



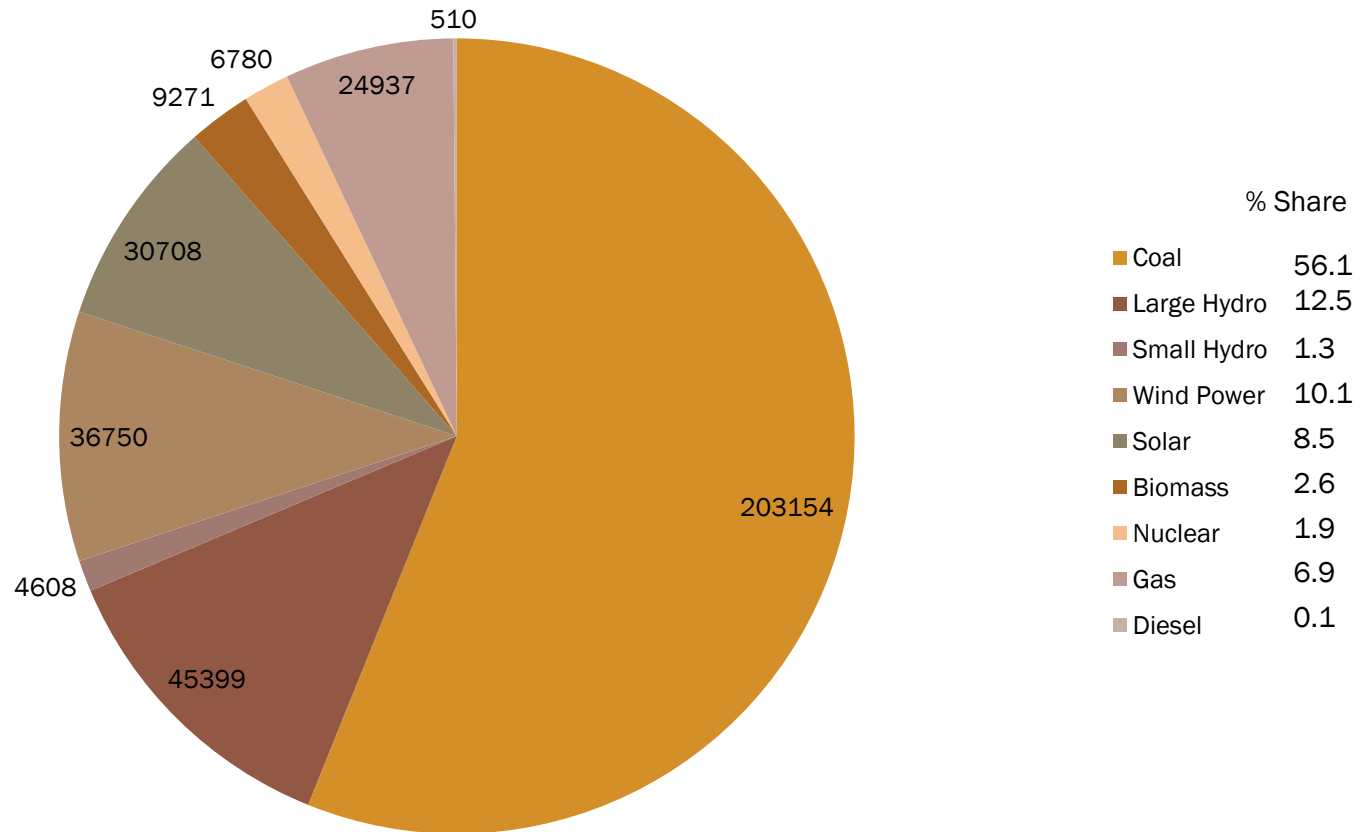
Flexible Operation of Coal Fired Plants and Environment Challenges of Indian Thermal Power Plants

S C Shrivastava
Chief Engineer, CERC

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Country Installed Capacity



Total Installed Capacity 362117 MW
as on 30.9.2019

All Fig in MW

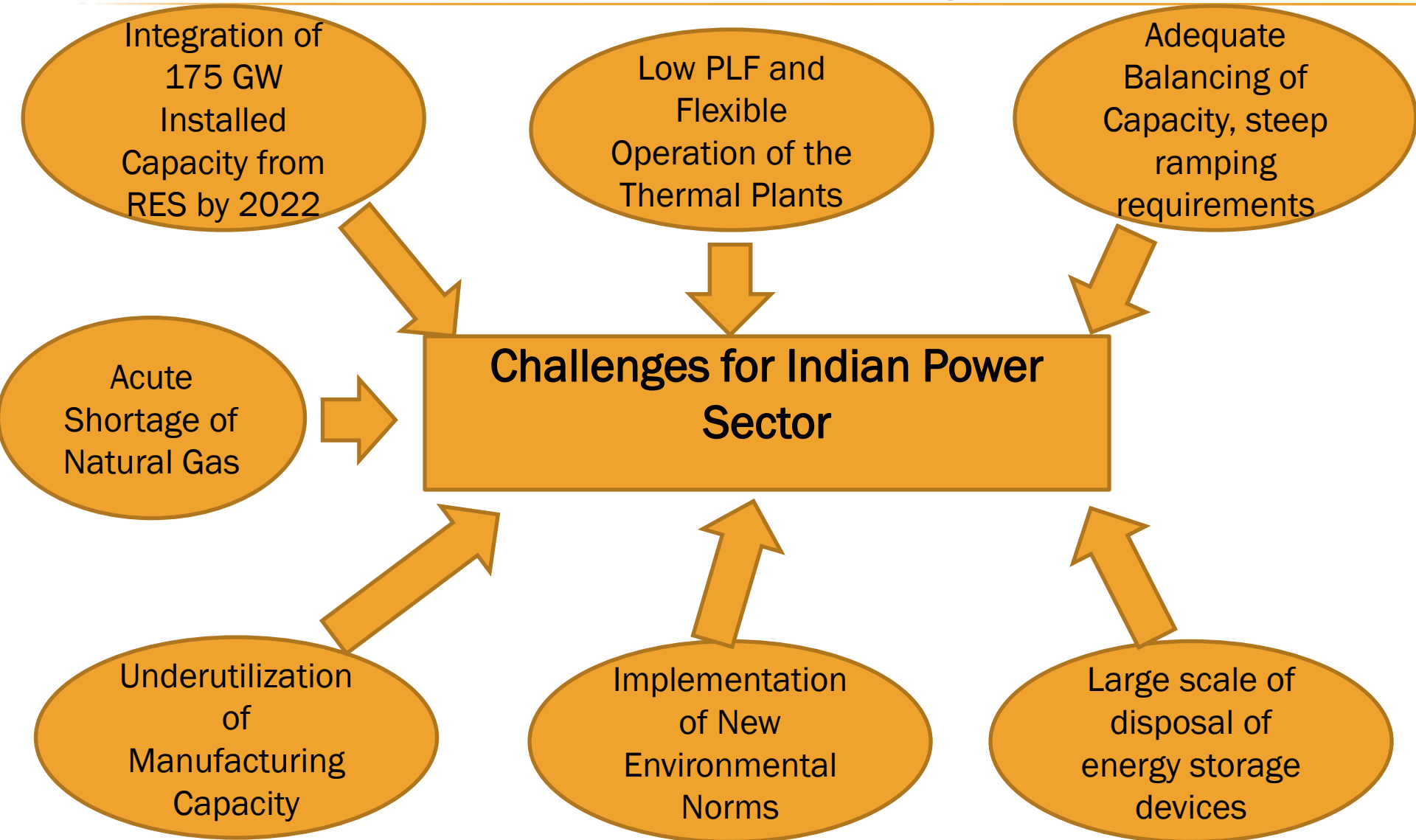


Country Installed Capacity

Sector	Thermal (MW)					Nuclear (MW)	Renewable (MW)		Total (MW)	%
	Coal	Lignite	Gas	Diesel	Sub-Total		Hydro	Other Renewable		
State	64,736	1,290	7,118	363	73,509	0	26,958	2,349	102,817	29
Central	56,340	3,140	7,237	0	66,717	6,780	15,046	1,632	90,176	25
Private	74,733	1,830	10,580	273	87,417	0	3,394	76,650	167,461	46
All India	195,809	6,260	24,937	637	227,644	6,780	45,399	80,632	360,456	100

Total Installed Capacity 360456 MW as on 31.7.2019

Flexible Operation and Challenges with Sector





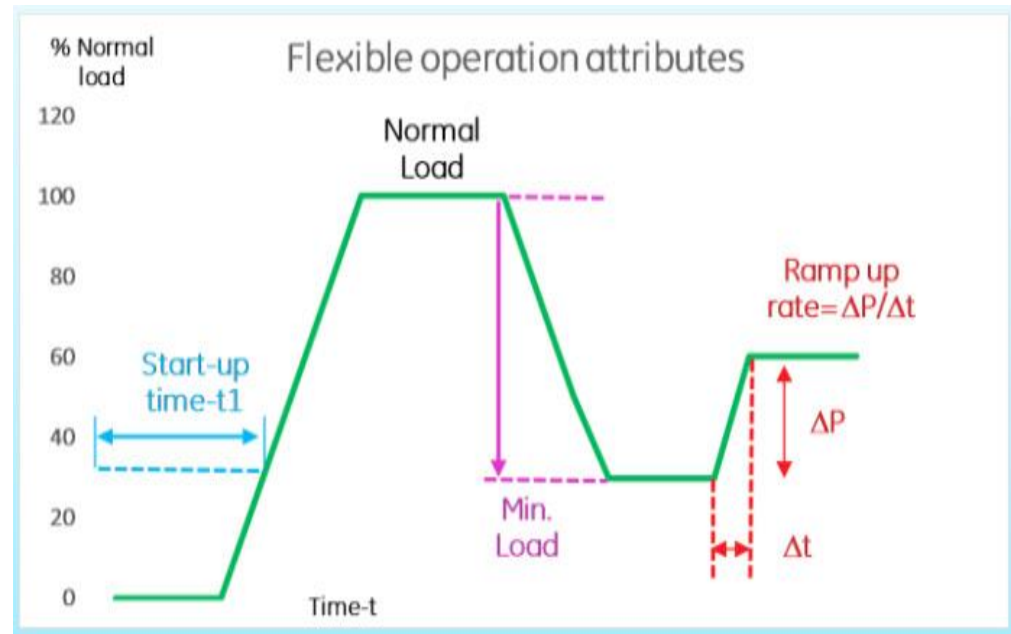
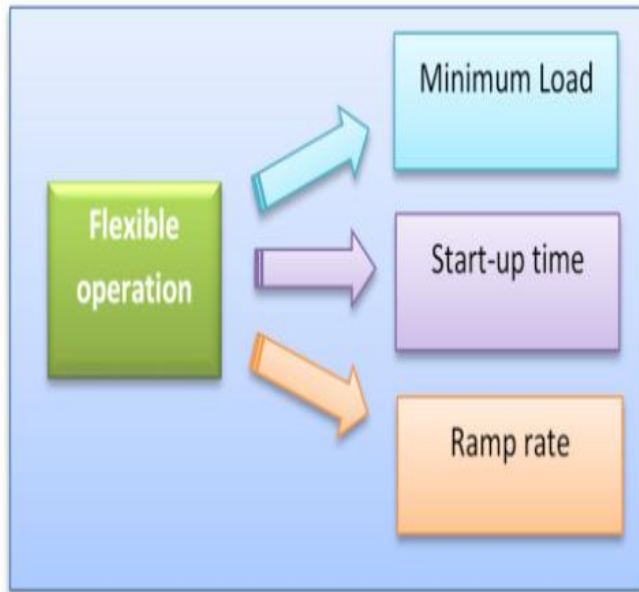
Flexible Operation Challenges

- **Maximum RES Integration**
- **Grid Security / Stability**
- **Reliability of Generating Unit**
- **Cost Optimization & Use of Available Infrastructure for Flexible Operation**
- **Way Forward**



Flexible Operation

- **Flexibility** : To operate reliably with **Significant share of variable Renewable Electricity**.





Time Required for Start Up Power Plant

- Start up time of different plant, varies conditions

Type of Start Ups	Unit out of Operation	Coal Based	Gas Based
Hot	<8 hrs	2-3 hrs	<1.5 hrs
Warm	8-48 hrs	3-5 hrs	~2 hrs
Coal	>48 hrs	5-10 hrs	2-3 hrs

Based on the Start time requirement, Conventional Plants to be kept operational to achieve the peak demand when RES not available



Challenges

- **Variation in demand met by different sources sample case study of 10.08.2018**

Fuel Source	Min Demand Met	Max Demand Met	Difference	Variation
Coal	107	118	11	10.28%
Hydro	22	29	7	31.82%
Gas	5	6	1	20.00%
RES	11.7	23.5	11.8	100.85%

Variation of 100% in RES power availability



Projected Installed Capacity 2021-22

Fuel Type	Capacity (MW)	%
Coal + Lignite	217302	45.3
Hydro	51301	10.7
Gas	25735	5.4
Total RES	175000	36.5
Total Capacity 2021-22	479418	100.0

RES share will increased to 36.5 % in installed capacity and 20-25% demand shall be met by RES.



RES Scenario 2021-22

- * In 2021-22, RES installed capacity shall be ~ 175GW, Minimum power available by RES - 23 GW and Maximum power generation possible - 108 GW.
- At RES power generation on peak ~ 108 GW conventional power generation to be back down. Steep Ramping of convention power plant / Gas power station to be done to meet the demand and Grid Stability

* From CEA Flexible Operation Report



Challenges with RES

- Advanced forecasting techniques need to be adopted to accurate prediction of the Power generation from RES.
- Transmission system needs to be strengthened to evacuate power from RES within State / DISCOM level and connectivity to ISTS system also to be made available.



Challenges / Risks with RES

- Fund Requirement
- State Govt. to continue subsidies or other benefits.
- Utilities / DISCOMs to off take of power

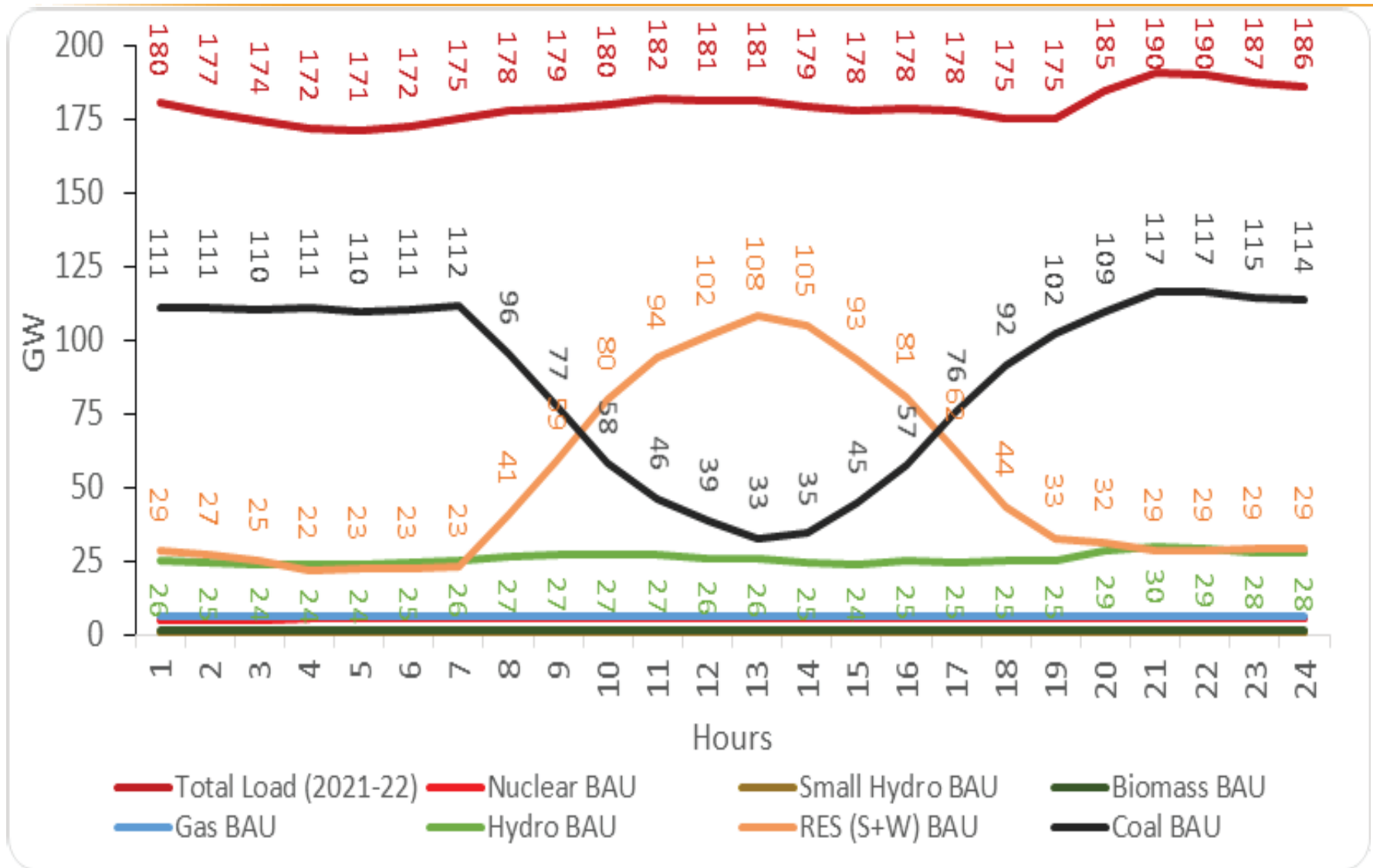


GRID Stability

- Capital Infusion for Strengthening of Transmission and Sub Transmission Networks.
- Bottlenecks at State Level Distribution / Transmission System need to be identified for strengthening.
- Advance Forecasting methods to be use for better generation assessment on real time / day ahead.



Projected Power Scenario of 2021





Reliability of Generating Units

- Reliable Operation of is need of hour.
- Conventional Power Plants to be operated on Partial Load.
- Sufficient Ramping capacity margin to be identified / proven of regular basis.
- Hydro / Gas Power Station to be schedule accordingly



Challenges with Reliable Operation

- Technology advancement requirement for partial load operation of thermal plants below certain limit.
- Allocation / availability of Gas for Power Sector to be reviewed.
- Frequent start / stop of conventional power plants



Cost Optimization of Flexible Operation

- Scheduling of grid connected generation
- cost effective / merit order.
- Power dispatch / clearance / Contract Settlement through Real Time market.
- Available Transmission System to be use for optimum power transmission.



Existing Norms of Station Heat Rate Degradation -Thermal (Coal)

Existing Norms			
Sl. No.	Unit loading as % of installed capacity of the unit	Increase in Station Heat Rate (%)	
		Sub- critical units	Super- critical units
1.	85- 100	Nil	Nil
2.	75 - 84.99	2.25	1.25
3.	65 - 74.99	4	2
4.	55 - 64.99	6	3



Existing Norms of Auxiliary Energy Compensation Degradation -Thermal (Coal/ Lignite)

Existing Norms		
Sl. No.	Unit loading as % of installed capacity of the unit	% Degradation in AEC admissible
1.	85- 100	Nil
2.	75 - 84.99	0.35
3.	65 - 74.99	0.65
4.	55 - 64.99	1.00



Existing Norms of Oil Compensation Degradation -Thermal (Coal/ Lignite)

Oil Compensation per Start Up (KI)				
Sl. No.	Unit Size (MW)	Hot	Warm	Cold
1.	200/210/250	20	30	50
2.	500	30	50	90
3.	660	40	60	110

In case generation falls below Technical Minimum – Generator may opt fir reserve shut down, 7 start / stop in a year shall be allowed

Initiative taken

- Ministry of Power declared Flexibility of Thermal Generation Scheme.
- Security Constraint Economic Dispatch – under implementation.
- Real Time Market for power dispatch - Public hearing held on 14.10.2019.
- Reserve Regulation Ancillary Services, DSM, DAM, etc.



Way Forward

- Technology for better forecasting of RES.
- New Technology for Energy Storage to be looked into.



Thank you