


 भारत सरकार/Government of India
 विद्युत मंत्रालय/Ministry of Power
 केंद्रीय विद्युत प्राधिकरण/ Central Electricity Authority
 तापीय अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
 Thermal Engineering & Technology Development Division

दिनांक: 13.01.2025

सचिव,
 केंद्रीय विद्युत विनियामक आयोग,
 तीसरी मंजिल, चंद्रलोक बिल्डिंग, 36, जनपथ,
 नई दिल्ली - 110 001.

विषय : द्वितीयक ईंधन तेल खपत के परिचालन मानदंडों पर सिफारिश -के संबंध में |
Subject: Recommendations on Operational norms of secondary fuel oil consumption -reg.

महोदय,

This is with reference to CERC D.O. No. CERC/CEA/T&C/2024 dated 04.10.2024 addressed to Chairperson, CEA regarding technical recommendations on:

- (i) Operational norms of secondary fuel oil consumption per start up (kl) for different unit sizes for hot, warm and cold start up separately;
- (ii) Any other technical aspects in relation to the above which has implication on tariff determination by the Commission.

2. In view of the above, based on detailed analysis of Thermal Power Station's operational data (for the last five years 2019-20 to 2023-24) and OEM data related to start up oil consumption, following "Recommendations on Operational norms of secondary fuel oil consumption per start up (kl) for different unit sizes for hot, warm and cold start up separately" are made:

(i) Based on the reference values, considering the ageing of the units and performance of the units, the following values for Cold, Warm and Hot start up are recommended i.r.o. of 210 MW, 500 MW, 660 MW and 800 MW units-

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
210 MW series	20	40	60
500 MW series	30	60	100
660 MW	45	75	130
800 MW	60	80	150

It is opined that the thermal units which are incurring high start-up oil consumption, needs to improve their operational practices and should try to bring the start-up oil consumption values to a level of OEM values.

(ii) Super critical / ultra super critical units may be provided 10% extra quantity of start-up oil for a period of 3 years from the Date of Commercial Operation (CoD), as they may face teething / stabilization issues. These units should strive to improve their operational practices for early resolution of teething / stabilization issues.

3. Explanatory Memorandum for the recommendations is enclosed.

4. This issues with the approval of the competent authority.

Encl. as above

भवदीय,

**(टी वेंकटेश्वरलु)
मुख्य अभियंता**

प्रतिलिपि (सूचनार्थ) :

1. अध्यक्ष , के.वि.प्रा.
2. सदस्य (तापीय), के.वि.प्रा.

Report on recommendation of Start-up Oil Consumption

1.1. Introduction:

The Tariff Policy notified by the Central Government under the Electricity Act 2003, provides that The Central Commission would, in consultation with the Central Electricity Authority, notify operating norms from time to time for generation and transmission.

The Central Electricity Regulatory Commission (CERC), vide D.O. No. CERC/CEA/T&C/2024 dated 04.10.2024, has informed that the Commission has initiated a review of the norms of additional compensation for secondary fuel oil consumption permissible over and above seven (7) start/ stop in a year for the generating station under Unit Shutdown in terms of Regulation 47 of the Grid Code Regulations 2023.

And, the norms of additional compensation for secondary fuel oil consumption per start up (KI) is to be specified for different unit size for hot, warm and cold start up separately.

In this regard, CERC has requested CEA to provide the technical recommendations on-

- (i) operational norms of secondary fuel oil consumption per start up (kl) for different unit sizes for hot, warm and cold start up separately;
- (ii) any other technical aspects in relation to the above which has implication on tariff determination by the Commission.

1.2. Existing norms of additional compensation for secondary fuel oil consumption permissible over and above seven (7) start/ stop in a year:

- a) As per Central Electricity Regulatory Commission (Indian Electricity Grid Code) (Fourth Amendment) Regulations, 2016

Regulation 6.3B – Technical Minimum Schedule for operation of Central Generating Stations and Inter-State Generating Stations

3(iii). Where the scheduled generation falls below the technical minimum schedule, the concerned CGS or ISGS shall have the option to go for reserve shut down and in such cases, start-up fuel cost over and above seven (7) start / stop in a year shall be considered as additional compensation based on following norms or actual, whichever is lower:

Unit Size (MW)	Oil Consumption per start up (KI)		
	Hot	Warm	Cold
200/210/250 MW	20	30	50
500 MW	30	50	90
660 MW	40	60	110

- b) As per Draft Central Electricity Regulatory Commission (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024

Regulation 70 (G): Compensation for the operation of generating station below normative plant availability factor

(6) The additional compensation for secondary fuel oil consumption shall be permissible over and above seven (7) start / stop in a year for the generating station under Unit Shutdown in terms of Regulation 47 of the Grid Code Regulations 2023. For the purpose of compensation under regulation (1) of this regulation, the secondary fuel oil consumption per start up shall be considered based on the following norms or actual, whichever is lower:-

Unit Size (MW)	Oil Consumption per start up (KI)		
	Hot	Warm	Cold
200/210/250 MW	20	30	50
500 MW	30	50	90
660 MW	40	60	110

Additional specific secondary fuel oil consumption of 0.2 ml/ kWh shall be provided for units operating below 55% unit loading.

1.3. Approach adopted for the current study

- i). For collection of operational data from thermal power stations for the last five years and design data from OEMs, CEA provided CERC with two proforma: one operational data format for coal/ lignite based thermal power stations and other design data format for OEMs.
- ii) Operating data and design data made available from the stations by CERC and that furnished by the utilities and OEMs has been the basis of computations and analysis made in the report.
- iii) The analysis has been carried out based on the operational data furnished for five (5) year period from 2019-20 to 2023-24 by coal/ lignite based thermal power stations and design data by OEMs.
- iv) The very high values of 5 year average “Oil consumption per start-up” have been excluded in analysis.

1.4. Data Received

The unit wise operational data for the last five years, of the central sector generating stations, some state sector and private sector stations, were received from different utilities as per provided format over a period of time. The data has been received for 71 generating stations, comprising of 66 coal based stations and 5 lignite based stations. The coal/lignite based stations comprise of 27 stations (121 units) of NTPC (including 1 JV), 6 stations (17 units) of DVC, 4 lignite based stations (13 units) of NLCIL, 17 state sector stations (59 units) and 17 IPP (42 units). The list of the stations from where data was received is provided in Annexure I.

1.5. Computations made

Based on the operational data received, the following parameters have been computed:

- Year wise per startup oil w.r.t cold, warm and hot start-up for FY 2019-20,2020-21,2021-22,2022-23 and 2023-24.
- 5 year average value of per startup oil w.r.t cold, warm and hot start-up.
- Exceptionally higher values of per startup oil have been identified.
- Sector wise and utility wise average values of per startup oil.

1.6. Data Analysis

1.6.1. The data of 5 year average values of per startup oil w.r.t cold, warm and hot start-up have been analyzed sector wise i.e central sector, state sector and private sector; utility wise within the central sector i.e NTPC, DVC and NLC and; overall 5 year average values, in respective capacities categories i.e 200 MW series, 500 MW, 660 MW and 800 MW.

Further, the same above mentioned analyses has been repeated after excluding the very high values from 5 year average start-up oil.

Additionally, the information received from OEM i.e BHEL has been taken into consideration while finalizing the recommendation.

A. Analysis of Start-up Oil of 200 MW series units:

The summary of the aforesaid analysis for 200MW series units is as per below Tables 1.2:

Table 1.2: 5 year average sector/utility wise per startup oil figures for 200 MW series

Sr. No.	Name of Utility/Sector	Per Start-up Oil (kl)			Per Start-up Oil (excluding very higher values) (kl)		
		Hot	Warm	Cold	Hot	Warm	Cold
	Central Sector						
1	NTPC	44	63	83	40	58	76
2	DVC	21	38	56	21	38	56
3	NLC	37	63	105	32	60	100
	Overall Central Sector	39	60	83	35	55	78
	Overall Central Sector excluding Lignite based units	40	59	78	35	53	72
	State Sector	27	47	73	25	44	73
	Private Sector	21	36	44	21	36	44
	Overall Average	32	52	74	29	48	70

Overall Average excluding Lignite based units	32	51	70	28	46	67
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Table 1.3: Oil Consumption per start up as per IEGC (4th amendment),2016 and Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 (Reference Values)

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
200/210/250 MW	20	30	50

Exclusions : For analysis, very high values have been excluded from unit wise 5 year average figures and year-wise figures of per start-up oil consumptions. The units with wall (front/rear/sides) fired boilers have also been excluded from analysis since these units tend to have relatively higher start-up oil consumption.

Reference Values : The oil consumption per start up values specified in Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 which are same as in IEGC (4th amendment), 2016 have been considered as **reference values**. The said reference values for 200MW series units are as per the above Table 1.3.

Observations in terms of comparative analysis of above mentioned 5 year average of actual values of per start-up oil (excluding very high values) w.r.t reference values is as below:

- (i). The **private sector** per start-up oil consumption is **close to the reference values** for hot and warm start-up, and **even lesser** compared to reference value **for cold start-up** i.e 44 kl w.r.t 50kl.
- (ii). The state sector per start-up oil consumption values are 5kl, 14kl and 23 kl higher than the reference values of hot, warm and cold start-up respectively.
- (iii). The central sector per start-up oil consumption values are 15 kl, 25 kl and 28 kl higher than the reference values of hot, warm and cold start-up respectively. The central sector per start-up oil consumption values considering only coal based stations i.e excluding lignite based stations are 15 kl, 23 kl and 22 kl higher than the reference values of hot, warm and cold start-up respectively. **The central sector values are significantly higher than the state and private sector values.**
- (iv). Within the central sector, the NTPC's per start-up oil consumption values are 20kl, 28kl and 26kl higher, DVC's values are 1kl, 8kl and 6kl higher and NLC's values of are 12kl, 30kl and 50kl higher than the reference values of hot, warm and cold start-up respectively. It is evident from this comparison that DVC's values are very close to the reference values, however NTPC's values are higher than DVC and overall central sector values. **NLC's cold start-up, warm start-up values are**

the highest all utility/sector and NTPC hot start-up are the highest all utility/sector.

- (v). It is observed that the **Central Sector per start-up oil values for 200 MW series are higher than that of both State Sector and Private Sector.**
- (vi). The overall average (considering all the 3 sectors) per start-up oil consumption values for 200 MW series are 9kl, 18kl and 20kl higher than the reference values of hot, warm and cold start-up respectively. The same considering only coal based units are 8kl, 16kl and 17kl higher than the reference values of hot, warm and cold start-up respectively.

The oil consumption per start-up values received from OEM i.e BHEL for 200 MW series is as per below Table 1.4:

Table 1.4: Oil Consumption per start up as provided by OEM

Unit Size (MW)	Oil Consumption per start up (Kl)		
	Hot	Warm	Cold
200/210/250 MW	5.5	32.56	48.03

It has been observed that the OEM values of oil consumption per start up are **very close** to reference values **for warm and cold startup** i.e only 2.56 kl higher and 1.97 kl lesser than the respective reference values. However, the OEM **hot start-up value** is **significantly lesser** that the reference value i.e 5.5 kl w.r.t 20 kl.

B. Analysis of Start-up Oil of 500 MW series units:

The summary of the aforesaid analysis for 500MW series units is as per below Tables 1.5:

Table 1.5: 5 year average sector/utility wise per startup oil figures for 500 MW units

Sr. No.	Name of Utility/Sector	Per Start-up Oil (kl)			Per Start-up Oil (excluding very high values) (kl)		
		Hot	Warm	Cold	Hot	Warm	Cold
	Central Sector						
1	NTPC	69	120	168	56	102	137
2	DVC	39	67	93	39	67	93
3	NLC	-	152	-	-	121	208
	Overall Central Sector	64	112	156	52	94	132
	Overall Central Sector excluding	64	111	156	52	93	129

	Lignite based units						
	State Sector	78	102	125	51	81	123
	Private Sector	33	69	94	33	68	92
	Overall Average	60	102	138	47	85	122
	Overall Average excluding Lignite based units	60	101	138	47	85	120

Table 1.6: Oil Consumption per start up as per IEGC (4th amendment),2016 and Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 (Reference Values)

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
500 MW	30	50	90

Exclusions: For analysis, very high values have been excluded from unit wise 5 year average figures and year-wise figures of per start-up oil consumptions.

Reference Values: The oil consumption per start up values specified in Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 which are same as in IEGC (4th amendment), 2016 have been considered as **reference values**. The said reference values for 500 MW units are as per the above Table 1.6.

Observations in terms of comparative analysis of above 5 year actual values of per start-up oil (excluding very high values) w.r.t reference values is as below:

- (i). The **private sector** per start-up oil consumption is **close to the reference values** for hot and cold start-up, and **slightly higher** compared to the reference value for **warm start-up** i.e 68kl w.r.t 50kl.
- (ii). The state sector per start-up oil consumption values are 21kl, 31kl and 33 kl higher than the reference values of hot, warm and cold start-up respectively.
- (iii). The central sector per start-up oil consumption values are 22 kl, 44 kl and 42 kl higher than the reference values of hot, warm and cold start-up respectively. The central sector per start-up oil consumption values considering only coal based stations are 22 kl, 43 kl and 39 kl higher than the reference values of hot, warm and cold start-up respectively. **The central sector values are closer to the state sector values but significantly higher than private sector values.**
- (iv). Within the central sector, the NTPC's per start-up oil consumption values are 26kl, 52kl and 47kl higher, DVC's values are 9kl, 17kl and 3kl higher and NLC's values of are -kl, 71kl and 118kl higher than the reference values of hot, warm and cold start-up respectively. It is evident from this comparison that DVC's values are very

close to the reference values, however NTPC's values are higher than DVC and overall central sector values. **NLC's cold start-up, warm start-up values are the highest of all utility/sector and NTPC's hot start-up values are the highest of all utility/sector.**

- (v). It is observed that the **Central Sector per start-up oil values for 500 MW series are closer to the state sector values but significantly higher than the private Sector values.**
- (vi). The overall average (considering all the 3 sectors) per start-up oil consumption values for 500 MW series are 17kl, 35kl and 32kl higher than the reference values of hot, warm and cold start-up respectively. The same considering only coal based units are 17kl, 35l and 30kl higher than the reference values of hot, warm and cold start-up respectively.

The oil consumption per start-up values received from OEM i.e BHEL for 500 MW series is as per below Table 1.7:

Table 1.7: Oil Consumption per start up as provided by OEM

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
500 MW	15.4	28	105

It has been observed that the OEM values of oil consumption per start are **quite lesser** with respect to the reference values **for hot and warm startup** i.e. 14.6kl lower and 22kl lower than the respective reference values. However, the OEM **cold start-up value is slightly higher** than the reference value i.e 105kl w.r.t 90kl.

C. Analysis of Start-up Oil of 660 MW units:

Table 1.8: 5 year average sector/utility wise per startup oil figures for 660 MW units

Sr. No.	Name of Utility/Sector	Per Start-up Oil (kl)			Per Start-up Oil (excluding very high values) (kl)		
		Hot	Warm	Cold	Hot	Warm	Cold
	Central Sector						
1	NTPC	106	200	282	78	164	246
	State Sector	96	132	198	91	132	198
	Private Sector	42	80	147	42	80	147
	Overall Average	83	149	233	63	115	194

Table 1.9: Oil Consumption per start up as per IEGC (4th amendment),2016 and Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 (Reference Values)

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
660 MW	40	60	110

Exclusions: For analysis, very high values have been excluded from unit wise 5 year average figures and year-wise figures of per start-up oil consumptions. The units with wall (front/rear/sides) fired boilers and new units have also been excluded from analysis since these units tend to have relatively higher start-up oil consumption.

Reference Values: The oil consumption per start up values specified in Draft CERC (Terms and Conditions of Tariff) (First Amendment) Regulations, 2024 which are same as in IEGC (4th amendment), 2016 have been considered as **reference values**. The said reference values for Super-critical units are as per the above Table 1.9.

Observations in terms of comparative analysis of above 5 year actual values of per start-up oil (excluding very high values) w.r.t reference values is as below:

(i). The **private sector** per start-up oil consumption is **almost close** to the reference values in the case of **hot start-up** i.e 42kl w.r.t 40kl. And, **slightly higher in case of warm and cold** i.e 20kl and 37kl higher than the reference values.

(ii). The **state sector** per start-up oil consumption values are 51kl, 72kl and 88kl **higher** than the reference values of **hot, warm and cold start-up** respectively.

(iii). The **central sector** per start-up oil consumption values are 38kl, 104kl and 136kl **higher** than the reference values of hot, warm and cold start-up respectively.

The **central sector** values are significantly **higher** than the **private sector** values.

And, in comparison to state sector values, the central sector values are **lesser for hot start-up** i.e 13kl lesser but **higher for both warm and cold start-up** i.e 32 kl and 48 kl higher respectively.

(iv). **NTPC's cold and warm start-up values are the highest among all sectors.**

(v). It is observed that the **Central Sector** per start-up oil values for 660 MW, in comparison to the **State Sector** are **lesser** for hot start-up and **slightly higher** for cold & warm start-up However, **Private Sector** per start-up values are **lowest** when brought into comparison with the **Central Sector and State Sector**.

(vi). The **overall average** (considering all the 3 sectors) per start-up oil consumption values for 660 MW are 23kl, 55kl and 84kl **higher** than the reference values of hot, warm and cold start-up respectively.

The oil consumption per start-up values received from OEM i.e BHEL for 660 MW series is as per below Table 1.6:

Table 1.10: Oil Consumption per start up as provided by OEM

Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
660 MW	25.12	72.59	127.96

It has been observed that the OEM values of oil consumption per start are **quite lesser** w.r.t the reference values **for hot startup** i.e. 14.88kl lower than the respective reference values. However, the OEM **warm and cold start-up values** are **higher** that the reference values i.e 72.59kl w.r.t 60kl and 127.96kl w.r.t 110kl respectively.

D. Analysis of Start-up Oil of 800 MW units:

Table 1.11: 5 year average sector/utility wise per startup oil figures for 800 MW units

Sr. No.	Name of Utility/Sector	Per Start-up Oil (kl)		
		Hot	Warm	Cold
	Central Sector			
	NTPC	162	275	423

In IEGC (Fourth Amendment) Regulations, 2016 and Draft CERC (Terms and Conditions of Tariff) (1st Amendment) Regulations, 2024, oil consumption per start-up norms for 800 MW has not been mentioned. **Therefore, there is no reference value for 800 MW units.** However, if the values for 660 MW in IEGC is taken as reference value, the average oil consumption per start-up for 800 MW is much higher than the reference i.e 122 kl, 215kl and 313 kl higher for hot, warm and cold start-up respectively w.r.t corresponding reference values.

Exclusions of very high values has not been possible for 800 MW as after excluding very high values, very few values are remaining which are not adequate for analysis.

In the data received, there are only 10 units of 800 MW capacity which are all NTPC's units. The 5 year average value of oil consumption per start-up is as per the below table:

Table 1.12

Sr. No.	Name of Station and Unit No.	5 year average Per Start-up Oil (kl)		
		Hot	Warm	Cold
1	DARLIPALI STPS U:1*	172	335	533
2	DARLIPALI STPS U:2*	302	348	478

3	GADARWARA TPP U:1	155	266	408
4	GADARWARA TPP U:2*	170	263	450
5	KUDGI STPP U:1**	115	193	321
6	KUDGI STPP U:2 #	98	243	366
7	KUDGI STPP U:3 #	116	107	311
8	LARA TPP U:1 #	80	254	365
9	LARA TPP U:2**#	189	369	371
10	NTPC TELANGANA U:1*	229	375	632

*Newer units with age less than 5 years

** Units with front and rear fired boilers

It is observed from the above table that out of 10 units, all are either newer units of age less than 5 years or units with wall fired boilers except for one unit i.e. Gadarwara U:1. The start-up oil in newer units may be higher due to stabilization issues. Units with wall fired boilers also tends to have higher oil consumption and have also been provided with higher SFOC norms in CERC Tariff Regulation, 2024. However, the start-up oil of the remaining 1 unit is also very high.

Table 1.13: Oil Consumption per start up as provided by OEM

Station Name and Unit Size (MW)	Oil Consumption per start up (kl)		
	Hot	Warm	Cold
Darlipali, 800 MW	33.3	133.2	321.9
Gadarwara, 800 MW	20.6	75.48	144.3

It has been observed from above table that the OEM value for Darlipali is significantly higher than that of Gadarwara. It has been informed by OEM that the values are higher for Darlipali due to higher start-up time as per the start-up curves and different make of Turbine and Boiler. Therefore, the OEM values of Gadarwara may be taken into consideration for comparison.

The 5 year average actual values as per the Table 1.12 are also much higher than the OEM values i.e around 141 kl, 199kl, 279 kl higher for hot, warm and cold start-up respectively in comparison to the corresponding OEM values.

E. Analysis of per start-up oil consumption of newer units (< 5 years of age):

The year wise oil consumption per cold start-up of newer units (< 5 years of age) is as per the below table:

Table 1.14

Name of Station	Unit No.	Unit Capacity	Per cold start-up oil consumption (kl)				
			2019-20	2020-21	2021-22	2022-23	2023-24
BARH	1	660 MW			355	283	276
BARH	2	660 MW					348
North karanpura	1	660 MW					322
North karanpura	2	660 MW					
NABINAGAR STPP	1	660 MW	437	313	262	285	214
NABINAGAR STPP	2	660 MW			164	225	
NABINAGAR STPP	3	660 MW				255	387
TANDA TPS	5	660 MW	432	569	289	333	355
DARLIPALI STPS	1	800 MW	633	604	548	470	411
DARLIPALI STPS	2	800 MW			609	465	359
GADARWARA TPP	1	800 MW	404	476	468	335	359
GADARWARA TPP	2	800 MW			481	451	417
KUDGI STPP	1	800 MW	376	366	307	296	261
KUDGI STPP	2	800 MW	540	256	397	332	308
KUDGI STPP	3	800 MW	378	331	236	192	416
LARA TPP	1	800 MW	450	369	246	376	383
LARA TPP	2	800 MW		369	332	412	
NTPC Telangana							632

As per the above table, the trend of year wise oil consumption per cold start-up has been analyzed and, it has been observed that in most of the newer units the per cold start-up oil consumption has decreased over the progressive years. For example in Nabinagar STPP Unit#1, the said value is decreased from 437 kl in 2019-20 to 214 kl in 2023-24, similarly in case of Kudgi STPP Unit #2 the said value is decreased from 540 kl in 2019-20 to 308 kl in 2023-24.

The high start-up oil consumption values in the initial year after commissioning indicates the effect of teething/stabilization issues in these units. In this respect, it is opined that with early resolution of these issues and with better operational practices, the start-up oil consumption may be further reduced.

1.6.2. Comparison between currently submitted data versus previously submitted data of NTPC stations:

It is to mention that previously during preparation of the recommendation of operation norms for the tariff period commencing from 1.4.2024 as requested by CERC, vide D.O. No. L-1/268/2022/CERC dated 19.05.2023, operational data related to start-up oil consumption, in addition to other operational parameter like PLF, SHR, APC, SFOC etc., was submitted by NTPC through CERC.

And, presently also NTPC has submitted operational data related to start-up oil consumption as per the format provided by CEA through CERC.

During comparison between currently submitted data and the previous data, it has been observed that though the figures of Station wise total Oil Consumption are same, but there are discrepancies in terms of number of start-ups and start-up oil consumption. For analysis, the start-up oil in terms of percentage of total oil has been calculated for some station of NTPC for 4 years, as per the current and previously submitted data. The summary of the analysis is as below:

From below table 1.15, it is evident that out of 48 evaluated values of current submission, 31 are higher than the previous submitted values i.e **64.6 % values are higher than previous submission.**

Table 1.15: Current versus previous data of NTPC stations

S. No	Name of the Project	Installed capacity (MW)	2019-2020		2020-2021		2021-2022		2022-2023	
			Current % age calculation	Previous % age calculation	Current % age calculation	Previous % age calculation	Current % age calculation	Previous % age calculation	Current % age calculation	Previous % age calculation
1	BARAUNI TPS	500	29.60#	33.60	90.29*	67.20	71.85*	68.40	76.79*	70.60
2	BONGAIGAN TPP	750	69.38*	65.01	83.19*	73.67	77.68*	48.44	63.08*	36.03
3	DARLIPALI STPS	1600	77.60*	21.45	94.85*	68.60	81.10*	68.56	99.89*	89.32
4	GADARWARA TPP	1600	92.09*	89.12	98.74#	114.50	84.55#	98.36	98.06*	94.94
5	KANTI-II	1050	66.33*	58.56	64.42*	53.93	63.43*	53.14	75.16*	55.96
6	KHARGONE STPP	1320	85.41#	100.00	92.72#	96.65	99.48*	80.69	97.47*	97.30
7	KUDGI STPP	2400	94.47*	89.57	67.53*	61.32	58.22#	61.29	63.20*	62.27
8	LARA TPP	1600	98.72*	98.56	97.16#	97.67	40.22*	38.89	66.19*	58.53
9	NABINAGAR TPP	1980	88.07#	91.67	92.32*	81.73	94.23*	89.39	99.85*	79.42
10	SINGRAULI STPS	2000	89.58#	100.00	89.70#	100.00	93.41#	100.00	90.97#	100.00
11	SIPAT STPS	2980	96.08#	100.00	88.65#	100.00	86.92#	100.00	93.75#	100.00
12	SOLAPUR STPS	1320	93.04*	73.08	100.00*	98.95	93.54*	89.36	78.81#	79.64

* Higher value than previous submitted value

Lesser than previous submitted value

1.6.3. Oil consumption in cold start-up just after overhauling vs. normal cold start-up oil consumption comparison

In the format (Annexure-I) prepared for collecting operational data related to start-up oil from utilities, the “Oil consumption in cold start-up just after overhauling” has been separately sought along with remaining other cold start-up oil consumption. The summary of comparison between both is as below:

Table 1.16: Cold Start-up Oil Consumption after overhauling vs normal start-up comparison

Sr. No.	Name of Utility/Sector	Cold Start-up Oil Consumption after overhauling vs normal start-up
1	NTPC	3.5 times
2	DVC	4.2 times
3	NLC	2.6 times
	Central Sector	3.5 times
	State Sector	2 times
	Private Sector	2.4 times
	Overall Average	2.9 times

From the above table, it is evident that the oil consumption in cold start-up subsequent to overhauling is much higher than any other cold start-up i.e nearly 3 times higher. Therefore, while analysis the after overhauling cold start-up oil consumption has not been included for calculation of oil consumption per cold start-up.

1.7. Conclusion and Recommendation

1.7.1. A summary of all the analyzed values for **200 MW series** is as per the below table

		Per Start-up Oil in KI		
		Hot	Warm	Cold
Reference Value (as per IEGC & Draft Tariff Regulation 1st Ammend.,2024)		20	30	50
OEM		5.5	33	48
Average	Central Sector	35	55	78
	State Sector	25	44	73
	Private Sector	21	36	44
	Overall Average	29	48	70
Recommendation		20	40	60

For 200 MW series, the OEM values are close to the reference values except for hot startup which is much lesser than the reference values. However, the actual average per startup oil consumption values are higher than both OEM and reference values. The reason of higher oil consumption may be the ageing effect on the units, as most of the 200 MW units are older with average age of around 29 years in central sector.

Taking the ageing factor into consideration, it is recommended that the “Oil Consumption per start up (KI)” for warm & cold start in case of 200 MW series units may be suitably increased than the OEM or reference values.

1.7.2. A summary of all the analyzed values for **500 MW series** is as per the below table

		Per Start-up Oil in KI		
		Hot	Warm	Cold
Reference Value (as per IEGC & Draft Tariff Regulation 1st Ammend.,2024)		30	50	90
OEM		15.4	28	105
Average of Actual Oil Consumption per start-up	Central Sector	52	94	132
	State Sector	51	81	123
	Private Sector	33	68	92
	Overall Average	47	85	122
Recommendation		30	60	100

For 500 MW, the OEM values are lower than the reference values for Hot and warm start-up, but higher in case of cold start. However, the actual average per startup oil consumption values are higher than both OEM and reference values. The reason of higher oil consumption may be the ageing effect on the units, as most of the 500 MW units are older with average age of around 20 years in central sector.

Taking the ageing factor into consideration, it is recommended that the “Oil Consumption per start up (KI)” for warm & cold start in case of 500 MW series units may be suitably increased than the OEM or reference values.

1.7.3. A summary of all the analyzed values for **660 MW series** is as per the below table

		Per Start-up Oil in KI		
		Hot	Warm	Cold
Reference Value (as per IEGC & Draft Tariff Regulation 1st Ammend.,2024)		40	60	110
OEM		25	73	128
Average of Actual Oil	Central Sector	78	164	246
	State Sector	91	132	198
	Private Sector	42	80	147

Consumption per start-up	Overall Average	63	115	194
	NTPC New Units (<5 yr age)	120	225	321
	State Sector New Units (<5 yr age)	74	113	151
	Recommendation	45	75	130

For 660 MW, the OEM values are lower than the reference values for Hot and warm start-up, but higher in case of cold start. However, the actual average per startup oil consumption values are higher than both OEM and reference values. Almost all the units in fleet of 660 MW are new, with oldest unit (for which data has been received) is of age of around 13 years.

It has been observed that start-up oil consumption in newer units of NTPC is much higher than other units, this may be due to unit stabilization issue. However, in one state sector station i.e Suratgarh TPS with 2 new 660 MW units, though it is having higher start-up oil values than reference value, but the values are close to state sector average value even lower in case of warm and cold start-up. Therefore, it can be stated that the effect of stabilization in start-up oil consumption is not that much visible in case of Suratgarh TPS.

In view of above, it may be stated that with improvement in operational practices and with early resolution of stabilization issue, the start-up oil consumption values of NTPC may be brought down up to a level of other units with time.

Taking all the above factors into consideration, the “Oil Consumption per start up (KI)” for 660 MW have been recommended suitably higher than the reference values.

1.7.4. A summary of all the analyzed values for **800 MW series** is as per the below table

	Per Start-up Oil		
	Hot	Warm	Cold
OEM	20.6	75.48	144.3
Average of Actual Oil Consumption per start-up	162	275	423
Recommendation	60	80	150

The actual Oil consumption per start-up value is very much higher than the OEM values (and also reference values of 660 MW) which may be due to stabilization issues of newer units.

In view of above, it may be stated that with improvement in operational practices and with early resolution of stabilization issue, the start-up oil consumption values of NTPC may be brought down up to a level of OEM values.

Based on the above, recommendation for 800 MW for cold, warm and hot start-up values have been made.

1.7.5. Recommendations:

- (i) Based on the reference values, considering the ageing of the units and performance of the units, the following values for Cold, Warm and Hot start up are recommended i.r.o of 210 MW, 500 MW, 660 MW and 800 MW units.

Unit Size (MW)	Oil Consumption per start up (KI)		
	Hot	Warm	Cold
210 MW series	20	40	60
500 MW	30	60	100
660 MW	45	75	130
800 MW	60	80	150

It is opined that the thermal units which are incurring high start-up oil consumption, needs to improve their operational practices and should try to bring the start-up oil consumption values to a level of OEM values.

- (ii) Super critical/ultra super critical units may be provided 10% extra quantity of start-up oil for a period of 3 years from Date of Commercial Operation (CoD), as they may face teething/stabilization issues. These units should strive to improve their operational practices for early resolution of teething/stabilization issues.

Annexure-I

Details of thermal power stations for which plant operational data has been received

Sl. No.	Power Station	Utility	Details of Units Installed (MW)	Capacity* (MW)
	<i>Coal/ lignite based stations</i>			
1	Barauni	NTPC	2x250	500
2	Barh	NTPC	4x660	2640
3	Bongaigaon	NTPC	3x250	750
4	Dadri Thermal	NTPC	4x210+2x490	1820
5	Darlipali STPS	NTPC	2x800	1600
6	Farakka	NTPC	3x200+3x500	2100
7	Gadarwara	NTPC	2x800	1600
8	Kahalgaon	NTPC	4x210+3x500	2340
9	Kanti-II/Muzaffpur	NTPC (estwhile KBUNL)	2x195	390
10	Khargone STPS	NTPC	2x660	1320
11	Korba	NTPC	3x200+4x500	2600
12	Kudgi STPS	NTPC	3x800	2400
13	Lara STPS	NTPC	2x800	1600
14	Mouda	NTPC	2x500+2x660	2320
15	North Karanpura	NTPC	2x660	1320
16	NTPC Telangana	NTPC	2x800	1600
17	Nabinagar STPS	NTPC	3x660	1980
18	Ramagundam	NTPC	3x200+4x500	2600
19	Rihand	NTPC	6x500	3000
20	Simhadri	NTPC	4x500	2000
21	Singrauli	NTPC	5x200+2x500	2000
22	Sipat	NTPC	3x660+2x500	2980
23	Solapur STPS	NTPC	2x660	1320
24	Talcher	NTPC	2x500+4x500	3000
25	Tanda	NTPC	4x110+2x660	1760
26	Unchahar	NTPC	5x210+1x500	1550
27	Vindhyachal	NTPC	6x210+7x500	4760

28	Bokaro	DVC	1x500	500
29	Chandrapura	DVC	2x250	500
30	Durgapur Steel	DVC	2x500	1000
31	Koderma	DVC	2x500	1000
32	Mejia	DVC	4x210+2x250+ 2x500	2340
33	Raghunathpur	DVC	2x600	1200
34	TPS I Expansion	NLCIL	2x210	420
35	TPS II	NLCIL	7x210	1470
36	TPS-II Expansion (CFBC)	NLCIL	2x250	500
37	NNTPPS	NLCIL	2x500	1000
38	Chandrapur STPS	MAHAGENCO	5x500+2x210	2920
39	Bhusawal Stage	MAHAGENCO	1x210+2x500	1210
40	Khaperkheda	MAHAGENCO	4x210+1x500	1340
41	Koradi	MAHAGENCO	1x210+3x660	2190
42	Nasik	MAHAGENCO	3x210	630
43	Paras	MAHAGENCO	2x250	500
44	Parli	MAHAGENCO	3x250	750
45	Chhabra TPP	RVUN	4x250	1000
46	Chhabra Super Critical TPP	RVUN	2x660	1320
47	Kalisindh TPP	RVUN	2x600	1200
48	Kota STPS	RVUN	2x110+3x210+ 2x195	1240
49	Suratgarh TPS	RVUN	6X250	1500
50	Suratgarh STPS	RVUN	2 X 660	1320
51	Rajiv Gandhi TPS	HPGCL	2x600	1200
52	Panipat TPS	HPGCL	1x210+2x250	710
53	Yamunanagar TPS	HPGCL	2x300	600
54	Singareni TPP	Singareni Collieries Company Ltd.	2 X 600	1200
55	Akaltara TPS	Wardha Power Company Ltd	3x600	1800
56	Amravati TPS	Rattan India Power Ltd	5x270	1350
57	Derang/Angul TPP	Jindal India Thermal Power Ltd	2x600	1200

58	GMR Warora TPS	GMR Energy Ltd	2x300	600
59	ITPCL TPP	IL&FS Tamil Nadu Power Company Ltd	2x600	1200
60	Jojobera TPS	Tata Power Company Ltd	2x120	240
61	Mahadev Prasad TPP	Adhunik Power and Natural Resources Ltd	2x270	540
62	Maithon RB TPP	Maithon power Ltd	2x525	1050
63	Muthiara TPP	Coastal Energen Pvt Ltd	2x660	1320
64	Neyveli TPS (Z)	ST-CMS Electric Company Pvt Ltd	1x250	250
65	Nigrie TPP	Jai Prakash Power Ventures Ltd	2x660	1320
66	Prayagraj TPP	Tata Power/ Prayagraj Power Generation Company Ltd	3x660	1980
67	Rajpura TPP	Nabha Power Ltd	2x700	1400
68	Sabarmati (D-F Stations)	Torrent Power Ltd	1x120+2x121	362
69	Sasan UMTTP	Sasan Power Ltd	6x660	3960
70	Trombay TPS	Tata Power Company Ltd	1x500+1x250	750
71	Vedanta TPP	Vedanta Ltd	1x600	600