Intelligent Reserve Deployment

PJM Package

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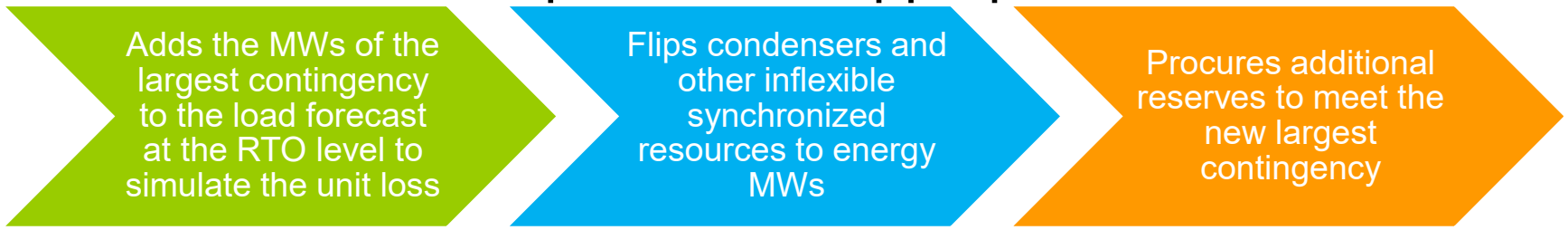
IRD Goals

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

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 reserve MWs to energy
    - Readily available for use, no lag time
    - Initiates faster response until appropriate RTSCED case available



Feedback Driven Changes

- IRD has gone through several iterations based on feedback and analysis.
  - Cases are running regularly using real-time data
- Shifted simulated loss bias to RTO level from zonal level.
- Enabled case to use existing load bias from base RTSCED case to factor in current conditions.
- Increased overall case flexibility by adding options and parameters that can be tuned on the fly.

Phased Approach

- Initial phase of 6 to 12 months to allow for adjustments.
  - IRD initiated deployments with updated basepoints
  - Ensure proper event recovery is achieved
  - Collect data on results to make informed decisions on path forward
- Improve and review metrics on reserve deployment events.
- Review and finalize deployment approach with SRDTF.
- Open to implementing all features at go-live.

IRD Cases

- Recent sample of 2900 IRD cases using production data.
- 474 shortage cases, 16% of all IRD cases.
  - In spirit of FERC Order 825
- Average system energy price across cases $287.
  - Existing transient shortage adder of $300+
- IRD cases are consistently available for operators.

IRD Comparison

- Two recent RTO deployment events during the late night period.
  - Ample reserves leading to fast recovery and overshoot
- IRD pricing in line with system conditions, no inflation.
  - Comparable to first RTSCED case with unit loss

Event	MWs Lost	Largest Unit MWs	SR Available	Initial Price	First Case Price	IRD Price
6/21 RTO	1141	1412	3230	$22.09	$23.50	$23.42
6/22 RTO	1188	1456	2765	$19.30	$19.77	$19.48

Upcoming Changes

- 5-min dispatching and pricing long-term changes.
  - Updates to unit ramping methodology in SCED
- Reserve Price Formation/ORDC changes.
  - Tier 1/Tier 2 consolidation
  - Change of 190 MW reliability reserve margin to downward sloping part of ORDC curve
  - Removal of $50 Tier 1 premium
  - Removal of DGP logic to account of generator performance

Uncertainty

- Upcoming changes should bring overall improvements but could introduce unexpected challenges.
- Existing resource performance during events is far from ideal.
- IRD solution addresses most interests and is flexible enough for changing conditions and needs.
  - Phased approach to fine tune and make improvements
- Level of uncertainty should be accounted for through a larger margin for issues that may come up.

Largest Contingency

- Largest contingency is basis for reserve requirement.
- MW value of largest resource can fluctuate by hundreds of MWs.
  - Less than status quo of deploying all available reserves
- Amount of available reserve MWs can vary by thousands of MWs.
  - Usage of a static percentage based approach may fall short
- Majority of events not triggered by loss of largest contingency.
  - Better to cautiously over deploy than to under deploy reserves

Emergency Procedure for Operators

- Synchronized Reserve events are emergencies governed by NERC and PJM standards.
  - NERC required 15 minute recovery, PJM policy is 10 minutes
- Goal to make process more streamlined than status quo.
  - Ready to initiate event at any time without needing to wait
  - Not having to switch tools and visuals during the event
  - Smooth transition and consistent control for constraints
- IRD effort initiated based on operator input and needs.

Summary

- IRD is an out of the box solution that seamlessly integrates into PJM's existing dispatch applications.
  - Highly customizable based on changing conditions and needs
  - Fully optimized SCED solution geared specifically towards deploying reserves
- Synchronized Reserve events are all different and each event can present unique challenges.
  - PJM needs to be prepared and can't jeopardize it's ability to respond to the worst contingent event

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