सत्यमेव जयते

भारत सरकार/ Government of India
विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
ग्रिड प्रबंधन प्रभाग/ Grid Management Division
****

सं.: 12/एक्स/एस.टी.डी.(सी.ओ.एन.एन)/जी.एम./2023/342 दिनांक: 05.10.2023

विषय: दिनांक 23.08.2023, 06.09.2023 और 25.09.2023 को सीईए (ग्रिड से कनेक्टिविटी के लिए तकनीकी मानक) विनियमों के अनुपालन के लिएसंबंधित मुद्दों पर चर्चा करने के लिए आयोजित बैठक का कार्यवृत्त ।

Subject: Minutes of Meeting held on 29.08.2023, 06.09.2023 and 25.09.2023 to discuss compliance of CEA (Technical Standards for Connectivity to the Grid) Regulations. – reg.

दिनांक 29.08.2023, 06.09.2023 and 25.09.2023 को आयोजित बैठक के कार्यवृत्त संलग्न है। यह पत्र सक्षम अधिकारी द्वारा अनुमोदित है।

Please find enclosed the minutes of the meeting held on 29.08.2023, 06.09.2023 and 25.09.2023. It is issued on approval of Competent Authority.

संलग्नक: यथोपरि।

5/10/2023

(चन्द्र प्रकाश)
(मुख्य अभियन्ता)

बैठक के सभी प्रतिभागियों को ई-मेल द्वारा प्रेषित ।

Minutes of Meeting held on 23.08.2023 (Wednesday) at 02:00 PM under the Chairmanship of Member (GO&D), CEA for compliance of CEA (Technical Standards for Connectivity to the Grid) Regulations.

Member (GO&D), CEA welcomed the participants to the meeting on the issue related to the temperature for the selection of WTG and Solar Inverter for a particular site with respect to the provisions in the CEA (Technical Standards for Connectivity to the Grid) Regulations for the RE plants. The list of the participants is enclosed at **Annexure-A**. Member (GO&D), CEA directed Chief Engineer (Grid Management), CEA to brief the committee about the agenda of the meeting.

2. Chief Engineer (GM), CEA stated that the agenda is to discuss the ambient temperature for operating the RE plants for which a draft note on cited issue was already shared with the participants. The draft note is attached at **Annexure-B**. He stated that various references have been received from RE developers to either relax the criteria for maximum temperature compliance at the Point of Interconnection (PoI), considering the limited occurrences of high temperatures, or alternatively, permit active power curtailment to prioritize reactive power support while adhering to the existing maximum temperature criteria. To demonstrate the compliance of Working Group Report at maximum temperature, the installation of additional infrastructure (such as inverters, VAR compensators etc.) is necessary. However, a significant portion of this infrastructure may remain underutilized for the majority of the plant's operational lifespan due to its specific design for extremely high temperatures at the project site. The frequency and occurrence of such High Ambient Temperatures (T > 45 °C) in a year is very low and predictable as per satellite data.

2.1 He further briefed about the adopted by Australia and Saudi Arabia in this regard:

(i) Australia Electricity Market Operator (AEMO) published guidelines to determine the maximum temperature wherein, the data for a minimum period of 10 years are considered and the 99th percentile of data is captured during the Hot Season to be used as a temperature at which the generating units shall present their compliance.

(ii) Saudi Arabia Grid Code (SAGC) requests the generator to submit the Generator Performance Chart which shall show curves for at least two values for each significant parameter (temperature), so that the TSP can assess the variation in performance over all likely values of these parameters by a process of linear interpolation or extrapolation. One of these curves shall be for the reference value at which the Generating Unit output equals its Registered Capacity.

2.2 Based on the practices followed in these countries (as ambient temperature are similar or higher than the Indian Sub-continent), the methodology suited for Indian scenario was proposed:

(i) 15-minute interval recorded temperature data from IMD at the proposed RE park site/ or at the nearest location to be made available.

(ii) Calculate 99th percentile, round off to next higher integer and then add 1°C to arrive at the maximum temperature for the proposed Solar/ Wind Park.

(iii) The rated active and reactive power shall be provided at the PoI at the computed maximum Temperature.

(iv) Above the computed maximum temperature, the RE developers shall provide the PQ curve for the proposed park but in any case the reactive power shall not be less than 33% of the rated active power above the maximum temperature approved for the proposed solar/ wind park.

(v) Other compliances as per the Working Group Report remains the same.

3. Member (GO&D), CEA asked how MNRE chooses a model for inclusion in the Revised List of Models and Manufacturers (RLMM) and for what temperature ratings are they designed or tested.

4. The Representative of Solar Energy Corporation of India (SECI), stated that the generator is designed internationally where the temperature doesn't go to such extreme limit and the OEMs do micro setting of the models to complement the condition of the location for installation. The RLMM list approved by the MNRE have models with machine operating range varying from 30 °C to higher temperature and they demand the models to be in order with the various Regulations and Standards.

5. Chief Engineer (GM), CEA added that RE developer generally select those models appropriate for the site so that the required capacity utilization factor (CUF) as mentioned in the bidding document are achievable.

6. The Representative of Grid-India stated that the RE developer need to select the model appropriate for the site at which the plant is being commissioned. According to NIWE Request for Selection (RfS) of 2018, the operating range of the device should be from 0 °C to 50 °C and the extreme condition for operation is from -5 °C to 60 °C, based on IEC 61400. He further added that CEA (Technical Standards for Connectivity to the Grid) Regulations requires the generators to be able to run at extreme condition but to optimize device design the machine should be at least able to run at operating ranges and give rated output.

7. The Representative of CTUIL stated that the only solar hours from 06:00 hours to 16:00 hours shall be taken while calculating the 99th percentile for Solar Power plants while Round the clock (RTC) can be done for Wind Power Plants. He suggested that central agency like NISE or NIWE can publish a project location wise data of temperature for compliance. This upfront data of temperature zones can rectify various issue occurring regarding temperature selection. In addition to this, the next step would to have design upgradation to match the condition arising in the country, for which type testing of 9-12 months' time will be needed which can then be added in RLMM list and models.

8. Chief Engineer (GM), CEA agreed to the suggestion presented and shared that OEMs have informed that testing is never done for a particular place instead RE developer install more Inverter and Solar Panel or WTG to meet the requirements of the plants for rated output at any other location.

9. The representative of Grid-India stated that the 99th percentile methodology for calculation of temperature is acceptable however it shall be calculated only for solar hours for solar plants and RTC for Wind power plants for compliance.

10. Chief Engineer (GM), CEA requested that the duration of solar hours may be provided for calculation of 99th percentile of temperature.

11. The Representative of the CTUIL suggested that derating by the RE developers may be allowed for CON-4 application under commissioning stage and if any issue arise from this shall be taken by Working Group on case to case basis in the interim period until the working group recommendations comes into effect. The Working group meanwhile may finalise the methodology of 99th percentile for temperature calculation for the future projects.

12. After detailed discussions, it was decided that the temperature zones need to be defined for the RE State/ area/ location as per the 99th percentile methodology by involving members from IMD, NIWE, NISE in the meetings of the Working Group.

The meeting ended with thanks to the chair.

****

Annexure-A

List of participants in the meeting on 23/08/2023 at 02:00 PM

Central Electricity Authority (CEA)

1. Sh. B.K. Arya, Member (GO&D), CEA
2. Sh. Chandra Prakash, Chief Engineer (Grid Management)
3. Sh. Sandeep Kumar, DD (Grid Management)
4. Sh. Shubhender Singh, AD (Grid Management)
5. Sh. Dhruv Kawat, AD (Grid Management)
6. Sh. Shubam Kumar Singh, AD (Grid Management)

Grid-India

1. Sh. Vivek Pandey, GM
2. Sh. Abhijeet Prakash, Chief Manager

Solar Energy Corporation of India (SECI) Limited

1. Sh. Kaustuv Roy, GM

CTUIL

1. Sh. P S Das, Sr. General Manager

Minutes of the Meeting held on 06.09.2023 (Wednesday) at 05:00 PM with the OEMs

Member (GO&D), CEA welcomed the participants to the meeting on the issue related to the temperature selection of WTG and Solar Inverter for a particular site. The list of the participants is enclosed at **Annexure-C**. It was mentioned that this meeting is in continuation of the meeting held on **23.08.2023 (Wednesday)**.

13. The representatives of Suzlon stated that the operating temperature for designing is derived based on the market requirement, i.e., the geographical topography where the machine will operate and on the actual customer requirement of that area so that product becomes optimum in regard to its generation. Apart from this, the techno-commercial aspect is also looked upon as they have observed that at high temperature wind speed is low and such instances of extreme temperature are low, so ultimately procuring a model which de-rates at higher temperature with low wind speed will not be beneficial as the speed of the wind can't make the turbine rotate being less than the cut-in speed of the wind turbine. In India, the certified models are listed in the Revised List of Models and Manufacturers (RLMM) and it is the customer who decides which model to choose for the site according to the requirements and specifications.

14. Chief Engineer (Grid Management), CEA asked about the specific temperature being considered by the OEMs while designing a machine to operate - whether it is average temperature at the site or the extreme temperature at the site, assuming that the wind speed does not reduce at higher temperatures.

15. The representatives of Suzlon stated that the machine is designed to operate for extreme temperature at the site but due to the few components operating at the upper boundary of the temperature, the machine is allowed to de-rate for safe operation of the machine.

16. The representatives of CTUIL enquired about how the machine is designed based on European environment and the upgradation or modification being made in the machine if the same machine is to be operated in Saudi Arabia where the temperature is high compared to Europe.

17. The representatives of Suzlon stated that whenever a customer approaches Suzlon, turbine site suitability test for a specific site is performed first. In this case (Saudi Arabia) where the temperature is on higher end, we have an energy production profile of the turbine which indicates the de-rating of the machine with increase in temperature. The component which are operating at their limit are responsible for de-rating is examined and redesigned so that the machine do not de-rates at extreme temperature defined by the customer.

18. The representatives of Fiemer India stated that the IGBTs of the machine are rated for a particular ambient temperature and if they are operating at their limit, we cannot get reactive power from the machine as the apparent power of the machine remains the same. Therefore, to increase the rated capacity we have to relook into the design of the machine and also on the trade-off between power versus size versus cost of the machine.

19. The versus of Sungrow stated that at higher temperature, inverter starts de-rating kVA capacity and this in turn also reduces the reactive power kVAr of the machine.

20. The versus of Grid-India stated that according to this, the machine can deliver rated power at unity power factor at the higher temperature but cannot support the 0.95 lag/ lead reactive power desired at the same.

21. Member (GO&D), CEA thanked all the participants for active participation. The discussion was concluded with all the stakeholders agreeing that the machine can be designed for the extreme temperature with an additional cost. Therefore, the machines, etc shall be designed in such a way that it doesn't impact the security of the grid and at the same time its viability commercially.

The meeting ended with thanks to the chair.

****

Annexure-C

List of participants in the meeting on 06/09/2023 at 05:00 PM

Central Electricity Authority (CEA)

1. Sh. B.K. Arya, Member (GO&D), CEA
2. Sh. Chandra Prakash, Chief Engineer (Grid Management)
3. Sh. Sandeep Kumar, DD (Grid Management)
4. Sh. Dhruv Kawat, AD (Grid Management)

Grid-India

5. Sh. Abhijeet Prakash, Chief Manager
6. Sh. Manas Ranjan Chand, DGM
7. Sh. Priyam Jain, Manager

CTUIL

8. Sh. P S Das, Sr. General Manager
9. Sh. Ajay Kumar, Assistant Manager

Solar Energy Corporation of India (SECI) Limited

10. Sh. Shreedhar Singh, GM

Representatives from various OEMs

Minutes of the Meeting held on 25.09.2023 (Monday) at 04:30 PM

In the continuation of the above meetings, today's meeting was called to seek considered views of the OEMs and RE developers who could not express their views in the meeting held on 06/09/2023. Member (GO&D), CEA once again requested OEMs and RE developers to express their considered views in the matter. The list of the participants is enclosed at **Annexure-D**.

22. The representative of Suzlon stated that based on the graphs of Temperature Vs Wind Speed for 4 different states, it can be summarised that: -

a) Instances crossing the Temperatures of 40 Deg Celsius are rare to nil in most states under discussion.

b) In Rajasthan, the temperatures beyond 40 Deg Celsius are observed, however very few hours. Instances of Temperatures above 45 Deg Celsius are very rare.

c) Importantly, at high temperatures (esp. > 45 Deg Celsius), the recorded wind velocities have not crossed the rated velocity of WTG (e.g. 9.5m/s for S120 2.1 MW WTG)

d) Suzlon WTGs are designed optimally for Indian conditions. The derating starts above 45 Deg Celsius subject to meeting of other design conditions. Hence, we do not see temperature derating as a concern.

Further, the machine is designed to operate for extreme temperature of the site but due to the few components operating at the upper boundary, the machine is allowed to derate for safe operation of the machine.

23. The Representative of Azure stated that working group should have regular meetings with a team of RE developer representative so that a fruitful deliberation can be held and resolution of the issues related to temperature or any other issue may be resolved in a given timeline. This will help in implementation of the CEA (Technical Standards for connectivity to the Grid) Regulations in a smooth manner. Further, if the RE plants are made to comply at maximum temperature then these projects will not be financially viable.

24. The Representative of ACME Solar stated that for one of its site in Jaisalmer they have done studies considering the 50 deg Celsius, however they have observed temperature to be around 40 deg Celsius. They have installed 96 inverters of 3.3 MW capacity for its 300MW plant. The inverter can supply rated output at 50 deg Celsius.

25. Chief Engineer (Grid Management) requested OEMs and RE developers to furnish to CEA (i) temperature related data, particularly, for Rajasthan and Gujarat, (ii) scheduling provisions in Indian Electricity Grid Code (IEGC) for RE based resources and (iii) international practices for scheduling of RE based resources.

26. Member (GO&D), CEA states that RE plants should be designed in such a manner that compliances pertaining to the CEA Standards for Connectivity to the Grid are met at the Point of interconnection (PoI) and accordingly, requisite the number and size of Inverter/ WTG and other elements may be computed at the RE plant. Further, he thanked all the participants for active participation and requested to provide the inputs in the matter.

The meeting ended with thanks to the chair.

****

Annexure-D

List of participants in the meeting on 25/09/2023 at 04:30 PM

Central Electricity Authority (CEA)

1. Sh. B.K. Arya, Member (GO&D), CEA
2. Sh. Chandra Prakash, Chief Engineer (Grid Management)
3. Sh. Sandeep Kumar, DD (Grid Management)
4. Sh. Dhruv Kawat, AD (Grid Management)

Representatives from various OEMs and RE developers

Draft Note on Ambient Temperature Selection criteria

Subject: - Request of the RE developers to revisit ambient temperature selection criteria for reactive power compliance by RE generators – reg.

The following references have been received in CEA:

1) M/s O2 Power reference dtd. 20th July, 2023
2) M/s Renew reference dtd. 16th June, 2023
3) M/s Amp India reference dtd. 20th June, 2023
4) M/s Sembcorp reference dtd. 3rd July, 2023
5) M/s Azure Power reference dtd. 19th April, 2023; 21st June, 2023 and 12th July, 2023

2. **The above references from the RE developers emphasize following points**: -

(i) The Renewable Energy (RE) power plants are required to submit system study compliance reports based on maximum and minimum temperature calculations, as outlined in the methodology presented in the **Working Group Report (WGR) published in July, 2022**. As per the Working Group Report, the generating station must be capable of delivering its "rated output" at the Point of Interconnection (**PoI**) **under extreme temperature conditions while satisfying the Power Quality (PQ) curve criteria**.

(ii) To demonstrate this compliance of WGR, the installation of additional infrastructure (such as inverters, Static VAR Generators [SVG], and cables) is necessary. However, a significant portion of this infrastructure may remain underutilized for the majority of the plant's operational lifespan due to its specific design for extremely high temperatures at the project site.

(iii) The frequency and occurrence of such High Ambient Temperatures (T >40Deg.C.) in a year is very low and predictable as per satellite data.

(iv) Based on the above, a request has been made in the references to either relax the criteria for maximum temperature compliance at the PoI, considering the limited occurrences of high temperatures, or alternatively, permit active power curtailment to prioritize reactive power support while adhering to the existing maximum temperature criteria.

3. **Analysis by Grid Management (GM) Division**:

In this regard, the Grid code of Australia and Saudi Arabia were studied.

I. Australia Electricity Market Operator (AEMO) published guidelines as per Wholesale Electricity Market (WEM) clause 3A.1.5 to determine the Maximum Temperature at which the Generating system must meet the Technical Requirements as mentioned in Appendix 12 of WEM Rules. As mentioned in Para 3.2 of the guidelines:

"3.2.3 AEMO when determining the Maximum Temperature, will use the maximum temperature data from the nominated weather station using:

(a) all available data for a minimum period of 10 years and up to a maximum of the most recent 30 years; and

(b) the 99th percentile of data captured during the Hot Season. Data outside of the Hot Season should be excluded from calculations.

3.2.4. AEMO will round up the recommended Maximum Temperature for a Facility to the nearest integer."

Further, **the RE generator submits the generator performance chart w.r.t to the active and reactive power compliance.** As per **Appendix 12** of WEM rules, the relevant clauses are as under:

***Rated Maximum Active Power**:*

Means:

*(a) in relation to a Generating Unit, subject to the energy source availability, the maximum amount of Active Power that the Generating Unit can continuously deliver at the Connection Point **when operating at its Nameplate Rating (adjusted for temperatures up to and including the maximum required ambient temperature as specified by the Network Operator**); and*

*(b) in relation to a Generating System, subject to the energy source availability, the combined maximum amount of Active Power that its Generating Units can deliver at the Connection Point, when its Generating Units are operating at their respective Nameplate Ratings (**adjusted for temperatures up to and including the maximum required ambient temperature as specified by the Network Operator**).*

A12.2 Active Power capability

A12.2.2 Ideal Generator Performance Standard

***A12.2.2.1.** The Ideal Generator Performance Standard is the same as the Minimum Generator Performance Standard for Active Power capability.*

A12.2.3 Minimum Generator Performance Standard

***A12.2.3.2.** The Generator Performance Standard for Active Power capability must include **Temperature Dependency Data up to and including the Maximum Temperature, which must include the Rated Maximum Active Power, and including ambient temperatures above the Maximum Temperature after which the Active Power capability is reduced**: (a) for the Generating System measured at the Connection Point; and (b) for each Synchronous Generating Unit measured at the Generating Unit terminal.*

A12.3 Reactive Power capability

A12.3.2 Ideal Generator Performance Standard

***A12.3.2.1.** For all operating conditions including temperatures up to and including the Maximum Temperature, each Generating Unit within the Generating System must be*

capable of supplying or absorbing Reactive Power continuously of at least the amount equal to the product of the Rated Maximum Active Power output of the Generating Unit at nominal voltage and 0.484 while operating at any level of Active Power output between its maximum ***Active Power output level as specified in the Temperature Dependency Data under Part A12.2,*** *and its Rated Minimum Active Power output level.*

A12.3.3 Minimum Generator Performance Standard

A12.3.3.1. *Subject to clause A12.3.3.3, for all operating conditions including temperatures up to and including the Maximum Temperature, the Generating System must be capable of supplying or absorbing Reactive Power continuously of at least the amount equal to the product of the Rated Maximum Active Power output of the Generating System and 0.329 while operating at any level of Active Power output level between its maximum Active Power output level as specified in the Temperature Dependency Data under Part A12.2, and Rated Minimum Active Power output level.*

A12.3.3.3*. Transmission Connected Generating Systems containing Intermittent Generating Systems may, with the Network Operator's agreement, achieve the Reactive Power Capability specified in clause A12.3.3.1* ***by reducing Active Power*** *output when* ***the ambient temperature exceeds 25 degrees*** *Celsius in their location, with the conditions forming part of the Generator Performance Standard.*

II. The relevant clauses as per the Saudi Arabian Grid Code (SAGC) pertaining to the practices followed by them regarding RE generators are as under:

2.5.5.1 *All Power Park Modules shall be capable of absorbing or supplying reactive power output at the connection point within the range Q = [-0.33, 0.33] of rated active power for Active Power output above 20% of rated power, unless a lower value of Active Power threshold is agreed upon expressly by the TSP in the Connection Agreement.*

Power Park Modules shall be capable of limiting reactive power output at the connection point within the range Q= [-0.05, 0.05] of rated power for Active Power output below 20% of rated power, unless a lower value of Active Power threshold is agreed upon expressly by the TSP in the Connection Agreement.

4.3.6.5 *For each Renewable Resource Generation whose performance varies significantly as a function of non-controllable external/ environmental parameters, such as (but not limited to) temperature, quantity of dust in the air, wind, solar irradiance, the Generator Performance Chart shall show curves for at least two values for each significant parameter, so that the TSP can assess the variation in performance over all likely values of these parameters by a process of linear interpolation or extrapolation. One of these curves shall be for the reference value at which the Generating Unit output equals its Registered Capacity.*

Observations from the AEMO & SAGC:

- As per AEMO, the rated active and reactive power compliance is performed at maximum temperature which is 99th percentile of the data captured during the hot season or as set by the Network Operator.
- Saudi Arabia Grid Code demands the Generator Performance Chart curves for at least two values for temperature and then assess the performance over all likely values by a process of linear interpolation or extrapolation.

4. **The data on prevailing temperatures at the project sites were sought by the GM Division**

The RE developers have provided the following temperature Data Sets:

(i) In the planning phase, RE developers utilize satellite-based hourly data (in accordance with industry standards) of **Solargis** to forecast the power generation potential of any RE facility.

(ii) Additionally, a **Weather Monitoring Station (WMS)** is deployed at the project site upon commissioning to capture actual minute-by-minute weather data.

The analysis of temperature occurrences is done as per the Solargis hourly data, WMS data from project sites in **Bikaner (Annexure-I)** and **Jaisalmer (Annexure-II)**, provided by **Azure and Renew.**

As per Working Group report the maximum temperature to be considered for compliance for Bikaner and Jaisalmer is 51°C.

4.1 Bikaner: During hot season (April - June), the temperature distribution and its occurrences are as under:

Temp Range (°C)	No. of instances as per Solargis (Total No of Instances 2184)	% count	No. of instances as per WMS (Total no of instances 2184)	% count
Below 40	1933	88.5	1686	77.20
40<T≤41	90	4.1	132	6.04
41<T≤42	70	3.2	136	6.23
42<T≤43	53	2.4	104	4.76
43<T≤44	18	0.8	61	2.79
44<T≤45	16	0.7	36	1.65
45<T≤46	4	0.2	20	0.92
46<T≤47	0	0.0	7	0.32
47<T≤48	0	0.0	2	0.09
48<T≤49	0	0.0	0	0.00
49<T≤50	0	0.0	0	0.00

The 99th percentile of temperature in Solargis is 43.95. Rounding it off to next integer it becomes 44. Add 1°C and it becomes 45.

The 99th percentile of temperature in WMS is 45.45. Rounding it off to next integar it becomes 46. Add 1°C and it becomes 47.

<u>4.2 Jaisalmer</u>: During hot season (April - June), the temperature distribution and its occurrences are as under:

Temp Range (°C)	No. of instances as per Solargis (Total No of Instances 2184)	% count	No. of instances as per WMS (Total no of instances 2168)	% count
Below 40	1829	83.75	1747	80.58%
40<T≤41	101	4.62	148	6.83%
41<T≤42	89	4.08	106	4.89%
42<T≤43	67	3.07	77	3.55%
43<T≤44	52	2.38	50	2.31%
44<T≤45	33	1.51	25	1.15%
45<T≤46	12	0.55	11	0.51%
46<T≤47	1	0.05	4	0.18%
47<T≤48	0	0.00	0	0.00%
48<T≤49	0	0.00	0	0.00%
49<T≤50	0	0.00	0	0.00%

The 99th percentile of temperature in Solargis is 44.65. Rounding it off to next integar it becomes 45. Add 1°C and it becomes 46.

The 99th percentile of temperature in WMS is 44.83. Rounding it off to next integar it becomes 45. Add 1°C and it becomes 46.

4.3 Limitations in Temperature Data shown above:

(i) The Solargis data is for a Typical Meteorological Year (TMY) i.e. reference year. It transforms multi-year time series into a Typical Meteorological Year, encapsulating the most frequent weather conditions for a given site during a specific period.

(ii) The WMS data recorded by RE developers has timestamps missing in the data for the year 2022-23. The data given by RE developers is 15-minute interval data which is averaged out for hourly temperature data. The Hourly temperature data is used to analyze the no of instances.

(iii) Based on the available data the analysis is done.

(iv) There is an error of +/- 1°C in the data of Solargis.

5. Based on the above, below two methodologies are worked out to tabulate the maximum temperature compliance at the PoI for both active and reactive power generated by RE plants.

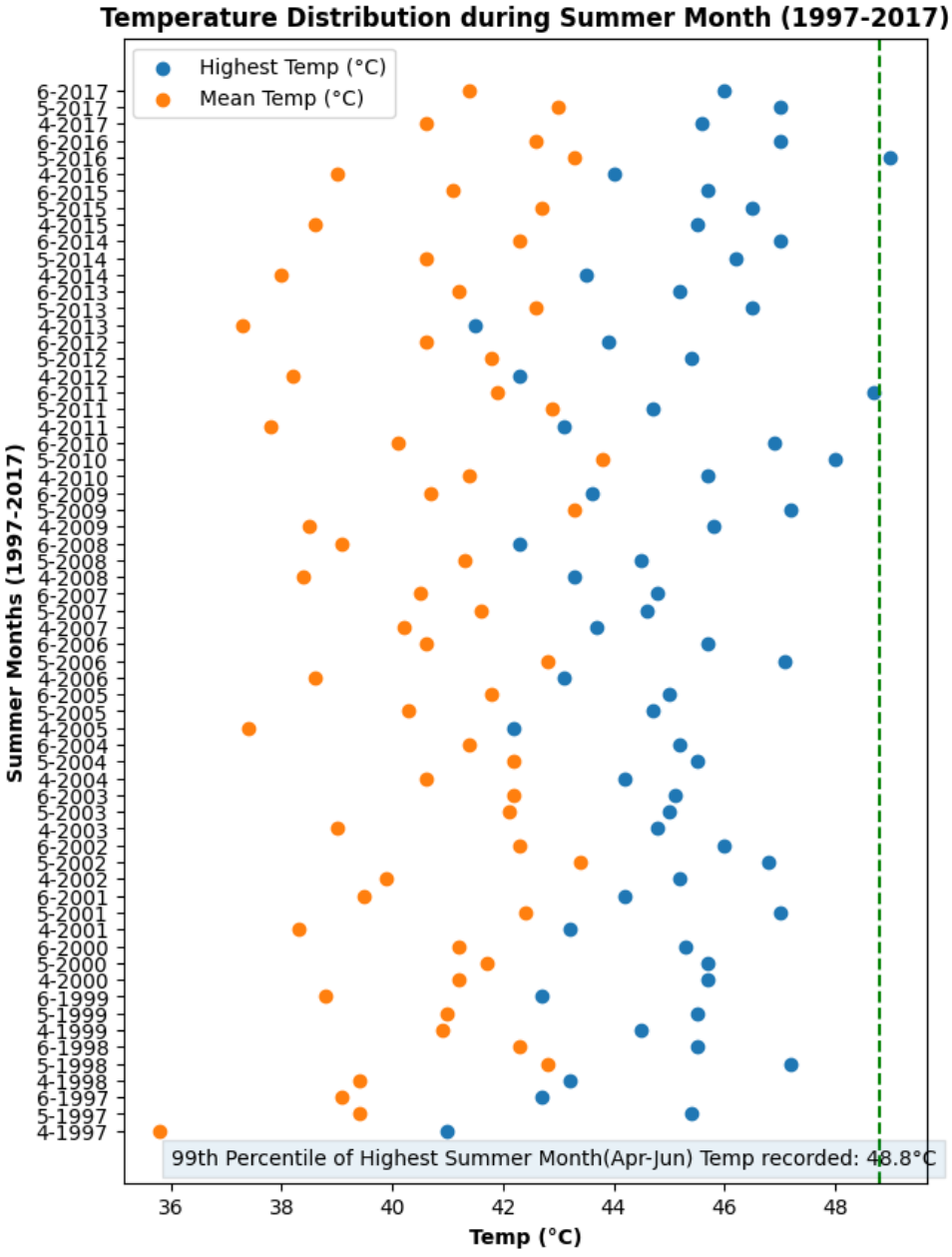
<u>Methodology-I:</u>

(a) The monthly maximum temperature data from IMD measuring Station nearest to the RE Generating Park for at least 25 years to be made available.

(b) Calculate the 99th percentile of the tabulated temperature data.
(c) Round it off to next higher integer value.

Data Limitations: The IMD's Monthly maximum temperature data has missing data entries and the data is not available for last 25 years. –provided by SEMBCORP

Jaisalmer: - IMD's Monthly Maximum temperature data spanning the past 20 years for (Annexure-III) is represented graphically below:



As calculated from Annexure-III, the **99th** percentile in the available data is 48.814°C. Rounding it off to next integer it becomes 49°C.

Methodology II:

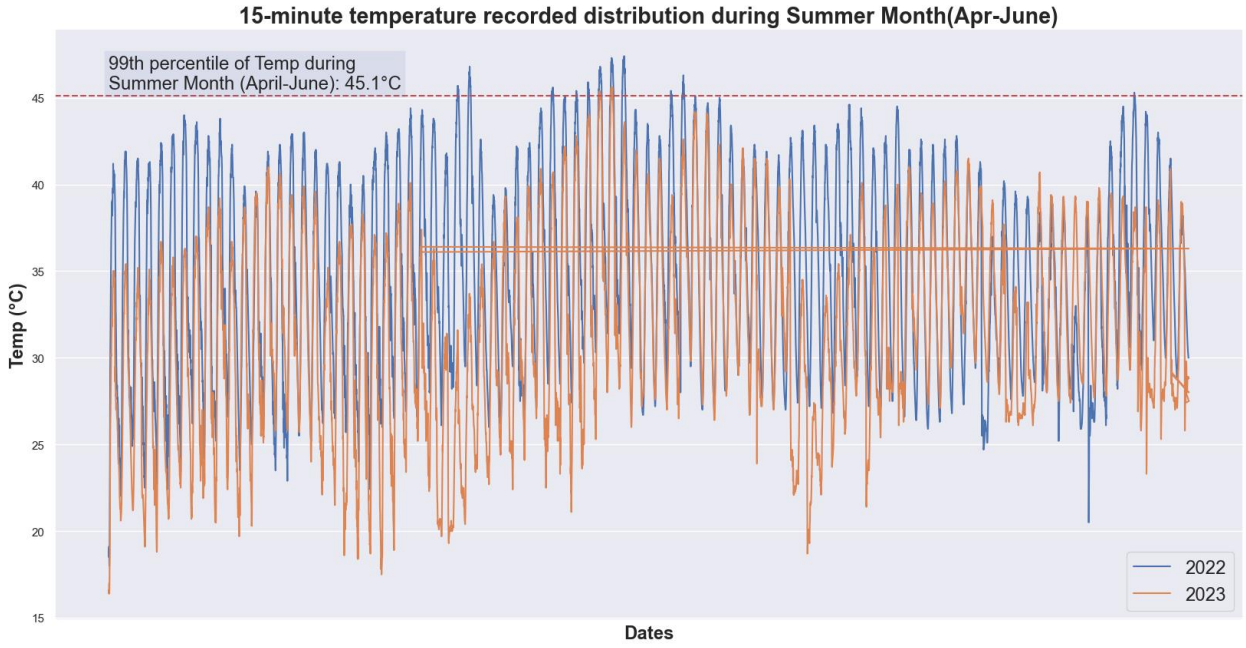
(a) The 15 minute interval recorded temperature data from IMD measuring Station nearest to the RE Generating Park for at least 10 years to be made available.

(b) Calculate the 99th percentile of the hourly temperature data during the hot season (April-June).

(c) Add +1°C margin to the calculated temperature and round it off to next higher integer value.

Data Limitations: 15 minute interval recorded IMD temperature data for Jaisalmer is downloaded from IMD website. **There are missing data entries but they are insignificant.**

Jaisalmer: - 15 minute interval recorded IMD temperature data for Jaisalmer for period (29.09.2021 to 14.08.2023) (Annexure-IV) during hot season (April-June) is represented graphically below:



As calculated from Annexure-IV, the 99th percentile during hot season is 45.1°C. Rounding it off to next integer it becomes 46°C and add 1°C, it becomes 47°C.

6. It is proposed that the methodology prescribed in the Working Group Report may be modified as per Methodology-II as it contains more plot points for calculation of 99th percentile.

Accordingly, the following steps are proposed:

(i) 15 minute interval recorded temperature data from IMD at the proposed RE park site/ or at the nearest location to be made available.

(ii) Calculate 99th percentile, round off to next higher integer and then add 1°C to arrive at the maximum temperature for the proposed Solar/ Wind Park.

(iii) The rated active and reactive power shall be provided at the PoI.

(iv) Above the maximum temperature, the RE developers shall provide the PQ curve for the proposed park but in any case the reactive power shall not be less than 33% of the rated active power above the maximum temperature approved for the proposed solar/ wind park.

(v) Remaining compliances as per the Working Group Report remains the same.