Regulation Three Pivotal Supplier Test

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- Utilized to mitigate Regulation market power as detailed in section 3.2.2A.1 of the PJM Tariff

- Conducted for each Regulation clearing hour in ASO

- Applied on a Regulation supplier basis (not a resource by resource basis)

- Performed on all valid and available supplies within 150% of cost-based RMCP – eligible to clear resources

- A Regulation supplier fails the RegTPS test in any hour in which such Regulation supplier and the two largest Regulation suppliers are jointly pivotal.

- When RegTPS score is less than or equal to 1.0 , then the three suppliers are jointly pivotal and fail the RegTPS
  - Any resource owner that failed the RegTPS Test will be offer-capped
  - Resources are offer-capped at the lesser of their adjusted cost-based or adjusted price-based regulation offer price

- Resources that do not submit a cost-based regulation offer price cannot provide regulation

- Reg TPS is not in the scope of proposed changes in the RMISTF

Prior to Reg TPS Test

1. Select Cheapest Offer

2. Calculate Adj. Cap$ and Adj. Perf $ + Adj. LOC

3. Rank resources to meet requirement

4. Determine the Cost RMCP

5. Determine resource eligibility for RegTPS

Performing Reg TPS Test

6. Group Effective MW by Supplier

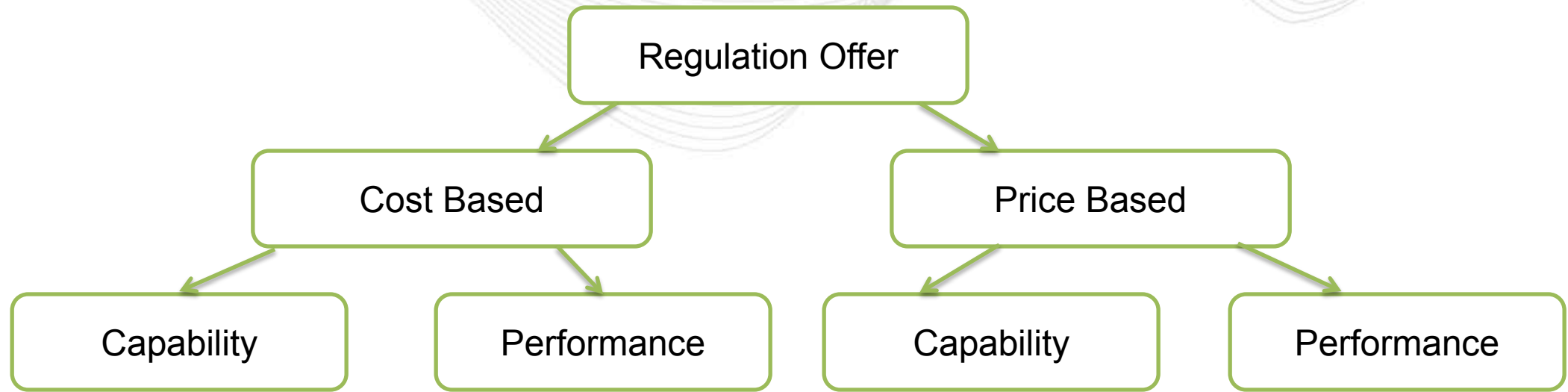7. Order Suppliers by Effective MW in descending order

8. Test each supplier against the two largest suppliers to determine TPS Score

9a. TPS Scores ≤ 1 Fail ➔ Offer cap remains for final solve

9b. TPS Scores > 1 Pass ➔ Price Offer used for final solve

10. Perform final solve to determine resource clearing

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                    ┌─────────────────────┐
                    │  Regulation Offer   │
                    └─────────────────────┘
                       │             │
            ┌──────────────┐    ┌──────────────┐
            │  Cost Based  │    │  Price Based │
            └──────────────┘    └──────────────┘
              │        │          │         │
      ┌────────────┐ ┌────────────┐ ┌────────────┐ ┌────────────┐
      │ Capability │ │Performance │ │ Capability │ │Performance │
      └────────────┘ └────────────┘ └────────────┘ └────────────┘
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- One of the initial steps in clearing is to offer-cap resources
  – Least of (Capability Cost + Performance Cost), (Capability Price + Performance Price)
  – If resource owner FAILED RegTPS test, offer-cap remains for final solve
  – If resource owner PASSED RegTPS test, offer is switched to price-based for final solve

- Convert offers to Adjusted offers by factoring in PBR metrics
  - Adjusted Capability $ = Capability Offer / (Benefits Factor * Historic Performance Score)
  - Adjusted Performance $ = (Performance Offer * Historic Mileage) /

    (Benefits Factor * Historic Performance Score)

- Calculate Rank for resources
  - Rank = Adjusted Capability $ + Adjusted Performance $ + Adjusted LOC $
  - Solve to determine least cost set of resources to meet the requirement
  - Rank of the marginal resource sets the Cost RMCP

- If resource Rank ≤ 150% * Cost RMCP → Eligible for RegTPS Test

- If resource Rank > 150% * Cost RMCP → Not Eligible for RegTPS Test
  - Not eligible means resource cannot provide Regulation for that hour
  - Not eligible resources have Effective MW set to zero
  - Not the same as resources failing RegTPS test

- Group Effective MW by Supplier

- Rank Suppliers in descending order by total Effective MW

- Calculate RegTPS Score

$$RegTPS_{Score} = \frac{TotalCompetitiveSupply - (Supplier1 + Supplier\ 2 + Supplier\ N)}{Regulation\ Requirement}$$

- Scores ≤ 1 Fail
  - All three suppliers are pivotal
  - Resources remain offer capped for final ASO solve

- Scores > 1 Pass
  - Offer cap is lifted and resources are placed on price offer (if available) for final ASO solve

No.	TPS Owner	Resource	Reg Requirement	50		
			Available Effective RegMW	Supplier Sum	RegTPS Score	RegTPS Result
1	Alpha	A	15	25	0.8	Fail
		B	10			
2	Bravo	C	25	40	Largest Supplier	Fail
		D	15			
3	Charlie	E	5	5	1.2	Pass
4	Delta	F	15	15	1	Fail
5	Gamma	G	20	35	Larger Supplier	Fail
		H	5			
		K	10			
6	Theta	L	10	20	0.9	Fail
		M	10			
			Total Supply	140		

$$RegTPS_{Score} = \frac{TotalCompetitiveSupply - (Supplier1 + Supplier\,2 + Supplier\,N)}{Regulation\ Requirement}$$

$$RegTPS_{Score\_Theta} = \frac{140 - (40 + 35 + 20)}{50} = 0.9$$

- After RegTPS test, clearing continues by re-solving for the least cost solution

- Rank = Adjusted Capability $ + Adjusted Performance $ + Adjusted LOC $

- Resources are ranked by least cost to meet the requirement

  - Determines which resources clear in ASO

Regulation Lost Opportunity Cost

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RegLOC – is the foregone revenue or increase in costs relative to the energy market for providing regulation

- Calculated only for resources providing energy along with regulation service
- Calculated only for pool scheduled regulation resources
- Is $0 for DSR, and self-schedule and Non-Energy Regulation resources
- Can only be positive, else zero
- Calculated only within Eco limit range
  - Economic Minimum to Economic Maximum range
- RegLOC is a component of the Regulation Market Clearing Price
- Re-evaluating schedule used in the Reg LOC calculation is within the scope of RMISTF

As described in Section 3.2.7 of M-11

$$|LMP - MC| * GENOFF$$
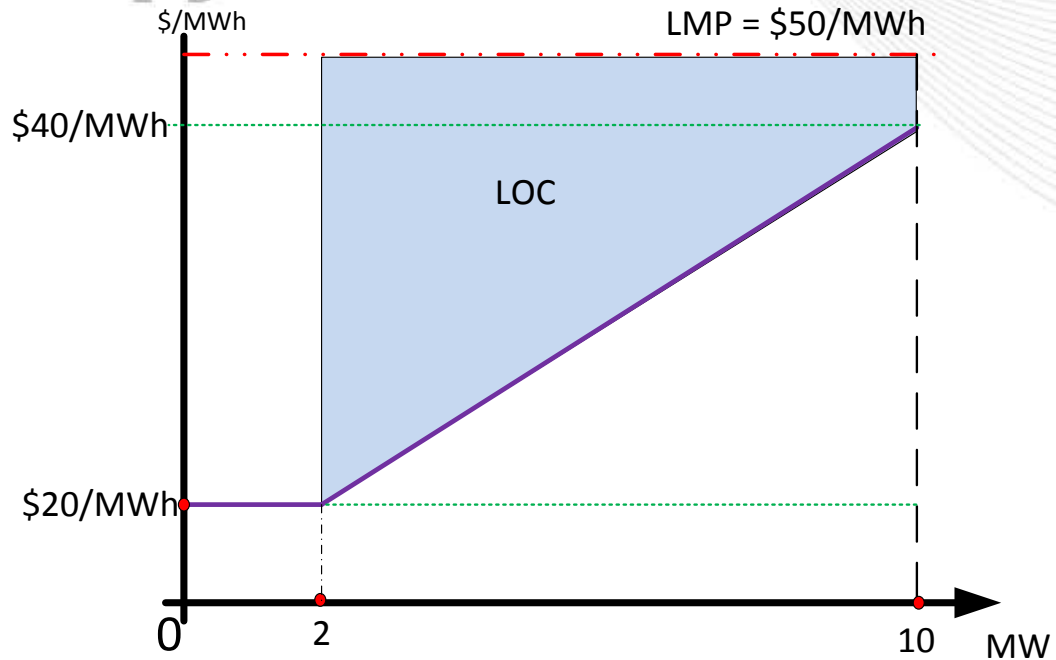
Where:

LMP – is the LMP at the resource bus;

MC – is the resource cost at the regulation set point;

GENOFF – is the MW deviation from the economic dispatch and the regulation set point

Note:

➢ In the clearing process, forecasted LMP is used

➢ In the pricing, Real-Time LMP is used

➢ RegLOC is further adjusted by:
  o Resource Historical Performance Score and
  o Resource Benefit Factor
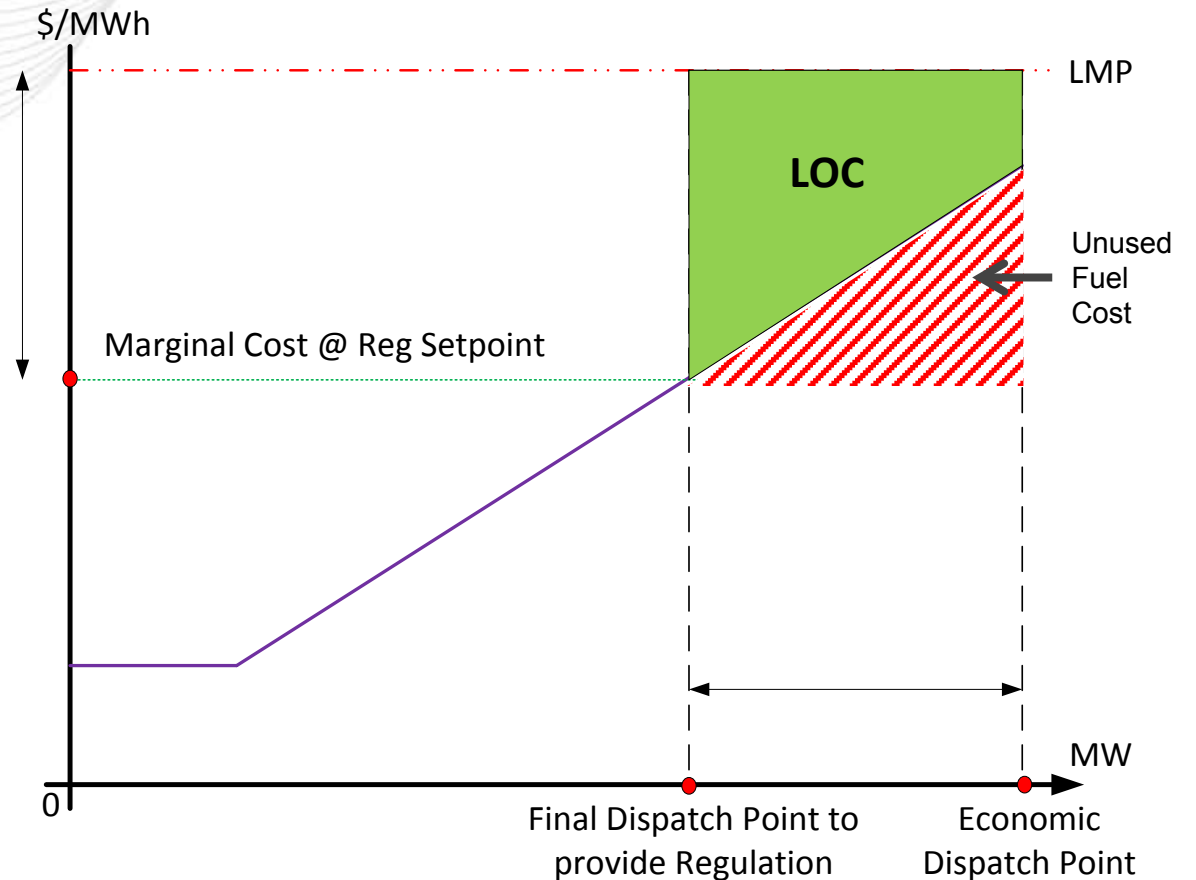
Reg MW = 8 MW
Reg Offer Price = $0
RegMax = EcoMax = 10MW
RegMin = -10 MW
LMP = $50
Energy cost at regulation set-point = $20

- Energy Only - no Regulation
- Energy Credit = LMP*MW = 50*10 = 500
- Energy Cost = (20*10) + (8*20*0.5) = 280
- Energy Revenue = 500 – 280 = 220

- Energy with Regulation
- Energy Credit = 50*2 = 100
- Energy Cost = 20*2 = 40
- Energy Cost not incurred due to RT reduction = (20*8) + (8*20*0.5) = 240
- Energy Revenue = 100 – 40 = 60
- RMCP Credit = 30*8 = 240
- LOC = (10*8) + (20*8*0.5) = 160
- Revenue when Energy with Regulation = 60 + 240 = 300
- There is an increase in margin of $80 for providing Regulation with Energy rather than Energy only

$$RegLOC\ Schedule = Least \begin{cases} available\ price - based\ energy\ schedule, \\ greatest\ (available\ cost - based\ energy\ schedule) \end{cases}$$
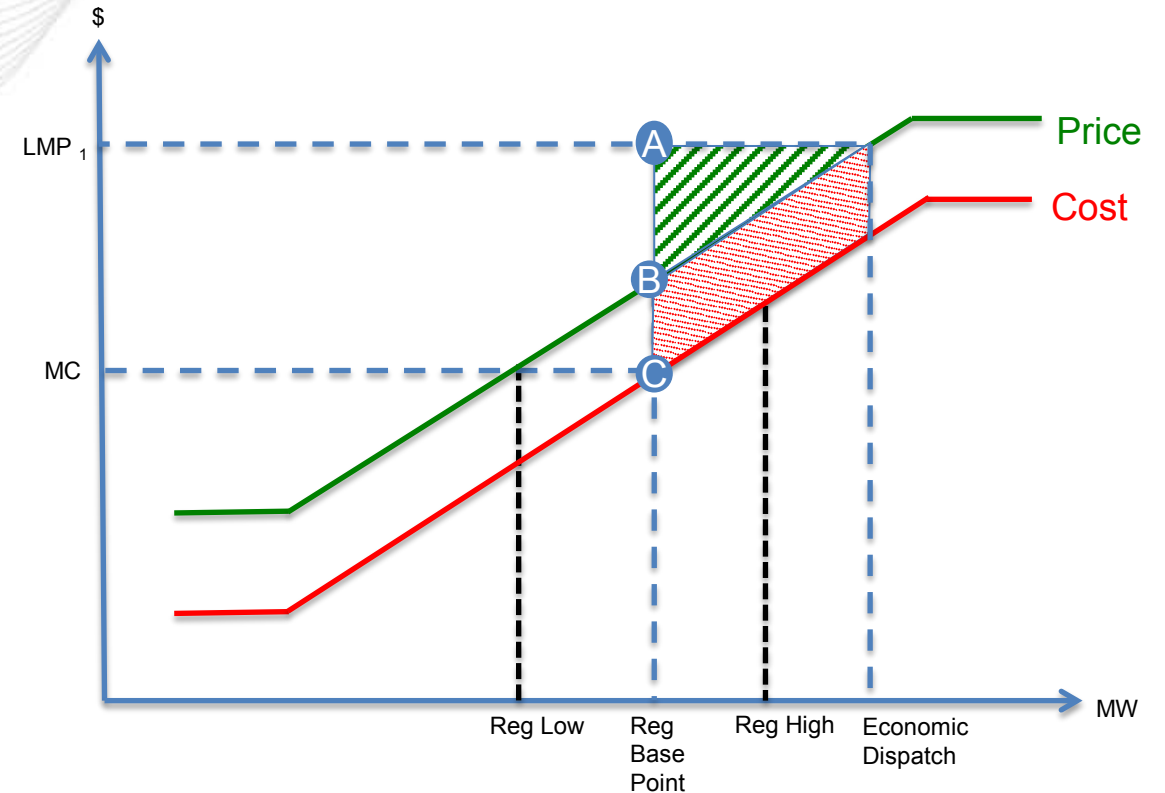
- ➤ Unit is running for energy on Price Schedule
- ➤ Reg LOC is calculated using Cost Schedule

$$LOC = \frac{|LMP_1 - MC|}{Economic\ Dispatch\ -\ Reg\ Basepoint}$$

$$LOC_{price} = \frac{|\$A\ -\ \$B|}{Economic\ Dispatch\ -\ Reg\ Basepoint}$$

$$LOC_{cost} = \frac{|\$A\ -\ \$C|}{Economic\ Dispatch\ -\ Reg\ Basepoint}$$

- ➤ Resource is paid the green + red portion
- ➤ Resource should only be paid the green portion
- ➤ In this case, we are overvaluing the cost of the resource to provide regulation

$$RegLOC \; Schedule = Least \left\{ \begin{array}{l} available \; price - based \; energy \; scheduled, \\ greatest \; (available \; cost - based \; energy \; schedule) \end{array} \right\}$$

- ➢ Unit is running for energy on Price Schedule
- ➢ Reg LOC is calculated using Cost Schedule

$$RegLOC = \frac{|LMP_2 - MC|}{Reg \; Basepoint - Economic \; Dispatch}$$

$$RegLOC_{price} = \frac{|\$A - \$B|}{Reg \; Basepoint - Economic \; Dispatch}$$

$$RegLOC_{cost} = \frac{|\$A - \$C|}{Reg \; Basepoint - Economic \; Dispatch}$$

- ➢ Resource is paid the red portion
- ➢ Resource should be paid the green + red portion
- ➢ In this case, we are undervaluing the cost of the resource to provide regulation
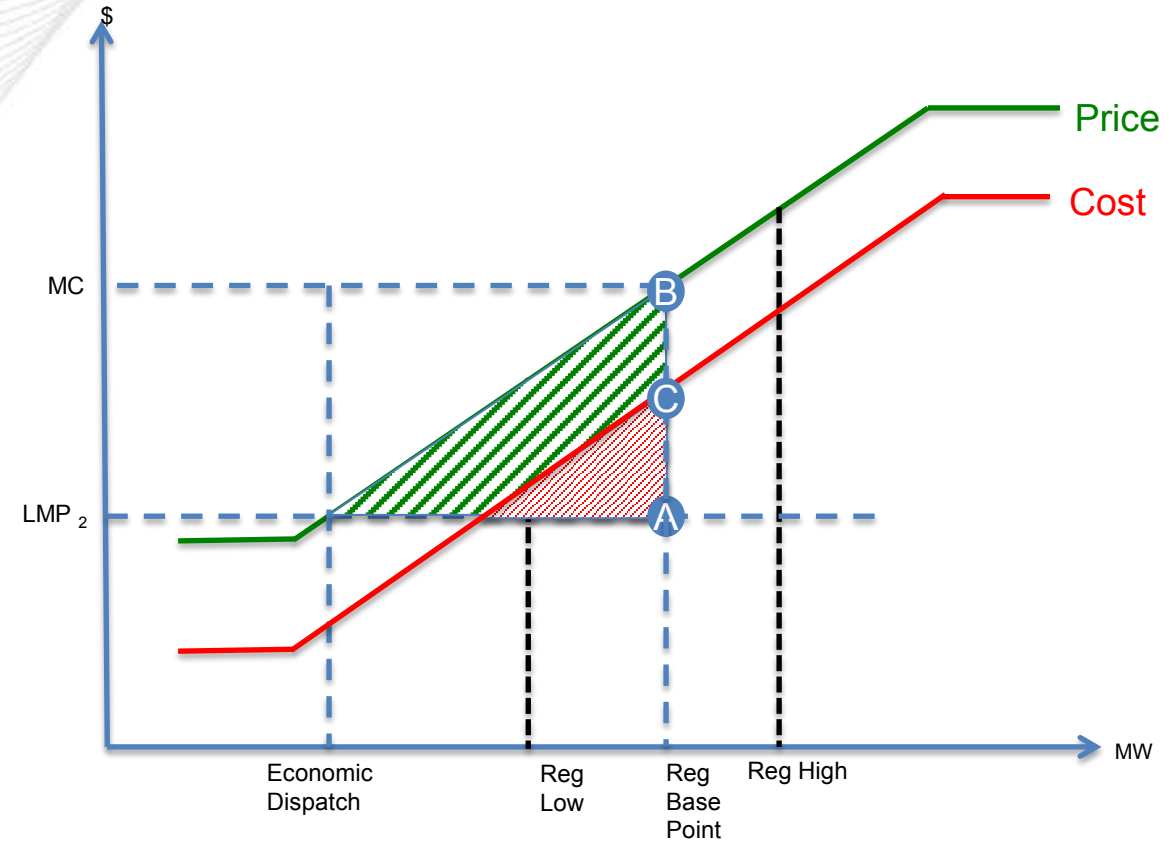
- If the marginal resource is backed down uneconomically to provide regulation, the RMCP is likely inflated

- If the marginal resource is raised uneconomically to provide regulation, the RMCP is likely suppressed

  – Resources are still compensated in settlements to cover costs after the fact

- RMCP in these cases may not send the correct market signal