

Stakeholder Feedback and IESO Response

Updates to IESO Monitoring Requirements: Phasor Data – November 19, 2020 webinar

Following the November 19, 2020 public webinar to discuss the approach for the roll-out of synchrophasor technology in Ontario, the Independent Electricity System Operator (IESO) received feedback from participants on the revised implementation plan and proposed Market Rules and Draft Market Manual.

The IESO received feedback from:

- [Capital Power](#)
- [Hydro One](#)
- [Ontario Power Generation](#)
- [TransAlta](#)

This feedback has been posted on the [Updates to IESO Monitoring Requirements: Phasor Data webpage.](#)

Notes on Feedback Summary

The IESO appreciates the feedback received from stakeholders on the revised implementation plan and proposed Market Rules and Draft Market Manual. The feedback has been noted and will be considered as the engagement moves forward. The IESO has provided a summary below, which outlines specific feedback or questions for which an IESO response was required at this time.

Revised Implementation Plan:

Feedback

Two stakeholder submissions indicated support for the revised implementation dates, and no stakeholders expressed concern with the revised dates. However, TransAlta suggested the implementation dates would be reasonable only should financial compensation be provided to existing generation facility owners to install the required equipment.

IESO Response

Market Participants are expected to install and maintain at their expense all necessary infrastructure to remain in compliance with the Market Rules, this includes any costs associated with providing phasor data to the IESO as part of the need for real-time monitoring to maintain system reliability.

Feedback

Regarding the overall implementation plan, stakeholders provided several specific suggestions for consideration:

- Capital Power believes that this requirement should be grandfathered for existing assets.
- OPG noted that for Market Participants with multiple facilities, it would be necessary to mutually agree to a staged implementation plan.
- Hydro One sought clarity on the timelines to establish a staged implementation plan for Market Participants with multiple facilities.

IESO Response

Ontario's current electricity system consists of a number of critical facilities already in operation. In order to serve a meaningful purpose of real-time system monitoring, it is necessary to monitor existing critical facilities as well as those to-be-built in future. The IESO is of the opinion that it is vital the system is monitored as an integrated unit whose behavior is determined by many factors including the behavior of critical facilities regardless of their in-service date.

The IESO suggests the timeline for a staged implementation plan should be discussed and finalized between the IESO and applicable Market Participants before December 31, 2021.

Feedback

One stakeholder suggested that to help inform cost-sharing mechanisms available to existing facilities, the costs of implementing PMUs be included as part of a cost-benefit analysis to be shared with stakeholders.

IESO Response

The cost for PMU implementation depends on many varying factors including the technology used for generation of phasor data (i.e. Phasor Measurement Unit-PMU or Intelligent Electronic Device-IED or Digital Disturbance Recorder-DDR) chosen by each Market Participant, the vendors chosen by each Market Participant to purchase the devices (i.e. Current Transformer-CT, Potential Transformer-PT, PMU, Phasor Data Concentrator-PDC), the IT infrastructure and communication method selected by each Market Participant, their labor cost and overheads etc. Each of these elements impact cost calculations of each Market Participant differently based on their specific individual needs and

scenarios. Therefore, it is impractical for the IESO to determine the cost for each Market Participant for PMU implementation. While the quantitative cost benefit analysis may not be practical, the IESO will take this suggestion back and consider providing qualitative cost benefit analysis as well as ball park estimate and generic ranges of cost to the extent practical for implementing PMUs in future.

Proposed Market Rule Amendments:

Feedback

Two stakeholders indicated the information presented to date by the IESO has been helpful in providing initial guidance, but that more information is required to enable Market Participants to provide informed comments:

- When market rules and market manual revisions are provided in draft form for review by the technical panel, Capital Power would appreciate the opportunity to provide further feedback at that point.
- A draft update of Market Rule Appendices 4.15 and 4.16 (similar to the draft version of the Market Manual provided) need to be provided before Market Participants can provide meaningful comments.

IESO Response

The IESO will provide opportunity for Market Participants to provide further feedback and the draft update of Market Appendix 4.15 and 4.16 will be made available.

Feedback

With respect to costs related to meeting the proposed requirements, stakeholders submitted the following suggestions and concerns:

- Concern that the proposed Market Rule amendments will create material costs for existing generation facility owners to install the required equipment.
- Determine cost responsibility of PMU costs borne by unregulated entities prior to seeking approval of the market rule amendments.
- Measured Quantities (Required): states that Generators to provide 3-phase voltages/currents. Also, Figure 4 shows locations for synchrophasor data. Ownership and capital/OMA costs of primary instrument transformers providing AC quantities are to be borne by Generator.
 - If the Generator approaches a Transmitter at a facility that has Generator and Transmitter owned assets seeking to utilize Transmitter assets to provide AC quantities, then some form of cost sharing should be applied... can this be addressed in the market rules somewhere?

IESO Response

While we understand that many varying factors (including the technology used by each MP, vendors chosen, selection of devices and type of IT infrastructure, labour etc.) impact cost calculations of each Market Participant differently based on their specific individual needs and scenarios, the IESO will take this suggestion back and consider providing ball park estimate and generic ranges of cost to the extent practical for implementing PMUs in future.

The phasor data requirements for transmitters and generators are separately specified in proposed Market Rules. If there are any overlaps in ability to use existing measuring devices owned by entity A

to fulfil obligations of entity B or same facility has assets owned by A and B, A and B must identify those situations and come to a formal agreement on delivery of data. The IESO could enable initial discussions between A and B after A or B request a meeting (if such meeting is requested for any needed clarity requiring IESO involvement), however the final obligation to provide phasor data to the IESO solely remains with either A or B as specified by the Market Rule.

Feedback

With respect to facility requirements, TransAlta's feedback included the following recommendations:

- Revise the market rule to only require new generation facilities to install PMUs, PDCs, and associated equipment. (i.e., grandfather existing generators)
- Develop a PMU placement plan similar to PJM's placement plan.

IESO Response

Ontario's current electricity system consists of a number of critical facilities already in operation. In order to serve a meaningful purpose of real-time system monitoring, it is necessary to monitor existing critical facilities as well as those to-be-built in future. The IESO is of the opinion that it is vital the system is monitored as an integrated unit whose behavior is determined by many factors including the behavior of critical facilities regardless of their in-service date.

Proposed Specifications for Market Manual:

Feedback

Two stakeholders submitted comments and questions on the information included in the Introduction section 1 of the draft Market Manual language:

- Capital Power requests that the IESO clarify whether there are any other specific equipment requirements apart from the Phasor Measurement Unit specifications. For example, is it required to have dedicated Current Transformer (CT) and Power Transformer (PT) equipment? Can the pre-existing CT and PT equipment installed at facilities be utilized to provide data through to the Phasor Measurement Unit (PMU)?
- Section 1.7: The first paragraph cites an oscillation frequency of 0.1 Hz
 - This seems to disagree with the waveform shown in Figure 3. OPG suggests updating the x-axis on the graph to align with the specifications in the text.

IESO Response

It is not essential to have dedicated CTs and PTs to provide phasor data, and the IESO will include this clarification in the draft market manual.

The x-axis is the time-axis for 1 sec. The AC waveform at steady-state is symmetrical and near 60 Hz, and that waveform will be distorted during dynamics. The intention of Figure 3 is to demonstrate one such sample example. In that specific example, dynamics caused the AC waveform as a whole to oscillate 6 times in 1 sec while underlying 60 Hz frequency still exists. This particular oscillation as observed by measuring devices can be identified as having frequency $6/60 = 0.1$ Hz oscillations in the system.

Feedback

OPG submitted a number of comments and questions on the **draft phasor data requirements for generators**, captured in section 2 of the draft Market Manual language.

1. Section 2.1: "Specifications noted as 'required' must be satisfied, specifications noted as 'preferred' are not required but add additional operational value and should be satisfied wherever possible."
 - o OPG suggests changing the phrase "wherever possible" to "wherever practical". Given the extra costs associated with meeting any one criterion, it is important the IESO clearly define preferences versus requirements. With enough time and financial support, any attribute would be technically "possible", but generators must understand which combination of attributes is satisfactory to the IESO. If the IESO does not strictly require the "preferred" attributes, OPG believes "wherever practical" aligns better with the intent.
2. Measurement Point (Required): If a single generating unit is rated equal to or greater than 100 MVA and directly connected to the IESO-controlled grid, provide synchrophasor data measured at generator terminal (i.e. low side of the generator output transformer).
 - o Please clarify that a current transformer (CT) installed on the generator neutral side is acceptable to meet this requirement.
3. Coordinates (Required): refers to "polar coordinates" and states "magnitudes must be in SI units."
 - o Please define which SI units the IESO is requesting. An example would be helpful in this situation.
4. Time-Tag Accuracy (Required): cites a "1 microsecond" accuracy requirement.
 - o Note this requirement is 26 times more restrictive than the maximum error allowed by IEEE Std C37.118-2005 Level 1. While 1 microsecond accuracy may be achievable in perfect weather conditions, such a standard would require substantial upgrades to station satellite clocks. Can the IESO explain its rationale for this requirement? As it will likely be difficult and costly to achieve such accuracy, OPG proposes the standard be relaxed to comply with IEEE Std C37.118-2005 Level 1.
5. Instrument Transformers (Required)
 - o From the Nov 19th stakeholder engagement, OPG understands that protection instrument transformers are acceptable for PMU use. Please verify whether this understanding is correct.
6. Latency (Preferred)
 - o OPG recommends changing the phrase "from PMU to the IESO control center" to "from PMU to IESO control center or IESO owned PDC". The time delay between IESO PDC to IESO control center is not under control of the generator owners.
7. Latency (Preferred)
 - o Meeting the IESO's preferences for 100 ms and 1 s latency would significantly increase the cost of PDC and communication channel infrastructure. Please specify a maximum latency that would meet the IESO's requirement, rather than the preference.
8. Figure 4 (Phasor Requirements for different generator connection configurations) shows "required" and "preferred" data measurement locations
 - o Would the IESO accept configurations that provide synchrophasor data from the "preferred" locations, but not from the "required" locations? Would such configurations be acceptable if the value at the "required" location could be inferred from the measurements at the "preferred" locations?

IESO Response

1. Agreed; the IESO will make the associated revisions in the next draft.
2. The IESO is available to further discuss and clarify this question based on your specific topology/situation.
3. Voltage must be in kV, current must be in Amperes, frequency must be in Hz, angle must be in degrees, active power must be in MW, reactive power must be in MVar.
4. The accuracy as per the IEEE C37.118-2005 standard level 1 where Total Vector Error (TVE which is a function of magnitude, angle and timing) less than 1% is acceptable.
5. It is acceptable for the IESO that OPG uses existing instrument transformers used for protection purpose for the purpose of data measurements for the PMU as long as the role of the instrument transformer in protection is not interfered or hampered or degraded by any means by its additional usage. Moreover, use of such instrument transformer should not compromise on any applicable reliability related requirements, standards or criteria.
6. Agreed; the IESO will make the associated revisions in the next draft.
7. The IESO will convey the expected latency requirement in due course of time to OPG. The latency requirement will depend upon the need and extent of purpose the IESO intends to use phasor data.
8. The IESO would require data from 'required' locations unless the OPG can clearly demonstrate to the IESO how 'required' data can be reliably estimated from the 'preferred' data. The IESO is in the opinion it will be very unlikely one angle can be inferred from another.

Feedback

Hydro One submitted a number of comments and questions on the **draft phasor data requirements for transmitters**, captured in section 3 of the draft Market Manual language:

1. Measurement Points and quantities (Required): states that "Terminals of circuits defining Interconnection Reliability Operating Limits (IROL) and Interties."
 - Further clarity required on whether one terminal of an interface is sufficient or all terminals are required to be measured
2. Scan Rate (Preferred): asks for sample rate of 10, 25, 50, 60 samples per second
 - We suggest removing 25 and 50 samples/second wording as that applies to 50Hz system.
3. DC Supply Variations (Required)
 - Is this indicating that the equipment measuring phasor data must be able to operate (measure phasor data accurately) even if subjected to DC supply voltage variations of +/-10%? Does this specific requirement need to be listed in this table?
4. Data Storage (Required)
 - This requirement should be removed as there may be potentially significant cost impacts associated with providing rolling storage of data.
5. Latency (Preferred)
 - The latency is measured end-to-end from PMU to end-user application so the latency time spans across Gen-IESO and Transmitter-IESO interface and the Transmitter can only potentially address latency issues within the Transmitter facilities.
6. Bandwidth (Required)
 - IESO should require a Quality of Service measure to clarify the actual requirement.

IESO Response

1. The measurements are required only from the terminals that is used to define the Interconnection Reliability Operating Limit (IROL) interface. For Interties, the measurements are required only from Ontario side of terminals.
2. Agreed, the IESO will make the associated revisions in the next draft.
3. No this does not need to be listed and will be removed.
4. Agreed, the data storage at Market Participant end must be at their discretion. The IESO must ensure rolling data storage is available at the data receiving site at the IESO.
5. Latency referred here is the time span from the instant data is measured at the Transmitter equipment to the instant data arrives at Transmitter-IESO interface which is the PDC location at the IESO.
6. The required bandwidth depends on data originating facility size, number of data to be transferred, communication segment etc. Further, when the IESO convey the expected applications of phasor data at the IESO in due course, the required bandwidth could be estimated such that the data can be transmitted to cater those applications.

General Comments/Feedback:

Feedback

Stakeholders provided the following general comments and questions:

1. There is a redundant paragraph that is repeated both above and below Figure 3 on page 5.
2. Table 1 makes reference to Figure 3, however it should be Figure 4.
3. The term "sample rate" is used throughout the document. Please clarify whether this term has the same definition as "reporting rates", as defined in the IEEE Std. C37.118-2005 Section 5.1.1. The term "sample rate" normally refers to the "Numbers per Cycle" or how many times an A/D (analog digital converter) can read the immediate value of an analog wave. OPG recommends changing the term to be consistent with IEEE Std. C37.118.
4. Section 1.7: The second paragraph is a duplicate of the first one. OPG believes this is a printing error.
5. Some of the requirements shown in Figure 4 could be met by existing Hydro One equipment. Can the IESO add a clause to the Market Manual to allow Market Participants to credit such Hydro One equipment, provided it meets the prevailing requirements?
6. OPG believes that it may be technically feasible to combine the DDR (Dynamic Disturbance Recorder) and PMU functions into the same hardware. Would the IESO accept such a configuration if it meets the prevailing requirements?
7. Many protection relay manufacturers claim their relay products comply with IEEE C37.118 Class 1 requirements. Is it acceptable to use such relays as part of PMU?

IESO Response

1. Agreed; the IESO will make the associated revisions in the next draft.
2. Agreed; the IESO will make the associated revisions in the next draft.
3. Agreed. It is how many data of a variable will be reported to the IESO PDC in one second.
4. Agreed; the IESO will make the associated revisions in the next draft.
5. The phasor data requirements for transmitters and generators are separately specified in proposed Market Rules. If there are any overlaps in ability to use existing measuring devices owned by A to fulfil obligations of B, A and B must identify those situations and come to a formal agreement on delivery of data. The IESO could enable initial discussions between A &

- B after A or B request a meeting, however the final obligation to provide phasor data to the IESO solely remains with either A or B as specified by the Market Rule.
6. Certain modern DDRs can provide PMU data. As long as the requirements for having the DDR and the requirements for having the PMU are both fulfilled, the usage of one device to fulfil both obligations are acceptable. The IESO requirement on phasor data is to provide specific phasor data from specific locations to the IESO PDC. The nature of the device used to generate phasor data is immaterial to the IESO. If one device is used for multiple purposes, the Market Participant must ensure the functionalities are not interfered with each other.
 7. Relays that can provide data with the accuracy as per the IEEE C37.118-2005 standard level 1 where Total Vector Error (TVE) less than 1% is acceptable.

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