Intelligent Reserve Deployment Education

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- Price operational actions and improve performance during spin events.
- Consistent usage of tools by operators throughout the event.
- Ensure timely recovery from event.

Event	Date	Start Time	End Time	Duration	Region	Tier 1 Estimate (MW)	Tier 1 Response (MW)
1	07/06/20	17:22	17:32	00:10	RTO	1464.0	526.1
2	07/23/20	21:03	21:12	00:09	RTO	1562.7	852.8
3	07/25/20	12:39	12:50	00:11	MAD	868.4	421.6

Event	Date	Start Time	End Time	Duration	Region	Tier 1 Estimate (MW)	Tier 1 Response (MW)
1	09/09/20	20:19:34	20:29:04	00:09:30	RTO	1275.4	453.6

Why IRD?

- Accurately price the deployment of reserves in a spin event.
- Using SCED to deploy reserves where needed and ideally not create other operational issues.
  - Generally have enough reserves at the start of events
  - Reduce deployment of excess reserves
- Improve unit response by having consistent pricing and basepoints throughout the event.
  - Avoid sudden interruptions when following PJM dispatch
  - Align pricing and dispatch to reduce conflicting messages

Phased Approach

- Initial phase with internal changes for PJM dispatch, no changes in expected performance during events.
  - Timeline to be communicated at future meeting
- Ensure proper event recovery with IRD prior to implementing more impactful changes.
- Collect data on results to make informed decisions on future enhancements to IRD and market design.
- Future phases based on initial phase results and stakeholder feedback.

Status Quo

- All-call to load 100% SR in MAD/RTO.
- System energy price from last priced RTSCED case.
  - Case would not have seen lost MWs
- Stale basepoints.
  - Could update if RTSCED case is approved during spin.
    - May require two cases to see lost unit due to five minute execution
- Manual actions for constraint control.

What is Intelligent Reserve Deployment (IRD)?

- Intelligent Reserve Deployment (IRD)
  - IRD is a SCED case that simulates the loss of the largest generation contingency. Approval of the case will trigger a spin event.
    - Economic dispatch based on real-time input including constraints
    - Converts inflexible Tier-2 reserve MWs to energy
    - Readily available for use, no lag time

Adds the MWs of the largest contingency to the load forecast at the RTO level to simulate the unit loss

Flips condensers and other inflexible synchronized resources to energy MWs

Procures additional reserves to meet the new largest contingency

Phase 1 Incremental Changes

- Improved functionality and visibility to dispatch during events.
- IRD case readily available for improved pricing during events.
  - 5-min dispatch change to execution frequency leads to longer time for RTSCED to see loss
  - Similar to approving high bias case
- Constraint control relaxed to prioritize event recovery.
- Loss of largest unit applied as RTO bias.
  - Moved from zonal bias based on stakeholder and IMM feedback

Feedback Driven Changes

- Constraint control percentages aligned with RTSCED.
  - Changed from 100% to allow consistent control throughout event
- Loss of largest unit applied as RTO bias.
  - Moved from zonal bias based on stakeholder and IMM feedback
- Base RTSCED case to be used as starting point for bias.
  - Previously used 0 as starting point
- Exploring governing document additions for added clarity.

IRD Cases

- Recent sample of 3173 IRD cases using production data.
- 480 shortage cases, 15% of all IRD cases.
  - In spirit of FERC Order 825
- Average system energy price across cases $248.
  - Existing transient shortage adder of $300+
- No failed cases, solve times in line with existing RTSCED cases.

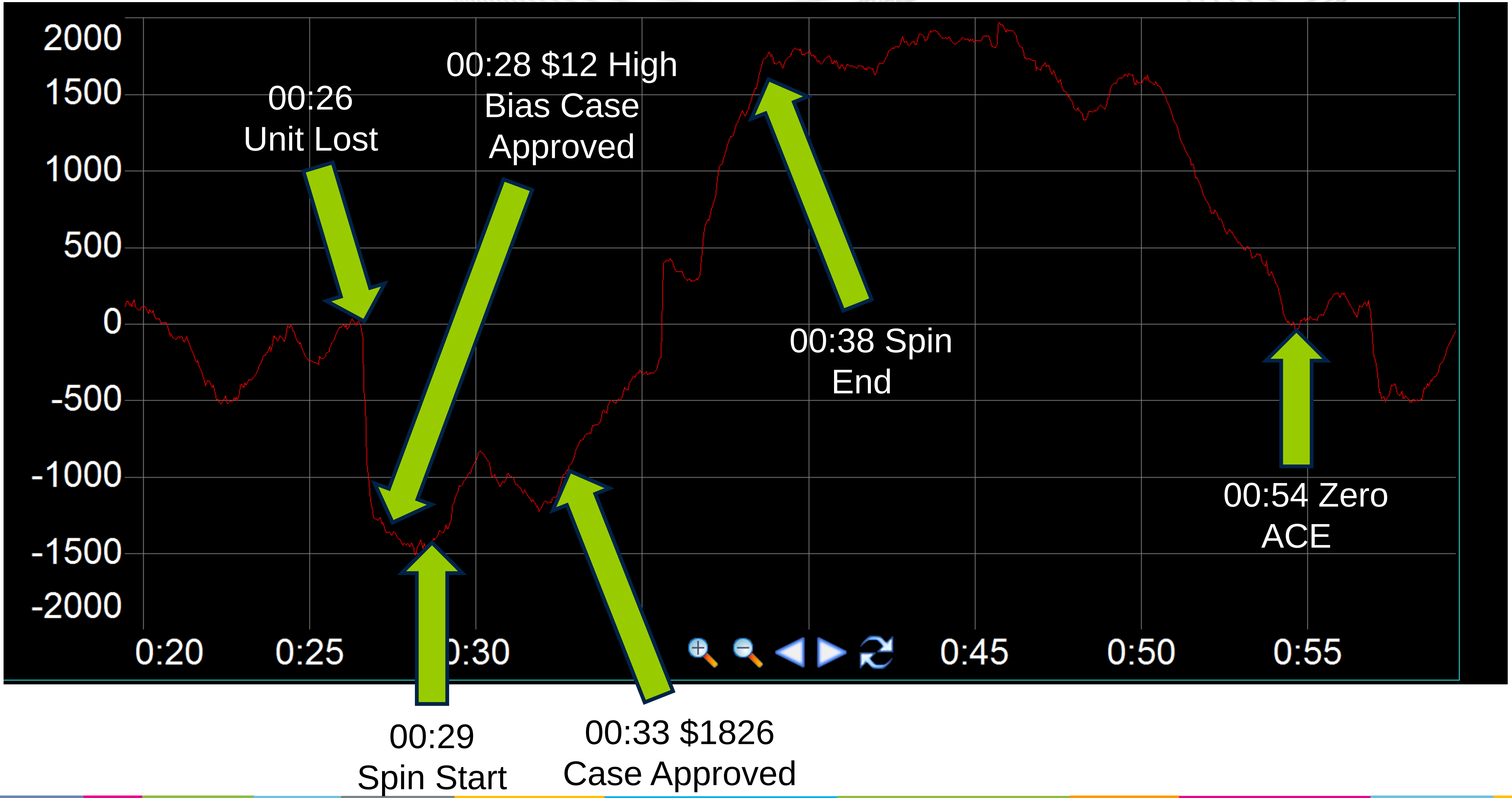
Spin Events

- 14 events this year, 1 had the actual largest unit.
- Loss of a significant unit would trigger an event.
  - System conditions at the time of unit loss is taken into account
  - NERC standard for 80% DCS
  - Loss or ramp down of multiple smaller units

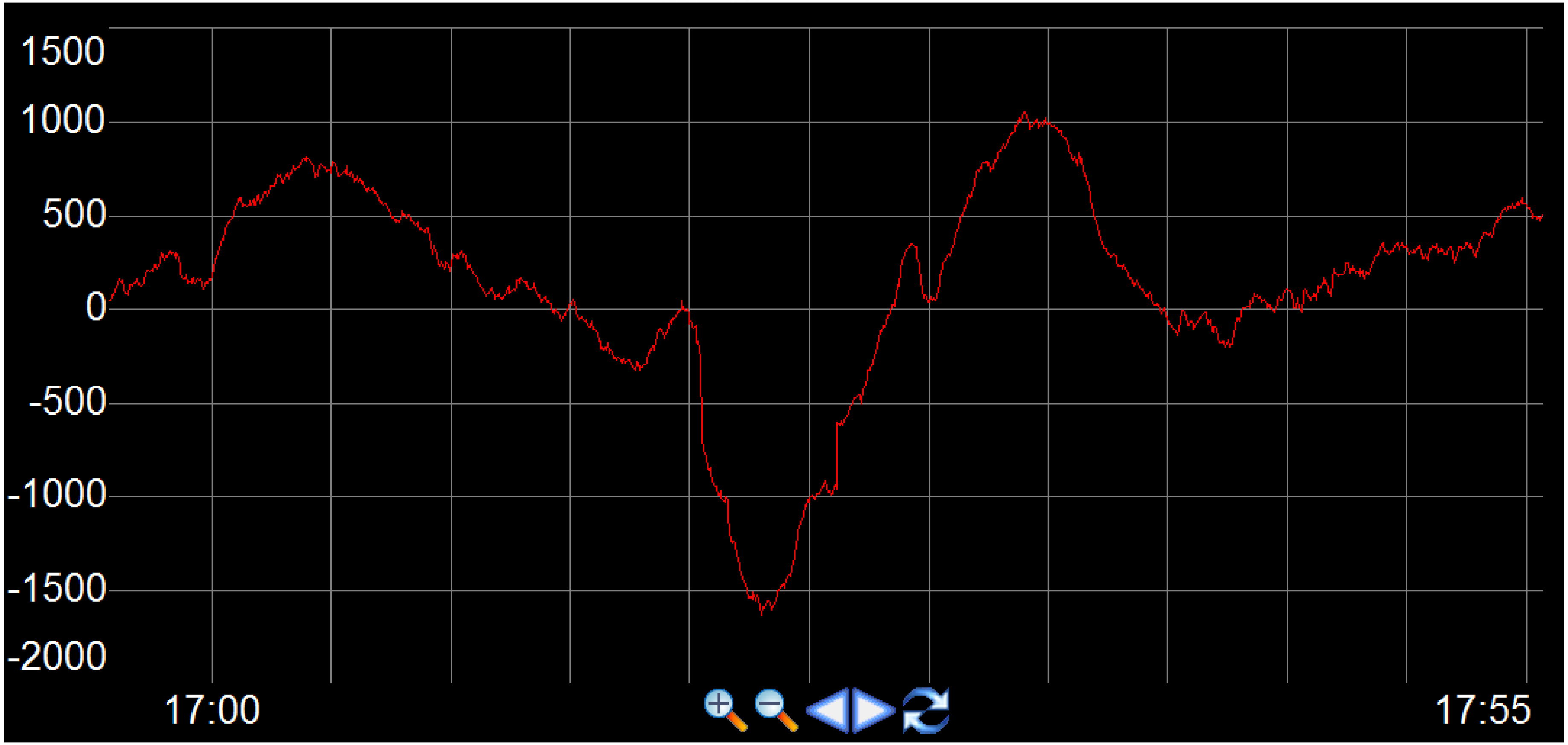
10/12 IRD Comparison

- RTO event from 10/12, lost 1 unit (1150MW), -1507 ACE.
- Largest contingency was 1348 MWs used by IRD.
- System energy price was $12 at time of loss. IRD spin price $632.
- $1826 transient shortage case approved half way into event.
  - Case reflected actual unit lost.
- +1971 ACE after recovery.

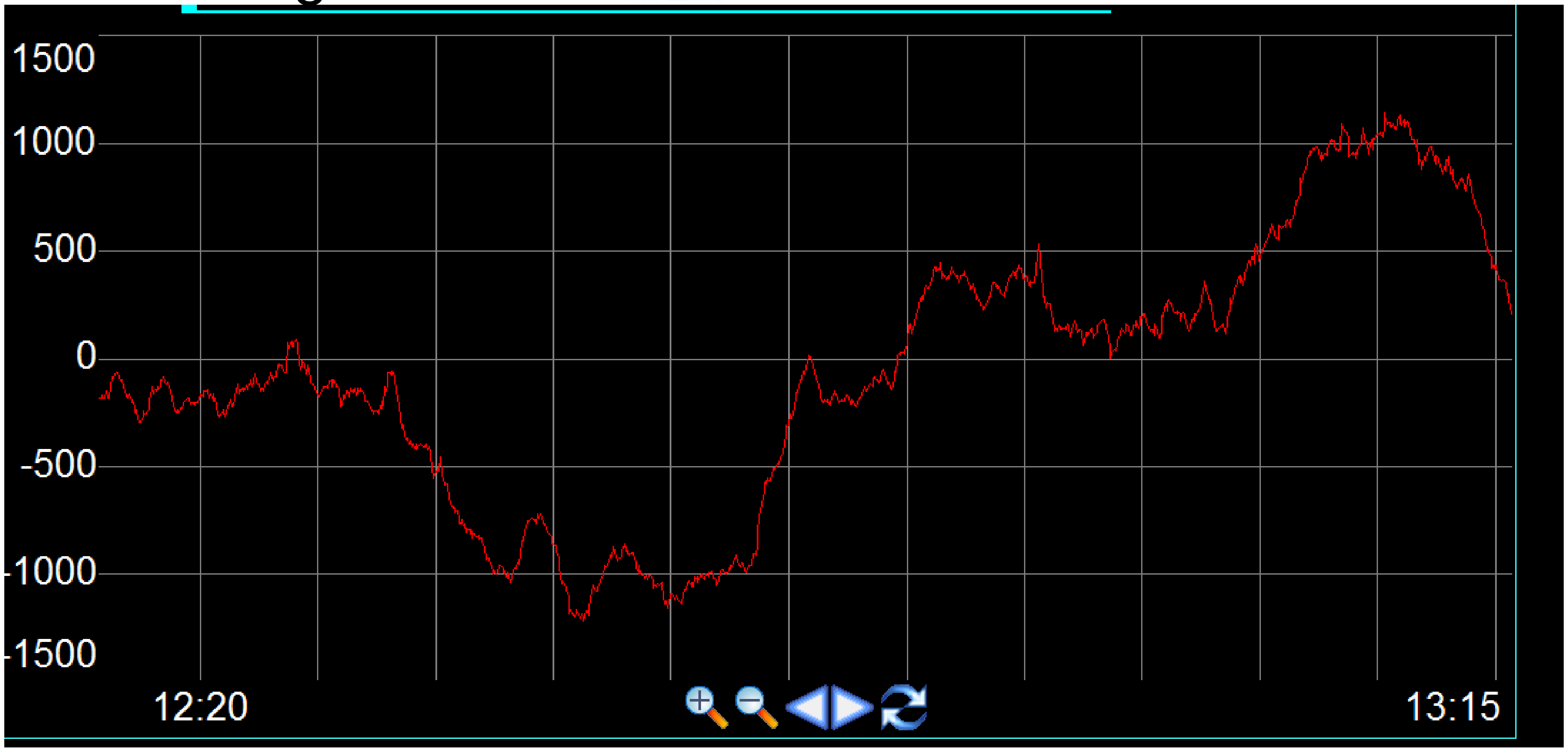
10/12 IRD Comparison



- 950 MW loss across two units. Energy price $64. Staggered response.



- Combination of factors led to low ACE. Energy price $25. Delayed response. Usage of MAD as mechanism for constraint control.



- Design with upcoming Market Initiatives in mind.
- Reserve Price Formation/ORDC changes work in conjunction with IRD.
  - IRD for deployment of reserves
  - ORDC for clearing reserves

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