Locational Procurement of Reserves

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Options for Locational Procurement

- Procure all reserves at a system (RTO) level
- Procure reserves within reserve sub-zones
- Procure reserves within separate reserves zones
- Procure reserves nodally

RTO Reserve Procurement

- Reserves are procured at a system level without reference to deliverability across network constraints.
- Reserve requirements are set for the entire RTO.
- For each reserve product, there is a single market clearing price for that reserve service across the RTO.
- There is a risk that reserves are cleared on resources that have been backed down to manage congestion on the network as these resources appear to have “free” unloaded headroom.

Sub-Zonal Reserve Procurement**

- Reserves are procured within sub-zones, which can be contained within other zones, such as the Mid-Atlantic Dominion sub-zone, which is within the full RTO zone.

- Reserve requirements are set for the entire RTO (super-zone) and at the reserve sub-zone level, where reserves within the sub-zone meet the sub-zone requirement and contribute toward meeting the RTO (super-zone) requirement.

- For each reserve product, there can be a separate market clearing price for each zone/sub-zone, depending on market clearing outcomes. The sub-zone reserve market clearing price for a reserve service can never be lower than the market clearing price of the super-zone in which it resides.

- Reserves are assumed to be deliverable within each sub-zone, and sub-zone definitions need to be determined and maintained based on analysis.

***PJM currently has a reserve sub-zone construct with the limitation that only one sub-zone can be active at any given time.*

Zonal Reserve Procurement

- Reserves are procured within reserve zones, where each zone is separate and no zone is contained within another zone.
- Reserve requirements are set separately for each zone.
- For each reserve product, there could be a separate market clearing price for each zone depending on market clearing outcomes.
- Reserves are assumed to deliverable within each zone, and zone definitions need to be determined and maintained based on analysis.

Nodal Reserve Procurement

- Reserves are procured nodally subject to the modeled network constraints.
- Reserve requirements are set for the entire RTO.
- For each reserve product, there is a single marginal system price, similar to the energy component of LMP, and a congestion component, which leads to nodal reserve prices.
- The network constraints used in representing reserve congestion in the optimization dictates reserve deliverability. These could be the same network constraints used for energy deliverability or reserve-specific, depending on the reserve need. This could allow for a more dynamic representation of reserve deliverability needs based on system conditions.

Practices Across ISO/RTOs: Locational Reserves

PJM	PJM has the ability to set reserve requirements based on flexible reserve sub-zones to manage system constraints. Only one sub-zone can be in effect at a time.
ISO NE	ISO NE establishes reserve zones seasonally (winter and summer) for 30-minute contingency response based on a rolling, two-year historical analysis.
MISO	Studies are conducted quarterly to establish the number and composition of MISO's reserve zones.
NYISO	Beginning in 2027, NYISO will be implementing nodal contingency reserves through their Dynamic Reserves Market Design, which was approved by their Management Committee in December 2024.
SPP	SPP has five reserve zones.
CAISO	Following enhancements that were implemented in 2022, CAISO's Flexible Ramping Product has been procured nodally to ensure deliverability.

Drivers that Dictate Locational Reserve Needs

- How resources with a reserve assignment are deployed (i.e., whether the deployment or dispatch is done locationally, such as through economic dispatch).
- Whether resources are deployed under emergency conditions during which transmission facility operating limits can be exceeded for a limited time.

PJM's Existing and Proposed Reserves Products

Reserve Product	Operational Drivers	Resource Eligibility	Deployment
Synchronized Reserves	Contingency reserves and ACE recovery.	Online	Deployed during an event outside of RTSCED.
Primary Reserves	Contingency reserves and ACE recovery.	Online or offline	Deployed during an event outside of RTSCED.
10-Min Ramp/Uncertainty Reserves – Up and Down	Addresses net-load ramping and net-load forecast uncertainty.	Online, must be RTSCED dispatchable.	Dispatched through RTSCED.
30-Min Ramp/Uncertainty Reserves	Addresses net-load ramping and net-load forecast uncertainty.	Online, must be RTSCED dispatchable.	Dispatched through RTSCED.
30-Min Secondary Reserves	Replacement Reserves to backfill 10-Min contingency reserves.	Online or offline	Dispatched through RTSCED or called online by PJM Dispatch.
Day-Ahead-Only Reserves	Addresses day-ahead uncertainty.	Online or offline	Used to pre-position the system day ahead. Deployed as energy or assigned as reserves in real-time, if needed.

Locational Needs for Synchronized and Primary Reserves

- Synchronized and Primary Reserves are deployed under emergency conditions, such as the loss of a large unit.

- Under these conditions, power flows can temporarily exceed transmission facility limits while PJM dispatchers work to re-dispatch the system and bring flow back under normal operating limits.

- PJM's preliminary recommendation is that for contingency reserves deployed for ACE recovery during an emergency event (i.e., SR and PR), the status quo locational procurement construct is sufficient to address the reliability need.

Locational Needs for Ramping and Uncertainty Reserves

- Ramping/uncertainty reserves would be procured to meet expected energy and deployed through RTSCED. To provide their intended value, these reserves must be deliverable.
- The risk of not recognizing deliverability constraints in procuring ramping/uncertainty reserves is that these reserves could be procured on bottled generation resources that look like they have “free” headroom because they have been backed down to manage system constraints.
- This is what caused CAISO to begin procuring their Flexible Ramping Product nodally.

What might locational procurement of ramp/uncertainty reserves look like?

- Ramp/uncertainty reserves are procured to ensure there is sufficient supply to serve energy needs in the 10-30 minutes beyond the target time.
- These reserves could then be modeled as future energy over existing system constraints.
- This would be achieved by introducing a new congestion constraint in the optimization for reserve deliverability.

PJM represents the need to maintain flows below facility limits across constrained transmission lines with an optimization constraint in the dispatch engine that takes the following form*:

$$-Tx\ limit \leq \sum [Gen_{energy} \times DFAX] - \sum [Load_{energy} \times DFAX] \leq Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- Gen_{energy}: Generator energy dispatch at the target interval
- $Load_{energy}$: Load withdrawal at the target interval
- $DFAX$: Generator or load distribution factor for each transmission constraint

**For the purposes of presentation, this equation has been simplified to only include generation and load. The iterators have also been omitted, but this represents the sum of all generators and all loads and their contributions to congestion (based on the appropriate distribution factors) for each transmission facility.*

For nodal ramp/uncertainty reserve procurement, PJM could introduce an additional congestion constraint for reserves.

PJM could represent energy and reserve congestion across constrained transmission lines with an optimization constraint in the dispatch engine for each RUR product as below:

$$-Tx\ limit \leq \sum[(Gen_e + RE_\Delta + Gen_{rur}) \times DFAX] - \sum[(Load_e + Load_\Delta) \times DFAX] \leq Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- Gen_e: Generator energy dispatch at the target interval
- RE_Δ: Expected change in wind and solar production at the forward interval
- Gen_{rur}: Generator ramp/uncertainty reserve assignments for the relevant RUR product(s)
- $Load_e$: Load withdrawal at the target interval
- $Load_\Delta$: Expected change in load withdrawal at the forward interval
- $DFAX$: Generator or load distribution factor for each transmission constraint

10-Min RUR Up Reserve Product Congestion Constraint

For the 10-Min RUR Up product, the congestion constraint more specifically becomes:

$$-Tx\ limit \leq \sum [(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,up}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- $Gen_{e,t}$: Generator energy dispatch at the target interval, t
- $RE_{\Delta,t+10}$: Expected change in wind and solar production between target interval t and t+10
- $Gen_{10rur,up}$: Generator 10-Min RUR Up assignment
- $Load_{e,t}$: Load withdrawal at the target interval, t
- $Load_{\Delta,t+10}$: Expected change in load withdrawal between target interval t and t+10
- $DFAX$: Generator or load distribution factor for each transmission constraint

Generator Numerical Example for 10-Min RUR Up

$$-Tx\ limit \leq \sum[(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,up}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

- Imagine that a generator has an energy dispatch of 100 MW for the target interval and a 10-Min RUR Up assignment of 10 MW.
- That would translate into this constraint as:
  - $Gen_{e,t} = 100\text{ MW}$
  - $Gen_{10rur,up} = 10\text{ MW}$
- This generator is not a wind or solar resource and so $RE_{\Delta,t+10}$ is 0 MW
- This generator's energy and 10-Min RUR Up contribution to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

Solar Resource Numerical Example for 10-Min RUR Up

$$-Tx\ limit \le \sum[(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,up}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \le Tx\ limit$$

- Imagine that a solar resource has an energy dispatch of 100 MW for the target interval (time *t*) based on the forecast for *t*. That same solar resource has an expected output at time *t+10* of 90 MW, representing a change of -10 MW in the future interval. The solar resource does not have a 10-Min RUR Up assignment.*

- That would translate into this constraint as:
    - $Gen_{e,t} = 100\text{ MW}$
    - $RE_{\Delta,t+10} = -10\text{ MW}$

- The contribution of this solar resource's energy and expected change in energy (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

In general, this would be the case as solar and wind resources (like under today's reserve eligibility rules) would only be eligible to provide RUR with an approved exception.

Load Numerical Example for 10-Min RUR Up

$$-Tx\ limit \leq \sum [(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,up}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

- Imagine that a load has an expected withdrawal of 100 MW for the target interval (time *t*) based on the forecast for *t*. The load forecast at time *t+10* predicts that the load withdrawal at time *t+10* will be 110 MW, representing a change of +10 MW in the future interval.

- That would translate into this constraint as:
  - $Load_{e,t} = 100\ \text{MW}$
  - $Load_{\Delta,t+10} = 10\ \text{MW}$

- The contribution of this load’s withdrawal and expected change in withdrawal (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

10-Min RUR Down Reserve Product Congestion Constraint

For the 10-Min RUR Down product, the congestion constraint more specifically becomes:

$$- Tx\ limit \le \sum [(Gen_{e,t} + RE_{\Delta,t+10} - Gen_{10rur,down}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \le Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- $Gen_{e,t}$: Generator energy dispatch at the target interval, t
- $RE_{\Delta,t+10}$: Expected change in wind and solar production between target interval t and t+10
- $Gen_{10rur,down}$: Generator 10-Min RUR Down assignment
- $Load_{e,t}$: Load withdrawal at the target interval, t
- $Load_{\Delta,t+10}$: Expected change in load withdrawal between target interval t and t+10
- $DFAX$: Generator or load distribution factor for each transmission constraint

Generator Numerical Example for 10-Min RUR Down

$$-Tx\ limit \leq \sum[(Gen_{e,t} + RE_{\Delta,t+10} - Gen_{10rur,down}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

- Imagine that a generator has an energy dispatch of 100 MW for the target interval and a 10-Min RUR Down assignment of 5 MW.
- That would translate into this constraint as:
  - $Gen_{e,t} = 100 \text{ MW}$
  - $Gen_{10rur,down} = 5 \text{ MW}$
- This generator is not a wind or solar resource and so $RE_{\Delta,t+10}$ is 0 MW
- This generator's energy and 10-Min RUR Up contribution to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

Solar Resource Numerical Example for 10-Min RUR Down

$$-Tx\ limit \leq \sum[(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,down}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

- Imagine that a solar resource has an energy dispatch of 100 MW for the target interval (time *t*) based on the forecast for *t*. That same solar resource has an expected output at time *t+10* of 105 MW, representing a change of 5 MW in the future interval. The solar resource does not have a 10-Min RUR Down assignment.

- That would translate into this constraint as:
  - $Gen_{e,t} = 100\ \mathrm{MW}$
  - $RE_{\Delta,t+10} = 5\ \mathrm{MW}$

- The contribution of this solar resource's energy and expected change in energy (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

Load Numerical Example for 10-Min RUR Down

$$- Tx\ limit \leq \sum [(Gen_{e,t} + RE_{\Delta,t+10} + Gen_{10rur,down}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+10}) \times DFAX] \leq Tx\ limit$$

- Imagine that a load has an expected withdrawal of 100 MW for the target interval (time *t*) based on the forecast for *t*. The load forecast at time *t+10* predicts that the load withdrawal at time *t+10* will be 95 MW, representing a change of -5 MW in the future interval.

- That would translate into this constraint as:
  - $Load_{e,t} = 100\ \text{MW}$
  - $Load_{\Delta,t+10} = -5\ \text{MW}$

- The contribution of this load's withdrawal and expected change in withdrawal (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

30-Min RUR Reserve Product Congestion Constraint

Recall that the 30-Min RUR product is the incremental expected net-load ramp and uncertainty from minute t+10 to t+30. Therefore, the congestion constraint for the 30-Min RUR product needs to include both the 10-Min RUR Up and the 30-Min RUR quantities:

$$-Tx\ limit \leq \sum[(Gen_{e,t} + RE_{\Delta,t+30} + Gen_{30rur} + Gen_{10rur,up}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+30}) \times DFAX] \leq Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- $Gen_{e,t}$: Generator energy dispatch at the target interval, t
- $RE_{\Delta,t+30}$: Expected change in wind and solar production between target interval t and t+30
- Gen_{30rur}: Generator 30-Min RUR assignment
- $Gen_{10rur,up}$: Generator 10-Min RUR Up assignment
- $Load_{e,t}$: Load withdrawal at the target interval, t
- $Load_{\Delta,t+30}$: Expected change in load withdrawal between target interval t and t+30
- $DFAX$: Generator or load distribution factor for each transmission constraint

Generator Numerical Example for 30-Min RUR

$$-Tx\ limit \leq \sum [(Gen_{e,t} + RE_{\Delta,t+30} + Gen_{30rur} + Gen_{10rur,up}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+30}) \times DFAX] \leq Tx\ limit$$

- Imagine that a generator has an energy dispatch of 100 MW for the target interval, a 30-Min RUR assignment of 20 MW, and a 10-Min RUR Up assignment of 10 MW.

- That would translate into this constraint as:
  - $Gen_{e,t} = 100\ \text{MW}$
  - $Gen_{30rur} = 20\ \text{MW}$
  - $Gen_{10rur,up} = 10\ \text{MW}$

- This generator is not a wind or solar resource and so $RE_{\Delta,t+10}$ is 0 MW

- This generator's energy, 30-Min RUR, and 10-Min RUR Up contribution to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

Solar Resource Numerical Example for 30-Min RUR

$$-Tx\ limit \leq \sum [(Gen_{e,t} + RE_{\Delta,t+30} + Gen_{30rur} + Gen_{10rur,up}) \times DFAX] - \sum [(Load_{e,t} + Load_{\Delta,t+30}) \times DFAX] \leq Tx\ limit$$

- Imagine that a solar resource has an energy dispatch of 100 MW for the target interval (time *t*) based on the forecast for *t*. That same solar resource has an expected output at time *t+30* of 85 MW, representing a change of -15 MW in the future interval. The solar resource does not have a 10-Min RUR Up or 30-Min RUR assignment.*

- That would translate into this constraint as:
  - $Gen_{e,t} = 100\ \mathrm{MW}$
  - $RE_{\Delta,t+30} = -15\ \mathrm{MW}$

- The contribution of this solar resource's energy and expected change in energy (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

In general, this would be the case as solar and wind resources (like under today's reserve eligibility rules) would only be eligible to provide RUR with an approved exception.

Load Numerical Example for 30-Min RUR

$$-Tx\ limit \leq \sum[(Gen_{e,t} + RE_{\Delta,t+30} + Gen_{30rur} + Gen_{10rur,up}) \times DFAX] - \sum[(Load_{e,t} + Load_{\Delta,t+30}) \times DFAX] \leq Tx\ limit$$

- Imagine that a load has an expected withdrawal of 100 MW for the target interval (time *t*) based on the forecast for *t*. The load forecast at time *t+10* predicts that the load withdrawal at time *t+30* will be 120 MW, representing a change of +20 MW in the future interval.

- That would translate into this constraint as:
  - $Load_{e,t} = 100\text{ MW}$
  - $Load_{\Delta,t+30} = 20\text{ MW}$

- The contribution of this load's withdrawal and expected change in withdrawal (based on the forecast) to congestion would then be included in the congestion constraint above for each transmission facility, using the distribution factor ($DFAX$) that represents its effect on congestion for that facility.

Pricing Congestion for Energy

When transmission constraints bind in the optimization engine (i.e., the energy flow on the transmission line is at or above the limit), this leads to non-zero congestion prices.

The shadow prices of these constraints become the congestion component of LMP and create price separation between different nodes in the network.

Today, transmission limit violations in the optimization are penalized at a level of $2,000/MW.

If the cost of re-dispatching the system to avoid violating a transmission limit is greater than $2,000, the optimization will allow the transmission limit to be violated.

Pricing Congestion for Reserves

- If a new congestion constraint were introduced to maintain energy and reserve flows below transmission limits, this would lead to a congestion price for reserves.
- Reserve clearing prices would then have two different components: a system marginal price (analogous to the energy component of LMP) and a congestion component.
- This would lead to price separation for reserves at different nodes in the network. Note that congestion prices can be both positive and negative, and so reserve prices at different nodes in the system could be greater than, equal to or less than the system marginal reserve price.
- Cost allocation will need to be discussed; while reserve clearing prices may be different at different nodes, that does not necessarily mean that loads at certain locations would pay more depending on how the cost allocation is designed.

Locational Needs for 30-Min Secondary Reserves

- 30-Min Secondary Reserves are procured to backfill contingency reserves.
- 30-Min Secondary Reserves are used to bring the system back to a stable operating position, particularly following an event.
- When 30-Min Secondary Reserves are deployed following an event, the topology of the system or the generation on the system may have changed.
- PJM monitors contingencies of concern that represent significant reliability risk, such as the risk of cascade following a unit loss. Today, resources may be committed out-of-market to manage these locational concerns.

What might locational procurement for 30-Min Secondary Reserves look like?

- PJM would identify a list of key transmission elements that need to be monitored for post-contingency conditions. These are contingencies that represent significant reliability risk, such as the risk of cascade.

- The appropriate distribution factors for the reserve constraints would be supplied to the economic dispatch engine and used in a 30-Min Secondary Reserve congestion constraint, similar to the RUR congestion constraint.

The congestion constraint for Secondary Reserves would utilize DFAX for the reserve constraints.

PJM could represent the need to maintain energy and reserve flows below facility limits across constrained transmission lines with an optimization constraint in the dispatch engine as below:

$$-Tx\ limit \leq \sum[(Gen_{energy} + Gen_{secr}) \times DFAX_{res}] - \sum[Load_{energy} \times DFAX_{res}] \leq Tx\ limit$$

Where:

- $Tx\ limit$: Transmission facility flow limit
- Gen_{energy}: Generator energy dispatch at the target interval
- Gen_{secr}: Generator Secondary reserve assignment
- $Load_{energy}$: Load withdrawal at the target interval
- $DFAX_{res}$: Generator or load distribution factor for the monitored reserve constraints

Transmission Facility Limits in Secondary Reserve Nodal Reserve Procurement

- For the reserve congestion constraint, the transmission limits that are monitored do not have to be the same as for energy.
- For energy dispatch, normal transmission operating limits are used to ensure that energy flows do not exceed facility limits to serve demand.
- For N-1 security, emergency limits are used, to ensure that following a single transmission facility loss, energy flows do not exceed emergency limits.
- For the Secondary Reserve congestion constraints, higher limits could be used, such as cascade limits, to ensure that redispatch can occur following high-risk contingencies without requiring manual load dump.

Locational Needs for Day-Ahead Reserves

Note: The below applies to reserves that are cleared in the Day-Ahead Market but may not be carried to meet real-time reserve needs. The locational procurement approaches described previously for RUR and 30-Min SECR products would be applied in both the Day-Ahead and Real-Time Markets.

- ☑ Day-Ahead Scheduling Reserves are used to ensure that there is sufficient generation committed to the system and prepared to operate to ensure that PJM can reliability meet its forecasted real-time load.
- ☑ These reserves are relied upon to serve demand in real-time under normal operating conditions and must be deliverable to provide their intended reliability benefit.
- ☑ PJM is still considering reserve deliverability constructs that address these reliability needs, appropriately reflect the best information available day ahead, and achieve a coherent market design.

Transmission Constraint Penalty Factors in Nodal Reserve Procurement

- The reserve congestion constraints would be distinct from the existing congestion constraint for energy. This means that energy + reserve flow violations could be penalized at a different rate than the one used for energy flow violations, essentially creating a hierarchy for reserving transmission capability for energy and different reserve serves.

- In a nodal reserve procurement construct, a penalty factor of $0 on the reserve congestion constraint would essentially mean that there was no locational procurement (i.e., reserves would be procured at an RTO level).

- By contrast, if the reserve congestion penalty factor were set as equal to the energy congestion penalty factor, then reserving transmission for reserve flows would be valued at the same rate as reserving transmission for energy.

- There is a spectrum between these two extremes that would allow the optimization to trade off between the reliability benefits of ensuring reserve deliverability and the cost of re-dispatching the system.

Summary of PJM's Perspective on Reserve Location Procurement

Synchronized and Primary Reserves	Status Quo
Ramp/Uncertainty Reserves *(both 10-Min and 30-Min)*	Nodal procurement where the reserve congestion constraint uses the same DFAX and the same transmission limits as for energy
30-Min Secondary Reserves	Nodal procurement where the reserve congestion constraint uses reserve-specific DFAX that reflect post-contingency flows for contingency scenarios of reliability concern
Day-Ahead Reserves	Solutions still being discussed

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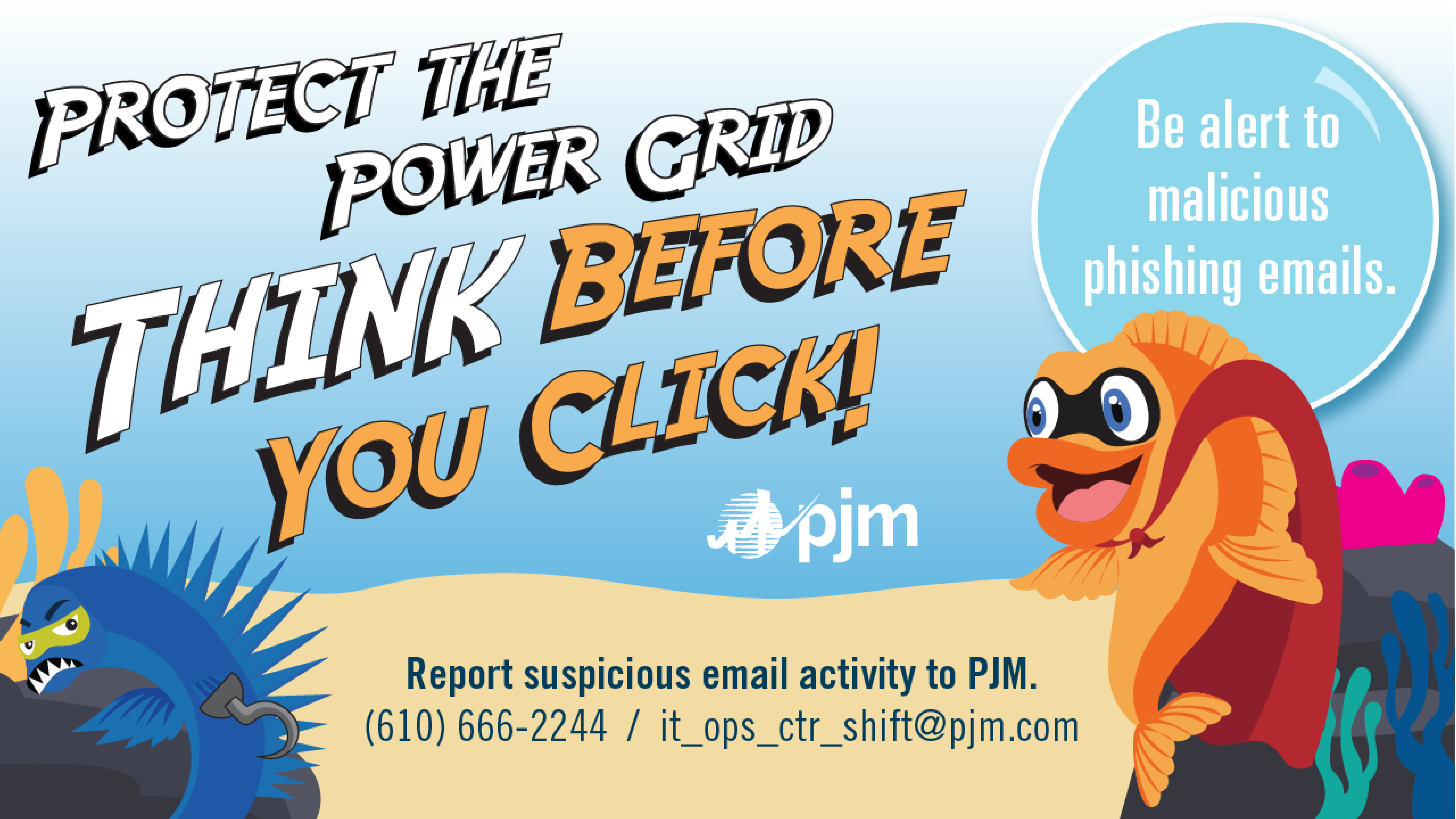
Acronyms

Acronym	Term & Definition
SR	**Synchronized Reserves** are reserves provided by resources that are synchronized to the grid and can respond within 10 minutes.
PR	**Primary Reserves** are reserves provided by resources that are either synchronized or not synchronized to the grid and can respond within 10 minutes.
RUR	**Ramping/Uncertainty Reserves** are reserves that would be procured to manage forecasted ramp and uncertainty operational flexibility needs.
MW	A **Megawatt** is a unit of power equaling one million watts (1 MW = 1,000,000 watts) or one thousand kilowatts (1 MW = 1,000 KW).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