Valuing Capacity for Resources with Energy Limitations

Wes Hall Principal Consultant
Dr. Bei Zhang, PhD Application Engineer
Thomas Legnard Application Engineer

GE Energy Consulting

24 July 2018

Background

In 2012 the NYISO and GE Energy Consulting performed an evaluation of the Contribution to Resource Adequacy of Special Case Resources for the Installed Capacity Subcommittee of the New York State Reliability Council.

This analysis considered:

Penetration

Duration of Use

Persistence of Use

http://www.nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS_Agenda135/2012%20SCR%20Study%20Report%20for%20ICS%20-final-05-01-12.pdf

Objective

Build upon the analysis performed for SCRs, expanding the scope to include distributed energy and other resources with energy limitations considering

The impacts of:

- **Duration of Use**
- **Penetration**
- **Persistence of Use**
- **Diversity of Resources**
- **Performance**
- **Seasonal or Daily Limitations**

On Capacity Value as Measured in:

- **Daily Loss of Load Expectation (LOLE - Days/Year)**
- **Hourly Loss of Load Expectation (LOLE Hours/Year)**
- **Loss of energy Expectation (LOEE)**

Definitions

Capacity Value: The amount of perfect capacity in the same location which would provide an equivalent reliability benefit. Capacity Value is independent of transmission constraints. Capacity value for a traditional generator can be approximated by UCAP.

NYCA-wide Reliability Value: The amount of perfect capacity spread throughout NYCA proportional to existing capacity which would provide an equivalent reliability benefit. NYCA-wide Reliability Value incorporates the impact of transmission congestion.

Capacity Value vs NYCA-wide Reliability Value

The objective of this analysis is to develop a methodology for calculating the Capacity Value of resources with energy limitations, as such, Transmission congestion is not considered.

The impact of transmission constraints on NYCA-wide reliability is captured by the Locational Minimum Capacity requirements (LCRs) and the price differential in the ICAP market.

It is assumed that the impact of transmission constraints for resources with energy limitations is consistent with the impact for a traditional generator and that the LCRs and ICAP Market Clearing prices will adequately account for transmission constraints.

GE will work with the NYISO to develop sensitivities to validate this assumption.

Approach

Approach

GE Energy Consulting will develop a GE MARS post processing routine to schedule resources subject to the parameters listed previously against the hourly NYCA capacity margin for each replication and load level of the GE MARS simulation.

Each replication's hourly NYCA capacity margin will be adjusted by the schedule, and the reliability indices recalculated.

Capacity will be removed until the relevant reliability index is returned to base case levels.

Resource Scheduling

Selecting the Days to Schedule

- Calculate hourly NYCA capacity margin and available Emergency Assistance for all replications and load levels
- If seasonal limitations are specified, filter the data to only those days where the resource is available
- Select the worst days for scheduling up to the limit on the number of calls
  1) Days with Loss of Load Events
  2) Days without loss of Load Events sorted by the sum of NYCA capacity margin and Available Emergency Assistance

Resource Scheduling

Selecting the Hours to Schedule

From the days selected for scheduling

- If time of day limitations are specified, filter to only those hours the resource is available
- If duration of use limitations are specified, calculate the rolling total capacity margin for the number of hours allowed, schedule the resource for the period with the minimum total
- If energy limitations are specified, schedule the resource for a block of consecutive hours until the available energy is utilized (starting from the worst hour, schedule outwards to the worst adjacent hour)

Resource Scheduling

Forced Outages and Intermittency

A probability density function (PDF) can be used to specify the probability a unit is at a given percentage of its output.

The scheduling tool will determine, based on this PDF and a randomly drawn number, what the output will be in any hour.

The PDF used can be specified by hour of the day and by month.

Resource Scheduling

Calculating Net Capacity Margin for Ranking

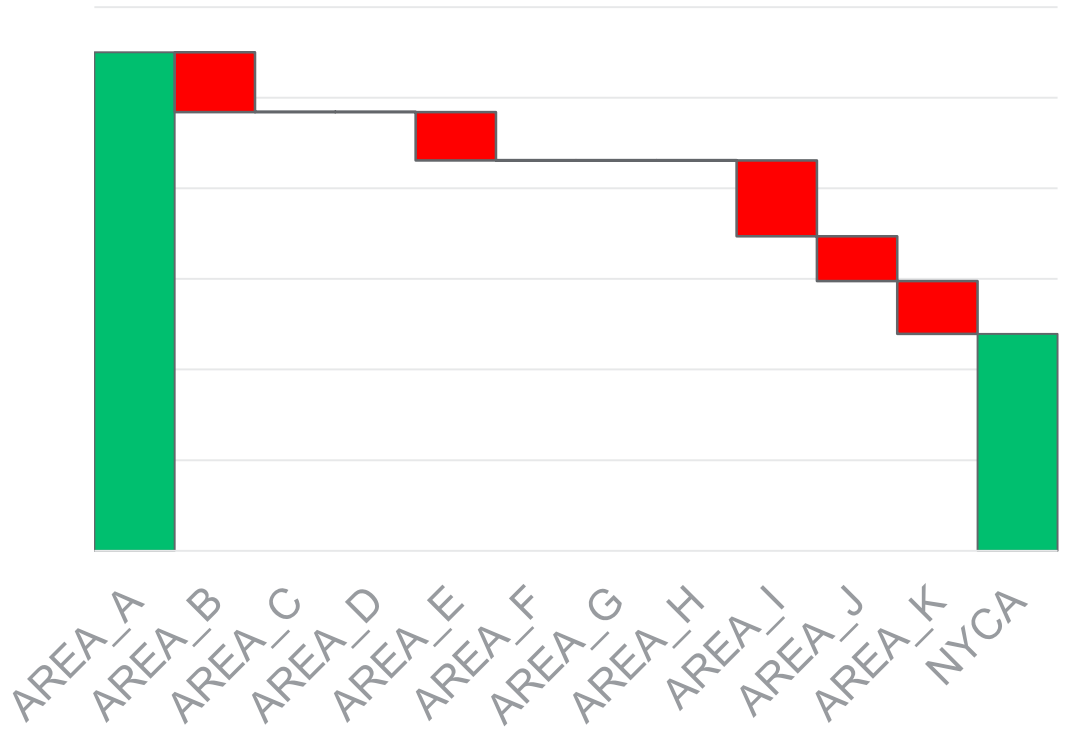
Discussion

Because loss of load events can occur due to transmission constraints, it is possible for NYCA to have a positive net margin and a loss of load

For such hours, only the negative area's margins will be counted towards ranking days / hours for scheduling

It is assumed that if there is a loss of Load event no Emergency Assistance is available

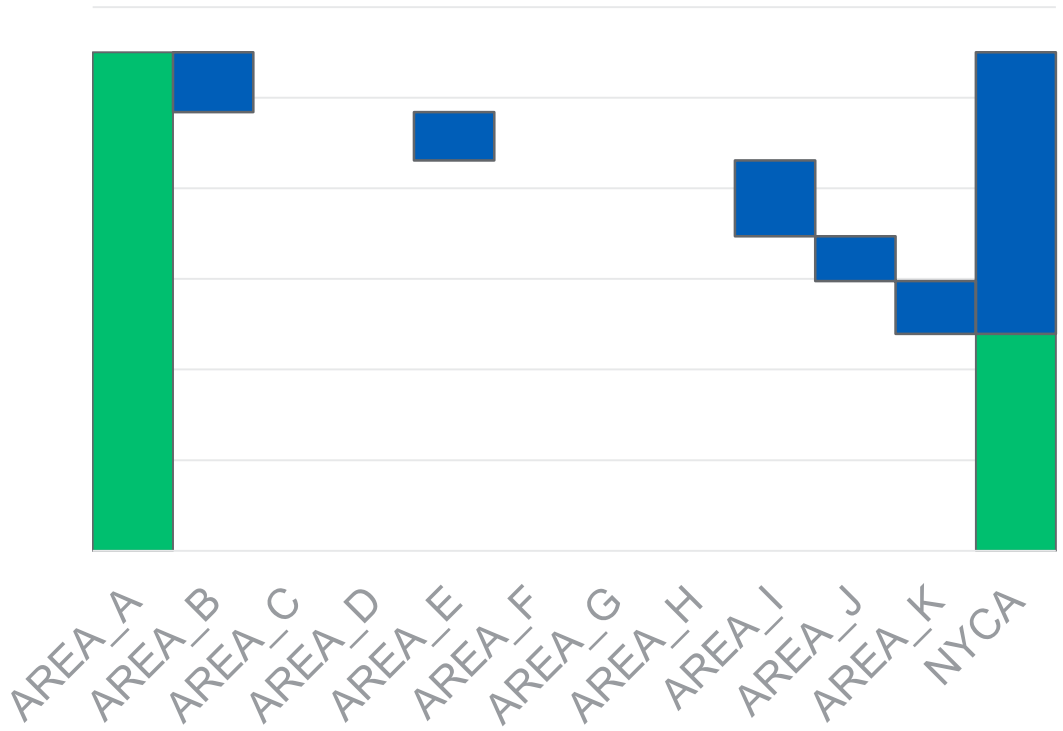
Sample Loss of Load Event Caused by Transmission



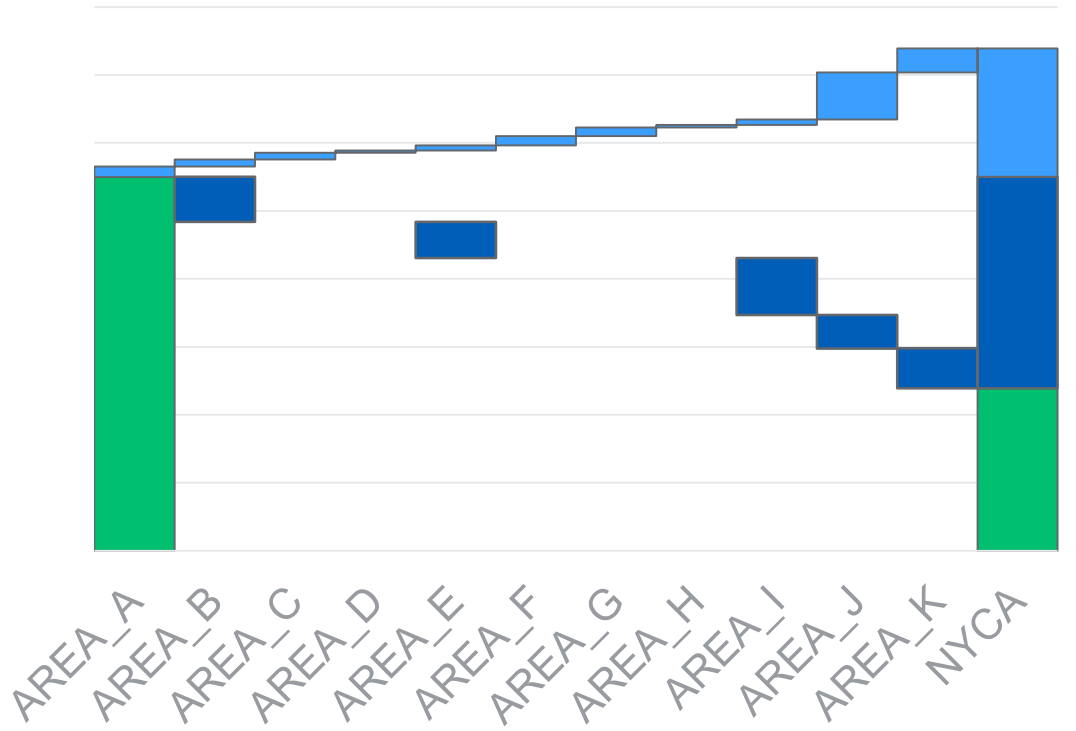
Resource Scheduling

Distribution of capacity among NY Areas

Negative Areas will be scheduled first



Capacity will then be scheduled proportional to load



Capacity Removal

A constant amount of capacity is removed from all hours to calculate capacity value

1) If the resource is scheduled in the hour, remove capacity from NY Areas proportional to the capacity added
2) If the resource is not scheduled and all NY Areas have capacity margins greater than or equal to zero, remove capacity from NY Areas proportional to the surplus
3) If the resource is not scheduled and any NY Area has a capacity margin less than zero, remove capacity proportional to base case UCAP

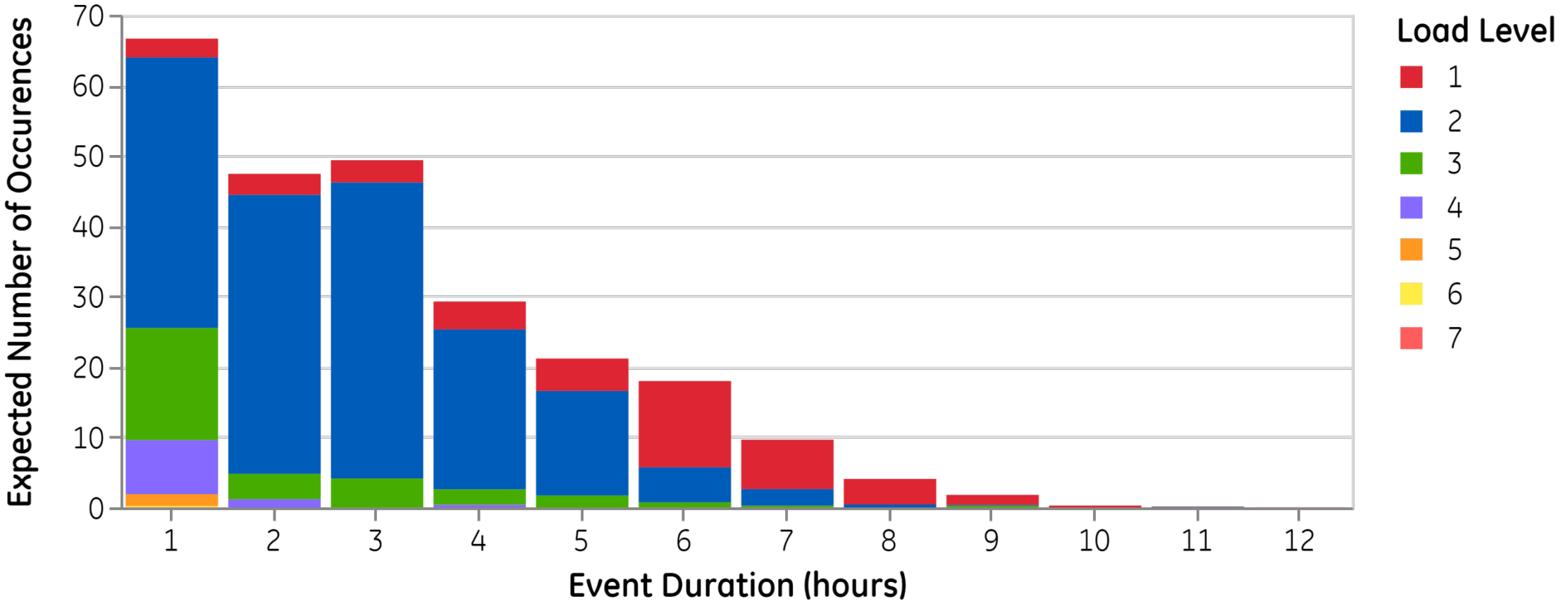
Capacity Removal

A combination of the three approaches may be employed if the capacity removal is larger than the resource addition in that hour (*i.e.* if the resource is partially on outage, or if a diverse resource is added and not all blocks are scheduled)

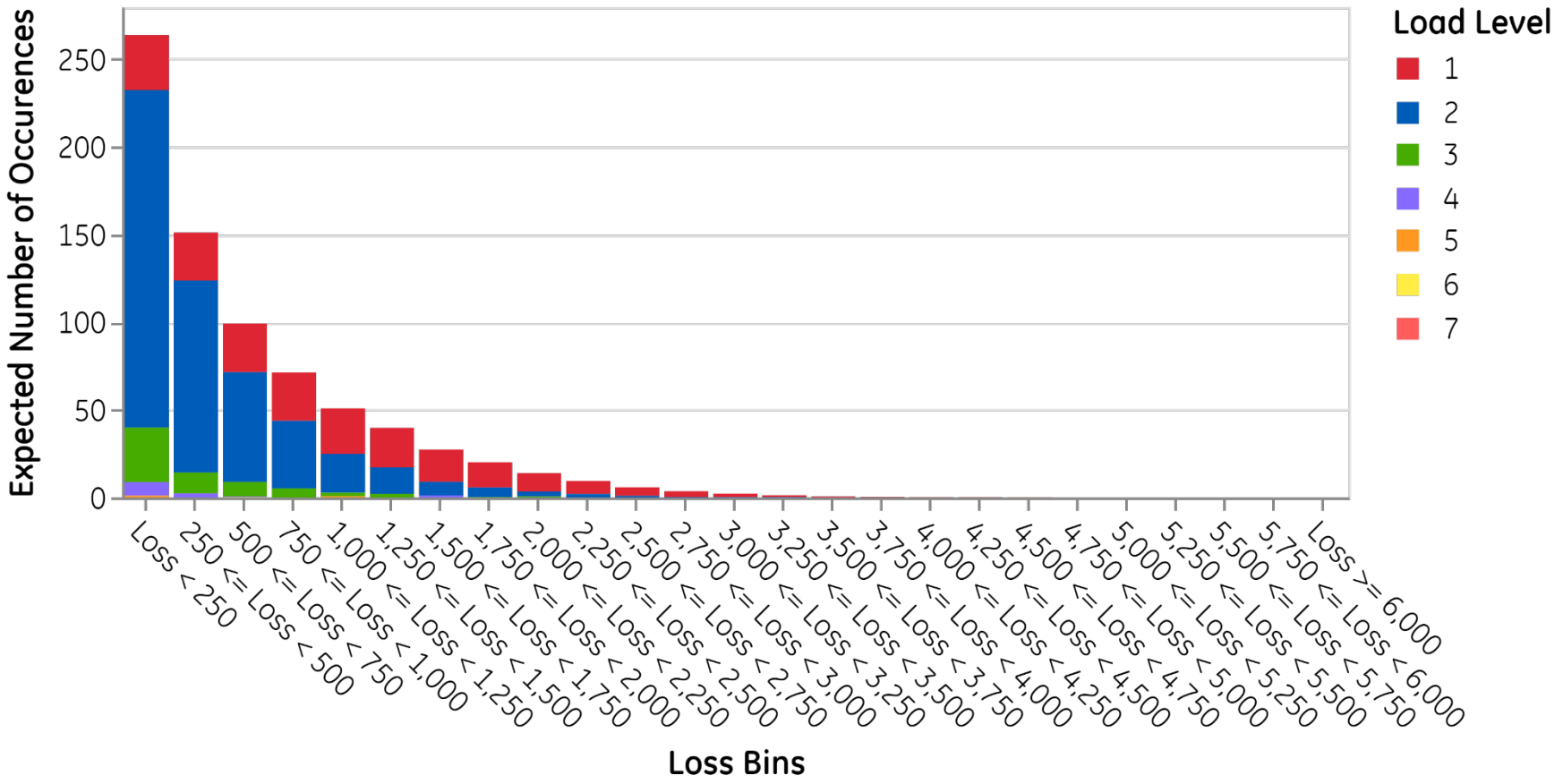
After removing capacity, if there is Emergency Assistance available which could reduce a loss of load, decrease the loss by the amount of available Emergency Assistance.

Details of the 2018 IRM Base Case Loss of Load Events

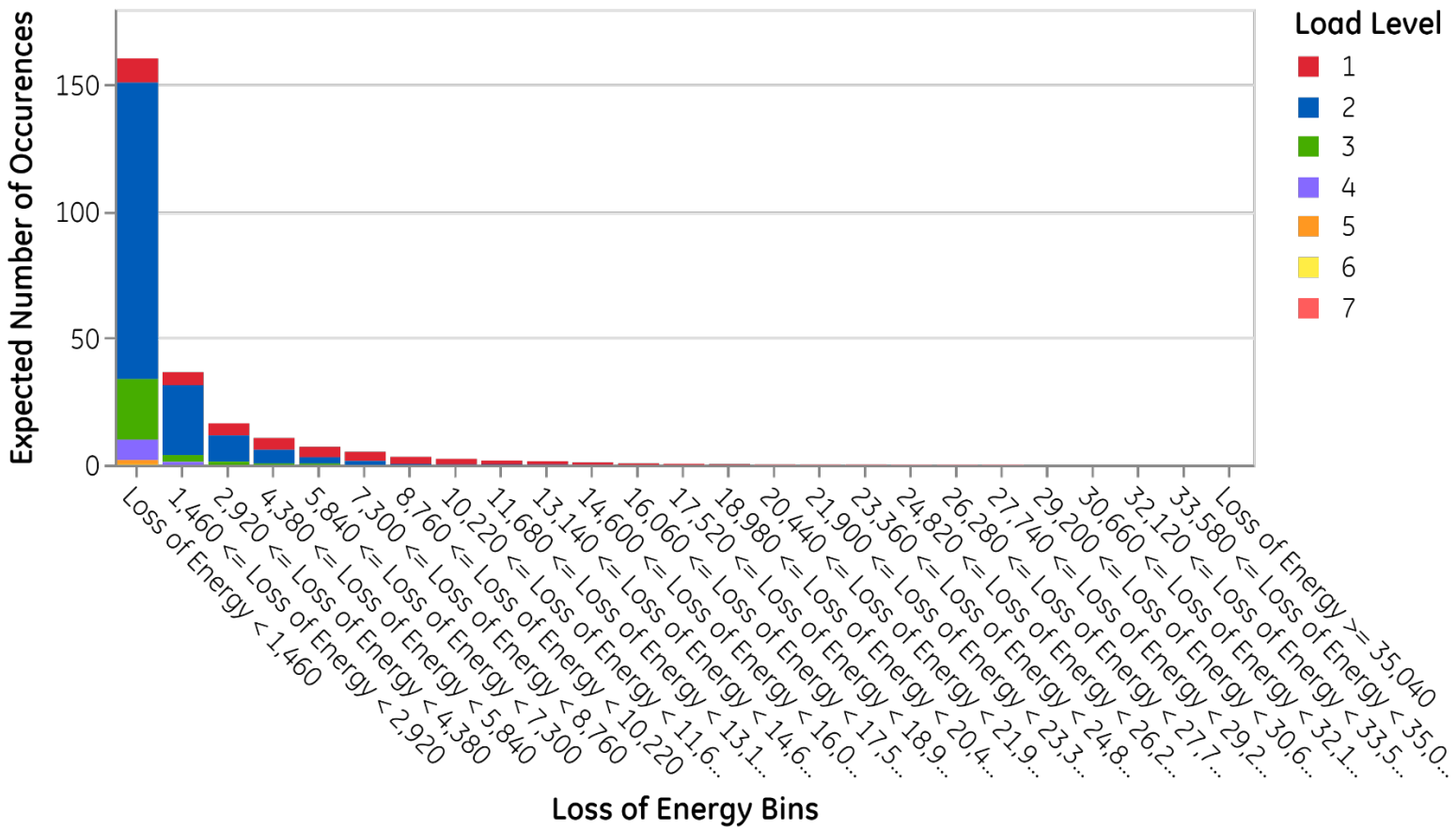
Distribution of Event Duration for Daily Loss of Load Events



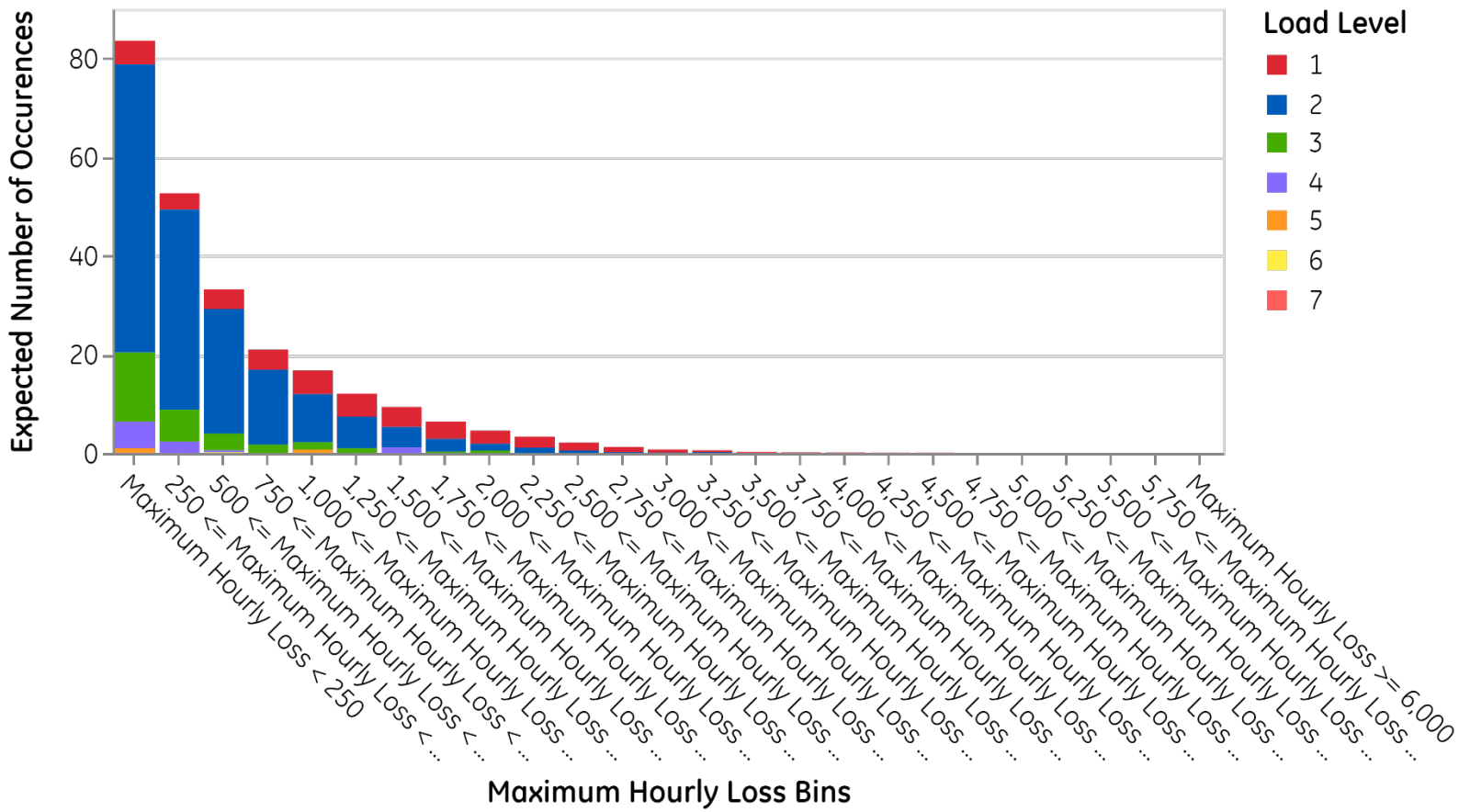
Distribution of Size of Hourly Loss of Load Events



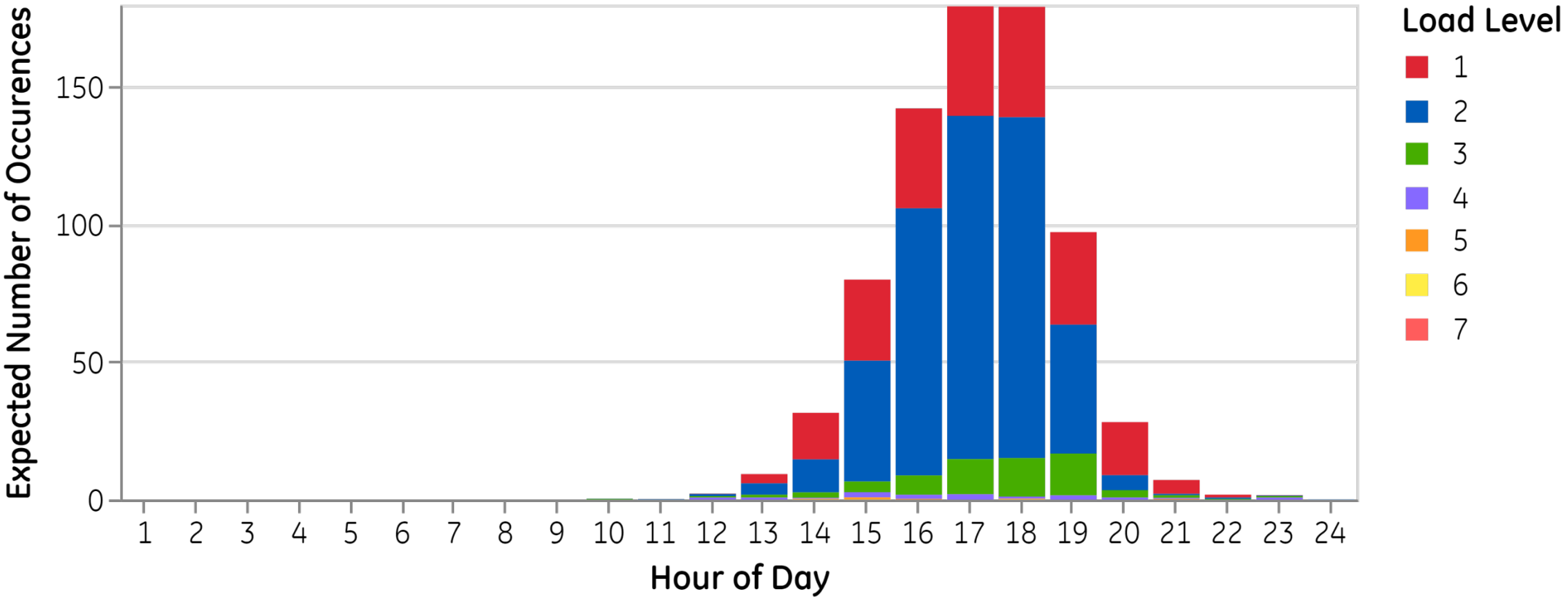
Distribution of Loss of Energy for Daily Loss of Load Events



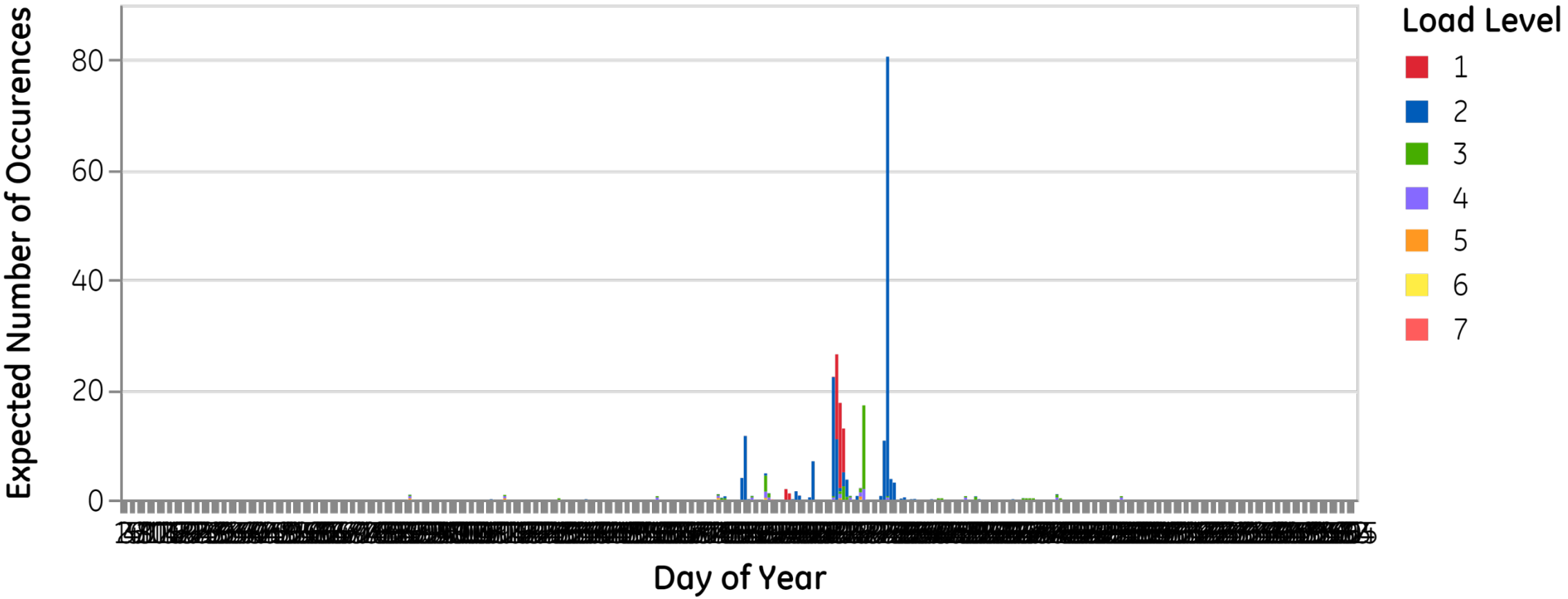
Distribution of Maximum Hourly Size of Daily Loss of Load Events



Time of Day


Expected Number of Occurences
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour of Day
Load Level
1
2
3
4
5
6
7

Time of Year


Expected Number of Occurences
80
60
40
20
0
Day of Year
Load Level
1
2
3
4
5
6
7

Time of Day and Time of Year Observations

- Loss of Load Events Occur on 57 unique days throughout the year, 36 of these days occur in July and August (96% of the loss of load expectation occurs in July and August)
- The earliest loss of load event in the year occurs on March 28th, and the latest event occurs on October 24th
- The earliest loss of load event in a day occurs in hour ending 10 AM, and the latest is hour ending 12 AM (97% of the loss of load expectation occurs between hour ending 2 PM and hour ending 8 PM)

Next Steps

Next Steps

- GE is working with the NYISO to validate preliminary base case results for presentation at a later stakeholder meeting
- When base case results are finalized GE will run the post processing tools developed for the 2018 IRM High Wind and High Solar Case