



# India SMART UTILITY Week 2024

## Managing VAR in Distribution Grid Stations *“Ways to Vitalize with Technical Advancements for Reliable Smart Grids for Smart Cities*

*By*

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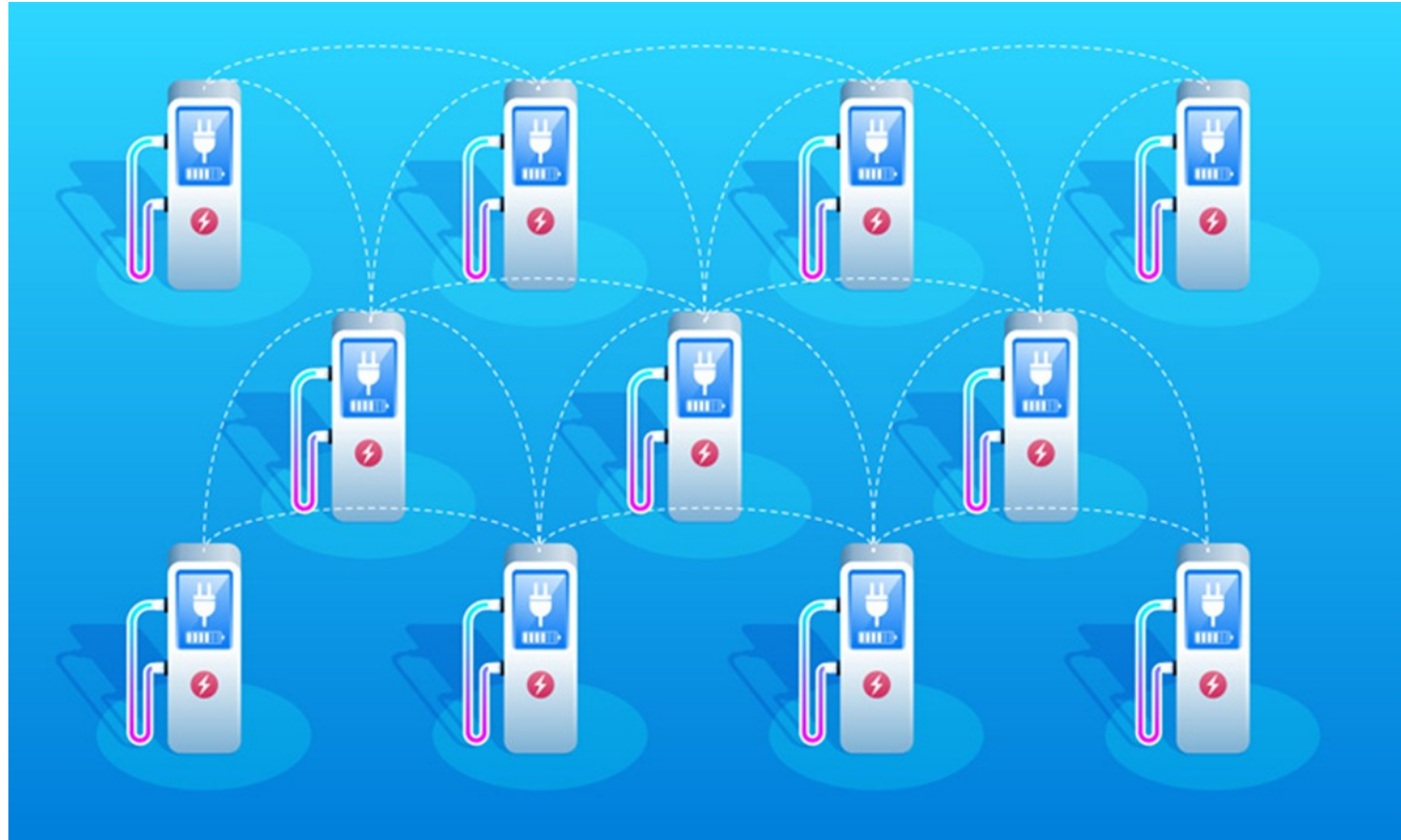
@indiasmartgridforum

# Smart Cities/Grids --- *Challenges & Solutions*



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- Gol has announced 100 cities as *Smart Cities*.
- These Smart Cities will require essentials like;
  - Security Systems
  - Street/Park smart Lights
  - Smart Traffic Controls
  - Metro Rail
  - Pollution free transport ie *EV Charging Systems*
  - Beautiful Picnic/Historic spots
  - Etc Etc

All such facilities will depend upon



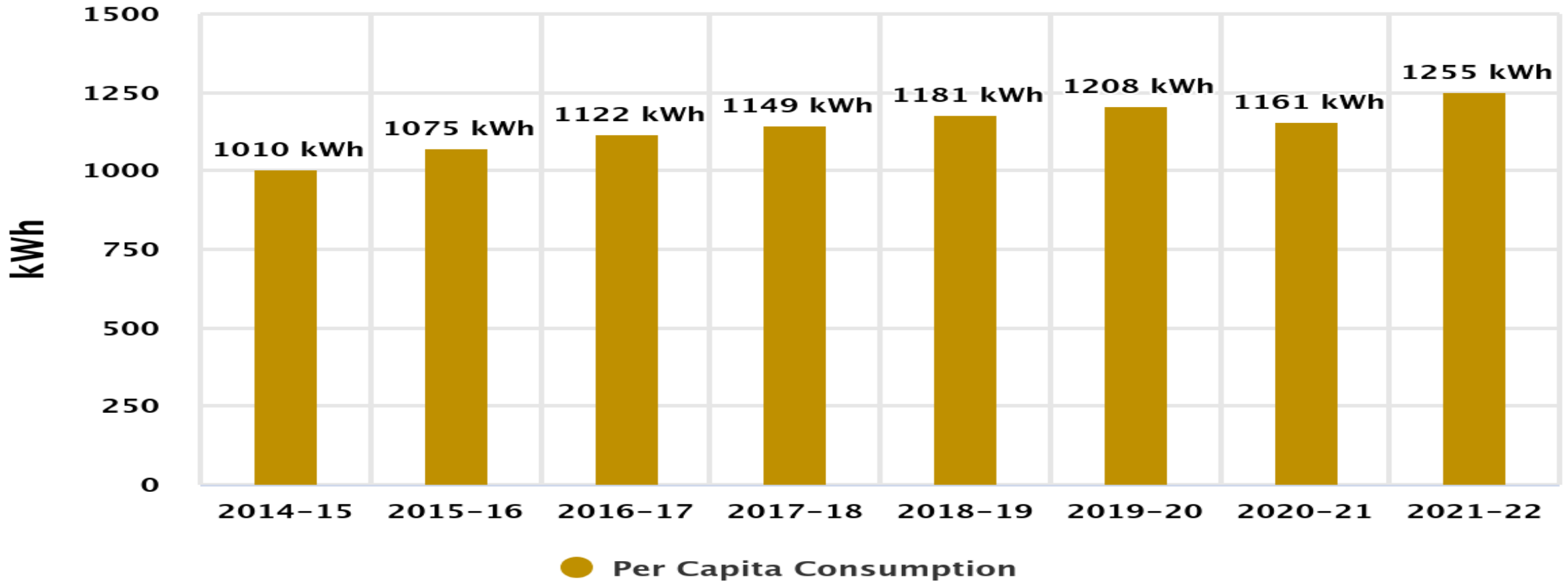
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- **Quality of electric supply with Reliability like;**
  - Voltage deviation within Limits**
  - Frequency deviation within limits**
  - Reliability with at least with N-1 technology.**
  - Availability at required ends.**
  - Etc. Etc**

# Per Capita Consumption

Per Capita Consumption (kWh)



# QUALITY POWER---?

- Adhering to Grid Code.
- **No fluctuations and unwanted distortion ( within limits)**
- Constant frequency
- **Voltage varies with in specified limits i.e. +/- 5 %**
- Pre-determined shut downs
- Periodic specified maintenance
- **Good Power Factor i.e. Reducing load on conductors**
- Equal loading on transformers
- **Energy auditing**
- Alternate paths for power transfer.
- **Load flow monitoring through SCADA.**

•To achieve improvement in supply at tail end, there are so many ways like

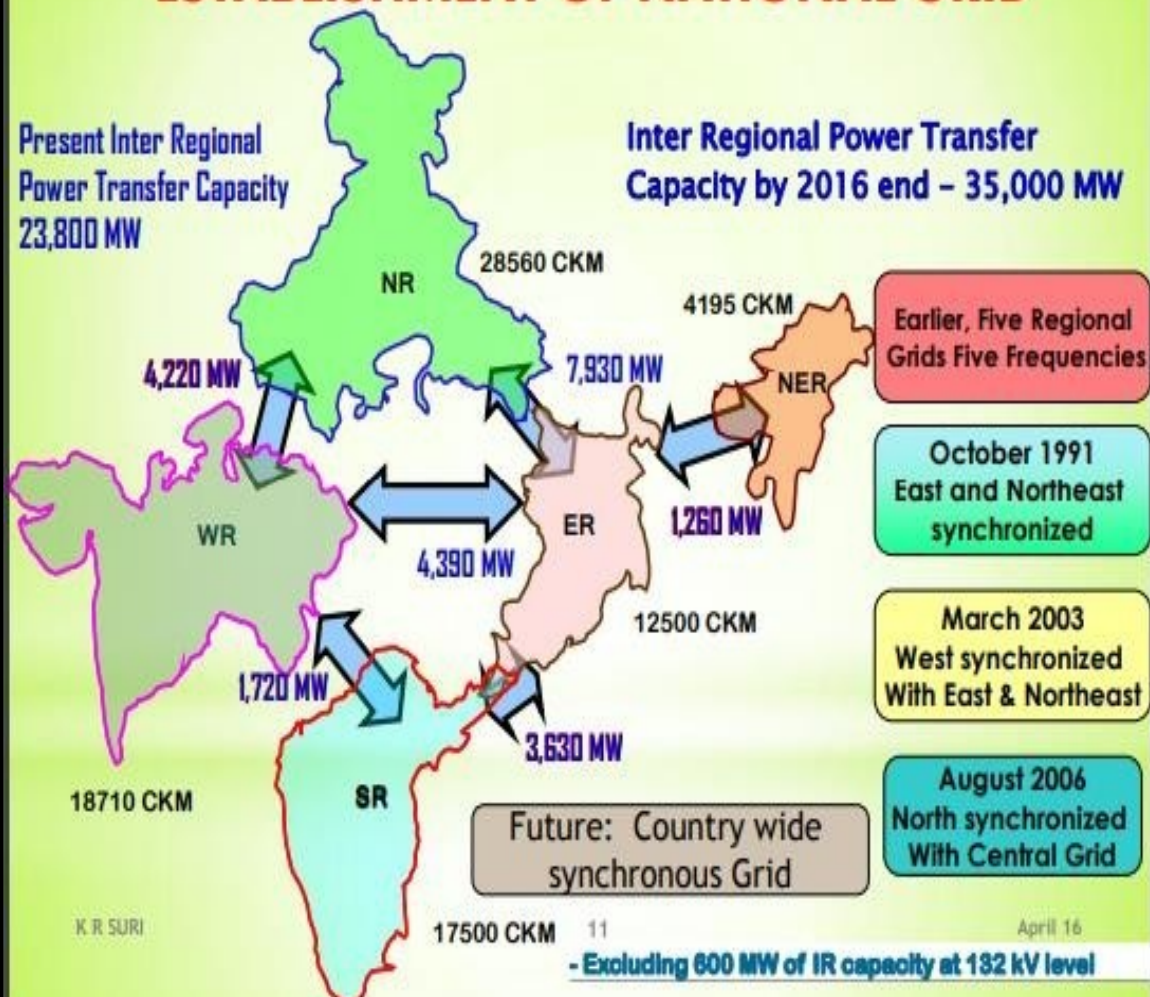
- **Frequent operation of transformer taps – up to some extent**
- **Use of HTLS/HPC Conductors**
- **Deployment of distortion filters like Capacitors/filters**
- ***Deployment of VAR Compensators at Sub-Transmission levels.***



# ONE NATION ONE GRID

Connected Grids by 2013 with VAR Compensators In Phased Manner

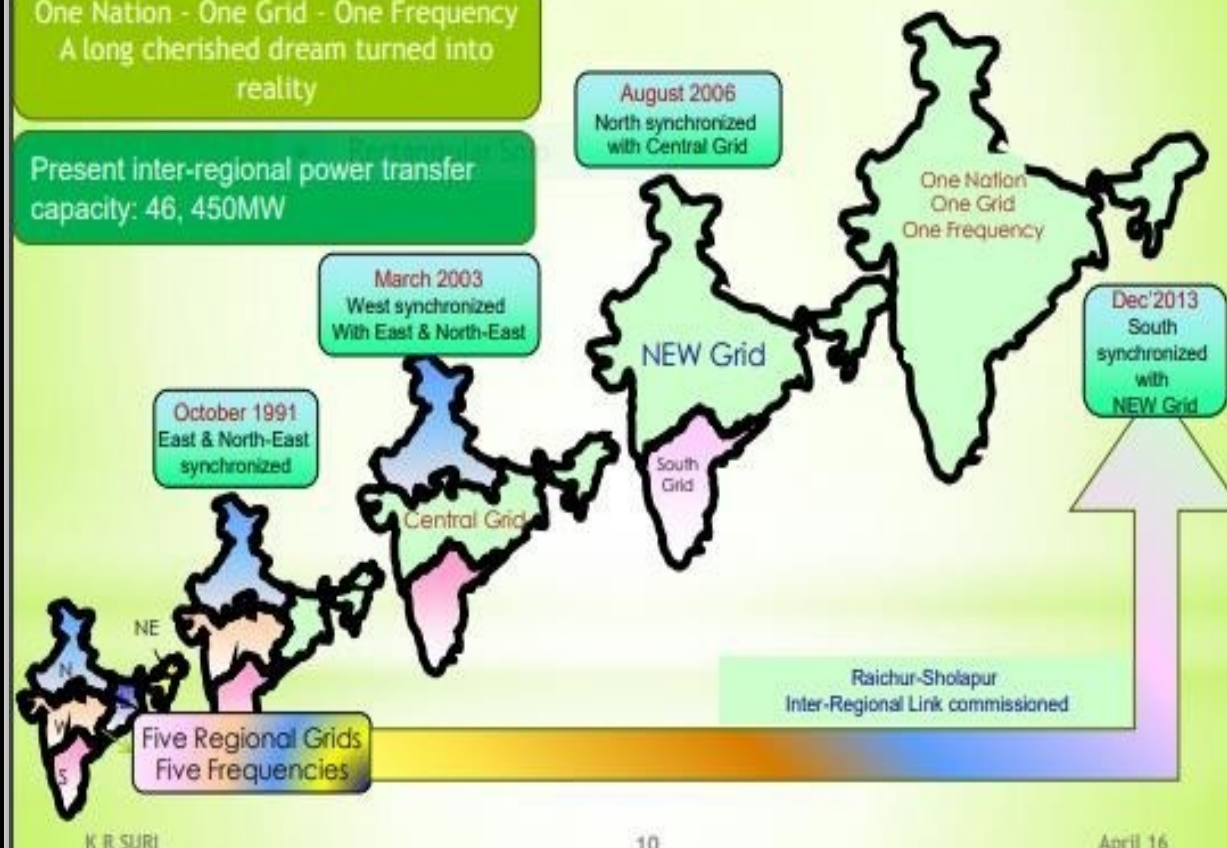
## ESTABLISHMENT OF NATIONAL GRID



## National Grid - Evolution

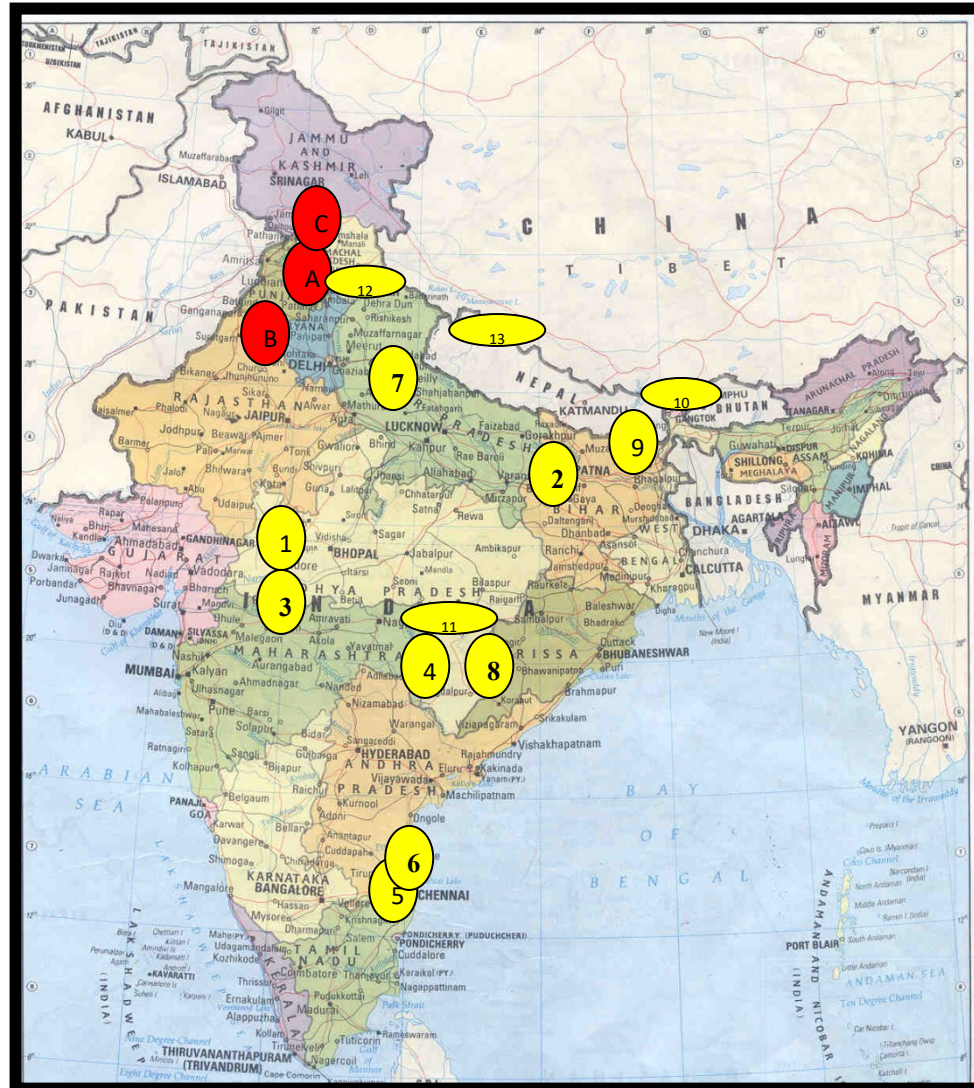
One Nation - One Grid - One Frequency  
A long cherished dream turned into reality

Present inter-regional power transfer capacity: 46,450 MW





# SVCs and STATCOMs..... (Commissioned / Under Execution)



## SVC

**Kanpur S/S: 2 X +/- 140MVAR  
-- Since 1992.**

**(De-Capitalized after completing 28Yrs)**

- A. Ludhiana S/s : (+) 600 MVAR / (-) 400 MVAR**
- B. Kanakroli S/s : (+) 400 MVAR / (-) 300 MVAR**
- C. New Wanpoh S/s - (+) 300 MVAR / (-) 200 MVAR**
- D. FC + TCR at Kurukshetra HVDC terminal**

K R Suri



# STATCOMS

- NP KUNTA S/S : +/- 100Mvar
- Rourkela  $\pm 300$  MVAR STATCOM ; 2X125 Reactor
- Aurangabad  $\pm 300$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Solapur  $\pm 300$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Satna  $\pm 300$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Ranchi  $\pm 300$  MVAR STATCOM ; 2X125 Reactor
- Jeypore  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 2x125MVAR Capacitor
- Kishanganj  $\pm 200$  MVAR STATCOM ; 2X125 Reactor
- Nallagarh  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 2x125MVAR Capacitor
- Gwalior  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor

- Lucknow  $\pm 300$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Hyderabad  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Trichy  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- Udumalpet  $\pm 200$  MVAR STATCOM ; 2X125 Reactor , 1x125MVAR Capacitor
- **UNDER CONSTRUCTION:**
  - 1. 2X300Mvar STATCOM at Fatehgarh with MSC & MSR
  - 2. 2X300Mvar STATCOM at Bhadla with MSC & MSR
  - 3 1X300Mvar STATCOM at Bikaner with MSC and MSR

## Merits

## SVCs/STATCOMs

- Reduction In MVAR Demand ie Improvement in PF and reduction in harmonics.
- Reduced equipment running cost
- Decreased energy charges
- Reduced Power losses ie Transmission losses.( Direct & Indirect)
- Incentive in electricity bills
- Reduce heat loss of transformers and associated equipment
- Prolonged life of equipment
- Stabilizes voltage levels
- Ultimately Increase system's capacity, etc.

# VAR Compensation by Discoms (VITAMIN)

- ***NOT IMPLEMENTED***
- Force the Industry to install Capacitors/SVCs for Voltage improvement & ***not as filters.***
- ***Even these are without studies like Harmonics level created ie a standard norms fixed by Discoms.***
- **Not Adhering to Grid Codes at Distribution/Sub Transmission levels.**
- **Not adhering to SCADA codes.**
- **Etc Etc**



# ***SVC**----- World wide installations at Lower Levels*



| World Wide       |                         |          |
|------------------|-------------------------|----------|
| <u>VOLTS(kV)</u> | LOCATION                | SUPPLIER |
| 220              | <u>Karavia, Congo</u>   | ABB      |
| 132              | Black Water, Queensland | Siemens  |
| 220              | Cerro Navia, Chile      | ABB      |
| 220              | <u>Polpaico, Chile</u>  | ABB      |
| 132              | Queensland              | ABB      |
| 132              | Iceland                 | ABB      |
| 132              | Vancouver, Canada       | ABB      |
| 18               | CERN, Geneva            | ABB      |

# SVC Light --- ABB --- Ref. List

| Location/Country  | Range(MVAR) | Voltage(KV) |
|-------------------|-------------|-------------|
| Uddehm/Sweden     | 0--44       | 33          |
| Amprion/Germany   | 0--38       | 20          |
| Outokumpo/Finland | 0--164      | 33          |
| SNCF/France       | +/- 17      | 90          |
| Gerdau/USA        | 0--64       | 13.2        |
| ZPSS/China        | +/-82       | 35          |
| SNCF/France       | +/-15       | 63          |
| Asia Steel/Japan  | 0--64       | 22          |
| Bankok            | +/- 120     | 22          |
| Saudi Arabia      | 0--125      | 33          |

## *OTHER WAYS TO IMPROVE QUALITY*

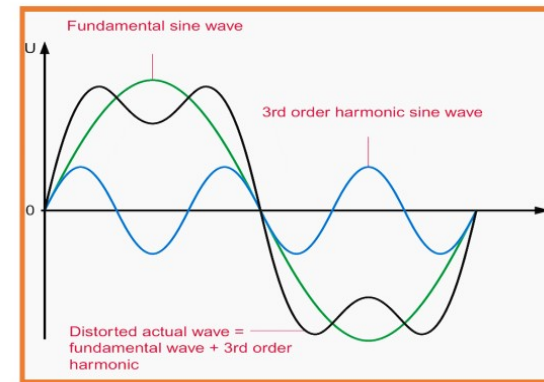
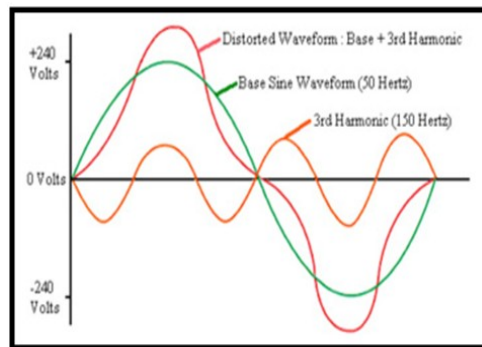
- HTLS/HPC CONDUCTORS
- ETOs
- Portable VAR Compensators



# Embedded Transformers

- Automatic Tap changer operations
- Oil sensors (DGA & other parameters)
- Temperature cum load monitoring etc.
- Central communication inter phase for data transfer
- Making cyber security proof.
- Etc.

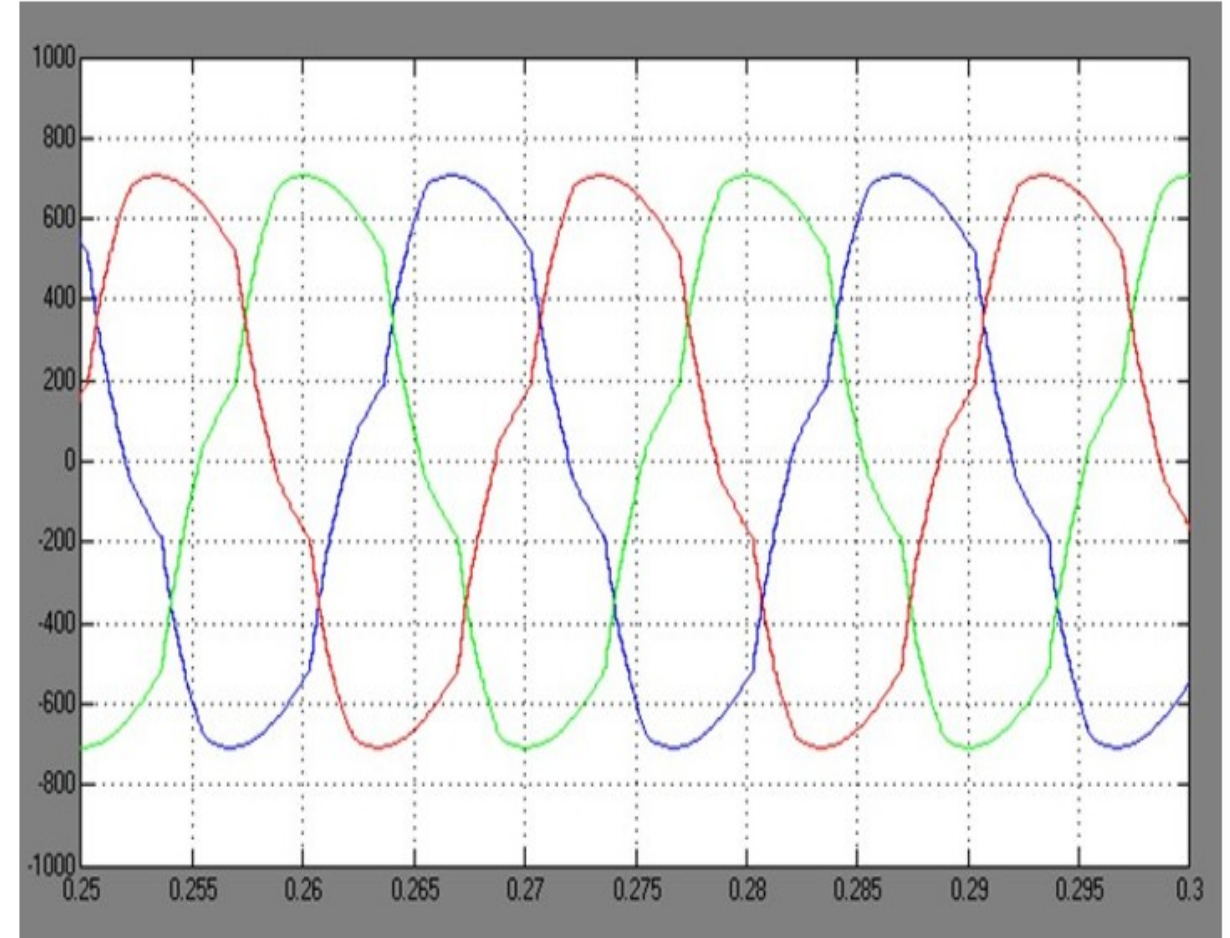
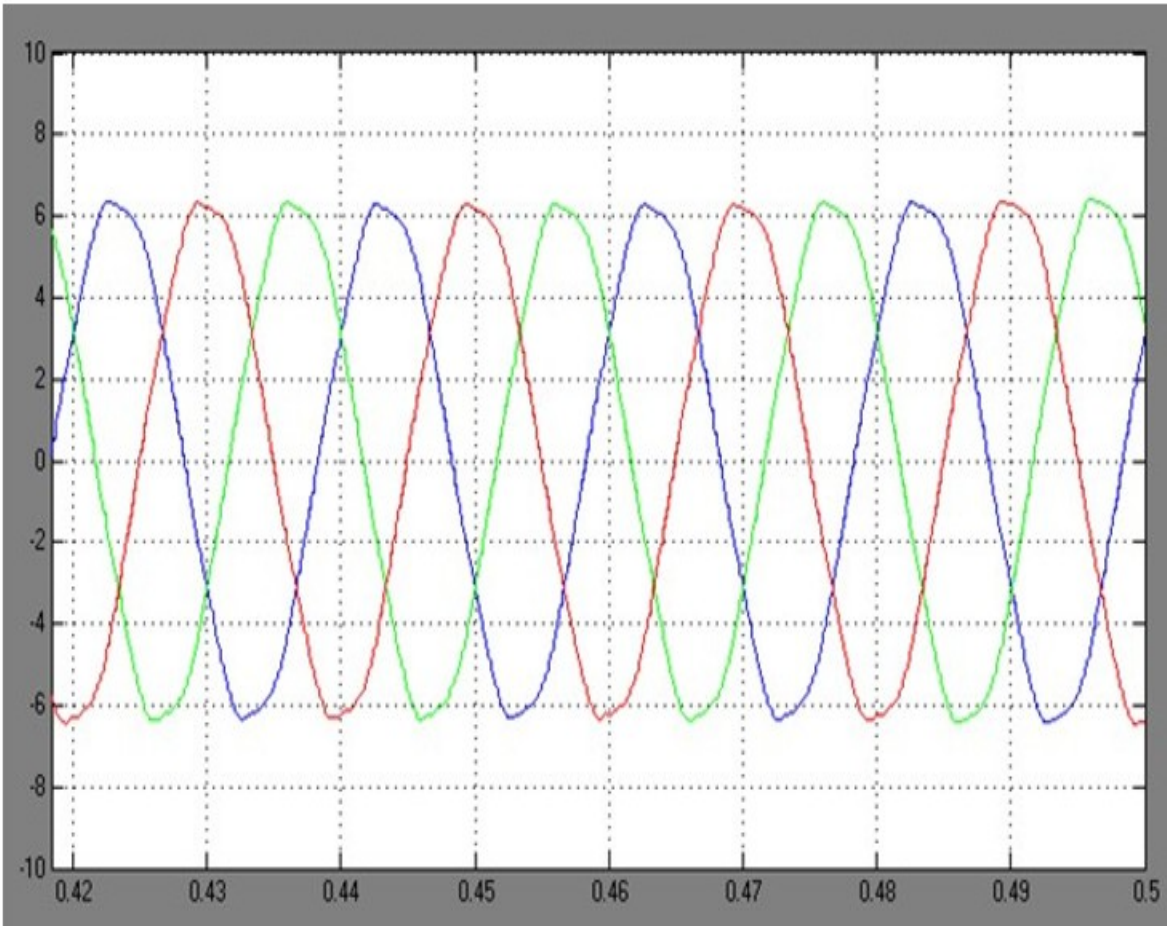
# EV — Charging --- Yet to be at Large Scale in BHARAT



This Distortion in cumulative has impact on life of Distribution Transformers like

- Insulation
- More stray losses
- More noise level
- Ultimately reduced life.

# Load Voltage waveform with & without *STATCOM*





# Available SVCs/STATCOMs



By Hitachi Energy

**Upto 33kv --- 40 Mvar  
Beyond – As per study**



By ABB



*Thank you*



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