

# **U-DER Responses to Grid Disturbances**

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# Ontario Renewable Capacity as of Dec 31, 2018

	Transmission (MW)	Distribution (MW)	Total (MW)
Wind	4,505	604	5,109
Solar	479	1,412	1,891
			7,000

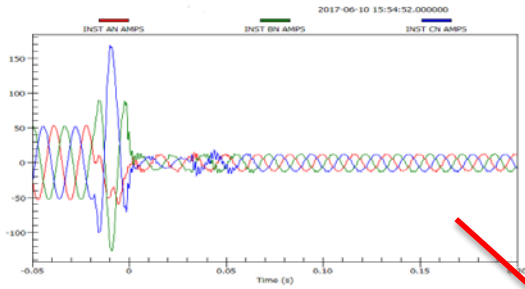
## Ontario Peak Demand

Year	MW
2006	27,005 (Aug.1, all time peak)
2018	23,456 (July 5)

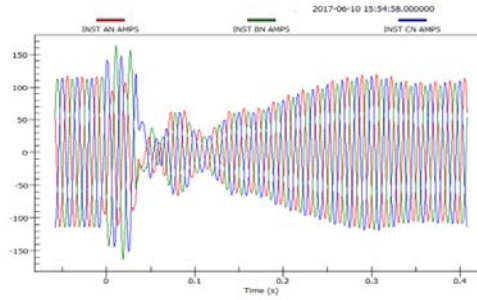
# Data Collections

- PQ meters for DGs > 250kW, at coupling transformers (U-DER only)
- Waveform records to verify ride-through performance after major events
- Shake-off issue is typical in installations under old standard, due to various reasons

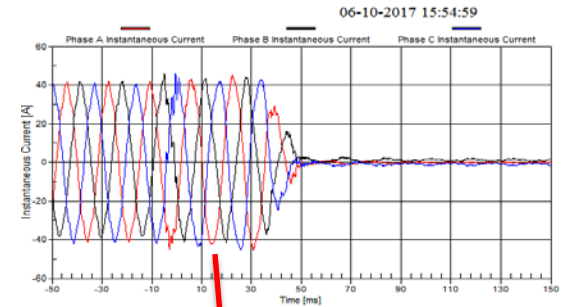
# Example — 500kV Bus SLG Fault in Toronto Area



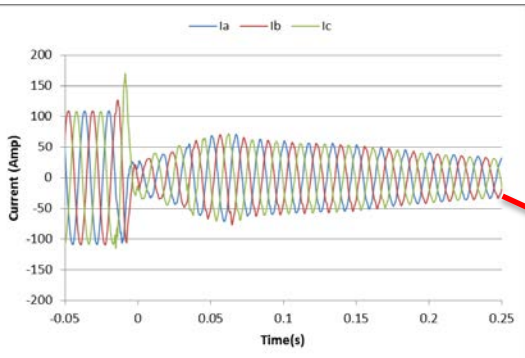
44kV 30+MW solar



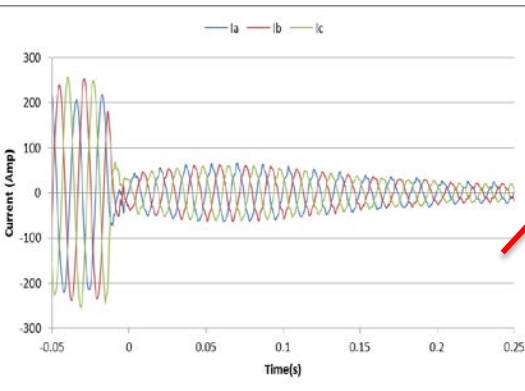
44kV 30MW solar



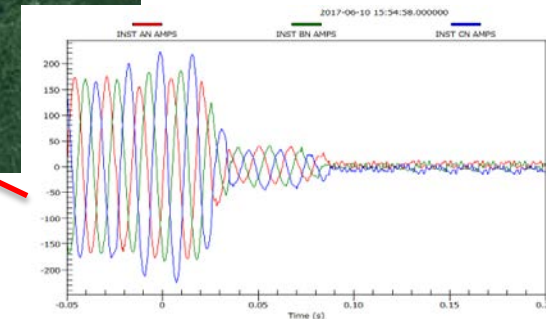
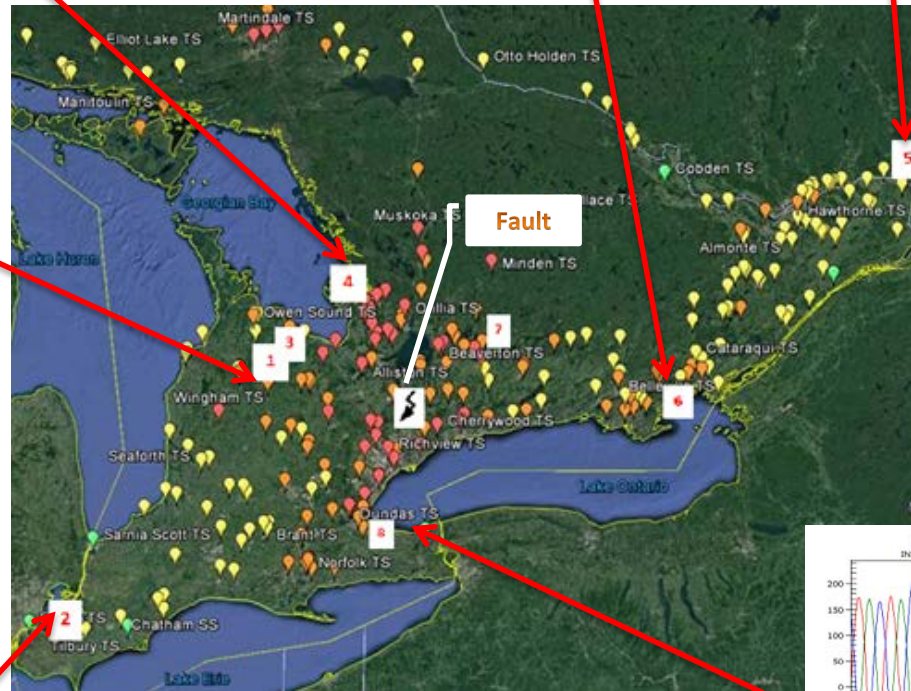
44kV 27MW solar



230kV 50MW solar



115kV 50MW solar



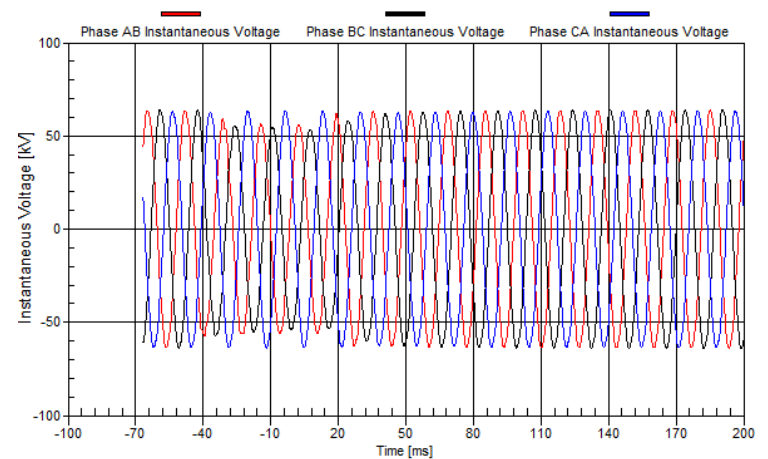
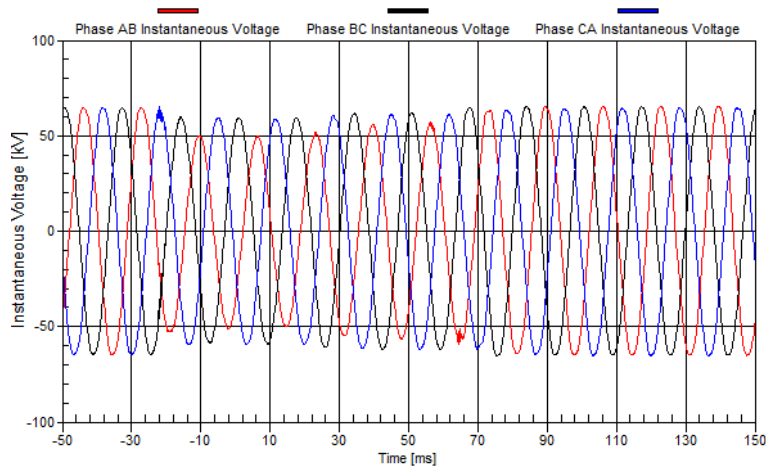
28kV 10MW wind

# Vendor 1 - U/V without delay (Type-3 wind 44kV)

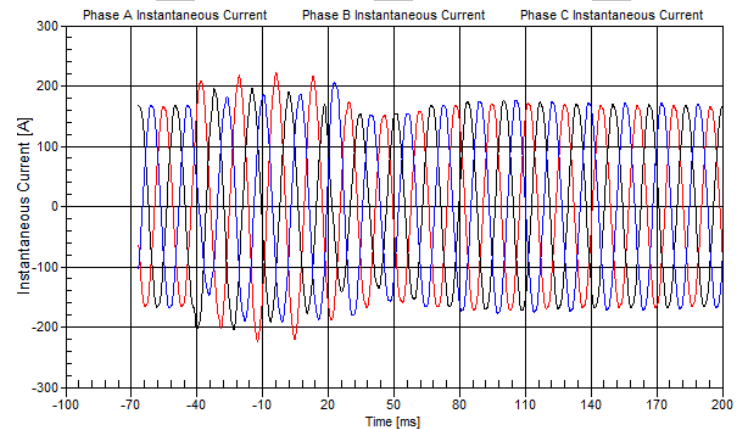
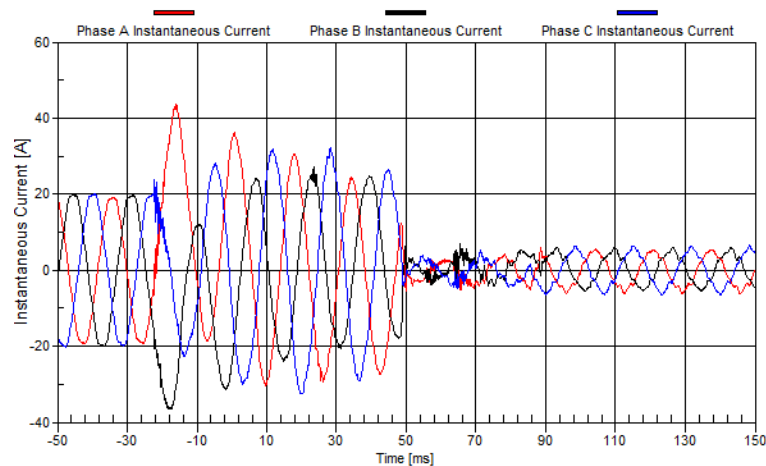
Before— 230kV fault

100ms time delay

After— 500kV fault



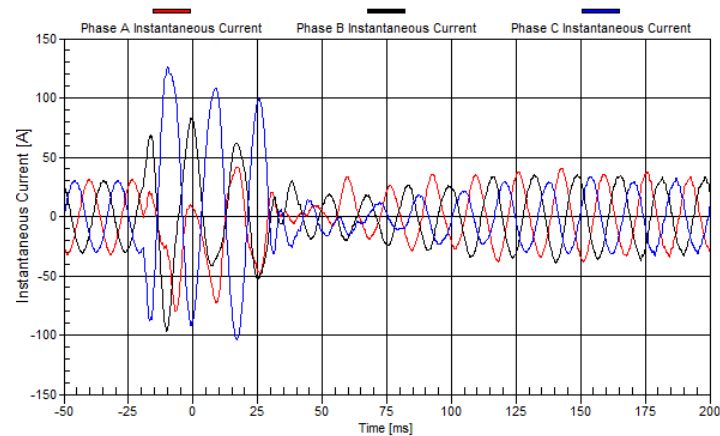
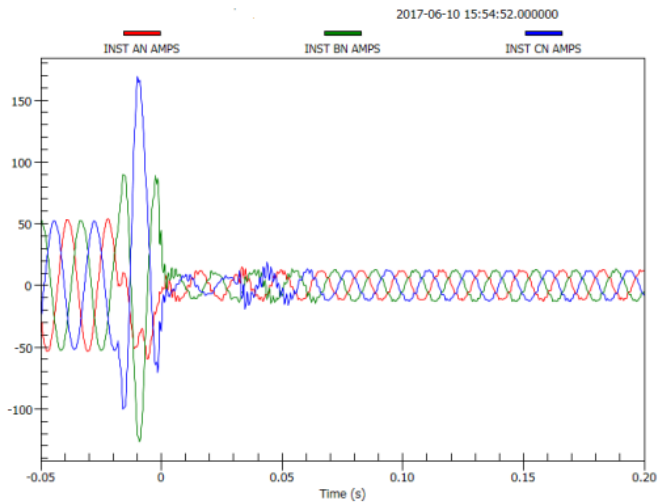
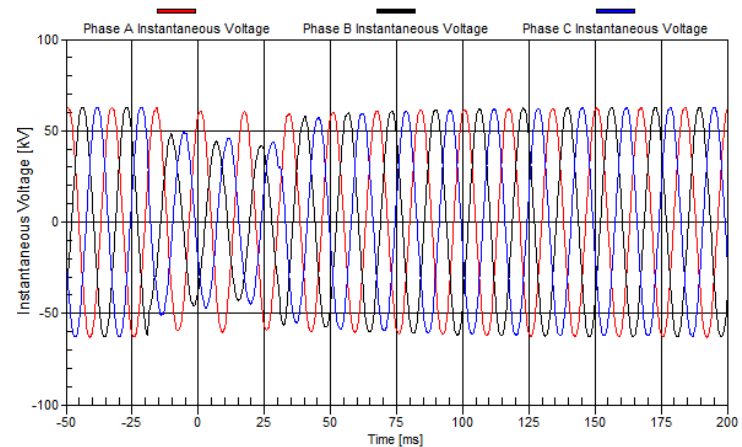
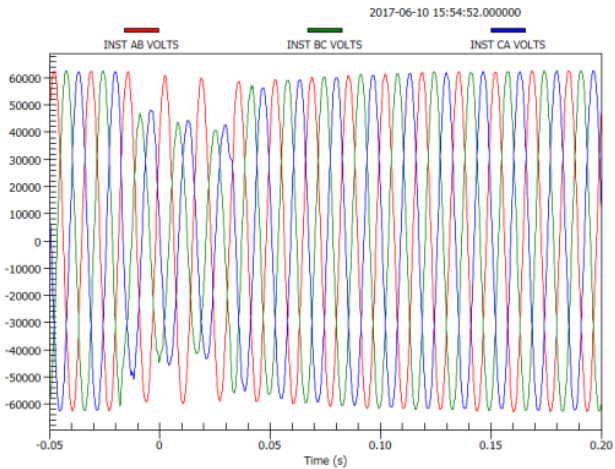
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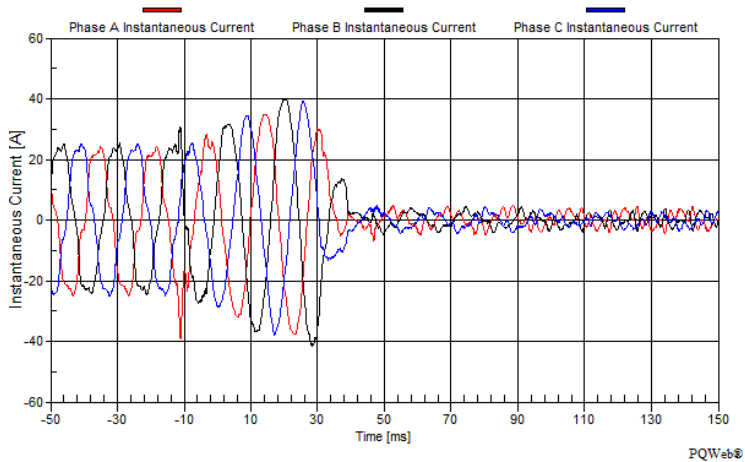
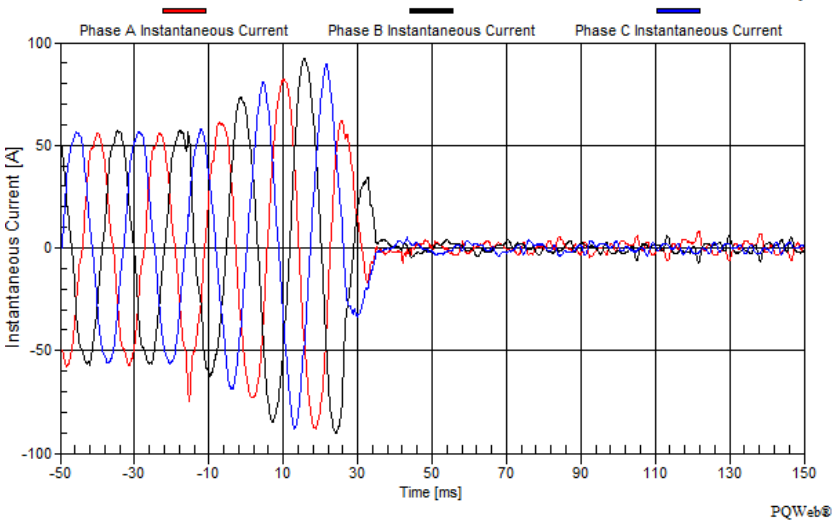
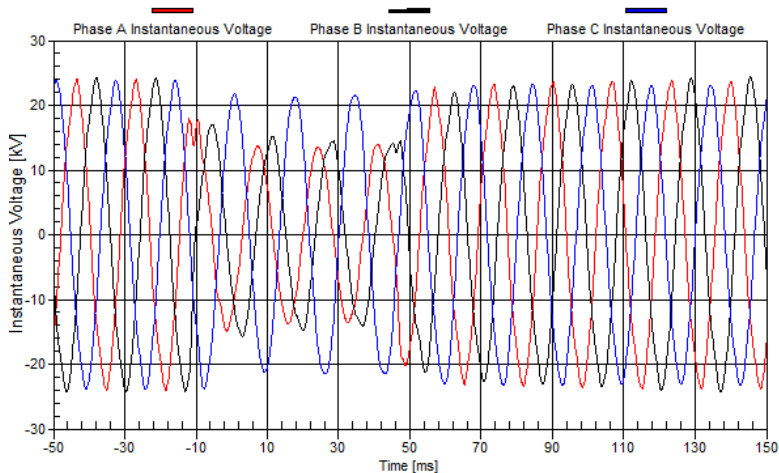
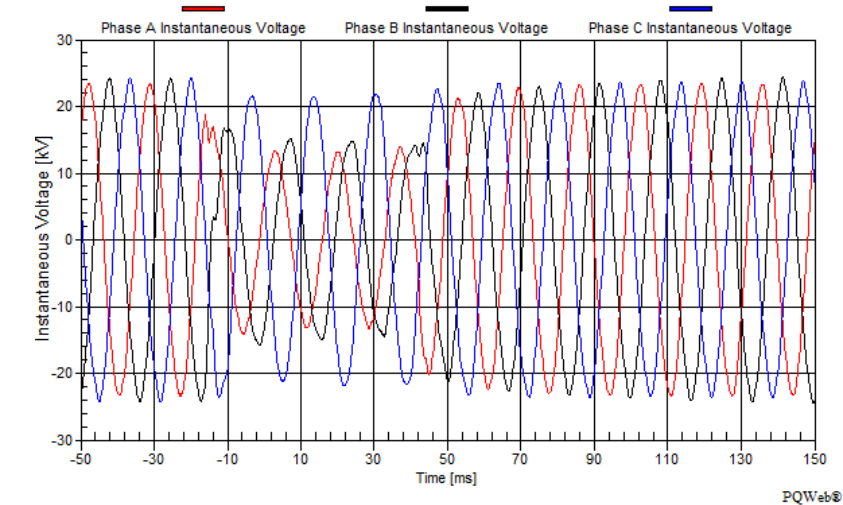
# Vendor 2 – Limited vs. Full Grid Support (Solar 44kV)

Limited Support— 500kV fault  $\xrightarrow{\text{Control mode}}$  Full Support— 500kV fault



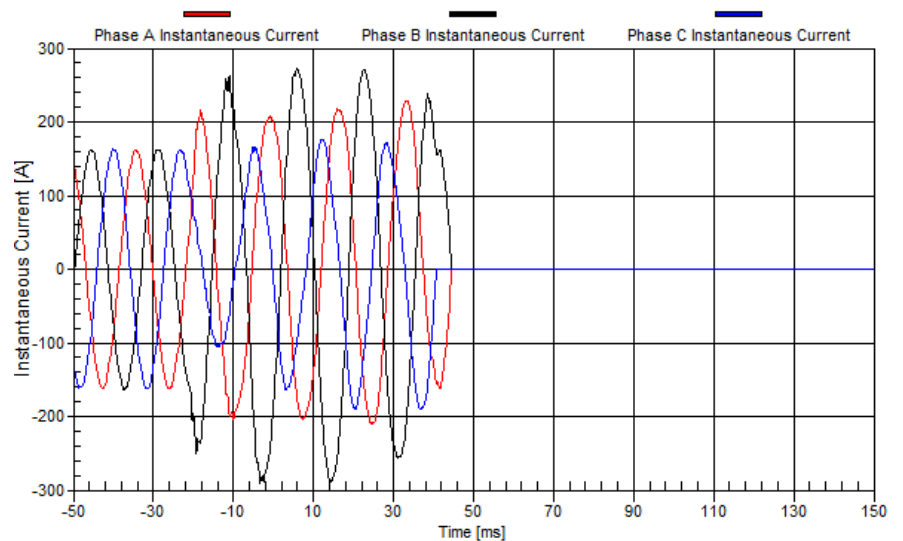
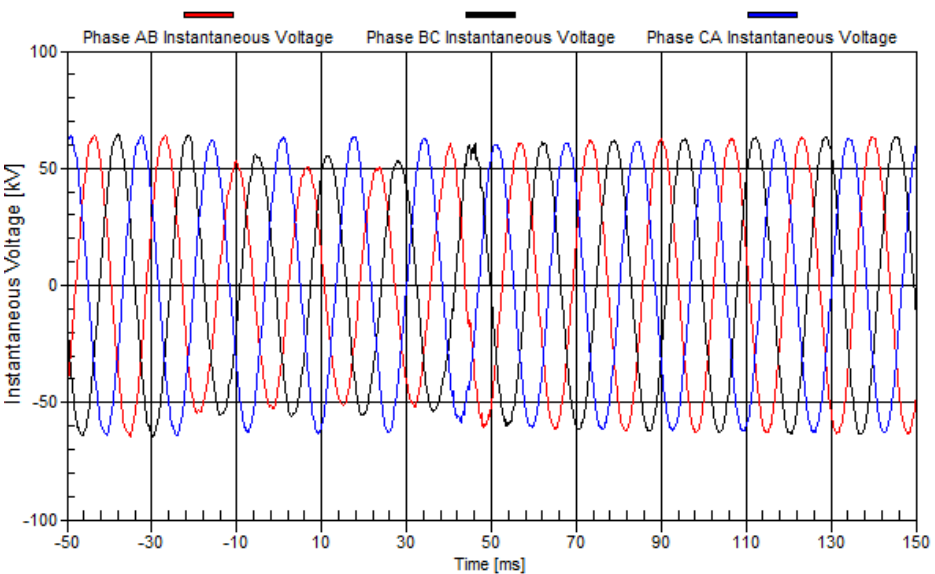
# Vendor 3 – Insufficient delay—Type 4 wind 28kV

U/V with 50ms delay— 230kV fault



# Vendor 4 – Negative sequence current instantaneous trip—Type 3 wind 44kV

67Q1T no delay, 500kV fault



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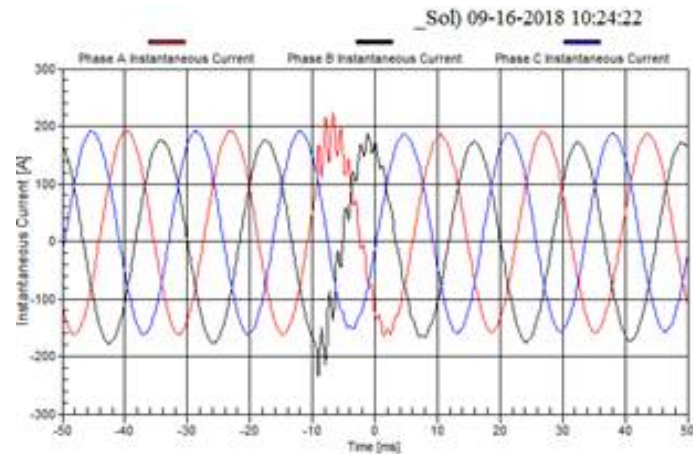
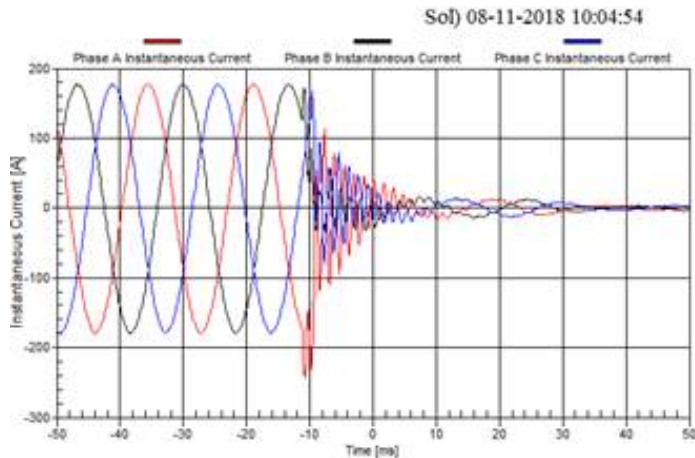
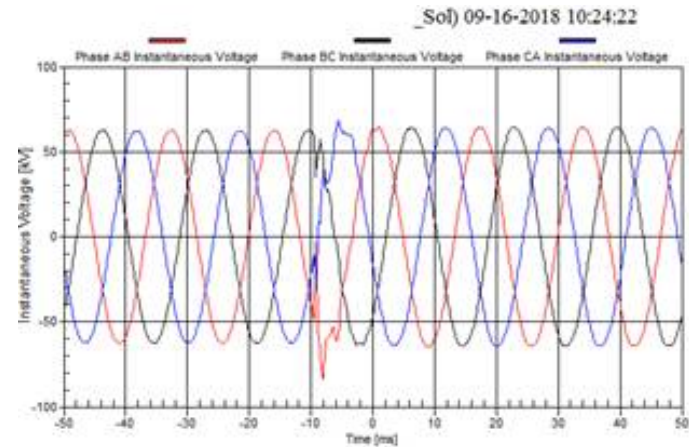
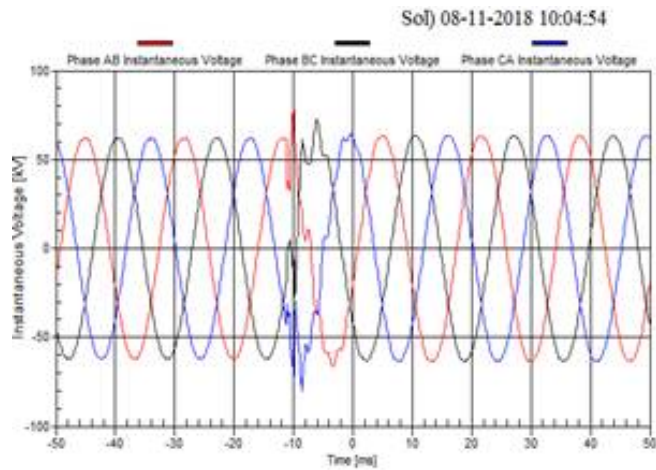


# Transient over-voltage may cause multiple IBR trips (solar or Type 4 wind) ---Capacitor switching

Before

No MC

After



# Discussions

- DER interruptions under external disturbances are not uncommon for installations under old standard
- Only U-DETs are monitored in HONI. In some regions U-DET may be equally important as R-DET
- Worked with vendors and GOs to mitigate. Instantaneous protections and MC are typical causes. Most mitigations are through software change, some remotely
- Less interruptions after multiple fixes