MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO.LTD.

CIN NO. U40109MH2005SGC153646

Office of the Chief Engineer,
Maharashtra State Load Dispatch Centre,
Thane-Belapur Road, P.O. Airoli, Navi Mumbai. Pin – 400 708.
Tele: 91-22-27601765 / 1766;
Fax: 91-22-27601769
Email: cesldc@mahasldc.in

RIGHT TO INFORMATION

Ref: MSLDC/TECH/OP/REMC/1019 **Date: 15.06.2023**

To,
Wind & Solar Generators as per mailing list.

Sub: Compliance of the CEA (Technical standards for Connectivity to the Grid) (Amendment) Regulations, 2019 dated 06.02.2019.
…Submission of test/study reports & information to MSLDC thereof.

Ref: 1. The CEA (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2019.
2. T.O. Circular No. MSLDC/TECH/OP/REMC/LVRT/1582 dated 07.09.2020.
3. WRLDC Letter No. WRLDC/SO-II/027/2023/10 dated 10.02.2023.
4. T.O. Circular No. MSLDC/TECH/OP/REMC/CEA/1018 dated 15.06.2023.

With reference to the above subject, it is to state that the CEA has notified CEA (Technical Standards for Connectivity to the Grid), Regulations, 2007 amended in 2019. In accordance with the said regulations, all the RE Generators are mandated to comply with various provisions. Further, the CEA had constituted a Working Group (WG) under the chairman ship of the Member (GO&D), CEA, having members from CEA, CTU, POSOCO & SECI for discussing various issues observed during compliance of these regulations. The said WG has submitted a report in July' 2022, based on detailed discussions with various Stake holders viz. RE Developers, Study agencies, OEMs, etc. The WG report has explanation for assessment of compliance, procedure & timelines and list of test/study reports. Further, it has been specified that the said WG report shall come in to effect from three months of issuance of the WG report. Thus, the recommendations of the said report have become effective from Nov' 2022.

The copy of said WG Report is attached herewith as **ANNEXURE – 1** for ready reference & the same is available on the below link:

https://www.ctuil.in/docs/files/Final%20Report%20of%20the%20Working%20Group%20(July%202022)_Final1.pdf

In view of the same, it is requested to adhere to the procedure specified in the said WG report and submit study/test reports in compliance with the said CEA regulations, in the prescribed formats in the WG report to MSLDC. It is requested to submit the information, Study/test reports on remc.operation@mahasldc.in

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Please note that any non-compliance in this respect shall be communicated to the appropriate Commission and action as per the Regulation No. 12 (3) of the CEA (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2019, shall be initiated.

All the QCAs are requested to inform the concerned generators connected to the PSS to which they are representing so as to smoothen the implementation process.

Please treat the matter as **MOST URGENT.**

Thanking you.

With regards,

Encl: As above.

(Mahesh Bhagwat)
Chief Engineer
MSLDC

Copy s.w.r.s. to:

- The Director (Operations), Prakashganga, MSETCL, Mumbai.
- The Executive Director, MSLDC, Airoli, Navi Mumbai.
- The Executive Director, WRLDC, Andheri, Mumbai.

Copy to:

- M/s. Manikaran Analytics Ltd.
- M/s. REConnect Energy Solutions Ltd.

Mailing List:

Name of PSS	Name of Generator	Cap. (MW)	Mail Id
AMBHERI	M/s GIRIRAJ ENTERPRISES	16	balkrishna.patil@senvion.in, saurabh@namangroup.com
AMBHERI	M/s TATA POWER COMPANY LTD.	32	sivanarayana@tatapower.com, gunesh.kusurkar@tatapower.com
ANDRALAKE	M/s CLP WIND FARMS (INDIA) PVT. LTD.	106.4	sukesh.kumar@windworldindia.com,pritesh.sharma@apraava.com
ARANVIHIRA	M/s RENEW WIND ENERGY (VAREKARWADI) PVT. LTD.	50.4	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
ARANVIHIRA	M/s RENEW WIND ENERGY (WELTURI) PVT. LTD.	23.1	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in

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Name of PSS	Name of Generator	Cap. (MW)	Mail Id
ARANVIHIRA	M/s RENEW SURYA ALOK PVT. LTD.	20	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
ARANVIHIRA	M/s RENEW SURYA KIRAN PVT. LTD.	5	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
BOTHE	M/s BOTHE WINDFARM DEVELOPMENT PVT. LTD.	199.7	dhananjay.joshi@continuumenergy.in,vijay.karale@continuumenergy.in
DASGAON	M/s RATNAGIRI WIND POWER PROJECTS PVT. LTD.	97.6	rajeshkumar@greenkogroup.com,dinu.viswanath@greenkogroup.com
FERMI SOLAR	M/s FERMI SOLAR FARMS PVT. LTD.	80	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
GANGAKHED	M/s FLEXI URJA JALGAON LTD.	20	mhsolarparbhani@gmail.com
GANGAKHED	M/s PARBHANI POWER PVT. LTD.	40	mhsolarparbhani@gmail.com
JBM SOLAR	M/s JBM SOLAR POWER MAHARASHTRA PVT. LTD.	100	bhupendra.singh@jbmgroup.com, pravin.kamble@sterlingwilson.com, sandeep.mittal@jbmgroup.com
JEUR KHANDKE	M/s LALPUR WIND ENERGY PVT. LTD.	49.6	srimay.pattnaik@windworld.com, fsteam@greenkogroup.com
KADEGAON	M/s GIRIRAJ ENTERPRISES	14.8	balkrishna.patil@senvion.in, saurabh@namangroup.com
KALEDHONE	M/s KHANDKE WIND ENERGY PVT. LTD.	36.8	srimay.pattnaik@windworld.com, fsteam@greenkogroup.com
KAVATHEMAHANKAL	M/s WIND WORLD INDIA LTD. (GI POWER COMPANY LTD.)	8.4	khanapur.operations@windworldindia.com , kiranranmale1@gmail.com , gajendra.badgujar@windworldindia.com , Anil.Nalla@windworldindia.com
KHANDKE	M/s CLP WIND FARM (KHANDKE) PVT. LTD.	50.4	pritesh.sharma@apraava.com
KHANDKE	M/s SHAH PROMOTERS & DEVELOPERS	7.2	powergeneration@shahgrouppune.com
KHANDKE	M/s TATA POWER GREEN ENERGY LTD. (TATA POWER COMPANY LTD.)	50.4	sivanarayana@tatapower.com, gunesh.kusurkar@tatapower.com
KHARDA	M/s KRISHNA WINDFARMS DEVELOPERS PVT. LTD.	10	rahul.hushare@mitconindia.com,
KORAL	M/s TORRENT SOLARGEN LTD.	26	LoharaKoral_Wind@torrentpower.com
LOHARA	M/s TORRENT	100	LoharaKoral_Wind@torrentpower.com

Name of PSS	Name of Generator	Cap. (MW)	Mail Id
	SOLARGEN LTD.		
MHATARGAON	M/s SOLAR EDGE POWER AND ENERGY PVT. LTD.	80	
MOHOL	M/s VISHWARAJ ENERGY PVT. LTD.	10	shelkeprashant.92@gmail.com
MUKTAINAGAR	M/s SOLAR EDGE POWER AND ENERGY PVT. LTD.	50	
NERLE	M/s PANAMA WIND ENERGY PVT. LTD.	72	ashintre@panamarenewable.com
OSMANABAD	M/s RENEW VAYU URJA PVT. LTD.	76	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in,
OSMANABAD	M/s MAHARASHTRA STATE POWER GENERATION CO. LTD.	50	cesolar@mahagenco.in
OZAR	M/s HINDUSTAN AERONAUTICS LTD.	15	pmohanlalsanghvi@gmail.com; gopal.kulkarni@hal-india.com
PALASWADI	M/s TATA POWER RENEWABLE ENERGY LTD.	55	sivanarayana@tatapower.com, gunesh.kusurkar@tatapower.com
PATHARI	M/s MH TECHNIQUE SOLAIRE INDIA PVT. LTD.	20	info@npmpd.com
PATHARI	M/s RENEW SUNLIGHT ENERGY PVT. LTD.	43	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in,
PATHARI	M/s RENEW SUN SHAKTI PVT. LTD.	7	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in,
PATHARI	M/s HINDUJA RENEWABLES ONE PVT. LTD.	14.3	
RAJPIMPARI	M/s PANAMA WIND ENERGY GODAWARI PVT. LTD.	80	ashintre@panamarenewable.com
RAJPIMPARI	M/S. PANAMA SOLAR ENERGY GODAWARI PVT. LTD.	4	ashintre@panamarenewable.com
RAJPIMPARI	M/S. PRAKREETEE SOLAR ENERGY GODAVARI PVT LTD (PANAMA SOLAR ENERGY GODAWARI PVT. LTD.)	6	ashintre@panamarenewable.com
SHIRSUPHAL	M/s MAHARASHTRA	50	cesolar@mahagenco.in

Name of PSS	Name of Generator	Cap. (MW)	Mail Id
	STATE POWER GENERATION CO. LTD.		
SHIVAJINAGAR	M/s MAHARASHTRA STATE POWER GENERATION CO. LTD.	125	cesolar@mahagenco.in
SHIVAJINAGAR	M/s ORANGE RENEWABLES LTD.	100	
SHIVAJINAGAR	M/s VARROC LTD.	5	sujoshi@silworld.in; ravindra.ingle@varroc.com
TELGAON	M/s TALETTUTAYI SOLAR PROJECTS FOUR PVT. LTD.	50	santhosh.kumar@solar-arise.com, sunil.kumar@solar-arise.com
WALSANG	M/s PUDHARI PUBLICATION PVT. LTD.	2	ssuyog@suzlon.com
WALSANG	M/s RELIANCE POWER	45	Suhas.Padmalkar@relianceada.com, lalitkumar_baid@yahoo.com
WALSANG	M/s RENEW WIND ENERGY (RAJKOT) PVT. LTD.	45	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
WALSANG	M/s RENEW WIND ENERGY (SHIVPUR) PVT. LTD.	49.5	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
VARKUTE MALWADI	M/s. AVAADA	28	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
VARKUTE MALWADI	M/S. AVAADA SATARA MH PVT. LTD.	72	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
VASPETH	M/s CLP WIND FARMS (INDIA) PVT. LTD.	60	pritesh.sharma@apraava.com
VASPETH	M/s GLOBAL METAL & ENERGY PVT. LTD.	2.55	d_rajeev23@yahoo.co.in
VASPETH	M/s INDO RAMA RENEWABLE JATH LTD.	30	
VASPETH	M/s RENEW WIND ENERGY (JATH) PVT. LTD.	76.15	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
VASPETH	M/s VENA ENERGY LTD.	30	
JALKOT	M/s. SUNBARN RENEWABLES PVT. LTD.	12.8	sachin.butani@cleantechsolar.com
JALKOT	M/s. GREENZEST SUNPARK PVT. LTD.	29.1	sachin.butani@cleantechsolar.com
JALKOT	M/s. FAIRSUN SOLAR PVT. LTD.	5.7	sachin.butani@cleantechsolar.com
JALKOT	M/s. CSE SOLAR	11.5	sachin.butani@cleantechsolar.com

Name of PSS	Name of Generator	Cap. (MW)	Mail Id
	SUNPARK MH PVT. LTD.		
JALKOT	M/s. SUNSOLE RENEWABLES PVT. LTD.	2.9	sachin.butani@cleantechsolar.com
JALKOT	M/s. SUNSTRENGTH SOLAR PVT. LTD.	3.9	sachin.butani@cleantechsolar.com
JALKOT	M/s. STRONGSUN SOLAR PVT. LTD.	6	sachin.butani@cleantechsolar.com
WAIPHALE	M/s RENEW WIND ENERGY (RAJASTHAN) PVT. LTD.	30	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
WALVAN	M/s WALWHAN SOLAR MH LTD. LTD.	20	sivanarayana@tatapower.com, gunesh.kusurkar@tatapower.com
BALAPUR	M/s. AVAADA MHKHAMGAON PVT LTD	50	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
BALAPUR	M/s. AVAADA MHBULDHANA PVT. LTD.	50	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
PARTUR	M/s TP KIRNALI LTD	100	sivanarayana@tatapower.com, gunesh.kusurkar@tatapower.com
SAONER	M/s. TASOULA ENERGY PVT. LTD.	45	bprakash@vibrantenergyholdings.com, SKumar2@vibrantenergyholdings.com
ARNI	M/s. Juniper Green Field Pvt. Ltd.	80	JGFPL.QCA@junipergreenenergy.com
VAIRAG	M/s.AVAADA MH SUSTAINABLE PVT LTD	100	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
TIGHARA	M/s. Juniper Green Field Pvt. Ltd.	70	JGFPL.QCA@junipergreenenergy.com
DOWNING SOLAR	M/s. Indigao Generation(I) Pvt. Ltd.	5	cvageria@agami.co.in
DOWNING SOLAR	M/s. Ironhide Generation(I) Pvt. Ltd.	5	cvageria@agami.co.in
AVAADA WAAI	M/s.AVAADA MH SUSTAINABLE PVT LTD	150	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
BHADGAON	M/s. HUOBAN ENERGY 1 PVT LTD	20	umesh.thakare@fourthpartner.co
BHADGAON	M/s. HUOBAN ENERGY 3 PVT LTD	2.64	umesh.thakare@fourthpartner.co
HASAPUR	M/s. RENEW BHANU SHAKTI PVT LTD	16.5	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in

*Sub: - **Compliance of the CEA (Technical standards for Connectivity to the Grid) (Amendment) Regulations, 2019 dated 06.02.2019.***
…Submission of test/study reports & information to MSLDC thereof.

Name of PSS	Name of Generator	Cap. (MW)	Mail Id
HASAPUR	M/s. RENEW SURYA SPARK PVT LTD	15.5	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in
NER	M/s. AVAADA MHVidharbha Pvt. Ltd	25	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
NER	M/s. AVAADA Sunlight Pvt. Ltd	25	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
NER	M/s. AVAADA MHYavat Pvt. Ltd	25	dhiren.bhatt@avaada.com ,saurabh.tyagi@avaada.com, Abhishek.soni@avaada.com
NANDGAON PETH	M/s. RENEW SUN RENEWABLES PVT. LTD.	15	jobin.abraham@renewpower.in, abhishek.dumka@renewpower.in, abhinav.saraswat@renewpower.in

Report of the Working Group

in respect of

Data Submission Procedure

and

Verification of Compliance to

CEA Regulations on Technical Standards for Connectivity to the Grid

by RE Generators

July 2022

CTUIL

Preface

A Working Group (WG) with members from CEA, CTU, POSOCO & SECI had been constituted in a meeting held on 23/09/2021 under the Chairmanship of Member (GO&D), CEA to discuss issues related to compliance of Central Electricity Authority (Technical Standards for Connectivity to the Grid), Regulations, 2007, and the amendments thereof, (hereinafter referred to as "CEA Regulations on Technical Standards for Connectivity to the Grid" / "CEA Technical Standards"), by RE Generators

The Working Group had since convened several meetings including meetings with RE Developers, Study agencies & OEMs to understand the issues and difficulties faced by them in respect of compliance of CEA Technical Standards for Connectivity to Grid and obtain their feedback. Based on deliberations in the various meetings, the initial Report of Working Group was compiled in January,2022, wherein primarily the timelines and procedure for CON-4 processing along with other immediate/urgent issues were concluded. However, in consideration of the complex nature of the pending issues which required further deliberations, the Working Group had proceeded to deliberate for resolution of these issues. Accordingly, the consolidated Report of the Working Group is presented herein.

The Report is constituted in three parts as detailed below:

Part-I: Explanation for assessment of compliance to CEA Regulations on Technical Standards for Connectivity to the Grid, by RE Generators

Part-II: Procedure & Timelines for submission of CON-4 data & documents for demonstration of compliance to CEA Technical Standards for Connectivity to the Grid, by RE generators

Part-III: List of Test/Study Reports required to be submitted by the RE Generators in compliance to CEA Regulations on Technical Standards for Connectivity to the Grid

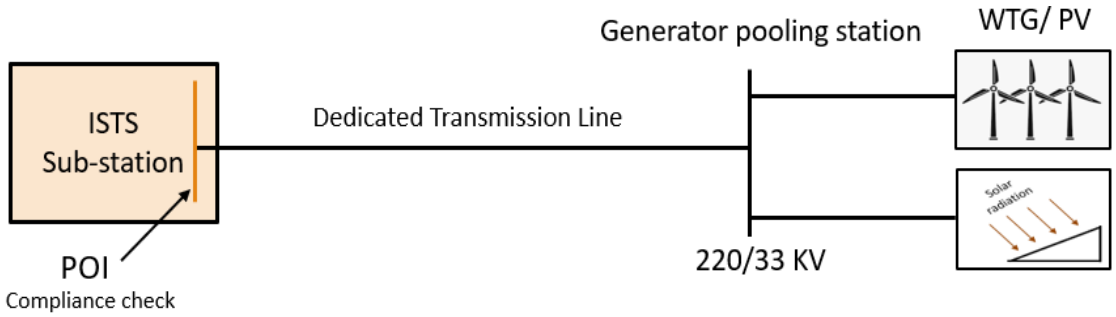
The RE Generators shall observe the explanations, procedures, timelines and furnish the Test/Study reports as contained herein in respect of submission of CON-4 documents/Technical Connection Data(formats for data submission available on CTUIL website) and demonstration of compliance to CEA Regulations on Technical Standards for Connectivity to the Grid. Further, the procedure outlined in the Report has also taken into consideration the implications of the Connectivity & GNA Regulations, published by CERC in 2022, which would commence upon notification of the same and accordingly the RE generators shall continue to comply with this Report even after continuation into the GNA regime.

The explanations, procedures, timelines and requirements mandated vide this Working Group (WG) Report shall come into effect from three months of issuance of this WG Report.

Explanation for assessment of compliance to CEA Regulations on Technical Standards for Connectivity to the Grid, by RE generators

The following aspects shall be considered while assessing compliance to CEA Technical Standards for Connectivity to the Grid by RE generators:

1) Point of Interconnection (POI) may be defined as the point of interconnection of RE generating station with the Grid (ISTS/Intra-state). The POI would be the reference point for assessment of compliance to CEA Regulations on Technical Standards of Connectivity to the Grid (viz. data/studies/all performance capabilities, etc) and the generator pooling station & dedicated transmission line & system of the RE shall be considered as a part of the RE Generator.



2) The RE generator should be able to demonstrate dynamic reactive power capability to operate at least up to 'V-curve' boundaries (0.95lag/lead as shown in the shaded region) at the corresponding generation level at the POI. The QV & PQ curve to be followed in this respect is depicted below:

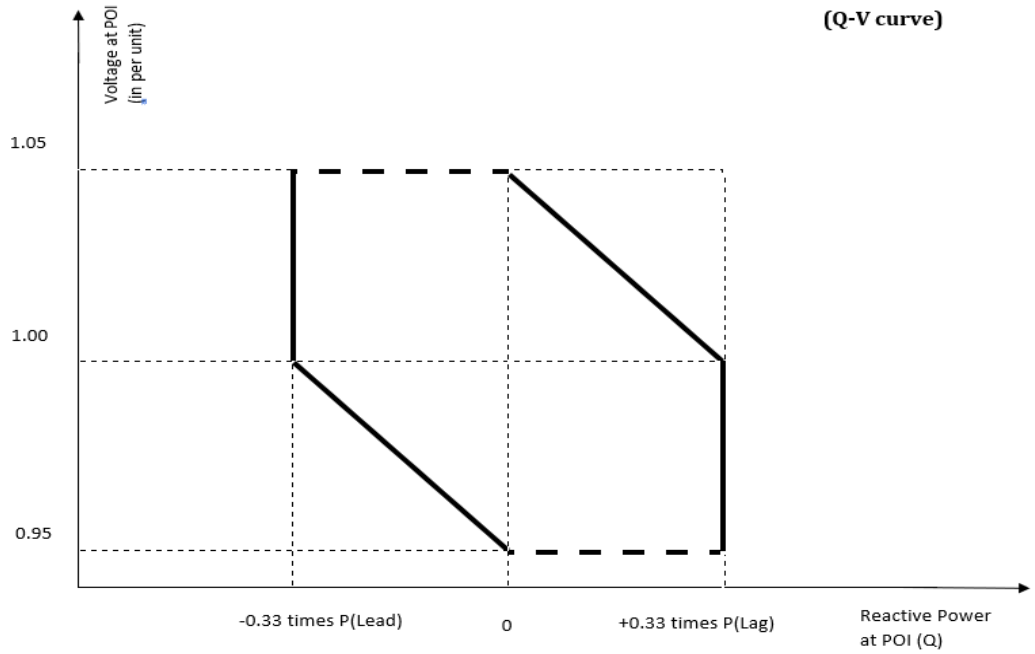


Fig 1: Reactive power capability of plant at POI in terms of Voltage at POI and reactive power

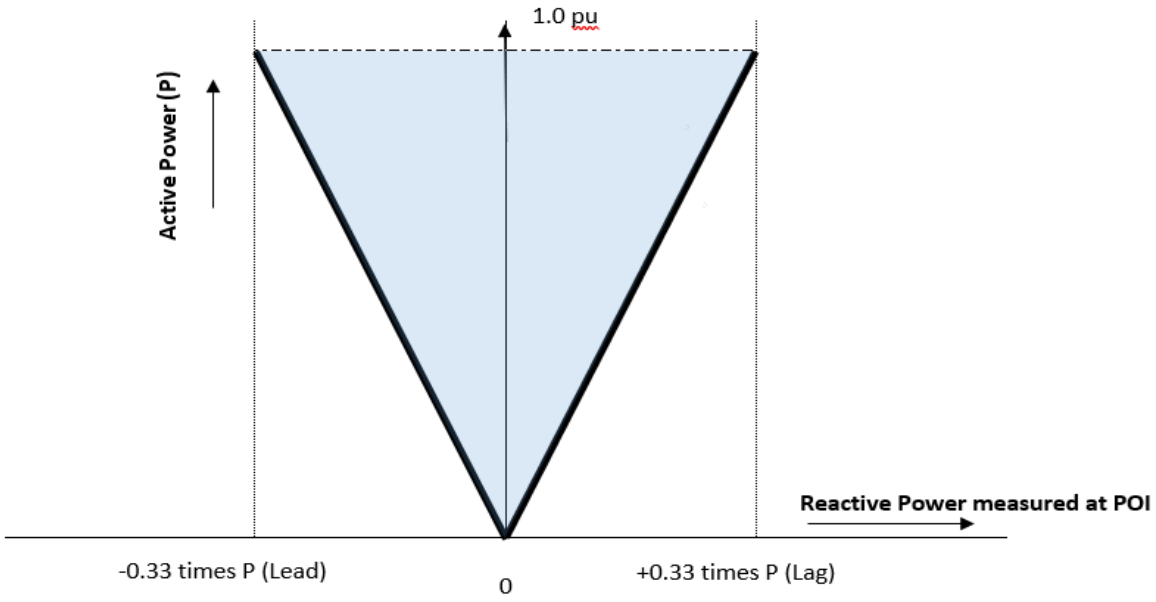


Fig 2: Reactive power capability of plant at POI in terms of active power and reactive power measured at POI

3) The control mode i.e. Automatic Voltage control/ Power Factor control/ Reactive Power Control shall be utilised as per requirements of the System Operator during Real Time System Operation. That is, the RE plant should have complete flexibility to operate in any of these modes.

4) In respect of design operating temperature to be considered for RE generators, Part-I(1)(3)(General)(Standards for Connectivity to the Grid) of the CEA (Technical Standards for Connectivity to the Grid) Regulations,2007, is quoted below:
"***The effects of wind, storms, floods, lightening, elevation, temperature extremes, icing, contamination, pollution and earthquakes must be considered in the design and operation of the connected facilities***"

   Accordingly, the RE generator shall design their machines (WTG/Inverter) considering temperature extremes corresponding to location of the generating station.

The following process is to be followed by the RE generators for assessing the maximum and minimum possible ambient temperature to be considered for design of their machines (WTG/Inverter):

- The RE generator shall obtain relevant temperature data from the India Meteorological Department (IMD), Pune (Ministry of Earth Sciences, Government of India) website. The IMD maintains the database related to monthly temperature on a pan India basis and the temperature extremum (highest maximum & minimum ever for a month) recorded by the IMD measuring station nearest to the location of the Generating Station shall be noted. In case of non-availability of IMD data, the RE Generator may consider the temperature data from any weather service provider of repute or, any weather station of RE project in vicinity. The source of temperature data and location of the weather station, is to be indicated by RE generator in submission to CTU & POSOCO.

- The extreme temperature for a particular IMD station can be found using the following link:

  https://cdsp.imdpune.gov.in/home_lab_2.php#extremes

  The above link gives the maximum and minimum temperature for a particular month (highest and lowest ever observed till date).
- The RE generator shall tabulate the maximum and minimum temperatures for each month of the year and from the table, select the highest and lowest temperature amongst the 12 months.
- For the higher extremum, a margin of 1°C shall be added to the temperature as obtained vide the above procedure and the same shall be rounded off (to the nearest higher integer) and considered for design temperature of the RE Generator at the higher extremum end.
- Similarly, for the lower extremum, a margin of 1°C shall be subtracted to the temperature as obtained vide the above procedure and the same shall be rounded off (to the nearest lower integer) and considered for the design temperature of the RE Generator at the lower extremum end.
- The RE generator shall furnish the entire evaluation process & data in a stepwise manner as indicated above under Affidavit for consideration of compliance.

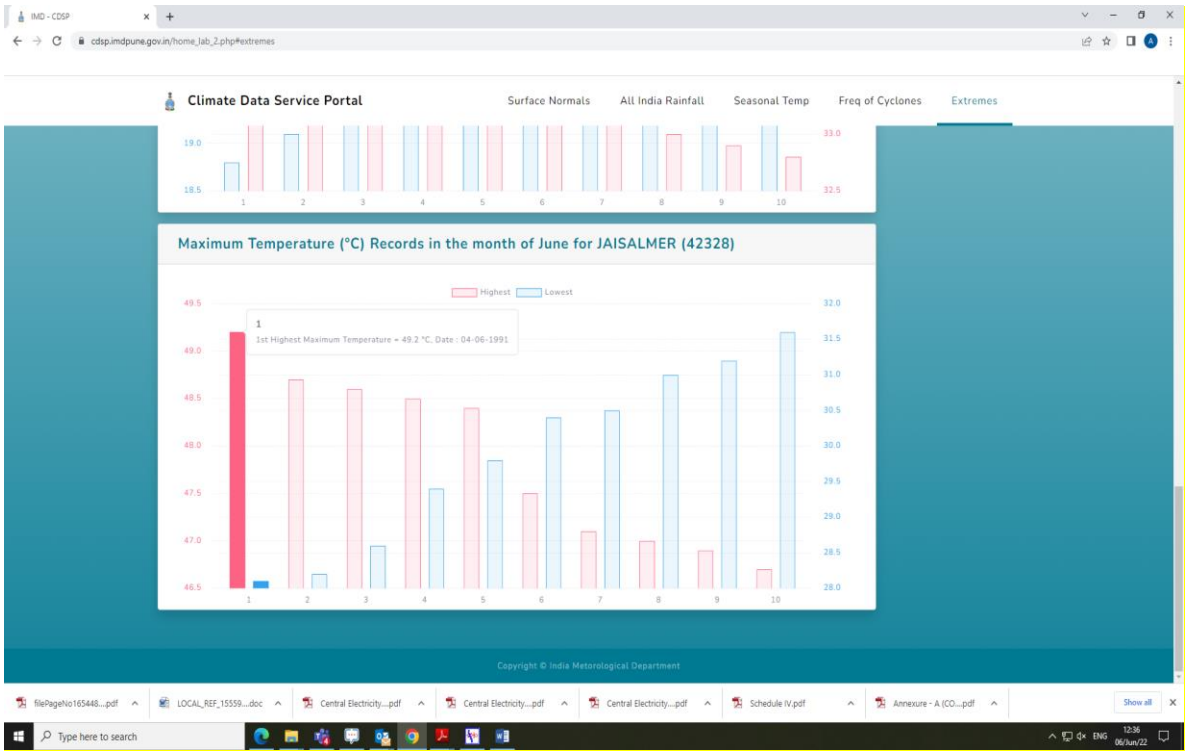
The above shall be made effective from three months of the issuance of this Working Group (WG) Report for purposes of designing of the technical specifications by the RE Generators.

Illustration: In order to find out the design temperature (at the higher & lower extremum end) for Jaisalmer (Rajasthan):

Go to: https://cdsp.imdpune.gov.in/home_lab_2.php#extremes

Select: **Location & Month e.g Jaislamer & June**

The maximum temperature shall be displayed as follows:



Maximum temperature of 49.2^{0}C can be observed from IMD website for the month of June. Similarly, there shall be different values of maximum temperature for the other different months of the year. The RE generator shall now tabulate the maximum and minimum temperatures for each month of the year as below:

Maximum and Minimum Temperatures observed for various months of a Year

Month	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)
January	35.8	-2.0
February	36.1	-4.4
March	42.3	3.4
April	45.8	11.1
May	49.0	16.1
June	49.2	18.8
July	47.1	20.1
August	43.1	20.6
September	43.0	16.4
October	41.7	11.3
November	38.8	4.6
December	34.4	0.6

The highest temperature amongst the monthly maximum is observed for the month of June is 49.2^{0}C, which after addition of a margin of 1°C and rounding off to the next higher integer would be 51^{0}C. Accordingly, for this case, the temperature (at the higher extremum) to be considered for design purpose of the RE Generator shall be 51^{0}C. A similar approach may be followed for evaluation of the design temperature at the lower extremum.

5) Over voltage observed in Wind Power Plants:

The applicable compliances by RE Generators are to be demonstrated at the POI reference point and accordingly the RE generators shall be capable of delivering/absorbing reactive power upto 0.95lag & 0.95lead at the POI in a way which is conducive to maintain the ISTS voltage as close as possible to the nominal value. Any over-voltage arising within the RE plant for complying with the above requirement, shall be taken care of by the RE Generator since the design and planning is under the purview of the RE Generator. The performance at POI shall not be compromised on account of any issues internal to the plant.

6) Treatment of RE generators physically connected to the Grid but have not submitted test reports/documents towards compliance to CEA Regulations on Technical Standards for Connectivity to the Grid:

The RE generators presently connected to the Grid and in operation, are mandated to comply with the CEA Regulations on Technical Standards for Connectivity to the Grid, as specified in the respective Regulations. Accordingly, all such RE generators who have been permitted connectivity to the Grid shall be required to demonstrate compliance with the applicable CEA Regulations on Technical Standards for Connectivity to the Grid, depending on the date of commissioning of the RE Generators. All supporting documents such as Test Reports/Simulation studies shall be submitted and necessary rectification measures taken by the RE Generators as may be necessary towards demonstration and obligation of meeting such compliances.

To achieve the above, as a first step, it is necessary to update the database of all such RE generators (some of which may have got connected a long time back). Thus, all RE

generators currently operational irrespective of their ownership and control area and who have not submitted the Test/Study Reports shall be required to update their data as per a database format to be finalized jointly by CTU & POSOCO. The above format shall also contain a checklist of the various compliances mandated as per the CEA Regulations on Technical Standards for Connectivity to the Grid. All RE generators shall have to reaffirm their compliance to the applicable CEA Regulations on Technical Standards for Connectivity to the Grid (depending on the date of commissioning of the Re Generators) by confirming the above checklist and submission of data in the circulated format through affidavit.

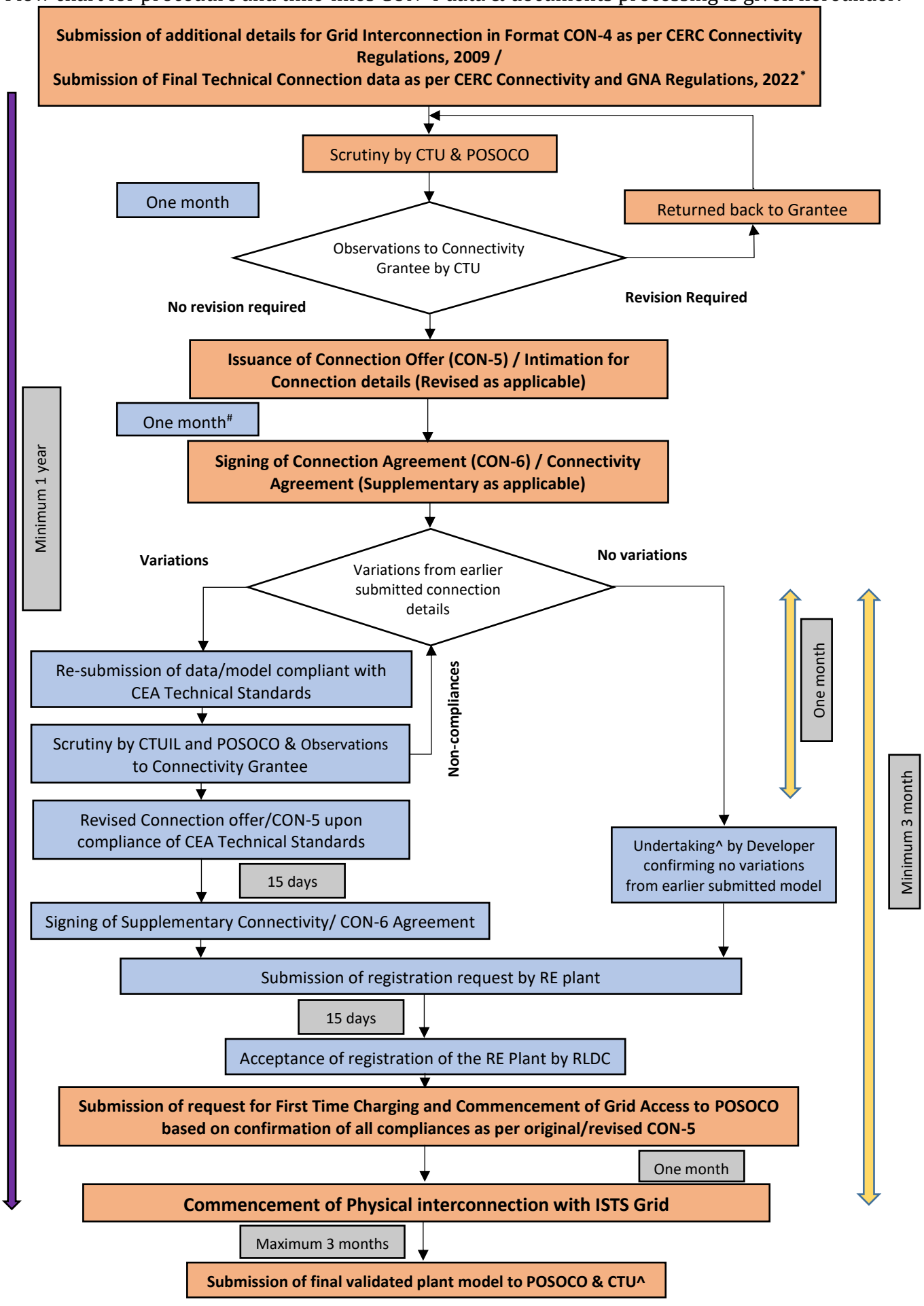
For this purpose, RLDCs shall take up with RE generators connected to the concerned regional ISTS while SLDCs shall take up with RE generators within their respective control areas, under intimation to the concerned RLDC. On updation of the database and confirmation of the checklist, POSOCO & CTU (i.r.o regional entity Generators) shall examine the data and POSOCO and CTU jointly shall identify cases of non-compliance based on Operational data/Grid events and impact of such grid events. Similarly, for Intra-State generators, SLDCs & STUs shall identify such cases as mentioned above. Thus, on basis of the Operational data, areas/pockets of non-compliance shall be identified jointly by CTU and POSOCO (for ISTS generators) and STUs and SLDCs (for intra-state generators) on basis of such data shall demand from the generators in the area/node an exhaustive list of documents as well as simulation based study from plant side as mentioned herein for scrutiny/observations related to compliance to the applicable CEA Regulations on Technical Standards for Connectivity to the Grid.

After scrutiny of the documents, in case of observed non-compliance, the RE Generators shall be informed (RLDC to inform regional entity generators and SLDCs shall inform intra-state generators) of the observations of CTU/RLDCs and STUs/SLDCs regarding non-compliances and a maximum period of one year shall be given to them for taking necessary measures and installation of additional equipment as may be necessary for making their plant compliant. A suitable advisory shall also be placed on the website of RLDC/SLDC mentioning the above. RE Generators who fail to make their plant compliant with the applicable CEA Regulations on Technical Standards for Connectivity to the Grid, within a period of one year from the date of intimation by RLDC/SLDC, shall be liable for appropriate action by CTU / respective STUs.

Part-II

Procedure & Timelines for submission of CON-4 data & documents for demonstration of compliance to CEA Technical Standards for Connectivity to the Grid, by RE Generators

Flow chart for procedure and time-lines CON-4 data & documents processing is given hereunder:



i. The RE generator shall submit the complete CON-4/technical connection data at least 12 months/1 year prior to the physical interconnection with Grid with the undertaking that the data/RE plant model submitted is accurate and representative of the actual plant response.

ii. Based on the submitted data/RE plant model and the studies carried out, the RE generator shall take advance action for implementation of the required corrective measures towards compliance with CEA Regulations on Technical Standards for Connectivity to the Grid, before physical interconnection with Grid, failing which physical interconnection may not be permitted.

iii. CTU shall share the submitted data and models (refer point-i) with POSOCO and both CTU & POSOCO shall, in parallel, examine the submitted data. POSOCO shall forward their comments to CTU and CTU shall convey the observations with respect to non-compliance of the CEA Regulations on Technical Standards for Connectivity to the Grid, to the RE developer within one month of the receipt of complete CON-4 data. The RE generator shall ensure compliance to CEA Regulations on Technical Standards for Connectivity to the Grid, before physical interconnection with Grid.

iv. Based on the above, CTU shall issue the CON-5/Connection details and Connection Agreement (CON-6) shall be signed with the RE generator for physical interconnection with the ISTS Grid.

v. In case of any changes w.r.t CON-4 data [submitted at Sl.(i)], the RE developer shall submit to CTU/POSOCO the aggregate changes/ revised data and models w.r.t CON-4 data at least three months prior to the physical interconnection. CTU and POSOCO shall examine the submitted revised data and CTU shall, within one month from the receipt of revised data, and convey the following to the RE developer:

   a. Observations regarding non-compliance of CEA Regulations on Technical Standards for Connectivity to the Grid, if any. In this case, the RE generator shall have to first ensure compliance to CEA Regulations on Technical Standards for Connectivity to the Grid, so as to obtain revised connection offer and proceed with interconnection with the grid.

   b. Revised Connection offer if compliance of all applicable provisions of CEA Regulations on Technical Standards for Connectivity to the Grid, are met.

   c. Supplementary Connectivity Agreement/CON-6 shall be signed within 15 days subsequent to issuance of revised connection details / CON-5.

   In case there are no changes w.r.t CON-4 data [submitted at S.No.(i)], the RE developer shall submit undertaking prior to physical Grid interconnection (to both POSOCO & CTU) confirming that there are no changes to the data/model submitted at S.No.(i).

vi. After compliance of the applicable CEA Regulations on Technical Standards for Connectivity to the Grid and receipt of CON-5/Connection offer along with signing of Connectivity Agreement/CON-6 with CTU, the RE developer shall apply for registration with the concerned RLDC as a grid user. The RLDC shall register the

generator as its user on receipt of fees as specified under CERC Regulations within a period of 15 days subject to fulfillment of all requirements. After successful registration, the RE generator shall request the System Operator (POSOCO) for First Time Charging and Commencement of physical Grid interconnection with ISTS as per POSOCO's First Time Charging Procedure for Grid Interconnection. The system operator shall process the FTC (First Time Charging) request within one month of submission of complete data subject to compliance of the CEA Regulations on Technical Standards for Connectivity to the Grid.

vii. The RE developer shall submit the final validated plant model of the implemented RE generating Station within 03 months of RE plant commissioning or commissioning of all such additional equipment/parameter tuning/setting changes. The guidelines in this regard are provided in **Part-III** of this Report.

NOTE:

** In case an entity is not in possession of final technical connection data, it may furnish tentative data and CTU/POSOCO shall furnish the observations (if any) within one month thereafter. The connectivity grantee shall rectify such deficiencies to enable compliance to CEA Regulations on Technical Standards for Connectivity to the Grid.*

The Connection data/CON-5 shall be issued within one month of receipt of final connection data compliant with CEA Regulations on Technical Standards for Connectivity to the Grid, followed by signing of Connectivity Agreement/CON-6. Any subsequent changes in Connection data / CON-4 shall be followed by issuance of revised Connection Offer/ CON-5 & Signing of Supplementary Connectivity Agreement/ CON-6 by the Connectivity Grantee.

The Grantee shall however ensure submission of technical connection data at least one year prior to physical connection.

 # In case of failure to sign the Connectivity Agreement by the entity that has been intimated final grant of Connectivity, as required under Regulation 10.3 of CERC Connectivity and GNA Regulations, 2022, the Nodal Agency may extend the time for signing the Connectivity Agreement for a maximum period of 30 days, failing which the final grant of Connectivity shall be revoked by the Nodal Agency under intimation to the Applicant and the Conn-BG1, Conn-BG2 shall be encashed, and Conn-BG3 shall be returned.

***^**The undertaking to be provided on applicant's company authorized signatory not below the rank of CMD or CEO or MD.*

Part-III

List of Test/Study Reports required to be submitted by RE Generators in compliance to CEA Regulations on Technical Standards for Connectivity to the Grid

In support of compliance with Connectivity Standards, the RE applicant shall submit the following Test/Simulation Study Reports as part of CON-4 documents as per the sequence indicated below. Other details such as model submission, test report (factory/lab/field) submission, benchmarking and validation report submission is provided at the end of this section.

Power Quality test

1. Harmonic Current Injection at POI
2. DC Current Injection at POI
3. Flicker injection at POI

Reactive Capability test

4. Reactive power capability (0.95 lag - unity - 0.95 leading) at rated output

Voltage ride through test

5. Study analysis to demonstrate ride through capability for balance and unbalanced faults (LVRT & HVRT)

Frequency response & operational capability test within specified frequency /voltage band

6. Rated output for voltage (0.95pu -1.0 pu – 1.05 pu) and Freq. (49.5 Hz – 50.5 Hz)
7. Frequency Response test

Active power control set point

8. Analysis to show capability to control active power injection in accordance with a set point

Ramping capability test

9. Study analysis for rate of change of power output

NOTE - Power Quality Study is to be carried out on detailed EMT / Power Quality Assessment Model. Reactive Power Capability assessment shall be carried out on detailed RMS and Equivalent EMT model. Other tests are to be carried out in both equivalent RMS and EMT Model. Model compatibility guidelines are provided in subsequent pages.

Details of the simulation studies to be carried out by the RE developer for demonstrating compliance with the CEA Regulations on Technical Standards for Connectivity to the Grid, are as below:

Test Domain	Clause No. of CEA Regulations	Detailed Clause	List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations
Power Quality	**B.1(1)**	Harmonic current injections from a generating station shall not exceed the limits specified in IEEE Standard 519	1. Harmonic Study report is required to be submitted considering complete Generating Station as a whole at POI (vide aggregation of individual PV inverter/WTG/Hybrid/BESS unit test reports). 2. The harmonic current limits for voltage class **above 161kV** as depicted in IEEE Standard 519-2014 shall be applicable. In case of interface at 132kV level POI, Harmonic currents limit for voltage class above **69 kV to 161 kV** would be applicable. 3. Harmonic evaluation (Current) shall be done at 10% incremental active power levels starting from 0-100% of rated output.
	B.1(2)	Generating station shall not inject DC current greater than 0.5% of the full rated output at the interconnection point.	Study report is required to be submitted considering complete Generating Station as a whole at POI (vide aggregation of individual PV inverter/WTG/ Hybrid/BESS unit test reports)
	B.1(3)	Generating station shall not introduce flicker beyond the limits specified in IEC 61000	Study report for Flicker evaluation is required to be submitted considering complete Generating Station as a whole at POI (vide aggregation of individual PV inverter/WTG/ Hybrid/BESS unit test reports)
	B.1(4)	Measurement of harmonic content, DC injection and flicker shall be done at least once in a year	Applicant shall indicate the month during which yearly measurement of harmonic content, DC current injection and flicker shall be done.
Reactive Capability	**B.2(1)**	Generating station shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within	Applicant shall submit study report indicating performance of power plant with the help of plant PQ capability curves considering different voltage levels (1.05,1.0,0.95) at POI under different power factors (0.95 lag- Unity-0.95 lead). List of studies to be provided are tabulated below:

<table>
<tr><th>Test Domain</th><th>Clause No. of CEA Regulations</th><th>Detailed Clause</th><th>List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations</th></tr>
<tr><td></td><td></td><td>limits of 0.95 lagging to 0.95 leading.</td><td>
<table>
<tr><th>Voltage at POI</th><th>Unity PF</th><th>0.95 lagging</th><th>0.95 leading</th></tr>
<tr><td>1.0 pu</td><td>To be provided</td><td>To be provided</td><td>To be provided</td></tr>
<tr><td>0.95 pu</td><td>To be provided</td><td>To be provided</td><td>-</td></tr>
<tr><td>1.05 pu</td><td>To be provided</td><td>-</td><td>To be provided</td></tr>
</table>
<u>Note</u>:
• Generating station should be able to deliver rated output (at POI for the above-mentioned conditions as per PQ curve attached at Annexure-A at specified design temperature.
• The voltage dependence of reactive power capability of RE Generator shall be governed as per QV curve attached at Annexure-A.
• Additional study cases shall be required to demonstrate reactive capability at 1.025 and 0.975pu voltage (at POI) as per QV curve.
• For all cases, report should include details of both active and reactive power exchange by generation pooling station with the grid at point of interconnection (POI)
• Plant PQ capability curve shall be demonstrated at the POI reflecting the effect of aggregated plant capacity along with contribution of dedicated transmission line
• The applicant shall clearly indicate the details of additional reactive compensation as may be required to be installed, for compliance of the above, supported vide study reports.
</td></tr>
<tr><td>Frequency response & operational capability</td><td>B.2(2)</td><td>The generating unit shall be capable of operating in the frequency range 47.5 to 52 Hz and be able to deliver rated output in</td><td>1. Study report showing that generating station is capable of operating in the frequency range 47.5 to 52 Hz.
<u>Note</u>:
The report should be tabulated as per following format:</td></tr>
</table>

<table>
<tr><th>Test Domain</th><th>Clause No. of CEA Regulations</th><th>Detailed Clause</th><th colspan="6">List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations</th></tr>
<tr><td>within specified frequency /voltage band</td><td></td><td>the frequency range of 49.5 Hz to 50.5 Hz:

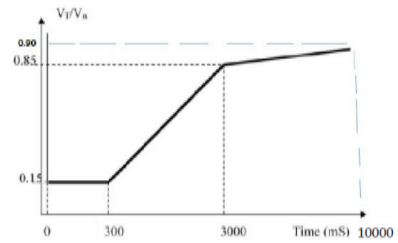
Provided that in the frequency range below 49.90 Hz and above 50.05 Hz, or, as prescribed by the Central Commission, from time to time, it shall be possible to activate the control system to regulate the output of the generating unit as per frequency response requirement as provided in sub-clause (4):

Provided further that the generating unit shall be able to maintain its performance contained in this sub-clause even with voltage variation of up to +/- 5% subject to availability of commensurate wind speed in case of wind generating stations and solar insolation in case of solar generating stations.</td><td colspan="6">
<table>
<tr><td rowspan="2">Voltage at PoI (pu)</td><td rowspan="2">Case*</td><td colspan="2">POI end</td><td colspan="2">Generator end</td></tr>
<tr><td>P(MW)</td><td>Q (MVAr)</td><td>P(MW)</td><td>Q (MVAr)</td></tr>
<tr><td rowspan="3">0.95 /1.0 /1.05</td><td>Unity pf</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lagging pf</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Leading pf</td><td></td><td></td><td></td><td></td></tr>
</table>
*The above report shall be submitted for cases corresponding to frequency values of 47.5Hz and 52 Hz.

2. Study report demonstrating frequency response based output power regulation in the range of 49.90Hz to 50.05Hz.
</td></tr>
<tr><td>Frequency response & operational</td><td>B.2(4)(ii)</td><td>The generating stations with installed capacity of more than 10 MW connected at voltage level of</td><td colspan="6">The following test shall be included:

1. Study report depicting governors or frequency controllers of the units are capable of operating with droop between 3 to 6% and a dead band not exceeding ±0.03 Hz</td></tr>
</table>

Test Domain	Clause No. of CEA Regulations	Detailed Clause	List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations
capability within specified frequency /voltage band		33 kV and above shall have governors or frequency controllers of the units at a droop of 3 to 6% and a dead band not exceeding ± 0.03 Hz. Provided that for frequency deviations in excess of 0.3 Hz, the Generating Station shall have the facility to provide an immediate (within 1 second) real power frequency response of at least 10% of the maximum Alternating Current active power capacity.	2. Study report demonstrating real power freq. response (within 1 sec) of at least 10% of maximum AC active power capacity for frequency deviation excess of 0.3 Hz
	B.2(4)(iii)	The generating stations with installed capacity of more than 10 MW connected at voltage level of 33 kV and above shall have the operating range of the frequency response and regulation system from 10% to 100% of the maximum Alternating Current active power capacity, corresponding to solar insolation or wind speed, as the case may be;	The test mentioned in B2 (4) (ii) shall be conducted for active power output at 10%, 50%, 100% of rated output.
Voltage Ride	**B.2(3)**	The generating station connected to the grid, shall remain connected	1. Study report to demonstrate LVRT capability of the power plant at POI considering full and partial (25% and 50% active power dispatch

Test Domain	Clause No. of CEA Regulations	Detailed Clause	List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations
through capabilities		to the grid when voltage at interconnection point on any or all phases dips up to the level depicted by the thick lines in curves. V_T: Actual Voltage; Vn: Nominal Voltage—  Provided that during the voltage dip, the supply of reactive power has first priority, while the supply of active power has second priority and the active power preferably be maintained during voltage drops, provided, a reduction in active power within the plant's design specifications is acceptable and active power be restored to at least 90% of the pre-fault level within 1 sec of restoration of voltage.	2. The LVRT tests shall be carried out for balanced (Three phase) and non-balanced fault (L-G) case Note: i. During the voltage dip, the supply of reactive power has first priority, while the supply of active power has second priority and the active power preferably be maintained during voltage drops, provided, a reduction in active power within the plant's design specifications is acceptable and active power be restored to at least 90% of the pre-fault level within 1 sec of restoration of voltage. ii. Applicant shall provide relevant plots including active and reactive power plots during LVRT test.

<table>
<tr><th>Test Domain</th><th>Clause No. of CEA Regulations</th><th>Detailed Clause</th><th>List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations</th></tr>
<tr><td></td><td>B.2(7)</td><td>The generating station connected to the grid, shall remain connected to the grid when voltage at the interconnection point, on any or all phases (symmetrical or asymmetrical overvoltage conditions) rises above the specified values given below for specified time
<table>
<tr><td>Over voltage (pu)</td><td>Minimum time to remain connected (Seconds)</td></tr>
<tr><td>1.30 < V</td><td>0 Sec (Instantaneous trip)</td></tr>
<tr><td>1.30 ≥ V > 1.20</td><td>0.2 Sec</td></tr>
<tr><td>1.20 ≥ V >1.10</td><td>2 Sec</td></tr>
<tr><td>V ≤ 1.10</td><td>Continuous</td></tr>
</table></td><td>1. Applicant shall submit the study report demonstrating the High voltage ride through capability of the power plant at POI considering cases of full (100% level) active power dispatch and partial (25% and 50% level) power dispatch.
2. Applicant shall provide relevant plots including active and reactive power plots during HVRT test.
3. The HVRT tests shall be carried out for balanced (Three phase) and non-balanced cases.
4. The Protection settings at Generator, Generator PS & Dedicated Transmission Line should be coordinated to enable HVRT compliance at POI.</td></tr>
<tr><td>Active power control set point</td><td>B.2(4)(i)</td><td>The generating stations with installed capacity of more than 10 MW connected at voltage level of 33 kV and above shall be equipped with the facility to control active power injection in accordance with a set point, capable of being revised based on directions of the State Load Dispatch Centre or Regional Load Dispatch Centre, as the case may be;</td><td>RE developers shall submit declaration depicting ability to comply with active power set point capability along with details of design & specifications supported vide documents from OEM, that the generation plant:
1. Is capable of controlling active power injection in accordance with a set point (to be done as a part of B2(4)(iv))
2. Is capable of revising the above mentioned set points based on directions of the State Load Dispatch Centre or Regional Load Dispatch Centre, as the case may be (OEM report showing this feature to be forwarded)</td></tr>
</table>

Test Domain	Clause No. of CEA Regulations	Detailed Clause	List of studies to be carried out in compliance of CEA Regulations on Technical Standards for Connectivity to the Grid (as amended) for RE Generating Stations
Ramping capability	**B.2(4)(iv)**	The generating stations with installed capacity of more than 10 MW connected at voltage level of 33 kV and above shall be equipped with the facility for controlling the rate of change of power output at a rate not more than ±10% per minute.	Study report demonstrating rate of change of power output at a rate not more than ±10% per minute. The report shall include capability demonstration for both active power ramping up and ramping down scenario.

NOTE:

- OEM technical datasheet of WTG /PV inverter/Hybrid/BESS module, IBR(Inverter Based Resource) Unit details, Unit transformer details, Power transformer details, conductor / cable details, SLD of the plant, PPC details , equivalent impedance calculation details for 33 kV network etc. shall be provided by the RE developer.
- Dedicated transmission line originating from Generating station to ISTS point should be included in the study analysis and accordingly all Study reports should be considering the POI reference point.
- The RE generator shall submit Single Inverter/WTG/Equipment **Test Report (Type Characteristic Test/ Measurement Report[1])** from a Certified Testing Agency demonstrating compliance with "*Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007"* and subsequent amendments thereof. The RE generator shall also submit **Statement of Compliance/Conformity certificate** along with the **evaluation report** from an "Accredited Certification Agency". Certificate of Accreditation of the certifying agency may also be asked for verification, if required.
- WTG/Inverter model response shall be benchmarked with the actual test (Lab/Factory/Field test) reports of single WTG/Inverter for compliance with all the Clauses of CEA Regulations on Technical Standards for Connectivity to the Grid.
- The RE Generator shall also submit the 'Benchmarking report' depicting performance comparison of actual test report Vs PSS/E and PSCAD simulation report (unit/single IBR level). The format for the same is given below:

[1] **Report indicating the electrical characteristic of single unit (inverter/WTG) and referred for the purpose of certification**

Test Description	Field/Lab/Factory Test Result	RMS Model Response	EMT Model Response

Further, following shall be included in the benchmarking report:

a) For RMS models, provide a table of all simulation model STATEs, VARs, CONS, ICONs, their values as implemented in the dynamic data files and a description of each function.
b) For EMT models, provide a table of all user-definable settings and status code outputs for all plant within the generating system, a range of acceptable values for each user-changeable variable and a description of each entry's function.
c) Software version of controller & Firmware version of converter of IBR/WTG unit shall be mentioned.
d) Lab/factory/field test reports shall be referenced in the benchmarking report.
e) The settings kept in inverter/WTG unit during testing & actual unit installed at site must be same. If there is any mismatch in settings, justification for the same shall be included.
f) Table for inverter/WTG unit controller setting and RMS & EMT model parameter for different control parameters as specified (for both RMS & EMT).

- RE developer shall submit the single inverter/WTG, aggregated and detailed RMS model of the RE plant in PSS/E alongwith PSCAD aggregated model. The guidelines to be followed for model submission are given below:

a) Generic RMS models shall be compatible with PSS/E version 34.4 and above.
b) EMT models shall be compatible with PSCAD version 4.6 and above with Intel Visual FORTRAN version 12 or higher compiler. Power quality assessment model shall also be submitted in PSCAD.
c) If user written/defined models (UDM) are being provided, then submission of the source code and compiling procedure along with the model is mandatory.
d) Model shall work for a range of dynamic simulation solution parameters rather than for specific settings only.
e) There shall be no initialization errors for the dynamic models and the warning messages are reviewed with resolution or explanation.

f) RE developer shall construct the detailed and equivalent plant model (at POI) using the benchmarked unit (single WTG/Inverter) model

- For validation of study analysis results, applicants shall submit associated files (PSSE/PSCAD/Python/.sld file/.dyr/.out/.plb etc.) including python recording/sequence of events simulated for a particular study/case. Model shall be validated by demonstrating that response obtained as per simulation, closely matches with the response obtained by testing under laboratory conditions.
- In case of observation of deviations vis-à-vis submitted data/reports during real time field operations, the RE developer shall be required to carry out necessary modifications including installation of additional equipment as may be necessary to rectify such deviation.
- The reactive power (or reactance) is considered to be dynamically variable in nature if the emulated reactance is variable in nature and is achieved through automatic control mechanism having adequate response time. Power apparatus like STATCOM & SVC emulates the dynamically varying reactance at the point of measurement, whereas, Power apparatus like mechanically switched capacitors & fixed capacitors are covered under the category of Static reactive compensation device considering long switching (mechanical) time and uncontrolled magnitude of reactance provided. WTG (Type-III & IV) and PV Inverter (Type-IV) have the capability to provide at its terminals, dynamically variable reactive power support almost instantaneously through their control mechanism. The RE Generators shall adopt appropriate measures for enabling such dynamic reactive response.
- In case of any change in the plant at a later stage due to installation of any additional equipment, changes in controller settings etc., the updated models along with the validation report shall be submitted within **03 month** of any such activity from time to time. The undertaking certifying the same shall be submitted along with the final validated models.
- In compliance to CEA's "*Technical Standards for Connectivity to the Grid, 2007"* and subsequent amendments, power quality (harmonic content, DC injection, flicker etc.) measurements shall be carried out at least once in a year and assessment report shall be submitted to CEA/RPC, CTU and POSOCO on an annual basis post commissioning of the plant. Failure to carry out the annual power quality assessment shall make the plant liable for disconnection from the grid.

- **<u>Plant Model Validation Report</u>**

  Post-commissioning of the complete RE plant, the response of models (RMS and EMT both) shall be validated against field measurements/on-site test results and the validated models along with the validation report shall be submitted within 03 months of the complete commissioning the RE plant. The guidelines to be followed for model validation are given below:

i) For LVRT and HVRT, the response of the models (RMS and EMT both) shall be validated preferably against field test results. In case the same is not possible within prescribed time-frame, the plant model shall preferably be validated against grid event, if any, after complete plant commissioning and same shall be included in the validation report.

ii) For following tests, the response of the models (RMS and EMT both) shall be validated against field measurements/on-site test results:

a. Power Quality (only in detailed power quality assessment model)
b. Active power set change (in both RMS & EMT equivalent model)
c. Reactive power control- V control, PF & Q control (in both RMS & EMT equivalent model)
d. Frequency response (in both RMS & EMT equivalent model)
e. Frequency band of operation (in both RMS & EMT equivalent model)

iii) The validation report shall include the following:

a. Model file names of RMS & EMT model.
b. Final SLD of the plant (ensuring same mapping of IBR in SLD, simulation model and SCADA)
c. Final simulation model parameters of Generator model, Electrical control model, drive train model, PPC etc. (for both RMS & EMT model).
d. The settings kept in inverter/WTG units as well as PPC during testing shall be same as the settings implemented at site. The table demonstrating the similarity between simulation model parameters/settings and settings implemented at site shall be provided.
e. Comparison of field measurement/on-site test measurement with simulation results (numerical as well as graphical) as per the format shown below.

Test Description	**Field Measurement / On-site Test Result / Grid Event**	**RMS Model Response**	**EMT Model Response**

iv) All field measurement/on-site tests/grid event data, actual/implemented protection settings, WTG/Inverter and PPC settings as downloaded from control software etc. shall be provided in suitable formats (preferably signed documents) along with the validation report and validated models.

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Annexure-A
(Q-V curve)

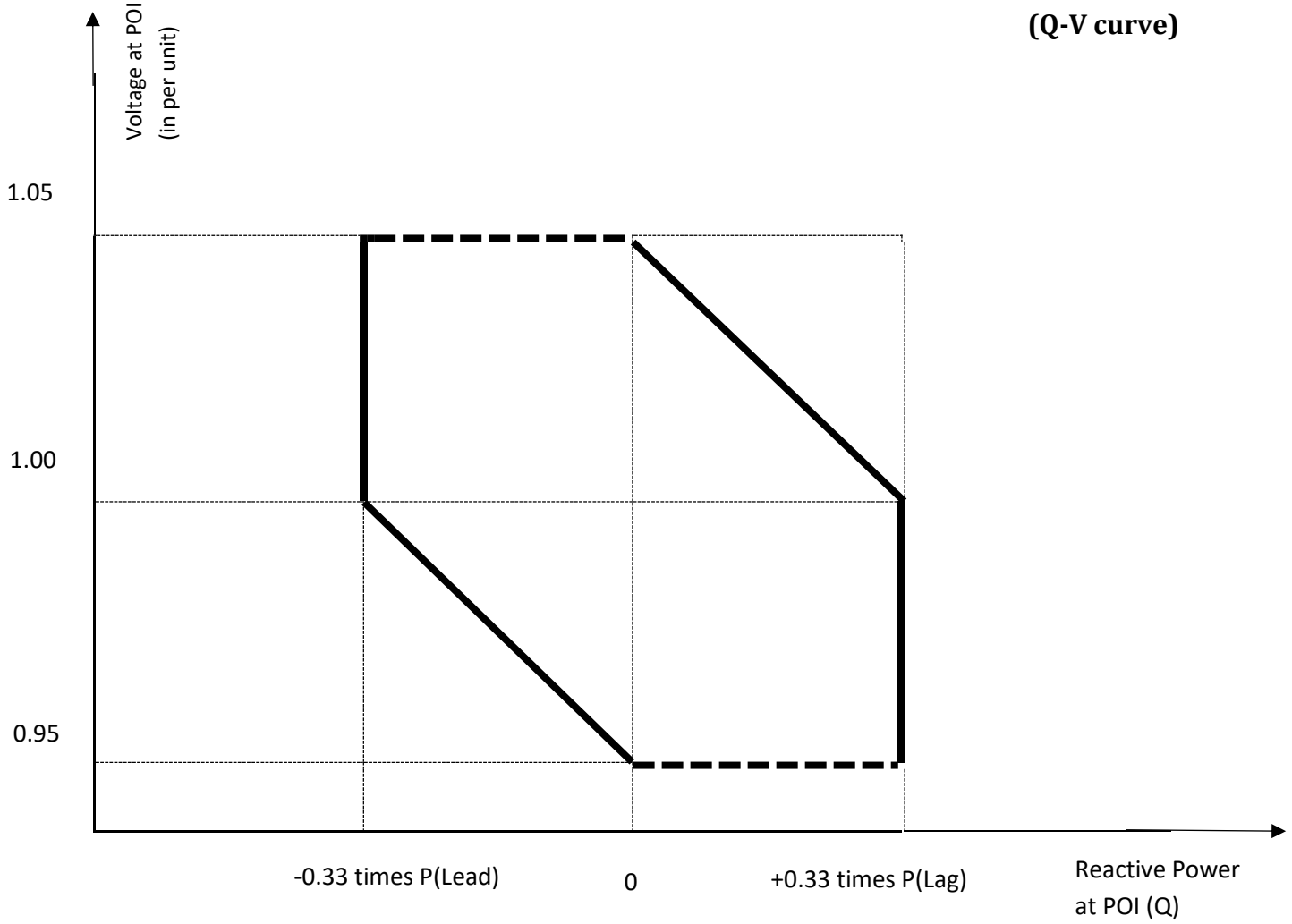

Fig 1: Reactive power capability of plant at POI in terms of Voltage at POI and reactive power

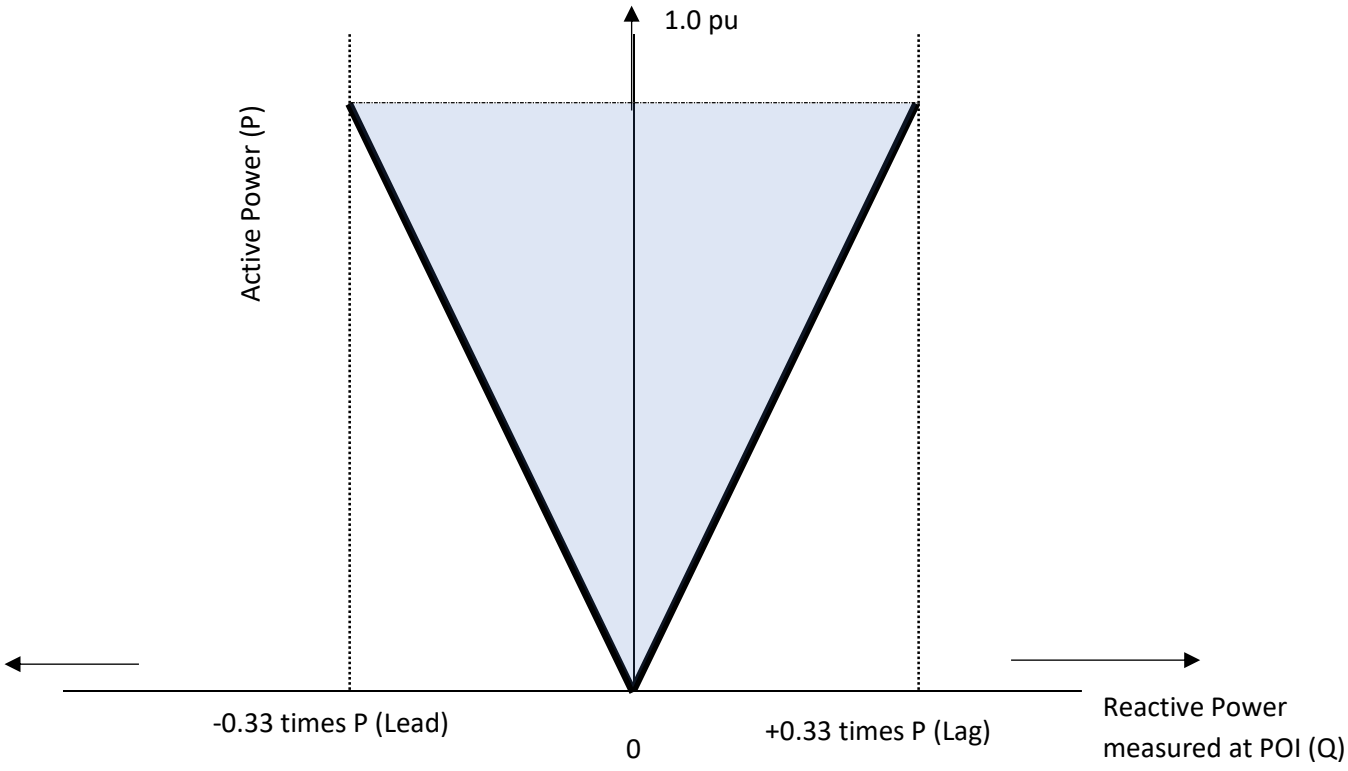

Fig 2: Reactive power capability of plant at POI in terms of active power and reactive power measured at POI