

Synchronized Reserve Events

RCSTF

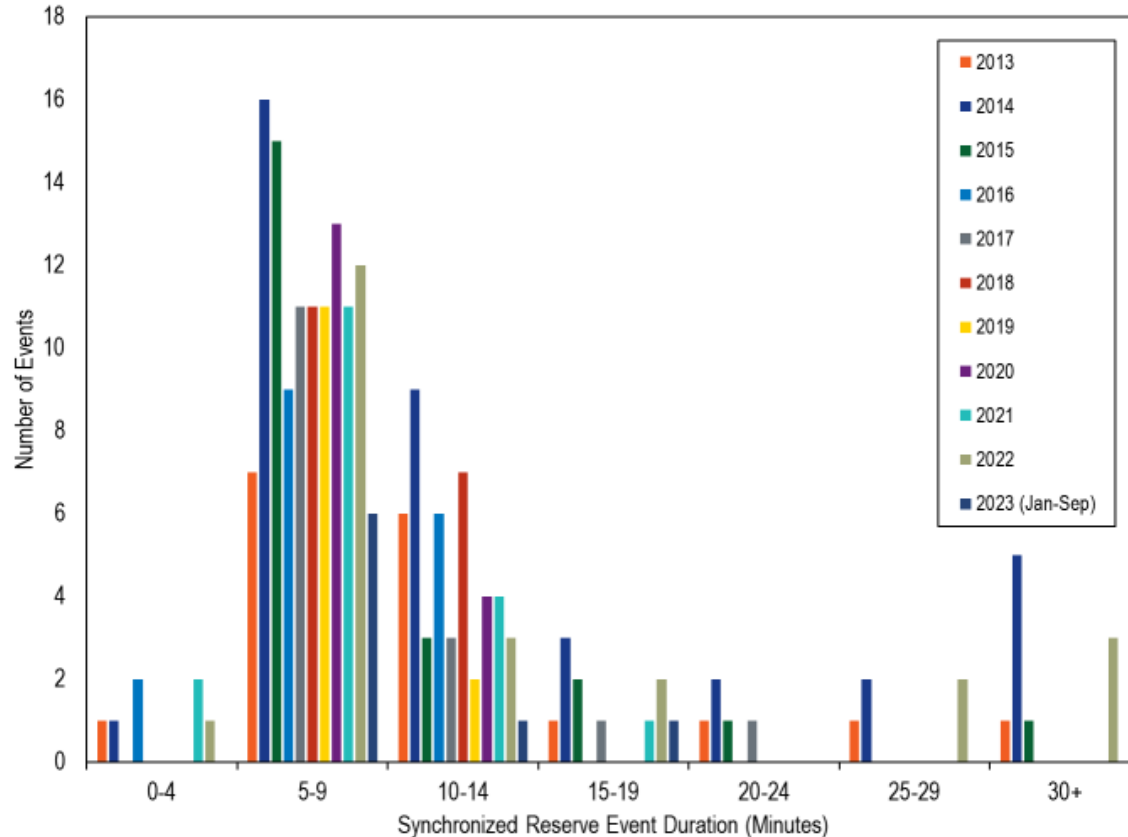
October 26, 2023

IMM



Monitoring Analytics

Synchronized Reserve Events by Duration



Event Triggers

- **A disturbance is defined by NERC as loss of the lesser of 900 MW and 80 percent of the largest single contingency within 60 seconds.**
- **In the absence of a disturbance, PJM operators have used synchronized reserve as a source of energy to provide relief from low ACE.**
- **Of the seven spin events that occurred during the first nine months of 2023, three were due to low ACE.**
- **The risk of using reserves for any nondisturbance reason is that it reduces the amount of synchronized reserve available for a disturbance.**

Event Ending

- **Many spin events, defined by PJM, are longer than the corresponding NERC defined Disturbance Control Standard (DCS) event, which ends when the reporting ACE recovers to zero or the precontingency level.**
- **PJM frequently overshoots when recovering ACE.**
 - **PJM defines the end of spin events minutes after ACE has returned to NERC required levels.**
- **If online resources are following their dispatch signal, an RT SCED case taking the disturbance event into account should be able to maintain ACE without overshooting.**

DCS Events vs Spin Events: Start/End/Duration

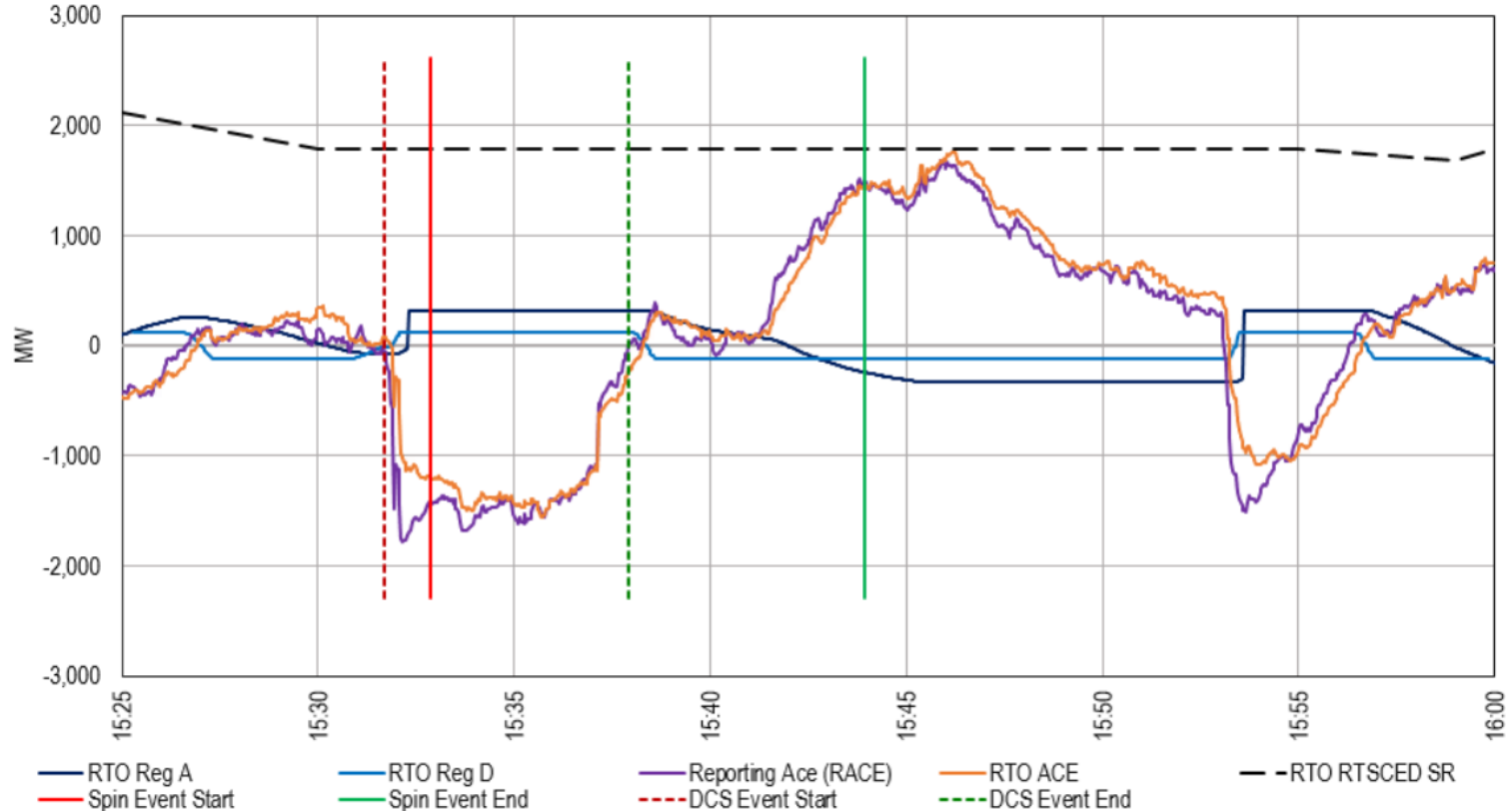
DCS Start	DCS End	DCS Length	Spin Start	Spin End	Spin Length
2022-03-03 12:18	2022-03-03 12:24	00:06:03	2022-03-03 12:20	2022-03-03 12:27	00:07:21
2022-04-06 11:44	2022-04-06 11:49	00:05:12	2022-04-06 11:45	2022-04-06 11:55	00:09:43
2022-04-14 09:28	2022-04-14 09:34	00:05:40	2022-04-14 09:30	2022-04-14 09:38	00:08:07
2022-05-16 15:31	2022-05-16 15:37	00:06:12	2022-05-16 15:32	2022-05-16 15:43	00:11:05
2022-05-16 15:53	2022-05-16 15:56	00:03:18	2022-05-16 15:53	2022-05-16 16:03	00:09:34
2022-05-23 17:17	2022-05-23 17:20	00:03:17	2022-05-23 17:17	2022-05-23 17:32	00:15:00
2022-06-27 17:00	2022-06-27 17:04	00:04:16	2022-06-27 17:01	2022-06-27 17:10	00:09:03
2022-07-07 17:20	2022-07-07 17:24	00:03:27	2022-07-07 17:21	2022-07-07 17:29	00:07:52
2022-09-26 03:35	2022-09-26 03:42	00:06:16	2022-09-26 03:39	2022-09-26 03:45	00:06:02
2022-10-29 02:10	2022-10-29 02:15	00:04:42	2022-10-29 02:12	2022-10-29 02:24	00:11:52
2022-11-04 15:01	2022-11-04 15:04	00:02:58	2022-11-04 15:03	2022-11-04 15:07	00:04:25
2022-11-29 16:29	2022-11-29 16:38	00:08:23	2022-11-29 16:30	2022-11-29 16:47	00:16:45
2022-12-24 02:23	2022-12-24 02:28	00:05:15	2022-12-24 02:23	2022-12-24 02:54	00:30:35
2023-01-05 12:42	2023-01-05 12:47	00:04:56	2023-01-05 12:43	2023-01-05 12:55	00:11:33

DCS Events vs Spin Events: Start/End/Duration

DCS Start	DCS End	DCS Length	Spin Start	Spin End	Spin Length
2022-06-15 07:24	2022-06-15 07:30	00:05:39	<i>No corresponding spin event.</i>		
2022-07-04 02:04	2022-07-04 02:07	00:02:42	<i>No corresponding spin event.</i>		
2022-08-28 13:48	2022-08-28 13:49	00:01:40	<i>No corresponding spin event.</i>		
2022-12-11 09:18	2022-12-11 09:25	00:07:13	<i>No corresponding spin event.</i>		
2022-12-23 16:58	2022-12-23 17:14	00:15:52	<i>No corresponding spin event. Occurs during Low ACE event.</i>		
2022-12-24 15:26	2022-12-24 15:29	00:03:07	<i>No corresponding spin event.</i>		
2023-02-03 20:43	2023-02-03 20:47	00:03:53	<i>No corresponding spin event.</i>		

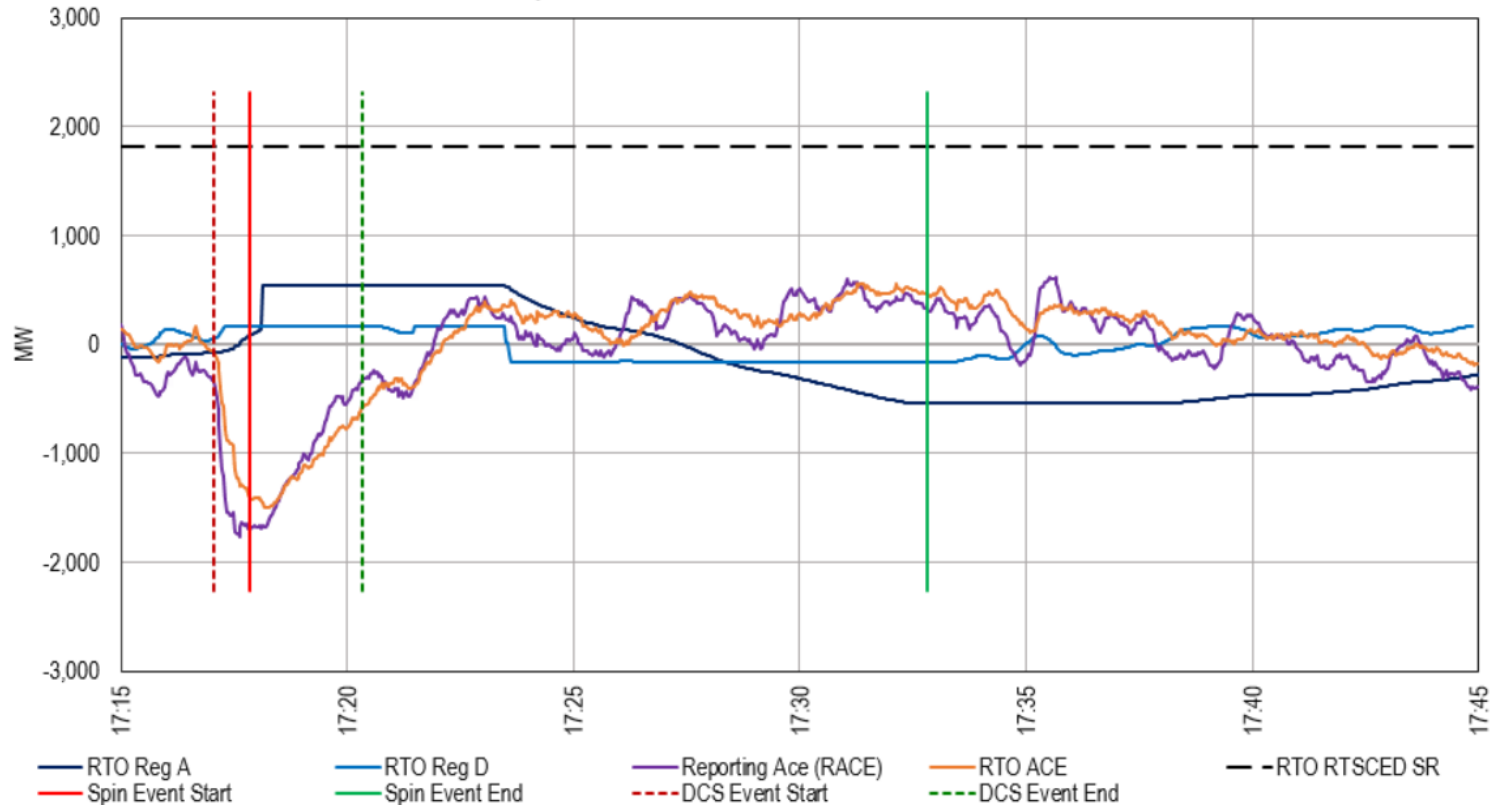
2022-05-16 (~6 min. DCS vs ~11 min. spin)

Spin Event: 2022-05-16 from 15:32 to 15:43 EPT (followed quickly by another event)



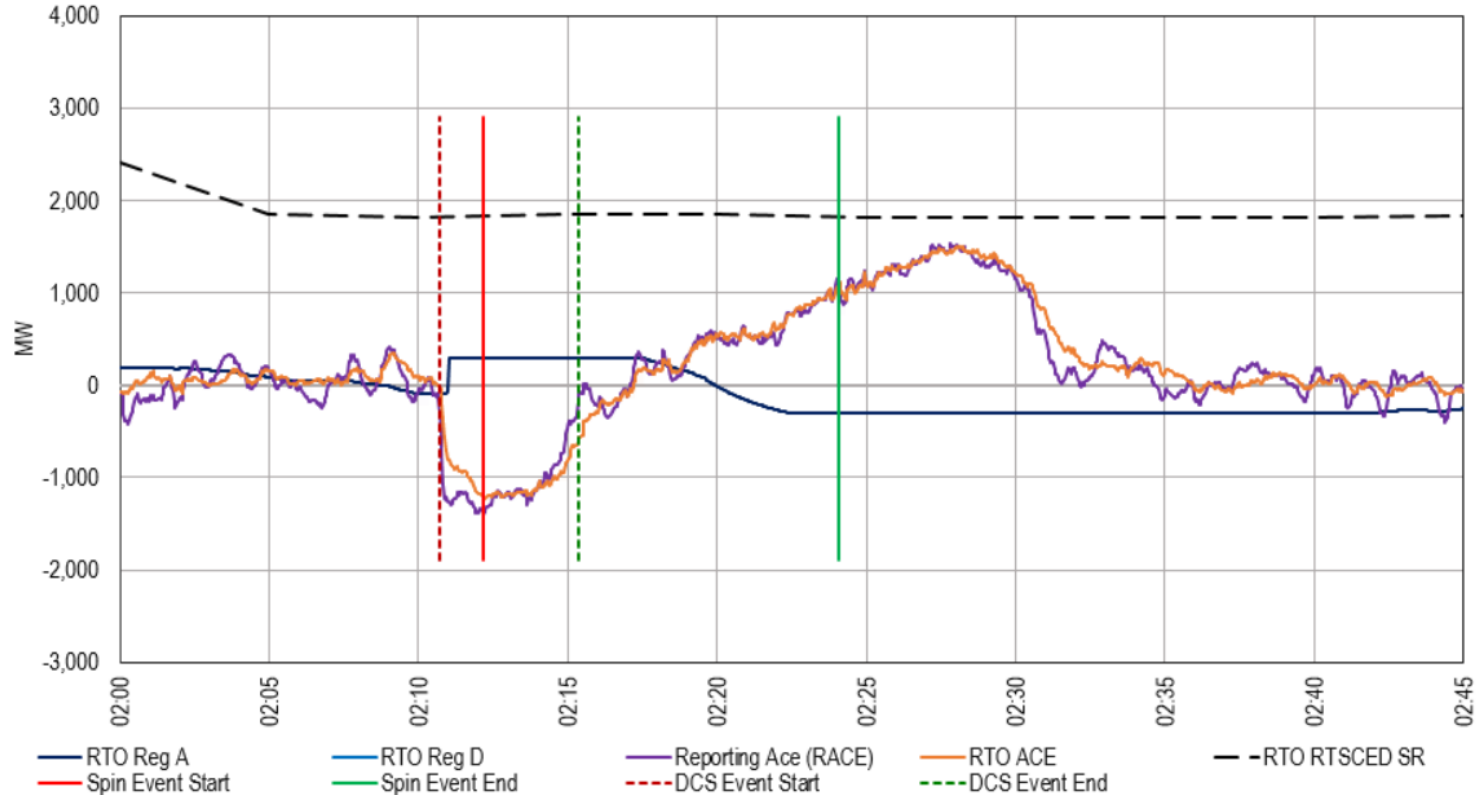
2022-05-23 (~3 min. DCS vs ~15 min. spin)

Spin Event: 2022-05-23 from 17:17 to 17:32 EPT

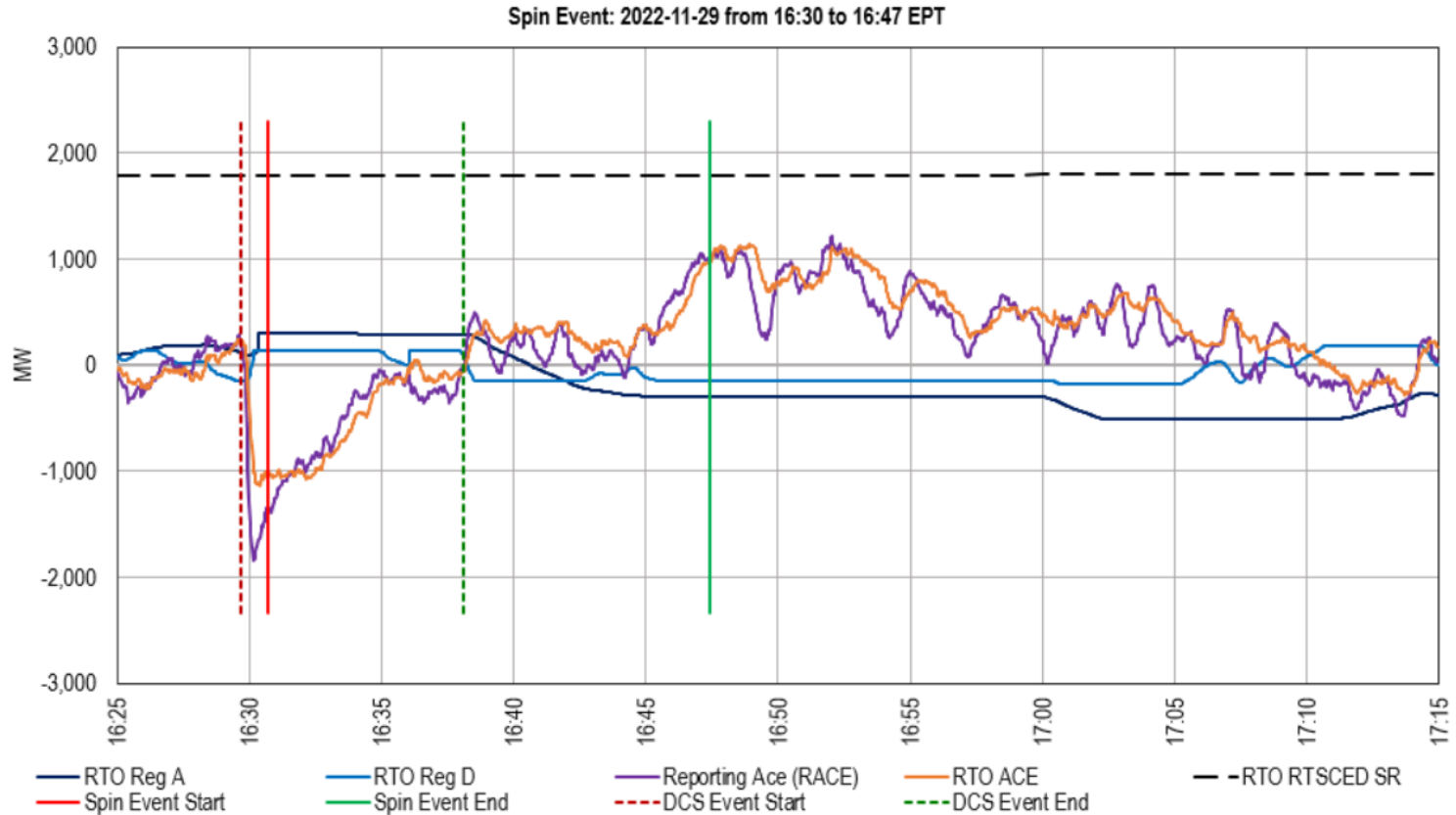


2022-10-29 (~5 min. DCS vs ~12 min. spin)

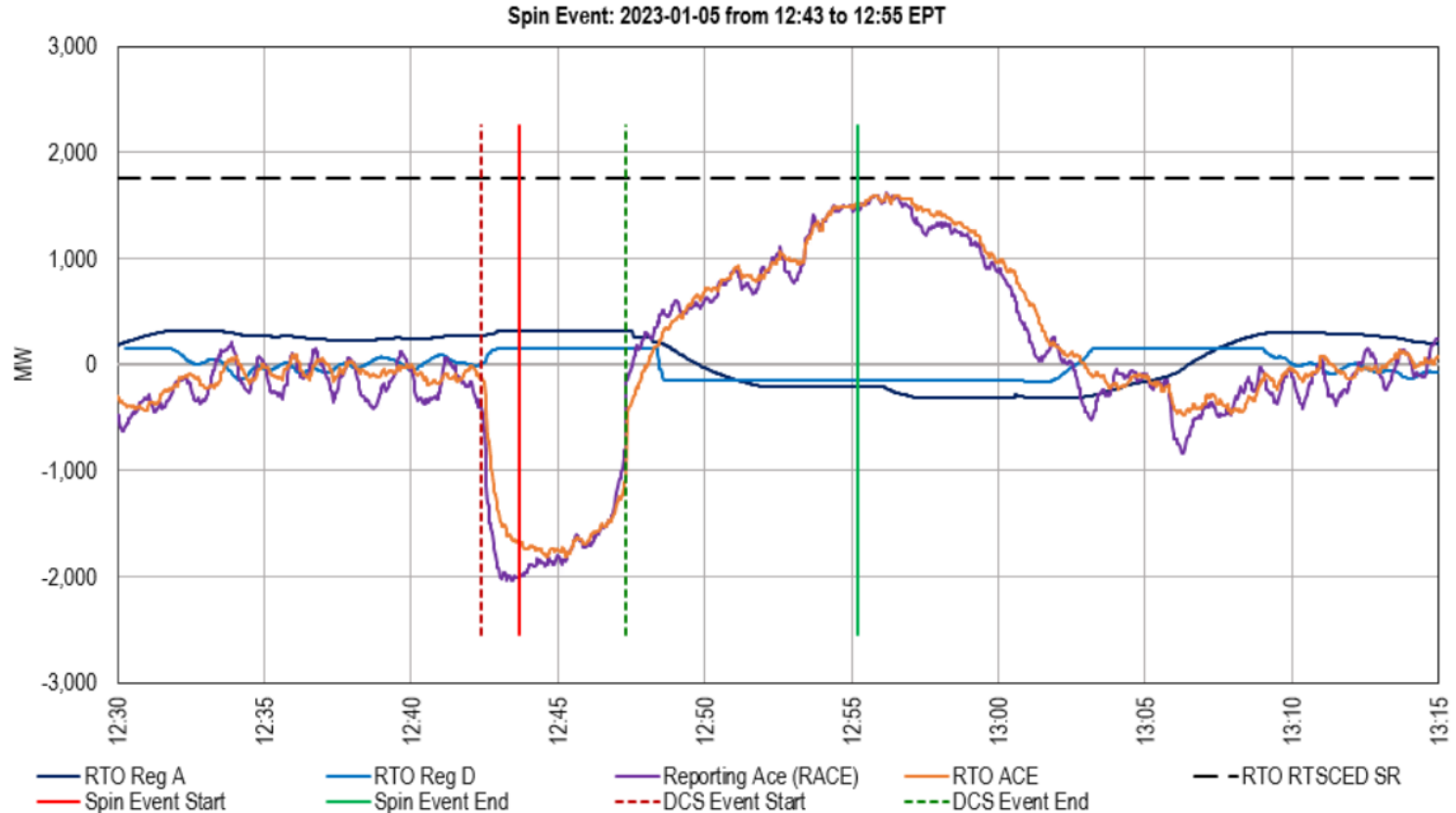
Spin Event: 2022-10-29 from 02:12 to 02:24 EPT



2022-11-29 (~8 min. DCS vs ~17 min. spin)



2023-01-05 (~5 min. DCS vs ~12 min. spin)



Event Performance

$$\text{performance (\%)} = \frac{\sum \text{cleared MW responding}}{\sum \text{cleared MW}}$$

- **Performance does not include MW that did not clear the synchronized reserve market.**
 - If a resource responds more than its cleared MW, the additional response is not included.
- **Cleared MW expanded significantly with reserve market changes on Oct. 1, 2022.**
 - Previous tier 1 resources now explicitly clear the market.

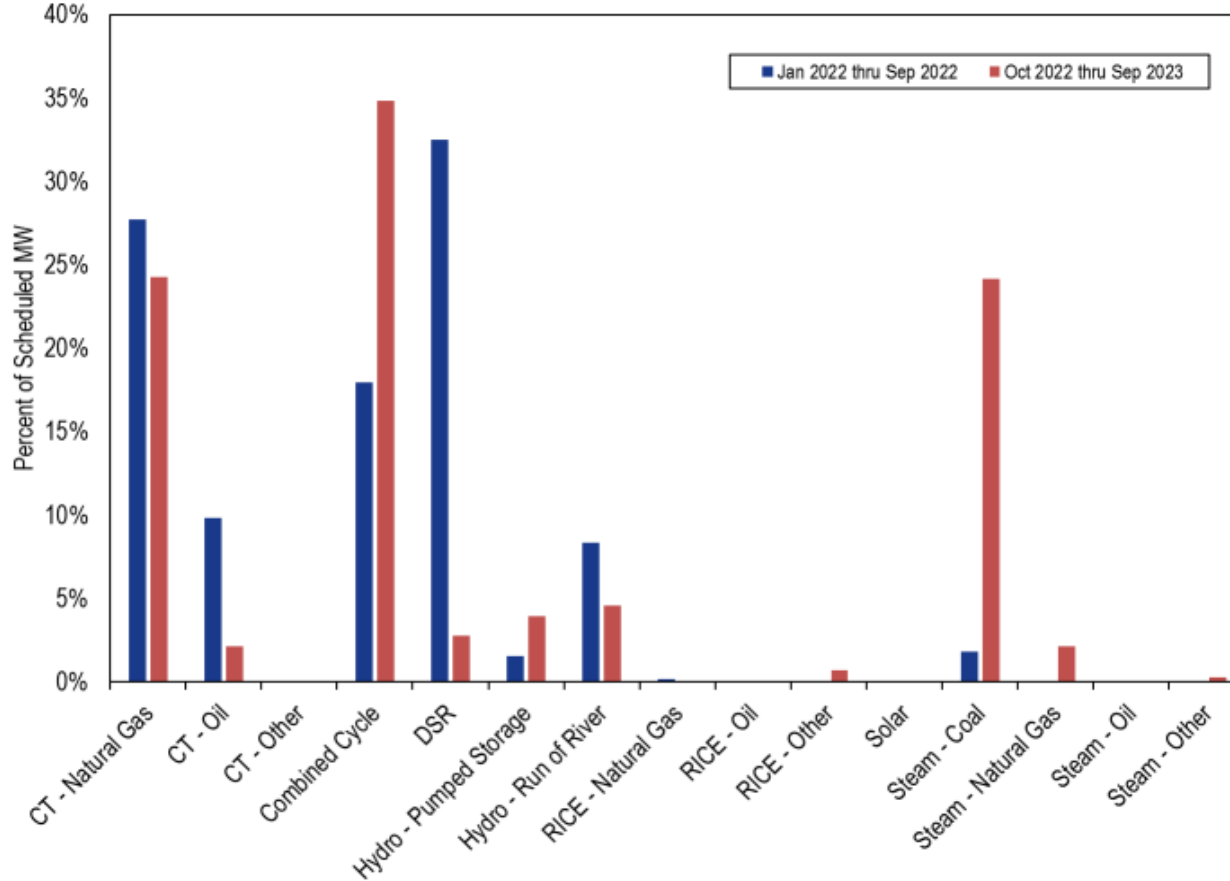
Synchronized Reserve Event Performance

Year	No. of Events Longer than 10 Minutes	Average Percent of Scheduled Synchronized Reserve MW that Responded
2016	7	85.5%
2017	6	87.6%
2018	8	74.2%
2019	3	86.8%
2020	5	59.5%
2021	5	83.1%
2022 (Jan - Sep)	3	71.2%
2022 (Oct - Dec excl. WSE)	2	41.8%
2023 (Jan - Jun)	2	56.9%

Composition of Cleared MW

- **The composition of resources clearing synchronized reserve has changed.**
- **Previous tier 1 resources now have explicit reserve cleared MW.**
 - **More steam units (CC and coal)**
- **Less demand response clearing as a percent of total**
- **The composition of shortfall MW is similar to the composition of clearing MW.**
 - **Though CT performance worse than CC**

Cleared Reserve MW by Resource Type



Distribution of Shortfall MW: October 2022 through April 2023 (excluding Winter Storm Elliot)

Events included:

- **October 29, 2022**
- **November 29, 2022**
- **January 5, 2023**
- **January 10, 2023**

Resource/Fuel Type	Shortfall MW	Percent of Total
CT - Natural Gas	1,604.2	41.8%
Combined Cycle	1,108.5	28.9%
Steam - Coal	761.5	19.8%
DSR	188.4	4.9%
Other	174.7	4.6%

Share of Reserves (Sched) vs. Shortfall (SF)

	CT - Natural Gas			Combined Cycle			DSR			Hydro - Run of River			Other			Steam - Coal			Steam - Other				
	Sched.	SF	Diff.	Sched.	SF	Diff.	Sched.	SF	Diff.	Sched.	SF	Diff.	Sched.	SF	Diff.	Sched.	SF	Diff.	Sched.	SF	Diff.		
2020-12-16 11:38	0.46	0.12	0.34	0.10	0.23	(0.13)	0.15	0.04	0.11				0.29	0.61	(0.32)								
2021-03-09 07:50				0.18	0.10	0.08	0.19	0.05	0.14				0.13	0.12	0.01	0.50	0.72	(0.22)					
2021-04-30 16:30							0.48	0.83	(0.35)				0.52	0.17	0.35								
2021-05-26 10:17							0.36	0.42	(0.05)				0.64	0.58	0.05								
2021-08-23 16:44							0.37	0.79	(0.42)				0.63	0.21	0.42								
2021-11-12 17:25	0.47	0.67	(0.19)	0.14	0.18	(0.04)	0.31	0.03	0.28				0.08	0.12	(0.05)								
2022-04-13 17:25	0.52	0.25	0.28				0.22	0.34	(0.12)				0.26	0.42	(0.16)								
2022-05-16 15:32													1.00	1.00	0.00								
2022-05-23 17:17				0.44	0.68	(0.24)	0.30	0.32	(0.02)				0.26	0.00	0.26								
2022-10-29 02:12	0.49	0.66	(0.16)	0.21	0.16	0.05							0.12	0.03	0.09	0.18	0.15	0.03					
2022-11-29 16:30				0.40	0.37	0.03				0.08	0.00	0.07	0.20	0.41	(0.20)	0.32	0.22	0.10					
2022-12-23 10:14				0.11	0.41	(0.30)							0.79	0.16	0.63	0.10	0.43	(0.34)					
2022-12-23 16:17	0.26	0.21	0.05	0.27	0.49	(0.22)	0.12	0.01	0.12	0.11	0.02	0.08	0.20	0.21	(0.02)	0.04	0.06	(0.02)					
2022-12-24 00:05				0.25	0.48	(0.23)				0.19	0.10	0.09	0.52	0.35	0.17	0.04	0.07	(0.04)					
2022-12-24 02:23				0.29	0.45	(0.16)	0.18	0.08	0.10	0.36	0.23	0.13	0.17	0.24	(0.07)								
2022-12-24 04:23				0.35	0.64	(0.29)	0.21	0.04	0.18				0.44	0.32	0.11								
2023-01-05 12:43				0.34	0.33	0.01							0.41	0.28	0.13	0.25	0.39	(0.14)					
2023-01-10 07:06	0.30	0.37	(0.06)	0.24	0.33	(0.09)	0.16	0.13	0.02				0.14	0.05	0.10	0.15	0.10	0.05			0.01	0.02	(0.01)

Event Shortfall Penalties

- The shortfall charge is based on the MW that failed to respond in the event and is charged for all intervals in the operating day of the event.

$$\text{shortfall charge} = \sum_{i \in \text{Day}} \text{Short MW}_i \times \text{RT SRMCP}_i$$

- The retroactive penalty is based on the MW that failed to respond minus the offsetting MW of overresponse from the portfolio. It applies to all intervals in the immediate passed interval (IPI).

$$\text{retro charge} = \sum_{i \in \text{IPI}} (\text{Short MW}_i - \text{Offsetting MW}) \times \text{RT SRMCP}_i$$

Retroactive Charge, IPI

- **Immediate Past Interval (IPI) is calculated as the average time, in number of days, since the start of the previous event over the previous two years or, if less, the number of days since the resource last failed to fully respond.**
- **For example, the maximum IPI effective January 1, 2023, is 21 days and was calculated using the events from November 1, 2020 through October 31, 2022.**

Synchronized Reserve Event Settlements: 2023

Resource/Fuel Type	Short Resources	Day-of Day-ahead Credits	Day-of Balancing Credits	Day-of LOC Credits	Shortfall Charges	Retro MCP Credits	Retro LOC Credits	Retroactive Penalties
CT - Condensers	15	\$16,601	\$55,712	\$26,671	\$149,356	\$5,496	\$7,909	\$3,580
CT - Non-Condensers	17	\$1,701	(\$1,497)	\$97	\$3,186	\$1,799	\$1,452	\$209
Combined Cycle	42	\$20,945	(\$65,958)	\$30,744	\$89,963	\$12,288	\$10,815	\$12,069
DSR	31	\$799	\$61,419	\$1	\$54,538	\$1,946	\$3	\$2,460
Other	4	\$223	\$12,763	\$1,782	\$1,709	\$152	\$0	\$313
Steam - Coal	18	\$8,242	(\$7,069)	\$952	\$32,399	\$6,981	\$4,020	\$9,365
Steam - Other	10	\$1,271	\$3,489	\$1,017	\$5,095	\$596	\$477	\$870
Total	137	\$49,783	\$58,858	\$61,264	\$336,246	\$29,258	\$24,675	\$28,866

- **Daily total settlements and previous settlements for all resources with shortfall charges and retroactive penalties for the two events in January 2023.**
- **It is possible for the total credits to exceed the total charges even when a resource fails to respond.**

IMM Penalty Recommendations

- **The MMU recommends that, for calculating the penalty for a synchronized reserve resource failing to meet its scheduled obligation during a spinning event, the unit repay all credits back to the last time that the unit successfully responded to an event 10 minutes or longer.**
 - **(Priority: Medium. First reported 2018. Status: Not adopted.)**

IMM Penalty Recommendations

- **The MMU recommends that, for calculating the penalty for a synchronized reserve resource failing to meet its scheduled obligation during a spinning event, the synchronized reserve shortfall penalty and the day-of shortfall charge should include LOC payments as well as SRMCP and MW of shortfall.**
 - **(Priority: Medium. First reported 2018. Status: Not adopted.)**

IMM Penalty Recommendations

- **The MMU recommends that aggregation not be permitted to offset unit specific penalties for failure to respond to a synchronized reserve event.**
 - **(Priority: Medium. First reported 2018. Status: Not adopted.)**



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