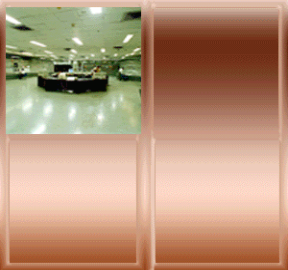




# **Generation and Energy Efficiency**

## **–R & D Initiatives of CPRI**



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**Preview**

# Upcoming technologies in thermal coal fired generation



- Clean coal technologies in general
- USC power generation cycle
- IGCC
- Fossil-renewable integration
- Energy efficiency improvement
- Water production for thermal generation
- Environmental control technologies



# Upcoming technologies in thermal coal fired generation



- Conversion of low grade materials like rejects, washery wastes through CFBC route
- Handling of fines
- Cooling technologies
- Instrumentation for high temp.  $O_2$ , online GCV, cheaper coal flow measurement, etc..

# CPRI groups



- Materials Technology – ferrous and non ferrous metals
- Energy Efficiency
- CFD and solid modelling
- Fuels- coal analysis
- Mechanical RLA - NDT, etc.
- Electrical RLA- IR, etc.
- Environmental technology
- Chemistry- liquid dielectrics, etc.





**Research, development  
and  
demonstration  
challenges**

# Materials development group



High temperature alloy development, material performance issues that limit the service temperature, evaluation of existing alloys for their service temperature up to 760°C etc.

Surface engineering technologies-wear, erosion and corrosion. life expectancy of components like warped & deformed burner nozzle, erosion protection shields, pulverizer wear parts and other liners-damage tolerance capacity of materials for high temperature wear and erosion resistance of thermal components.

800 MWe Adv-USC Power Plant on a Mission Mode, as a collaborative project involving IGCAR, NTPC, BHEL and CPRI.

Materials for furnace area of high temperature gasification reactors.



# CFD modelling group

- Steam turbine internals
- Pump and fan internals and adjoining ducts
- Flue gas passages
- Air flow passages
- Pulverized coal flow





# Energy efficiency group



- Control of O<sub>2</sub> in the furnace -high temperature O<sub>2</sub> measurement
- Control of DM water
- Control of valve passing
- Control of APH leaks and basket damage
- Waste heat recovery from flue gases down to 100 °C.
  - **Vapor Absorption Air-conditioning**
  - **Aqua-Ammonia Cycle**
  - **Organic Rankine Cycle**
- Power plant performance optimization-development of algorithms for plant optimization.
- Energy storage systems-flywheel storage and thermal storage
- Knowledge management

# Fuels group

- Blending of coals
- Washery: yield-efficiency optimization
- High temperature gasification and gas processing for IGCC
- CCS processes-Pressure Swing Adsorption  
Microalgal process for CO<sub>2</sub> fixation

# Chemistry-chemical engg. group



- Hot Gas Cleanup Systems for Integrated Gasification Combined Cycle
- Development of schemes for monitoring of wastewater generated in Thermal Power Plants and treatment options for reuse
- Establishing laboratory for monitoring of dioxin and furan in WtE plants, pilot scale validation of existing treatment technologies and development of new treatment technologies.



# Mechanical RLA group

- Robotic based boiler tube system for water wall tubes through eddy current based robotic system.
- Phased array technique is a specialized type of testing that utilizes multi element array transducers and software controls for steering the ultrasonic beam.
- Development of advanced RLA methodologies (robotic corrosion mapping, phased array technology, digital radiography, remote eddy current, residual stress measurements etc.) for condition assessment of plant components.

# Electrical RLA group



- Studies on materials with better insulation properties for generators, GTs and HT motors.
- Development of diagnostic techniques for condition assessment of high value electrical components.

# Environmental group



- Effect of fly ash characteristics viz. ash resistivity, composition, size, unburnt carbon on the efficiency of ESP components, and improved efficiency through Flue gas flow modeling
- Technical study on relationship of fly ash resistivity with particle size for classification of fly ash
- Bulk Transportation options for supply of fly ash between TPP & end users.
- Schemes for online monitoring of  $SO_x$ ,  $NO_x$ , Hg and particulate matter and control options including carbon capture and storage
- Database for ash quality (bottom ash, fly ash and ponded ash)
- Reducing exit water temperature in once through cooling

# Instrumentation, automation groups



- On-line measurements of coal flow, fineness, heating value, and balancing for combustion optimization in utility boilers
- Online GCV measurement
- Fire ball visualization and flame scanner visualization

# Limitations



- R & D institutions like CPRI are geared up for simulation, laboratory analysis, experimental analysis and experimental studies on prototypes.
- R & D institutions do not have the infrastructure for full scale prototype development and large experimental model development for which only the Original Equipment Manufacturers (OEMs) have the infrastructures-highly cost intensive and cannot be duplicated. A mechanism for OEMs to share their infrastructure with R & D institutions for prototype development and experimental model development. In case the OEMs do not share, development will be difficult for the R & D institutions to proceed- tends to go out of synchronization.
- In conducting the simulation, modeling and optimization studies the basic design details of the original pre-R & D equipment must be shared by the OEMs with the R & D institutions.



# CONCLUSIONS



- R & D areas are centred on development for new technologies for conversion of high ash Indian coals.
- Areas of interest to CPRI are based on expert groups available.
- Original equipment manufacturers play a major role in co-operating with R & D institutions in providing design information and sharing their costly prototyping and experimental model making facilities.

# TOPOGRAPHIC MAP OF INDIA



# THANK YOU

ARABIAN SEA

### ALITITUDE SCALE

Color	Altitude / Feature
Purple	Metres
Brown	6000 Snow Line
Orange	1800
Yellow	900
Pink	600
Light Green	300
White	0 Sea level
Light Blue	75
Dark Blue	300

