



Rajasthan Rajya Vidyut Utpadan Nigam Ltd.



Presentation on Flexible Operation Of Thermal Power Plant

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CTPP, CHHABRA, 4X250MW

The global shift toward renewable energy sources like wind and solar has fundamentally changed the role of coal-based thermal power plants. Traditionally designed for "base load" operation—running at a constant, high output—these plants must now operate flexibly to balance the intermittent nature of renewables.

Flexible operation, often called flexibilization, involves varying the power output rapidly, frequent starting and stopping, and operating at low loads.

Special Challenges in Indian Old Units

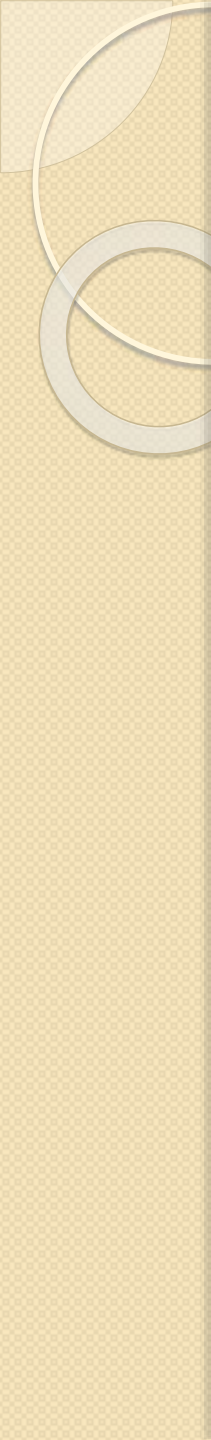
Older units in India face additional issues:

- High ash coal
- Aging APHs
- Obsolete DCS
- Poor instrumentation
- Low automation
- Coal quality variation
- Limited design margin

Hence retrofit prioritization becomes very important.



**Issues Yet to be Addressed
Besides Proposed
Retrofit/Modifications For
Flexible Operations**



Though solutions /modifications are available for Burners, Scanners, Control system etc. but no solution available for following Issues:

- **Boiler & Turbine Thermal Stress related issues, e.g. reduction of life, frequent break downs, longer down times.**
- **High wear & tear of grinding media of Mills.**
- **Low Flue gas temperature at ESP I/L causing increased corrosion in ducts/ESPs, specially in winters.**

Difficulty in Shut downs required for modifications due to power demand.

Looking to current scenario of rising power demand, its hard to obtain Planned shut downs for Units. Even ASDs/ COHs are to be postponed for accomodating power demands. A well-planned and organized co-ordination will be required amongst Generation, Transmission, Discoms, LDC and RUVNIT to arrange shut-downs for the large fleet of power plants.

Compensation not taken care-of for:

Reduction in useful life of Generator /Turbine/Boiler and other equipments.

- Fixed cost & other compensation for break downs on part of thermal fatigue due to high ramp rate.
- Compensation on account of higher wear & tear and high consumption of grinding media.
- Compensation on account of corrosion in APH, ducts, ESP etc due to low flue gas temperature & condensation there-of.
- Current provision for compensation on account of APC/SHR/SOFC are on cumulative basis, which offsets low load operation with high load operation, nullifying losses occurred during low load period.

High demand of modification to be met by a few service provider

Most of the thermal plants out of 225 GW in India require modifications for flexible operation. There are a few Service Providers to cater this large fleet.

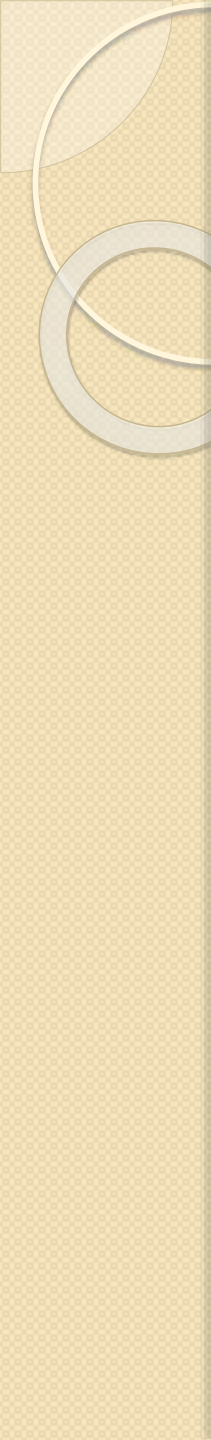
Training of staff and change in mind- set.

Presently deployed staff in operation is acquainted to run the Units in conventional manner. The new concept of flexible operation is hard to accept/adopt. Therefore, training and regular updation in knowledge of staff at Plants with implemented Flexible operation is required.



Timely Regulator approvals for capital for modifications.

Huge Capital is required for modification the funds should timely be allowed/allocated by regulator on the head of capital expenditure.



OEM demonstrate flexible capacity for short duration under controlled parameters, which are different in real world operations.

Practical problems on regular flexible operation

- i. Coal quality variation – Up & Down side.
- ii. Varying weather conditions
- iii. Quick and immediate back-down and normalization schedule by Load controller at high Ramp rates.



Alternate Arrangements to Look For

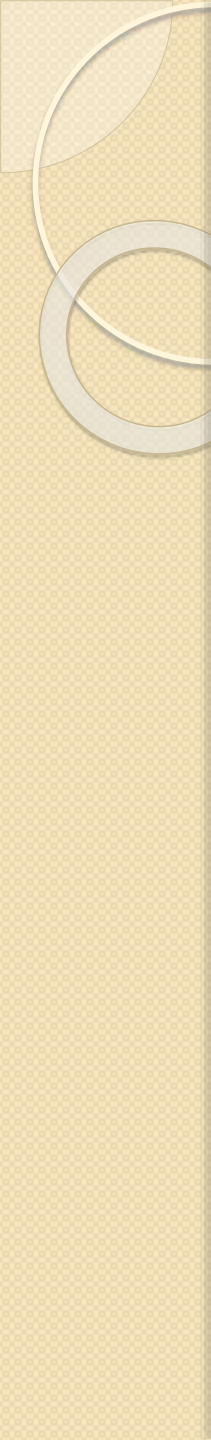


Managing RE specially Solar during Up & Down time to reduce ramp rates.

The Solar Power injection during start of the day and during sunset may be restricted by scheduling or by using BESS to avoid sharp ramp rates for thermal plants, which will be very beneficial to avoid thermal stress related degradations in the boilers and turbines.

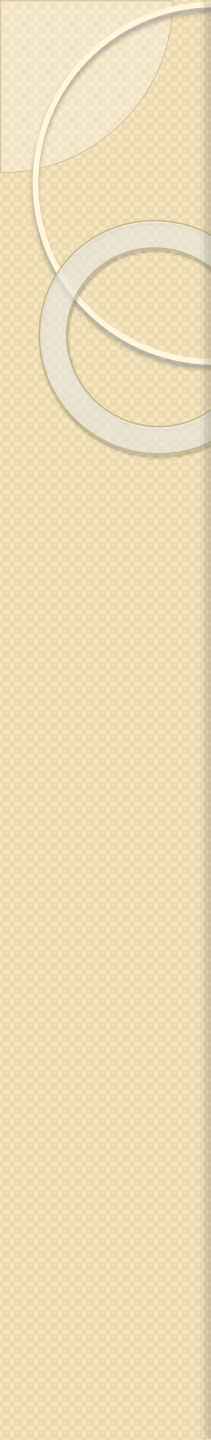
Installation of BESS

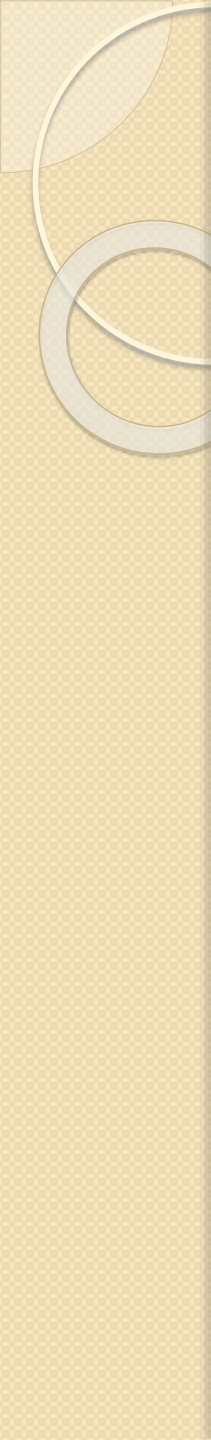
- By using BESS at thermal plant generating end or at RE end upto 5-10% of dispatchable capacity may help to regulate/control achieving technical minimum load in a safe and sustainable manner.



Implementation of TOD tariff to blunt peak hour demands and bring uniformity in load on round the clock basis, which will:-

1. Reduce requirement of BESS capacity.
2. Provide thermal plants opportunity for availing planned shutdowns as per machine's requirement for ASD/COH/R&M/Modifications which are not easily available.

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- Strengthening transmission capacity to export excess power to other needy regions to avoid curtailment in RE and Thermal Power.
 - A strong transmission network along with AI based power trading tools may be utilized to trade available power and avoid back-downs up to TML.

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- Solar plants with Storage capacity may only be allowed in future or for some time now onwards, to ease pressure on thermal fleet

Phase-Wise Retrofit Roadmap

Phase 1 — Diagnostic Assessment & Baseline Study

(This phase determines the actual flexibility capability and bottlenecks)

- A. Technical Assessment
- B. Control System Assessment
- C. Data Collection

Phase 2 — Immediate Low-Cost Operational Improvements

(These provide fast gains with low CAPEX)

- A. Combustion Optimization
- B. Soot Blowing Optimization
- C. Operator Training

Phase 3 — Boiler Retrofit Package

(This is usually the most critical phase)

- A. Burner System Retrofit
- B. Mill System Retrofit
- C. Air Preheater (APH) Retrofit
- D. Draft System Modernization
- E. SH/RH Temperature Control Improvement

Phase 4 — Turbine & Cycle Retrofit

- A. Sliding Pressure Operation
- B. Thermal Stress Monitoring Install online monitoring for:
- C. Startup Optimization Measures

Phase 5 — Automation & Digitalization

- A. Advanced Process Control (APC)
- B. AGC Readiness
- C. AI/ML-Based Monitoring

Phase 6 — Environmental System Retrofit

(Older environmental systems often struggle at low load.)

- A. ESP Optimization
- B. FGD Flexibility Enhancement

Phase 7 — Reliability & Life Extension

(Flexible operation accelerates equipment degradation.)

- A. Life Assessment
- B. Critical Spare Strategy

Typical Timeline

Sr. No.	Phase	Duration
1	Diagnostic study	1–3 months
2	Quick-win improvements	3–6 months
3	Major retrofit engineering	6–12 months
4	Outage implementation	1–3 outages
5	Optimization & stabilization	3–6 months
6	Total typical roadmap	1.5 to 2 years

Indicative Retrofit Cost

Sr. No.	Retrofit Level	Typical Cost
1	Basic flexibility package	Rs. 20–40 Crore
2	Moderate retrofit	Rs. 40–80 Crore
3	Comprehensive modernization	Rs. 80–150+ Crore



Thanks