Facilitate IBR Integration with High-resolution Data

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Data Resources in Electric Utilities

| Data Resource	Availability	Resolution	Sources	Coverage	Bandwidth
SCADA	High	2-4 sec	RTUs	Substations	Low
Synchrophasor	Medium	30-60 Hz	Digital Relays, DFRs, PMUs	Transmission Substations	High
Point-on-wave /COMTRADE /Oscillography	Medium/Low	4800-1M Hz	Digital Relays, DFRs, PQ Meters	T&D, POI	Low/Medium

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Value of High-resolution Data

- Transient dynamics in timescale of sub-cycles

- Coverage on distribution circuits and point of interconnection (POI)

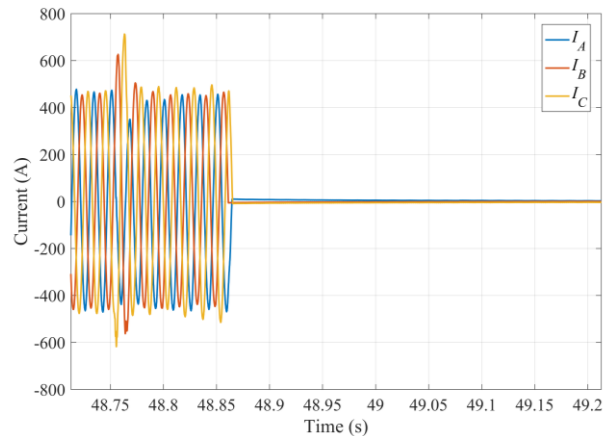- Event triggered – high "information density"

Use Case #1 – Protective Relaying

- Reduced fault strength due to IBRs

- Need to characterize IBR fault responses

- Fault response is short in duration and challenging to capture
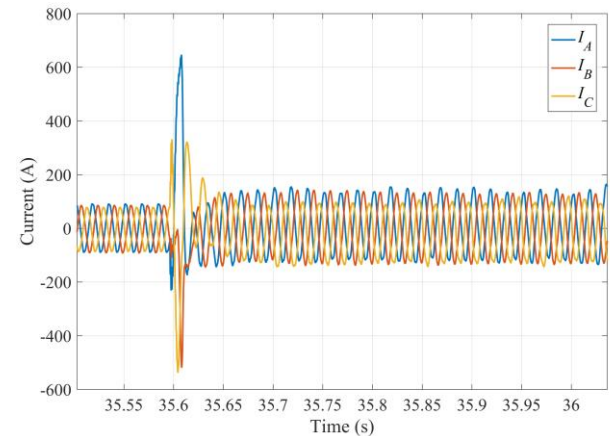
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Use Case #1 – Fault response of solar farms
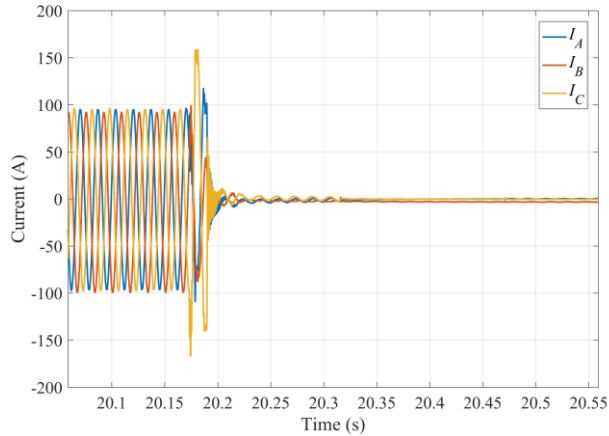
Momentary Cessation

Constant I

Constant P

Use Case #1 – Deliverables

- Critical input for fault analysis, effective grounding, arc flash calc, ground grid design, breaker duty

- Accurate modeling and validation of IBRs in short circuit and transient analysis

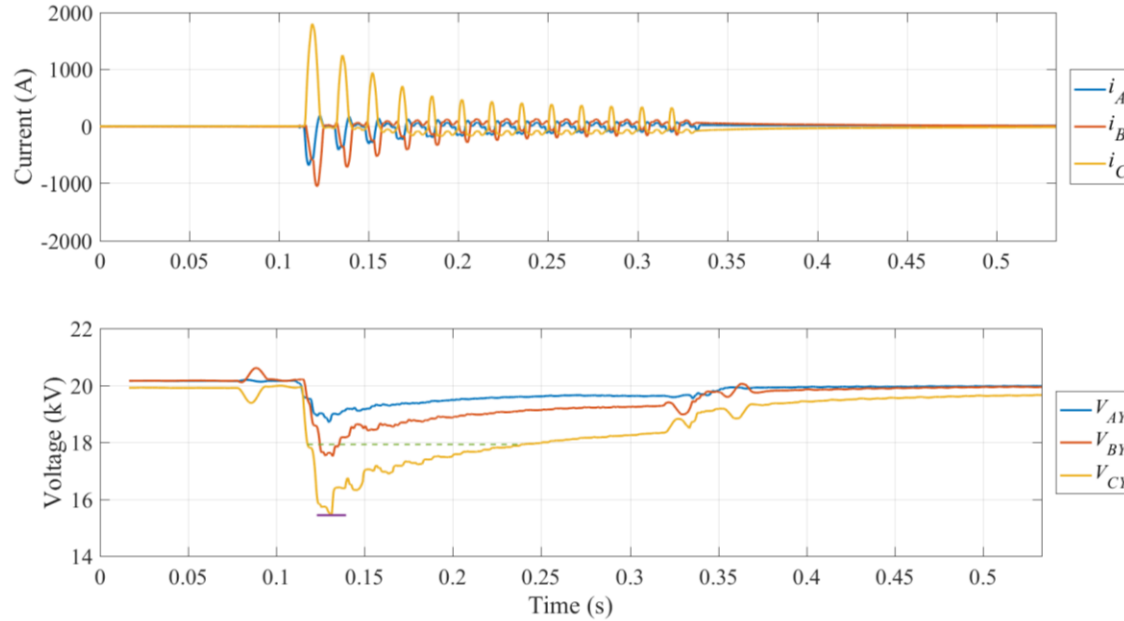- Proper design of protection schemes and relay settings near IBRs

Use Case #2 – Power Quality

- Transformer energization inrush at solar farms

- Voltage sags on distribution circuits

- Risks on nearby load customers
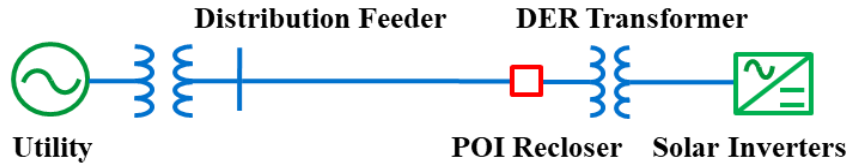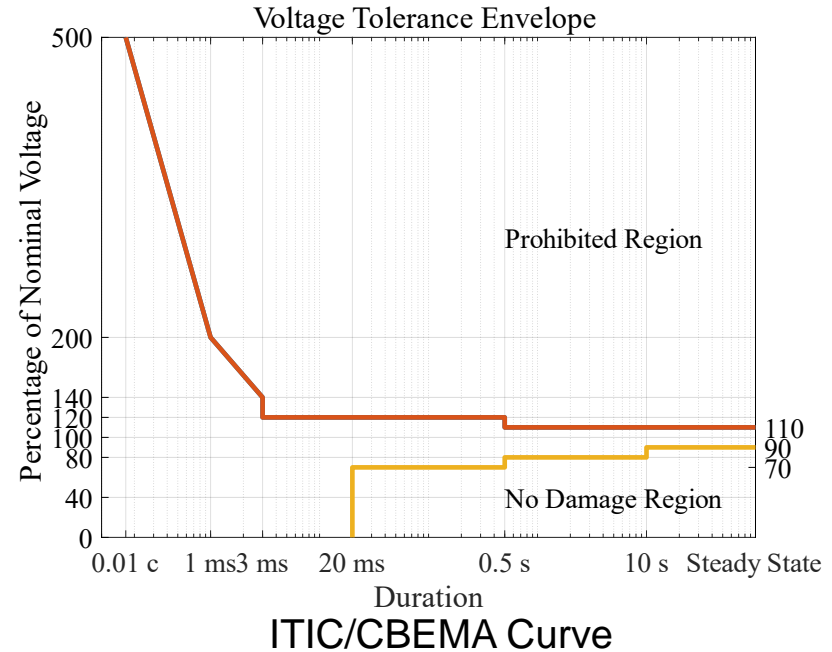
Use Case #2 – Power Quality

Inrush oscillography

Use Case #2 – Deliverables

- Power quality monitoring and root cause analysis

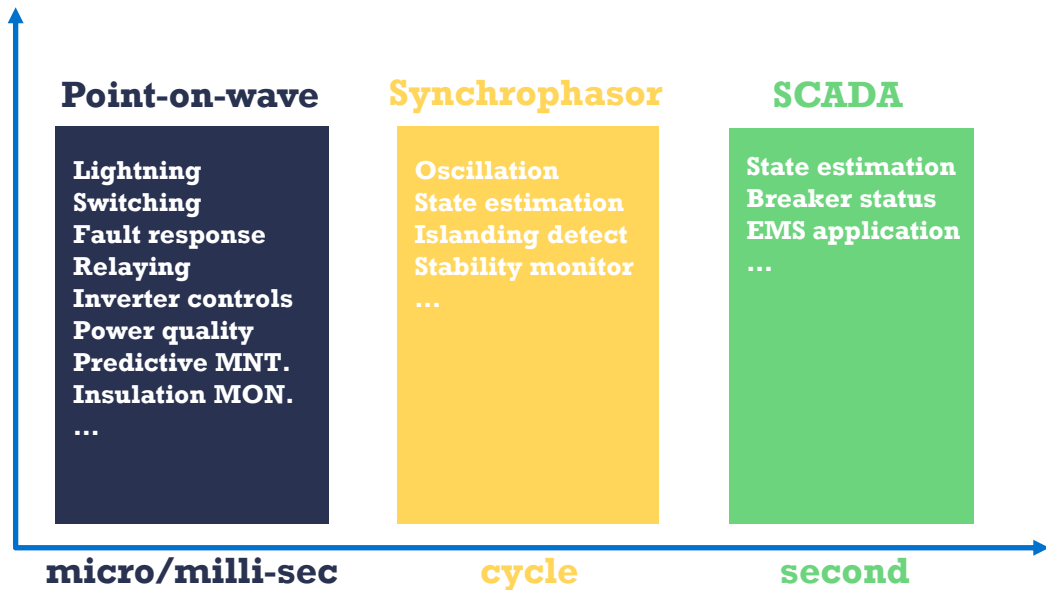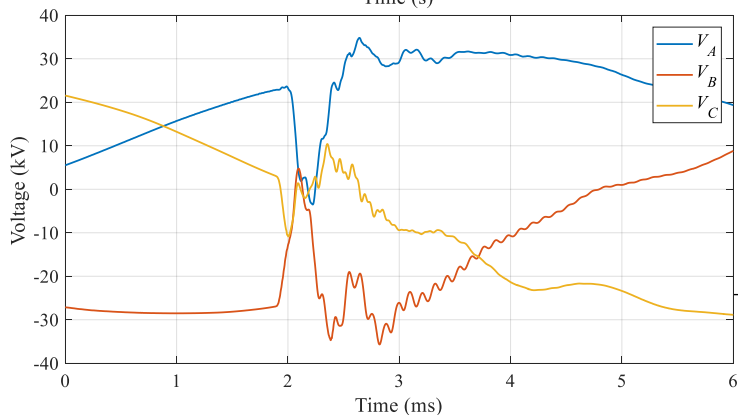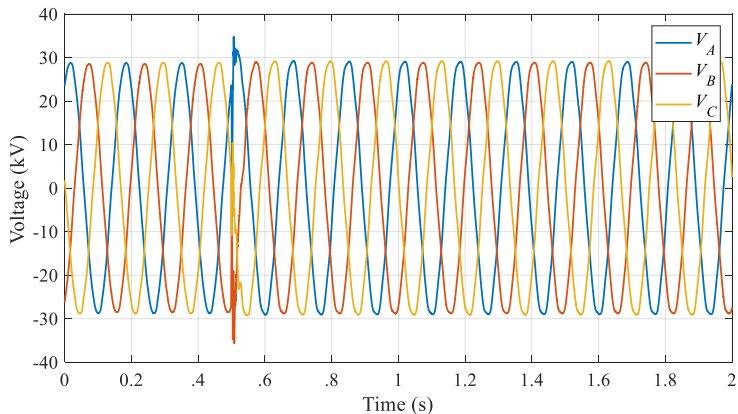- Refined interconnection study process

ITIC/CBEMA Curve

Use Case #3 – Megahertz Measurement

- Joint U.S. DOE project with PNNL

- Travelling wave relays deployed at distribution solar plants

- 1 megahertz reporting rate

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Use Case #3 – Megahertz Measurement

Cap bank switching oscillography

Point-on-wave

Lightning
Switching
Fault response
Relaying
Inverter controls
Power quality
Predictive MNT.
Insulation MON.
...

Synchrophasor

Oscillation
State estimation
Islanding detect
Stability monitor
...

SCADA

State estimation
Breaker status
EMS application
...

micro/milli-sec   **cycle**   **second**

Data Infrastructure Requirements

- Digital devices in the field

- Communication bandwidth

- Cyber security

- Data collection and archiving

- Data applications
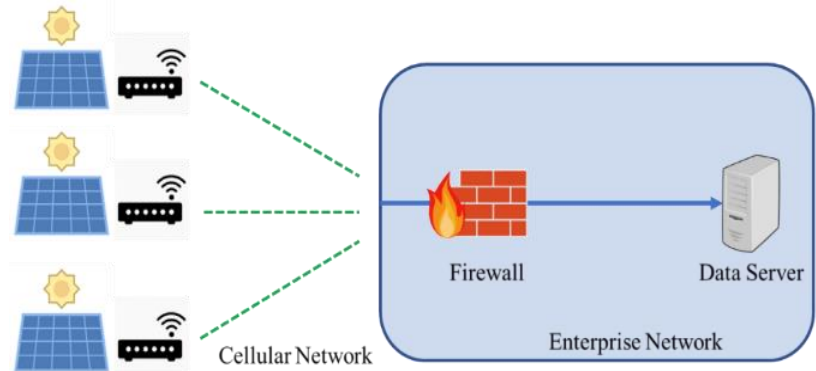
Takeaways

- Enabling new capabilities in modeling, monitoring, asset management, etc.

- Requiring advanced data infrastructure and analytics capabilities

- Opportunities in holistic approaches and enterprise-level solutions

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Thank you!