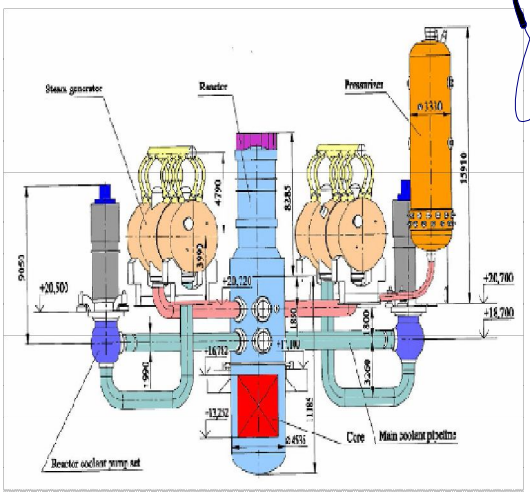
Topics

- About KKNPP -VVER
- C&I Systems of KK
- Brief Description of MCDS and its subsystems
  - In-Core Instrumentation System (ICIS)
  - Vibration Monitoring System (VMS)
  - Coolant Leak Monitoring System (CLMS)
  - Loose Part Monitoring System (LPMS)
  - System of Integrated Analysis (SIA)

Kudankulam Nuclear Power Plant (KKNPP)-VVER

- Kudankulam (KK) Project consists of 2 units of 1000MW Pressurized Light Water reactors (PWR) (VVER-320 model), which are being built with Indo-Russian collaboration.
- This type of reactor uses light water as coolant and moderator and enriched uranium (about 2.2 to 4.4% U235 max) as fuel.
- Similar reactors are in operation, World over (countries like Russia, China etc).

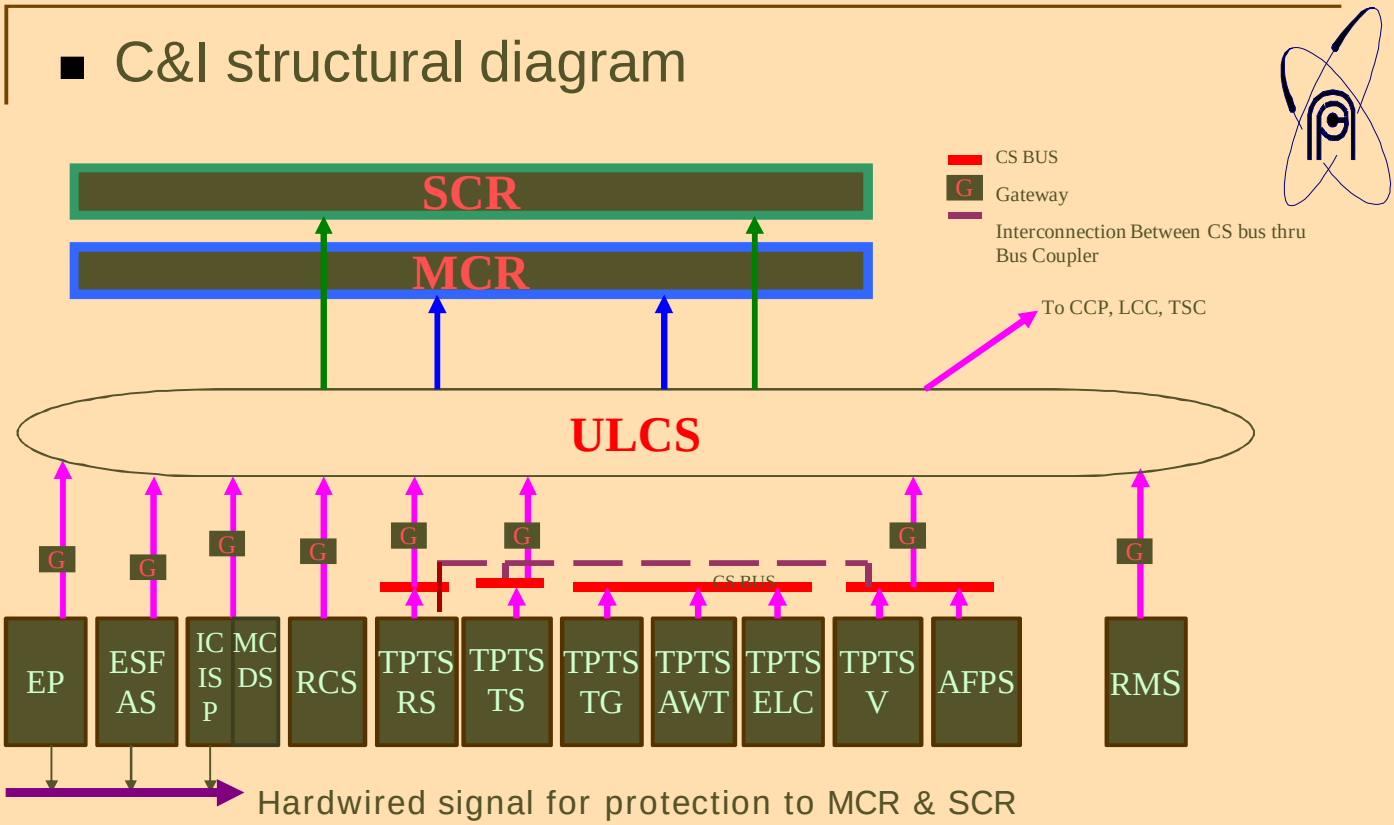


- **Distance from Nagercoil is 35Kms.**
- **Distance from Kanyakumari is 27Kms.**

C&I Systems of KKNPP

- C&I of KK is broadly divided into following categories:-
  - Control System → Reactor Control System (RCS)
    Plant Control System (TPTS)
  - Safety System → Emergency Protection System (EP)
    Engineered Safety Feature Actuation System (ESFAS)
  - Monitoring & Diagnostic system → Monitoring Control & Diagnostic System (MCDS)
    Automatic Fire Protection system (AFPS)
    Radiation Monitoring system (RMS)
  - Operator Interface → Main Control Room (MCR)
    Upper Level Control System (ULCS)

- C&I structural diagram



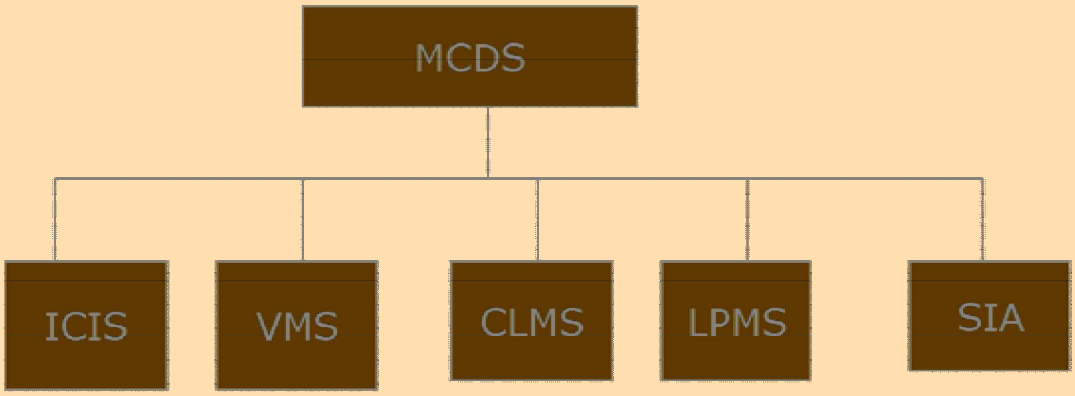
- Integrated to plant upper level control system by LAN and Gateways.

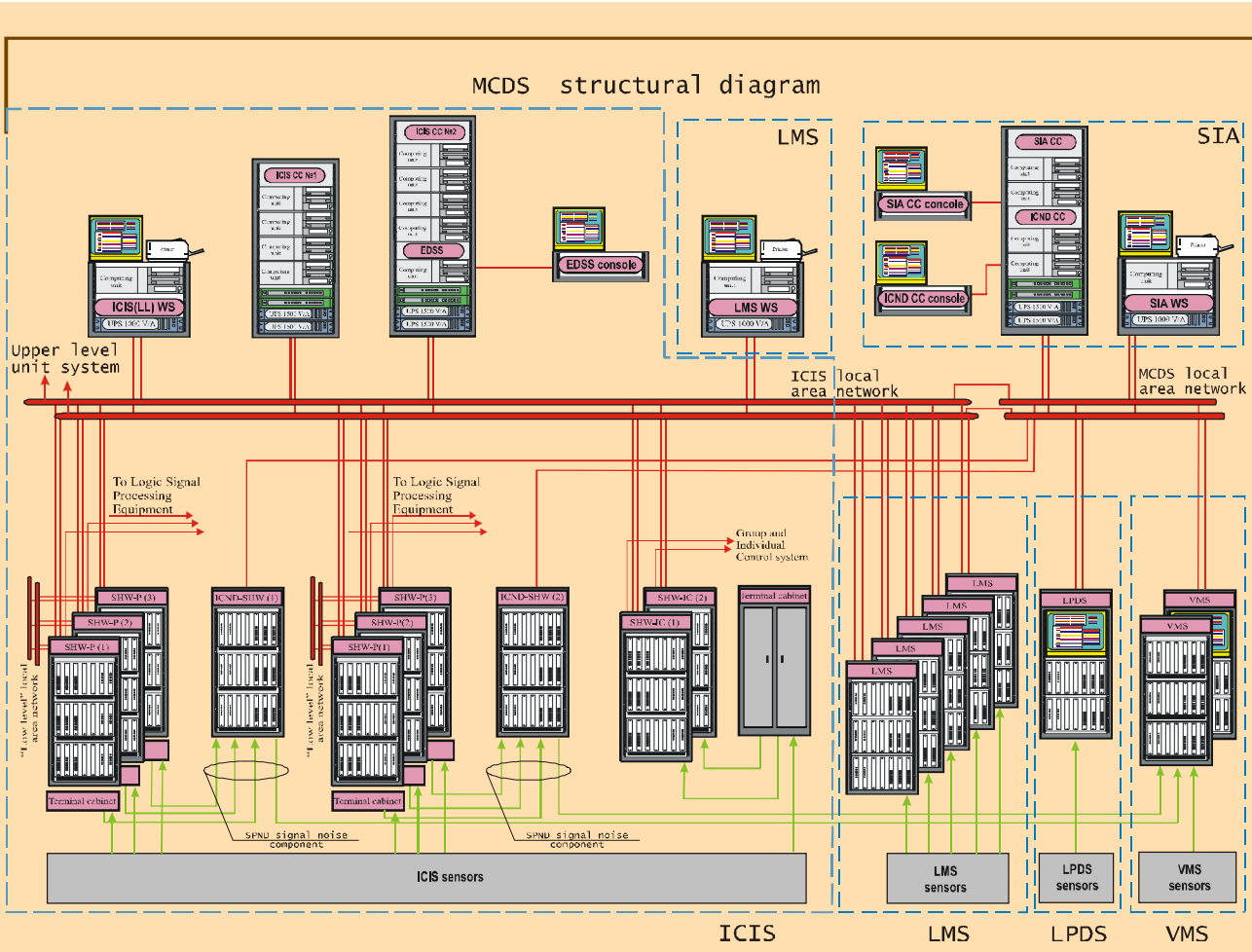
Monitoring Control & Diagnostic System (MCDS)

MCDS is one of the vital and unique C&I system which acts as key tool for improving performance and availability of plant operation.

MCDS- Subsystems

- In-Core Instrumentation System (ICIS)
- Vibration Monitoring System (VMS)
- Coolant Leak Monitoring System (CLMS)
  - Acoustic Leak Monitoring System (ALMS)
  - Humidity Leak Monitoring System (HLMS)
- Loose Part Monitoring System (LPMS)
- System for Integrated Analysis(SIA)

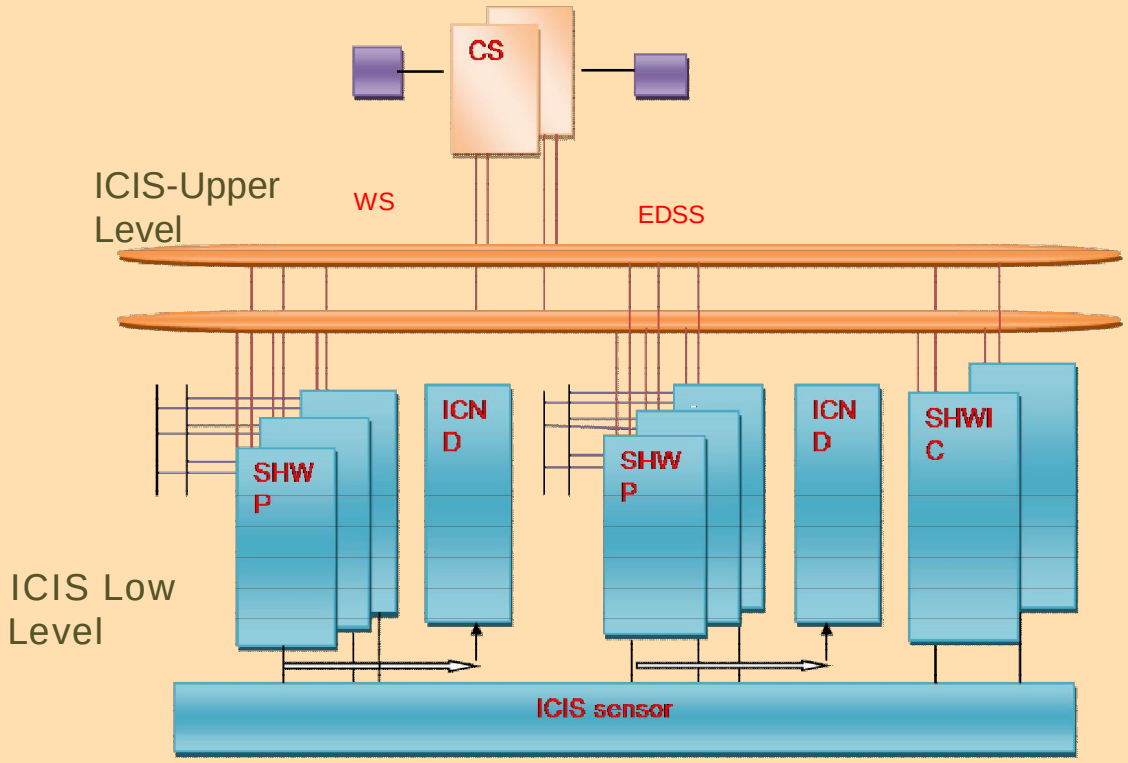



MCDS structural diagram
LMS
SIA
ICIS CC №1
ICIS CC №2
EDSS
EDSS console
ICIS(LL) WS
LMS WS
SIA CC concole
ICND CC console
SIA CC
ICND CC
SIA WS
Upper level unit system
ICIS local area network
MCDS local area network
To Logic Signal Processing Equipment
To Logic Signal Processing Equipment
Group and Individual Control system
SHW-P (3)
SHW-P (2)
SHW-P (1)
ICND-SHW (1)
SHW-P(3)
SHW-P(2)
SHW-P(1)
ICND-SHW (2)
SHW-IC (2)
SHW-IC (1)
Terminal cabinet
Terminal cabinet
SPND signal noise component
SPND signal noise component
ICIS sensors
LMS sensors
LPDS sensors
VMS sensors
ICIS
LMS
LPDS
VMS

In-core Instrumentation System (ICIS)

In–core Instrumentation System

- It performs following functions
  - Online monitoring of neutron flux, process parameters and thermal-hydraulic properties of the reactor in-core, primary and secondary circuits in all modes of reactor operation.
  - Calculation of **Departure from Nucleate Boiling Ratio (DNBR)** & **Linear Heat Generation Ratio (LHGR)** and generation of reactor trip signal whenever these local parameters exceed safety limits
  - Generation of signal for power field distribution control (flux tilt control)
  - Online monitoring of neutron noises.
  - Transmission of information to SIA and ULCS for operator interface.
- **DNBR**: Measures of proper cooling of reactor.
- **LHGR**: Ensures localized heating of fuel within safe limits



ICIS Block Diagram

ICIS Low Level

- **SHW-P**-used for protection function.
  - calculate DNBR and LHGR
  - generate reactor trip

- **SHW-IC**-used control and information function
  -acquire information on current state of reactor core, primary and secondary circuits**.**
  -generate Control signal for flux tilt control

- **SHW-ICND**- used for noise diagnostic
  - monitor neutron noises to detect the local boiling of the coolant in the in-core volume.
  - transmits signal to VMS

- **ICIS Upper Level –** consists of two dual redundant servers (CS), workstation (WS), Engineering Duty Service station (EDSS).

- It performs following functions:
  - Receives and analyzes the information from low level system/ other subsystem of MCDS to determine critical parameters like **thermal power of reactor** etc
  - Periodically acquires, updates and transmits coefficients required for DNBR/LHGR calculation
  - Exchanges data with the SIA to define the current status and forecast the development of processes in the reactor core.
  - Provides display, storage and archive of information and interface with ULCS.

Vibration Monitoring System (VMS)

Vibration Monitoring System

- It performs following functions:
  - Monitoring of reactor plant (RP) equipment vibration when reactor is in operation
  - Perform analysis and inform the operator in advance about the increased vibrations of RP equipment or deteriorating conditions of RP equipment supporting structures.
  - Monitoring of displacement of RP equipment during heat up and cool down of reactor.

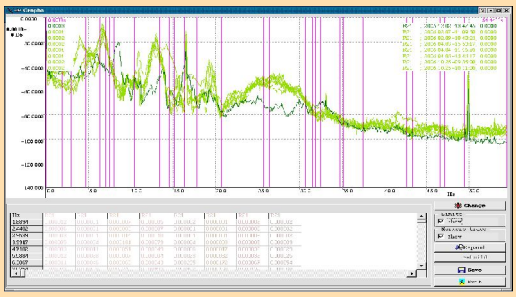
VMS System Description

- It measures vibration of RP equipment by using signals from following detectors:
  - displacement transducers (absolute, relative)
  - pressure oscillation transducers
  - signals from ICND (two assemblies)
  - ex-core signals

RDT

- The displacement and pressure oscillation transducers are placed at reactor main studs, SG, RCP supports and at inlet/outlet headers etc.

- VMS compares actual vibration spectrum of equipment with baseline vibration spectra representing normal operation conditions, providing assessment of equipment's condition and generate records on vibration value, nature and severity of possible anomalies.



Video screen for VMS

Coolant Leak Monitoring System (CLMS)

Coolant Leak Monitoring System

- It works based on "***leak before break concept***" and performs following functions
  - Continuous monitoring of leak from primary equipment and primary coolant pipelines like Main coolant pipelines, ECCS pipelines etc
  - Evaluation of size and place of leak within a stipulated time limit
  - Provides display, recording and transmission of information to SIA.

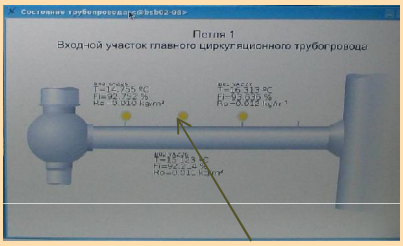
- **Methods of leak detection**: Leak detection is carried out by two methods viz; **Humidity method, Acoustic method.**

CLMS System Description

Humidity leak monitoring system (HLMS)

HLMS

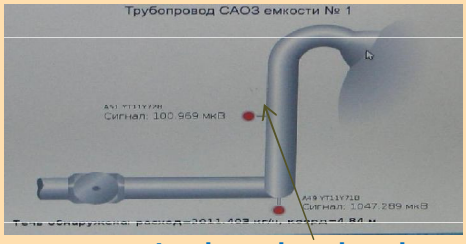
- Monitors the occurrence of leak by measuring relative humidity and temperature using a capacitive probe and RTD.
- Detect a leak of 1.0 lpm within 3 mins
- Evaluate the size and place within 20 min



Leakage but not break

Acoustic leak monitoring system (ALMS)

- Detects leak by measuring acoustic noise signal (generated due to leak), using piezo electric transducers
- Detect a leak of 3.8 lpm within 3 mins
- Evaluate the size and place within 3 min



Leakage into break

Loose Part Monitoring System (LPMS)

Loose Part Monitoring System

- LPMS detects any loose objects upto 0.05 Kg in the primary system
  - which may be left during commissioning, operation or after maintenance.
- **System Description**
  - Detects loose objects by measuring acoustic noise from the structure to which accelerometers (piezo electric type) are attached.
  - Sensing point is selected where there is possibility of loose object accumulation and areas of bolting of RP equipments.

System Integrated Analysis (SIA)

System of Integrated analysis

- It performs following function
  - Acquire information on current state of plant current core and Reactor Plant from subsystems of MCDS and main plant system
  - Performs integrated analysis of and forecasts about expected trend/anomalies/transients in reactor operation and enables the operators to handle above situations more efficiently and effectively.
  - Provides valuable input to reactor physicist for core configuration during refueling.
  - Provides display, storage and archive of information .

Thank You

"End User's Perspective On Control & Instrumentation Implementation Power Generation-Thermal"

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Presentation Agenda

- Indian Power Sector
- Power Sector Requirement:- Key Performance Aspects
  - Role Of C&I and philosophies at NTPC
- Automation Advancements at a glance
  - Some recurring C&I issues
- End User Concern, Challenges and Expectations
- Conclusion

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Indian Power Sector

Present Capacity of just over 150,000 MW

11th plan target of adding 78,700 MW by 2012

- 11th Plan Target of Power to all

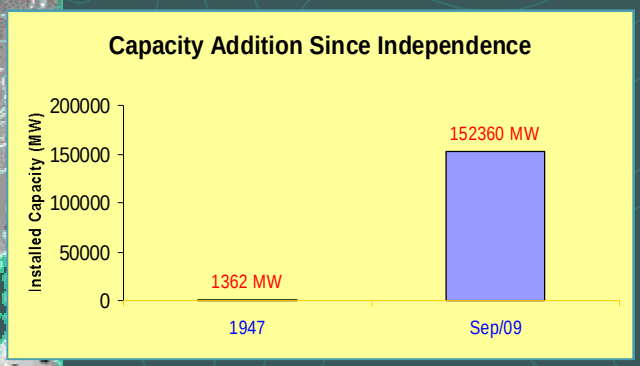
Economic growth is predicted at around 8.5%.

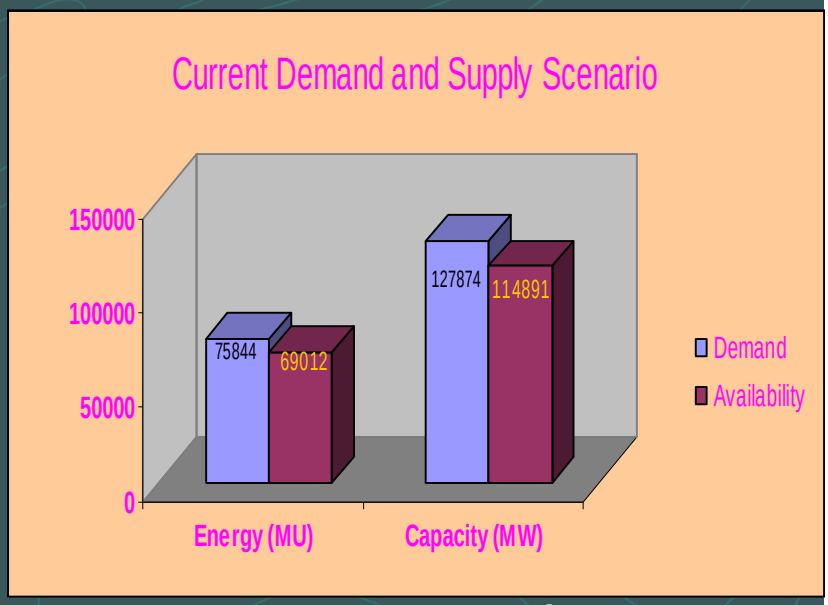
- Power growth needs to be around 9.5 % to sustain the GDP growth

Government policy initiatives in terms of Electricity Act-2003

- Reforms in generation, transmission and distribution sectors
- Establishment of CERC and SERC
- Facilitating involvement of private sector participation
- Competitive based bidding for Power projects
  - UMPP's
- Incentives on timely completion of projects

Still India has Power shortages



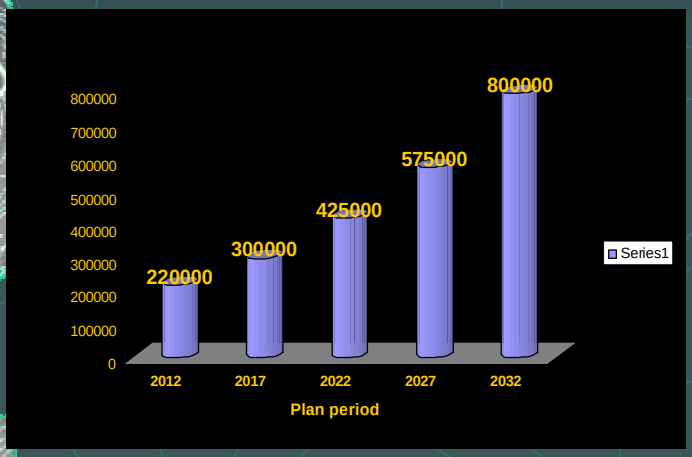


Energy Shortfall 9.9%

Peak Shortage 11.3%

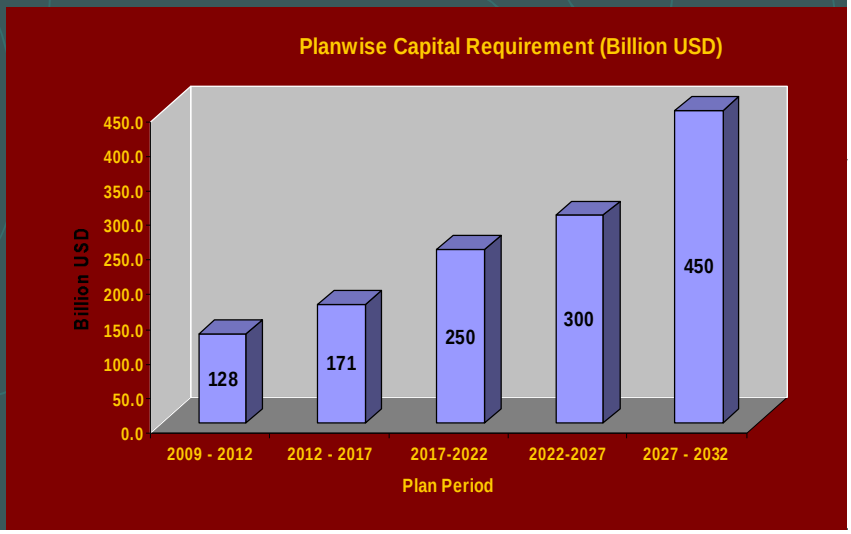
Source:http://www.cea.nic.in/power_sec_reports/Executive_Summary/2009_09/1-2.pdf

Huge Investments and opportunities



US $ 1300 Billion with an average of US $ 56.5 Billion per year in next 23 years will be required

(Including T&D)



Source(1) Integrated Energy Policy &
(2)CEA's summary report – sept'09