Post-Commissioning Model Validation – Selection of Event Triggers

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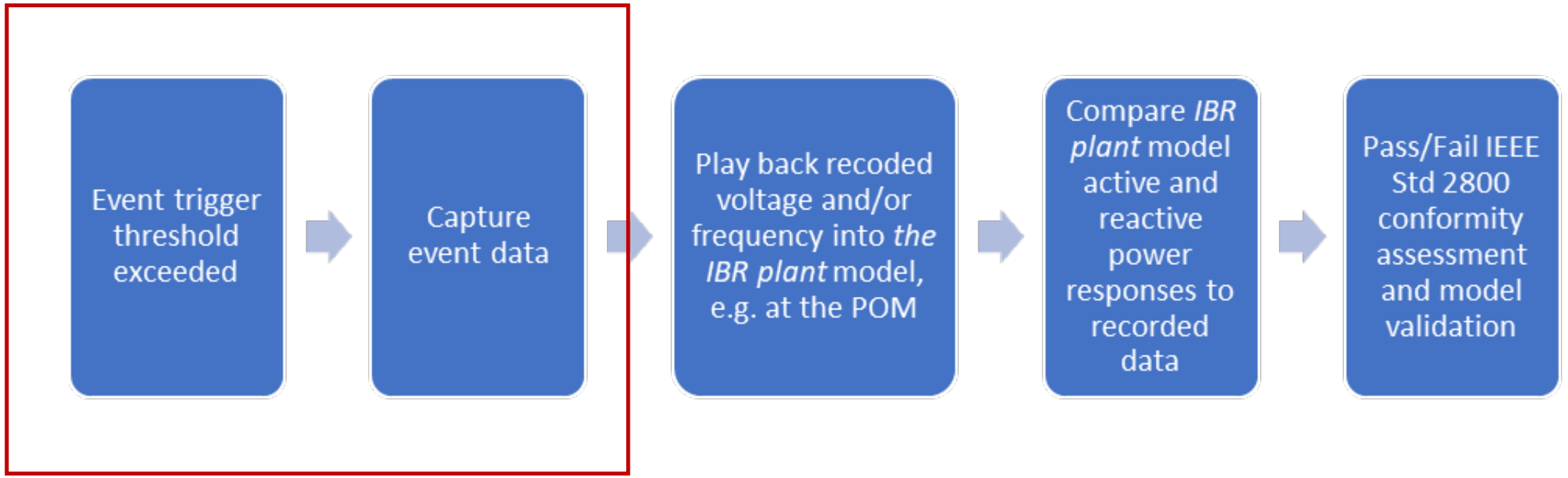
Post-Commissioning Monitoring Process



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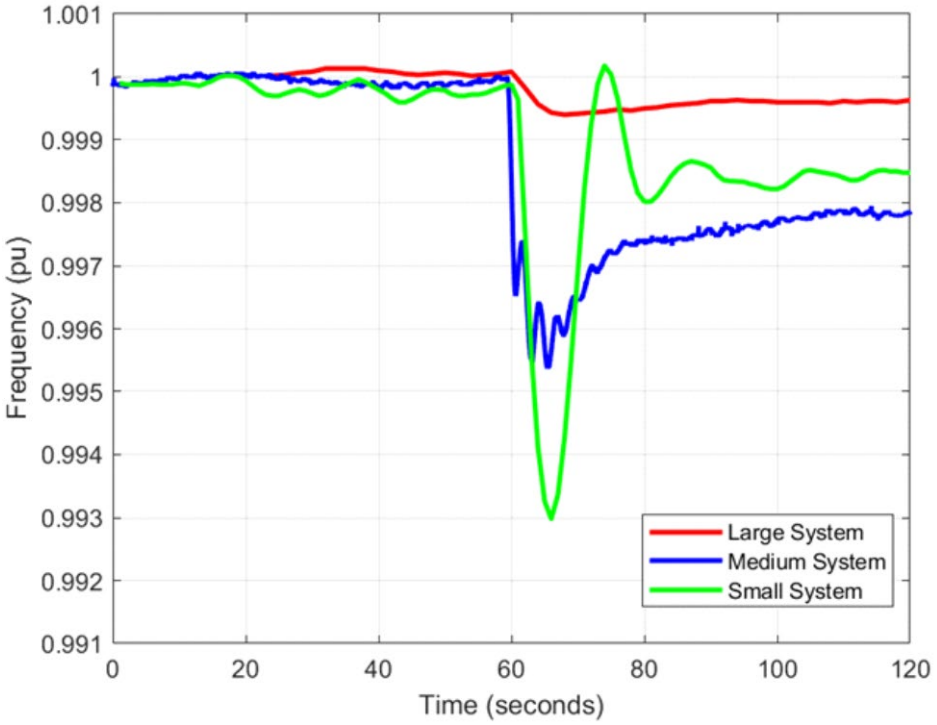
Event Triggers - General Considerations

- Multi-phase transmission faults are rare
- Even with post-commissioning monitoring conformity with all aspects of the performance requirements cannot necessarily be verified during the life of the plant
- The vast majority of disturbances will be smaller, e.g. a sudden (few %) change in POM voltage due to
  - remote faults or
  - transmission equipment switching events.
- Small disturbance data are still helpful in routine conformity assessment of the volt/var response and dynamic performance of the IBR plant.
- Frequency events due to the loss of large generation or large load are useful for routine conformity assessment of the primary frequency response (PFR) or fast frequency response (FFR) dynamic performance of the IBR plant.

Selection of Event Triggers

- The appropriate evet trigger settings depend on the characteristics of the BPS
- If the triggers are set too narrow:
  - too many events may be recorded
  - data storage of the recording device fills up and
  - data overwriting happens.
- If the triggers are set too wide:
  - the events useful for conformity assessment may not be captured
- A balance should be achieved between the trigger settings and data retention time, as per Table 19 of IEEE Std 2800
- The trigger settings may need to be adjusted periodically due to changing generation mix, other nearby resource installations, or changes to other system characteristics.

Frequency response after a generator trip event for different system sizes



Source: IEEE Task Force Report, Stability Definitions and Characterization of Dynamic Behavior in Systems with High Penetration of Power Electronic Interfaced Technologies, PES-TR77, April 2020

Example Frequency Event Trigger

- If the system is large (>400 GW), start with a setting of ±40 mHz.
- If the system is medium sized (100 GW to 200 GW) then start with a setting of ±100 mHz.
- If the system is small (<20 GW) then start with a setting of ±200 mHz.
- Depending on a number of captured events these triggers can be revised, as needed and when practical, in consultation with the TS owner/TS operator.
- The trigger should be set to capture PFR or FFR response, and thus needs to be coordinated with applicable PFR or FFR deadband (e.g. ±36 mHz as per IEEE Std 2800)

Example Voltage Event Trigger

- Voltage trigger setpoints may also be system-dependent based on factors such as, e.g.:
  - fault current availability and fault characteristics,
  - weather patterns (e.g., areas prone to lightning will have greater occurrence of voltage disturbances), etc.
- A similar approach should be taken to that above, with due consideration given to usefulness of the recorded event and efforts involved in evaluating those.
- Start by setting a trigger to record events if there is voltage deviation of greater than ± 2%.
- In some cases, the voltage deviation trigger could be set to as high as ±10%.
- Depending on a number of captured events, the triggers can be revised, as needed and when practical, in consultation with the TS owner/TS operator.

Capturing Event Data

- IEEE Std 2800-2022 Table 19 outlines measurement data points, minimum recording sampling rate, data retention time, recording duration for various types of monitored and recorded data, including:
  - plant SCADA,
  - plant equipment status,
  - unit functional settings,
  - sequence of events recording (SER) data,
  - digital fault recorder (DFR) data,
  - dynamic disturbance recorder (DDR) data,
  - IBR fault codes and dynamic recordings, and
  - a host of power quality data.
- Applicable measurements are also specified in Table 19 and throughout the standard

Digital Fault Recorders (DFRs)

- DFRs should be used to capture the desirable point-on-wave data to evaluate IBR plant performance during and shortly after the disturbance events.
- DFRs triggers to record disturbance events for the purposes of model validation and conformity assessment should be selected in consultation with the TS owner/TS operator.
- It is important to:
  - Coordinate DFR triggering settings at an IBR plant with the triggering settings of the DFRs in the bulk power system (BPS)
  - Use a common time reference so that data from different DFRs can be visually "lined up", for analysis.

Frequency and number of model validation instances

- The IBR plant performance evaluation, model revalidation, and conformity assessment should be performed with the relevant clauses of IEEE Std 2800 at least once every 24 months, assuming a significant voltage or frequency event occurred
- An entity may perform such work on every event captured if they so wish.
- Some events may still be too small to assess conformity with IEEE Std 2800 but may provide an opportunity to assess performance of the IBR plant controls and to validate the relevant aspects of the plant model.

THANK YOU

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