Mahendragarh discovers Automatic Power Factor Correction system.

Static Synchronous Compensator, a power electronic device, anchors the key innovation to trim auxiliary power cost.

±500 kV Mundra-Mahendragarh HVDC transmission system is a bipolar link that evacuates up to 2500 MW of power from the Adani Power - Mundra Super Thermal Power Station at Gujarat to the Mahendragarh of Haryana state.

However, auxiliary power cost is a major expense at Mahendragarh Substation. In a bid to cut down this cost a 1 MW Solar power plant was installed here in July 2017.

Auxiliary load in the Mahendragarh station is mainly inductive. Two most critical systems, Transformer Cooling System and Valve Cooling System make use of Induction motors.

Due to this inductive auxiliary equipment, Mahendragarh station was drawing more reactive power from the grid leading to the poor power factor.

Therefore, ATIL commissioned a study to understand the load conditions of auxiliary system.

Power quality measurement was performed at different locations to understand the present load conditions of auxiliary system (both 33 kV and 415 V). The measurement was conducted using HIOKI 3197 Power Quality Analyser.

Decoding Auxiliary Power structure at Mahendragarh Converter Station-

1. Auxiliary power is supplied through two nos. 33 kV incomer feeders and each is connected to distinct substation of state utility (at a time one feeder is used).
2. Tariff metering is done at sending end (State Electricity Board) of utility and tariff is based on apparent power demand (kVA).
3. Two nos. dedicated 33 kV/415 V, 2000 kVA Transformers feed each Pole-1 & Pole-2 of HVDC converter station. The required auxiliary systems of Pole-1 and Pole-2 of HVDC Bi-Pole link is catered through the dedicated 415 V AC Distribution Boards (i.e., ACDB-1 [POLE-1] & ACDB-2 [POLE-2]).

Problem Statement:

- Low (lagging) power factor due to inductive auxiliary load.
- Variation in power factor due to site specific conditions.
- Variation in Auxiliary load with respect to operational requirements.
Opportunity -

- Correction of power factor provided an opportunity for sizeable savings in Auxiliary power cost.

Key findings of the data analysis:

- Minimum power factor observed on 33 kV switchgear incomer was 0.76.
- The Total Voltage Harmonic Distortion’s ($V_{THD}$) at 33 kV switchgear was well within the acceptable IEEE519 limits.
- Variation of load profile during the measurement was -15% with respect to maximum loading.
After analysis it was decided to provide a compensation of 1000 kVAR to improve the power factor.

A reactive power compensation STATCOM system at 33 kV level by GEPC was selected for power factor correction. The power factor compensator converter system consists of STATCOM (LV Voltage source converters), Transformer and control system. The STATCOM system can provide variable compensation between ± 1000 kVAR at 33 kV based on PWM technique.

About STATCOM:

STATCOM or Static Synchronous Compensator is a power electronic device using force commutated devices like IGBT, GTO etc. to control the reactive power flow through a power network and thereby increasing the stability of power network.

It is a member of the Flexible AC Transmission System (FACTS) family of devices.

STATCOM is a shunt device which is connected in shunt with the line.

The terms Synchronous in STATCOM means that it can either absorb or generate reactive power in synchronization with the demand to stabilize the voltage of the power network.

Conclusion:

The initiative helped in increasing the power factor of auxiliary supply system from 0.76 to unity. It cut down the auxiliary power consumption and led to considerable savings in auxiliary power expenses.
Savings Statistics:

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<th>IR</th>
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<th>VRY</th>
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Power consumption before installation of APFC

Power consumption after installation of APFC

Benefits:

Power factor of Auxiliary supply system increased from 0.76 to unity. It has decreased the Auxiliary power consumption and has led to considerable savings in auxiliary power expense.