Staff Paper
on

Mechanism for Compensation for Competitively Bid Thermal Generating Stations for Change in Law on account of Compliance of the Revised Emission Standards of the Ministry of Environment, Forest and Climate Change, Government of India (MoEF&CC)

September, 2020

Central Electricity Regulatory Commission
3rd Floor, Chandralok Building,
36, Janpath, New Delhi – 110001
Website: www.cercind.gov.in

Disclaimer

The views presented in this staff paper do not represent views of the Central Electricity Regulatory Commission, or its Chairperson, or its Members, and are not binding on the Commission. The views are essentially that of the staff of the Commission and are being presented with an aim of initiating discussions and soliciting inputs from stakeholders on the mechanism for compensation for competitively bid thermal generating stations for change in law on account of compliance of the Revised Emission Standards of the Ministry of Environment, Forest and Climate Change, Government of India (MoEF&CC).

Contents

1. Introduction

1.1. The Ministry of Environment, Forest and Climate Change, Government of India ("MoEF&CC") has notified the Environment (Protection) Amendment Rules, 2015 on 7th December, 2015 (in short, "the 2015 Rules") amending the Environment (Protection) Rules, 1986 specifying revised emission standards[1] and water consumption limit for coal and lignite based thermal generating stations. In order to meet these revised emission standards for coal and lignite based generating stations, the generating companies[2] are required to install or upgrade Emission Control Systems ("ECS"). ECS includes Flue-Gas Desulfurization (FGD) system, Electrostatic Precipitators (ESP), Selective Catalytic Reduction (SCR) system or Selective Non-Catalytic Reduction (SNCR) system etc. For meeting norms of emission of Particulate Matter (PM), retro-fitting of existing ESPs or installing new ESPs would be required. Norms of emission of Sulphur Dioxide (SO_2) can be met by installation of FGD system (wet limestone based FGD or dry limestone based FGD or sea water based FGD etc). Modification of combustion process using low NOx burners and/or installation of de-nitrification systems such as Selective Non-Catalytic Reduction (SNCR) System or Selective Catalytic Reduction (SCR) System or their combinations can be used for controlling emission of Oxides of Nitrogen (NOx). Plants with Once-Through-Cooling (OTC) system need to install Cooling Tower and need to comply with water consumption limit.

1.2. Installation of ECS requires substantial capital expenditure and involves operational expenditure as well, which will have an impact on the tariff at which electricity is being supplied under the PPA. Substantial part of such capital expenditure may have to be in

[1]*Revised emission standards refers the emission limit of Particulate Matter, Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx) and Mercury (Hg) notified in Environment (Protection) Amendment Rules, 2015 substituting serial number 25 in Schedule-I of the Environment (Protection) Rules, 1986.*

[2]*Generating companies mentioned in this paper refers the generating companies owning the coal or lignite based thermal generating stations.*

the form of debt from banks and other financial institutions. Often, the banks and financial institutions, before committing to such funding, insist on approval of regulator as regards the proposed capital expenditure and a mechanism for recovery of such capital expenditure through tariff[3]. The Power Purchase Agreements (PPAs) between the generating companies and the procurers have provisions for compensating the affected party on account of Change in Law. In several petitions, the Commission has declared that installation of ECS is a Change in Law event in terms of the PPAs. The generating companies are, therefore, invoking the provisions of Change in Law in respective PPAs and are approaching the Commission for allowing recovery of the capital expenditure on account of installation/ up-gradation as well as operational expenditure for operation of ECS through increased tariff.

1.3. Since installation of ECS will have an impact on the existing tariffs, it is necessary that the procurers, sellers and lenders are aware of such likely impact. Therefore, there is a need for developing and adopting a uniform mechanism, *on ex-ante* basis, for compensation and determination of its impact on the tariff on account of the Change in Law.

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

[3]The Commission has recognized this in its order dated 23rd April, 2020 in Petition no. 446/MP/2019, order dated 6th May, 2020 in Petition No. 209/MP/2019, order dated 18th May,2020 in Petition No. 210/MP/2019 and order dated 22nd June, 2020 in Petition No. 168/MP/2019

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.

1.5. While acknowledging the 2015 Rules as a Change in Law event under the PPA and approving provisional cost for installation of FGD system, the Commission, vide order dated 23rd April, 2020 in Petition No. 446/MP/2019, issued directions to staff as under:

> *"40. We have approved provisional capital cost and other costs related to installation of FGD system that is likely to provide enough comfort to financial institutions. However, we recognise that certainty of stream of cash flow in form of tariff is likely to give further comfort to these financial institutions and that it is also equally important for the procurers as well as sellers to know the tariff implications on account of installation of FGD system.*
>
> *41. Therefore we direct staff of the Commission to float a staff paper at the earliest on the issue of compensation mechanism and tariff implications on account of the 2015 Notification in case of those thermal power plants where the PPA does not have explicit provision for compensation mechanism during the operation period and the PPA requires the Commission to devise such mechanism, inviting comments from all the stakeholders."*

Similar direction has also been issued by the Commission in its order dated 6th May, 2020 in Petition No. 209/MP/2019.

1.6. Subsequently, in its order dated 18th May,2020 in Petition No. 210/MP/2019, the Commission has issued the following directions to the staff:

> *"68. Accordingly, the Commission vide order dated 23.4.2020 in Petition No. 446/MP/2019, has directed the staff of the Commission to float a staff paper on the issue of compensation mechanism and tariff implications on account of the 2015 Notification in case of those thermal power plants where the PPA does not have explicit provision for compensation mechanism during the operation period and the PPA requires the Commission to devise such mechanism, inviting comments from all the stakeholders.*
>
> *69. The Respondents have submitted that the Aggregate Contracted Capacity under the PSA dated 18.02.2016 is 570 MW for a period of 8 years. The Respondents have submitted that the Petitioner has made the present claims of installation of FGD system based on the entire installed capacity of the 660 MW of Unit-2 of the Project whose useful life is 25 years. The Respondents have further submitted that the effect of any Change in Law should be restricted to incremental cost or additional expenditure on installation or up-gradation of the plant and equipment and not for the entire capital expenditure.*
>
> *70. We understand that in several cases, the useful life of the FGD system, the remaining useful life of the generating station and term of the PPA would not be the same. Further, FGD may be required to be installed for the entire capacity of the generating station, while*

the PPA or the contracted capacity may be only for a part of the total capacity of the generating station. We have already, in paragraph 52above, clarified that while the FGD system may be required to be installed for the full capacity of the generating station, the compensation granted by the Commission would apply only for the contracted capacity of the respective Respondent. 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.

71. The issue of spread of cost recovery, whether to be spread over the useful life of the FGD system or the remaining useful life of the generating station, would be suitably addressed in the Staff Paper. The staff is directed accordingly."

1.7. In compliance with directions of the Commission in the above-mentioned Orders, this paper discusses the compensation mechanism for installation of ECS. The compensation mechanism proposed in this Staff Paper can be made applicable to following generating stations provided that PPAs do not have any pre-specified formulae for providing relief for Change in Law event during the operation period:

a) Generating stations which have been commissioned, whose tariff has been discovered through tariff based competitive bidding process under Section 63 of the Electricity Act, 2003 and which have installed/ upgraded ECS for compliance with the 2015 Rules; and

b) Generating stations which have valid PPA(s) with procurer(s), having provisions of relief under Change in Law and the 2015 Rules qualifying as a Change in Law event in terms of the said PPA.

2. Contractual framework for Compensation

2.1. The Ministry of Power, Government of India has issued "*Guidelines for Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees*" (hereinafter referred to as the "Guidelines") along with Standard Bidding Documents under Section 63 of the Electricity Act, 2003 (in short, "the Act"). The Standard Bidding Documents include the model power purchase agreements that contain provisions related to Change in Law events. The provisions related with compensation on

account of Change in Law in the model power purchase agreement are discussed in subsequent paragraphs.

a) Model PPA for long-term power procurement under Case-1 bidding:

2.2. Clause 10.3.1 of the model PPA deals with relief during construction period whereas Clause 10.3.2 of the model PPA deals with relief during operation period for any Change in Law event. These clauses are extracted as under:

> ***"10.3 Relief for Change in Law***
>
> *10.3.1 During Construction Period*
>
> *As a result of any Change in Law, the impact of increase/decrease of Capital Cost of the Power Station in the Tariff shall be governed by the formula given below:*
>
> *For every cumulative increase/ decrease of each Rupees …….. [Insert amount] in the Capital Cost during the Construction Period, the increase/ decrease in Non Escalable Capacity Charges shall be an amount equal to ……..[Insert amount] of the Non Escalable Capacity Charges. In case of Dispute, Article 14 shall apply.*
>
> *It is clarified that the abovementioned compensation shall be payable to either Party, only with effect from the date on which the total increase/ decrease exceeds amount of Rs. …… [Insert Amount].*
>
> *10.3.2 During Operating Period*
>
> *The compensation for any decrease in revenue or increase in expenses to the Seller shall be payable only if the decrease in revenue or increase in expenses of the Seller is in excess of an amount equivalent to 1% of the value of the Letter of Credit in aggregate for the relevant Contract Year.*
>
> *10.3.3 For any claims made under Articles 10.3.1 and 10.3.2 above, the Seller shall provide to the Procurer(s) and the Appropriate Commission documentary proof of such increase/ decrease in cost of the Power Station or revenue/ expense for establishing the impact of such Change in Law.*
>
> *10.3.4 The decision of the Appropriate Commission, with regards to the determination of the compensation mentioned above in Articles 10.3.1 and 10.3.2, and the date from which such compensation shall become effective, shall be final and binding on both the Parties subject to right of appeal provided under applicable Law."*

b) Model PPA for long-term power procurement under Case-2 bidding:

2.3. Sub-clause (a) of Clause 13.2 of the model PPA deals with relief during construction period whereas sub-clause (b) of Clause 13.2 of the model PPA deals with relief during operation period for any Change in Law event. These clauses are extracted as under:

"13.2 Application and Principles for computing impact of Change in Law

While determining the consequence of Change in Law under this Article 13, the Parties shall have due regard to the principle that the purpose of compensating the Party affected by such Change in Law, is to restore through Monthly Tariff Payments, to the extent contemplated in this Article 13, the affected Party to the same economic position as if such Change in Law has not occurred.

a) Construction Period

As a result of any Change in Law, the impact of increase/decrease of Capital Cost of the Project in the Tariff shall be governed by the formula given below:

For every cumulative increase / decrease of each Rupees [Insert amount] in the Capital Cost over the term of this Agreement, the increase/decrease in Non Escalable Capacity Charges shall be an amount equal to [Insert amount] of the Non Escalable Capacity Charges. Provided that the Seller provides to the Procurers documentary proof of such increase/ decrease in Capital Cost for establishing the impact of such Change in Law. In case of Dispute, Article 17 shall apply.

It is clarified that the above mentioned compensation shall be payable to either Party, only with effect from the date on which the total increase/decrease exceeds amount of Rs. [Insert amount].

b) Operation Period

As a result of Change in Law, the compensation for any increase/decrease in revenues or cost to the Seller shall be determined and effective from such date, as decided by the Central Electricity Regulatory Commission whose decision shall be final and binding on both the Parties, subject to rights of appeal provided under applicable Law.

Provided that the above mentioned compensation shall be payable only if and for increase/ decrease in revenues or cost to the Seller is in excess of an amount equivalent to 1% of Letter of Credit in aggregate for a Contract Year."

c) Model Power Supply Agreement (DBFOO[4] Model):

2.4. For Case-1 bidding document under DBFOO model, Clauses 34.1, 34.2, 34.3, 34.4, 34.5 and 36.4 of the model PPA deal with relief for any Change in Law event. Relevant clauses are extracted as under:

"34.1 Increase in costs

If as a result of Change in Law, the Supplier suffers an increase in costs or reduction in net after-tax return or other financial burden for and in respect of Contracted Capacity, the aggregate financial effect of which exceeds the higher of Rs. 1 crore (Rupees one crore) and 0.1% (zero point one per cent) of the Capacity Charge in any Accounting Year, the Supplier may so notify the Utility and propose amendments to this Agreement so as to place the Supplier in the same financial position as it would have enjoyed had there been no such Change in Law resulting in the cost increase, reduction in return or other financial burden

[4]*Design, Build, Finance, Own and Operate (DBFOO)*

as aforesaid. Upon notice by the Supplier, the parties shall meet, as soon as reasonably practicable but no later than 30 (thirty) days from the date of notice, and either agree on amendments to this Agreement or on any other mutually agreed arrangement:

Provided that if no agreement is reached within 90 (ninety) days of the aforesaid notice, the Supplier may by notice require the Utility to pay an amount that would place the Supplier in the same financial position that it would have enjoyed had there been no Change in Law, and within 15 (fifteen) days of receipt of such notice, along with particulars thereof, the Utility shall pay the amount specified therein; provided that if the Utility shall dispute such claim of the Supplier, the same shall be settled in accordance with the Dispute Resolution Procedure. For the avoidance of doubt, it is agreed that this clause 34.1 shall be restricted to changes in law directly affecting the Supplier's costs of performing its obligations under this Agreement

34.2 Reduction in costs

If as a result of Change in Law, the Supplier benefits from the reduction in costs or increase in net after-tax return or other financial gains for and in respect of Contracted Capacity, the aggregate financial effect of which exceeds the higher of Rs. 1 crore ((Rupees one crore) and 0.1% (zero point one per cent) of the Capacity Charge in any Accounting Year, the Utility may so notify the Supplier and propose amendments to this Agreement so as to place the Supplier in the same financial position as it would have enjoyed had there been no such Change in Law resulting in the decrease cost, reduction in return or other financial gains as aforesaid. Upon notice by the Supplier, the parties shall meet, as soon as reasonably practicable but no later than 30 (thirty) days from the date of notice, and either agree on such amendments to this Agreement or on any other mutually agreed arrangement:

Provided that if no agreement is reached within 90 (ninety) days of the aforesaid notice, the Utility may by notice require the Supplier to pay an amount that would place the Supplier in the same financial position that it would have enjoyed had there been no Change in Law, and within 15 (fifteen) days of receipt of such notice, along with particulars thereof, the Supplier shall pay the amount specified therein; provided that if the Supplier shall dispute such claim of the Utility, the same shall be settled in accordance with the Dispute Resolution Procedure. For the avoidance of doubt, it is agreed that this clause 34.1 shall be restricted to changes in law directly affecting the Supplier's costs of performing its obligations under this Agreement.

34.3 Protection of NPV

Pursuant to the provision of Clauses 34.1 and 34.2 and for the purpose of placing the Supplier in the Supplier in the same financial position as it would have enjoyed had there been no Change in Law affecting the costs, returns or other financial burden or gains, the parties shall rely on the Financial Model to establish a net present value (the " NPV") of the net cash flow and make necessary adjustment in costs, revenues, compensation or other relevant parameters, as the case may be, to procure that the NPV of the net cash flow is the same as it would have been if no Change in Law had occurred.

34.4 Restriction on cash compensation

The Parties acknowledge and agree that the demand for cash compensation under this Article 34 shall be restricted to the effect of Change in Law during the respective Accounting Year and shall be made at any time after commencement of such year, but no later than one year from the close of such Accounting Year. Any demand for cash compensation payable for and in respect of any subsequent Accounting Year shall be made after the commencement of the Accounting Year to which the demand pertains, but no later than 2 (two) years from the close of such Accounting Year.

34.5 No claim in the event of recovery from Buyers

Notwithstanding anything to the contrary contained in this Agreement, the Utility shall not in any manner be liable to reimburse to the Supplier any sums on account of a Change in Law if the same are recoverable from the Buyers."

…

36.4 Adjudication by the Commission

36.4.1 In the event a Dispute is required under Applicable Laws to be adjudicated upon by the Commission, such Dispute shall, instead of reference to arbitration under Clause 36.3, be submitted for adjudication by the Commission in accordance with Applicable Laws and all references to Dispute Resolution Procedure shall be construed accordingly. For the avoidance of doubt, the Parties hereto agree that the adjudication hereunder shall not be final and binding until an appeal, if any, against such adjudication has been decided by the appellate tribunal, or no such appeal has been preferred within the time specified in the Applicable Law.

36.4.2 Where any dispute is referred by the Commission to be settled through arbitration, the procedure specified in Clause 36.3 shall be followed to the extend applicable."

2.5. The provisions of the model PPAs for long-term power procurement under Case-1 and Case-2 bidding provide for the following as regards granting compensation due to any Change in Law event:

a) Event of Change in Law is occurrence of specified events after the cut-off date, which is seven (7) days prior to the Bid Deadline. It implies that the model PPA recognises the Change in Law event before commencement of construction, during construction period or during operation period of the generating plant;

b) There is different treatment as regards compensation on account of Change in Law during construction period and operation period:

i) During construction period, the impact is to be assessed based on the increase/ decrease of capital cost. The relief to the supplier/ procurers for incremental increase/ decrease in capital cost is calculated through a pre-specified formula provided in the PPA itself. This formula provides for increase/ decrease in the quoted non-escalable capacity charges (specified in percentage) of each year of the tenure of the PPA;

ii) During operation period, PPA envisages that the compensation for any increase/ decrease in revenue or cost to the Seller shall be determined and effective from such date, as may be decided by the Central Electricity Regulatory Commission, whose decision shall be final and binding on both the Parties. This compensation can be triggered if the increase/ decrease in revenue or cost to the Seller is in excess of an amount equivalent to 1% of the value of the Letter of Credit in aggregate for relevant contract year;

iii) Onus of proving that an event of Change in Law has occurred and that compensation is payable, lies with the Seller who has to provide documentary proof for establishing the impact of such Change in Law.

c) The purpose of compensation is to restore the affected party to the same economic position as if such Change in Law has not occurred.

2.6. The provisions of DBFOO Model-Power Supply Agreement (”PSA”) provide for the following as regards granting compensation due to any Change in Law event:

a) Compensation for Change in Law kicks in if the supplier suffers/ benefits on account of such Change in Law in terms of increase/ decrease in costs or reduction/ addition in net after-tax return or other financial burden/ gains for and in respect of contracted capacity;

b) Compensation is admissible if aggregate financial effect of Change in Law exceeds the higher of Rupees one crore or zero point one per cent of the Capacity Charge in any Accounting Year;

c) The Supplier has to be placed in the same financial position as it would have enjoyed had there been no such Change in Law resulting in increase/ decrease in costs, reduction/ addition in net after-tax return or other financial burden/ gains;

d) The parties for the purpose of arriving at compensation are required to rely on the Financial Model to establish a net present value (NPV) of the net cash flow and make necessary adjustment in costs, revenues, compensation or other relevant parameters so as to ensure that NPV of the net cash flow is the same as it would have been without such Change in Law;

e) In case dispute with regard to compensation under Change in Law is not resolved among parties, parties may approach CERC for adjudication of the dispute.

2.7. Thus, in terms of the model PPAs, during Operation Period, in case of Case-1 bidding and Case-2 bidding, the Commission is required to determine the compensation as well the effective date from which such compensation is payable and the same is binding on the parties. In the DBFOO model, the role of the Commission with respect to determining compensation in case of any Change in Law event starts if the parties, based on the Financial Modelling, are not able to settle the issue amicably and refer the same to the Commission for adjudication.

3. The Approach

3.1. Installation and operation of an ECS involves following additional capital cost and revenue cost:

a) One-time capital expenditure towards plant and machinery for installation of ECS;

b) Revenue expenditure (including Operation & Maintenance Expenditure and Interest on Working Capital) on recurring basis;

c) Operational expenses (cost of reagent used for ECS e.g. limestone in case of Wet Limestone based FGD system) on recurring basis.

3.2. Several PPAs (based on model PPA) provide for pre-specified formula for computing compensation for any Change in Law event during the construction period and such compensation needs to be determined by applying such pre-specified formula. Some examples of pre-specified formula in PPAs are as under:-

a) PPA between Sasan Power Ltd. and MPPMCL & others provide the impact of 0.267% on non-escalable tariff for every Rs. 50 crore increase or decrease in cost[5];

b) PPA between Adani Power Ltd. and GUVNL & others provide the impact of 0.267% on non-escalable tariff for every Rs. 12.50 crore increase or decrease in cost[6].

3.3. In view of above, this paper discusses compensation mechanism for Change in Law event only during the operation period in accordance with the provisions of PPAs. For cases where ECS has been installed during construction period and has an impact during operation period, provision of paragraph 6 of this paper would be applicable.

3.4. Article 13.2 of the model PPA in respect of Case-2 bidding (similar provisions exist in Case-1 bidding PPA) provides that the parties affected by Change in Law should be restored to the same economic position as if the Change in Law had not occurred. While interpreting this provision, the Appellate Tribunal for Electricity in its judgement dated 13.4.2018 in Appeal No. 210 of 2017, held as under:

> *"**x.** Further, the provisions of Article 13.2 i.e. restoring the Appellant to the same economic position as if Change in Law has not occurred is in consonance with the principle of 'restitution' i.e. restoration of some specific thing to its rightful status. Hence, in view of the*

[5] *"[For every cumulative increase/decrease of each Rupees Fifty crores (Rs. 50 crores) in the Capital Cost over the term of this Agreement, the increase/decrease in Non Escalable Capacity Charges shall be an amount equal to zero point two six seven (0.267%) of the Non Escalable Capacity Charges. Provided that the Seller provides to the Procurers documentary proof of such increase/ decrease in Capital Cost for establishing the impact of such Change in Law. In case of Dispute, Article 17 shall apply….."*

[6] *"[For every cumulative increase/decrease of each Rupees Fifty crores (Rs. 12.50 crores) in the Capital Cost over the term of this Agreement, the increase/decrease in Non Escalable Capacity Charges shall be an amount equal to zero point two six seven (0.267%) of the Non Escalable Capacity Charges. Provided that the Seller provides to the Procurers documentary proof of such increase/ decrease in Capital Cost for establishing the impact of such Change in Law. In case of Dispute, Article 17 shall apply."*

provisions of the PPA, the principle of restitution and judgment of the Hon'ble Supreme Court in case of Indian Council for Enviro-Legal Action vs. Union of India &Ors., we are of the considered opinion that the Appellant is eligible for Carrying Cost arising out of approval of the Change in Law events from the effective date of Change in Law till the approval of the said event by appropriate authority. It is also observed that the Gujarat Bid-01 PPA have no provision for restoration to the same economic position as if Change in Law has not occurred. Accordingly, this decision of allowing Carrying Cost will not be applicable to the Gujarat Bid-01 PPA."

3.5. The Hon'ble Supreme Court has upheld the above judgment of APTEL and observed as under:

"10. A reading of Article 13 as a whole, therefore, leads to the position that subject to restitutionary principles contained in Article 13.2, the adjustment in monthly tariff payment, in the facts of the present case, has to be from the date of the withdrawal of exemption which was done by administrative orders dated 06.04.2015 and 16.02.2016. The present case, therefore, falls within Article 13.4.1(i). This being the case, it is clear that the adjustment in monthly tariff payment has to be effected from the date on which the exemptions given were withdrawn. This being the case, monthly invoices to be raised by the seller after such change in tariff are to appropriately reflect the changed tariff. On the facts of the present case, it is clear that the respondents were entitled to adjustment in their monthly tariff payment from the date on which the exemption notifications became effective. This being the case, the restitutionary principle contained in Article 13.2 would kick in for the simple reason that it is only after the order dated 04.05.2017 that the CERC held that the respondents were entitled to claim added costs on account of change in law w.e.f. 01.04.2015. This being the case, it would be fallacious to say that the respondents would be claiming this restitutionary amount on some general principle of equity outside the PPA. Since it is clear that this amount of carrying cost is only relatable to Article 13 of the PPA, we find no reason to interfere with the judgment of the Appellate Tribunal."

3.6. It is clear from above judgments of APTEL and the Hon'ble Supreme Court that the provision contained in Article 13.2 of the PPAs requiring to restore the affected parties to the same economic position as if the event of Change in Law had not occurred "*is in consonance with the principle of 'restitution' i.e. restoration of some specific thing to its rightful status"* and that the affected party "*is eligible for Carrying Cost arising out of approval of the Change in Law events from the effective date of Change in Law till the approval of the said event by appropriate authority"*. Keeping the principles laid down in the judgements of APTEL and the Hon'ble Supreme Court, this Staff Paper attempts to formulate a generic mechanism of compensation to restore the affected parties to the same economic position.

4. Mechanism for Compensation for Change in Law event during operation period

4.1. As discussed in paragraphs 3.2, 3.3 and 3.6 above, this Staff Paper attempts to formulate a generic mechanism of compensation due to a Change in Law event on account of installation of ECS only during the operation period to restore the affected parties to the same economic position. Compensation during operation period would require estimating the following impacts:

A) Impact due to additional capital expenditure;

B) Impact due to additional Operation & Maintenance expenses and additional Interest on Working Capital;

C) Impact due to consumption of reagent; and

D) Impact due to additional auxiliary energy consumption.

A) Additional Capital Expenditure (ACE_{ECS}):

4.2. During operation period, the expenditure on installation of ECS will be an additional capital expenditure. It would include base cost of ECS, taxes and duties, IDC (interest during construction) and miscellaneous costs associated with installation of ECS. This additional capital expenditure needs to be serviced by way of increase in monthly tariff spread over useful life of the ECS through Supplementary Capacity Charges (SCC) which includes:

a) Depreciation (ACE_{Dep}); and

b) Cost of Capital Employed for ECS (ACE_{coc}).

a) Depreciation (ACE_{Dep}) and Useful Life

4.3. In accounting terms, depreciation is treated as one of the expenses, efflux with time and recovered over the useful life of the asset. The key question is what should be useful

life of ECS such as FGD system. Different periods are taken as useful life of a thermal generating station in different cases:

i) The generating stations whose tariff is determined through the competitive bidding process and tariff is adopted by Appropriate Commission under Section 63 of the Electricity Act, 2003 charge depreciation as per provisions of the Companies Act, 2013. As per the Companies Act, 2013, the useful life of thermal generating station or asset is 40 years.

ii) The generating stations whose tariff is determined by the Commission under the Section 62 of the Electricity Act, 2003 charge depreciation as per the applicable Tariff Regulations notified by the Commission. As per the CERC (Terms and Conditions of Tariff) Regulations, 2019 (in short, the 2019 Tariff Regulations), useful life of a thermal generating station is 25 years.

iii) In the 2019 Tariff Regulations (as well as in the Tariff Regulations for previous tariff periods), there is a provision for extension of useful life of thermal generating station through Renovation & Modernization.

iv) Quite a few Central sector and State sector thermal generating stations are in operation for more than 25 years.

v) The model PPA (based on DBFOO) provides for extension of the useful life of 10 years beyond initial useful life of 25 years.

vi) As a recognized industry practice followed by electricity regulatory commissions, useful life of thermal generating stations along with its major assets used for electricity generation e.g. boiler, turbine, generator, BFPs etc., is considered to be 25 years for all techno-financial calculations including the recovery of capital cost to the tune of 90%, through depreciation.

4.4. Thus, 25 years is the minimum period that has been considered as life of a thermal generating station. Accordingly, the useful life of the ECS is considered as 25 years in line with the other major equipment of generating plant. However, many generating stations have already been in operation for a few years and the remaining useful life in case of such generating stations is less than 25 years. Therefore, while considering the useful life of ECS as 25 years, it has been assumed that the useful life of the generating station would be subsequently extended. The salvage value of ECS has been considered as 10% after completion of its useful life.

4.5. A generating station whose tariff is discovered under Section 63 of the Act may have more than one concurrently running PPAs for different contracted capacities (sum of which may be less than or equal to the installed capacity (ex-bus) of the generating station), of different tenures with different start/ end dates. In many cases, the term of the PPA may be ending earlier than the useful life of the generating station.

4.6. There can be no obligations on the existing procurers to procure power beyond the contracted period and contracted capacity as per the PPA. Therefore, recovery of compensation from the existing procurers for the period beyond the contracted period of PPAs is not justified, as the same would amount to paying compensation for the services not availed. Therefore, a procurer should be liable to pay compensation for Change in Law on account of installation of ECS only for the duration of its contract and commensurate to its contracted capacity.

4.7. Where ECS is installed after the COD of the generating station, the useful life of the generating station would be over before the useful life of ECS, both being 25 years. However, compensation is proposed to be worked out considering the useful life of ECS as 25 years starting from the Date of Operation (ODe) of ECS, irrespective of the fact that

useful life of the plant gets over before the useful life of ECS. This is because of the fact that it is generally observed that even after the expiry of useful life of 25 years, well-maintained generating stations operate efficiently for another 10 to 15 years (many Central sector/ State sector thermal generating stations are already operating after completing 25 years of useful life) by incurring marginal expenditure towards Renovation & Modernization. Therefore, the generating company has an option to recover the un-recovered compensation by continuing to run the generating station beyond its useful life.

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 which is defined as under:

> *'Date of Operation' or 'ODe' in respect of an emission control system means the date of putting the emission control system into use after meeting all applicable technical and environmental standards, certified through the Management Certificate duly signed by an authorised person, not below the level of Director of the generating company"*

4.9. 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.

b) Cost of Capital Employed (ACE_{coc})

4.10. The cost of capital employed also known as the cost of fund infused represents the weighted average cost of debt fund and equity fund deployed in the project. Considering the fact that any compensation mechanism needs to be based on the principle of restitution, there can be no expectation of profit in any component of tariff.

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.

B) Additional Operation & Maintenance expenses and additional Interest on Working Capital:

4.12. Operation of ECS would involve additional recurring expenses towards Operation and Maintenance (O&M) and Interest on Working Capital (IWC) towards maintaining stock of reagents, receivables and O&M expenses. These are required to be reimbursed to the generating company on monthly basis to restore it to the same economic position. The proposed methodology of computation for additional O&M expenses and additional IWC are as under:

a) Additional O&M Expenses ($ARE_{o\&m}$)

4.13. The Commission, in some of the orders[7], has allowed provisional first year O&M expenses @2% of capital expenditure for installation of FGD (excluding IDC and FERV) admitted by the Commission after prudence check. On similar lines, it is proposed that additional O&M expenses ($ARE_{o\&m}$) for first year may be allowed @2% of additional capital expenditure (ACE_{ECS}) for installation of ECS (excluding IDC and FERV), admitted by the Commission after prudence check. For subsequent years, the first year O&M expenses ($ARE_{o\&m}$) may be esclated @3.5% or any other escalation rate as may be

[7] *In order dated 28th March, 2018 in petition 104/MP/2017, O&M expenses provisionally allowed at the rate of 2% per annum of the capital cost of FGD, subject to adjustment in the light of the norms to be prescribed by CEA.*

specified by the Commission. The above O&M expenses may subsequently be reviewed based on actual O&M expenses of ECS installed at various generating stations.

b) Additional IWC (ARE_{IWC})

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.

Supplementary Annual Capacity Charges (SACC)

4.15. The four components, namely, ACE_{Dep}, ACE_{COC}, $ARE_{O\&M}$ and ARE_{IWC} shall be calculated in Rs. lakh on annual basis for the useful life of ECS i.e. 25 years starting from ODe of the ECS. The sum of these is termed as Supplementary Annual Capacity Charges (SACC). The recovery of Supplementary Annual Capacity Charges by way of monthly billing shall be in line with the recovery and payment of quoted capacity charges for generating stations in accordance with the PPA. The formulation for recovery of Supplementary Annual Capacity Charges from various procurers are discussed subsequently in the paper.

C) Additional Operational Expenses due to Consumption of Reagent (AOE_{COR}):

4.16. Some kind of reagent is required to be used in ECS to meet the norms as specified by the 2015 Rules. CEA (Central Electricity Authority) has suggested the norms of specific reagent consumption (grams/kWh). The norms of specific reagent consumption and auxiliary energy consumption as specified by CEA, for different variants of FGD system, SNCR system and SCR system, have been indicated at *Annexure-I* to this Staff Paper. The cost of reagent per unit of electricity generated at generator terminal of the generating station shall be calculated based on the specific reagent consumption (grams/kWh) and landed price of the reagent at the generating station.

4.17. It is observed that specific reagent consumption (SRC) norms as specified by the CEA are at the generator terminal i.e. it is for gross generation from the generating station. Accordingly, to arrive at the cost of reagent per unit of electricity generated ex-bus of generating station, the cost of reagent at generator terminal shall be grossed up with the auxiliary energy consumption of the generating station after installation of the ECS. Accordingly, the same may be included as Supplementary Energy Charge Rate (SECR). The supplementary energy charges recoverable during a month shall be arrived at by multiplying the energy scheduled by a procurer during the month with SECR. The formulation for recovery of Supplementary Energy Charges for a month has been discussed subsequently in the paper.

D) Additional Auxiliary Energy Consumption (AUX_{ECS}):

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.

Illustration

(i) Consider a generating station with Installed Capacity of 4000 MW with auxiliary energy consumption (AUX_{Org}) of 5%. As such, maximum ex-bus power for which this generating station can conclude long-term PPAs is 3800 MW [i.e. 4000 x (1 - 5%)]. Assuming that this generating station is fully tied up with single procurer right from the COD of the generating station for 15 years, the Contracted Capacity (CC_{Org}) under this PPA will be 3800 MW.

(ii) As per the model PPAs, the seller has to quote tariff in four components as under:

i) Non-Escalable Capacity Charges (NECC) for each year of the contract period;

ii) Escalable Capacity Charges (ECC) for first year to be escalated as per procedure mentioned in PPA for arriving at the capacity charges for the subsequent years;

iii) Non-Escalable Energy Charges (NEEC) for each year of the contract period; and

iv) Escalable Energy Charges (EEC) for first year to be escalated as per procedure mentioned in PPA for arriving at the energy charges for the subsequent years.

The above charges are quoted in paise /kWh or Rs./kWh. The quoted figures get recorded in the respective schedule i.e. tariff of the PPA.

(iii) Under the PPAs, recovery of the quoted capacity charges (both ECC and NECC) is based on the availability declared by the generating station. In case the availability declared by the generating station is above the normative availability (say, 85%) on cumulative basis till the month of billing, the generating company gets full capacity charges corresponding to contracted capacity. For supply of energy above the normative availability, the generating company gets incentive.

(iv) Suppose, in the fourth year of operation, the aforesaid generating station with Installed Capacity of 4000 MW is required to install ECS (say, wet limestone based FGD system) with auxiliary energy consumption (AUX_{ECS}) of 1% of gross generation i.e. 40 MW (1% of 4000 MW). After installation of FGD system, the generating station requires total auxiliary energy consumption (AUX_{Total}) of 6% (i.e. 5% AUX_{ORG} plus 1% AUX_{ECS}). Thus, the power available ex-bus to the single procurer now would be 3760 MW [4000 x (1 - 6%)] as against 3800 MW [4000 x (1 - 5%)] before

installation of ECS. This power available ex-bus becomes its Revised Contracted Capacity ($CC_{Revised}$) from the Date of Operation (ODe) of ECS, say, starting from the seventh year of the PPA. The obligation of the procurer for payment of compensation for installing ECS would start from ODe (starting from seventh year of contract) till end of the PPA (say, 15 years). Thus, the single procurer, with full share of the capacity of the generating station, would be liable to pay full supplementary capacity charges only for remaining period of PPA i.e. 8 years (since ODe of the ECS is in 7^{th} year of the PPA). After the expiry of the contract of 15 years, generating company will have to recover the un-recovered compensation by continuing to run the generating station either by signing new PPAs (Short term, Medium-term and Long-term) or selling the capacity or energy in the market.

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 Original Auxiliary Energy Consumption (AUX_{Org}) shall be the minimum of actual auxiliary energy consumption and values arrived at by applying one of the following methodologies:

a) where 100% ex-bus capacity is tied up under single PPA such as in case of UMPP (Ultra Mega Power Project), the auxiliary energy consumption computed as per the following formula:

   [{(actual Installed Capacity or capacity indicated in RFP whichever is lower) – (aggregated contracted capacity)} / (actual Installed Capacity or capacity indicated in RFP whichever is lower)];

b) auxiliary energy consumption mutually agreed between the parties under PPA;

c) auxiliary energy consumption indicated in any of the Petitions filed earlier by the generating station that has been accepted by the Appropriate Commission;

d) in case of unavailability of figures as at (a), (b) and (c) above, auxiliary energy consumption as per the 2014 Tariff Regulations or the 2019 Tariff Regulations, as the case may be, in respect of generating stations with commensurate technical parameters.

Impact of AUX_{ECS} on Quoted Capacity Charge

4.20. Suppose, revenue and energy reconciliation are being done on yearly basis. Also suppose, the non-escalable capacity charge for the year was Rs.1.25/kWh and cumulative availability (average of the availability declared for 365 x 96 time-blocks) of the generating station for the year was 3230 MW (i.e. 0.85 x 3800 MW). For simplicity of calculations, availability has been assumed to be exactly equal to normative availability of 85% in terms of PPA which defines it as follows:

Availability (%) = Availability declared in MW x 100/Contracted Capacity (MW)

4.21. For availability declaration of 85%, non-escalable capacity charges allowable to be recovered by the generating company from the procurer for the whole year would be:

NECC (Rs. in crore) to be recovered for whole year =

CC_{Org} (MW) x 1000 x Normative Availability (%) x 8760 x NECC (Rs./kWh) /10^7

Which, for the example in hand, would be Rs. 3800 x 1000 x 0.85 x 8760 x 1.25/10^7 = Rs. 3536.85 crore.

4.22. After installation of the ECS, taking into account the additional auxiliary energy consumption on account of ECS, the Revised Contracted Capacity ($CC_{Revised}$) would be 3760 MW and, therefore, 3196 MW (3760*0.85) would translate into availability of 85% (instead of earlier 3230 MW) with respect to the revised contracted capacity. The principle

of restitution requires same revenue recovery for the generating station, as if no ECS was installed, for same availability declaration (%) before and after installation of ECS. However, considering the fact that energy corresponding to 3196 MW ($CC_{Revised}$ x 0.85) would be on lower side as compared to 3230 MW (CC_{Org} x 0.85), there would be loss of revenue to the seller unless appropriate adjustments are made to arrive at the same revenue recovery. Factoring in the Availability (%) as well as energy corresponding to Revised Contracted Capacity, the quoted NECC needs to be revised upward to $NECC_{Mod}$ so as to enable the generating company to recover the same annual revenue for declaring availability of 85%. The value of $NECC_{Mod}$ can be arrived at by equating the two revenue streams ($3800 \times 1000 \times 0.85 \times 8760 \times 1.25 / 10^7 = 3760 \times 1000 \times 0.85 \times NECC_{Mod} / 10^7$) which gives $NECC_{Mod}$ = 3800 x1.25/3760 = Rs.1.263/kWh.

Or in terms of formulae:

$$NECC_{Mod} = NECC \times CC_{Org}/CC_{Revised}$$

$$= NECC \times \{IC \times (1-AUX_{Org})] / \{IC \times (1-AUX_{total})\}$$

$$= NECC \times (1-AUX_{Org}) / (1-AUX_{Total})$$

4.23. Similarly, quoted Escalable Capacity Charges (ECC) shall also be adjusted upwards with the same factor for restoring the generating company to the same economic position. Accordingly, $ECC_{Mod} = ECC \times (1-AUX_{Org}) / (1-AUX_{Total})$

$$\text{Availability (\%)} = \frac{\text{Availability declared in MW} \times 100}{\text{Revised Contracted Capacity}}$$

which is availability declared with respect to Revised Contracted Capacity.

Impact of AUX_{ECS} on Quoted Energy Charge

4.24. Quoted energy charges i.e. sum of Escalable Energy Charges (EEC) and Non-Escalable Energy Charges (NEEC) represent the fuel cost incurred for generation of one unit at ex-bus of generating station and is equal to fuel cost for generating one unit at

generator terminal grossed up with respect to original auxiliary energy consumption (AUX_{Org}). The formulae for the same is:

EEC + NEEC = Landed fuel cost for generating one unit at generator Terminal / $(1-AUX_{Org})$,

4.25. However, after installation of ECS, though the fuel cost for generating one unit at generator terminal would remain the same, but due to increase in auxiliary energy consumption, the fuel cost for generating one unit ex-bus would increase and would be represented by:

Modified Energy Charges or Mod (EEC + NEEC) = Landed fuel cost for generating one unit at generator terminal/$(1-AUX_{Total})$.

Dividing two equations yields

$(EEC_{Mod} + NEEC_{Mod}) = (EEC + NEEC) \times (1- AUX_{Org})/(1- AUX_{Total})$

On individual basis:

$EEC_{Mod} = EEC \times (1-Aux_{Org})/(1-Aux_{Total})$ and

$NEEC_{Mod} = NEEC \times (1-Aux_{Org})/(1-Aux_{Total})$

4.26. Thus, all four components of quoted tariff i.e. NECC, ECC, NEEC and EEC shall be increased by a factor $(1-Aux_{Org})/(1-Aux_{Total})$ so as to restore the seller to same economic condition with respect to increase in auxiliary energy consumption. The quoted capacity charges will be recovered by considering availability formula with respect to Revised Contracted Capacity, as follows:

$$\text{Availability (\%)} = \frac{\text{Availability declared in MW} \times 100}{\text{Revised Contracted Capacity}}$$

4.27. As such, except for the change in formulae for calculating availability (%) and revision of components of quoted tariff as discussed above, all other terms, conditions and methodology for recovery of original capacity and energy charges as per respective PPAs shall prevail. The above procedure just restores the generating company to same economic position which was available to it before installation of ECS. As such, increase in quoted tariff due to additional auxiliary energy consumption shall not form part of supplementary capacity charge and supplementary energy charge.

4.28. For generating stations under DBFOO model, the capacity charges and energy charges for a year shall be calculated from the base capacity and energy charge as worked out by following the procedure as mentioned in the PSA and then escalated by multiplying with the factor $(1\text{-}AUX_{Org})/(1\text{-}AUX_{Total})$ and again availability shall be calculated with respect to revised contracted capacity. This will restore the generating company to the same economic position with respect to additional auxiliary energy consumption after installation of ECS.

5. Recovery of Supplementary Capacity Charges and Supplementary Energy Charges and Procedure for Payment

A) Monthly Supplementary Capacity Charges

5.1. The Supplementary Annual Capacity Charges (SACC) as discussed in earlier part of this paper pertains to the whole capacity of the plant. As such, for dividing it to respective concurrent PPAs based on their Revised Contracted Capacity, following formulae is proposed :

$$SACC_{(PPA1)} = SACC \times [CC_{(revised1)} / (IC \times (1\text{-}AUX_{Total}))]$$

$$SACC_{(PPA2)} = SACC \times [CC_{(revised2)} / (IC \times (1\text{-}AUX_{Total}))]$$

……

$$SACC_{(PPAi)} = SACC \times [CC_{(revised2)} / (IC \times (1\text{-}AUX_{Total}))]$$

Where,

$SACC_{PPAi}$ represents Supplementary Annual Capacity Charges corresponding to the i^{th} PPA on proportionate basis. The contract period as per PPAs may be less than useful life of the ECS and the obligation of the procurer is limited to its contract period and contracted capacity. $SACC_{PPA}$ is the amount that is payable for each year of the remaining contract years.

5.2. The Supplementary Annual Capacity Charges for a PPA ($SACC_{PPA}$) as calculated above shall be payable by following procedure:

1) The $SACC_{PPA}$ (Rs. in lakhs) will be converted into per unit charges by applying following formula:

Supplementary capacity charge rate (Rs./kWh)

$= [SACC_{PPA} \times 10^5 / \{CC_{Revised} \times 1000 \times (1-AUX_{Total}) \times NA \times$ Total hours in the year]

Where NA is normative availability in percentage (%).

2) By applying the above value of the Supplementary capacity charge rate (Rs./kWh), the generating company, based on the formulae or methodology for recovery of quoted non-escalable capacity charges as indicated in the PPA, shall recover the supplementary capacity charges on monthly basis depending upon the cumulative availability achieved till the end of each month. No supplementary incentive shall be allowed to the generating company for declaring the availability beyond the normative availability. The availability and payment of supplementary capacity charges shall be reconciled on annual basis.

3) Notwithstanding the availability declaration by the generating station, where the generating company has operated the generating station without operation of the

ECS at any period of time, for any reason whatsoever based on instruction of CPCB or SPCB, Regional Load Despatch Centre or State Load Despatch Centre, the supplementary capacity charges shall be payable corresponding to the availability achieved by ECS.

B) Monthly Supplementary Energy Charges

5.3. The recovery of monthly Supplementary Energy Charges (SEC_m) will be made by applying following formula:

SEC_m (Rs.) = AEO_m x[(SRC)/(1-AUX_{Total})] x LPR / 1000)

Where,

AEO_m is the scheduled energy during the month 'm' (in kWh)

SRC is the specific reagent consumption on account of emission control system (in g/kWh) for a unit generated at generator terminal. This shall be normative number recommended by CEA for different variants of the ECSs as indicated in *Annexure-I*.

LPR is the weighted average landed price of reagent for ECS (in Rs./kg).

C) Procedure for Payment

5.4. PPAs already have a procedure for payment of Bills and there is no need to devise any separate procedure for the purpose of payment of monthly Supplementary Capacity Charges and monthly Supplementary Energy Charges. The generating company may raise the Bill for payment on account of operation of ECS in the same manner as any other bill provided in the PPA and such Bill shall be paid by the procurer(s). Provisions related to Due Date, Rebate, Late Payment Surcharge etc. will be as provided in the PPAs.

6. Mechanism for Compensation for Change in Law event during construction period

6.1. The power purchase agreements recognize two distinct phases of a generating station, construction period and operation period. During construction period, any compensation on account of installation of ECS as a Change in Law event needs to be calculated in terms of formula provided in the PPA. However, even in cases where installation of ECS has been undertaken during the construction period of the generating station, the operation cost of ECS which includes operation and maintenance expenses, interest on working capital and impact on quoted capacity charges and quoted energy charges due to additional auxiliary energy consumption needs to be considered along with the supplementary energy charges to cover the cost of reagent, during operation period as per the methodology discussed in this staff paper.

Annexure-I

(In line with CEA Recommendation)

1. Additional Auxiliary Energy Consumption (∆AUX):

Name of Technology	∆AUX (as % of gross generation)
(1) For reduction of emission of Sulphur Dioxide:	
a) Wet Limestone based FGD system (without Gas to Gas heater)	1.0%
b) Lime Spray Dryer or Semi dry FGD System	1.0%
c) Dry Sorbent Injection System (using Sodium bicarbonate)	NIL
d) For CFBC Power plant (furnace injection)	NIL
e) Sea Water based FGD system (without Gas to Gas heater)	0.7%
(2) For reduction of emission of oxide of nitrogen:	
a) Selective Non-Catalytic Reduction system	NIL
b) Selective Catalytic Reduction system	0.2%

Provided that where the technology is installed with Gas to Gas heater, auxiliary energy consumption specified as above shall be increased by 0.3% of gross generation."

2. Norms for consumption of reagent:

(1) The normative consumption of specific reagent for various technologies for reduction of emission of sulphur dioxide shall be as below:

(a) For Wet Limestone based Flue Gas Desulphurisation (FGD) system: The specific limestone consumption (g/kWh) shall be worked out by following formula:

= [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 SO_2 Removal Efficiency/96%) for units to comply with SO_2 emission norm of 100/200 mg/Nm^3or (26.8xDesign SO_2 Removal Efficiency/73%) for units to comply with SO_2 emission norm of 600 mg/Nm^3;

Provided further that the limestone purity shall not be less than 85%.

(b) For Lime Spray Dryer or Semi-dry Flue Gas Desulphurisation (FGD) system: 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 Flue Gas Desulphurisation (FGD) system: The reagent used is sea water, therefore there is no requirement for any normative formulae for consumption of reagent.

(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.