

2019-2020 NYCA IRM Requirement Study

Preliminary Base Case (PBC) Model Assumptions

Assumption Matrix

Draft V~~1.0~~2.1

June 27, 2018

Load Parameters

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|--|---|---|---|--------------|------------------|
| 1 | Peak Load Forecast (Preliminary Base Case – Parametric & Sensitivities) | 2017 Gold Book NYCA: 33,078 MW NYC: 11,707 MW LI: 5,305 MW G-J: 16,070 MW | 2018 Gold Book NYCA: 32,857MW NYC: 11,474 MW LI: 5,323 MW G-J: 15,815 MW | Most recent Gold Book Forecast is used for Preliminary Base Case parametric study and sensitivity cases | N | Low(-) |
| 2 | Peak Load Forecast (Final Base Case) | October 2017 Fcst. NYCA: 32,868 MW NYC: 11,541 MW LI: 5,445 MW G-J: 15,890 MW | October 2018 Fcst. NYCA: xx,xxx MW NYC: yy,yyy MW LI: z,zzz MW G-J: ww,www MW | Forecast based on examination of 2018 weather normalized peaks. Top three external Area peak days aligned with NYCA | N | |
| 3 | Load Shape (Multiple Load Shape) | Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 | Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 | ICS Recommendation | N | None |
| 4 | Load Forecast Uncertainty | Zonal Model to reflect current data with input from Con Ed and LIPA. (Attachment A) | Zonal Model to reflect current data with input from Con Ed and LIPA. (Attachment A) | No Change from 2108 IRM. Based on TO and NYISO data and analyses. | N | None |

*(-) indicates a reduction in IRM while (+) indicates an increase. Range: Low < 0.5%, Medium 0.5% - 1%, High > 1%, Minimal indicates there may be some movement but within 0 to +/- 0.1%.

Generation Parameters

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|--|--|--|--|--------------|------------------|
| 1 | Existing Generating Unit Capacities | 2017 Gold Book values. Use min (DMNC vs. CRIS) capacity value | 2018 Gold Book values. Use min (DMNC vs. CRIS) capacity value | Latest Gold Book publication | N | |
| 2 | Proposed New Units (Non-Renewable) and re-ratings | 784 MW of new non-wind resources, plus 52 MW of project related re-ratings. (Attachment B1) | MW <u>11.1 MW</u> of new non-wind resources, plus <u>276.8227.6</u> MW of project related re-ratings. (Attachment B1) | Latest Gold Book publication, NYISO interconnection queue, and generator notifications | N | <u>Low(-)</u> |
| 3 | Retirements, Mothballed units, and ICAP ineligible units | 0 MW retirements or mothballs reported or Units in IIFO and IR (Attachment B2) | <u>0 MW of retirements, 541.4 399.2 MW of unit deactivations, and 249.8 MW of IIFO and IR¹</u> (Attachment B2) | Latest Gold Book publication and generator notifications | N | <u>Low(+)</u> |
| 4 | Forced and Partial Outage Rates | Five-year (2012-2016) GADS data for each unit represented. Those units with less than five years – use representative data. (Attachments C and C1) | Five-year (2013-2017) GADS data for each unit represented. Those units with less than five years – use representative data. (Attachments C and C1) | Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period | N | <u>Minimal</u> |
| 5 | Planned Outages | Based on schedules received by the NYISO and adjusted for history | Based on schedules received by the NYISO and adjusted for history | Updated schedules | N | |

¹ ICAP Ineligible Forced Outage (IIFO) and inactive Reserve (IR)

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|----|--------------------------------------|---|---|---|--------------|------------------|
| 6 | Summer Maintenance | Nominal 50 MWs – divided equally between zones J and K | | Review of most recent data | N | |
| 7 | Combustion Turbine Derates | Derate based on temperature correction curves provided | Derate based on temperature correction curves provided | Operational history indicates the derates are in-line with manufacturer's curves | N | <u>None</u> |
| 8 | Existing and Proposed New Wind Units | 77.7 MW of Wind Capacity additions totaling 1733.4 MW of qualifying wind (Attachment B3) | 79.9 158.3 MW of Wind Capacity additions totaling 1813.3 1891.7 MW of qualifying wind (Attachment B3) | <u>Renewable ICAP</u> units based on RPS agreements, interconnection queue, and ICS input. | N | <u>Low (+)</u> |
| 9 | Wind Shape | Actual hourly plant output over the period 2012-2016. New units will use zonal hourly averages or nearby units. | Actual hourly plant output over the period 2013-2017. New units will use zonal hourly averages or nearby units. | Program randomly selects a wind shape of hourly production from the most recent five-year period for each model iteration. | N | |
| 10 | Solar Resources (Grid connected) | Total of 31.5 MW of qualifying Solar Capacity. (Attachment B3) | Total of 31.5 MW of qualifying Solar Capacity. (Attachment B3) | ICAP Resources connected to Bulk Electric System | N | |
| 11 | Solar Shape | Actual hourly plant output over the period 2012-2016. New units will use zonal hourly averages or nearby units. | Actual hourly plant output over the period 2013-2017. New units will use zonal hourly averages or nearby units. | Program randomly selects a solar shape of hourly production from the most recent five-year period for each model iteration. | N | |

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|----|-----------------------|---|---|--|--------------|------------------|
| 12 | BTM- NG Program | Change Stony Brook to its full 47 MW output (formerly modeled at 9.6 MW net of host load). Forecast Load adjusted to account for exposure of host load. (Attachment B4) | No Additions | Both the generation of the participating resource and the full (former) host load is modeled. | N | None |
| 13 | Small Hydro Resources | Derate by 46% | Actual hourly plant output over the period 2013-2017. | Program randomly selects a Hydro shape of hourly production from the most recent five-year period for each model iteration. | N | |
| 14 | Large Hydro | Probabilistic Model based on 5 years of GADS data | Probabilistic Model based on 5 years of GADS data (2013-2017) | Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period | N | |
| 15 | Land Fill Gas | Derates based on Capacity Factors | Actual hourly plant output over the period 2013-2017. | Program randomly selects a LFG shape of hourly production from the most recent five-year period for each model iteration. | Y | Minimal |

Transactions – Imports and Exports

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|--|--|--|--|--------------|------------------|
| 1 | Capacity Purchases | Existing Rights: PJM – 1080 MW HQ – 1110 MW All contracts model as equivalent contracts | Existing Rights: PJM – 1080 MW HQ – 1110 MW All contracts model as equivalent contracts | Grandfathered Rights, ETCNL, and other awarded long-term rights. | N | |
| 2 | Capacity Sales | Long Term firm sales Summer 283.8 MW | Long Term firm sales Summer 279.3 MW | These are long term federal contracts. | N | |
| 3 | FCM Sales from a Locality ² | No Sales within study period | No Sales modeled within study period | White Paper, NYISO recommendation, and ICS discussions | N | |
| 4 | New UDRs | No new UDR projects | No new UDR projects | Existing UDR elections are made by August 1 st and will be incorporated into the model. | N | |

² Final FCM sales that will materialize are unknowable at the time of the IRM study. To reflect the impact these sales have on reliability, the NYISO applies a Locality Exchange Factor in the market.

Topology

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|------------------------------|--|--|---|--------------|------------------|
| 1 | Interface Limits | All changes reviewed and commented on by TPAS | All changes reviewed and commented on by TPAS <u>Update provided to TPAS with no New York changes with updated VFT return path</u> (Attachment E) | Based on the most recent NYISO studies and processes, such as Operating Study, Operations Engineering Voltage Studies, Comprehensive System Planning Process, and additional analysis including interregional planning initiatives. | N | |
| 2 | New Transmission | None Identified | None Identified | Based on TO provided models and NYISO's review. | N | |
| 3 | AC Cable Forced Outage Rates | All existing Cable EFORs updated for NYC and LI to reflect most recent five-year history (2012-2016) | All existing Cable EFORs will be updated for NYC and LI to reflect most recent five-year history (2013-2017) | TO provided transition rates with NYISO review. | N | |
| 4 | UDR Line Unavailability | Five year history of forced outages(2012-2016) | Five year history of forced outages (2013-2017) | NYISO/TO review. | N | |

Emergency Operating Procedures

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|------------------------|--|--|---|--------------|------------------|
| 1 | Special Case Resources | July 2017 –1219 MW based on registrations and modeled as 868 MW of effective capacity. Monthly variation based on historical experience* | July 2018 –yyyy MW based on registrations and modeled as zzz MW of effective capacity. Monthly variation based on historical experience* | SCRs sold for the program discounted to historic availability. Summer values calculated from July 2018 registrations. Performance calculation updated per ICS presentations on SCR performance. (Attachment F) | N | |
| 2 | EDRP Resources | July 2017 16 MW registered modeled as 3 MW in July and proportional to monthly peak load in other months. Limit to five calls per month | July 2018 aa MW registered modeled as b MW in July and proportional to monthly peak load in other months. Limit to five calls per month | Those sold for the program discounted to historic availability. Summer values calculated from July registrations and forecast growth. | N | |
| 3 | Other EOPs | 609.6 MW of non-SCR/non-EDRP resources | Ccc MW of non-SCR/non-EDRP resources (Attachment D) | Based on TO information, measured data, and NYISO forecasts. | N | |

* The number of SCR calls is limited to 5/month when calculating LOLE based on all 8,760 hours.

External Control Areas

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|----------------------|--|--|--|--------------|------------------|
| 1 | PJM | Load and Capacity data provided by PJM/NPCC CP-8 Data may be adjusted per NYSRC Policy 5 | Load and Capacity data provided by PJM/NPCC CP-8 Data may be adjusted per NYSRC Policy 5 (Attachment E) | Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes. | N | |
| 2 | ISONE, Quebec, IESO | Load and Capacity data provided by ISONE/NPCC CP-8 Data may be adjusted per NYSRC Policy 5 | Load and Capacity data provided by ISONE/NPCC CP-8 Data may be adjusted per NYSRC Policy 5 (Attachment E) | Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes. | N | |
| 5 | Reserve Sharing | All NPCC Control Areas indicate that they will share reserves equally among all members and then among non-members | All NPCC Control Areas indicate that they will initially share reserves equally among all members and then among non-members | Per NPCC CP-8 WG. | N | |
| 6 | Emergency Assistance | Statewide Limit of 3,500 MW of emergency assistance allowed from neighbors. | Statewide Limit of 3,500 MW of emergency assistance allowed from neighbors. | White paper on Modelling of Emergency Assistance for NYCA in IRM studies | N | |

Miscellaneous

| # | Parameter | 2018 Model Assumptions | 2019 Model Assumptions | Basis for Recommendation | Model Change | Est. IRM Impact* |
|---|---------------------------|--|------------------------|---|--------------|------------------|
| 1 | MARS Model Version | Version 3.21.9 | Version 3.22.6 | Per benchmark testing and ICS recommendation. | N | None |
| 2 | Environmental Initiatives | No estimated impacts based on review of existing rules and retirement trends | | Review of existing regulations and rules. | N | |

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Attachment A

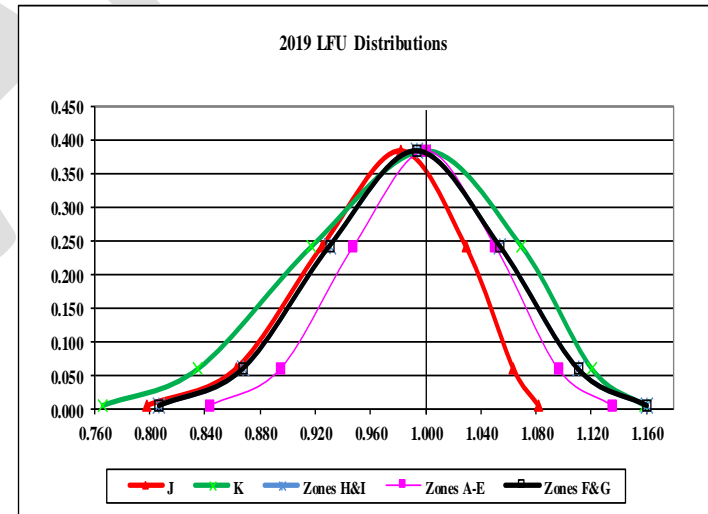
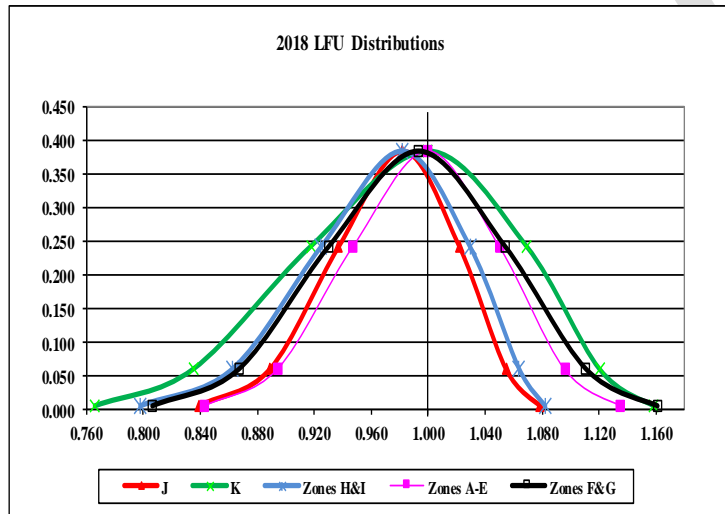
NYCA Load Forecast Uncertainty Model

2018 and 2019 LFU Models

2019 Model is Unchanged from 2018

| 2018 Load Forecast Uncertainty Models | | | | | | |
|---------------------------------------|------------|-----------|-----------|-----------|------------|----------|
| Step | Multiplier | Zones A-E | Zones F&G | Zones H&I | Con Ed (J) | LIPA (K) |
| 1 | 0.0062 | 0.8431 | 0.8067 | 0.7978 | 0.8388 | 0.7659 |
| 2 | 0.0606 | 0.8944 | 0.8674 | 0.8624 | 0.8887 | 0.8351 |
| 3 | 0.2417 | 0.9474 | 0.9303 | 0.9249 | 0.9371 | 0.9175 |
| 4 | 0.3830 | 1.0000 | 0.9933 | 0.9817 | 0.9821 | 1.0000 |
| 5 | 0.2417 | 1.0502 | 1.0541 | 1.0293 | 1.0219 | 1.0695 |
| 6 | 0.0606 | 1.0959 | 1.1107 | 1.0639 | 1.0547 | 1.1206 |
| 7 | 0.0062 | 1.1351 | 1.1608 | 1.0822 | 1.0786 | 1.1586 |

| 2019 Load Forecast Uncertainty Models | | | | | | |
|---------------------------------------|------------|-----------|-----------|-----------|------------|----------|
| Step | Multiplier | Zones A-E | Zones F&G | Zones H&I | Con Ed (J) | LIPA (K) |
| 1 | 0.0062 | 0.8431 | 0.8067 | 0.7978 | 0.8388 | 0.7659 |
| 2 | 0.0606 | 0.8944 | 0.8674 | 0.8624 | 0.8887 | 0.8351 |
| 3 | 0.2417 | 0.9474 | 0.9303 | 0.9249 | 0.9371 | 0.9175 |
| 4 | 0.3830 | 1.0000 | 0.9933 | 0.9817 | 0.9821 | 1.0000 |
| 5 | 0.2417 | 1.0502 | 1.0541 | 1.0293 | 1.0219 | 1.0695 |
| 6 | 0.0606 | 1.0959 | 1.1107 | 1.0639 | 1.0547 | 1.1206 |
| 7 | 0.0062 | 1.1351 | 1.1608 | 1.0822 | 1.0786 | 1.1586 |



Attachment B1

New Non-Wind Units and Unit Re-ratings³

| B1 - Proposed Non-wind Units and Unit Re-ratings (summer ratings) | | | | | |
|---|------|----------------------|---------------------|-------------------------|----------------------|
| Project or Generator Name | Zone | 2018 MARS Model (MW) | 2018 Gold Book (MW) | New or Incremental (MW) | 2019 MARS Model (MW) |
| New Units | | | | | |
| Arthur Kill Cogen | J | 0 | 11.1 | 11.1 | 11.1 |
| Total New Units | | 0 | | 11.1 | 11.1 |
| Existing Unit Re-ratings | | | | | |
| Bethlehem Energy Center | F | 808.9 | 787.2 | 26.1 | 813.3 |
| Bayonne Energy Center II | J | 482.5 | 458.2 | 120.4 | 578.6 |
| East River 1 | J | 152.3 | 153.1 | 2.8 | 155.1 |
| East River 2 | J | 149.1 | 154.0 | 6.9 | 156.0 |
| East River 6 | J | 136.3 | 136.3 | 8.0 | 144.3 |
| Nine Mile Point 2 | C | 1246.6 | 1,246.6 | 63.4 | 1310.0 |
| Total Unit Rerates | | | | 227.6 | |
| Total New Units + Re-rates | | | | 238.7 | |

³ Unit re-ratings are for generation facilities that have undergone uprate projects.

Attachment B2

Retiring and Ineligible Generating Units

| Attachment B2 - Announced Unit Retirements, Deactivations, and ICAP Ineligible Forced Outage (IIFO) | | | |
|---|------|-----------|---|
| Generator Name | Zone | CRIS (MW) | CRIS adusted value from 2017 Gold Book (MW) |
| Retirements | | 0.0 | 0.0 |
| Binghamton BOP | C | 43.8 | 43.7 |
| Greenport GT1 | K | 51.9 | 51.9 |
| Selkirk 1 | F | 82.1 | 78.2 |
| Selkirk 2 | F | 291.3 | 277.3 |
| Pilgrim GT1 | K | 45.6 | 45.2 |
| Pilgrim GT2 | K | 46.2 | 44.8 |
| Total Retirements | | 417.2 | 399.2 |
| Deactivations | | | |
| Ravenswood 9 | J | 21.7 | 16.3 |
| Lyonsdale?? | E | 20.2 | 20.1 |
| Ravenswood 2-1 | J | 40.4 | 31.4 |
| Ravenswood 2-2 | J | 37.6 | 29.9 |
| Ravenswood 2-3 | J | 39.2 | 28.9 |
| Ravenswood 2-4 | J | 39.8 | 30.7 |
| Ravenswood 3-1 | J | 40.5 | 31.9 |
| Ravenswood 3-2 | J | 38.1 | 29.4 |
| Ravenswood 3-4 | J | 35.8 | 31.2 |
| ICAP Ineligible | | 313.3 | 249.8 |
| Total Removals | | 730.5 | 649.0 |

Attachment B3

New Wind and Bulk Solar⁴ Resources

| B3 - New Wind and Solar Resources | | | | |
|-------------------------------------|------|-----------|------------------------|---|
| Wind Resource | Zone | CRIS (MW) | Summer Capability (MW) | CRIS adusted value from 2018 Gold Book (MW) |
| New Wind Units | | | | |
| Copenhagen Wind | E | 79.9 | 79.9 | 79.9 |
| Arkwright Summit | A | 78.4 | 78.4 | 78.4 |
| Total New Wind | | | | 158.3 |
| New (bulk power) Solar Units | | | | |
| | | | | |
| Total New Solar | | | | 0.0 |
| Total New Wind and Solar | | | | |
| | | | | 158.3 |

⁴ Bulk Power System connected solar resources. Distributed solar resource impacts are accounted for in the load forecast.

Attachment B4

New Resources in the Behind the Meter Net Generation Program (BTM-NG)

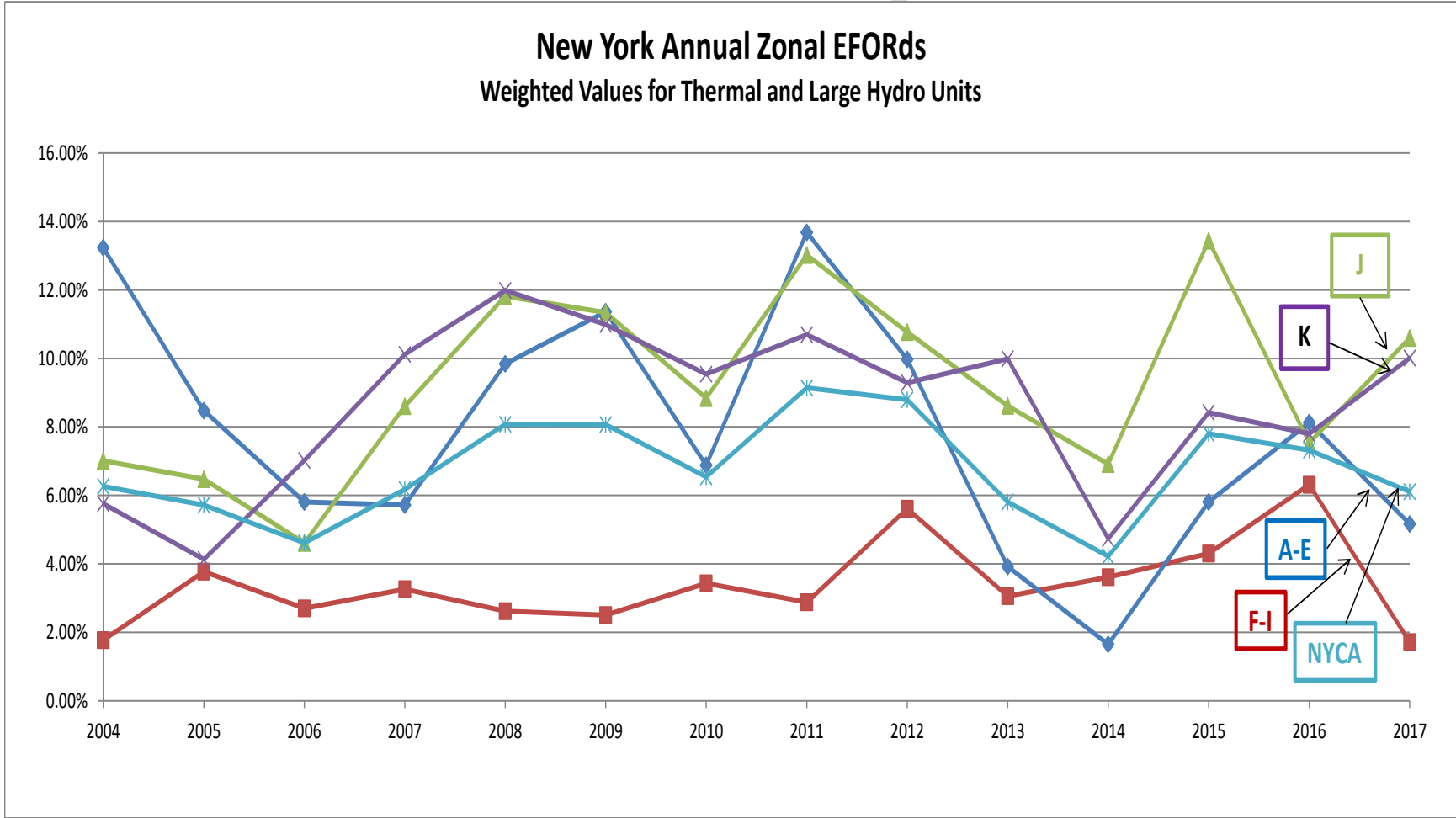
| Attachment B4 -New Units in the Behind the Meter Net Generation Program* | | | |
|---|-------------|--|--|
| Generator Name | Zone | Resource Value (MW)¹ | Peak Load Adjustment (MW)² |
| | | | |
| | | | |
| | | | |
| | | | |
| Total New BTM Gen | | 0.0 | 0.0 |

* The IRM study independently models the generation and load components of BTM:NG Resources

1. Based on adjusted DMGC value
2. Based on ACHL

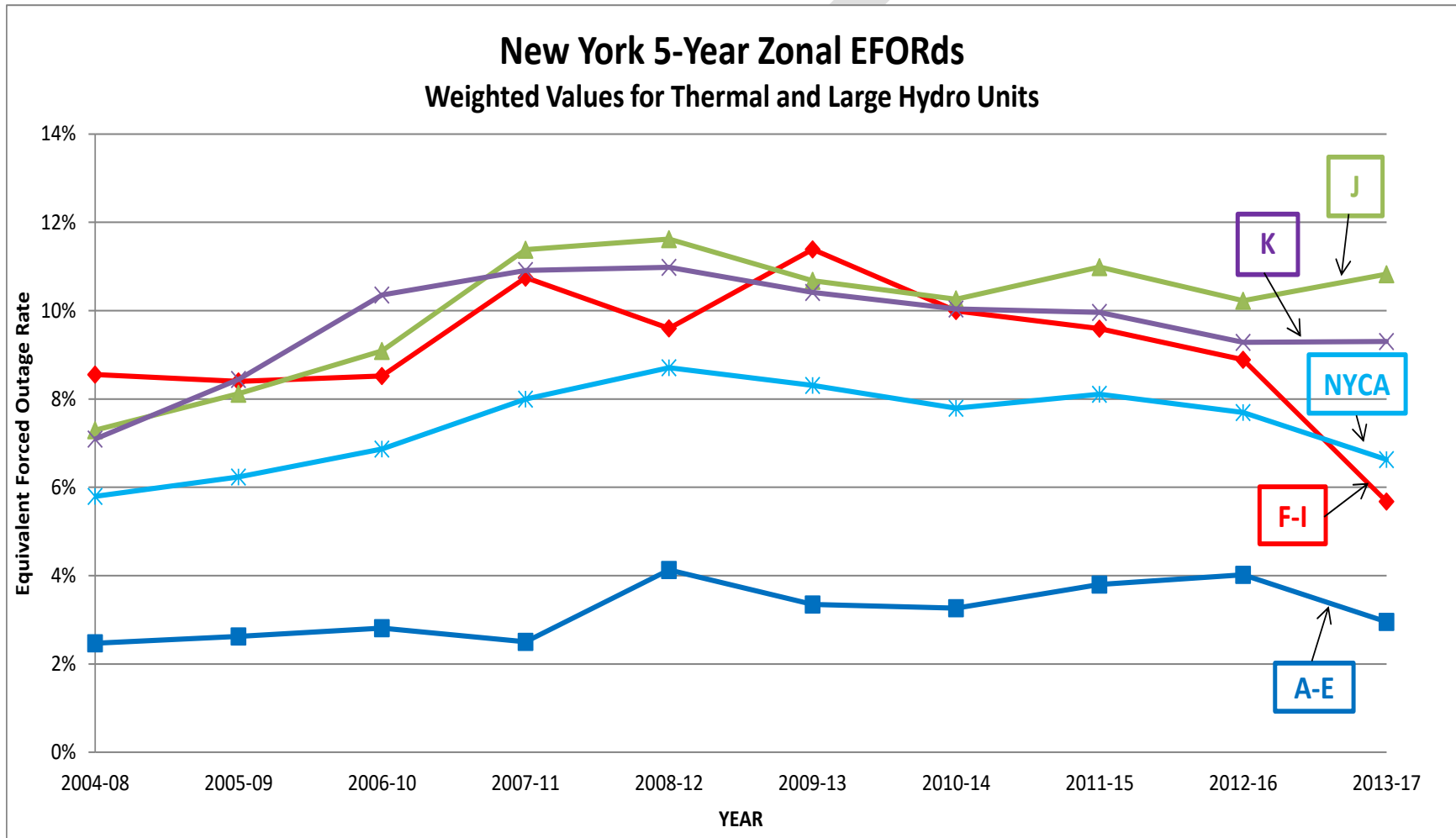
Attachment C

NYCA Annual EFORs



Attachment C1

NYCA Five Year EFORds



Attachment D

Emergency Operating Procedures

PLACEHOLDER

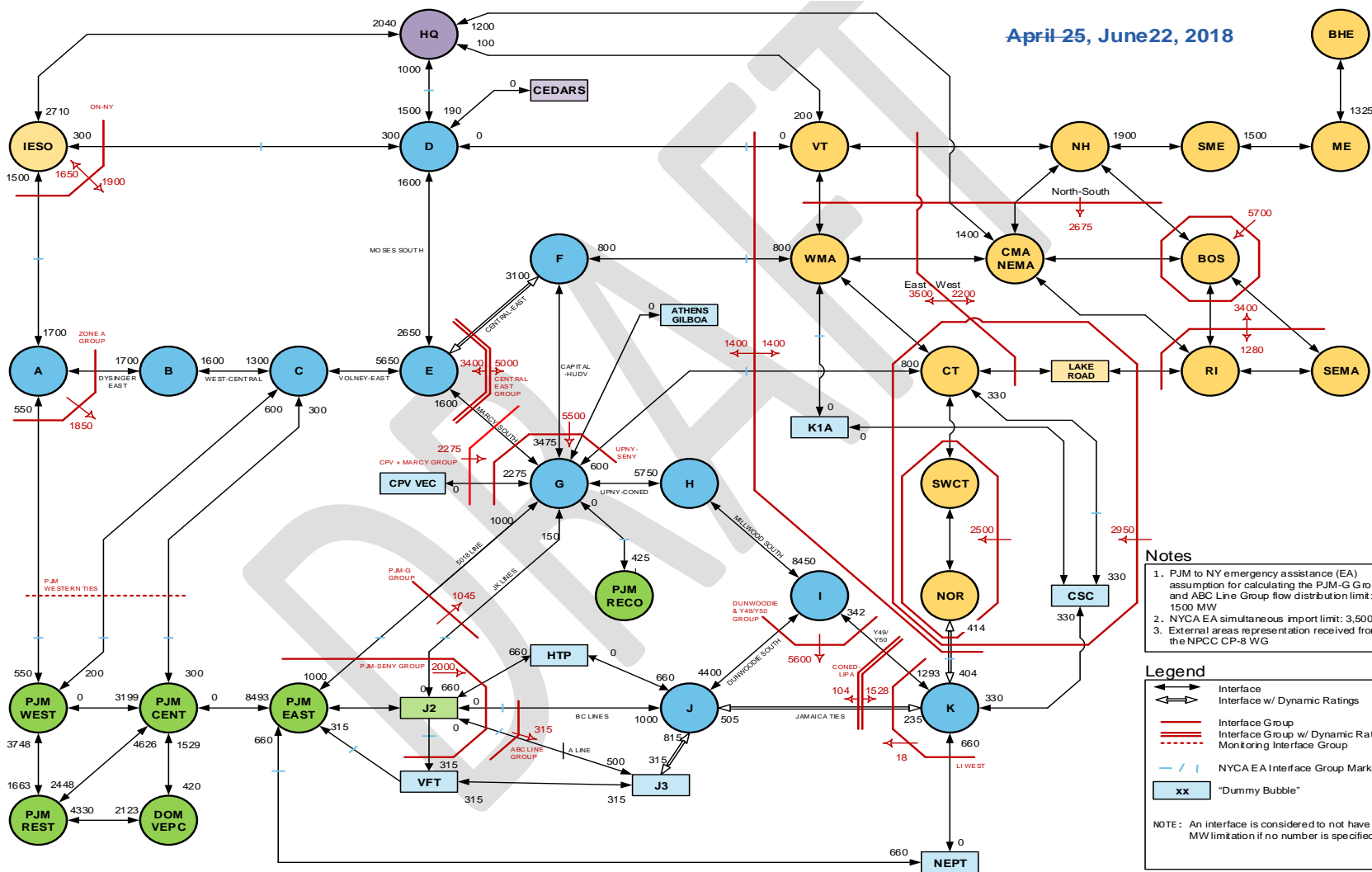
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Attachment E

IRM Topology

2019 IRM Preliminary Topology (Summer Ratings)

April 25, June 22, 2018



- Notes**
1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-G Group and ABC Line Group flow distribution limit: 1500 MW
 2. NYCA EA simultaneous import limit: 3,500 MW
 3. External areas representation received from the NPCC CP-8 WG

Legend

- ↔ Interface
- ↔ Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- - - Monitoring Interface Group
- / - NYCA EA Interface Group Marker
- xx "Dummy Bubble"

NOTE: An interface is considered to not have a MW limitation if no number is specified

Attachment F

SCR Determinations

PLACEHOLDER

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Assumption Matrix History

| Date | Ver | Preliminary Base Case | Date | Ver | Final Base Case |
|---------|------------|--|------|-----|-----------------|
| 1/30/18 | V0.0 | Preliminary assumptions without attachments. | | | |
| 5/2/18 | V1.0 | -Attach. A- LFU, no change. -Attachment C & C1 - Gen perform updated. -Attach. E- Topology, no NY change. -New row entry for Land Fill Gas Attachments B1-B4 added | | | |
| 6/22/18 | <u>2.1</u> | <u>Attachments B1-B3 updated, added TPAS change to VFT return path on attachment E</u> | | | |
| | | | | | |
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