

Successful Implementation – Energy Conservation Measure

Measure
Transformer load management – Load re-distribution and switching off transformers to save on no-load losses
Equipment
Transformers
Industry / Sector
Automobile
Year of Implementation
1997
Cost Benefit Analysis
o Type of Measure: Short term
o Annual Energy Savings: 1.70 kWh
o Actual cost savings: Rs. 6.00 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 unit wherever transformers are kept as hot standby ☞ Though the energy saving are marginal, the compounding duplication of measure will result in huge savings ☞ The implementation can be made in-house with out external expertise ☞ Inexpensive measure

Summary

Energy conservation in transformers exists through transformer load management, re-distribution of loads and switching off transformers

Background

A leading automobile manufacturer has main incomer at 132 kV. This voltage is stepped down to 11 kV. From 11 kV to 433 V, plant has several transformers located in eight substations.

During an energy audit, loading on transformers located at various substations was analyzed. In few of the cases it was observed that some transformers are grossly under loaded (around 10-20%) and the scope exists to shift or distribute this load to other transformer in the substation. This would also ensure optimum level of loading. While achieving optimum loading, the standby transformers at various substations were suggested to be kept open on H.T side to save no-load losses. Also an operating schedule was proposed to alternate the transformer operation weekly so as to keep them in good health.

- ☞ In sub station # 1, one transformer was kept as stand by. This hot standby transformer can be kept open (Energy savings 0.45 lakh per annum)
- ☞ In sub station # 3, transformers #1 and #2 were drastically under loaded (i.e, 20% and 15% respectively). Loads of transformer # 2 were transferred to Transformer # 1 and Transformer # 2 was switched off (Energy savings 0.37 lakh kWh/year)
- ☞ In sub station # 7, transformers # 2 and # 3 were drastically under loaded (i.e, 10% and 25% respectively). Loads of transformer # 2 was transferred to Transformer # 2 and Transformer # 2 was switched off (Energy savings 0.42 lakh kWh/year)
- ☞ In substation # 8, keeping hot standby transformer open, resulted in energy saving of 0.45 lakh kWh per year.

Principle

Normally transformers have very high efficiency (98% or more).

Transformer Losses are:

- ☞ No-load losses (iron losses) are constant. These are 0.2 - 0.5% of nominal power.
- ☞ Load losses (copper losses) vary with square of load. These are 0.7 - 2.1% of nominal power.
- ☞ Maximum transformer efficiency is realized at a percentage loading given by $= \text{Sqrt}(\text{Iron Loss} / \text{Copper Loss})$

Details of techno-economics:

Particulars	Actual energy savings
Annual Total energy savings, lakh KWh	1.69
Annual Cost savings, Rs. lakh	5.9
Cost of Implementation, Rs. lakh	00
Simple payback period, Year	Immediate

Implementation issues

- ☞ While implementing there were some practical difficulties in substation number 3 to transfer the loads to other bus sections hence it was taken up for gradual implementation.
- ☞ Due to increase in plant electrical load from 46 million units to 71 million units, the plant has increased reactive compensation from 6.729 MVAR to 9.856 MVAR, out of which 2x240 kVAR of banks have been adopted through APFC panel so as to avoid overcompensation in light load condition. Presently the average system p.f is maintained at 0.96 lag.