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Power Factor Correction by Introdusing Bypass Condensor at Power Distribution Boards Inshop Floors

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ABSTRACT

Wasted energy capacity, also known as poor power factor, is often overlooked. It can result in poor reliability, safety problems and higher energy costs. The lower your power factor, the less economically your system operates. The actual amount of power being used, or dissipated, in a circuit is called true power. Reactive loads such as inductors and capacitors make up what is called reactive power. The linear combination of true power and reactive power is called apparent power. Power system loads consist of resistive, inductive, and capacitive loads. Examples of resistive loads are incandescent lighting and electric heaters. Examples of inductive loads are induction motors, transformers, and reactors. Examples of capacitive loads are capacitors, variable or fixed capacitor banks, motor starting capacitors, generators, and synchronous motors. Power factor correction (PFC) is usually achieved by adding capacitive load to offset the inductive load present in the power system. The power

factor of the power system is constantly changing due to variations in the size and number of the motors being used at one time. This makes it difficult to balance the inductive and capacitive loads continuously. There are many benefits to having power factor correction. As a customer the cost doesn't get passed on for having a low power factor. As a utility company, equipment has a much longer life span and maintenance costs remain low.

Keywords: power factor correction, load compensation, reactive power control, static VARs compensator, power system modelling.

I. INTRODUCTION

Power factor is an energy concept that is related to power flow in electrical systems. To understand power factor, it is helpful to understand three different types of power in electrical systems. Real Power is the power that is actually converted into useful work for creating heat, light and motion.

Real power: Is measured in kilowatts (kW) and is totalized by the electric billing meter in kilowatt-hours (kWH). An example of real power is the useful work that directly turns the shaft of a motor.

Reactive Power: Is the power used to sustain the electromagnetic field in inductive and capacitive equipment. It is the nonworking power component. Reactive power is measured in kilovolt-amperes reactive (kVAR). Reactive power does not appear on the customer billing statement.

Total Power or Apparent power is the combination of real power and reactive power. Total power is measured in kilovolt-amperes (kVA) and is totalized by the electric billing meter in kilovolt-ampere-hours (kVAH). Wyandotte Municipal Service provides generation, transmission and distribution capacity to supply both real and reactive power to all its customers. Power factor

- (PF) is defined as the ratio of real power to total power, and is expressed as a percentage (%).

$$PF = \frac{\text{Real Power (kWh)}}{\text{Total Power (kVAH)}} \times 100$$

POWER FACTOR AND ELECTRICAL LOADS

In general, electrical systems are made up of three components: resistors, inductors and capacitors. Inductive equipment requires an electromagnetic field to operate. Because of this, inductive loads require both real and reactive power to operate. The power factor of inductive loads is referred to as lagging, or less than 100%, based upon our power factor ratio. In most commercial and industrial facilities, a majority of the electrical equipment acts as a resistor or an inductor. Resistive loads include incandescent lights, baseboard heaters and cooking ovens. Inductive loads include fluorescent lights, AC induction motors, arc welders and transformers.

II. METHODOLOGY

Methods of Improving Power Factor

- ❖ **Static Capacitor:**

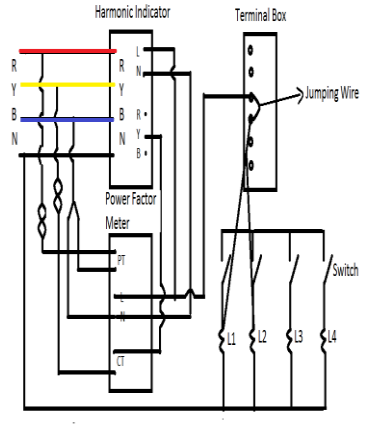
- ➢ These are capacitors that are connected in a circuit in parallel with the load.
- ➢ A circuit with low, lagging (inductive) power factor (pf) can be improved by those static capacitors by decreasing the circuit's inductive reactive power.
- ➢ They act as a source of local reactive power and thus less reactive power flows through the line. Basically they reduce the phase difference between the voltage and current.

- ❖ **Synchronous Condenser:**

- ➢ A synchronous condenser is an overexcited synchronous motor, which draws leading currents from the system and hence compensates for lagging VARs.
- ➢ It is used as a reactive power compensator in some systems for power factor correction purposes.
- ➢ For inductive loads, synchronous condenser is connected towards load side and is overexcited.
- ➢ This makes it behave like a capacitor. It draws the lagging current from the supply or supplies the reactive power.

- ❖ **Phase Advancer**
- ➢ This is an ac exciter mainly used to improve pf of induction motor.
- ➢ They are mounted on shaft of the motor and is connected in the rotor circuit of the motor.
- ➢ It improves the power factor by providing the exciting ampere turns to produce required flux at slip frequency.
- ➢ Further if ampere turns are increased, it can be made to operate at leading power factor.

CIRCUIT CONNECTION



III. RESULT AND DISCUSSION

Loads	Voltage	Current	PF	Error	Harmonics
200w Bulb	230V	0.7	C 0.99	r ct (reverse ct)	Ithd-1.4% Vthd-1.1%
40W FTL	230V	0.3	L0.49	UC	Ithd-11.6% Vthd-1.4%
AFTER REVERSING CT CONNECTION					
200W Blub	230V	0.7	C0.99	OC	Ithd-1.3% Vthd-1.1%
40W FTL	230V	0.3	L0.51	UC	Ithd-11.4% Vthd-1.2%
9W CFL	230	0.1	1.00	UC	Ithd-0% Vthd-1.4%
20W LED	230	0.1	1.00	–	Ithd-0% Vthd-1.2%
AFTER INSERTING THE 2.5 μF CAPACITOR					
40W FTL	230	0.24	L0.86	–	Ithd-19.6% Vthd-1.1%
AFTER INSERTING THE 3.15 μF CAPACITOR					
40W FTL	230	0.5	0.92	–	Ithd-21.7% Vthd-1.1%

Observation:
Power factor improved from 0.5-0.86, but harmonics also increased from 11.5%-21.7%.

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Power factor improved from 0.5-0.86, but harmonics also increased from 11.5%-21.7%.

IV. CONCLUSION

- By observing all aspects of the power factor it is clear that power factor is the most significant part for the utility company as well as for the consumer.
- Utility companies get rid from the power losses while the consumers are free from low power factor penalty charges.
- As of now power factor in maintained above 0.98 at 66kv. So, no KEB penalty imposed so far, but power factor maintained at 11kv bill in z-division is found below 0.95 which just down to threshold limit of 0.95.
- So, we conclude that power factor maintained in y-division near to unity or by crossing to leading power factor.

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