

Successful Implementation – Energy Conservation Measure

Measure
Conversion in to star mode of under loaded motors
Equipment
Motors
Industry / Sector
Automobile
Year of Implementation
1997
Cost Benefit Analysis
o Type of Measure: Marginal investment
o Annual Energy Savings: 0.15 kWh
o Actual cost savings: Rs. 0.50 lakh
o Actual investment : Nil
o Payback: Immediate
Implementation Highlights
<p>Implementation of the measure has resulted in</p> <ul style="list-style-type: none"> ☞ Low cost measure ☞ This measure can be duplicated in any motor in any industry wherever motors are under-loaded below 50% & are not meant to provide high-starting torque ☞ Though the energy saving are marginal, the compounding duplication of measure in under loaded motors will result ins huge savings ☞ The conversion can be made in house with out external expertise ☞ If the loading of the motor increases in future, it is easy to convert back to the delta connection ☞ Inexpensive

Summary

Conversion of delta connection in to star mode will result in reduction motor losses

Background

A leading automobile manufacturer has machine shop, in which six grinding machines are installed. Each grinding machine has a motor of 22-30 kW rated capacity.

The measure motor power indicated that the motors are under loaded. The following gives the loading details of the motor

- ☰ Grinding machine # 1 (Rated kW : 22) – actual load was 7.2 kW
- ☰ Grinding machine # 2 (Rated kW : 30) – actual load 8.3 kW
- ☰ Grinding machine # 3 (Rated kW : 22) – actual load was 5.3 kW
- ☰ Grinding machine # 4 (Rated kW : 22) – actual load was 5.6 kW
- ☰ Grinding machine # 5 (Rated kW : 22) – actual load was 6 kW

In view of under loading of the motors, Grinding machine # 4 was connected in star mode to demonstrate the power savings. The power consumption in the star mode was 5 kW, yielding energy saving of 0.6 kW. The plant personnel have implemented the measure in all other under loaded motors.

Principle

For motors, which operate at loads below 40-45% of rated capacity, an inexpensive and effective measure might be employ delta/star switches. A change from the standard delta operation to star operation involves re-configuring the wiring of the three phases of power input.

Operating in the star mode leads to voltage reduction $\frac{1}{\sqrt{3}}$ per phase. Motor output falls to $\frac{1}{3}$ of the value in the delta mode, but performance characteristics as a function of load remain unchanged. Thus full load in star mode operation gives higher efficiency and power factor than partial load operation in delta mode. However, motor operation in star mode is possible only for application where the torque to speed requirement also reduces with reduced load.

Details of techno-economics:

Particulars	Actual energy savings
Annual Total energy savings, lakh kWh	0.15
Annual Cost savings, Rs. lakh	0.50
Cost of Implementation, Rs. lakh	00
Simple payback period, Year	Immediate

Implementation issues

It is reported that in one machine the motor got tripped after sometime of conversion. While discussing this issue with the plant personnel, it is felt that the operational variation including change of job-material properties can result in higher torque requirement which in-turn reflects as overloading of the star connected motor. This problem can be circumvented by way of continuous load monitoring, change of overload relay setting and adopting auto-changeover mechanism, which will increase the cost of implementation. Such auto delta-star converter shall help in operating the motor in appropriate mode depending on the loading.