सत्यमेव जयते

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विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Power System Engineering & Technology Development Division

Date: 19.03.2025

सेवा में,

<As per attached list>

विषय: Issuance of "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" - reg.

महोदया/महोदय,

A Committee was constituted vide CEA letter dated 04.10.2025 under the Chairmanship of Member (Power System), CEA [PMU Committee] to suggest ways to harmonize various requirements for PMU installation into one single Guideline. The PMU Committee held two Meetings on 05.12.2024 and 27.01.2025 to deliberate & finalize "Guidelines for Unified Philosophy for placement of Phasor Measurement Units (PMUs) in Indian Grid".

2. Based on the extensive deliberations held during the meetings and recommendations of the Committee, A Report of the Committee on "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" have been finalized. Subsequently, a meeting was held on 13.03.2025 under the Chairmanship of Chairperson, CEA to discuss the way forward for adoption of the Committee Report for implementation.

3. The Minutes of the Meeting including the Report of the Committee on "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" are enclosed herewith for your kind reference and necessary action.

4. The Guidelines shall be adopted for implementation for URTDSM (Phase-II) project and all upcoming schemes with applicability as under:
   - These Guidelines shall be applicable to all the upcoming Tariff-based Competitive Bidding (TBCB)/ Regulated Tariff Mechanism (RTM) based Projects. Additionally, these guidelines shall also be applicable to Projects (through TBCB or RTM route) for which the tender has been published before the date of issue of these guidelines for which the price bids are yet to be submitted.

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- For the Transmission Scheme for which bidding was submitted on or after 27.12.2022 (the date of notification of CEA Construction Standards, 2022) but before 19.01.2024 (the date of notification of CERC Guidelines on Interfacing requirements, 2024), PMUs shall be installed as per RfP document.
- For the transmission Scheme for which bid was submitted on or after 19.01.2024, PMUs shall be installed as per RFP duly factoring in CERC Interface Guidelines.
- The PMU Committee Guidelines, viz., "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" shall be effective from the date of issue of the Guidelines (19.03.2025).

This issues with the approval of Chairperson, CEA.

भवदीय,

NRLK 19/3/2025

(एन.आर.एल.के. प्रसाद/ N.R.L.K. Prasad)
मुख्य अभियंता (का.प्र.)/ Chief Engineer(I/C)

प्रतिलिपी:

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Chairman & Managing Director		

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सत्यमेव जयते

भारत सरकार/ Government of India

विद्युत मंत्रालय/ Ministry of Power

केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority

विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग

Power System Engineering & Technology Development Division

सेवा में,

<as per attached list>

विषय: Minutes of the Meeting held on 13.03.2025 to discuss the way forward on the Draft "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" - reg.

महोदया/महोदय,

A Meeting was held on 13.03.2025 at 09:45 hrs at Chintan Conference Hall of CEA under the chairmanship of Chairman, CEA to discuss the way forward on the Draft "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid".

2. The Minutes of the Meeting including the Final Report of the Committee on "**Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid"** are enclosed for kind information and necessary action please.

This issues with the approval of Chairperson, CEA.

Encl: as above

भवदीय,

NRLK 19/3/2025

(एन.आर.एल.के. प्रसाद/ N.R.L.K. Prasad)

मुख्य अभियंता (का.प्र.)/ Chief Engineer(I/C)

Copy to:

1. Chief Engineer, NPC, CEA
2. Chief Engineer, PCD Division, CEA
3. SA to Chairperson, CEA
4. SA to Member (PS), CEA

तीसरी मंजिल,सेवा भवन, आर. के. पुरम-I, नई दिल्ली-110066 टेलीफैक्स: 011-26732307 ईमेल: ce-psetd@nic.in वैबसाइट:www.cea.nic.in
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Power System Engineering & Technology Development Division
New Delhi

Minutes of the Meeting held on 13.03.2025 to discuss the Way Forward on the Draft "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid"

1. A meeting was held on 13.03.2025 in the Chintan Conference Hall of CEA under the Chairmanship of Chairperson, CEA to discuss the Way Forward on the implementation of Draft "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid". List of participants is at **Annexure-A**.

2. At the outset of the meeting, Chairperson, CEA welcomed all the participants and stated that the discussions around suitable locations for PMU have been happening for some time. In this connection, a Committee formed under the Chairmanship of Member (Power System), CEA (PMU Committee) dealt with the matter in detail, and finalized a set of Guidelines for implementation in all upcoming projects. This meeting was being held to discuss the way-forward on the same. Thereafter, he requested Chief Engineer I/C (PSE&TD) to present the details.

3. Chief Engineer I/C (PSE&TD) gave a brief Presentation (**Annexure-B**). The salient points of the Presentation are as follows.
   a) The different Guidelines/ Standards dealing with the requirements of placement of PMUs in the Indian Electric Grid are noted as follows:
      (i) Regulation 48 (6) of Central Electricity Authority (Technical Standards for Construction of Electric Plants and Electric Lines) Regulations, 2022. *The regulation specifies the Locations of PMUs in general.* (**Annexure-C)**.
      (ii) Report of the Sub-Committee on PMU Placement and Analytics under URDTSM Phase-II brought out in 2023. *The report extensively deals with various possible Locations of PMUs.* (**Annexure-C)**.
      (iii) Guidelines on Interface Requirements brought out under the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017 and issued vide CERC Order dated 19.01.2024. *The Guidelines primarily deal with various Parameters to be telemetered from PMUs placed on various equipment (power system elements) in various Stations* (**Annexure-D**).

   b) In this connection, a meeting was held on 20.06.2024 to bring clarity about the locations of Phasor Measurement Units (PMUs) in the Grid and the Parameters to be telemetered from them. As per the decision taken in the Meeting, a Committee under the Chairmanship of Member (Power System), CEA with representatives from CEA, CTUIL, POWERGRID, GRID INDIA, NTPC, NHPC, Electric Power Transmission Association (EPTA), Independent Power Producers Association of India (IPPAI), CPRI, National Physical Laboratory (NPL), Sustainable Project Developer Association (SPDA), Indian Wind Power Association (IWPA) was constituted vide CEA letter dated 04.10.2025 to suggest ways to harmonize various requirements for PMU installation into one single Guideline.

   c) This PMU Committee held two Meetings on 05.12.2024 and 27.01.2025 to deliberate & finalize draft "Guidelines for Unified Philosophy for placement of Phasor Measurement Units (PMUs) in Indian Grid". In the second meeting of the Committee held on 27.01.2025, Analytics Tool Developers, viz., M/s Electric Power Group (EPG) and M/s GE were also invited for taking their opinion regarding the placement of PMUs.

   d) Based on the extensive deliberations held during the meetings and recommendations of the Committee, Draft "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" have been finalized. *These Guidelines (**Annexure-E**) primarily specify both the optimized locations &*

the elements on which PMUs are required and the optimized list of signals/ data to be telemetered from those PMUs.

e) In this regard, a Comparative Statement on PMU Locations between PMU Committee Guidelines and URTDSM Sub-Committee Guidelines (**Annexure-F**) is presented. A Comparative Statement on PMU Parameters to be telemetered between PMU Committee Guidelines and CERC Guidelines on Interfacing Requirements (**Annexure-G**) is also presented.

f) W.r.t. PMU Locations, the following is noted:
- PMU Locations as per PMU Committee Guidelines are basically an optimized list of that present in URTSM Sub-Committee Report, and sufficient to obtain required levels of observability.
- ***Accordingly, for Uniformity in approach w.r.t Placement of PMUs in the Indian Grid, above finalized PMU Committee Guidelines, 2025 shall be adopted for implementation.***

g) W.r.t. Parameters to be telemetered from PMU's, the following is noted:
- W.r.t. Analog and Digital Parameters, the Items present in PMU Committee Guidelines are basically an optimized list of that present in CERC Interfacing Guidelines, and sufficient to obtain required observability levels
- W.r.t. Protection Parameters, the Items not present in CERC Interfacing Guidelines, but present in PMU Committee Guidelines, are general in nature, and not mandatory; PMU Committee Guidelines, 2025 are in general agreement with CERC Guidelines on Interfacing Requirements, 2024 w.r.t. PMU Parameters to be telemetered; as such, there is no need to bring any Amendment in CERC Guidelines on Interfacing Requirements, 2024.
- ***Therefore for Uniformity in approach w.r.t PMU Parameters to be telemetered in the Indian Grid, above finalized PMU Committee Guidelines, 2025 shall be adopted for implementation.***

4. Chairperson, CEA raised the concern that CERC should not issue the Guidelines on Technical matters in power sector, as CEA is primarily responsible for that. ***He requested Chief Engineer (NPC) to issue address a letter to Secretary, CERC in this regard so that duplication of efforts and attendant confusion arising from multiple guidelines/ Standards on same technical matter may be avoided***. However, CERC may give the reference of relevant Technical Standards issued by CEA in their regulations.

5. Chairperson, CEA enquired whether PMUs are being manufactured in India. Representative from National Physical Laboratory (NPL) and POWERGRID stated that there are two manufacturers viz M/s Valiant Communications Ltd and M/s Hitachi Energy who are manufacturing PMUs in India.

6. Representative from NPL stated that PMUs are being tested at NPL. NPL is also supporting an indigenous PMU manufacturer by providing technical services. However, none of the PMUs installed in Phase-1 of URTDSM were tested at CSIR-NPL. In addition to NPL and CPRI, testing facility for PMUs is also available with Powergrid Advanced Research and Technology Centre (PARTeC) at Manesar. Testing facility at POWERGRID is traceable to the National Standards of India. In this connection, it was noted that no testing facility is available in India for Synchro-Phasor Data Transfer. So, if testing facility for PMU Data Transfer as per Standard IEEE C37.118.2 is required, CSIR-NPL, being the National Measurement Institute of the country, will extend its facilities in this area if requirement for the same is received.

7. CPRI through email informed that for PMU communication/ data transfer, compliance w.r.t. Standard, IEC 61850-10, may be ensured. In CPRI, its compliance for IEDs is being done using a tool. However, the required tool is not available in CPRI for testing of PMU Communication compliance as per IEEE C37.118.2:2011. CPRI also informed that so far no requirement has been received from PMU manufacturers like Hitachi, GE Vernova and Siemens for testing as per IEEE C37.118.2:2011.

8. Chairperson, CEA enquired about the requirements of PMUs, especially in view of the above PMU Committee Guidelines 2025. Representative from POWERGRID stated that earlier there is a requirement of 4000 PMUs under the URTDSM Phase-II, which may come down to 2000-2500 as per these Guidelines. ***Chairperson, CEA requested to carry out the assessment of the PMUs in view of increase in sudden demand due to these Guidelines, and requested that PMU manufacturers may also be consulted regarding their manufacturing capacity.***

9. Grid-India also confirmed the sufficiency of PMU locations and PMU Parameters as brought out in the PMU Committee Guidelines, 2025, and requested for their early implementation.

10. In this connection, since the Guidelines require PMUs to be provided at only one end of the line, the need to clearly specify the PMU requirements on various lines at station (s) of a project as part of its RfP document was discussed. On this, Chairperson, CEA requested CTUIL to bring the proposal of the Transmission Scheme to NCT with clear requirement of PMUs in line with these guidelines. ***That is CTUIL shall clearly mention the requirement of PMUs at a Substation in line with these Guidelines by duly factoring in the availability of the PMUs at the existing stations and that under bidding transmission schemes & under-construction transmission schemes.***

11. Chairperson, CEA stated that as these Guidelines are in alignment with CERC Guidelines on Interfacing Requirements, 2024, there is no contradiction observed between these two; therefore the PMU Committee Guidelines which optimally specify the PMU Locations and PMU Parameters to be telemetered shall be adopted for implementation for URTDSM (Phase-II) project and all upcoming schemes with applicability as under:
    - These Guidelines shall be applicable to all the upcoming Tariff-based Competitive Bidding (TBCB)/ Regulated Tariff Mechanism (RTM) based Projects. Additionally, these guidelines shall also be applicable to Projects (through TBCB or RTM route) for which the tender has been published before the date of issue of these guidelines for which the price bids are yet to be submitted.
    - For the Transmission Scheme for which bidding was submitted on or after 27.12.2022 (the date of notification of CEA Construction Standards, 2022) but before 19.01.2024 (the date of notification of CERC Guidelines on Interfacing requirements, 2024), PMUs shall be installed as per RfP document.
    - For the transmission Scheme for which bid was submitted on or after 19.01.2024, PMUs shall be installed as per RFP duly factoring in CERC Interface Guidelines.
    - The PMU Committee Guidelines, viz., "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" shall be effective from the date of issue of the Guidelines.

12. The finalized "Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid" are given at **Annexure-H** for kind reference and necessary action by all concerned.

13. The meeting ended with thanks to chair.

*****

Annexure-A

List of Participants

CEA

1. Sh. Ghanshyam Prasad, Chairperson, CEA – in Chair
2. Ms. Rishika Sharan, Chief Engineer (NPC)
3. Sh. N.R.L.K. Prasad, Chief Engineer I/C (PSE&TD)
4. Sh. Bhanwar Singh Meena, Director (PSE&TD)
5. Sh. Pankaj Kumar Verma, Deputy Director (PSE&TD)

CTUIL

1. Sh. T.N. Pauan Kalyan Kumar, E.T.

GRID-INDIA

1. Sh. Manas Ranjan Chand, DGM
2. Sh. Aman Gautam, Manager

POWERGRID

1. Sh. Mohan Kishor. N. DGM
2. Sh. Awanish Kumar, Chief Manager

NTPC LTD.

Sh. Abhishek Khanna, Sr. Manager

NHPC LTD

Sh. Jaganath Pani, Sr. Manager

CSIR-NPL

Dr. Avni Khattar, Scientist

ADANI

Sh. Sumeet Sharma, Vice President

RESONIA LTD. (Erstwhile STERLITE POWER)

Sh. Anurag Patel, Chief Manager

ACME

Sh. Nitish Kumar, AGM

WELSPUN

Sh. Akash Bhatnagar, Dy. Manager

FPEL

Sh. Karan, B.D.

Annexure-B

Meeting on Way Forward for Implementation of the Draft "Guidelines on Unified Philosophy for Placement of Phasor Measurement Units (PMUs) in Indian Grid"

PMUs in Indian Grid

Annexure-B

- PMU is a Device that produces synchronized phasor, frequency, and rate of change of frequency (ROCOF) estimates from voltage and/or current signals and a time synchronizing signal. PMUs are essential components (building blocks) of Wide Area Monitoring System (WAMS).

- Given the increasing penetration of renewable energy (RE) leading to increasing Variability and Unpredictability in power generation, the role of PMUs becomes crucial **to enhance visualization of power system dynamics in real-time** and they are also being utilized extensively in post-dispatch analysis.

- PMU's Deployment: The deployment of PMUs in India began as a pilot project in 2008-2010; and this soon blossomed into a large-scale PMU based Wide Area Monitoring System (WAMS) called, **Unified Real-Time Dynamic State Measurement (URTDSM)**, which was proposed to be implemented in Two Phases.

Unified Real Time Dynamic State Measurement (URTDSM) Project

- Under URTDSM Phase-I Project, which was executed during 2014 - 2021, locations for PMU placement in the Indian Grid were selected based on the Philosophy decided in the Joint Meeting of all Five Reginal Standing Committee on Power System Planning held on 05.03.2012 and availability of wide-band communication at the sub-stations.

  --- *[Annexure-I (URTDSM1-Criteria)]*

- Based on the experience of installation of PMUs under URTDSM Phase-I, and feedback provided by Grid-India (erstwhile POSOCO) to CEA/ CERC and all Stakeholders, requirement for New Locations for PMUs & Additional Analytics on PMU Data came up.

- Accordingly, a Committee, set up by NPC Division of CEA in September, 2021, came up with a "Report on PMU Placement and Analytics under URTDSM Phase II", and the same was approved by NPC in its 13th Meeting held on 05.07.2023.

Different Guidelines in force for PMU Installation in Indian Grid

- It has been observed that the following three Guidelines/ Standards are prevalent with specified criteria for placement of PMUs in the Indian Electric Grid:

1) Regulation 48 (6) of Central Electricity Authority (Technical Standards for Construction of Electric Plants and Electric Lines) Regulations, 2022 – [**specifies the Locations of PMUs in general**] ---***[Annexure-I (CEA-CSR Criteria)]***

2) Report of the Sub-Committee on PMU Placement and Analytics under URDTSM Phase II brought out in 2023 – [**extensively deals with <u>various possible Locations of PMUs</u>**] ---***[Annexure-I (URTDSM Sub-Committee Criteria)]***

3) Guidelines on Interface Requirements brought out under the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017 and issued vide CERC Order dated 19.01.2024 [**primarily deal with <u>various Parameters to be telemetered from PMUs</u> placed on various equipment (power system elements) in various Stations**]

---***[Annexure-II (CERC-GIR Criteria)]***

PMU Committee Guidelines, 2025

- In this connection, a meeting was held on 20.06.2024 to bring clarity about the **locations of Phasor Measurement Units (PMUs)** in the Grid **and the Parameters to be telemetered** from them.

- As per the decision taken in the Meeting, a Committee - *under the Chairmanship of Member (Power System), CEA with Members from CEA, CTUIL, POWERGRID, GRID INDIA, NTPC, NHPC, Electric Power Transmission Association (EPTA), Independent Power Producers Association of India (IPPAI), CPRI, National Physical Laboratory, Sustainable Project Developer Association (SPDA), Indian Wind Power Association (IWPA)* - was constituted vide CEA letter dated **04.10.2024** to suggest ways to harmonize various requirements for PMU installation into one single Guideline.

PMU Committee Guidelines, 2025 [contd…]

- This PMU Committee held TWO Meetings on **05.12.2024** and **27.01.2025** to deliberate & finalize draft "Guidelines for Unified Philosophy for Placement of Phasor Measurement Units (PMUs) in Indian Grid".

- In the second meeting of the Committee held on 27.01.2025, Analytics Tool Developers, viz., M/s Electric Power Group (EPG) and M/s GE were also invited for taking their opinion regarding the placement of PMUs.

- Based on the extensive deliberations held during the meetings and recommendations of the Committee, Draft "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" have been finalized.
- **These Guidelines primarily specify the optmised locations & the elements on which PMUs are required as well as the optimized signals/ data to be telemetered from those PMUs.** ***--[Annexure-III (PMU Committee Criteria)]***

Way Forward

- CEA Construction Standards, 2022 specifies **Locations of PMUs placement in general**

- URTDSM Sub-Committee Report, 2023 specifies **extensive list of possible locations** for PMUs placement

- CERC Guidelines on Interfacing Requirements, 2024 specify **list of parameters to be telemetered from PMUs** placed on various equipment in various sub-stations and generating stations

- PMU Committee Guidelines, 2025 specify **both optimized locations for PMUs placement and optimized list of Signals to be telemetered from PMU's**

Way Forward [contd…]

Annexure-B

- A Comparative Statement on **PMU locations** between PMU Committee Guidelines and URTDSM Sub-Committee Guidelines is given at **Annexure-IV**
- A Comparative Statement on **PMU Parameters** between PMU Committee Guidelines and CERC Guidelines on Interfacing Requirements is given at **Annexure-V**
- ***W.r.t. PMU Locations, the following is noted:***
  - **PMU Locations as per PMU Committee Guidelines are basically an optimized list of that present in URTSM Sub-Committee Report, and sufficient to obtain required levels of observability.**
  - **Accordingly, for Uniformity in approach w.r.t Placement of PMUs in the Indian Grid, *above finalized PMU Committee Guidelines, 2025 shall be adopted for implementation*.**
- ***W.r.t. Parameters to be telemetered from PMU's, the following is noted:***
  - ***W.r.t. Analog and Digital Parameters, the Items present PMU Committee Guidelines are basically an optimized list of that present in CERC Interfacing Guidelines, and sufficient to obtain required observability levels***
  - ***W.r.t. Protection Parameters, the Items not present in CERC Interfacing Guidelines, but present in PMU Committee Guidelines, are general in nature, and not manadatory; PMU Committee Guidelines, 2025 are in general agreement with CERC Guidelines on Interfacing Requirements, 2024 w.r.t. PMU Parameters to be telemetered; as such, there is no need to bring any Amendment in CERC Guidelines on Interfacing Requirements, 2024.***
  - **Therefore for Uniformity in approach w.r.t PMU Parameters to be telemetered in the Indian Grid, *above finalized PMU Committee Guidelines, 2025 shall be adopted for implementation*.**

THANK YOU

Annexure-C

URTDSM1-Criteria

Criteria for PMU Locations under URTDSM Phase-I:

During the Joint Meeting of all the five Regional Standing Committees on Power system Planning held on 05.03.2012, following PMU placement philosophy was decided:

a) All 400 kV Stations in State and ISTS Grids
b) All Generating Stations at 220 kV and above
c) HVDC Terminals and inter-regional and inter-national Tie- lines
d) Both ends of all the transmission lines at 400 kV and above: State and ISTS Sector

CEA-CSR-Criteria

As per Regulation 48(6) of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022:

48 (6) PMU Requirements:

(a) *Synchrophasor measurement using Phasor Measurement Units along with fibre optic connectivity, Global Positioning System Receiver and communication equipment shall be provided for monitoring the entire interconnected grid on real time basis* ***at substations of 400 kV and above voltage level, switchyard of generating stations at 220 kV and above voltage level, Alternating Current side of converter bays of High Voltage Direct Current stations and Pooling Point of renewable energy generating stations of fifty mega watt and more and Battery Energy Storage System of fifty mega watt and more****.*

(b) *Phasor Measurement Units shall comply with IS 60255-118-1-2018.*

(c) *The dispersedly located Phasor Measurement Units shall communicate with Phasor Data Concentrators installed at certain strategic locations at State, Regional and National level*

Annexure-C

URTDSM Sub-Committee-Criteria

The "Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II" suggested, inter alia, the following minimum criteria for placement of PMUs for URTDSM Phase-II:

1) At one end of all 400 kV and above transmission lines.
2) At the HV side of all ICTs connected to 220 kV and above.
3) On HV side of coupling transformer of SVC/STATCOM for measurement of HV Bus voltage and current of coupling transformer
4) At one end of line wherever FSC/ TCSC are installed.
5) On HV side of converter transformers for measuring HVAC bus voltage and current of converter transformer on each converter station.
6) On both ends of Inter-regional and trans-national tie lines and on boundary buses for such lines.
7) At the Generating Transformers (GTs) at LV side (having HV side of 220 kV and above) of the Generating units with capacity above 200 MW for Thermal units, 50 MW for Hydro units and 100 MW for Gas units.
8) On all 220 kV substations for measuring voltage of 220 kV bus and current of two lines/transformer catering to load centers.
9) All 132 kV and above ISTS lines in NER & Sikkim and important load centers.
10) At RE developer end of the evacuating line connecting the Renewable Energy Pooling Stations (PS) to point of interconnection with the grid of 50 MW and above.
11) Islanding, Separating & Restoration Points- At one end of line which is connected to black start stations along with circuit breaker status via synchro phasors.
12) Fiber Optic should be covered under Phase – II for all the above locations of the URTDSM project.
13) At all ICTs, Bus reactors, Switchable line reactors of critical substations.

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Annexure-D

CERC Guidelines on Interface Requirements

B. PMU Signal List

Sl. No	Description	Analog Points	Digital Points	Protection Signal
1	Line	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT	-Main Breaker status -Tie Breaker status -Isolators	Main1/Main2 protection,
2	Bays		- Breaker -Isolators	
3	Main Buses, Transfer Buses	- **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} F, DF/DT	Bus Sectionalizer, Bus Coupler Breaker	
4	Transformer/Coupling Transformer/Converter Transformer	- **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW/MVAR for HV& LV Side	-Breaker -Isolators	Main1/Main2 protection
5	Reactor	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	-Breaker -Isolators	
6	FSC/TCSC	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	-Bypass Breaker - -FSC ON/OFF Status	

7	SVC	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	Breaker	
8	Generator	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT for HV& LV Side	-RGMO/FGMO ON/OFF Status Breaker Status -Isolators	V
9	STATCOM	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT	- CB OF EACH MODULE MSR, MSC	
10	Phase Shifter	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} HV & LV MW / MVAR F, DF/DT	- CB	

Annexure-E

Criteria for Placement of PMUs (Location, Elements) and Signals to be Measured and Reported by PMUs

SN	Locations for Placement of PMU	Elements to be considered	Signals to be measured and reported by PMUs		
			Analog Points	Digital Points	General List of Protection Signals $
1.	Substations of 400 kV and above Voltage Level	At one end of all Transmission Line Bays of 400 kV and above. Note: Of the two ends of the line, PMU needs to be provided at only ONE end	• Voltage and Current • MW and MVAR	Circuit Breaker (CB) Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 400 kV and above	Bus voltage and frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker back up protection (50LBB) And any other signal as per requirement

2.	Switchyard of 220 kV and above voltage level of Generating Stations (200 MW and above for Thermal, 50 MW and above for Hydro (including Pump Storage plants), 100 MW and above for Gas, 200 MW and above for Nuclear and 100 MVA and above for SYNCON)	At the LV side of the GT of the Generating Units/ Step-Up Transformer of the SYNCON connected with 220 kV and above Bus	• Voltage and Current • MW, MVAR	RGMO/FGMO status, GT HV side CB status	Generator Protection Trip (unit wise) • And any other as per requirement
		Bus bars of 220 kV and above at Generating Stations	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement
3.	Substations of 220 kV and above voltage level RE Generating stations with renewable/ Hybrid plants of 50 MW and more.	All Transmission Line Bays of 220 kV and above	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 220 kV and above	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B)

					• Local breaker backup protection (50lbb) And any other as per requirement
4.	Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more	All Transmission Line Bays of 220 kV and above emanating from RE Pooling station to other non-generating sub-station.	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 220 kV and above	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement
		HV side of 765/400 kV ICTs and in the absence of 765 kV Bus, on the HV side of 400/220 kV ICT.	• Voltage and Current • MW and MVAR	CB Status	Protection Trip operated • Transformer differential protection (87T) • Non direction IDMT

					O/C & E/F protection (51,51N) And any other as per requirement
5.	High Voltage Direct Current stations (HVDC)	On HV side of Converter Transformers in HVDC Stations	• Voltage and Current • MW and MVAR	CB Status	Protection Trip operated • Transformer differential protection (87T) • Non direction IDMT O/C & E/F protection (51,51N) And any other as per requirement
6.	Stations with STATCOM/ FSC/ TCSC/ SVC/ Phase Shifter	On HV side of STATCOM/ FSC/ TCSC/ SVC On both Primary & Secondary sides of Phase Shifter	• Voltage and Current • MW and MVAR	CB Status of each Module (FSC, MSR, MSC as applicable)	Protection Trip operated • Over current protection • Differential And any other as per requirement

7.	Battery Energy Storage Stations (BESS) of 50 MW and more	At Line bay of 132 kV and above of Battery Energy Storage Systems	• Voltage and Current • MW and MVAR	CB Status, Controller Status, RGMO/ FGMO Status, Modes (Energy Storage, Frequency Regulation etc.,)	Protection Trip operated LVRT, HVRT And any other as per requirement
8.	All ISTS Lines in NER and Sikkim of 132 kV and above	At one end of all Transmission Line Bays of 132 kV and above in NER and Sikkim. Note: Of the two ends of the line, PMU needs to be provided at only ONE end	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
9.	Inter-Regional/Trans-national Tie lines at 132 kV and above	At both ends of Line Bays of all Inter-Regional and Trans-National tie lines	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
10	220 kV Substations: only Stations catering to	At one end of all Transmission Line Bays of 220 kV and above	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2)

	Metropolitan cities.	Note: Of the two ends of the line, PMU needs to be provided at only ONE end			• Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 220 kV	Bus voltage and frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement
11	Bulk consumers at 132 kV and above	At the one end of 132 kV and above	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 132 kV and above	Bus voltage and frequency and DF/DT	Bus Sectionalizer/	Bus Bar Protection operated

				Bus Coupler wherever applicable	• Bus bar differential protection (87B) • Local breaker backup protection (50LBB) • And any other as per requirement
12	Islanding, Separating and Restoration Points-	At one end of line which is connected to black start stations, islanding & restoration points	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement

$ The list of protection signals are general in nature. The actual protection signals shall be decided during the execution stage of the Projects in consultation with the GRID INDIA. The actual signals shall be provided based on the availability of the spare ports in the PMUs. In any case, no additional PMUs shall be installed just for the capturing the protection signals.

Note:

1. *Wherever Line Voltage/Bus Voltage and Line Current are mentioned above, it means 3-phase Voltages and 3-phase Currents.*
2. *In One-and-Half-Breaker Scheme, CB Status means Status of both Main and Tie Breakers.*
3. *For NER: 132 kV and above Voltage level shall be considered in place of 220 kV and above*

Annexure-F

Comparative Statement on PMU Locations between PMU Committee Guidelines and URTDSM Sub-Committee Guidelines

SN	Station	Location for PMU Placement	
		Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II	**PMU Committee Guidelines**
1.	Substations of 220 kV and above Voltage Level	➢ At one end of all 400 kV and above transmission lines ➢ At the HV side of all ICTs connected to 220 kV and above	**Substations of 400 kV and above Voltage Level** ➢ At one end of all Transmission Line Bays of 400 kV and above. ➢ Bus bars of 400 kV and above
2.	Switchyard of 220 kV and above voltage level of Generating Stations	**Generating units with capacity above 200 MW for Thermal units, 50 MW for Hydro units and 50 MW for Gas units** ➢ Generating Transformers (GTs) at LV side (having HV side of 220 kV and above)	**Switchyard of 220 kV and above voltage level of Generating Stations (200 MW and above for Thermal, 50 MW and above for Hydro (including Pump Storage plants), 100 MW and above for Gas, 200 MW and above for Nuclear and 100 MVA and above for SYNCON)** ➢ At the LV side of the GT of the Generating Units/ Step-Up Transformer of the SYNCON connected with 220 kV and above Bus ➢ Bus bars of 220 kV and above at Generating Station
3.	Substations of 220 kV and above voltage level of RE Generating stations	➢ At RE developer end of the evacuating line connecting the Renewable Energy Pooling Stations (PS) to point of interconnection with the grid of 50 MW and above.	➢ All Transmission Lines of 220 kV and above ➢ Bus bars of 220 kV and above

4.	Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more	➢ At one end of all 400 kV and above transmission lines ➢ At the HV side of all ICTs connected to 220 kV and above	➢ All Transmission Line Bays of 220 kV and above emanating from RE Pooling station to other non-generating sub-station. ➢ Bus bars of 220 kV and above ➢ HV side of 765/400 kV ICTs and in the absence of 765 kV Bus, on the HV side of 400/220 kV ICT
5.	High Voltage Direct Current stations (HVDC)	➢ On HV side of converter transformers	➢ On HV side of Converter Transformers in HVDC Stations
6.	Stations with STATCOM/ FSC/ TCSC/ SVCC/ Phase Shifter	➢ On HV side of coupling transformer of SVC/STATCOM ➢ At one end of the line wherever FSC/ TCSC are installed.	➢ On HV side of STATCOM/ FSC/ TCSC/ SVC/Phase Shifter
7.	Battery Energy Storage Stations (BESS) of 50 MW and more	Not included	➢ At Line Bays of all 132 kV and above of Battery Energy Storage Systems
8.	All ISTS Lines in NERC Sikkim of 132kV and above	➢ All 132 kV and above ISTS lines in NER and Sikkim and important load centers	➢ At one end of all Transmission Line Bays of 132 kV and above in NER and Sikkim.
9.	Inter-Regional/Trans-national Tie lines	➢ Both ends of Inter-regional and trans-national tie lines ➢ Boundary buses for such lines.	➢ At both ends of Line Bays of all Inter-Regional and Trans-National Tie-lines at 132 kV & above voltage level.
10	All 220 kV substations catering to load centers.	➢ 220 kV Bus bars ➢ Two lines/transformer catering to load centers	**Only Critical 220 kV Substations catering to Metropolitan Cities** ➢ At one end of all Transmission Line Bays of 220 kV and above ➢ Bus bars of 220 kV

11	Islanding, Separating and Restoration Points	➢ At one end of line which is connected to black start stations	➢ At one end of line which is connected to black start stations, islanding & restoration points
12	Critical substations	➢ ICTs ➢ Bus reactors ➢ Switchable line reactors	Not included
13	Bulk consumers at 132 kV and above	➢ Not included	➢ At the one end of 132 kV and above ➢ Bus bars of 132 kV and above

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Annexure-G

Comparative Statement on PMU Parameters between Draft PMU Committee Guidelines and CERC Guidelines on Interfacing Requirements

SN	Description	Analog Points		Digital Points		Protection Signal	
		CERC Guidelines	PMU Committee Guidelines	CERC Guidelines	PMU Committee Guidelines	CERC Guidelines	PMU Committee Guidelines
1	Line	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MW, MVAR, F, DF/DT	• Line Voltage and Current	• Main Breaker status • Tie Breaker Status • Isolators	• Circuit Breaker Status • Tie breaker Status, in case of one-and-half-breaker Scheme	• Main1/Main2 protection	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) • And any other as per requirement
2	Bays	—	—	• Breaker • Isolators	—	—	—
3	Main Buses, Transfer Buses	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • F, DF/DT	• Bus Voltage and Frequency	• Bus Sectionalizer • Bus Coupler Breaker	• Bus Sectionalizer/ Bus Coupler wherever applicable		• Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) • And any other as per requirement

Annexure-G

4	Transformer/Coupling Transformer/Converter Transformer	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MW/MVAR for HV& LV Side	a) On HV side of 765/400 kV ICTs and in the absence of 765 kV Bus, on the HV side of 400/220 kV ICT in case of Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more • Voltage and Current b) On HV side of Coupling Transformer of STATCOM • Voltage and Current c) On HV side of Converter Transformers in	• Breaker • Isolators	• Circuit Breaker Status	• Main1/Main2 protection	• Transformer differential protection (87T) • Non direction IDMT O/C & E/F protection (51,51N) • And any other as per requirement

			HVDC Stations • Voltage and Current				

5	Reactor	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MVAR	—	• Breaker • Isolators	—		—
6	FSC/TCSC	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MVAR	• Voltage and Current	• Bypass Breaker • FSC ON/OFF Status	• CB Status of each Module (FSC, MSR, MSC as applicable)		• Over current protection • Differential • And any other as per requirement
7	SVC	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MVAR	• Voltage and Current	• Breaker	• CB Status of each Module		• Over current protection • Differential • And any other as per requirement

8	Generator	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MW, MVAR, F, DF/DT for HV& LV Side	At the LV side of the GT of the Generating Units/ Step-Up Transformer of the SYNCON connected with 220 kV and above Bus: • Voltage and Current	• RGMO/FGMO ON/OFF Status • Breaker Status • Isolators	• RGMO/FGMO status • GT HV side CB status	V	• Generator Protection Trip (unit wise) • And any other as per requirement
9	STATCOM	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • MW, MVAR, F, DF/DT	• Voltage and Current	• Circuit Breaker of each Module Module MSR, MSC	• CB Status of each Module	—	• Over current protection • Differential • And any other as per requirement
10	Phase Shifter	• **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} • **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} • HV & LV MW / MVAR F, DF/DT	• Voltage and Current	• Circuit Breaker	• CB Status		• Over current protection • Differential • And any other as per requirement

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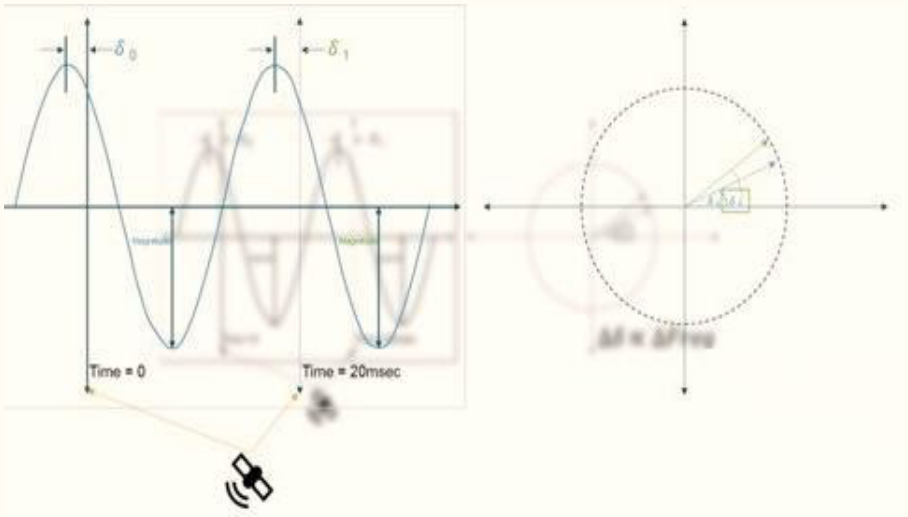
Guidelines for Unified Philosophy for Placement of Phasor Measurement Units (PMUs) in Indian Grid



GOVERNMENT OF INDIA
MINISTRY OF POWER
CENTRAL ELECTRICITY AUTHORITY

March, 2025

Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMUs) in Indian Grid

March, 2025

Table of Content

1. Introduction

India's power grid is one of the largest in the world, spanning different regions with varying demand profiles, generation sources, and transmission elements. Increasing penetration of renewable energy RE), especially solar and wind, in Indian Grid, introduces variability and unpredictability in power generation. In such a scenario, the requirement of Phasor Measurement Units (PMUs) in the grid becomes crucial. PMUs are critical devices in Wide Area Monitoring Systems (WAMS). Phasor measurement units (PMUs) measure current and voltage by amplitude and phase at selected stations of the transmission system. The high-precision time synchronization (via GPS/ NavIC) allows comparing measured values (synchrophasors) from different substations far apart and drawing conclusions as to the system state and dynamic events such as power swing conditions.

Phasor Measurement Unit captures the Current and Voltage at a high sampling rate which enables estimation of the accurate phasor. The data in each PMU is time-synchronized via Global Positioning System (GPS)/ NavIC receivers and aggregated in the Phasor Data Concentrator (PDC). The phasors measured simultaneously provide snapshots of the conditions at monitored nodes. By comparing these snapshots, the steady state and also the dynamic state of critical nodes can be observed across transmission and sub-transmission networks.

Under URTDSM Phase-I Project, which was executed during 2014 - 2021, locations for PMU placement in the Indian Gird were selected based on the suggestion of Panel of Experts and availability of wide-band communication at the sub-stations. The data from PMUs is presently available at a resolution of 40 ms (25 frames per second). Subsequently, with the expanding Electric grid owing to expansion in Renewable Energy capacity addition, PMUs are being installed at more locations and elements. The objective of these guidelines is to define the criteria for placement of PMUs in Indian Electric Grid.

2. Existing Philosophy for Placement of PMUs

2.1 The following three guidelines/standards are prevalent with specified criterion for placement of PMU in Indian Electric Grid.

(i) Regulation 48 (6) of the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.

(ii) Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II.

(iii) "Interface Requirements" under the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017

2.2 <u>As per Sub-Committee Report on PMU Placement and Analytics under URTDSM Phase-II:</u> Based on the experience of installation of PMUs under URTDSM Phase-I, feedback was provided by Grid-India (erstwhile POSOCO) to CEA/ CERC and all stakeholders. Subsequently, National Power Committee, CEA vide letter 20.09.2021 set up a Sub-Committee to provide recommendations of the placement of PMUs in URTDSM phase-II and to suggest applications for deployment. The "Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II" suggested *inter alia* minimum criteria for placement of PMUs for URTDSM Phase-II. As per this report (Page No-68 of the report) following locations should have PMUs (Minimum Criteria):

(i) At one end of all 400 kV and above transmission lines

(ii) At the HV side of all ICTs connected to 220 kV and above

(iii) On HV side of coupling transformer of SVC/STATCOM for measurement of HV Bus voltage and current of coupling transformer

(iv) At one end of line wherever FSC/ TCSC are installed.

(v) On HV side of converter transformers for measuring HVAC bus voltage and current of converter transformer on each converter station.

(vi) On both ends of Inter-regional and trans-national tie lines and on boundary buses for such lines.

(vii) At the Generating Transformers (GTs) at LV side (having HV side of 220 kV and above) of the Generating units with capacity above 200 MW for Thermal units, 50 MW for Hydro units and 100 MW for Gas units.

(viii) On all 220 kV substations for measuring voltage of 220 kV bus and current of two lines/transformer catering to load centers.

(ix) All 132 kV and above ISTS lines in NER & Sikkim and important load centers.

(x) At RE developer end of the evacuating line connecting the Renewable Energy Pooling Stations (PS) to point of interconnection with the grid of 50 MW and above.

(xi) Islanding, Separating & Restoration Points- At one end of line which is connected to black start stations along with circuit breaker status via synchro phasors.

(xii) Fiber Optic should be covered under Phase – II for all the above locations of the URTDSM project.

(xiii) At all ICTs, Bus reactors, Switchable line reactors of critical substations.

2.3 As per Guidelines on "Interfacing Requirements" brought out under the Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017: Based on the inputs from NLDC and in consultation with all the stakeholders, CERC has notified these Guidelines on Interface Requirements vide Order dated 19.01.2024. These guidelines provide the signals that need to be telemetered from PMUs installed at any location. As per the guidelines the parameters to be telemetered from various sub-stations and generating stations with respect to PMU are as per the table given below:

SN	Description	Analog Points	Digital Points	Protection Signal
1	Line	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA}	–Main Breaker status –Tie Breaker status –Isolators	Main1/Main2 protection,
		CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA}		
		MW, MVAR, F , DF/DT		
2	Bays		- Breaker –Isolators	
3	Main Buses, Transfer Buses	– **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} F, DF/DT	Bus Sectionalizer, Bus Coupler Breaker	

4	Transformer/Coupling Transformer/Converter Transformer	– **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA}	–Breaker –Isolators	Main1/Main2 protection
		CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA}		
		MW/MVAR		
		for HV& LV Side		
5	Reactor	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA}	–Breaker –Isolators	
		CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA}		
		MVAR		
6	FSC/TCSC	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA}	–Bypass Breaker - –FSC ON/OFF Status	
		CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA}		
		MVAR		
7	SVC	VOLTAGE {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	Breaker	
8	Generator	VOLTAGE {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT for HV& LV Side	–RGMO/FGMO ON/OFF Status Breaker Status –Isolators	V
9	STATCOM	VOLTAGE {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} CURRENT {IRM, IYM,	-CB OF EACH MODULE MSR, MSC	

		IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT		
10	Phase Shifter	VOLTAGE {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} CURRENT {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} HV & LV MW / MVAR F, DF/DT	- CB	

2.4 As per Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022: As per Regulation 48(6) of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, it is mandatory to install PMUs at substations of 400 kV and above voltage level, switchyard of generating stations at 220 kV and above voltage level. The relevant extract of Regulation 48(6) is as under:

48 (6) Phasor Measurement Units:

(a) Synchrophasor measurement using Phasor Measurement Units along with fibre optic connectivity, Global Positioning System Receiver and communication equipment shall be provided for monitoring the entire interconnected grid on real time basis at substations of 400 kV and above voltage level, switchyard of generating stations at 220 kV and above voltage *level, Alternating Current side of converter bays of High Voltage Direct Current stations and pooling point of renewable energy generating stations of fifty mega watt and more and Battery Energy Storage System of fifty mega watt and more.*

(b) Phasor Measurement Units shall comply with IS 60255-118-1-2018.

(c) The dispersedly located Phasor Measurement Units shall communicate with Phasor Data Concentrators installed at certain strategic locations at State, Regional and National level.

2.5 It has been observed that existing criteria/ philosophies as mentioned above for placement of PMUs in the substations are not uniform. The said guidelines are not aligned with each other. Therefore, there is a need to harmonise these varying philosophies.

3. Committee for the Unified Philosophy for Placement of PMUs in Indian Grid:

A committee was constituted vide letter No CEA-PS-14-12/9/2024-PSETD Division dated 04.10.2024 to study the different guidelines for the requirement of PMU installation currently in force in the country and to suggest ways to harmonize the requirements for placement of PMUs into one single document. The draft Guidelines were formulated based on the inputs from the committee members. Subsequently, the first meeting of the Committee was held on 05.12.2024 to discuss the draft "Guidelines for Unified Philosophy for placement of Phasor Measurement Units (PMUs) in Indian Grid". The second meeting of the Committee was held on 27.01.2025 in which Analytics Tool Developers, viz., M/s Electric Power Group (EPG) and M/s GE were invited for taking their opinion regarding the placement of PMUs. Based on the discussion during the meeting and recommendations of the Committee, this Unified Philosophy for placement of PMUs in Indian Grid has been finalised.

4. General Requirements of PMUs

4.1 PMU shall comply with the latest version of IS/IEC/IEEE 60255-118-1 and IEEE C37.118.2 Standards as amended. PMU shall include the supporting components such as fiber optic connectivity, Navigation with Indian Constellation (NavIC) and Global Positioning System (GPS) based time receiver system and associated network Ethernet Switches. The PMU shall support measurement of minimum two feeders or elements (i.e. two sets of three phase voltage and current phasors).

4.2 The PMU shall support data reporting rates of 25 and 50 frames per second for 50 Hz System. For RE generating plants, BESS and other grid connected invertor/ convertor based equipment including the hybrid generation plant, PMU shall support reporting rate of minimum 100 frames per second. PMUs shall communicate with the Phasor Data Concentrators (PDCs) installed at strategic locations at respective State, Regional and National Level.

4.3 The PMUs shall be able to acquire/measure/calculate at least the following signals and report it to the PDCs specified above:

a) 3-phase voltage Phasors, (Magnitude and angle),
b) 3-phase current Phasors, (Magnitude and angle),
c) Positive sequence voltage, (Magnitude and angle),
d) Positive sequence current, (Magnitude and angle),
e) Circuit Breaker Status (ON/OFF)
f) Protection operated status
g) Frequency (Hz)
h) Rate of Change of Frequency (ROCOF)-df/dt
i) Analog Values (MW, MVAR)

5.0 Criteria for placement of PMUs

Criteria for placement of PMUs in the system shall be as per **Annexure-I**. This criteria specifies the locations, the elements on which PMUs are required at specified location and the signals/data to be reported by the PMUs.

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Annexure-I

Criteria for Placement of PMUs (Location, Elements) and Signals to be measured and reported by PMUs

SN	Locations for Placement of PMU	Elements to be considered	Signals to be measured and reported by PMUs		
			Analog Points	Digital Points	General List of Protection Signals $
1.	Substations of 400 kV and above Voltage Level	At one end of all Transmission Line Bays of 400 kV and above. Note: Of the two ends of the line, PMU needs to be provided at only ONE end	• Voltage and Current • MW and MVAR	Circuit Breaker (CB) Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 400 kV and above	Bus voltage and frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker back up protection (50LBB) And any other signal as per requirement

2.	Switchyard of 220 kV and above voltage level of Generating Stations (200 MW and above for Thermal, 50 MW and above for Hydro (including Pump Storage plants), 100 MW and above for Gas, 200 MW and above for Nuclear and 100 MVA and above for SYNCON)	At the LV side of the GT of the Generating Units/ Step-Up Transformer of the SYNCON connected with 220 kV and above Bus	• Voltage and Current • MW, MVAR	RGMO/FGMO status, GT HV side CB status	Generator Protection Trip (unit wise) • And any other as per requirement
		Bus bars of 220 kV and above at Generating Stations	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement
3.	Substations of 220 kV and above voltage level RE Generating stations with renewable/ Hybrid plants of 50 MW and more.	All Transmission Line Bays of 220 kV and above	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement

		Bus bars of 220 kV and above	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50lbb) And any other as per requirement
4.	Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more	All Transmission Line Bays of 220 kV and above emanating from RE Pooling station to other non-generating sub-station.	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 220 kV and above	Bus Voltage and Frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement

		HV side of 765/400 kV ICTs and in the absence of 765 kV Bus, on the HV side of 400/220 kV ICT.	• Voltage and Current • MW and MVAR	CB Status	Protection Trip operated • Transformer differential protection (87T) • Non direction IDMT O/C & E/F protection (51,51N) And any other as per requirement
5.	High Voltage Direct Current stations (HVDC)	On HV side of Converter Transformers in HVDC Stations	• Voltage and Current • MW and MVAR	CB Status	Protection Trip operated • Transformer differential protection (87T) • Non direction IDMT O/C & E/F protection (51,51N) And any other as per requirement
6.	Stations with STATCOM/ FSC/ TCSC/ SVC/ Phase Shifter	On HV side of STATCOM/ FSC/ TCSC/ SVC	• Voltage and Current • MW and MVAR	CB Status of each Module (FSC, MSR,	Protection Trip operated

		On both Primary & Secondary sides of Phase Shifter		MSC as applicable)	• Over current protection • Differential And any other as per requirement
7.	Battery Energy Storage Stations (BESS) of 50 MW and more	At Line bay of 132 kV and above of Battery Energy Storage Systems	• Voltage and Current • MW and MVAR	CB Status, Controller Status, RGMO/ FGMO Status, Modes (Energy Storage, Frequency Regulation etc.,)	Protection Trip operated LVRT, HVRT And any other as per requirement
8.	All ISTS Lines in NER and Sikkim of 132 kV and above	At one end of all Transmission Line Bays of 132 kV and above in NER and Sikkim. Note: Of the two ends of the line, PMU needs to be provided at only ONE end	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
9.	Inter-Regional/Trans-national Tie lines at 132 kV and above	At both ends of Line Bays of all Inter-Regional and Trans-National tie lines	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59)

					• Main1+Main2 Protection (Combined) And any other as per requirement
10	220 kV Substations: only Stations catering to Metropolitan cities.	At one end of all Transmission Line Bays of 220 kV and above Note: Of the two ends of the line, PMU needs to be provided at only ONE end	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 220 kV	Bus voltage and frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) And any other as per requirement
11	Bulk consumers at 132 kV and above	At the one end of 132 kV and above	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2)

					• Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement
		Bus bars of 132 kV and above	Bus voltage and frequency and DF/DT	Bus Sectionalizer/ Bus Coupler wherever applicable	Bus Bar Protection operated • Bus bar differential protection (87B) • Local breaker backup protection (50LBB) • And any other as per requirement

12	Islanding, Separating and Restoration Points-	At one end of line which is connected to black start stations, islanding & restoration points	• Voltage and Current • MW and MVAR	CB Status	• Distance protection relay (21-1/21-2) • Over Voltage Protection (59) • Main1+Main2 Protection (Combined) And any other as per requirement

$ The list of protection signals are general in nature. The actual protection signals shall be decided during the execution stage of the Projects in consultation with the GRID INDIA. The actual signals shall be provided based on the availability of the spare ports in the PMUs. In any case, no additional PMUs shall be installed just for the capturing the protection signals.

Note:

1. *Wherever Line Voltage/Bus Voltage and Line Current are mentioned above, it means 3-phase Voltages and 3-phase Currents.*
2. *In One-and-Half-Breaker Scheme, CB Status means Status of both Main and Tie Breakers.*
3. *For NER: 132 kV and above Voltage level shall be considered in place of 220 kV and above*

Annexure-II

CEA-PS-14-12/9/2024-PSETD Division I/43540/2024

सत्यमेव जयते

भारत सरकार/ Government of India
विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Power System Engineering & Technology Development Division

Date: 04.10.2024

Office Order

विषय: Constitution of Committee to examine the various guidelines currently in force for the PMU installation and to suggest the ways to harmonize the requirements into one single guideline - reg.

महोदया/ महोदय,

This is in reference to the minutes of the meeting issued vide dated 18.07.2024 of the meeting held on 20.06.2024 for clarifications regarding the installation of Phasor Measurement Units (PMUs) wherein Member (Power System), CEA advised to examine the various PMU guidelines currently in force viz., CERC interface guidelines, CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 and Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II.

2. In the view of above the committee is constituted with following members.

1.	Member (Power System), CEA	Chairman
2.	Chief Engineer (NPC), CEA	Member
3.	Chief Engineer (PCD), CEA	Member
4.	Representative of CTUIL	Member
5.	Representative of Powergrid	Member
6.	Representative of Grid India	Member
7.	Representative of NTPC	Member
8.	Representative of NHPC	Member
9.	Representative of EPTA	Member
10.	Representative of Independent Power Producers Association of India (IPPAI)	Member
11.	Representative of CPRI	Member
12.	Representative of National Physical Laboratory (NPL)	Member
13.	Representative of Sustainable Projects Developers Association(SPDA)	Member
14.	Representative of Indian Wind Power Association (IWPA)	Member
15.	Director (PSE&TD), CEA	Member Convener

तीसरी मंजिल,सेवा भवन, आर. के. पुरम-I, नई दिल्ली-110066 टेलीफैक्स: 011-26732304 ईमेल: ce-psetd@nic.in वेबसाइट:www.cea.nic.in
3rd Floor, Sewa Bhawan, R.K Puram-I, New Delhi-110066 Telefax: 011-26732304 Email: ce-psetd@nic.in Website: www.cea.nic.in

f- JEIC (PMRP)

3. The committee shall study the different guidelines for the requirement of PMU installation currently in Force in the country and shall suggest the ways to harmonize the requirements for PMU installation into one single guidelines.

4. The committee shall finalise the single guidelines within three months of the constitution of the committee.

This issues with the approval of Competent Authority.

भवदीय,

4/10/2024

(भंवर सिंह मीना/ Bhanwar Singh Meena)

निदेशक/ Director

To,

CEO, CTUIL, 2nd Floor, Corporate Centre, Plot No:2, "Saudamini",Sec-29, Near IFFCO Chowk, Gurgaon	pcgarg@powergrid.in Cc: kksarkar@powergrid.in rakesh.kumar@powergrid.in
CMD, Powergrid Corporation of India Ltd. Saudamini, Plot No. 2, Sector – 29, Gurgaon – 122001 (Haryana)	cmd@powergrid.in tyagir@powergrid.in
M/s Grid Controller of India limited -9 (1st Floor), Qutab Institutional Area, Katwaria Sarai, New Delhi -110016	cmd@grid-india.in Cc: vivek.pandey@grid-india.in manas@grid-india.in priyam.jain@grid-india.in
CMD, NTPC Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road, New Delhi - 110003	cmd@ntpc.co.in
CMD, NHPC Limited, NHPC Office Complex, Sector-33, Faridabad - 121003 (Haryana)	cmd@nhpc.nic.in
Electric Power Transmission Association	ddg.epta@epta.in epta.dg@gmail.com
Independent Power Producers Association of India (IPPAI), Diamond House, 2nd Floor, 11, Primrose Road, Bengaluru - 560025	dharun@ippaimail.org gulrez@ippaimail.org
Director General, Central Power Research Institute, Prof. Sir C.V. Raman Road, Post Box No: 8066, Bengaluru	dgcpri@cpri.in
Director, CSIR-National Physical Laboratory,	director@nplindia.org

Annexure-III

CEA-PS-14-12/9/2024-PSETD Division I/45349/2024

सत्यमेव जयते

भारत सरकार/ Government of India
विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Power System Engineering & Technology Development Division

सेवा में,

<as per attached list>

विषय: Minutes of the meeting held on 05.12.2024 to examine the various guidelines currently in force for the PMU installation and to suggest the ways to harmonize the requirements into one single guidelines-reg.

महोदया/ महोदय,

A meeting of the committee was convened on 05.12.2024 at 11:00 hrs at Manthan Conference Hall, 2nd Floor, Sewa Bhawan, R.K. Puram Sector-1, New Delhi under the chairmanship of Member (PS), CEA to examine the various guidelines currently in force for the PMU installation and to suggest the ways to harmonize the requirements into one single guidelines.

The minutes of the meeting is attached for your information and necessary action.

भवदीय,

Signed by Pankaj Kumar Verma
Date: 17-12-2024 13:03:48

(पंकज कुमार वर्मा/Pankaj Kumar Verma)
उप-निदेशक/Dy. Director

Copy To,

1. Chief Engineer, PCD Division, CEA
2. Chief Engineer, NPC, CEA
3. Director (PSE&TD), CEA
4. SA to Member (PS), CEA
5. PS to Chief Engineer (PSE&TD), CEA

तीसरी मंजिल,सेवा भवन, आर. के. पुरम-I, नई दिल्ली-110066 टेलीफैक्स: 011-26732435 ईमेल: ce-psetd@nic.in वेबसाइट:www.cea.nic.in
3rd Floor, Sewa Bhawan, R.K Puram-I, New Delhi-110066 Telefax: 011-26732435 Email: ce-psetd@nic.in Website: www.cea.nic.in

To,

1.	CMD, NTPC Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road, New Delhi-110003	cmd@ntpc.co.in Sachingarg01@ntpc.co.in ankurtripathy@ntpc.co.in
2.	CMD, Powergrid Corporation of India Ltd. Saudamini, Plot No. 2, Sector – 29, Gurgaon – 122001 (Haryana)	awanish.kumar@powergrid.in mohan.kishor@powergrid.in Cc: cmd@powergrid.in tyagir@powergrid.in
3.	M/s CTUIL, 2nd Floor, Corporate Centre, Plot No:2, "Saudamini",Sec-29, Near IFFCO Chowk, Gurgaon	tanay@powergrid.in rshakya@powergrid.in Cc: pcgarg@powergrid.in ashok@powergrid.in
4.	CMD, NHPC Limited, NHPC office complex, Sector-33, Faridabad - 121003	surendramishra@nhpc.nic.in Cc: cmd@nhpc.nic.in
5.	Director, CSIR-National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi - 110012	avni.khatkar@nplindia.org Cc: director@nplindia.org
6.	M/s Grid Controller Of India Limited (1st Floor), Qutab Institutional Area, Katwaria Sarai, New Delhi-110016	amangautam@gridindia.in Cc: cmd@grid-india.in
7.	Director General, Central Power Research Institute, Prof. Sir C.V. Raman Road, Post Box No: 8066, Bengaluru	kaliappan@cpri.in Cc: dgcpri@cpri.in
8.	Electric Power Transmission Association	sumeet.sharma@adani.com Cc: ddg.epta@epta.com epta.dg@gmail.com
9.	Indian Wind Power Association Door – E, 6th Floor, Shakti Towers-1 766, Anna Salai, Chennai – 600002	kmn@windplus.in Cc: secretary.general@windpro.org jwpahq@windpro.org
10.	President, Sustainable Projects Developers Association (SPDA), 910, 9th floor Surya Kiran Building, 19, KG Marg, New Delhi - 110001	upendra.kumar@avaada.com ankit.gupta@avaada.com Cc: spda@solarpda.com spda@spdaonline.com

11.	Independent Power Producers Association of India (IPPAI), Diamond House, 2nd Floor, 11, Primrose Road, Bengaluru-560025	dharun@ippaimail.org gulrez@ippaimail.org divya@ippaimail.org
12.	M/s Adani Power	Sunnykumar.singh@adani.com
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16.	M/s Avada Energy	pawan.kumar2@avaada.com

Minutes of the meeting held on 05.12.2024 to examine the various guidelines currently in force for the PMU installation and to suggest the ways to harmonize the requirements into one single guideline.

1. List of participants is at Annexure-III-B. No member from Independent Power Producers Association of India (IPPAI) and Indian Wind Power Association participated in the meeting.

2. Member (Power Systems) welcomed all the participants and stated that as discussed in the meeting held on 20.06.2024, there are multiple guidelines available regarding the installation of PMUs and there is need to harmonize these guidelines into one single guideline. In this regard, EPTA in consultation with POWERGRID has prepared a draft unified guidelines. These draft guidelines have been circulated among all the Members of the Committee.

3. Deputy Director (PSETD), CEA, displayed a comparative statement of provisions for PMU in different documents which is attached at Annexure-III-A. The locations for which deliberations were held are listed below and the remaining locations mentioned in Annexure-I were agreed by all.

I. PMU Locations at Substations of 400 kV and above Voltage Level

4. As per the Draft Guidelines, PMU locations at 400 kV and above Voltage level Substation were proposed for all the transmission lines bays of 400 kV and above and bus bars of 400 kV and above. The Representative of Grid India stated that PMU at any one end of the line is sufficient to provide visibility of the Network.

5. The Representative of POWERGRID stated that in case of PMU to be installed at one end the transmission line, it will be difficult to decide whether the PMU will be under the scope of the existing substation owner or the new TSP. Therefore, PMU should be installed at both ends of the 400 kV and above transmission line to avoid any ambiguity in the scope of TBCB based transmission Scheme.

6. Chief Engineer (PSE&TD), CEA stated that in case of different owner of the bays at both ends of the line, the scope of PMU installation will be clearly specified in the RfP document. He suggested that in the RfP the provision of the space for PMU for future lines may be mentioned.

7. Chief Engineer (NPC), CEA stated that optimal location should be selected for installation of PMU. Installing PMU at both ends will not provide additional information. Grid India agreed and stated that installation of PMU at one end only will be sufficient to meet the requirement of the grid.

8. Based on the discussion, it was decided that PMUs are to be installed at the one end of the Transmission line of 400 kV and above.

9. All participants agreed that there is no requirement to install the PMUs in the Transformer bays.

II. PMU Locations at Switchyard of 220 kV and above voltage level of Generating Stations (200 MW and above for Thermal, 50 MW and above for Hydro and 100 MW and above for Gas)

10. Representative of NTPC was in agreement with the above requirement of PMU installation for the upcoming projects. However, he raised the concern that PMU location for the existing substation of 220 kV and above voltage level of Switchyard should be decided after a proper assessment of the requirement of PMU.

11. Representative of Grid India suggested that Nuclear Power Plants Pumped Storage Plant (PSP) should also be considered for PMU installation for better visibility.

12. Based on the discussion, it was agreed that for the new Generating Unit (all Nuclear units, Thermal units with 200 MW and above, Hydro units with 50 MW and above, all the Pump Storage Plant) connected with 220 kV and above switchyard, PMUs are to be installed at the LV side of Generator Transformer. In addition to this, PMUs are to be installed at 220 kV Switchyard for all Transmission Lines of 220 kV and above and Bus bars of 220 kV and above. In case of North Eastern region and Sikkim, PMUs are to be installed for LV side of Generator Transformer connected with 132 kV and above Voltage, for all Transmission Lines of 132 kV and above and Bus bars of 132 kV and above.

13. It was agreed that for the existing Generating units PMU requirements shall be based on the assessment.

III. PMU Locations at Substations of 220 kV and above voltage level of RE Generating stations with renewable/ Hybrid plants of 50 MW and more

14. It was agreed that at the RE Generating Station (Solar Park Pooling Station) with renewable/ Hybrid plants of 50 MW and more, PMUs are to be installed at all the 220 kV and above transmission line and Bus bars of 220 kV and above. For the line connecting the RE generating station and the RE pooling station, PMU are to be installed at the RE developer's end only. For the line emanating from RE Generation plant, PMUs need not be installed at the other end.

IV. PMU Locations at Stations with STATCOM/ FSC/ TCSC/ SVCC Phase Shifter

15. It was agreed that no separate PMUs for FSC/TCSC are required as the PMU located at one of the ends of the line will be sufficient to measure the voltage and current. However, it should be ensured that in the case of FSC/TCSC, the digital signals pertaining to circuit breaker status of each module of FSC/TCSC are measured by the PMU. Therefore, PMU should be located at the end of the line where FSC/TCSC is installed.

16. It was agreed that in the existing line if later on FSC/TCSC is installed then it should be ensured that PMU is installed at the end where FSC/TCSC is installed irrespective of whether PMU is installed on the other end.

17. It was agreed that PMUs are to be installed at HV side of the coupling Transformer for the Synchronous Condenser (SynCon).

V. PMU Location at Inter-Regional/ Trans-national Tie Lines

18. It was agreed that many inter-regional level lines exist at voltage levels lower than 132 kV, therefore, to bring more clarity only lines of 132 kV and above may be included in elements to be considered under Inter-Regional/ Trans-national Lines for PMUs installations.

VI. PMU Location at Islanding, Separating and Restoration Points

19. It was discussed that under URTDSM phase-II guidelines, PMUs are to be installed at one end of the line which is connected to black start stations along with circuit breaker status via synchro phasors for Islanding, Separating and Restoration Points.

20. Representative of Grid-India stated that PMU at Islanding, Separating and Restoration points helps in quick and smooth restoration after a Blackout. Therefore, PMUs should also be installed at these locations.

21. After deliberation, it was agreed that PMUs are to be installed at any one end of the line which is connected to the black start stations.

VII. PMU Location at Load Centre

22. Under URTDSM phase-II guidelines, PMUs are to be installed on all 220 kV substations for measuring voltage of 220 kV bus and current of two lines/transformer catering to load centers. It was opined that covering all load centers will lead to the installation of PMUs to all the Substations. Therefore, it was agreed that PMUs are to be installed at 220 kV and above substations catering the load of Metropolitan cities.

23. Representative of NPL stated that PMU should be tested as per the applicable Indian Standard i.e IS/IEC/IEEE 60255-118-1. She further mentioned that testing facility for PMU is available with NPL as well as CPRI. However, PMUs are not getting tested in their laboratory since these are not getting manufactured in India. She further stated that as of now there is no testing facility available with NPL to test PMU as per IEEEC 37.118.2. However, NPL is ready to extend the testing facility if there is the requirement to do so.

24. Representative of CPRI stated that IEEE C37.242-2021 which is about the installation of PMU may also be specified. He further stated that IEC 61850-90-5 which is about transfer of data from PMU to next level may also be incorporated in the unified

guidelines. POWERGRID stated that the existing Phasor Data Concentrator (PDC) are not compatible with IEC 61850-90-5. Therefore, it will not be possible to use the IEC 61850-90-5 for the PMUs communicating the data with existing PDC. Chief Engineer (PSE&TD) suggested that this provision may be included where new PDC are being installed. He requested POWERGRID to provide the feedback after discussing with PMUs manufacturers regarding inclusion of IEC 61850-90-5.

25. The Representative of CPRI stated that as per the General requirement of PMU clause of the draft guidelines, the PMU shall support data reporting rates of 25 and 50 samples per second for 50 Hz System and 100 samples per second for RE generating plants including the hybrid generation plant. However, as on date no manufacturers have tested their PMU for 100 samples per second. POWERGRID stated that some of the manufacturers have confirmed 100 samples per second. Grid India stated that for RE generating plants, PMU should support reporting rate of minimum 200 samples per second. In this regard, Chief Engineer (PSE&TD), CEA requested POWERGRID to check the availability of PMUs with the sampling rate of 200 samples per second.

26. Grid India suggested to mention the sampling rate of 25 and 50 samples per second for Generating Plant, BESS and other Grid-connected Inverter.

27. Grid India stated that as per draft guidelines, the protection signal for line i.e Main-1 and Main-2 are to be provided. However, these information are of no use to Grid India. The information required in the case of the line is the actual Protection zone operated. POWERGRID stated that providing the information of all the protection will lead to more number of inputs to PMUs. However, PMUs have constraints regarding the number of input signals. If there is the requirement of all the protection signals then it may happen that they have to install an additional PMU for each line. Chief Engineer (PSETD), CEA requested Grid India to modify draft guidelines accordingly.

28. Chief Engineer (PSETD), CEA requested POWERGRID to check the compatibility of PMU with NAVIC based time receiver system.

29. TSPs raised the issue that a single requirement of PMUs signal is not coming from Grid India. M/s Adani stated that WRLDC is asking them to provide the PMU signal for the Transformer bays at one of their stations. Grid India stated that as per CERC guidelines signals at the Transformer bays are to be provided if PMUs are installed at the transformer bays. In case PMUs are not installed at the transformer bay then signals for transformer bays are not required. Further, he stated that as per these draft guidelines, there is no requirement to install the PMU in the transformer bay. Chief Engineer (PSETD), CEA requested Grid India to convey the requirement to WRLDC accordingly. Further Chief Engineer (PSETD), CEA requested Grid India to issue the instruction to all RLDCs to maintain uniformity regarding any issue.

The meeting was concluded with following decisions.

(i) As per the discussion in the meeting Grid India may carry out the necessary changes in the draft guidelines and submit within one week.

(ii) POWERGRID may take the feedback from PMU manufacturers regarding the sampling rate of 200 samples/ sec, availability of IEC 61850-90-5 compliant PMUs and compatibility of PMU with NAVIC based time receiver system.

(iii) Grid India may instruct WRLDC to remove the requirement of PMUs in the Transformer bay.

The meeting ended with thanks to the chair.

Annexure-III-A

Comparative statement of provisions for PMU in different documents

S.No.	Station	Location for PMU Placement		
		Report of the Sub-Committee on PMU Placement and Analytics under URTDSM Phase II	**CERC guidelines on "Interface Requirements"**	**Draft Guidelines**
1.	Substations of 220 kV and above Voltage Level	➢ At one end of all 400 kV and above transmission lines ➢ At the HV side of all ICTs connected to 220 kV and above	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	➢ All Transmission Line Bays of 400 kV and above ➢ Bus bars of 400 kV and above
2.	Switchyard of 220 kV and above voltage level of Generating Stations	Generating units with capacity above 200 MW for Thermal units, 50 MW for Hydro units and 100 MW for Gas units ➢ Generating Transformers (GTs) at LV side (having HV side of 220 kV and above)	➢ Generator Transformer (both HV and LV side)	Substations of 220 kV and above voltage level of Generating Stations (200 MW and above for Thermal, 50 MW and above for Hydro and 100 MW and above for Gas) ➢ Generating Units connected (through GT) with 220 kV and above Bus ➢ All Transmission Lines of 220 kV and above ➢ Bus bars of 220 kV and above
3.	Substations of 220 kV and above voltage level	➢ At RE developer end of the evacuating line connecting the Renewable Energy Pooling Stations (PS) to point of	➢ Line ➢ Bus bars ➢ Transformer	tations of 220 kV and above voltage level of RE Generating stations

	of RE Generating stations	interconnection with the grid of 50 MW and above.	➢ Reactor	with renewable/ Hybrid plants of 50 MW and more. ➢ All Transmission Lines of 220 kV and above ➢ Bus bars of 220 kV and above
4.	Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more	➢ At one end of all 400 kV and above transmission lines ➢ At the HV side of all ICTs connected to 220 kV and above	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	Renewable Energy (RE) Pooling Stations of 220 kV and above voltage level connecting 50 MW and more ➢ All Transmission Line Bays of 220 kV Level ➢ Bus bars of 220 kV and above
5.	High Voltage Direct Current stations (HVDC)	➢ On HV side of converter transformers	➢ Converter Transformer	➢ AC side of Converter transformers in HVDC Stations
6.	Stations with STATCOM/ FSC/ TCSC/ SVCC/ Phase Shifter	➢ On HV side of coupling transformer of SVC/STATCOM ➢ At one end of the line wherever FSC/ TCSC are installed.	➢ Coupling Transformer	➢ HV side of STATCOM/ FSC/ TCSC/ SVCC/Phase Shifter
7.	Battery Energy Storage Stations (BESS) of 50 MW and more	Not included	Not included	➢ Battery Energy Storage Systems
8.	All ISTS Lines in NERC Sikkim of 132kV and above	➢ All 132 kV and above ISTS lines in NER and Sikkim and important load centers	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	➢ Line Bays of all 132 kV and above lines
9.	Inter-Regional/Trans-national Tie lines	➢ Both ends of Inter-regional and trans-	➢ Line	➢ Line Bays of all Inter-Regional

		national tie lines ➢ Boundary buses for such lines.	➢ Bus bars ➢ Transformer ➢ Reactor	and Trans-National tie lines
10.	All 220 kV substations cater to load centers.	➢ 220 kV Bus bars ➢ Two lines/transformer catering to load centers	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	Not included
11.	Islanding, Separating and Restoration Points	➢ At one end of line which is connected to black start stations	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	Not included
12.	Critical substations	➢ ICTs ➢ Bus reactors ➢ Switchable line reactors	➢ Line ➢ Bus bars ➢ Transformer ➢ Reactor	Not included

Annexure-III-B

List of Participants

CEA

1. Sh. A.K. Rajput, Member (PS)
2. Ms Rishika Sharan, Chief Engineer (NPC)
3. Sh. Y. K Swarkar, Chief Engineer (PSE&TD)
4. Sh. Bhanwar Meena , Director (PSE&TD)
5. Sh. Satyendra Kumar Dotan, Director (NPC)
6. Sh. Pankaj Kumar Verma, Deputy Director (PSE&TD)
7. Sh. Bhavesh Mahawar, Assistant Director (PSE&TD)

NTPC

1. Sh. Sachin Garg, DGM(CC-OS)
2. Sh. Ankur Tripathi, Sr Manager (PE-Electrical)

POWERGRID

1. Sh. Awanish Kumar, Chief Manager
2. Sh. Mohan Kishor.N, DGM

CTUIL

1. Sh. Rahul Kumar Shakya, Engineer
2. Sh. Tanay Jaiswal, Engineer Trainee

NHPC

Sh. Surendra Kumar Mishra , GM (O&M)

CSIR-NPL

Ms. Avni khatkar, Scientist

CPRI

Dr. Kaliappan Perumal

GRID INDIA

Sh. Aman Gautam, Manager

EPTA

1. Sh. Manvendra Deswal, DDG
2. Sh. Sumeet Sharma, VP, Adani
3. Sh. Sunny Kumar Singh, Manager, Adani
4. Sh. Anurag Patel, Chief Manager, Sterlite Power
5. Sh. Sahil Kumar, Asst. Manager, Sterlite Power
6. Md. Shaique Afjal , Lead- Regulatory Affairs & Policy Advisory, Apraava Energy
7. Md. Washim Alam, Sr Manager (BD & Regulatory), Apraava Energy
8. Sh. Lokendra Singh Ranawat, Head Regulatory, Indigrid

Sustainable Projects Developers Association (SPDA)

Sh. Pawan Kumar, GM, Avaada Energy

Annexure-IV

CEA-PS-14-12/9/2024-PSETD Division I/47196/2025

सत्यमेव जयते

भारत सरकार/ Government of India
विद्युत मंत्रालय/ Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority
विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Power System Engineering & Technology Development Division

सेवा मे,
<as per attached list>

विषय: **Minutes of the Meeting to examine the various guidelines currently in force for the Phasor Measurement Unit (PMU)installation and to suggest the ways to harmonize the requirements into one single guidelines**

महोदया/ महोदय,

A meeting of the committee was convened on 27.01.2025 at 15:00 hrs at Manthan Conference Hall, 2nd Floor, Sewa Bhawan, R.K. Puram Sector-1, New Delhi under the chairmanship of Member (PS), CEA to examine the various guidelines currently in force for the **Phasor Measurement Unit (PMU)** installation and to suggest the ways to harmonize the requirements into one single guidelines.

The minutes of the meeting is attached for your information and necessary action.

भवदीय,
Signed by Pankaj Kumar Verma
Date: 28-02-2025 13:13:20
(पंकज कुमार वर्मा /Pankaj Kumar Verma)
उप-निदेशक/Dy. Director

Copy To,

1. Chief Engineer, PCD Division, CEA
2. Chief Engineer, NPC, CEA
3. CE (ETI) Division
4. Director (PSE&TD), CEA
5. SA to Member (PS), CEA
6. PS to Chief Engineer (PSE&TD), CEA

To,

1.	CMD, NTPC Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road, New Delhi-110003	cmd@ntpc.co.in Sachingarg01@ntpc.co.in ankurtripathy@ntpc.co.in amaurya@ntpc.co.in abhisheksaini@ntpc.co.in amanna@ntpc.co.in
2.	CMD, Powergrid Corporation of India Ltd. Saudamini, Plot No. 2, Sector – 29, Gurgaon – 122001 (Haryana)	mohan.kishor@powergrid.in sanjay4kumar@powergrid.in Cc: cmd@powergrid.in tyagir@powergrid.in
3.	M/s CTUIL, 2nd Floor, Corporate Centre, Plot No:2, "Saudamini",Sec-29, Near IFFCO Chowk, Gurgaon	tanay@powergrid.in rshakya@powergrid.in Cc: ashok@powergrid.in
4.	CMD, NHPC Limited, NHPC office complex, Sector-33, Faridabad - 121003	surendramishra@nhpc.nic.in jaganathpani@nhpc.nic.in Cc: cmd@nhpc.nic.in
5.	Director, CSIR-National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi - 110012	avni.khatkar@nplindia.org Cc: director@nplindia.org
6.	M/s Grid Controller Of India Limited (1st Floor), Qutab Institutional Area, Katwaria Sarai, New Delhi-110016	amangautam@gridindia.in manas@grid-india.in Cc: cmd@grid-india.in
7.	Director General, Central Power Research Institute, Prof. Sir C.V. Raman Road, Post Box No: 8066, Bengaluru	kaliappan@cpri.in Cc: dgcpri@cpri.in
8.	Electric Power Transmission Association	sumeet.sharma@adani.com Cc:ddg.epta@epta.com epta.dg@gmail.com
9.	Indian Wind Power Association Door – E, 6th Floor, Shakti Towers-1 766, Anna Salai, Chennai – 600002	kmn@windplus.in cr.srinivas@enerfra.com Cc: secretary.general@windpro.org jwpahq@windpro.org

10.	President, Sustainable Projects Developers Association (SPDA), 910, 9th floor Surya Kiran Building, 19, KG Marg, New Delhi - 110001	upendra.kumar@avaada.com ankit.gupta@avaada.com pawan.kumar2@avaada.com Cc: spda@solarpda.com spda@spdaonline.com
11.	Independent Power Producers Association of India (IPPAI), Diamond House, 2nd Floor, 11, Primrose Road, Bengaluru-560025	dharun@ippaimail.org gulrez@ippaimail.org divya@ippaimail.org
12.	M/s Adani Power	Sunnykumar.singh@adani.com

Minutes of the meeting held on 27.01.2025 of the committee to examine the various guidelines currently in force for the Phasor Measurement Unit (PMU) installation and to suggest the ways to harmonize the requirements into one single guideline.

1. List of participants is at **Annexure-IV-A**.
2. At the outset of the meeting, Member (Power Systems), CEA welcomed all the participants and stated that based on the deliberation held during the first meeting held on 05.12.2024, a draft report was prepared and shared among committee members for their comments. The comments were received from GRID INDIA and POWERGRID. GRID INDIA is of the view that a discussion is essential to evaluate the inclusion of Interconnecting Transformers (ICTs) in the criteria, as these ICTs are currently utilized in critical applications for calculating inertia and short-circuit strength. Further POWERGRID has also commented on the list of protection signals required. Thereafter he requested to take the agenda points.

3. Deputy Director (PSETD), CEA stated that since GRID INDIA has requested to take the opinion of the Analytics Tool Developer regarding the placement of PMU, two Analytics Tool Developer i.e. M/s Electric Power Group (EPG) and M/s GE have been invited in the meeting.

4. Thereafter M/s EPG gave the presentation. The brief of the Presentation is as follows:
   (i) Followings are the factors which are key drivers for Synchrophasor Technology and Wide Area Measurement System (WAMS) Analytics.
      (a) Digitization of Economy: Power Electronics Controllers and High-Speed Computing and Communications
      (b) Integration of Renewables: Variability from IBRs reduces inertia and demands real-time monitoring.
      (c) Rising Power Demands: Large data centers and concentrated loads stress the grid.
      (d) Power Quality Issues: Voltage sags, harmonics, and instability require continuous monitoring.
      (e) Oscillations: Interconnected networks face local and inter-area oscillations.
      (f) Dynamic Grid Needs: Adaptation to real-time conditions like dynamic line ratings.
      (g) Resilience Challenges: Frequent disturbances require fast fault detection and recovery.

   (ii) Strategic Placement of PMUs is important. Fewer PMUs, when strategically located, can provide sufficient coverage for essential grid analytics. Focus should be on Important Buses, Tie lines, Inverter based Resources (IBRs) (RE) Point of common Coupling (PCC), High Voltage Direct Current (HVDC), Static VAR Compensators (SVCs), STATCOM, Large Data Centers and Generation buses.

   (iii) Following are the key analytics enabled by PMU:

(a) Voltage Stability and Sensitivity

- Purpose: Monitor Voltage profiles at buses to ensure grid stability and detect voltage anomalies.
- Need: Analyze voltage stability and sensitivity to maintain system reliability.
- PMU Requirements: Measure bus voltage.
- PMU Location: One end of the line.

(b) Oscillation Detection and Source Location

- Purpose: Identify and monitor power system oscillations and their sources like generation buses, major tie lines etc to enhance grid stability.
- Need: Analyze oscillation amplitude, damping, duration, and dissipating energy.
- PMU Requirements: Measure bus voltages and currents.
- PMU Location: One end of the line.

(c) Generator and System Modeling

- Purpose: Accurately capture real-time generator dynamics and system behavior for improved grid control.
- Need: Analyze voltages and currents to compare real and reactive power dynamics with simulation models.
- PMU Requirements: Measure bus voltage and currents.
- PMU Location: One end of the line (high-voltage side of the generator).

(d) Linear State Estimation (LSE)

- Purpose: Enhance grid observability, data validation, and calibration to improve traditional state estimation techniques.
- Need: Voltages and currents from buses for real-time state estimation.
- PMU Requirements: Measure bus voltage and currents.
- PMU Location: One end of the line.

(e) System Inertia

- Purpose: Real-time monitoring of system inertia to assess frequency stability and inertial awareness in asynchronous areas.
- Need: Monitor active power from all inputs into the bus and measure bus frequency.
- PMU Requirements: Measure bus voltage and all element currents.
- PMU Location: One end of the line.

(f) System Strength

- Purpose: Real-time monitoring of system strength to assess voltage stability and the impact of renewable energy (RE) resources.
- Need: Voltages and currents from all elements connected to the bus to evaluate system robustness.

- PMU Requirements: Measure bus voltage and all element currents.
- PMU Location: One end of the line.

(g) Phase Angle Difference Monitoring

- Purpose: Measure angle differences across key tie lines to assess angular stability and stress on the transmission network.
- Need: Monitor voltage, phase angles, and resynchronization conditions.
- PMU Requirements: Measure bus voltages and phase angles.
- PMU Location: Both ends of the line.

(h) Islanding Detection and Resynchronization

- Purpose: Identify and isolate portions of the grid during disturbances or faults and ensure seamless resynchronization.
- Need: Monitor voltage, angle differences, and frequency from both ends of the line.
- PMU Requirements: Measure bus voltages and currents.
- PMU Location: Both ends of the line.

(i) Line Parameter Measurements

- Purpose: Improve transmission models, enable dynamic line ratings, and enhance fault analysis.
- Need: Monitor voltages and currents from lines to evaluate resistance, reactance, and impedance.
- PMU Requirements: Measure bus voltage and currents.
- PMU Location: Both ends of the line.

(j) Fault Location

- Purpose: Accurately identify fault locations within the power system.
- Need: Use voltages and currents from both ends of the line to calculate the distance to the fault.
- PMU Requirements: Measure bus voltage and currents.
- PMU Location: Both ends of the line.

(iv) Strategic PMU Placement enables efficient observation of system dynamics, including voltage, frequency, and phase angles, with fewer PMUs.

(v) Analytics Coverage supports key functions like fault detection, oscillation monitoring, and system resilience with optimal PMU distribution.

(vi) Full observability can be achieved with approximately 1/3 PMU coverage, enhanced by Linear State Estimation technology.

5. Following queries were raised by the Committee members to the representative of M/s EPG.

   (i) Whether PMUs need to be installed at data centers (distribution level)?
   Response: Yes, PMUs need to be installed at data centers due to their high reactive power requirements. In the USA, it has been seen that sudden change in the load at the data centre are leading to Oscillations Therefore it becomes essential that PMUs are to be installed at data centers.

   (ii) How does the System Strength tool work?
   Response: The tool measures effective Short Circuit Ratio (SCR) using Thevenin equivalent. To evaluate the strength of a bus, PMUs need to measure all elements connected to it.

   (iii) Do PMUs need to be installed on ICTs (Interconnecting Transformers)?
   Response: Yes, PMUs need to be installed on ICTs if they are connected to the Nodes which are used for Inertia and Strength applications, as these measurements require monitoring all elements connected to the particular bus where inertia or strength is being evaluated.

   (iv) Do PMUs need a processor or data filtering hardware?
   Response: No, PMUs do not require a processor or hardware for data filtering. This is managed entirely by software.

   (v) How does the Inertia tool work?
   Response: The inertia tool uses the change in active power relative to frequency to assess system inertia.

   (vi) Can the locking and unlocking phenomena use NAVIC for synchronization?
   Response: Yes, switching to NAVIC is possible, provided the pulse synchronization concept is maintained.

   (vii) What is the current resolution capability of PMUs?
   Response: Based on present trends, a resolution of 100 Hz is sufficient.

   (viii) Do different buses with sectionalizers need to be measured using PMUs?
   Response: Yes, it is necessary to measure all sectionalized buses using PMUs to ensure comprehensive data and observability.

6. It was deliberated that to evaluate the inertia at/strength of a bus, PMUs need to measure all elements connected to the bus including ICTs. Since the Nodes to which RE Pooling stations are connected typically have issues relating to inertia and strength, it was opined that in case of RE Pooling Substation, PMUs need to be installed on HV side of 765/400 kV ICTs and in the absence of 765 kV Bus, on the HV side of 400/220

kV ICT. Grid-India suggested that in the already executed Project, five to eight substations in each region may be identified where all elements including ICTs will be monitored using PMUs.

7. On the list of protection signals as specified in the draft report, representative from the POWERGRID stated that the list of protection signals as mentioned in the Draft report is long list which may lead to installation of the additional PMUs to provide the mentioned list of Protection signals. Representative of GRID INDIA stated that if there are ports available in the PMUs to capture the signals then the mentioned protection signals may be provided. There is no such requirement to install the additional PMUs to provide the all the Protection Signals mentioned in the report. It was opined that the list may be kept in the report as a general list. However, the actual protection signals which may be provided based on the availability of the spare ports can be decided during the execution stage in consultation with GRID INDIA.

8. On the applicability of guidelines, it was decided that as per the Minutes of the meeting (MoM) issued of the meeting held under the chairmanship of Member (PS), CEA on 20.06.2024, for the Transmission Scheme for which bidding was completed after December, 2022 but before January 2024 i.e. date of notification of CERC Interface Guidelines, PMUs shall be installed as per RfP document. For the transmission Scheme for which bid is to be completed after January, 2024, PMUs shall be installed as per CERC Interface Guidelines. The Guidelines on Unified Philosophy for Placement of Phasor Measurement Unit (PMU) in Indian Grid shall be effective from the date of issue of the guidelines. These guidelines shall be applicable for the underbidding Schemes for which price bid has not been submitted and for all the upcoming Schemes. The applicability of these guidelines shall be mentioned in the letter while issuing the guidelines.

9. The meeting was concluded with the decision that based on the above deliberation, the guidelines shall be modified and issued.

   The meeting ended with thanks to the chair.

*****

Annexure-IV-A

List of Participants

CEA

1. Sh. A.K. Rajput, Member (PS)
2. Sh. N.R.L.K. Prasad, Chief Engineer (PSE&TD)
3. Sh. Satyendra Kumar Dotan, Director (NPC)
4. Sh. Pankaj Kumar Verma, Deputy Director (PSE&TD)
5. Ms Priyam Srivastava, Deputy Director (PCD)

CTUIL

Sh. Tanay Jaiswal, ET

GRID-INDIA

1. Sh. Manas R. Chand, DGM
2. Sh. Aman Gautam, Manager

POWERGRID

1. Sh. Mohan Kishor N., DGM
2. Sh. Sanjay Kumar, Manager

NHPC

Sh. Jaganath Pani, Sr. Manager

NTPC

1. Sh. Avinash Manna, DGM
2. Sh. Ankur Tripathi, Sr. Manager
3. Sh. Akhileshwar Maurya, Sr. Manager
4. Sh. Abhishek Saini, Dy. Manager

CSIR-NPL

Ms. Avni Khatkar, Scientist

ADANI

1. Sh. Sumeet Sharma, Vice President
2. Sh. Sunny Kumar Singh, Manager

STERLITE

Sh. Anurag Patel, Chief Manager

EPG

1. Dr. Krish Narender, COO & Technology Lead
2. Sh. Sudhir Gadh, Ex. Director

GE

Sh. Dayakishan Bhardwaj