

2024 Winter Storm Peak Study

A study simulating the conditions experienced during Winter Storm Gerri on January 17th has been performed by EKPC's Transmission Planning department. In particular, a model of the peak hour that occurred on 1/17/2024 at 07:30 EST was developed.

The starting-point model was the 2023/24 winter peak-load model that was developed by EKPC as part of the annual base-case development process in 2023. The actual loads on EKPC's system (see Table 1 below) and generation for EKPC at the peak of the storm (07:30 EST on 1/17/2024) were uploaded into the model. EKPC's total system load in this peak model is ~3,645 MW and based on 15-minute peaks. This differs from the peak value of ~3,780 MW based on hourly integrated peak. Actual transmission-facility outages that were occurring on the EKPC system at that time were included in the model (see Table 2 below) to re-create real-time conditions. Due to the lack of actual load and complete generation information for surrounding utilities, "virtual" generators were placed at various tie buses with set voltages in order to match real-time voltage average values at these tie buses and flows across tie lines as closely as possible across the system. Once this base model that closely approximates actual winter storm conditions ("WS model") was developed, the virtual generators at the tie buses were locked at their real and reactive power output levels in preparation for performing contingency analysis on the model.

Contingency analysis was performed on the WS model without any additional generation outages simulated, as well as a scenario where only the Cooper 1 and 2 units were simulated offline, and another scenario where only the LG&E/KU Brown 3 unit was simulated offline.

The heat maps below were created using the data from all of the studies to provide an insight to the areas of EKPC's transmission system where potential issues were identified.

Table 1. EKPC System Modeled Load

Load Type	Total MW's
EKPC Native	2886
EKPC on KU	760
KU on EKPC	117

Table 2. Transmission-Facility Outages

Outage Type	Outage
Planned	Charters-Oak Ridge 69kV
Planned	Big Bone Tap-Munk 69kV
Planned	Liberty Junction-KU Liberty Tap 69kV
Planned	Shopville Capacitor Bank
Planned	Booneville Tap-White Oak 69kV
Planned	Campton-Zachariah 69kV

Exhibit 1. No Generation-Outage Dispatch

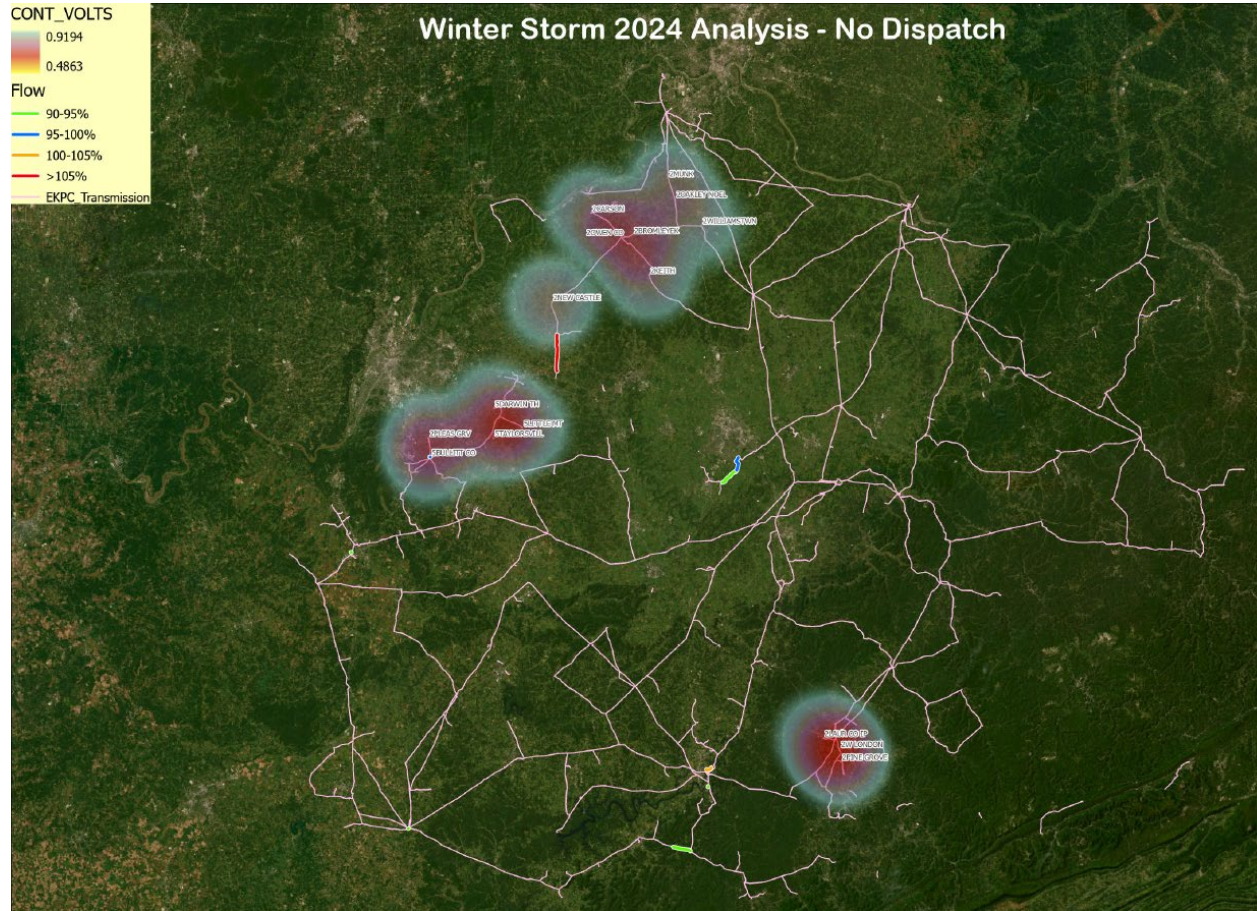


Table 3. No Generation-Outage Dispatch Thermal Overloads:

Lines above 100% of thermal rating	Critical Contingency	Overload %
Clay Village-Defoe Tap 69kV	KU Ghent-Scott 138kV (Owen Co)	108
Somerset KU-Ferguson SO 69kV (foreign limit)	Cooper1-Cooper2 161kV (Bus Tie Breaker)	103
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69kV transformer	101
Bullitt Co 161-69kV transformer	KU Mill Creek-Redmon Road 345kV	99
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Cooper 161-69kV transformer (nearly overloaded CT has been upgraded)	KU Elihu-Ferguson 69kV	95
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	95

Table 4. No Generation-Outage Dispatch Worst Contingency Voltages:

Bus	Outage	Contingency Voltage
Munk area	Owen Co Jct-Bromley EK with switching solution 69kV	0.486
Owen area	KU Ghent-Scott 138kV (Owen Co)	0.886
Bullitt Co 161kV	KU Middletown-Blue Lick 345kV	0.900
Pine Grove	Keavy Tap-Pine Grove Tap 69kV	0.909

Exhibit 2. Cooper 1&2 Generation-Outage Dispatch

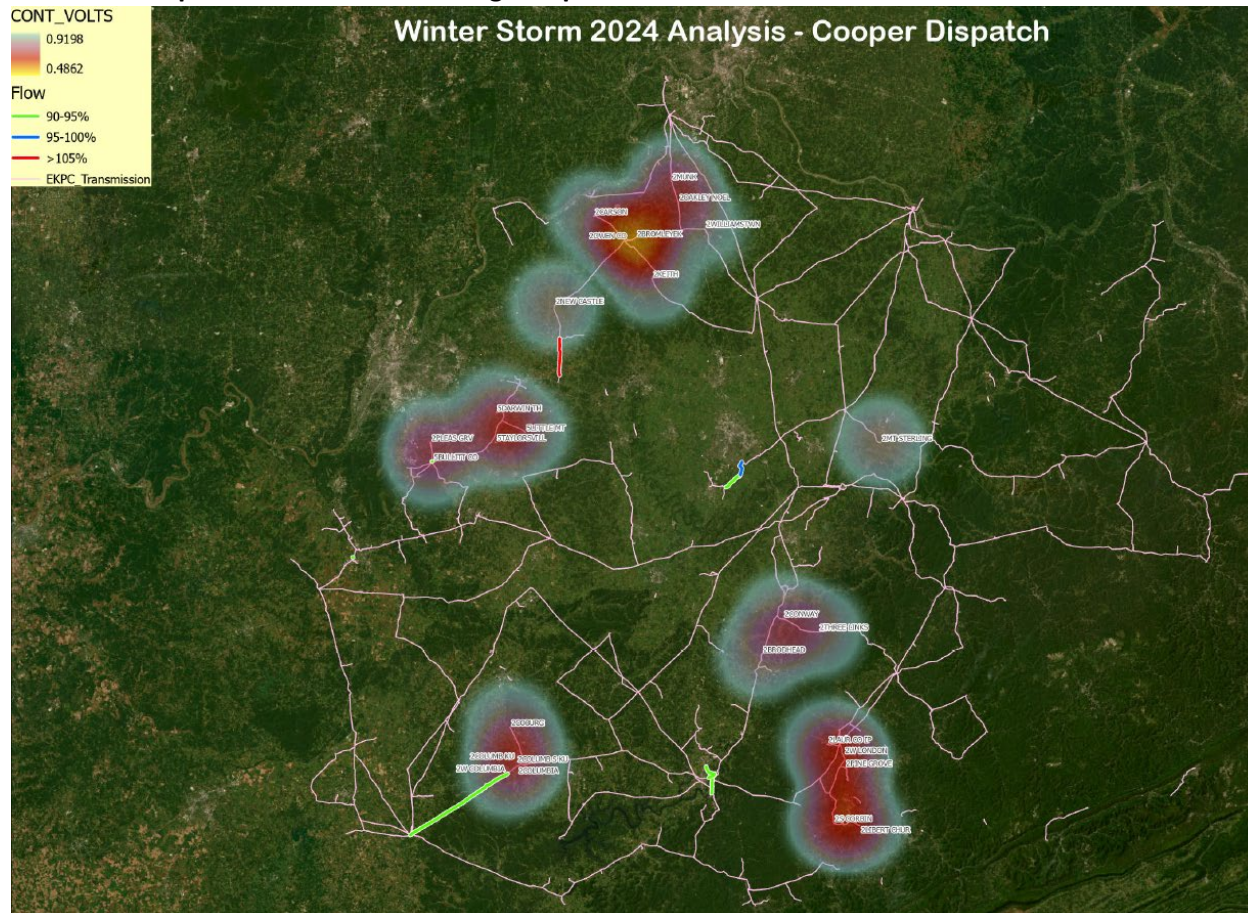


Table 5. Cooper 1&2 Generation-Outage Dispatch Thermal Overloads:

Lines above 100% of thermal rating	Critical Contingency	Overload %
Somerset KU-Ferguson SO (foreign limit) 69kV	Cooper2-Elihu KU 161kV	131
Clay Village-Defoe Tap 69kV	KU Ghent-Scott 138kV (Owen Co)	108
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	98
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69kV transformer	96
Bullitt Co 161-69kV transformer	KU Hardin Co-Redmon Road 345kV	95

Table 6. Cooper 1&2 Generation-Outage Dispatch Worst Contingency Voltages:

Bus	Outage	Contingency Voltage
Munk area	Owen Co Jct-Bromley EK with switching solution 69kV	0.486
Owen area	KU Ghent-Scott 138kV (Owen Co)	0.884
Pine Grove	Keavy 1 Tap-Pine Grove Tap 69 kV	0.898
Bullitt Co 161kV	KU Middletown-Blue Lick 345kV	0.902
West London	Keavy Tap-Pine Grove Tap 69kV	0.903

Exhibit 3. Brown 3 Generation-Outage Dispatch

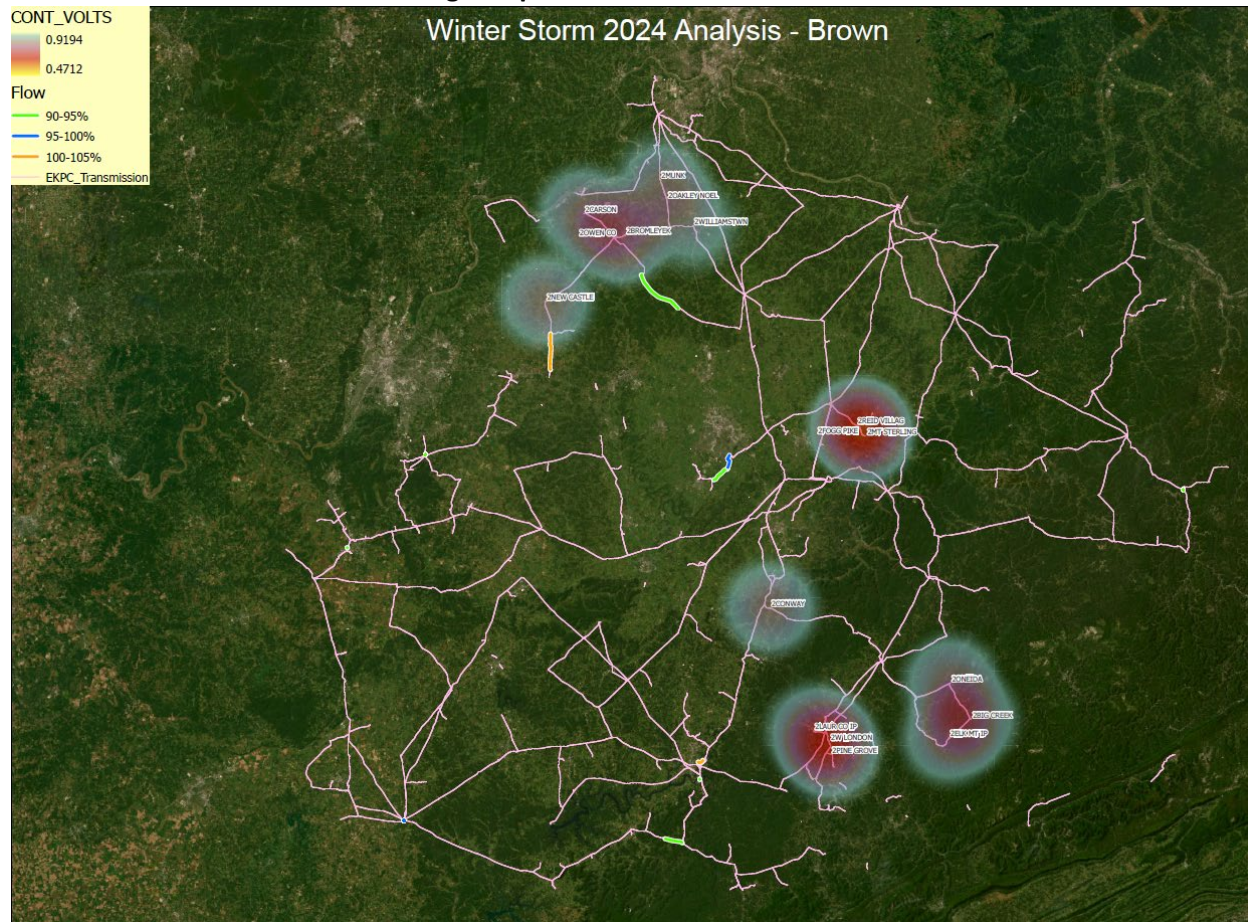


Table 7. Brown 3 Generation-Outage Dispatch Thermal Overloads:

Lines above 100% of thermal rating	Critical Contingency	Overload %
Clay Village-Defoe Tap 69kV	Owen Co-Owen Co Tap 138kV	101
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69kV Transformer	101
Somerset KU-Ferguson SO 69 kV (foreign limit)	Cooper1-Cooper2 161kV (Bus Tie Breaker)	101
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	97

Table 8. Brown 3 Generation Dispatch Worst Contingency Voltages:

Bus	Outage	Contingency Voltage
Munk area	Owen Co Jct-Bromley EK with switching solution 69kV	0.471
Owen area	KU Ghent-Scott 138kV (Owen Co)	0.893
Pine Grove	Keavy 1 Tap-Pine Grove Tap 69kV	0.899
West London	Keavy Tap-Pine Grove Tap 69kV	0.905

Additional analysis was performed in a follow up study to determine what the system would have looked like if all of the out-of-service line sections had been restored.

Exhibit 4. No Generation-Outage Dispatch with All Outages Restored

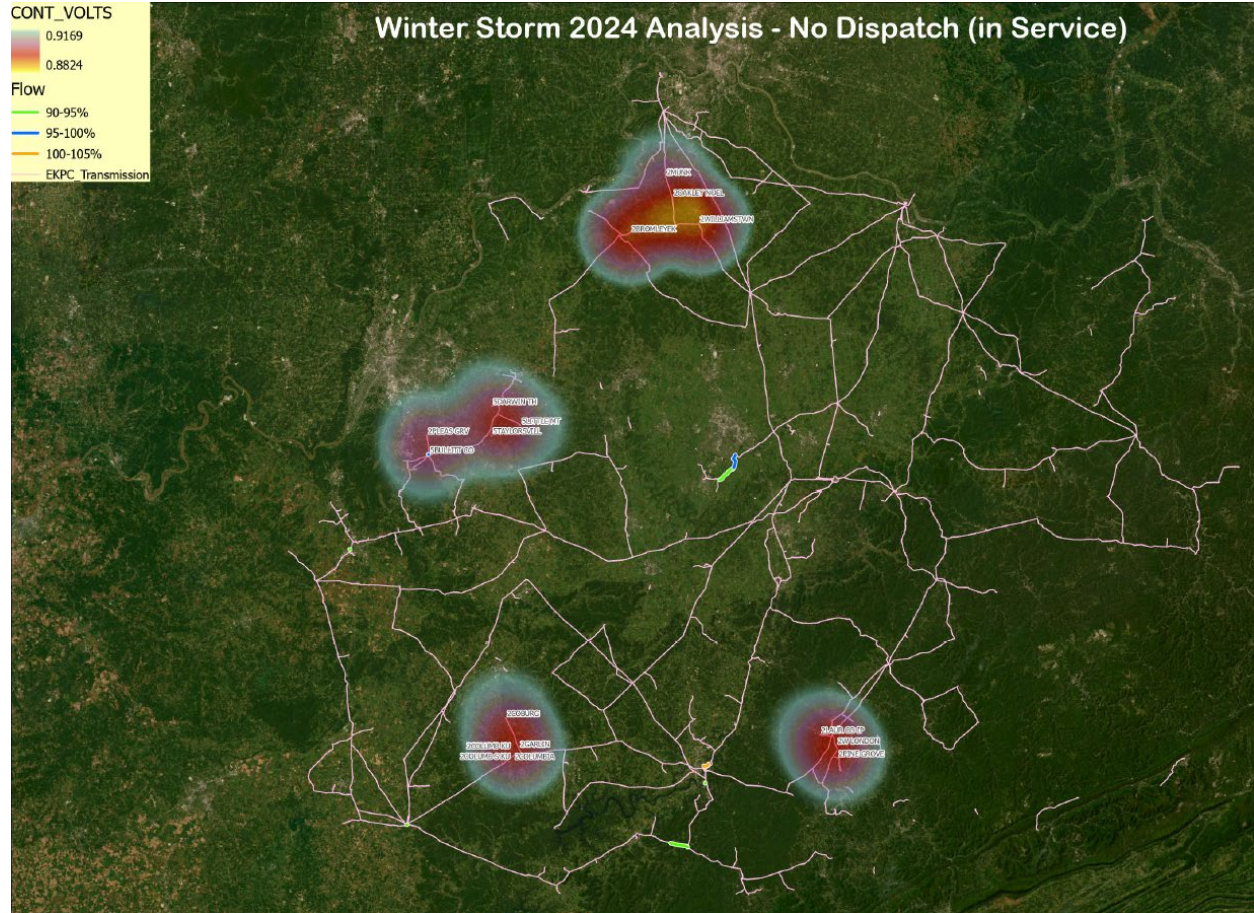


Table 9. No Generation-Outage Dispatch Thermal Overloads (In-Service):

Lines above 100% of thermal rating	Critical Contingency	Overload %
Somerset KU-Ferguson SO 69kV (foreign limit)	Cooper1-Cooper2 161kV (Bus Tie Breaker)	103
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69kV transformer	100
Bullitt Co 161-69kV transformer	KU Mill Creek-Redmon Road 345kV	99
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Cooper 161-69kV transformer	KU Elihu-Ferguson 69kV	95
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	95

Table 10. No Generation-Outage Dispatch Worst Contingency Voltages (In-Service):

Bus	Outage	Contingency Voltage
Munk area	Owen Co-Owen Co J1 69kV	0.882
Bullitt Co 161kV	KU Middletown-Blue Lick 345kV	0.900

Exhibit 5. Cooper 1&2 Generation-Outage Dispatch with All Outages Restored

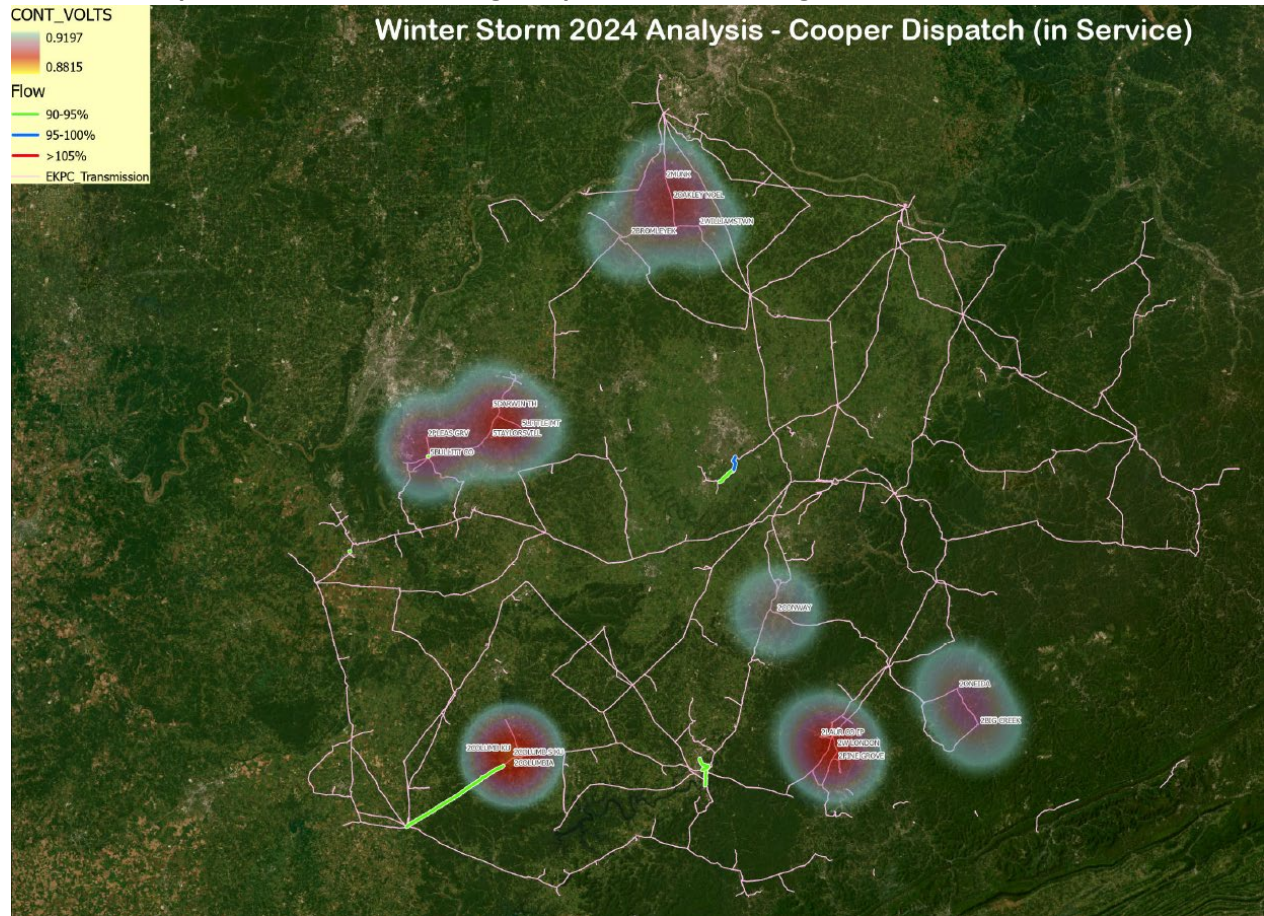


Table 11. Cooper 1&2 Generation-Outage Dispatch Thermal Overloads (In-Service):

Lines above 100% of thermal rating	Critical Contingency	Overload %
Somerset KU-Ferguson SO (foreign limit) 69kV	Cooper2-Elihu KU 161kV	131
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	97
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69 kV transformer	95
Bullitt Co 161-69kV transformer	KU Hardin Co-Redmon Road 345kV	95

Table 12. Cooper 1&2 Generation-Outage Dispatch Worst Contingency Voltages (In-Service):

Bus	Outage	Contingency Voltage
Munk area	Owen Co-Owen Co J1 69kV	0.882
Bullitt Co 161kV	KU Middletown-Blue Lick 345kV	0.903
Pine Grove	Keavy 1 Tap-Pine Grove Tap 69kV	0.903
West London	Keavy Tap-Pine Grove Tap 69kV	0.908

Exhibit 6. Brown 3 Generation-Outage Dispatch with All Outages Restored

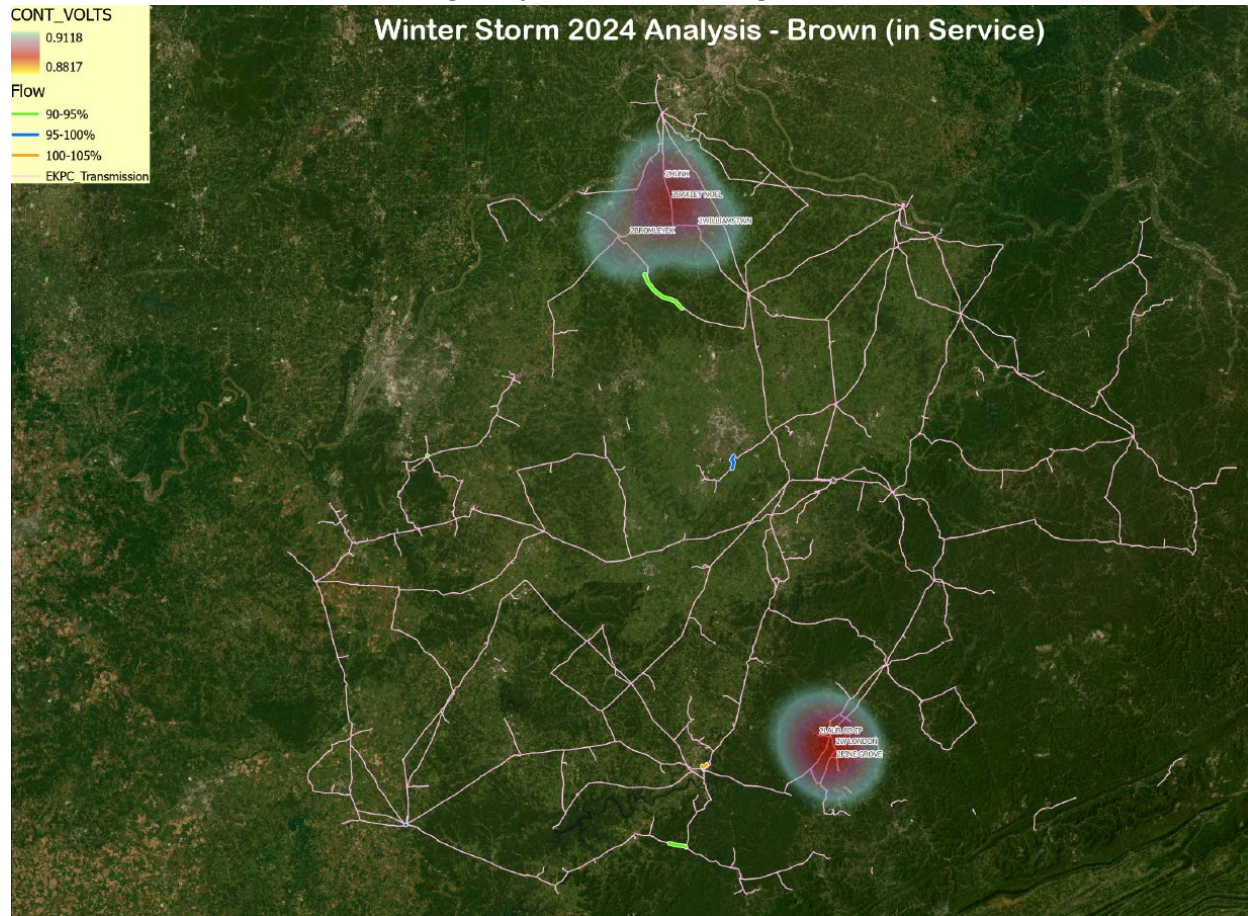


Table 13. Brown 3 Generation-Outage Dispatch Thermal Overloads (In-Service):

Lines above 100% of thermal rating	Critical Contingency	Overload %
Somerset KU-Ferguson SO 69 kV (foreign limit)	Cooper1-Cooper2 161kV (Bus Tie Breaker)	102
Pittsburg-Pittsburg KU (foreign transformer tie)	Laurel County 161-69kV Transformer	101
Davis-Fayette 69kV	Baker Lane 138kV tie	99
Summer Shade 161-69kV transformer	TVA E Glasgow-S Glasgow 161kV	97
Keith-Penn 69kV	KU Owen Co Tap-Scott Co 138kV	95

Table 14. Brown 3 Generation Dispatch Worst Contingency Voltages (In-Service):

Bus	Outage	Contingency Voltage
Munk area	Owen Co-Owen Co J1 69kV	0.882
Pine Grove	Keavy 1 Tap-Pine Grove Tap 69kV	0.904
West London	Keavy Tap-Pine Grove Tap 69kV	0.909