IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

THE REAL TIME DATA ANALYSIS & POWER THEFT DETECTION OF POWER SYSTEM WITH A DEMO NETWORK USING ETAP SOFTWARE.

(The Novel Approach of Software Analysis of Power System)

[1]Mr.Abul KalamAsad,[2]Mr.Aritra Patra,[3]Mr.Biman Chandra Das. [4]Mr.Nitesh Kumar, [5]Ms.Suparna Pal

[1-5]Department of Electrical Engineering, JIS College of Engineering, Kalyani, West Bengal, India.

Abstract: A modern power grid needs a perfect protection to provide an affordable, reliable, and sustainable supply of electricity. However, the majority of these activities emphasized only the distribution grid and demand side leaving the big picture of the transmission grid in the context of smart grids unclear. This study has been undertaken to investigate the REAL TIME data analysis of power system with a demo grid. To observe the REAL TIME data analysis ETAP Software is used. The demo grid network consists of two real small grid sub-stations (KALYANI AREA, OLD CALCUTTA (Load division)). This paper presents a unique vision for the improvement of power system by identifying power theft & studies load flow, System stability of the power system. The Analytical framework contains

Index Terms–Over-Voltage, Balancing Condition, Power Theft Detection.

I. INTRODUCTION

The electric power transmission grid has been progressively developed for over a century, from the initial design of local dc networks in low-voltage levels to three- phase high voltage ac networks, and finally to modern bulk interconnected networks with various voltage levels and multiple complex electrical components. The most common problem that occurs in a power system network is voltage instability, Power theft detection Different researchers are worked and analysis of power system network by different ways and proof their analysis process more advanced and better. It is observed that researchers are analysis only demo network and proof there point of views but in more complex ways. In this research analysis we have analyzed a real time network of W.B.S.E.B, put all real time data and simulate network and get overview idea of different buses voltage, current, percentage of drops and other parameters. The pictorial simulation gives us clearly prediction of all situation of network and we take a decision of different design creation of parameters to improve of the network. As we known that power system is a high-voltage network, it is not possible to work or change parametric values to change of conditions directly, researchers, engineers are directly depending upon simulation results what they want to change. So ETAP is easiest analysis software where we can test our research, change data's, parameteric values of power network and get a complete simulation of that of that network and easily tested, compared with old, new, predicted values and give a better idea of power system stability and planning. Whereas the innovation of the transmission grid was driven by technology in the past, the current power industry is being modernized and tends to deal with the challenges more proactively by using state-of-the-art technological advances in the areas of sensing, communications, control, computing, and information technology. In this situation if we more improve the voltage issues, improving the balance condition & thefting issues then unnecessary power consumption can be controlled & will be helpful to maintain the stability of power grid. For those reasons load flow analysis is essential before changing any parameters of network for making more stability of grid. In this paper we are not analysis only load flow study but also, we have studied power thefting effect of transmission line also.

II. ANALYSIS

1. Problem Statement:

Stability and design problem is the main issues of modern power system and researchers are research continuously to improve their system. So here we also simulate & analysis a demo network by incorporating real time data and observe how to change the characteristics of voltage parameters and improve bus data by incorporating condenser in bus and make a comparative study. We also studied power thefting effect in this network, analysis its changing condition of bus voltages which gives us real time scenario. So major issues analysis is

(a) Electricity Theft: Electricity theft is the criminal practice of stealing electrical power. The global cost of electricity theft was estimated at approx. $96 billion every year.

b) Over Voltage Conditions, Stability and real time data analysis of Electrical Power System.

2. Simulation: (a) OVER VOLTAGE: Overvoltage happens in a condition where the voltage is increased and exceed its design limit. This situation may lead to harmful damage to machines or related equipment that connected to the system. Overvoltage can exist in a form of transient, voltage spike or permanent, depending on its duration.

Case:-1

In this paper we are discuss about real time effect of different inductive loads in distribution lines, how input data has change with loads. Power system over voltage due to inductive reactance of inductive load. In real system power network runs with highly inductive loads and it is very difficult to us to observe proper characteristics because it is high voltage network and network changes its input parameters when loads are operated. It is impossible to testing in live lines, simulation is only solution to solve these problems. Here we have taken total generation 2000 MVA (800 MVA and 1200 MVA) and this power transmitted and distributed by demo network with total loads 1400 MW.

In case -I we give real time data in the network and simulate load flow study and analysis it voltages. We have seen that without fault some bus voltages are changed, some buses are not affected but in power system network we are not allowed changing bus voltages. In power system network with rated load all bus voltages are remain same but practically it is not happened which show us load flow study.

So, second step required to improvement of bus voltages by incorporating some voltage improvement devices just like capacitor. We have also installed it in our network and again studied it load flow study, we observed that all bus voltages are improved and stable just like normal network. These two analysis has been shown in table and diagram. As we can see in the diagram.

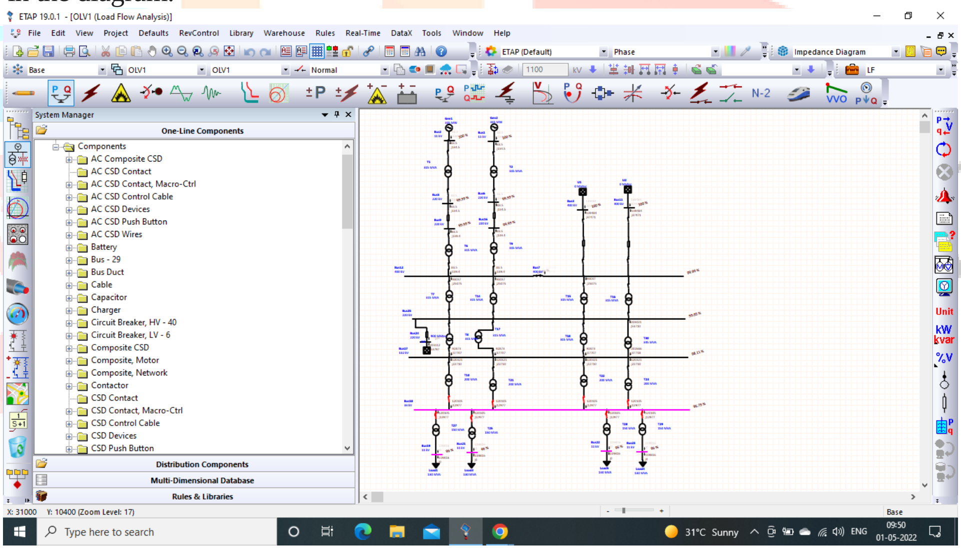


Fig.1 OVER VOLTAGE CONDITIONS

Table-1: Variation of voltages (load flow studies) with respect to bus.

BUS NO	NOMINAL VOLTAGE (KV) (Input data)	VOLTAGE (%) (case study-1w.r.t input data)	**VOLTAGE(KV)(after load flow)**	**VOLTAGE DROP(KV)**
1	**11**	**100**	**11**	**0**
2	**11**	**100**	**11**	**0**
3	**400**	**100**	**400**	**0**
5	**220**	**99.99**	**219.97**	**.03**
6	**220**	**99.99**	**219.97**	**.03**
7	**400**	**99.99**	**399.96**	**.04**
9	**220**	**99.99**	**219.97**	**.03**
11	**400**	**100**	**400**	**0**
12	**400**	**99.99**	**399.96**	**.04**
16	**220**	**99.99**	**219.97**	**.03**
17	**132**	**98.11**	**129.50**	**2.5**
18	**33**	**96.79**	**31.94**	**1.06**
19	**11**	**96**	**10.56**	**.44**
21	**11**	**96**	**10.56**	**.44**
22	**11**	**96**	**10.56**	**.44**
23	**11**	**96**	**10.56**	**.44**
24	**220**	**100**	**220**	**0**
25	**220**	**99.95**	**219.89**	**.11**

(b)BALANCING CONDITION: In electric power distribution, capacitor banks are used for power-factor correction. These banks are needed to counteract inductive loading from devices like electric motors and transmission lines, thus making the load appear to be mostly resistive. Automatic Power-factor Correction (APFC) Capacitor Banks also known as Shunt Capacitor Banks (SCB) are installed to provide reactive compensation and power factor correction. The use of shunt capacitor bank is to improve voltage regulation, saves power loss and improve transmission capabilities. So we can't find any over voltage issues in the ETAP diagram i.e. we can't see any kind of pink or red bus bar which we have seen in the previous diagram. So by using capacitor bank we can balance our demo system which we can see below.

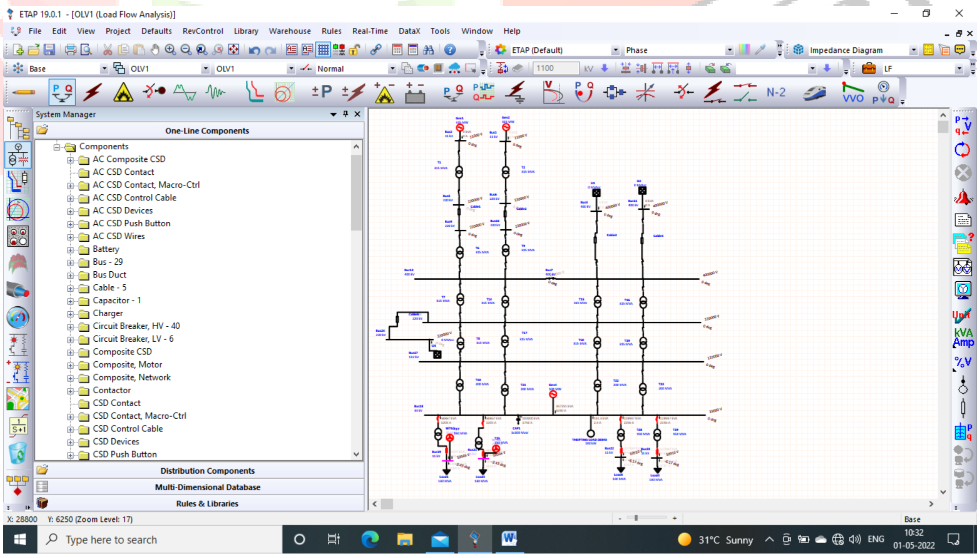


Fig.2 BALANCING CONDITIONS

Table-2: Variation of voltages(BALANCING CONDITION) with respect to bus.

BUS NO	NOMINAL VOLTAGE (KV)	BALANCING CONDITION (%)	BALANCING CONDITION(KV)	VOLTAGE DROP(KV)
1	11	100	11	0
2	11	100	11	0
3	400	100	400	0
5	220	100	220	0
6	220	100	220	0
7	400	100	400	0
9	220	100	220	0
11	400	100	400	0
12	400	100	400	0
16	220	100	220	0
17	132	100	132	0
18	33	100	33	0
19	11	99.18	10.90	.1
21	11	99.18	10.90	.1
22	11	99.18	10.90	.1
23	11	99.18	10.90	.1
24	220	100	220	0
25	220	100	220	0

Analysis: - We have seen that how real time situation handled when bus voltages are dropped due to loading, over loading, transients etc. Distribution company maintained stable voltages always with changing loads in load duration curve and tried to make balanced supply overall with maintaining all reliability conditions. But it is impossible to maintained balanced voltages in all lines due to thefting of power. Thefting of power is burning problems of transmission and distribution company. One area or one bus power theft will affect entered system network then balancing of voltages of all buses are impossible to maintained. Thefting of power will give dangerous effect in our system because when, how and where it will be happened it is unknown but when it happened, it effect in our entire lines by dropping of voltages as a results out steps occurred in power system and huge amount revenue loss occurred. This condition also analysis there in case study -3

Case Study 3

(c) THIEFTING: - Electricity theft is the criminal practice of stealing electrical power. As we know the global cost of electricity theft was estimated around approximately $96 billion every year. Some punishments for the crime include fines and incarceration. The electricity losses caused by the theft are classified as non-technical losses .There are various types of electrical power theft, including Tapping a line or bypassing the energy meter. According to a study, 80% of worldwide theft occurs in private dwellings and 20% on commercial and industrial premises. The various types of electrical power theft include: Direct hooking from line, Bypassing the energy meter, Injecting foreign element in the energy meter, Physical obstruction, ESD attack on electronic meter. So, if load increases due to thief ting issues, then the voltage drop will be increased. Then we have to add more power with respect to demand side but it involves the extra cost in power system network which is indirectly affect to increase of tariff.

Here we are incorporating thefting load in distribution bus and run the load flow with same data set (case-1 and II) and observed that at thefting bus, voltage drops are increased which indicates when thefting is occurred in any areas, surrounding areas voltage drops are increased. So when we observed that voltage dropped are increasing certainly then we have to required checking of that area and identify and disconnect the theft load as quickly as possible otherwise it creates more voltage drops in other buses for which system may be collapsed, or out steps.

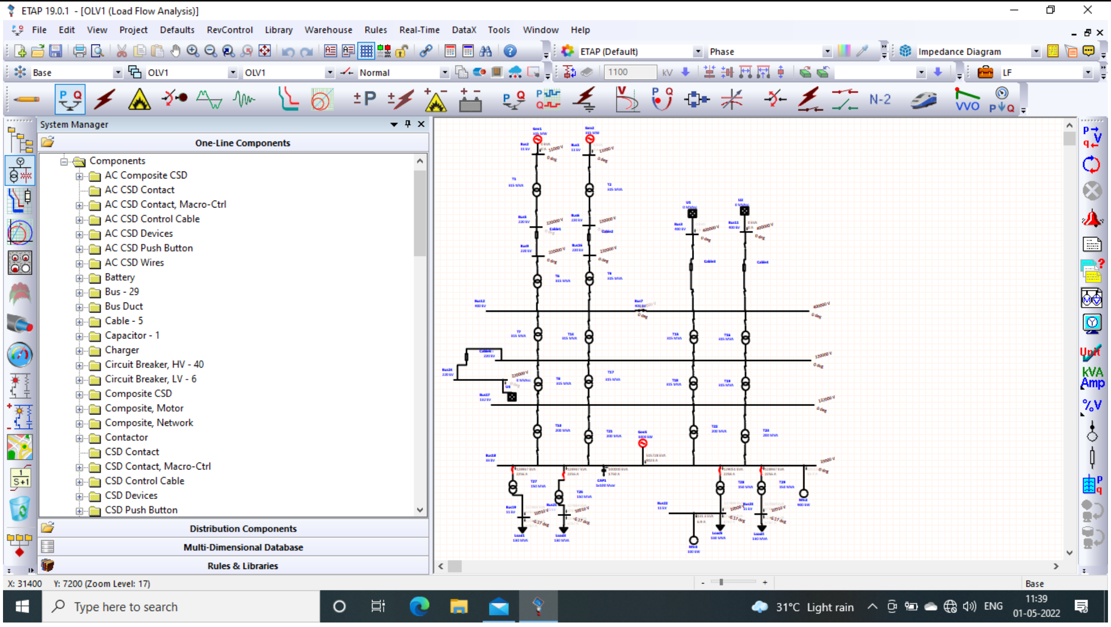


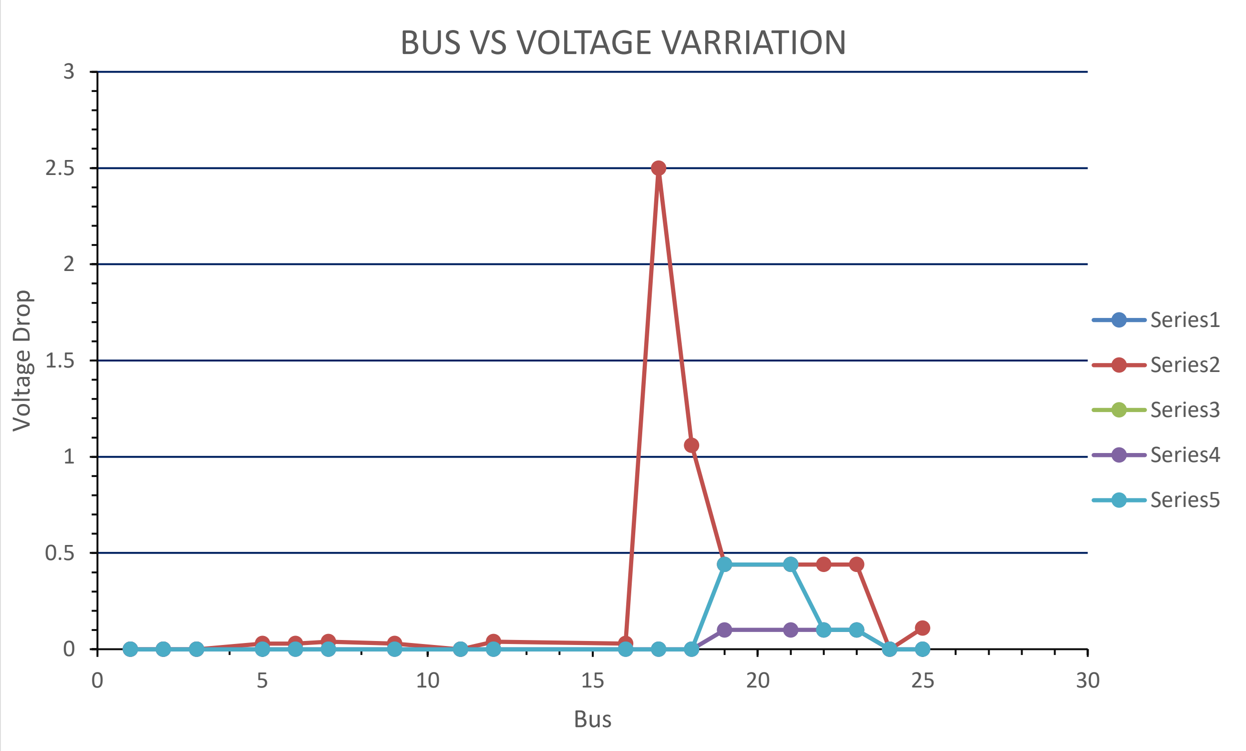
Fig.3- Power theft

Table-3: Variation of voltages (POWER THEFT CONDITION) with respect to bus.

BUS NO	NOMINAL VOLTAGE (KV)	AFTER POWER THEFT (% OF VOLTAGES)	POWE THEFT(KV)	VOLTAGE DROP(KV)
1	11	100	11	0
2	11	100	11	0
3	400	100	400	0
5	220	100	220	0
6	220	100	220	0
7	400	100	400	0
9	220	100	220	0
11	400	100	400	0
12	400	100	400	0
16	220	100	220	0
17	132	100	132	0
18	33	100	33	0
19	11	96.05	10.56	.44
21	11	96.05	10.56	.44
22	11	99.18	10.90	.1
23	11	99.18	10.90	.1
24	220	100	220	0
25	220	100	220	0

(c) **RESULT & ANALYSIS**: Load distribution is crucial to maintain power system stability. Only after analyzing it we are able to predict the Over voltage condition, Power theft detection. The transmission network of Kalyani sub area has been shown in to buses and four loads. The Bus VS voltage drop variation Curve shows Maximum voltage drop occurs at over voltage condition which is 2.5 KV at bus number 17. After introducing capacitor bank in the system this voltage drop reduce to zero.

In thefting conditions, the voltage drop again show the value of 0.44 KV. In the Bus VS Voltage variation curve, red color line indicates the Over Voltage Condition, whereas blue color line and violet color line represents Theft Conditions and Balancing condition respectively.



Overall Analysis: -

In this demo project we achieved a simple solution how to overcome over, under voltage, voltage drop. Our solving technique is to analysis of voltage drop from load flow study. It can give a easiest solution process of identifying and analysis of power theft (Non-technical) From Table-1, Bus number 5, 6, 9, 16 shows the value of 0.3 KV Voltage drop, bus number 7, 11, 19 21, 22, 23 shows the value of 0.44 KV, whereas bus number 17 and 18 displays 2.5 KV and 1.06 KV respectively. After introducing Capacitor bank in the system, the voltage drop in all the buses is zero except bus number 19, 21, 22 and 23. The bus number 19, 21, 22 and 23 show 0.1 KV Voltage drop. Which shows practical scenario because zero percentage voltage drop never occurred in power system because power system always run with reactive load. Now considering Power theft condition (bus number 19, 21) again shows the value of 0.44 KV, which is much greater than balancing conditions. So, we can conclude easily we can identifying and detecting the voltage drop area to prevent power theft.

III. ***FUTURE ASPECTS:*** We can improve the power grid (demo) load capacity as improvement of over voltage condition and maintaining the stability by analysis load flow study. This is simplestway of identifying thefting power by analyzing voltage drop. If we detect and identify power thefting area simple way then easily we can prevent theft of power because in Indian scenario power sector always run loss of revenue and it is very difficult to implement complex process to detect power theft because maximum power theft occurred in rural or semi urban area where power system infrastructures are very poor, so it is neglected to identify thefting power and also lack of maintenance and improvement of power stability. These type of attitude of power company will affect entered system and effected to urban area power distribution also.

CONCLUSION: - As we know that in power system network loads are always changing, demands is more but system is always run with loss of revenue. It is an industry; no industry can survive if system is continuously run with loss of revenue. Due to lack of revenue, it is very difficult to further new planning, installation, maintenance of power network to maintain and distribution highly reliable, quality of power supply to all hook and nook corner of India. Now India goes to implement smart, smarter and smartest (Nano, AI. VR) technology in power sector via smart grid. But everything is happening for urban and high-class area only. India lives in village. So, we should think about them also how to maintained 24 hours uncut (quality) power supply to every house of Indian villages. It is possible only when power tariff will be reduced and proper observation and maintenance of whole network with cheapest cost. For that reason, stability analysis and identification of power theft is essential that power sector recover its loss of revenue due to power theft. This paper gives little bit lightening to solve power loss and loss of revenue issues.

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V.AUTHORS:

Mr. Abul Kalam Asad is currently pursuing Bachelor of Technology (B.Tech, 8th sem) in Electrical Engineering from JIS College of Engineering, Kalyani.

Mr, Aritra patra is currently pursuing Bachelor of Technology (B.Tech, 8th sem) in Electrical Engineering from JIS College of Engineering, Kalyani.

Mr.Nitesh Kumar is currently pursuing Bachelor of Technology (B.Tech, 8th sem) in Electrical Engineering from JIS College of Engineering, Kalyani.

Mr. Biman Chandra Das is currently pursuing Bachelor of Technology (B.Tech, 8th sem) in Electrical Engineering from JIS College of Engineering, Kalyani.

Mrs. Suparna Pal is currently an Assistant Professor in the Department of Electrical Engineering in JIS College of Engineering, Kalyani. She completed her M.Tech from the University of Calcutta in 2002 and has 17 years of teaching experience. Her areas of interest in research include Power System, Control System and Renewable Energy.