A Maharatna Company

PAT Target Achievement: Strategies and Practices

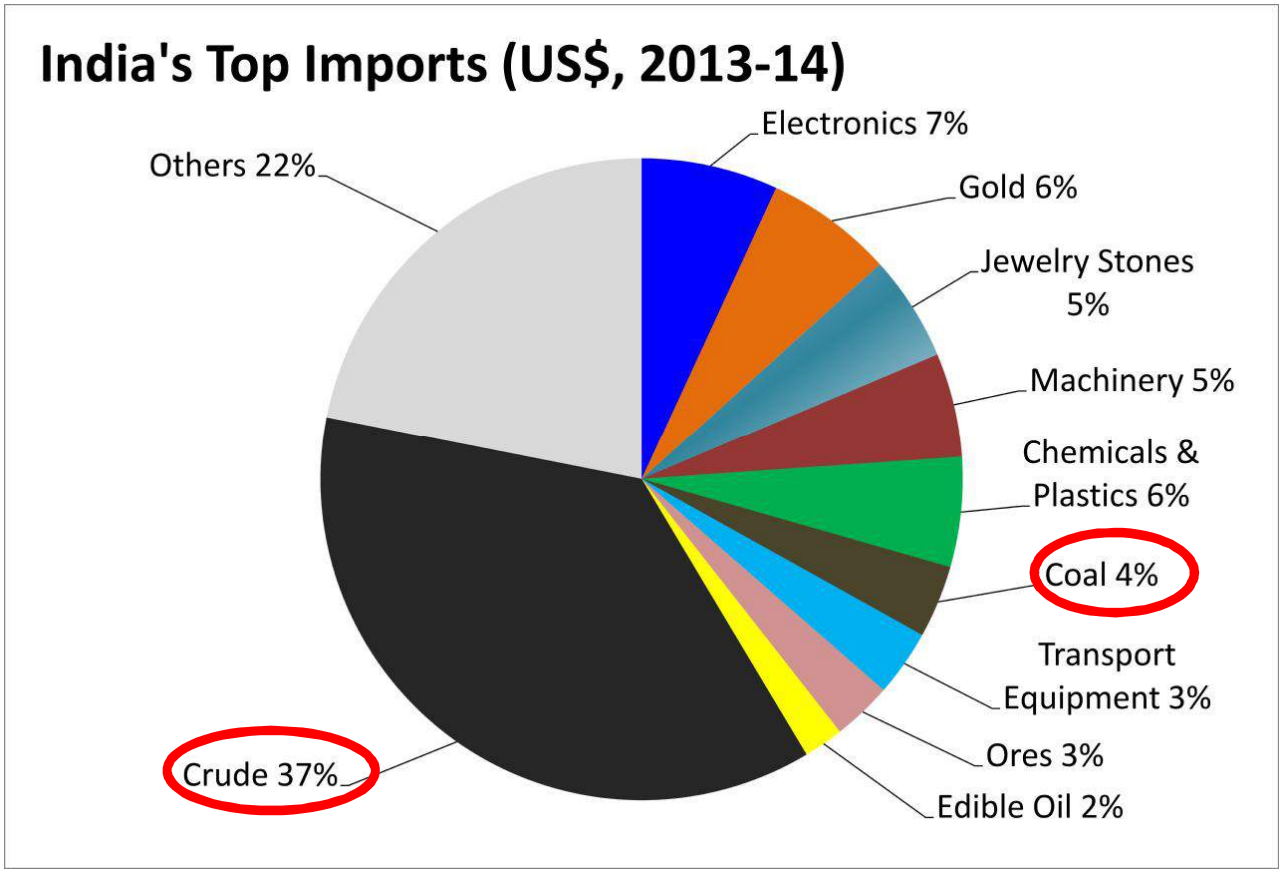
EEC Conference
31st August, 2015

CenPEEP, NTPC

Energy Efficiency Imperative For County's Economic Health

A Maharatna Company

Energy import is major drag on India's Current Account Deficit contributing almost 40% of total import. Therefore, to meet GDP growth rate & energy security for sustainable future both power generation & uses have to be more energy efficient.

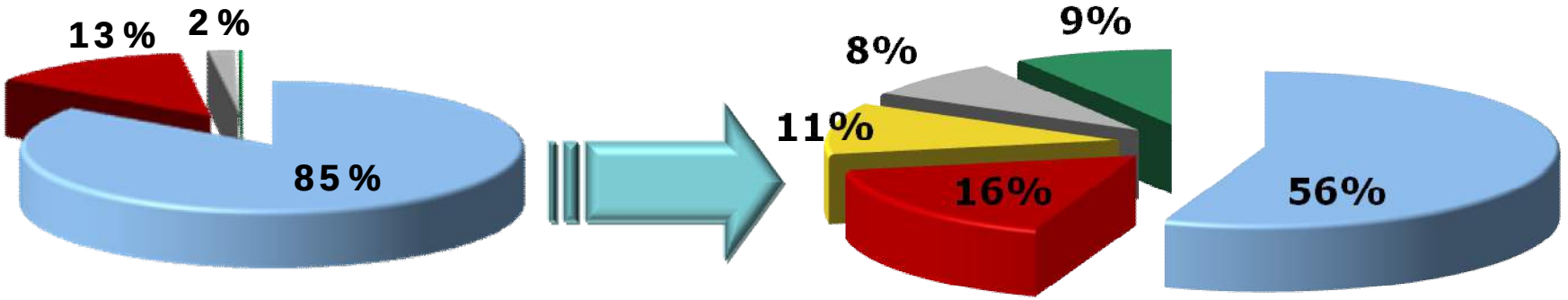


NTPC – Powering India's Growth

A Maharatna Company

Today
45 GW*

2032
~ 128 GW



* Includes 800 MW Hydro & 110 MW Solar Capacity

Coal | Gas | Nuclear | Hydro | Renewables

Capacity under construction: ~23,000 MW

NTPC Stations

A Maharatna Company

	No. of plants	Capacity (MW)	Share (%)
NTPC Owned			
Coal	18	33925	75.3
Gas/Liquid fuel	7	4017	8.9
Hydro	1	800	1.78
Solar	8	110	0.24
Sub-Total	34	38852	86.3
Owned by JVs			
Coal	6	4229	9.4
Gas	1	1967	4.4
Sub-Total	7	6196	13.7
Total	41	45048	100

NTPC 2014-15

Revenue ~ 73246 Crores

Expenditure ~ 62072 Crores

Fuel Cost ~ 48845 Crores

Fuel Cost is almost **80%** of the total expenditure & any performance improvement initiative has a major impact on Fuel expenditure.

Performance Enhancement - Financial Impact

A Maharatna Company

Typical Financial Implications for 200 & 500 MW Units

	200 MW Unit	500 MW unit	100 MW Gas APM / RLNG
10 kcal GHR Improvement	Rs 1.7 Cr	Rs 4.1 Cr	Rs 1.3 Cr / Rs 4.4 Cr
0.1 % APC	Rs 0.4 Cr	Rs 1.1 Cr	Rs 0.15 Cr
10 Kcal NHR Improvement	Rs 1.5 Cr	Rs 3.8 Cr	Rs 1.15 Cr / Rs 4.25 Cr.

Performance improvement - key to meet the challenges in the changed business scenario, new environment regulations and stringent regulatory regime

PAT targets: an additional market mechanism to give more focus on performance

PAT Targets (Net Heat Rate): Coal Stations

A Maharatna Company

SN	STATIONS	Design HR kcal/kWh	Net Des HR with Act APC	Baseline NHR	% NHR dev	Target for NHR Reduction (kcal/kWh)
1	**Sipat**	**2289**	**2422**	**2491**	**2.8**	**7**
2	**Singrauli**	**2312**	**2488**	**2577**	**3.6**	**9**
3	**Kahalgaon**	**2321**	**2516**	**2614**	**3.9**	**9**
4	**Unchahar**	**2302**	**2502**	**2596**	**3.7**	**10**
5	**Korba**	**2279**	**2425**	**2526**	**4.1**	**11**
6	**Vindhyachal**	**2270**	**2422**	**2532**	**4.6**	**11**
7	**Talcher K**	**2242**	**2374**	**2492**	**5**	**12**
8	Rihand	2232	2387	2512	5.2	21
9	Ramagundam	2250	2390	2520	5.4	22
10	Simhadri	2228	2358	2490	5.6	22
11	Dadri	2272	2453	2580	5.2	22
12	Farakka	2293	2467	2597	5.3	22
13	Tanda	2256	2895	3083	6.5	32
14	Badarpur	2500	2731	2988	9.98	46
15	**Talcher-Th**	**2587**	**2880**	**3196**	**10.98**	**66**

PAT Targets (Net Heat Rate): Gas Stations

A Maharatna Company

Stations	Baseline NHR (kcal/kWh)	Design NHR	% NHR deviation	Target NHR (kcal/kWh)	PAT Target for NHR Reduction (kcal/kWh)
Gandhar	**2075**	**2041**	**1.6**	**2072**	**3**
Dadri Gas	**2037**	**1975**	**3.1**	**2031**	**6**
Kayamkulam	**1994**	**1931**	**3.3**	**1988**	**6**
Kawas	**2070**	**1986**	**4.2**	**2062**	**8**
Anta	**2091**	**1994**	**4.8**	**2081**	**10**
Faridabad	**2001**	**1895**	**5.6**	**1983**	**18**
Auraiya	**2190**	**2028**	**8**	**2163**	**27**

Capacity wise NTPC is 23% of Indian Power Sector, in PAT target it is 10% of Power Sector.

PAT Targets: Some operational Facts

A Maharatna Company

- Baseline Period for PAT targets was 2007-10: This was best operating period in terms of loading factor and efficiency - making further improvement in M&V period a challenging task.
- Coal Quantity shortage scenario – use of Coal Blending
- Increasing cost of generation, Less demand: part load operation
- New Strategy required for additional performance improvement

PAT Targets Achievement: NTPC Approach

A Maharatna Company

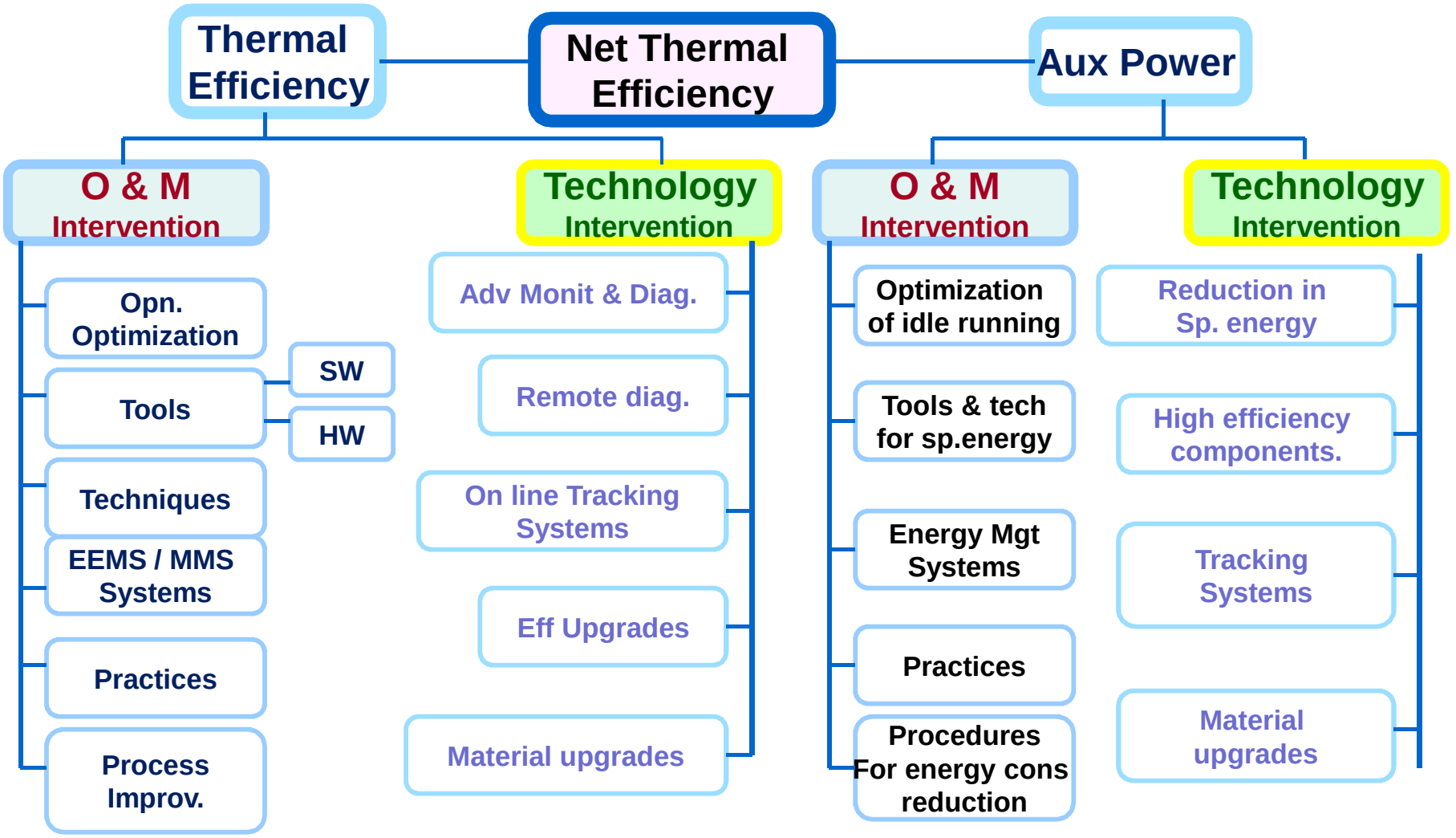
- Develop comprehensive Plan for HR and APC improvement and execute.
  - ✓ a high level Committee at Corporate Centre formed, to examine various options to achieve target and make comprehensive recommendations
  - ✓ Regularly sensitizing the stations for PAT targets & facilitating in structured data organization for M&V

Strategy - PAT Implementation

A Maharatna Company

Improvement → Efficiency & Reliability → Sustainability

E Evaluation of Perf. gaps **P** Plan the roadmap **I** Implement the action



PAT Implementation : NTPC Approach

A Maharatna Company

- Net heat rate (NHR) action plan developed for each station segregated into 2-categories:
  - Actions without additional investment that can be implemented under O&M
  - Actions with additional investment
- R&M activity (Midlife and Mega R&M) having positive impact on APC & Heat rate improvement identified

PAT Implementation: NTPC Approach

A Maharatna Company

Summary of actions without additional investments

- Improvement in loading factor
- Operational Optimization (listing in separate slide)
- Condenser loss reduction –
  - Restoration of COLTS, regular & effective operation of COLTS
  - Installation of additional screens at the intake channel for removal of debris;
  - Regular and opportunity cleaning of condenser
- Air ingress reduction in FG ducts & AH tube replacement
- Turbine-Replacement of turbine internals (seals, etc.) in COH as required based on efficiency degradations / gap analysis.
- Turbine- replacement of LP casing

PAT Implementation: NTPC Approach

A Maharatna Company

Summary of actions without additional investments (contd.)

- Cooling Tower (O&M): revamping wherever necessary
- Installation of Wind Ventilators Fans in TG Roof
- FW temp at inlet to Economiser: HPH to be kept in service
- MS pressure restoration
- Conversion of FRS from DP control to scoop control
- Replacement of BFP recirculation valves (single stage to multi stage)
- Modification of mills by hi-chrome liners to enhance capacity
- FG duct internals modification using CFD modeling with the help of NETRA and CenPEEP
- Improvement of coal quality
- Installation and use of Online Energy monitoring system for finding potential gap areas for better monitoring & reduction of APC.

PAT Implementation: NTPC Approach

A Maharatna Company

- **Optimization of operations:**

  All Stations to continue efforts for the following:

  - Optimization of number of mills operation
  - Cooling tower performance optimization
  - Ash water ratio optimization
  - Improvement of CHP utilization factor
  - Non-cycle makeup water reduction
  - Plant compressor operation optimization
  - Maximization of TDBFP running
  - Optimization of operation of HFO pump house

  Any other action based on local requirement and unit design

- **APC reduction :** 0.1% is equivalent to about 3 kcal/kwh in NHR.
  - VFD applications for 9 type of equipments identified
  - Additionally, pump coatings, debris removal, and use high efficiency motors, etc.

PAT Implementation: NTPC Approach

A Maharatna Company

Summary of actions with additional Investments

- Installation of VFD in selected HT & LT drives
- Polymer coating in CW pumps
- CT: Additional CT cells and VFD in CT for gas station
- Additional measures for arresting dust ingress in CT
- Turbine-Procurement of new turbine rotor (at one of the Stations)
- Installation/Revival of Condenser on line tube cleaning system (COTCS)
- Mill Capacity enhancement
- Boiler Reheater material upgrade to avoid overheating and reduce RH spray
- Replacement of existing motors with energy efficient motors
- Replacement of all FG ducts and hot PA ducts expansion joints, APH modified seals, heat transfer elements profile & material
- Condition based BFP cartridge replacement with Energy efficient cartridge
- Installation of debris removal system

A Maharatna Company

Summary of actions with additional Investments (contd.)

- Up gradation of one set of Ash Slurry pumps at one of the Stations
- Boiler modification including
  a) RH modification - area increase, material up gradation from T91/T22 to TP 347H,
  b) SH criss-cross modification
  c) replacement of AH baskets by BHEL
- Replacement of SAPH CE baskets with DU baskets.
- Replacement of existing lighting lamps with T5 lamps
- Replacement of boiler insulation & refractory
- Replacement & modification of flue gas ducts & guide vanes based on CFD modeling
- Replacement of HP heaters
- Replacement of existing BFP re-circulating valves with inconel type re-circulating valves
- Retrofitting of 24 sector APH in existing 12 sector APH to reduce the seal leakage
- CT fills replacement in applicable cases

Systems Approach – Continuous Improvements

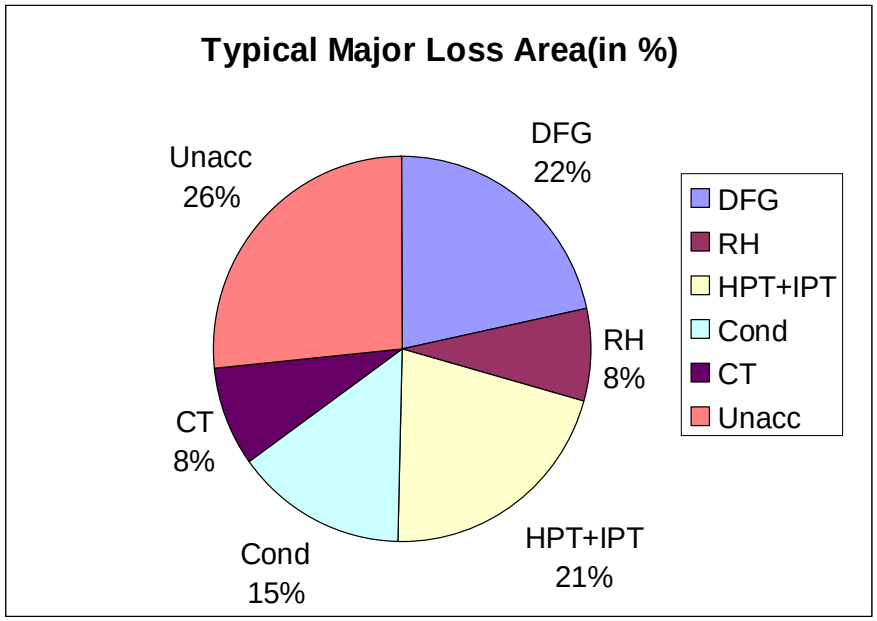
A Maharatna Company

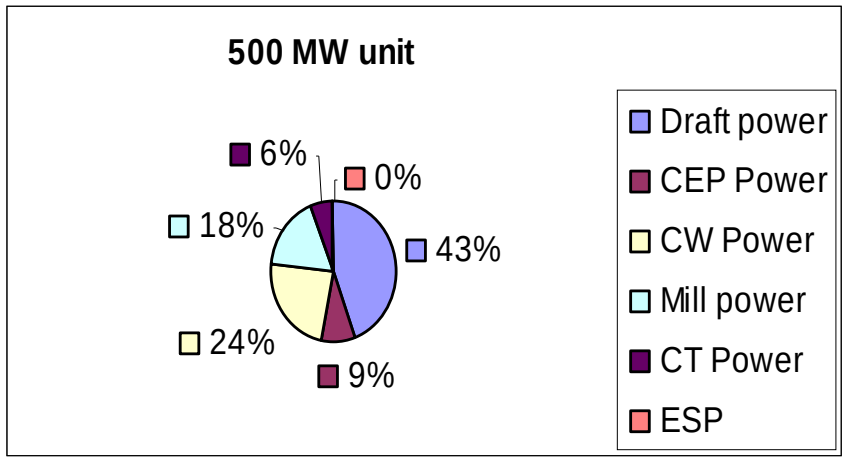
- **Focus on Systems & procedures**
- **Enablers to be institutionalised**
  - Energy Efficiency Management System (EEMS)
  - Maintenance management System
  - Outage Management & Planning System
  - Audits – Insulation, APC, Water, Lighting System
  - Training & awareness programs
  - Guidelines & Checklists
  - Simulation & modelling tools

Systemic approach is essential for sustained & continual improvements

Heat Rate & APC - Coal fired plants

A Maharatna Company





1. High loss category (40-80 kcal)

- Condenser & Cooling Tower
- Dry Flue Gas Loss
- HP/IP Turbine

2. Medium loss category (20-40 kcal)

- RH Spray
- Unaccountable (LPT Efficiency, Hi Energy drain passing, Insulation loss)

3. Low loss category (<20 kcal)

- Unburnt Carbon Loss
- MS & HRH Temperature deviations
- Feed water Temperature deviations

1. **Draft Power Consumption (43%)**
2. **Milling Power consumption (18%)**
3. **Pump power consumption (30%)**

Improvement through O&M Practices

A Maharatna Company

- Real time monitoring of aberrations of critical parameters
- Monitoring of unit startups & shut downs
- Strategic operation of efficient units at higher loading factor
- Focus on make up and cycle isolation
- Improvements through effective overhauls
- Opportunity utilization for cleaning of condensers & Air heaters
- Chemical dosing in CW system to improve CW quality
- APC monitoring during startups, shut down & idle running
- APC optimization – Energy Management System

APC Reduction Program

A Maharatna Company

Implementation of Structured APC Reduction Program in all Stations

- Optimization of no of CW pumps & CT fans in service as per weather conditions and unit load
- Optimization of No. of mills in service as per coal quality and unit load
- Sliding Pressure operation
- Excess air optimization
- Optimization of no of HT / LT drives in service at part load
- Unit startup with one series of drives only
- Optimization in CHP and AHP areas
- Merit order operation

Quality Overhauls for performance improvements

A Maharatna Company

Planning & Execution of Overhauls - for sustained efficient & reliable operation

- **Overhaul Preparedness**
  - Pre OH Surveys & performance tests
  - Identification of defects and activities in Engg. declaration
  - Work scope finalization - inputs from Repeat work Order analysis, gap analysis, Energy audits, OEM recommendations etc.
  - 24 months monitoring cycle for Spares, consumables & contracts

- **Skilled quality manpower & contractors**
- **Activity Protocols - Check lists for Pre & Post Inspections**
- **Quantification of benefits - Cost benefit analysis**
- **Optimization of overhaul duration and intervals -** Learning from previous OH, Operational & performance parameters, equipment condition, loss recovery pattern

Conclusion

A Maharatna Company

- Meeting PAT target: a challenge under changed Business Scenario – Coal shortages, coal imports & blending need, low generation schedules, part load operation
- NTPC committed to meet PAT target
- Strategies: Blend of operational optimization, identification and implementation of various heat rate and APC improvement activities: specific to each NTPC station
- Focus both on system, initiatives and timely implementation
- Joint and collaborative working with BEE for implementation of judicious normalization scheme for factors beyond the control of NTPC
- New innovative measures specific to each station required for any further improvement
- Power utilities need to develop appropriate strategies to continually improve performance under changing business environment

THANKS