

ЭЛЕКТРОТЕХНИКА



УДК 621.3.072

OPTIMAL OPERATION OF ELECTRICAL POWER GENERATORS FOR OIL WELLS OPERATED BY ARTIFICIAL LIFTING AT RUMILA FIELD

Majid Abdulhameed Abdulhy Al-Ali¹, V.Yu. Kornilov², A.G. Gorodnov³

¹ Rumaila Operating Organization, Basra, Iraq

²Kazan State Power Engineering University, Kazan, Russia

³Kazan National Research Technical University named after A. N. Tupolev – KAI, Kazan, Russia

Abstract: Numerous oil wells within Rumaila field contain Electrical Submersible Pumps (ESPs). ESPs are utilised to maximise the oil production from existing wells by providing artificial lift where pressure is low, which helps maintain oil production levels. The number of ESPs installed throughout the Rumaila.

Field is growing consistently to sustain oil field production. Due to the remote locations for each of the ESPs the current strategy is to supply power to ESPs using individual diesel engine generators located at each remote ESP well site. This is an inefficient design, as individual diesel engines are resource intensive due to maintenance and frequent diesel filling. The generators are also a source of significant unreliability causing ESP shutdowns/trips resulting in extended downtime. Given the above a Pre-FEED has been carried out considering supplying ESPs using OHTL's supplying electrical power from EPP to ESPs in Area C. by uses parallel operation of diesel Generators, we could to constrict 124 from 184 and use 60 only, by this we get high economic gain and technique, in additional that environmental protection by decreasing pollution.

Keywords: diesel generators, the Newton Raphson method, load factor, electrical submersible pumps correction power, Steiner trees.

DOI:10.30724/1998-9903-2018-20-11-12-127-132.

For citation: Majid Abdulhameed Abdulhy Al-Ali, V.Yu. Kornilov, A.G. Gorodnov. Optimal operation of electrical power generators for oil wells operated by artificial lifting at rumila field. Proceedings of the higher educational institutions. ENERGY SECTOR PROBLEMS 2018. vol. 20. № 11-12. pp. 127-132. DOI:10.30724/1998-9903-2018-20-11-12-127-132.

Introduction

Iraq super-giant field

Rumaila is one of the world's greatest so-called super-giant oil fields – those that contain over a billion barrels of recoverable oil. It is estimated that some 17 billion barrels of recoverable oil are still contained within Rumaila's reservoirs.

Location and surface area

The field is located 50km to the west of the city of Basra, southern Iraq. The Basra region is home to all six of Iraq's ports, including the deep-water facility at Umm Qasr. Rumaila encompasses an area of 1,600 square kilometres, extending approximately 80km north to south

and 20km west to east, with the main anticline consisting of two domes, South Rumaila and North Rumaila.

Why use ESP?

As a result of reduction in the reservoir pressures in the depth of wells and to enhancement the productivity, petroleum companies used to apply ESP[1-5] technology which is represented by insertion special pumps operated by three phases induction motors its voltage is ranged from 1.5-3.5 KV and its horse power is ranged from 100-1000 HP its technologies are in compliance with the depth and temperature of the oil reservoirs in addition to other conditions pertaining fluids and Gases fig(1).

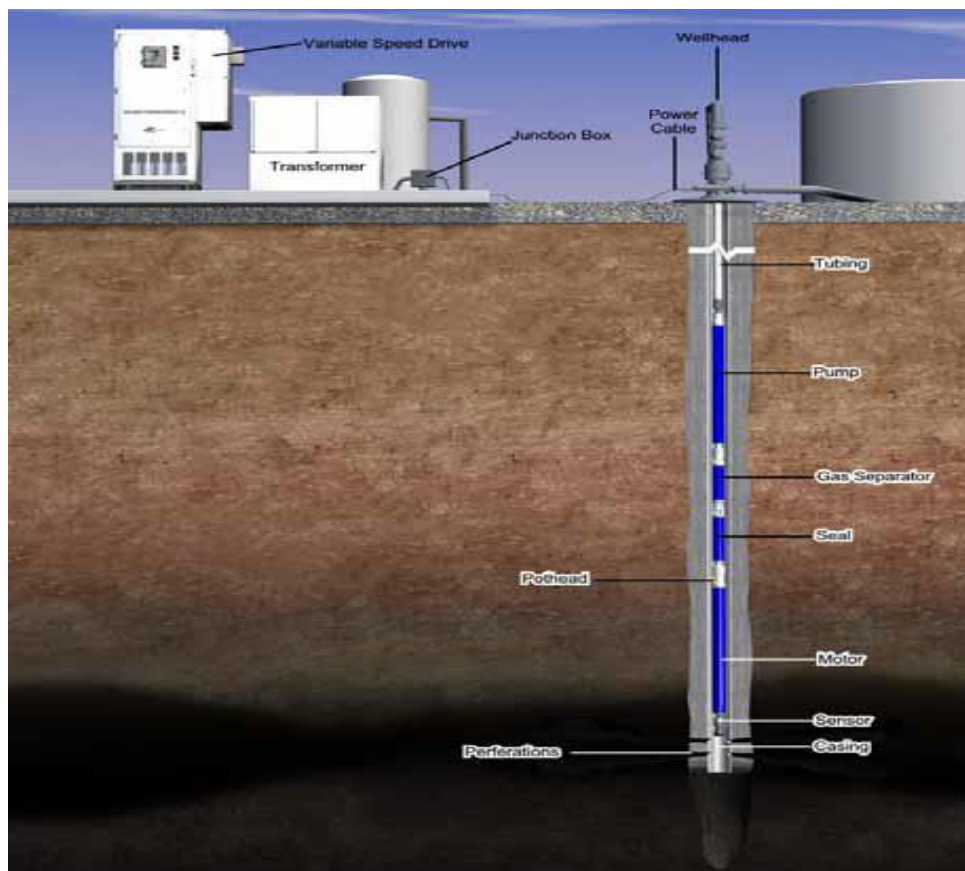


Fig 1. Electrical submersible pump components

Since Technical Service Contract was signed in 2009 between Basra oil company and BP, PetroChina and the State Oil Marketing Organization (SOMO) to establish the Rumaila Operating Organisation (ROO) to transform the oilfield into a sustainable world-class oilfield and to enhance the productivity to the higher level within specific period applying ESP technology for operate the almost stopped wells and weaken wells so that the plan of 10 next years included operating more than 500 oil wells.

As a result of frequent electricity shutting down, the concerned companies put a plan to overcome (Instability in the main power grid) such these cases putting Diesel generators on each wells so that these companies contracted with international companies for supply, maintenance and operation. In spite of the validity of the treatment and its application using diesel generators, but there are technical and economical important mistakes resulted from using such these

generators on each oil wells operated by artificial lifting technology.

Research Issues

This research put to solve more than problem represented by:

Operation of single generator at one oil well .As the Amps and Voltages Daily for electrical submersible pumps operation to Rumaila field on March 2018 which supplied from 126 electrical diesel generator . we see :

Low load factor

There more of 60% for generators were worked at load factor less than 0.5. fig(2).

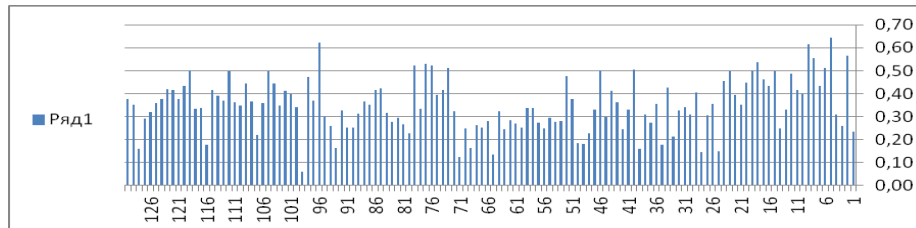


Fig. 2. Load factor to singular operation of diesel generators

Loss electrical power

The actual electric power to operate 184 oil wells were (27026 KVA) . While their production were (125120 KVA). That mean there excess power (98094 KVA).fig (3).

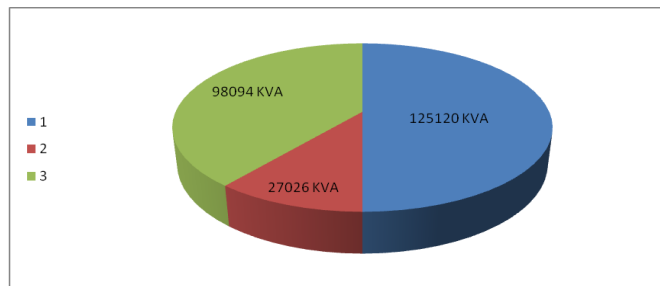


Fig. 3. The actual, real and excess electrical power KVA

High finance cost

The high finance cost that represented by operate this huge of diesel generators (fuel, operators, logistic support, spare part and maintenance)and pollution of environment.

Reduce the risk on operators and equipment for operate 60 GE in lieu of 180 GE

Aims

We aim to get optimal operation of diesel generators under ideal technique standards to get stable electric energy with the same existing equipment just we add synchronous equipment and overhead transmission lines install.

Objectives

When we complete this project we will to achieve reduce the financial cost for expenditure for Iraqi oil production cost. fig (4).

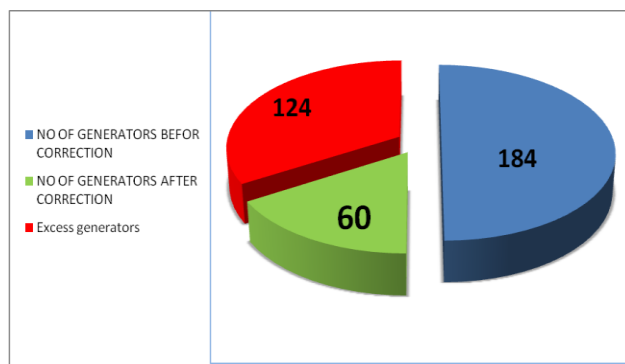


Fig. 4. Number of generator before and after correction

The main goal we can use 60 diesels Generator to supply all the ESP wells, and the rest (124) will be spare parts for our stations. it mean we can supply the power continuous for five year with any extended or increase on load without buy any spare parts .that is big achievement.

Methodology

For Parallel operate of electrical power generators we will do: 1.6.Must be locate the ten area (10 zone) are distributed at all the area of Rumaila and locate near the separation of gas station (DS), and near locate of electrical overhead transmission lines (medium voltage 11 KV, 6.6 KV) fig(5).

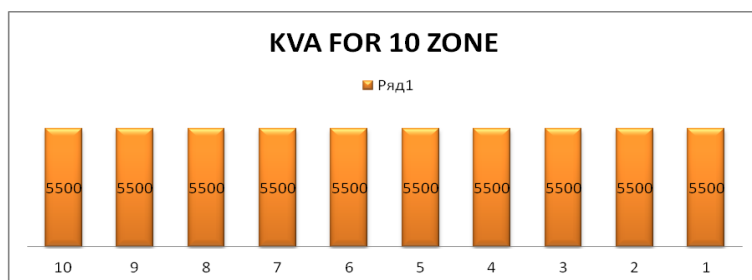


Fig. 5. Number of zones for coverage all Rumaila field area

Every zone consist of 20 diesel generators to supply of 550 KVA electrical power as fig (6).

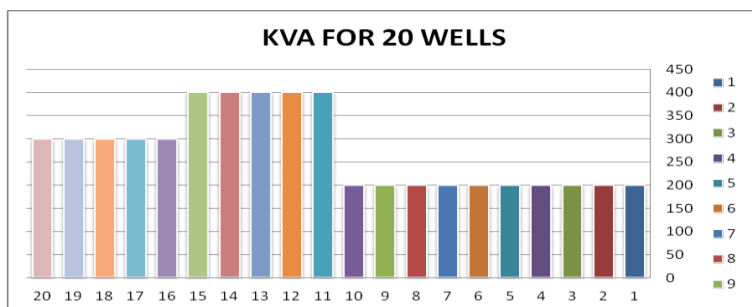


Fig. 6. Number of diesel generators for one zone

3.6. The 550 KVA of generators twenty will distribute for the following: table 1.

Table 1

Types and power rated of GE

No of GE	Types of GE	KVA
20	Caterpillar	1250
10	Jinan	280
10	Perkins+ Jinan	550
20	Caterpillar + Perkins	1100

If a group of generators are installed in parallel with each other at one place to be one feeding source for electricity (Power feeding station) and then this voltage will be raised through voltage transformers to be medium voltages (11 KV) to be transmitted through recycling distribution for zones [6,7,9] in compliance with the number of wells and its electricity powers. The choice of optimum position of set diesel generators depends on reference information on the elements of the maximum cross-section of wires, their brand, cross-section, linear mass, parameters of supports, step-down transformers. When developing an algorithm for constructing SES wiring for wiring, the cost of the designed network is taken as the main criterion. The task of building SES can be represented as the construction of connecting trees of a special type - Steiner trees.

Power System study bases

Software tool and methodologies

ETAP version 14.1.0 has been used for the study. Newton Raphson method has been used for solving iteratively the load flow equations. The Newton Raphson method possesses unique quadratic convergence characteristics. It has a very fast convergence speed compared to other load flow calculation methods. Short circuit performance analyses the effect of 3 phase and line to ground faults in the system. The program calculates the short circuit currents I_k'' , I_b , I_p , I_k with the contribution from motor load, and utility tie in. Fault duties are in compliance with the latest edition of IEC 60909.

Input Data

Input Data used for the network analysis are as below:

Grid short circuit contribution from EPP (PP01-706-ESB001) (Data based on EPP Power system study)

- Maximum Short Circuit Level
- Three Phase Fault – 13.83 KA
- Single Phase Fault – 0.207 kA
- Positive Sequence X/R Ratio – 16.55
- Zero Sequence X/R Ratio – 0.47
- Minimum Short Circuit Level
- Three Phase Fault – 4.463 kA
- Single Phase Fault – 0.161 kA
- Positive Sequence X/R Ratio – 10.11
- Zero Sequence X/R Ratio – 0.56

Cable and OTHL Conductors

- 11kV Cable and OHTL are as per Cable schedule
- 400V Cables not included in study.

Well site Equipment

- Transformers
- 11/0.42kV ONAN
- 4% Impedance for 500kVA, 5% Impedance for 1000kVA.
- Dyn1
- Primary Winding: Delta

- Secondary Winding Solidly Earthed.

Each well site is assumed to have an average load of 300kVA at each well site, as per the Basis of design For Pre-FEED analysis purposes the ESPs (consisting of VFD and Motor) at each well site have been modelled identically such that all well sites have a total power draw of 300kVA at 400V [8.10].

After collecting all the information and complete the technical studies and calculate the all coefficients of network and loads . And after locate the suitable position for main power plant. We will start construction and install concrete basis for GE and OHL .Beyond that we will connect the wiring and finishing works.

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Authors of the publication

Majid Abdulhameed Abdulhy Al-Ali – PhD student, Chief Engineer of «Rumaila Operating Organization».

Vladimir Yu Kornilov – Grand PhD in Engineering sciences, Professor Kazan State Power Engineering University.

Anton G. Gorodnov –senior lecturer Kazan National Research Technical University named after A.N. Tupolev – KAI.

Поступила в редакцию

03 декабря 2018 г.