FICCI's Representation on Mechanism for Compensation on account of change in law for compliance with Revised Emission Standards notified by MoEF&CC in respect of Competitively Bid Thermal generating – Staff Paper thereof

Submitted to:

Central Electricity Regulatory Commission

Submitted to CERC on 4th Oct-2020

Recommendations on Mechanism for Compensation on account of change in law for compliance with Revised Emission Standards notified by MoEF&CC in respect of Competitively Bid Thermal generating – Staff Paper thereof

A) A Notification on *'Mechanism for Compensation on account of change in law for compliance with Revised Emission Standards notified by MoEF&CC in respect of Competitively Bid Thermal generating'* was published by Central Electricity Regulatory Commission on 5th September, 2020 and had invited comments/suggestions from the stakeholders by 04.10.2020.

B) The Staff paper is a step forward towards clearing some concerns like the tariff implications on account of installation of FGD system, payment mechanism etc. Commission relied on principle of restitution i.e. restoration of some specific thing to it's rightful status and it is a good attempt by the Commission to formulate a generic mechanism of compensation to restore the affected parties to the same economic position.

C) In this regard, FICCI's comments/suggestions are the following:

Sr. No.	Clause No.	Relevant Extract	Comments	Rationale
1.	-	-	The proposed methodology considers power plants having PPAs through competitive bidding process. However, there are projects which do not have PPAs but implementation of ECS is mandated. A cost recovery methodology for such plants is also needed as there is considerable capacity. Further, in absence of long term PPAs going forward, the current PPAs would start completing its tenure depending upon PPA tenure. Such projects, though covered under the proposed mechanism, would certainly need clarity for open capacity in future. Despite tariff increase under the proposed mechanism, in absence of cost recovery for open capacity post PPA period financing of such projects will be a challenge. It is suggested that cost recovery possibilities and possible mechanism should also be developed.	-

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2.	-	-	Procedure and timelines for filing of application/petition for tariff determination for ECS have not been specified. In absence of clarity on timelines procedure, there would be delay in determination of additional tariff by more than a year after commissioning of ECS. This would affect generators revenues who are already stressed. It would also add to cost for consumers as there would be a carrying cost due to delay. Further, without having a clear timeline for determination and more importantly actual recovery starting immediately after commissioning of ECS would be a challenge. **<u>It is thus suggested that</u>** **a provisional tariff based on the norms proposed and finalized along with the benchmark costs approved by CEA may be notified subject to truing up post commissioning of ECS.** **OR** **the petition for determination of tariff may be allowed to be filed six months prior to scheduled commissioning of ECS so that the additional tariff is paid from the month in which ECS is commissioned.**	Proposed staff paper fails to give any confirmation that such cash flow would be certain from date of operation of ECS. iii. Thus, a very critical need is the inclusion of a provision which allows a GENCO to bill for such change in law from date of operation of ECS, based on the normative capex, opex and interest cost. iv. Upon determination of tariff by appropriate electricity regulatory commission, any prior period adjustment can be handled through true up once capex is fully ascertained post commissioning of the ECS.

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3.	**Clause 1.4**	1.4. The Commission, for installation of ECS (like FGD system), vide order dated 23.4.2020 in Petition No. 446/MP/2019 and vide subsequent orders in other petitions, has provisionally allowed capital cost based on cost discovered through competitive bidding process, indicative cost notified by Central Electricity Authority (CEA) and prudence check of the cost claimed. While approving provisional capital cost, certain cost components like taxes and duties, IDC and management cost have not been considered, with the observation that these components shall be allowed after prudence check after the installation of FGD system. **Similarly, as regards opportunity cost i.e. revenue/ tariff which may not be available to the generator during the period of plant shutdown for integration of the FGD system with the generating station, it has been decided that the same would be considered after installation of FGD system.**	• It is submitted that considering revenue recovery for the shutdown period for FGD installation on ex post facto basis will create uncertainty over the recovery. Therefore, to remove uncertainty it may be necessary to specify that the Generators would be entitled for Deemed Capacity Charges, however, the period for which the recovery would be allowed will be decided on a case to case basis subject to prudence check by the Commission. • Further, during the shutdown period for FGD integration the generators would be subject to additional charges for short / non- lifting of coal under the FSA with coal companies. It is submitted that such charges should also be allowed for recovery from the beneficiaries in accordance with the restitution principle in terms of the Section 63 PPAs. • While the staff paper mentions that the opportunity cost in terms of tariff during shut down period would be considered after installation of FGD, we hereby suggest that a clear methodology may be put in place for recovery of fixed charges and other incidental costs for shutdown period. **It is suggested that following costs for shutting down of the plant which should be compensated to the extent of actual number of days of shutdown may be specified:** • **Fixed capacity charges.** • **Recovery of LTOA charges** • **Waiver /reimbursement of penalty payable under PPA if any for lower plant availability.**	-
4.	**Clause 1.6 (CERC order dated 18.05.2020 in**	We understand that in several cases, the useful life of the FGD system, the remaining useful life of the generating	• Besides, the additional cost on account of emission control mechanism shall be excluded from MOD stack in line with the directives issued by MOP.	-

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	Petition No. 210/MP/2019)	station and term of the PPA would not be the same. It is further clarified that while the cost recovery for the FGD system would be spread over the useful life of the FGD system or the remaining useful life of the generating station, the Respondents shall be liable to pay the compensation as granted by this Commission only for the remaining term of the PPAs.		
5.	**4 A a:** Depreciation & Useful life	Based on the above, life of 25 years has been considered for ECS. Accordingly, 90% (considering salvage value of 10%) of additional capital expenditure on account of installation of ECS is proposed to be recovered by the generating company in 25 years as depreciation {straight line method @3.6% (90%/25) per year} starting from ODe of ECS.	The normative total life of a thermal plant is very well recognized as 25 years both by the industry as well as by Hon'ble Commission. Based on the same, CERC has been approving the tariff of plants where tariff is determined U/S 62 assuming plant life of 25 years. It may be the case that few projects have been operating even after 25 years. However, such extended plant life is not assured and would depend upon many factors including: 1) Physically condition of the plant 2) Commercial viability and availability of sizable market for thermal power. Both the above factors may not get fulfilled for all the plants, especially considering the fact that there is huge surplus in the country and technological transformation by moving away from thermal towards RE & Storage. Further with increasing RE proportion, thermal plants are facing technical issues in terms of cycling impact which may that thermal plants would not be able to operate even for their defined useful life of 25 years.	All existing plants will try to maximise funding through debts for installation of ECS. However, maximum tenure for debt funding would not go beyond 85% of the plant life less the years expired during operation so far. ii. As per CERC Tariff Regulations, effective useful life of thermal power plant is 25 years. iii. Considering the above, most of the plants are in operation for 6-7 years, debt will be available for typically with a repayment period of 12-13 years. iv. The commission by prescribing Debt interest rate for equity component, is effectively encouraging 100% debt funding. v. Thus entire funding needs to be recovered in debt tenure of 12-13 years. vi. Assuming that 90% of the debt needs to be recovered in 12 years, rate of depreciation as per straight line method comes out to be 7.5%

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			The competitively bid projects also does not get any assured compensation for additional investment to be made for Renovation and Modernization which plants where tariff is determined CERC U/S62 would get. Considering life of above 25 years for ECS, which goes beyond useful life of power plant would also not qualify the "Parent/Child" Fixed Asset relationship unless depreciation accounting for the main plant is also proposed to be changed and recomputed based on 40 years. Even if Companies Act, 2013 recognize 40 years of plant life, the Commission after due consideration still approved plant life as 25 years, then a "Child" asset i.e. ESC which cannot operate without the plant be useful for more than 25 years. Considering the above, useful life of power plant beyond 25 years cannot be considered as a benchmark/norm. Further, the deprecation rate has been suggested as SLM over useful life. In practice the debt repayment itself is much higher than deprecation leading to revenue loss to the generator. **Thus, it is suggested that:** **1. the useful life of ESC to be considered as the remaining useful life of power plant.** **2. depreciation for the initial 12 years of operation may be considered at higher rate of 7% to service the debt repayment and the remaining depreciation to be determined on SLM basis till end of power plant life.** Depreciation component in the tariff allows developer to recover principal repayment part. Hence, the rate at which assets get depreciated shall match nearly with the principal	vii. Proposed Depreciation of 3.6% would create a cash flow gap of 3.9% (7.5% - 3.6%) of investment value. Illustration – • A plant of 1000 MW capacity will require ~ Rs 600 crs for FGD installation with Debt Equity ratio of 80:20. • As per the staff paper, plant will recover Rs 20 crs towards depreciation while it would have to pay Rs 40 crs towards principal repayment assuming 12 years of debt tenure. • There is huge shortfall (~ Rs 20 crs) which can be met only by having a higher rate for depreciation (~ 7.5%)

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			repayment profile so that investment doesn't suffer cash flow issues. ii. Useful life of ECS, for recovery of loan repayment should be considered as the balance plant life or the maximum loan tenure lenders are willing to provide in the prevailing business environment. iii. Depreciation rate to be ~ 7.5% (as per straight line method) in order to recover the debt portion, so that without any under recovery loan amount can be repaid.	
6.	**4 A b:** Cost of capital employed	It is proposed that the cost of capital would be estimated based on Net Fixed Assets (NFA) value of fixed assets reducing each year by depreciation value. The cost of such NFA would be at Lower of SBI MCLR + 3.5% or Actual rate of interest on loan	It has been proposed that the cost of capital would be calculated as lower of SBI MCLS+3.5% or actual RoI of loan. The SBI MCLR + 3.5% as on date works out to 10.5%, such rate of return on equity investments is very low and does not even provide for minimum cost of equity for a no profit scenario. Considering the actual rate of interest on loan also for determining cost of capital would provide lower returns to a developer who is more efficient in procuring loan at lower interest rates. This would only penalize an efficient player and incentivize an inefficient player. Instead, a proper financially prudent method of providing RoE and interest on debt should be followed as has been approved for plants where tariff is determined by CERC U/S 62. Further, it has not been specified how the tax on return on equity would be treated. In absence of clarity, the RoE or cost of capital would attract tax and thus would lead to losses to the generator, even with a minimum return on equity. **Thus, it is suggested that:** • **Instead of cost of capital, a notional Debt:Equity ratio of 70:30 should be used**	-

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			• **RoE should be allowed on the equity component** • **RoE should be 15.5% post tax i.e. the RoE should be grossed up by the tax rate.** • **Debt RoI should be considered as lower of actual rate and SBI MCLR +3.5%**	
7.	**Clause 4.8**	The PPAs require the Commission to decide the date from when the compensation on account of Change in Law shall be applicable. It is suggested that the compensation for installation and operation of the ECS should be available to the seller from the Date of operation (ODe) of the ECS	• While Clause 4.8 of staff paper talks about when change in law will be applicable, staff paper is silent from which date invoice can be raised and amount can be realised. • There shall be a provision for Interim Tariff to be charged immediately from date of operation of ECS.	Staff Paper says certainty of cash flow. This should include timing of starting of cash flow also.
8.	**Clause 4.11**	Accordingly, additional capital expenditure on installation of emission control system is proposed to be serviced on Net Fixed Assets (NFA) basis (value of fixed assets reducing each year by the depreciation value) @ weighted average rate of interest of loans raised by the generator or at the rate of Marginal Cost of Lending Rate of State Bank of India (for one year tenor) plus 350 basis points, as on 1st April of the year in which emission control system is put into operation, whichever is lower.	The proposed mechanism does mention that the IDC would be considered as part of additional capital. However, there is no specific mention of methodology for estimation of the same. The proposed mechanism does not mention that the initial spares and undischarged liabilities would be considered as part of additional capital. The components of additional capital expenditure should include all the capital expenditure heads with a prudence check. It is noted that i. Initial spares ii. Undischarged liabilities have been allowed for plants where tariff is determined by Hon'ble Commission U/S 62. However, these cost components have not been allowed/specified for competitively bid projects. The capital cost components cannot be different while some allowed and some are not depending upon the tariff determination methodology for the power plant.	-

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<u>It is requested that</u>
IDC to be allowed as allowed to plants U/S 62 i.e. on actual loan if equity is less than 30% or
IDC to be allowed on actual loan + normative loan (equal to amount in excess to 30% fund deployment)
To include norms for IDC/Pre-ops expenses/Contingency/Taxes etc. for calculating the project capex on a normative basis.
ii. Suggest to provide norms for each of the component, to arrive at a normative capex, to be trued up for actuals when ECS starts operation.
iii. Suggested %age are given separately in the table as below. For illustration purpose a typical break up (Actual could vary) is given:
<table>
<tr><th>Particulars</th><th>Rs Cr</th><th>%age of the project cost</th></tr>
<tr><td>EPC Cost</td><td rowspan="3">609</td><td rowspan="3">69%</td></tr>
<tr><td>Civil</td></tr>
<tr><td>Non EPC</td></tr>
<tr><td>Pre Operative Expenses</td><td>15</td><td>2%</td></tr>
<tr><td>Spares</td><td>21</td><td>2%</td></tr>
<tr><td>Contingency</td><td>30</td><td>3%</td></tr>
<tr><td>Base Project Cost</td><td>676</td><td>76%</td></tr>
<tr><td>Taxes and Duties</td><td>115</td><td>13%</td></tr>
<tr><td>Finance Charges</td><td>95</td><td>11%</td></tr>
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			Total Project Cost | 886 | 100% • **Un-discharged liability may be allowed for competitively bid plants as additional capital expenditure during the year it is discharged, subject to prudence check.**	
9.	**Clause 4.13** **Additional O&M Expenses (AREo&m)**	Additional O&M expenses allowed at 2% of ECS capitalization (excluding IDC and FERV) for first year. For subsequent years escalation at 3.5% or rate specified by Commission on 1st Year O&M It has been proposed that the O&M expense to be reviewed based on actuals.	• Disposal cost of Gypsum along with transportation cost to be reimbursed. As all thermal stations will install FGD's, market for Gypsum sale may become thin & Gypsum disposal may become a big challenge. Hence, this Gypsum disposal cost shall form part of the additional O&M expenses. • In case of coastal plants which use seawater, cost towards desalination is incurred which is over and above the proposed O&M cost. • Further it has been proposed that the O&M cost would be reviewed based on actuals. It is submitted that once commissioned the ECS becomes an integral part of the plant and would be difficult to identify O&M cost for it from the overall O&M cost of the plant and thus would become a contentious issue leading to disputes. **<u>It is thus suggested that</u>** • **O&M cost to be arrived @ 2.5% of the capex in the interim. Post prudence check, to be allowed for actuals.** • **O&M escalation rate to be fixed @ 4.77% in line with the prevailing tariff regulations.** • **For coastal plants an additional O&M cost of 0.5% of ECS capitalization (excluding IDC and FERV) may be allowed.** **The provision of revision of O&M expenses based on actual may be deleted**	i. ECS is the new addition to the plant system. There is no historic data available for O&M cost to be incurred while operating ECS. ii. The study at various forums and petitions indicate that actual O&M cost shall be higher than 2% which is currently prescribed under this staff paper. iii. Commission is also aware that there will be an additional cost to be incurred for disposal of the waste produced during operation of ECS. iv. While the O&M cost is ascertained by the commission after prudence check, it will be prudent to give a reasonable O&M cost in the interim, so that there is no negative cash flow issues to the generator. v. During the initial tariff regulations regime, O&M cost was proposed to be given as 2.5% of the capex for new plants. Same to be allowed in the interim. Post prudence check, same to be allowed at actuals. vi. Escalation rate to be allowed in line with the existing tariff

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				regulations as O&M for ECS operation is similar to the existing O&M being undertaken by plant in other components. vii. Any under recovery is against the PPA provisions related to change in law which is agreed to put the generator at the same economic position as before.
10.	**Clause 4.14 –** **Additional IWC (AREIWC)** **Interest on Working Capital**	4.14. Working capital may include: i) Cost of limestone or reagent towards stock for 20 days corresponding to the normative annual plant availability factor and advance payment for 30 days towards cost of reagent for generation corresponding to the normative annual plant availability factor; ii) Operation and maintenance expenses in respect of emission control system for one month and maintenance spares @20% of operation and maintenance expenses in respect of emission control system; and iii) Receivables equivalent to 45 days of supplementary capacity charge and supplementary energy charge for sale of electricity calculated on the normative annual plant availability factor.	• While the staff paper provides for a mechanism of computing the incremental working capital towards FGD system, it does not specify any mechanism to compute the interest on such incremental working capital. It is presumed that the same would be on the lines of the regular interest on working capital norms as per MYT Regulations however, it is requested that the same be clarified. • To meet the availability commitments the generator will have to keep stock of reagent to last at least for a month to protect against supply disruptions, quality issues etc. **It is thus suggested to include the cost of limestone or reagent for 30 days generation corresponding to the normative annual plant availability factor to be included.**	i. Current SBI MCLR is 7%. Therefore, staff paper allows only 10.5% interest rate, whereas many of the current IPPs are already paying interest rates which is more than 12%. ii. Lenders shall charge different interest rates to different projects/companies depending on many factors including their previous exposure/financial health of the power procurers etc. iii. Unless interest rate is fully recovered, lenders will not finance the ECS. Already explained above in point no 1. iv. Therefore, putting a cap on the interest rate and in case some part of the interest component is not recovered, it would not help implementation of ECS. v. This is also against the principle of restitution to the same economic position, hence actual interest rate needs to be allowed.

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				vi. Alternatively, if commission wants to go ahead with MCLR regime then • Current clause 4.11 states – "………………………………………. Net Fixed Assets (NFA) basis (value of fixed assets reducing each year by the depreciation value) @ weighted average rate of interest of loans raised by the generator or at the rate of Marginal Cost of Lending Rate of State Bank of India (for one-year tenor) plus 350 basis points, as on 1st April of the year in which emission control system is put into operation, whichever is lower" Having MCLR as on 1st April of the year in which ECS is commissioned makes it a fixed rate, which certainly will not be the intent of the commission. It means that MCLR, which should be floating in nature, now will be fixed rate for the entire period. • This is an ambiguity and defeats the concept of restitution which needs correction. 1 yr MCLR should be taken as on 1st April of every year instead of the year when ECS is commissioned. • Also, MCLR should be average of MCLR notified by all the banks.
11.	**Clause 4.14 (i)**	Cost of limestone or reagent towards stock for 20 days corresponding to the normative annual plant availability factor and advance payment for 30 days towards cost of reagent for generation	Landed price of limestone or the reagent at the generating station shall be considered.	-

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		corresponding to the normative annual plant availability factor;		
12.	**Clause 4.18 and 4.19**	**D) Additional Auxiliary Energy Consumption (AUXECS):** 4.18. The ex-bus energy charges quoted by the generating company will undergo change due to additional auxiliary energy consumption on account of installation of ECS. This is explained using the illustration given below. …… 4.19. The Revised Contracted Capacity after installation of the ECS can be arrived at as follows: $CC_{Revised} = CC_{Org} \times (1-AUX_{Total})/(1-AUX_{Org})$ where $AUX_{Total} = AUX_{Org} + AUX_{ECS}$.	• The formula to compute the Auxiliary Consumption for plants where 100% ex bus capacity is tied under one PPA, as the difference between installed capacity and contracted capacity may not stand correct in some cases where there are multiple units in a generating station and entire installed capacity of certain units is contracted under a PPA by meeting the auxiliary power requirement of such units from other units of the power station. • Therefore, it is necessary to clarify that the proposed formula in staff paper would not apply to cases as mentioned above. In such cases, Installed Capacity of the entire power station and aggregate contracted capacity of all PPAs needs to be considered for deriving the Auxiliary Power Consumption. • Further is also needs to be clarified that in case the entire installed capacity of a unit is contracted under PPA, auxiliary consumption can be met from other units. • Further, the staff paper provides detailed methodology for estimation of impact of additional auxiliary consumption on capacity and energy charges in a very unambiguous manner. It has been proposed to use the normative Auxiliary consumption for ECS as proposed by CEA. It may be noted that the norm proposed are on benchmark basis and does not consider plant specific requirements. In case of coastal plants there would be additional auxiliary power consumption to operate desalination plant for water to be supplied to ECS. **It is thus suggested that an additional 0.2% auxiliary consumption over and above proposed by CEA should be allowed in case of coastal plants.**	-

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13.	**Clause 5. Recovery of Supplementary Capacity Charges and Supplementary Energy Charges and Procedure for Payment**	It has been proposed to include following costs in supplementary energy charges: • Cost of Capital Employed • Depreciation • Interest on working capital • O&M expenses	As far as ECS is considered the cost recovery and additional tariff determination principle is same for all plants, irrespective tariff determination methodology of the power plant i.e. recovery of all costs while neither of the plants are allowed and expected to make profits though installation of ECS. Having different approach depending upon the tariff methodology is not justified for cost recovery on capital employed. **<u>It is suggested that competitively bid plants should also be allowed to recover the cost of funds under separate heads of "Return on Equity" and "Interest on loan capital" as allowed to plants where tariff is determined by CERC U/S 62.</u>**	-
14.	**Clause 5.3** The recovery of monthly Supplementary Energy Charges (SECm) will be made by applying following formula: ……….	The recovery of monthly Supplementary Energy Charges (SECm) will be made by applying following formula: i SECm (Rs.) = AEOm x[(SRC)/(1-AUXTotal)] x LPR / 1000)	Hon'ble Commission may provisionally consider the impact of 1.01% on Normative Station Heat Rate i.e. (SHR/(1-1%)) due to reduction boiler efficiency by 1% while finalizing the Regulations subject to true-up as per bid guarantee as it would severally impact the energy cost for reasons not attributable to Generating Stations.	Emission Control System will have impact on the Station Heat Rate of the generating unit(s). Hence, the normative SHRs of the generating unit(s) should also be adjusted appropriately. The 'in-combustion control system' which is one of the most suited method for abatement of NOx upto range of 450mg/Nm3 is sensitive to operational aspects and majorly impacts the boiler efficiency. Boiler efficiency will reduce due to increased unburnt carbon loss after implementation of 'In Combustion Control Technology'. The same has been highlighted by all the bidders for installation of In-Combustion control system for limiting NOx emissions. It is understood that the adverse impact on boiler efficiency would vary in the range of 0.8% to 1.8% depending on the

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				site condition as per the discussions with vendors. Also, in case of SNCR system, because of water injection in the furnace, Boiler efficiency will decrease by 0.3% to 0.4% leading in increase in normative unit / station heat rate which will impact energy charges.
15.	**Annexure I Sr. no 2:** Norms for Regent Consumption – SOX Emission control	**a) For Wet Limestone based FGD system:** [0.85 x K x SHR (kCal/kWh) x S (%)]/[GCV (kCal/kg) x LP (%)] Where, S = Sulphur content in percentage, LP = Limestone Purity in percentage; Provided that value of K shall be equivalent to (35.2 x Design SO2 Removal Efficiency/96%) for units to comply with SO2 emission norm of 100/200 mg/Nm3or (26.8xDesign SO2 Removal Efficiency/73%) for units to comply with SO2 emission norm of 600 mg/Nm3; Provided further that the limestone purity shall not be less than 85%. **b) For Lime Spray Dryer or Semi-dry FGD system:**	In addition to Sulphur in the flue gas, hydrogen fluorides and chlorides are also present which also react with limestone. This would result in higher limestone consumption in case of Limestone based FGD than as has been proposed. Further, restricting the limestone purity at 85% may not be in control of the developer and would depend on its availability in the market, especially when there will be sudden increase in demand with significant FGD installations. **It is thus suggested that** • **an additional 3-5% consumption may be added over and above the proposed formula to compensate for consumption of limestone by hydrogen chlorides and fluorides** • **condition of minimum purity of 85% of limestone may be removed. At least in the initial years till the limestone market and norms are established.** • **It is requested to consider SO2 conversion factor 100% i.e. 100% Sulphur available in coal will be converted to SO2.**	It may kindly be noted that the assumptions considered for evaluation of normative consumption of Specific Reagent for various technologies for reduction of emission of Sulphur Dioxide would depend on several parameters such as (a) Normative Station Heat Rate (after duly factoring impact of ECS system) (b) GCV of Coal, (c) Sulphur content of Coal (f) Purity of Reagent (g) Design SO_2 Removal efficiency of the ECS and (h) Stoichiometric molar ratio of reagent consumption and therefore assigning normative values in some of the cases may not be correct. As such a common empirical formula may be provided to compute the specific reagent consumption for various technologies wherein it is proposed that these parameters may be considered at actual/or as recommended by CEA rather than assigning them predefined values which seems inappropriate.

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		The specific lime consumption shall be worked out based on minimum purity of lime (PL) as at 90% or more by applying formula [0.90 x 6 /PL(%)] gm/kWh; **c) For Dry Sorbent Injection System (using sodium bicarbonate):** The specific consumption of sodium bicarbonate shall be 12 gm per kWh at 100% purity. **d) For CFBC Technology (furnace injection) based generating station:** The specific limestone consumption for CFBC based generating station (furnace injection) at 85% purity limestone (kg/kWh) shall be computed with the following formula: = [62.9 x S (%) x [SHR (kCal/kWh) /GCV (kCal/kg)] x [0.85/ LP] Where S= Sulphur content in percentage, LP = Limestone Purity in percentage. **e) For Sea Water based FGD system:** The reagent used is sea water, therefore there is no requirement for any normative formulae for consumption of reagent.		The details of common empirical formula with relevant details in enclosed in **Annexure 1** for kind consideration of the Hon'ble Commission. It may be noted that this is the same formula that CEA has used, including for computation of K, and incorporates all parameters considered by it. Further, in the formulation of CEA, the value of SO2 conversion factor has been considered as 0.95 or 95% for which no basis has been given, whereas in most of calculations by bidders nowadays this factor is taken as 100%. Similarly, for computing limestone purity, it may be clarified that the same relates to purity with refence to reactive component of limestone. Thus, in a limestone with purity of say 85%, 5-10% may be non-reactive limestone and, hence, effective purity of reactive limestone shall be in the range of 76.50%-80.75%. This is again a commonly sought factor by bidders for the purposes of guaranteed purity. It is also to be noted that while CEA has acknowledged that stoichiometric ratio increases with increase in efficiency of Sox or NOx removal system, it has considered only one value of stoichiometric ratio which is on lower side as per our assessment based on

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				discussions on guarantees with bidders in this regard. Therefore, we have proposed slightly higher stoichiometric ratios, which are practically achievable and are requested to be considered. Also, it may be noted that Limestone with lower purity can also be used specially in eastern region plants where low grade limestone from Jharkhand, Orissa and West Bengal can be sourced. Hence cap on limestone purity may be removed. Further, the variation in the price of the limestone does not vary linearly with the purity and therefore, in case when avenue of utilization of disposal is not available or the overall cost of lower purity limestone is less than high purity levels, flexibility should be given to the Generators to choose the appropriate purity of limestone after having cost benefit analysis of reagent cost plus disposal cost of the byproducts. Therefore, in cases, where utilities are not able to fully use gypsum produced, they may source low quality limestone for reducing reagent cost and, hence, energy cost.
16.	**Annexure-I, Additional Auxiliary Power Consumption**	1) For reduction of sulphur dioxide a) For wet limestone FGD (without Gas to Gas Heater) - 1% b) Semi dry FGD system - 1%	Regarding auxiliary consumption as given in annexure 1, the following may be considered: a) For wet limestone based FGD, Auxiliary Power Consumption will be dependent on plant specific design. The limit of Auxiliary Power Consumption for	

Sr. No.	Clause No.	Relevant Extract	Comments	Rationale
		c) DSI (using sodium bicarbonate) - Nil d) For CFBC Power Plant - Nil e) Sea water based FGD (without GGH) - 0.7% 2) For reduction of emission of oxides of nitrogen a) SNCR - Nil b) SCR system - 0.2%	wet limestone based FGD Shall be 1.2% in place of 1.0%. b) Auxiliary Power consumption for DSI should be 0.5% c) Auxiliary Power Consumption without Gas to Gas heaters for sea water based FGD shall be 0.9%. For Gas to Gas Heater, additional APC of 0.3% shall be considered. Auxiliary Power Consumption for SNCR System shall also be considered. It shall be 0.05%	-
17.	**Annexure-I, 2 (1) Norms for consumption of reagent. c) For Dry Sorbent Injection System**	The specific consumption of sodium bicarbonate shall be 12 gm per kWh at 100% purity.	The Hon'ble Commission is suggested to indicate Sodium Bicarbonate consumption with SO2 removal efficiency and inlet SO2 loading.	Specific reagent consumption values given corresponds to approx. 60% SO2 removal efficiency, inlet SO2 loading of 1450 mg/Nm3 and meeting SO2 limit of 600 mg/Nm3. In case of higher removal efficiency say 70% SO2 removal efficiency & inlet SO2 loading of 1800 mg/Nm3, specific reagent consumption will be 21 g/KWH. Hence, it is suggested to indicate Sodium Bicarbonate consumption with SO2 removal efficiency and inlet SO2 loading. We have, therefore, proposed a generic formulation for DSI, wet limestone and dry/semi dry FGD as given in **Annexure 1**, which accommodates these parameters as variables for different site conditions
18.	**Annexure-I, 2 (1) Norms for consumption of reagent,**	The specific limestone consumption for CFBC based generating station (furnace injection) at 85% purity limestone (kg/kWh) shall be computed with the following formula:	The Hon'ble Commission is requested to re-check the K value for CFBC Boiler, indicate range of efficiency for which K value is specified and factor design efficiency.	In case of CFBC Boilers, Ca / S molar ratio depends on SO2 removal efficiency required & with increase in removal efficiency, Ca/S molar ratio increases. The SO2 removal efficiency required will depend on inlet SO2 level and outlet SO2

Sr. No.	Clause No.	Relevant Extract	Comments	Rationale
	(d) For CFBC Technology Furnace Injection System.	= [62.9 x S (%) x [SHR (kCal/kWh) /GCV (kCal/kg)] x [0.85/ LP] Where S= Sulphur content in percentage, LP = Limestone Purity in percentage.		level to be achieved. The inlet SO2 level will depend on fuel being fired in CFBC Boilers. Hence it is suggested not to give general formula for specific reagent condition for CFBC Boilers. Even if, it need to be indicated, corresponding conditions like range of SO2 removal efficiency need to be indicated and design efficiency need to be factored similar to wet limestone based FGD. It is suggested to re-check the K value for CFBC Boiler, indicate range of efficiency for which K value is specified and factor design efficiency. As stated above, a common formula has been proposed in **Annexure 1** to capture the above points.
19.	**Annexure 1** 2 (2)	**Annexure 1** 2 (2) The normative consumption of **specific reagent for various technologies for reduction of emission of oxide of nitrogen** shall be as below: (a) **For Selective Non-Catalytic Reduction** (SNCR) System: The specific urea Consumption of SNCR system shall be 1.2 gm per kWh at 100% purity of urea. (b) **For Selective Catalytic Reduction (SCR)** System: The specific ammonia consumption of SCR system shall be 0.6 gm per kWh at 100% purity of ammonia.	Hon'ble CERC may consider not to specify norms in view of the rationale provided.	Additional new clause (F) Norms for consumption of reagent Sub clause (2) Normative Consumption for specific reagent for various technologies for emission of Nitrogen Oxides a) Selective Non catalytic reduction Comments: 1. It is to be specified that reagent consumption indicated is for reducing NOx emission to <300 mg/Nm3 from the base level achieved after 'In Combustion Modification' 2. Specific Urea consumption will depend on NOx value achieved during 'In Combustion Modification'. In case NOx value achieved during 'In Combustion

Sr. No.	Clause No.	Relevant Extract	Comments	Rationale
				Modification is 450 mg/Nm3, specific urea consumption will be 1.55 gm / KWH. In case NOx value achieved during 'In Combustion Modification is 400 mg/Nm3, Specific urea consumption shall be 1.30 gm/KWH. Accordingly, a generic formula based on CEA's methodology has been given in **Annexure 1**, but with slightly higher stoichiometric ratios.
20.	-	The Paper does not talk about Reduction in Long Term Access (LTA) Capacity for Beneficiaries due to Lower Declared capacity (DC) on account of the enhanced auxiliary power consumption due to ECS	The Hon'ble Commission is requested to device a mechanism for relinquishment of the transmission capacity equivalent to auxiliary power consumption of ECS without any liability.	Reduction in DC due to Additional Auxiliary Consumption due to FGD system as well as increase in AUX consumption, would mean that Long Term Open Access Capacity booked by the beneficiaries would not be fully utilized to the extent it was envisaged at the time of taking LTA with the CTU. The LTA Capacity would, therefore, need to be reduced to the extent of Additional Auxiliary Consumption for FGD. Hon'ble Commission is requested to allow the same immediately after installation of FGD system as per applicable Regulations for the same.
21.	-	The staff paper is not clear about waste water treatment O&M expenses e.g. if due to Zero Liquid Discharge (ZLD) status, plants are not allowed to dispose FGD water and treatment scheme has to be put, e.g filter press followed by	In such condition following addition cost / APC shall be allowed: a) Additional APC in Waste Water Treatment Plant b) Cost towards additional steam consumption / compensation in SHR due to steam consumed in waste water treatment plant c) Additional cost of chemical	-

Sr. No.	Clause No.	Relevant Extract	Comments	Rationale
		multistage evaporator and incinerator, then cost towards chemical dosing as well as steam, electricity will have to be also accounted for apart from the huge CAPEX.		
22.	-	The Staff Paper doesn't consider fresh water consumption in supplementary energy charges	Fresh water consumption shall also be considered in "supplementary energy charges". It shall be (i) Wet limestone based – 0.21 m3/MWH (ii) Sea water based FGD – Service water 0.02 m3/MWH	-

Annexure-I

Generic Formulation of Reagent Consumption

As stated in the comments, normative consumption of Specific Reagent for various technologies for reduction of emission of Sulphur Dioxide depends on several parameters such as (a) Normative Station Heat Rate (after duly factoring impact of ECS system) (b) GCV of Coal, (c) Sulphur content of Coal (f) Purity of Reagent (g) Design SO_2 Removal efficiency of the ECS and (h) Stoichiometric molar ratio of reagent consumption and therefore assigning normative values in some of the cases may not be correct. As such a common empirical formula may be provided to compute the specific reagent consumption for various technologies wherein it is proposed that these parameters may be considered at actual/or as recommended by CEA rather than assigning them predefined values which seems inappropriate.

In view of above following empirical formulae may be followed for working out reagent consumption in kg/kWh in case of various technologies for reduction of emission of sulphur dioxide:

$RC = \{(SHR/CVPF) \times (S/100) \times (SO_{2Mol}/S_{Mol}) \times SO_{2Fac} \times SO_{2RemEff} \times MR \times (Reagent_{Mol}/SO_{2Mol}) \times (StoRat / RP) \}$………………………………………………. in kg/kWh
Or
$RC = 1000 \times \{(SHR/CVPF) \times (S/100) \times (SO_{2Mol}/S_{Mol}) \times SO_{2Fac} \times SO_{2RemEff} \times MR \times (Reagent_{Mol}/SO_{2Mol}) \times (StoRat / RP) \}$……………………………… in g/kWh

Where,
RC = Reagent Consumption, in kg/kWh or g/kWh
SHR = Normative Gross station heat rate (duly taking into impact on Normative Heat Rate on due to Emission Controlled System), in kCal per kWh;
CVPF = (a) Weighted Average Gross calorific value of coal as received, in kCal per kg for coal-based stations less 85 Kcal/Kg on account of variation during storage at generating station; (b) Weighted Average Gross calorific value of primary fuel as received, in kCal per kg, per litre or per standard cubic meter, as applicable for lignite, based stations;
S = Sulphur content in percentage,
SO_{2Mol} = Molecular weight of Sulphur Dioxide; 64 g/mol
S_{Mol} = Molecular weight of Sulphur; 32 g/mol
$SO_{2\,Fac}$ = Sulphur to Sulphur Dioxide Conversion factor = 1.00 (and not as per CEA assumption of 0.95)
$SO_{2\,RemEff}$ = SO2 removal efficiency, in %
Reagent $_{Mol\,=}$ Reagent Molecular Weight in g/mol = 100 for CaCO3 (limestone), 56 for CaO (lime) and 84 for NaHCO3 (Sodium Bicarbonate)
MR = Theoretical Molecular Ratio = No. of Moles of Reagent Required to convert one mole of SO2
StoRat = Stoichiometric ratio of reagent consumption (given in Table below against those mentioned by CEA for different technologies)
RP = Reagent Purity in percentage (Reactive Component purity),

Since, SO_{2Mol}, S_{Mol}, $SO_{2\,Fac}$ is constant, the formula can be represented in following manner:

$RC = K \times \{(SHR/CVPF) \times S \times SO_{2RemEff} \times MR \times Reagent_{Mol} \times (StoRat / RP) \}$ in g/kWh

Provided that K = 10 x (SO_{2Mol}/S_{Mol}) x SO_{2Fac} /SO_{2Mol}
= 10 x (64/32)x1.00/64 = 0.3125

Whereas StoRat i.e. Stoichiometric ratio of reagent consumption will be in line with recommendations given by CEA for different technologies and enclosed in the Draft as Appendix II. However, in case of conversion efficiency is in between the efficiencies for which CEA has provided the stoichiometric Ratio, prorate may be followed to workout the stoichiometric Ratio: Below table exhibits the Stoichiometric Molar ratio of reagent consumption as mentioned by CEA for different technologies:

SL. No	Technology	Molar Ratio	Molecular Weight of Reagent (g/mol)	Stoichiometric Ratio given by CEA	Stoichiometric Ratio Suggested by us
1	Wet Limestone based FGD System (CaCO3)	1	100	1.05 at all $SO_{2RemEff}$	1.10 at all $SO_{2RemEff}$
2	For Lime Spray Drier or Semi-Dry Flue Gas Desulphurisation (CaO)	1	56	1.35 for around 70% removal efficiency range 1.8 for around 90% efficiency range.	1.56 for around 70% removal efficiency range 2.0 for around 90% efficiency range.
3	For Dry Sorbent Injection System (Using Sodium bicarbinate-NaHCO3):	2	84	0.5 for around 30% removal efficiency range 1.0 for around 50% removal efficiency range 2.0 for around 70% removal efficiency range	1 for around 30% removal efficiency range 1.5 for around 50% removal efficiency range 2.0 for around 60% removal efficiency 2.3 for around 70% removal efficiency range
4	For CFBC Technology (furnace injection) based Generating Station (CaCO3):	1	100	2.0 for around 90-95% removal efficiency range	2.0 for around 90-95% removal efficiency range
5	SNCR (Urea-(NH2)2CO)	0.5	60	1.1 for 30-40% efficiency	1.6 for 30-40% efficiency
6	SCR (Ammonia – NH3)	1	17	1.08 for 75-85% efficiency	1.4 for 75-85% efficiency

Similarly, for NOx abatement system

RC = NO_{xcon} x $NO_{xRemEff}$ x MR x Reagent $_{Mol}$/NO_{xMol} x StoRat …………………….. in g/kWh
Where,

NO_{xcon} = NOx concentration after in-combustion control = Design NOx emission concentration x (1-Design Efficiency of In-combustion control) …. In g/kWh (subject to minimum NOx concentration of 750 mg/Nm3 converted to g/kWh with 260 g/GJ and normative SHR)
NO_{xMol} …= NOx Molecular weight = 46 g/mol
$NO_{xRemEff}$ = Design NOx removal efficiency of SNCR or SCR
StoRat = Stoichiometric ratio
MR = Theoretical Molecular Ratio = No. of Moles of Reagent Required to convert one mole of NOx

Here it is important to note that CEA has considered a fixed NOx concentration of 750 mg/Nm3, which is first brought down to 450 mg/Nm3 by In-combustion burner modification and then to 300 mg/Nm3 by SNCR or to 175 mg/Nm3 by SCR. Accordingly, CEA has computed a fixed number for reagent consumption assuming efficiency of removal in the range 30-40% (stoichiometric ratio 1.1) for SNCR and efficiency of 75-80% (stoichiometric ratio 1.08) considering molecular weight of NO2 (46). This methodology has to be modified to generic formulation given above as the numbers are for fixed NOx concentration/kWh, fixed efficiency and, hence, stoichiometric ratio, whereas percentage of nitrogen in actual coal and, hence, NOx concentration in flue gases may be higher than 750 mg/Nm3. In such cases, in combustion control may not reduce NOx to 450 mg/m3 even after 300 mg/Nm3 reduction by them. Hence, higher efficiency SNCR and SCR may be required. Thus, needing a generic formulation as suggested above for Sox removal. Further, stoichiometric ratio also increases with increase in efficiency and, hence, higher stoichiometric ratio needs to be taken for higher efficiency than 40% considered for SNCR and 75-85% considered for SCR. Higher ratio may considered as per design.