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Capacitor Installation on Agricultural Pumps

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***Abstract*—** Power Quality is main concern in Agriculture, many of the Agricultural Consumers have complained about Power quality problems like undervoltage mainly during peak period, overvoltage during light load condition and harmonics problems etc. This poor power quality affects on the Motors of AG pumps which leads to overheating and burning of windings. Capacitor installation on all agricultural pumpset improves voltage profile and reduces the power consumption of the pumps. This paper explains analysis of different parameters like voltage, current, power factor and power agricultural pumps with or without capacitor installation.

Keywords- *Agricultural pumps; Capacitor and Power factor; Voltage Improvement;*

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I. INTRODUCTION

Since independence in 1947, the power sector in India has been effectively controlled by the Government of India, which created State Electricity Boards that were responsible for the complete supply chain of power, including generation, transmission, and distribution. However, the State Electricity Boards turned out to be unprofitable and inefficient and, thus, required high subsidies from the Government of India and state governments to survive. The reasons for the low power quality of agricultural power supply can be found in the political economy of the Indian agricultural sector. Agriculture plays a vital role in India's domestic economy, as about 70 % of the population generate their income from agricultural activities.

Substation covering different villages and distribution transformers (DTR), transform power to the 11 kV level. Depending on a DTR's capacity, between five and 25 pumpsets can be connected, each of which can negatively effect on power quality. Exclusion of low-standard pumpsets is, however, difficult. Power quality, or lack thereof, spreads within the electric power distribution grid, affecting all users, as the decision of one farmer to use a low-quality pumpset affects all other pumpsets connected to the same DTR. Meanwhile, if all farmers choose to install low-quality pumpsets, the utilization of a standard-approved pumpset by only one farmer cannot improve power quality. Yet, if all farmers were to install a standard-approved pumpset, repair costs would be drastically reduced and all farmers better off. The use of a capacitor to balance out voltage fluctuations is subject to a similar coordination problem. Furthermore, if only one farmer uses a capacitor, equipment damages may often even increase, as "the equipment installed to increase productivity is also often the equipment that suffers the most from common power disruptions. And the equipment is sometime the source of additional power quality problems"

II. AGRICULTURAL PUMPSETS

Two types of pumpsets, centrifugal and submersible, are typically used for agricultural irrigation. Centrifugal pumpsets are used more frequently, because investment costs for them are lower than for submersible pumpsets, but they are usually operated in shallow wells. A centrifugal pumpset is relatively simply constructed, consisting of an impeller and a diffuser. The impeller is the only moving part in the pumpset and is directly powered by the motor through a shaft, creating the (head and) pressure that is required to draw water. A diffusor then directs the water. A submersible pumpset operates in a vertical position and consists of a pump bowl, a directly attached motor, a discharge column and a head assembly. It is used for bore wells and is installed submerged into them. much deeper than shallow open wells, the motor is not easily accessible, so repairing and maintaining a submersible pumpset is more laborious than it is with a centrifugal one. Nonetheless, a submersible pumpset is more efficient, because the motor is directly attached, thus reducing friction, and cooling is provided by the water in which it is placed. It is also more resistant to changes in water levels and can be used in very deep wells. When used for irrigation, both types of pumpsets have a rating of between 2 and 15 kW. The overall energy efficiency of a pumpset is influenced by the quality of the power input, the efficiency and friction of its motor, the efficiency of the pumpset itself, and the layout and design of

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the piping system. Efficient pumpsets have less copper and iron losses and reduce inefficiencies at the extreme ends (head and flow). The efficiency of a pumpset depends also on field characteristics. Efficiency losses occur, for example, when the size of a pumpset is not adequate for the conditions. In many cases, pumpsets are oversized and are, consequently, not being Operated at the optimum load.

III. POWER FACTOR AND CAPACITORS

The power factor is defined as the ratio of active or real power, measured in kW, and apparent power, measured in kVA. Apparent power is also called as total power and refers to the power that is actually being provided to a system. Active power is the important share of the apparent power that can be transferred into other, productive forms of energy. Unused power is known as reactive power, which is minimized in properly working distribution systems. Three-phase inductive loads required by high rating electrical motors need the three phases to be balanced to reach a high power factor. The larger the imbalance is, the lower the power factor. Overloaded DTRs, wrongly sized motors, increased line voltages and already-existing imbalances at substations can lead to low power factors. In addition to being able to resolve these issues, capacitors can also help to correct the power factor. A capacitor contains of two parallel metal plates with a gap in-between, which is filled with (dielectric) insulating material. This construction allows it to store and release electrical energy. The energy storage ability of a capacitor is called its capaci-tance. Static capacitors, as used in this project, have a fixed capacitance. Based on a given uncorrected power factor, one can determine the required capacitance necessary to reach a power factor of unity.

IV. POWER QUALITY PROBLEMS ON AGRICULTURAL FEEDER

Power Quality is main concern in Agriculture, many of the Ag Consumers have complained about Power quality issues like undervoltage mainly during peak period, overvoltage during light load condition and harmonics problems etc. This poor power quality affects on the Motors of AG pumps which leads to overheating and burning of windings. Farmers rewind the motors from local electrician and continue using the inefficient motors. The cost of motor burnouts is equivalent to the electricity bill of the farmers. Over the medium term, farmers' income, would increase if quality of power supply was improved partially financed through higher tariffs. Marginal and small farmers incomes stand to gain even more from an improvement in the power supply conditions at higher tariffs.

V. CAPACITOR INSTALLATION ON AGRICULTURAL PUMPS

Kodri Agricultural (AG) feeder is selected from Shegaon Region. It is from Paturda substation about 35 km away from Shegaon. 61 Capacitors are installed on 7 DTC'S of Kodri AG feeder. All consumers having pumps are covered in this survey. 3 phase capacitors are installed of rating 1 kVAR, 2 kVAR and 3 kVAR on 3 HP,5 HP,7.5 HP pumps respectively. Reading before and after capacitor installation is taken.

Three case studies are taken in this paper as below:

Three Phase Voltages:

SR. No.	Before Capacitor Installation			After capacitor Installations		
1	216.5	232.7	231.6	220.3	232.9	228.6
2	231.6	234.2	215.9	231.3	208.2	242
3	232.1	224.6	215.9	240.3	237.2	221.4

Three Phase current

SR. No.	Before Capacitor Installation			After capacitor Installations		
1	11.97	13.3	12.28	10.93	12.42	10.98
2	3.95	4.09	3.16	5.21	4.81	5.96
3	7.37	6.78	6.31	7.63	6.74	6.21

Three Phase Power factors:

SR. No.	Before Capacitor Installation			After capacitor Installations		
1	0.89	0.88	0.81	0.97	0.95	0.91
2	0.4	0.44	0.51	0.59	0.76	0.78
3	0.87	0.78	0.85	0.86	0.77	0.85

Three Phase Power factors:

SR. No.	Before Capacitor Installation			After capacitor Installations		
1	0.89	0.88	0.81	0.97	0.95	0.91
2	0.4	0.44	0.51	0.59	0.76	0.78
3	0.87	0.78	0.85	0.86	0.77	0.85

Three Phase Power in Watts:

SR. No.	Before Capacitor Installation			After capacitor Installations		
1	2322	2724	2301	2387	2808	2367
2	345	529	346	621	750	1115
3	1474	1071	1130	1512	1203	1140

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From above observations we can analyze that

- Considerable Voltage improvement is not obtained
- Current consumption of pump sets are reduced
- Power factor is improved

VI. OTHER PROBLEMS FACED BY FARMERS

Almost all consumers are facing problems related to frequent breakdown on feeder/DTC (D.O.- Drop out fuse), under -voltage. Many DTC'S are not having fuses and have open (not insulated) connections. Farmers have to pay to local electricians for rectification of DTC related problems having frequency of about 3-4 times in a month. Wild animals like boar & deer, cause damage to the crops. People also fear snake bites and wild boar attacks. Farmers are not aware of the Capacitor and its cost/effects. Many of farmers came to know about capacitor on our first day of Installation, some of them forced us to install capacitor on their pump after knowing that it is free of cost and useful.

VII. CONCLUSION

In this paper different parameters like voltage, current, power factor and power agricultural pumps with or without capacitor installation are studied from survey data. Also different problems of farmers are explained which observed during survey like breakdown, irregular power supply, wild animals attack etc.

REFERENCES

[1] Julian Sagebiel, Christian Kimmich, Malte Müller, Markus Hanisch ,Vivek Gilani, " Enhancing Energy Efficiency in Irrigation A Socio-Technical Approach in South India",springer briefs in environemntal science book

[2] Dugan R C etc. Electrical power systems quality. New York, McGraw2Hill,1996.

[3] D.O.Koval,R.A.Bocancea and K.Yao et al.Canadian national power quality survey: frequency and duration of voltages sags and surges at industrial sites.IEEE Trans.on IA,1998,Vol.34,No.5.