15	26.41	0.0556262

## Branch Connections Zero Sequence Impedance

Project:	MASTER THESIS	ETAP	Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV	annay same and	Config:	Normal

CKI	Branch	Coa	mected Bus ID	% Imp	edance, Zer	ro Seq., 10	MVAb
ID	Type	From But	To But	R0	X0	Z.0	2.0
Linell	Line	Besl	Bat30	3.65	26.15	26.41	0.0556262
Line12	Line	Bus17	Ban21	9.67	68.65	69.33	0.1460189
Line13	Line	Bu117	Bun23	74.16	\$26.33	531.53	1.1194780
Line14	Line	Bus21	Ban23	64.45	457.68	462.20	0.9734595

Project:	MASTER THESIS	ETAP		Page:	12
Location:	BOUN CITY - LIBYA	12.6.0H		Date:	28-66-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Case		Coufig:	Normal

#### Machine Input Data

	Machine		Connected Bus	Rat	ing (Base	)	W Ne	gative Seq	Imp.	0	rounding	Ŕ.	967	Lero Seq.	Imp.
	ID	Type	ID	MVA	kV	RPM	X/R	R3	X2	Caun.	Type	Amp	X/R	R9	X0
Ū1		Grid	Bun3	22.101	220.000	C	10.00	9,950	99.50	11.74	Solid		19.00	35.648	356.48
U2		Grid	Bm4	22.101	220.000		10.00	9.950	99.50	Wyw	Solid		19.00	17.738	177.38
U3		Grid	Bas5	22.101	220.000		10.00	9.950	99,50	Wyr	Solid		10.00	17.738	177.38

Project:	MASTER THESIS	ETAP		Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: H		Revision:	Base
Filename:	HOUN SUBSTATION 220kV	ound cases in	a	Config:	Normal

## Harmonic Library

Current Harmonic Source in %

Manufa	cturer:	Typical-D	EEE														
Model: Order	Freq. He	12 Pulse2 Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. He	Mag. 96	Order	Freq. Hz	Mag.
1,60	50.00	106.00	11.90	550.00	8.30	13.00	650,00	6.70	23.00	1158.00	2.88	25.00	1250.60	2.30	35.00	1750.00	0.80
37.00	1850.00	0.60	47.90	2350.00	0.20	49.96	2450.00	0.20									

Manufa	churer:	Typical-I	EEE														
Model: Order	Freq. Hz	12 Pulse2 Mag. %	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag. 96
1.00	50.00	108.00	11.00	550.00	8.30	13.00	658.00	6.70	23.00	1158.00	2.50	25.00	1259.60	2.30	35.00	1750.00	0.80
.37.00	1850.00	0.60	47.90	2350.00	0.20	49,00	2450.00	0.20									

Manufa Model:	cturer:	Typical-II 12 Pulse2	EFE														
Order	Freq. Hz	Mag. 46	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 96
1.00	58.00	100.00	11.00	550.00	8.30	13.00	650.00	6.70	23.00	1350.00	2.80	25.00	1250.00	2,30	35.00	1758.00	0.80
37,60	1850.00	9.60	47.90	2358.00	0.26	49.90	2450.00	0.20									

Manufa Model:	cturer:	Typical-1 12 Pulse	EEE 2														
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mag.
1,60	50.00	100.00	11.99	550.00	8.30	13.00	650,00	6.70	23.00	1150.00	2,38	25.00	1250.00	2.38	35.00	1750.00	0.80
.37.00	1850.00	0,60	47.90	2350.00	0.20	49.00	2450.00	0.20									

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and a second second	Config:	Normal

## Harmonic Source from Library

			Harm	onic Source Informa	tion	
Bus ID	Device ID	Type	Maunfacturer	Model	Fund. Freq.	Mod. Freq.
Bux34	Inv11	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus36	Inv15	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus37	Inv18	Current	Typical-IEEE	12 Pulse2	0.00	0.00
Bus39	Inv21	Current	Typical-IEEE	12 Pulse2	0.00	0.00

Project:	MASTER THESIS	ETAP	Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 2204V	State Care Int	Config:	Normal

			Filte	r Inpu	t Data			
Filter Type: Single-Tun	ed							
Filter	Connected Bus	c	apacitor (	1	I	aductor 1	1	R
ID	ID	kV	Max kV	kvar	XI	Q Fact.	Max I	Ohm
HF2	But2	66.000	100.000	420.7	85.5804	90.00	100.0	0.0000
HF1	Burl	66.000	100.000	140.1	257.0066	70.00	100.0	0.0000

MASTER THESIS	ETAP		Page:	16
HOUN CITY - LIBYA	12,6.0H		Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department			SN:	
SAND MUSTAFA AL-REFAI	Study Case: 1	HA	Revision:	Base
HOUN SUBSTATION 220kV	oning curve a		Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 2201/V	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 220kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Sndy Case: HA Revision:   HOUN SUBSTATION 220kV Config:

But		Volt	age	Gene	ration	Lo	ad		Load Flow				XFMF
ID	RV.	HeMlag-	Aug.	MW	Myar	MW	Mour	ID	MW	Myat	Amp	16 PF	96 Tap
Bust	66.000	101.068	-29.1		0	0.000	-0.144	Bun12	-7.726	0.622	67.1	-99.7	
								Bus13	0.000	-0.290	2.5	0.0	
								Blas 27	0.014	-5.274	45.7	-8.5	
								Bast	0.000	.0.060	0.5	0.0	
								Bus8	0.000	.0.060	0.5	0.0	
								Bur30	0.900	.0.129	1.0	0.0	
								Bur.3	7.712	5.328	81.1	82.5	
								Bush	6.000	0.000	0.0	0.0	
Bax2	66.000	100.193	30.7		0	0.000	-0.426	Bus11	-5.799	0.384	50.7	-99.8	
								Bunl 4	0.000	0.262	2.3	0.9	
								Bun15	0.000	-0.540	3.8	0.0	
								Bust7	0.000	-0.059	0.5	0.8	
								Bas 7	0.000	-0.059	0.5	0.0	
								Bar31	0.000	-0.118	1.0	0.9	
								Buri 5	5.799	0.551	51.2	98.9	
Bus3	229,000	100.000	0.0	-7.705	-5,157	0	0	Busi	-7.798	-5.157	24.3	83.1	
Bau\$	228,000	100.000	0.0	-5.795	-0.813	0	0	Ban2	-5.798	-0.513	15.4	99.0	
Bush	11.000	101.068	-59.1		0	0		Bun1	0.005	8,000	0.0	0.0	
Bus7	66.900	100,194	30.7		0	0	0	Bus2	0.000	0.000	0.0	0.0	
								Ban2	0.000	0.000	0.0	0.0	
								Biart9	0.000	0.000	0.0	0.9	
Bus\$	65.000	101.069	-29.1		0	0	0	Busi	0.000	0.000	0.0	0.0	
								Bun1	0.000	0.000	0.0	0.0	
								Ban10	0.000	0.000	0.0	0.0	
Burl	11.909	160.194	0.7			0	0	Bus7	0.000	0.000	0.0	0.0	
Bus10	11.000	101.069	-59.1		0	0	0	Bus8	0.006	0.000	0.0	0.0	
Buil1	66.000	100,194	30.7		0	0	9	Biat2	5.799	-0.455	50.8	-99,7	
								Bus42	-5.799	0.455	50.8	-99.7	
Bus12	66.000	101.069	-29.1	0	0	0	0	BusI	7.726	-0.695	67.1	-99.5	
								Bus-41	-7.726	0.695	67.1	-59.6	
Bus1.5	66.000	101.090	-29.1		0	0		Busi	0.000	0,000	0.0	8,8	
								Bus15	0.000	0.000	0.0	0.0	
Bus14	66.900	100.215	30.7		0	0	0	Bas2	0.000	0.000	0.0	0.0	
								Busló	0.000	0.000	0.0	0.0	
Bus15	11.000	161.090	-59.1		0	0	0	Bus13	0.000	0.000	0.0	0.0	
Busló	11.000	100.215	0.7		0	0	0	Busl4	0.000	0.000	0.0	0.0	
Busl?	65.000	101,980	-29.2			0		Bun27	-0.007	4.971	42.6	.0.1	

## Fundamental Load Flow Report

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	17 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 2204V	start case. We	Config:	Normal

Bus		Volt	age	Gene	ration	Lo	ad	Load Flow						XFM
ID	kV	Weblag.	Aug.	MW	Mvar	MW	Myar		ID	MW	Mrat	Amp	46 PF	96 Taj
								But21		0.004	-2.488	21.3	-0.1	
								But23		0.003	-2.484	21.3	-0.1	
								Ban19		0.000	0.990	0.0	0.0	
Fas18	65.000	100.224	30.7	0	0		0	Bus2		0.000	0.000	0.0	0.0	
								Bun20		0.000	6.000	0.0	0.0	
las19	11,000	101.980	-59.2	0				Bun17		0.000	0.000	0.0	0.0	
Ren 20	11.000	100.224	0.7	0				Buil8		0.000	6.000	6.0	0.0	
lus 21	66.009	102.356	-29.5	0				Buil7		-0.002	2.175	18.6	-0.1	
								Bun23		0.002	-2.173	18.6	-0.1	
								Burt22		0.000	0.000	0.0	0.0	
len22	11.000	102.356	-59.3		0		0	Bun21		0.000	0.000	0.0	0.0	
us23	66.000	183,530	-29.4	0	0		0	Buil7		0.000	-0.001	0.0	-16.2	
								Bas21		0.005	0.001	0.0	-16.2	
								Bus25		0.000	6.000	0.0	0.0	
us25	11.000	103.530	-59.4	0				Bun23		0.000	0.000	0.0	0.0	
ev27	66,000	101.992	-39.1				0	But17		0.011	-5.170	44.6	-0.2	
								Busl		-0.011	5.170	44.6	0.2	
								Bier28		0.005	0.000	0.0	0.0	
								Bur 29		0.000	0.000	0.0	0.0	
m128	11.000	101.392	-59.1		0			Bur27		0.000	0.000	0.0	0.0	
an19	11.008	101.392	-59.2		0			Bun27		0.000	0.000	0.0	0.0	
as30	65,009	101.072	-29.1	0			.0	Bunl		0.000	0.000	0.0	0.0	
								Bar32		0.000	6.000	0.0	0.0	
us51	66,009	100.197	30.7	0				Bus2		0.000	0.000	0.0	0.0	
								Bur33		0.000	0.000	0.0	0.0	
ari32	11.009	101.072	-59.1				0	Bun36		6,000	6.000	0.0	0.0	
us33	11.000	100.197	0.7					But31		0.000	6.000	0.0	0.0	
10.14	0.400	101.715	-24.0	1.952	0.000		.0	Bus41		1.952	0.000	1769.6	100.0	
as35	9,409	101.713	-24.0	1.957	0.000		0	Bas4)		1.952	0.000	2769.6	180.0	
at36	0.400	101.715	-24.0	1.952	0.000		0	Bus41		1.952	0.000	2769.6	100.0	
ian37	0,200	101.715	-24.0	1.952	0.000		0	Bus41		1.952	0.000	2769.6	100.0	
es38	0,409	108.847	35.3	1.952	0.000			Bun42		1.952	0.000	2793.4	180.0	
ws39	9,400	100.847	35.1	1.952	0.000			Bus42		1.952	0.000	2793.4	100.0	
an.10	6.004	100.847	36.1	1.955	0.000			Barrid?		1.947	0.000	2793.4	100.0	
leid1	11,000	101 134	-56.2	0				Bas12		7.756	0.101	402.5	-80.0	
		Contract,	1000					Ban34		-1.015	0.076	100.1	.90.0	
								Rue 15		1.955	0.075	160.7	.00.0	
								and the second second			10.00	4 M M A	-25.2	
								Burl6		.1.050	0.075	100.7		

Project:	MASTER THESIS	ETAP	Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Case. 194	Config:	Normal

Bus		Volt	age	Gene	ration	Lo	ad		Load Flow				XFMR
ID	kV	%Mag.	Ang.	MW	Mvar	MW	Myar	ID	MW	Mvar	Amp	% PF	% Tap
Bun42	11.000	100.263	2.9	0	6		0	Bmll	5.837	-0.251	364.7	-99.5	
								Ber38	-1.939	0.077	101.6	.99.5	
								Ban39	-1.939	0.677	161.6	.99,9	
								Bas40	-1.939	6.877	101.6	.99.9	

* Indicates a valtage regulated bus (valtage controlled or using type machine connected to it) # indicates a bus with a load minmatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP	Page:	19
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220RV	Construction of the second	Config:	Normal

Buc					Valt	are Distort	ion			
ID	kV	Fund. 46	RMS %	ASUM 96	THD %	TIF	TIHD	TSHD %	THDG	THDS 55
Buil	66.000	101.07	101.09	103.78	1.85	52.15	0.00	0.00	1.85	1.85
But2	66.000	100.19	100.20	101.56	1.40	31.80	0.00	0.00	L.48	1.40
Bus3	226.000	100.00	100.02	102.60	1.79	50,45	0.00	0.00	1.79	1.79
Ban5	220.000	100.00	100.01	101.59	1.34	30.51	0.00	6.00	1.34	1.34
Build	11.000	101.07	101.09	103.78	1.85	52.15	0.00	0.00	1.85	1.85
Bus7	66.000	100.19	100.20	101.86	1.40	31.85	0.00	0.00	1.40	1.40
Bus8	66.000	101.07	101.09	163.79	1.85	52.31	0.00	0.00	1.85	1.85
Bus9	11.000	100.19	100.20	101.86	1.40	31.85	0.00	0.00	1.40	1.40
Bus10	11.000	101.07	101.09	103.79	1.85	\$2.31	0.00	0.00	1.85	1.85
Bus11	66.000	100.19	100.20	101.86	1.40	31.80	0.00	0.09	1.40	1.49
Bus12	66.000	101.67	101.09	103.78	1.85	52.15	0.00	0.00	1.85	1.85
Bus13	66.000	101.09	101.11	104.02	1.93	56.50	0.00	0.00	1.93	1.93
Bus14	66.000	100.22	100.23	101.97	1.45	35.17	0.00	0.00	1.45	1.45
Buil5	11.600	161.09	101.11	104.02	1.93	56.50	0.00	0.00	1.93	1.93
Bun16	11.000	100.22	100.23	101.97	1.45	33.17	0.00	9.00	1.45	1.45
Bus17	66.000	101.98	102.00	104.54	1.97	44.24	0.00	0.00	1.97	1.97
Bm18	66.000	100.22	100.23	102.02	1.47	33.81	0.00	0.00	1.47	1.47
Bur19	11.000	101.98	102.00	104,34	1.97	44.24	0.00	0.00	1.97	1.97
Bar20	11.000	100.22	100.23	102,02	1.47	33.81	0,00	0.00	1.47	1.47
But21	66.000	102.36	102.38	105.45	2.06	57.63	0.00	0.00	2.86	2,06
Bus22	11.000	102.36	102.38	105.45	2.06	57.63	0.00	0.00	2.06	2.06
Bus25	66.000	103.53	103.55	105.69	1.97	45.95	0.00	0.00	1.97	1.97
Bux25	11.000	103.53	103.55	105,69	1.97	43.98	0.00	0.00	1.97	1.97
Bus27	66.000	101.39	101.41	103.91	1.88	46.12	0.00	0.00	1.88	1.88
Bus28	11.000	101.39	101.41	103.91	1.88	46.12	0.00	0.00	1.88	1.88
Bus29	11.000	101.39	101.41	103.91	1.88	46.12	0.00	0.00	1.88	1.88
But50	66.000	101.07	101.09	165.82	1.85	52.51	0.00	0.00	1.86	1,86
Bur51	66.000	100.20	100.21	101.87	1.40	32.02	0.00	0.00	1.4	1.41
Bun32	11.000	101.07	101.69	103.82	1.86	52.81	0.00	0.00	1.86	1.86
Bui33	11.000	100.20	100.21	101.57	1.40	32.02	0.00	0.00	1.41	1.41
But34	0,400	161.71	101.57	115.53	5.56	266.09	0.00	9.05	5.56	5.56
Bus35	0.400	101.71	101.75	107.60	2.50	123.58	0.00	0.00	2.50	2.50
Bun36	0.400	101.71	101.87	115.53	5.56	266.09	0.00	0.00	5.56	5.56
Bui37	0.400	101.71	101.87	115.53	5.56	266.09	0.00	9.00	5.56	5.56
Bus38	0.409	100.85	100.86	103.95	1.80	46.03	0.00	0.00	1.80	1.50
But39	0.409	100.85	100.97	112.47	4.91	192.81	0.00	0.00	4.91	4.91
Bus40	0.400	100.85	100.86	103.95	1.80	46.03	0.00	0.00	1.80	1.80
Bas41	11.000	101.13	101.17	107.42	2.69	132.53	0.00	0.00	1.69	2.69
Bas42	11.000	100.26	100.28	183.57	1.95	49.42	0.00	0.00	1.93	1.93

System Harmonics Bus Information

* IndicatesTHD (Total Harmonic Distortion) Exceeds the Limit. # Indicates IHD (Individual Harmonic Distortion) Exceeds the Limit.

Project:	MASTER THESIS	ETAP	Page:	20
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Вач
Filename:	HOUN SUBSTATION 220kV		Coufig:	Normal

Buy						Current	Distortion						
From Bus ID	To Bus ID	Fund. Amp	RMS Amp	ASUM Amp	THD	TIF	IT Анр	ITя Апр	ITR Amp	TIHD	TSHD %	THDG	THDS
Buil	Buil2	67.09	67.13	71.92	3.70	98.60	6619.51	6619.51	0.00	0.09	0.00	3.70	3.70
	Buil3	2,51	2.61	3.76	27.95	1043.89	2724.26	2724.26	0.00	0.00	0.00	27,98	27.98
	Bus27	45.65	45.69	49.33	434	197.18	9010.11	9910.11	0.00	0.00	0.00	4.34	4.34
	Bus8	0.52	0.54	0.77	27.13	984.55	\$31.29	531.29	0.09	0.00	0.00	27.35	27.13
	Bus8	0.52	0.54	0.77	27.13	984.55	531.29	\$33.29	0.00	0.00	0.00	27.13	27.15
	Ban30	1.64	1.05	1.54	27.25	991.21	1070.07	1070.07	0.00	0.00	0.00	27.25	27.23
	Bun3	81.15	81,13	81.45	0.32	7.60	616,61	616.61	0.00	0.00	0.00	0.32	0.52
	Bush	0	Ð	0		6	0.00	616.61	0.00	0.00	0.00	0.00	0.00
Bus2	Bail1	59.74	50,75	52,38	1.69	42.04	2133.63	2133.63	0.00	0.00	00.8	1.69	1,69
	Ban14	2.29	2.33	2.88	18.85	466.02	1083.93	1065.93	0.00	0.00	0.00	18.83	18.83
	Bus18	2,97	5.02	3.76	18,99	473.23	1430.20	1439.20	0.00	0.09	0.00	18.99	18.99
	But7	0.52	0.53	0.65	18.49	452.59	237.64	237.64	0.00	0.00	0.00	18.49	15.49
	Bas?	0.52	0.53	0.65	15.49	452.59	237.64	237.64	0.00	0.09	0.00	15.49	15.49
	Bai.31	1.65	1.08	1.29	18.53	454.22	477.02	477.62	0.00	0.00	0.00	18.53	18.53
	Bus5	51.21	\$1,21	51.43	0.39	8.62	441.31	441.31	0.00	0.00	0.00	0.39	0.39
Bend	Butl	24.34	24.34	24.44	0.52	7.60	184.98	184.98	0.00	0.00	0.06	0.32	0.32
But5	Bat2	15.36	15.36	15.43	0.39	8.62	132.39	132.39	0.00	0.00	0.00	0.39	0.39
Bursh	Burl.		0	.0		0	0.00	132.39	0.00	0.00	0.00	0.00	0.00
Bus?	Bus2		0	0	. 0	0	0.00	132,39	0.00	0.00	0.00	0.00	0.00
	But2		0	.0		8	6.00	132.39	0.00	0.00	0.00	0.00	9,90
	Ber?	0	0	0	9	0	0,00	132.39	0.00	0.00	0.00	0.00	9,00
Bush	Bux1	0	0	.0		0	0.00	132.39	0.00	0.00	0.00	0.00	0.00
	Bml	0	0	0	0	0	0,00	132,39	0.00	0.00	0,00	0.00	0.00
	Bas10		0	.0		0	0.00	132.39	0.00	0.00	0.09	0.00	9,90
Bu:9	Bas7	0	0	.0	0	0	0,00	152.39	0.00	0.00	0.00	9,90	9,00
Bush0	Bus8		0	0		0	0.00	132.39	0.00	0.09	0.09	0.00	0.99
Bush1	Bas2	50.79	50.80	52,35	1.58	41.88	2127.24	2127.24	0.00	0.00	0,00	1.58	1.58
	Bas4I	58,79	56.89	52,35	1.58	41.88	2127.24	2827.24	0.00	0.00	0.00	1.58	1.58
Bas12	Busi	67.14	67.19	72.02	3.79	95.73	6432.11	6452.11	0.00	0.00	0.00	3.79	3.79
	Bun41	67,14	67.19	72.02	3.79	95.75	6432.11	6452.11	0.00	0.09	0.00	3.79	3,79
Buil3	Buil	0	D	0	0	0	0,00	6432.11	0.00	0.00	0,00	0.00	0.00
	Bas15		0	0	0	0	0.00	6432.11	0.00	0.00	0.00	0.00	0.00
Burl 4	Bat2	0	0	0	0	0	0,00	6432.11	0.00	0.00	0.00	9.00	0,00
	Bun16		0	0		0	0.00	6452.11	0.00	0.09	0.00	0.00	0.00
Bus1#	But15		0	0	0	0	0.60	6432.11	0.00	0.00	0.00	0.00	0.00
Buil6	Bun14		0	0	0	0	0.00	6452.11	0.09	0.00	0.00	0.00	0.00
Buil7	Bat27	42.64	42.68	45.77	4.09	226.17	9652.35	9652.35	0.00	0.00	0.00	4.09	4.69
	Bas21	21.34	21.39	24.15	7.01	411.52	\$795.41	\$795.41	0.09	0.00	0.00	7.01	7,81
	But25	21.30	21.31	22.61	2.65	161.77	3447.68	3447.68	0.00	0.00	0.00	2.65	2.65
	Bun19		0	0	0	0	0.00	3447.68	0.09	0.00	0.00	0.00	0.00

## System Harmonics Branch Information

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H		Page: Date:	21 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	На	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stand Cartes		Config:	Normal

Bus						Curren	Distortion						
From Bus ID	To Bet ID	Fund	RMS	ASUM	THD	TIF	Π	ITe	ITa	TIHD	TSHD	THDG	THDS
	- 194-19-	Amp	Ашр	Amp	94		Amp	Amp	Amp	. 16	16	- 96	.96
Builf	Bus2	0	0	٠	a	0	0.09	3447.68	0.00	0.00	8.80	0.00	0.08
	Bas20		0		0		0.00	3447.68	0.00	0.09	8.00	0.00	6.00
Burl9	Bus17		0		0		0.00	3447.68	0.00	0.09	8.00	0.00	0.00
Bus20	Bus18	0	0		0		8.00	3447.68	0.00	0.00	0.00	0.00	0.00
Bus21	Bus17	18.57	18.62	23.14	6.94	399.58	7439.84	7439,84	0.00	0.09	8.00	6.94	6.94
	Bus23	18.57	38.62	21.14	6.94	399.58	7439.84	7439.84	9.30	0.08	0.00	6.94	6.94
	Bier22	٥	0		0	٥	0.00	7439,84	8.00	0.00	0.00	0.00	0,00
Bus22	Bus21		0		0		0.00	7439.84	9.90	0.08	0.00	0.09	9.00
Bus23	Bus17	0,01	0.38	0.57	4660.62	2847.38	1068.26	1068.36	0.00	0.00	0.00	4660.62	4660.63
	Bun21	0.01	0.38	0.57	4660.62	2847.38	1068.26	1068.26	8,00	0.00	0.00	4660.62	4660.62
	Bus25		0		0		0.00	1068.36	0.00	0.00	0.00	0.00	0.00
Bui25	Bun2.5	8	0	6	0		0.00	1068.26	0.00	0.09	6.00	0.08	8.60
But27	Bun17	44.61	44.65	48.21	4.58	213.40	\$528.12	9528.12	0.90	0.08	0.00	4.50	4.50
	Bunl	44.61	44.65	48.21	430	213.40	9528.12	9528.12	0.80	0.09	6.00	4.30	4.50
	Bun28		0		0		0.00	9528.32	0.00	0.09	0.00	0.00	0.00
	Bus29		0		0		0.00	9528.12	9.90	0.00	0.00	0.00	0,00
Bun28	Bus27		0		0		0.00	9528.32	0.00	0.09	0.00	0.00	0.00
Bun29	Bun27		0		0		0.00	1528.12	8,90	0.00	8,00	0.09	0.00
Bas30	Busl	0	0		0		0.00	9528.12	0.00	0.09	8.00	0.00	4.00
	Bun32		0		0		0.00	9528.32	8,90	0.00	0.00	0.00	9.00
But31	Bus2		Ú.		0		0.00	9928.12	8.00	0.00	8.00	0.00	6.00
	But33	0	0		0		0.00	9528.12	0.00	0.00	0.00	0.00	0.00
Bert32	Bun30		0		0		0.00	9928.12	8.00	0.00	8.00	0.00	8.00
Burkh	Bun31		0		0		0.00	9528.12	0.00	0.09	8.60	0.00	0.00
Bur34	Ben41	2769.58	2775.20	3841.75	5.11	129.85	368095.00	360095.00	0.00	0.00	0.00	5.11	5.11
Buch5	Bus41	2769.58	2769.59	2784.30	0.27	8.90	24656.24	24656.24	0.00	0.09	8.60	0.27	0.27
Bushi	Bus41	2769.58	2773.29	3041.73	5.11	129.85	368095.00	360095.00	0.00	0.00	0.00	5.11	5.11
But37	Bus41	2769.58	2773.28	3041.73	5.11	129.85	368095.00	369095.00	0,90	0.00	8,60	5.11	5.11
But38	Bus42	2793.38	2793.38	2803.04	0.23	5,17	14430.58	14439.58	0.00	8.00	0.00	0.25	0.23
Bur39	Bus42	2793.38	2797.02	5970.48	5.11	132.97	371924.50	371924.50	8.00	0.00	8.00	5.31	5.11
Bun40	But42	2793.38	2793.38	2803.04	0.23	5.17	14430.58	14430.58	9,90	0.00	0.00	0.25	0.23
Bund]	Bunl 1	402.85	485.14	452.10	3.79	95.73	38592.68	38592.68	0.00	0.00	9.00	3.79	3.79
	But54	109,71	100.84	110.61	5.11	129.85	13094.57	13094.37	08.6	0.09	6.00	5.11	5.11
	Bas.35	100,71	100.71	101.25	0.27	5,50	896.59	896,59	0.90	0.05	0.00	0.27	0.27
	Bui36	109,71	100.84	110.61	5.11	119.85	13094.57	13094.37	0.00	0.09	6.00	5.11	5.11
	Bun37	100.71	100.84	110.61	5.11	129.85	13094.37	13094.37	0.00	0.09	8.60	5.11	5.11
Bun#2	Buill	304.73	394.77	314.12	1.58	41.88	12763-0	12763.43	0.00	0.09	6.00	1.58	1.58
	Bun38	101.58	101.58	101.93	0.23	5.17	524.75	524.75	0.00	0.00	8.80	0.23	0.23
	Bun39	101.58	101.71	111.65	5.11	132.97	13524.53	13524.53	9,90	0.00	8.00	5.11	5.11
	Bus40	101.58	101.58	101.95	0.23	5.17	524.75	524.75	0.90	0.00	8,00	0.23	0.25

Project:	MASTER THESIS	ETAP	Page:	22	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SNL		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV	and the second	Config:	Normal	

#### Bus Tabulation Harmonic Voltages (% of Fundamental Voltage) Bus ID: Fund. kV: Berl 66.705 Ereq. Mag. Order Freq. Order Free. Mag. Order Mag. Order Freu, Mag. Order Freu Mag. Order Free Mag. 16 0.05 37.00 Hz Hz 46 Hz HI 44 Hz Hz 46 46 25.00 1250.00 11.00 \$59.00 0.02 13.00 650.00 1.75 23.00 1159.00 0.31 0.50 35.00 1750.00 1850.00 0.00 47.80 49.00 2459.00 1350.00 0.03 0.02 But ID: Fund. kV: Bar10 11.315 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq Mag. Order Freq. Mag. Ha 84 Ha -Ha -H 14 Hz 44 He 46 11.00 558.00 0.02 13.60 653.80 1.75 23.00 1159.00 6.32 25.08 1250.00 0.51 35.00 1750.00 0.05 37.00 1850.00 6.60 47,00 2358.00 49:00 2450.00 0.03 0.02 But ID: Fund. kV: Bas11 66.128 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Free Mag. 64 Hz 0.13 25.00 1250.00 HI 14 Hz 46 Hz 54 Hz 14 37.00 Ha 44 . . . .... ..... 11.00 \$55.00 0.00 15,00 658.00 1.59 23.00 1159.00 0.10 35.00 1750.00 0.02 1850.00 0.01 47.00 2350.00 0.00 49.00 2450.00 0.00 Bm ID: Fund kV: Bas12 66.706 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Frey. Mag. Order Freq. Mag. Order Freq. Mag. Hz 16 Ht 16 Hr 16 Hr 86 Hz 16 Hr 96 11.00 1.75 23.60 1150.00 25.00 1250.00 35.00 1750.00 37.00 550.00 0.02 13,00 650.00 0.32 0,50 0.05 1850.00 0.69 \$7.00 2350.00 0.03 49.00 7,153.00 0.07 Bas ID: Fund. kV: Hack) 66.715 Order Mag. Order Freq. Mag. Order Freq. 66 Hz 66 Hz Mag. 16 Order Free Order Order Freq. Mag. Freq Mag. Free Mag. Ha 16 Ha Hr Hr Hz 96 35.00 11.00 658.00 1.81 23.00 1159.00 0.35 25.68 0.57 \$7.00 \$50.00 0.02 13.00 1250.00 1750.00 8.05 1550.00 8,00 2359.00 49.00 2450.00 0.04 17.00 0.85 Ber ID: Fund kV: Bun14 66.142 Order Freq. Mag. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Order Freq Mag. Order Eres. Mag Hz Ha Ha Hr Hr 16 16 66 56 Hs 16 96 11.80 558.00 0.08 13.00 658.00 1.43 23.00 1159.80 0.15 25.00 1250.00 0.11 35.00 1750.00 37.00 1850.00 0.05 6.02 47.00 2358.80 0.01 49,00 3459.00 0.05 But ID: Bail5 Fund, kV: Order Freq. Mag. Order Freq Mag. Order Freq. Mag. Order Freq. Mag. Order Freq Mag. Order Freq Mag. Ha 44 Hz 84 Hz - 64 Hr 14 H 44 Hr 16 11.00 558.00 0.02 11.00 650.00 1.81 23.00 1150.00 0.35 25.00 1250.00 0.57 35.00 1750.00 0.06 37.00 1850.00 0.00 17.00 2359.00 0.05 49.00 2458,00 0.04 Ban16 11.024 Ban ID: Fund kV: Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Free Mag. Order Freq. Mag. Order Hı 44 Hz 14 Hz 16 Hz 14 Hz 16 Hz 96 11.00 550.00 0.00 15.00 650.00 1.43 25.00 1150.00 0.15 25.00 1250.00 0.11 35.00 1750.00 0.05 37.00 1850.00 0.02

Project: MASTER THESIS ETAP	Page: 23
Location: HOUN CITY - LIBYA 12.6.0H	Date: 28-06-2016
Contract: NEAR EAST UNIVERSITY - EEE Department	SN:
Engineer: SAND MUSTAFA AL-REFAI Study Case: HA	Revision: Base
Filename: HOUN SUBSTATION 220kV	Config: Normal

								Bus Tal	bulation								
_						Harr	monic Vol	tages (%)	of Funda	mental Vo	dtage)						
Bui ID: Fund. EV:	Bm16 11.024																
Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. He	Mag. 54
47.00	2350.09	10,0	49.00	2450.00	0.00												
Bui ID: Fund. kV:	Bm17 67.306																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
11.00	550.00	0.01	13.00	650,00	1.97	13.00	1150.00	0.10	25.00	1250.00	0.05	35.00	1750.00	0.08	37.00	1859.00	0.05
47.00	2350.00	0.61	49.00	2459.00	6.01												
But ID: Fund. kV:	Bus18 66.148																
Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 16	Order	Freq. Hz	Mag.
11.00	550.00	6.00	13.00	650.00	1.45	23.60	1156.00	0.16	25.00	1250.00	6.12	35.00	1750.00	0.03	37,60	1550.00	0.02
47.00	2350.00	0.01	49.00	2450.00	0.01												
But ID: Fund. hV:	Bar19 11.215																
Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Ereq. Hz	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag.
11.00	\$50.00	0.01	13.00	659.00	1.97	23.60	1158.00	0.10	25.60	1250.00	0.65	35.00	1750.00	0.05	37.00	1858.00	0.05
47.00	2350.00	0.01	49.00	2450.00	0.01												
But ID: Fund kV:	Bus2 66.128																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Free Ha	Mag.	Order	Freq. Hz	Mag.
11.00	550.00	6.00	13.00	650.00	1.39	23.00	1150.00	0.15	25,00	1250.00	0.10	35.09	1750.00	0.02	\$7,00	1850.00	0.01
47.00	2350.00	0.00	49.00	2450.00	0.09												
But ID: Fund. kV:	Bes10 11.015																
Order	Freq. Hz	Mag. Si	Order	Freq. Hi	Mag.	Order	Freq. Hz	Mag.	Ordes	Ereq. Ha	Mag.	Order	Freq. Ha	Mag. 46	Order	Fireg. Hz	Mag. 19
11.00	550.00	0.00	15.00	659.00	1.45	23.00	1150.00	0.16	25.00	1250.00	0.32	35.00	1750.00	0.03	37,00	1850.00	0.02
47,00	2350.00	0.03	49.08	2450.00	0.01												
But ID: Fund. kV:	Bm21 67.555																
Order	Freq. Hz	Mag. Ni	Order	Freq. Hz	Mag. 94	Order	Freq. Ha	Mag.	Order	Freq. Hz	Mag. 94	Order	Freq. Ha	Mag. 86	Order	Freq. Hz	Mag. 96
11.00	550.00	0.61	13.08	650.00	1.95	23.00	1156.00	9.39	25.00	1250.00	0.51	35.00	1750.00	0.09	37.00	1850.00	0.07
47.00	2350.00	0.01	49.00	2450.00	0.08												
But ID: Fund. kV:	Bas22 11.259																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	\$50.00	0.01	13.00	650.00	1.95	23.60	1158.00	0.39	25.60	1250.00	0.51	35.00	1750.00	0.09	37,00	1858.00	0.07
47.00	2350.00	0.01	49.08	2450.00	0.00												

MASTER THESIS	ETAP		Page:	24
HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department			SN:	
SAND MUSTAFA AL-REFAI	Study Case	На	Revision:	Base
HOUN SUBSTATION 220kV	and carrie		Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 2206/V	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.8H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HOUN SUBSTATION 2204V	MASTER THESIS ETAP HOUN CITY - LIBYA 124.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 2204V	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.9H   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: HA   HOUN SUBSTATION 220kV Config:

								Bus Ta	bulation	(							
						Har	monic Vol	tages (%	of Funds	mental Vo	altage)						
But ID: Fund. kV:	Ben23 68.330																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 95	Order	Freq. Hz	Mag.
11.00	550.00	0.02	15.00	650.00	1.97	23.80	1150,00	0.05	25.00	1250.00	0.05	35.00	1750.00	6.99	37.00	1858.00	9.00
47,80	2350.00	8.00	49.00	2450.00	0.09												
But ID: Fund. kV:	Bus15 11.388																
Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Fireg. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag.
11.00	550.00	0.02	13.00	650.00	1.97	23.86	1150.00	0.05	25.00	1250.00	0.05	35.00	1750.00	0.00	37.00	1850.00	0.00
47.90	2350.00	0.08	49.00	2450.00	0.00												
But ID: Fund. kV:	Bes37 66.919																
Order	Freq. Hz	Mag. 96	Order	Freg. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hi	Mag. 96	Order	Freg. Hz	Mag. \$6
11.00	550.00	0.02	13.09	650,00	L.84	23.00	1159,00	0.17	25.00	1250.00	0.32	35.00	1750.00	0.06	37.00	1850.00	0.03
47.80	2350.00	8.02	49.00	2450.00	0.01												
Ber ID: Fund, kV:	Ben28 11.153																
Order	Freq. Hr	Mag. 54	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 84
11.00	550.00	6,62	13.00	650.00	1.84	23.00	1150,00	0.17	25.00	1250.00	9,32	35.00	1750.00	0.06	37.00	1850.00	0.03
47,00	2350.00	0.02	49.00	2450.00	0.01												
Bus ID: Fund. kV:	Bas29 11.153																
Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
11.00	550.00	0.02	13.00	650.00	1.84	23.66	1159.00	0.17	25.00	1250.00	0.52	35.00	1750.00	0.06	37.00	1850.00	0.03
47.00	2350.00	0.02	49.09	2450.00	0.01												
Bm ID: Fund. kV:	Bas3 220.00	a															
Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag.
11.00	550.00	9.92	15.09	650.00	1.69	23.00	1150.00	0.50	25.00	1250.00	9.49	35.00	1750.00	0.04	37.00	1850.00	0.00
47,80	2350.00	0.05	49.00	2450,00	0.02												
But ID: Fund. hV:	Bus30 66.707																
Order	Freq. Hr	Mag.	Order	Freg. Hr	Mag.	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. to
11.00	550.00	6.62	15.00	650.00	1.76	23.00	1150,00	0.32	25.60	1250.00	0.52	35.00	1750.00	0.05	37.00	1850.00	0.00
47,00	1550.00	8.85	49.00	2450.00	0.02												
But ID: Fund. kV:	Ben.51 66.130																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.
11.80	550.00	0.00	13.00	650.00	1.39	23.00	1159.00	0.14	25.00	1250.00	0,10	35.00	1790.00	0.02	37.00	1859.00	0.01

Project:	MASTER THESIS	ETAP		Page:	25
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220KV			Config:	Normal

								Bus Ta	bulation	1							
-						Har	nonic Vol	tages (%	of Funda	mental Ve	dtage )						
Bus ID: Fund. kV	Ban31 66.130																
Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 44	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
47,09	2350.00	0.00	49.00	2450.00	0.00												
Bus ID: Fund. kV:	Ben32 11.118																
Order	Freq. Hz	Mag. 94	Order	Ereq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. Na	Order	Ereq. Hz	Mag. 94
11.09	558.00	0.02	15.00	650.00	1.76	23.60	1150.00	8.32	25.00	1250.00	0.52	35.00	1750.00	0.05	37.00	1850.00	0.00
47,00	2359.00	0.03	49.00	2450.00	0.02												
Ber ID: Fund. kV:	Bm33 11.022																
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. %6	Order	Freq. Hz	Mag. %6	Order	Freq. Hz	Mag. 55	Order	Freq. Hz	Mag.
11.00	550.00	0.00	13.00	650.00	1.39	25.00	1150.00	0.14	25.00	1250.00	0.10	35.00	1750.09	0.02	37.00	1850.00	0.01
47.00	2358.00	0.00	49.00	2458.00	0.00												
Bus ID: Fund. kV:	Ban34 0.407																
Order	Freq. Hr	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 56
11.09	\$50.00	3.18	13.00	650.00	1.90	23.00	1150.00	2,71	25.00	1250.00	2.63	35.00	1750.00	1.21	37.00	1850.00	1,00
47.00	2359.00	0.46	49.00	2450.00	0.50												
Bus ID: Fund, kV:	Bm35 0.407																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 96	Order	Freq. Ht	Mag.	Order	Freq. Ht	Mag.	Order	Freq. Hz	Mag. 56	Order	Freq. Ht	Mag. 96
11.00	550.00	1.42	13.00	650.00	0.54	23.00	1150.00	1.30	25.00	1250.00	1.56	35.00	1750.00	0.45	37.00	1850.00	0.39
47.09	2350.00	0.16	49.00	2450.00	0.17												
Bus ID: Fund. kV	Ban36 8.407																
Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 56	Order	Freq. Hr	Mag. 96	Order	Freq. Hs	Mag. %6	Order	Freq. Hz	Mag. 55
11.09	550.00	3.18	13.00	650.00	1.90	23.00	1150.00	2.71	25.00	1250.00	2.63	35.00	1750.00	1.21	37.00	1850.00	1.00
47.00	2350.00	0.46	49.00	2450.00	0.50												
But ID: Fund, kV	Bun37 0.407																
Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 99	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 99
11.00	550.00	5.18	15.00	650.00	1.90	25.60	1150.00	2.71	25.00	1250.00	2.63	35.00	1750.00	1.21	37.90	1850.00	1.00
47.09	2359.00	0.46	49.00	2450.00	0.50												
Bus ID: Fund. kV	Ban36 0.403																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 96	Order	Freq. Hr	Mag.	Order	Freq. Hz	Mag. 56	Order	Freq. Hz	Mag. Ni
11.09	550.00	0.49	13.00	650.00	1.68	23.00	1150.00	0.25	25.00	1250.00	0.25	35.00	1750.00	0.15	37.00	1850.00	0.12
47.80	2350.00	0.06	49.00	2450.00	0.06												

Project:	MASTER THESIS	ETAP		Page:	26
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Same care		Config:	Normal

								Bus Tal	bulation								
						Har	monác Vol	tages (%	of Funda	mental Vo	oltage)						
Bas ID: Fund kV	Buc.39 0.403																
Order	Ereq. Hz	Mag. %	Order	Freq. Hz	Mag. 10	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. Nb	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.99	550.00	2.29	13.00	650.00	3.38	23.00	1159.00	1.75	25.00	1258.00	1.65	35.00	1758.60	0.94	37.00	1850.00	9.77
47.00	2359.00	0.37	49.00	2450.00	0.40												
Buy ID: Fund. kV:	Bun-4 220.00	0															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Treq. Hz	Mag.	Order	Freq. Ha	Mag.
Bus ID: Fund. kV:	Bas40 0.403		_			_						_				_	
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Bz	Mag. 96	Order	Freq. Hr	Mag. 84
11,09	\$59.00	0.49	15.00	650.00	1/68	23.00	1159.00	0.25	25.00	1250.00	0.25	35.00	1758.00	0.15	37.00	1850.00	9.12
47.90	2350.00	0.06	49.00	2450.00	0,06												
Bus ID: Fund. kV:	But-41 11.125																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
11.90	550.00	1.53	13.00	650.00	0.57	23.60	1150.00	1.40	25.00	1250.00	1.46	.55.00	1750.00	0.49	37.00	1850.00	0.42
47.00	2359.00	0,17	49,00	2450.00	0.18												
Bus ID: Fund. kV:	Ban42 11.029																
Order	Freq. Ha	Mag. %	Order	Freq. Hz	Mag. 86	Order	Freq. Ha	Mog. Hi	Order	Freq. He	Mag. No	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	0.53	13.00	650.00	1,50	23.00	1159.00	0.27	25.00	1258.00	0.27	35.00	1758.00	0.16	.37.00	1850.00	0.33
47.00	2359.00	0.06	49.00	2450.00	0,07												
Bus ID: Fund. kV:	Bas5 220.00	0															
Order	Freq. Hz	Mag. 56	Order	Freq. Hz	Mag. 96	Order	Freq. He	Mag. 19	Order	Freq. Hr	Mag. 96	Order	Freq. He	Mag. 16	Order	Freq. Hz	Mag. 96
11.90	550.00	0.00	13.00	659.00	1.33	23,60	1159.00	0.13	25.00	1258.00	0,09	35.00	1750.00	0.02	37.00	1850.00	0.61
47.00	2359.00	0.00	49.00	2450.00	0.00												
Bas ID: Fund. kV:	Bes6																
Order	Freq. Hz	Mag. 56	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hr	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hr	Mag.
11.00	550.00	0.02	15.00	650.00	1,75	23.00	1150.00	0.31	25.00	1258.00	0.50	35.00	1750.00	0.05	.37.90	1850.00	0.00
47.00	2350.00	0.03	49.00	2450.00	0.02												
Bus ID; Fund. kV:	Bar7 66.128																
Order	Firep. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 96
11.00	550.00	0.00	13.00	650.00	1.39	23.00	1156.00	0.14	25.00	1258.00	0.10	35.00	1750.00	0.02	37.00	1856.00	0.61
47.00	2350.00	0.00	49.00	2450.00	0.00												

Project:	MASTER THESIS	ETAP		Paget	27
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SNI	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 229kV	study care.	5552.6	Config:	Normal

	Bus Tabulation																
						Harr	monic Vol	tages (%	of Funda	mental Vo	ltage)						
Bus ID: Fund. kV:	Bes8 66.786																
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag. 76	Order	Freq. Hz	Mag. 16	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag.
11.00	558.00	0.02	13.00	659.00	1.75	23.00	1158.00	8.32	25.00	1259.00	0.51	35.00	1750.00	8.05	37.00	1850.00	0.00
47.00	2359.00	0.03	49.00	2450.00	0.02												
Bus ID: Fund. kV:	Bas9 11.021																
Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 19	Order	Freq. Hz	Mag. 96	Order	Freq. Hr	Mag. 94	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. %
11.00	559.00	0.00	13.60	650.00	1.59	25.00	1150.00	0.14	25.00	1256.00	0.16	35.00	1750.00	0.02	37.00	1850.00	0.01
47.00	2350.00	0.00	49,00	2450.00	0.00												

Project:	MASTER THESIS	ETAP	Page:	28
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV		Config:	Normal

								Bus Tal	bulation	6							
Harmonic Voltages (% of Nominal Voltage)																	
Bus ID: Nom. kV	Bus1 66.000	0				_											
Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. No	Onler	Freq. Hz	Mag. 46
11.00	550.00	9.02	13.00	650.00	1.77	23.00	1159.00	9.32	25.00	1250.00	0.51	35.00	1758.00	0.05	37.00	1850.00	0.09
47.00	2359,00	0.63	49.00	2458.00	0.02												
Bus ID: Nom. kV	Bus10	5															
Order	Freq. Hz	Mag. 86	Order	Freq. Ht	Mag. 96	Order	Freg. Hz	Mag. 86	Order	Freq. Hz	Mag. 5%	Order	Freq. Hz	Mag. %6	Order	Freq. Hz	Mag. 86
11.00	550.00	6.02	15.00	650.00	1.77	23.00	1159.00	0.32	25.00	1250.00	0.51	35,00	1758.00	8.05	37.00	1850.00	B.00
47.00	2350.00	0.05	49.00	2450.00	0.02												
Bus ID: Nom. kV	Buill 66.000	0															
Order	Freq. Hz	Mag. 9%	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Ordey	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16
11.00	556,60	8.00	13.00	650.00	1.39	23.00	1159.00	0,13	25.00	1250.00	0.10	35.00	1758.00	0.62	37,00	1850.00	6.01
47.89	2359.40	0.00	49.06	2450.00	0.00												
Bus ID: Nom. kV	Bus12 66.000	0															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. No	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mng. 96
11.00	559,00	0.02	15.00	650.00	1.77	23.00	1159.00	0.32	25.00	1250.00	0.51	35.00	1759.00	0.05	37.00	1850.00	0.00
47.00	2350.00	0.03	49.00	3450.00	0.02												
Bus ID: Nom. kV	Buil3	5															
Order	Freq. Ha	Mag. 99	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 89	Order	Fireq. Ha	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46
11.00	550,00	0.02	15.00	650.00	1.83	23.00	1159.00	0.35	25.00	1250.00	0.58	35.00	1750.00	0.06	37.00	1850.00	0.00
47.00	2356.00	0.05	49.00	1450.00	0.04												
Bus ID: Nom. kV	Bus14																
Order	Freq. Ha	Mag. 96	Order	Freq. Hi	Mag.	Order	Freq. Hz	Mag. 80	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 84
11.00	559,00	0.00	13.00	650.00	1.44	23.00	1156.00	0.15	25.00	1250.00	0.11	35.00	1750.00	0.65	37.00	1850.00	0.02
47.00	2350.00	10.6	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus15	5															
Order	Freq. Hz	Mag. 99	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Ha	Mag. 99	Order	Freq. Hi	Mag. 16	Order	Freq. Hz	Mag. 96
11.00	\$59,00	0.02	13.00	650.00	1.83	23.00	1150.00	0.35	25.00	1250.00	0.55	35.00	1750.00	0.06	37,00	1850.00	0.00
47.09	2350.00	0.05	49.00	2450,00	0.04												

Project:	MASTER THESIS	ETAP	Page:	29
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI Study Case: HA		Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Court and	Config:	Normal

#### Bus Tabulation Harmonic Voltages (% of Nominal Voltage) Bus ID: Bus16 Nom. kV: 11.000 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. < Order Mag. Fren Mag. Hi -Hz 16 25.00 1250.00 11.00 550.00 0.00 13.00 650.00 1.44 23.00 1150.00 9.15 0.11 35.00 1750.00 0.05 37.00 1850.00 0.02 47.00 2350.00 0.01 49.00 2450.00 0.00 Bus ID: Bus17 Nom. kV: 66.000 Order Freq Mag. Freq Mag Mag Mag. Order Order Order Freq. Mag. Order Freq. Freq. Order Free Mag HI ** Hr 44 Hz 14 Hz 44 Hz 40 H . 37,00 11.00 550.00 650.00 2.01 23.00 1150.00 25.00 1250.00 35.00 1850.00 0.01 13.00 0.10 0.05 1750.00 9,65 9,05 47.00 2350.00 49.00 1450.00 6.01 0.01 But ID: Buy18 Nom. kV: 66.000 Mag. Mag. Order Freq Order Freq Order Freq Mag. Freq. Freq. Freq Mag. Order Order Mag. Order Mag. -Hr Hr 44 Hz 44 Hz 44 Hz 44 H 14 11.00 550.00 0.00 13.00 650.00 1.46 23.00 1150.00 0.16 25.00 1250.00 0.12 35.00 1750.00 6.63 37.60 1850.00 0.02 47.00 2350.00 0.61 49.00 1450.00 0.01 Bus ID: Ras10 Nom kV: 11.000 Freq. Order Freq. Mag. Order Freq Mag. Order Freq Mag. Order Freq. Mag. Order Freq. Mag. Order Mag. Hr ** Hz 44 Hz 44 Hz 46 Hz 44 Ha 14 11.00 550.00 6.61 11.00 650.00 2.61 23.00 1150.00 8.10 25.00 1250.00 8.65 35.00 1750.00 0.05 \$7.00 1850.00 0.05 47.80 1350.00 0.01 49.00 2450.00 6.61 Bus ID: Bus2 Nom. kV: 96.000 Freq. Mag. Order Order Freq Mag. Order Freq. Mag. Order . Freq. Mag. Order Freq. Mag. Order Freq. Mag Hr 14 Hz 55 Hr 84 Hz 44 Ha 44 Hr 14 11.00 550.00 0.00 13.00 650.00 1.39 23.00 1150.00 0.14 25.00 1250.00 0.10 35.00 1750.00 0.02 57.00 1850.00 0.01 47.00 2350.00 0.00 49.00 2450.00 0.00 Bus ID: Bus20 Nom. kV: 11.000 Order Freq. Mag. Order Freq Mag. Order Freq Mag. Order Freq Mag. Order Freq. Mag. Order Errq. Mag. Hr ..... Hz 46 Hz 16 Hz 44 Hz 46 Br . 11.00 \$\$0.00 13.00 650.00 1.46 23.00 1150.00 9.16 25.00 1250.00 9.12 35.00 1750.00 0.03 37.00 1850.00 0.02 0.00 47.00 2350.00 0.01 49.00 2450.00 0.01 But ID: Bus21 Nom. kV: 06.000 Order Freq. Hz Mag. Order Freq. Hr Mag. 46 Order Freq. Hz Mag. 59 Order Freq. Hz Mag. 46 Order Freq. Hz Mag. Order Freq. Hz Mag. 9a 14 46 11.00 550.00 0.01 13.00 650.00 1.99 23.00 1150.00 0,40 25.00 1250.00 0.52 35.00 1750.00 0.09 37,09 1850.00 9,07 47.00 2350.00 0.01 49.00 1450.00 6.00
Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H		Page: Date:	30 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and seen		Config:	Normal

								Bus Ta	bulation								
						H	armonic V	'oltages (	% of Non	ninal Volta	ege)						
Bus ID: Nom. kV	Bus22 11.000																
Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. No	Order	Freq. Hz	Mag. 96
11.00	.550.00	0.01	13.00	650.00	1.99	25.00	1159.00	8,40	25.00	1250.00	0.52	35.00	1750.00	0.09	37.99	1850.00	0.07
47.00	2350.00	0.01	49.00	2458.00	0.00												
Bus ID: Nom. kV	Bus23 66.000	k															
Order	Freq. Hz	Mog. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	0.02	13.09	650.00	2.04	23.00	1150.00	0.05	25.00	1250.00	0.05	35.00	1756.00	0.00	37.00	1855.00	0.09
47.00	2350.00	0.00	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus25																
Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. 9k	Order	Freq. Ha	Mag. %	Order	Freq. He	Mag. 96	Order	Freq. Ha	Mag. 46	Order	Freq. Hz	Mag. 94
11.00	550.00	0.02	13.00	650.00	2.04	25.00	1159.00	0.05	25.00	1250.00	0.05	35.00	1750.00	0.00	37.00	1850.00	0.00
47.90	2350.00	0.00	49.00	2450.00	0.00												
Bus ID: Nom. kV	Bus27	k															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 16	Order	Freq. Hr	Mag. 16
11.00	550.00	0.02	13.00	650.00	1.87	23.00	1150,00	0.18	25.00	1250.00	0.33	35.00	1750.00	0.06	37.90	1850.00	0.03
47.00	2358.00	0.02	49.00	2450.00	0.01												
Bus ID: Nom. kV	Bus28																
Order	Freq. Ha	Mag. 94	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	0.02	13.00	659.00	1.87	23,00	1150.00	0.18	25.00	1250.00	0.33	35.00	1750.00	0.06	37.00	1850.00	0.03
47.99	2350.00	0.02	49.09	2458.00	10.0												
Bus ID: Nom. kV	Bu:29																
Order	Freq. Hz	Mag. 99	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550.00	0.02	13.00	650.00	1.87	23.00	1150.00	0.18	25.00	1250.00	0.33	35.00	1750.00	0.06	37,80	1858.00	8.03
47.00	2350.00	0.02	49.00	2450.00	0.01												
Bus ID: Nom. kV	Bus3 220.00	10															
Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 84	Onler	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96
11.00	\$50.00	0.02	13.00	650.00	1.69	23.00	1150.00	0.50	25.00	1258.00	0.49	35.00	1750.00	0.04	37.00	1889.00	0.00
47.00	2350.00	0.03	49.00	2450.00	0.02												

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	31 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SIN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	come const.	Config:	Normal

#### Bus Tabulation Harmonic Voltages (% of Nominal Voltage) Bus ID: But to Nom. kV: 66.000 Order Freq. Mag Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Hr 56 Hz 44 Hz 44 Hz 56 Hz 56 Hz 46 0.32 25.00 1250.00 11.00 550.00 0.02 13.00 655.00 1.78 23.00 1150.00 0.52 35.00 1750.00 0.05 37.00 1850.00 0.00 47.00 2350.00 0.65 49.00 2450.00 0.03 Bus ID: Bus31 Nom. kV: 66.000 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Ereq. Mag. Order Freq. Mag. Ha Ha H Ha Ha Ha 16 14 14 16 16 14 23.00 1150.00 11.00 \$\$0.00 0.00 15.00 855.00 1.40 0.14 25.00 1250.00 0.10 35.00 1758.00 0.02 37.00 1350.00 0.61 47.00 2556.00 0.00 19.00 2455.00 0.08 Bus ID: Bus32 Nom. kV: 11.000 Mag. 96 Order Freq. Mag. Order Freq. Order Freq. Mag. Order Freq. Hz % Hz Mag. Order Freq. 86 Hz Mag. Order Freq. Mag. Hz Hr Hr Hr 14 Hz Hz 46°) 96 11.00 650.00 1.78 23.00 1150.00 25.00 1250.00 550.00 0.02 13.00 0.32 0.52 35.00 1750.00 0.05 37.08 1550.00 0.00 47.00 2350.00 0.03 49.00 2459.00 0.03 Bas ID: Bus33 Nom. kV: 11.000 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq Mag. Order Freq. Mag. Hz .19 Hz 94 Hr 14 Hz Ha 44 Hz 46 44 25.00 1150.00 25.00 1250.00 11.60 \$58,00 0.00 13,00 655.00 1.40 0.14 0.10 35,00 1750.00 0.02 37.00 1550.00 0.01 0.00 47.00 2350.00 49.00 2450.00 0.08 But ID: Resta Nom. kV: 0.400 Freq Order Freq. Mag. Order Freq. Frey Order Freq Mag. Order Mag. Mag. Order Mag. Order Freq. Mag. Hr 14 H 44 H 44 Hz. 14 He 46 He 44 23.00 1150.00 11.60 550.00 3.23 13.00 659.00 1.93 2.76 25.00 1250.00 2.68 35.00 1750.00 1.23 37.00 1850.00 1.02 47.00 2350.00 0.47 49.00 2450.00 0.51 Bas ID: Bus35 Nom. kV: 0.400 Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Order Freq. Mag. Hz 16 Hz 14 HI 14 HI 14 Hr 14 Hz 76 - -1.1 . . 1.33 25.00 1250.00 . . ..... 23.00 1150.00 35.00 1750.00 11.00 1.45 15.00 0.54 37.00 1850.00 \$50.00 650.00 1.38 0.46 0.39 47.00 2350.00 0.16 19.00 \$450.00 0.17 Bus ID: Bus36 Nom. kV: 0.400 Order Freq. Mag. Order Hz % Freq. Hz Mag. 96 Order Freq. Hz Mag. Order Freq. Hz Mag. Order Freq. Hr Mag. Order Freq. Mag. Hz 44 2.76 ٩6. 44 . ... 11.00 550.00 1850.00 3.28 15,90 659.00 1.93 23.00 1150.00 25.00 1250.00 2.68 35.00 1750.00 1.23 37.00 1.02 47.60 2550.00 0.47 49.00 2459.00

0.51

MASTER THESIS	ETAP	Paget	32
HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department		SN:	
SAND MUSTAFA AL-REFAI	Study Case: HA	Revision:	Base
HOUN SUBSTATION 2201A	Contract Contract	Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 2201AY	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HA HOUN SUBSTATION 2200AV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: HA   HOUN SUBSTATION 2200AV Config:

								Bus Ta	bulation	l.							
						н	armonic V	oltages (	% of Non	rinal Volta	ige)						
Bus ID; Nom. kV	Bux37 0.400											~~~					
Order	Freq. Hz	Mag. 44	Order	Free Hr	Mag. No	Order	Freq. Ha	Mag. No	Order	Freq. H:	Mag. 96	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. 94
11.09	550.00	3.23	13.09	650.00	1.93	23.00	1150.00	2.76	25.00	1250.00	2.68	35.00	1750.00	1.23	\$7.00	1850.00	1.02
47.00	2350.00	0.47	49,00	2450.00	0.51												
Bus ID: Nom. kV	Bus38																
Order	Freq. Hz	Mag. 46	Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag. %b	Order	Firq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Ha	Mog.
11.00	550.00	0.50	15.00	650.00	1.70	23.09	1150.00	0.26	25.00	1250.00	0.25	35.00	1750.00	0.15	37.00	1850.00	0.13
47.00	2350.00	0.06	49.00	2450.00	0.06												
Bus ID: Nom. kV	Bus39																
Order	Freq. Hz	Mag. 49	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Feeg. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Ereq. Hz	Mag.
11.00	550.00	2.31	13.00	650.08	3.41	23.09	1150.00	1.77	25.00	1258.00	1.64	35.00	1750.00	0.94	37.00	1850.00	0.77
47.00	2350.00	0.38	49.00	2450.00	0.43												
Bus ID: Nom. kV	Bus4 220.00	10															
Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.	Order	Freq	Mag.	Order	Freq.	Mag.	Order	Freq.	Mag.
Bus ID: Nom. kV	Bus40 : 0.400	-	_									_		-			
Order	Freq. Hz	Mag.	Order	Ereq. Ha	Mag.	Order	Freq. Ha	Mag. No	Order	Freq. Ha	Mag. 96	Order	Freq. Ha	Mag.	Order	Freq. Ha	Mag.
11.00	550.00	0,50	13.00	650.08	1.70	23.09	1150.00	0.26	25.00	1250.00	0.25	35.00	1750.00	0.15	\$7.09	1850.00	0.13
47.00	2350.00	0.96	49.00	2450.08	9.96												
Bus ID: Nom. kV	Bus41 : 11.000	1															
Order	Freq. Hz	Mag. 86	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag. %	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 16	Order	Freq. Hz	Mag.
11.00	550.00	1.54	13.00	650.08	0.58	23.00	1150.00	1.42	25.00	1250.00	1.48	35.00	1750.00	0.49	37.00	1850.00	0.42
47.00	2350.00	0.17	49.08	2450.08	0.19												
But ID: Nom. kV	Bus42																
Order	Freq. Hz	Mag.	Order	Free, Hz	Mag.	Order	Eseq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.
11.00	\$\$0.08	0.53	13.00	650.08	1.51	25.00	1150.00	0.27	25.00	1250.00	0.27	35.00	1750.00	0.16	37.08	1850.00	0.13
47.00	2350.00	0.06	49.00	2450.00	0.07												
Bus ID: Nom. kV	Bus5 220.00	ю															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag.	Order	Freq. Hr	Mag. 16	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 96	Order	Ereq. Hr	Mag.
11.00	550.00	0.00	15.00	650.00	1.33	23.00	1150.00	0.13	25.00	1250.00	0.09	35.00	1758.00	0.02	37.00	1850.00	0.01

Project:	MASTER THESIS	ETAP		Page:	33
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineers	SAND MUSTAFA AL-REFAI	Study Case:	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.		Coufig:	Normal

								Bus Ta	bulation								
						н	ermonic V	oltages (	% of Non	unal Voltz	ige)						
Bus ID: Nom. kV	Bus5 1 220.0	00															
Order	Freq. Hz	Mag. 14	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 85	Order	Freg. Hz	Mag. 96
47.00	2359.00	0.00	49,00	2450.00	0.00												
Bus ID: Nom, kV	Bus6 11.00	0															
Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hr	Mag. 94	Order	Freq. Ha	Mag. 96	Order	Freg. Hz	Mag. 96
11.00	550.00	0.02	13.00	650.00	1.77	23.00	1159.00	0.32	25.00	1256.00	0.51	35.00	1750.00	0.05	37.00	1858.00	0.00
47.00	2350:00	0.03	49.00	2450.00	0.02												
Bus ID: Nom. kV	Bus7 66.00	0															
Order	Freq. Ha	Mag. 99	Order	Freq. Ha	Mag.	Order	Freq. Ha	Mag. 16	Order	Freq. Ha	Mag. 96	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96
11.00	550,00	8.00	13.00	650.00	1.39	23.00	1150.00	0.14	25.00	1250.00	0.10	35.00	1750.00	0.02	37.00	1859.00	0.01
47.08	2350.00	0.00	49.00	3450.00	0.00												
Bus ID: Nom. kV	Bus8 66.00	0															
Order	Freq. Hz	Mag. 54	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96	Order	Freq. Hz	Mag. 86	Order	Freg. Hz	Mag. 96
11.00	559.80	0.02	13.00	650.00	1.77	23.00	1150.00	0.32	25.00	1250.00	0.91	35.00	1750.00	0.05	37.00	1859.00	0.00
47.09	2350.00	0.05	49.00	2450,00	0.02												
Bus ID: Nom. kV	Bus9 11.00	0															
Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 96	Order	Freq. H2	Mag. 46	Order	Freq. Hz	Mag.	Order	Freq. Hz	Mag. 46	Order	Freq. Hz	Mag. 96
11.00	550.00	0.00	13,00	650,00	1.59	25,00	1150.00	0.14	25.00	1250.00	0.10	35.00	1750.00	0.02	37.00	1859.00	0.01
47.00	2350.00	0.00	49,00	3450,00	0.00												

Project:	MASTER THESIS	ETAP		Page:	
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case: H.	2002)	Config:	Normal

# Filter Overloading Filter Overloading Filter Capacitor C1 Inductor L1 Capacitor C2 Inductor L2 ID Type Connection kV kV Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % Max. Oper. % % Max. Oper. % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % % %</

Filter Type:: 0 = By-Pass, 1 = High-Pass (Damped), 2 = High-Pass (Undamped), 3 = Single Tuned, 4 = 3rd Order Damped, 5 = 3rd Order C-Type

Project:	MASTER THESIS	ETAP	Page:	35
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cate: HA	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and case. In	Config:	Normal

#### Alert Summary Report % Alert Settings Critical Marginal Bus Individual Bus VTHD / VIHD values are used. Transformer Total I 100.0 95.0 Filter 100.0 95.0 Capacitor kV 100.0 Inductor Amp 95,0 Canacitor 100.0 95.0 Max kV Cable 100.0 95.0 Ampacity

# **APPENDIX 12**

# TRANSIENT STABILITY ANALYSIS WITHOUT PV

Project:	MASTER THESIS	ETAP	Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Staty Case. 15	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### Electrical Transient Analyzer Program

Transient Stability Analysis (Without PV)

Initial Loading Category (1): Design

Initial Generation Category (1): Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total	
Number of Buses:	3	0	39	42	

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	SPDT	Total
Number of Branches:	26	0	0	16	0	10	0	52

	Generator	Grid	Motor	Induction Machines	Lumped	Total	
Number of Machines:	0	3	0	0	14	17	

Method of the Initial LF Solution:	Adaptive Newton-Raphson
Maximum Number of Iterations:	1000
Solution Precision for the Initial LF:	0.9901000000
Acceleration Factor for the Initial LF:	0.00
Time Increment for Integration Steps $(\Delta t)$ :	0.0010
Time Increment for Plots:	20 times $\Delta t$
System Frequency:	50.00 Hz
Frequency Dependent Models for Machines and Net	work are Not Used
Unit System:	Metric

Project:	MASTER THESIS	ETAP		Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Sound course	10	Config:	Normal

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Project:	MASTER THESIS	ETAP		Page:	3
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	13	Config:	Normal

					Load								
	Bus		Initial V	oltage	Consta	at kVA	Centra	ant Z.	Con	itant I	Ge	neric	
ID	hV	Sab-131	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Myar	MW	Myar	
luil	66.090	1	99.1	-5.1									
us2	66.000	1	98.9	-1.9									
us3	220,000	1	100.0	0.0									
lus4	220.000	1	100.0	0.0									
445	220.000	1	100.0	0.0									
luső	11.000	1	98.1	-5.1	0.000	0.995	0.000	0.249					
lun7	66.000	1	98.5	-1.9									
lus8	66.090	1	\$9.5	-5.2									
Perul	11,000	1	98.1	-2.5	1.600	6.992	0.400	0.2.48					
lui10	11.000	1	97.8	-7.2	5.680	3.471	1.400	0.868					
Just1	66,090	1	99.1	-1.2									
Bun12	65.000	1	99.4	-4.2									
lusIX	66.000	1	98.3	-5.6									
lun14	66.000	1	95.0	-2.4									
lan15	11.000	1	98.7	-8.5	4.990	2.975	1.200	0.744					
lun16	11.000	1	98.3	-5.4	4.890	2.975	1.299	0.744					
as17	66.000	1	98.9	-6.8									
uil8	66.000	1	98.8	-2.5									
lui19	11.000	1	98.7	-8.4	4.400	0.090	1.190	0.000					
lus20	11.090	1	98.7	-3.3	2,880	9,000	0.700	0.000					
3ut21	66.009	1	58,9	-7.5									
Jus22	11.000	1	98.4	-10.4	4.890	0.000	1.299	0.009					
Bus23	66,090	1	99.3	-7.9									
Bus24	66.000	1	100.0	0.0									
Bus25	11.090	1	98.1	-8.8	1.690	0.991	0.490	0.248					
3us26	11.000	1	100.6	0.0	4.000	2.479	1.000	0.620					
Jus27	66.090	1	99.8	-5.8									
lus28	11.000	1	98.4	-6.7	2,490	1.487	0.690	0.371					
us20	11.000	1	98.4	-6.7	2.400	1.487	0.680	0.371					
3ues30	66.000	1	98.5	-5.5									
Bus31	66.000	1	98.6	-2.1									
Bus32	11.000	1	98.0	8.7	8.890	5.455	2.290	1.364					
Jui 33	11,000	1	100.5	-3.5	4.000	2.479	1.090	0.620					
Jus34	0.400	1	100.0	1.1									

# Bus Input Data

Project:	MASTER THESIS	ETAP		Paget	4
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220EV	and a cape.	13	Config:	Normal

							Load								
Bu	Bus		Initial Voltage		Constant kVA		Constant Z		Constant I		Gene	nic			
ID	kV	Sub-sys	% Mag.	Ang.	MW	Myar	MW	Myar	MW	Myar	MW	Myar			
Bun.35	0.400	1	109.0	1.1				50							
Bus,34	0.000	1	109.0	1.3											
Bei 37	0.400	1	108.0	1.1											
Bas38	0.400	1	100.0	3.3											
Bar.59	0.400	1	100.0	3.3											
Bun 49	6.200	1	109.0	3.3											
Bui41	11.000	1	9.5.9	-1.2											
Ban42	11.000	1	98.6	1.0											
Total Number of Buser: 45					£1 009	15.765	13,000	6.446	0.000	0.000	0.000	0.000			

Note: Dynamically modeled mutur loads are not included in the bus motor load. See machine and motor pages for detail.

	Voltage		Generation			Myar Limits				
ID	kV	Type	Sub-typ	% Mag.	Angle	MW	Mvar	96 PF	Man	Min
Bui 5	220.000	Suing	1	100.0	0.0	-	-		-	
Bm4	220.000	Swing	1	100.0	0.0					
But5	220.000	Swing	1	100.0	8.8					
						6.000	0.000			

Project:	MASTER THESIS	ETAP		Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Casar	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220RV	Stany Case.		Config:	Normal

# Line/Cable Input Data

			Ohms or Siemens per 1900 m per Conductor (Cable) or per Phase (Line)											
_	Line/Cable	_		Leng	th									
	ID	Library	Stor	Adj. (m)	76 Tal.	#Phase	T (°C)	RI	XI	¥1	RP	X0	Y0	
CableI	1	11MCU53	390	190.0	0.0	1	75	0.076302	0.057410	0.0001646	0.240351	0.215000		
Cable2		11MCUS3	300	190.0	6.0	1	75	0.076302	6.087400	0.0001646	0.240351	0.215000		
Linel			674	19300.0	0.0	1	75	0.056003	0.374256	0.0000031	0.200077	1.368791	0.0000017	
Line2			674	10,500.0	6.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016	
Line)			674	23090.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016	
Line4			674	15000.0	0.0	1	- 75	0.056001	0.342069	0.0000034	0.200637	1.424941	0.0000016	
Line5			674	\$090.0	0.0	1	75	0.056001	0.342069	0.0000034	9.200637	1.424041	0.0000016	
Lines			674	4000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016	
Line7			674	4000.0	6.0	1	75	0.056001	0.542069	0.0000634	0.200637	1.424041	0.0000016	
Line\$			674	4090.0	0.0	1	75	0.056001	0.542969	0.0000634	0.200637	1.424041	0.0000016	
Line?			674	4090.0	0.0	1	75	0.056001	9,342969	0.0000634	0.200637	1.424041	0.0000016	
Line10			674	8090.0	6.0	1	75	0.056001	0.342069	0.0900034	0.200637	1.424041	0.0000016	
Linell			674	\$000.0	6.0	1	75	0.056001	6.542069	0.0000634	0.200637	1.424041	0.0000016	
Line12			674	21000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016	
Line15			674	161000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0006016	
Line14			674	140000.0	0.0	1	75	0.056001	0.342069	0.0000634	0.200637	1.424941	0.0000016	

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP	Page:	6	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220hV	Shidy Case. 15	Config:	Normal	

## 2-Winding Transformer Input Data

Transformer			Rating			2	Variatio		96 T Sett	Tap ting	Adjusted	Phase	Shift
ID	MVA	Prim. kV	Sec. kV	46 Z	X/R	+ 596	- 5%6	% Tal.	Prim.	Sec.	14 Z	Type	Angle
π	63.800	220.000	65.000	12.50	45.00	0	0	0	0	3.750	12,5000	Dyn	0.000
Т2	63.000	220.000	66.005	12.50	45.00	Ð	6		Ð	0.625	12.5000	Dyn	0.000
T3	63.000	226.096	66.005	12.50	45.00				0	0.625	12.5000	D78	0.000
T4	10.000	66.000	11.000	8.35	13.00	0	0		0		\$,5500	Dyn	0.000
15	20.000	66.000	11.000	10.00	20.00	Ð	0	•	0	0	10.0000	Dyn	0.000
T6	20.000	66.000	11.000	16.00	20.00				0	1.250	18.0000	Dyn	0.008
17	12.500	11.000	65.009	8.35	13.00		0		-1.250		8,3599	YNd	0.008
TB	12.500	11.000	65.000	8.35	13.00	0			-1.250		\$.3500	YNd	0.000
T9	10.000	66.090	11.000	8,35	15.00				0	4.375	5,3500	Dyn	0.000
T10	10.000	66.000	11.000	8.35	15.90	Ð	0	0	0	4.375	8.3500	Dyn	0.000
m	20.000	66.000	11.000	19.00	20.00	0		0	0		10.0000	Dyn	0.000
T12	20.000	66.000	11.009	10.00	20.06				0		18.0000	Dyn	8.008
T13	10.000	66.000	11.009	8.35	13.00	0		0	0		8.3500	Dyn	0.000
TH	10.000	66.000	11.000	8.35	13.00	0	0	0	0	0	8,3500	Dyn	0.000
T15	10,000	66.090	11.000	8.35	13.00	Ð	0	0	0	3.750	8.3500	Dyn	0.000
T16	20.000	\$5,099	11.009	19.90	20.00		0		0	0.625	18.0000	Dya	0.000
117	20.000	66.000	11.009	19.00	20.00	÷			0	6.625	16.0000	Dyn	0.000
T18	20.000	66.090	11.000	19.80	20.00	.0		0	0	3.750	19.0000	Dyn	0.000
T19	20.000	66.000	11,000	18.60	20.00		0		0	3,750	10.0000	Dyn	0.000
T20	3.900	0.400	11.000	6.25	6.00	Ð	0		0		6.2500	YNd	0.000
T21	3.000	0.400	11.000	6.25	6.00	0			0		6.2580	YNd	0.000
T22	3.000	0.400	11.009	6.25	6.00		0		0		6.2500	YNd.	8.008
T23	3.000	0.400	11.000	6.25	6.00	0		0	0	8	6.2500	YNd.	6.008
T24	3.000	0.400	11.000	6.25	6.00	0	0	0	0	0	6.2580	YNd	0.000
T25	3,000	0.400	11.000	6.25	6.00	0	0		0	0	6,2500	YNd	0.008
T26	3.000	0.400	11.009	6.25	6.00	0		0	0	0	6.2580	YNd	0.000

# 2-Winding Transformer Grounding Input Data

								Groundin	2			
Transformer	22	Rating		Conn.		Primary			ä	Seconda	ay	
D	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	Ohm	Type	ŁV	Анр	Ohm
TI	65.000	220.000	66.000	DA					Solid			
T2	\$3.000	226.000	66.000	DIV					Solid			

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cate	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	13	Config:	Normal

								Groundia	e a			
Transformer		Rating		Conn.		Primary	ý			Secondar	y .	
D	MVA	Prim, kV	Ser. kV	Type	Type	kV	Amp	Ohm	Type	EV	Amp	Ohm
ТЗ	63,600	220.090	66.000	D/Y			_		Solid			
T4	10.000	66.090	11.000	D/Y					Solid			
<b>T5</b>	20,000	66.000	11.000	D/Y					Solid			
16	20,000	66.090	11.000	D/Y					Solid			
17	12.500	11.000	56.000	D/Y					Solid			
<b>T8</b>	12.500	11.000	66.000	$\mathbf{D}/\mathbf{A}_{i}$					Solid			
Ts	10.000	66.000	11.000	D/Y					Solid			
T10	10.000	66.000	11.000	D/Y					Solid			
ти	20.000	66.090	11.000	D/Y					Solid			
T12	20.000	66.000	11.000	D/Y					Solid			
тв	10.000	66.000	11.000	D/V					Solid			
T14	10.000	65.000	11.000	D/Y					Solid			
T15	10.000	66.000	11.000	D/Y					Solid			
T16	20.000	66.000	11.000	D/Y					Solid			
T17	20.000	66.090	11.000	D/Y					Solid			
T18	28.000	66.000	11.960	D/Y					Solid			
T19	20.000	66.000	11.000	D/Y					Solid			
T20	3.000	0.460	11.000	D/Y					Solid			
T21	3.000	8.400	11.000	D/Y					Solid			
T22	3.000	0.400	11.000	D/Y					Solid			
T23	3.000	0.400	11.000	D/Y					Solid			
124	3.000	0.400	11.000	D/Y					Solid			
T25	3.000	0.400	11.000	D/X					Solid			
T26	3.000	0.400	11.000	D/Y					Solid			

## 2-Winding Transformer Grounding Input Data

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 12.6.0H	Page: Date:	8 28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	change care and	Config:	Normal

CKT/	Branch	Cou	mected Bus ID	% Impe	dance, Pos.	Seq., 100 3	IVA Base
ID	Type	From But	To Bus	R	X	Z	Y
T1	2W XFMR	Basi	Butl	0.46	29.58	28,59	
T2	2W XFMR	Bun-i	Butl	8.44	19.96	19.97	
T3	2W XFMR	Bus5	Bun2	8.44	19,96	19.97	
T4	2W XFMR	But1	Bund	6.40	83.25	83.50	
15	2W XFMR	But7	Bun9	2.50	49.94	50.00	
T6	2W XFMR	Bus8	Bur10	2.53	50.56	50.63	
17	2W XFMR	Bus42	Burl1	5.06	65,77	65.97	
TB	2W XEMB	Bun41	But12	5.06	65.77	65.97	
T9	2W XFMR	Burl3	Bwi15	6.68	86.90	87.15	
T10	2W XFMR	But14	Bur16	6.63	86.90	87.15	
T11	2W XEMR	Buil7	But19	2.50	49.94	58.09	
T12	2W XFMR	But18	But20	2.50	49.94	58.09	
T13	2W NFMR	Bes11	Bun22	6.40	83.25	83,50	
T14	2W XEMR	Bust3	Bur25	6.40	\$3.25	83.50	
T15	2W XFMR	Bus24	Bas26	6.64	\$6.38	86.63	
T16	2W XFMR	But27	Burt28	2.51	50.25	50.31	
T17	2W XFMR	But27	But29	2.51	50.25	50.31	
T18	2W XFMR	Bat30	Ban32	2.59	51.81	51.88	
T19	2W XFMR	Bur31	Bm33	2.59	51.81	51.85	
T20	2W XFMR	Bus34	Ber41	34.25	295.50	208.33	
T21	2W XFMR	Bus.35	Bes41	.54.25	205.50	205.33	
T22	2W XFMR	Bus36	Bus41	54.25	205.50	205.33	
T23	2W XFMR	But37	Bun41	34.25	205.50	205.33	
T24	2W XFMR	Bus38	Bur42	34.25	205.50	208.33	
T25	2W XFMR	Bur.39	Bur42	34.25	205.50	208.33	
T26	2W XFMR	Bus-40	Bm42	34.25	205.50	208.33	
CableI	Cable	Bus11	Bm2	0.02	0.02	0.05	0.0716998
Cable2	Cable	Bus12	Burl	0.02	0.02	0.03	0.0716995
Linel	Line	Bas2	Bm14	2.48	16.58	16.77	0.2607629
Line2	Line	Busl	Buy13	2.48	15,16	15.36	0.2842267
Line3	Line	Bus2	Burl 8	2.96	15.06	18.59	0.3387157
Line4	Line	But27	Bun17	1.93	11.78	11.94	0.2209015
Line5	Line	Burl.	Bun27	1.03	6.28	6.37	0.1178142
Line6	Line	Bus2	Bun7	0.51	3,34	3,18	0.0539071
Line7	Line	Butl	Bun8	0.51	3.14	3.18	0.0589071
Line8	Line	But2	Ban7	8.51	3.34	3.18	0.0589071
Line9	Line	Busl	Ban8	0.51	3.34	3.15	0.0589071

# Branch Connections

Project:	MASTER THESIS	ETAP		Paget	9
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	15	Config:	Normal

CKT/	Branch	Cos	mected Bus ID	% Impe	dance, Pos.	Seq., 100 %	IVA Base
ID	Type	From Bus	To But	R	X	Z	Y
Line10	Line	But2	But31	1.03	6.28	6.37	0.1178142
Line11	Line	Bur1	But30	1.03	6.28	6.37	0.1178142
Line12	Line	Bun17	Bus21	2.70	16.49	16.71	0.3092622
Line13	Line	Bun17	Bas23	20.70	126.43	128.11	2.3710100
Line14	Line	Bas21	But23	15.00	109.94	111.40	2.0617450
sw1	Tie Switch	Bun1	Bus2				
SW2	Tie Switch	Bus7	BusS				
SW3	Tie Switch	Bus13	Bus14				
5174	Tie Switch	But17	But18				
5183	Tie Switch	Bas23	Bun24				
5776	Tie Switch	But25	Bus26				
sw7	Tie Switch	Bun28	Bus29				
518	Tie Switch	But30	But31				
\$179	Tie Switch	Bus32	But33				
SW10	Tie Switch	Ban41	Bas42				

Project:	MASTER THESIS	ETAP		Page:	10
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	Stany Case.	15	Coufig:	Normal

#### Branch Connections Zero Sequence Impedance

ID     Type     From Bas     To Bas     R0     X0     Z0     V0       T1     2V XIMR     Bed     Bed     Bed     Bed     Feature     Fea	CK	T/Branch	Con	inected Bus ID	% In	apedance, Z	ero Seq., 100	MVAb
Ti 2W XYMR Be3 Bu1   T2 3W XYMR Be4 Bu1   T3 3W XYMR Be4 Bu5   T4 3W XYMR Be4 Be6   T4 3W XYMR Be7 Be6   T6 2W XYMR Be4 Bu1   T7 3W XYMR Be4 Bu1   T6 2W XYMR Be4 Bu1   T7 3W XYMR Be4 Bu12   T8 2W XYMR Be4 Bu12   T9 3W XYMR Be4 Bu12   T9 3W XYMR Be4 Bu14   T10 3W XYMR Be4 Bu15   T11 3W XYMR Be14 Bu15   T12 3W XYMR Be14 Bu25   T14 3W XYMR Be21 Bu25   T15 2W XYMR Be24 Bu5   T16 2W XYMR Be24 Bu5   T17 3W XYMR Be24 Bu5   T18 2W XYMR Bu24 Bu5   T19 3W XYMR Bu5 Bu45   T21 3W XYMR Bu5 Bu45   T23 2W XYMR Bu5 Bu41   T24 3W XY	ID	Туре	From Ban	To Bus	RO	X9	Z.0	2.0
1712NY NR8n48n41732NY NR8n58n5742NY NR8n78n6752NY NR8n78n6762NY NR8n88n1712NY NR8n48n1732NY NR8n48n1742NY NR8n48n1752NY NR8n48n1762NY NR8n48n1712NY NR8n48n5712NY NR8n48n57142NY NR8n18n57152NY NR8n28n57162NY NR8n28n57172NY NR8n28n57182NY NR8n28n57172NY NR8n38n57182NY NR8n38n57192NY NR8n38n47192NY NR8n38n47142NY NR8n38n47152NY NR8n38n47162NY NR8n38n47172NY NR8n38n47182NY NR8n38n47192NY NR8n38n47202NY NR8n38n47312NY NR8n38n47442NY NR8n38n47542NY NR8n38n47542NY NR8n38n47542NY NR8n38n47542NY NR8n38n4	Ť1	2W XFMR	Bus3	Busl	1.1			
1924% SMR8ef8ef7424% SMR8ef8ef7524% SMR8ef8ef7624% SMR8ef8ef7724% SMR8ef8ef7824% SMR8ef8ef7924% SMR8ef8ef7124% SMR8ef8ef7124% SMR8ef8ef71424% SMR8ef8ef71524% SMR8ef8ef71624% SMR8ef8ef71724% SMR8ef8ef71824% SMR8ef8ef71824% SMR8ef8ef71824% SMR8ef8ef71824% SMR8ef8ef71924% SMR8ef8ef71924% SMR8ef8ef71924% SMR8ef8ef71924% SMR8ef8ef71424% SMR8ef8ef71524% SMR8ef8ef71624% SMR8ef8ef71724% SMR8ef8ef71824% SMR8ef8ef71924% SMR8ef8ef71924% SMR8ef8ef71424% SMR8ef8ef71524% SMR8ef8ef71624% SMR8ef8ef7178ef8ef8ef71824% SMR8ef8ef71924% SMR8e	72	2W XFMR	Bun4	BusI				
T42W XMR8u18u6T52W XMR8u78u7T62W XMR8u68u1T73W XMR8u48u1T82W XMR8u48u1T92W XMR8u38u5T102W XMR8u38u5T112W XMR8u18u5T122W XMR8u18u5T132W XMR8u18u5T142W XMR8u18u5T152W XMR8u18u5T162W XMR8u28u5T172W XMR8u38u5T182W XMR8u68u5T192W XMR8u68u5T192W XMR8u68u5T192W XMR8u68u5T192W XMR8u68u6T192W XMR8u68u6T212W XMR8u68u6T222W XMR8u68u6T342W XMR8u68u6	T3	2W XFMR	Bus5	Bas2				
152W XMR8e78e9162W XMR8e48e4172W XMR8e48e1172W XMR8e18e1182W XMR8e18e1192W XMR8e18e1102W XMR8e18e11112W XMR8e18e11122W XMR8e18e21132W XMR8e18e21142W XMR8e18e21152W XMR8e38e21162W XMR8e38e21172W XMR8e38e31182W XMR8e38e31192W XMR8e38e31192W XMR8e38e31192W XMR8e38e31212W XMR8e38e41222W XMR8e38e41232W XMR8e38e41242W XMR8e38e41252W XMR8e38e41262W XMR8e38e41272W XMR8e38e41282W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e41292W XMR8e38e4<	T4	2W NFMR	Butl	Bas6				
Té2WXFMRBe3Be4T72WXFMRBe42Be14T82WXFMRBe43Be43T92WXFMRBe44Be45T142WXFMRBe44Be45T142WXFMRBe44Be45T142WXFMRBe47Be47T152WXFMRBe24Be45T142WXFMRBe24Be45T152WXFMRBe24Be45T162WXFMRBe44Be45T172WXFMRBe44Be45T182WXFMRBe44Be45T182WXFMRBe44Be45T182WXFMRBe44Be45T192WXFMRBe44Be44T212WXFMRBe44Be41T222WXFMRBe44Be41T242WXFMRBe44Be41T242WXFMRBe44Be41T242WXFMRBe44Be41T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be42T242WXFMRBe44Be44T242WXFMRBe44Be44 <td>15</td> <td>2W XFMR</td> <td>Bas7</td> <td>Barr9</td> <td></td> <td></td> <td></td> <td></td>	15	2W XFMR	Bas7	Barr9				
172W XFMRBed4Bed1T62W XFMRBed4Bed2792W XFMRBed4Bed5T12W XFMRBed4Bed5T122W XFMRBed5Bed4T132W XFMRBed5Bed5T142W XFMRBed5Bed5T152W XFMRBed7Bed5T162W XFMRBed7Bed5T172W XFMRBed7Bed5T182W XFMRBed7Bed5T172W XFMRBed7Bed5T182W XFMRBed7Bed5T172W XFMRBed7Bed5T182W XFMRBed7Bed5T192W XFMRBed7Bed4T212W XFMRBed5Bed4T222W XFMRBed5Bed4T232W XFMRBed5Bed4T242W XFMRBed5Bed4T252W XFMRBed5Bed4T242W XFMRBed5Bed4T252W XFMRBed7Bed4T262W XFMRBed7Bed4T262W XFMRBed7Bed4T262W XFMRBed7Bed4T262W XFMRBed7Bed4T27Bed7Bed7Bed7T282W XFMRBed7Bed7T292W XFMRBed7Bed7T292W XFMRBed7Bed7T292W XFMRBed7Bed7T29Bed7	<b>T6</b>	2W NFMR	Bull	Bar16				
T92N XFMBa4Ba12T9XN XFMBa13Ba13T10XN XFMBa14Ba16T11XN XFMBa17Ba17T12XN XFMBa12Ba12T13XN XFMBa21Ba21T14XN XFMBa24Ba25T15XN XFMBa24Ba26T16XN XFMBa24Ba26T17XN XFMBa24Ba26T18XN XFMBa24Ba26T17XN XFMBa24Ba26T18XN XFMBa27Ba36T19XN XFMBa31Ba31T24XN XFMBa34Ba31T25XN XFMBa36Ba31T24XN XFMBa36Ba32T25XN XFMBa38Ba32T26XN XFMBa30Ba32T27XN XFMBa39Ba32T28XN XFMBa39Ba32T29XN XFMBa39Ba32T30XN XFMBa39Ba32T31XN XFMBa30Ba32T34XN XFMBa30Ba32T34Lin2Ba31Ba32T34Lin2Ba32Ba32T34Lin2Ba32Ba32T34Lin2Ba32Ba32T34Lin2Ba32Ba32T34Lin2Ba32Ba32T34Lin2Ba32Ba33Lin3Lin3Ba32Lin4Li	17	2W XFMR	Bus42	Bus11				
79200 XPXRBal3Bal5110200 XPXRBal4Bal5111200 XPXRBal7Bal9112200 XPXRBal2Bal2113200 XPXRBal2Bal2114200 XPXRBal3Bal5115200 XPXRBal2Bal2116200 XPXRBal2Bal2117200 XPXRBal2Bal2118200 XPXRBal3Bal2119200 XPXRBal3Bal4120 XPXRBal3Bal4121 XPXRBal3Bal4121 XPXRBal3Bal4121 XPXRBal3Bal4121 XPXRBal3Bal4121 XPXRBal3Bal4121 XPXRBal3Bal4122 XPXRBal3Bal4123 XPXRBal3Bal4124 XPXRBal3Bal4125 XPXRBal3Bal4126 XPXRBal3Bal4127 XPXRBal3Bal4128 XPXRBal3Bal4129 XPXRBal3Bal4120 XPXRBal3Bal4121 XPXRBal3Bal4122 XPXRBal3Bal4123 XPXRBal3Bal4124 XPXRBal3Bal4125 XPXRBal3Bal4126 XPXRBal4Bal4127 XPXRBal4Bal4128 XPXRBal4Bal4129 XPXRBal4Bal4120 XPXRBal4<	TS	2W XFMR	Bus41	Bus12				
Ti0WX XMRBul4Bul6T11WX XMRBul7Ba19T12WX YMRBul8Bur29T13WX YMRBu21Bur29T14WX YMRBu21Bur21T15WX YMRBu21Bur26T16WX YMRBu21Bur26T17WX YMRBu21Bur27T18WX YMRBu27Bu27T19WX YMRBu30Bu32T19WX YMRBu30Bu31T20WX YMRBu34Bu31T21WX YMRBu34Bu31T22WX YMRBu36Bu31T23WX YMRBu36Bu31T24WX YMRBu36Bu31T25WX YMRBu30Bu32T24WX YMRBu30Bu31T25WX YMRBu39Bu32T26WX YMRBu39Bu32T27WX YMRBu39Bu32T24WX YMRBu39Bu32T25WX YMRBu30Bu32T26CableBu11Bu22CableBu3Bu31Bu31Lin2Lin2Bu2Bu14Lin2Lin2Bu3Bu33Lin3Lin2Bu31Bu33Lin4Bu32Bu33Bu34Lin5Lin3Bu34Bu34Lin4Bu34Bu34Lin5Bu34Bu34Lin3Lin4Bu34Lin4Bu34Bu3	19	2W XFMR	Buil3	But15				
TilWXFMRBul?Bul?Ti2WXFMRBul?Bul?Ti3WXFMRBul?Bul?Ti4WXFMRBul?Bul?Ti5WXFMRBul?Bul?Ti6WXFMRBul?Bul?Ti7WXFMRBul?Bul?Ti7WXFMRBul?Bul?Ti7WXFMRBul?Bul?Ti7WXFMRBul?Bul?Ti7WXFMRBul?Bul?Ti8WXFMRBul?Bul?Ti9WXFMRBul?Bul?Ti2WXFMRBul?Bul?Ti2WXFMRBul?Bul?Ti2WXFMRBul?Bul?Ti2WXFMRBul?Bul?Ti4WXFMRBul?Bul?Ti5WXFMRBul?Bul?Cibl?QWXFMRBul?Bul?Ti6UXYFMRBul?Bul?Ti6UXYFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6UXYFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?Ti6SuXFMRBul?Bul?T	T10	2W XEMR	Burl4	Bus16				
T122W XFMRBu81Bu72T132W XFMRBu21Bu72T142W XFMRBu23Bu73T152W XFMRBu24Bu73T162W XFMRBu74Bu73T172W XFMRBu74Bu73T182W XFMRBu39Bu74T192W XFMRBu34Bu74T202W XFMRBu34Bu74T142W XFMRBu34Bu74T212W XFMRBu34Bu74T222W XFMRBu35Bu34T232W XFMRBu36Bu74T242W XFMRBu76Bu74T252W XFMRBu76Bu74T262W XFMRBu74Bu74T272W XFMRBu76Bu74T282W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu76Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74T292W XFMRBu74Bu74C404B	711	2W XFMR	Buil7	Bus19				
T13UW XFMRBu21Bu22T14UW XFMRBu23Bu24T15UW XFMRBu24Bu26T16UW XFMRBu27Bu23T17UW XFMRBu27Bu29T18UW XFMRBu30Bu32T19UW XFMRBu31Bu31T20UW XFMRBu34Bu41T21UW XFMRBu36Bu41T22UW XFMRBu36Bu41T23UW XFMRBu36Bu41T24UW XFMRBu38Bu42T25UW XFMRBu38Bu42T26UW XFMRBu38Bu42T27UW XFMRBu38Bu42T28UW XFMRBu39Bu42T24UW XFMRBu39Bu42T25UW XFMRBu39Bu42T26UW XFMRBu31Bu42T26UW XFMRBu31Bu42T26LubeBu31Bu42T26LubeBu31Bu42T26LubeBu31Bu32T36LubeBu31Bu32LubeBu31Bu32Bu34LubeBu31Bu32Bu34LubeBu31Bu32Bu34LubeBu31Bu32Bu34LubeBu31Bu32Bu34LubeBu31Bu34Bu34LubeBu31Bu34Bu34LubeBu31Bu34Bu34LubeBu31Bu34 <t< td=""><td>T12</td><td>2W NFMR</td><td>Bus18</td><td>Bus26</td><td></td><td></td><td></td><td></td></t<>	T12	2W NFMR	Bus18	Bus26				
T142W XFMRBu23Bu24T152W XFMRBu24Bu26T162W XFMRBu27Bu28T172W XFMRBu27Bu29T182W XFMRBu30Bu32T192W XFMRBu31Bu31T202W XFMRBu34Bu41T212W XFMRBu35Bu41T222W XFMRBu36Bu41T232W XFMRBu36Bu41T242W XFMRBu38Bu42T252W XFMRBu38Bu42T262W XFMRBu38Bu42T272W XFMRBu39Bu42T282W XFMRBu39Bu42T242W XFMRBu39Bu42T252W XFMRBu31Bu42T262W XFMRBu31Bu42T262W XFMRBu41Bu42CableCableBu41Bu42CableCableBu41Bu42Line1LineBu2Bu41Line2Bu41Bu43Bu44Line4LineBu41Bu44Line4LineBu41Bu44Line4LineBu41Bu44Line4LineBu41Bu44Line4LineBu41Bu44Line4LineBu41Bu44Line4LineBu44Bu44Line4LineBu44Bu44Line4LineBu44LineLine4Bu44 <td< td=""><td>TIS</td><td>2W XFMR</td><td>Bun21</td><td>Bus22</td><td></td><td></td><td></td><td></td></td<>	TIS	2W XFMR	Bun21	Bus22				
T152W XYMR8e24Be25T162W XYMR8e27Be25T172W XYMRBe30Be42T182W XYMRBe30Be33T292W XYMRBe31Be44T142W XYMRBe34Be44T212W XYMRBe36Be44T222W XYMRBe36Be44T232W XYMRBe36Be42T242W XYMRBe37Be42T252W XYMRBe38Be42T262W XYMRBe30Be42T272W XYMRBe30Be42T262W XYMRBe30Be42T272W XYMRBe30Be42T262W XYMRBe30Be42T272W XYMRBe30Be42T262W XYMRBe30Be42T262W XYMRBe30Be42T262W XYMRBe43Be42T26CableBe14Be42T26CableBe14Be42CableBe12Be42CableBe14Be42CableBe12Be43LinelBe14Be43LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44LinelBe14Be44Linel<	T14	2W XFMR	But23	Bus25				
TifeWX XFMRBu27Bu23TifWX XFMRBu27Bu29TikWX XFMRBu30Bu32Ti9WX XFMRBu31Bu33Ti4WX XFMRBu34Bu41Ti4WX XFMRBu35Bu41Ti2WX XFMRBu36Bu41Ti3WX XFMRBu36Bu41Ti4WX XFMRBu36Bu41Ti4WX XFMRBu36Bu41Ti4WX XFMRBu36Bu42Ti5WX XFMRBu38Bu42Ti5WX XFMRBu30Bu42CableBu40Bu42CableBu40Bu42CableBu40Bu42Line1LineBu2Line2LineBu41Line3Bu42Bu42Line4LineBu2Line4LineBu42Line5LineBu41Line4LineBu42Line5LineBu41Line4LineBu42Line5LineBu41Line4LineBu42Line5LineBu42Line4LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42Line5LineBu42	T15	2W XFMR	Bm24	Bus26				
T172W XFMRBu?Bu32T182W XFMRBu30Bu32T192W XFMRBu31Bu33T292W XFMRBu34Bu41T212W XFMRBu35Bu41T222W XFMRBu36Bu41T232W XFMRBu37Bu41T242W XFMRBu38Bu42T252W XFMRBu39Bu42T262W XFMRBu39Bu42T272W XFMRBu39Bu42T262W XFMRBu30Bu42Cable1CableBu11Bu2Cable2CableBu12Bu14Line1LineBu2Alia1494Line2LineBu2Bu13Line3LineBu2Bu31Line4LineBu2Bu31Line5LineBu3Alia2Line4LineBu2Bu31Line5LineBu3Alia2Line4LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5LineBu31Alia2Line5Line <td>T16</td> <td>2W XFMR</td> <td>Bus27</td> <td>Bus25</td> <td></td> <td></td> <td></td> <td></td>	T16	2W XFMR	Bus27	Bus25				
Tils2W XFMRBu30Bu32Ti92W XFMRBu31Bu33T202W XFMRBu34Bu41T212W XFMRBu35Bu41T222W XFMRBu36Bu41T232W XFMRBu37Bu41T242W XFMRBu38Bu42T252W XFMRBu39Bu42T262W XFMRBu39Bu42T262W XFMRBu39Bu42CableBu11Bu52Cable1CableBu12Bu14Line1LineBu2Bu14Line2LineBu63Bu15Line4LineBu2Bu14Line5LineBu63Bu63Line4LineBu63Bu63Line5LineBu63Bu63Line4LineBu63Bu63Line5LineBu63Bu63Line4LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63Line5LineBu63Bu63 <td>T17</td> <td>2W NFMR</td> <td>But27</td> <td>Bus29</td> <td></td> <td></td> <td></td> <td></td>	T17	2W NFMR	But27	Bus29				
TI92W XFMRBea31Bea34T202W XFMRBea34Bea41T112W XFMRBea35Bea41T222W XFMRBea36Bea41T342W XFMRBea37Bea42T342W XFMRBea38Bea42T252W XFMRBea39Bea42T262W XFMRBea40Bea42Cable1CableBea19Bea42Cable2CableBea12Bea14Line1LineBea12Bea13Line2LineBea12Bea13Line3LineBea14Al19145Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea13Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19Bea19Line4LineBea19	T18	2W XFMR	Bus30	Bus32				
T202W XFMRBu34Bu44T212W XFMRBu35Bu44T222W XFMRBu36Bu44T342W XFMRBu37Bu44T342W XFMRBu38Bu42T352W XFMRBu39Bu42T262W XFMRBu39Bu42Cable1CableBu11Bu2Cable2CableBu12Bu14Line1LineBu12Bu13Line2LineBu12Bu14Line3LineBu12Bu13Line4LineBu2Bu14Line4LineBu14Bu13Line4LineBu13Bu14Line4LineBu14Bu14Line4LineBu14Bu14Line4LineBu17Bu14Line4LineBu17Bu17Line5LineBu14Bu17Line4LineBu37Bu37Line5LineBu14Bu37Line5LineBu14Bu37Line5LineBu17Bu37Line5LineBu37Bu37Line5LineBu37Bu37Line5LineBu37Bu37Line5LineBu37Bu37Line5Line5Bu37Bu37Line5Line5Bu37Bu37Line5Line5Bu37Bu37Line5Line5Bu37Bu37 <trr>Line5Line5Bu37</trr>	T19	2W XFMR	Bui31	Bus33				
T212W XFMRBu35Bu41T222W XFMRBu36Bu41T342W XFMRBu37Bu41T442W XFMRBu38Bu42T252W XFMRBu39Bu42Cable12W XFMRBu31Bu42Cable2CableBu12Bu14Line1LineBu12Bu13Line2LineBu12Bu13Line4LineBu12Bu14Line4LineBu12Bu13Line4LineBu14Al19145Line4LineBu13Al19145Line4LineBu14Al19145Line4LineBu13Al19145Line4LineBu14Al19145Line4LineBu15Al19145Line4LineBu17Al19145Line4LineBu17Al19145Line5LineBu17Al19145Line4LineBu37Al19145Line5LineBu37Al19145Line5LineBu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5Bu37Al19145Line5Line5B	T29	2W XFMR	Bus34	Bus41				
T212W XFMRBes/6Bes/4T332W XFMRBes/7Bes/4T442W XFMRBes/8Bes/2T252W XFMRBes/9Bes/2T262W XFMRBes/9Bes/2Cable1CableBes/1Bes/2Cable2CableBes/2Bes/3Line1LineBes/2Bes/3Line2LineBes/2Bes/3Line3LineBes/3Bes/3Line4LineBes/3Bes/3Line5LineBes/3Bes/3Line4LineBes/3Bes/3Line5LineBes/3Bes/3Line4LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5LineBes/3Bes/3Line5Line5Bes/3Bes/3Line5Line5Bes/3Bes/3Line5Line5Bes/3Bes/3Line5Line5Bes/3Bes/3	721	2W XFMR	Bus35	Bus41				
T232W XFMRBus?Bus41T242W XFMRBus38Bus42T252W XFMRBus39Bus42T262W XFMRBus40Bus42Cable1CableBus11Bus2Cable2CableBus12Bus14Lins1LinsBus12Bus13Lins2LinsBus12Bus13Lins4LinsBus130.1599255Lins4LinsBus170.162592Lins4LinsBus170.162592Lins5LinsBus170.0276131Lins6LinsBus170.0276131Lins6LinsBus170.0276131Lins6LinsBus170.0276131Lins6LinsBus170.0276131Lins6LinsBus17Bus17Lins6LinsBus170.0276131Lins6LinsBus17Bus17Lins6LinsBus17Bus17Lins6LinsBus17Lins6LinsBus17Lins7LinsBus17Lins7LinsBus17Lins7LinsBus17Lins7Lins7Bus17Lins7Lins7Bus17	722	2W XFMR	But36	Bus41				
T242W XFMRBu38Bu42T252W XFMRBu39Bu42T262W XFMRBu40Bu42Cable1CableBu11Bu52Cable2CableBu12Bu14Line1LineBu2Bu14Line2LineBu12Bu13Line3LineBu14Bu13Line4LineBu12Bu14Line5LineBu17Bu19Line4LineBu21Bu19Line5LineBu21Bu17Line5LineBu14Bu21Line5LineBu19Bu21Line6LineBu21Bu37Line5LineBu21Bu37Line6LineBu21Bu37Line7LineBu2Bu37Line5LineBu31Line5LineBu31Line7LineBu31Line5LineBu31Line5LineBu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Bu31Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5Line5 <td>T23</td> <td>2W XFMR</td> <td>Ban37</td> <td>Bus41</td> <td></td> <td></td> <td></td> <td></td>	T23	2W XFMR	Ban37	Bus41				
T252W XFMRBus39Bus42T262W XFMRBus40Bus42Cable1CableBus11Bus2Cable2CableBus12Bus14Line1LineBus12Bus130.1410145Line2LineBus12Bus130.1590255Line3LineBus2Bus130.1590255Line4LineBus170.1042592Line5LineBus130.0550255Line6LineBus12Bus170.0550255Line5LineBus12Bus170.0278131Line6LineBus12Bus170.0278131Line7LineBus13Bus140.0278131	T24	2W XFMR	Bu:38	Bus42				
T262W XFMRBus0Bus2Cable1CableBus1Bus2Cable2CableBus12Bus1Line1LineBus2Bus14Line2LineBus1Bus13Line3LineBus2Bus18Line4LineBus2Bus18Line5LineBus2Bus17Line5LineBus1Bus27Line6LineBus2Bus27Line6LineBus2Bus27Line7LineBus1Bus27Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Bus2Line7LineBus1Line7LineBus1Line7LineBus1Line7Line2Bus1Line7Line2Bus1Line7Line2Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1Line3Bus1	T25	2W XFMR	Bun39	Bus42				
Cablel     Cable     Buil     Bui2       Cable2     Cable     Buil     Buil     Buil       Line1     Line     Bui2     Buil4     0.1410145       Line2     Line     Buil     Buil3     0.1541963       Line3     Line     Buil     Buil3     0.1541963       Line4     Line     Buil2     Buil8     0.1590255       Line4     Line     Buil7     Buil9     0.1042992       Line5     Line     Buil     Buil7     0.0656263       Line6     Line     Bui2     Bui7     0.0278131       Line7     Line     Buil     Buis9     0.0278131	T26	2W XFMR	Bus40	Bus42				
Cable2     Cable     Bul1     Bul1       Line1     Line     Buc2     Bul4     0.1410145       Line2     Line     Bul1     0.1541963     0.1541963       Line3     Line     Bul2     Bul3     0.1590255       Line4     Line     Buc2     Bul17     0.1042992       Line5     Line     Buc1     0.0456063       Line6     Line     Buc2     Buc3     0.0278131       Line7     Line     Buc1     Buc5     0.0278131	Cahle1	Cable	Sul1	Bus2				
Line     Line     But2     But14     0.1410145       Line2     Line     But1     But33     0.1341963       Line3     Line     But2     But18     0.1341963       Line4     Line     But2     But18     0.1590255       Line4     Line     But2     But17     0.1042992       Line5     Line     But2     But27     0.05562653       Line6     Line     But2     But7     0.0278131       Line7     Line     But1     But58     0.0278131	Cable2	Cable	Bus12	But1				
Line?     Line     Buil     Buil3     0.1341963       Line3     Line     Buil2     Buil3     0.1599255       Line4     Line     Buil7     Buil7     0.1042992       Line5     Line     Buil     Buil7     0.00556263       Line6     Line     Buil2     Buil7     0.0278131       Line7     Line     Buil     Buil5     0.0278131	Line1	Line	Bus2	Bus14				0.1410145
Line3     Line     But2     But15     0.1599255       Line4     Line     But27     But17     0.1042992       Line5     Line     But1     But27     0.1042992       Line6     Line     But2     But27     0.00556263       Line6     Line     But2     But7     0.0278131       Line7     Line     But1     But95     0.0278131	Line2	Line	Busl	Bus13				0.1341963
Line     Line     Bux27     Bux17     0.1042992       Line5     Line     Bux1     Bux27     0.0550263       Line6     Line     Bux2     Bux7     0.0278131       Line7     Line     Bux1     Bux5     0.0278131	Lins5	Line	But2	Bus15				0.1599255
Line     Burl     Burl?     0.0556263       Line     Line     Burl?     Burl?     0.0278131       Line?     Line     Burl     Burl\$     0.0278131	Line4	Line	Bun27	Bus17				0.1042992
Line6 Line Bus2 Bus7 0.0278131 Line7 Line Bus1 Bus8 0.0278131	Line5	Line	Busl	Bus27				0.0556263
Line? Line Burl Burl 0.0278131	Line6	Line	Bun2	Bus7				0.0278131
	Line?	Line	Burl	Bur\$				0.0278131

Project:	MASTER THESIS	ETAP		Page:	11
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cose	TS	Revision:	Base
Filename:	HOUN SUBSTATION 2201/V	Stilluy Case.	15	Config:	Normal

CKT	Branch	Con	mected Bus ID	% Im	pedance, Zo	ero Seq., 1	00 MVAb
ID	Type	From Bus	To Bus	R0	X0	Zð	¥0
LineS	Line	But2	Bus7				0.0278131
Line9	Line	Buil	Bus5				0.0278131
Line 10	Line	Bm2	Bm31				0.0556263
Linell	Line	Buil	Bus30				0.0556263
Line12	Line	Buil7	But21				0.1460189
Line13	Line	Buil7	Bui23				1.1194780
Line14	Line	Bur21	Bus23				0.9734595
SW1	Tie Suitch	Buil	Bur2				
SW2	Tie Snitch	But7	Buiß				
SW3	Tie Switch	Bur13	Buil4				
5W4	Tie Suitch	Buil7	Buel8				
SW5	Tie Switch	Bui23	Bus24				
5W6	Tie Switch	But25	Bus26				
SW7	Tie Suitch	Bus28	But29				
SW8	Tie Suitch	Bu:30	Bus31				
511.9	Tie Switch	But32	Bus35				
SW10	Tie Switch	Bur41	Bus42				

Project:	MASTER THESIS	ETAP	Page:	12	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220KV	100 million (1990)	Config:	Normal	

## Synchronous Machine Parameters

		Machine				Rat	ing		P	Positive S	Sequenc	e Imped	lance (%)	ù.		Zer	o Seq. Z	(%)
	ID	Туре	Mo	ā-l		MVA.	kV	Ra	Xd"	Xď	Xd	$Xq^{\prime\prime}$	Xq'	Xq	XI	X/R	RØ	X0
UI	Pi	mer Geid	NA	2		22.101	220,000	9.95		99,50							35.65	356.48
U2	P	mer Grid	N/A			11.101	220.000	9,95		99.50							17.74	177.38
U3	Po	mer Geid	N/A			22,101	220,000	9,95		99.50							17.74	177.38
	Machine	0	unected Ba	15	п	me Con	stants (S	Hr.)	H (Se	c.), D (A	[Wpm/l	£2) & 54	durati	Gene or Lo	rator ading		Ground	24
	TD	<u> </u>	ID		Tdo"	Tdo'	Tqs=	Tue'	H	40	\$100	\$120	Shreak	MW	Myar	Cens.	Type	Amp
	Machine		G	enerator	Motor			Couplin	g		Prin	ae Move	r/Load		Equ	uralent	Total	
	ID	Type	RPM	BE.		H	RPM	WR'	H	E R	PM	WR*	Н	RP	M	WR!	н	

WR': kg-m' H: MW-5er/MVA

Machine	÷	Shaft Torsion				
ID	Type	DI	D2	KI	K	

D1, D2: MW (pu)/Speed (pu) K1, K2: MW (pu)/Radiant

Project:	MASTER THESIS	ETAP	Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	and the second second	Coufig:	Normal

				Lumper	Loan mp	ut Data				
Conventional Type							L	ad		
ID	kV	kVA	ŁW	kvar	% PF	Amp	% Motor	96 Static	Ta	Gamma
Lumpl	11.000	1243	0	1243	0.01	65.3	80	20	0	0
Lump10	11.000	5882	5000	3098	85,000	308.7	80	20	0	0
Lumpli	11.000	3529	3000	1859	85	185.2	80	20	0	0
Lump12	11.000	3529	3000	1859	85	185.2	50	20	0	0
Lump13	11.000	12942	11000	6815	85.000	679.3	80	20	0	0
Lump14	11.000	5883	5000	3099	85.000	368.8	80	20	0	0
Lump2	11.000	2353	2000	1240	85	123.5	90	20	0	0
Lump3	11.000	8236	7000	4539	\$5.000	432.3	80	20	0	0
Lump4	11.600	7058	6000	3718	85	370.5	80	20	0	0
Lump5	11.000	7058	6000	3718	85	370.5	80	29	0	0
1.ump6	11.000	5500	5500	0	100	288.7	50	20	0	0
Lamp?	11.000	3500	3500	0	100	183.7	59	20	0	0
Lump8	11.000	6000	6000	0	100	314.9	80	20	0	0
Lump9	11.000	2352	2000	1239	85	123.5	80	20	0	0

# Lumped Load Input Data

Project:	MASTER THESIS	ETAP		Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision	Bate
Filename:	HOUN SUBSTATION 220kV	annay case.		Config:	Normal

# LOAD FLOW REPORT (Without PV) @ T = 0.000-

	Bus		Volt	age	Gene	ration	La	ad			Load Flow	ri			XFMR
	m	kV	We Mag.	Ang.	MW	Myar	MW	Myar	-	ID	MEW	Myar	Amp	16PF	No Tap
Busl		66.000	99.118	-11.6	0	8	0	0	Burl3		6.817	3.963	63.6	83.5	
									Burl27		19.518	1.155	172.6	99.8	
									Buil		3.479	2.276	36.7	83.7	
									ButS		3.479	2.276	36.7	\$3.7	
									Bm30		10.979	7.655	118.3	\$1.9	
									But3		-43.474	-18.606	417.3	91.9	3.750
									Buth		0.001	1.247	11.0	0.1	
Bus2		66.000	98.852	-17.5			0	0	Buil4		6.009	3.992	63.8	83.3	
									Bur18		3,488	-0.246	30.9	-99.8	
									Bui7		0,994	0.572	10.1	86.7	
									Bat7		0.994	0.572	10.1	86.7	
									Bur31		5.022	3.198	52.7	84.4	
									Bus5		-16.507	-5.089	162.7	89.8	9.625
Busd		228.099	108.000	.19.5		٠		0	Buil		43.582	23.466	129.9	88.0	
									UI		-45,582	-23.466	129.9	88.0	
Buil		228,099	100.000	0.0			0		U2		0.000	0.000	9.0	0.0	
But5		229,090	100.000	-25.6			0	0	Bm2		16.522	8.783	49.1	88.3	
									US		-16.522	-8.783	49.1	88.3	
Bust		11.000	96.071	-44.6			0.000	1.254	Burl		0.000	-1.254	66.0	0.0	
Bus7		65.099	98.828	-17.5				6	Buil		-0.994	-0.629	10.4	84.5	
									But2		-0.994	-0.629	10.4	84.5	
									Bur9		1.987	1.259	20.8	84.5	
Bush		66.000	99.027	-44.7				0	Buil		-3.478	-2.329	37.0	83.1	
									Bm1		-3.478	-2.329	37.0	83.1	
									Buil0		6,956	4.657	73.9	\$3.1	
Bus9		11.000	98.346	-28.3			1.986	1.231	Bus7		-1.986	-1.251	124.9	85.0	
Bus10		11.000	97,770	-46.7			6.938	4.301	Buiß		-6.938	-4.901	438.2	85.0	1.250
Built		66.000	98,344	-45.1			0	0	Butl		-6.004	-4.158	65.0	82.2	
									Bur15		6.004	4.158	65.0	82.2	
Buil4		66.009	98.615	-28.8			0		Burl2		-5.996	-4.155	65.1	82.2	
									Builé		5.996	4.155	65.1	82.2	
Buil5		11.009	95.692	-48.8			5.968	3.699	Buill		-5.968	3.699	373.4	85.0	4.375
Buile		11.000	98,339	-51.0			5.960	3.694	Bm14		-5.960	3.694	574.2	\$5.0	4.375
Busl7		66.000	98.917	-16.3			0	8	Bus17		-13,472	2.510	121.7	.97,8	
8383797C		1.1.1.1.00	1000			100			Bes21		6.692	-1.319	59.5	-95.1	
									But13		1.390	1.644	19.0	-64.6	
									Bm19		5,480	0.153	48.5	100.0	
Busl7		55,000	98.917	-46.3	•	•	0	8	Buil4 Buil7 Buil1 Buil3 Buil9		-13.472 6.602 1.399 5.480	2,810 -1,319 -1,644 0,153	121.7 59.5 19.0 48.5	.97.5 -95. -64.1 100.1	9 1 6 0

Project:	MASTER THESIS	ETAP	Page:	15	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV	and y care as	Config:	Normal	

## LOAD FLOW REPORT (Without PV) @ T = 0.000-

Bus		Volt	age	Gene	ration	Lo	nđ		Load Flow	¥.			XFMR
ID	kV	96 Mag.	Ang.	MW	Munt	MW	Myar	ID	MW	Mvar	Amp	94PF	** Tap
Buils	65.000	95,765	-17.9	0	0	- 0	-0	Bus2	-3.484	-0.062	30.9	100.6	
								Bus20	5.484	0.062	30.9	100.0	
Buil#	11.000	98,749	-47.9	0	0	5.472	0.000	But17	-5,472	8.090	290,9	100.0	
Bur20	11,000	95,661	-28.9	0	0	3.481	0.000	Burl\$	-3.481	0.000	185.2	109.0	
Bus21	65,000	95,935	-47.0	0	0	0	0	Buil7	-6.590	1.092	59.1	-98.7	
								Bus23	0.604	-1.398	13.5	-39.6	
								Bur21	5.986	0.306	53.0	99,9	
Bus22	11.000	98.422	-49.5	0	0	5.962	0.000	But21	-5.962	0.000	318.0	100.0	
Bun25	66.009	99,263	47.4	0	0	0	0	Bus17	-1.385	-0.656	13.5	50.4	
								Bur21	-0.603	-8.621	7.6	69.6	
								Bun25	1.985	1.277	20.8	84.1	
Bun25	11.000	95.077	-83	0	0	1.984	1.230	But23	-1.954	-1.230	124.9	85.0	
Bus27	66.000	98.847	-45.3	0	0	0	0	But17	13.569	-2.797	122.1	.97.9	
								Butl	-19.478	-1.026	172.6	99.5	
								Bus28	2.984	1.912	31.4	84,2	
								But29	2.984	1.912	31.4	84.2	
But28	11.000	98.428	-\$6.2	0	0	2.981	1.848	But27	-2.981	-1.848	187.9	85.0	0.625
Bus29	11.000	95,428	-46.2	0	0	2.981	1.848	Bus27	-1.981	-1.848	187.0	\$5.8	0.625
Bun30	65.000	98.515	-45.0	0	0	0	0	Buil	-10.961	-7.688	118.9	\$1.9	
								Bus32	10,961	7.688	118.9	81.9	
But51	66.000	95.594	-27.7	0	0			Buil2	-5.019	-3.290	53.2	83.6	
								Bus33	5.919	3.298	53.2	83.6	
Buc32	11.009	98.056	-45,2	0	0	19,914	6.765	Bu130	-10.914	-6,765	687.5	85.0	3.750
Bur33	11,009	109.463	-19.1	0	0	5.009	3.105	Bus51	-5,009	-3.105	397.9	\$5,0	3.750
u	229.000	291.912	0.0	54.612	133,771		6	Busð	54.612	133.771	129,9	37.8	
U2	229.000	109.000	0.0	0	0		0	Bus4	0.000	0.000	0.0	0.0	
U3	229.009	162.988	0.0	18.099	24.547	0	.0	ButS	18.099	24,847	49,1	\$9,3	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a bus with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP	Page:	16
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		.SN:	
Engineer	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	oning care. 10	Config:	Normal

# LOAD FLOW REPORT (Without PV) @ T = 0.800-

	Bus		Volt	age	Gene	ration	Lø	ad			Load Flow	és:			XFMR
	ID	45	46 Mag.	Ang	MW	Myar	MW	Myar	_	ID	MW	Moar	Amp	%PF	% Tap
Buil		66.000	193.796	-35,3	6	0	0	8	Bm13		9.563	5.183	49.1	87.9	
									But27		30.507	-10,785	146.1	-94.5	
									Ber8		5.446	3.266	28,7	\$5.8	
									Bu18		5.446	3.266	28.7	85.8	
									Bm30		17.411	10.974	92.9	84.6	
									Bin3		-68.374	-13.828	314.9	98.0	3.750
									Ber6		0.001	1.929	8.7	0.0	
But!		66.000	98.852	-37.5	0	0	0		Burl4		6.009	3.992	63.5	\$3.3	
									Buil8		3.488	.0.246	30.9	.99.8	
									But7		0.994	0.572	10.1	86.7	
									Bus7		0.994	0.572	10.1	86.7	
									But31		5.022	3.198	\$2.7	84.4	
									Bas5		-16.597	-5.059	162.7	89.5	0.625
Buth		220.000	188.559	.33.1	0	0	.0	0	Buil		68.435	16.594	98.0	97.2	
									UI		-68.435	-16.594	98.0	97.2	
Bm4		220.000	100.000	0.0	0	0	.0		U2		8.900	0.000	0.0	0.0	
Bui5		220.000	100.000	-25.6		0	0		Bus2		16.522	8,783	49.1	88.3	
									13		-16.522	-8.783	49.1	88.3	
Buth		11,009	192.967	-35.5	0	0	0.000	1.920	Burl		0.000	-1.920	52.2	0.0	
Ber7		66.000	96.825	-27.5	0	0	0		Bet2		-8.994	-0.629	10,4	84.5	
									Bm2		0.994	-0.629	19.4	84.5	
									Bur9		1.987	1.259	20.5	84.5	
Burß		66.000	193.727	-35.3	6	0	0		Beil		-5.446	-3.483	29.2	84.2	
									Buil		-5.446	-3.483	29.2	84.2	
									Bur10		10.891	6.966	58.4	84.2	
Bm9		11.000	98.346	-28.1	0	0	1,986	1.231	But7		1.986	-1.231	124.9	\$5.0	
Burl@		11.000	294.207	-36.1	6	0	16.836	6,744	Bush		-10.880	-6.744	346.0	\$5.0	1.250
Buil3		66.000	193.227	-35.5	0	0	0	0	Bm1		-9.555	-6.197	51.6	83.9	
									Bus15		9.555	6.197	51.6	83.9	
Berl4		66.000	98.015	-28,0		0	.0		Bet2		-5.996	-4.155	65.1	82.2	
									But16		5,996	4.155	65.3	\$2.2	
Burl5		11.000	198.606	-36.7	0	0	9.533	5,916	Bm13		-9.533	-5.968	296.4	\$5,0	4.375
Builé		11.000	98.339	-31.0	6	0	5.960	3.694	Buil4		-5.960	-5.684	374.2	\$5.0	4.375
Buil7		66.000	194.744	-36.0	0	0	0		But27		-21.105	15,776	115.5	-50.1	
									Bus21		10.341	-7.834	58.3	-79.7	
									Bus23		2.195	-8.032	37,4	-26.3	
									Bes19		8.571	0.097	38.5	100.0	

Project:	MASTER THESIS	ETAP	Page:	17
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stati Case. 15	Config:	Normal

#### LOAD FLOW REPORT (Without PV) @ T = 0.800-

Bus		Volt	age	Gene	ration	Lo	ad .		Load Flow				XFMR
ID	łł	% Mag.	Ang.	MW	Myar	MW	Myar	ID	MW	Mean	Amp	96PF	% Tap
Basis	65.009	98,765	-27.9	0	0	0		Bet2	-3.484	-0.062	30,9	106.0	_
								Beri20	3.484	0.062	30.9	100.0	
Bun19	11.000	194.622	-36.7	0	0	8.567	0.000	Ben17	-8.567	0.090	231.0	100,0	
Ban20	11.000	95.661	-28.9	6	0	3.481	0.000	Bus18	-3.481	0.000	185.2	199.0	
Bus21	66.000	195.217	-36.3	0	6			Bus17	-10.329	6.728	55.2	-83.5	
								Ber23	0.958	-6.920	32.3	-13.7	
								Bet12	9.372	0.192	42.0	106.0	
Bas22	11.000	194.568	-37.5	0	0	9.357	0.000	Bus21	.9.357	0.000	252.0	100.0	
Bas23	66.000	196,815	-36.6	0	0	0		But17	-2.183	-0.996	19.7	90.9	
								Bus21	-4.953	0.973	6.1	70.0	
								But25	3.136	1.972	16.5	84.7	
Bas25	11.000	195.883	-36.9	0	0	3.134	1.942	Bus25	-3.154	-1.942	96.8	115.0	
Bas27	65.008	193,979	-35.6	0	0	0		Bus17	21.141	-16.385	129.6	-79.0	
								Bet1	-58.478	10.520	145.4	.94.5	
								But28	4.669	2.932	24.9	84.7	
								Bur29	4.659	2.932	24.9	84.7	
Bas28	11.000	194.375	-36.8	6	0	4.667	2,892	Bus27	-4.667	-2.892	148.2	115.0	8.625
Bus29	11,009	194.375	-36.0	0	0	4.667	2,892	Bus27	-4.667	-3.892	148.2	85.0	0.625
Bus30	66.000	193.341	-35.5	0	0	0		Berl.	-17.395	-11.343	94.9	83.8	
								Bush2	17.399	11.343	94.0	83.8	
Biet31	65.000	98.594	-27.7	0	0	0	8	Bart2	-5.019	-3.296	53.2	83.6	
								Bus33	5.019	3.290	53.2	\$3.6	
Biar.52	11.000	197,370	-36.8	0	0	17.370	10.767	Bes30	-17.370	-10.767	543.5	85.0	3.750
Bus33	11,000	100,463	-29.1	0	0	5.009	3.145	Bush	-5.009	-3.195	397.9	35.0	3.750
u	228.000	291,912	0.0	74.714	79.386	0		Ber.3	74.714	79.386	98.0	68.5	
U2	229.000	100.000	0.0	0	0	9		Bus4	0.000	0.000	0.0	0.0	
13	228,098	162,988	0.0	18.099	24.547			But5	15.099	24.547	49.1	59.3	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a buy with a lead minimatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineers	SAND MUSTAFA AL-REFAI	Study Casar	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	stanty Carry		Config:	Normal

## LOAD FLOW REPORT (Without PV) @ T = 1,000-

Bu	5	Volt	age	Gene	ration	Lo	ad			Load Flow	Ċ.			XFMR
ID	kV	96 Mag.	Ang.	MW	Mvar	MW	Mvar		ID	MW	Myar	Amp	1425	% Tap
Basl	66.000	0.000	90.0	0	0	0	0	Bat13		0.000	0.000	0.0	0.0	
								Bet17		0.000	0.000	0.0	0.0	
								But8		0.000	0.000	0.0	0.0	
								Bmi8		0.000	0.000	0.0	0.0	
								Bur30		8.000	0.000	0.0	0.0	
								But3		8.000	0.000	521.2	0.0	3.750
								Bas6		8.000	0.000	0.0	0.0	
Bas2	66.000	0.000	90.0	6	0	Ð		Bus14		0.005	0.000	0.0	0.0	
								Bas18		0.000	0.000	0.0	0.0	
								Bus7		0.000	0.000	0.0	0.0	
								Ben7		8.000	0.000	0.0	0.0	
								Bun31		0.000	0.000	0.0	0.0	
								But5		0.000	0.000	0.0	0.0	0.625
Ban3	220.000	12.264	4.3	0		0		Burl		0.165	7.579	162.2	2.2	
								UI		-0.168	-7.579	162.2	2.2	
Bun-4	220.000	180.000	0.0	0	0	0	0	U2		8.000	0.000	0.0	0.0	
Bar5	220.000	0.000	90.0	0	a	0	0	Bun2		8,000	0.000	0.0	0.0	
								U3		0.000	0.000	94.5	0.0	
But	11.000	0.000	90.0	0		Ð	0	Burl.		0.000	6.000	0.0	0.0	
Basy7	66.000	0.000	90.0	0		0	0	Bas2		0.006	0.000	0.0	0.0	
								Ban2		0.000	0.000	0.0	0.0	
								But9		8.000	0.000	0.0	0.0	
Bust	66.000	0.000	90.0	0		0	0	Buil		0.000	0.000	0.0	0.0	
								Buil		0.000	0.000	0.0	0.0	
								Bat10		0.000	6.000	0.5	0.0	
Bast	11.000	0.000	90.0	0		0		Bus7		0.000	0.000	0.0	0.0	
Ban10	11.000	0.000	90.0	a		Ð		Buiß		0.000	0.000	0.0	0.0	1.250
Bat13	66.000	0.000	90.0	0	0	0		Buil		8.000	0.000	0.0	0.0	
								Bus15		0.000	0.000	0.0	0.0	
Burl4	66.000	0.000	90.0	0	0	0	0	Bert2		0.000	0.000	0.0	0.0	
								Build		0.000	0.000	0.0	0.0	
Burl5	11.000	0.000	90.0	0	0	0		Bm13		8.000	0.000	0.0	0.0	4.375
Bun16	11.900	0.000	\$0.0	0		0		Berl4		8.000	0.000	0.0	0.0	4.375
Bun17	66.000	0.000	90.0	0		0		Buil?		8.000	0.000	0.0	0.0	
								Bas21		0.000	0.000	0.0	0.0	
								Bus23		0.000	6.000	0.0	0.0	
								Bas19		0.000	0.000	0.0	0.0	

Project:	MASTER THESIS	ETAP		Page:	19
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	15	Revision:	Base
Filename:	HOUN SUBSTATION 229kV	pinny case.	13	Config:	Normal

#### LOAD FLOW REPORT (Without PV) @ T = 1.000-

But		Volt	age	Gene	ration	Lo	ađ		Load Floy	<b>T</b>			XFMR
ID	LV.	16 Mag.	Ang.	MW	Myar	MW	Myar	ID	) MW	Myar	Amp	442F	% Tap
Bus1\$	66.000	0.000	99.0	0	0	0	0	Bur2	0.000	0.000	0.0	0.0	
								Bar20	8.000	0.000	0,0	0.0	
Bus19	11.909	8,009	90.0	0	0	0	.0	Buil7	9,909	0.000	0.0	9,0	
Bui20	11.000	0.000	90.0	0	0	0	0	Buil8	0.900	0.000	0.0	0.0	
But21	66.000	9,000	90.0	0	0	.0	0	Buil7	0.000	0.000	0.0	0.0	
								Bur23	0.009	0.000	0.0	0,0	
								Bus22	0.000	0.000	0.0	0.0	
Bus22	11.000	0.000	90.0	0	0	Ð	0	But21	0.000	0.000	9.0	0.0	
Bus23	66.000	8,000	90.0	0	0	Ð	0	Bus17	0.900	0.000	0.0	0.0	
								Bus21	0.000	0.000	0.0	0.0	
								Bus25	0.900	0.000	0.0	0.0	
Bui25	11.000	0.000	90.0	0	0	0	0	Bus23	0.000	0.000	0.0	0.0	
But27	66.000	8.008	90.0	0	0	0	0	Bus17	0.000	0.006	0.0	0,0	
								Buil	8.000	0.000	9.0	0.0	
								Bun28	0.000	0.000	0.0	0.0	
								Bus29	0.000	0.000	0.0	0.0	
Bus28	11.000	0.000	90.0	0	0			Bus27	0.000	0.000	0.0	0.0	0.625
Bus29	11.000	0.000	90.0	0	0	0	0	Burt27	0.000	0.000	0.0	0.0	0.625
But30	66.000	0.000	99.0	0	0	Ð	.0	Buil	0.000	0.000	9.0	0.0	
								Bus52	0.000	0.000	0.0	0,0	
Bus31	66.000	0.000	90.0	0	0	0	0	Bun2	0.000	0.090	0.0	0.0	
								Bur33	0.000	0.000	0.0	0.0	
Bus32	11,009	0.000	90.0	0	0	0	0	Bur50	0.000	0.000	0.0	0.0	3.759
Bur33	11.000	0.000	90.0	0	0		0	Bus31	0.000	0.000	0.9	0.0	3.750
UI	220,600	291.912	0.0	17.571	179.600	0	0	Bush	17.371	179.600	162.2	9,6	
U2	229.000	100,000	0.0	0	0	0	0	Bm4	0.000	0.000	0.0	0.0	
U3	220,000	162.968	0,0	5.842	58.420	0	0	But5	5.842	58.420	94,5	10.0	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a bus with a load minmatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	20
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	15	Config:	Normal

## Dynamic Stability

The tabulated plot data is not printed since the option of "Skip Tabulated Plots" is checked. To print tabulated plot data go to the Transient Stability Study Case Editor and in the Info Page uncheck the "Skip Tabulated Plots" option.

Project:	MASTER THESIS	ETAP		Page:	21
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stand Carses		Config:	Normal

Time (Sec.)	Element ID	Туре	Zone No
0.000	Busl	Bus	2
0.000	Bus10	But	2
0.000	Bus13	Bus	2
0.000	Buil4	Bus	1
0.000	Buil5	Bus	2
0.000	Buil6	Bui	1
0.000	Buil7	Bus	8
0.000	Bus18	Bus	1
0.000	Bus19	Bm	3
0.000	Bat2	Bus	1
0.000	Bmi20	But	1
0.000	Bus21	Bus	2
0.000	Bus22	Bm	
0.000	Bus23	Bus	1
0.000	Bus25	Bus	3
0.000	Bus27	Bui	
0.000	Bus25	But	1
0.000	Bus29	Bui	3
0.000	Bus3	Bus	1
0.000	But.50	Bm	
0.000	Bus31	Bus	1
0.000	Bus32	But	6
0.000	Bus33	Bus	1
0.000	Bun4	Bus	83
0.000	But5	Bus	1
0.000	Bush	Bui	3
0.000	Bus7	But	1
0.000	Bus8	Bus	
0.000	Basy	But	1
0.000	UI	Power Grid (Ref.)	2
0.000	U2	Power Grid (Ref.)	3
0.000	03	Power Grid (Ref.)	1

# System Islanding Index

Project:	MASTER THESIS	ETAP		Page:	22
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	15	Config:	

#### Action Summary Event ID Time (Sec.) Device Type Device ID Action Busl event2 0.500 But 3 Phase Fault event2 0.800 But But5 3 Phase Fault

# **APPENDIX 13**

# TRANSIENT STABILITY ANALYSIS WITH PV

Project:	MASTER THESIS	ETAP		Page:	1
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Sound enter	10	Config:	Normal

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

# Electrical Transient Analyzer Program

Transient Stability Analysis (With PV)

Initial Loading Category (1): Design

Initial Generation Category (I): Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	3	7	32	42

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	SPDT	Total
Number of Branches:	26	0	0	16	0	10	0	52
	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total	_	
Number of Machines:	0	3	0	0	14	17		

Method of the Initial LF Solution:	Adaptive Newton-Raphson
Maximum Number of Iterations:	1000
Solution Precision for the Initial LF:	0.0001000000
Acceleration Factor for the Initial LF:	0.00
Time Increment for Integration Steps (34):	0.0010
Time Increment for Plots:	20 times $\Delta t$
System Frequency:	50.00 Hz
Frequency Dependent Models for Machines and Net	work are Not Used
Unit System:	Metric

Project:	MASTER THESIS	ETAP	Page:	2
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Casel 13	Coufig:	Normal

Adi	astments		
Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		
Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	1
Cable Resistance:	Yes	Individual	

Project: Location: Contract:	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department	ETAP 12.6.0H	Page; Date: SN:	3 28-06-2016
Engineer:	SAND MUSTAFA AL-REFAI	Stude Come TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case: 15	Config:	Normal

						Lo	ad							
	Bas		Initial V	Initial Voltage		Initial Voltage		at kVA	Cent	saf Z	Cear	itant I	Gett	veric
ID	ŁV	Sub-sys	% Mag.	Aug.	MW	Myar	MW	Myar	MW	Myar	MW	Myar		
Bur.l	66.000	1	99.4	-4.2										
Bun2	\$6,000	1	99.1	-1.2										
Bun3	220.000	1	100.0	0.0										
Bus4	220.000	1	100.0	0.0										
But5	220.000	1	100.0	0.0										
Buső	11.000	1	98.3	-4.2	0.090	0.995	0.000	0.249						
Bus7	66.000	1	99,0	-1.2										
Busil	66.090	1	99.3	-4.5										
Bun9	11.000	1	98.4	-1.8	1.690	0.992	0.400	0.248						
Bas10	11.000	18	98.0	-6.3	5.600	3.471	1.499	0.868						
Bun11	66.000	1	99.1	-1.2										
Buil2	66.000	1	99.4	-4.2										
BusLA	\$6.000	1	98.6	-4.7										
Bus14	66.000	1	98.2	-1.7										
Ban15	11.000	1	99.0	-7.6	4,500	2.975	1.200	0.744						
Bun16	11.000	1	98.6	-4.7	4.599	2.975	1.200	0.744						
Burl7	66.000	1	99.2	-5.9										
Bus18	66.000	1	99.0	-1.6										
Bus19	11.000	1	99.0	-7.5	4.400	0.000	1.100	0.000						
Bus20	11.000	1	95.9	-2.6	2.890	0.000	0,700	0.000						
Bu:21	66.000	1	99.2	-6.5										
Ben22	11.000	1	98.7	-9.4	4.500	0.000	1.209	0.000						
Bun23	66.000	1	99.5	-6.9										
Bus24	\$6.000	1	100.0	0.0										
Bus25	11.000	1	98.4	.7.9	1.690	0.991	0.400	0.248						
Ban26	11.000	1	100.0	0.0	4.000	2,479	1.000	0.620						
Bus27	66.000	1	99.1	-4.9										
Bast28	11.000	1	98.7	-5.8	2.499	1,487	0.600	0.372						
Bun29	11.000	1	98.7	-5.8	2,490	1.487	0.689	0.372						
Bui30	66.000	1	98.8	-4.6										
Bur51	66.000	1	98.8	-1.4										
Bus32	11.000	1	98.3	-7.8	8.899	5.485	2.200	1.364						
Bur 33	11.000	1	100.7	-2.8	4,000	2.479	1.000	0.620						
Bun34	0.400	1	100.0	11										

# Bus Input Data

Project:	MASTER THESIS	ETAP	Page:	4
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename	HOUN SUBSTATION 220KV	Study Case. 15	Config	Normal

								Lo	ad			
Buy			Initial Ve	Initial Voltage		Countrast kVA		Constant Z		ant I	Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Myar	MW	Myar	MW	Mvar	MW	Myar
Bm35	0.400	1	100.0	1.1					-			-
Ban36	0.400	1	100.0	1.1								
But37	0,400	1	100.0	1.1								
Bu:38	0,400	1	100.0	3.3								
But.39	0.400	1	100.0	.3.3								
Bert40	0.400	1	100.0	3.3								
Bui4I	11,000	1	98.9	-1.2								
Bur42	11.000	1	98.6	1.0								
Total Number of Bases: 42					51,999	25.785	13.000	6.446	0,800	0.000	8.000	0.000

Total Number of Buses: 42

Note: Dynamically modeled motor loads are not included in the bus motor load. See machine and motor pages for detail.

		Volta	age	i.	Generation	8 00	Myar I	imits		
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Mis
Bet.3	220.000	Swing	1	100.0	0.0		_			_
Ban4	220.000	Swing	1	100.0	0.0					
Bas5	220.000	Swing	1	100.0	0.0					
Ber.54	0.400	Veltage Control	1	100.5	1.1	1.960			0.899	0.000
Ber35	0.400	Voltage Control	1	100.0	1.1	1.960			0.899	0.000
Bas36	0.400	Voltage Control	1	100.0	1.1	1.960			0.899	0.000
Bei 37	0.400	Veltage Control	1	100.0	1,1	1.960			0.399	0.000
Bas.38	0.490	Voltage Control	1	100.0	3.3	1.960			0.899	0.000
Ban.39	0.400	Voltage Control	1	100.0	3.3	1,960			0.899	0.000
Bus #9	0.400	Voltage Countral	1	100.0	3.3	1.950			0.899	0.000
						13,719	0.000			

Project:	MASTER THESIS	ETAP		Page:	5
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Bate
Filename:	HOUN SUBSTATION 2201A	Study Case.	***	Config:	Normal

## Line/Cable Input Data

		Ohms or Siemens per 1000 m per Conductor (Cable) or per Phase (Line)											
L	Line/Cable ID			Leag	rth				XI				
		Library	Size	A48.040	99 Tal.	#Phase	T (°C)	Rl		¥1	RØ	N0	F.0
Cablel		1IMCU83	300	190.0	0.0	1	78	0.076302	0.087400	0.0001646	0.240351	0.215000	
Calife2		11MCUS3	300	106.0	0.0	1	75	0.076302	0.857.000	0.0001646	0.240351	0.215000	
Linel			674	19300.0	0.0	1	75	0.056003	0.374255	0.0000031	0.200077	1.360791	6.6000017
Line2			674	19300.0	0,0	1	75	0.056001	0.342069	6.0090034	0.200637	1.424041	0.0000016
Line3			674	23000.0	0.0	1	75	0.056001	8.342069	0.0000034	0.200637	1.424041	8.0000016
Line4			674	15000.0	0.0	1	78	0.056001	0.342069	0.0000034	0.200637	1.424041	9,0000016
Line5			674	8000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	8.0000016
Line6			674	4000.6	0.5	1	75	0.056001	8.342069	0.0000034	0.200637	1.424041	0.0000016
Line?			674	4000.0	0.0	1	75	0.056001	0,342069	0.0000034	0.200637	1.434041	0.0000016
LineS			674	4090.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016
Line9			674	4099.0	9.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000616
Line10			674	3000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424941	0.0000016
Linell			674	\$000.0	0.0	1	75	0.056001	0.342069	0.0000034	0.200637	1.424041	0.0000016
Line12			674	21009.0	0.6	1	75	0.056901	0.342069	0.0000034	0.289637	1.424041	0.0000016
Line13			674	161000.0	0.0	1	75	0.056001	8.342069	0.0000034	0.200637	1.424041	0.0000016
Line14			674	140000.0	0.0	1	78	0.056001	8.342069	0.0000034	0.200637	1.424041	0.0000016

Line / Cable resistances are listed at the specified temperatures.

Project:	MASTER THESIS	ETAP		Page:	6
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	15	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	study care.		Config:	Normal

2-Winding Transformer Input Data

DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### 94 Tap Setting Transformer Rating Z Variation Adjusted Phase Shift ID MVA. Prim kV Sec. hV % Z X/R + 5% 516 % Tel Prim Sec. 16 Z Type Angle π 65.000 229,009 66.000 12.50 45.00 3,750 12,5000 Dyn 0.000 . 0 Ú. . 13 63.000 229.000 66.000 12.50 45.00 0 12.5000 0.000 ő 8 0.625 Dya -8 **T**3 \$3,000 220.000 66.000 12.50 45.04 0 0.625 12.5000 Dyn 0.000 . 6 8 **T**4 10.000 65,605 11.065 \$.15 15.08 6 . 8 8 8,3580 Dyn 0.000 ٠ **T5** 0.000 10,000 66.000 11,000 10.66 20.08 à . 0 . 18,0060 Den ٠ 20.000 11.000 0 1,250 18.0000 0.000 **T6** 65.000 18.00 20.00 0 6 Dva . 17 8.16 8.3500 0.000 12,500 11,000 66,000 13.00 à . 1.350 0 YN4 . 18 12,500 11.009 65.990 \$.35 13.00 -1.250 8,3580 YNd 0.000 0 0 0 . **T**9 10.000 8.35 13.00 4.375 \$.3500 0.000 65.000 11.000 ٠ 6 0 Den T10 10.000 65.000 11.000 \$.35 13.00 0 4.375 \$,3580 Dyn 0.090 ò . T11 20.000 65,000 11,860 10.00 10.00 ė. . 6 . 10.0000 Dys 0.000 . 0.000 T12 20.000 66.000 11,000 18.40 20.08 . ő. . 0 . 10.0000 Dea 0 0.000 TH 10.000 65.000 11.000 8.35 13.00 . . \$ 3580 Dre . 8 T14 8.35 0 \$,3580 0.000 10.000 11,000 13.00 8 Dyn 66,000 ٠ 8 . T15 10.000 65.000 11.000 1.16 13.00 ė . 0 3.750 8,3500 Dyn 0.000 . T16 20.000 65.000 11.000 10.80 20.00 ٠ 0 . 0 0.625 10.0000 Dys 0.000 T17 20.000 65.000 11.000 19.00 20.00 . ú . 0 0.625 10.0000 Dyn 0.000 T15 20.099 65,000 11,900 10.00 20.00 . 0 0 0 3,750 10.0000 Dyn 0.000 T19 20.000 65,000 11,000 10.00 26.00 ٠ 0 . 0 5,780 10.0000 Des 0.000 T18 1.000 0.100 11.000 6.74 6.1488 VN4 0.006 6.00 ٠ ė 8 0 . 0.000 T21 3,000 11,000 6.25 6.2500 6.400 6.98 0 YNd . ė . 0 6.000 T22 5.000 0.400 11.000 6.25 6.00 0 6.2500 YNd . 0 . 0 T23 3.000 6.25 6.2589 YNd 0.000 0.400 11.000 6.00 0 0 0 . 0 T24 3.000 0.400 11.000 6.25 6.00 0 0 6.2500 174 0.000 . T25 3.000 0,400 11.000 6.25 6.00 ò 0 0 6,2580 YNd 0.000 ٠ ÷ 6.2500 756 3.000 0.406 11.000 6.25 6.66 . ė. . ń. . YNd 0.000

#### 2-Winding Transformer Grounding Input Data

Crownilling

								of sumary					
Transformer	Rating			Conn. Primary					Secondary				
ID	MVA	Prim. kV	Sec. kV	Type	Type	£V.	Атр	Ohm	Type	kV	Amp	Ohm	
ті	63.000	229.909	66.000	D/X		96 - B			Solid	S	10		
T2	63.000	220.000	66.000	D/Y					Solid				

Project:	MASTER THESIS	ETAP		Page:	7
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision:	Base
Filename:	HOUN SUBSTATION 229kV		1.5	Config:	Normal

				Grounding								
Transformer	Rating			Conn.		Primary				Secondary	ry	
D	MVA	Prim. kV	Sec. kV	Type	Type	kV	Amp	Ohm	Туре	hV .	Amp	Ohm
13	63.000	220.000	66.900	D/Y	121	-			Solid			
T4	16.000	66.000	11.000	D/V					Solid			
T5	28.000	66.000	11.000	D/Y					Solid			
T6	20.000	66.000	11.000	DY					Solid			
17	12.500	11.000	66.000	D/Y					Solid			
78	12.500	11.000	66.000	D/Y					Solid			
T9	18.000	66.000	11.000	D/Y					Solid			
T10	18.000	66.000	11.000	D/Y					Solid			
TII	28.000	66.000	11.000	D/Y					Solid			
T12	20,000	66.000	11.000	D/Y					Solid			
T13	10.000	66.000	11.000	D/Y					Solid			
714	19.000	66.000	11.000	DW					Sodid			
T15	10.000	66.000	11.000	DY					Solid			
T16	20.000	66.000	11.000	DA.					Solid			
T17	29.009	66.000	11.000	D/V					Solid			
T18	20.000	66.000	11.000	D/Y					Solid			
T19	29.000	66.000	11.000	D/Y					Solid			
T20	3.000	0.400	11.000	D/Y					Solid			
T21	3.000	0.400	11.900	DA					Solid			
T22	5.000	0.400	11.909	D/Y					Solid			
T23	3.000	0.400	11.000	D/X					Solid			
T24	3.000	0.400	11.000	DA					Solid			
T25	3.000	0.400	11.000	D/Y					Solid			
T26	3.000	0.400	11.000	D/Y					Solid			

# 2-Winding Transformer Grounding Input Data

Project:	MASTER THESIS	ETAP	Page:	8	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV	Shug Call. 15	Config:	Normal	

#### CKT/Branch Connected Bus ID % Impedance, Pos. Seq., 100 MVA Base 7 TD From Bus To Buy R x v Type TI 2W XEMR Bes 3 Birt 1 0.46 20.58 28.59 T2 2W XFMR Burl Bunl 0.44 19,96 19.97 13 2W XEMR Bus2 0.44 19.96 19.97 Bus5 **T**4 2W XFMR Buil Band 6.40 \$3.25 \$3.50 2W XEMR 75 Ber7 Bar0 2.50 49.94 50.00 2W XEMR Bur10 2.53 **T**6 Ben8 50.56 50.63 17 2W XFMR Bm42 Burl1 5.06 65.77 65.91 **T**8 2W XFMR But41 Bus12 5.06 65.77 65.97 **T9** 2W XFMR Ber13 Bus15 6.65 \$6.99 87.15 2W XEMR 87.15 T10 Burl4 Bus16 6.68 86.90 2W XFMR 1.50 Beil7 Bun19 49.94 50.00 TII T12 2W XFMR Bai15 Bas20 1.50 49.94 50.00 TIS 2W XFMR Ber11 Bies22 6.40 83.25 \$3.50 T14 2W XFMR Bm23 But25 6.40 83.25 \$3.50 115 2W XEMR Ber24 Ban26 6.64 86.38 36.63 T16 2W XEMR Ber27 Bus28 2.51 59.25 50.31 117 2W XFMR Ber17 Bus29 1.51 50.25 50.31 T18 2W XFMR Bai.50 But32 2.59 51.81 51.88 T19 2W XFMR Bm31 But33 1.59 51.81 51.88 T20 2W XFMR But34 Ban41 34.25 205.50 208.33 2W XFMR T21 Ban35 Bas41 34.25 205.50 208.33 T22 2W XFMR Ban.36 Bas41 34.25 305,50 208.33 W XFMR T23 Bei37 Bat41 34.25 205.50 205.53 2W XFMR T24 Bas42 Bas38 34.25 205.50 208.33 T25 2W XFMR Ban39 Ban42 34.25 205.50 208.53 T26 2W XFMR Bast40 Bun42 34.25 205.50 208.35 Cable1 Cable Bm11 But2 0.02 0,62 0.03 0.0716998 0.0716998 Cable? Cable Ber12 Bunl 0.02 0.02 0.03 16.77 0.2607629 Line Bus14 2.48 16.58 Linel Bert2 0.2842267 Line2 Line Beil Bus13 1.48 15.16 15.36 Line3 Lipe Ber2 Bus18 2.96 15.06 18.30 0.3387157 Line4 Line Ber27 Ban17 1.93 11.78 11.94 0.2209015 Line Line5 Ber1 Ber27 1.03 6.25 6.37 0.1178142 Line Line6 Ber1 But7 0.51 3.14 3.18 0.0589071 Line 0.51 0.0589071

Burl

Bm12

Bar1

Line

Line

Line?

Line8

Line0

#### Branch Connections

Bus8

But7

Buck

3.14

3.14

3.14

0.51

0.51

3.18

3.18

3.18

0.0589071 0.0589071
Project:	MASTER THESIS	ETAP	Paget	9
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case. 13	Config:	Normal

CKT	Branch	Cot	Connected Bus ID				% Impedance, Pos. Seq., 100 MVA Base					
D	Type	From But	To Bus	R	х	Z	Y					
Line10	Line	Bus2	Bm31	1.03	6.28	6.37	0.1178143					
Line11	Line	Buil	Bun30	1.03	6.28	6.37	0.1178142					
Line12	Line	Buil7	Bar21	2.70	16.49	16.71	0.3092622					
Line13	Line	Buil7	But25	20.70	126.43	128.11	2.3710100					
Line14	Line	Bus21	But23	18.00	109.94	111.49	2.0617480					
sw1	Tie Switch	Buil	Bm2									
5112	Tie Switch	But?	Buri S									
5W3	Tie Switch	Bus13	Burl4									
SW4	Tie Switch	Bus17	Burl8									
5103	Tie Switch	Bus23	Bui24									
5116	Tie Switch	Bui25	But26									
sw7	Tie Switch	Bus28	But29									
5118	Tie Switch	Bui30	Bm31									
511.9	Tie Switch	But32	Bun33									
SW10	Tie Switch	Bus41	Bu:42									

Project:	MASTER THESIS	ETAP		Page:	10
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Cale.	15	Config:	Normal

CKT	Branch	Con	meeted Bus ID	Si Im	medance 7	to Sea 100	MVAb
ID ID	Type	From Bus	To But	RO	X0	Z0	2.0
n	2W XFMR	Bun3	Beil				
T2	2W XFMR	But4	Betl				
T3	3W XFMR	Burt5	Bun2				
T4	2W XFMR	Burl	Ban6				
T5	2W XFMR	But7	Burt9				
T6	2W XFMR	Bun8	Ban10				
17	2W XFMR	Bus42	Buill				
18	2W XFMR	But41	But12				
19	2W XFMR	Bur13	Bur15				
T19	2W XFMR	But14	Bat16				
T11	2W XFMR	But17	Bur19				
T12	1W XEMR	Bun18	Bur20				
T13	2W XFMR	Bur21	Bei22				
T14	2W XFMR	Bur23	Bat15				
T15	2W XFMR	Bur24	Bur26				
T16	2W XFMR	Bwi27	Bur28				
T17	2W XFMR	But27	Bet29				
T18	2W XFMR	Bas30	Bat52				
T19	2W XFMR	Bur.31	Bus33				
120	1W XFMR	But34	Bun41				
T21	2W NFMR	Bun35	Bun41				
T22	2W XFMR	Buri.56	Bun41				
T23	2W XFMR	But 37	Bus41				
T24	2W XEMR	Bun38	Bus42				
T25	2W XFMR	Bun.59	Bast42				
T26	2W XFMR	But40	Bus42				
Cablel	Cable	Butll	Bus2				
Cable2	Cabše	Bun12	Burl .				
Linel	Line	But2	Bus14				0.1410145
Line2	Line	But1	Bur13				0.1341983
Line3	Line	But2	Bat18				0.1599255
Line4	Line	Bun27	Bus17				0.1042992
Line5	Line	Bun1	Bus27				0.9556263
Line6	Line	Bart2	Bus7				0.0278131
Line7	Line	But1	Bush				0.0278151

#### Branch Connections Zero Sequence Impedance

Project:	MASTER THESIS	ETAP		Paget	11
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			5N:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	study Case.		Config:	Normal

CKT/	Branch	Con	mected Bus ID	% Im	pedance, Zo	tro Seq., 10	00 MVAb
ID	Туре	From Bas	To But	RO	X0	Zð	2.0
Line8	Line	Bus2	But?				0.0278131
Line9	Line	Busl	Bută				0.0278131
Linel0	Line	Bas2	Bm31				0.0556263
Linell	Line	Busl	Burs30				0.0556263
Line1:	Line	Buil7	Bm21				0.1460189
Line13	Line	Buil7	Ban23				1.1194780
Line14	Line	But21	Bun23				0.9734595
SWI	Tie Switch	Butl	Bas2				
SW2	Tie Switch	Bus7	Buså				
5W3	Tie Switch	Buil3	Buil4				
5W4	Tie Switch	Buil7	But18				
SW5	Tie Switch	But23	Bus24				
SW6	Tie Switch	Bus25	Bun26				
SW7	Tie Switch	But28	But29				
5178	Tie Switch	But30	Bur31				
SW9	Tie Switch	Bus32	Bux33				
SW10	Tie Switch	Bus41	Bun42				

MASTER THESIS	ETAP		Page:	12
HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department			SN:	
SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
HOUN SUBSTATION 220kV	Study Case,	13	Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV Study Case:	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: T5 HOUN SUBSTATION 220kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBYA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: TS   HOUN SUBSTATION 220kV Study Case: TS

## Synchronous Machine Parameters

		Machine				Rati	ing		1	Positive	Sequent	e Imped	lance (%)	)		Zer	o Seq. Z	(16)
-	ID	Type	Mo	Ael	м	NA.	RA.	Ra	Xď	Xď	Xd	Xq ⁺⁺	Xq'	Xq	31	X/R	R0	20
C1		Power Geid	N/A	8		22.101	226,000	9.95		99.50	-	1	10.00			2	35.65	356.48
12		Power Grid	N/A	8		22.101	229.000	9.95		99.50							17.74	177.38
U3		Power Grid	N/A		1	22.101	220.000	9,95		99.50							17.74	177,38
	Machine	c	onnected Bu	8.	Tim	e Con	stante (Se	c.)	H (Se	e.), D ()	Wpul	Iz) & Sa	turati	Gen or Lo	erator		Groundi	ng
	ID		Ð		Tdu"	Tde'	Tqo"	Tqu'	н	*sD	5100	5120	Sherak	MW	Myar	Conn.	Туре	Ang
	Machine		G	enerator	Motor			Couplin			Prin	ne Move	r Load		Equ	ivalent	Total	
	ID	Type	RPM	WR	H		RPM	WR:	1	H 3	PM	WR ²	н	R	PM	WR:	Н	

Machine			Shaft	Fortion	
ID	Type	D1	Đ2	Kl	K2

D1, D2: MW (pu)/Speed (pu) K1, K2: MW (pu)/Radiant

Project:	MASTER THESIS	ETAP	Page:	13
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 229kV		Config:	Normal

Lumped Load Input Data

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DESIGN OF A LARGE SCALE SOLAR PV SYSTEM AND IMPACT ANALYSIS OF ITS INTEGRATION INTO LIBYAN POWER GRID

#### Conventional Type Load ID LV. IVA. kW 96 PF Amp % Motor % Static kvar Та Gamma Lunpl 11.000 1245 1245 0.01 65.3 20 50 ō. Ű Lump10 11.000 5882 3098 \$5,000 308.7 80 20 5000 ü Lump11 11.000 3529 3000 1859 85 185.2 50 20 0 Lump12 11.000 1859 20 3529 3000 85 185.2 50 0 50 Lump13 11.000 12942 11000 6818 \$5,000 679.3 20 0 Lump14 11.000 5883 \$000 3099 \$5,000 308.8 80 20 Ű Lump2 11.000 1353 2000 1240 85 123.5 80 26 Ű Lump3 11.000 8236 4339 432.3 80 20 7000 85.000 0 Lump4 11.000 7058 3718 370.5 80 20 6000 85 0 Lump5 11.000 7058 6000 3718 370.5 \$0 20 0 \$5 Lump6 11.000 5500 \$500 0 100 288.7 \$0 20 0 Lump7 11.000 3500 3500 0 100 183.7 80 20 0

0

12.59

100

85

514.9

123.5

\$0

80

20

20

11.000

11.000

6800

2352

6000

2000

Lump5

Lump9

## 277

Project:	MASTER THESIS	ETAP	Page:	14
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cara- TS	Revision:	Base
Filename:	HOUN SUBSTATION 2201/V	Study Case, 15	Config:	Normat

# LOAD FLOW REPORT (With PV) @ T = 0.000-

	Bus		Volt	age	Gene	ration	Lo	ad			Load Flow	ŕ			XFMR
	TD	kV	14 Mag.	Aug.	MW	Mvar	MW	Myar		ID	MW	Mvar	Amp	*oPF	46 Tap
Basl		65.009	99,388	-39.5	0	0			Bet12		-7.754	.8.376	65.5	99.9	
									Build		6.024	3.964	63.5	83.5	
									Bur27		19.539	1.129	172.5	99.8	
									But8		3.483	2.278	36.6	83.7	
									Ber8		3.483	2.278	36.6	83.7	
									But30		10.992	7,691	118.1	81.9	
									Bach		-35.767	-18.211	353.3	89.1	3.750
									Buil		0.061	1.248	11.0	0.1	
Ban2		65.000	99.061	-19.0	0	0	0		Buill		-5.821	-0.725	51.8	99.2	
									Berl4		6.014	5,993	63.7	83.3	
									Buil8		3.491	-0.248	30.9	-99.7	
									Bus7		0.994	0.573	10.1	56.7	
									Ben7		0.994	0.573	10.1	\$6.7	
									But31		5.827	3,200	52.6	84.4	
									Bur5		-10.700	-7.365	114.7	82.4	0.625
Bath		228,000	100.000	-35.3	0	0			Buil		35.844	21.494	116.0	85.6	
									U1		-35.844	-21.494	119.0	85.6	
Band		229,000	100.000	0.0		0			U2		0.000	0.000	8.0	0.0	
Barf		229.009	106.000	-17.8		0			Bert2		16.708	7.711	54.6	81.1	
									U3		-10.708	-2.711	34.6	81.1	
Ban6		11,000	98.343	-39.5	0	0	0.000	1.235	Buil		0.000	-1.235	65.9	0.0	
Bies?		65.099	99,036	-19.0		0			Bm2		-0.994	-0.630	10.4	84.5	
									Bm2		.0.994	-0.650	10.4	84.5	
									Bur9		1.989	1.260	28.8	84.5	
Bes8		65.009	99.297	-39.6		0			Burl.		-3.482	-2.330	36.9	83.1	
									Bm1		-3.482	-2.330	36.9	83.1	
									Ban19		6.964	4.661	73.8	83.1	
Ber9		11,600	98.356	-19.6	0	0	1.987	1.232	Bur7		-1.987	-1.232	124.8	85.0	
Buil0		11.000	95.048	-41.6		0	6.946	4,305	Busß		-6.946	-4.305	437.5	\$5.0	1.250
Beill		66.000	99.062	-19.0	0	0	0		Bert2		5.821	0.654	51.7	99.4	
									Bmi42		-5.821	-0.654	51.7	99.4	
Bas12		65.009	99.390	-39.5	0	8			Buil		7.754	0.306	68.5	99.9	
									Ber41		-7.754	-0.306	68.3	99.9	
Bus13		66.000	98.615	-40.0	0	0	0		Buil		-6.011	-4.161	64.8	82.2	
									Bar15		6.011	4.161	64.8	82.2	
Bus14		66.909	98.224	-19.5		0			Bes1		-6.001	-4.157	65.0	82.2	
									Berlé		6.092	4.157	65.0	87.7	

Project:	MASTER THESIS	ETAP		Page:	15
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220EV	Sindy Case.	10	Coufig:	Normal

#### LOAD FLOW REPORT (With PV) @ T = 0.000-

	Bus		Volt	age	Gene	ration	Lo	be			Load Flow				XFMR
	ID	EV	% Mag.	Aug.	MW	Myar	MW	Myar	-	ID	MW	Mvar	Антр	%PF	46 Tap
Buils		11.000	98.983	-42.9	0	0	5,975	3.783	Bun15		-5,975	-3.703	372.8	85.0	4.375
Bar16		11.000	98.564	-22.4	0		5.965	3,697	Burl4		-5.965	-3.697	373.7	85.0	4.375
Busl7		66,000	99.192	-41.2	0	0		0	Bus27		-13,487	2.837	121.5	.97,9	
									Bus21		6.609	-1.333	59.5	.98.9	
									Bus25		1.391	-1.657	19.1	-64.3	
									Bun19		5.486	0.153	45.4	109.0	
Bus18		66,000	98.973	-19.4	0			0	Bus2		-3.487	-0.062	30.5	100.0	
									Bus20		3.487	0.062	30.8	100.0	
Bun19		11.009	99.016	-42.8	0		5.478	0.900	Bus17		-5.478	0.000	290.4	100.0	
Bun20		11.009	98.870	-20.4	6	8	3.484	0.000	Buil8		-3.484	0.000	185.0	100.0	
But21		66,000	99.215	-41.9	0			0	But17		-6,597	1.104	59.0	-95.6	
									But23		0.604	-1.409	13.5	-39.4	
									Bus22		5.992	0.384	\$2.9	99,9	
Bus22		11,000	98.700	44.5	0		5.969	8.000	Bus21		-5.969	0.000	517.4	100,0	
Bus23		66.500	99.545	42.3	0			0	Bus17		-1.387	-0.656	13.5	90.4	
									Bus21		-9.603	-0.622	7.6	69.6	
									Bur25		1.990	1.278	20,8	84.1	
Bus25		11.000	98.360	-43.2	0		1.987	1.231	Bus23		-1.987	-1.231	124.7	85.0	
Bus27		66.000	99.119	-40.2	0	0		0	But17		13,524	-2.826	121.9	-97.9	
									Burl		-19,499	-1.001	172.3	99.9	
									Bun28		2.988	1.514	51.3	84.2	
									Bas29		2.998	1.914	31.3	84.2	
Bus28		11.000	98.793	-41.1	0	0	2.984	1.850	Bus27		-2.984	-1.850	196.7	85.0	0.625
Bus29		11.009	98.705	-41.1	0	0	2.984	1.850	Bus27		-2.984	-1.850	196.7	85.0	0.625
Bus30		65,009	98.787	-39.9	6	8		0	Bush		-10.975	-7,692	115.7	\$1.9	
									Bui32		10.973	7.692	118,7	81.9	
But51		66.000	98.802	-19.2	0	0		0	Bus2		-5.023	-3.292	53.2	83.6	
									Bus35		5.023	3.292	53.2	83.6	
Bun32		11,009	98.326	-43.1	0	0	10.927	6.775	Bus30		-10.927	-6.773	686.2	85.0	3.750
Bux33		11.008	100.682	-20.6	0		5.014	3.108	Bus31		-5.814	-3.108	307.5	85.0	3,750
Bus34		0.400	100.000	.34.3	0	0		0	Bus41		1.960	0.258	2853.2	99.1	
									Inv2		-0.980	-8.129	1426.6	99.1	
									Inv4		-0.990	-0.129	1426.6	99.1	
Bun35		0.400	100.000	-34.3	0	0		0	Bus41		1.960	0.258	2853.2	99.1	
									Inv8		-0.950	-0.129	1426.6	99.1	
									Inv7		-0.980	-0.129	1426.6	99.1	
But.36		8.400	100.000	343	0			0	But41		1.960	0.258	2853.2	99.1	

Project: Location:	MASTER THESIS HOUN CITY - LIBYA	ETAP 126.0H	Page: Date:	16 28-06-2016	
Contract:	NEAK EAST UNIVERSITY - EEE Department		5.82		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 2201V	and a second second	Config:	Normal	

#### LOAD FLOW REPORT (With PV) @ T = 0.000-

But		Volt	age	Gene	ration	Lo	ad			Load Floy	r .			XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mear	_	ID	MW	Mvar	Ang	55PF	% Tap
								Inv10		-0.980	-4.129	1426.6	99.1	
								Inv9		-0.980	-0.129	1426.6	99.1	
Bus37	0.400	100.000	-34.5			0	0	Bus41		1.960	0.258	2853.2	99.1	
								Inv12		0.980	-0.129	1426.6	99.1	
								Inv91		.0.980	-9.129	1426.6	99.1	
Buds	0.400	100.060	-14.5			0		Bus42		1.960	0.378	2885.8	98.2	
								Inv90		-0.950	-0.189	1440.4	98.2	
								Inv89		-0.980	-0.189	1448.4	98.2	
Bu:39	9.400	100.000	44.5			0	0	Bus42		1.960	0.378	2880.8	98.2	
								Inv87		-0.950	-0.189	1440.4	98.2	
								Inv86		.0.950	-0.189	1440.4	98.2	
Bas40	0.400	100.000	-14.5	. 0		0	0	Bas42		1.960	0.378	2899.8	98.1	
								Inv102		-0.930	-0.189	1448.4	98.2	
								Inv14		-0.950	-0.189	1440.4	98.2	
Bus41	11.000	98.877	-36.6			0	0	Bus12		7.786	0.712	415.0	99.6	-1.250
								Bus34		-1.946	-8,178	193.8	99.6	
								Bus35		-1.946	-0.178	103.8	99.6	
								Bus36		-1.946	-0.178	103.8	99.6	
								Bus37		-1.946	-0.178	105.8	99.6	
Bus42	11.890	98.630	-16.8			0	0	Bus11		5.838	0.857	514.5	98.9	-1.250
								Bus38		-1.946	-0.296	104.8	98.9	
								Bus39		-1.946	-0.296	104.5	98.9	
								Bus40		-1.946	-0.296	194.8	98.9	
UI	220.000	262.107	0.0	43.747	100.727	0	.0	Bush		43.747	100.727	110.0	39.8	
U2	228.000	180.000	0.0	0		0	0	Bus4		0.000	0.000	0.0	0.0	
13	220.000	146.534	0.0	11,492	15.550	0	0	Bus5		11.492	15.550	34.6	59.4	
Inv2	0.400	160.800	.37.1	1.584	8.129	0	0	Bus34		1.584	6.129	1426.6	99.7	
Inv4	0.400	160.800	-37.1	1.584	0.129	0	0	But34		1.584	0.129	1426.6	99.7	
Inv8	0,409	168.800	.37.1	1.584	0.129	0	0	Bus35		1.584	0.129	1426.6	99.7	
Inv7	0.400	160.800	.37.1	1.584	9.129	0	0	Bus35		1.584	0.129	1426.6	99.7	
Tav10	0.400	160.800	-37.1	1.584	0.129	0	0	But36		1.584	0.129	1426.6	99.7	
Inv9	0,400	160.800	-37.1	1.584	9.129	0	0	Bus36		1.584	0.129	1426.6	99.7	
Inv12	0.400	160.800	-37.1	1.584	0.129	0	0	Bus37		1.584	0.129	1426.6	99.7	
Inv91	0.400	160.800	-37.1	1.584	8,129	0	0	Bus37		1.584	0.129	1426.6	99.7	
Inv90	0,400	161.026	-18.7	1.596	0.189	0	Ú.	Bus38		1.596	0.189	1440.4	99.3	
Inv39	0.400	161.026	-18.7	1.596	0.189	0	0	Bus38		1.596	0.189	1440,4	.99.5	
Inv87	0.400	161.026	-18.7	1.596	0.189	0		Bus39		1.595	0.139	1448.4	99.3	

Project:	MASTER THESIS	ETAP		Page:	17
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN;	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Bate
Filename:	HOUN SUBSTATION 220kV	Study Case.	10	Config:	Normal

# LOAD FLOW REPORT (With PV) @ T = 0.000-

Bus		Volt	age	Gene	ration	Lo	ad			Load Flow				XFMR
ID	4Y	% Mag.	Ang.	MW	Myar.	MW	Mvar	-	ID	MW	Man	Amp	%PF	% Tap
Inv86	0.400	161.026	-18.7	1.596	0.199	0	0	Bnt39		1.596	0.189	1440.4	99.3	
Isv102	0.400	161.026	-18.7	1.596	0.159	0	0	Bun40		1.596	0.189	1449.4	99.3	
Inv14	0.400	161.026	-18,7	1.596	0.159	0		Bas-40		1.596	0.139	1449.4	99.3	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a bur with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP	Page:	18
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Caser TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	anna caser 19	Coufig:	Normal

Bus		Volt	age	Generation		Lo	ad		Load Flow				XFMR
ID	¥V.	% Mag.	Ang.	MW	Myar	MW	Myar	ID	MW	Myar	Amp	**PF	16 Tap
Basl	66.000	136.647	-38.2		0	0	0	Bus12	-4.409	-0.283	28.5	99.8	
								Ben13	7.142	4.264	53.2	85.9	
								Ben27	23.005	-2.852	148.4	.99.2	
								Bui8	4.145	2.563	31.0	84.8	
								Bus8	4.105	2.563	31.0	84.8	
								But30	13.023	8.567	99,8	83.5	
								Bun3	-46.971	-16.283	318.2	94.5	3.750
								Butf	0.001	1.462	9.4	0.1	
Ben2	66.000	99.061	-19.0		.0			Buill.	-5.821	-0.725	51.8	99.2	
								Bm14	6.014	3.993	63.7	83.3	
								Ben18	3,491	0.248	38.9	-99.7	
								Bes?	0.994	0.573	19,1	\$6.7	
								But7	0.994	0.573	19.1	86.7	
								BatM	5.027	3.200	52.6	84.4	
								Bat5	-10.700	-7.365	114.7	82.4	0.625
Bui3	220.000	134.501	-35.2					Bunl	47.034	19.109	99,1	92.6	
								UI	-47.634	-19.109	99.1	92.6	
Ben4	220.000	100.000	0.0					U2	0.000	0.000	0.0	0.0	
Ber5	220.000	100.000	-17.8		.0	9	9	Burt2	10.705	7.711	34.6	83.1	
								13	-10.708	-7.711	34.6	81.1	
Buth	11.000	135,756	-38.2		0	0.000	1,453	Burl	0.000	-1.455	56.2	0.0	
Bes?	66.000	99.036	-19.0		.0	0		Bus2	4,994	-0.630	19.4	84.5	
								Bert2	-6.994	-0.650	29.4	84.5	
								But9	1.989	1.260	20.8	84.5	
Ber8	66.090	136.572	-38.2			0		Buil	-4.105	-2.669	33.4	83.8	
								Buil	-4.105	-1.669	31.4	83.8	
								Bun10	8,209	\$.337	62.7	83.8	
Ban9	11.000	98.356	-19.6		0	1.987	1.232	But?	-1.987	-1.232	124.8	\$5.0	
Ban10	11.000	136.183	-39.5		0	8.196	5.890	Ban8	-\$.196	-5.680	371.7	85.0	1.250
Beill	66.000	99.062	-19.0					Bun2	5.821	0.654	51.7	99.4	
								Bm42	-5.821	-0.654	51.7	99.4	
Bm12	66.000	136.648	-38.2				0	Buil	4.410	0.150	28.2	99.9	
								Ban41	-4.410	-0.150	28.2	99.9	
Bm13	66.000	136.017	-38.5			8	8	Bun1	-7.132	-4.734	55.1	83.3	
								Bm15	7.132	4.734	95.1	83.3	
Bm14	66.000	98.224	-19.5					Ben1	-6.001	-4.157	65.0	82.2	
								-	F 000	1127	42.0		

## LOAD FLOW REPORT (With PV) @ T = 0.800-

Project:	MASTER THESIS	ETAP		Page:	19
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	sound cases		Config:	Normal

# LOAD FLOW REPORT (With PV) @ T = 0.800-

	Bus		Volt	age	Gene	ration	Los	be			Load Flow	í.			XFMR
	ID	kV.	% Mag.	Aug.	MW	Myar	MW	Munr		ID	MW	Myar	Amp	%PF	56 Tap
Bas15		11.000	138.660	-40.3	0		7,107	4.404	Bun13		-7.107	-4.404	316.5	85.0	4.375
Ben16		11.000	98.564	-22.4			5.965	3.697	Bun14		-5.965	-3.697	373.7	85.0	4.375
Beil7		66.000	136.996	-39.2	0		. 0	0	Bai27		-15.901	7.646	111.1	-91.4	
									Bus21		7,790	-3.462	54.4	.91.4	
									Bus23		1.645	-3.695	25.8	-40.7	
									Bun19		6.455	0.111	41.5	100.0	
Bas18		66.000	98.973	-19.4	0		0	0	But2		-3.487	-0.062	39.8	100.0	
									Bus20		3.487	0.062	38.8	100.0	
Bas19		11,000	136.858	-40.2		٠	6.460	8,000	Bus17		-6.400	0.000	247.8	100.0	
Ber20		11,000	98.870	-20.4	0		5.484	0.000	But18		-3.484	0.000	185.0	100.0	
Buill		66.099	137.228	-39.7	0		. 0	0	Bat17		-7.788	2.945	53.0	.93.5	
									Bas23		0.716	-3.163	29.7	-22.1	
									Bus22		7.064	0.221	45.1	100.0	
Bur22		11.000	136.831	-41.5	0		7.047	0.000	But21		-7.047	0.000	179.3	100.0	
Ber23		66.090	138.115	-40.0	0			0	Bas17		-1,640	-0.759	11.4	90.8	
									Bun21		-0.714	-0.733	6.5	69.8	
									Ban25		2.354	1.491	17.6	84.5	
Bei25		11.000	137.114	-40.5			2.351	1.457	Bas23		-2.351	-1.457	105.9	85.0	
Bes27		65.000	136.604	-38.6	0		0	0	Bus17		15.933	-7.267	112.1	-91.0	
									Burl		-22.975	2.815	145.2	.99.3	
									Bus28		3.521	1.127	26.7	84.5	
									Bias29		3.521	1.227	26.7	84.5	
Ban28		11.000	136.580	-39.2	8	٠	3.519	2.181	Biss27		-3.519	-2.181	159.1	\$5.0	0.625
Bas29		11.000	136.590	-39.2	0		3.519	2.181	Bas27		-3.519	-2.181	159.1	\$5.0	0.625
Bas30		66.000	136.151	-38.4	0		. 0	0	Bas1		-13.009	-8.704	109.6	83.1	
									Bus32		13,009	8,764	100.6	83.2	
Bastl		66.000	98.892	-19.2	0		0	0	Bus2		-5.023	-3.292	55.2	83.6	
									But33		5,023	3.292	53.2	83.6	
Ben32		11.000	137.781	-40.4	0		12.976	8.644	Ban30		-12.976	-8.044	781.6	85.0	3.750
Bat33		11.000	100.682	-20.6			5.014	3.108	Bat31		-5.014	-3.168	307.5	85.0	3.750
Bus34		0.400	135.565	36.6	0		0	0	Bas41		1.106	0.068	1179.8	99.8	
									Inv2		-4.553	-0.034	589.9	99.8	
									Inv4		-4.553	-0.034	589.9	99.8	
Bai35		0.400	135.565	-36.6	0		0	0	Ban41		1.106	6.068	1179.8	99.8	
									Inv5		4.553	-0.054	589.9	99.8	
									Inv7		-4.553	-0.034	589.9	99.8	
Bat.36		0.400	135.565	-36.6	0		. 0	0	Bat41		1.106	0.065	1179.8	99.8	

Project:	MASTER THESIS	ETAP	Page:	29	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-66-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Course TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV	Study Case: 13	Config:	Normal	

## LOAD FLOW REPORT (With PV) @ T = 0.800-

	Bas		Volt	age	Gene	ration	La	ad			Load Flow				XFMR
_	ID	kV	94 Mag.	Ang.	MW	Myar	MW	Myar		ID	MW	Myar	Amp	46PF	46 Tap
									Inv10		-4.553	-0.034	589.9	99.8	
									Iav9		-0.553	-0.034	589.9	99.8	
Bm37		0.400	135.565	-36.6		0	0	0	Baril		1.106	0.068	1179.8	99.8	
									Inv12		-9.553	-0.034	589.9	99.8	
									Inv91		-0.553	-0.034	589.9	99.8	
Ben38		0.400	100.000	-14.5	. 0	0	0	0	Bm43		1.960	0.378	2880.8	98.3	
									Inv90		-0.980	-0.189	1440,4	98.2	
									Inv89		.4.980	.4.189	1440.4	98.3	
Ber.59		0.400	100.000	-14.5	0	D	0	0	Bas42		1.960	0.378	2880.8	95.2	
									Inv87		-0.950	-0.189	1440.4	98.2	
									Inv86		-0.980	-0.189	1440.4	98.2	
Bin40		0.400	100.000	-14.5	0	0	0	0	Bat42		1.960	0.378	1880.8	95.2	
									Inv101		-0.980	-0.199	1440.4	98.2	
									Inv14		-0.580	.4.189	1440.4	98.2	
Bur41		11.000	135,192	-37.5				0	But12		4.415	0.219	171.6	99,9	-1.250
									Bes34		-1.104	-0.055	42.9	99.9	
									Bar35		-1.104	-0.055	42.9	99.9	
									Bas36		-1.104	-8.655	42.9	99,9	
									Bus37		-1.104	-0.055	42.9	99,9	
Bas42		11.090	98.659	-16.8	0	0	0	0	Banll		5.838	0.837	314.3	95.9	-1.250
									BaiJ8		-1.946	-0.296	104.8	95.9	
									Bui39		-1.946	-0.296	104.5	98,9	
									Bas40		-1.946	-0.296	104.8	98.9	
Ul		220.000	262,107	0.0	53.448	\$3.252	0	0	Bed		53.448	83.252	99.1	54.0	
U2		220.000	100.000	0.0	. 0	0	0	0	Ben4		0.000	0.000	0.0	0.0	
U3		220.000	146,534	0.0	11.492	15.550		e	Bur5		11.492	15.550	34,6	59.4	
Im2		0.400	160.800	-37.1	0.656	0.034	0	0	Bat.M		0.656	0.034	589.9	99.9	
Int4		0.400	160,800	-57.1	0.656	0.034	0	0	Bat.54		0.656	0.034	589.9	99.9	
Invil		0.400	160,800	-37.1	0.656	0.034	0	0	Bat35		0.656	0.034	589.9	99.9	
Im7		0.400	160,800	-37,1	0.656	9.034	0	8	Bus35		0.656	0.034	589.9	99,9	
Inv10		0.400	160.800	.37.1	0.656	0.034	0	0	Bm36		0.656	0.634	589.9	99.9	
Inv9		0.400	160.800	-37.1	0.656	0.034	0	0	BasM		0.656	0.034	589.9	99.9	
luv12		0.400	160.300	.37.1	0.656	0.034		0	Bur37		0.656	0.034	589.9	99,9	
Inv91		0.400	160.800	-37.1	0.656	0.034	0	0	But37		0.656	0.034	589.9	99,9	
Inv99		0.400	161.026	-18.7	1.596	0.159	0	0	Bas38		1.596	0.189	1440.4	99.3	
Inv89		0.400	161.026	-18.7	1.595	0.159	0	0	Bar38		1.596	0.189	1440.4	99.3	
Inv87		0.400	161.026	-18.7	1.595	0.159		0	Buc39		1.596	0.189	1440.4	99.5	

Project:	MASTER THESIS	ETAP		Page:	21
Location:	HOUN CITY - LIBYA	12.6.9H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	orany care.		Config:	Normal

## LOAD FLOW REPORT (With PV) @ T = 0.800-

Bus		Volt	age	Gene	ration	Lo	ađ			Load Flow	0			XFMR
ID	kV	% Mag.	Ang.	MW	Myar	MW	Mvar	-	ID	MW	Myar	Amp	%6PE	46 Tap
Inv86	0.400	161.026	-18.7	1.596	0.189	0	0	Bur.39		1.596	0.189	1440.4	99.3	
Inv102	0.400	161.026	-18.7	1.596	0.189	0	0	Bus40		1.596	0.189	1440.4	99,3	
Inv14	0.490	161.026	-18.7	1.596	0,189	0		Ban40		1.596	0.189	1440.4	99.3	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a buy with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	22
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Cate	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	1.139)	Config:	Normal

# LOAD FLOW REPORT (With PV) @ T = 1.000-

	Bus		Volt	age	Gene	ration	Lo	ba			Load Flow				XFMR
	ID	ŁV	% Mag.	Ang.	MW	Myar	MW	Myar		ID	MW	Myar	Amp	%PF	% Tap
Busl		66.000	0.000	90.0	0	0	0		Buil2		0.000	0.000	174,7	0.0	
									Buil3		0.000	9,000	0.0	0.0	
									But27		0.000	0.000	0.0	0.0	
									Bur8		0.000	0.000	0.0	0.0	
									ButS		0.000	0.000	0,0	0.0	
									Bus36		6.000	0.000	0.0	0.0	
									Bus3		0.000	0.000	465.0	0.0	3.750
									But6		0.000	0.000	0,0	0.0	
Bus2		65.000	2.964	59,9	.0	0		0	Buill		-0.024	-0.444	131.3	5.5	
									Bus14		0.005	0.005	1.9	83.4	
									Built		0.003	0.000	0.9	-99.7	
									Bus7		0.001	0.000	0.3	\$6.7	
									Bus7		0.001	0.000	0.3	86.7	
									Bus31		0.005	0.005	1.6	84.3	
									But5		0.010	0.437	129.1	2.2	0.625
Bui3		210.000	11.912	4.5		0	.0		Busl		0.136	6.110	145,7	2.2	
									U1		-0.156	-6.110	145,7	2.2	
Bui4		220,000	100.000	8.0	.0	0			12		0.000	0.000	9.0	0.0	
But5		220,000	0.000	90.0	0	0	0		Bux2		0.000	0.000	59.0	0.0	
									03		0.000	0.000	85,0	0.0	
Butő		11.000	0.000	90.0		0			Bus1		0.000	0.000	0.0	0.0	
Bus7		65.009	2.963	59.9		ė			But2		-0.001	-0.001	0.3	84.5	
									Bus2		-0.001	-9.001	0.5	84.5	
									Bur9		0.002	0.001	0.6	84.5	
But8		65.009	0.000	90.0		0			Buil		6.000	0.000	0.0	0.0	
									Bus1		0.000	0.000	0.0	0.0	
									Bur10		0.000	0.000	0.0	0.0	
Bur9		11.000	2.943	59.3		0	0.002	0.001	Bus7		-0.002	-0.001	3.6	85.0	
Buil0		11.000	0.000	96,0		0			Buill		6.000	0.006	0.0	0.0	1.250
Bm11		65.000	2.967	59.9		0			Bus2		8.025	0.445	131.3	5.6	
									Bus42		-0.025	.0.445	131,3	5.6	
Buslt		66.000	0.005	3.3		0			Butl		0.001	0.001	174,7	65.8	
									But41		-0.001	.4.001	174.7	65.8	
Bus13		66.009	0.000	90.0		0			Buil		0.000	0.000	0.0	0.0	
									Bus15		0.000	0.000	0.0	0.0	
Barl4		66.000	2.940	59.4		0	.0		But2		-0.005	-0.004	1.9	82.5	
									Build		0.005	0.004	1.9	82.3	

MASTER THESIS	ETAP		Page:	23
HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
NEAR EAST UNIVERSITY - EEE Department			SN:	
SAND MUSTAFA AL-REFAI	Shade Case:	TS	Revision:	Base
HOUN SUBSTATION 220kV	study case.	15	Config:	Normal
	MASTER THESIS HOUN CITY - LIBYA NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBYA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: HOUN SUBSTATION 220kV	MASTER THESIS ETAP HOUN CITY - LIBVA 12.6.0H NEAR EAST UNIVERSITY - EEE Department SAND MUSTAFA AL-REFAI Study Case: TS HOUN SUBSTATION 220kV	MASTER THESIS ETAP Page:   HOUN CITY - LIBVA 12.6.0H Date:   NEAR EAST UNIVERSITY - EEE Department SN:   SAND MUSTAFA AL-REFAI Study Case: TS   HOUN SUBSTATION 220kV Config:

# LOAD FLOW REPORT (With PV) @ T = 1.000-

	Bus		Volt	age	Gene	ration	Los	nd			Load Flow	3			XEMR
	ID	kV	19 Mag.	Ang.	MW	Myar	MW	Myar		ID	MW	Myar	Amp	%PF	% Tap
Bar15		11.000	0.000	90.0	0	0	0	0	But13		0.000	0.000	0.9	0.0	4.375
Builé		11.000	1.951	56.5		0	0.005	0.003	Buil4		-0.605	-0.063	10.9	85.0	4.375
Berl7		66.000	0.000	90.0	0	0			Bus27		0.000	0.000	0.0	0.0	
									Bus21		0.000	0.000	0.0	0.0	
									Bus25		0.000	0.000	0.0	0.0	
									Builf		0.006	0.000	0.0	0.0	
Ber18		66.000	2.961	59.6	0	0			Bun2		4.603	0.000	0.9	100.0	
									Bm20		0.005	0.000	0.9	100.0	
Bm19		11.009	0.000	90.0	0	0			Butl7		0.000	0.000	0.0	0.0	
Bm20		11.009	2.958	58.6		0	0.003	0.000	But18		.0.003	0.000	5.4	100.6	
Ber21		66.000	0.000	90.8	0	0			Busl7		0.000	0.000	0.0	0.0	
									Bur23		0.000	0.000	0.0	0.0	
									Bus22		0.000	0.000	0.0	0.0	
Bur22		11.009	0.000	90.0	0	0			Bur21		0.000	0.000	0.0	0.0	
Bur23		66.000	0.000	90.0	0	0		8	Busl7		0.000	0.000	0.0	0.0	
									But21		0.000	0.000	0.0	0.0	
									Bus25		0.000	0.000	0.0	0.0	
Bus25		11,009	0.000	90.0		0			Bur23		0.000	0.000	0.0	0.0	
Bus27		66.000	0.000	90.0	0	0		0	Bus17		0.000	0.000	0.0	0.0	
									Buil		0.000	0.000	0.0	0.0	
									Bus28		0.000	0.000	0.0	0.0	
									But29		0.000	0.000	0.0	0.0	
Ben25		11.000	0.000	90.0	0	9		0	Buil7		0.000	0.000	0.0	0.0	0.625
Ben29		11.000	0.000	90.0	0	0		0	But27		0.000	0.000	0.0	0.0	0.625
Bax30		66.000	0.000	90.0	.0	0	. 0		Buil		0.000	0.000	0.0	0.0	
									Bm52		0.000	0.000	0.0	0.0	
Bm31		66.000	1.956	59,7	0	0		0	Bun2		.0.005	-0.003	1.6	\$3.6	
									Bus33		0.005	0.063	1.6	85.6	
But52		11.000	0.800	90.0	0	0	0		But30		0.000	0.900	9,9	0.0	3,750
Bm33		11.000	3.912	58.3	0	0	0.005	0.003	Buo51		-0.005	-0.003	9.3	85.0	3,750
But34		0.400	23.686	37.8	0	0			Bus41		0.139	1.199	7296.8	11.6	
									Inv2		-0.065	-0.595	3648.4	11.6	
									Inv4		-8.869	-0.595	3648.4	11.6	
Bm35		0.400	23.686	37.8	0	9		0	Bui41		0.139	1.159	T296.8	11.6	
									hrv8		.0.069	-0.595	3648.4	11.6	
									hev7		-0.069	-0.595	3648.4	11.6	
Bui36		0.400	23.686	37.8	0	0	. 0	0	But41		0.139	1.189	7296.8	11.6	

Project:	MASTER THESIS	ETAP		Page:	24
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case:	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Stady Case.	10	Config:	Normal

## LOAD FLOW REPORT (With PV) @ T = 1,000-

	Bus		Volt	age	Gene	ration	Lo	ad			Load Flow				XFMR
Q	ID	FA.	% Mag.	Ang.	MW	Муат	MW	Mvar	_	ID	MW	Myar	Amp	96PF	% Tap
			-	and a local division of the local division o					Inv10		-0.069	-0.595	3648.4	11.6	-
									Inv9		-0.069	-0.595	3648.4	11.6	
Bus37		0.400	23.686	37.8	0	0	0		Bus-41		0.139	1,189	7296.8	11.6	
									Inv12		-0.069	.0.595	3648.4	11.6	
									Inv91		-0.069	.0.595	3648.4	11.6	
Bas38		0.409	23.363	56.5	0	0	0		Bus41		0.135	1,176	7313.7	11.4	
									Inv90.		-8.967	-0.588	3656.9	11.4	
									Inv89		-0.067	-0.588	3656.9	11.4	
Bas39		0.400	23.363	56.5	0	0	0		Bus42		0.135	1.176	7313.7	11.4	
									Inv87		-0.067	-0.58E	3656.9	11,4	
									Inv\$6		-0.067	.0.588	3656.9	11.4	
Ban40		0.400	23.363	56.5	0	0	0	0	Bus42		0.135	1.176	7313.7	11.4	
									Inv102		-0.067	-0.585	5656.9	11.4	
									Inv14		-0.067	-0.588	3656.9	11.4	
Bus41		11,000	13.177	40.0	0	0	0		Buil2		0.205	2.657	1961.4	7.7	-1.250
									Bus34		-0.051	-0.664	265.3	7.7	
									Bus35		-0.051	-0.664	265.3	7.7	
									Bus36		-0.051	-0.664	265.3	7.7	
									Bus37		-0.051	-0,664	265.3	2.7	
Ban#2		11.000	12.832	58.9	0	0	0	۰	But11		0.149	1.946	197.9	7.2	-1.250
									Bus38		-0.047	-0.649	266.0	7.2	
									Bus39		-0.047	-0.649	166.0	7.2	
									Bun40		-0.047	-0.649	266.0	7.2	
UI.		220.000	262.107	0.0	14.004	144.797	0		Bus\$		14.004	144.797	145.7	9.6	
U2		220.000	100.000	0.0	0	0	0		Bus4		0.009	0.006	0.0	0.0	
13		220.000	146.534	0.0	4.722	47,220	0		Bus5		4.722	47.220	\$5.0	10.0	
Inv2		0.400	160.900	-37.1	4.021	0.595	0		Bus34		4.021	0.595	3648.4	98.9	
Inv4		0.400	160.900	-37.1	4.021	0.595	0	۰	But34		4.021	0.595	3648.4	98.9	
Inv8		0.400	168.800	-37.1	4.021	0.595	0	0	Bun35		4.021	0.595	3648.4	95.9	
Inv7		0.488	160.800	-37.1	4.021	0.595	0		Bus35		4.021	0.595	3648.4	98.9	
Inv10		0.400	160.809	-37.1	4.021	0.595	0		Bus36		4.021	0.595	3648.4	98.9	
Inv9		0.400	160.800	-57.1	4.021	0.595	0		But36		4.021	0.595	3648.4	98.9	
Inv12		0.400	168.800	-37.1	4.021	0.595	0		Bus37		4.021	0.595	3648.4	95.9	
Inv91		0.400	160.800	.37.1	4.021	0.595	0		Bus37		4.021	0.595	3648.4	98.9	
Inv90		0.400	161.026	-18.7	4.037	0.588	0		Bus.38		4.037	0.588	3656.9	99.0	
Inv89		0.400	161.026	-18.7	4.037	0.588	0		Bun38		4.037	0.585	3655.9	99.0	
Inv87		0.400	161.026	-18.7	4.037	0.588	0		Bus39		4.057	0.588	3656.9	99.0	

Project:	MASTER THESIS	ETAP	Page:	25	
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016	
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:		
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base	
Filename:	HOUN SUBSTATION 220kV	study cases 13	Config:	Normal	

## LOAD FLOW REPORT (With PV) @ T = 1.000-

Bus		Volt	age	Gene	ration	Lo	bi			Load Flow				XFMR
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Myar		ID	MW	Myar	Атр	<b>%PF</b>	% Tap
Inv86	0,400	161.026	-18.7	4.037	0.555	0	0	But39		4.037	4.555	3655.9	99.0	-
Inv102	0.400	161.026	-18.7	4.037	0.558		0	Ban40		4.037	6.588	3656.9	99.0	
Inv14	0.400	161.026	-18.7	4.037	0.588		0	Bun40		4.037	0.588	3656.9	99.0	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

# indicates a bus with a load mismatch of more than 0.1 MVA

Project:	MASTER THESIS	ETAP		Page:	26
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Study Case.	20	Config:	Normal

## Dynamic Stability

The tabulated plot data is not printed since the option of "Skip Tabulated Plots" is checked. To print tabulated plot data go to the Transient Stability Study Case Editor and in the Info Page uncheck the "Skip Tabulated Plots" option.

Project:	MASTER THESIS	ETAP	Page:	27
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	only care 13	Coufig:	Normal

Time (Sec.)	Element ID	Type	Zone No
0.000	Buil	Bui	1
0.000	Bus10	But	1
0.000	Bas11	Bui	1
0.000	But12	But	1
0.000	Burl3	Bun	1
0.000	Bay14	But	1
0.000	Bux15	Bus	2
0.000	Burl6	But	1
0.000	Burl7	But	3
0.000	Bus18	Bus	1
0.000	Bus19	Bus	2
0.000	Bus2	But	1
0.000	Bast20	But	1
0.000	Bus21	Bus	3
0.000	Bus22	Bus	3
0.000	Bas25	But	1
0.000	Bun25	Bus	2
0.000	Bax27	But	1
0.000	But28	Bm	2
0.000	But29	Bus	1
0.000	Band	Bm	2
0.000	Bux30	Bus	2
0.000	Ban51	Bus	1
0.000	Ban32	Bus	2
0.000	Bur33	But	1
0.000	Bus34	But	2
0.000	But35	But	2
0.000	Bux36	But	2
0.000	But37	But	2
0.000	Bux38	Bus	1
0.000	Bux39	But	1
0.000	Bun4	Bm	3
0.000	Bur40	But	1
0.000	Bus41	But	2
0.000	Bus42	But	1
0.000	Rar4	But	

## System Islanding Index

Project:	MASTER THESIS	ETAP		Page:	28
Location:	HOUN CITY - LIBYA	12.6.0H		Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department			SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Care	15	Revision:	Base
Filename:	HOUN SUBSTATION 220kV	Shady Case.	15	Config:	Normal

Time (Sec.)	Element ID	Type	Zone No.	
0.000	Banó	Bus	2	
0.000	Bas 7	Ban	1	
0.000	Biet8	Bus	2	
0.000	Ban9	Ban	1	
0.000	Iuv10	Power Geid	2	
0.000	Inv102	Power Grid	1	
0.000	Inv12	Power Geid	2	
0.000	Inv14	Power Geid	1	
0.000	Inv2	Pawer Grid	2	
0.000	Inv4	Power Grid	2	
0.000	Inv7	Power Grid	2	
0.000	Inv8	Power Grid	2	
0.000	Inv86	Power Grid	1	
0.000	Inv87	Power Grid	1	
0.000	Inv89	Power Grid	1	
0.000	Inv9	Power Grid	2	
0.000	Inv90	Power Grid	1	
0.000	Inv91	Power Grid	2	
0.000	u	Power Grid (Ref.)	2	
0.000	02	Power Grid (Ref.)	3	
0.000	03	Power Grid (Ref.)	1	

# System Islanding Index

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Project:	MASTER THESIS	ETAP	Page:	29
Location:	HOUN CITY - LIBYA	12.6.0H	Date:	28-06-2016
Contract:	NEAR EAST UNIVERSITY - EEE Department		SN:	
Engineer:	SAND MUSTAFA AL-REFAI	Study Case: TS	Revision	: Base
Filename:	HOUN SUBSTATION 220kV	Study Cases 1.5	Config:	Normal

			Action Summary		
Event ID	Time (Sec.)	Device Type	Device ID	Action	
event2	0.500	Bus	Buil	3 Phase Fault	
event2	0.800	Bus	Bus5	3 Phase Fault	