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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Data Center Event

Recent Large Load Loss Event

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NERC EAS
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Incident Review

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Considering Simultaneous Voltage-Sensitive Load Reductions

Primary Takeaways

Operators and planners of the Bulk Electric System (BES) should be aware of the risks and challenges associated with voltage-sensitive large loads that are rapidly being connected to the power system. Specifically, when considering data centers and cryptocurrency mining facilities, entities should be aware of the potential for large amounts of voltage-sensitive load loss during normally cleared faults on the BES. Voltage-sensitive data center-type loads have increased on the system and are predicted to continue growing rapidly. The 2024 NERC *Long-Term Reliability Assessment* (LTRA) documents and discusses this potential growth of data center-type loads. This vignette highlights this load-loss potential based on analysis of a recent event in the Eastern Interconnection and offers some considerations for BES operators, planners, and regulators concerning identifying and mitigating the potential reliability effects and risks presented by these large voltage-sensitive load losses for future operations.

Summary of Incident

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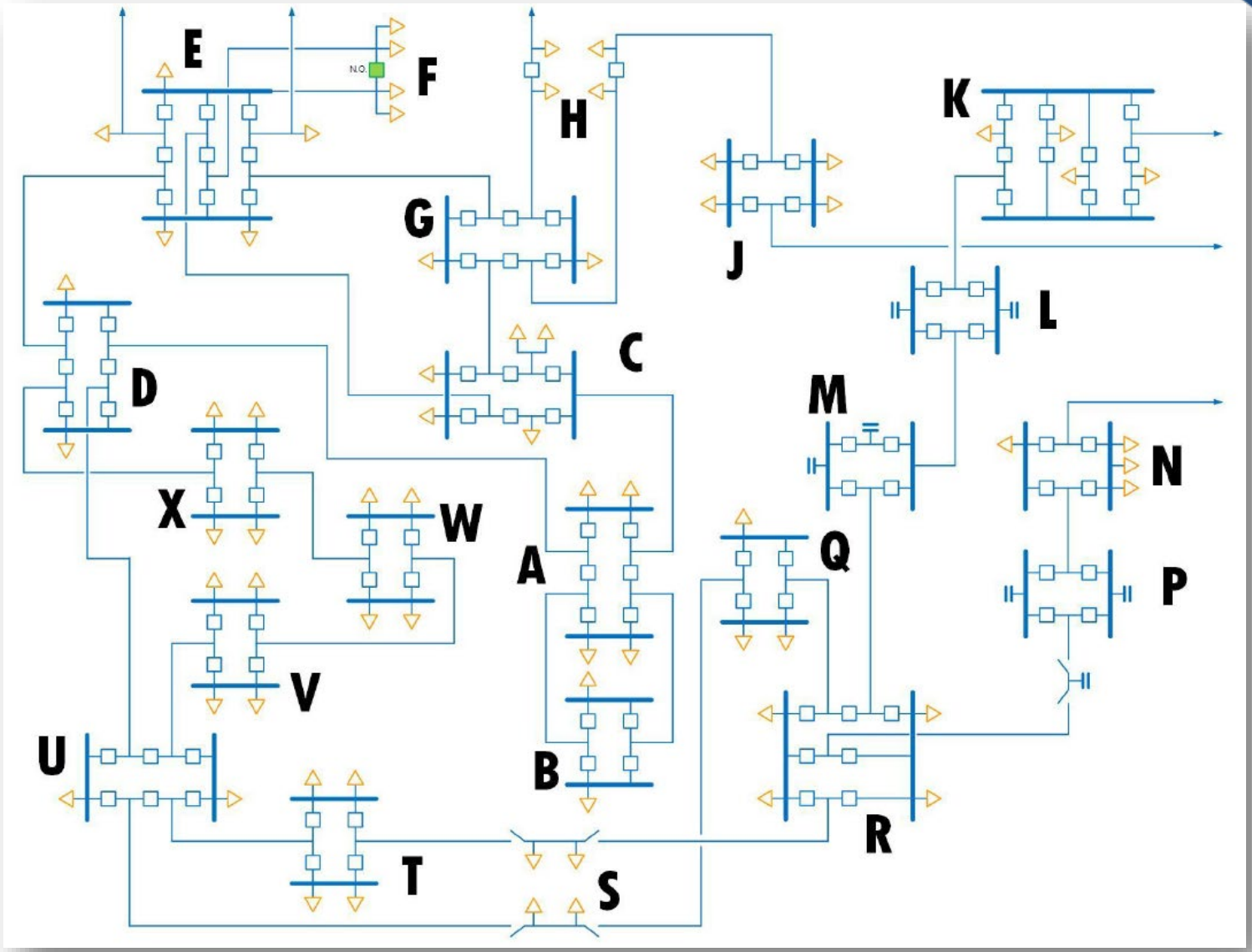
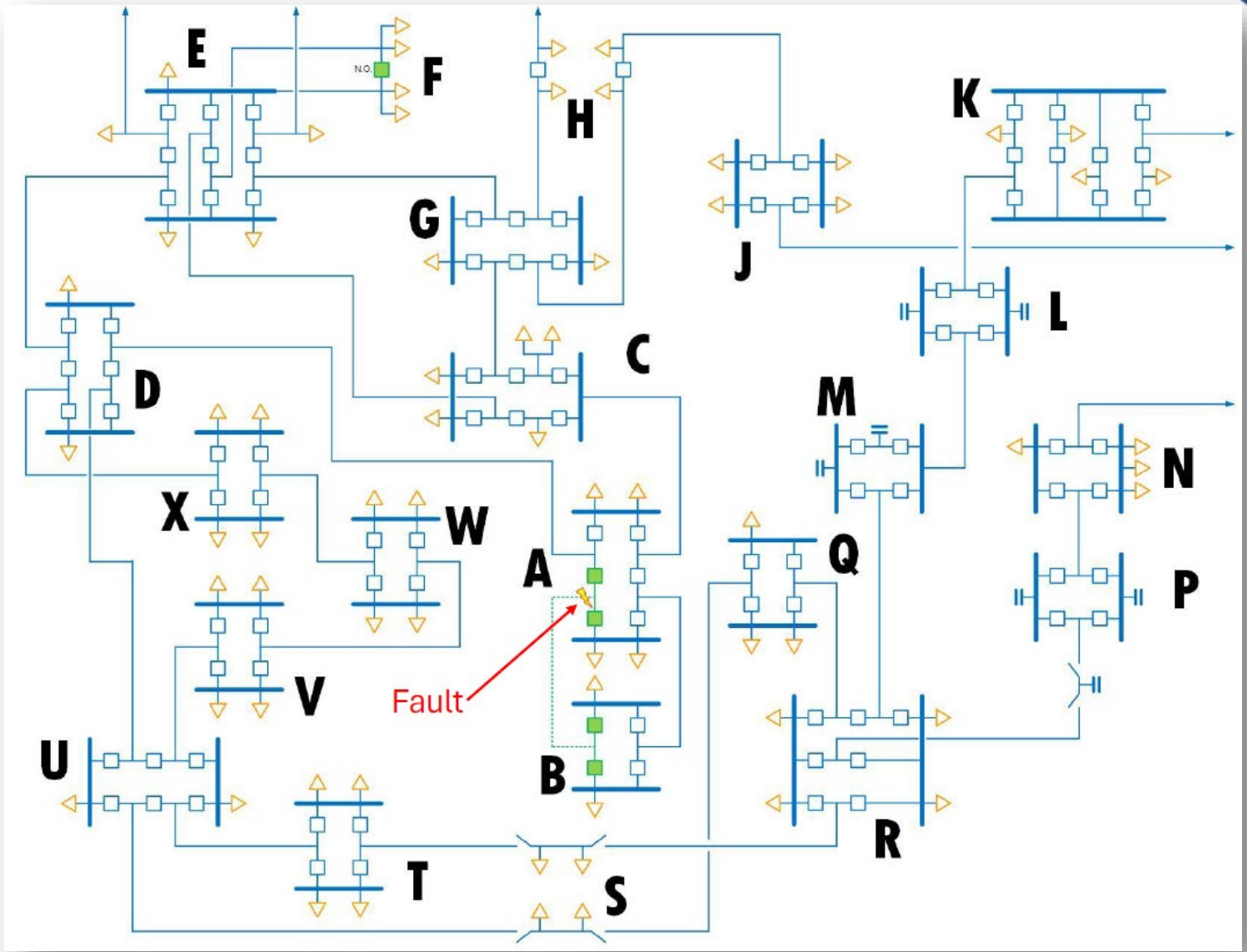
Incident Details

At approximately 7:00 p.m. Eastern on July 10, 2024, a lightning arrestor failed on a 230 kV transmission line in the Eastern Interconnection, resulting in a permanent fault that eventually "locked out" the transmission line. The auto-reclosing control on the transmission line was configured for three auto-reclose attempts staggered at each end of the line. This configuration resulted in 6 successive system faults in an 82-second period. The protection system detected these faults and cleared them properly. The shortest fault duration was the initial fault at 42 milliseconds, and the longest fault duration was 66 milliseconds. The voltage magnitudes during the fault ranged from .25 to .40 per unit in the load-loss area.

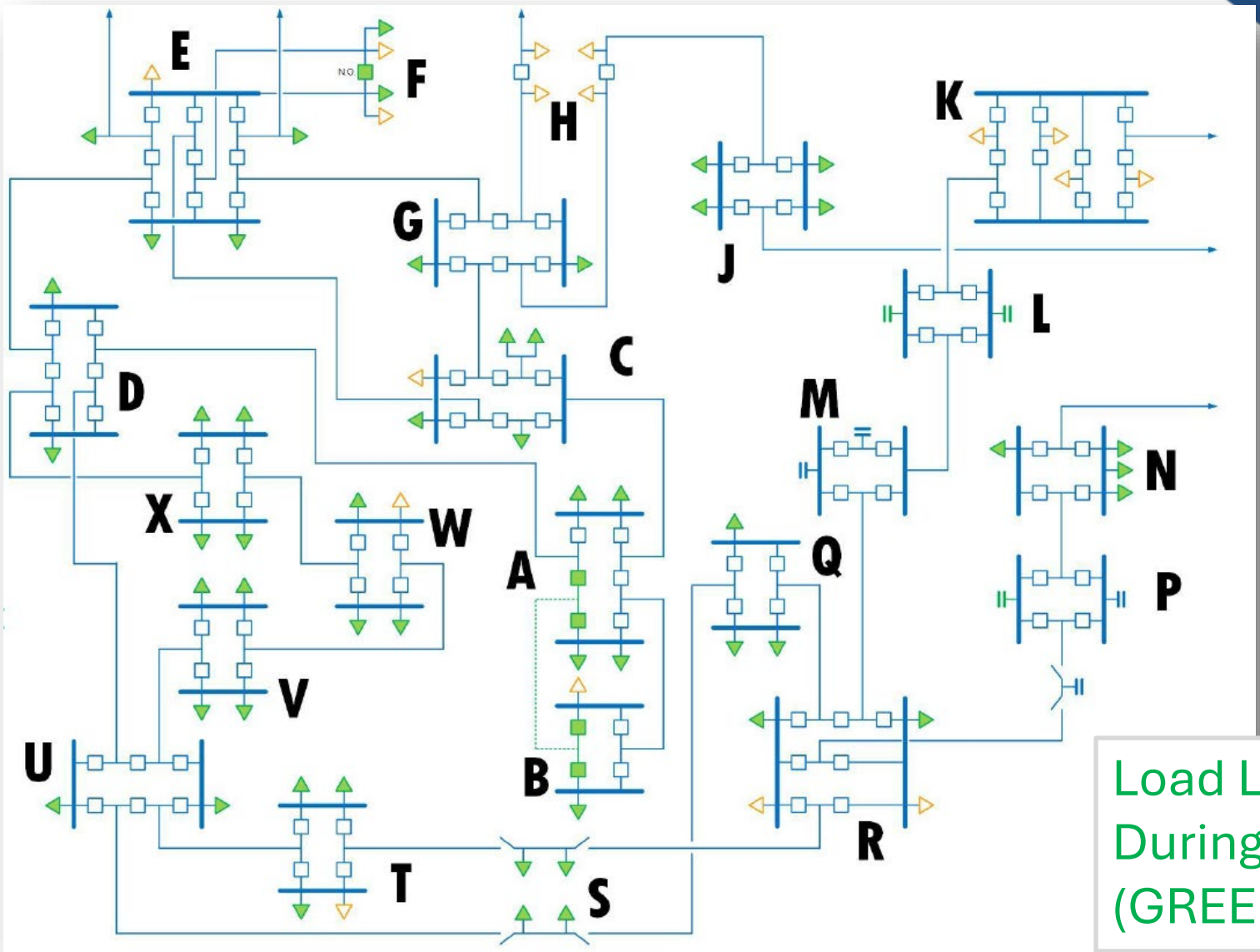
Load Loss



Load Loss

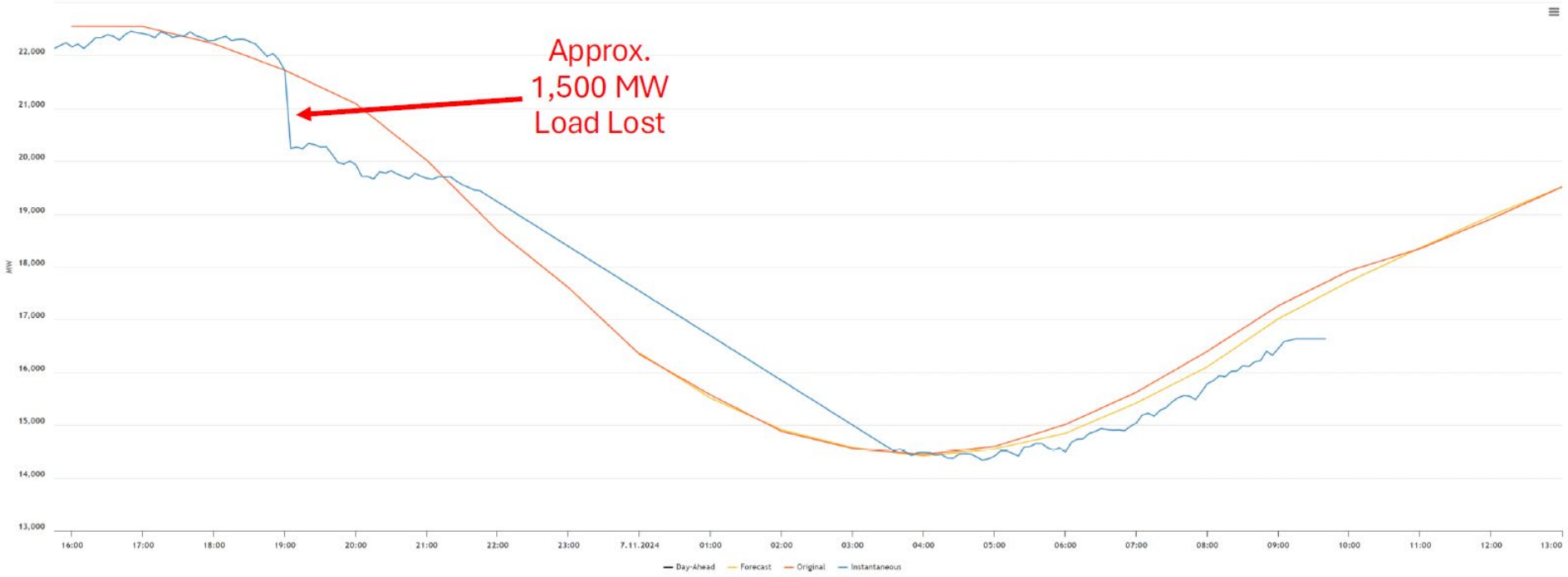


Load Loss



Load Lost During Event (GREEN)

Load Loss


Approx.
1,500 MW
Load Lost
MW
22,000
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
7.11.2024
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
Day-Ahead
Forecast
Original
Instantaneous

Load Loss

- Exclusively Data Center load
- 25-30 substations
- ~ 60 individual data center load points
- Individual load loss ranged from 2 MW to 85 MW

Data Center Load Transferred

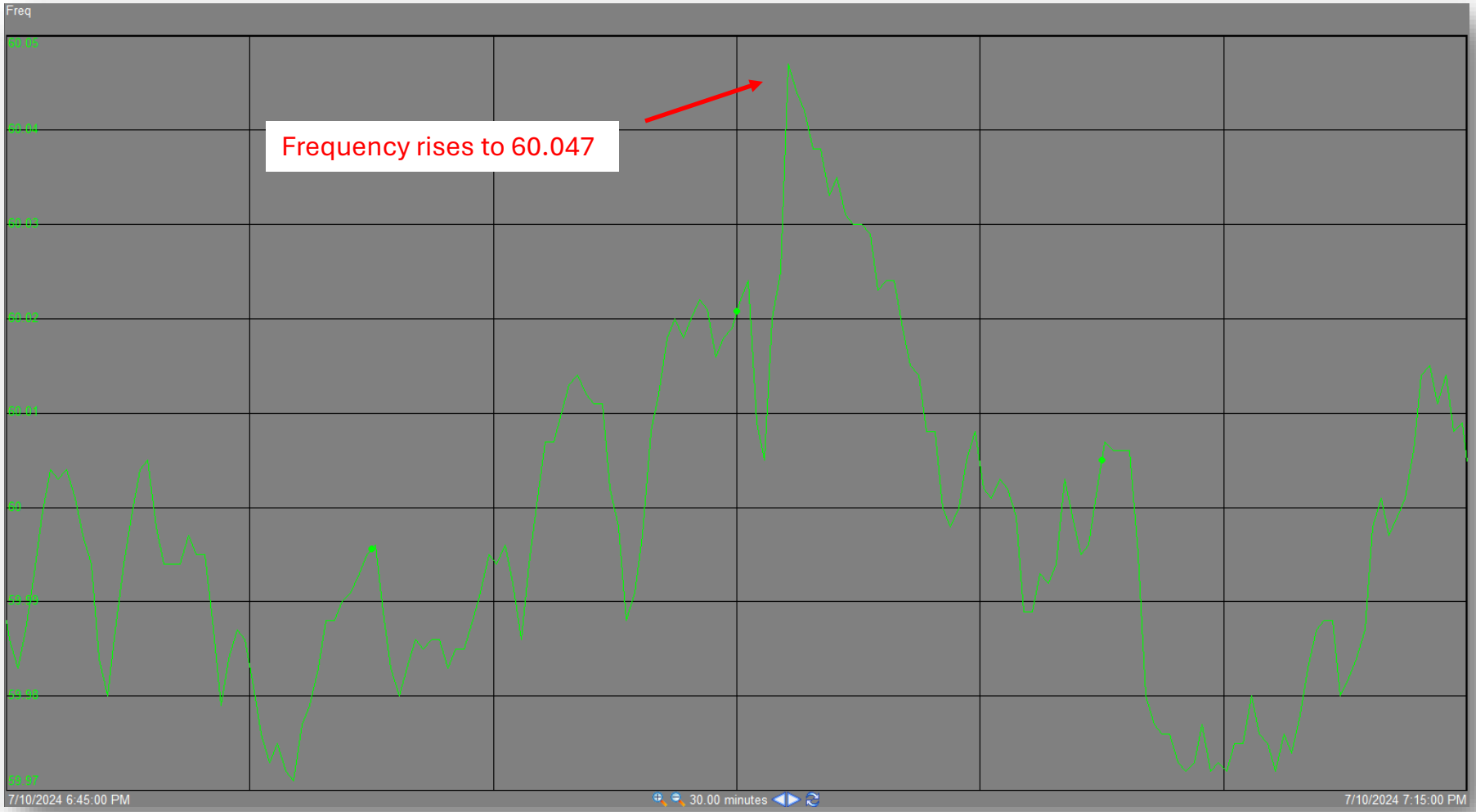
Station	TX	MVA	Customer
[redacted]	1	10	[redacted]
	2	20	
	3	20	
	4	20	
	6	15	
	1	25	
	2	10	
	3	60	
	5	40	
	2	2	
	3	2	
	1	2	
	2	2	
	3	2	
	4	20	
	1	60	
	2	55	
	3	75	
	4	45	
	3	10	
	4	2	
	5	5	
	1	5	
	3	13	
	4	2	
	3	8	
	1	2	
	2	5	
	3	3	
	4	20	

Station	TX	MVA	Customer
[redacted]	4	10	[redacted]
	2	22	
	3	20	
	4	10	
	2	2	
	4	10	
	1	30	
	2	40	
	3	40	
	4	30	
	1	72	
	2	95	
	1	72	
	2	55	
	3	32	
	6	27	
	2	15	
	3	10	
	3	35	
	4	35	
	1	5	
	2	10	
	3	15	
	4	15	

Station	DP	MVA	Customer
[redacted]	1	50	[redacted]
	2	10	
	1	45	
	1	82	
	1	55	
	2	42	

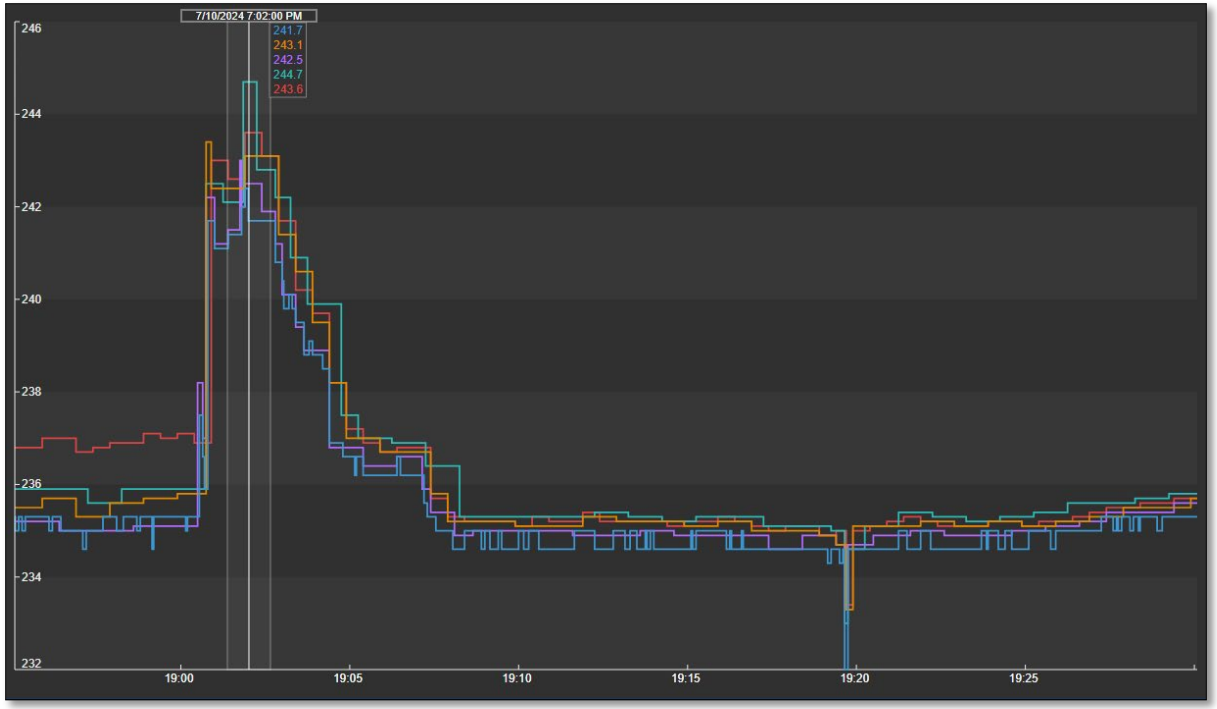
DEV SUBTOTAL = 1,267
COOP SUBTOTAL = 284
TOTAL LOAD = 1,551

Load Loss Effects

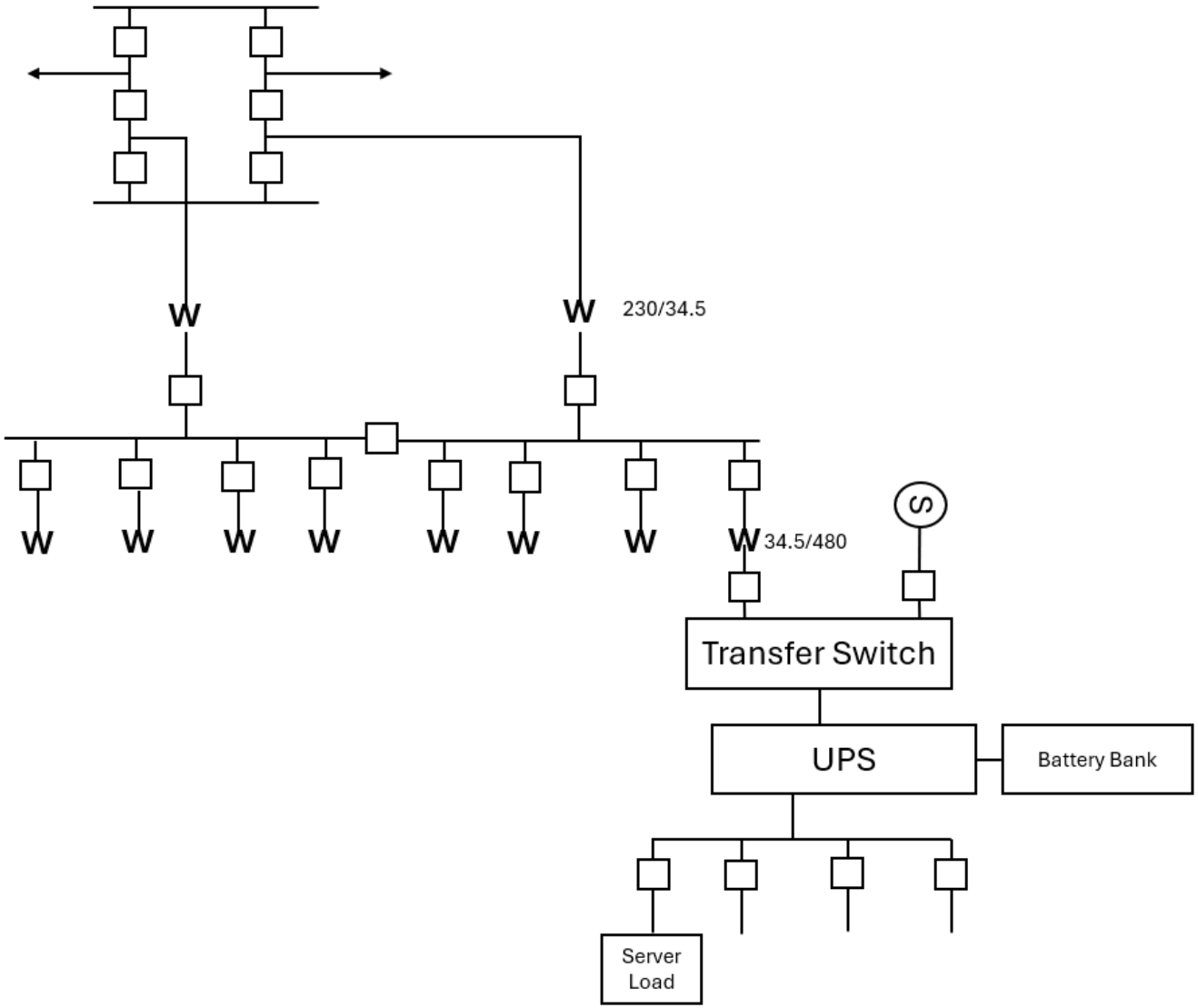


Load Loss Effects

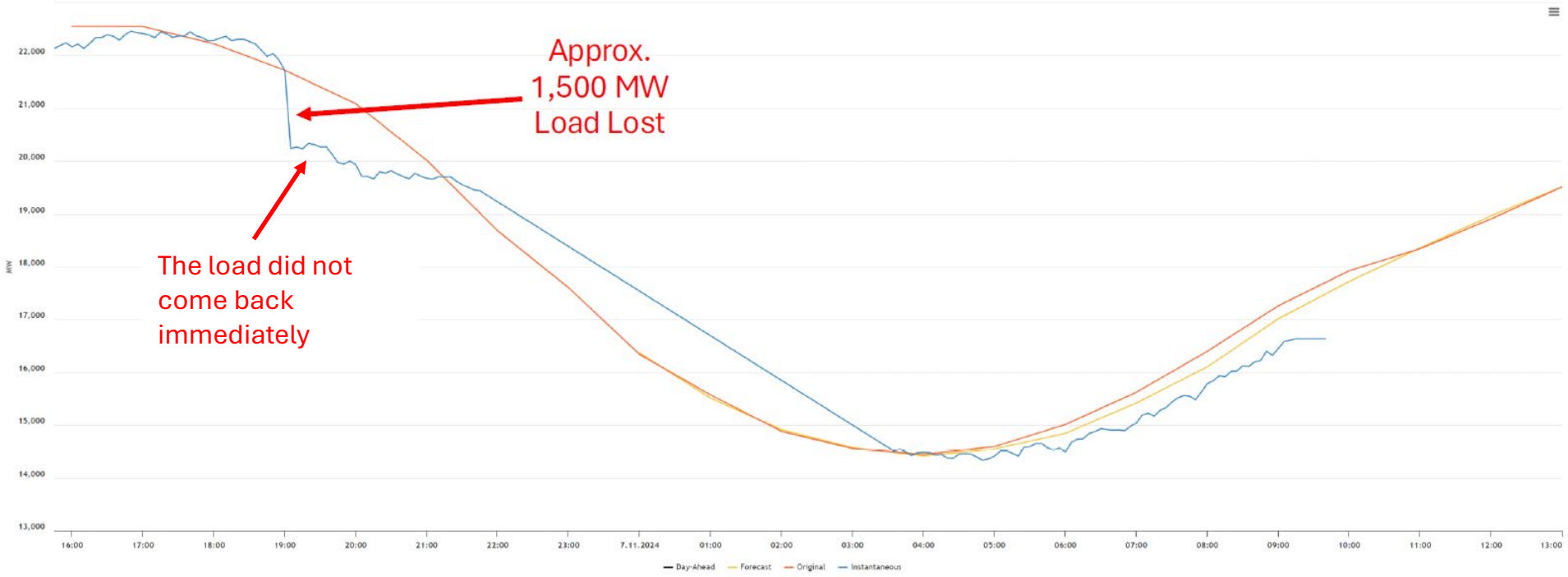
- High Voltage
- Less than 1.1 per unit
- Operators removed local area 230 kV capacitor banks to reduce voltage



Analysis


230/34.5
34.5/480
S
Transfer Switch
UPS
Battery Bank
Server Load

Load Loss


Approx.
1,500 MW
Load Lost
The load did not come back immediately
MW
22,000
21,000
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
16:00
17:00
18:00
19:00
20:00
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7.11.2024
01:00
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Original
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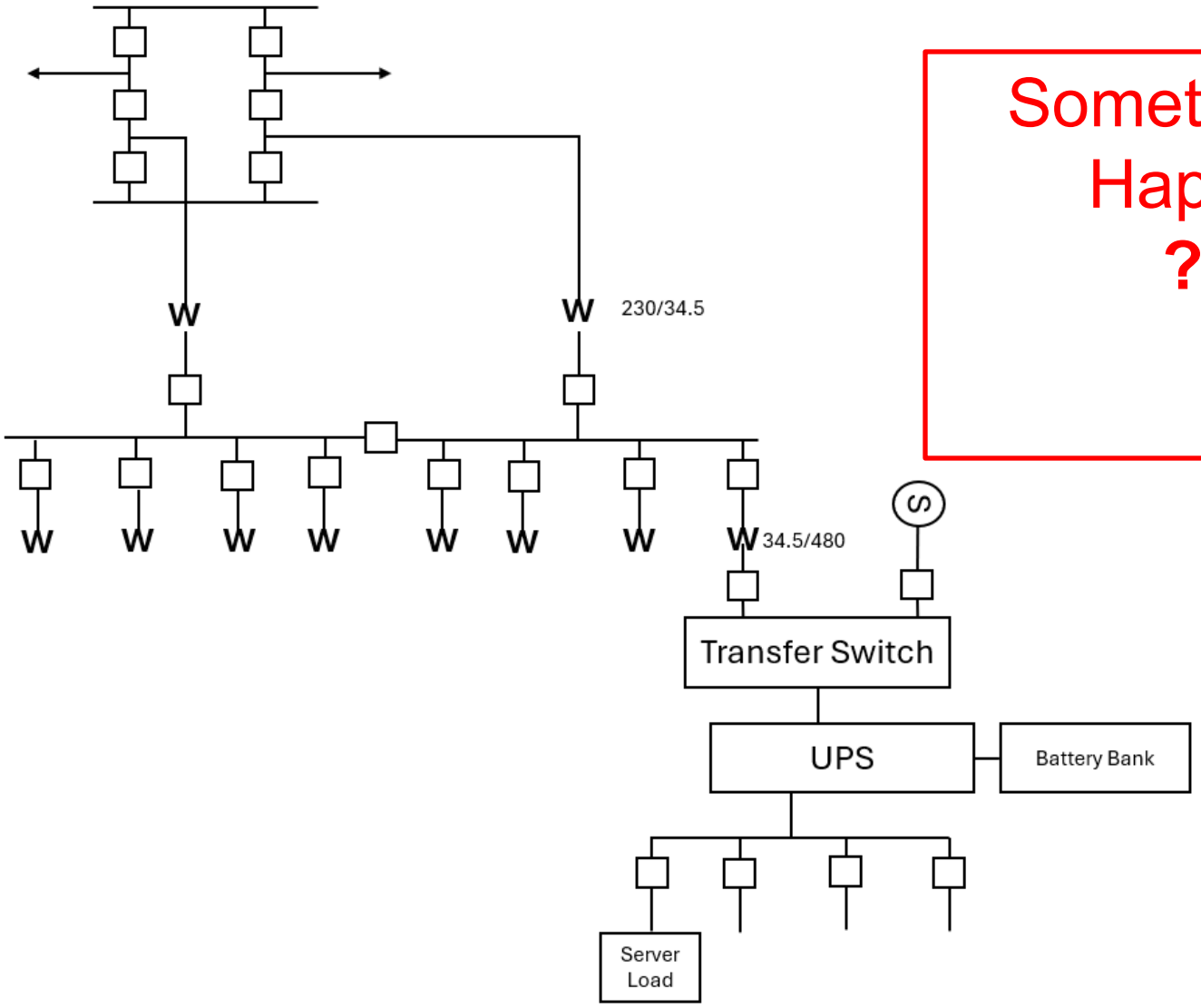
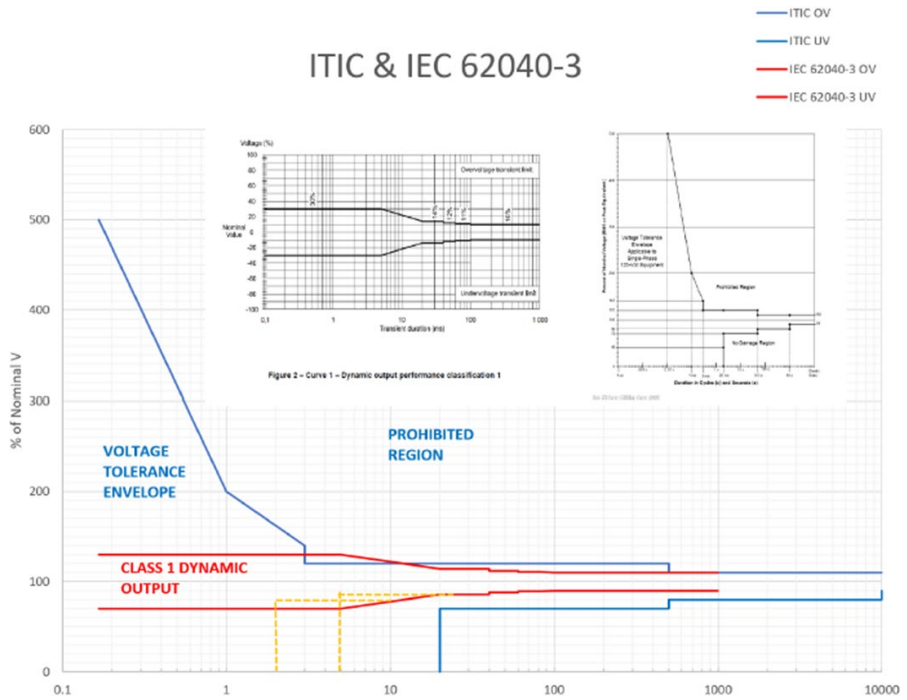


Something Else Happened ????

Data Center Coalition

- Call with Data Center Coalition (DCC)
  - Cooling load is critical after voltage disturbance
  - Design follows ITIC curve
  - Will “lockout” after a number of events in a specific period of time
  - More than one power distribution architecture



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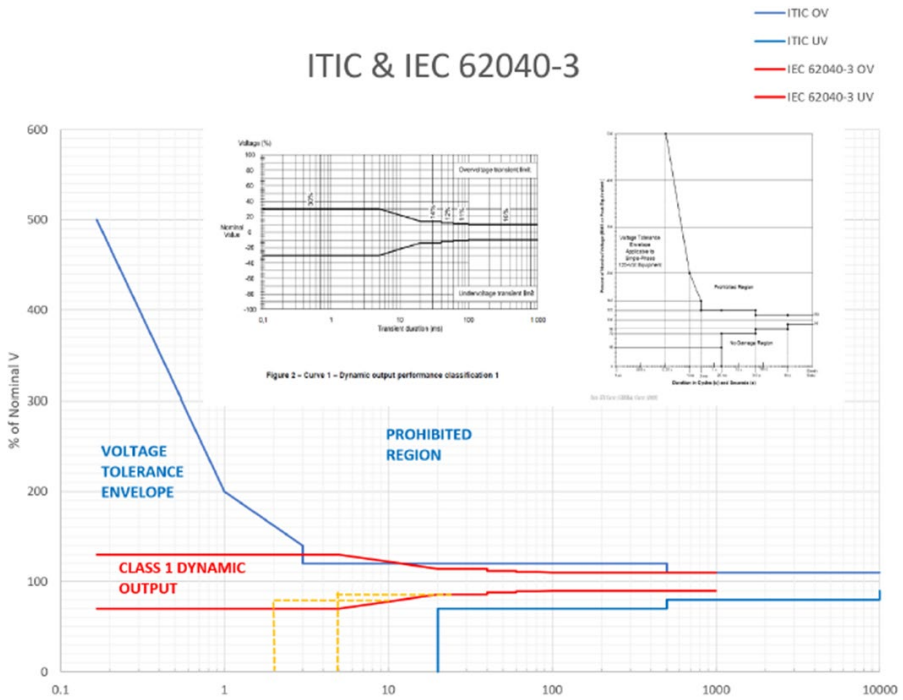
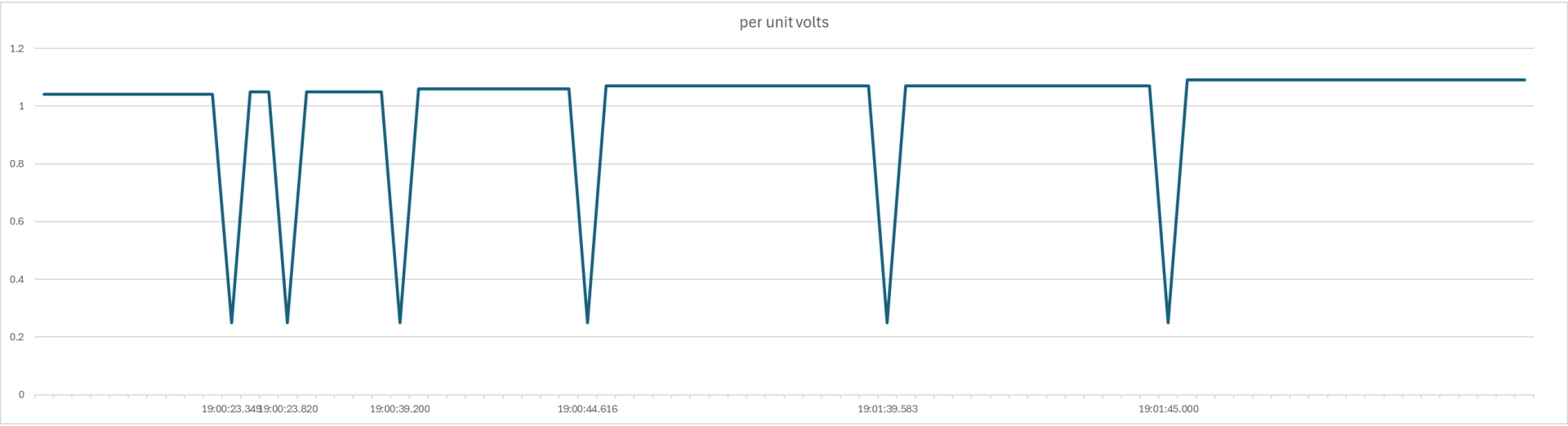
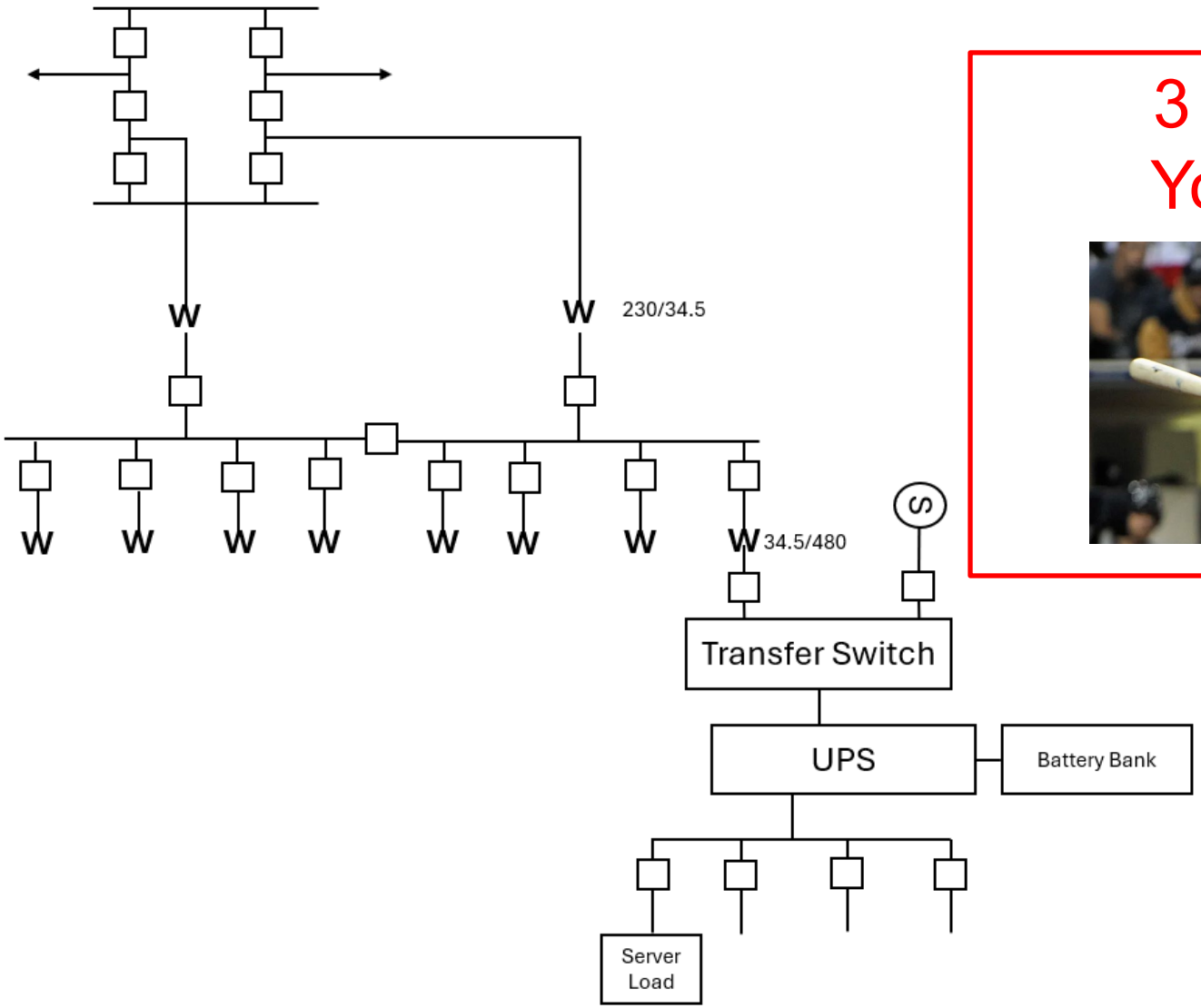


The rest of the story…



Analysis



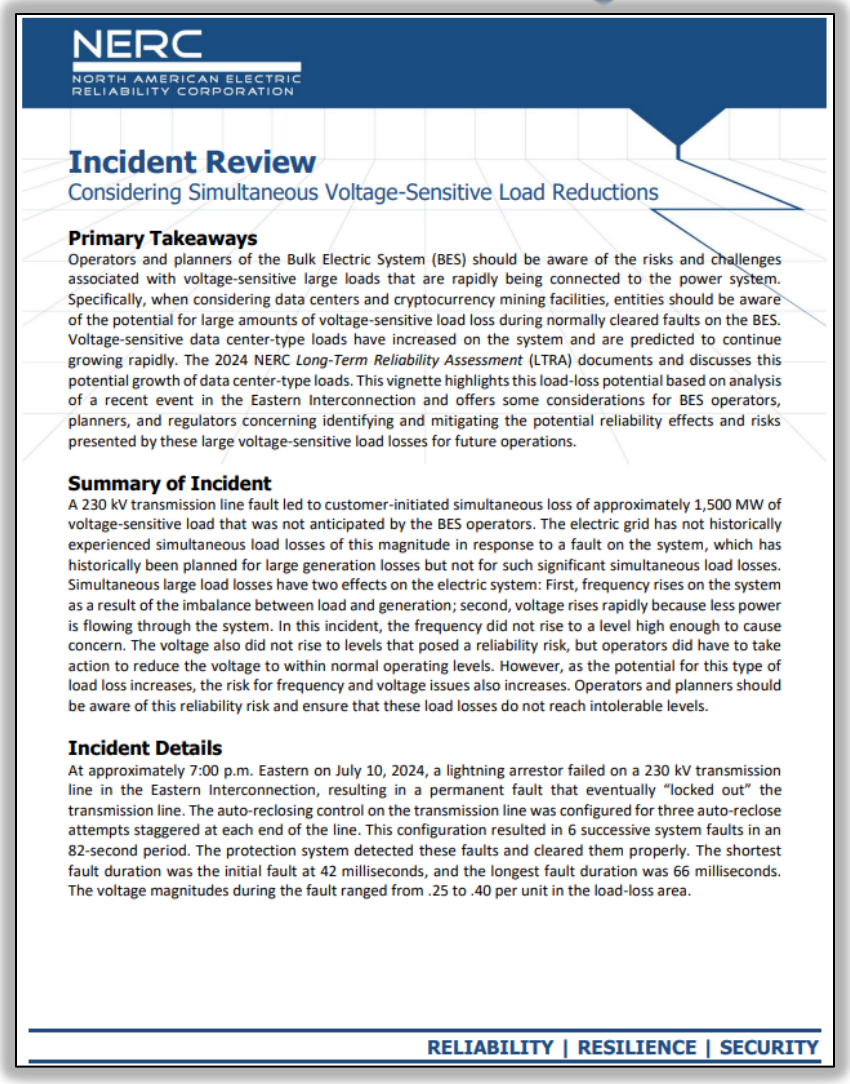
3 Strikes…
You're Out!

Why the concern?

- *"The demand for data centers is currently exploding, with Goldman Sachs projecting a 160% increase in demand by 2030. AI is a huge part of that. A ChatGPT inquiry requires almost 10 times as much electricity as a Google one."*

Considerations

- Require dynamic response models of large loads in facility interconnection requirements
- Perform studies to determine the potential magnitude of load loss for system disturbances (faults)
- Take into consideration the potential for voltage-sensitive load loss when configuring automatic reclosing schemes



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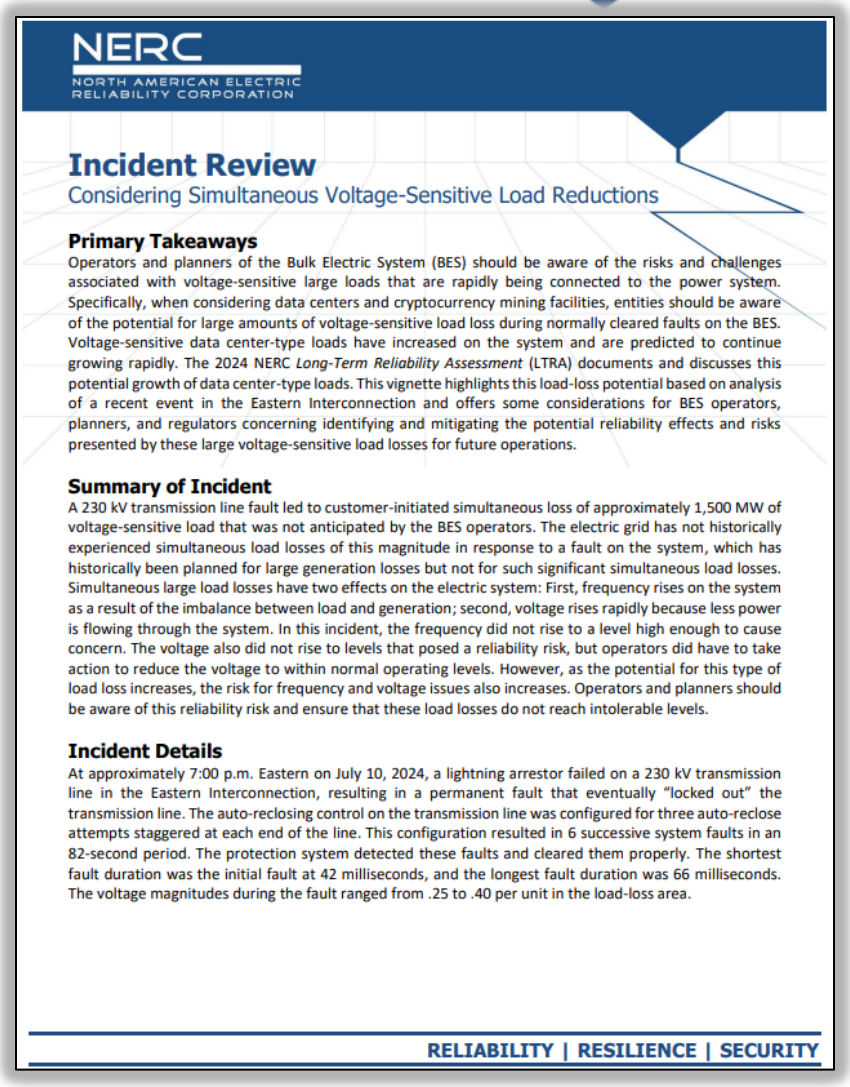
Critical Questions to Resolve

- Should large loads be a NERC registered entity?
- Should NERC Reliability Standard modifications be developed for large load interconnection requirements?



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Next Steps

- Heighten Industry Awareness of Data Center voltage sensitivity and “3 strikes you’re out” protection/control philosophy.
- Analyze and determine the BES risk of large blocks of voltage sensitive load disconnecting from the system for a common disturbance.
- Determine if changes to NERC registration or Standards is needed based on that identified risk.
- NERC Large Load Task Force (LLTF)

Questions