

# Central Electricity Regulatory Commission

New Delhi

## Draft Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2022

no. L-1/265/2022/CERC

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### Explanatory Memorandum

#### 1. Background

- 1.1. The Central Electricity Regulatory Commission (CERC) (herein after referred as “the Commission”) was constituted under the erstwhile Electricity Regulatory Commissions Act (ERC), 1998 and has been deemed to be constituted under the Electricity Act, 2003 (herein after referred as “the Act”), after enactment of the Act. The Commission has been vested with power to specify the regulations pertaining to Grid Code in terms of clause (g) of sub section 2 of Section 178 of the Act read with clause (h) of sub-section (1) of Section 79 of the Act. Accordingly, the Commission notified the Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations 2010 on 28.04.2010 (hereafter referred to as ‘2010 Grid Code’). Till date there have been six amendments to the 2010 Grid Code.
- 1.2. The 2010 Grid Code contains the provisions regarding the roles, functions and responsibilities of the concerned statutory bodies, generating companies, licensees and any other person connected with the operation of the power systems within the statutory frameworks envisaged in the Electricity Act and the Rules and Notifications issued by the Central Government.

- 1.3.** In the last decade, the National grid as well as entities in the Grid have evolved significantly. There has been significant capacity addition of generation under private sector as well as inter-State transmission system. Further increased focus on renewables poses challenges which are to be addressed through evolving Grid Code. Indian grid has been integrated through cross border interconnections with Nepal, Bhutan, Bangladesh and Myanmar.
- 1.4.** When the first Grid Code was prepared in 1999, Indian electricity grid was divided among regions and was operating at four independent frequencies. Since then the grid has expanded and grown rapidly and has been strongly integrated in to one synchronous grid operating at a common frequency. It has increased the grid stability and its capacity to accommodate the variability of renewable generation. The nominal operating frequency band has been progressively narrowed and charges for deviations from the schedules have been tightened, significantly controlling frequency excursions. Operating an integrated national grid with cross-border interconnections makes the task of grid operation challenging.
- 1.5.** There has been significant progress in the growth of power system including RES in India. As per the Executive Summary on Power Sector for July 2022 published by CEA, the installed capacity of RES (including Small Hydro but excluding Large Hydro) has increased from 1628.39MW around i.e. 0.015% (at the end of 9<sup>th</sup> Plan) to 114437.37 MW i.e. around 28.31% (up to July, 2022). As per CEA's "Report on Optimal Generation Capacity Mix For 2029-30" in the year 2029-30, non-fossil fuel (solar, wind, biomass, hydro & nuclear) based installed capacity is likely to be about 64% of the total installed capacity (817254 MW) and accordingly, the installed capacity of RES(including Small Hydro but excluding Large Hydro) is likely to be 445306 MW i.e. around 54% of the total installed capacity (817254 MW) during the year 2029-30. Further, the All-India peak

electricity demand for the year 2021-22 (as per Peak Power Supply Position Report (Revised) published by CEA) is 203014 MW which is expected to touch around 370462 MW by 2031-32 (as per 19th Electric Power Survey of India report published by CEA).

**1.6.** Over the years, the Commission has taken several initiatives through laying down required framework for effective and secure grid operations. Few of such initiatives are mentioned hereby for reference.

(a) The Commission vide its order dated 13<sup>th</sup> October 2015 in 11/SM/2015 provided a roadmap for operationalize reserves in the country. The primary reserves have been ensured through suitable amendments in the Grid Code which require the generating stations to keep such reserves for system security, by not scheduling beyond their installed capacity. For secondary reserves, the Commission has taken phased approach by implementing pilots with a few ISGS (inter-State Generating Stations) and subsequently directing vide Order dated 28.08.2019 in Petition No. 319/RC/2018 that all inter-State generating stations (ISGS) should be AGC enabled. As regards tertiary control, the Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015 (in short, 'the RRAS Regulations') has started with administered mode of Ancillary Procurement with idea to shift to market based procurement of Ancillary Service with sufficient experience.

(b) The Commission through suitable amendments facilitated creation of reserves at the regional level by specifying norms for technical minimum and upper limit for scheduling interstate generation stations

(c) Further, keeping in view of the variable nature of generation from wind and solar resources and the effect such variability has on the inter-state grid, the Commission also introduced Forecasting and scheduling framework for wind and solar generating stations along with required framework for Deviation

and Settlement Mechanism (DSM) through suitable amendments in the Regulations.

- (d) The Commission, over the period, has tightened the operating band of frequency with due regard to the need for safe, secure and reliable operation of the grid. The Commission, in view of emerging market conditions has also reviewed the deviation settlement mechanism (DSM) rates, including their linkages with operational the band of frequency. Further, The Commission, in its meeting dated 23<sup>rd</sup> March 2017 resolved to declare National Frequency as 50 Hz and also directed to constitute a high-level expert committee consisting of representatives from CEA, POSOCO, CTU and other concerned with the mandate to suggest further steps required to bring power system operation closer to the national reference frequency of 50 Hz.
- (e) The Expert Group (hereafter referred to as “**50 Hz Committee**”), deliberated upon the issues related to grid operation and its existing operational band of frequency and brought out its first volume of the report discussing “review and suggestive measures for bringing power system operation closer to National Reference Frequency”. The some of the recommendations of the Committee Report (volume-I) which were considered in the preparing the draft Regulations are listed below for ready reference.
- i. Move to an operating frequency band of 49.95 Hz to 50.05 Hz
  - ii. Establishing the Frequency control continuum for Indian grid conditions detailing out the response time of inertia response, primary response, secondary response and tertiary response and consider Reference frequency of 50 Hz for frequency control

- iii. Monitoring of 'Area Control Error' and frequency response characteristics (FRC) by Regional Load Despatch Centres (RLDCs)
- (f) In view of the intermittency of RE sources, there was a need for an organized market platform to enable buyers and sellers to meet their energy requirements closer to real time of operation. The Commission hence introduced the framework for Real-time Market for Electricity in India (RTM) which came into effect from 1st June, 2020. RTM brought the required flexibility in the market to provide real time balance, while ensuring optimal utilization of the available surplus capacity in the system. The Real Time Market introduced the concept of "Gate Closure", with an appropriate timeline in consonance with half hourly market. 'Gate Closure' implies the point of time after which no trade or revision of schedule is allowed. This is considered necessary for bringing in the desired firmness in schedules during the hours of market operation. After Gate Closure, the system operator takes over the responsibility for balancing the system. The Commission believes that Real Time Market provides an alternate mechanism for Distribution Companies to access larger market at competitive price. On the other hand, generators also benefit by participating in the RTM with their un-requisitioned capacity. The same has been continued through the similar provision in the draft Grid Code.
- (g) The Commission has introduced the concept of Security Constrained Economic Despatch (SCED) with a view of ensuring optimization of generation resources at National level though a pilot vide its Orders from time to time. The prime driver behind the pilot is to explore the scope of optimization and therefore the possibility of minimizing the system cost without major structural changes in the existing system. The pilot optimises the injection from generating resources with the objective of minimization of

production cost, after the beneficiaries submit their last revision i.e. seven to eight blocks before the actual dispatch of power. The optimisation of generation has been achieved by creating a national level merit order by dispatching cheaper generating station after duly factoring in technical constraints such as technical minimum, maximum generation, ramping constraints, transmission constraints etc. Thus, optimisation at national level is achieved by increasing the lower variable cost pit-head generation while reducing the higher variable cost generation for the generators participating in the pilot. Around 50 generating stations have been participating in the pilot having 120 generating units and capacity of around 53,000 MW in the country. Since its inception in April 2019, SCED has resulted in reduction of variable cost of generation by more than ₹ 2000 crore. In view of this, the Commission has decided to introduce legal framework for the same by incorporating it in the draft Grid Code.

- 1.7.** Further, the Commission envisages that the next decade may see challenges on account of the following aspects:
- (a) India has a target to integrate around 500 GW of non-fossil fuel sources in the system by 2030. Due to this addition, issues on account of intermittent generation such as reduction in inertia, ramping requirements and availability of adequate generation to match the variability have to be addressed.
  - (b) Due to integrated nature of the grid as well as intermittent nature of RE generation, coordination between various stakeholders shall be required to manage any exigency situation.
  - (c) Due to increased size of the grid including cross border interconnections, in any unforeseen event such as transmission line tripping or generation unit outage may trigger widespread grid collapse, if not managed properly.

Therefore, adequate contingency measures must be made available to cater to unforeseen situations.

(d) Managing physical and cyber security threats.

**1.8.** In view of the foregoing as well as the requirement to amend the Grid Code due to the recent developments in power sector in India, changes in market structure and future challenges which include high level of renewable penetration in the grid, the Commission appointed an Expert Group (hereafter referred to as “**Expert Group**”) chaired by Shri Rakesh Nath to review the provisions of IEGC 2010 and prepare draft IEGC making recommendations for proposed amendment or changes in the existing Grid Code. The Expert Group submitted its report on 9<sup>th</sup> January 2020 wherein it proposed the Draft Indian Electricity Grid Code. Expert Group Report is available at CERC website at following link:

<https://cercind.gov.in/2020/reports/Final%20Report%20dated%2014.1.2020.pdf>

**1.9.** The Expert Groups mainly gave the following recommendations:

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- a) *The planning code has been thoroughly overhauled covering all facets of power system planning including demand forecasting, generation resource planning (flexibility, ramping, minimum turndown level), requirements of energy storage system, system reserves, system inertia for grid stability, inter-state system planning (including reoptimization system study, adequacy, enhancement of total transfer capability (TTC) across inter-regional boundaries as well as ISTS interfaced with STU network).*
- b) *The Connection Code has been reviewed and made applicable to the generators as well as the transmission licensees. This code specifies the requirements to be fulfilled by the connectivity grantees prior to obtaining the permission of the RLDC/NLDC/SLDC for first time energizing of a new or modified power system element. In addition to above, this code specifies the technical requirements to be complied by a transmission licensee including deemed transmission licensees*

*or cross-border entity prior to being allowed by RLDC/NLDC/SLDC to energize a new or modified power system element. The code also specifies the tests required before trial run.*

- c) A new code namely, protection and commissioning code has been added. A centralized data base containing details of relay setting for grid elements shall be maintained by RPC and system wide study twice a year for validating the protection setting shall be carried out by RPC secretariat. The new protection code provides for annual self-audit and third party once in five years. In the commissioning code procedure for trial run and declaration of CoD for renewable generators has been included. Further, to confirm the flexibility of generators for grid security, some necessary tests prior to trial run have been prescribed for different type of conventional and renewable generators.*
- d) The draft IEGC 2020 has suggested frequency response measures to correct the load generation imbalances in an automated manner with the help of primary, secondary and tertiary reserves coupled with demand response as a last resort. In view of the comfortable power supply position, it is now possible to have reserve generating capacity on bar for a quick response. NLDC has already done the preparatory work with regard to automatic generation control or AGC. We are getting initial or primary response at the rate of about 12–14 GW/Hz to contain frequency excursions. In place of restricted governor mode of operation (RGMO), the new Grid Code has proposed free governor mode of operation (FGMO) for all generating units in the country in order to arrest steady fall in the frequency in the event of a major grid disturbances. The primary response shall be provided by the generating machines immediately up to five minutes by which time the secondary response shall take over through automatic generation control to recover the frequency.*
- e) The quantum of reserve capacity required to be maintained for grid security is related to credible contingency including net error in the forecasts of demand and renewable generation. In the draft IEGC 2020, demand forecasting activity has been properly organized and there is a monitoring mechanism for errors in*

*demand forecasting. The operating code provides for ensuring and monitoring of availability of reserve capacity.*

- f) In order to minimize forecasting errors of renewable generators, aggregation of renewable energy has been allowed at one or more pooling stations for the purpose of deviation settlement. An institutional mechanism (QCA) for the composite scheduling and common deviation settlement of renewable generating stations at one or more pooling stations has been provided. The role and functions of QCA has been specified in the Grid Code.*
- g) In order to accurately forecast grid behavior in different eventualities it is necessary to validate the performance characteristics of power system elements particularly, generating units. Therefore, field testing of machines for validation of their mathematical models to be used in power system studies has been mandated once in five year.*
- h) The draft IEGC 2020 mandates adequacy of generation resources for round the clock supply to all consumer categories. It proposes load shedding through demand response contracts or through special protection schemes in the event of an emergency situation.*
- i) There is emphasis on continuous re-optimisation of interstate transmission system with a view to achieving economy and efficiency in operation. In addition to inter-regional power transfer capability, both CTU and NLDC shall be required to declare import/export transfer capability at the electrical periphery of a state in coordination with the STU.*
- j) Wind, solar, wind-solar hybrid and hydro plants (in case of excess water leading to spillage) shall be treated as MUST RUN power plants and shall not be subjected to curtailment on account of merit order despatch or any other commercial consideration.*
- k) In the event of transmission or system security constraint, the renewable generation may be curtailed after harnessing available flexible resources including energy storage systems.*

- l) In the event of extreme circumstances when any MUST RUN plant has to be curtailed, the details shall be published on the RLDC/SLDC website the following day, as the case may be, giving the date, name of RE generation plant, installed capacity, curtailment quantum in MWh, duration of curtailment and detailed reasons thereof.*
- m) Flexibility has been granted to the distribution utilities/ buyers having long-term transmission access for scheduling power out of their basket of power purchase agreements, including short-term contracts, up to the approved quantum of LTA. This will facilitate the distribution utilities to optimize their power procurement cost.*
- n) Distribution utilities/ buyers having short-term bilateral access shall be able to revise their schedule as per the same timelines provided for the long-term or medium-term schedule.*
- o) With a view to enhancing the flexibility of coal, lignite and gas based thermal generating stations for the emerging scenarios of high renewable energy penetration the compensatory mechanism for below the normative plant load factor has been reviewed and rationalized. The compensation for degradation in performance parameters resulting in higher cost of energy shall be calculated for each time block and settled on monthly basis. However, the extant mechanism has been retained for sharing of efficiency gain for power plants.*

*A new Code namely, Cyber Security has been added. The code provides for identification of Critical Information Infrastructure, appointment of Information Security Officer as per the Information Technology Rules 2018 and take necessary measures in accordance with guidelines by National Critical Information Infrastructure Protection Centre.”*

**1.10.** The Commission, vide its notification dated 31<sup>st</sup> January 2022 notified the Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2022 (hereinafter referred to as ‘2022 Ancillary Service Regulations’) which includes