

Appendix K - Response Rate Auditing Calculation

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I. OVERVIEW

ISO uses Manual Response Rate (MRR) data to determine Real-Time Dispatch Instructions and account for on-line Generator Asset Ten-Minute Spinning Reserve, Ten-Minute Non-Spinning Reserve, and Thirty-Minute Operating Reserve. In order to verify that MRRs are consistent with Generator Asset performance, ISO shall conduct MRR auditing by analyzing a Generator Asset's historical response to electronic dispatch signals. Dispatches that are indicative of a Generator Asset's response in a certain initial output range shall be analyzed for MRR when the Generator Asset is required to increase MW output. This analysis shall take into account the statistical variation of a Generator Asset's response to dispatches, and includes a time-varying weighting factor for those dispatches to determine a probabilistic weighted average MRR for a Generator Asset, given an initial starting output. The ISO's analysis is described in Sections II and III of this Appendix.

II. DISPATCH INTERVAL CRITERIA

1. An electronic dispatch instruction to an on-line Generator Asset shall be referred to as a qualified dispatch interval (QDI) and utilized for MRR evaluation if all the following conditions are met:

- a. Generator Asset is dispatchable
- b. Current output is greater than or equal to Economic Min
- c. Desired Dispatch Point (DDP) is greater than current output
- d. DDP remains greater than current output for at least five minutes, and
- e. Change in DDP is greater than 5 times MRR or a defined percentage of the Generator Asset's dispatchable range (whichever is less). The defined percentage shall be based upon initial Generator Asset output as follows:

| Bin # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--|----|----|----|----|----|---|---|---|---|----|
| DDP change as percentage of dispatchable range | 10 | 10 | 10 | 10 | 10 | 9 | 7 | 6 | 5 | 5 |

Where each bin is 10% of the Generator Asset's dispatchable range in MW

2. A QDI shall end for a particular Dispatch Instruction when any of the following conditions are met:

- a. Dispatch Instruction has been in effect for 15 minutes
- b. DDP minus Generator Asset output is less than 0.5% of Economic Max, or
- c. DDP is less than Generator Asset output

3. A Dispatch Instruction that meets the above criteria may be removed from the MRR analysis if that instruction was not indicative of normal MRR response. This may occur because of conditions such as, but not limited

to, resource maintenance, outages, fuel switching, or manual dispatch.

III. CALCULATING MANUAL RESPONSE RATE

1. A QDI evaluation will produce an MRR as a ratio of the change in MW output to the amount of time required to effect that change in minutes.
2. The QDI and corresponding MRR value shall then be binned, based upon the Generator Asset's initial output, into one of ten equal MW bins across the Generator Asset's largest observed dispatchable range from Economic Min to Economic Max.
3. Statistical MRR outliers shall be removed from the analysis by removing the tails of the statistical distribution using the mean value and standard deviation.

$$\sigma_j = \sqrt{\frac{1}{N_j} \sum_{i=1}^{N_j} (R_{j,i} - \mu_j)^2}, \quad \mu_j = \frac{1}{N_j} \sum_{i=1}^{N_j} R_{j,i}$$

Where:

μ = mean value

σ = standard deviation

N_j = number of samples in a MW range

R_j = set of ramp rates allocated to a MW range

l = sample number

j = MW bin number

Samples that are within two standard deviations of the mean shall be retained so that retained samples satisfy: $\mu_j - \varepsilon_3 \cdot \sigma_j < R_j < \mu_j + \varepsilon_3 \cdot \sigma_j$

Where: $\varepsilon_3 = 2.0$

Resulting set of the ramp rates in the bin j without outliers is \tilde{R}_j
with the number of samples \tilde{N}_j

4. Each sample shall be weighted for age of the sample. The older the sample, the lower the weight in the probability distribution.

The weighting factor for each sample is:

$$w_{j,i} = e^{-\alpha \cdot (T_0 - T_{j,i}^{st})}$$

Where:

$\alpha = 0.05$

$T_0 - T^{st}$ = the number of months since the sample was taken

5. A weighted average MRR shall then be determined for each MW range for a Generator Asset using the weighting factor and probability distribution.

$$R_j^* = \frac{\sum_{i=1}^{\tilde{N}_j} q_{j,i} \cdot w_{j,i} \cdot \tilde{R}_{j,i}}{\sum_{i=1}^{\tilde{N}_j} q_{j,i} \cdot w_{j,i}}$$

Where:

$q_{j,i} = \{0,1\}$ = factor used to exclude a sample manually

6. The resultant MRRs shall then be evaluated for consistency and reasonability by analyzing any MRRs that:
- Have less than five samples in that MW bin, or
 - Deviate more than 50% from the MRRs in the adjacent MW bins.
7. MRRs that are found to be inconsistent with adjacent bin values shall be removed from the final resultant MRR values.
8. The MRR cap value shall be determined as the maximum of the remaining MRR values over the Generator Asset's dispatchable range.

OP-23 Appendix K Revision History

Document History

| Rev. No. | Date | Reason |
|----------|----------|---|
| Rev 0 | 01/04/19 | Initial version |
| Rev 1 | 12/07/20 | Periodic review performed by procedure owner with minor grammatical and defined term changes. |
| Rev 1.1 | 08/25/22 | Periodic review performed by procedure owner requiring no intent changes. |
| Rev 1.2 | 08/21/24 | Biennial review performed by procedure owner requiring no changes. |
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