



POWER QUALITY CASE STUDY - STEEL PLANT

BY NAAC ENERGY CONTROLS PVT. LTD.

HOW MINIMISING HARMONIC DISTORTION (THD) ALONG WITH IMPROVING POWER FACTOR CAN INCREASE PRODUCTION AND REDUCE SPECIFIC ENERGY CONSUMPTION IN MINI STEEL PLANTS

BACKGROUND

A large number of MINI STEEL PLANTS are operating in INDIA which have induction furnace (IF) ROUTE of steel making. These are small in capacity ranging from 0.15 to 0.5MT per year. These steel plants have Rolling Mills to produce long steel products, wire rods, pipes etc.

Induction furnaces employ 12 pulse or 24 pulse full bridged rectifiers converting AC voltage to DC and DC to AC through inverters to feed induction coils of induction furnaces. These rectifiers produce harmonic currents of various frequencies in the supply system.

Total Harmonic Distortion (THD) is an important aspect in any power system and it should be kept as low as possible. Lower THD in power system gives higher power factor, lower peak currents and higher efficiency for the plant. Harmonics influence the Power factor and lead to poor energy efficiency for the plant.

In steady state of operation, the quantity of THDs and power factor are recorded to analyse and approach solution for reasonable power factor correction and limited distortions in Sinusoidal voltage of plant. Most of the steel Plants have provided HT capacitor banks without reactors to improve the power factor at metering point.

Further, LT transformers have been provided APFC panels connected to PCCs, having plain Cap. Banks or Detuned Capacitor Bank feeders, each feeder having 7% or 14% reactors at 480V/525V rating capacitors. Such a practice is causes severe voltage & current distortions in the sinusoidal voltage of plant. Detuned. Capacitors Banks (APFCS) having 7% or 14% Reactors do not mitigate harmonics, to improve sinusoidal voltage & sinusoidal current waves of supply system. Also true unity P.F. cannot be achieved due to harmonics. Premature failure of reactors, capacitor banks, motors, cables, electronic devices are caused.

Most of the rolling mills are employing Thyristor FED DC Motors or VFD Drives for AC motors. As such a high magnitude of harmonics are created for the 415V / 660V supply system. It becomes essential to provide harmonic filter banks on the PCC buses to mitigate harmonics and achieve permissible THDs (voltage & current distortions) for the system along with Unity power factor for the fluctuating loads of mill by providing Thyristor Switched Automatic Harmonic Filter Bank feeders.

Higher Voltage Distortions (THD-V) & Current Distortions (THD-I) at various 415V buses cause frequent failures of motors, electronic cards, higher losses of power and interruptions in production cycle. The mitigation of harmonics currents benefits the plant not only in reducing energy consumption KWH/TON of their product of furnace and rolling mill due to reduced losses with proper sinusoidal voltage but also eliminate pre-mature failures of motors, transformers, cables and electronic equipment.

NAAC ENERGY is helping Steel Plants in

- Reducing Specific Energy Consumption
- Increasing Production in Tonnage
- Reducing Operational Faults & Maintenance Cost

Case Study of a Steel Plant in Telangana for the Commissioning of Harmonic Filter Banks by NAAC ENERGY

One of the Steel Plant receives power from electricity board, and distributes power to the plant at 33 KV voltage to Steel Complex (25 ton Induction Furnace, billet Caster etc) & rolling mill. One 33 KV/ 0.433KV transformer, feeds the auxiliary Loads of SMS complex including Billet Caster. 2 No. of Transformers, 33KV / 0.433 KV transformers, feed the entire load of the Rolling Mill. VFD Drive is provided for the blower of the Induction Furnace, for pollution control.

Realcomp Automatic Thyristor Switched Harmonic Filter Bank feeder with Reactors Tuned to 3rd, 5th Harmonic frequencies, have been provided at 415V buses of Rolling Mill and SMS, to improve Power Factor and to mitigate Harmonics at the source point itself. 690V Capacitor units are provided in these new Thyristor Switched Harmonic Filter Banks.

One Passive Harmonic Filter for the 350 KW VFD Drive Feeder has been installed to reduce the harmonics being contributed by the drive. To achieve unity power factor for the Steel Plant and to mitigate harmonic current, 33 KV Filter Banks Tuned to 5th and 7th Harmonic Frequencies have been installed at Main Substation.

With the installation of HT & LT Harmonic Filter Banks, specific energy consumption / ton of product have reduced by 5% and production has increased using additional power available within the agreed contract demand with the Utility grid.

Company is able to recover the cost of complete System within first few months itself. Infact System has become profit centre in itself offering continuous savings per month. With very long operational life of the System the Company shall drive the advantage with competitive edge over its rivals. Harmonic Distortions has been limited as per IEEE Standards.

Higher Voltage distortions (THD-V) and Current distortions (THD-I) at various 415V buses cause frequent failures of motors, electronic cards, higher losses of power and interruptions in production cycle.

The mitigation of harmonics currents benefits the plant not only in reducing energy consumption KWH/TON of their product of furnace and rolling mill due to reduced losses with proper sinusoidal voltage but also eliminate pre-mature failures of motors, transformers, cables and electronic equipment offering long and stable life to the critical load side equipment. The Plant benefits with lower breakdown and higher uptime.

The above schemes have been implemented in many Mini Steel plants all over India giving them immense benefits in terms of reduced energy losses , savings in specific energy consumption , reduced failures in plant equipment , long operational life of Reactive power / harmonic filtration equipment .

SOLUTIONS OFFERED BY NAAC ENERGY

Installation / selection of capacitors require proper study of supply system and information regarding harmonic currents likely to be imposed by the non-linear loads. Sometimes capacitors cause amplification of harmonics current due to parallel resonance conditions with the supply system impedance.

In Mini Steel Plants, induction furnaces and DC drives/VFD drives in rolling mill, inject harmonics currents of various frequencies into the supply system causing lower power factor and severe non-sinusoidal voltages. Provision of Harmonic Filter Banks,

not only eliminates the reactive power requirement from the grid and achieve correct unity power factor but also improves the voltage sinusoidal wave.

For analysis of the problem and for improvement of plant Power Factor, NAAC ENERGY conducts Harmonic Current Study for the non-linear loads of Induction Furnaces and Rolling Mills for different operating conditions.

5 & 7, 11 Harmonic Filter Banks at HT bus and Thyristor Switched APFC Filter Banks Tuned to 3rd & 5 Harmonic at all 415V PCCs are the right solutions to mitigate Current harmonics at the source point itself and to improve power factor up to Unity at all 415V buses and at HT bus. Overall power factor gets improved to Unity at metering point and THD-V & THD-I are achieved within limits as recommended by IEEE standards.

Harmonic Filter Banks at 415V buses are controlled by Thyristor Switched feeders to achieve Unity Power Factor for the fluctuating load of Rolling Mill and SMS. Voltage Distortion (THD-V) and Current Distortion (THD-I) are achieved will within the limits recommended by IEEE Standards.

NAAC ENERGY have sufficient experience to design & offer Harmonic Filter Banks for both HT & LT network of steel plant, textile industry, sugar industry etc. to mitigate the various harmonics currents at the source point itself and to achieve Unity Power Factor at the metering point.