Winter Storm Elliott

February 6, 2023

Southern Company

Winter Storm Elliott Event Summary and Observations

- Operating company crews responded to safely restore service to nearly 390,000 customers
- Loads set all-time December highs, with the coldest December temperatures since 1989
- Forecasts were significantly below actual loads, expecting typical declines in demand over weekends and holidays
- Combination of higher demand and loss of generation early Christmas Eve morning led to an EEA1, progressing to an EEA2
- Actions taken with declarations of EEA1 and EEA2 both reducing demand and increasing supply mitigated risk of firm load shed
- Establishment of a winter target planning reserve margin (25.5%) supports reliability in extreme cold conditions
- All generation types and fuels contributed to serving loads throughout the event
- Extreme cold weather design changes were tested and should continue to be implemented
- Fuel assurance strategies and our diverse fuel mix proved critical to system operations
- Communications and collaboration across functions and neighboring utilities were critical to managing system reliability



Timeline



*Operating Reserves increase as loads ramping down, some generating capacity returns and solar ramps up

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Reserves & Energy Emergency Alert (EEA) process

Balancing Authorities have an obligation to manage resources and load in a manner that does not burden the interconnection

Operating Reserves

- Generation capability that can be deployed in 90 minutes

Contingency Reserves

- Subset of operating reserves that can be deployed in 10 minutes
- Provides response to the loss of the most severe single contingency (loss of the largest unit)

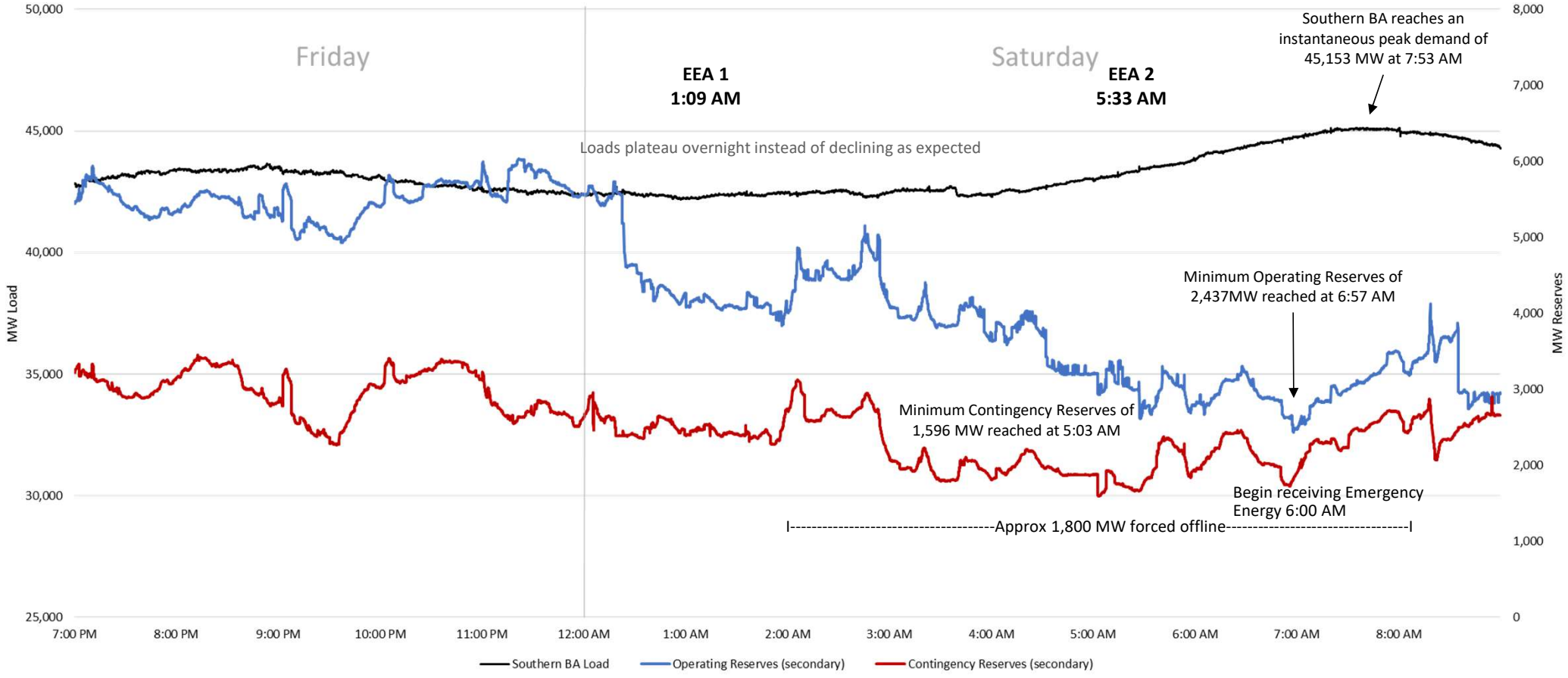
Southern Balancing Authority Operator performs an evaluation of system conditions against identified and projected thresholds to make determination of EEA Levels

- Operating reserves
- Contingency reserves
- Load ramp rates
- Peak load forecast and timing

PCC and each electric operating company TCC has an EEA procedure/plan (yearly review and drills)

- The PCC issues specific directives based on the level of alert and system conditions
- Each TCC is responsible for responding to the PCC System Alert directives for their respective operating company
  - TCC communicates internally within their operating company (Corp Communications, Facilities, Marketing/Major Accounts, etc.)

Southern Balancing Area (SBA)



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Regional view

TVA had its first ever rolling blackouts on 12/23 and 12/24, shedding 5-10% of system load.

- Load on 12/23 reached a winter record 33,425 MW.
- Forecasting errors reached at least 10%.*
- Two coal units representing 1,873 MW capacity went offline. TVA also acknowledged there were issues at another coal plant and some gas units.
- Net imports peaked at 7,179 MW, mostly from MISO.

Duke also instituted its first ever rolling blackouts, impacting about 500,000 customers in the Carolinas on 12/24.

- Duke Energy Carolinas load peaked at 20,879 MW on 12/24, 12% above forecast; load for Duke Energy Progress peaked at 14,083 MW, 5% above forecast.*
- About 2,500 MW were unavailable including 360 MW CC and 675 MW ST, as previously weatherized instrumentation lines froze, and at least 1,250 MW of firm purchases were cut.

Other South Carolina utilities struggled to meet load on 12/24.

- **Santee Cooper** employed one 15 minute rolling blackout, impacting 12,000 customers.
- **Dominion** announced it "implemented a controlled load shed" in South Carolina.

PowerSouth and **Oglethorpe** set record peaks.

- PowerSouth reached 2,674 MW, 9% above its previous peak (Jan 2018).
- Oglethorpe peaked at 11,034 MW, 15% above its previous winter peak and 8% above its previous all-time high (Jun 2022).

The **ERCOT**, **MISO**, and **PJM** systems were stressed but avoided rolling blackouts.

- The DOE waived some emissions standards to allow ERCOT and PJM to maximize generation.
- MISO and PJM declared maximum generation emergencies and took conservations actions.
- ERCOT set a new winter record with a demand of 74 GW and had forecasting errors of up to 10 GW.
- PJM's peak load forecast fell short by about 10% and their overnight valley was 40,000 MW higher than the next highest Christmas Eve.
- Up to 3,000 MW from PJM ended up flowing to the southeast via MISO.

Southern Company both gave and received emergency assistance during Elliot.

- On 12/23, SO provided TVA with 5,000 MWh.
- On 12/24, SO sent 3,700 MWh to Dominion, while receiving 6,375 MWh from FPL and 100 MWh from MISO.

*Day ahead forecasts and demand numbers from EIA.

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Winter Preparedness

- Establishment of winter target reserve margins (25.5 % for winter)
- Generating unit design changes for extreme cold temperatures
- Annual winter preparedness procedures
- Annual assessment of winter reliability risk
- Energy Emergency Alert drills conducted semi-annually
- Fuel assurance planning



Seasonal Planning

Winter Target Reserve Margins

- Measures to improve winter reliability implemented after the 2014 Polar Vortex.
- Seasonal Planning and Winter Target Planning Reserve Margin implemented in 2019.
- Neighboring utilities have winter reserve margin targets ranging from 12.6% (OPC) to 25% (TVA).

Seasonal planning drivers

1. Narrowing of summer and winter peak loads
2. Distribution of peak loads relative to the norm
   (winter peaks more volatile than summer peaks)
3. Cold-weather-related unit outages
4. Solar resource penetration
   (solar is less aligned with winter peak demand than summer)
5. Increased natural gas reliance
   (subject to natural gas pipeline constraints at cold temperatures)
6. Market purchase availability
   (limited on cold days)

Utility	Winter Planning Reserve Target
TVA	25%
Santee Cooper	17%
Duke Energy Carolina	17%
Dominion	14% for resource planning + 7% for peak
Oglethorpe (OPC)	12.6%
ERCOT	13.75% minimum
MISO	16.5%
PJM	14.9% planning, 20% operations
PowerSouth	26% under CPO

Areas for Review & Lessons Learned

- Load forecasting in extreme cold weather
- Unit availability and winterization
- Planning assumptions and target reserve margins
- Demand response programs
- Oil and demineralized water needs for CT operations
- Availability of market energy purchases
- Processes and plans for communications with customers and other stakeholders




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