Eskom

Power Factor: A Basic Overview

Fact Sheet

Eskom

Power factor Series

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Poor power factor adds to the facility inefficiencies, increases operating costs, increases plant breakdowns, and subsequently increases maintenance costs. Many electricity utilities charge an additional fee if a facility's power factor is less than a specified nominal, for Eskom this is 0.96. Low power factor also reduces the electrical system's distribution capacity by increasing current flow, thereby causing voltage drops. By improving the power factor, customers should be able to increase their productivity without requiring additional electrical capacity.

The aim of this fact sheet is to provide a basic overview of power factor and provide insight into how to reduce electricity bills, minimise plant maintenance and enhance your electrical system's capacity by improving the power factor. For more detailed technical information, please refer to Eskom's Power Factor Technical Overview and Power Factor Sizing Guide.

What is power factor?

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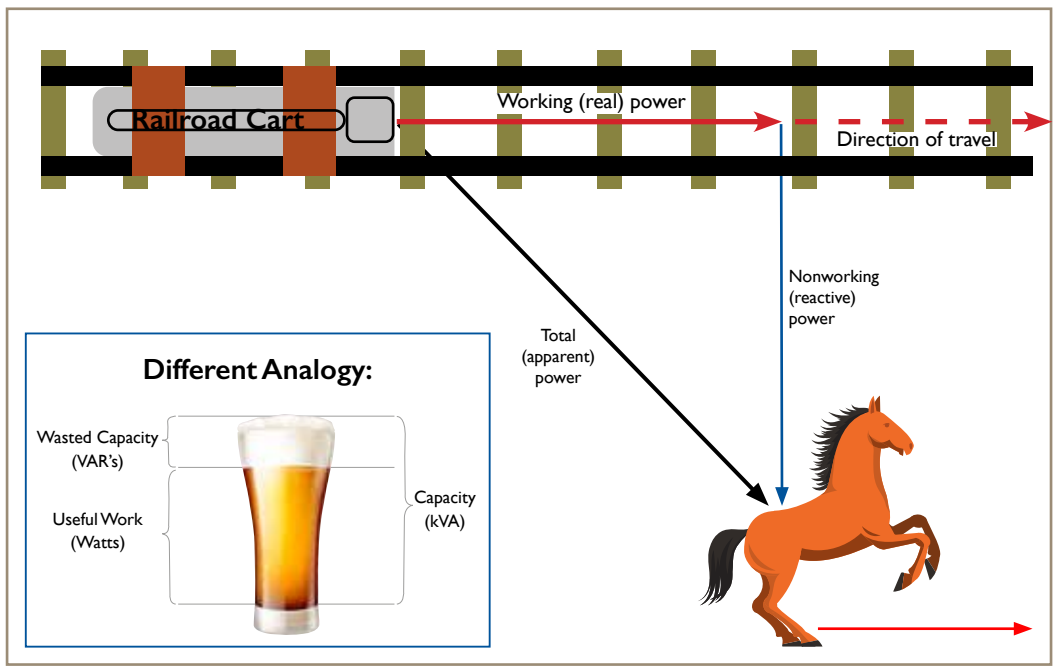
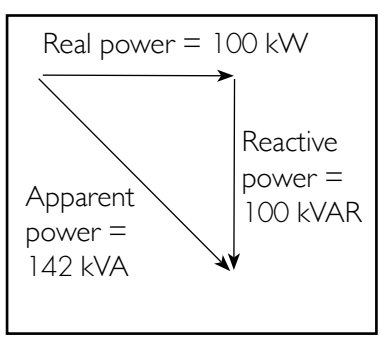
To understand power factor we use a simple analogy. Visualise a horse pulling a railroad cart down a railroad track. Because the railroad ties are uneven, the horse must pull the car from the side of the track, which means the horse is pulling the railroad cart at an angle to the direction of the cart's travel. The usable power required to move the railcar down the track is the working (**real**) power. The full effort of the horse to overcome the angle of pull is the total (**apparent**) power. Because of the angle of the horse's pull, not all of the horse's effort is used to move the railcart down the track. The railcart will not move sideways; therefore, the sideways pull of the horse is wasted effort or nonworking (**reactive or wasted**)



power. The angle of the horse's pull compared to the direction of motion of the cart is related to measure of power factor, which is defined as the ratio of real (working) power to apparent (total) power. If the horse is led closer to the centre of the track, the angle of side pull decreases and the real power approaches the value of the apparent power. Therefore, the ratio of real power to apparent power (the power factor) approaches unity (1). As the power factor approaches 1, the reactive (nonworking) power approaches 0. The equation to represent this is:

$$\text{Power Factor} = \frac{\text{Real Power}}{\text{Apparent Power}}$$

For example, using the power triangle illustrated below, as with the horse-railcart analogy, if



Real power = 100 kW

and

Apparent power = 142 kVA

then

Power Factor = 100 / 142 = 0.70 or 70%

This indicates that only 70% of the power provided by the electrical utility is being used to produce useful work.

3 Causes of poor Power factor

Poor power factor is caused by inductive loads (such as transformers, electric motors, and high-intensity discharge lighting), which are a major portion of the power consumed in industrial complexes. Unlike resistive loads that create heat by consuming kilowatts, inductive loads require the current to create a magnetic field, and the magnetic field produces the desired work. The total or apparent power required by an inductive device is a composite of the following:

- Real power (measured in kilowatts, kW)
- Reactive power, the nonworking power caused by the magnetizing current, required to operate the device (measured in kilovars, kVAR)

The reactive power required by inductive loads increases the amount of apparent power (measured in kilovolt amps, kVA) in your distribution system. The increase in reactive and apparent power causes the power factor to decrease.

4 Why improve Your power factor?

Low power factors waste money directly because of higher electricity bills, and indirectly by reducing the efficiency and capacity of the plant distribution system and the productivity of the equipment it serves. Correcting the system power factor provides four major benefits:

1. Lower electricity bills because of reduced premium and penalty charges
2. Increased system capacity without expansion of the power distribution system
3. Higher, constant voltage levels which result in more effective motor performance
4. Lower line currents, which decrease the electrical losses in the lines and equipment between the power source and the capacitors

5 Conclusions

The question of "will correcting power factor really reduce my electric bill" is not an easy question to answer. However, improving power factor is a proven way of increasing the efficient use of electricity for utilities and end-users.

Economic benefits for end-users may include reduced energy bills, lower cable and transformer losses, and improved voltage conditions, while utilities benefit from released system capacity.

Capacitors are an effective, proven, and efficient means of improving power factor.

6 Eskom advisory Services

Eskom's role is to aid the client with basic information in the decision-making process. Thereafter the Eskom Advisor will fulfil the role of energy advisor as part of the team that the business selects.

Optimise your energy use

Eskom's Energy Advisors, in regions across South Africa, offer advice to business customers on how to optimise their energy use by:

- Understanding their energy needs
- Understanding their electrical systems (including quality of supply) and processes
- Investigating the latest technology and process developments, including electric infrared heating and drying systems
- Analysing how to reduce energy investment costs
- Optimising energy use patterns in order to grow businesses and industries
- Providing information on financial incentives, grants and solutions

Call 08600 37566, get a reference number, leave your name and number and request that an Energy Advisor contacts you. Alternatively, e-mail your advisor at **advisoryservice@eskom.co.za**.

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The aim of this document is solely to provide the reader with some basic information on measures to be implemented to improve the electrical quality of supply, decreasing risk and losses while potentially increasing profits.

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