Power Quality Issues and Challenges for RES Grid Integration

Keynote Address

By A.VELAYUTHAM

Ex –Member, MERC

Ex –Member Secretary, WREB

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PQ Issues –RES Grid Integration

- Power Scenario
- PQ Overview
- Electricity Act 2003 Provisions
- Regulations of Regulatory Agencies
- Variable RES Grid Integration Issues
- Way forward Action Plans

INSTALLED CAPACITY GROWTH

YEAR	Installed Capacity (MW)
1947	1362
1977	21469
2007	132329
2011	182344

INSTALLED CAPACITY (MW) AS ON 30.09.2011 (TYPE WISE)

THERMAL	**118696**
HYDRO	**38706**
RES	**20162**
NUCLEAR	**4780**
TOTAL	**182344**

POWER SUPPLY POSITION (April-December 2010)

POWER	Demand (MW)	Met (MW)	Shortage (%)
	119437	107286	10.2
ENERGY	Requirement (MU)	Availability (MU)	Shortage (%)
	638181	582225	8.8

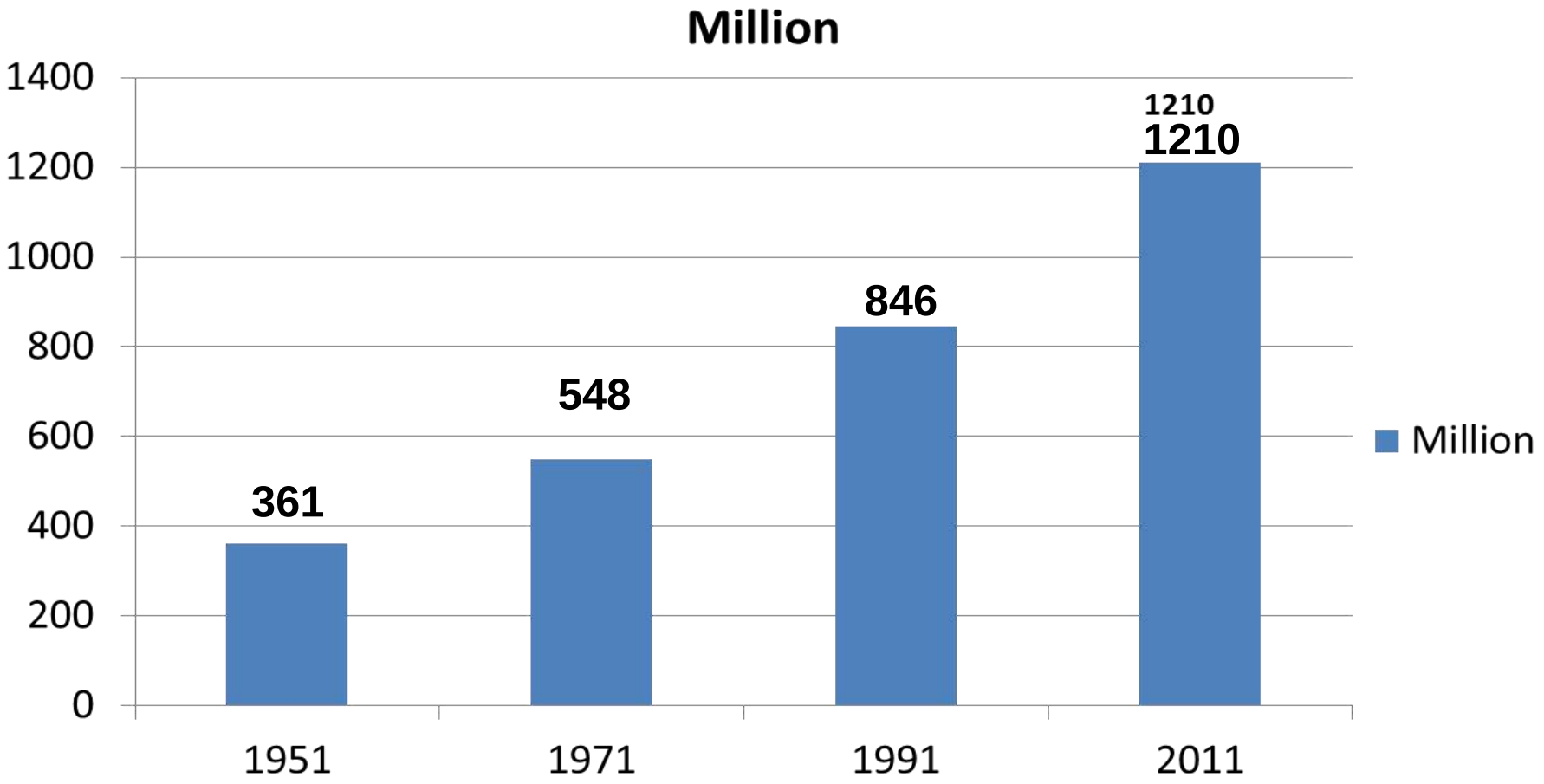
FREQUENCY PROFILE OF INDIAN GRID (APRIL-JUNE 2011)

Region	N,W,E& NE	South
Below 49.5Hz (%)	4.92	9.23
49.5 –50.2Hz (%)	91.53	88.72
Above 50.2Hz (%)	3.55	2.05
Average	49.89	48.80
Max (Hz) Min (Hz)	50.73 48.88	50.86 48.80

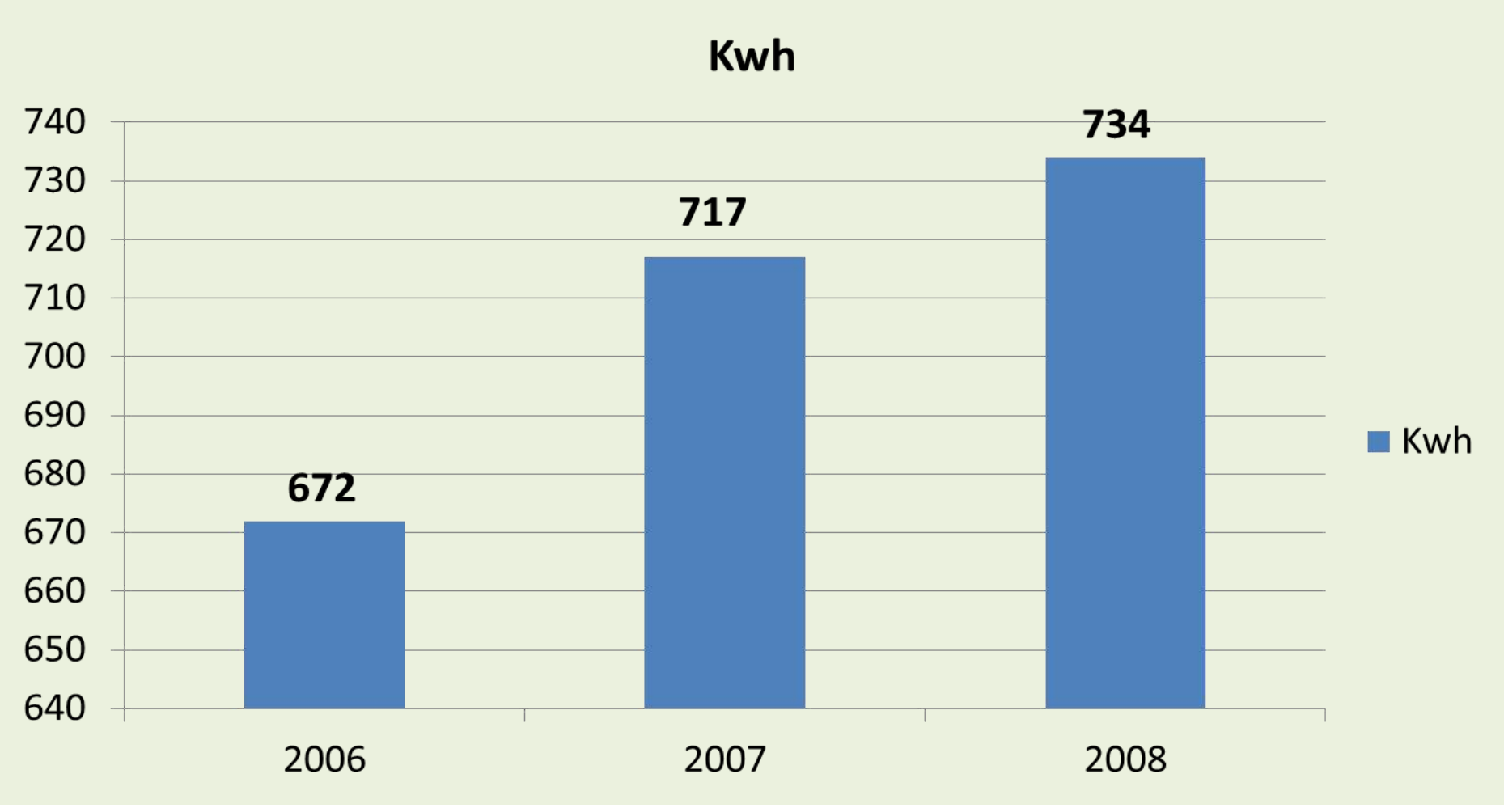
FREQUENCY PROFILE OF INDIAN GRID

- Before July,2002 the frequency of operation prevailing was 48.0 – 51.5Hz
- After July 2002, the permitted operating freq was 49.0 – 50.5Hz.
- From June 2009, the band was restricted to 49.2 – 50.3Hz.
- As per IEGC, present operating range permitted is 49.5 – 50.2Hz.
- It is proposed to reduce the range further to 49.7 – 50.2Hz

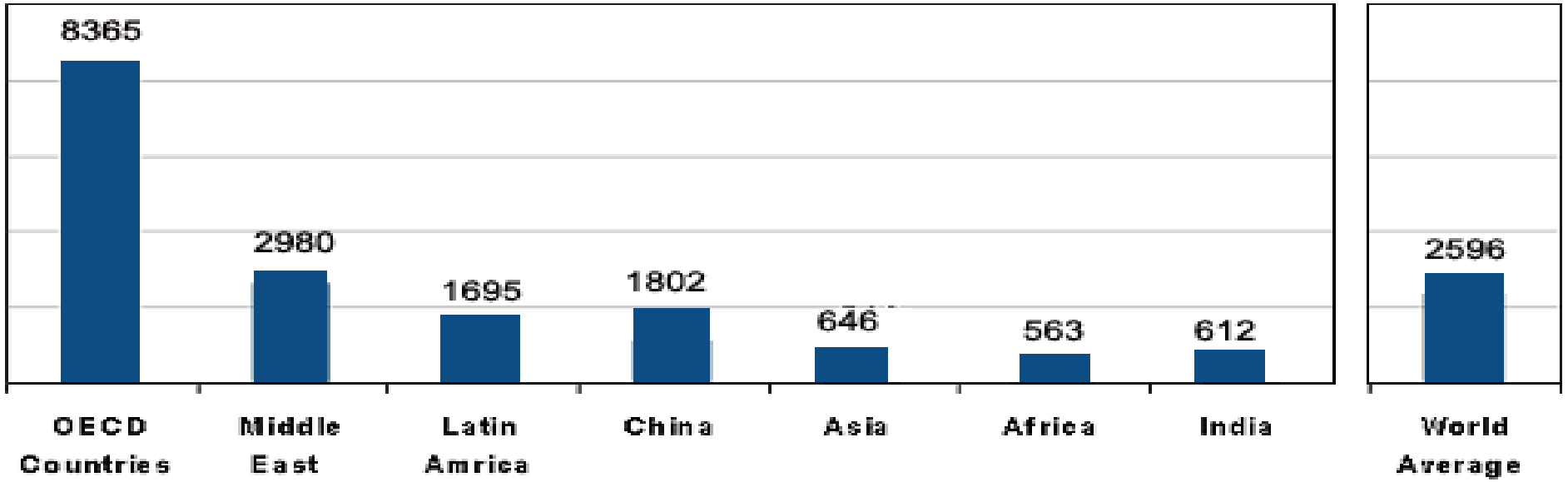
POPULATION GROWTH IN INDIA



PER CAPITA CONSUMPTION (INDIA)



COMPARATIVE PER CAPITA CONSUMPTION OF ELECTRICITY (kWh)



Source : Key World Energy Statistics (2007)

PQ Overview

- The definition ***of' power quality*** or more specifically, a ***power quality disturbance,*** is generally accepted as: any change in the power(voltage, current, or frequency) that interfere with normal operation of electrical equipment.
- It is the susceptibility of the end-use equipment that defines the necessary level of power quality.
- Non –linear load
- True RMS value, True Power Factor

  –Harmonic influence

PQ Overview (Contnd…)

- PQ in Indian context
- Ignorance of Indian Industry on PQ impact
- Priority of Implementing agencies
- Insufficient data to focus on the impact
- Distribution utility's reluctance to display PQ performance data in Public domain

EA 2003 PROVISIONS

- Suspension of Distribution License when failed to maintain quality of electricity(section 24 (1)(a))
- CERC to adjudicate dispute with reference to PQ in Regional Grid system between RLDC and Regional System users(Section 29(5))
- SERCs to adjudicate dispute with reference to PQ in State Grid system between SLDC and State System users (section 33(4))
- District Co-ordination Committee to review the quality of power supply and consumer satisfaction (Section 166(5)(b))

EA 2003 PROVISIONS (Contnd…)

- CERC to specify and enforce the standards with respect to quality, continuity and reliability of service by licensees. (Section 79(1)(i))
- Central Advisory Committee to advise CERC on matters relating to PQ (Section 81(ii))
- SERCs to specify and enforce the standards with respect to quality, continuity and reliability of service by licensees. (section 86(1)(i))
- State Advisory Committee to advise SERC on matters relating to PQ (Section 88(ii))

REGULATION OF REGULATORY AGENCIES

- Indian Electricity Grid Code issued by CERC
- State Grid Code issued by SERCs
- Standard of Performance issued by SERCs
- Distribution Code issued by SERCs
- Technical standards issued by CEA
- Equipment standard issued by BIS

CEA REGULATIONS 2007 – TECHNICAL STANDARDS FOR GRID CONNECTIVITY

- Grid connectivity standards as applicable to Distribution Utility and Bulk Consumers
- Reactive Power(Schedule Part IV. 2)
  - Distribution Utility & Bulk Consumers Power Factor shall not be less than 0.95.
  - Adequate compensation shall have to be provided, shall not draw reactive power from grid

CEA REGULATIONS 2007 – TECHNICAL STANDARDS FOR GRID CONNECTIVITY
(CONTND…)

- Voltage and Current Harmonics(Schedule Part IV. 3)
  - The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%
  - The total harmonic distortion for current drawn from the transmission system at the connection point shall not exceed 8%
  - The limits prescribed in (1) and (2) shall be implemented in a phased manner so as to achieve complete compliance not later than five years from the from the date of publication (21st Feb,2007)

CEA REGULATIONS- GRID STANDARDS 2010(Notified on 26,June,2010)

System Voltage (kV rms)	Total Harmonic Distortion (%)	Individual Harmonic of any Particular Frequency(%)
765	1.5	1.0
400	2.0	1.5
220	2.5	2.0
33 to 132	5.0	3.0

ERCs REGULATIONS

- Some of the commissions (not all) have notified std. of performance, harmonic deviation limit, SAIDI,SAIFI have been specified. Distribution licensees were asked to submit SAIDI,SAIFI data.
- Very few commissions have notified Distribution Code.
- Orissa ERC have constituted PQ monitoring Committee and the committee meets periodically

VARIABLE RES GRID INTEGRATION

- Policy Directions
- Transmission
- Grid Connectivity
- Grid Operation
- Power Quality

Grid Operation Challenges (RES)

- Frequency Control
  - Commercial Signal
  - Frequency Error Penalty
- Reactive Power Support
- Balancing Act
- Ancillary Services
- Merchant Power Plants
- Pumped Storage Power Plants

Connectivity Issues (RES)

- Transmission Planning Criteria
  - SIL, N -1 criteria
- Evacuation inadequacy
- MNRE funding Evacuation Schemes
- FRT capability
- Variable RES forecast
- Separate LDC under SLDC/RLDC
- Cost Sharing
  - Evacuation, Balancing

WAY FORWARD ACTION PLANS

- Developing Ancillary Services Market
- Creating Separate LDC for RES
- APQI to continue its activities –advocacy
- Identifying issues for study and R & D and also the Agencies
- Addressing funding requirements and the agencies
  - MNRE,MOP,ERCs, RES developers,APQI,CPRI etc.

WAY FORWARD ACTION PLANS (contnd…)

- CPRI to interface with funding and R & D agencies
- CPRI to take input from APQI,LPQI of Europe & USA
- CPRI to have joint activity with EPRI,USA
  - PQ related
  - RES grid integration

Join & Contribute to resolve the issues of the Nation

THANK YOU ALL