SPP Southwest Power Pool

SOUTHWEST POWER POOL'S RESPONSE TO THE DECEMBER 2022 WINTER STORM

A COMPREHENSIVE REVIEW, ANALYSIS AND RECOMMENDATIONS

By Southwest Power Pool
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SPP Southwest Power Pool

REVIEW OF SPP'S RESPONSE TO THE DEC. 2022 WINTER STORM

By SPP COMMUNICATIONS

Published April 17, 2023

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Thank you to the real-time operators at SPP and member companies who protected the reliability of the grid during Winter Storm Elliott.

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Thank you to the Winter Storm Elliott Review Team who cleared schedules to participate in an interdepartmental effort to complete this review and develop recommendations.

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CONTENTS

EXECUTIVE SUMMARY 1
New Recommendations 2

REVIEW OF 2022 WINTER STORM 3
Analysis of Winter Storm Elliott (2022) 3
SPP Operations During Elliott 5
SPP Markets During Elliott 12
Key Challenges During the 2022 Winter Storm 14
Comparison to Winter Storm Uri (2021) 18
Changes Since 2021 Winter Storm Uri 19
Key Differences Between 2021 and 2022 21
Analysis of SPP's Response to 2022 Winter Storm 24
Improvements Since Winter Storm Uri 24
Opportunities for Improvement 27

RECOMMENDATIONS & CONCLUSION 31
Review of 2021 Uri Recommendations 31
New Recommendations 31
Conclusion 35

APPENDIX A: 2022 STORM TIMELINE A-1
APPENDIX B: URI RECOMMENDATIONS B-1
APPENDIX C: STORM RESPONSE SURVEY C-1
APPENDIX D: COMMUNICATION SURVEY D-1

EXECUTIVE SUMMARY

From Dec. 21 to 26, 2022, an extratropical cyclone, unofficially named Winter Storm Elliott by The Weather Channel, created extreme conditions including blizzards, high winds and record cold temperatures. This event affected the majority of the United States and portions of Canada. Some examples of the dangerous conditions created by Elliott include:

- Temperatures in Denver, Colorado, set a record, dropping 37° F in one hour.
- Alabama's Mobile Bay partially froze.
- More than 5,700 flights were canceled in the midst of holiday travel.
- 39 inches of snow fell on areas of New York.
- 1.7 million East Coast customers lost power.
- The Tennessee Valley Authority and Duke Energy experienced "rolling blackouts."

This cold weather event occurred less than two years after February 2021's Winter Storm Uri. There are distinct differences between the two storms and their impacts. Uri moved into and settled in the SPP region for six days, with significant winter precipitation. Elliott, by comparison, was relatively brief, with three days of consequential system impacts.

Both storms presented significant challenges to SPP and its members for maintaining reliability. Overall, Elliott was not as severe as Uri and had fewer gas and wind outages. However, during Elliott, we experienced a higher level of outages and derates of coal fired resources. During Uri, SPP experienced multiple Level 3 energy emergency alerts (EEA) and had to curtail up to 6.5% of demand to prevent uncontrolled outages. During Elliott, SPP reached EEA 1 but was not required to direct load shed, though there was the potential for it, with peak demand higher than accredited generation resource availability at times. One of SPP's member Transmission Operators in Missouri determined it needed to shed load locally to maintain reliability.

Many of the lessons learned by staff and stakeholders from the review of the 2021 storm were helpful during Elliott. The occurrence of two "historic" weather events in 20 months may indicate that extreme weather is becoming more frequent across SPP's footprint. New winterization standards were developed by the North American Electric Reliability Corporation (NERC) in collaboration with SPP and other stakeholders. Some of SPP's recommended changes following Uri are still in process. After a review of Elliott, SPP staff recommends staying the course to complete Tier 1 recommendations by January 2024 and other recommendations by 2025.

SPP Staff also identified a limited number of changes that could help SPP and its stakeholders be better prepared for, and be equipped to respond more efficiently to, extreme events in the future. These recommended changes are primarily related to internal processes, tools or functions and should not require significant reprioritization of resources or ongoing work within SPP's stakeholder processes. SPP staff will continue to collaborate with stakeholders as it implements improvements, because SPP's success, in the past, present and future, depends largely on the strength of its stakeholder engagement.

NEW RECOMMENDATIONS

In addition to new recommendations from Elliott, staff recommends staying the course on current market enhancements and efforts to implement Uri recommendations.

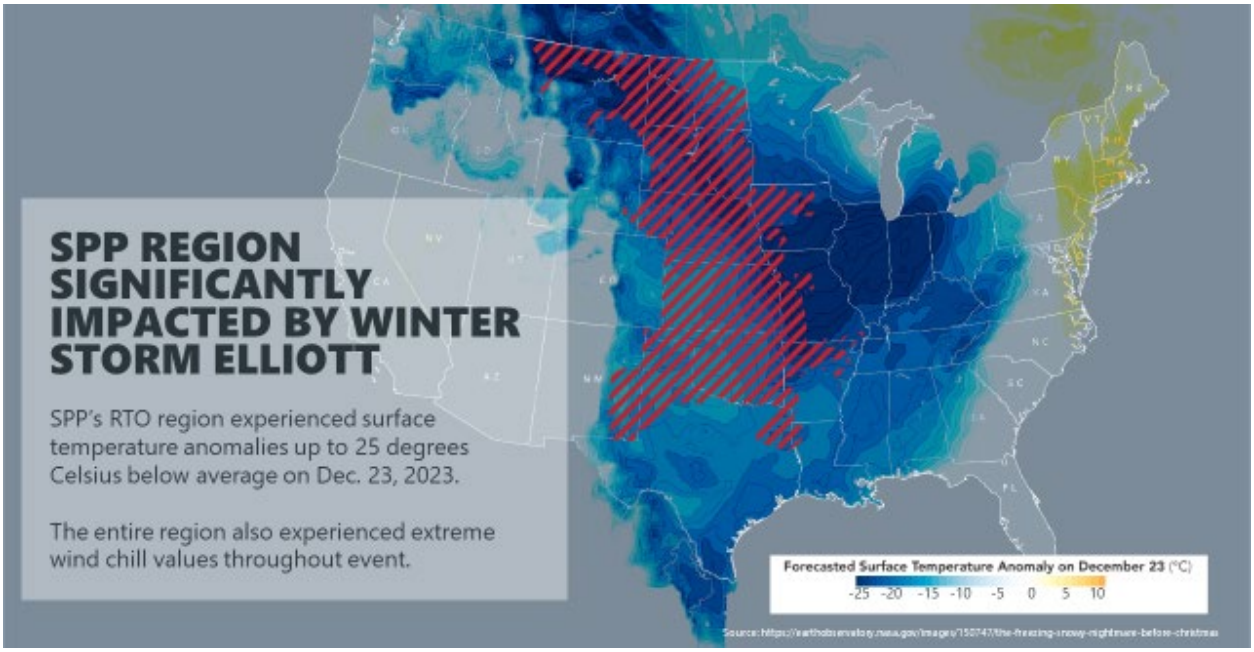
Table 1 – Winter Storm Elliott Recommendations

#	TYPE	LEAD	RECOMMENDATION
1	Compliance	Members & Staff	The SPP Reliability Coordinator and member transmission operators (TOP) should collaborate to review revisions to TOP emergency operations plans for compliance with NERC extreme cold weather winterization standards.
2	Operations	Staff	Identify conditions for issuing transmission emergency alerts to more consistently inform entities of transmission congestion severity. Update operator guidelines where appropriate.
3	Operations	Staff	Improve situational awareness of neighboring entities' conditions during extreme winter events to maintain reliability across the combined footprint of all entities.
4	Operations	Staff	Identify options to better mitigate and manage congestion during extreme winter events
5	Operations	Staff	Improve or develop processes to identify areas at risk for low voltage or extreme congestion when extreme winter events are forecast.
6	Operations	Staff	Identify improvements for forward-looking studies to more efficiently apply uncertainty of forecasting for load, wind, outages, fuel supply, interchange and external impacts.
7	Markets	Staff & Members	Educate market participants about the importance of timely updates of offers based on gas price forecast and resource lead time during extreme cold weather.
8	Transmission Planning	Staff	Include extreme winter weather analysis in the Integrated Transmission Planning (ITP) Assessment.
9	Transmission Planning	Staff	Analyze areas of SPP that experienced voltage and congestion issues to determine the impact of previously approved, but not yet in-service, transmission projects.
10	Communications	Staff	Launch an SPP app that incorporates push notifications.
11	Communications	Staff & Members	Educate stakeholder communications staff on emergency procedures at SPP's 2023 Communications Conference.

REVIEW OF 2022 WINTER STORM

From Dec. 21 to 26, 2022, an extratropical cyclone, unofficially named Winter Storm Elliott by the Weather Channel, created extreme conditions including blizzards, high winds, snowfall or record-cold temperatures across the majority of the United States and parts of Canada. Denver, Colorado, experienced a record rate of temperature change: 37° F in one hour. Alabama's Mobile Bay partially froze, more than 5,700 flights were canceled during holiday travel and 39 inches of snow fell on upstate New York in "zero-mile" visibility conditions.[1]

Figure 1 – Map of surface temperature anomalies, Dec. 23, 2022



On Dec. 24, 110, million people across 36 states were under wind chill alerts, 1.7 million customers along the East Coast lost power and the Tennessee Valley Authority and Duke Energy "created rolling blackouts to reduce energy demands."[1]

ANALYSIS OF WINTER STORM ELLIOTT (2022)

Elliott began in the Pacific Northwest, but intensified in the Great Lakes, bringing blizzard conditions, strong winds and extreme cold. It moved rapidly across the Eastern Interconnection and created gas supply challenges and historic load forecast volatility. SPP's Balancing Authority area (BAA) experienced the coldest temperatures (-5° to -20° F) in its North region Thursday,

[1] Weather Underground, "Winter Storm Elliott Intensified Into Bomb Cyclone" (article)

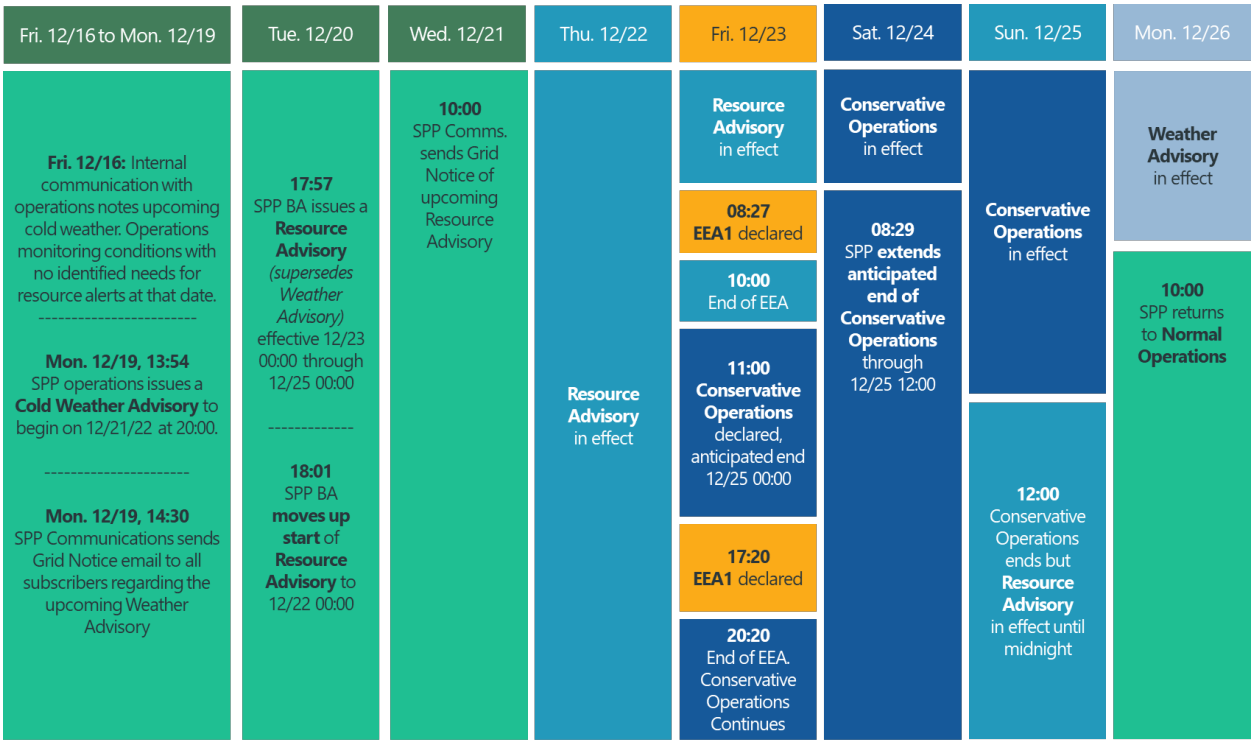
Dec. 22, 2022. Temperatures in the middle of the BAA reached their lowest levels Friday, Dec. 23. Wind chill was extremely low (around -20° F), resulting in increased energy demand for heating.

SPP began receiving system overrun limitation alerts for gas pipelines during the week of Dec. 19, 2022. This was an early indication of potential fuel supply problems and was considered when evaluating potential forecast errors, including forecasts of resource unavailability.

Between Dec. 22 and Dec. 25, SPP received communication from plant operators about fuel procurement issues through operator-to-operator communication and SPP's Control Room Operation Window (CROW) outage system. Based on forecasts of capacity-constrained timeframes, including considerations for wind, resource availability and renewable uncertainty, SPP began to mitigate increased generator unavailability by coordinating early future commitments of gas fired power plants.

SPP issued a Cold Weather Advisory for the entire region of the SPP RC East footprint at 13:54 CT on Dec. 19, 2022, effective 12/21/2022 20:00 CT, and a Resource Advisory at 18:00 CT on Dec. 20, effective at 00:00 CT Dec. 22. Below is an overview of the alerts issued by SPP BAA:

Figure 2 – Timeline of operational communications: Dec. 19-26, 2022 (blocks are not to scale)



SPP OPERATIONS DURING ELLIOTT

Forecast

SPP issued a Cold Weather Advisory for the entire SPP RC East footprint Dec. 19, 2022, at 13:54 CT. The advisory was effective from Dec. 21 at 20:00 CT. SPP expected the cold weather conditions to last until Dec. 26.

SPP's seven day load forecasting tools initially forecast an SPP BAA Load level between 43 GW and 44 GW for the coldest two days (Dec. 22 and 23). SPP ended up with an actual Load level of 47.2 GW Dec. 22 at 18:30 CT. The weighted ambient temperature of the SPP BAA at that time was 0° F.

The load forecasting tools had never experienced similar weather conditions and load levels to Elliott, therefore the data history wasn't available to the tools to perform accurate load forecasting. This was attributed to the weather system moving in faster and colder than forecast for many horizons (similar experience from other RTOs), the potential impact from heavy snow in previous cold events adjusting load and weather relationships downward and extreme wind chills beyond those represented in historical load forecast training and relationships (wind chill is an input to load forecast).

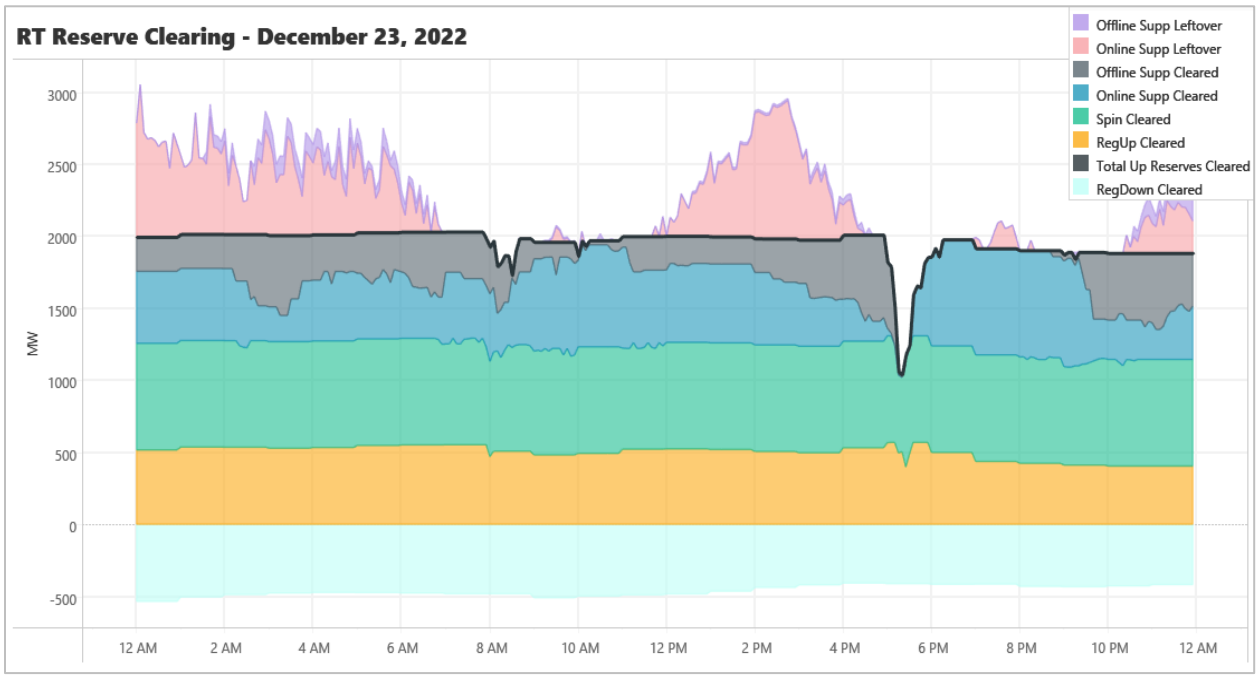
EEA Levels

SPP did not experience significant reserve shortages for most of the event until the two EEA1 periods on Dec. 23, 2022. On this day, SPP issued two EEAs due to capacity concerns. Both were the lowest level (EEA1) and one transmission emergency was declared due to a significant volume of congested flowgates within SPP's RC area.

The EEA1 alerts were issued for two short periods in which the online capacity declined to a point in which it was appropriate to notify the Interconnect. The first EEA1 was issued Dec. 23, 2022 (Friday morning) at 08:27 CT, which was terminated at 10:00 CT as load decreased. The second EEA1 was issued later on this same day at 17:20 CT and terminated at 20:20 CT that evening. At no time did SPP enact load management during the EEAs, or progress to an EEA2 or EEA3.

The SPP BAA experienced operating reserve shortages Dec. 23, 2022, during 28 five-minute intervals. During the first EEA1 event, SPP curtailed approximately 600 MW of non-firm exports and during the second EEA1 event SPP curtailed approximately 1,100 MW of non-firm exports.

Figure 3 – Real-time clearing of reserve energy: Dec. 23, 2022



Wind Levels

Wind resources performed above accredited capacity on Dec. 22, 2022, coinciding with when the BAA Load was high. During the highest load level of 47.2 GW on Dec. 22, 2022, at 18:30 CT. the wind level was 17.9 GW. The wind level started slowly decreasing after the Dec. 22, 2022, load peak and reached its lowest level of 2.7 GW 20 hours later Dec. 24, 2022, at 17:00 CT. At that time SPP BAA load levels were down 7 GW to 35 – 40 GW.

Uncertainty

SPP has an Uncertainty Response Team (URT), which helps to identify and address upcoming capacity challenges given forecast system conditions. Going into the winter event SPP had to anticipate uncertainty in the following areas:

- Uncertainty of accurate load forecasting for Dec. 23, Dec. 24, Dec. 25 due to wind chill.
- Uncertainty if the forecast for high wind levels would hold, and to what extent wind farms would be shut down or de-rated for low ambient temperatures.
- Uncertainty if the gas resources SPP committed would be able to purchase gas.
- Uncertainty if resources SPP committed would be timely due to preheat and start-up.
- Uncertainty of how many resources would trip because of freezing of equipment resulting from low temperatures and high wind chill conditions.
- Uncertainty of how much congestion SPP would experience that required re-dispatch of resources that could lock up headroom of resources.

- Uncertainty of net scheduled interchange (NSI) changes resulting from mostly non-firm interchange scheduling performed by TC's and Marketers partly triggered by price differences between real-time markets.
- Uncertainty if the Missouri River would develop ice blocks preventing adequate river flow and potentially limit hydro generation and cooling water availability.

SPP staff recommended long lead commitments Dec. 21, 2022, for Dec. 22, 2022, and Dec. 23, 2022, to help with capacity, deliverability concerns and uncertainty. To aid in securing needed fuel based on projected limited availability, SPP staff assessed forward looking commitment studies and coordinated early resource commitments. Long lead commitments were again recommended on Dec. 22, 2022, for Dec. 24, 2022, and Dec. 23, 2022, for Dec. 25, 2022.

SPP committed several GW of primarily gas generation ahead of time for Dec. 22 through Dec. 25, to cover normal long-lead time units as well as help ensure there was a sufficient amount of gas procured to cover the forecast obligations. Due to transmission deliverability limitations, some of the generation was not committed during this time; this would have resulted in more severe congestion.

Forward-looking risk

The SPP BAA observed low to negative capacity margins when adjusting for uncertainty risk for Dec. 23-Dec. 25 based on historical risks observed with resource outages, derates and load forecast in those temperature ranges as well as wind forecast error at those forecast levels.

SPP also had concerns based on information regarding potential gas supply limitations as well as wind farm icing and low-temperature cut-out to add to these risks, so commitment actions were targeting Dec. 22 – Dec. 25.

Unavailable Resources and Risk of RTO Load Shed

SPP went into winter storm Elliott with normal generation outage levels. SPP had approximately 4 GW planned maintenance outages that decreased during winter storm Elliott to 3 GW. As the weather event progressed, generation unavailability increased by 2-3GW per day and went as high as 25-26GW on Dec.25, 2023. That includes renewable generation outages. The increase was primarily due to de-rates and forced outages.

Primary causes for the outages and derated capacity in the SPP BAA were fuel supply and equipment failure. The equipment failures increased as the cold system moved in Dec. 22 and peaked Dec. 23. The lost capacity due to fuel supply (primarily gas) grew and peaked later in the event as the cold stayed in place and the gas system was more limiting.

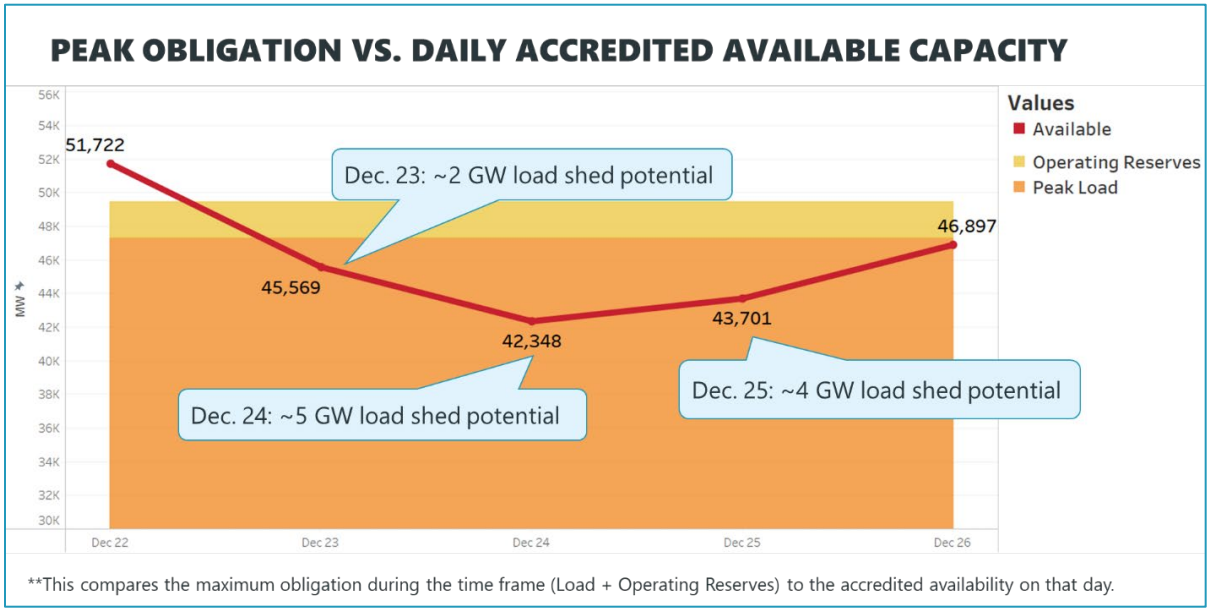
Table 2 – Capacity Unavailability

	Unavailable Capacity Including De-rates		Unavailable Capacity Resulting from Fuel Supply Issues
Date	MW in Registered Capacity	MW in Accredited Capacity	MW in Accredited Capacity
12/20/2022	18,300 MW	11,100 MW	
12/21/2022	19,700 MW	12,000 MW	500 MW
12/22/2022	23,600 MW	14,800 MW	1,600 MW
12/23/2022	25,200 MW	15,500 MW	3,500 MW
12/24/2022	25,800 MW	15,200 MW	4,000 MW
12/25/2022	25,900 MW	16,500 MW	4,000 MW

Unavailable accredited capacity on Dec. 23, 2022, and Dec. 24, 2022, was in average 14-15 GW (35-40% Coal, 45-60% gas), which is two times average normal summer level of 7.5 GW unavailable accredited capacity. Dec. 24, 2022, experienced a total availability of accredited generation approximately 13 GW lower than the five-year average on this date. Gas supply availability contributed to increased unplanned outages. The unavailable accredited capacity resulting from Fuel Supply issues (Gas & Coal) is listed in table above.

During Dec. 22, 2022 and Dec. 23, 2022, wind generation outperformed accredited amounts helping to set new winter peak loads with higher total resource availability. In combination with other resource type unavailability, wind availability decreased in the following days resulting in low accredited resource availability on Dec. 24, 2022, of approximately 42.4 GW. When comparing, on non-coincident basis, such availability to the winter peak set only a few days prior Dec. 22, 2022, of approximately 47.2 GW, the accredited capacity was 4.8 GW lower than the event's peak load.

Figure 4 – Peak obligation vs. daily accredited available capacity: Dec. 22 through Dec. 26



In comparison with Uri, total resource availability at its lowest still remained approximately 7 GW higher in Elliot. This can largely be contributed to total Gas generation availability, which was approximately 8.7 GW higher during Elliot than during Uri. (Slide 20 MOPC winter storm deck). Coal did however provide approximately 2.3 GW less available generation in Elliot when comparing some peak time frames during the two events.

Transmission Operator-Directed Load Shed

One of the Transmission Operators (TOP) in Missouri initiated local load shed in the Branson area from 21:00 to 23:00 CT, Dec. 22, 2022. This local load shed was approximately 29 MW. The TOP initiated the load shed after the SPP BAA experienced multiple unit and capacitor bank contingencies in Missouri on the afternoon of Dec. 22, 2022.

These contingencies occurred in the same geographic area, resulting in low 345 kV voltage levels and low 161 kV voltage levels in southwest Missouri. Ultimately, some of the hydro generation in the area was brought back to provide MVAR support after the multiple contingencies. This allowed the load to be restored within a few hours as voltages recovered.

Interchange

The SPP BAA net interchange was fluctuating during winter storm Elliott. On the days leading into winter storm Elliott, SPP BAA was a net importer (1–2.5 GW) during the day hours changing to net exporter (1–1.5 GW) in the evening and night.

That changed Dec. 22, 2022, in the afternoon and evening. The SPP BAA started the day of Dec. 23, 2022, with an import of 2-2.5 GW that decreased during the day gradually to an export of 1 GW. The change from import to export on Dec. 23, 2022, contributed to the need for two short EEA1 declarations Dec. 23, 2022, with the SPP BAA experiencing challenges to maintaining adequate operating reserves.

To limit further increase of the export of the SPP BAA, the SPP transmission service provider (TSP) reduced the TTC of the SPP export interface from 21:00 CT, Dec. 23, 2022, through 12:00 CT, Dec. 25. SPP reduced the allowed ramp of the SPP BAA interchange in the ramp reservation system.

SPP BAA communicated this action with MISO, Tennessee Valley Authority and Southern Company and notified them to contact SPP if they needed assistance and SPP would evaluate our ability to help. These calls were on the morning of the 24th.

In comparison to Uri, in which SPP was a heavy importer throughout the timeframe, SPP experienced much less net import and timeframes in which the BA was a net exporter. This contributed to a net obligation increase needed to be served at times during Elliott.

Congestion

While there were a few transmission outages impacting flows, there was still a very significant amount of transmission congestion limiting flows and transfers into the eastern portion of SPP's footprint.

SPP experienced 48 hours of severe congestion starting at noon Dec. 22, 2022, and lasting until end of Dec. 24, 2022. The most severely loaded region were the southern Missouri and northern Arkansas regions. The Kansas City area (including north-to-south flows toward it) and southeastern Oklahoma regions also experienced heavy loading. SPP observed up to 36 flowgates with congestion at the same time (in a single RTBM interval) during the event and up to 88 distinct transmission constraints saw congestion over a two-day period.

The high load coupled with several key generation losses in the eastern part of SPP's footprint were the primary drivers of this loading. With high wind availability in SPP and MISO, there were significant flows from west to east and north to south, with the heaviest impacts flowing toward the southern Missouri and northern Arkansas areas. SPP observed voltages dipping down into the low 90% range on both the 345kV and 161kV systems on the peak flow loading periods Dec. 22 evening (where 161kV was lowest) and Dec. 23 morning (where 345kV was lowest).

The SPP East RC declared a transmission operating Emergency Dec. 23, 2022, at 10:33 CT. This transmission operating Emergency declaration was in response to abnormally large numbers of system constraints that were breached due to system conditions. No pre-contingent load shed was implemented for this congestion, but post-contingent plans were put in place by TOPs.

The purpose of the transmission emergency declaration was to ensure internal and neighboring entities were aware of the abnormal system conditions the SPP footprint was experiencing. This declaration was also aligned with prior severe weather operations analysis and reviews recommending this action for future similar events. At no time during this event did SPP have an IROL exceedance. The transmission operating Emergency ended Dec. 23, 2022, at 15:09 CT.

SPP BAA lost 1,400 MW of generation in the East of the footprint on Thursday 12/22/2022 in a very short time frame between noon and 18:00 CT. That contributed to increased congestion and low voltage levels in East of SPP footprint

The primary mitigations used by SPP were market redispatch and manually limiting (per Out of Merit Energy (OOME) instructions) some generation that were close to the thermal constraints. In some of the more severe cases, post-contingent load plans were relied upon.

SPP had several M2M flowgates in effect Dec. 22, 2022, and Dec. 23, 2022, but both SPP and MISO real time balancing markets had insufficient re-dispatch capability left to effectively mitigate the congestion on Seams.

OOME

To help mitigate congestion, the SPP RC issued several OOME's to lower SPP BAA generation that was contributing to congestion starting Dec. 21, 2022. On Dec. 22, 2022, and Dec. 23, 2022, the OOME's contributed to the SPP BAA running out of dispatchable generation and the generation capacity the SPP BAA still had available offline in market and reliability status, was located at the wrong place on the transmission system to the east and north of the constraints. Committing that generation would further aggravate congestion.

Table 3 – Out of Energy Merit (OOME) Caps on Generation by Date

Total OOME Capped by MW	Total OOME Capped by MWh
• Dec. 21: 623 MW • Dec. 22: 752 MW • Dec. 23: 1,335 MW • Dec. 24: 278 MW.	• Dec. 21: 1,381 MWh, • Dec. 22: 4,689 MWh • Dec. 23: 13,035 MWh • Dec. 24: 1,702 MWh.

Impact of Regional Directional Transfer (RDT) Flow

Leading into – and throughout – the event, SPP coordinated with its neighboring RCs with notifications of specific Advisories, Alerts and Emergencies. Additionally, SPP discussed real-time operational issues as they occurred, with a primary focus on managing large-scale, regional and interregional flows to allow power to get to the load within the transmission system limits. The MISO North-South dispatch parallel flow (RDT Flow) was from South to North on the days leading into winter storm Elliott (Dec. 19, 2022, Dec. 20, 2022, and Dec. 21, 2022), not a significant causer or contributor to congestion.

Early in the morning of Dec. 22, 2022, the RDT flow started increasing in the North to South direction and reached a value of 2,650 MW (North → South) Dec. 23, 2022, starting 08:00 CT up to 10:30 CT. This aggravated congestion on multiple SPP flow gates and negatively impacted the reliability of the SPP transmission system.

The most severe interregional flows on SPP's system were on Friday morning, Dec. 23, as SPP and its neighbors MISO, AECI, and ERCOT were approaching morning peak load. SPP observed multiple flowgates exceeding their emergency limits (post-contingent calculation) and voltages in its eastern region continued to drop. SPP requested a reduction in the MISO Regional Directional Transfer (RDT) flow to help maintain control of transmission constraints, particularly on the northern side of the footprint (around the Nebraska/Iowa/Kansas/Missouri seams).

MISO was able to comply and provide the relief, while SPP eventually entered into an EEA1. The RDT reduction was released later that afternoon. Additionally, SPP did agree to allow a further increase in the RDT early Saturday (Dec. 24) for an emergency assistance request that Tennessee Valley Authority had made from MISO.

Voltages

On the evening of Dec. 22, 2022, the SPP RC area experienced low and declining voltages across several areas in the system, increasing loading on thermal constraints. Following several unplanned generation losses (two trips) and one planned shutdown of generation in a short period of time (20:50-21:00 CT Dec. 22), voltages dropped to a low level on the 161kV system, causing one TOP to initiate local load shed in the Branson area.

Voltage levels were restored at midnight but decreased again on Dec. 23, 2022, in the morning. Voltage levels were again restored around noon on Dec. 23, 2022. Voltages were low across a significant portion of the eastern SPP footprint as well as its neighbors. This was driven mostly by the lack of generation (forced outages), high load and heavy transfers into the area.

Transmission Outages

The SPP BAA didn't experience an increase in transmission outages during winter storm Elliott. Transmission Operators made efforts to bring as many transmission lines back in service as possible before the start of the winter storm. Part of that was planned already because of the upcoming holidays. SPP noticed a decrease of total transmission outages of 20-30 between 12/19/2022 and 12/24/2022.

The most significant forced outage of the Muskogee – Muskogee Tap 138kV line increased loading on the 161kV and 69kV systems in the area.

The most significant planned transmission outage was the Neosho – Riverton 161kV line, which was out for several months (from September 2022 to January 2023) for a rebuild. This had some impact on congestion experienced in the Missouri/Arkansas/Kansas/Oklahoma border areas.

SPP MARKETS DURING ELLIOTT

Resource Commitments

As the Balancing Authority (BA), SPP committed generation across multiple time horizons, including before the close of the Day-Ahead Market (DAMKT) starting Dec. 22. The BA deemed these commitments necessary to ensure sufficient capacity is available for dispatch.

Commitments made before the DAMKT are considered committed in the DAMKT for clearing. SPP also observed an increase in commitments initiated by the Market Participating (self-commitments) on Dec. 21. Many of the self-commitments during this time and the subsequent operating days were for Resources that started before the cold weather to ensure they would be available during the event.

DAMKT Participation and Activity

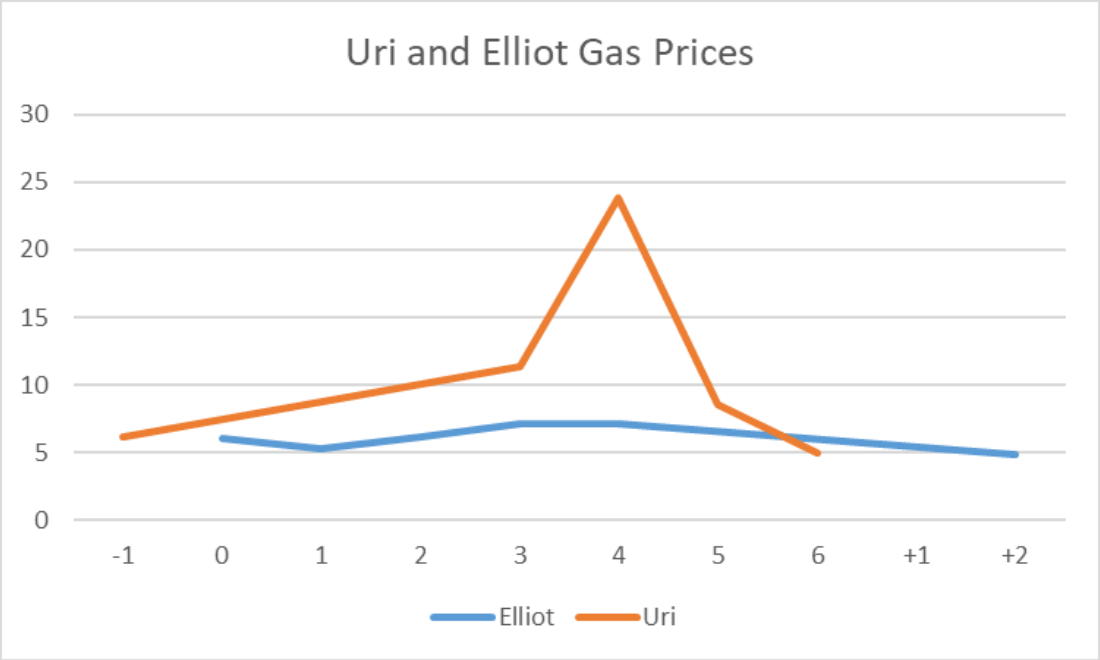
Overall, load was higher in Winter Storm Elliot across the event than that observed in Winter Storm Uri. Elliot had an average DAMKT obligation of 39.2 GW while Uri had 38.7 GW. Elliot had significantly more virtual clearing than Uri. This increased virtual clearing is strongly correlated with higher wind participation/clearing in DAMKT. DAMKT wind in Uri was impaired due to widespread icing across the SPP footprint. Conversely, in Winter Storm Elliot, SPP had larger magnitudes of virtual load and generation, which impacts DAMKT clearing.

- **Virtual activity** in the DAMKT was higher during Winter Storm Elliot than what SPP saw during Winter Storm Uri. This could be attributed to various reasons, one of which is the absence of curtailment of this activity in Elliott, unlike what SPP saw during Winter Storm Uri.

- **Make-Whole Payments:** Comparing Elliot and Uri, SPP saw a *significantly larger* make-whole payment during Winter Storm Uri. SPP attributes this to increased Natural Gas prices, the volatility of the fuel costs and the greater reliance on this gas generation during storm Uri because of the comparatively low wind output some of which was related to icing.

- **Gas Prices:** Uri Storm's prices increased significantly more than Elliot's prices. Looking at gas prices during each of the winter events compared to each of their previous 90-day rolling averages, unlike during Uri, gas prices during Elliot stayed close to the 90-day rolling average. Looking at the ratio of natural gas prices compared to the 90-day rolling average during each winter storm, gas prices during Uri increased above the average by up to eight times the rolling average.

Figure 5 – Chart comparing gas price ratios during Winter Storms Uri and Elliott



- **Market Prices:** Looking at the data, winter storm Uri was affected by Natural Gas prices during the storms at a greater level than during Elliot. This is indicated by the higher instances when gas resources were marginal during Elliot. On an average operating day, gas generation is marginal at an average of 30% of market solutions. While SPP saw this increase slightly during Elliot, Uri had a more drastic increase in this metric, making Uri market prices more correlated with gas costs.

- **Imports, Exports and Interface:** Comparing MISO's Day-ahead market interface price to SPP's DAMKT interface price, along with the SPP DA net scheduled interchange, during Elliot, both MISO and SPP market prices (at the MISO interface) were reasonably convergent, as result, there was no significant incentive for interchange to be predominantly in one direction or another. As a comparison, during Uri, SPP saw a larger divergence of market interface prices between MISO and SPP, which resulted in a clear incentive to import into SPP.

KEY CHALLENGES DURING THE 2022 WINTER STORM

Key challenge #1: Large Load forecast error for Dec. 22, 2022

Load forecasts were too low for Dec. 22 and 23 for most areas, when the temperature forecast was off high. Load forecasts were too high for Dec. 24 and 25 for most areas, when the temperature forecast was off low. Transmission losses peaked around 1,550 MW during this week's event. A normal level of transmission losses is 1,000 MW.

There was heavy snow during Uri, which appears to have contributed to significant *reductions* in load. This was not evident during Elliott and was likely part of the reason for actual load coming in above forecast. Extreme wind chill impact may also have contributed to load forecast error.

Key challenge #2: Low voltages

SPP experienced voltage issues in Missouri on both Dec. 22, 2022, and Dec. 23, 2022, but those were more related to trip of resources and variations of MVAR support by Hydro of the NW Arkansas area. Not so much RDT. SPP observed changes of our import to export Dec. 23, 2022, and that contributed to some extent to congestion on Seams.

Low voltages were observed in similar locations during both Uri and Elliott, but the Elliott event saw a more extreme voltage reduction (multiple 345kV facilities in the low 90% range). This was primarily due to the loss of generation in the eastern portion of SPP's footprint and heavy transfers required to get replacement power from outside the pocket.

Key challenge #3: Transmission Operator-directed Load Shed

Due to reliability circumstances related to voltage issues created by outages, a TOP in Missouri initiated localized load shed Dec. 22 between 21:00 CT. and 23:00 CT.

Key challenge #4: Increased Generation Outages

The average unavailable accredited capacity was 14,300 MW (around 35-40% was coal, and 45-60% was gas). This is two times the average summer level of 7,500 MW unavailable accredited capacity. Unavailability due to fuel supply issues was between 1,600 MW and 4,000 MW during Elliott. SPP experienced losses of multiple key generation units on Dec. 22 and Dec. 23.

Key challenge #5: Congestion

Heavy congestion started around noon Dec. 22 and lasted until the end of Dec. 24. There were 65 total "30-minute exceedance" events during that period, the longest lasting 25 hours. SPP had 35-40 flow gates loaded: 10 were M2M, 20 were breaching and 10 were binding.

SPP considered declaring a transmission emergency earlier but didn't until Dec. 23 at 10:33 CT, ended it Dec. 23 at 15:09 CT.

Low and declining voltages across several areas in the system increased loading on thermal constraints. SPP issued some OOMEs to limit internal generation near the constraint, but this was a challenge in already tight operating circumstances. What SPP had was to the east and north of the constraints: 700 MW Dec. 22 and 1,300 MW Dec. 23 around 16:00 CT.

Key challenge #6: Resource Adequacy

SPP called for conservative operations Dec. 23 at 11:00 CT. Reserves were tight on Dec. 23 resulting in two declarations of EEA1. SPP did not experience reserve shortages until Dec. 23 at 19:55 CT, when during that EEA1 SPP had only 1000 MW of contingency reserves cleared.

SPP's issued Energy Emergency Alerts, driven by generation unavailability, lack of fuel supply, extreme cold weather-related outages and record winter energy consumption. SPP set a record for winter seasonal demand of 47,157 MW on Dec. 22 at 17:27 CT.

SPP took action under the EEA1 declaration to curtail non-firm exports during both EEAs: curtailing 600 MW on Dec. 23 from 08:27 CT. to 10:00 CT. and curtailing 1,100 MW on Dec. 23 from 17:20 to 20:20 CT.

Key challenge #7: Imports and Export

SPP imported energy from within the Eastern Interconnection on Dec. 22 and 23, and to limit increase of exports, the SPP TSP reduced the Total Transfer Capability (TTC) and allowed ramp of interchange from Dec. 23 at 21:00 CT to Dec. 25 at 12:00 CT.

The SPP BAA communicated these actions with MISO, Tennessee Valley Authority and Southern Company, stating that if they needed assistance to reach out and SPP would evaluate our ability to help. These calls occurred on the morning of the Dec. 24.

Key challenge #8: Early Commitments Before DAMKT

SPP called for early commitments out of concern that gas resources might wait to procure gas until committed, and when they were needed they might not have adequate gas secured:

- 60 gas resource commitments on Dec. 21 for Dec. 22.
- 108 gas resource commitments and 1 coal resource commitment Dec. 21 for Dec. 23.
- 124 gas resource commitments Dec. 22. for Dec. 24.
- 189 gas resource commitments Dec. 23. for Dec. 25.

Some of the commitments didn't show up for variety of reasons. Although SPP was forecast to be tight because of high uncertainty levels, SPP ultimately ended up with:

- 10 GW available (unused) accredited capacity Dec. 22, 2022
- 4.5 GW available (unused[2]) accredited capacity Dec. 23, 2022,
- 5 GW available (unused) accredited capacity Dec. 24, 2022
- 6.5 GW available (unused) accredited capacity Dec. 25, 2022

CHALLENGES BEYOND THE GRID

SPP experienced other challenges during Winter Storm Elliott that were not directly a part of real-time operation of the bulk electric grid or Integrated Marketplace functions. These challenges still had, or could have had, an impact on SPP's ability to respond to Winter Storm Elliott:

Gas Pipelines

On Dec. 20 SPP began receiving natural gas notifications that flexibility and other non-firm usage of pipelines would be greatly limited through Dec. 28.

SPP Facilities

On Dec. 23 the transformer on the distribution system for SPP's facilities on in Little Rock malfunctioned. SPP operated on backup generators during the event. SPP's Little Rock data center cooling system was inoperable for six hours due to low weather temperatures until a system bypass was put in place

River Freezing

From Dec. 23 through Dec. 24, the Missouri River developed ice block that reduced or prevented river flow. This obstruction to the flow of the river threatened thousands of MWs of generation.

[2] Some of the "unused" capacity was "used" for managing congestion

Knowledge and Information

Responses to SPP's surveys indicated that member operational staff would have appreciated more context as a part of operational alerts, not just direction of action. Additional information provided with alerts or directed action could possibly result in improved decision making by member operators.

Responses from non-operational member staff indicated a need for additional education about the circumstances for issuance of EEAs. Some survey respondents asked SPP not to declare any level of EEA if load shed would not be needed, to avoid declaring them during holidays, to provide advance notice of when EEAs would be declared or to extend EEAs for longer periods, rather than going in and out of EEA declarations.

NERC has established three levels of EEAs. Reliability coordinators are to use these terms when communicating Energy Emergencies to each other. In Coordination with the BAA, the Reliability Coordinator may declare whatever alert level is necessary, and need not proceed through the alerts sequentially.

Table 4 – NERC definitions of Energy Emergency Alert levels

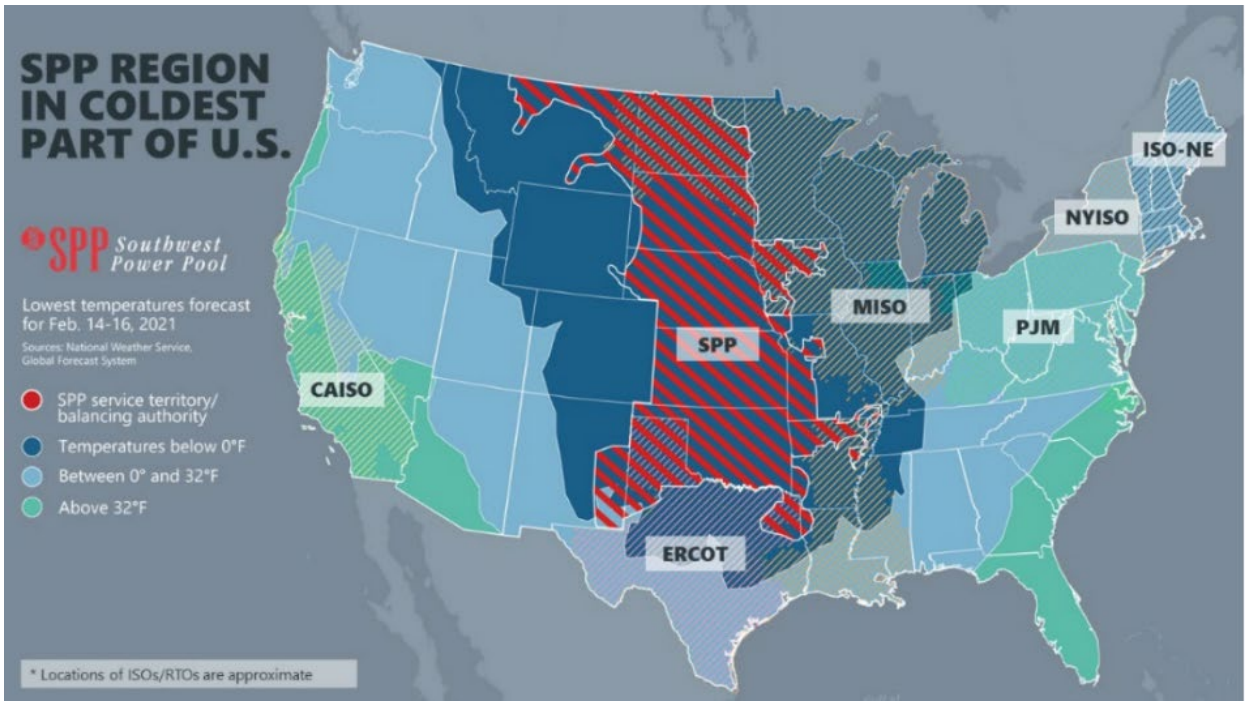
NERC-defined EEA Level[3]	Circumstances for Issuance
EEA 1 – All available generation resources in use.	The Balancing Authority is experiencing conditions where all available generation resources are committed to meet firm load, firm transactions and reserve commitments, and is concerned about sustaining its required Contingency Reserves. Non-firm wholesale energy sales (other than those that are recallable to meet reserve requirements) have been curtailed.
EEA 2 – Load management procedures in effect.	The Balancing Authority is no longer able to provide its expected energy requirements and is an energy deficient Balancing Authority. An energy deficient Balancing Authority has implemented its Operating Plan(s) to mitigate Emergencies. An energy deficient Balancing Authority is still able to maintain minimum Contingency Reserve requirements.
EEA 3 – Firm Load interruption is imminent or in progress.	The energy deficient Balancing Authority is unable to meet minimum Contingency Reserve requirements.

[3] NERC EOP-011-1 provides the process and descriptions of the levels used by the Reliability Coordinator to communicate the condition of a Balancing Authority which is experiencing an Energy Emergency. (link)

COMPARISON TO WINTER STORM URI (2021)

During the week of Feb. 14-20, 2021, locations across the SPP service territory from North Dakota to the Texas panhandle experienced record-low temperatures for days on end. As consumers' electricity and natural gas use increased, power production was limited due to fuel-supply issues, equipment malfunctions and transmission system constraints. The overall reliability of the bulk electric system was severely tested.

Figure 6 – Map of temperatures across ISO and RTO regions during Winter Storm Uri



Despite these challenges, SPP was able to continuously maintain a reliable supply of wholesale electric service across its region, with two brief exceptions. Following its emergency operations procedures and to prevent a more severe system failure, SPP directed its Transmission Operators to temporarily reduce regional electricity use twice: by about 1.5% for 50 minutes Feb. 15 and by about 6.5% for approximately three hours Feb. 16. Underscoring the historic significance of this event, these were the first times in SPP's history that region-wide curtailments were necessary.

SPP's independent board directed staff and stakeholders to conduct a comprehensive review of the organization's response to the event. The review yielded seven key observations and 22 recommendations to help SPP learn, mitigate and be better prepared for future extreme reliability threats.

CHANGES SINCE 2021 WINTER STORM URI

Winter Storm Uri created widespread challenges for consumers and grid operators alike. In its wake, the Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC) determined there was a need for new standards and guidelines related to extreme cold weather events. In advance of national recommendations, SPP conducted its own internal review of performance during the event.

SPP's Winter Storm Report Recommendations

Throughout the comprehensive review, SPP staff and stakeholders evaluated hundreds of potential process changes, system enhancements, new and amended policies, further assessments and other potential solutions meant either to address the root causes of the February 2021 event's impact on the SPP system or to better enable SPP and its stakeholders to respond to future extreme system events. Ultimately that review[4] resulted in 22 recommended actions, policy changes and assessments categorized in three tiers according to urgency, importance, impact and other factors (see Appendix B for a list of recommendations and status).

SPP has been working diligently on these recommendations. The Winter Weather Event Tier 1 program, made up initially of four distinct projects, started in the fall of 2021 under the guidance of a newly formed Improved Resource Availability Task Force (IRATF). The first board-approved project to satisfy a Tier 1 recommendation was Fuel Assurance 2 (FA2):

- A staff-generated white paper explored the possibility of an emergency cap on natural gas prices in the event of extreme conditions.
- SPP staff formalized involvement in organizations that foster coordination between electric utilities and gas operations.
- The task force provided input into language proposed for gas contracts to increase gas supply availability during energy emergencies.
- Anticipated benefits are improved reliability, lower costs and improved quality of life.

As of March 30, 2023, more than half of the 25 Tier 1 initiatives encompassed in the four PMO-led projects are complete. Remaining Tier 1 projects continuing in 2023 are Fuel Assurance 1, Resource Planning and Availability 1 and Resource Planning and Availability 2. See Appendix B of this report for the full list of recommendations from Winter Storm Uri and the estimate percent of completion for each of those recommendations.

NERC Response to 2018 Winter Storm

NERC initiated "Project 2019-06 Cold Weather" in response to the FERC and NERC staff report[5] analyzing the cold weather event Jan. 15-19, 2018. That storm affected a large area of the south

[4] SPP: "A Comprehensive Review of Southwest Power Pool's Response to the February 2021 Winter Storm" (**link**)
[5] NERC: "The South Central United States Cold Weather Bulk Electric System Event of Jan. 17, 2018" (**link**)

central region of the United States with below-average temperatures causing outages, derates or failures to start of 183 generating resources in SPP, MISO, TVA and SERC

That 2019 Report recommended development or enhancement of one or more NERC Reliability Standards to address generator readiness and reliability during cold weather conditions.

SPP sponsored the Standard Authorization Request (SAR) at NERC and SPP employee Matthew Harward chaired the project. The drafting team included an industry wide-diversity of generator owner staff and consultants, RTO/ISO representatives and Regional Entity staff.

The resulting reliability standards included industrywide requirements for cold weather preparatory activities by BES generating units and data specifications to enhance Balancing Authorities, Reliability Coordinators and Transmission Operators awareness of generating unit capabilities and limitations during local forecast cold weather.

Additionally, the standards require the TOPs and BA to perform certain actions under its respective Emergency Operations Plans related to separation of critical loads from manual and automatic load shedding processes in order as a means to promote additional reliability during cold weather events. FERC approved these standards, which became effective April 1, 2023.

NERC Response to 2021 Winter Storm Uri

NERC initiated "Project 2021-07 Extreme Cold Weather Grid Operations, Preparedness and Coordination" in response to the joint FERC, NERC and Regional Entity (RE) staff report[6] on cold weather outages caused by Winter Storm Uri.

The 2021 Report recommended revisions to NERC Reliability Standards to build upon those standards established in Project 2019-06 and require additional steps for generator readiness. Recommendations include investment in freeze protection measures for new and existing generating units, protection of critical natural gas infrastructure load and additional communication and planning paradigms between generator operators and BAs, RCs and TOPs.

In the 2021 Report, FERC recommended 10 issues for development or clarification. The standard drafting team is addressing these issues in two phases based on the implementation timeframes contained in the 2021 Report and formalized in the SAR. SPP and its members are involved this process. Kenny Luebbert (Evergy) chairs the team and Matthew Harward (SPP) is Vice-Chair.

Phase 1 of revisions to reliability standards to address some of the key recommendations in the 2021 report were approved by FERC in February 2023. Additional clarifications and work were directed by FERC in that order. Phase 2 is currently in draft development stage. The effective date for these additional requirements is to be determined after final approval of the implementation plan by FERC.

[6] FERC, NERC and RE: "February 2021 Cold Weather Outages in Texas and the South Central United States" (**link**)

KEY DIFFERENCES BETWEEN 2021 AND 2022

Winter storm Elliott was not as severe as winter storm Uri (February 2021). SPP experienced fewer gas supply outages and de-rates than during winter storm Uri. While there was no SPP BAA-directed load curtailment during winter storm Elliott, there was BAA load shed potential if the SPP BAA load level would have stayed high Dec. 23 and Dec. 24, 2022. Due to localized voltage issues, one TOP directed temporary load shed until voltage could be restored.

During winter storm Uri the wind was slowly decreasing starting Sunday, Feb. 14, 2022, before the SPP BA observed the higher load levels and increased forced outage levels. During winter storm Elliott the wind generation decreased at same time the SPP BAA load level decreased and wind levels were high during the load peak.

Unlike during Uri, SPP was not a large net importer during Elliott, with some time periods leading into EEA showing net export. The primary differences between the two events were weather differences and the impacts on SPP generation, transmission and our neighbors.

Weather Pattern

The system impact of Winter Storm Uri lasted over six days in the SPP region, compounded by freezing rain, icing and heavy snowfall, with a weighted ambient temperature of -10° F, as part of a system that moved southward and settled in to the region for much of the storm duration. Winter storm Uri had more significant precipitation and lower wind availability than Elliott. Higher wind during Elliott, added to system wide capacity, but required heavy transfers to help serve load and replace the lost thermal generation.

By comparison, Elliott was relatively brief, with the system impact lasting only three days, with much less precipitation, slightly higher weighted ambient temperatures (0° F) but more extreme wind chills. The storm front moved more quickly that Uri's and swept from northwest to southeast, pushing impacts into eastern neighbors as it moved.

Operational Circumstances

Operationally, Elliott was not as severe as winter storm Uri. SPP experienced fewer gas and wind outages during Elliott. Gas supply was significantly disrupted in Uri, which resulted in a more significant reduction in generation available in SPP. Coal outages and derates were *worse* in Elliott. SPP had a lower level of total available generation during Uri: 9 GW less of available total MW (ecomax plus actual wind) and 4 GW less conventional resource capacity. There was no BA-directed load shed in Elliott, but there was load shed potential. SPP did not have significant net imports during Elliott, with some periods before EEA actually in net export.

Table 5 – Comparison of environmental and operational circumstances between Winter Storms Uri and Elliott

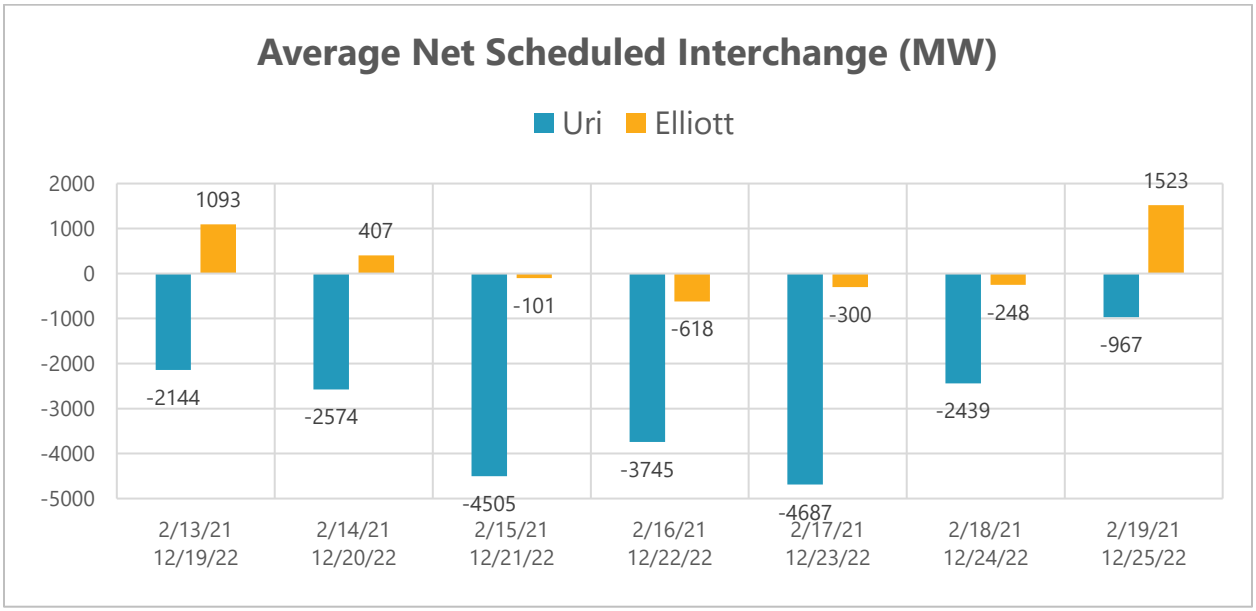
	Winter Storm Uri	Winter Storm Elliott
	Feb. 13 - 19, 2021	**Dec. 20 - 25, 2022**
System Impact Days	Six days	Three days
Weather characteristics	Freezing rain, icing, snow. Weighted ambient temperature:-10° F	Wind child and low temperatures. Weighted ambient temperature: 0° F
Peak Load	SPP BA peak load of **43,661 MW** *(If not curtailed, estimate 45-46 GW)*	SPP BA peak load of **47,157 MW** *(no BA-directed load shed)*
Load Levels	38,000 to 44,000 MW	36,000 to 47,000 MW
Wind Levels	1,000 to 7,000 MW	7,000 to 14,000 MW
Gas Unavailable	9,000 to 14,000 MW	1,600 to 4,000 MW
Planned Outage Levels	2,500 to 3,800 MW	4,000 MW
Forced Outage Levels	20,000 MW	10,000 to 16,000
Commits Before DAMKT	All resources	60 - 190 resources
Available total MW ***(Ecomax Conv + Actual Wind)***	36,000 - 44,000 *(Lowest level 36.2 GW on 2/17)*	45,500 - 53,000 *(Lowest level 45-46 GW Dec. 24)*
Available total conventional MW	35,000 - 41,000 *(Lowest level 34.3 GW on 2/19)*	38,000 - 42,000 *(Lowest level 38 GW Dec. 24)*
Operating Reserves	Low on 2/15, 2/16 and 2/17 OR Shortage Intervals: 184-225	Low on Dec. 23 OR Shortage Intervals: 28
BA-directed Load Shed (Directed/Actual MW)	2/15: 610/641 MW 2/16: 1359/1408 + 1359/1394 MW	No BA Load Shed.
Interchange	Imported between 1000 - 6000 MW	Fluctuated from import to export. Imported between 500-2500 MW
Peak Congestion	30-35 flow gates >100% 15 flow gates >110%	35-40 flow gates loaded, 20 breaching, 10 binding
Total OOME Capped MWh:	2/14: 3,384 MWh 2/15: 7,719 MWh **2/16: 12,348 MWh** 2/17: 2,004 MWh	Dec. 21: 1,381 MWh Dec. 22: 4,689 MWh **Dec. 23: 13,035 MWh** Dec. 24: 1,702 MWh
Voltage	Some local low voltage situations.	Isolated voltage as low as 90%
Transmission Outages	Between 133-147 (2/13-2/18)	Between 168-197 (Dec. 19-Dec. 24)
Market Prices Peaks (4 highest days)	2/15: $4,500 2/16: **$6,500** 2/17: $4,500 2/18: $3,000	Dec. 21: $723 Dec. 22: $245 Dec. 23: **$1,682** (avg. $272) Dec. 24: $270

Neighboring Operational Circumstances

SPP's largest neighbors – the Electric Reliability Council of Texas (ERCOT) and MISO – did not experience as many system challenges during Elliott as they did during Uri. They were able to provide more generation, in the form of interchange schedules, to SPP during and following the worst timeframes of Elliott.

SPP was importing much more heavily during the Uri event. In Elliott, SPP imported less energy and was actually a net exporter during the start of both EEA1 events.

Figure 7 – Comparison of average net scheduled interchange between Winter Storms Uri and Elliott



Differences between 2021 and 2022 in ERCOT

During Uri, the Electric Reliability Council of Texas (ERCOT) experienced record-setting temperatures below 0° F, several extended load shed events, power outages and gas supply issues. During Elliott, temperatures in ERCOT dropped to as low as 11° F in Dallas and 10° F in the Midland-Odessa area between Dec. 22 and Dec. 25. ERCOT had no need to declare an emergency or issue an advisory during Elliott. ERCOT's load peaked at 74 GW.

Differences between 2021 and 2022 in MISO

During Uri, MISO North experienced peak conditions with a maximum generation event on 2/16, but did not require an EEA. MISO South was forced to declare an EEA3 on 2/16. During Elliott, MISO declared conservative operations for Dec. 23-24 for its North regions and for Dec. 22-25 for its South region, with need for a maximum generation declaration for the South Dec. 23.

ANALYSIS OF SPP'S RESPONSE TO 2022 WINTER STORM

At the direction of the Board of Directors, staff completed an interdepartmental review of Winter Storm Elliott. As a part of this review, staff analyzed SPP's performance during the event and surveyed stakeholders to get external feedback. Staff assessed the completion of recommendations from Winter Storm Uri and examined the impact of those improvements that were completed, and the impact of those that were not. Staff also conducted a study of the impact of transmission on key areas in SPP that experienced voltage and congestion challenges during Elliott. After this review, SPP identified new opportunities for improvement.

IMPROVEMENTS SINCE WINTER STORM URI

A staff assessment of the Winter Weather Event (WWE) recommendations from Winter Storm Uri showed that, as of March 2023, SPP has completed 65%[7] of WWE recommendations. Despite the difference between the storm events, there was evidence of improvement in SPP's response to Elliott that directly correlates with changes made since Winter Storm Uri.

Improved Operational Communication

- SPP continuously alerted operators as conditions changed
- SPP provided advance notification to members committee
- Communicated with Operating Reliability Working Group and provided public notifications as system conditions changed
- Committed gas generation early to help fuel procurement

Improved Market Communication and Function

Communications between legal, markets, reliability/BA and operations happened earlier and in advance of the MDRA commitments. This was an efficiency gained from lessons learned post-Uri. The cold weather forecast resulted in SPP utilizing the MDRA process to identify and commit resources in advance of the event. Elliott reinforced the need to finish implementation of the tariff changes that are in process from Uri.

A combination of vastly different weather and operational conditions, plus improvements in Markets processes led to a drastic difference in Markets settlements after each storm. There were more than 300 Settlements related disputes filed in the aftermath of Uri with more than $400 million at issue. Three settlements related disputes with less than $1 million at issue in aggregate have been filed related to Elliott. These differences are more likely attributable to more favorable weather and resource availability conditions during Elliott than to changes in markets function, though process improvements had a positive impact.

[7]Average of estimated "percent complete" for each Uri recommendation topic area. See overview of Uri recommendation statuses as of March 30, 2023 in Appendix B.

Winter Storm Elliot reaffirmed the need for SPP to stay its course with its current prioritization of enhancements scheduled to be completed in 2023. Several SIRs and initiatives are considered high priority. They would have allowed SPP to systematically and appropriately better manage these extreme conditions through proper incentives and energy compensation.

- Resource Commits: SPP recommends that SPP continue to work on the Multi-Day Reliability Assessment enhancement recommendation from winter storm Uri and address managing those resources with "Not Participating" status for Resources that are committed before the DAMKT. SPP also recommends that as a part of the Multi-Day Reliability Assessment ongoing enhancements, SPP will continue to work with the member to determine if self-committed Resources should be eligible for Make-Whole Payments during BA capacity conditions.

- DAMKT: SPP sees no need to pursue changes related to DAMKT participation beyond what is in scope for Multi-Day commitments, curtailment, or Virtual activity participation during capacity conditions. It is worth noting that SPP's MMU published observations as part of the post-mortem analysis of Winter Storm Uri. Several SIRs related to the Multi-Day Reliability Assessment address improvement in managing the participation of these types of commitments in the DAMKT. SPP is working with members to develop solutions and is modifying the SPP Tariff and Market Protocols accordingly.

- Make whole payments: SPP sees no need to reprioritize its ongoing work on previous SIRs initiated after Storm Uri. Several SIRs related to Multi-Day Reliability Assessment address improvement in Market-Whole Payments. SPP is working with members to develop solutions and is modifying the SPP Tariff and Market Protocols accordingly.

- Market prices: SPP sees no need to reprioritize its ongoing work on previous SIRs initiated after Storm Uri. SPP is addressing several SIRs related to price formation, specifically, pricing during capacity conditions. SPP is working with members to develop solutions and is modifying the SPP Tariff and Market Protocols accordingly.

- Imports/Exports: Seams management and pricing continue to be a point of discussion for SPP and its members. SPP has sufficient and effective Seams agreements with its neighboring entities ensuring mechanisms are in place for assistance.

SPP's Market Design team will continue to ensure that work in 2023 prioritizes efforts from Winter Storm Uri. Current plans include addressing the "Not participating" commit status for resources committed before the DAMKT and determining the appropriateness for self-committed resources to be eligible for Make-Whole Payments during extreme events.

SPP Market Design work for 2023 includes enhancements covering Multi-Day Reliability Assessment, Multi-Day Economic Commitment, FERC Order 831 implementation, Make-Whole payments and Price Formation during extreme events.

Improved Corporate Communications

Less than a month after Winter Storm Elliott, SPP staff surveyed member communications and government affairs staff, SPP's Board of Directors and SPP's Regional State Committee (see Appendix D). This survey was intentionally similar to one sent following Winter Storm Uri, using the same or similar questions and rating scales to allow for comparison. In 2022, respondents rated the overall effectiveness of SPP's communication 3.44 (Effective to Highly Effective) compared to 2.88 in 2021. In 2022, scores improved over 2021 for every measure.

Open-ended comments from the survey noted improvements since Winter Storm Uri and overall effectiveness of SPP's communication. Some comments mentioned a need to improve speed of communication, potentially by using text messages or apps. Others expressed a desire for more advanced notice of EEAs, to not declare EEAs unless necessary, or to stay in an EEA for longer rather than going in and out of EEA status.

Collaboration with NERC on Winterization Standards

SPP invested time and staff resources to collaborate with NERC and other stakeholders on the Standard Drafting Teams for Project 2019-06 (Cold Weather) and Project 2021-07[8] (Extreme Cold Weather Grid Operations, Preparedness and Coordination). As a result of these projects, new NERC standards were approved[9] by FERC in 2021 and 2023, with additional standards and guidelines for extreme cold weather in process.

The new standards will require generator operators (GO) to implement specific freeze protection measures to meet a determined low temperature for critical components on the units that are subject to freezing issues. New standards will require GOs to develop and maintain cold weather preparedness plans which include annual personnel training and data specification to be provided to the BA for use in the BAs analysis functions and real-time assessments and for operating reserves management.

The standards will also require generating units to perform corrective action plans to address freezing issues that cause forced outages, failure to start or failures to synchronize to the transmission system.

Additionally, the standards will require identification and prioritization of critical natural gas infrastructure loads and minimize manual and automatic load shedding during extreme cold weather and prohibition of these loads from participating in demand response programs during the emergency events.

[8] NERC: May 24, 2022 Industry Webinar for Project 2021-07 (**link**)
[9] "FERC approves extreme cold weather reliability standards, directs improvements" (**link**)

OPPORTUNITIES FOR IMPROVEMENT

Operations

Few of the Operations & Reliability improvements identified during Uri had a direct correlation with the operational circumstances of Elliott. Relevant improvements were to communication with members. Some changes in information availability were made in R-Comm, conference calls were held to help inform key reliability participants and the process for committing a larger portion of the generation fleet multiple days in advance did seem to generate less confusion and questions in Elliott compared to Uri.

Most of the remaining operational recommendations from Uri were either longer-term items or were focused on improving load shed processes for capacity, and balancing that with congestion and generation. SPP did not get to that level of EEA, and did not have to direct load shed during Elliott.

The winter storm response experience gained by operators during Uri helped SPP and its members make improved qualitative assessments, and informed operational expectations ahead of the storm event. Data from Uri also informed more quantitative forms of risk analysis and preparation. While each storm is unique, lessons learned from Winter Storm Uri in 2021 contributed to successful operations during Elliott

After Winter Storm Elliott, SPP surveyed a cross section of stakeholders to get feedback on SPP's performance during the storm (see Appendix C). The survey included an option to provide open-ended comments, including asking for feedback on any topic given a rating of "average" or below. Of the 81 substantive[10] comments, 19 indicated positive performance by SPP, often mentioning improvements since Winter Storm Uri:

- Commitments were the subject of 11, with suggestions for earlier commitments
- Gas supply was the main topic of 9 comments, which cited more advanced notice to secure fuel, unnecessary fuel consumption from reliability unit commitment and a lack of communication from SPP about fuel suppliers.
- Multiple comments suggested changes for markets and pricing during cold weather to ensure reliable generation.
- A few comments mentioned email or website information lagging behind operational communication and a need for faster notice by app or text.

As mentioned above, there were some improvements in communications with members, as well as a more efficient unit commitment process. Operators reported that SPP's commitment process seemed to run more smoothly during Elliott than during Uri.

[10] Some comments noted the topic was not applicable. Others indicated no feedback beyond the rating.

SPP's load forecasting performed worse than desired, with load coming in higher than forecast. Most of the error was accounted for in risk expectations. While some was due to the underlying weather model and weather forecast error, there were some areas identified (snow impact, extreme wind chill impact) that appear to have room for improvement. Load forecast errors were the smallest of three primary risks: outage/derate risk, wind forecast risk and load forecast risk. If possible, SPP may consider how to improve representation of snow and ice in load forecast models to reduce reliance on manual adjustments.

One operational aspect that could continue to be improved here is communication. While some detailed information is shared on the reliability of the operations calls leading into an event, SPP may be able better identify what contextual information should be shared in advance

A staff review also indicates an opportunity to investigate a better assessment of interchange transaction capability. This could be a new tool or an enhancement to existing processes and tools. There may also be an opportunity to improve tariff language or business practices related to how scheduled interchange is arranged.

Markets

SPP observed that resources committed before the DAMKT could be offered as "Not Participating" in the DAMKT. Typically, these commitments offer statuses that ensure the resource is not considered for commitment or dispatch in the DAMKT.

SPP will investigate implementing an approach for managing these types of commitments and address how they should be treated in the DAMKT based on the commitment offer status, including "Outage" and "Not Participating."

Transmission and Infrastructure

SPP had one localized area that had unique operational challenges during Winter Storm Elliott, in southwest and south central Missouri. This area experienced the impact of multiple resource outages occurring in a very short period of time

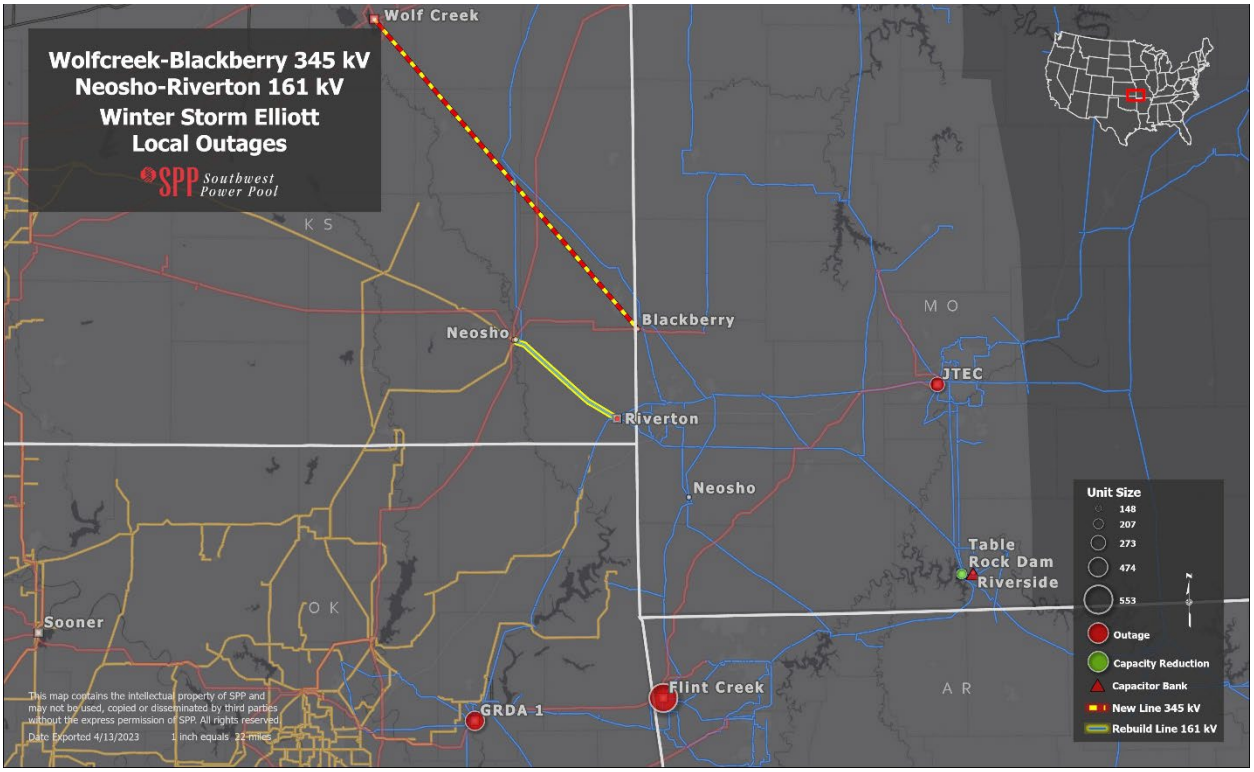
SPP had two high-impact transmission lines still under construction during Winter Storm Elliot, and that affect Northwest Arkansas and southern portions of the Kansas and Missouri border. These lines are the Neosho to Riverton 161 kV line and the new Wolf Creek to Blackberry 345 kV line.

SPP staff conducted an analysis to determine the impact on the system if the two lines had been in place during Winter Storm Elliott. Each of these lines is expected to increase the ability of energy from the central portions of the SPP system to move east into the area most impacted during Winter Storm Elliott.

The Neosho to Riverton 161 kV line leaves the Neosho station and heads southeast to the Riverton station. In 2020, SPP directed two of its member utilities to rebuild the line, increasing the amount of energy allowed to flow across it. Under normal circumstances, this line sends energy west-to-east to the Joplin area. This line was out of service for upgrades during Elliott and is now back in service.

The new Wolf Creek to Blackberry 345 kV line leaves the Wolf Creek station and heads southeast, ending at the Blackberry station. This new line is expected to be in service by January 2026. The line will provide an additional 345 kV path for energy from a nuclear plant at Wolf Creek and other nearby renewable resources to serve load in the eastern portion of SPP's system.

Figure 8 – Map of the Neosho to Riverton and Wolf Creek to Blackberry Transmission Lines and Local Outages



SPP reviewed state estimator cases representing a specific interval near the time of TOP-directed load shed to understand the support these two lines could have provided the transmission system. SPP observed 292 buses below SPP's per unit voltage threshold defined in the SPP Criteria across multiple SPP zones in the state estimator case.

Table 7 shows the impact the Neosho-Riverton (at rebuilt values) and the Wolf Creek-Blackberry lines would have had on system voltages assuming no changes in generation dispatch, individually and combined. Additionally, the table shows the impact of the offline capacitor bank with and without the new transmission lines.

Table 7 – Impact of N-R, WC-BB and a capacitor bank on buses below voltage threshold during Elliott

State Estimator	With N-R	With WC-BB	Riverside Cap Online	With N-R and WC-BB	With N-R and WC-BB and cap bank
292	71	78	154	38	25

Of the 38 and 25 SPP buses below the per unit voltage threshold with the two lines and cap bank available, 11 buses and 1 bus, respectively, are located in the area of TOP initiated load shed. While the two lines and the capacitor bank may not have mitigated all of the voltage issues related to the multiple resource outages during Elliott, they will provide significant improvements to transmission capacity in that area during future challenging circumstances.

Communications

Operational communication functioned well and was improved since Uri, but there are still opportunities to improve. After Uri, SPP produced a scale of the relative severity of alerts and includes language about potential new alerts if conditions worsen in all Grid Notice emails, website updates and social media posts. Staff can examine other contextual information that could be included in communication of advisories and alerts.

Some stakeholders asked whether the necessity of SPP's EEA1 declaration or if EEAs should be held in place for longer periods of time rather than changing status multiple times. SPP may need to better educate non-operations stakeholders on how, why and when EEAs are declared.

Other respondents noted improvements to SPP's speed of communication beyond operator-to-operation, but that the earliest storm notice was slower to arrive and there was a lag between operator alerts and SPP's corporate communication. Some suggested examining ways to automate some alerts or use other mediums to get alerts out more quickly.

Stakeholders

Stakeholder inputs to market systems can have an impact on real-time operations. Timely updates to generation physical parameter data (startup times, minimum-down-times, etc.) are critical. Changes to unit availability and notice times should be reflected in these parameters and communicated electronically via the existing structure for resource offers in the market system. This ensures SPP can efficiently and accurately assess parameters for hundreds of units and match them with demand, risk and deliverability to issue timely commitment instructions.

RECOMMENDATIONS & CONCLUSION

Over the course of this review, staff made several observations and arrived at a set of recommendations for continuous improvement. Staff learned that, despite differences in weather conditions and operational impact, the lessons learned from Uri and changes made since that event had a positive impact on SPP and stakeholders' response to Winter Storm Elliott. Some Uri recommendations that are in process, but not yet complete, would have helped mitigate some issues during the storm. The ongoing implementation of the recommendations from Uri is a worthwhile endeavor. Staff also identified 11 other opportunities for internal process improvements that could mitigate challenges during future extreme weather events.

REVIEW OF 2021 URI RECOMMENDATIONS

A staff assessment of the recommendations from Winter Storm Uri showed that, as of March 2023, SPP has completed 65%[11] of recommendations. The assessment found that most of the issues that arose during Elliott were not correlated with incomplete recommendations from Uri.

Some exceptions were Credit and Market Design recommendations. Staff believes the completion of these recommendations would have helped mitigate some market issues during Elliott. Due to the differences between the events, it was difficult to objectively identify challenges SPP and stakeholders *did not* experience because of changes since Uri.

Overall, it is staff's opinion – affirmed by stakeholder survey responses – that recommendations from Uri were helpful during Winter Storm Elliott. Incomplete Tier 1 recommendations are on track for completion by January 2024. Other recommendations are on track for completion by 2025. Staff does not recommend any reprioritization of Uri recommendations.

NEW RECOMMENDATIONS

RECOMMENDATION FOR SUPPORTING NERC COMPLIANCE

1	The SPP Reliability Coordinator and member transmission operators (TOP) should collaborate to review revisions to TOP emergency operations plans for compliance with NERC extreme cold weather winterization standards.

[11]Average of estimated "percent complete" for each Uri recommendation topic area. See overview of Uri recommendation statuses as of March 30, 2023, in Appendix B.

In August 2021, FERC approved extreme cold weather reliability standards for U.S. generators, Balancing Authorities, Reliability Coordinators developed by NERC in collaboration with stakeholders, in response to the 2018 Cold Weather Event. All registered NERC entities for which the standards apply will need to be compliant with these first set of cold weather standards effective April 1, 2023.

Additionally, in February 2023, FERC approved additional extreme cold weather reliability standards developed in response to Winter Storm Uri; and all registered NERC entities for which the standards apply will need to be compliance with these additional standards once the effective date is established by FERC.

SPP is compliant and ready to go for the applicable April 1 standards in regard to its data specification and modifications to its Emergency Operations Plan. As TOPs revise emergency operations plans to comply with the April 1 standards, SPP, as the RC, can review them.

RECOMMENDATIONS FOR SPP OPERATIONS

2	Identify conditions for issuing transmission emergency alerts to more consistently inform entities of transmission congestion severity. Update operator guidelines where appropriate.

SPP should consider reviewing the guidelines for congestion conditions that determine when to issue transmission emergency alert to inform Transmission Operators and neighboring BAs and RCs of the congestion conditions experienced by SPP RC.

3	Improve situational awareness of neighboring entities' conditions during extreme winter events to maintain reliability across the combined footprint of all entities.

SPP staff should work with neighboring entities to improve broader situational awareness. Staff has an opportunity to identify further enhancements to the coordination with our neighbors that can improve situational awareness across a larger area than just SPP BA and can result in quicker decision-making during extreme weather conditions.

4	Identify options to better mitigate and manage congestion during extreme winter events.

Staff should analyze the causes of severe congestion during Winter Storm Elliott and identify potential mitigations that are broadly applicable to future extreme weather events. Some potential mitigation options that staff may consider for analysis are:

- Creating more dispatchable headroom in or around critical congestion areas.
- Issuing TLR level 3 to curtail non-firm transactions if M2M is not effective

- Limiting parallel flow from neighboring BAs
- Limiting import or export that contributes to congestion
- Ways to minimize potential for low generation levels in critical areas.
- Identifying known critical areas, based on N-2 or N-3 assessments during extreme weather events, that may require additional commitments of resources

5	Improve or develop processes to identify areas at risk for low voltage or extreme congestion when extreme winter events are forecast.

SPP staff should analyze causes of low voltage situations and identify potential mitigations. Staff can review lessons learned from low voltage issues during Elliott to identify mitigation options that could have been used, or used earlier, to limit voltage decline.

6	Identify improvements for forward-looking studies to more efficiently apply uncertainty of forecasting for load, wind, outages, fuel supply, interchange and external impacts.

To improve application of uncertainty, SPP staff should complete a comparison of forecasts before of Winter Storm Elliott to real-time operational data from the event to identify process improvements.

Staff should continue automation of uncertainty process and continue operator use of intra-day uncertainty cases. Finally, staff should explore how to establish locational uncertainty or margin for delivery.

RECOMMENDATION FOR SPP MARKETS

SPP should stay the course with current prioritization of enhancements that came out of Winter Storm Uri. These enhancements would have allowed SPP to better manage Elliot's extreme conditions. They are on track for completion in 2023. Staff's review of Elliott resulted in one internal recommendation for markets:

7	Educate market participants about the importance of timely updates of offers based on gas price forecast and resource lead time during extreme cold weather.

SPP staff have an opportunity to remind market participants of importance of timely updates of resource information. Updates that may help improve response to future extreme weather events include:

- Timely update of offers based on forecast of expected gas prices
- Timely update of lead time of resources during extreme cold weather events
- Timely update of resource characteristics (for startup during extreme conditions)

RECOMMENDATIONS FOR TRANSMISSION PLANNING

8	Include extreme winter weather analysis in the Integrated Transmission Planning (ITP) Assessment.

SPP is currently working to include extreme winter weather analysis into its 2024 Integrated Transmission Planning (ITP) Assessment. In its current state, the analysis consists of developing an extreme winter weather case based on a list of agreed-upon system stressors such as the effect of low temperatures on load, generation, transmission facilities, fuel supply, etc.

This type of analysis should be included in ITP assessments going forward consistent with the recommendation of SPP's TXP1 and TXP 2 recommendations from its Winter Storm Uri report. Additionally, the 2024 ITP will study a model representing conditions near the time of transmission owner specific load shed during Winter Storm Elliott.

SPP will look for optimized transmission solutions that may be incremental investment or alternate projects that address the normal system needs and increase the resiliency of the grid.

9	Analyze areas of SPP that experienced voltage and congestion issues to determine the impact of previously approved, but not yet in-service, transmission projects.

SPP staff conducted an initial review of transmission availability during Winter Storm Elliott with hypothetical availability of upcoming transmission project completions. Staff should finalize this analysis to determine if upcoming projects meet needs identified during the winter storm.

RECOMMENDATIONS FOR COMMUNICATIONS

Both staff's assessment of communication and stakeholder feedback on communication during Winter Storm Elliott showed improvements since Winter Storm Uri. Key takeaways from Elliott were that SPP has opportunities to improve the speed of notifications to non-operations stakeholders and to better educate stakeholders about how, why and when EEAs are declared.

10	Launch an SPP app that incorporates push notifications.

SPP can build on completed recommendations from Winter Storm Uri that improved the speed of timely updates, by continuing with plans to launch an SPP app that incorporates push notifications for energy alerts.

11	Educate stakeholder communications staff on emergency procedures at SPP's 2023 Communications Conference.

SPP has a near-term opportunity to educate stakeholder communications staff with a review of emergency procedures for communications at SPP's 2023 Communications Conference, happening in June 2023, in Kansas City, Kansas.

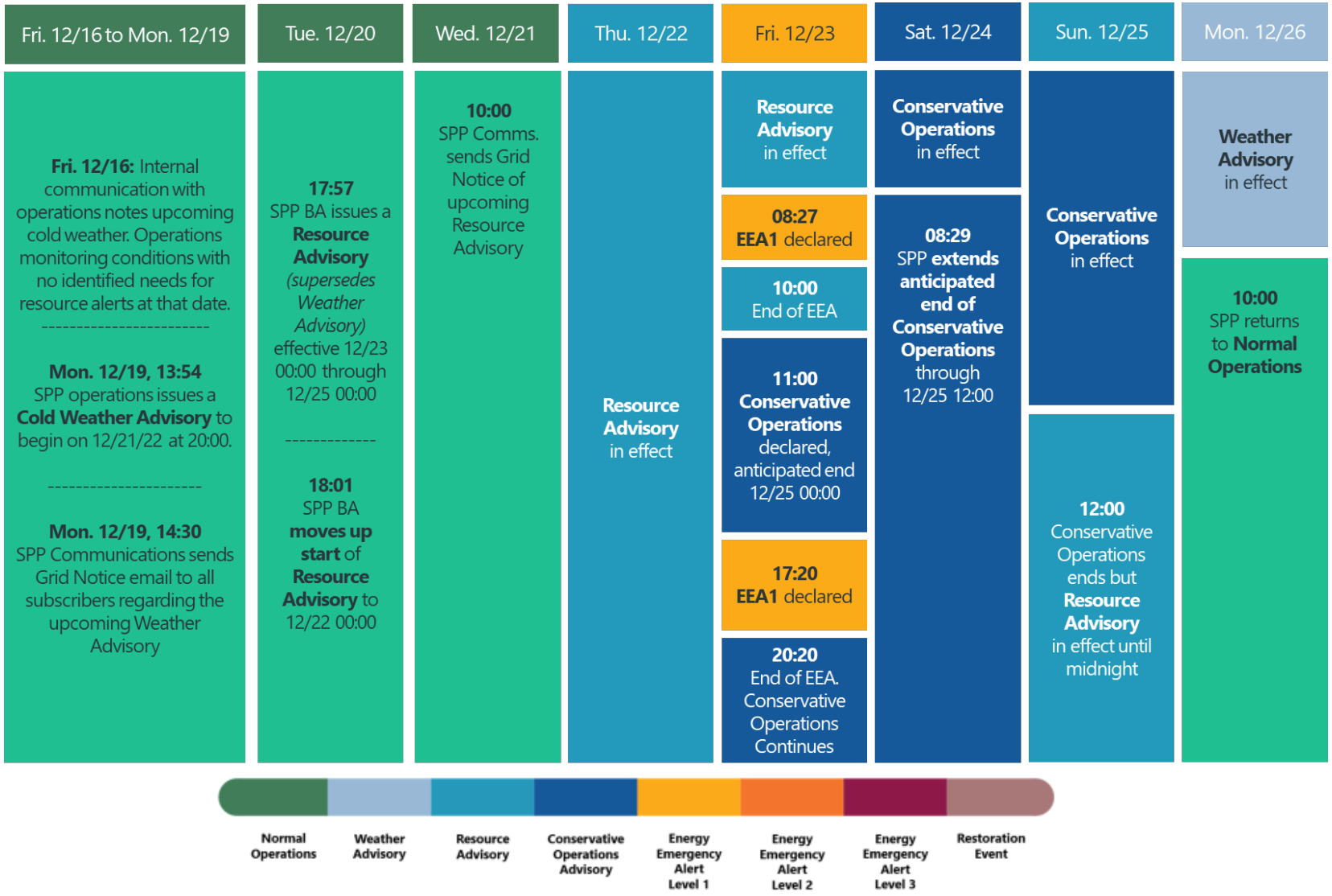
CONCLUSION

The winter storm of Dec. 21 to 26, 2022, created extreme conditions including blizzards, high winds, snowfall or record-cold temperatures across the majority of the United States and parts of Canada. This event affected the entire SPP region and presented significant challenges for SPP and its members. This extreme cold weather event, following closely on the heels of the winter storm of February 2021, indicates that "historic" extreme weather events may become a regular experience for SPP.

The lessons learned from Winter Storm Uri, many of which are still being incorporated into SPP's daily processes, were extremely helpful in SPP's response to Elliott. Staff suggest fully implementing the Uri recommendations, which are expected to be completed this year.

After a review of SPP's performance during the 2022 winter storm, staff identified a limited number of changes that could help SPP and its stakeholders be better prepared for extreme events in the future. These recommended changes are to internal processes, tools or functions and should not require additional resources or stakeholder prioritization to complete. Though the new recommendations can be accomplished internally, SPP staff will continue to collaborate with stakeholders, because SPP's success, in the past, present and future, depends largely on the strength of its stakeholder engagement.

APPENDIX A: 2022 STORM TIMELINE



APPENDIX B: URI RECOMMENDATIONS

Uri Issue	Tier	Category	Recommendation	% Complete
Fuel Assurance 1	1	Policy	Develop policies that enhance fuel assurance to improve the availability and reliability of generation in the SPP region	80%
Fuel Assurance 2	1	Assessment	Evaluate and advocate for improvements in gas industry policy to assure gas supply is readily available during extreme events	80%
Fuel Assurance 3	2	Policy	Develop policies to improve gas-electric coordination that will better inform and enable improved emergency response	73%
Resource Planning & Availability 1	1	Assessment	Perform initial and ongoing assessments of minimum reliability attributes needed from SPP's resource mix	89%
Resource Planning & Availability 2	1	Policy	Improve/develop policies that ensure resources will be available during normal and extreme conditions	77%
Emergency Response Process & Plan 1,2 & 3	2	Action	Implement identified improvements to load shed processes.	70%
Operator Tools, Comms & Processes	2	Action	Develop or enhance the identified tools, communications and processes needed to improve SPP and Stakeholder response to extreme conditions	32%
Seams	2	Action	Improve seams agreement provisions with neighboring parties to facilitate adequate emergency assistance and fairly compensate emergency energy	47%
Market Design 1	2	Policy	Develop and improve policies to ensure price formation and incentives reflect system conditions	20%
Market Design 2	2	Action	Develop and implement identified market design and market related enhancements to improve operational effectiveness and ensure governing language provides the needed flexibility and clarity.	25%
Market Design 3	2	Policy	Develop policies to ensure financial outcomes during emergency conditions are commensurate with the benefits provided	0%
Transmission Planning 1	2	Policy	Develop policies that facilitate transmission expansion needed to improve SPP's ability to more effectively utilize the transmission system during severe events	20%
Transmission Planning 2	2	Policy	Develop transmission planning policies that improve input data, assumptions, or analysis techniques to better account for severe events	100%
Credit 1	2	Assessment	Assess need for a waiver of credit-related provisions in the tariff to avoid expected reduction of virtual activity in Q1 2022.	100%
Credit 2	3	Assessment	Evaluate SPP's credit policy during extreme events (price/volume risk, exposure, participant/counterparty risk, etc.) — and develop policy changes.	40%
Credit 3	3	Action	Clarify tariff language related to SPP's settlements and credit-related authorities and responsibilities.	40%
Communication 1	2	Action	Update SPP's Emergency Communications Plan annually and share as appropriate with stakeholders.	100%
Communication 2	2	Assessment	Evaluate and propose enhancements to communications tools and channels (websites, app, automation, etc.)	100%
Communication 3	3	Action	Form a stakeholder group (ECUF) whose scope would include discussion of matters related to emergency communications.	100%
Communication 4	3	Action	Develop materials to educate general audiences on foundational electric utility industry concepts and SPP's role	100%

APPENDIX C: STORM RESPONSE SURVEY

SPP launched its 2022 Winter Storm Survey Jan. 4, 2023, and closed the survey Jan. 20, 2023. Staff sent 141 survey invitations to the rosters of the Markets and Operations Policy Committee (MOPC), SPP Membership and the Members Committee.

Across five topic-specific questions, respondents gave SPP an average rating of 2.65 (Average to Above Average). For SPP's overall performance, respondents gave a rating of 2.75 (near Above Average). Multiple open-ended comments from respondents characterized "Average" as correlating to SPP's having "operated as expected" or having no problems.

Table 1: Average Ratings by Question

RATINGS BY QUESTION	AVG.
Q1. SPP's communication about changing conditions	2.77
Q2. SPP's commitment of resources (day-ahead and real-time)	2.50
Q3. SPP's Integrated Marketplace performance	2.59
Q4. SPP's real-time operation of the grid	2.84
Q5. SPP's coordination and communication with members related to fuel supply	2.55
Average of topic-area responses	**2.65**
Q6. SPP's overall performance during the winter storm event	**2.75**

Rating Scale: (0) Poor, (1) Below Average, (2) Average, (3) Above Average, (4) Outstanding

Topic-specific comments were only sought for ratings of Average or below; some commenters said they chose a slightly lower rating in order to leave a comment. Ratings were generally positive. There were seven "Poor" ratings out of 264 total ratings (2.7%). Poor ratings and their comments are in Appendix A. SPP received 44 "Outstanding" and 44 "Above Average" ratings.

Of the 81 substantive[12] comments, 19 indicated positive performance by SPP, often mentioning improvements since Winter Storm Uri. **Commitments** were the subject of 11, including suggestions of earlier commitment of dispatchable generation. **Gas supply** was the main topic of 9 comments, which cited more advanced notice to secure fuel, unnecessary fuel consumption from reliability unit commitment and a lack of communication from SPP about fuel suppliers. Multiple comments suggested **changes for markets and pricing during cold weather** to ensure reliable generation. A few comments mentioned email or website information lagging behind **operational communication** and a need for faster notice by app or text.

Specific suggestions for improvements may help SPP better prepare for future energy emergencies. Overall, SPP's performance during Elliott was rated as Above Average.

[12] Some comments noted the topic was not applicable. Others indicated no feedback beyond the rating.

APPENDIX D: COMMUNICATION SURVEY

SPP launched its 2022 Winter Storm Communications Survey Jan. 4, 2023, and closed the survey Jan. 20, 2023. Staff sent 202 survey invitations to SPP's Board of Directors and Regional State Committee and to communications and government affairs staff from our member companies. There were 55 respondents.

In 2021, SPP received 155 responses to a similar survey rating SPP's communication during Winter Storm Uri. The 2022 survey used the same or similar questions and rating scales. In 2022, respondents rated the overall effectiveness of SPP's communication 3.44 (Effective to Highly Effective) compared to 2.88 in 2021. In 2022, scores improved over 2021 for every measure.

Table 1: Average rating by question with comparison to 2021

QUESTION	2021* AVG.	2022 AVG.
Q1. How would you rate the overall effectiveness of SPP's communication during the winter storm event?	**2.88**	**3.44**
Q2. SPP communicated with appropriate frequency and in a timely manner during the winter storm event.	2.97	3.25
Q3. Communication from SPP during the winter storm event was clear and understandable.	2.97	3.38
Q4. SPP's communications clearly explained what actions (if any) were expected from stakeholders and/or their customers during the winter storm event.	2.72[13]	3.36
Q5. SPP effectively and appropriately used a variety of communication methods (email, press releases, webinars, phone calls, website updates and social media) during the event.	2.92[14]	2.95
Q6. SPP's communications during the event increased my trust in the credibility of SPP.	2.84	3.05
AVERAGE OF TOPIC-AREA RESPONSES:	**2.88**	**3.20**

Overall Rating Scale: *(0) Highly Ineffective, (1) Ineffective, (2) Neutral, (3) Effective, (4) Highly Effective*
Agreement Rating Scale: *(0) Strongly Disagree, (1) Disagree, (2) I don't know, (3) Agree, (4) Strongly Agree*

Open-ended comments noted improvements since Winter Storm Uri and overall effectiveness of SPP's communication. Some comments mentioned a need to improve speed of communication, potentially by using text messages or apps. Others expressed a desire for more advanced notice of EEAs, to not declare EEAs unless absolutely necessary, or to stay in an EEA for longer rather than going in and out of EEA status.

[13] *2021: "SPP's communications clearly explained the actions stakeholders should take during the winter storm event."*
[14] *2021: "SPP effectively used a variety of communication methods (email, press releases, webinars, phone calls, website updates and social media) during the event.*