Performance Scoring

Regulation Market Issues Senior Task Force

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Performance Compliance

Performance Based Regulation

Resources qualify and are provided compensation based on performance.

- Performance scores reflect how well the resource is following the regulation signal.

PJM scores resources on three components:

Accuracy: *the correlation or degree of relationship between control*

Delay: *the time delay between control signal and point of highest correlation*

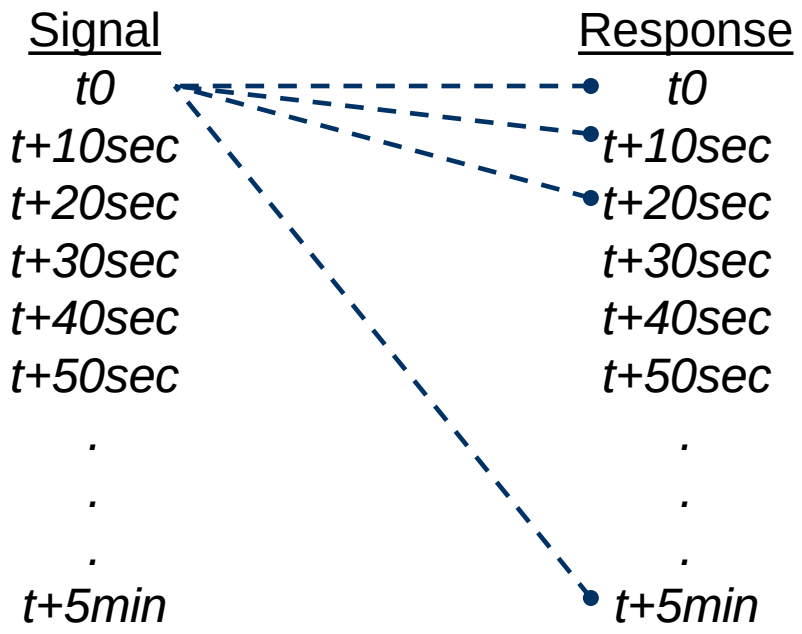
Precision: *the instantaneous error between the control signal and the regulating unit's response*

A resource's performance score is calculated as:

$$\text{Perf\_Score} = \frac{1}{3}*\text{Accuracy} + \frac{1}{3}*\text{Delay} + \frac{1}{3}*\text{Precision}$$

Accuracy: *the correlation or degree of relationship between control*

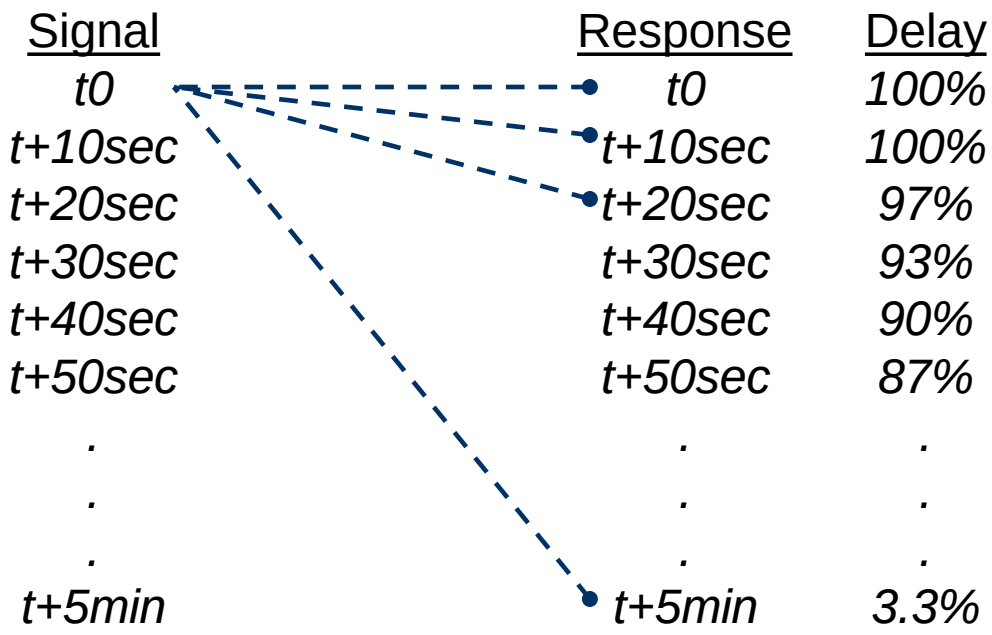
- Over a five-minute period with a 10-second propagation delay



- **Correlation of response compared to signal over a five-minute period**
- **Best correlation is used for performance scoring**

Delay: *the time delay between control signal and point of highest correlation*

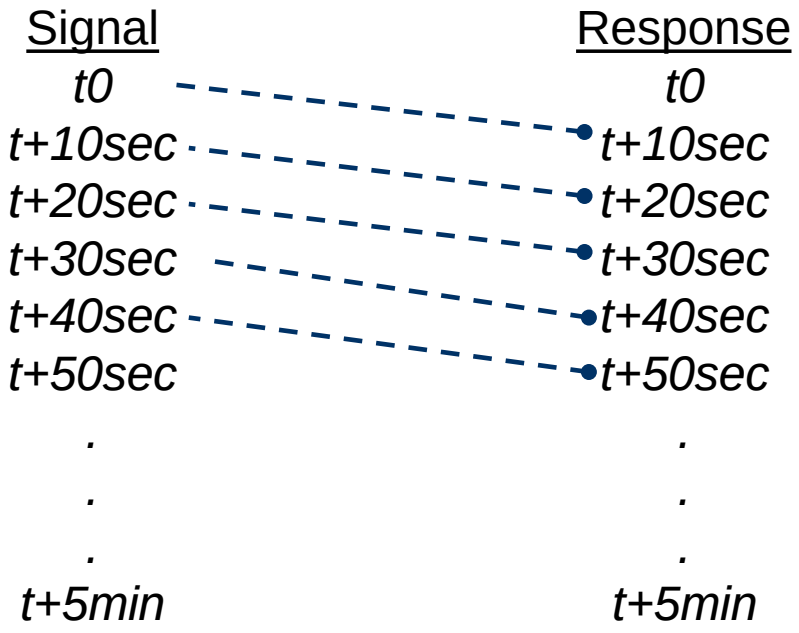
- Five-minute rolling correlation with 10-second granularity



- **Delay score is measured at the highest point of correlation at each 10-second interval**
- **Best correlation at t0 or t+10sec will produce 100% delay score**

Precision: *the instantaneous error between the control signal and the regulating unit's response*

- Difference between the area under the curve



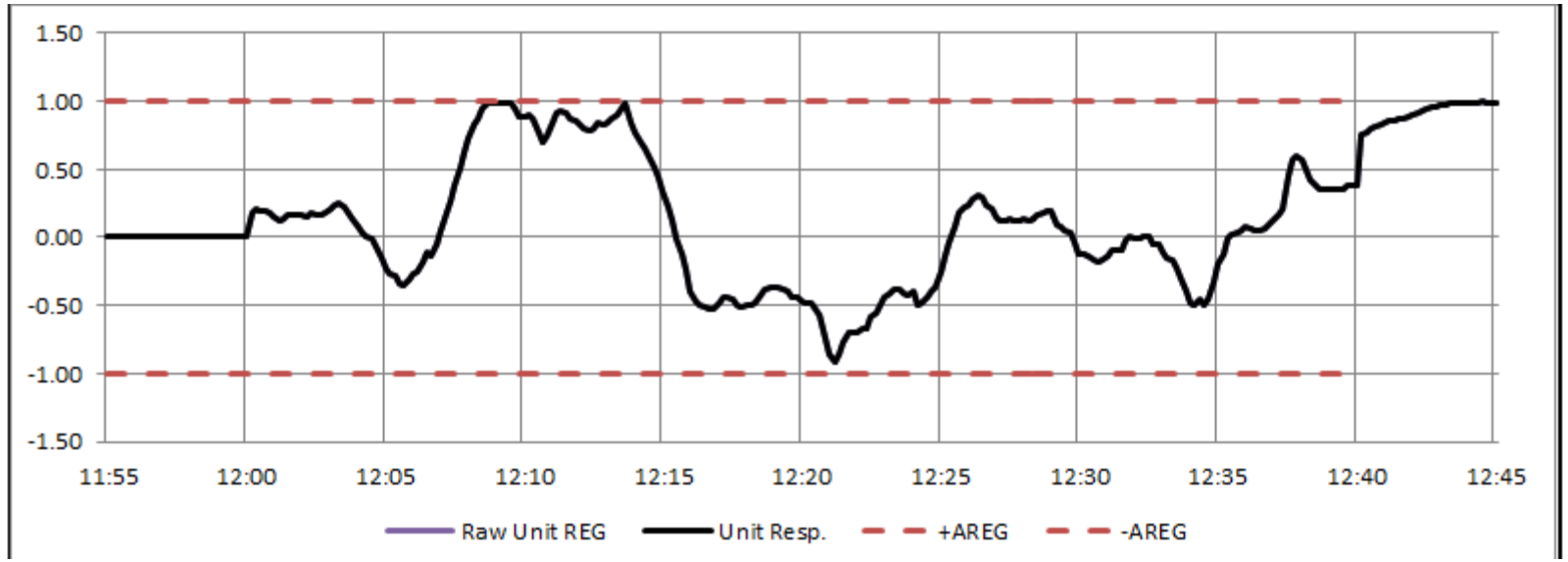
$$Error = Avg\ of\ Abs\left|\frac{Response - Regulation\ Signal}{Hourly\ Average\ Regulation\ Signal}\right|$$

- **Precision score has 10-second delay built in for performance scoring**
- **When t+10sec for response = t0 for signal, 100% performance score**

Scoring Example – No Delay

TIME	AGC MW	Fleet Regulation Control Signal
11:59:50	0.00	0
12:00:00	0.00	0.00
12:00:10	0.18	0.18
12:00:20	0.21	0.21
12:00:30	0.20	0.20
12:00:40	0.19	0.19
12:00:50	0.18	0.18
12:01:00	0.15	0.15
12:01:10	0.12	0.12
12:01:20	0.14	0.14
12:01:30	0.16	0.16
12:01:40	0.17	0.17
12:01:50	0.17	0.17
12:02:00	0.16	0.16
12:02:10	0.16	0.16
12:02:20	0.18	0.18
12:02:30	0.17	0.17
12:02:40	0.16	0.16
12:02:50	0.18	0.18
12:03:00	0.20	0.20
12:03:10	0.23	0.23
12:03:20	0.25	0.25
12:03:30	0.22	0.22
12:03:40	0.18	0.18
12:03:50	0.14	0.14
12:04:00	0.08	0.08

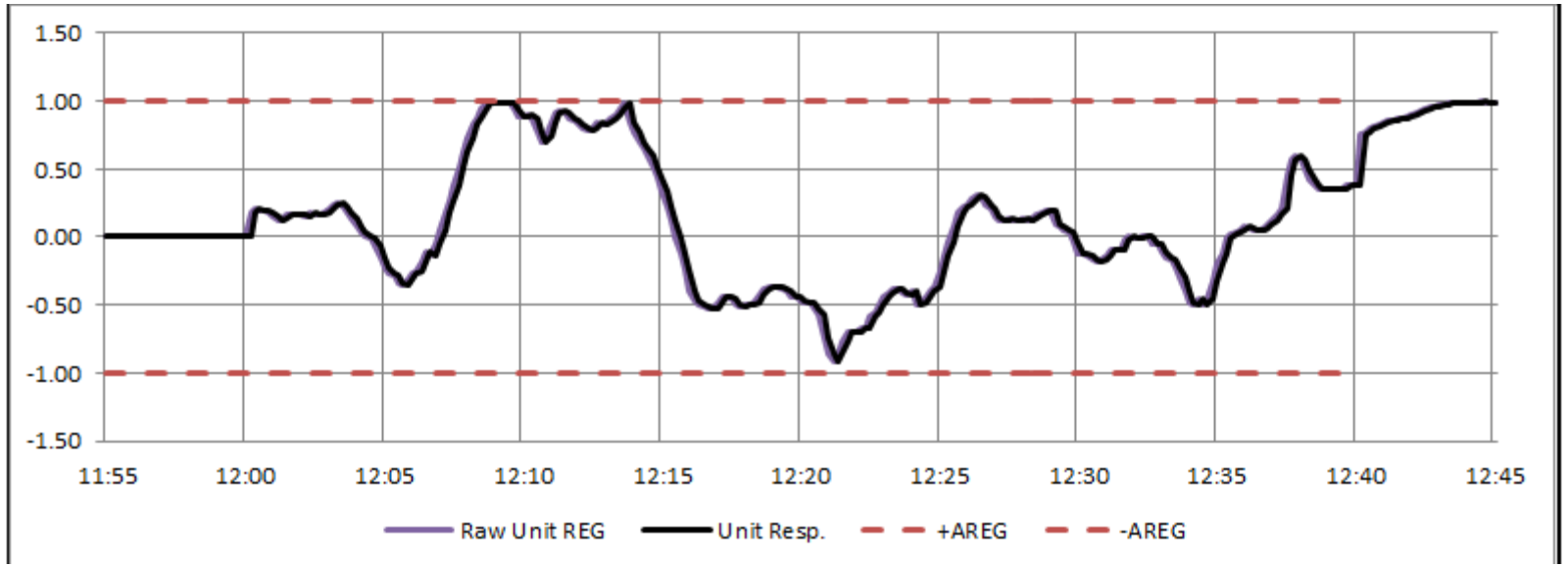
Performance score	**0.962**
Accuracy score	1.000
Delay score	1.000
Precision score	0.886



Scoring Example – 10-second Delay

TIME	AGC MW	Fleet Regulation Control Signal
11:59:50	0.00	0
12:00:00	0.00	0.00
12:00:10	0.00	0.18
12:00:20	0.18	0.21
12:00:30	0.21	0.20
12:00:40	0.20	0.19
12:00:50	0.19	0.18
12:01:00	0.18	0.15
12:01:10	0.15	0.12
12:01:20	0.12	0.14
12:01:30	0.14	0.16
12:01:40	0.16	0.17
12:01:50	0.17	0.17
12:02:00	0.17	0.16
12:02:10	0.16	0.16
12:02:20	0.16	0.18
12:02:30	0.18	0.17
12:02:40	0.17	0.16
12:02:50	0.16	0.18
12:03:00	0.18	0.20
12:03:10	0.20	0.23
12:03:20	0.23	0.25
12:03:30	0.25	0.22
12:03:40	0.22	0.18
12:03:50	0.18	0.14
12:04:00	0.14	0.08

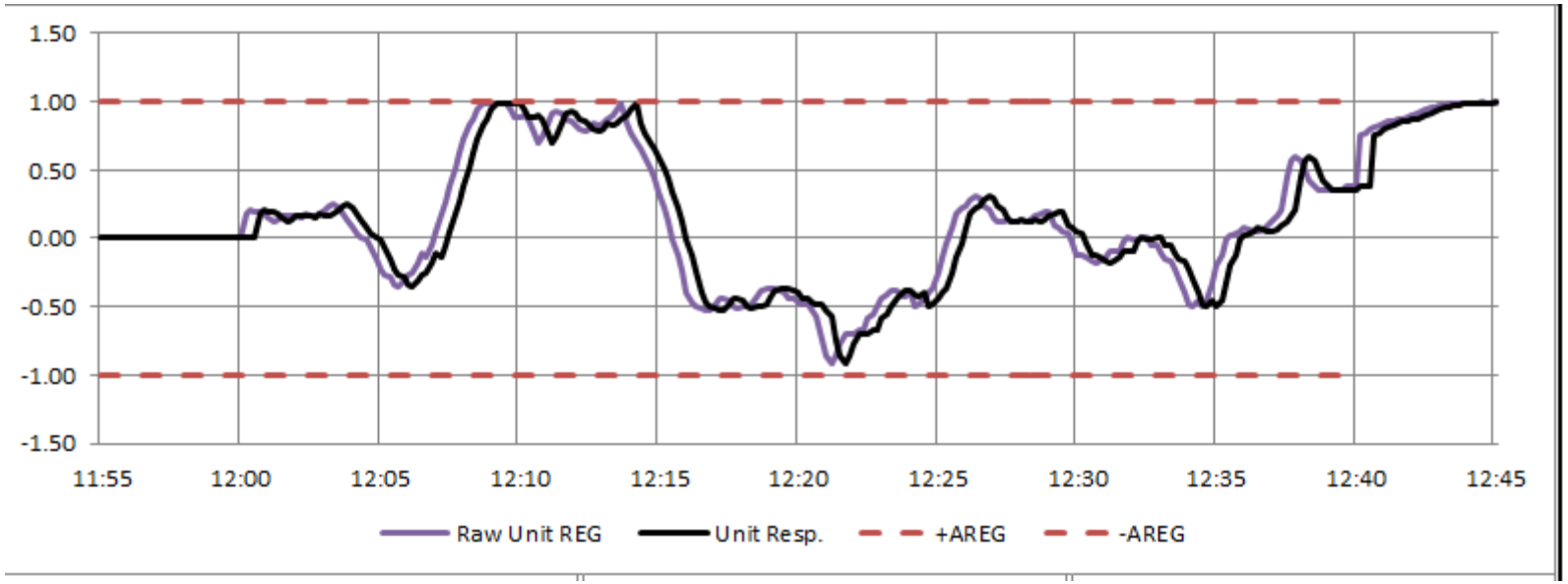
Performance score	**1.000**
Accuracy score	1.000
Delay score	1.000
Precision score	1.000



Scoring Example – 30-second Delay

TIME	AGC MW	Fleet Regulation Control Signal
11:59:50	0.00	0
12:00:00	0.00	0.00
12:00:10	0.00	0.18
12:00:20	0.00	0.21
12:00:30	0.00	0.20
12:00:40	0.18	0.19
12:00:50	0.21	0.18
12:01:00	0.20	0.15
12:01:10	0.19	0.12
12:01:20	0.18	0.14
12:01:30	0.15	0.16
12:01:40	0.12	0.17
12:01:50	0.14	0.17
12:02:00	0.16	0.16
12:02:10	0.17	0.16
12:02:20	0.17	0.18
12:02:30	0.16	0.17
12:02:40	0.16	0.16
12:02:50	0.18	0.18
12:03:00	0.17	0.20
12:03:10	0.16	0.23
12:03:20	0.18	0.25
12:03:30	0.20	0.22
12:03:40	0.23	0.18
12:03:50	0.25	0.14
12:04:00	0.22	0.08

Performance score	**0.912**
Accuracy score	0.987
Delay score	0.960
Precision score	0.790



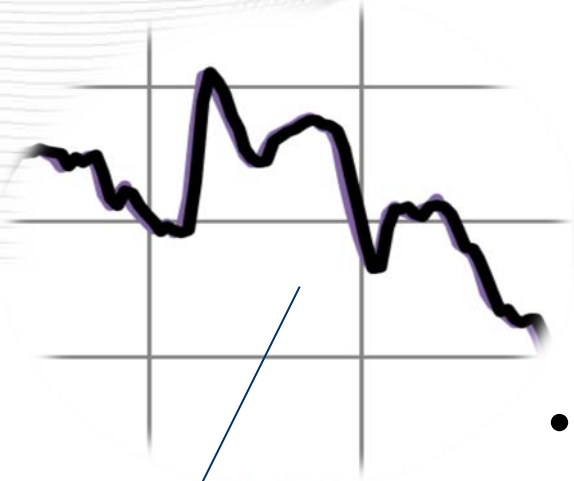
Removing 10-second Delay

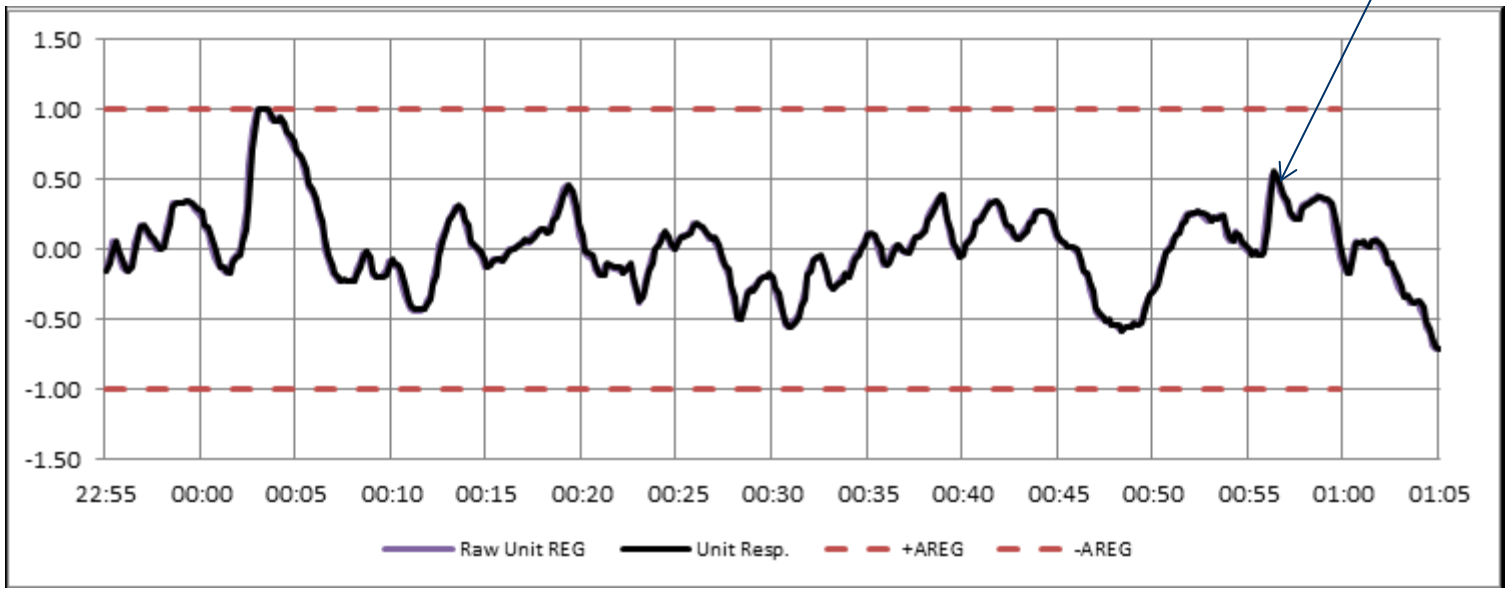
With 10sec delay

Partial Scores	
Accuracy Score	0.990008
Delay Score	1
Precision Score	0.923805
Composite Score	0.971271

Without 10sec delay

Partial Scores	
Accuracy Score	0.990008
Delay Score	1
Precision Score	0.874878
Composite Score	0.954962





- Changing precision scoring to not include 10-second delay decreases performance score; even on resources that look to be responding quickly.

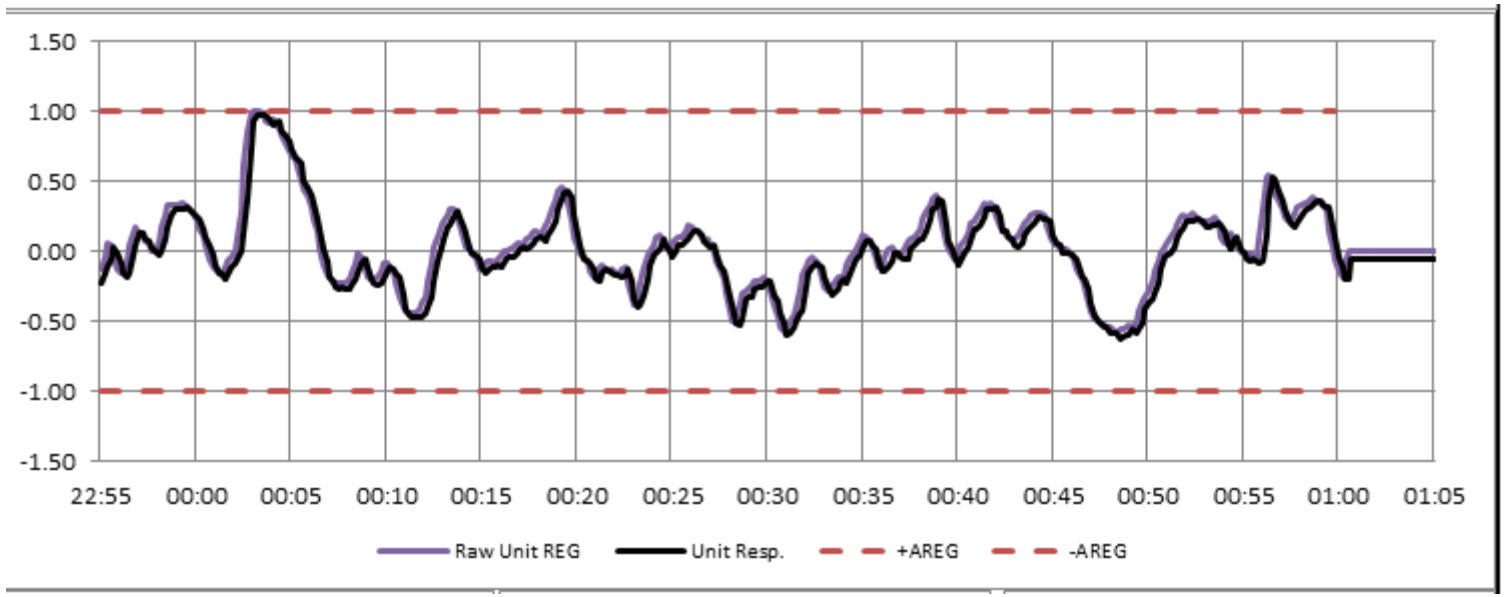
Removing 10-second Delay

With 10sec delay

	Partial Scores
Accuracy Score	0.983865
Delay Score	0.998333
Precision Score	0.832888
Composite Score	0.938362

Without 10sec delay

	Partial Scores
Accuracy Score	0.983865
Delay Score	0.998333
Precision Score	0.694132
Composite Score	0.89211



- Changing precision scoring to not include 10-second delay decreases performance score
- Even more relevant on units that have a larger delay in response

Summary

- Precision is the only component of the regulation score that provides a different score when a resource response is at t0 or with a 10-second delay.
- Resources are unable to respond instantaneously and thus benefit from 10-second delay in scoring.
  - Resources would only benefit if communication round-trip was consistently less than five seconds.
  - Communication round-trip is approximately 9-11 seconds.