Tailored Availability Metric

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Agenda

- Recap
- Purpose of Discussion
- Background
- Analysis
- Next Steps & Schedule

Recap

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Recap

- For availability-based resources, stakeholders encouraged the NYISO to evaluate an hourly weighting of the EFORd calculation in order to more accurately reflect availability of the resources
- Previous analysis focused on statistics that represented start time and duration of forced outages, forced derates, and failed starts in Combustion Turbines (CTs), Combined Cycles (CCs) and Steam Turbines (STs)
  - See Appendix

Purpose of Discussion

Purpose of Discussion

- The purpose of this presentation is to discuss the additional analysis done for availability-based resources using the EFORd to determine the Seasonal Derating Factor (AEFORd)
  - We will come back at a future Working Group meeting with discussion and analysis for performance-based resources

Background

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EFORd Background

- The Equivalent Forced Outage Rate demand (EFORd) is defined as the portion of time a unit is in demand, but is unavailable due to forced outages and forced derates
- The NYISO uses the calculated EFORd in order to measure the amount of unforced capacity a unit is allowed to sell
  - UCAP = Available ICAP * (1 – AEFORd)
  - A higher EFORd value results in less UCAP for the unit, and a lower EFORd value will result in more UCAP

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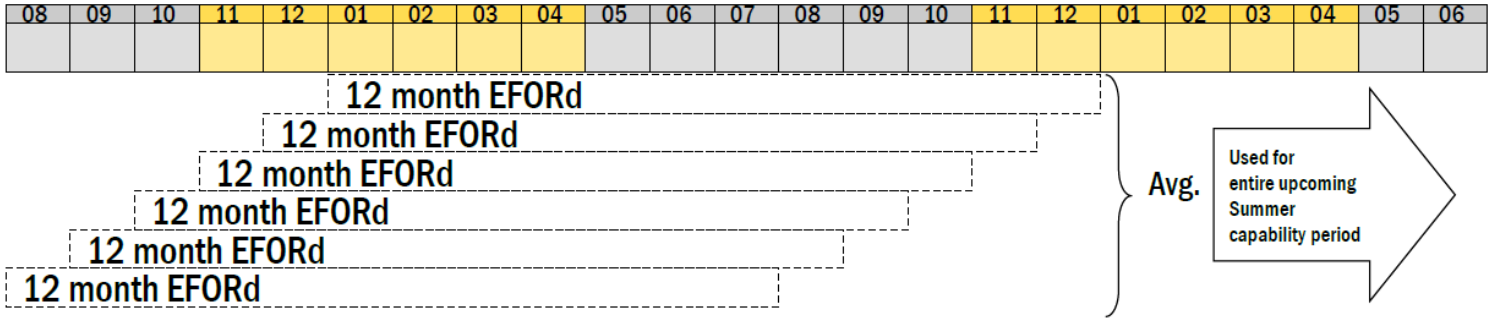
EFORd Background

- The current methodology for calculating a Capability Period AEFORd is the average of six consecutive (rolling) 12-month EFORd calculations
- For a Summer Capability Period AEFORd, the value is calculated based on the following months:



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EFORd Background

- **Currently, for the Summer Capability Period AEFORd, the summer peak months (June, July, and August) account for 25% of the weight of the calculation**
  - This means that 75% of the weight of the calculation for a Summer Capability Period AEFORd is measured based off of data from peak winter months and shoulder months

EFORd Calculation

- **The EFORd equation looks at 7 different inputs to calculate the value**
- **Event Hours:**
  - Service Hours (SH) – sum of all Unit Service Hours
  - Reserve Shutdown Hours (RSH) – sum of all Unit Reserve Shutdown Hours
  - Forced Outage Hours (FOH) – sum of all hours experienced during Forced Outages or Startup Failure
  - Equivalent Forced Derated Hours (EFDH) – the sum of all forced derating hours multiplied by the size of the reduction (MW), divided by the Net Maximum Capacity (NMC)
- **Event Counts:**
  - Number of Forced Outage Events
  - Number of Attempted Start Events
  - Number of Actual Start Events

EFORd Calculation

$$EFORd = \frac{f_f \times FOH + f_p \times (EFDH)}{SH + f_f \times FOH}$$

$$f_f = \frac{\frac{1}{r} + \frac{1}{T}}{\frac{1}{r} + \frac{1}{T} + \frac{1}{D}} \qquad f_p = \frac{SH}{AH}$$

- $r = average\ forced\ outage\ deration = \frac{FOH}{number\ of\ forced\ outages}$
- $T = average\ time\ between\ calls\ for\ a\ unit\ to\ run = \frac{RSH}{number\ of\ attempted\ starts}$
- $D = average\ run\ time = \frac{SH}{number\ of\ successful\ starts}$

Analysis

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Analysis

- **In the analysis completed thus far for availability-based resources, statistics have been compiled that more accurately reflect event data for these different resource types**
  - Heat maps of the data for the Summer Capability Period 2018 for CTs, CCs, and STs shows the percentages of duration and count of the analyzed events
  - See Appendix

Analysis

- **For CTs and CCs, longer duration events have a higher weight in the total number of hours, and shorter duration events have a higher weight in the total count**
  - A unit with a forced outage that lasts 6 months will have a high number of Forced Outage Hours, and one forced outage count
  - A unit with multiple shorter duration outages (i.e., 1 hour) will have a lower number of Forced Outage Hours, and high number of forced outage counts
- **The next analysis shows Forced Outage Hours and Service Hours drive the EFORd calculation, more so than other variables**

Analysis

- **Additional analysis done calculated a total, peak, and non-peak AEFORd for 4 different units**
  - Calculated EFORd values show what potential changes could occur when peak hours are weighted
    - Summer: HB 12 through HB 19
    - Winter: HB 14 through HB 21

EFORd Calculation

- **Generators that use GADS submit data on an event by event basis**
  - Events are reported every minute
    - Service Hours are not submitted but can be calculated by the time in between each reported event
  - A typical event report will include the event type with its respective start and end time stamp, as well as the derating amount each event has on the unit
- **By assigning timestamps, events can be separated into peak and non-peak hours**
  - Summer: HB 12 through HB 19
  - Winter: HB 14 through HB 21

EFORd Calculation

- **Using the existing methodology to calculate the NYISO EFORd, a total, peak, and non-peak Seasonal Derating Factor can be calculated**
  - The data analyzed calculated an AEFORd for Summer Capability Period 2018
    - Using the rolling 12-month average of the current model, this looked at data from August 2016 to December 2017
- **Using this process, the NYISO analyzed 3 peaker gas turbine units, and 1 steam turbine weighting the peak EFORds**
  - GT Units 1 and 2 recorded a high EFORd
  - GT Unit 3 recorded an extremely low EFORd
  - ST Unit 4 recorded a low EFORd

Gas Turbine Unit 1

Calc No.	EFORd	Peak	Non-Peak	Weighted (1:2)	Weighted (2:2)	Weighted (3:2)	Weighted (4:2)
1	20.89	19.88	25.13	23.38	22.51	21.98	21.63
2	16.59	15.73	15.73	15.73	15.73	15.73	15.73
3	13.32	12.08	17.20	15.49	14.64	14.12	13.78
4	10.62	8.90	14.97	12.94	11.93	11.33	10.92
5	11.44	9.62	15.77	13.72	12.70	12.08	11.67
6	12.70	10.15	47.99	35.38	29.07	25.29	22.76
AEFORd (%)	14.26	12.73	22.80	19.44	17.76	16.76	16.08

- The weighting shows the ratio of peak to non-peak
  - For example: (1 peak: 2 non-peak)

Weighting	
Peak	1
Non-Peak	2
Denominator	3
Peak	2
Non-Peak	2
Denominator	4
Peak	3
Non-Peak	2
Denominator	5
Peak	4
Non-Peak	2
Denominator	6

Gas Turbine Unit 2

Calc No.	EFORd	Peak	Non-Peak	Weighted (1:2)	Weighted (2:2)	Weighted (3:2)	Weighted (4:2)
1	21.71	16.57	35.94	29.49	26.26	24.32	23.03
2	13.02	11.00	30.55	24.04	20.78	18.82	17.52
3	6.10	2.65	18.10	12.95	10.37	8.83	7.80
4	0.43	0.36	0.67	0.57	0.52	0.49	0.46
5	9.76	8.95	15.25	13.15	12.10	11.47	11.05
6	18.01	17.27	23.00	21.09	20.13	19.56	19.18
AEFORd (%)	11.51	9.47	20.59	16.88	15.03	13.92	13.17

Weighting	
Peak	1
Non-Peak	2
Denominator	3
Peak	2
Non-Peak	2
Denominator	4
Peak	3
Non-Peak	2
Denominator	5
Peak	4
Non-Peak	2
Denominator	6

Gas Turbine Unit 3

Calc No.	EFORd	Peak	Non-Peak	Weighted (1:2)	Weighted (2:2)	Weighted (3:2)	Weighted (4:2)
1	1.75	1.57	1.91	1.80	1.74	1.70	1.68
2	1.70	1.47	2.03	1.84	1.75	1.69	1.66
3	1.75	1.61	1.93	1.82	1.77	1.74	1.72
4	1.78	1.63	1.99	1.87	1.81	1.77	1.75
5	1.80	1.63	2.01	1.89	1.82	1.79	1.76
6	2.08	1.88	2.16	2.07	2.02	2.00	1.98
AEFORd (%)	1.81	1.63	2.01	1.88	1.82	1.78	1.76

Weighting	
Peak	1
Non-Peak	2
Denominator	3
Peak	2
Non-Peak	2
Denominator	4
Peak	3
Non-Peak	2
Denominator	5
Peak	4
Non-Peak	2
Denominator	6

Steam Turbine Unit 4

Calc No.	EFORd	Peak	Non-Peak	Weighted (1:2)	Weighted (2:2)	Weighted (3:2)	Weighted (4:2)
1	5.96	6.01	5.98	5.99	6.00	6.00	6.00
2	6.55	6.56	6.61	6.59	6.59	6.58	6.58
3	6.75	6.76	6.83	6.80	6.79	6.79	6.78
4	4.93	4.93	4.97	4.96	4.95	4.95	4.94
5	4.35	4.35	4.38	4.37	4.37	4.36	4.36
6	4.06	4.07	4.08	4.08	4.07	4.07	4.07
AEFORd (%)	5.43	5.45	5.48	5.47	5.46	5.46	5.46

Weighting	
Peak	1
Non-Peak	2
Denominator	3
Peak	2
Non-Peak	2
Denominator	4
Peak	3
Non-Peak	2
Denominator	5
Peak	4
Non-Peak	2
Denominator	6

Conclusions

- **The driving force behind the EFORd calculation is the Service Hours in relation to the Forced Outage Hours**
  - For these four peaker plants, Service Hours typically occur during Peak Hours
  - If an outage occurs that has a long duration (e.g., 1 month), it will drive the non-peak EFORd up due to the fact that the peaking units typically record less Service Hours during non-peak periods

Conclusions

- For example, one 12-month EFORd recorded for Unit 1:

	SH	FOH	PH	EFORd (%)
Peak	61.3	58.6	2920	16.6
Non-Peak	9.1	142.1	5840	35.9

SH	Service Hours
FOH	Forced Outage Hours
PH	Period Hours

- Under a weighting methodology, if the non-peak EFORd is much higher than the peak EFORd, the results show the total AEFORd value increases

Conclusions

- At this time, the NYISO believes the current structure of the EFORd calculation captures the incentive to be available during peak hours

Market Design Concept Proposal

- **The NYISO proposes to weight peak months more heavily in the EFORd calculation**
  - Peak months are currently weighted 25% in the existing Capability Period AEFORd calculation
    - Summer Peak months: June, July, and August
    - Winter Peak months: December, January, and February
- **Monthly weightings will be analyzed as a part of the Market Design Complete**

Next Steps & Schedule

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Next Steps

- The NYISO will begin detailed discussion of assessing performance-based resources at a later working group meeting

Schedule

- **Stakeholder Engagement Plan:**
  - This meeting - July, 2019: Discussion of Analysis
  - August – September, 2019: Discussion of Analysis and Results of Analysis
  - September, 2019: Market Design Concept Proposal for performance-based resources
  - 2020: Market Design Complete

Feedback/Questions?

- The NYISO will consider input received during today's Working Group meeting and further input sent in writing to deckles@nyiso.com and econway@nyiso.com

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Appendix

Resource Type

Resource Type	Availability-Based	Performance-Based
Most Generation	X	
Dispatchable DER	X	
ESRs	X	
Intermittent Resources		X
Limited Control RoR Hydro		X
SCRs		X

ICAP Manual Attachment J

- ICAP Manual Link
  - (https://www.nyiso.com/documents/20142/2923301/icap_mnl.pdf/)
- $UCAP = (1 - EFORd) \times DMNC$
- $EFORd = \frac{f_f \times FOH + f_p \times (EFDH)}{SH + f_f \times FOH}$
- $f_f = \frac{\frac{1}{r} + \frac{1}{T}}{\frac{1}{r} + \frac{1}{T} + \frac{1}{D}}$

ICAP Manual Attachment J

- $r = average\ forced\ outage\ deration = \dfrac{FOH}{number\ of\ forced\ outages}$
- $T = average\ time\ between\ calls\ for\ a\ unit\ to\ run = \dfrac{RSH}{number\ of\ attempted\ starts}$
- $D = average\ run\ time = \dfrac{SH}{number\ of\ successful\ starts}$
- $f_p = \dfrac{SH}{AH}$

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ICAP Manual Attachment J

- $f_f = full\ f - factor$
- $f_p = partial\ f - factor$
- $FOH = (Full)\ Forced\ Outage\ Hours$
- $EFDH = Equivalent\ Forced\ Derated\ Hours$
- $SH = Service\ Hours; time\ a\ unit\ is\ electrically\ connected\ to\ the\ system$
- $AH = Available\ Hours; time\ a\ unit\ is\ capable\ of\ producing\ energy, regardless\ of\ capacity\ level$
- $RSH = Reserve\ Shutdown\ Hours; time\ a\ unit\ is\ available\ for\ service\ but\ not\ dispatched$
- $PH = Period\ Hours; 24\ times\ the\ number\ of\ days\ in\ the\ reporting\ period$

UOL Calculation

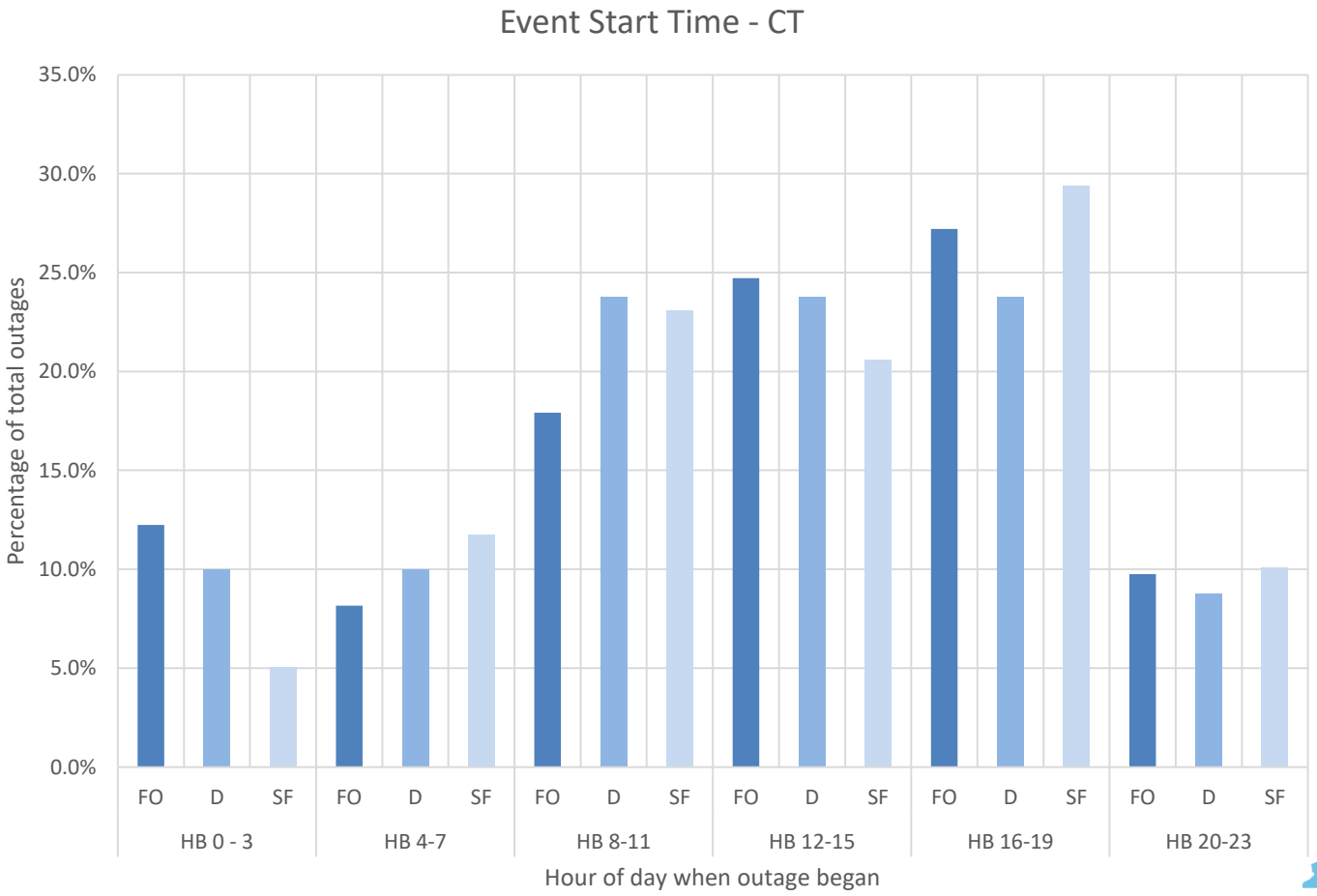
- **Derating Factors for Energy Storage Resources will be calculated based upon a time-weighted UOL availability evaluated against the ICAP sold**
  - For each RTD interval that the UOL is adjusted down due to a NYISO or a TO reliability need, the NYISO will replace the UOL with the bid UOL
  - The Normal UOL will have a floor of 0 and be capped against the ICAP Sold, and the number of seconds will be calculated for that interval
  - For the intervals where the unit was on a planned or scheduled outage approved by NYISO operations, the seconds will be set to 0, removing it from the calculation

UOL Calculation

- **Derating Factors for Energy Storage Resources will be calculated based upon a time-weighted UOL availability evaluated against the ICAP sold**
  - For each month, 4 values will be calculated
    - Total Seconds – Sum of seconds in the month that the unit was not on an approved outage
    - Total Available Capacity – Sum of (Normal UOL for interval * seconds in interval) for the month
    - Total Expected Capacity – ICAP sold * Total Seconds
    - Monthly Availability – Total Available Capacity / Total Expected Capacity

UOL Calculation

- 12-month blocks will be calculated, summing the Total Available Capacity, the Total Expected Capacity, and the availability calculation for the 12- month block
- The Derating Factor for Energy Storage Resources will be the average of 6 of the 12-month blocks
  - These will be the same 12-month blocks used in the existing EFORd calculation
    - Derating Factor to determine Summer UCAP uses a 12 month period ending in July, August, September, October, November, and December from the prior year
    - Derating Factor to determine Winter UCAP uses a 12 month period ending in January, February, March, April, May, and June from the current year
    - Derating Factor = 1 – Availability Factor



Class Average EFORd:
9.05 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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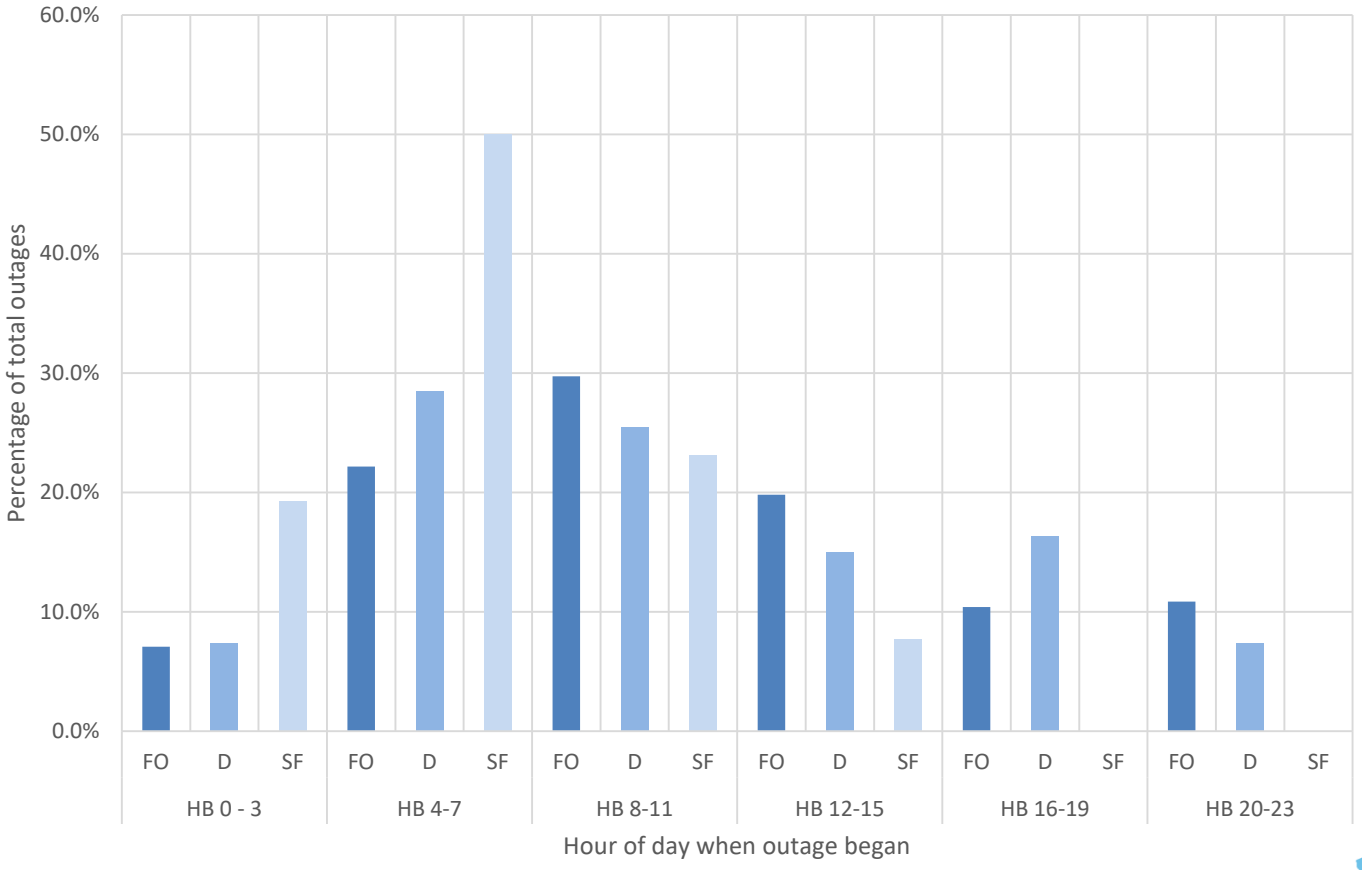
Event Start Time - CC



Class Average EFORd:
3.72 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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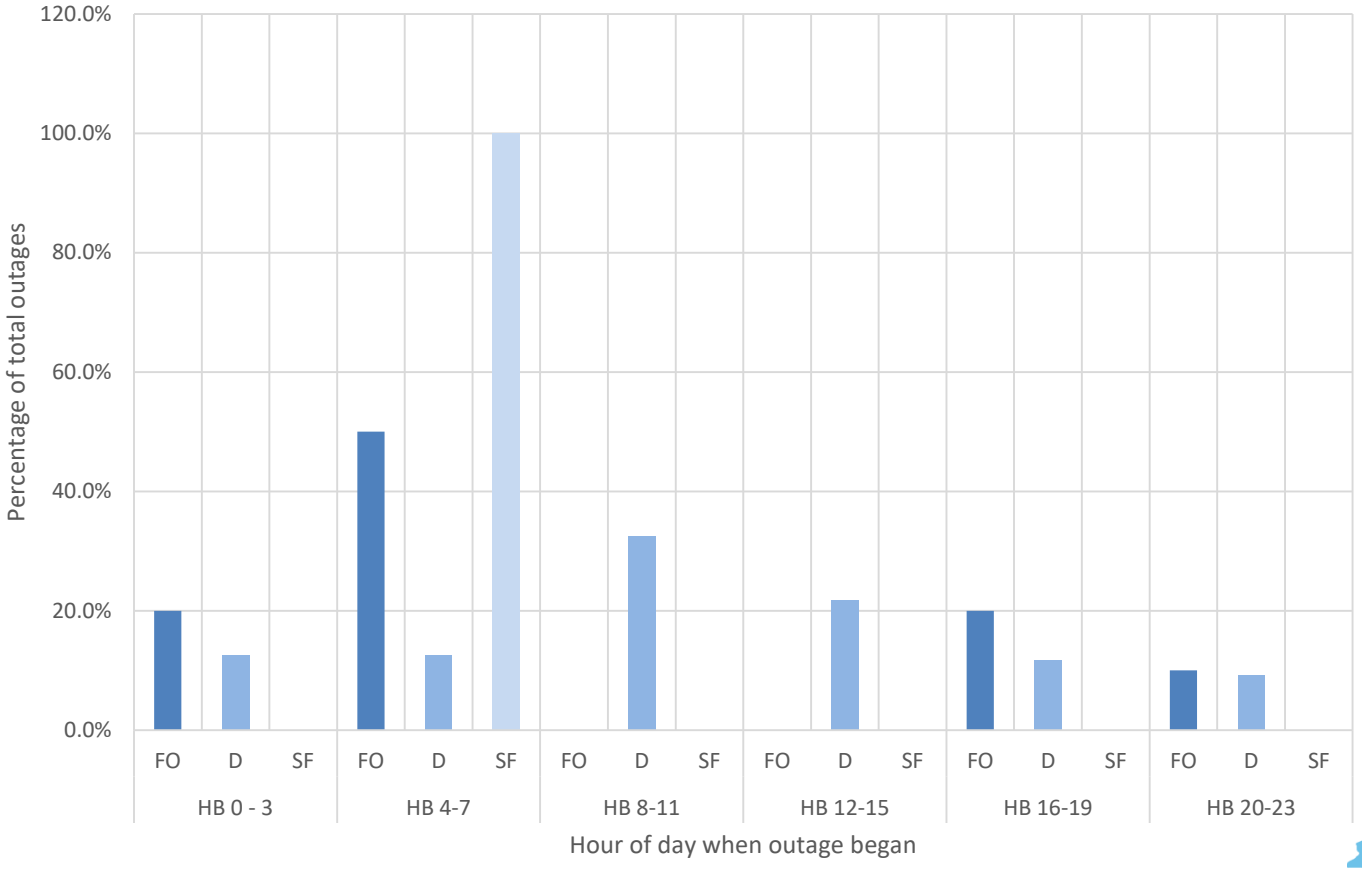
Event Start Time - ST



Class Average EFORd: 7.96 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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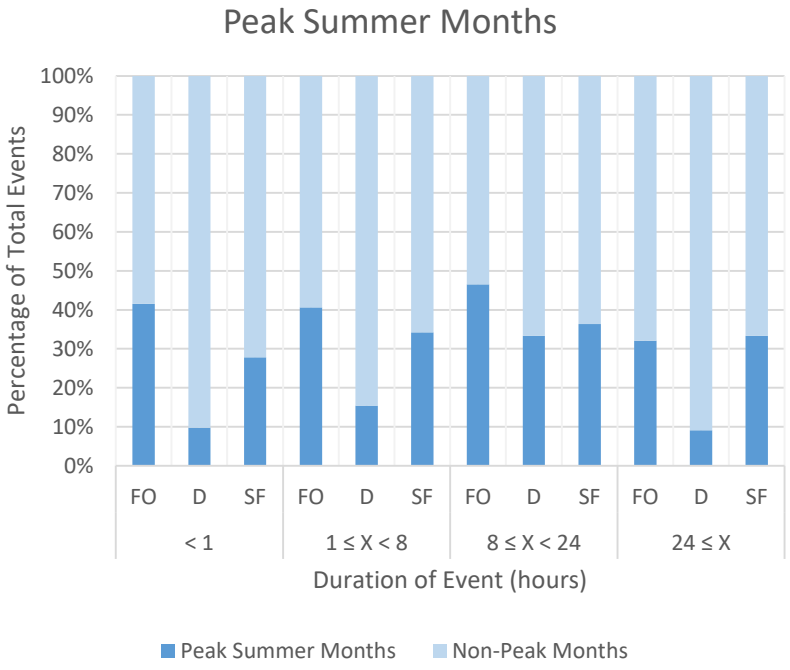
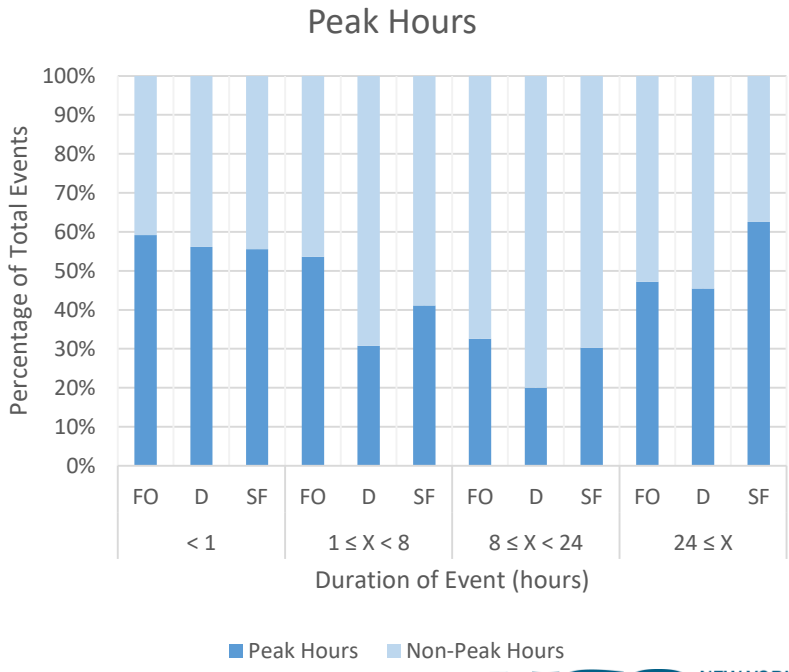
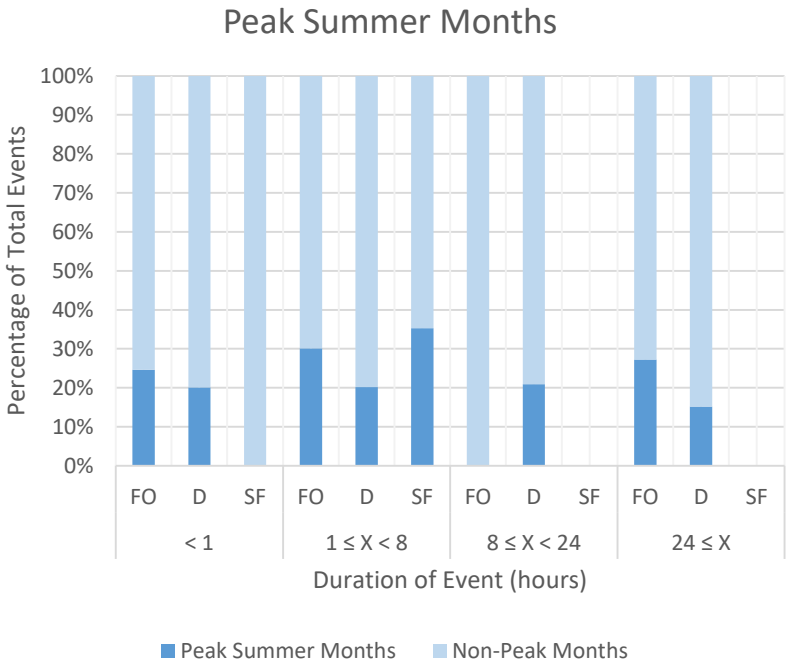
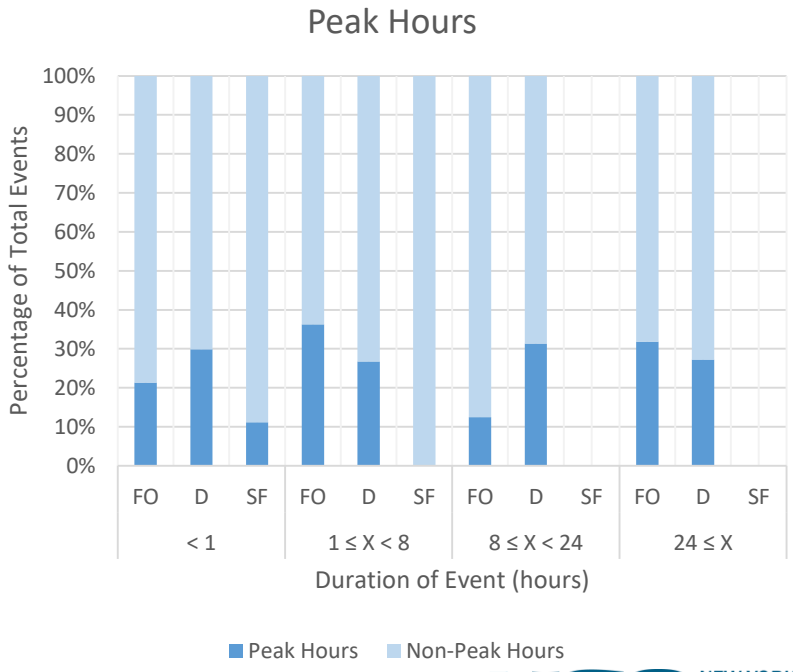
Duration of Events - CT



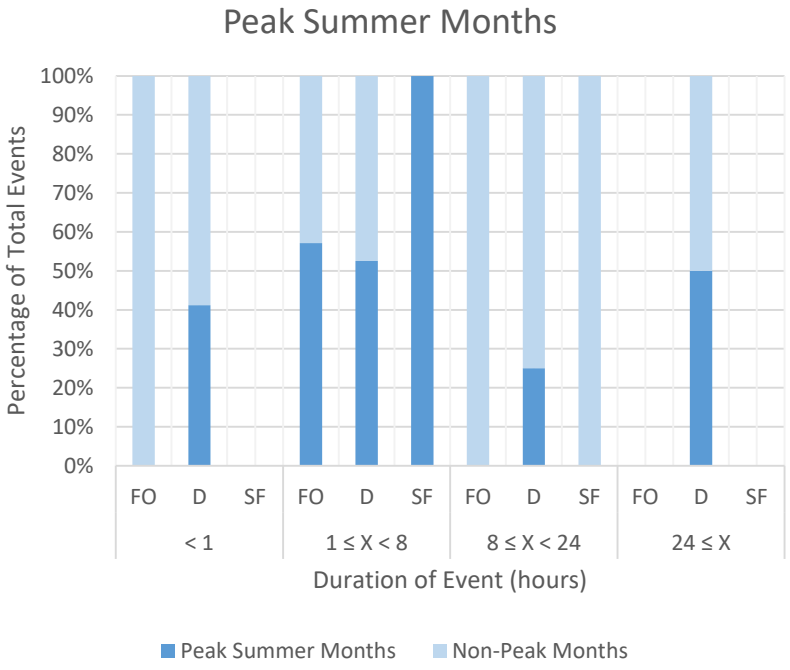


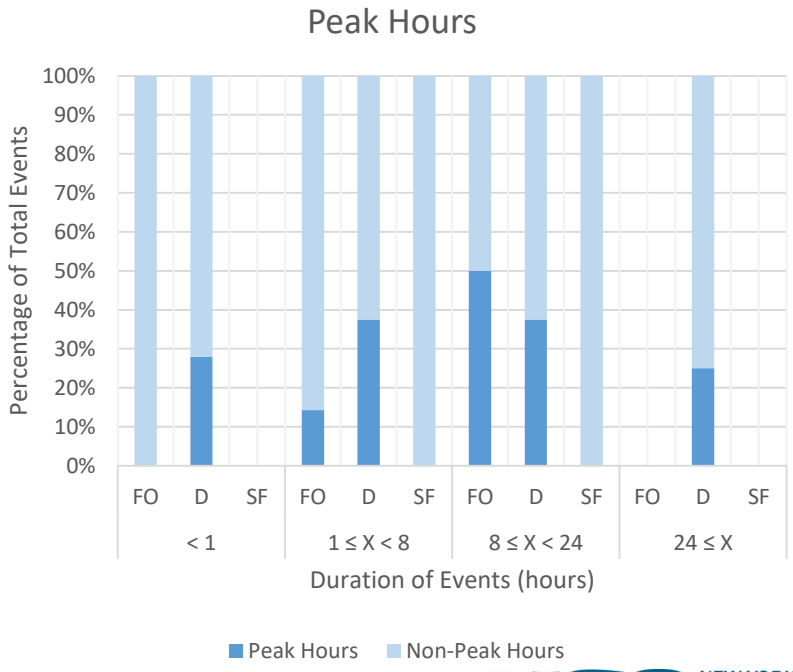
Duration of Events - CC





Duration of Events - ST





GTs – Forced Outages

	Total Forced Outage Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	1%	0%	2%	3%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	1%	1%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	0%	0%	0%
7	0%	0%	0%	0%	0%	1%	1%
8	0%	0%	0%	0%	0%	18%	19%
9	0%	0%	0%	0%	0%	30%	30%
10	0%	0%	0%	0%	0%	1%	1%
11	0%	0%	0%	0%	0%	1%	1%
12	0%	0%	0%	0%	0%	1%	2%
13	0%	0%	0%	0%	0%	1%	2%
14	0%	0%	0%	0%	0%	3%	3%
15	0%	0%	0%	0%	0%	5%	6%
16	0%	0%	0%	0%	0%	4%	4%
17	0%	0%	0%	0%	1%	1%	2%
18	0%	0%	0%	0%	0%	0%	1%
19	0%	0%	0%	0%	1%	1%	2%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	1%
22	0%	0%	0%	0%	0%	6%	6%
23	0%	0%	0%	0%	0%	15%	15%
Total	0%	0%	0%	4%	4%	91%	

	Total Forced Outage Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	6%	1%	1%	8%
1	0%	0%	1%	0%	1%	0%	2%
2	0%	0%	0%	0%	0%	0%	2%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	1%	0%	0%	1%
6	1%	0%	0%	1%	0%	0%	2%
7	1%	1%	1%	1%	0%	0%	4%
8	3%	1%	0%	1%	0%	1%	6%
9	2%	0%	0%	2%	0%	1%	4%
10	2%	0%	0%	1%	0%	0%	4%
11	1%	0%	0%	1%	0%	0%	3%
12	1%	1%	0%	1%	0%	1%	4%
13	2%	4%	1%	1%	1%	0%	9%
14	3%	0%	0%	0%	0%	1%	4%
15	4%	1%	1%	0%	0%	1%	8%
16	2%	1%	0%	1%	1%	1%	5%
17	4%	0%	1%	3%	1%	0%	10%
18	2%	0%	1%	3%	0%	0%	7%
19	2%	0%	0%	0%	1%	1%	6%
20	1%	0%	0%	0%	0%	0%	2%
21	0%	0%	0%	1%	1%	0%	2%
22	1%	0%	0%	0%	0%	0%	2%
23	0%	1%	0%	1%	1%	1%	4%
Total	34%	12%	6%	27%	10%	11%	

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GTs – Forced Derates

	Total Derating Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	56%	56%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	1%	1%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	1%	0%	1%
7	0%	0%	0%	0%	0%	0%	0%
8	0%	0%	0%	0%	0%	1%	1%
9	0%	0%	0%	0%	0%	0%	0%
10	0%	0%	0%	0%	0%	1%	2%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	1%	1%
13	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	0%	0%	0%	32%	32%
15	0%	0%	0%	0%	0%	1%	1%
16	0%	0%	0%	0%	0%	1%	1%
17	0%	0%	0%	0%	0%	1%	1%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	0%	0%	1%	1%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	1%	3%	96%	

	Total Derate Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	3%	3%
1	5%	0%	0%	0%	0%	0%	5%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	1%	0%	1%	3%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	1%	0%	0%	1%	3%	0%	5%
7	3%	0%	0%	1%	1%	0%	5%
8	3%	0%	0%	0%	1%	1%	5%
9	1%	0%	0%	1%	1%	0%	4%
10	3%	1%	1%	3%	3%	1%	11%
11	3%	0%	0%	0%	1%	0%	4%
12	1%	0%	0%	1%	0%	1%	4%
13	3%	1%	1%	1%	0%	0%	6%
14	5%	0%	1%	1%	0%	1%	9%
15	3%	0%	0%	0%	1%	1%	5%
16	5%	0%	0%	1%	0%	1%	8%
17	4%	1%	0%	1%	0%	1%	8%
18	6%	0%	0%	0%	0%	0%	6%
19	1%	0%	0%	0%	0%	1%	3%
20	3%	0%	0%	0%	0%	0%	3%
21	1%	0%	0%	0%	0%	0%	1%
22	1%	0%	0%	0%	1%	0%	3%
23	3%	0%	0%	0%	0%	0%	3%
Total	53%	4%	4%	14%	13%	14%	

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GTs – Startup Failures

	Total Startup Failure Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	1%	1%	0%	2%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	2%	3%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	0%	1%	1%
7	0%	0%	0%	0%	0%	3%	3%
8	0%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	0%	2%	0%	3%
10	0%	0%	0%	0%	1%	2%	3%
11	0%	0%	0%	0%	0%	10%	10%
12	0%	0%	0%	0%	1%	2%	3%
13	0%	0%	0%	0%	1%	6%	7%
14	0%	0%	0%	0%	0%	7%	8%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	1%	10%	12%
17	0%	0%	0%	0%	1%	16%	18%
18	0%	0%	0%	0%	1%	3%	4%
19	0%	0%	0%	0%	1%	11%	13%
20	0%	0%	0%	0%	0%	1%	1%
21	0%	0%	0%	0%	1%	1%	2%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	1%	4%	5%
Total	1%	1%	1%	4%	12%	81%	

	Total Startup Failure Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	1%	0%	1%	1%	0%	3%
1	1%	0%	0%	0%	0%	0%	1%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	1%	0%	0%	1%
5	1%	0%	0%	0%	0%	0%	2%
6	5%	0%	0%	0%	0%	0%	5%
7	3%	0%	0%	0%	0%	0%	3%
8	2%	0%	0%	0%	0%	0%	2%
9	1%	1%	1%	2%	3%	0%	8%
10	3%	1%	0%	2%	0%	0%	7%
11	3%	1%	1%	0%	0%	1%	6%
12	1%	0%	1%	1%	1%	1%	5%
13	3%	1%	0%	0%	0%	1%	5%
14	2%	1%	0%	0%	0%	1%	4%
15	5%	0%	0%	0%	0%	0%	6%
16	6%	2%	0%	1%	1%	1%	12%
17	3%	0%	1%	2%	1%	1%	8%
18	5%	0%	0%	0%	0%	0%	6%
19	1%	0%	0%	0%	1%	1%	4%
20	0%	0%	0%	0%	0%	0%	1%
21	3%	0%	0%	0%	1%	0%	5%
22	1%	0%	0%	0%	0%	0%	1%
23	1%	0%	0%	0%	1%	0%	3%
Total	48%	11%	5%	14%	12%	10%	

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CCs – Forced Outages

	Total Forced Outage Hours							
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <		Total
0	0%	0%	0%	0%	1%	5%		6%
1	0%	0%	0%	0%	0%	0%		0%
2	0%	0%	0%	0%	0%	0%		1%
3	0%	0%	0%	0%	0%	2%		2%
4	0%	0%	0%	1%	0%	8%		10%
5	0%	0%	0%	1%	1%	4%		6%
6	0%	0%	0%	1%	0%	0%		2%
7	0%	0%	0%	0%	1%	0%		2%
8	0%	0%	0%	1%	1%	0%		2%
9	0%	0%	0%	1%	0%	0%		2%
10	0%	0%	0%	1%	1%	21%		22%
11	0%	0%	0%	1%	0%	3%		5%
12	0%	0%	0%	1%	0%	7%		9%
13	0%	0%	0%	1%	0%	0%		1%
14	0%	0%	0%	1%	0%	0%		1%
15	0%	0%	0%	1%	0%	6%		7%
16	0%	0%	0%	0%	0%	3%		4%
17	0%	0%	0%	0%	0%	3%		3%
18	0%	0%	0%	0%	0%	0%		0%
19	0%	0%	0%	0%	0%	2%		2%
20	0%	0%	0%	0%	0%	3%		4%
21	0%	0%	0%	0%	0%	3%		4%
22	0%	0%	0%	0%	0%	0%		0%
23	0%	0%	0%	0%	0%	5%		5%
Total	2%	3%	2%	11%	7%	76%		

	Total Forced Outage Count							
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <		Total
0	0%	0%	0%	0%	1%	1%		2%
1	0%	0%	0%	0%	0%	0%		1%
2	0%	1%	0%	0%	0%	0%		1%
3	1%	0%	0%	0%	0%	0%		3%
4	1%	0%	0%	1%	0%	0%		4%
5	1%	1%	0%	2%	0%	0%		6%
6	2%	2%	1%	2%	0%	0%		8%
7	2%	1%	0%	0%	1%	0%		5%
8	3%	2%	0%	1%	1%	0%		8%
9	3%	1%	0%	2%	0%	0%		7%
10	3%	0%	1%	2%	0%	2%		9%
11	2%	1%	0%	1%	0%	0%		6%
12	0%	1%	1%	3%	0%	0%		7%
13	1%	1%	0%	1%	0%	0%		5%
14	0%	1%	0%	1%	0%	0%		4%
15	2%	0%	0%	1%	0%	1%		5%
16	1%	2%	0%	0%	0%	0%		5%
17	0%	0%	0%	0%	0%	0%		2%
18	0%	1%	0%	0%	0%	0%		1%
19	0%	1%	0%	0%	0%	0%		3%
20	1%	1%	0%	1%	0%	0%		4%
21	0%	0%	1%	1%	0%	1%		3%
22	0%	0%	0%	0%	0%	0%		2%
23	0%	0%	0%	0%	0%	1%		1%
Total	29%	22%	9%	24%	6%	10%		

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CCs – Forced Derates

	Total Derating Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	1%	1%	10%	12%
1	0%	0%	0%	0%	0%	3%	4%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	1%	1%	0%	2%
5	0%	0%	0%	2%	1%	3%	6%
6	0%	0%	0%	1%	1%	3%	5%
7	0%	0%	0%	2%	1%	7%	11%
8	0%	0%	0%	0%	1%	5%	7%
9	0%	0%	0%	1%	0%	1%	2%
10	0%	0%	0%	1%	2%	9%	12%
11	0%	0%	0%	1%	2%	0%	3%
12	0%	0%	0%	0%	1%	0%	2%
13	0%	0%	0%	1%	0%	2%	3%
14	0%	0%	0%	1%	0%	1%	2%
15	0%	0%	0%	0%	0%	2%	3%
16	0%	0%	0%	1%	1%	0%	3%
17	0%	0%	0%	1%	1%	0%	2%
18	0%	0%	0%	1%	0%	4%	5%
19	0%	0%	0%	0%	0%	1%	3%
20	0%	0%	0%	0%	0%	1%	1%
21	0%	0%	0%	0%	2%	0%	2%
22	0%	0%	0%	1%	2%	6%	9%
23	0%	0%	0%	0%	1%	1%	2%
Total	2%	3%	3%	15%	19%	59%	

	Total Derate Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	1%	1%	0%	1%	0%	1%	3%
1	0%	0%	0%	0%	0%	0%	1%
2	1%	0%	0%	0%	0%	0%	1%
3	1%	0%	0%	0%	0%	0%	2%
4	1%	0%	0%	1%	0%	0%	3%
5	1%	1%	1%	3%	0%	0%	7%
6	2%	1%	0%	2%	1%	1%	6%
7	4%	2%	1%	3%	1%	1%	12%
8	3%	1%	1%	1%	1%	0%	6%
9	4%	1%	0%	1%	0%	0%	8%
10	2%	1%	0%	1%	1%	1%	6%
11	1%	1%	0%	2%	1%	0%	5%
12	2%	0%	0%	0%	1%	0%	4%
13	2%	1%	1%	1%	0%	0%	5%
14	1%	0%	0%	1%	0%	0%	3%
15	2%	1%	0%	1%	0%	0%	4%
16	3%	0%	0%	2%	1%	0%	5%
17	1%	0%	0%	1%	1%	0%	3%
18	1%	1%	0%	1%	0%	0%	4%
19	2%	1%	1%	0%	0%	0%	4%
20	0%	0%	0%	0%	0%	0%	1%
21	0%	0%	1%	0%	1%	0%	2%
22	0%	0%	0%	1%	1%	1%	3%
23	1%	0%	0%	0%	0%	0%	1%
Total	36%	15%	9%	23%	10%	7%	

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CCs – Startup Failures

	Total Startup Failure Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	10%	0%	0%	0%	10%
3	2%	0%	5%	13%	0%	0%	20%
4	0%	3%	0%	7%	0%	0%	10%
5	2%	6%	0%	10%	0%	0%	19%
6	1%	0%	5%	0%	0%	0%	6%
7	1%	3%	0%	8%	0%	0%	12%
8	2%	4%	0%	0%	0%	0%	6%
9	0%	3%	0%	0%	0%	0%	3%
10	0%	7%	0%	0%	0%	0%	7%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	6%	0%	0%	0%	6%
14	2%	0%	0%	0%	0%	0%	2%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	0%	0%	0%	0%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	9%	27%	26%	38%	0%	0%	

	Total Startup Failure Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	8%	0%	0%	0%	8%
3	4%	0%	4%	4%	0%	0%	12%
4	0%	4%	0%	4%	0%	0%	8%
5	8%	8%	0%	4%	0%	0%	19%
6	4%	0%	4%	0%	0%	0%	8%
7	8%	4%	0%	4%	0%	0%	15%
8	8%	4%	0%	0%	0%	0%	12%
9	0%	4%	0%	0%	0%	0%	4%
10	0%	8%	0%	0%	0%	0%	8%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	4%	0%	0%	0%	4%
14	4%	0%	0%	0%	0%	0%	4%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	0%	0%	0%	0%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	35%	31%	19%	15%	0%	0%	

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STs – Forced Outages

	Total Forced Outage Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	8%	0%	0%	8%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	5%	0%	0%	0%	0%	5%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	24%	0%	0%	24%
7	1%	7%	0%	14%	0%	0%	22%
8	0%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	0%	0%	0%	0%
10	0%	0%	0%	0%	0%	0%	0%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	0%	0%	0%	0%	0%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	23%	0%	0%	23%
19	0%	0%	0%	15%	0%	0%	15%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	4%	0%	0%	0%	0%	4%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	1%	16%	0%	83%	0%	0%	

	Total Forced Outage Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	10%	0%	0%	10%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	10%	0%	0%	0%	0%	10%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	10%	0%	0%	10%
7	10%	20%	0%	10%	0%	0%	40%
8	0%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	0%	0%	0%	0%
10	0%	0%	0%	0%	0%	0%	0%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	0%	0%	0%	0%	0%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	10%	0%	0%	10%
19	0%	0%	0%	10%	0%	0%	10%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	10%	0%	0%	0%	0%	10%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	10%	40%	0%	50%	0%	0%	

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STs – Forced Derates

	Total Derating Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	1%	5%	21%	27%
1	0%	0%	0%	2%	0%	0%	3%
2	0%	0%	0%	1%	0%	0%	1%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	1%	0%	1%
7	1%	0%	0%	1%	0%	0%	1%
8	0%	0%	0%	0%	1%	0%	2%
9	0%	0%	0%	0%	0%	0%	1%
10	1%	0%	0%	1%	0%	0%	1%
11	0%	0%	0%	1%	0%	0%	1%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	0%	1%	0%	40%	41%
14	0%	0%	0%	2%	3%	0%	5%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	1%	0%	0%	1%
17	0%	0%	0%	1%	2%	0%	3%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	1%	0%	0%	1%
20	0%	0%	0%	0%	2%	0%	2%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	2%	3%	0%	5%
23	0%	0%	0%	1%	0%	0%	1%
Total	4%	3%	2%	14%	17%	61%	

	Total Derate Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	2%	2%	1%	4%
1	2%	0%	1%	3%	0%	0%	5%
2	0%	0%	1%	2%	0%	0%	3%
3	1%	0%	0%	0%	0%	0%	1%
4	0%	0%	0%	0%	0%	0%	0%
5	1%	1%	0%	0%	0%	0%	2%
6	0%	0%	0%	0%	1%	0%	1%
7	8%	1%	0%	1%	0%	0%	10%
8	3%	2%	0%	0%	1%	0%	6%
9	9%	0%	0%	1%	0%	0%	10%
10	8%	2%	0%	1%	0%	0%	11%
11	3%	2%	0%	1%	0%	0%	6%
12	2%	0%	1%	0%	0%	0%	3%
13	3%	1%	0%	1%	0%	2%	6%
14	6%	1%	1%	2%	1%	0%	10%
15	3%	1%	0%	0%	0%	0%	3%
16	1%	0%	0%	1%	0%	0%	2%
17	1%	2%	0%	2%	1%	0%	5%
18	2%	1%	0%	0%	0%	0%	3%
19	1%	1%	0%	1%	0%	0%	3%
20	0%	0%	1%	0%	1%	0%	2%
21	1%	0%	0%	0%	0%	0%	1%
22	1%	0%	0%	2%	1%	0%	3%
23	3%	0%	0%	1%	0%	0%	3%
Total	57%	13%	4%	18%	7%	3%	

NEW YORK INDEPENDENT SYSTEM OPERATOR

STs – Startup Failures

	Total Startup Failure Hours						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	73%	0%	73%
7	0%	0%	0%	27%	0%	0%	27%
8	0%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	0%	0%	0%	0%
10	0%	0%	0%	0%	0%	0%	0%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	0%	0%	0%	0%	0%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	0%	0%	0%	0%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	27%	73%	0%	

	Total Startup Failure Count						
Hour	≤ 1	1< X ≤ 2	2 < X ≤ 3	3 < X ≤ 10	10 < X ≤ 24	24 <	Total
0	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	50%	0%	50%
7	0%	0%	0%	50%	0%	0%	50%
8	0%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	0%	0%	0%	0%
10	0%	0%	0%	0%	0%	0%	0%
11	0%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	0%	0%	0%	0%
13	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	0%	0%	0%	0%	0%
15	0%	0%	0%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	0%	0%
18	0%	0%	0%	0%	0%	0%	0%
19	0%	0%	0%	0%	0%	0%	0%
20	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	50%	50%	0%	

NEW YORK INDEPENDENT SYSTEM OPERATOR

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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