DESIGN AND IMPLEMENTATION OF PV SOLAR SYSTEM

By

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ABSTRACT

Energy is the most valuable resource and foundation of civilization. Saving and improving this resource for future requires an in-depth understanding of energy resources, optimal operation and sustainable usage. In this project, modeling and simulation of a solar panel to study its characteristics is presented. The investigation of the panel characteristics depends on MATLAB/Simulink and INSEL software. Some experiment measurements of the panel characteristics are also done. There are two photovoltaic solar systems: one is the off-grid and the second is the on-grid. In this project a design of Photovoltaic off-grid system is considered which can be used for isolated areas which are difficult to feed from the electrical networks. The off-grid system consists of Photovoltaic panel, charger controller, battery and inverter. The project deals with the design of inverter, charger controller and tracker. The implementation of an off-grid system as a product is finally produced. Finally, a design of PV solar system for lighting the Faculty of Engineering (Rabigh) is considered.

Index Terms: Renewable energy, PV solar system, On-grid system, Off-grid system, Charge controllers, Inverters, Solar batteries, Trackers.

INVESTIGATION OF MVAR VARIATION IN MADINAH AND MAKKAH SAUDI ELECTRICITY NETWORKS UNDER THE EFFECT OF COMPENSATION

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INTRODUCTION

Load flow studies are performed for Madinah and Makkah Saudi Electricity Network voltages (380, 110, 33)KV. Three different load levels (light, medium and peak) have been considered in the investigation. Power World Simulator PWS has been used to perform the load flow analysis. The obtained results of load flow studies are compared to the actual load flow and founded identical. Shunt capacitors installed in transmission and distribution networks will increase transmission capability, reduce losses and improve the power factor. High voltage banks for any voltage and power rating can be designed by series and parallel connection of capacitor units. Shunt capacitors are primarily used to improve the power factor in the network. Inductive loads consume reactive power, e.g. magnetization power for transformers, motors and reactors. The reactive power needed is generated by capacitors. Real and reactive power can be controlled by else off nominal tap ratio changing and regulating transformer.

PROJECT OBJECTIVES

The main scope of this study is to investigate the effect of Mvar variation in an electrical power system under the effect of compensation. The study will be conducted on part of the Saudi Electricity Company (SEC) power network Madinah and Makkah, which results in minimum reactive power generation while satisfying the system constraints. Therefore, the main objective of this project can be summarized as follows:

- Load flow studies are to be performed on different Madinah and Makkah system levels,i.e.380 kV and 110 kV.
- These load flow results should be compared with the actual load flow as recorded in the Madinah and Makkah load dispatch centers.
- Find the optimum number, location(s) of shunt capacitors which minimize the objective function while satisfying the system constraints.
- Recommendation which size of capacitors might be needed.
- Off-nominal tap ratio studied for Madinah and Makkah city to control of active and Reactive power flow.

PROJECT FRAMEWORK / METHODOLOGY

The idea of this study the Saudi Electricity work is to company a wide range of capacitor compensation vision and the expected outcome. This analysis should guide the network operators on what and where the capacitor compensation are needed during each load level. In this method, the optimization process consists of four major steps.

- First is the choice of the location. The program scans all the buses and calculate the objective function at each time for single bus shunt compensation.
- Second is the improvement of the solution considering the standard bank size. The aim of this step is to decrease the objective function.
- Third, the program will sort the best ten locations and their objective functions.
- Fourth, The algorithm will stop when there is no further improvement in the objective function from the previous case.

FIGURES / TABLES

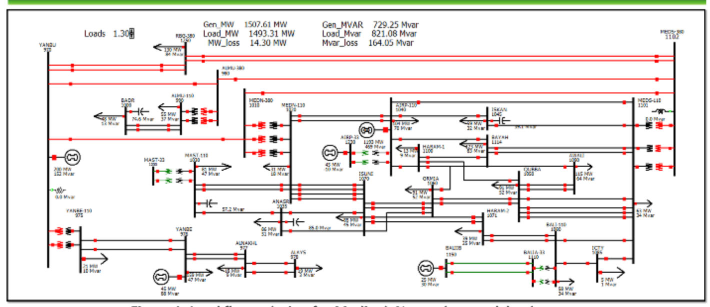

Figure 1: Load flow solution for Madinah Network at peak load

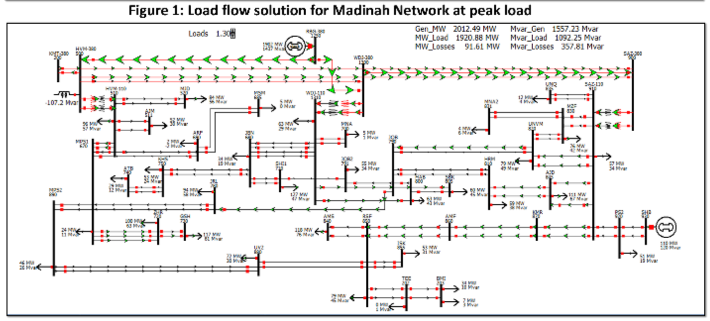

Figure 2: Load flow solution for Makkah Network at peak load

Table 1: Load Flow Result For Madinah Network

Base Case	Light Load	Medium Load	Peak Load
Pg (MW)	865	1156.8	1509.7
Qg (Mvar)	429	672.2	1023.8
Sg (MVA)	965	1337	1823
Ploss (MW)	8.7	8	16.4
Qloss (Mvar)	-44	40.8	202.8

Table 2: Load Flow Result For Makkah Network

Base Case	Light Load	Medium Load	Peak Load
Pg (MW)	1051.24	1520.74	2012.49
Qg (Mvar)	530.74	957.61	1557.23
Sg (MVA)	1167	1796	2544
Ploss (MW)	16.92	43.14	91.61
Qloss (Mvar)	-203.27	0.49	357.81

RESULTS AND DISCUSSION

The obtained results of load flow studies are compared to the actual load flow and founded identical. Shunt capacitors installed in transmission and distribution networks will increase transmission capability, reduce losses and improve voltage load.

By power factor correction in group of loads to 0.97, the voltage profile on bus #1060 improved from 0.932 p.u to 0.95 p.u, and the real power losses reduced from 11.89 MW to 11.34 MW while the reactive power losses reused from 181.5 Mvar to 169.86.Mvar

For the off nominal tap ratio of transformer between 1300-1310 buses, off-nominal tap ratio is 0.96 then P_{loss} is 91.61 MW and Q_{loss} is 357.81 Mvar, the voltage load bus #855 0.827 p.u. by increasing off-nominal tap ratio the real and reactive power losses will decreased

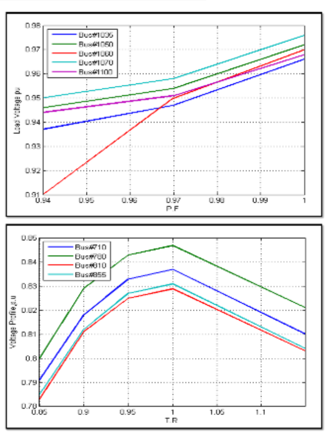

Figure 3 : Load voltage profile

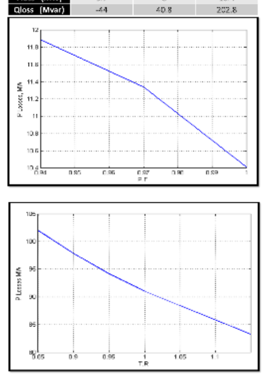

Figure 4 : Active power losses

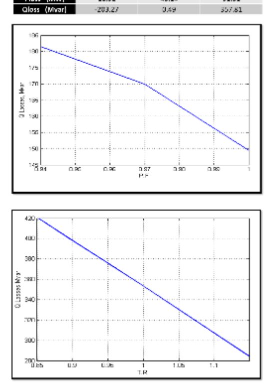

Figure 5: Reactive power losses

CONCLUSION AND RECOMMENDATIONS

- Applying shunt compensation as close as possible to loads is more economical than compensating at the 380 kV network.
- Shunt compensation at substations with large loads results in a better reduction of the generated MVA than at substations with low loads.
- The effect of the off-nominal tap ratio was studied for each network based on the maximum reduction in the generated MVAR.

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