



Grid Geo – A Situational Awareness Tool at ERCOT

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ESIG

Agenda

- Introduction
- Grid Network Model
- Grid Reliability and Security
- Brief History/Evolution of Grid Geo
- Grid Geo – Subcomponents and Data Flows
- Grid Geo – Business Use cases
- Q&A

ERCOT Grid Network Model

- ❑ Significant increase in ERCOT network model size in last 5 years, it is getting complex!!!.
- ❑ 2020 June – number of buses around 7,000, **2025 June – close to 10,000 buses.**
- ❑ Number of Generating Units (1500+) almost doubled from 2020 due to significant increase in IRRs and Batteries.
- ❑ Peak Demand until 2020 ~ 74000 MW, **Peak Demand now ~ 85500 MW (occurred on 08/10/2023)**

ERCOT Grid Reliability and Security

- Procure sufficient generation capacity (day ahead & hour ahead).
 - Balance Generation and Load in real-time to maintain frequency around 60 Hz, ensure sufficient reserves are available.
 - Monitor, Identify and Resolve/Mitigate network violations – look ahead (with studies) and in real-time:
 - Voltage Violations at all Buses.
 - Thermal Limit Violations of Transmission Lines, Transformers and other transmission equipment.
 - Stability Limit Violations of Interfaces (group of transmission lines between different regions)
- ***Requires situational awareness tools built on latest technologies that can provide wide area monitoring of ERCOT Grid with enhanced user experience for Control Room Operators, Grid Operations, Market Operations and Grid Planning teams.***

History/Evolution of Grid Geo

Control Room Situational Awareness Tools

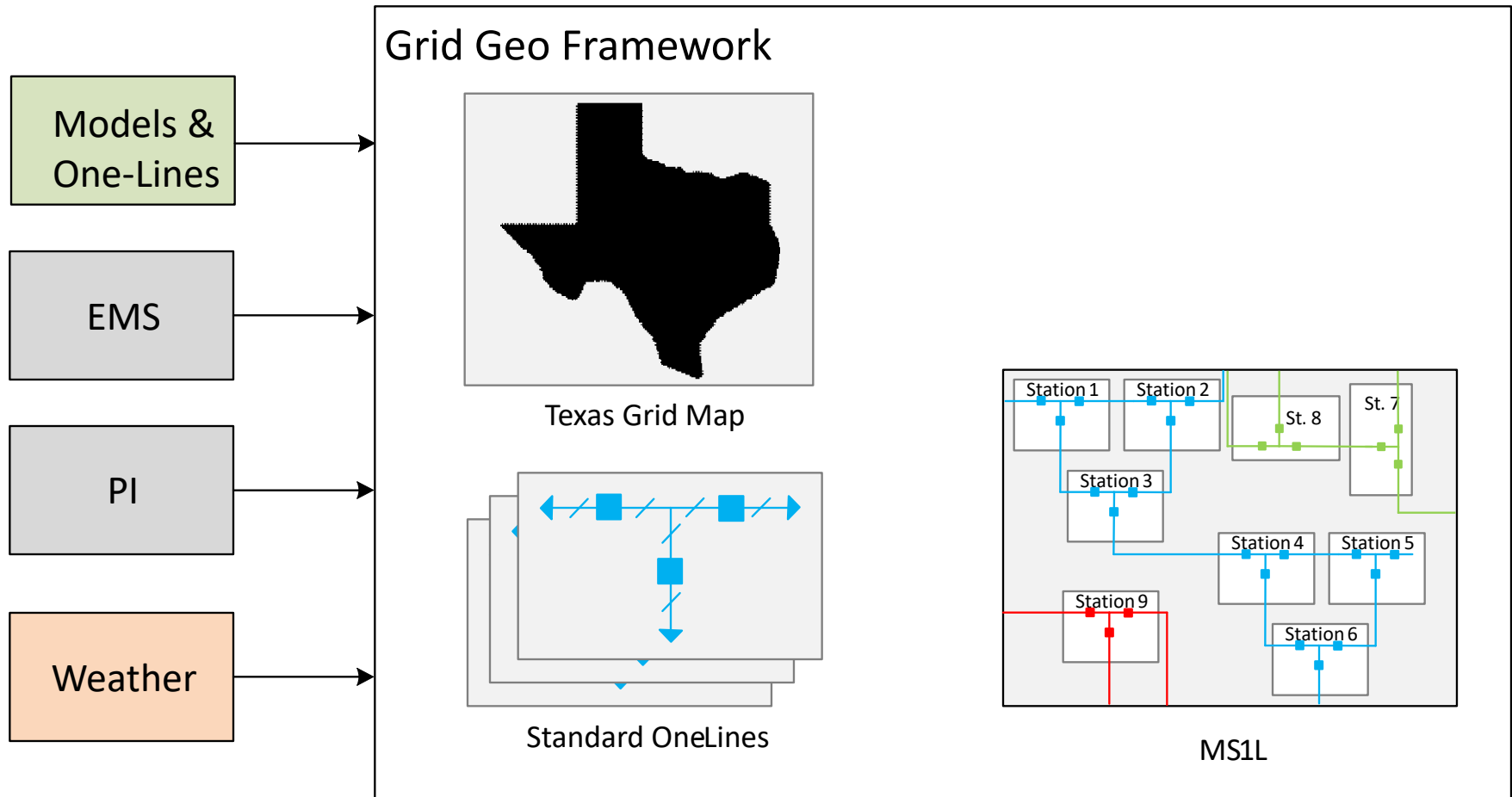
EMS/PI Displays - EMS
One lines + Bus Diagrams +
EMS Tabular Displays + PI
Displays
(Before 2011)

**EMS/PI Displays +
Macomber Map**
(2011-2018)

**Grid Geo +
PI/EMS Displays**
(From 2018)

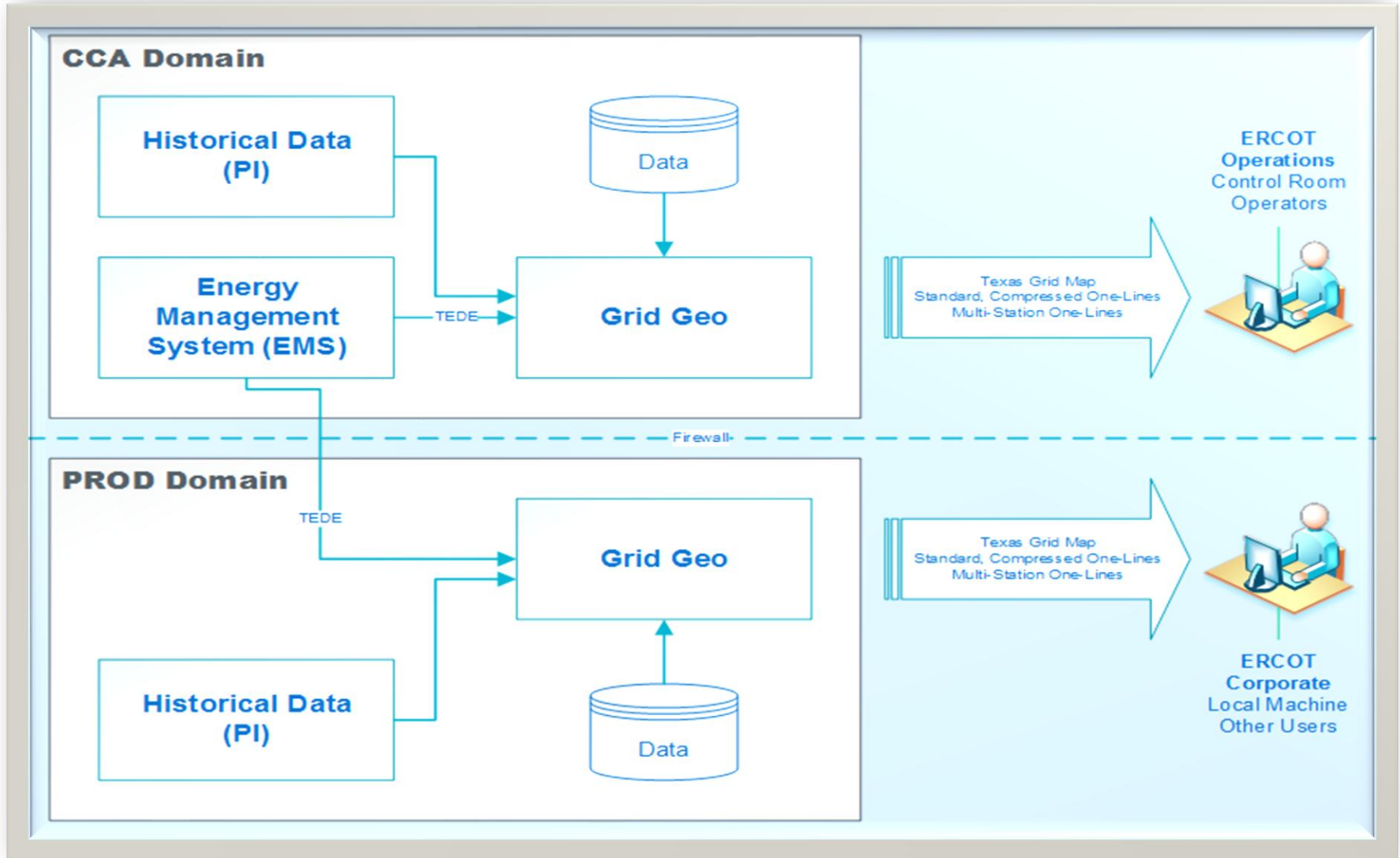
- **Grid Geo - ERCOT developed, geospatial browser-based platform built on HTML5 canvas for ERCOT-wide area overview of reliability data**
 - Usage - 450 ERCOT Users and close to 100 External Users

GridGeo – Data Source and Subcomponents



- **MS1L- Multi Station one lines**, key feature of Grid Geo used by control room operators and shift engineers for thermal congestion, GTCs, voltage violations analysis in real-time and look-ahead.

GridGeo – Data Flow



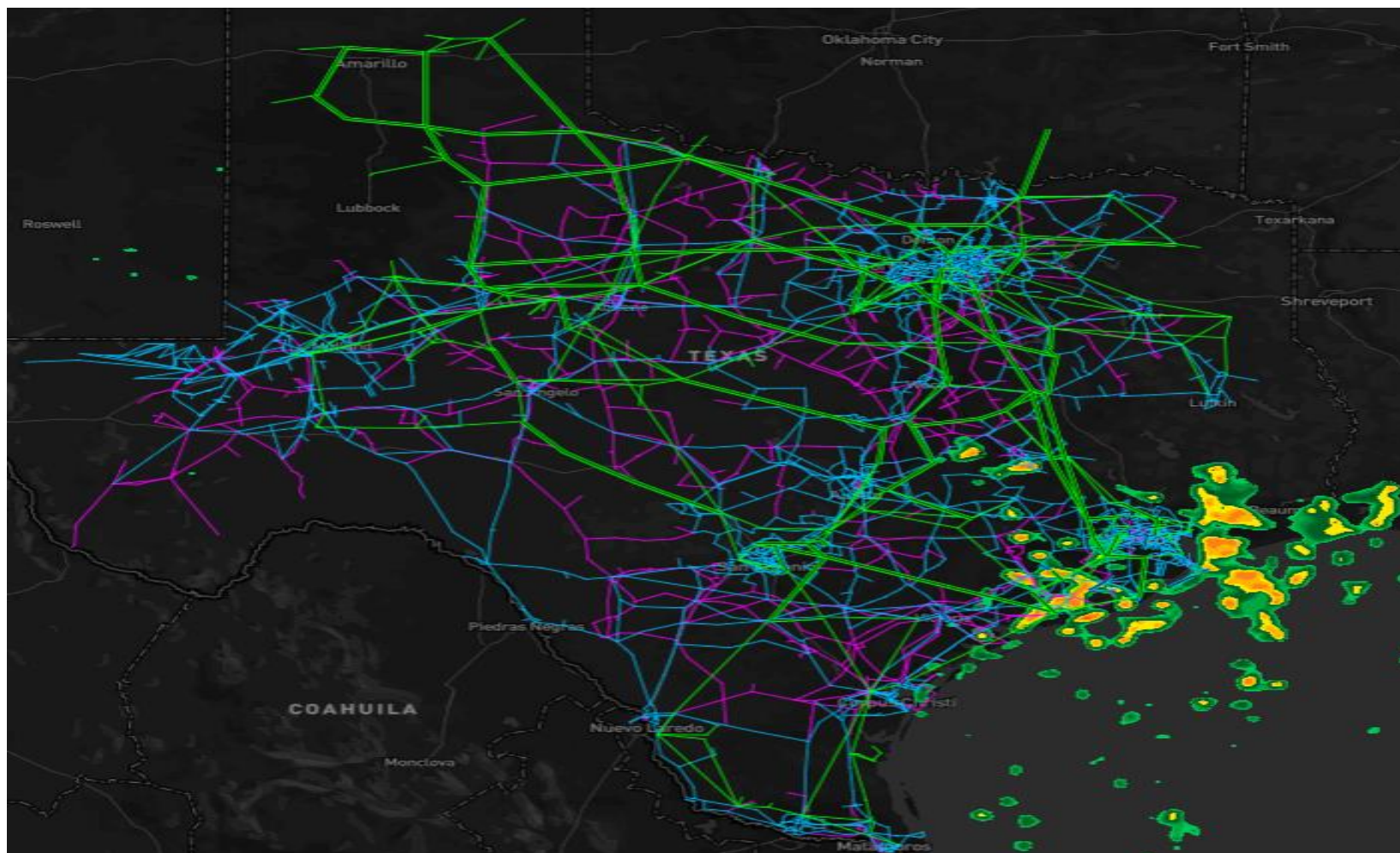
Grid Geo – Data Input

- Maps and layer files – Mapbox
- Network Model – Weekly Model Load
- Telemetry data, outages, State Estimator/CA/AGC/OTS – from EMS/OTS, every 2-4 seconds
- Weather Data – External Weather Connector
- PI Historian

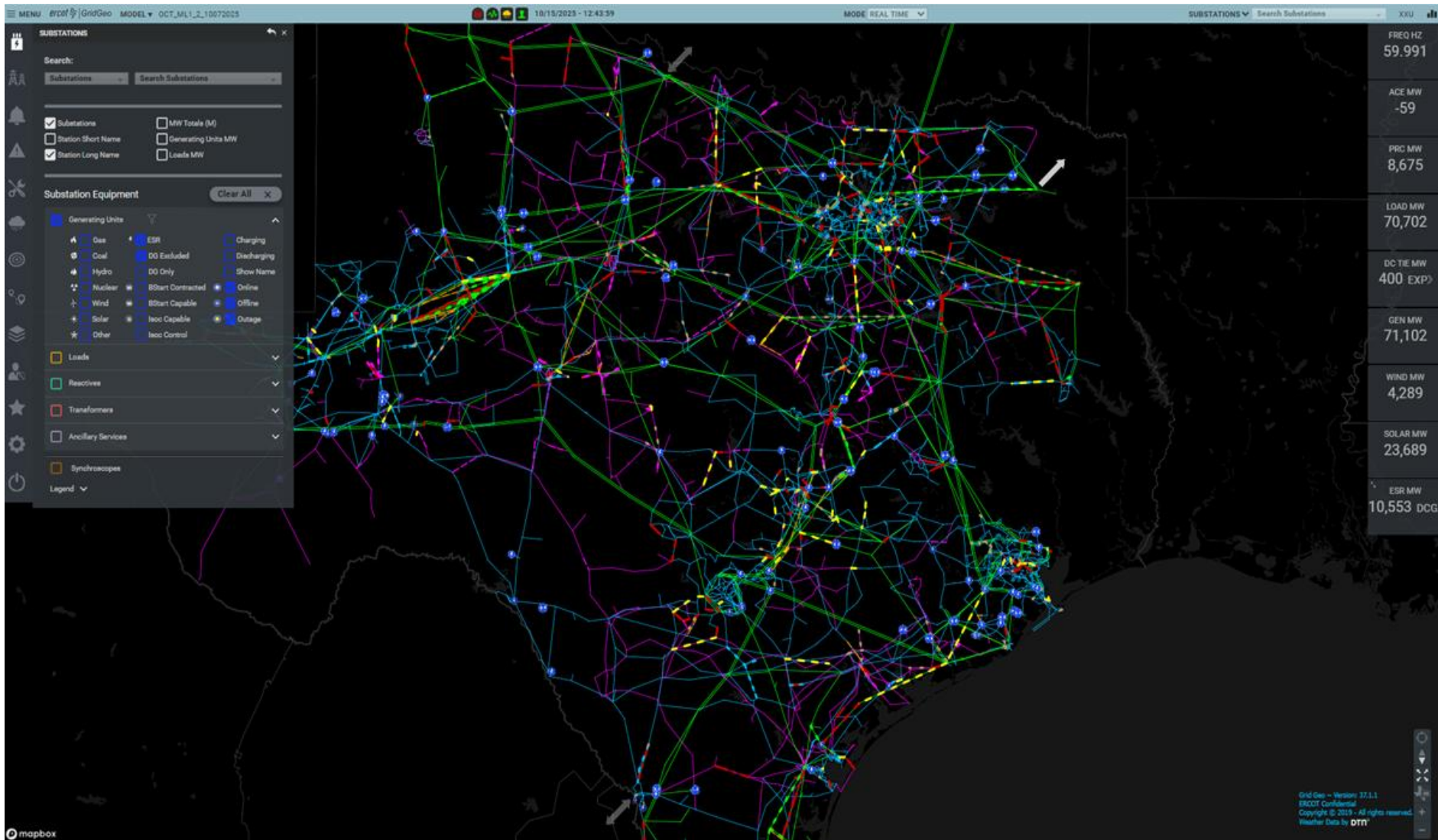
Grid Geo - Business Use Cases

- **Situational Awareness – System level overview of the Grid**
 - Filters: generator, load, transmission
 - Thermal/Stability/Voltage Violations
 - Outages: scheduled, forced
 - Contour Map: voltage
 - Weather Layers
 - Wind, Solar, ESR's
- **Substation one lines – also support multiple substation one-lines**
- **Control Room, Support Engineers and Outage Coordination Studies – Connect to EMS STNET in the backend.**
 - **Study Pro** – Can trigger EMS STNET studies, retrieves and shows the results on TGM and one-lines.
 - **Study View** – share your EMS STNET studies with other operators/engineers
- **Hurricanes/Storms/Cyclones Trajectory – Control Room performs studies based on Hurricane/storms trajectory and impacted substations on trajectory**
- **Operator Training Simulation Tool – Connect to OTS in the backend.**
 - Operator Training
 - Winter Storm Drill and Black Start Training with Market Participants
- **External Grid Geo for TDSPs and NERC – To provide situational awareness to TDSPs and NERC with different access levels.**

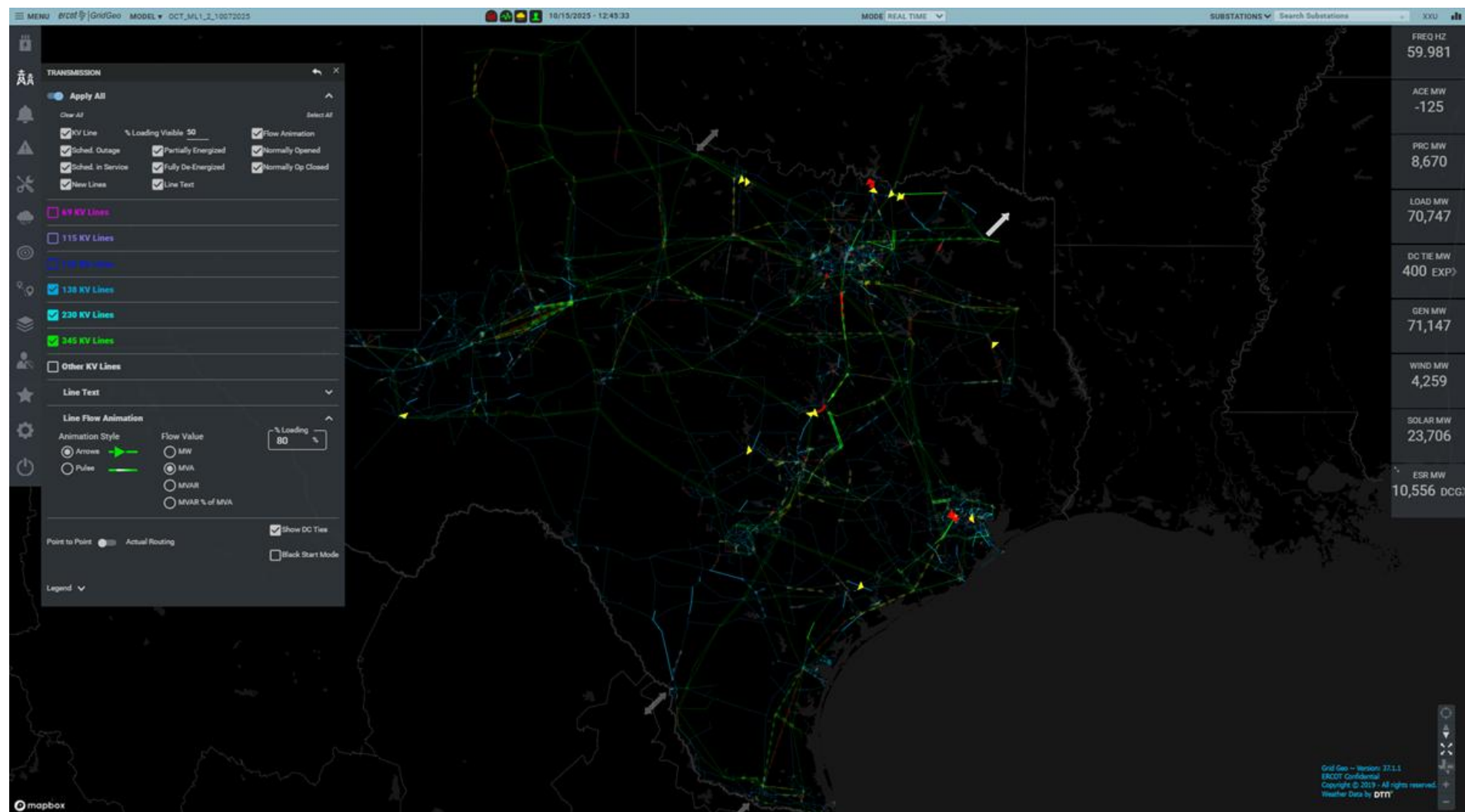
Grid Geo – Texas Grid Map (TGM)



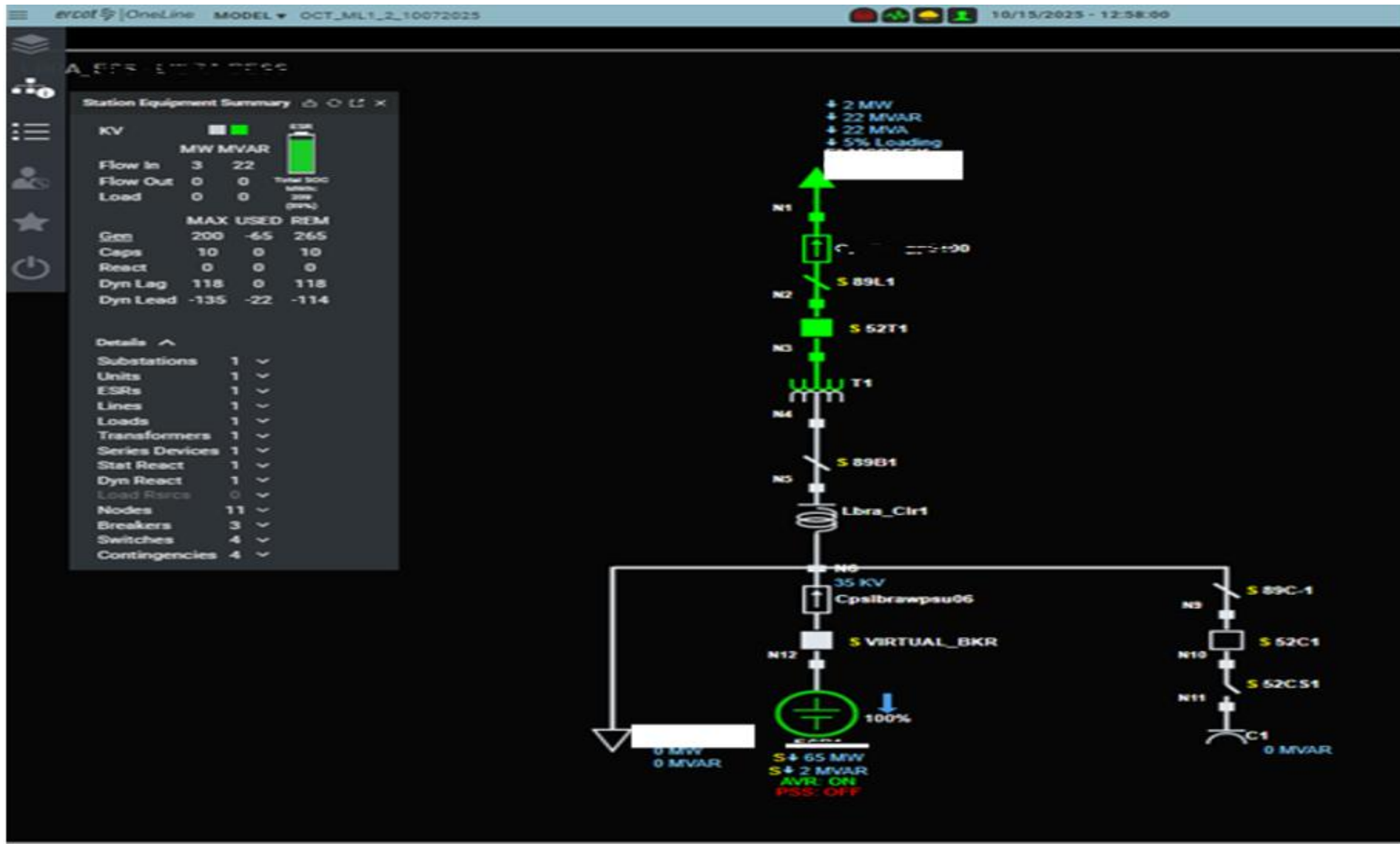
TGM - Substation Filters



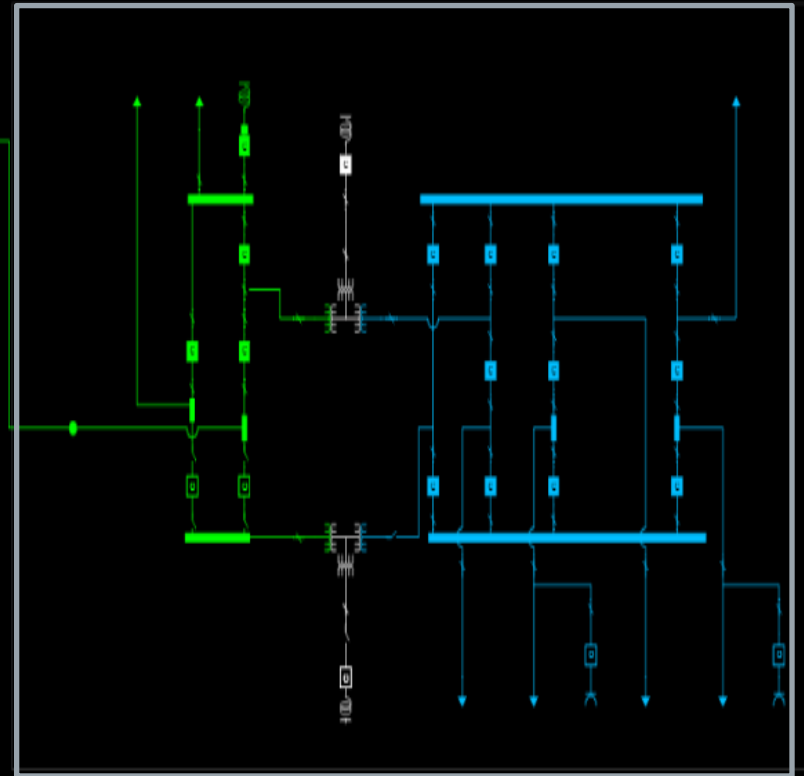
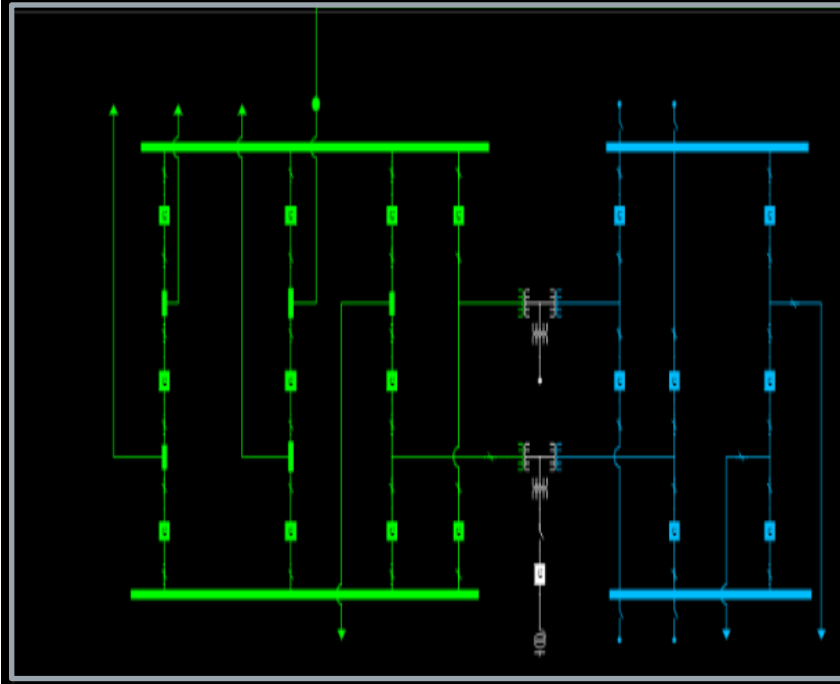
TGM – Transmission Line Filters



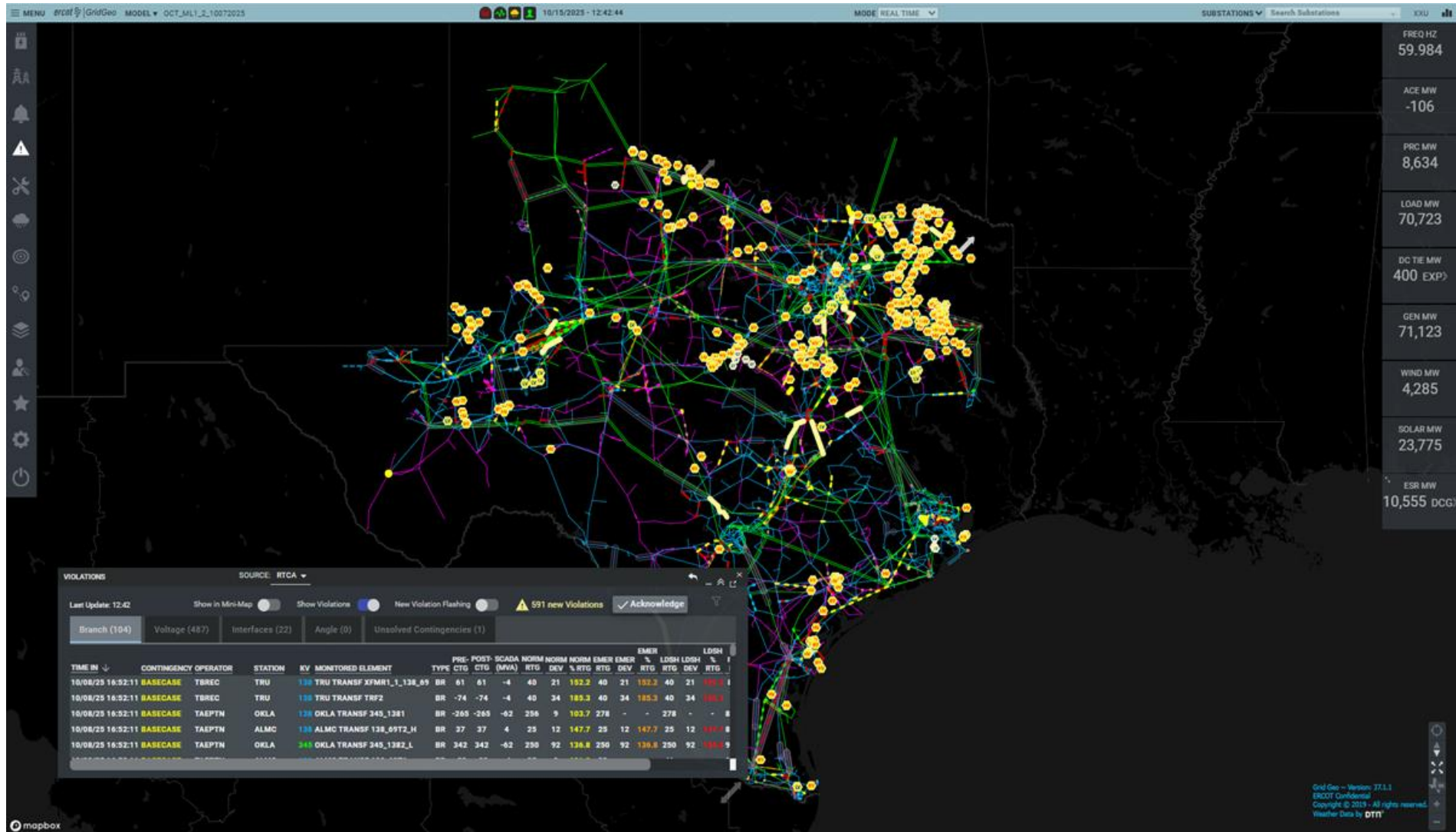
TGM – Substation One-Lines



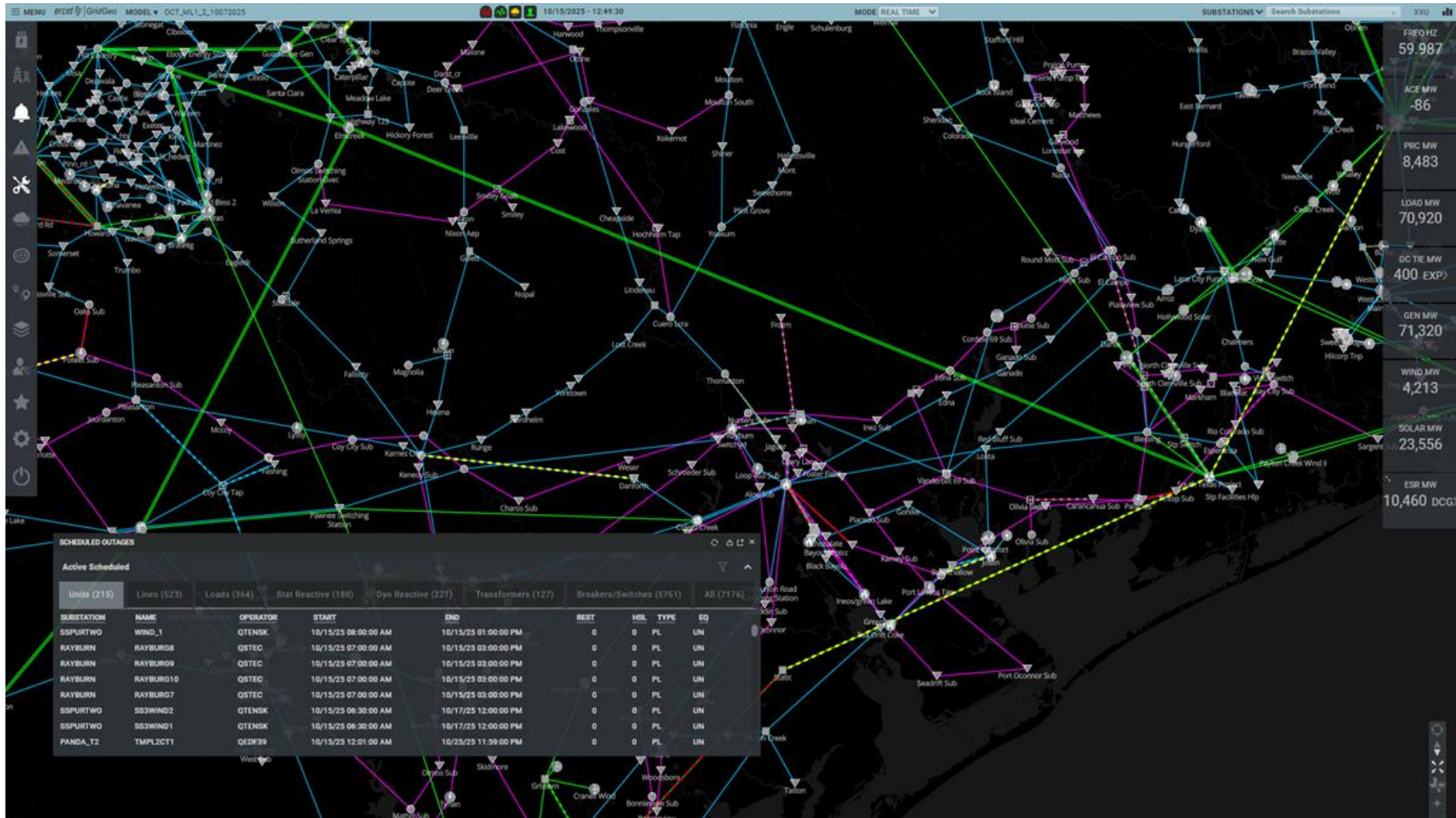
TGM – Multi Station One-Lines (MS1L)



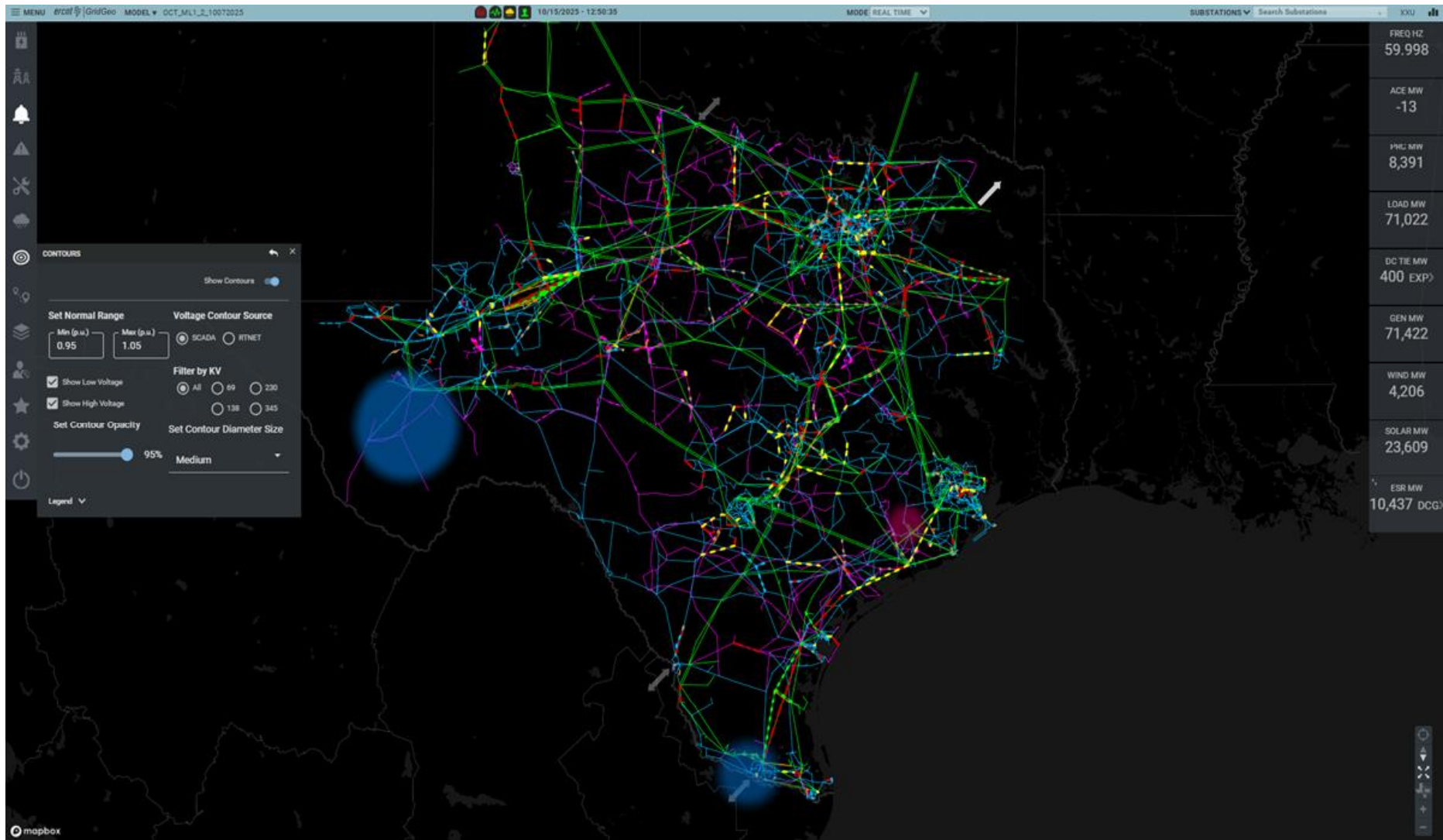
TGM - EMS Real-Time Contingency/SCADA Violations



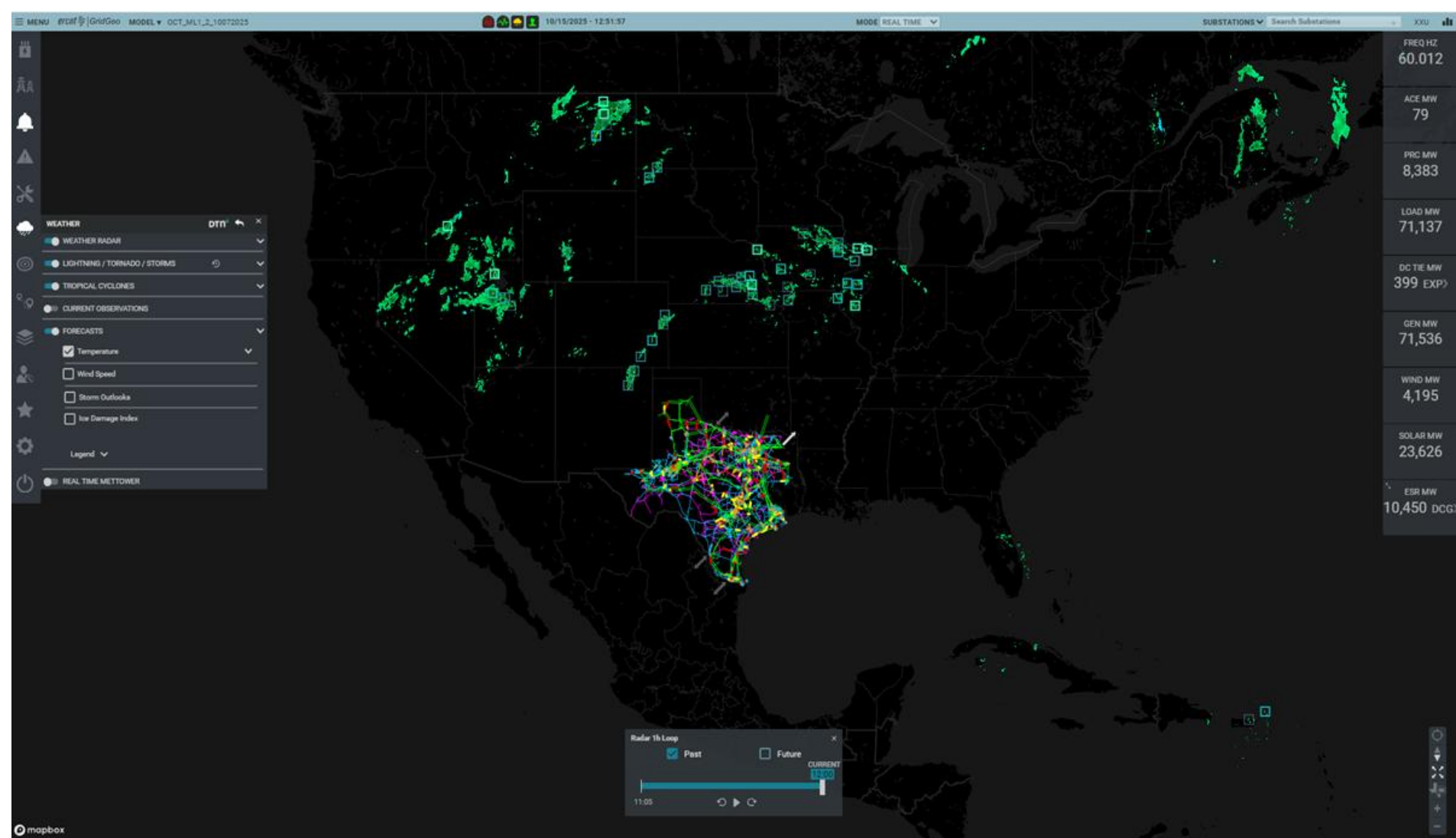
TGM – Scheduled Outages



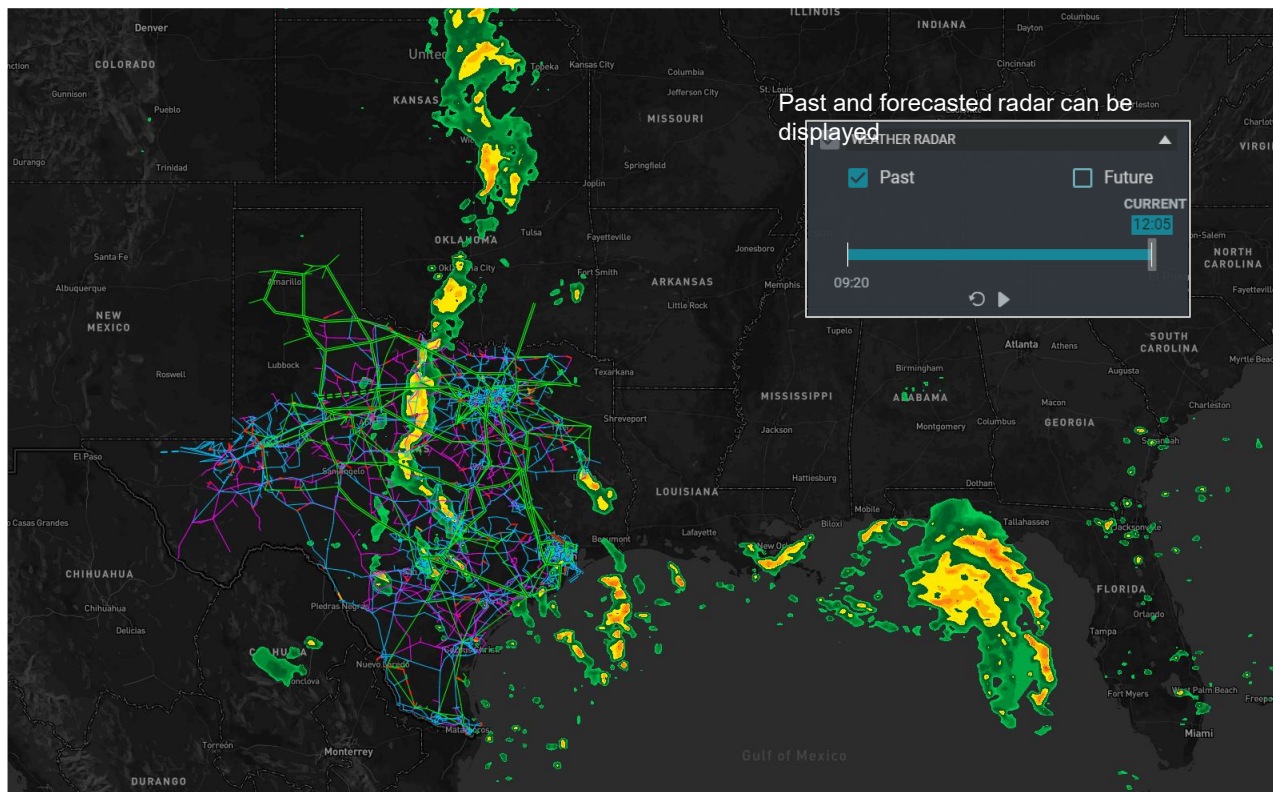
TGM – Voltage Contour



TGM - Weather Layers

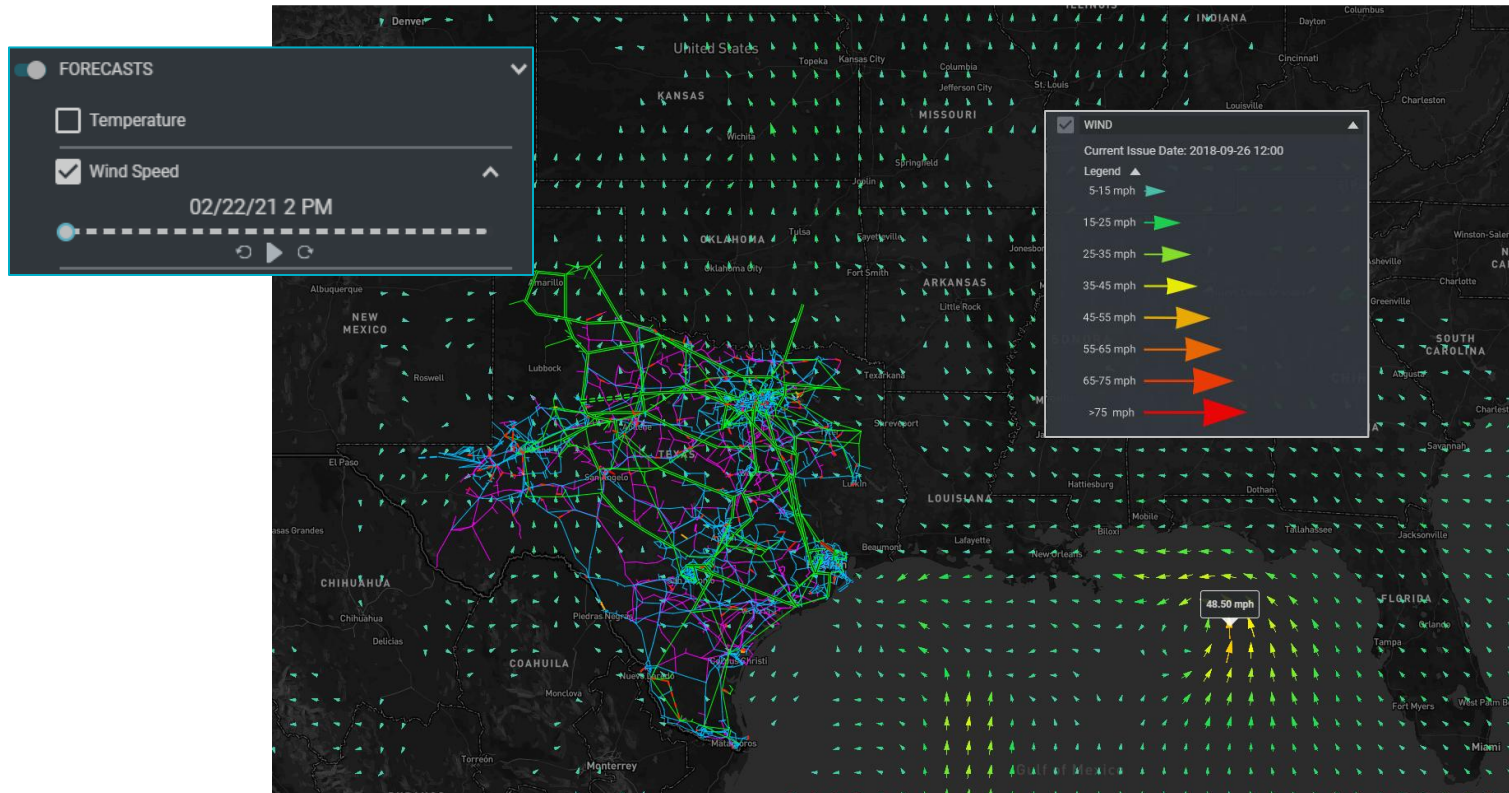


TGM - Radar Layer



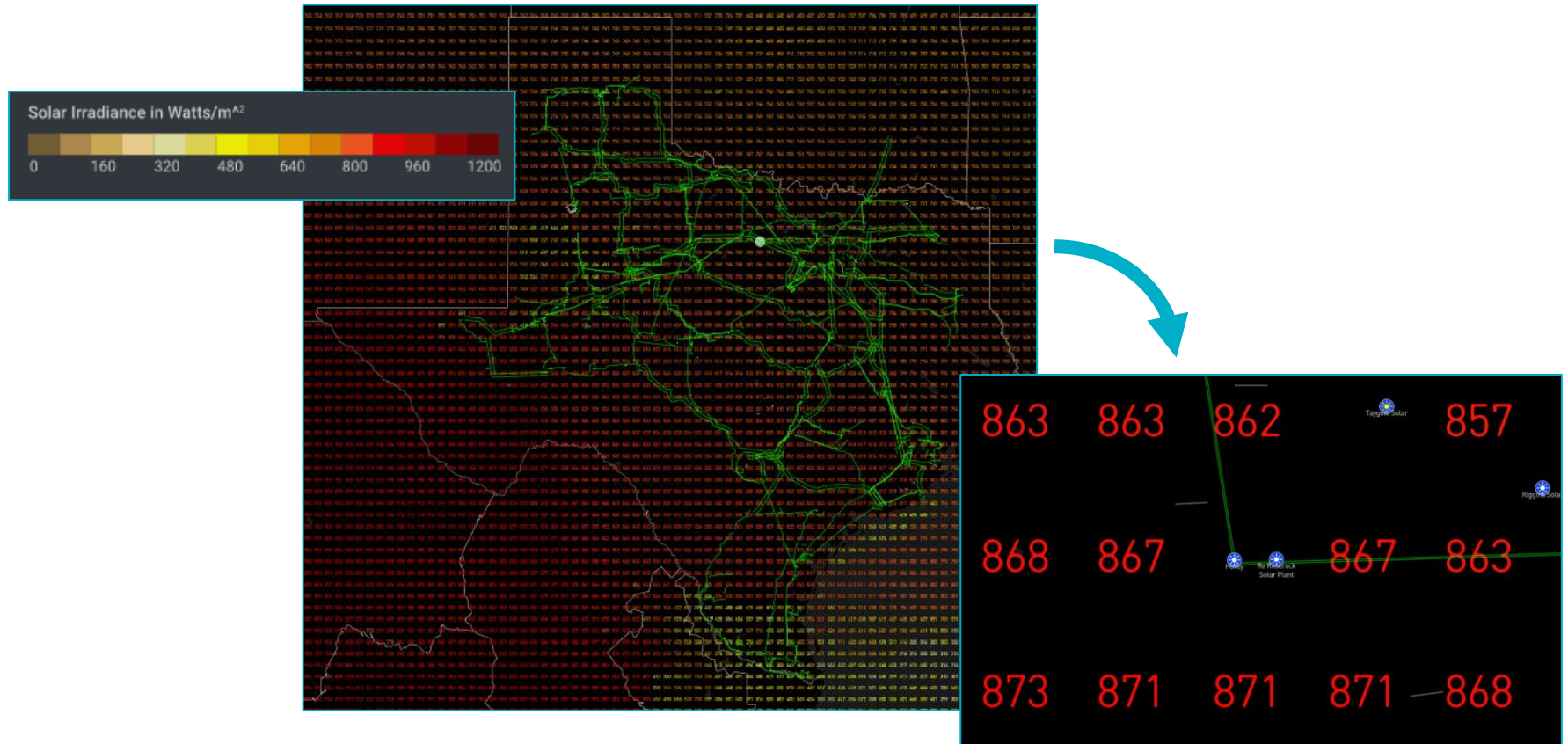
The GridGeo 3.0 release introduced weather layers, including radar, to the TGM.

TGM – Wind Layer



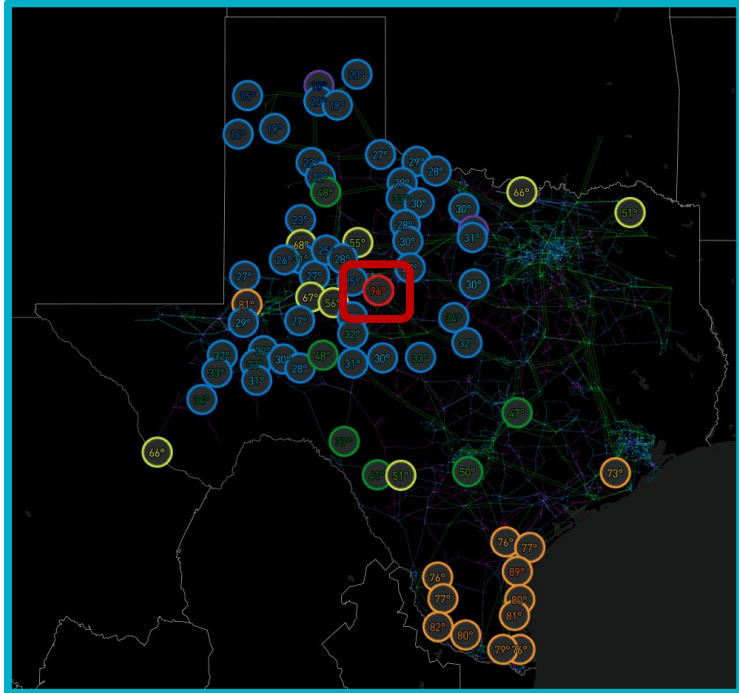
Current or future forecasted wind can be displayed on the Texas Grid Map

TGM – Solar Irradiance



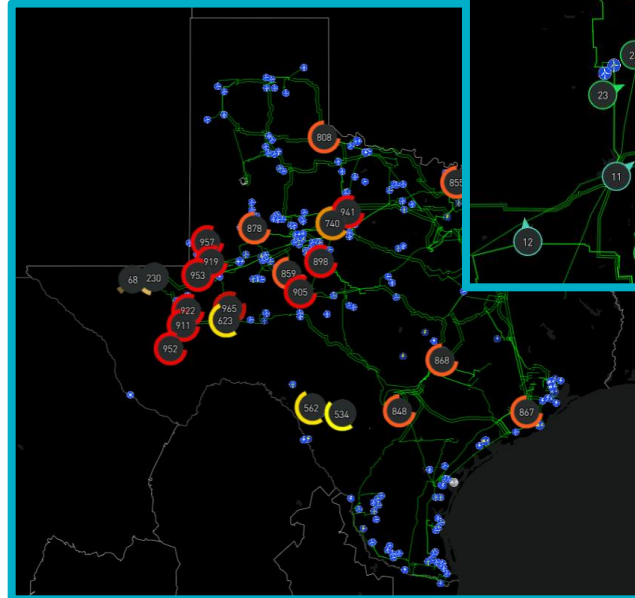
TGM – Addition of Meteorological Tower Location and Telemetry

Questionable telemetry can easily be located and corrected



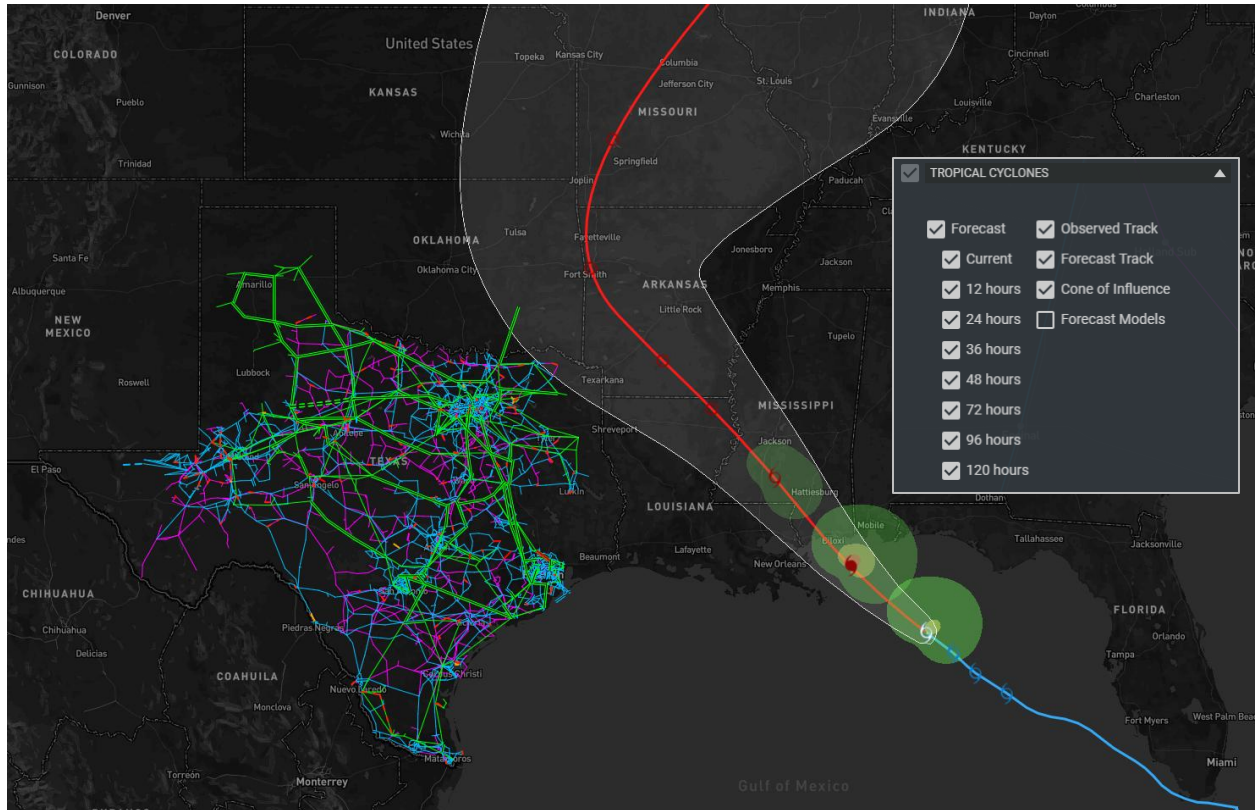
Temperature at IBR sites

Irradiance at solar sites



Wind speed at wind sites

TGM – Cyclone Layer

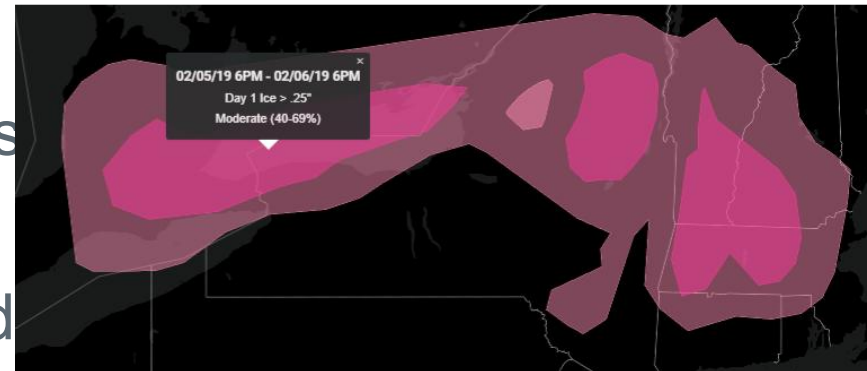
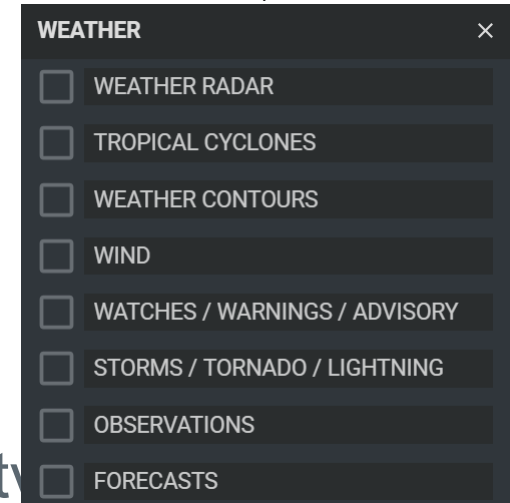


Cyclone layer displayed on TGM.

TGM – Additional Weather Layers

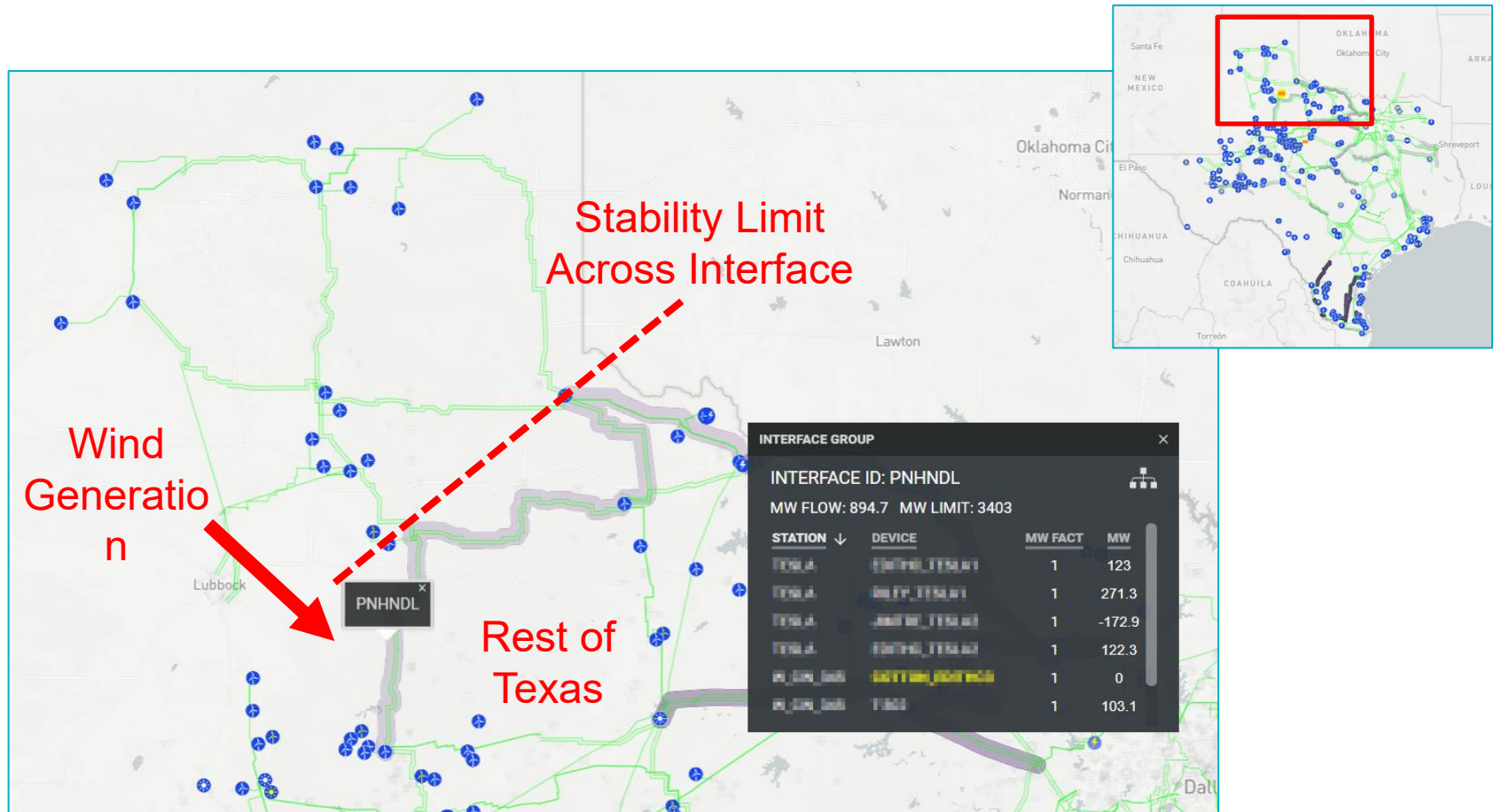
- Other weather layers include:
 - Icing forecasts
 - Fire conditions
 - Severe weather forecasts
 - Storm details (e.g. direction and intensity)
 - Hail
 - Tornado signatures and paths
 - Fog
 - NWS watches, warnings, and
 - Observed and forecasted lightning
 - Estimated rainfall

Top-level weather menu



Layer depicting forecasted icing damage.

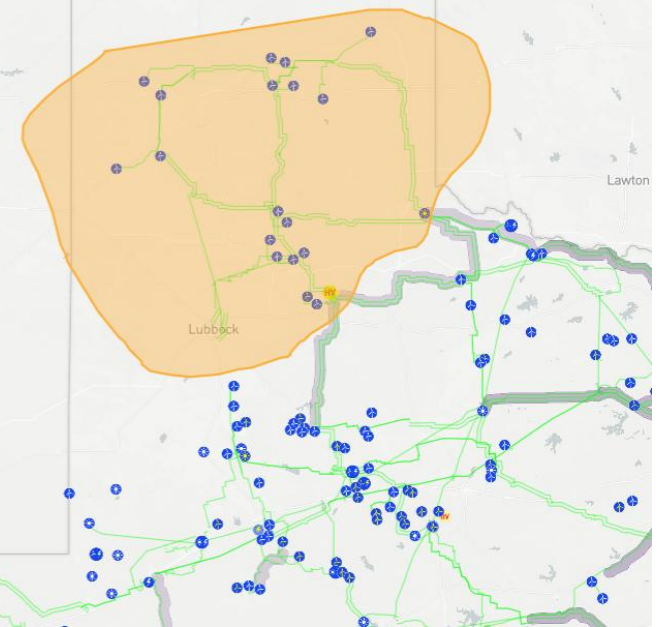
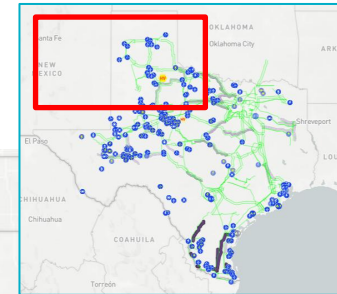
Visualizing Stability Interfaces (Cut Planes)



Gray shading represents the interfaces elements

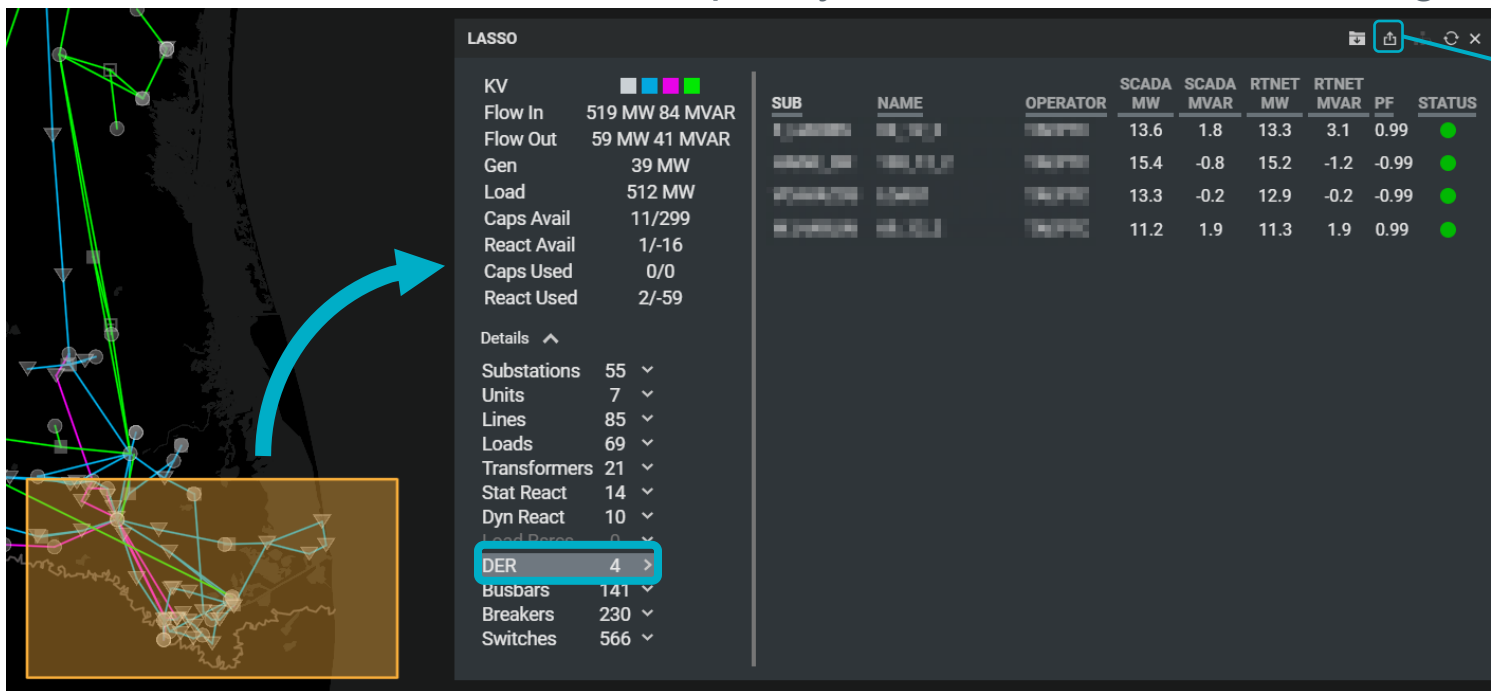
TGM: Lasso to Find Generation

LA SSO



TGM - Distribution Energy Resource (DER) in Lasso Table

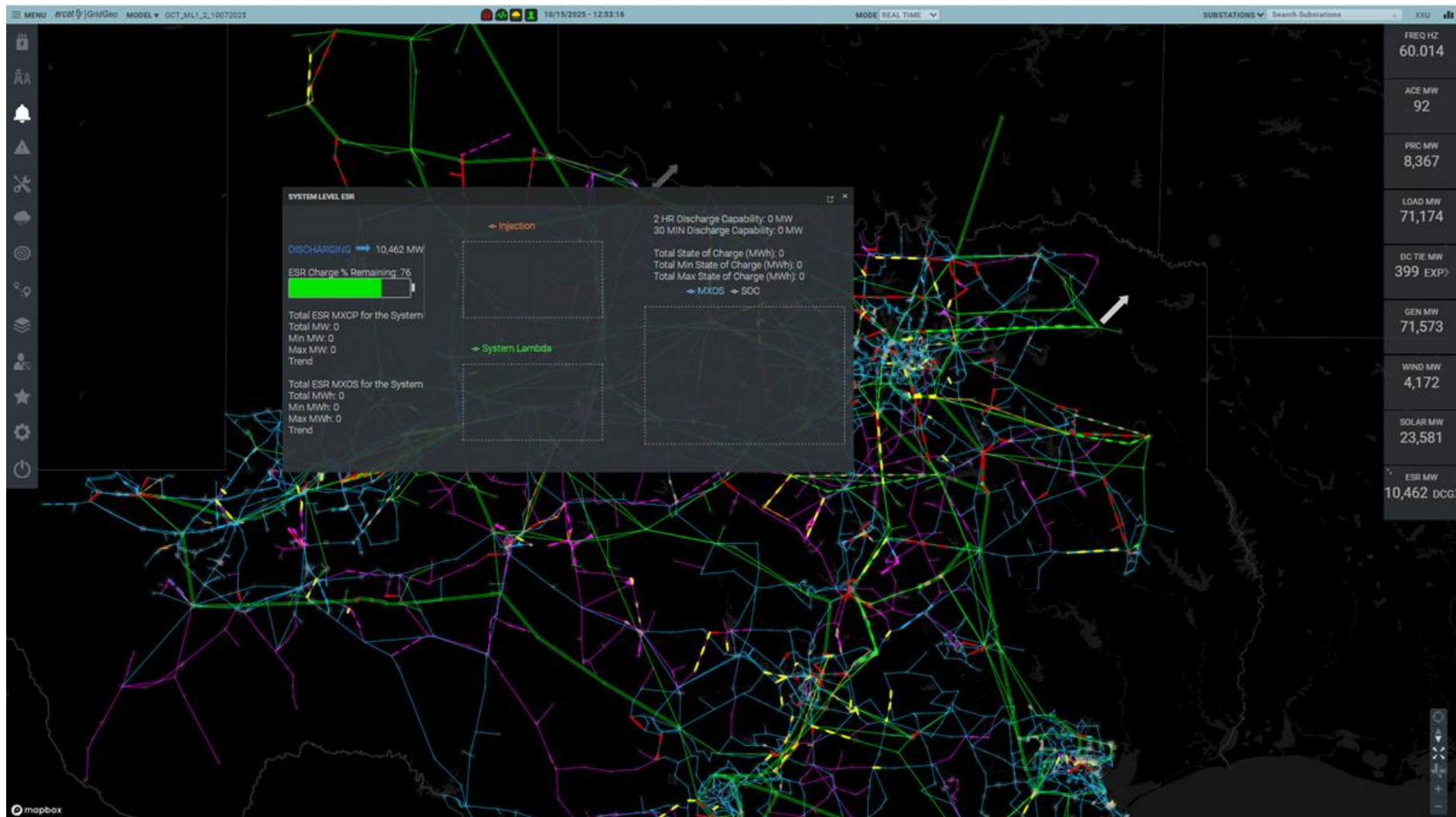
Users can now lasso an area to quickly see loads associated to registered DERs



Users can also export the results to an Excel file by clicking the export button

Users can select an area with a lasso and expand the menu to view the DER loads

TGM - Energy Storage Resource Information



Black Start Training – Generator Control Panel



Black Start Training – Load and Breaker Control Panel

LOAD CONTROL PANEL -

Substation

Network Load

Current MW 0.39

Current MVAR 0.08

Current Target 0.39

☒ Set MW

Est Cold Load Pu 0.00

Max MW 20.00

Normal MW 1.09

Normal MVAR 0.09

Energized ☐ Remove Load

BREAKER CONTROL PANEL -

Substation

Elem Type BREAKER

Breaker

	Near	Far
Node Name	8089	4851
BS #	6285	6285
KV	13.80	13.80
Phase Angle	0.00°	0.00°
Island Id	9	9
Hz	59.98	59.98

OPEN

Synchroscope

0

SLOW FAST

SYNCHROSCOPE

4851 8089

59.98 Frequency: 59.98

13.80 Voltage (kV): 13.80

Frequency Difference: 0.00

Angle Difference: 0.0°

Q&A Session

