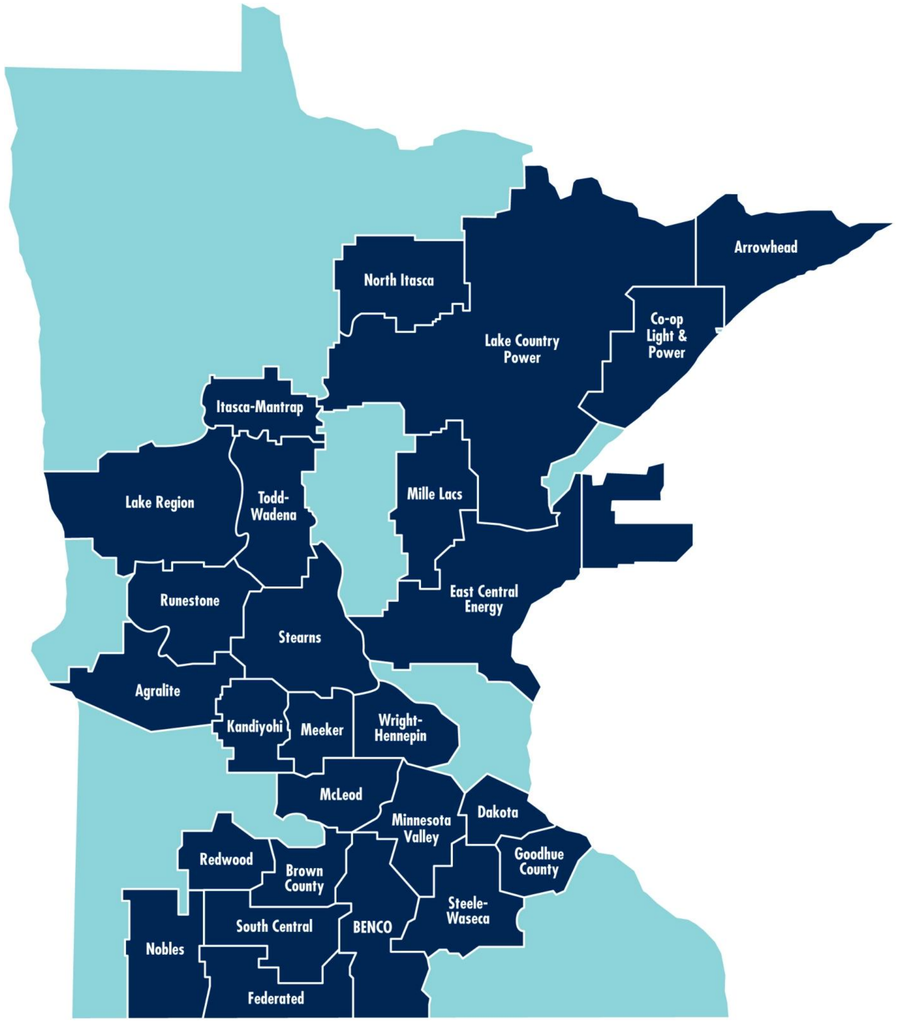
Great River Energy use of Dynamic Line Ratings

March, 2025

Great River Energy: Who we serve

- 26 member-owner cooperatives
- 5,000+ miles of transmission lines
- 1,500+ miles 115kv and above



Dynamic Line Rating Evaluation

- Increased capacity of transmission lines can reduce congestion cost
- Expanding capacity of existing lines could allow GRE to delay more costly work
- Another tool for congestion management
- Doesn’t replace need for system upgrades

Heimdall Power Partnership

- Original pilot with one line, four Neurons
- Expanded project on eight additional GRE lines with 52 sensors
- Two additional lines using Virtual Neurons
- MISO Integration

Installation locations

Transmission line
Pleasant Valley – Austin
Benton – Mud Lake – Riverton
Inman - Rush Lake – Schuster
Bunker-Blaine-Linwood-Rush City
Johnson Junction – Morris (pilot)

One congestion event per line
estimated cost to GRE: $3.157M

Neuron installations

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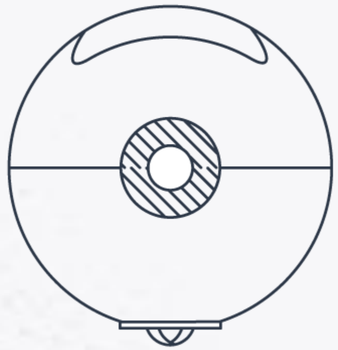
Neuron installations

- Pilot project installed on live line by GRE field crew
- Majority of additional sensors installed with Heimdall drone
- Two weeks for 40+ Neuron install including a couple weather days
- 115kv and 230kv lines
- Mostly ACSR 795 45/7 Tern

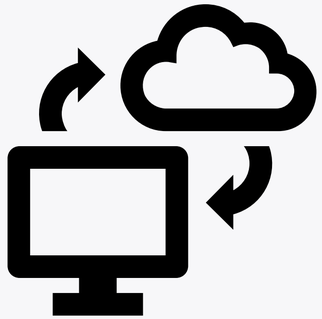
DLR Data Flow

Neuron

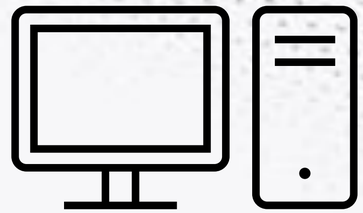


Cellular

Heimdall Cloud

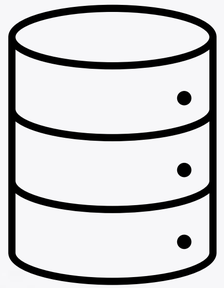


Oauth 2.0



GRE Interface Server

DNP RTU



GRE SCADA System

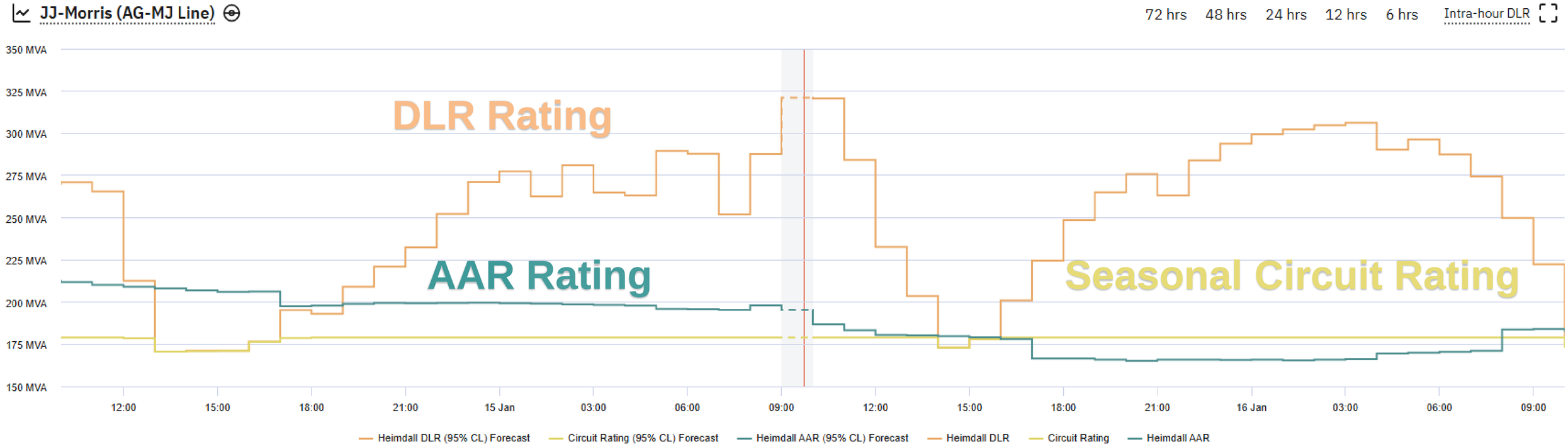
ICCP

MISO

Example Results

Forecast Length (24 hrs) | Select data | **Interval:** 5 minutes | 95 % Confidence Level | **Expected load** 86.92 MVA | **Export data** | Monitoring | Forecast

179.0 MVA	179.0 MVA	179.0 MVA	179.0 MVA	179.0 MVA	179.0 MVA	173.1 MVA	178.1 MVA
15 m rating	Intra-Hour DLR	DLR T +1	DLR T +2	DLR T +3	DLR T +4	DLR T +5	DLR T +6
		10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00



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Pilot Line 12 Month Results

Key Capacity Metrics

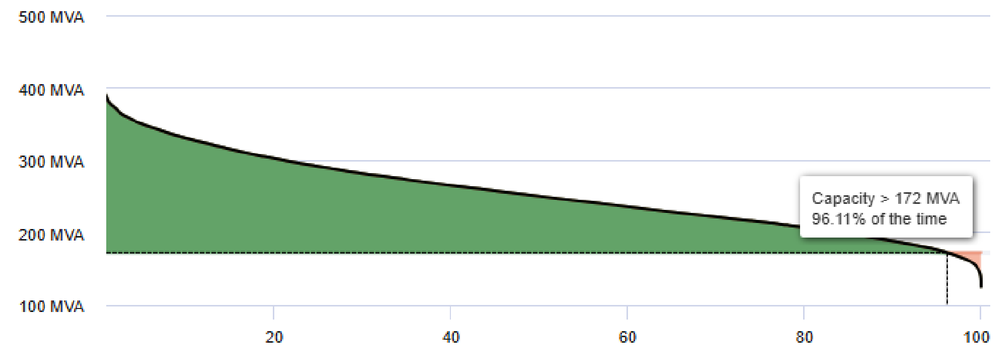
28.82%
Average Line Utilization

+5.61%
Capacity with AAR (Average)

+48.37%
Capacity with HeimdallDLR (Average)

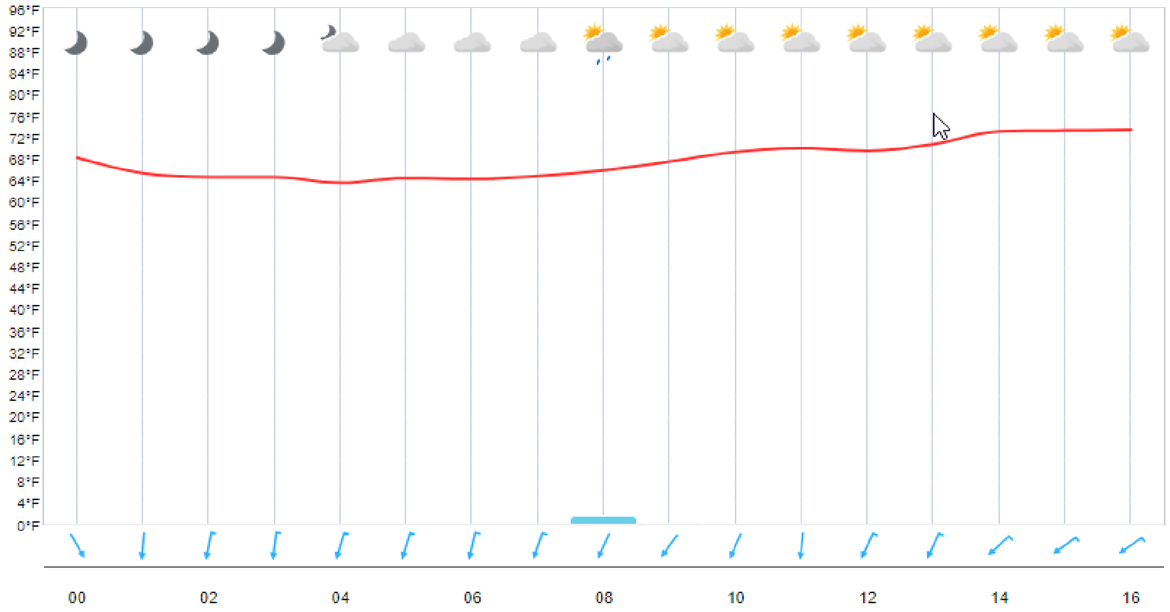
Line DLR

Duration Curve



Meteogram

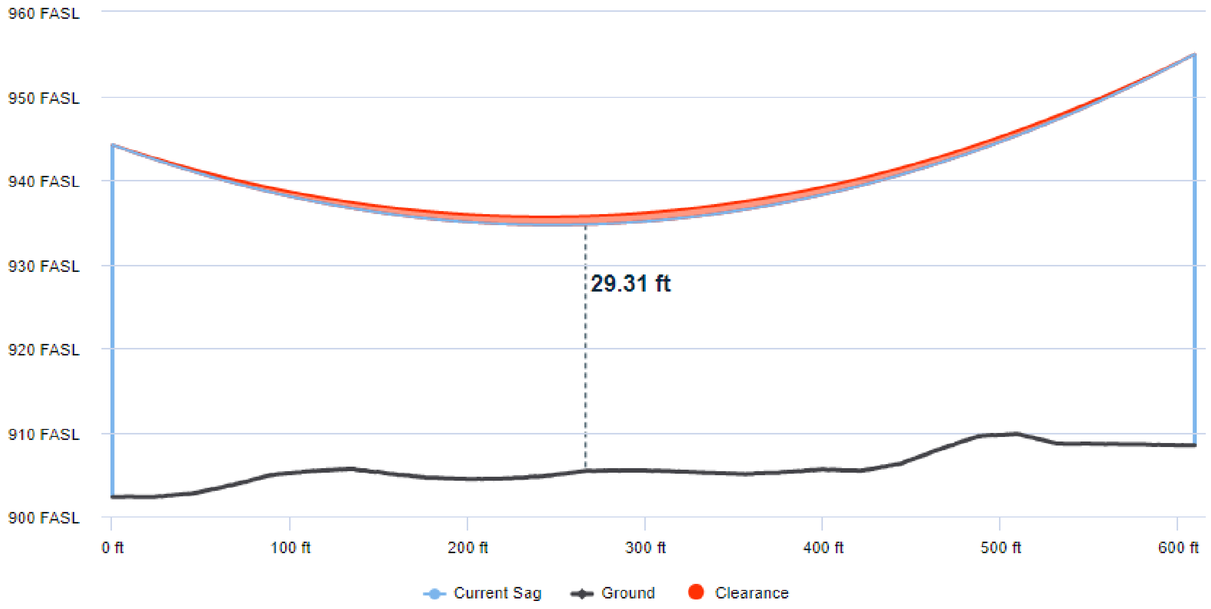
Weather data provided by Meteomatics



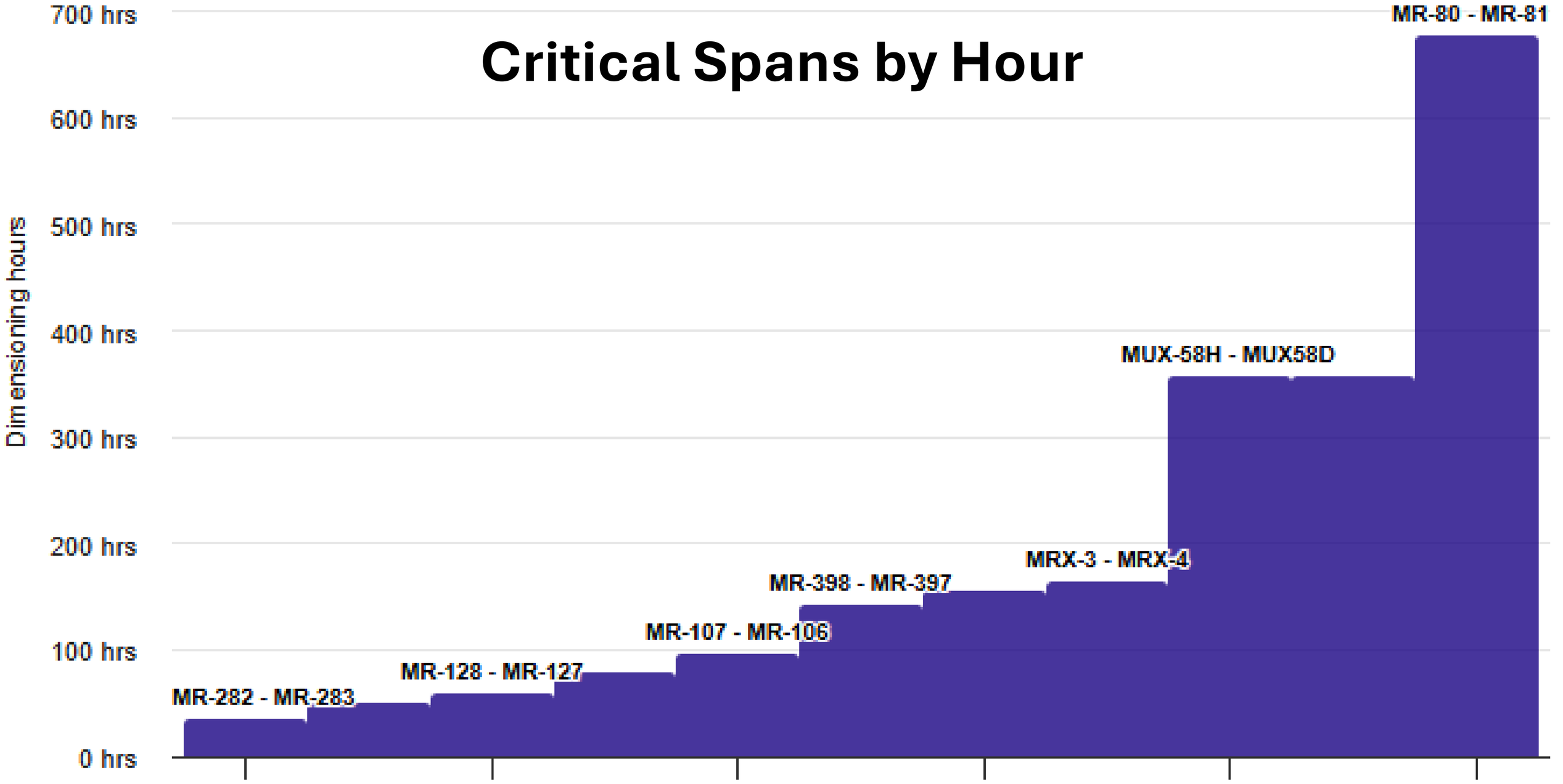
Span Model

PR-294-PR-295

Time Series



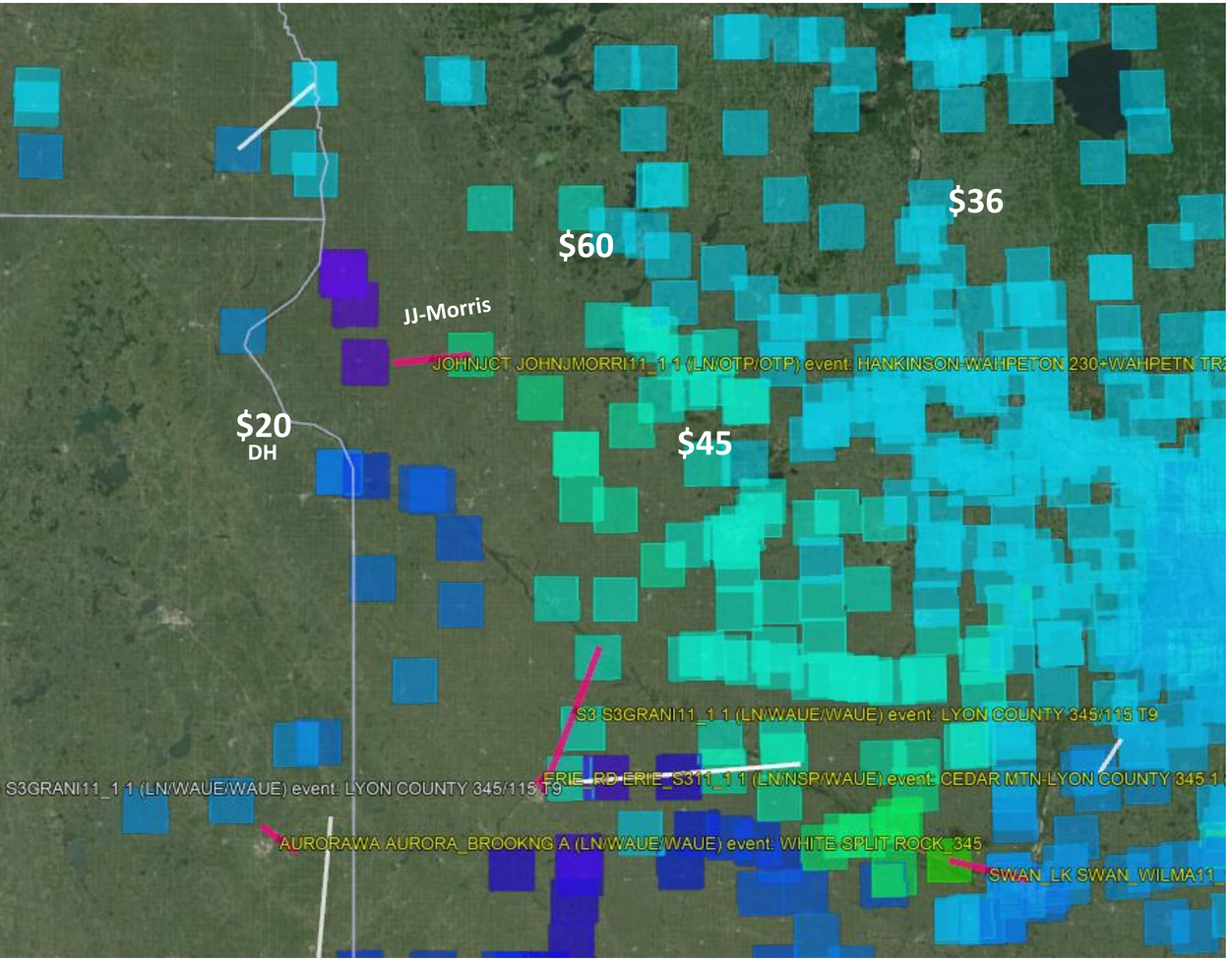
Critical Spans by Hour



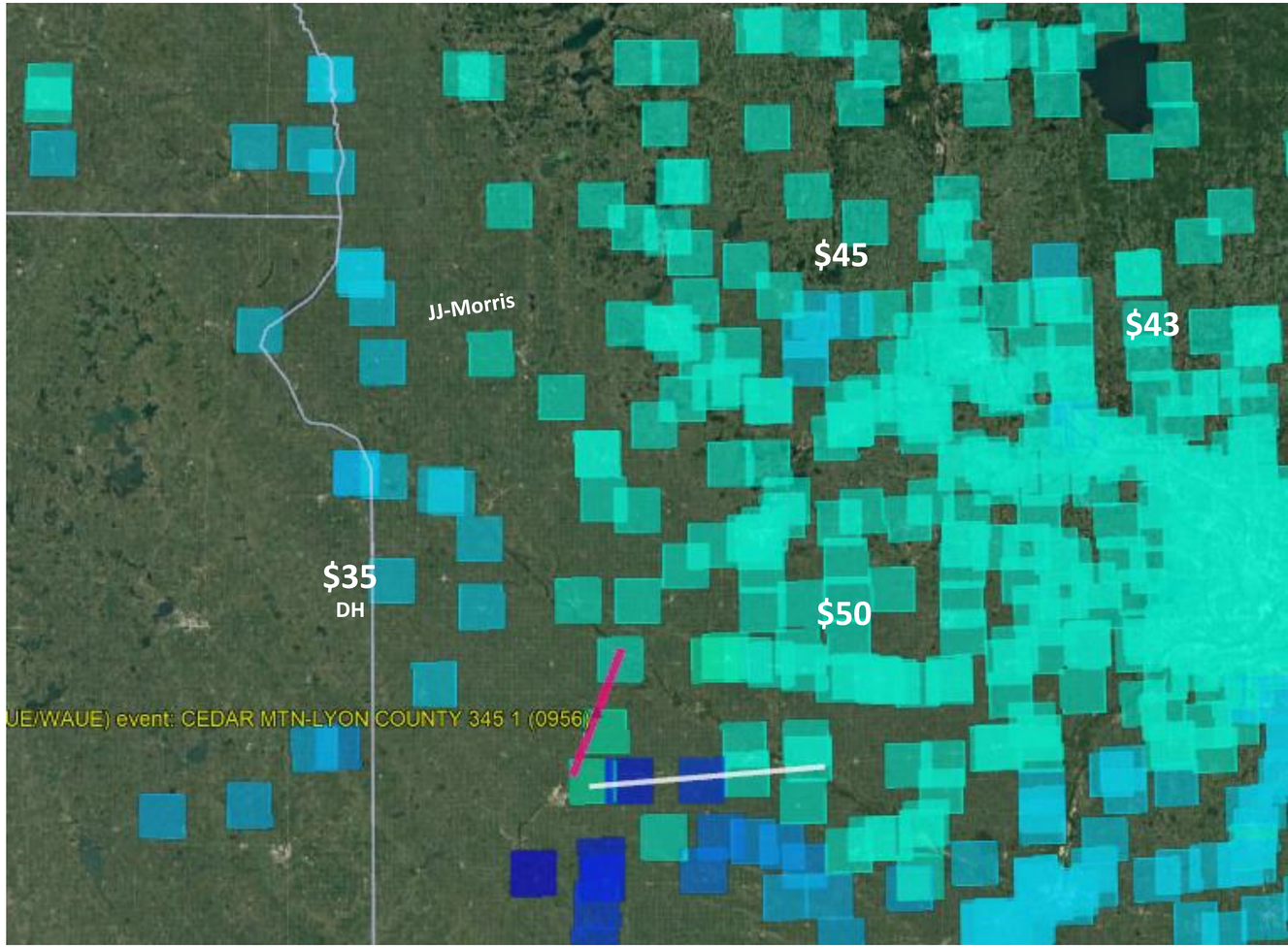
Constraint Event July 2024

Friday 3 pm

Day-ahead market (binding)



Real-time market (not binding)



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DLR Next Steps

- Integration between Heimdall and GRE EMS SCADA system via virtual DNP RTU
- Added to MISO model for ratings and passing values to MISO via ICCP
- Working with MISO to verify their use of DLR ratings
- Project underway for AAR using EMS system