West Texas Solar & LFL Event: October 26, 2023

IBRWG

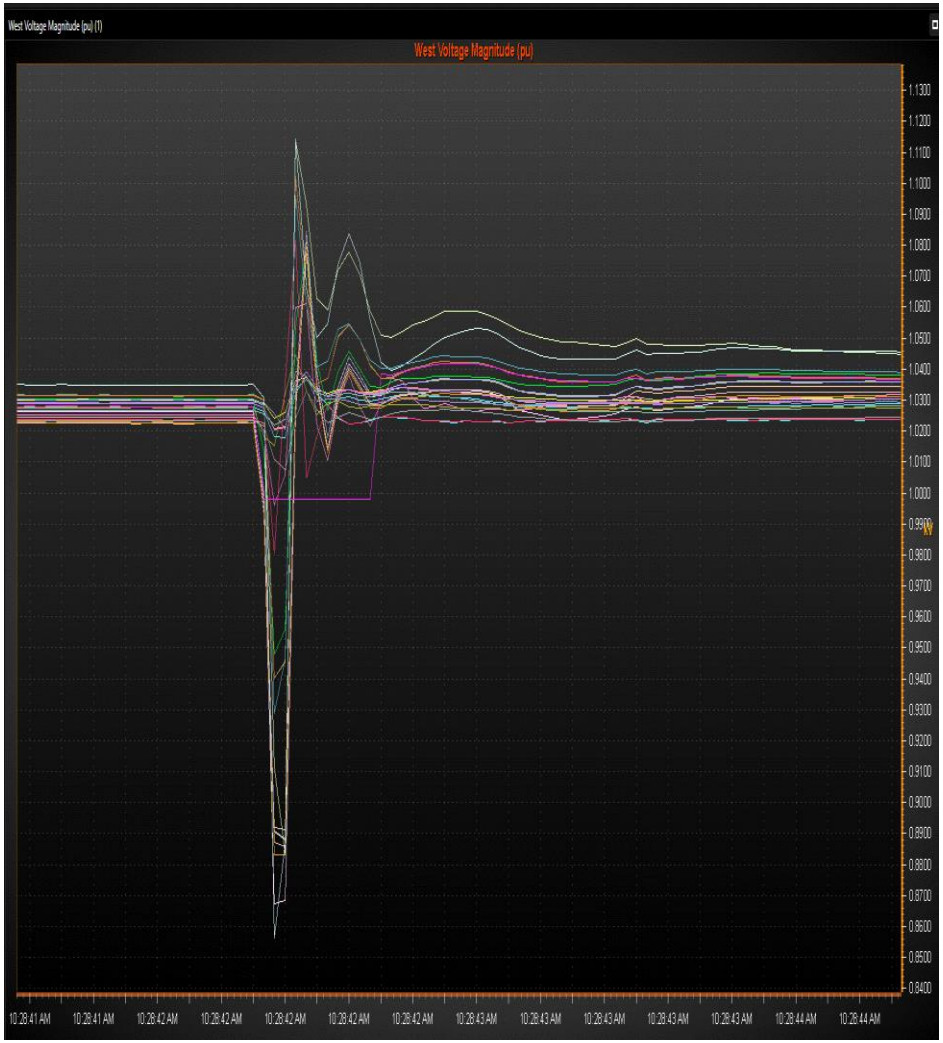
February 9th, 2024

West Texas Solar Event Summary

- On October 26, 2023, at 10:28 AM CDT, a 138 kV line at a switching station in West Texas experienced an unbalanced (Phase-A to ground) fault
- The event resulted in a loss of approximately 246 MW of IRR generation, 144 MW of conventional generation, and 179 MW of Large Flexible Load (LFL) consumption
  - All IRR generation lost was solar
  - Several of the LFLs involved in the event reduced consumption without breaker operation
- System frequency dropped to 59.972 Hz and returned to 60 Hz within approximately 10 seconds
- This event was not classified as NERC reportable; however, ERCOT staff intends to investigate the loss of IRR generation and LFL consumption further

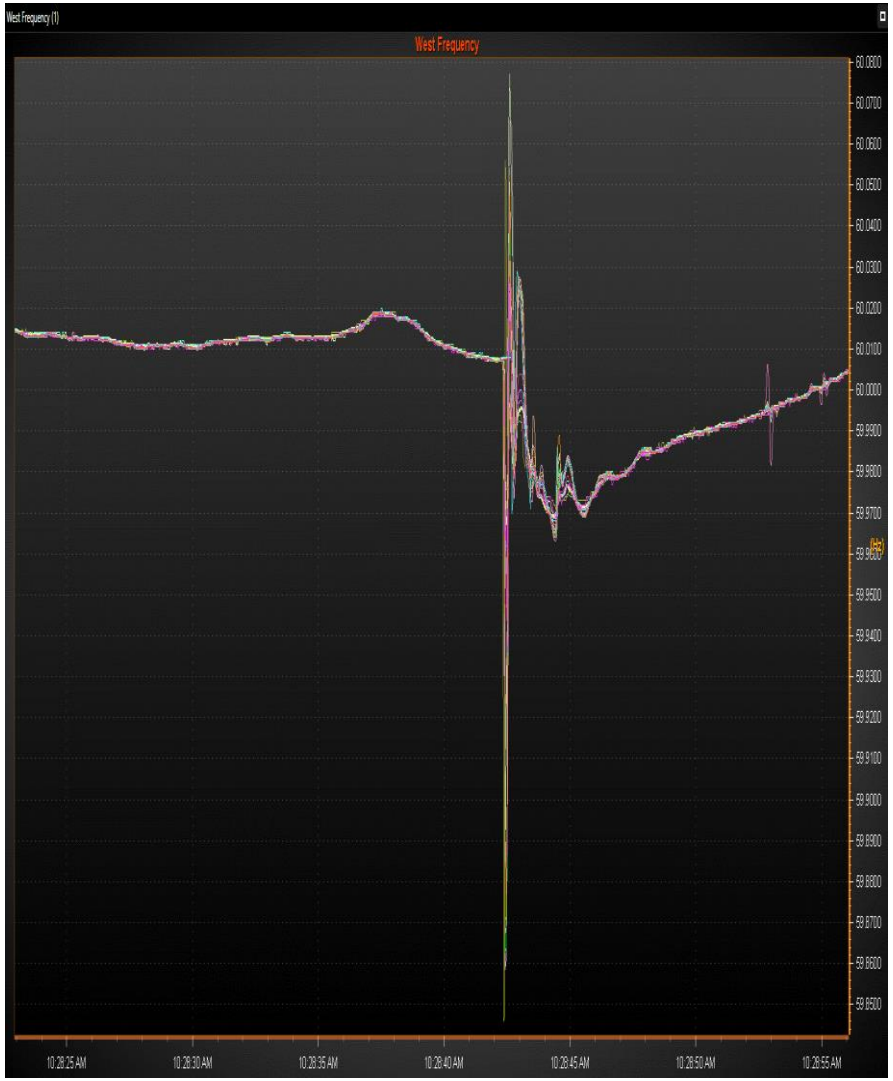
Real Time PMU Voltage

- Lowest West Texas PMU voltage recorded was 0.85 pu on a 138 kV line
- An erroneous connection was made between an energized section of the bus and ground resulting in the fault
- Protective devices isolated the fault in approximately 4 cycles (~66 ms)



Real Time PMU Frequency

- Single PMU in West Texas picked up the lowest freq. of 59.85 Hz during the fault
- System frequency never fell below 59.972 Hz



Event Progress

- RFIs were sent to the QSEs of all the LFLs that tripped or reduced consumption in response to this event and the QSE of the conventional generator that reduced following the fault
- A list of questions have been sent to all IRRs involved with this event to investigate the root cause of each trip
- Summary of responses in the following slides

Past Events Comparison

Facility ID	Capacity (MW)	Odessa 2021		Odessa 2022		January 23rd, 2023		October 26th, 2023
		MW Loss	Root Cause	MW Loss	Root Cause	MW Loss	Root Cause	MW Loss
Plant A	180	28	Unknown	0	N/A	6	Several inverters went into "Idle Mode" for unknown reasons	6
Plant F	50	48	Inverter Underfrequency	47	Unknown	17	AC Overcurrent	16
Plant K/L	158	153	Momentary Cessation	130.6	Momentary Cessation	74	Momentary Cessation and overcurrent	109
Plant N/O	160	23	Unknown	49.5	Unknown; Inaccurate fault code	30	Unknown; Possible PPC Interaction	3
Plant P	158	9	N/A	10.2	AC Overcurrent	1.5	AC Overcurrent	6
Totals	**706**	**261**		**237.3**		**128.5**		**140**

- Several of the facilities involved with the October 26 event were also involved in both Odessa events and the January 23, 2023 event
- Note that with the most recent event, and other small events we have been keeping track of, ERCOT has observed a disproportionate deviation in frequency to the amount of generation lost
  - In the October 26th event, there was only a net drop of 211 MW of generation (246 MW (IRR) + 144 MW (Conv.) – 179 MW (Load) = 211 MW), but there was a 0.035 Hz drop in frequency
    - Since the last IBRWG meeting, ERCOT held an internal discussion highlighting that the momentary loss of generation was much greater accounting for the frequency drop
  - PMUs monitoring lines to solar facilities are showing excessive drops in active power during fault and recovering to pre-disturbance output within 1 second

Solar Facilities Responses

Unit	Inverter OEM	Pre-Disturbance MW	Lowest MW	MW Loss during fault	Post-Disturbance MW	MW Loss	Root Cause
PLANT A	KACO	129	68	61	123	6	4 inverters tripped due to AC overcurrent protection
PLANT K	TMEIC	144	33	111	38	106	Returned to pre-disturbance output in 7 seconds. Low inverter ramp rate.
PLANT F	KACO	34	18	16	18	16	10 inverters tripped due to AC overcurrent protection
PLANT K	PE	68	13	55	13	55	Same performance as previous events
PLANT K	PE	67	13	54	13	54	
PLANT N	KACO	89	17	72	86	3	3 inverters tripped. Cause unknown
PLANT P	KACO	142	136	6	136	6	3 inverters tripped on AC overcurrent.

- Three out of the seven impacted facilities had inverters trip on AC overcurrent
- One facility continues to have similar ride-through issues to previous events
- Low inverter ramp rate issue has already been addressed by TMEIC and there is ongoing work to fix the issue
- KACO is out of business causing some difficulty for facilities to adjust their inverter settings

LFL Responses

Load	Pre-Disturbance Consumption (MW)	Post-Disturbance Consumption (MW)	Consumtion (MW) Loss	Root Cause
LOAD A	71	0	71	Phase-to-phase current imbalance triggered protection of operations of a breaker at the facility
LOAD B	71	0	71	Phase-to-phase current imbalance triggered protection of operations of a breaker at the facility
LOAD C	34	26	8	No reason provided
LOAD D	71	65	6	No reason provided
LOAD E	31	14	17	No feeder breaker operation, but their low voltage main distribution panels for their Phase 2 transformers all tripped due to the sag in voltage
LOAD F	30	24	6	Did not respond to RFI

- Five out of the six loads responded to their request for information, awaiting response from the sixth load owner
- Lowest voltage sag observed by a PMU at these facilities was around 0.85 p.u.
- Apparent that LFLs have limited VRT capability (tripping due to small sag in voltage)

Next Steps

- Continue working with solar facilities that have KACO inverters to provide whatever information we can to help them ride through future events
- Keep tracking LFL events as they occur on the system
- Work with LFL owners to address any questions pertaining to VRT

Questions?