2022 Odessa Disturbance Update

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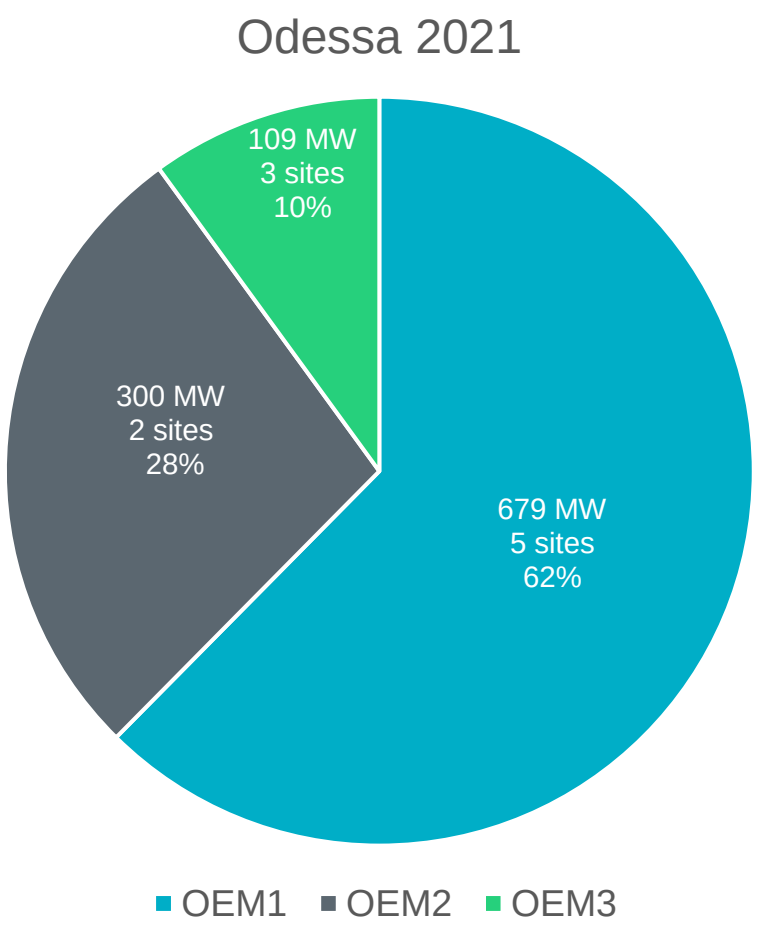
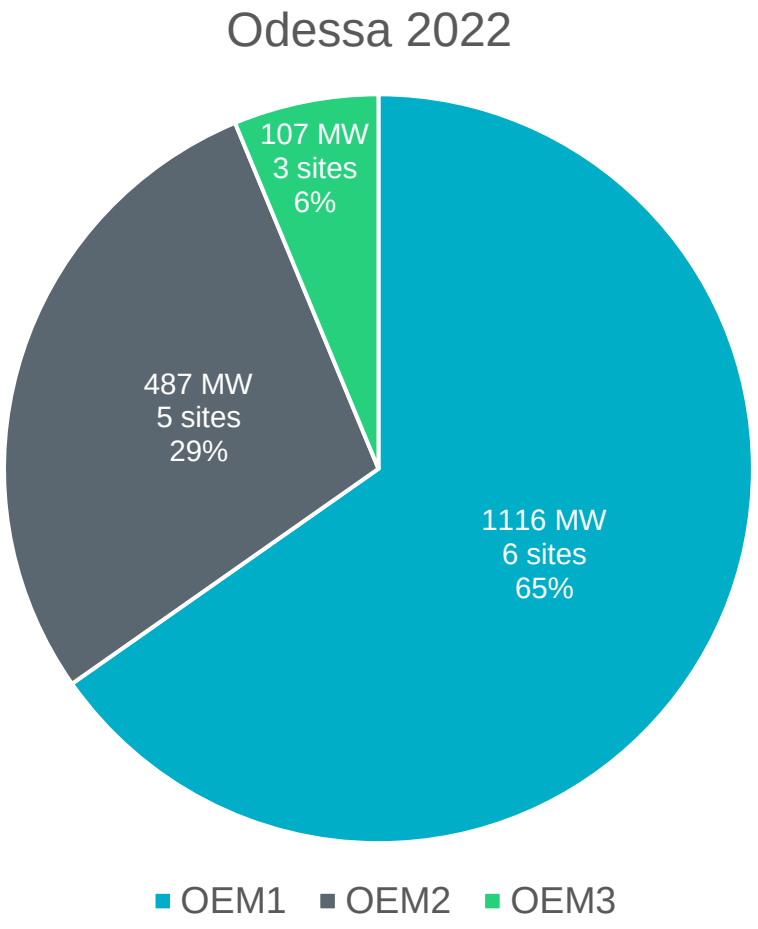
IBRTF Meeting
September 13, 2022

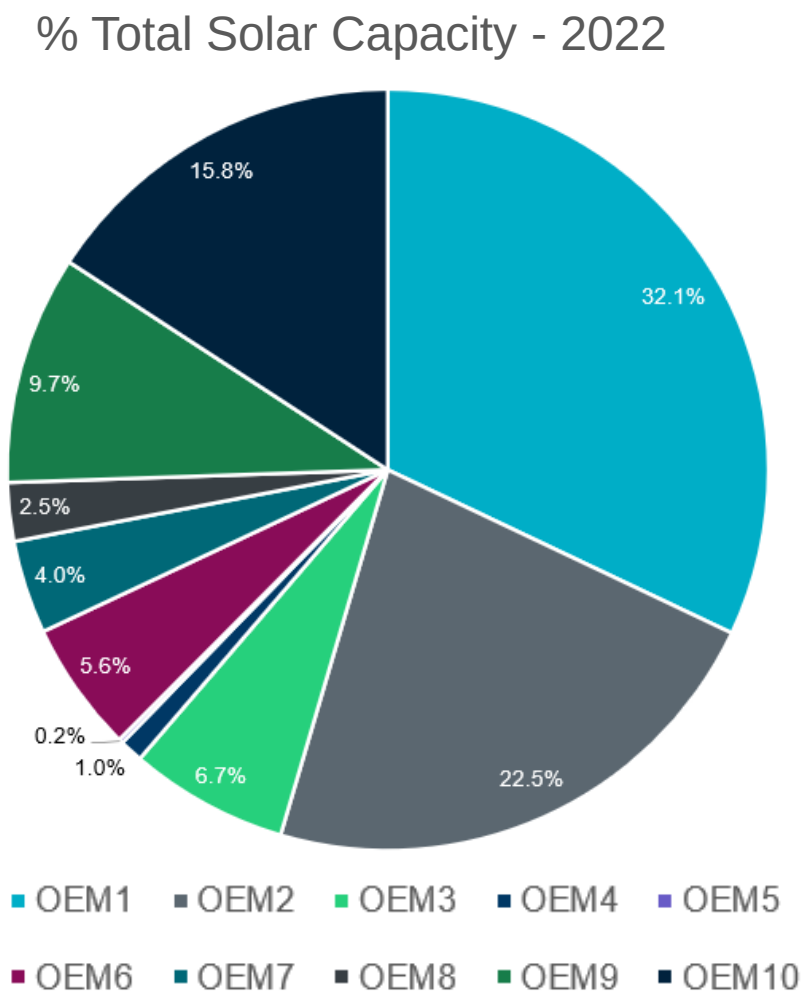
2022 Odessa Disturbance Event Overview

- On June 4, 2022, @ 12:59 PM CDT, Phase-B to ground fault occurred due to lightning arrestor failure in the Odessa area
- Fault cleared within 3 cycles, consequentially tripping off 542 MW of thermal generation
- Additional 309 MW lost from combined cycle plant in South Texas
- Non-consequential loss of 1,709 MW of solar generation from 14 different sites following the fault
- Combined loss of 2,560 MW of generation
- 1,116 of Load Resources provided Responsive Reserve Service automatically
- Categorized as NERC Cat 3a event (generation loss > 2000 MW)

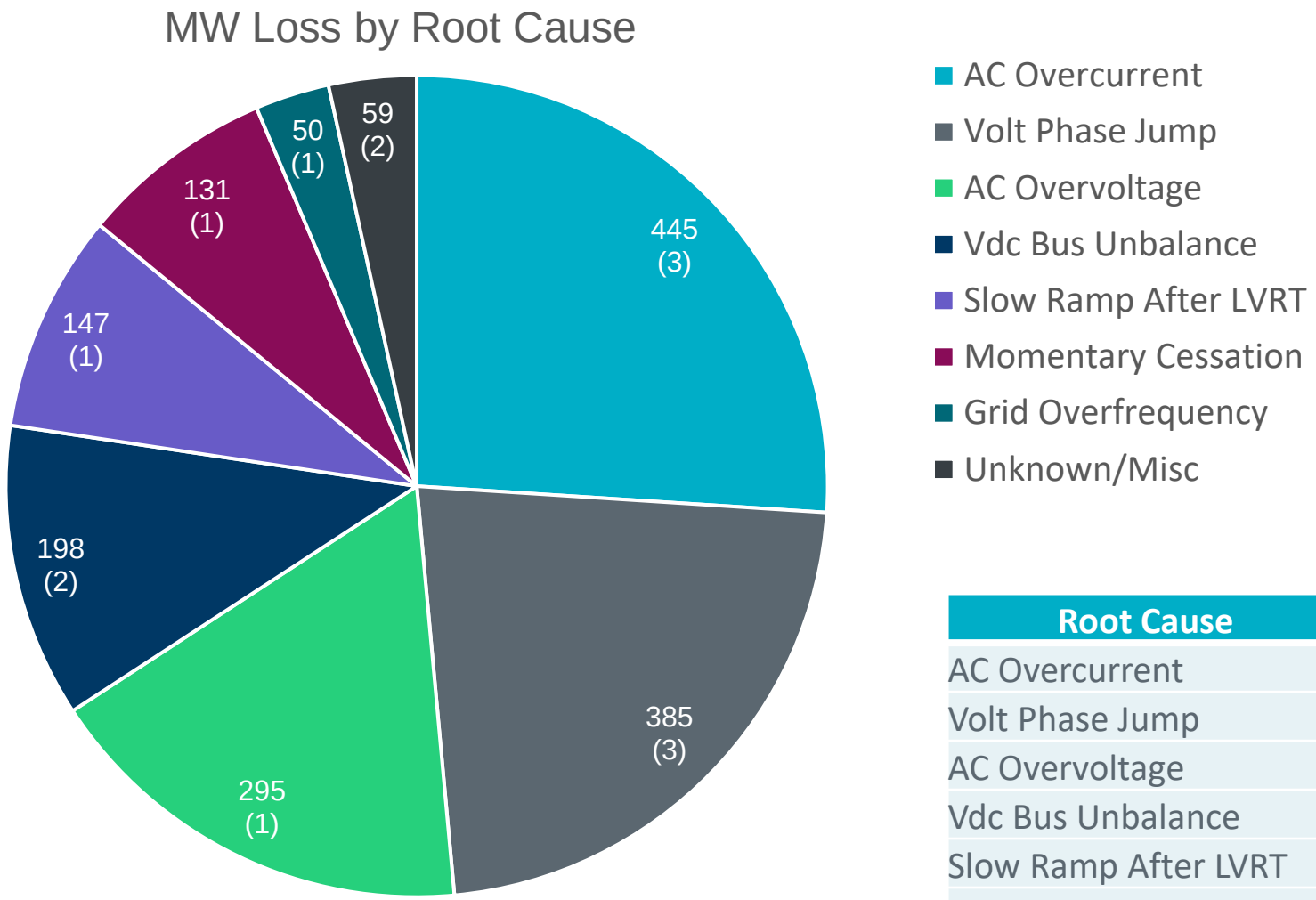
MW Loss per Inverter Type and Capacity





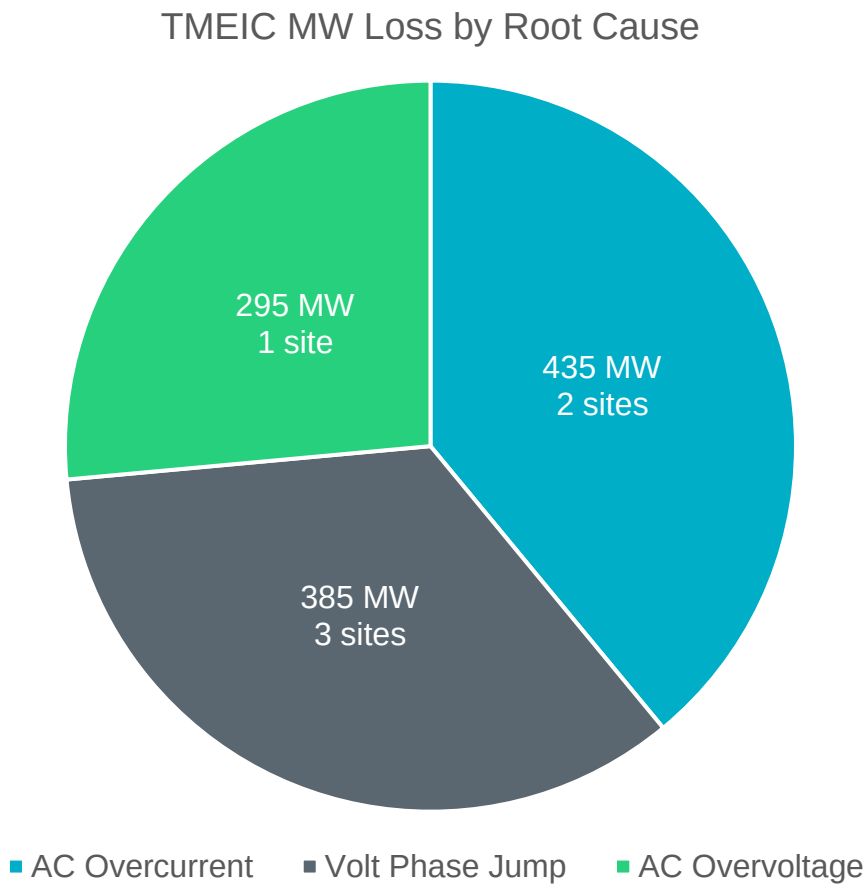


Causes of Solar PV Reduction – 2022 Odessa



Root Cause	# Affected Facilities	MW Loss
AC Overcurrent	3	445
Volt Phase Jump	3	385
AC Overvoltage	1	295
Vdc Bus Unbalance	2	198
Slow Ramp After LVRT	1	147
Momentary Cessation	1	131
Grid Overfrequency	1	50
Unknown/Misc	2	59

TMEIC (OEM1) MW Loss by Root Cause



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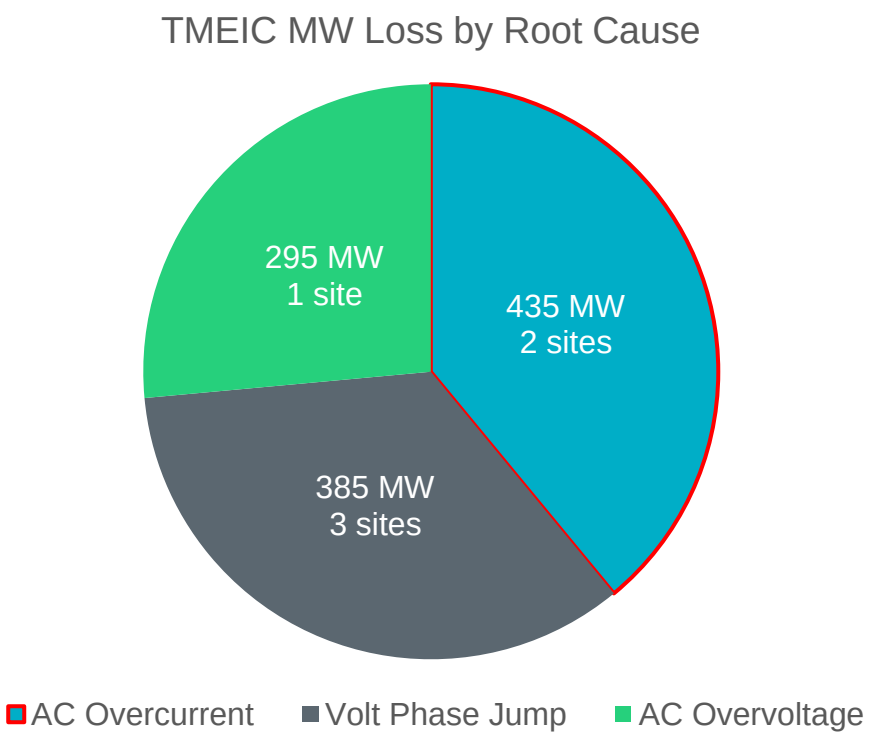
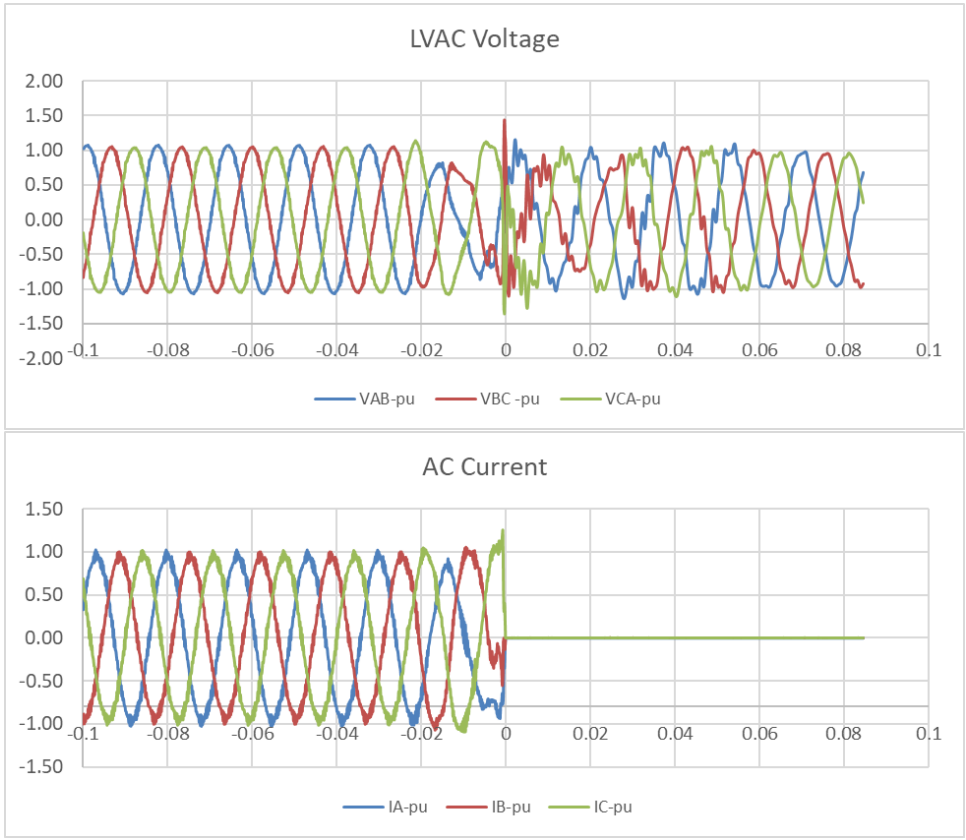
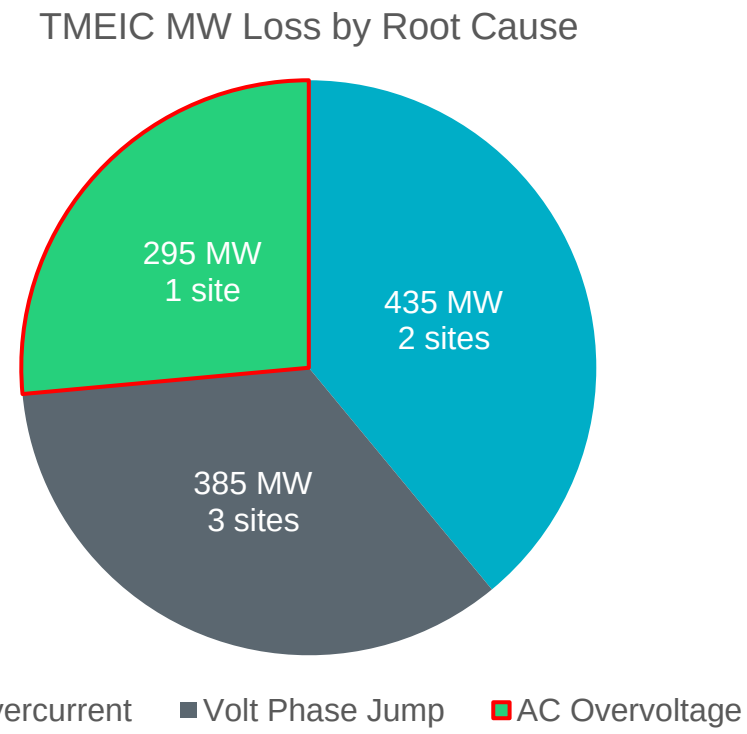
TMEIC - Overcurrent

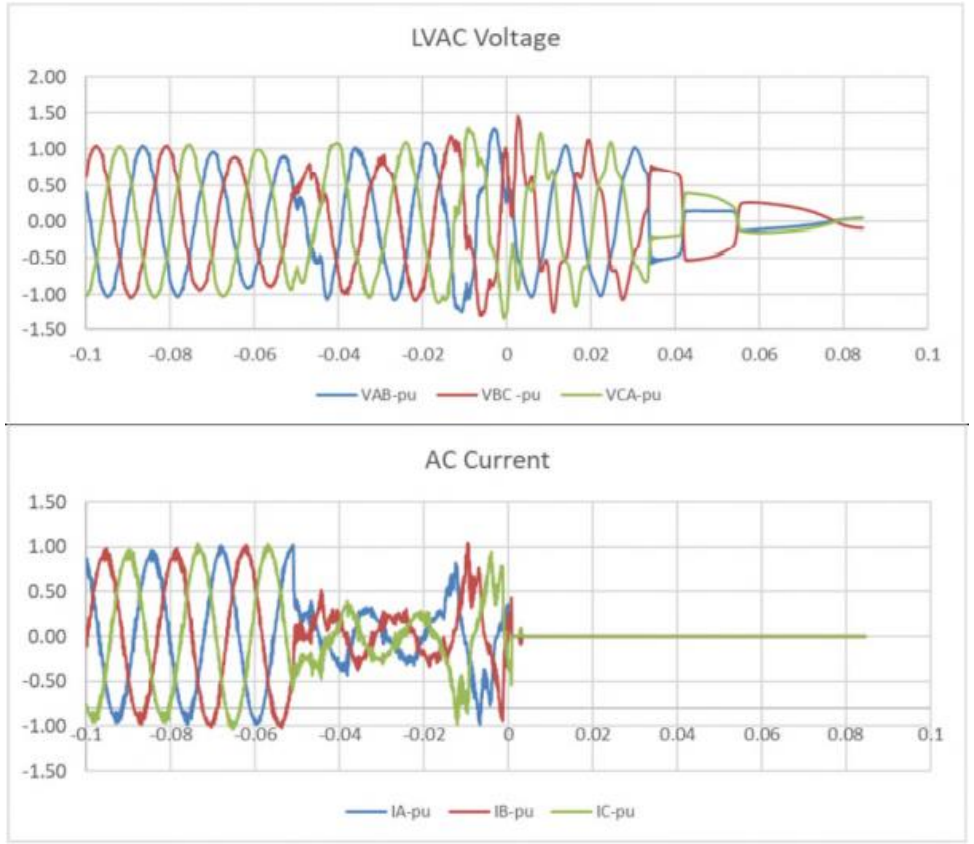




- Follow up call with TMEIC and RE (same for both sites) week Sept. 1
- Cannot increase overcurrent protection thresholds due to potential damage to inverter IGBTs
- TMEIC developing algorithm to prevent current spikes during grid voltage disturbances (in testing)
- RE to develop mitigation plan and timeline to submit to ERCOT

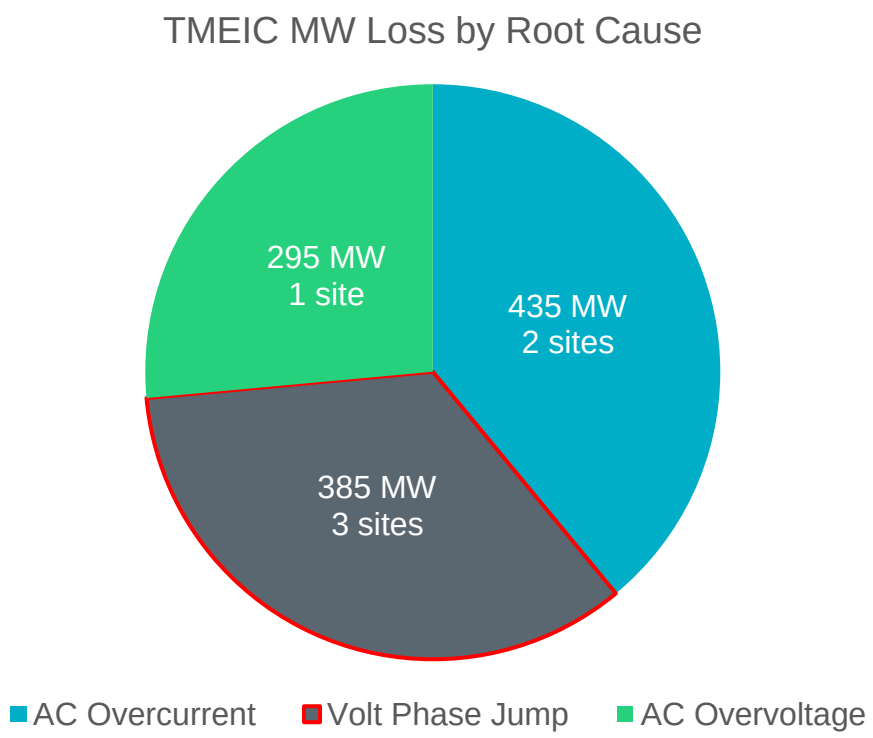
TMEIC - Overvoltage





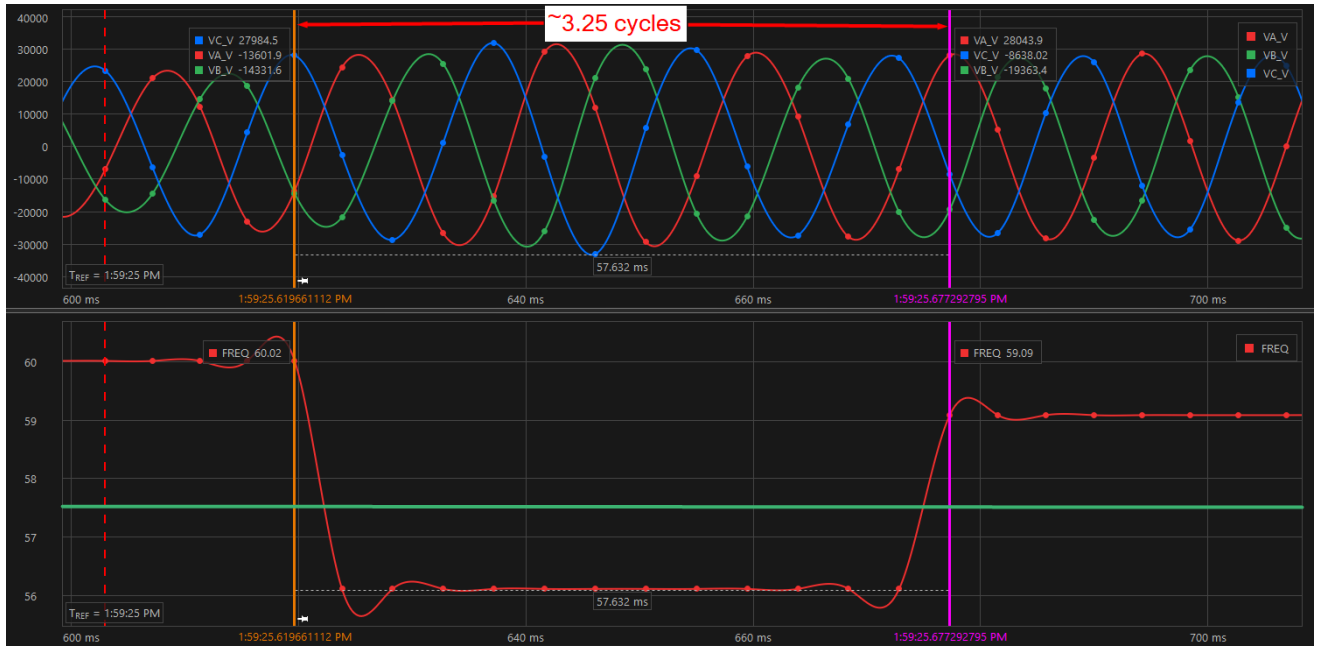
- Follow up call with TMEIC and RE week Sept. 1
- TMEIC increasing fast overvoltage protection thresholds (rollout has begun on some sites)
- TMEIC recommends decreasing k factor of DVC from 2 to 1 (default for new projects set to 1) to prevent overvoltage upon fault clearing
- RE to develop mitigation plan and timeline to submit to ERCOT

TMEIC - Volt Phase Jump



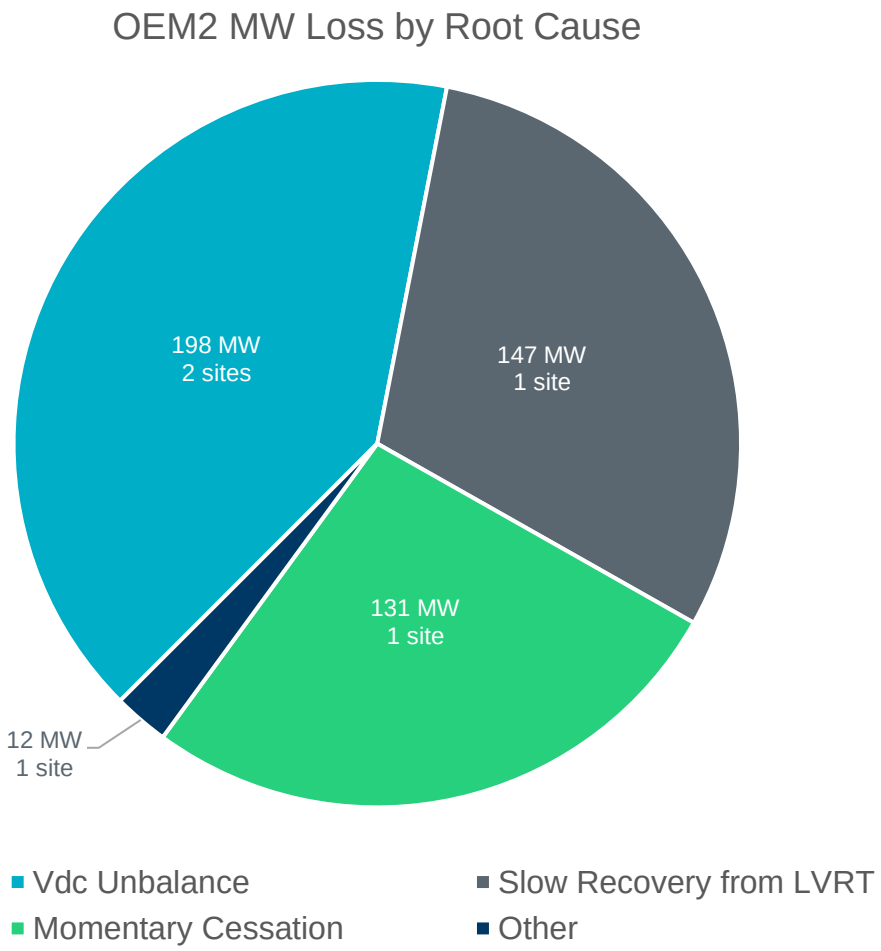
- Follow up calls with TMEIC and all 3 REs week of August 22
- Anti-islanding protection primarily used in distribution to protect lineman
- Protection not required on BPS nor for inverter protection
- Anti-islanding protection required for UL 1741 certification
- TMEIC recommends either extending threshold from 15 to 35 degrees or disabling protection altogether
- GO must request changes to volt phase jump protection settings
- REs to develop mitigation plan and timeline to submit to ERCOT

Feeder Breaker Underfrequency Tripping



- 3 feeder breakers tripped during event for frequency below 57.5 Hz
- Inverters tripped for other reasons so breaker tripping not primary root cause
- Issue highlighted in Odessa 2021 NERC event report
- Relay manufacturer recommends minimum time delay for frequency tripping to be 5 cycles
- Plants with feeder breaker tripping on underfrequency have increased measurement window to 10 cycles

OEM2 MW Loss by Root Cause



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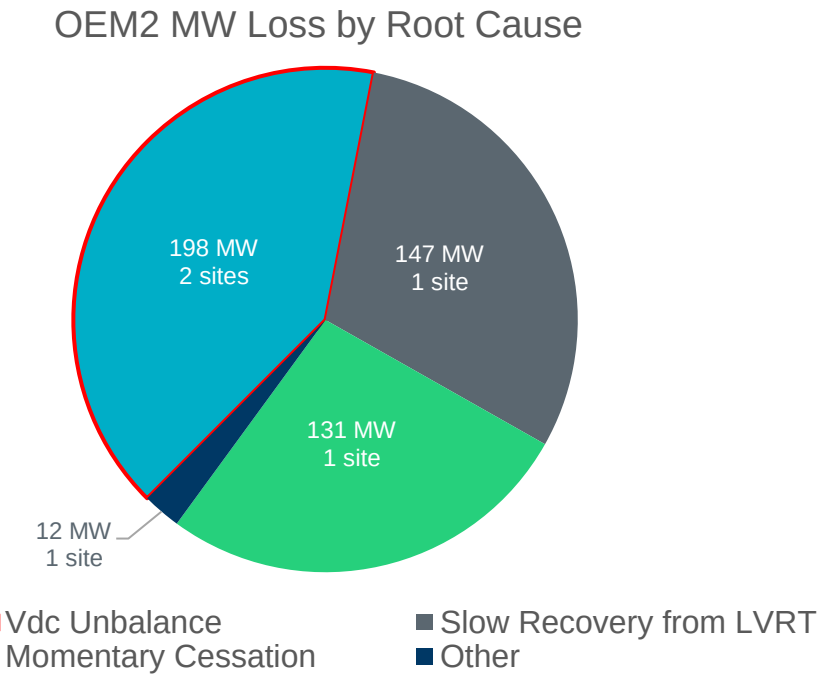
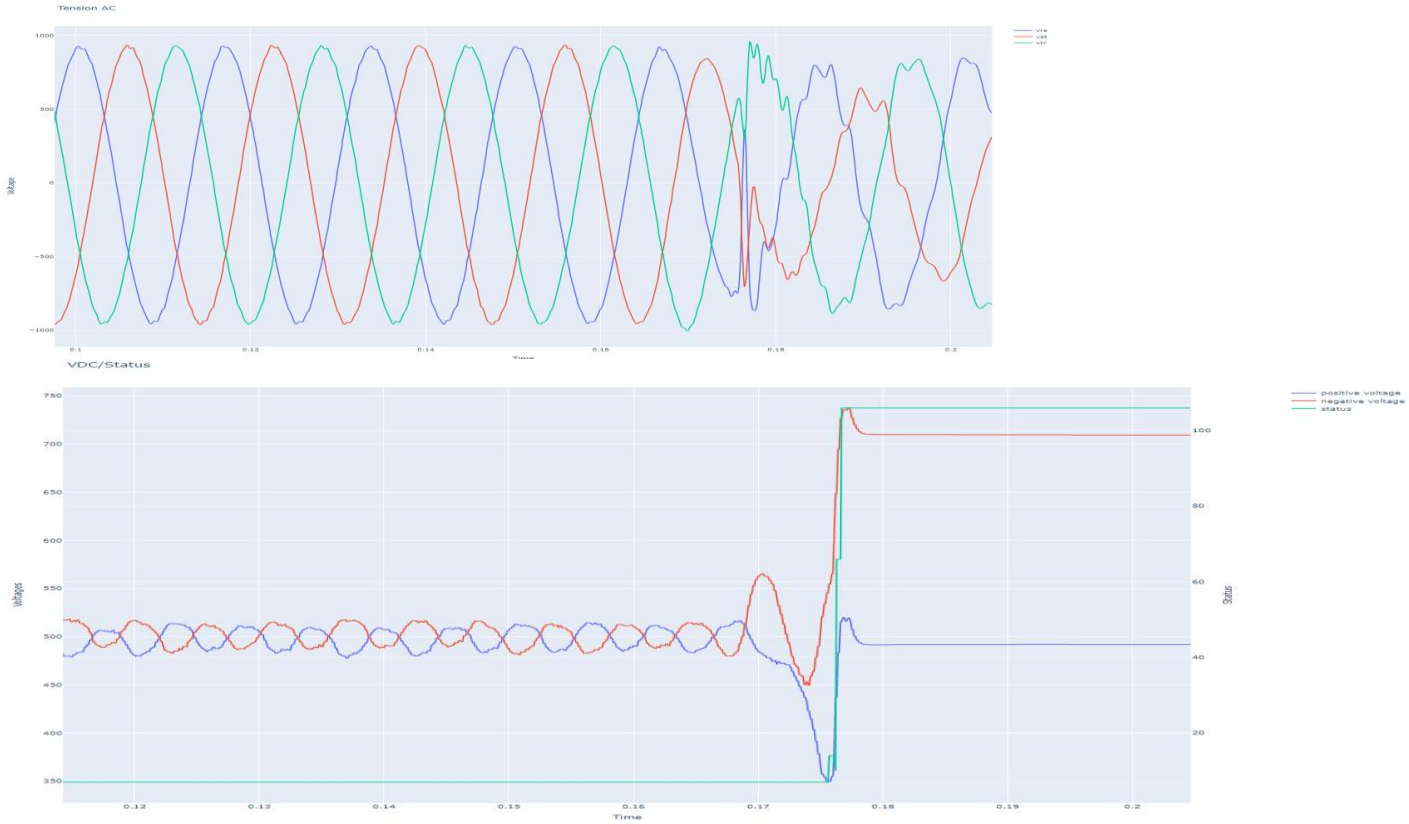
Unknown/Misc	2 (1)	59 (12)

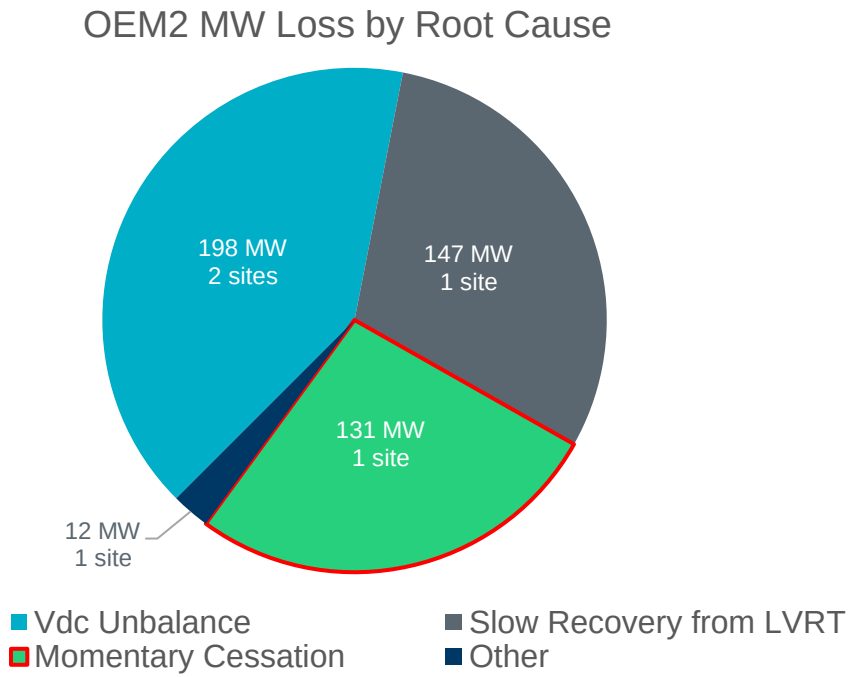
OEM2 – Vdc Unbalance

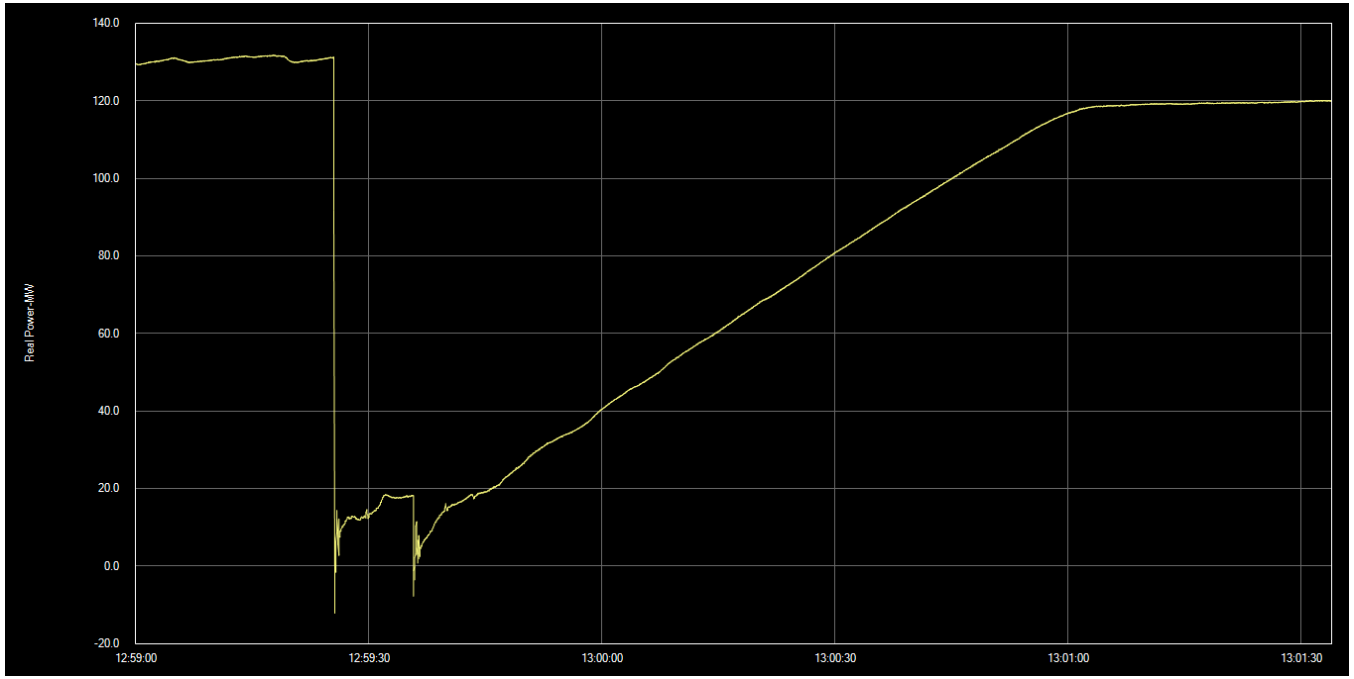




- Protection occurs when DC-side positive and negative bus voltage becomes unbalanced very rapidly – potential short
- AC-side voltage phase became unbalanced faster than controls could regulate DC-side due to disturbance
- OEM2 had seen issue in previous events and were already testing software update to mitigate
- Software update improves DC bus regulation response time during voltage disturbances
- OEM completed update to one plant on Aug. 29, second plant to be scheduled soon
- Update to be applied to all OEM2 inverters in ERCOT (with one exception)

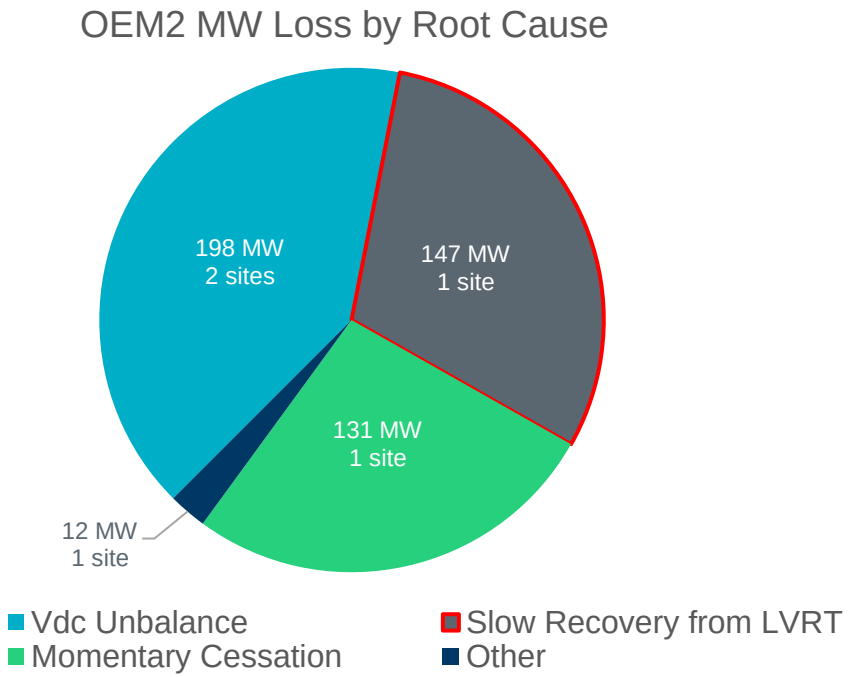
OEM2 – Momentary Cessation

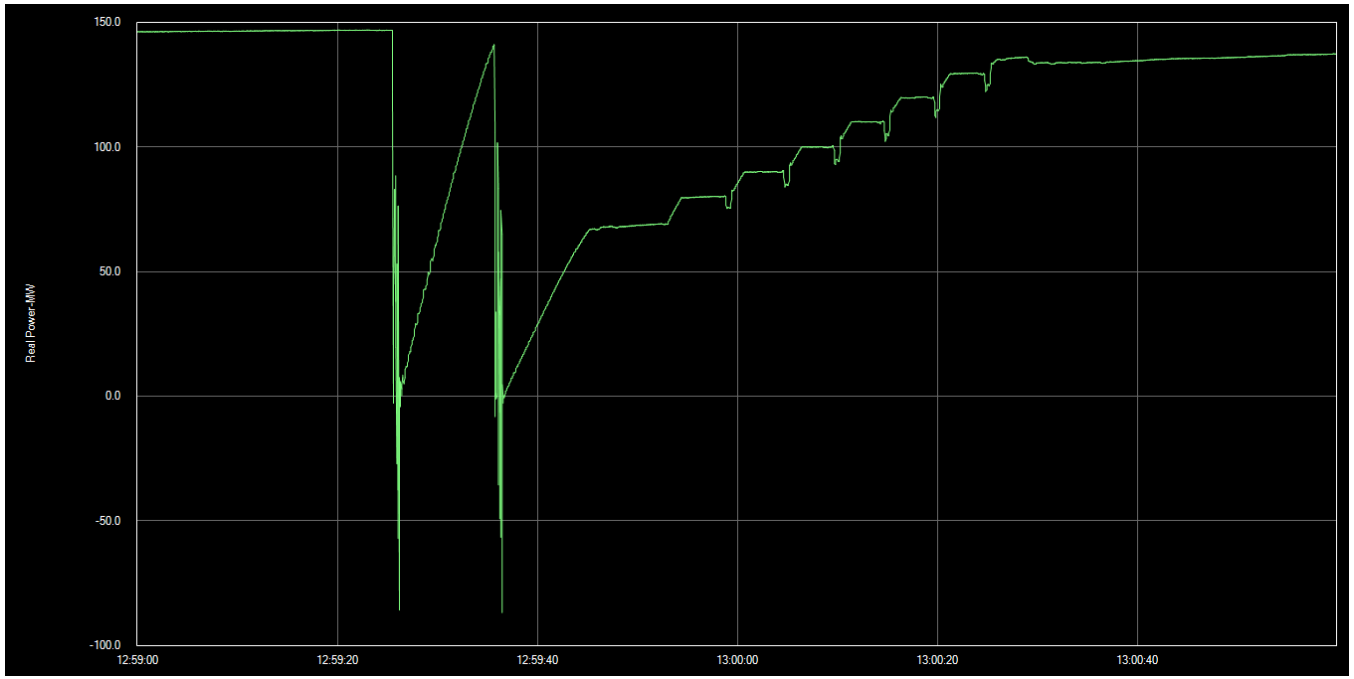




- Unclear whether inverters went into momentary cessation or reduced active power and were unable to recover quickly due to loss of auxiliary power
- Older inverters with limiting logging capabilities – difficult to identify corrective actions to improve response
- Unclear whether voltage drop or phase jump caused initial active power loss
- RE to work to OEM to develop mitigation plan and timeline – installed new PPC since 2021 Odessa event
- Potentially may not be able to meet current VRT requirements with current inverters

OEM2 – Slow Recovery from LVRT





- Follow up call scheduled Sept. 13
- May have already implemented corrective actions to limit MW reduction during LVRT and increase thresholds for low/high voltage inverter trip settings
- Need to determine why recovery after LVRT is slow and cause of oscillations
- Potentially some PPC interactions that need to be addressed

OEM3 and Miscellaneous

Root Cause	# Affected Facilities	MW Loss
AC Overcurrent	3(1)	445(10)
Volt Phase Jump	3	385
AC Overvoltage	1	295
Vdc Bus Unbalance	2	198
Slow Ramp After LVRT	1	147
Momentary Cessation	1	131
Grid Overfrequency	1	50
Unknown/Misc	2	59

- Calls scheduled with OEM3 and two plants (combined 97 MW loss) on Sept. 21
- OEM3 out of business – working with reps that took over service contracts
- Plant with grid overfrequency inverter trips had ongoing investigations at time of RFI response
- Plant with 47 MW loss unable to determine root cause – need to improve logging capabilities
- Third plant with OEM3 inverter lost <10% due to a couple inverters tripping on overcurrent
- Final plant with OEM2 inverters lost ~5% due to inverter tripping
- Will follow up with last two via email

Questions?