Tailored Availability Metric

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ICAPWG/MIWG

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Agenda

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

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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

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Purpose of Discussion

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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

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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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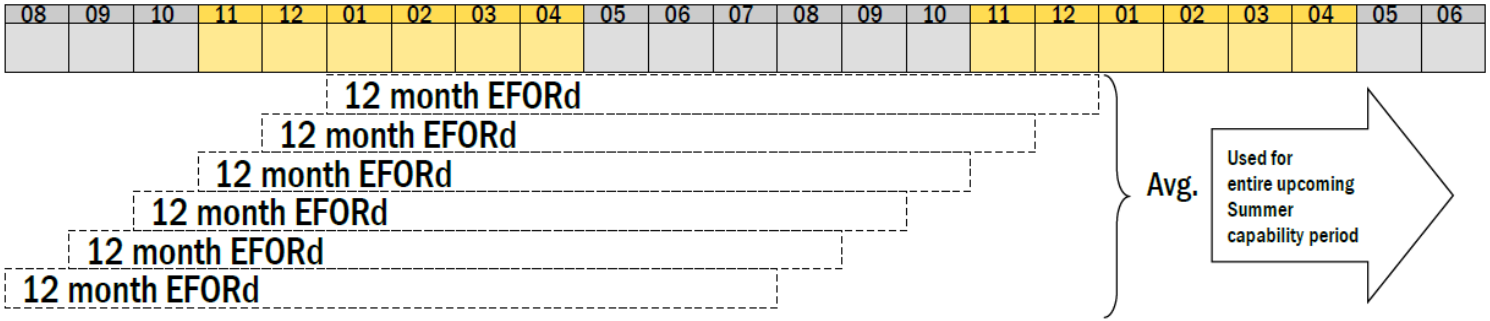
EFORd Background

- 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

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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

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EFORd Calculation

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

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

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

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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

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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**

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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

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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

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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

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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	20.03*	18.60	17.88	17.45	17.16
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	49.42	36.33	29.78	25.86	23.24
AEFORd (%)	14.26	12.73	23.75	20.08	18.24	17.14	16.40

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

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

* Correction to original posted value

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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

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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

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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

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Conclusions

- **The driving force behind the EFORd calculation is the Service Hours in relation to the Forced Outage Hours**
  - For these three 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

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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

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Conclusions

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

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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**

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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

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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

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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

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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

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ICAP Manual Attachment J

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

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ICAP Manual Attachment J

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

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ICAP Manual Attachment J

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

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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

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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

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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

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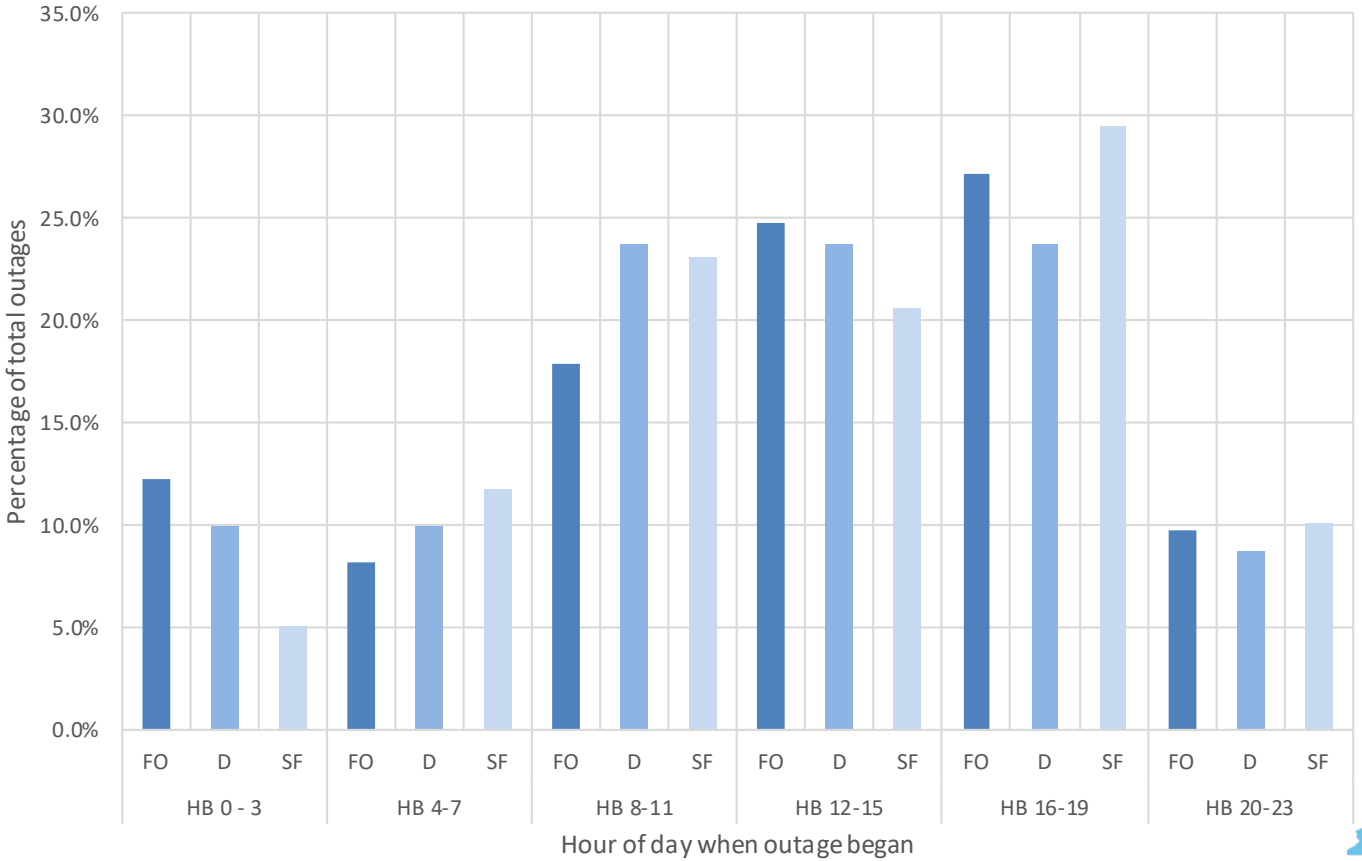
Event Start Time - CT



Class Average EFORd:
9.05 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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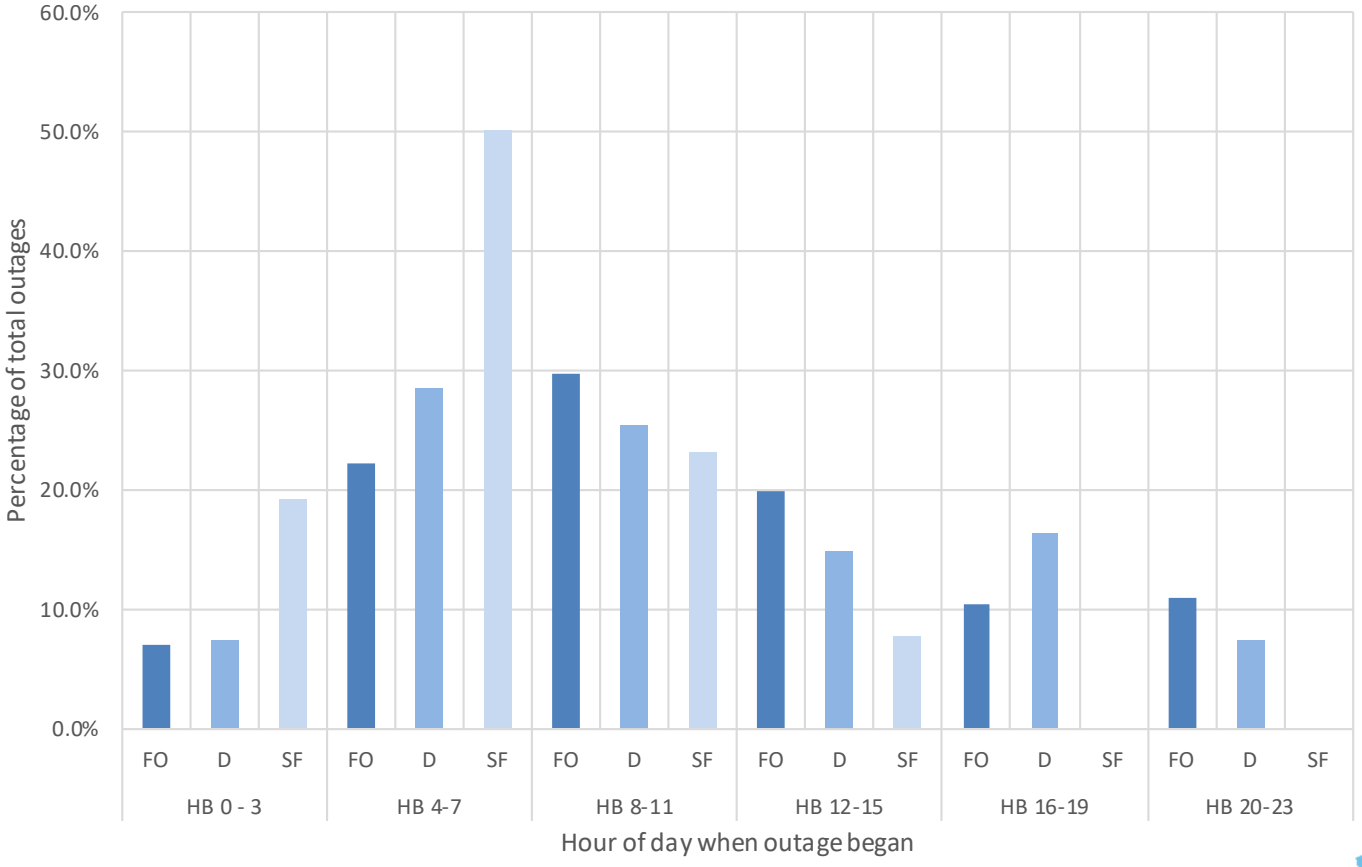
Event Start Time - CC



Class Average EFORd: 3.72 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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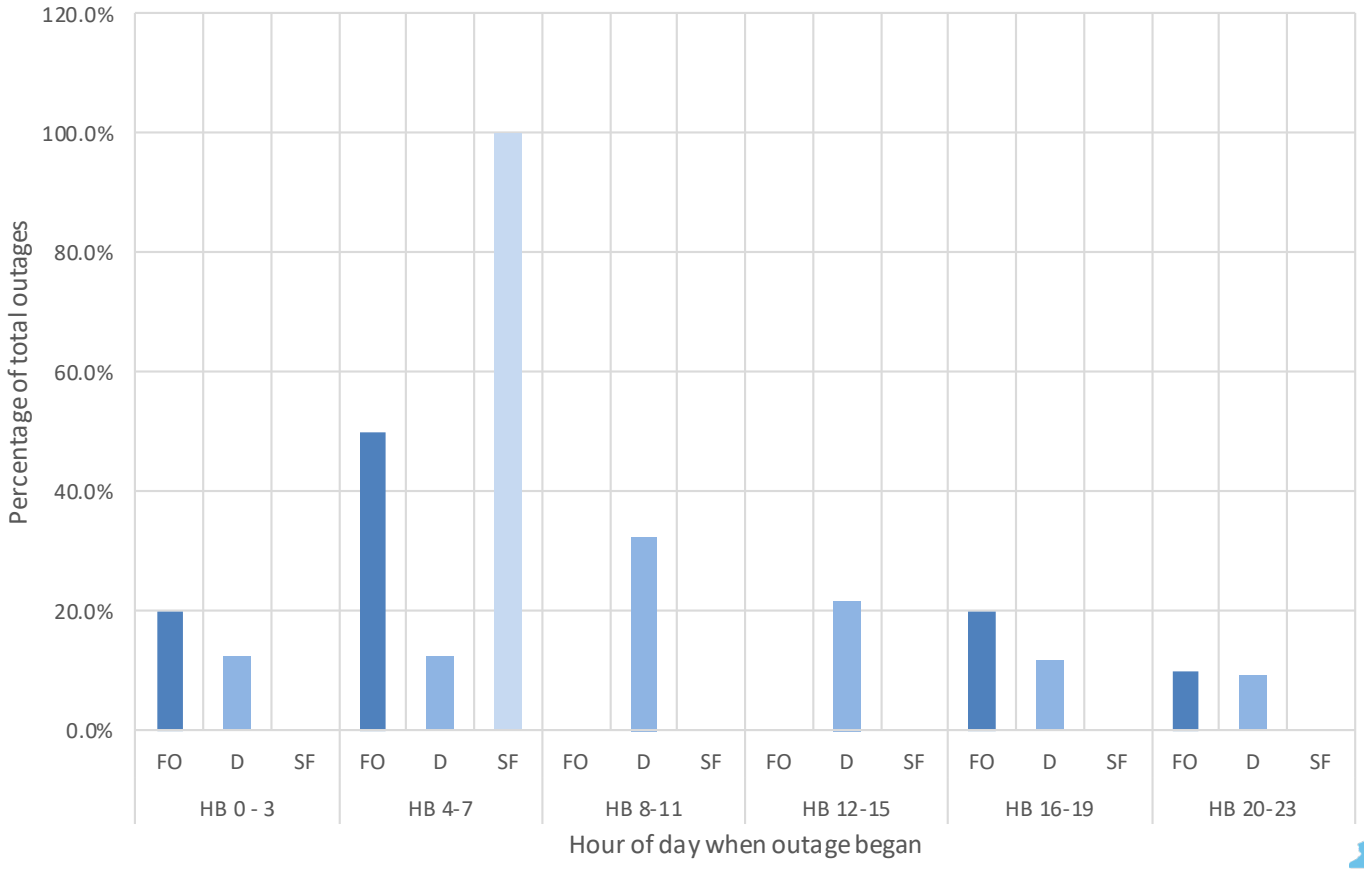
Event Start Time - ST



Class Average EFORd: 7.96 %

FO = Forced Outage
D = Derate
SF = Startup Failure

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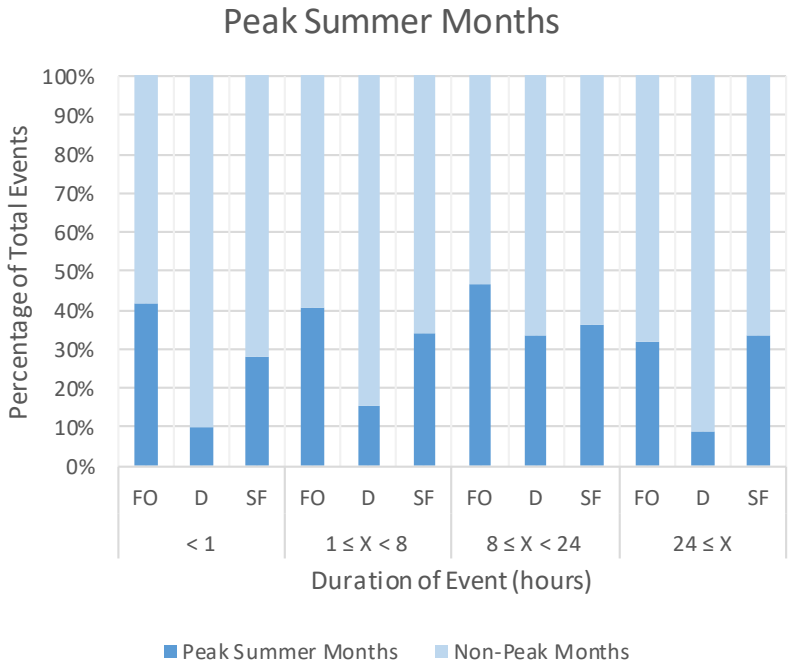
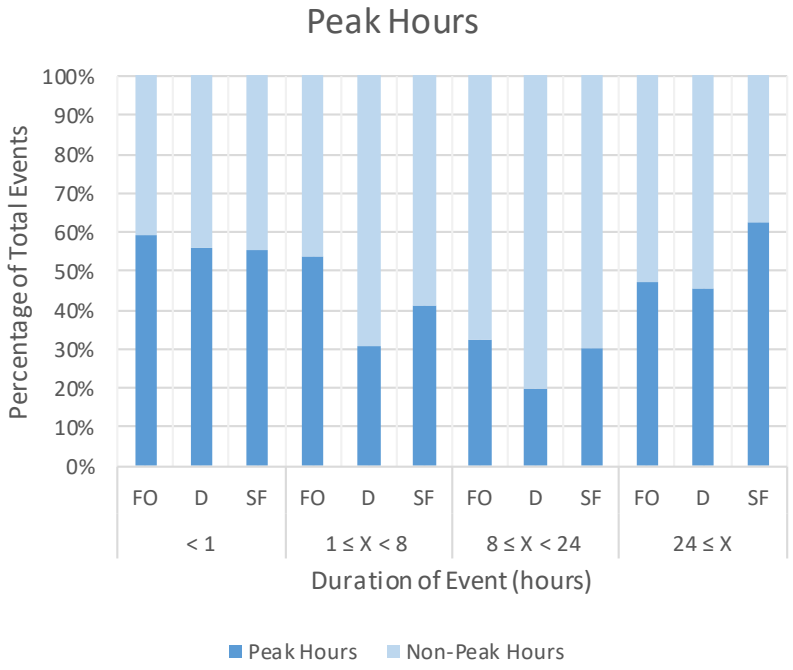
Duration of Events - CT





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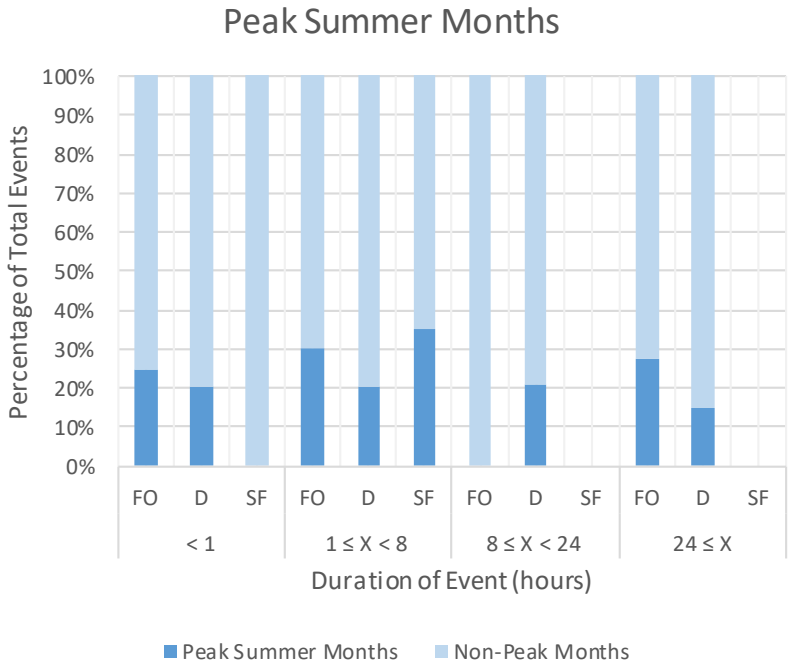
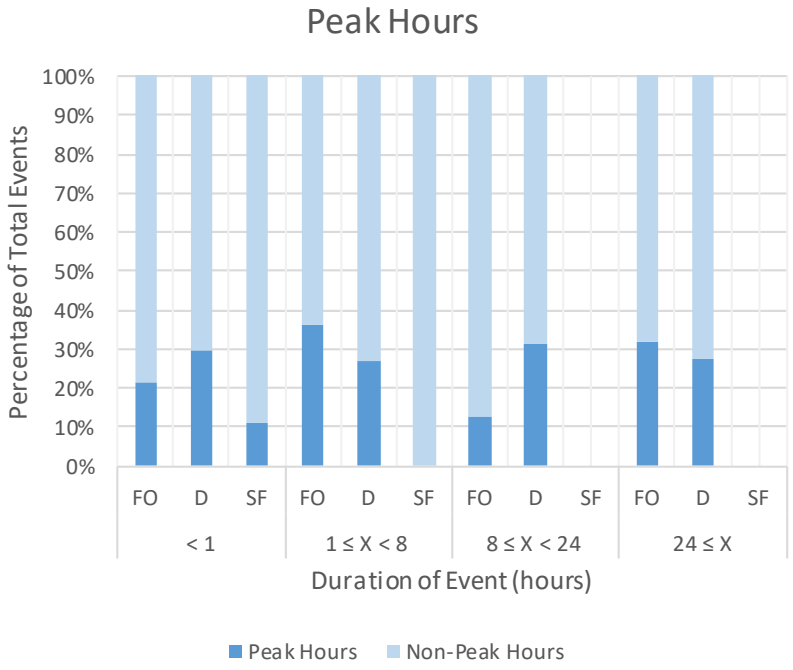
Duration of Events - CC





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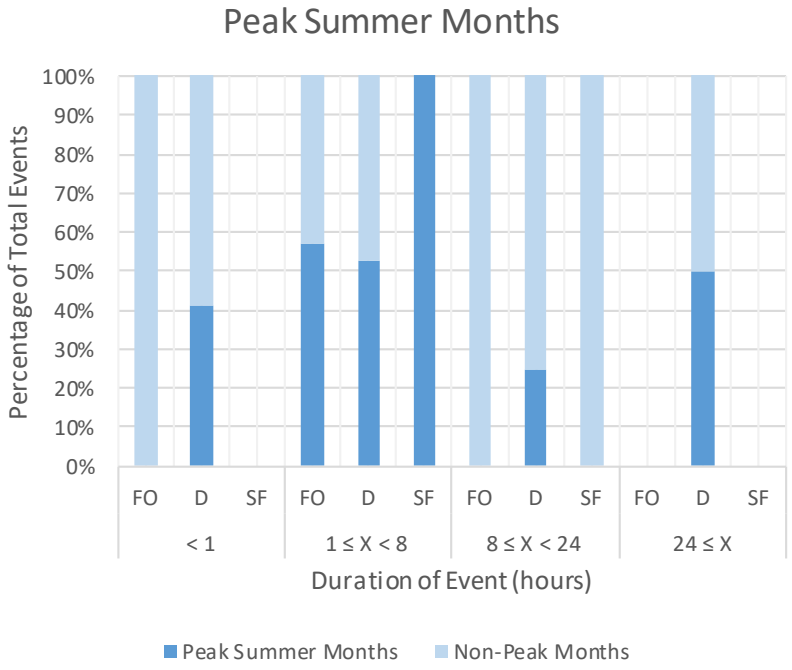
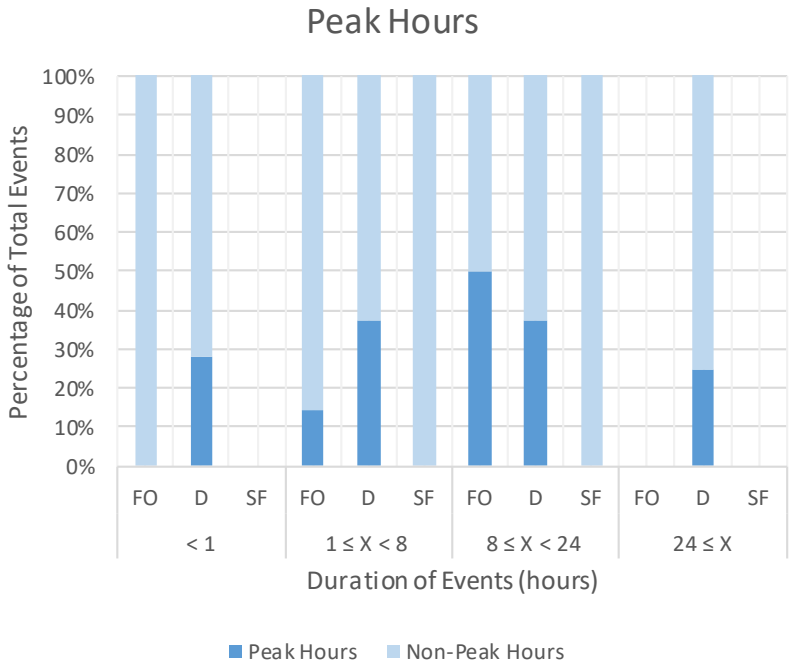
Duration of Events - ST





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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%	

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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%	

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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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