Purpose

This document provides visualizations of the requirements for the different reserve services in the RCSTF proposal based on 2025 data. SR requirements are maintained at status quo, so the visualizations focus on new or updated reserve services in the RCSTF proposal.

2025 Real-Time Requirements

In the real-time market, reserves are proposed for the following services: (i) Synchronized Reserves (SR), (ii) 10-Min Ramping/Uncertainty Reserves (RUR) Up, (iii) 10-Min RUR Down, (iv) 30-Min RUR, and (v) 30-Min Reserves. For each season of 2025, the average real-time (RT) requirements for each hour of the day for the RUR and 30-Min reserve services are shown in Figure 1. The seasonal average of RT requirements over a seven-day period is shown in Figure 2.

The requirements from the reserve services that require up-ramping are stacked on top of each other in the following order: 10-Min RUR Up, 30-Min RUR, and the MSSC portion of the 30-Min Reserve requirement. The 10-Min RUR Down requirement is shown reflected below the X-axis. We can see that the RUR requirements reflect the hourly trends in load and renewable generation for each season.

For the non-summer seasons, the requirements associated with up-ramping reserves peak in the early morning and early evening hours, anticipating the morning and evening up ramps in the net-load. For the summer season, these requirements have a relatively sustained shape throughout the daylight hours peaking around noon. Moreover, the 10-Min RUR Down requirements complement the 10-Min RUR Up requirements, with some overlap when there is a higher uncertainty component in the RUR requirements.

Figure 3 shows the distributions of the 10-Min RUR Up and Down, 30-Min RUR, and 30-Min reserve service requirements for the RT market in 2025. Note that the 30-Min reserve requirement includes the 30-Min RUR requirement. The RUR service requirements have bimodal distributions with one mode at 0 MW (since the netload ramp is bidirectional). The second mode is influenced by the hours with net-load ramp. The figure shows that the distribution of the 30-Min reserve requirements is a right shifted version of the 30-Min RUR requirement (since the 30-Min reserve requirement has an additional MSSC component; the MSSC values across the year influence the modes for the distribution of the 30-Min reserve requirements).

The distributions of the RT requirements for 2025 for SR, 10-Min RUR Up and Down, 30-Min RUR, and 30-Min reserve services by hour of day are shown in Figure 4. The figure includes marginal box plots for each of the reserve services to illustrate the statistical properties of the requirements in 2025.

Figure 1. Reserve Requirements in RT market for the new or updated reserve services using 2025 data. The requirements are shown for each hour of the day, averaged across each of the four seasons.

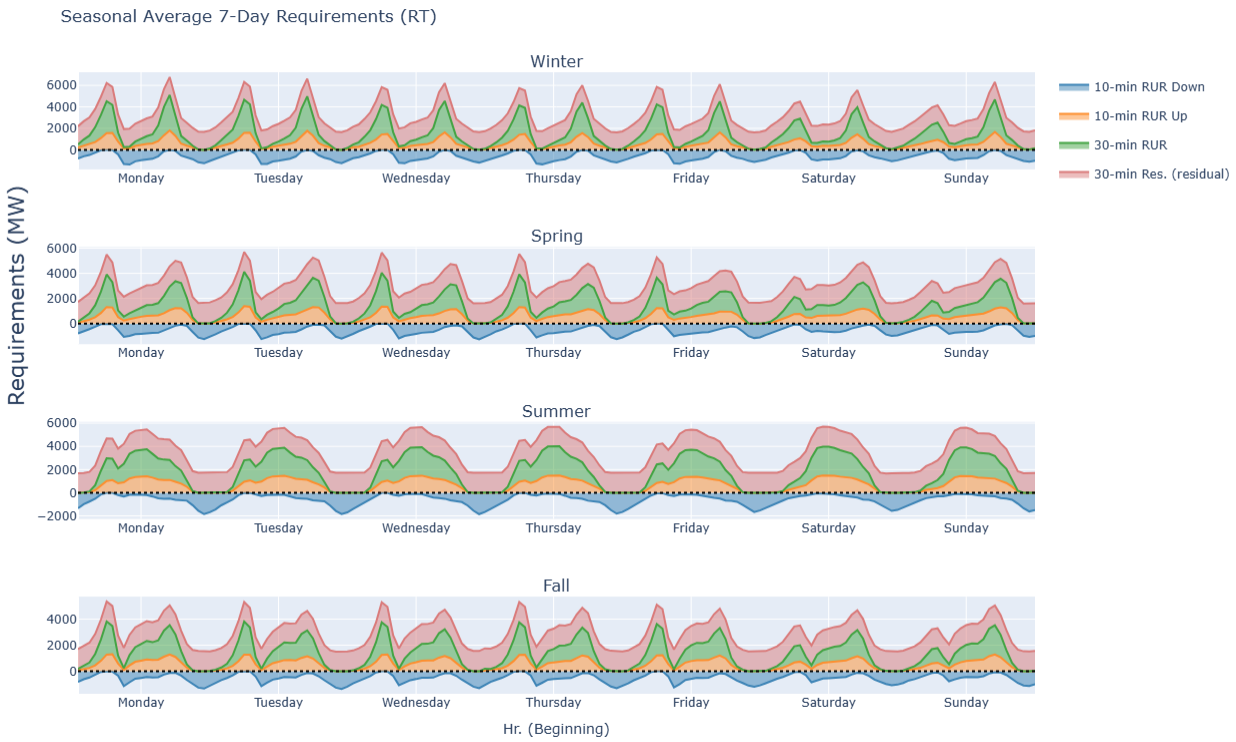

Figure 2. 7-day average trend in RT reserve requirements for each season of 2025.

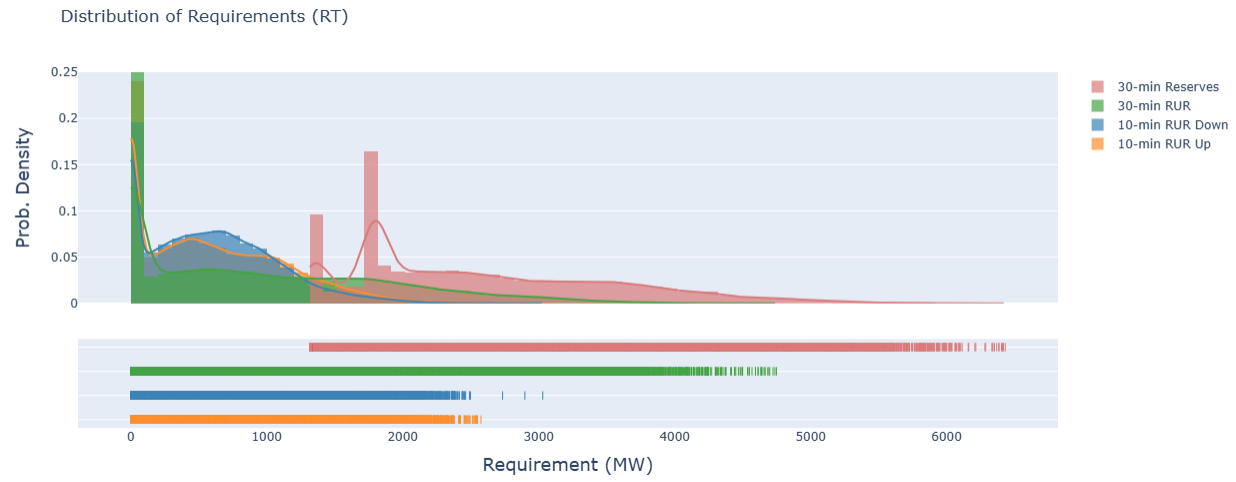

Figure 3. Full distributions of the proposed RT reserve requirements for 2025.

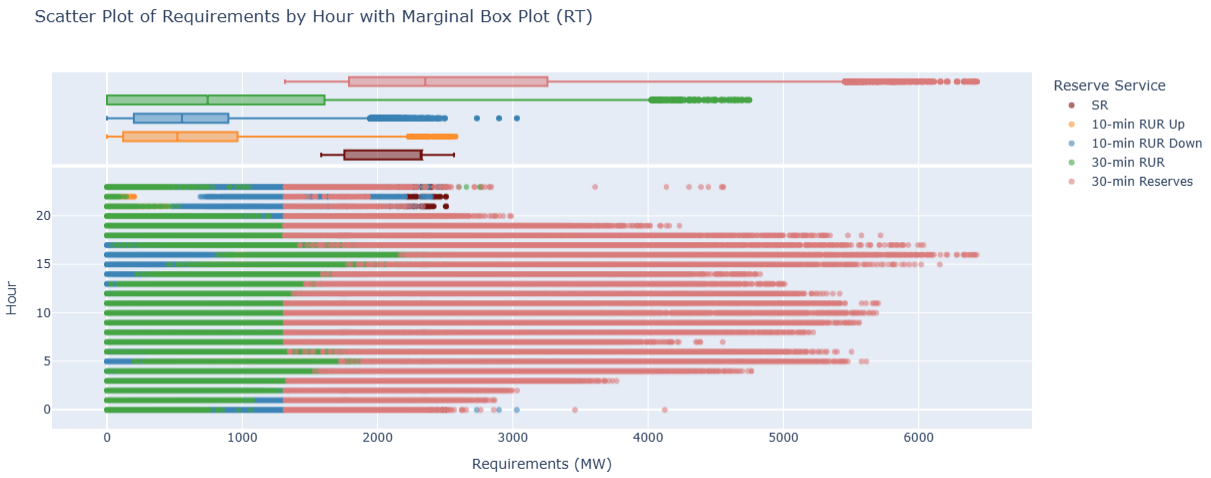

Figure 4. RT reserve requirements for 2025 by hour of day with a marginal box plot.

2025 Day-Ahead Requirements

In the day-time market, reserves are proposed for the following services: (i) Synchronized Reserves (SR), (ii) 10-Min RUR Up, (iii) 10-Min RUR Down, (iv) 30-Min RUR, (v) 30-Min Reserves, (vi) Energy Gap (EG), and (vii) Day-Ahead Scheduling Reserves (DASR). Each day has an associated risk-level: (i) low, (ii) medium, or (iii) high. There were four medium risk days and five high risk days in 2025. All five high risk days occurred around the Martin Luther King Jr. Day weekend. The DASR requirements vary based on the daily risk categorizations (higher requirement associated with higher risk levels). In 2025, an energy gap reserve requirement of 4,500 MW is applied for high and medium risk days in the months of November through March (this quantity is based on the 90th percentile of the observations of historical energy gap in the months of November through March).

For each season of 2025, the average day-ahead (DA) requirements on low-risk days for each hour of the day for the RUR, 30-Min reserve, and DASR services are shown in Figure 5. The seasonal average of DA requirements on low-risk days over a seven-day period is shown in Figure 6.

The requirements from the reserve services that require up-ramping (except DASR) are stacked on top of each other in the following order: 10-Min RUR Up, 30-Min RUR, and the MSSC portion of the 30-Min Reserve requirement. The 10-Min RUR Down requirement is shown reflected below the X-axis. The DASR requirement is shown as a dashed line. This is because the RUR and 30-Min secondary reserve products can also be used to satisfy the DASR requirement. When the DASR requirement line is above the stacked requirements from the other reserves, we will need to clear additional reserves to meet the DASR requirement. On the other hand, when the DASR requirement line is below the stacked requirement plot, the products cleared to meet the stacked requirement already satisfy the DASR requirement. In other words, the total requirement in the DA market (excluding SR) is the higher of the dashed line or the stacked plot.

The variations in the RUR and 30-Min reserve requirements are similar to the variations observed in the RT requirement plots (Figure 1 and Figure 2). The average DASR requirements have a morning peak in winter, afternoon peak in spring, and evening peaks in summer and fall, corresponding the peaks in load. The DASR line is usually below the stacked requirements of the other reserve services during the high net-load ramping hours.

Figure 7 shows the requirements for high and medium risk days of 2025. For the days in the cold weather months, there is an additional 4,500 MW requirement for EG shown in the dashed pink line. The DASR line is stacked above the energy gap line. Comparing this figure to the figures from the low risk days, we can see that on the elevated risk days, the cumulative DASR and EG requirement is substantially higher. Moreover, the DASR line is above the stacked requirements of the RUR and 30-Min Reserve services on elevated risk days, implying that more reserve products than those already cleared for the RUR and 30-Min Reserve requirement need to be cleared to meet the DASR requirement.

Figure 8 shows the distributions of the proposed reserve requirements in the DA market for 2025. The distributions for the RUR and 30-Min services are similar to those observed in the figure showing the distribution of the RT reserve requirements. The DASR and EG requirements are shown together cumulatively. This cumulative distribution is unimodal with the mode corresponding to DASR requirements on low-risk days. It has a long tail because of the sparse higher requirements on elevated risk days.

The distributions of the DA requirements for 2025 for all the reserve services by hour of day are shown in Figure 9. The requirements from DASR and EG are shown cumulatively. The figure includes marginal box plots for each of the reserve services to illustrate the statistical properties of the requirements in 2025.

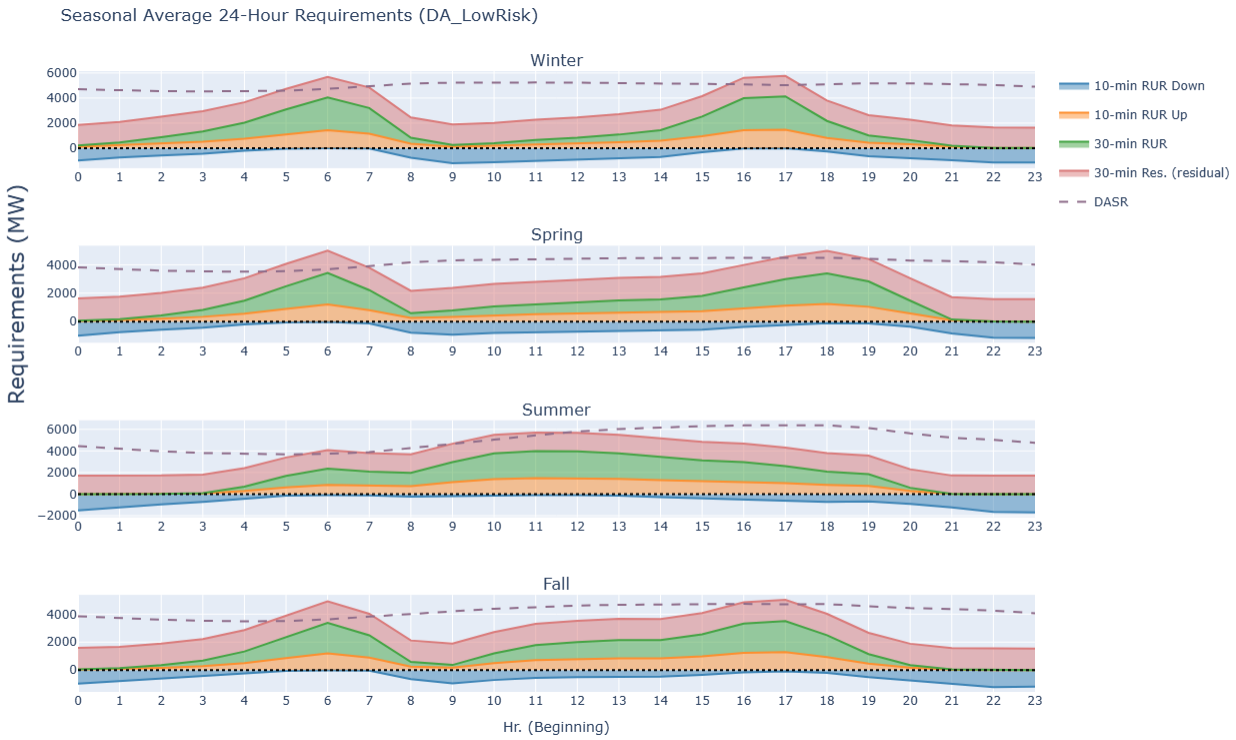

Figure 5. Reserve Requirements in DA market for the new or updated reserve services for low-risk days using 2025 data. The requirements are shown for each hour of the day, averaged across each of the four seasons.

Figure 6. 7-day average trend in DA reserve requirements for low-risk days in each season of 2025.

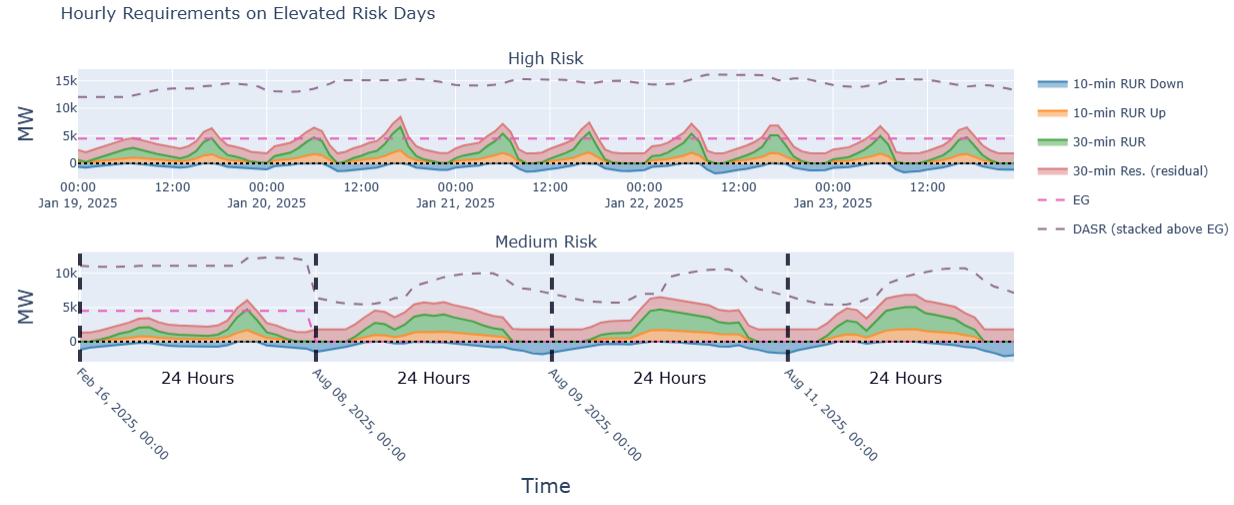

Figure 7. 2025 day-ahead reserve requirements for elevated risk days.

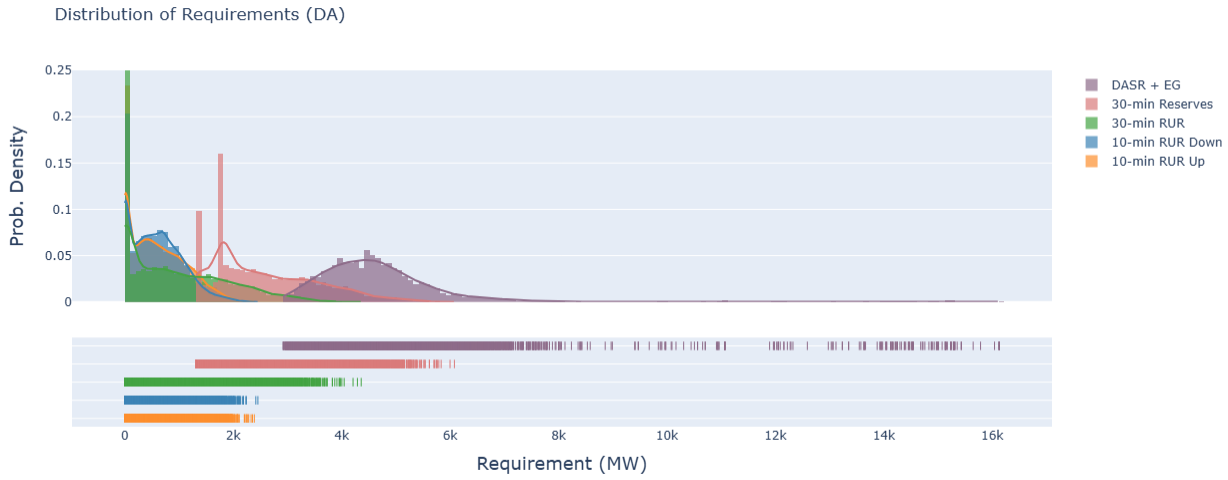

Figure 8. Full distributions of the proposed DA reserve requirements for 2025.

Figure 9. Hourly variations of proposed DA reserve requirements for 2025, with marginal box plots.