УДК 621.3.072

OPTIMIZE THE PERFORMANCE OF ELECTRICAL EQUIPMENT IN GAS SEPARATION STATIONS (DEGASSING STATION DS) AND ELECTRICAL SUBMERSIBLE PUMPS OF OIL EQUIPMENT FOR OIL RUMAILA FIELD

Majid Abdulhameed Abdulhy Al-Ali[1], V.Yu. Kornilov[2], A.G. Gorodnov[3]

[1]Rumaila Operating Organization, Basra, Iraq
[2]Kazan State Power Engineering University, Kazan, Russia
[3]Kazan National Research Technical University named after A. N. Tupolev - KAI, Kazan, Russia

Annotation: *There are various types of electrical equipment used in the extraction of oil at the Rumaila field, with an average voltage of 11 kV and a low voltage of 0.4 kV. The most common elements in this class are transformers and reactors, engines and gas discharge lamps. All of this equipment consumes reactive power and reduces the value of the power factor. (Power factor is the ratio of kW to kVA). The closer the power factor to the maximum possible value of 1, the greater the benefit for the consumer and supplier. In case of low power factor, the current will be increased, and this high current will lead to (large line losses, an increase in the nominal total power of kVA and overhaul dimensions of electrical equipment, deterioration in voltage regulation process and an increase in voltage drop, a decrease in efficiency).*

Power factor improvement allows the use of smaller transformers, switchgear and cables, etc. as well as reducing power losses and voltage drop in an installation. Improving the power factor of an installation requires a bank of capacitors which acts as a source of reactive energy. These arrangements provide reactive energy compensation. In Rumila, An improvement of the power factor of an installation presents several technical and economic advantages, notably in the reduction of electricity bills, we save (685.854.007 Iraqi Dinar= 550.000 $) for one month . All this work takes 6 to 12 month.

Keywords: *electric submersible pumps, power correction, degassing station, active power filters, hybrid filters.*

DOI:*10.30724/1998-9903-2018-20-11-12-141-145.*

For citation: *Majid Abdulhameed Abdulhy Al-Ali, V.Yu. Kornilov, A.G. Gorodnov. Optimize the performance of electrical equipment in gas separation stations (degassing station DS) and electrical submersible pumps of oil equipment for oil Rumaila field. Proceedings of the higher educational institutions. ENERGY SECTOR PROBLEMS. 2019. vol. 21. № 1-2. pp. 141-145. DOI:10.30724/1998-9903-2018-20-11-12-141-145.*

INTRODUCTION

Correction power factor for oil stations.

Oil production is operated by Rumaila Operating Organisation, with 14 degassing stations (Gases Separating stations) currently installed 7 in the North field and 7 in the South field. These stations provide 3-phase separation (oil, water & natural gas). Crude oil is sent by pipeline to local refineries or ports in Basra for export. Natural gas is provided to the Basra Gas Company. Water is disposed into disposal wells. Adding that there are 10 injection water stations.

Degassing station (Gases Separating stations) names:

• North Rumaila: DS1, DS2, DS3, DS4, DS5, NIDS, SIDS

• South Rumaila: Markezia (Rumaila), Janubia , Shamyah, Qurainat, Mishrif Shamyah, Mishrif Qurainat, Ratqa.

All this Gases Separating stations DS that feed by electrical supplies from ministry of Iraq electrical (132 KV TO 11 KV). Accordingly this DS will distributor the electrical power to feed electrical submersible pumps and the other equipment which oil production sharing.

Most of these electrical loads are inductive loads, that mean power factor is lagging and these low value. As the reading of power sources, we read the value of power factor value 0.6 to 0.65. Schedule (1). If we assume corrected the power factor to 0.9.

Schedule 1

Electrical power consumption in Gases Separating stations (Degassing station DS)

Rumaila	Name of electricity metering stations	Consumers related to electricity metering station	Monthly consumption of active electricity, kW*h	Monthly consumption of total electricity, kVA*h	Expected consumption of total electricity for a month after compensation (cosφ = 0.9), kVA*h
North Rumaila	CPS1 (T1)	CPS1	1782000	2921000	1980000
	CPS1 (T2)	CPS1	2126000	3429000	2362222
	CPS2 (T1)	CPS2, CS5	18000	29000	20000
	CPS2 (T2)	CPS2, CS5	4725000	7875000	5250000
	CPS3 (T1)	CPS3,DS5	3079000	5048000	3421111
	CPS3 (T2)	CPS3,DS5	19000	31000	21111,11
	CPS4	CPS4	6828000	10668000	7586667
	CPS5 (T1)	CPS5, CS2,	868000	1335000	964444,4
	CPS5 (T2)	CPS5, CS2,	5137000	8026000	5707778
	CPS9	CPS9	28000	44000	31111,11
	CS4	CS4, DS4, NIDS	1431000	2271000	1590000
	DS2 (T1)	DS2, SIDS	298000	473000	331111,1
	DS2 (T2)	DS2, SIDS	4000	6000	4444,444
	Old Rum (T1)	DS1,DS3	1630000	2587000	1811111
	Old Rum (T2)	DS1,DS3	1038000	1622000	1153333
South Rumaila	Janubia	Janubia CS, Janubia DS, Ratga DS	673200	1085800	748000
	Markzia	Markzia CS, Markzia DS	1302400	2019200	1447111
	Shamia	Shamia CS, Shamia DS	360800	572700	400888,9
	M. Shamia	M. Shamia DS	66000	105000	73333,33
	Qurinat (T1)	Qurinat CS, Qurinat DS,	245000	376000	272222,2
	Qurinat (T2)	Qurinat CS, Qurinat DS,	1560000	2399000	1733333
	M. Qurinat	M. Qurinat DS	2100	3300	2333,333
Total			**33220500**	**52926000**	**36911667**

Correction power factor electrical submersible pumps.

The electrical submersible pumping systems deliver an effective and economical means of lifting large volumes of fluids from great depths under a variety of well conditions. The ESP system is comprised of an electric motor, seal section, rotary gas separator optional, multistage centrifugal pump, electric power cable, motor controller and transformers fig (1). ESP is a very versatile artificial lift method and can be found in operating.

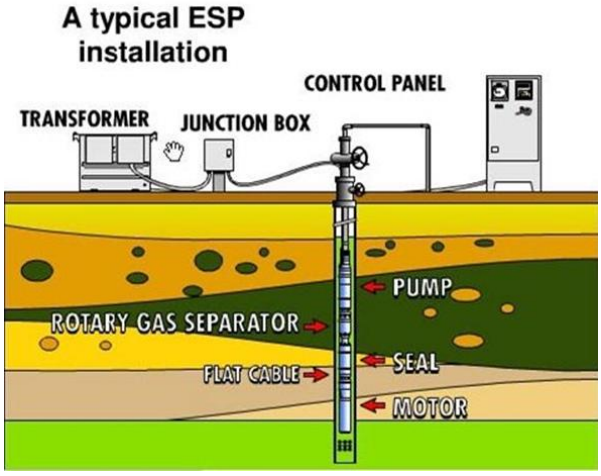

Fig. 1. Electrical submersible pump components

A high power factor allows the optimization of the components of an installation. Overating of certain equipment can be avoided, but to achieve the best results, the correction should be effected as close to the individual inductive items as possible.[1-4] The installation of a capacitor bank can avoid the need to change a transformer in the event of a load increase, the reactive power absorbed by a transformer cannot be neglected, and can amount to (about) 5% of the transformer rating when supplying its full load. Compensation can be provided by a bank of capacitors. In transformers, reactive power is absorbed by both shunt (magnetizing) and series (leakage flux) reactance[5-8]. Complete compensation can be provided by a bank of shunt-connected LV capacitors. Individual motor compensation is recommended where the motor power (kVA) is large with respect to the declared power of the installation.

Capacitors are especially sensitive to harmonic components of the supply voltage due to the fact that capacitive reactance decreases as the frequency increases[9-12]. In practice, this means that a relatively small percentage of harmonic voltage can cause a significant current to flow in the capacitor circuit. The presence of harmonic components causes the (normally sinusoidal) wave form of voltage or current to be distorted, the greater the harmonic content, the greater the degree of distortion. If the natural frequency of the capacitor bank power-system reactance combination is close to a particular harmonic, then partial resonance will occur, with amplified values of voltage and current at the harmonic frequency concerned. In this particular case, the elevated current will cause overheating of the capacitor, with degradation of the dielectric, which may result in its eventual failure. Several solutions to these problems are available. This can be accomplished by [13-18]

a. Shunt connected harmonic filter and/or harmonic-suppression reactors or

b. Active power filters or

c. Hybrid filters

Research Issues

Iraq is suffering from electricity power lack ,As summer temperatures go up each spring, wherefore demand of power its increase too ,as the oil stations consider the most consumption of electrical power and it need continual power , we must be find the reduce

consumption methods. Power factor correction one of this method .where we get the gain 60 MW extra fig. (2).

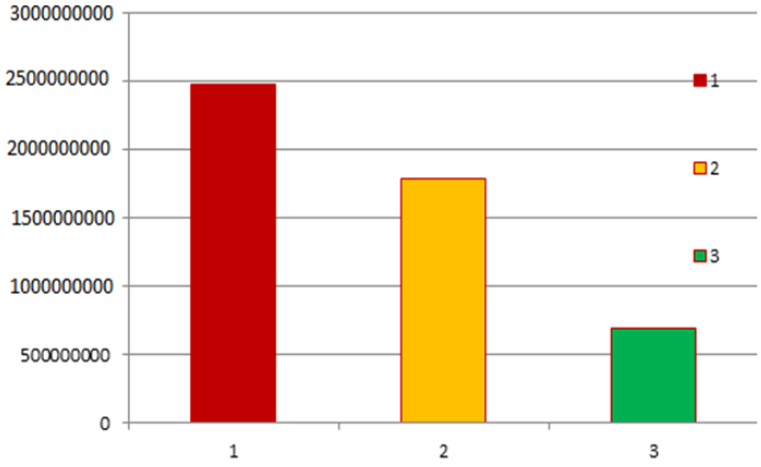

Fig. 2.represented the electrical power consumption(VA)

AIMS

In general, the equipment that working in oil industry have to heavy duty and high ability and works at hard condition. Correcting power factor will be improve the performance of this equipment, add that the reduce electricity bills expense where we are get the gain 550.000 $ at one month.

OBJECTIVES

This research will be to resolve more problems attached to:

Reduction in the cost of electricity.

Technical/economic optimization.

There more of utility will be usefulness (oil and electrical ministry), and this project was achieved by add power factor correction equipment(capacitors and filtering), with calculated the harmonics action on the grid(the third and five harmonic).

METHODOLOGY

The steps proposed to complete the research represented by the correction should be effected as close to the individual inductive items as possible as :

Compensation at the terminals of a transformer.

Compensation to increase the available active power output or Compensation of reactive energy absorbed by the transformer.

Power factor correction of induction motors Connection of a capacitor bank and protection settings.

Lighting and electronic devices as soft starting and variable frequency speed .connect directly with the Capacitor elements. Protection, control devices and connecting cables.

Collect and analyse the data by taking the read of kwh meters at every station.

References

1. Badrzadeh D., Smith K., Wilson R. Designing passive harmonic filters for an aluminum smelting plant. – IEEE trans. on industry applications. 2011, Vol. 47, No 2, pp. 973-983.

2. Chen Y.-M. Passive filter design using genetic algorithms. – IEEE transactions on industrial electronics, Vol. 50, No. 1, 2003, pp. 202-207.

3. Cirrincione M., Pucci M., Vitale G., Miraoui A. Current harmonic compensation by a single-phase shunt active power filter controlled by adaptive neural filtering. – IEEE trans. on

Industrial Electronics, Vol. 56, No. 8, 2009, pp. 3128-3143.

4. De Lima Tostes M., Bezerra U., Silva R. Impacts over distribution grid from the adoption of distributed harmonic filters on low-voltage customers. – IEEE transactions on power delivery, vol. 20, No. 1, 2005, pp. 384 – 389.

5. Fujita H., Akagi H. Voltage-regulation performance of a shunt active filter intended for installation on a power distribution system. – IEEE trans. on power electronics, Vol. 22, No. 3, 2007, pp. 1046-1053.

6. Ginn H. L., Czarnecki L. S. An optimization based method for selection of resonant harmonic filter branch parameters. – IEEE transactions on power delivery, Vol. 21, No. 3, 2006, pp. 1445-1451.

7. Hamadi A., Rahmani S., Al-Haddad K. A hybrid passive filter configuration for VAR control and harmonic compensation. – IEEE transactions on Industrial Electronics, Vol. 57, No. 7, 2010, pp. 2420- 2434.

8. He N., Xu D., Huang L. The application of particle swarm optimization to passive and hybrid active power filter design. – IEEE transactions on industrial electronics, Vol. 56, No. 8, 2009, pp. 2841-2851.

9. Karimi H., Karimi-Ghartemani M., Iravani M. An adaptive filter for synchronous extraction of harmonics and distortions. IEEE transactions on power delivery, Vol. 18, No. 4, 2003, pp. 1350-1355.

10. Klempka R. A new method for the C-type passive filter design. – Przeglad Elektrotechniczny, 2012, NR 7f, pp. 277-280.

11. Morsi W., El-Hawary M. Defining power components in nonsinusoidal unbalanced polyphase systems: the issues. – IEEE transactions on Power delivery, Vol. 22, No. 4, 2007, pp. 2428-2438.

12. Nassif A. D., Xu W., Freitas W. An investigation on the selection of filter topologies for passive filter applications. – IEEE transactions on Power De- livery, Vol. 24, No. 3, 2009, pp. 1710-1718.

13. Rivas D., Moran L., Dixon J., Espinoza J. Improving passive filter compensation performance with active techniques. – IEEE trans. on industrial electronics, Vol. 50, No. 1, 2003, pp. 161-169.

14. Tan P-C., Morrison R. E., Holmes D. Voltage form factor control and reactive power compensation in a 25-kV electrified railway system using a shunt active filter based on voltage detection. – IEEE trans. on industry applications, Vol. 39, 2003, No. 2, pp. 575-581.

15. Yazdani D., Bakhshai, Jain P. A three-phase adaptive notch filter- based approach to harmonic/reactive current extraction and harmonic decomposition. – IEEE trans. on power electronics, Vol. 25, No. 4, 2010, pp. 914-923.

16. El-gammal, M. A. Dynamic Voltage Restorer (DVR) for Voltage Sag Mitigation / M. A. El-gammal, A. Y. Abou-ghazala, T. I. El-shennawy // Int. J. Electr. Eng. Informatics. – 2011. – Vol. 3. – № 1. – P. 1–11.

Authors of the publication

Majid Abdulhameed Abdulhy Al-Ali – Rumaila Operating Organization, Basra, Iraq.

Vladimir Yu Kornilov – Kazan State Power Engineering University, Kazan, Russia.

Anton G. Gorodnov – Kazan National Research Technical University named after A. N. Tupolev - KAI, Kazan, Russia.

Поступила в редакцию ***03 декабря 2018 г.***