Dynamic Reserves

Matthew Musto

Market Solutions Engineering

Ashley Ferrer

Energy Market Design

Kanchan Upadhyay

Ting Dai

Market Solutions Engineering

ICAPWG/MIWG

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Agenda

- Background
- Scheduling and Pricing of Long Island Reserves
- Scheduling and Pricing of Long Island Reserves: Examples
- Next Steps

Background

Previous Presentations

Title/Topic	Link
March 7, 2023 MIWG	https://www.nyiso.com/documents/20142/36639552/Dynamic%20Reserves%20-%2020230307%20MIWG_final.pdf/a29ccf5d-4c26-5cbf-0103-5bece7edb276
March 31, 2023 MIWG	https://www.nyiso.com/documents/20142/36828420/MIWG%20March%2031%20Dynamic%20Reserves%20Postings%20and%20LMP.pdf/81c35384-2438-1e03-e021-6e7ecc18f9d7
September 5, 2023 MIWG	https://www.nyiso.com/documents/20142/39768278/2%2020230905%20MIWG%20-%20Dynamic%20Reserves.pdf/d58e28ab-de87-7a86-4296-a8c21f7c764f
September 14, 2023	https://www.nyiso.com/documents/20142/40004830/20230914%20MIWG%20-%20Dynamic%20Reserves.pdf/a1c6d806-5b67-a8fc-9d04-a1669a926f54

Current Progress

- At the 9/14/2023 MIWG, the NYISO provided numerical examples to demonstrate and discuss how a Nodal Reserve Design will impact energy scheduling, reserve scheduling, LBMP formation, and reserve price formation
  - Those examples were based on a topology similar to an interface into an existing reserve area, such as NYC
- Today's presentation will utilize the same model to demonstrate how the Nodal Reserve Design will be used to solve in an export-constrained area such as Long Island
  - This presentation will also discuss how Long Island will be modelled in the optimization

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Foundation for Market Design Concepts

- **Energy scheduling constraints are formulated as follows:**
  - $\sum Shift\ Factors\ * (Gen\ and\ Load\ Schedules) \leq \text{Line Limit}$
    - 'Line Limit' is based on the normal limit for a base case constraints and LTE or MTE limits for a post contingency constraints.
    - The associated shift factors for Generation and Load come from the Network Security Analysis (NSA) power flow tool.
- **This formulation would be extended for Operating Reserves subject to successful integration into NYISO BMS software**
  - NYISO has identified approximately 20 lines which make up key interfaces across NYCA and factor into reserve area definitions, for which NYISO would monitor for post-contingency limits
  - New reserve constraints need to be modeled similarly to the transmission constraint and validated within the market software: $\sum Shift\ Factors\ (Gen, Load, and\ Reserves) \leq Line\ Limit$
  - Reserve shift factors are negative in the above equation so that only resources which would provide relief for the constraint would be evaluated
  - The 'Line Limit' and reserve product would be based on the projected overload and timing requirements to restore the flows on the facility, after the contingency
  - The shift factors used to calculate the reserve constraints are based on the appropriate constraints operating requirements

Generator Shift Factor Approach: Defining Locational Reserve Constraints

- **The locational reserve requirements (except for NYCA) would need to reflect the post-contingency system conditions as defined by reliability criteria:**
  - Loss of Transmission: The constraint would be evaluated for each monitored transmission element or interface[1] (*e.g.*, Central-East)
    - 10-Minute Total Reserves: Transmission elements must be below applicable limits[2] within 15 minutes following a single transmission contingency
      - [Post-Contingency Energy Flow – 10-Minute Reserves] <= Applicable Limits
    - 30-Minute Total Reserves: Transmission elements must be below Normal Transfer Criteria within 30 minutes following two transmission contingencies
      - [Post-Contingency Energy Flow – 30-Minute Reserves] <= Normal Transfer Criteria

1: The only interface that would be evaluated would be Central-East. All other transmission elements would be monitored individually.
2: An applicable limit for different constraints based on reliability criteria or system topology. For example, 1) reserve constraints for voltage conditions across the East interface would be based on Central East – Voltage Collapse maximum transfer capability and 2) reserve constraints for thermal conditions in NYC may be based on actual flows over LTE limits and 3) reserve constraints for thermal conditions in Long Island may be based on post contingency flows for the next contingency over LTE limits.

Generator Shift Factor Approach: Defining Locational Reserve Constraints (continued)

- **The locational reserve requirements (except for NYCA) would need to reflect the post-contingency system conditions as defined by reliability criteria:**
  - Loss of Generation: The constraint would be evaluated for each monitored transmission element or interface against the loss of each generator
    - 10-Minute Total Reserves: Transmission elements must be below applicable limits within 15 minutes following the loss of a generator
      - [Post- Generator Contingency Energy Flow – 10-Minute Reserves*] <= Applicable Limits
    - 30-Minute Total Reserves: Transmission elements must be below Normal Transfer Criteria within 30 minutes following the loss of two generators
      - [Post- Generator Contingency Energy Flow – 30-Minute Reserves*] <= Normal Transfer Criteria
  - Loss of Generation and Transmission: This constraint would be evaluated for each monitored transmission against the loss of a generation and transmission element
    - 30-Minute Total Reserves: [Post-Contingency Energy Flow – 30-Minute Reserves*] <= Normal Transfer Criteria
    - N-1 Transmission flow and loss of largest effective unit (Gen_MW * N-1_SF) for 30T requirement

* Not counting Reserves on the lost unit

Generator Shift Factor Approach: Defining NYCA Reserve Constraints

- **Transmission flows and limits are only used in determining the reserve distribution within the NYCA**
  - NPCC and NYSRC rules require the NYISO to procure reserves in NYCA to cover the largest capability loss; therefore, the determination of the reserve requirement for NYCA does not consider transmission from external control areas
- **Nodal transmission security will determine distribution of the requirement**
  - All Reserve providers will have a shift factor of “unity” towards NYCA requirement
- **The proposed reserve constraints for NYCA would be:**
  - 10-Minute Spin: Equal to one-half of the NYCA 10-Minute Total requirement
  - 10-Minute Total: Equal to the output of most severe contingency (*i.e.*, largest generator schedule)
  - 30-Minute Total: Equal to the output of the Largest Generator + Second Largest Generator + max(0,(Forecast – Bid))
    - Basing the requirement on the combined output of the largest and second largest generators meets the NYSRC requirement for 30-Minute reserves. The NYSRC requirements state that: 1) NYISO must have enough 30-Minute Reserves equal to one-half of the 10-Minute Reserve requirement (i.e., one-half of the capability of the largest generator; and 2) NYISO must restore 10-Minute reserves within 30 minutes of a contingency[1]
    - NYISO’s use of a multiplier of 2*largest generator is an approximation of this requirement. Calculating the reserve requirement based on the capability of the largest and second largest contingency would allow NYISO to have enough reserves to restore flows and 10-Minute reserves within 30 minutes

1: https://www.nysrc.org/wp-content/uploads/2023/07/RRC-Manual-V46-final.pdf

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Scheduling and Pricing of Long Island Reserves

Current Procurement of Reserves on Long Island

- **Long Island is an export constrained area**
  - For reserves, this means that the current Long Island reserve requirement is limited to a static value
    - The amount of reserves scheduled on Long Island is set to 270-540 MW, depending on the hour
  - Reserves cannot be scheduled in excess of those requirements, even if:
    - More reserves are economically available to contribute to the SENY, East, and NYCA reserve requirements
    - System capability exists to ensure physical delivery
  - As discussed during the 2022 MDCP, Dynamic Reserves would allow reserves to be economically and dynamically scheduled up to transmission limits
    - Activation of reserves on LI would reduce import energy flows to LI
    - LI reserves would be able to contribute to the NYCA reserve requirement
- **To implement Dynamic Reserves on Long Island, the following would need to occur:**
  - Deactivate/Remove static limits on reserve scheduling
  - Eliminate penalty cost for scheduling reserves over the requirement

Long Island Reserve Scheduling: Proposal

- **Long Island Reserve constraints will work similar to other reserve constraints, i.e., reserves required to restore the flow to appropriate transmission elements' limits in the event of a transmission and/or generator contingency(s)**
- **Reserves carried on Long Island generators can count towards NYCA Reserve Requirement**
  - The inflow on lines into Long Island would set a cap on how much Long Island reserves can count towards meeting the NYCA requirement
    - E.g. Suppose there are two lines into Long Island (LI) – Y1 and Y2. Flow on Y1 and Y2 into LI is 400MW and 300MW, respectively. This means only reserves that would reduce the flow on Y1 up to 400MW and/or on Y2 up to 300MW can count towards NYCA requirement.
    - This would be modeled as a reserve export constraint
  - A similar concept can be utilized to model reserves from other export constrained areas, if needed in future

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Long Island Energy & Reserve Prices

- **The Long Island nodal generator LBMPs need to account for the flow constraint that limits the amount of Long Island reserves that count towards the NYCA reserve requirement**
  - This constraint will be referred to as Long Island reserve export constraint
  - Long Island generators have a negative sensitivity to inflow into Long Island, so the shadow price of the Long Island reserve export constraint times the generator shift factor needs to be included in LBMP formation for Long Island generators
- **Reserve prices for Long Island generators also should take into account if the Long Island reserve export constraint is binding**
- **LI Energy and Reserve pricing concept has been demonstrated through simple examples in subsequent slides**
- **Under the Generator Shift Factor approach, reserve providers on Long Island will be paid the nodal reserve price**
  - Today, Long Island reserve providers are settled at the SENY clearing price for reserves

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Scheduling and Pricing of Long Island Reserves: Examples

Long Island Reserve Examples

- **As discussed at the 9/14/23 MIWG, the NYISO developed a Security Constrained Economic Dispatch (SCED) 5 Bus Model to test the feasibility of the Generator Shift Factor Approach to solve for 10-Minute Reserves (N-1 transmission or generation contingency)**
  - This model is similar to a transmission interface into an existing reserve area (such as NYC, SENY, East, and Long Island)
  - The 9/14/23 examples were based on an interface into an area similar to NYC
- **The model discussed today was developed to test the feasibility of the reserve constraints into an export constrained area such as Long Island**
  - The setup and results of this model are discussed on the following slides
- **The model supports the concept of a Nodal Reserve Design to solve for reserves and exportability in an export-constrained area**
  - The examples also include pricing and scheduling calculations

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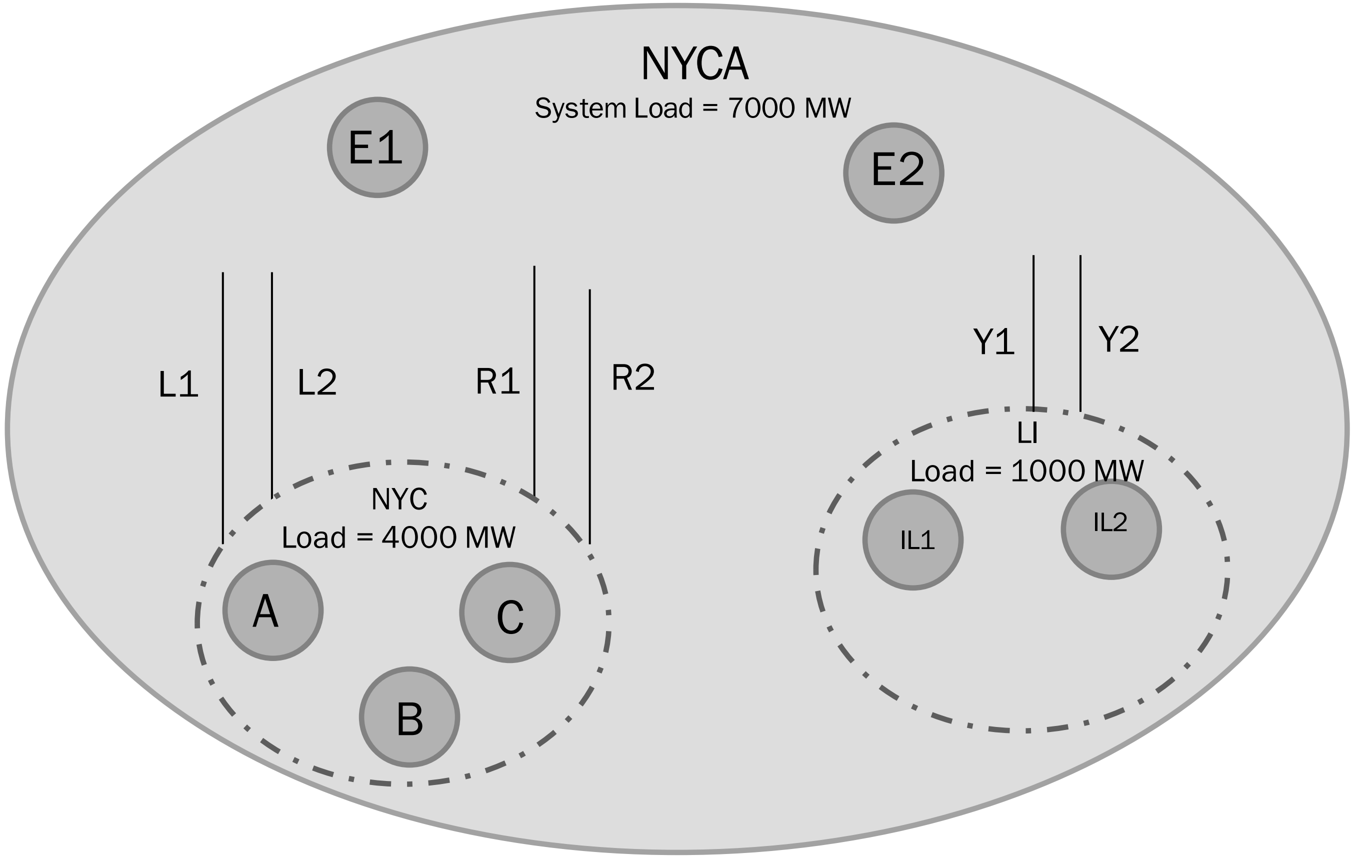
Model Setup: System Topology

- **The model solves for a system load of 7000 MW, NYC load of 4000 MW, and LI load of 1000 MW**
- **The model consists of:**
  - 6 transmission lines (3 transmission interfaces with 2 lines each): 2 interfaces into NYC and 1 interface into LI
  - 7 generators: 2 generators rest-of-state, 3 generators in NYC, and 2 generators in LI
    - Generators E1 and E2 are assumed to have high ramp rates to represent collective ramp available on multiple units
- **The line ratings provided are the Normal/LTE/MTE ratings**
- **This model also assumes a NYCA reserve requirement of 1000 MW**
  - All units will have a unity shift factor of "1" towards meeting the NYCA reserve requirement



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Model Setup: Pre-Contingency Generator Shift Factors

- **The model utilizes the following pre-contingency generator shift factor assumptions:**
  - NYC generators have high negative shift factors on the transmission lines into NYC; Long Island generators have high negative shift factors on the transmission lines into Long Island. Upstream generators have low negative shift factors or positive shift factors on interface lines
    - These examples assume equal distribution of inflow into LI between Y1 and Y2
  - Pre-contingency generator shift factors are used to evaluate whether energy schedules violate limits in the base case, and whether energy plus reserve schedules violate limits in the Loss of Generation contingency cases

Pre-contingency Generator Shift Factors

	L1	L2	R1	R2	Y1	Y2	Sum
A	-0.375	-0.375	-0.125	-0.125	0	0	-1
B	-0.24	-0.24	-0.26	-0.26	0	0	-1
C	-0.075	-0.075	-0.425	-0.425	0	0	-1
E1	0.025	0.025	-0.025	-0.025	0	0	0
E2	-0.025	-0.025	0.025	0.025	0	0	0
IL1	-0.025	-0.025	0.025	0.025	-0.5	-0.5	-1
IL2	-0.025	-0.025	0.025	0.025	-0.5	-0.5	-1

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Model Setup: Post-Contingency Generator Shift Factors

- **The model utilizes the following generator shift factor assumptions:**
  - Post-contingency generator shift factors are used for post-contingency flow analysis and Loss of Transmission reserve constraints
  - The table on this slide shows the post-contingency shift factors for Generator A. The post-contingency shift factors for Generators B, C, E1, E2, IL1, and IL2 are in the Appendix

Generator A Post-Contingency Shift Factors

Loss of L1						
L1	L2	R1	R2	Y1	Y2	Sum
N/A	-0.65	-0.175	-0.175	0	0	-1
Loss of L2						
L1	L2	R1	R2	Y1	Y2	Sum
-0.65	N/A	-0.175	-0.175	0	0	-1
Loss of R1						
L1	L2	R1	R2	Y1	Y2	Sum
-0.4	-0.4	N/A	-0.2	0	0	-1
Loss of R2						
L1	L2	R1	R2	Y1	Y2	Sum
-0.4	-0.4	-0.2	N/A	0	0	-1

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Model Setup: Load Shift Factors

- **Load shift factors are also an input into the Dynamic Reserves solution. The load shift factors represent the impact a MW of load has on the reserve constraint.**
- **The model utilizes the following load shift factor assumptions:**
  - Upstream load: This load is modeled to be located at the Marcy Bus and therefore have a shift factor of 0 on the interface lines.
  - Downstream load in NYC: An equal distribution across each line, with a pre-contingency load shift factor 0.25 for each line, and a post-contingency load shift factor 0.33 for each line.
  - Downstream load in LI: An equal distribution across each line, with a pre-contingency load shift factor 0.5 for each line, and a post-contingency load shift factor 1 for each line.

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Model Setup: Reserve Constraints

- Reserve constraints are introduced into the model to represent each potential N-1 contingency only
- These constraints require that there be enough reserves to restore flows to the LTE rating within 15 minutes following a generation or transmission contingency (10-minute reserves used to meet 15-minute requirement)
- In this model, there are 30 different reserve constraints which are evaluated
  - For example, the 14 Loss of Transmission constraints includes: 12 NYC constraints (Loss of L1 on R2, Loss of L1 on R3, Loss of L1 on L2, etc.) and 2 Long Island constraints (Loss of Y1 on Y2 and Loss of Y2 on Y1)
  - For example, the 16 Loss of Generation constraints includes: 12 NYC Constraints (Loss of Generator A on L1, Loss of Generator A on L2, Loss of Generator A on R1, Loss of Generator A on R2, etc.) and 4 Long Island constraints (Loss of IL1 on Y1, Loss of IL1 on Y2, Loss of IL2 on Y1, Loss of IL2 on Y2)
- This model also includes the reserve export constraint to set a cap on how much Long Island reserves can count towards meeting the NYCA requirement

Development of Examples

- **NYISO developed 2 examples to demonstrate Long Island Reserve Pricing and Scheduling**
  - Example 1: All Long Island Reserves are exportable to meet NYCA requirements
  - Example 2: Not all Long Island Reserves are exportable to meet NYCA requirements
- **The following generator parameters change between Example 1 and 2:**
  - Increased UOL on Long Island generators
  - Reduced offers on Long Island generators
  - Increased ramp rates on Long Island generators
  - Reduced limits on Y1 and Y2

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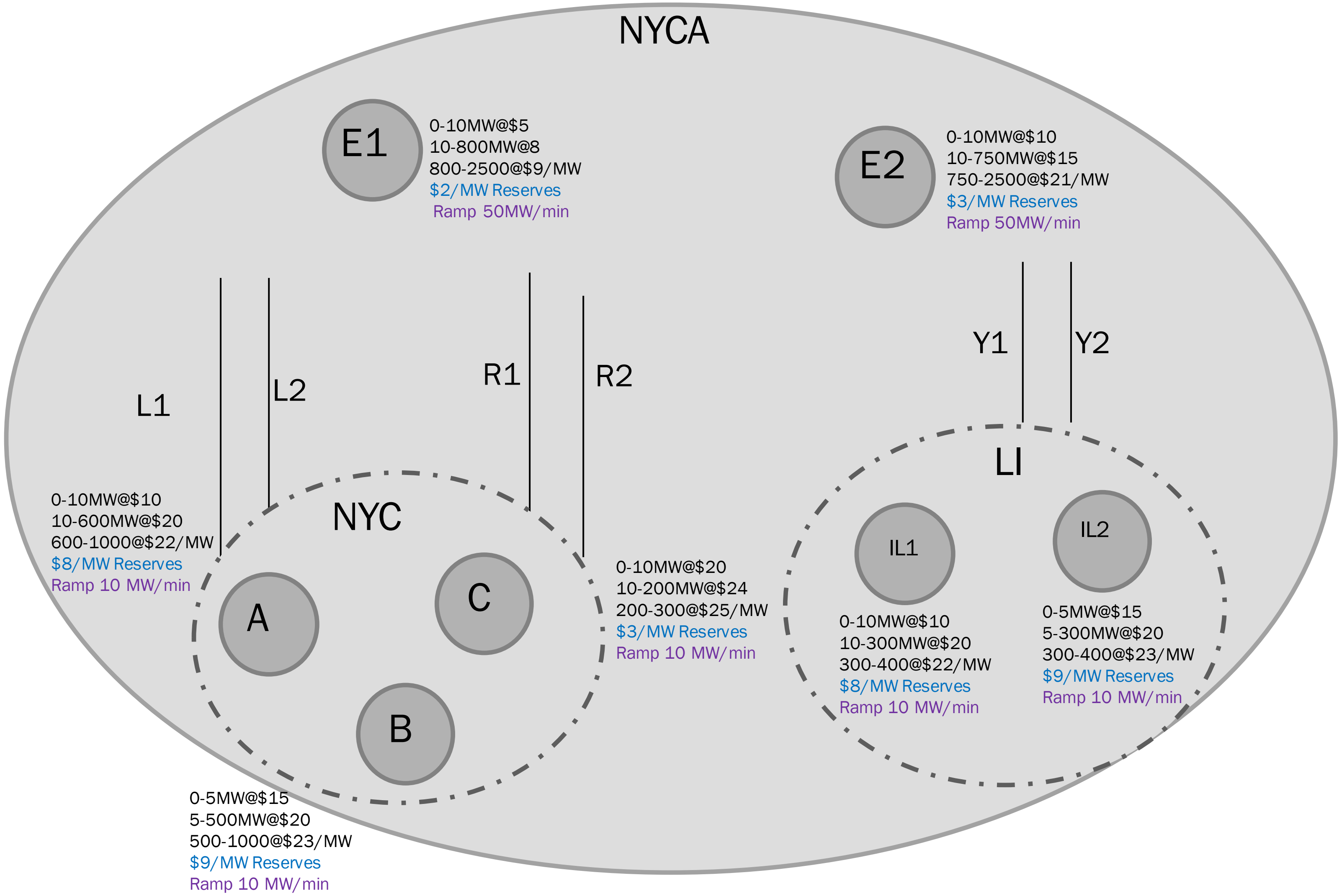
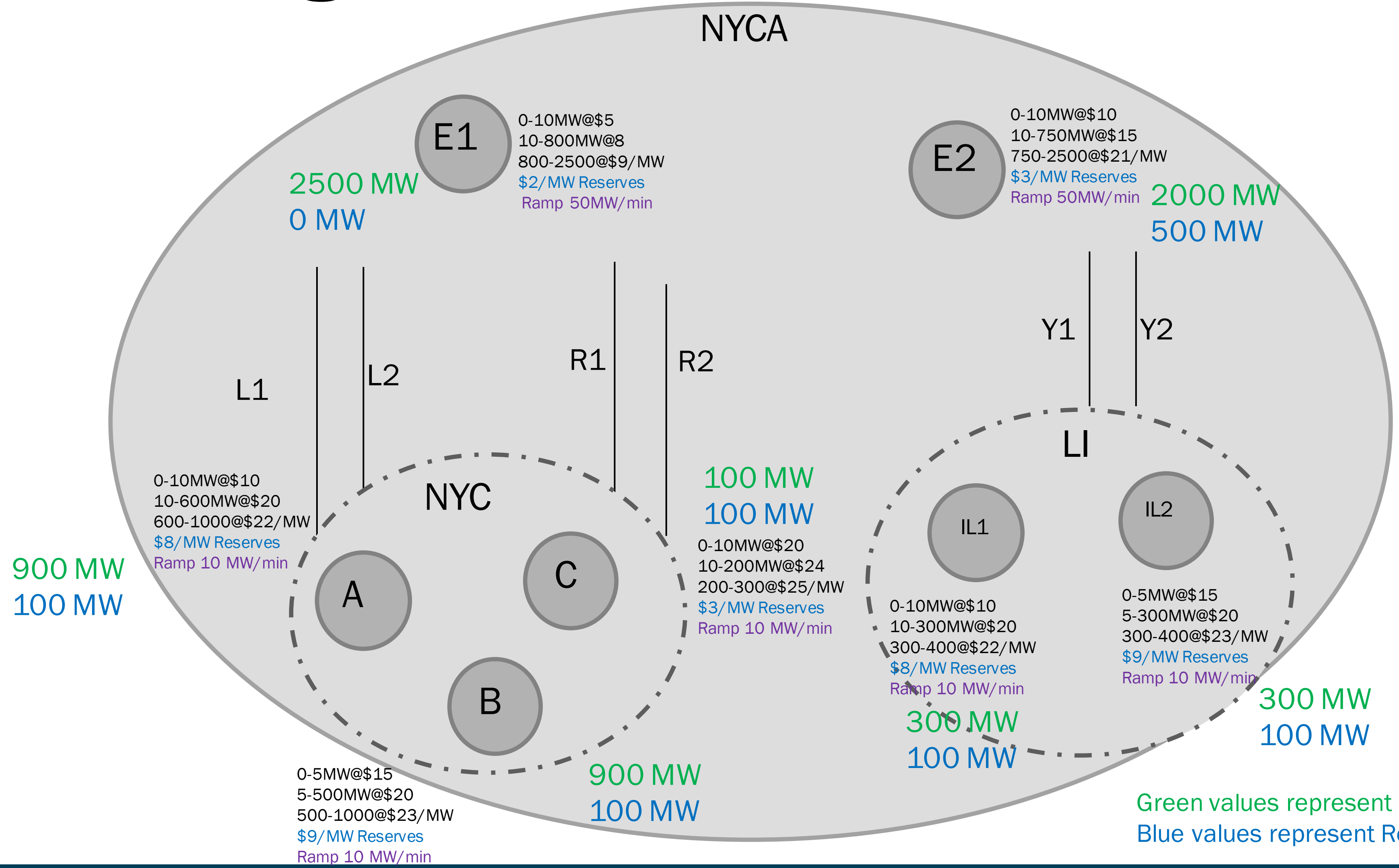
Example 1

Long Island Example 1 Inputs: Generator Offers and Ramp Rates



Long Island Example 1 Results: Generator Scheduling



Green values represent Energy Schedules
Blue values represent Reserve Schedules

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Long Island Example 1 Results: Solve for Reserve Constraints

- **In Example 1, the reserve procurement is 1000 MW**
- **200 MW of reserves is on Long Island generators**
  - This is below scheduled flows of 200 MW into Long Island over Y1 and Y2 each, therefore, all reserves are exportable to meet NYCA requirements
- **The table on the right shows the base case flows and worst-case post-contingency (transmission and generation) flows for each line**
  - In this case, post-contingency flows are below LTE for all transmission lines

	L1	L2	R1	R2	Y1	Y2
Line Ratings (Normal/LTE/MTE)	741/858/1083.5	741/858/1083.5	799/956/1249.5	799/956/1249.5	677/913/913	693/940/940
Base Flow	424	424	626	626	200	200
N-1 Transmission Contingency Flow	676	676	876	876	400	400
N-1 Generation Contingency Flow	762	762	860	860	350	350

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Example 1 Results: Reserve Constraint Shadow Prices

- **There are no binding reserve constraints except for NYCA constraint**
  - Post-contingency flows are below LTE for all transmission lines
- **The reserve shadow price for the NYCA Reserve Requirement is $10/MW**
  - All reserve providers have a shift factor of "1" towards the NYCA reserve requirement
  - Since the NYCA requirement is static for these examples, the NYCA reserve price will only be included in the generator reserve price, not the generator LBMP
  - Gen A and B are setting the reserve price with their offers and lost opportunity cost of energy

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Example 1 Results: Generator Energy and Reserve Pricing

- Since there are no binding transmission or reserve constraints in this example, the generator LBMP for each generator is equal to the System Lambda of $24/MW
- The reserve procurement in this example was 1000 MW, which is the NYCA reserve requirement
  - The reserve price is $10/MW

	LBMP	Nodal Reserve Price
Generator A	$24.00	$10.00
Generator B	$24.00	$10.00
Generator C	$24.00	$10.00
Generator E1	$24.00	$10.00
Generator E2	$24.00	$10.00
Generator IL1	$24.00	$10.00
Generator IL2	$24.00	$10.00

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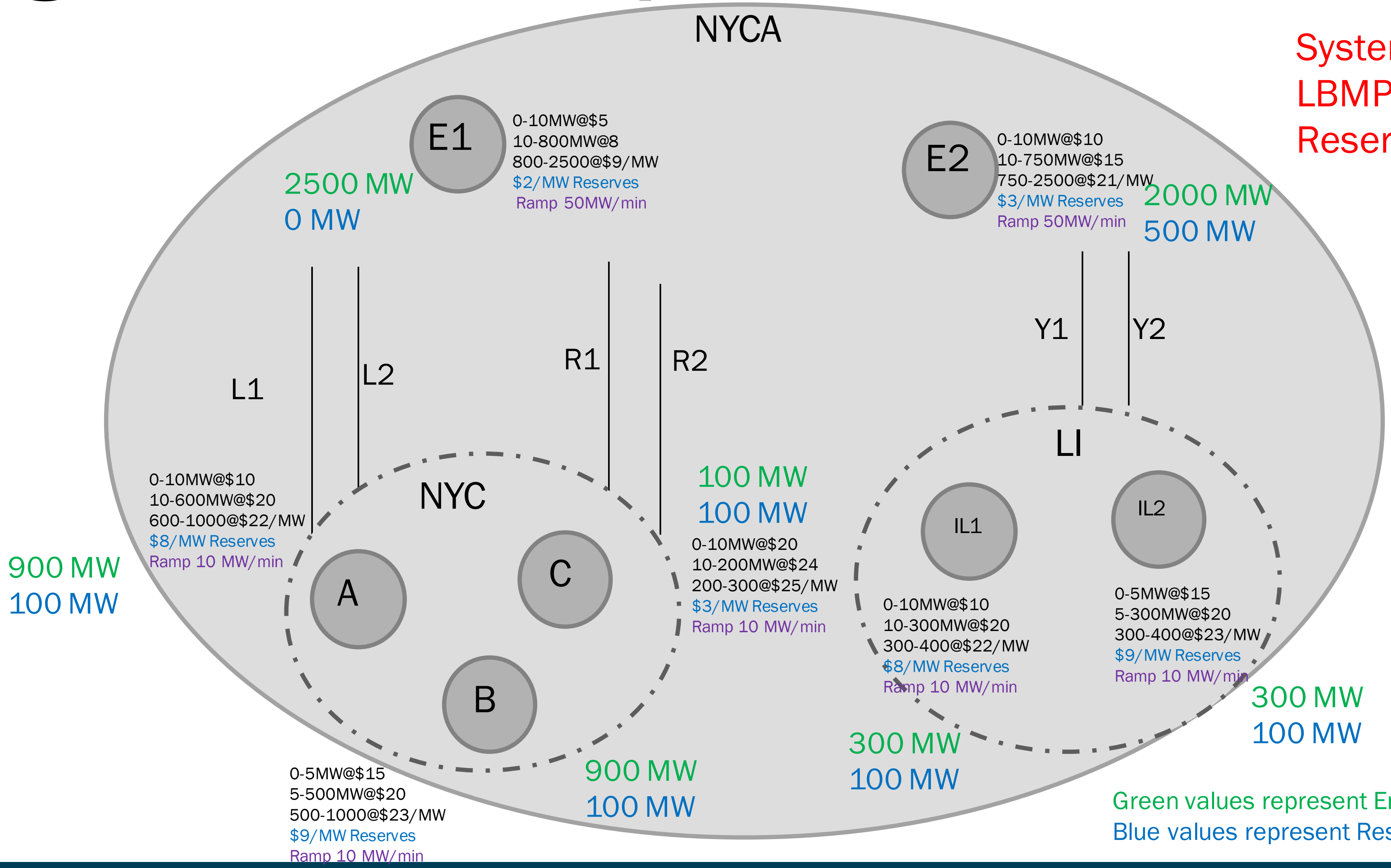
Long Island Example 1 Results



System Lambda = $24/MW
LBMP = $24/MW
Reserve price = $10/MW

Green values represent Energy Schedules
Blue values represent Reserve Schedules

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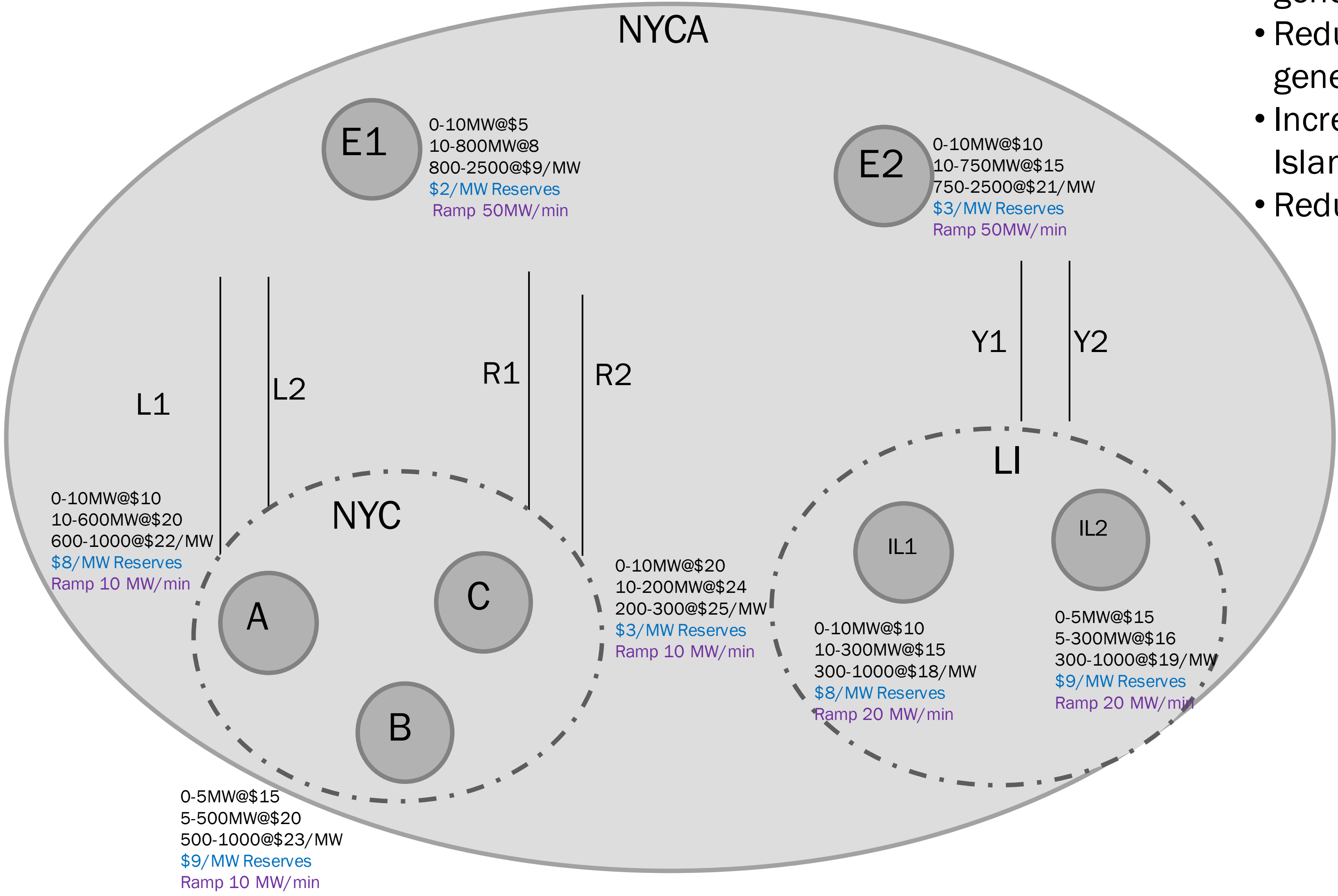
Example 2

Long Island Example 2 Inputs: Generator Offers and Ramp Rates



Changes from Example 1:

- Increased UOL on Long Island generators
- Reduced offers on Long Island generators
- Increased ramp rates on Long Island generators
- Reduced limits on Y1 and Y2

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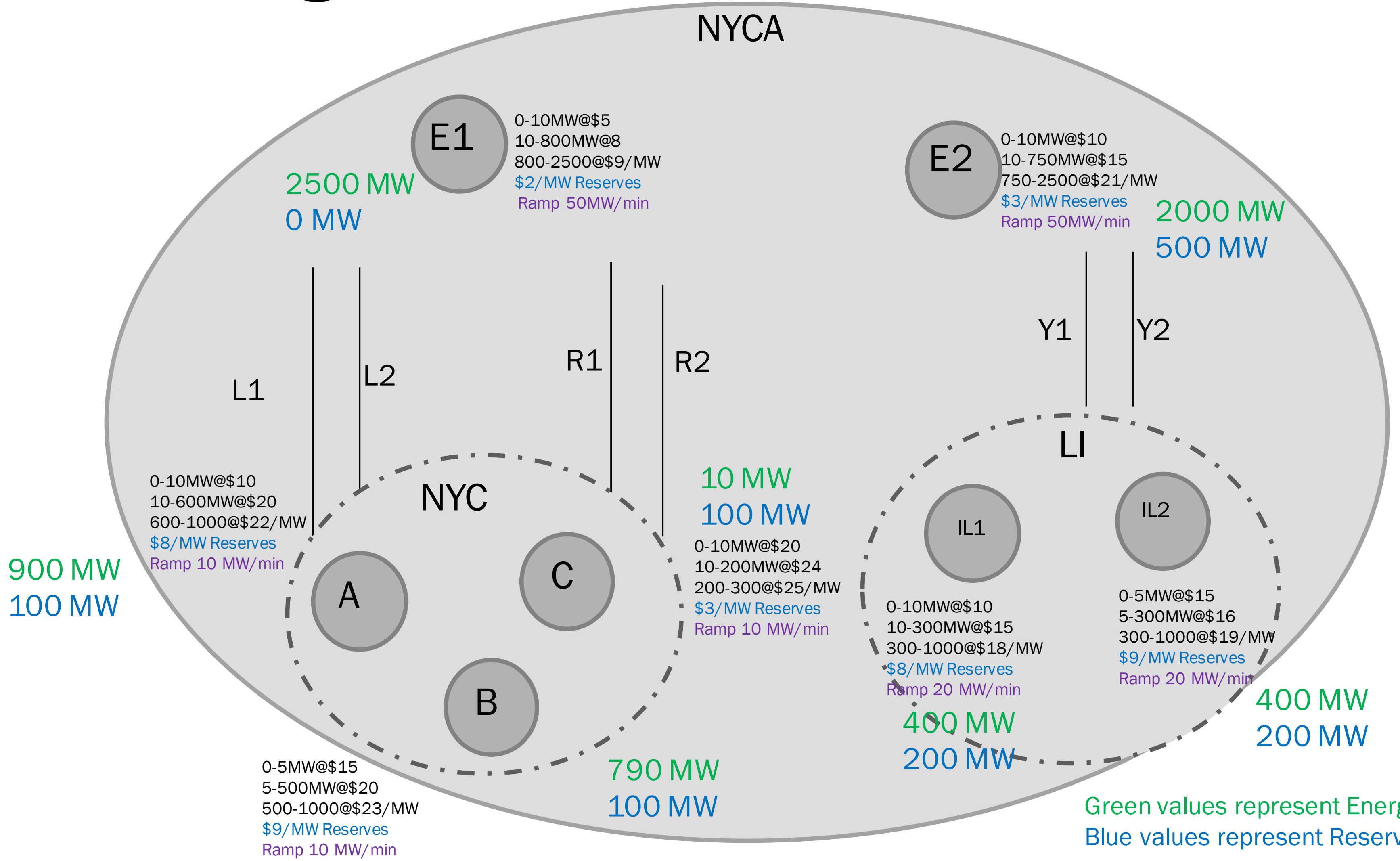
Long Island Example 2 Results: Generator Scheduling



Green values represent Energy Schedules
Blue values represent Reserve Schedules

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Long Island Example 2 Results: Solve for Reserve Constraints

- **In Example 2, the reserve procurement is 1200 MW**
- **400 MW of reserves are on Long Island generators**
  - This is greater than the 200 MW of flows on Y1 and Y2
  - Only 200 MW of reserves from Long Island can be scheduled to meet the NYCA reserve requirement
  - The total reserve procurement is greater than 1000 MW to account for this export constraint
    - This is a co-optimized model, indicating that it is the most cost-effective solution to hold 1200 MW of reserves
- **The table on the right shows the base case flows and worst-case post-contingency (transmission and generation) flows for each line**
  - In this case, the two binding constraints are the Loss of IL1 on Y1 and Loss of IL2 on Y2
  - Following the loss of either generator, the total available relief would be the reserves on the remaining generator: 200 MW*0.5 = 100 MW, which would bring line flows from 300 MW to the LTE of 200 MW

	L1	L2	R1	R2	Y1	Y2
Line Ratings (Normal/LTE/MTE)	741/858 /1083.5	741/858 /1083.5	799/956 /1249.5	799/956 /1249.5	125/200 /300	125/200 /300
Base Flow	452	452	698	698	100	100
N-1 Transmission Contingency Flow	715	715	954	954	200	200
N-1 Generation Contingency Flow	790	790	903	903	300	300

Long Island Example 2 Results: Reserve Constraint Shadow Prices and Generator Energy Pricing

- **There are three binding reserve constraints with non-zero Shadow Prices:**
  - For the Loss of Generator IL 1 on Y1: $18/MW
  - For the Loss of Generator IL 2 on Y2: $16/MW
  - Reserve export constraint: $13/MW

	System Lambda	Shadow Price for Loss of Generator IL1 on Y1	Pre-Contingency Shift Factor on Y1	Shadow Price for Loss of Generator IL2 on Y2	Pre-Contingency Shift Factor on Y2	Shadow Price of Reserve Export Constraint	Shift Factor Reserve Export Constraint	LBMP Formation	LBMP
Generator A	23	18	0	16	0	13	0	$LBMP_A = 23 + 0 * 18 + 0 * 16 + 0 * 13$	$ 23.00
Generator B	23	18	0	16	0	13	0	$LBMP_B = 23 + 0 * 18 + 0 * 16 + 0 * 13$	$ 23.00
Generator C	23	18	0	16	0	13	0	$LBMP_C = 23 + 0 * 18 + 0 * 16 + 0 * 13$	$ 23.00
Generator E1	23	18	0	16	0	13	0	$LBMP_{E1} = 23 + 0 * 18 + 0 * 16 + 0 * 13$	$ 23.00
Generator E2	23	18	0	16	0	13	0	$LBMP_{E2} = 23 + 0 * 18 + 0 * 16 + 0 * 13$	$ 23.00
Generator IL1	23	18	N/A	16	-0.5	13	1	$LBMP_{IL1} = 23 + 0.5 * 16 - 1 * 13$	$ 18.00
Generator IL2	23	18	-0.5	16	N/A	13	1	$LBMP_{IL2} = 23 + 0.5 * 18 + 0 * 16 - 1 * 13$	$ 19.00

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Long Island Example 2 Results: Reserve Constraint Shadow Prices

- The reserve procurement in this example was 1200 MW
- The reserve export constraint is binding due to export constraints for Long Island reserves
- Long Island reserve providers will be paid the marginal price for reserves, which reflects the constraint on the exportability of reserves to meet the NYCA requirement

	NYCA Reserve Price	Shadow Price Loss of Generator IL1 on Y1	Pre-Contingency Shift Factor on Y1	Shadow Price Loss of Generator IL2 on Y2	Pre-Contingency Shift Factor on Y2	Reserve Price Formation	Reserve Price
Generator A	13	18	0	16	0	$ReservePrice_A = 13 + 0 * 18 + 0 * 16$	$ 13.00
Generator B	13	18	0	16	0	$ReservePrice_{\boldsymbol{B}} = 13 + 0 * 18 + 0 * 16$	$ 13.00
Generator C	13	18	0	16	0	$ReservePrice_C = 13 + 0 * 18 + 0 * 16$	$ 13.00
Generator E1	13	18	0	16	0	$ReservePrice_{E1} = 13 + 0 * 18 + 0 * 16$	$ 13.00
Generator E2	13	18	0	16	0	$ReservePrice_{E2} = 13 + 0 * 18 + 0 * 16$	$ 13.00
Generator IL1	-	18	N/A	16	-0.5	$ReservePrice_{IL1} = 0.5 * 16$	$ 8.00
Generator IL2	-	18	-0.5	16	N/A	$ReservePrice_{IL2} = 0.5 * 18$	$ 9.00

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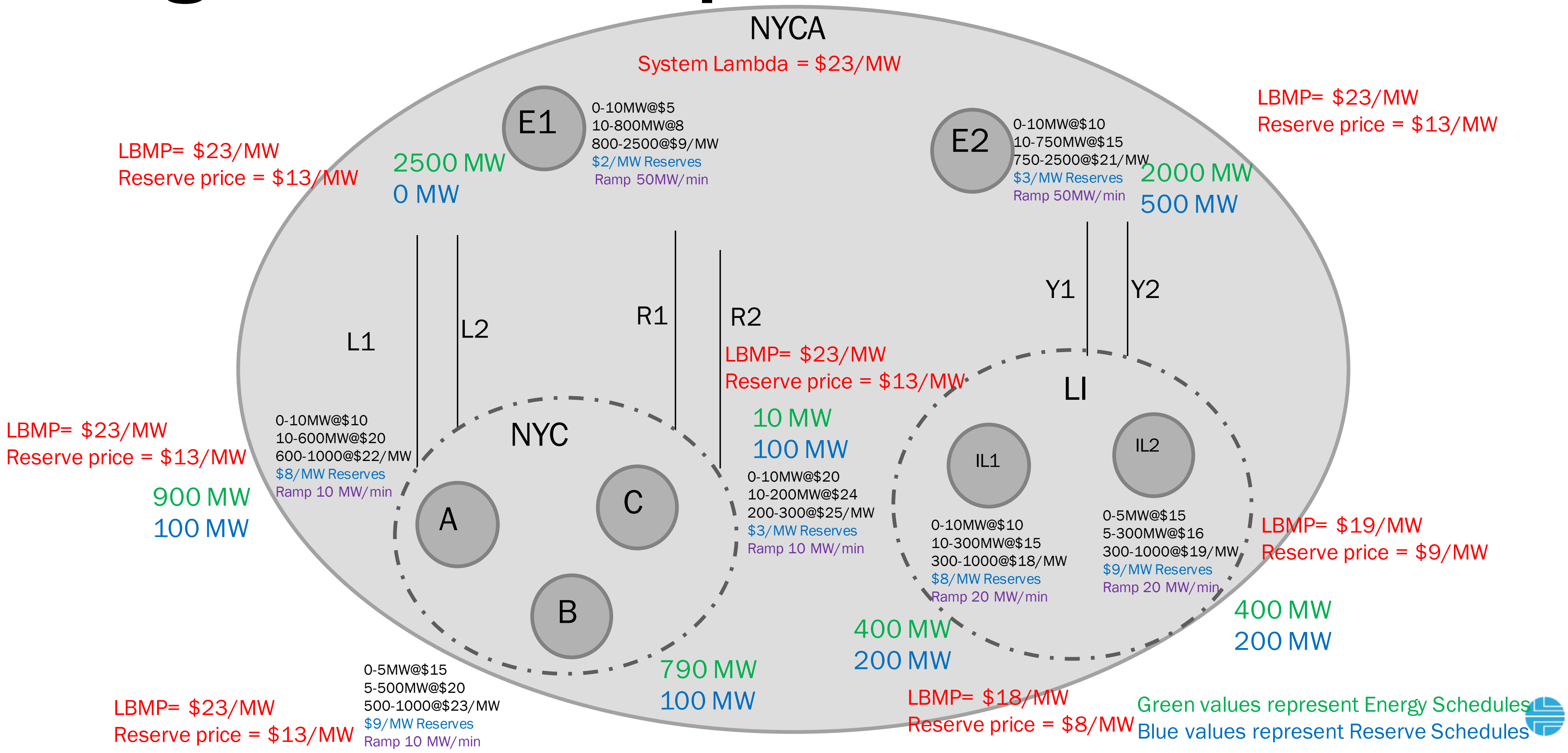
Long Island Example 2 Results



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Next Steps

Next Steps

- **The deliverable for 2023 is Market Design Complete**
- **Timeline to completion of MDC**
  - Review market design elements and comments at 9/26/23 MIWG
  - Discuss remaining outstanding market design elements and tariff at October MIWGs
  - Present MDC and tariff at November BIC

Questions?

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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Appendix: Model Setup

Model Setup: Post-Contingency Generator Shift Factors for Generator B and Generator C

Generator B - Loss of L1					
L1	L2	R1	R2	Y1	Y2
N/A	-0.4	-0.3	-0.3	N/A	N/A
Loss of L2					
L1	L2	R1	R2	Y1	Y2
-0.4	N/A	-0.3	-0.3	N/A	N/A
Loss of R1					
L1	L2	R1	R2	Y1	Y2
-0.3	-0.3	N/A	-0.4	N/A	N/A
Loss of R2					
L1	L2	R1	R2	Y1	Y2
-0.3	-0.3	-0.4	N/A	N/A	N/A

Generator C - Loss of L1					
L1	L2	R1	R2	Y1	Y2
N/A	-0.1	-0.45	-0.45	N/A	N/A
Loss of L2					
L1	L2	R1	R2	Y1	Y2
-0.1	N/A	-0.45	-0.45	N/A	N/A
Loss of R1					
L1	L2	R1	R2	Y1	Y2
-0.125	-0.125	N/A	-0.75	N/A	N/A
Loss of R2					
L1	L2	R1	R2	Y1	Y2
-0.125	-0.125	-0.75	N/A	N/A	N/A

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Model Setup: Post-Contingency Generator Shift Factors for E1 and E2

Generator E1 - Loss of L1					
L1	L2	R1	R2	Y1	Y2
N/A	0.05	-0.025	-0.025	N/A	N/A
Loss of L2					
L1	L2	R1	R2	Y1	Y2
0.05	N/A	-0.025	-0.025	N/A	N/A
Loss of R1					
L1	L2	R1	R2	Y1	Y2
0.025	0.025	N/A	-0.05	N/A	N/A
Loss of R2					
L1	L2	R1	R2	Y1	Y2
0.025	0.025	-0.05	N/A	N/A	N/A

Generator E2 - Loss of L1					
L1	L2	R1	R2	Y1	Y2
N/A	-0.05	0.025	0.025	N/A	N/A
Loss of L2					
L1	L2	R1	R2	Y1	Y2
-0.05	N/A	0.025	0.025	N/A	N/A
Loss of R1					
L1	L2	R1	R2	Y1	Y2
-0.025	-0.025	N/A	0.05	N/A	N/A
Loss of R2					
L1	L2	R1	R2	Y1	Y2
-0.025	-0.025	0.05	N/A	N/A	N/A

New York ISO

Model Setup: Post-Contingency Generator Shift Factors for IL1 and IL2

Generator IL1 - Loss of Y1
Y2
-1
Generator IL1 - Loss of Y2
Y1
-1

Generator IL2 - Loss of Y1
Y2
-1
Generator IL1 - Loss of Y2
Y1
-1