

September 9, 2020

To: PUD Personnel – System Wide

From: John Price, CSP

Re: CO₂ Monitoring Data at Priest Rapids Dam

PUD Personnel,

Between August 10 and August 20, 2020, carbon dioxide (CO₂) monitoring was performed in various areas at Priest Rapids Dam. The purpose of this monitoring was to assess high occupancy areas for CO₂ concentrations. This data may be used to evaluate if adequate outside (fresh) air is being cycled into the ventilation systems, thereby diluting CO₂ concentrations in control rooms, office areas, and break rooms. Other areas of the powerhouse have not been evaluated at this time.

For reference, the permissible exposure limit for CO₂ is 5000 parts per million (ppm). ASHRAE's recommendation for a comfortable office environment is that CO₂ concentrations be maintained at no more than 800-ppm above background (outside air) concentrations, which are typically measured at about 400-ppm, so indoor air may have up to 1200-ppm by the ASHRAE recommendation.

Out of an abundance of caution, during the pandemic the PUD is using a limit of 800-ppm CO₂ as the acceptable amount of CO₂ in a PUD facility. The purpose for using 800-ppm as our limit is that evidence suggests SARS CoV-2 may spread through aerosols which may stay suspended in the air for a significant amount of time. By keeping the CO₂ levels to a minimum, we expect aerosols will be diluted to an acceptable level, especially when other pandemic protocols are being implemented: physical distancing, good hygiene practices, and face coverings.

Below is a description of the findings which are displayed in the attached graphs.

Control Room

Two monitoring devices were set up in the control room: one behind where the senior operator sits and one in the area where journeymen operator's store their personal items, use a shared computer, and sometimes take breaks. During the monitoring period, CO₂ levels did not exceed 600-ppm. The first couple readings on these two graphs represent outside air (approximately 420-ppm). Upon entering the powerhouse, the readings increased to over 500-ppm. There were 5-operators during the day shift and 2-operators on the back shift. Additionally, some PUD craft were present during the monitoring period while working on systems or components in the control room.

Based on the available data and room occupancy information, there does not appear to be a concern regarding the HVAC system, fresh air intake, and occupancy at the time of this monitoring event.

Mechanic's Office Area

1st Test

One monitor was placed in the mechanic's office area on the 4th floor. Approximately 5 mechanics were using this office area during the day; assembling for start of work, ABC meeting, morning break, lunch, afternoon break, and end of shift assembly. The graph shows an increase in CO₂ levels throughout the morning, exceeding 800-ppm at approximately 11:40 a.m., eventually peaking at 1174-ppm at 1:30 p.m. and 1102-ppm at 2:40 p.m., reducing back down below 800-ppm at approximately 5:30 p.m. This elevated period between 11:40 a.m. and 5:30 p.m. indicates that the amount of fresh air intake is not sufficient for the number of workers occupying this space.

Based on this data, adjustments were made to open the fresh air intake to full. The results of the follow-up testing are described below.

2nd Test

The second monitoring event occurred after the fresh air intake was increased. The occupancy during this monitoring event was similar to the first test. The CO₂ concentrations appear to have reduced by approximately 100-ppm from the first test but are still over the 800-ppm limit we would like to maintain

during the pandemic period. Looking at the data on the right side of the graph, you can see CO₂ concentrations elevate during the 5:00 a.m. hour, when crews begin arriving for work. The steps show the additive effect of occupancy, effectively showing that the fresh air intake is not enough to reduce CO₂ concentrations to background. This may become evident in the next graph.

Mechanic's Breakroom

One monitor was placed in the mechanic's breakroom. During the monitoring period, CO₂ levels did not exceed 650-ppm (note the peak on the left side of the graph is likely from breathing directly on the sensor while setting up the device. There were 4-mechanics using the breakroom during the monitoring period. day shift and 2-operators on the back shift.

Based on the available data and room occupancy information, there does not appear to be a concern regarding the HVAC system, fresh air intake, and occupancy at the time of this monitoring event.

As a side note, this is a classic example of a best-case scenario, where the air handling system is able to return CO₂ concentrations to background levels when the room isn't occupied during morning meetings, breaks, and lunch.

Electrician's Office

Two monitors were placed in the electrician's office area. During the monitoring period, CO₂ levels did not exceed 720-ppm. There were 3 electricians using the room during the monitoring period.

Based on the available data and room occupancy information, there does not appear to be a concern regarding the HVAC system, fresh air intake, and occupancy at the time of this monitoring event. The graphs are virtually identical, which is expected due to the size and configuration of the room. The graphs clearly show occupancy during the morning ABC meeting, morning break, lunch, afternoon break, and end of shift meeting/gathering.

4.5

One monitor was placed on 4.5 for a half day of monitoring. Two employees were present during the monitoring event; the super-foreman and the mechanical engineer. Both employees were in and out of

the office frequently, but there does appear to be a bump around 10:00 a.m. and then again around noon. CO₂ levels did not exceed 700-ppm during this monitoring event.

The ventilation system for 4.5 is very similar to the 4th floor mechanic's office, as these areas were constructed inside the powerhouse in the mid-90's. While this information appears to be positive, it is very possible that increasing occupancy in this area by one or two employees may make a significant difference in the CO₂ concentrations.

5th Floor Main Lobby

One monitor was placed in the fan room on the 5th floor main lobby area. One employee was in one of the three offices during the monitoring event. Employees walked through the main lobby during the entire monitoring period. CO₂ levels did not exceed 450-ppm.

The fan room acts as the return air plenum for the lobby, restroom, and offices. There is at least one open roof vent in this area and the two exterior doors are opened frequently throughout the day. There does not appear to be a concern regarding the HVAC system, fresh air intake, and occupancy at the time of the monitoring.

Summary/Discussion

Most of the CO₂ monitoring performed at PRD during August 2020 showed acceptable levels of CO₂, showing that ventilation system is bringing in fresh air and therefore diluting the build-up of respired air from building occupants.

The 4th floor mechanic's office area is not able to maintain CO₂ levels below the 800-ppm limit which is our target for this pandemic period. Based on information from long-term employees and architectural drawings for this mid-90's addition, it appears this 4th floor area was originally intended to provide 4 or 5 "roomy" offices for PUD employees. The space currently is set up to hold 10 employees, although all ten have not frequently reported to work at the same time since March 10, 2020.

4.5 is likely very similar to the 4th floor mechanic's office. Monitoring should be performed as more employees report back to work in this area.

The CO₂ levels in the 3rd floor electrician's office appear to be acceptable with 4-electricians in the area. If all of the electricians reported for work on the same shift, the CO₂ levels may exceed the 800-ppm limit. More monitoring should be performed as the workforce is brought back to full staffing levels.

Recommendations

Two options which may help to reduce CO₂ levels in the 4th floor mechanic's office area are to reduce occupancy in the room or increase fresh intake into the HVAC system. As a temporary measure, portable fans may be placed to create air flow through the office area to the main powerhouse. Once these modifications are made, monitoring can be performed to determine the effectiveness of the changes.

Any modifications to the HVAC system should be designed by a professional engineer and implemented by qualified personnel.

If CO₂ levels cannot be reduced to below 800-ppm, HEPA filtered fans may reduce the aerosol load in the mechanic's office area, however there currently is no testing currently available to the PUD to confirm any reduction in the aerosol load by using the HEPA filters. Additionally, the use of HEPA filtered fans will require ongoing maintenance and filter replacement costs.

Once the planners and engineers begin reporting to PRD on a regular (daily) basis, monitoring should be performed on 4.5 to compare CO₂ levels between 2-employees and 6-employees.

PRD employees have requested CO₂ monitoring in additional areas. The monitors are currently being used in other areas of the District. Once the monitors become available, these additional areas will be assessed, although the intent of this monitoring event was to document CO₂ levels in the control room, office areas, and breakrooms.

It must be stated that this monitoring is not to be used as evidence that masks are not necessary, rather masks are helping to minimize droplets ("My mask protects you, your mask protects me"). The premise for this monitoring is that by reducing CO₂ levels to de minimis levels, in addition to having a robust

PPE policy requiring face coverings, physical distancing, and good hygiene, the PUD is lowering the risk of exposure to SARS CoV-2 for PUD employees and contractors.

Please don't hesitate to contact me with any questions regarding the information in this report.

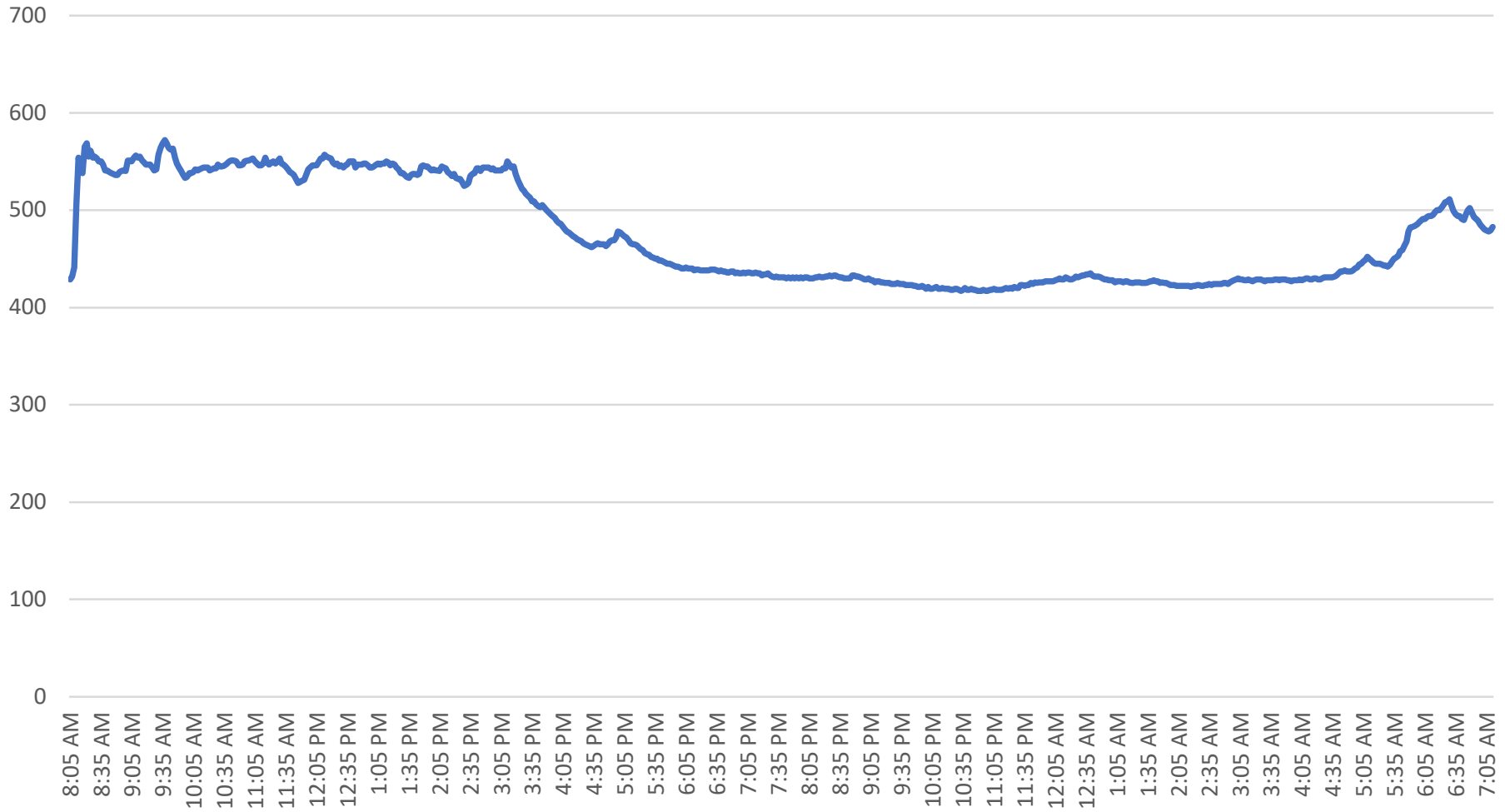
Sincerely,

John Price, CSP

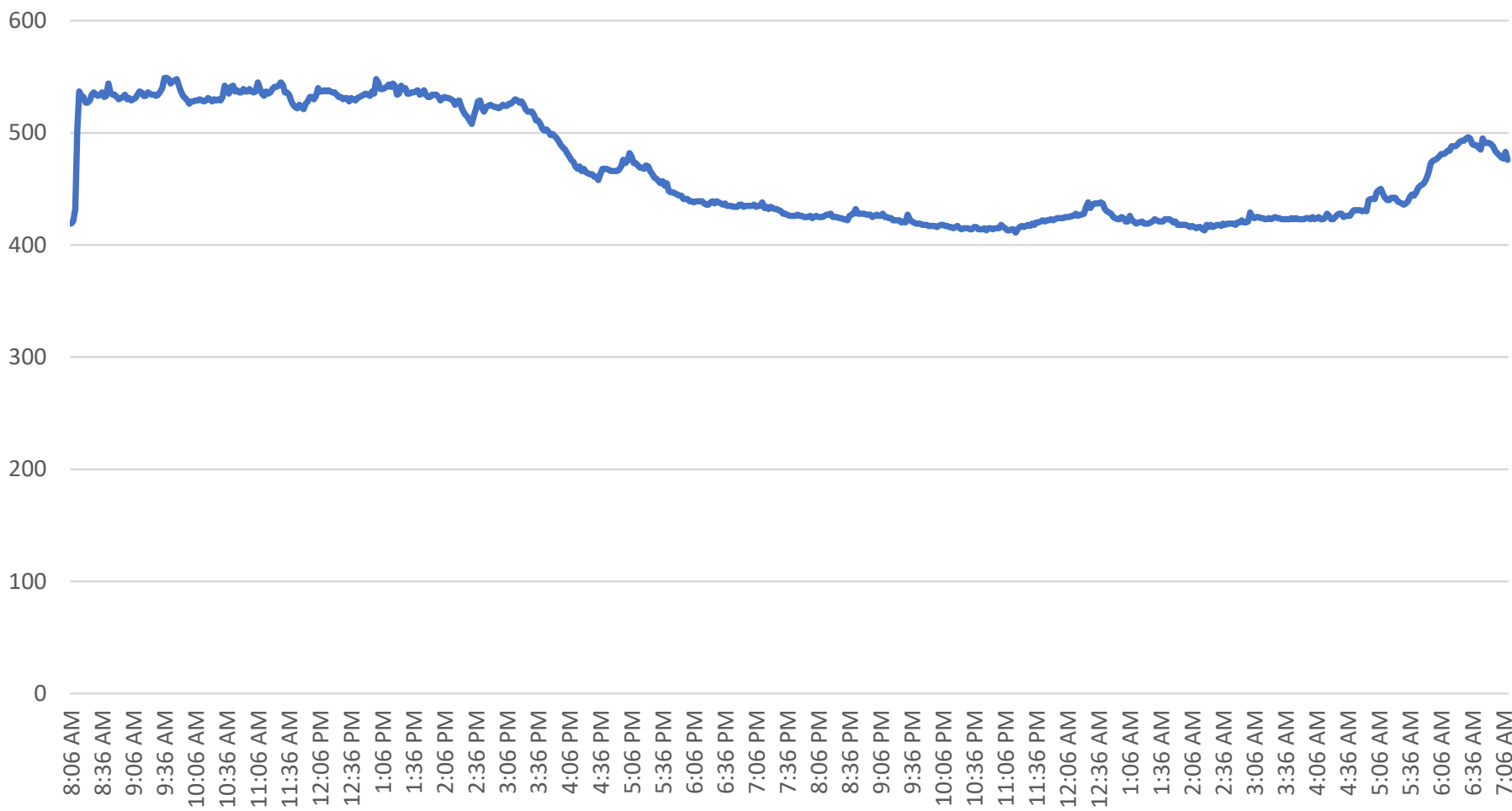
Sr. Safety Coordinator

Priest Rapids Dam

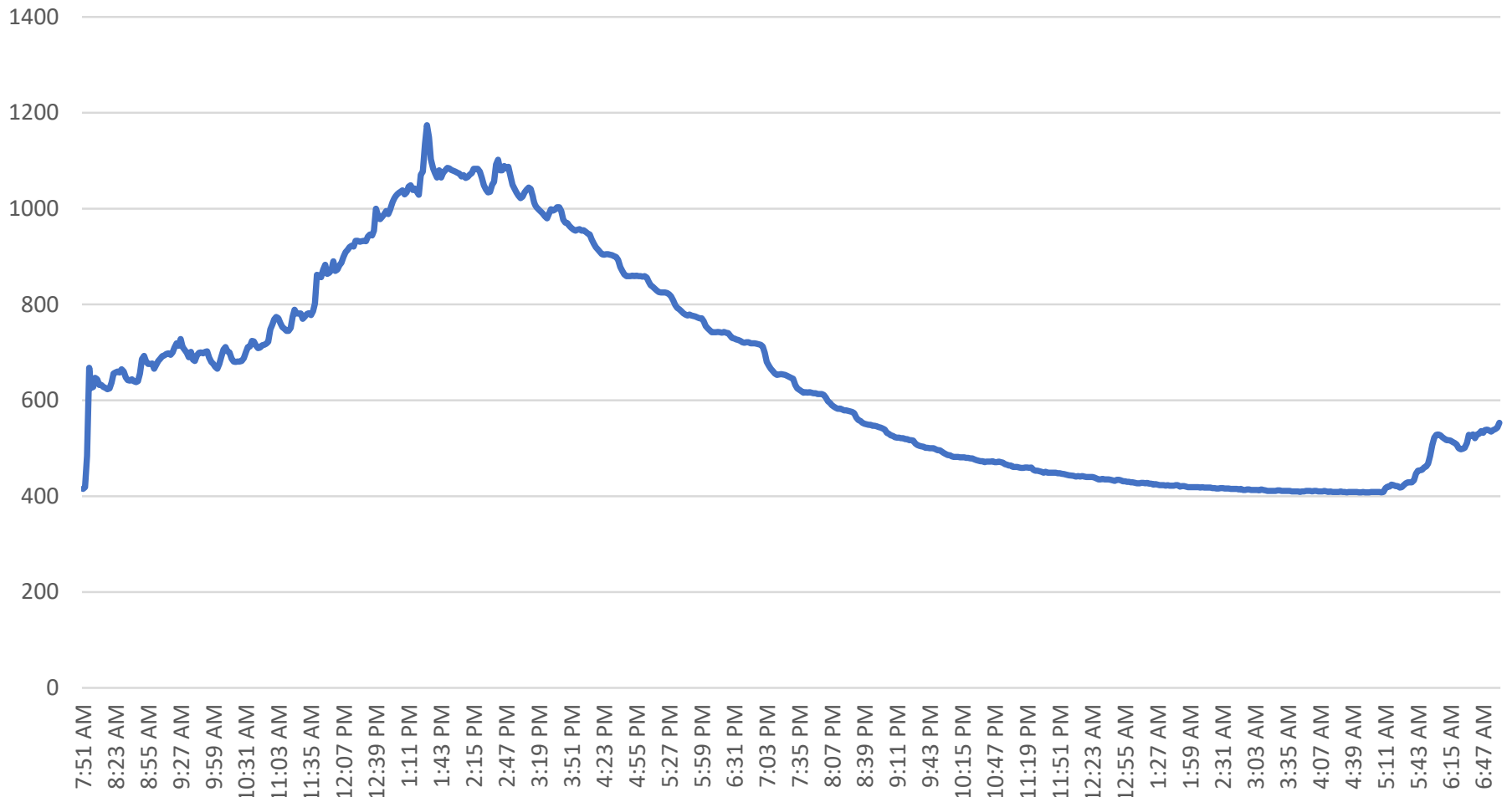
CO₂ PRD Control Room Journeymen Area 8/11/20



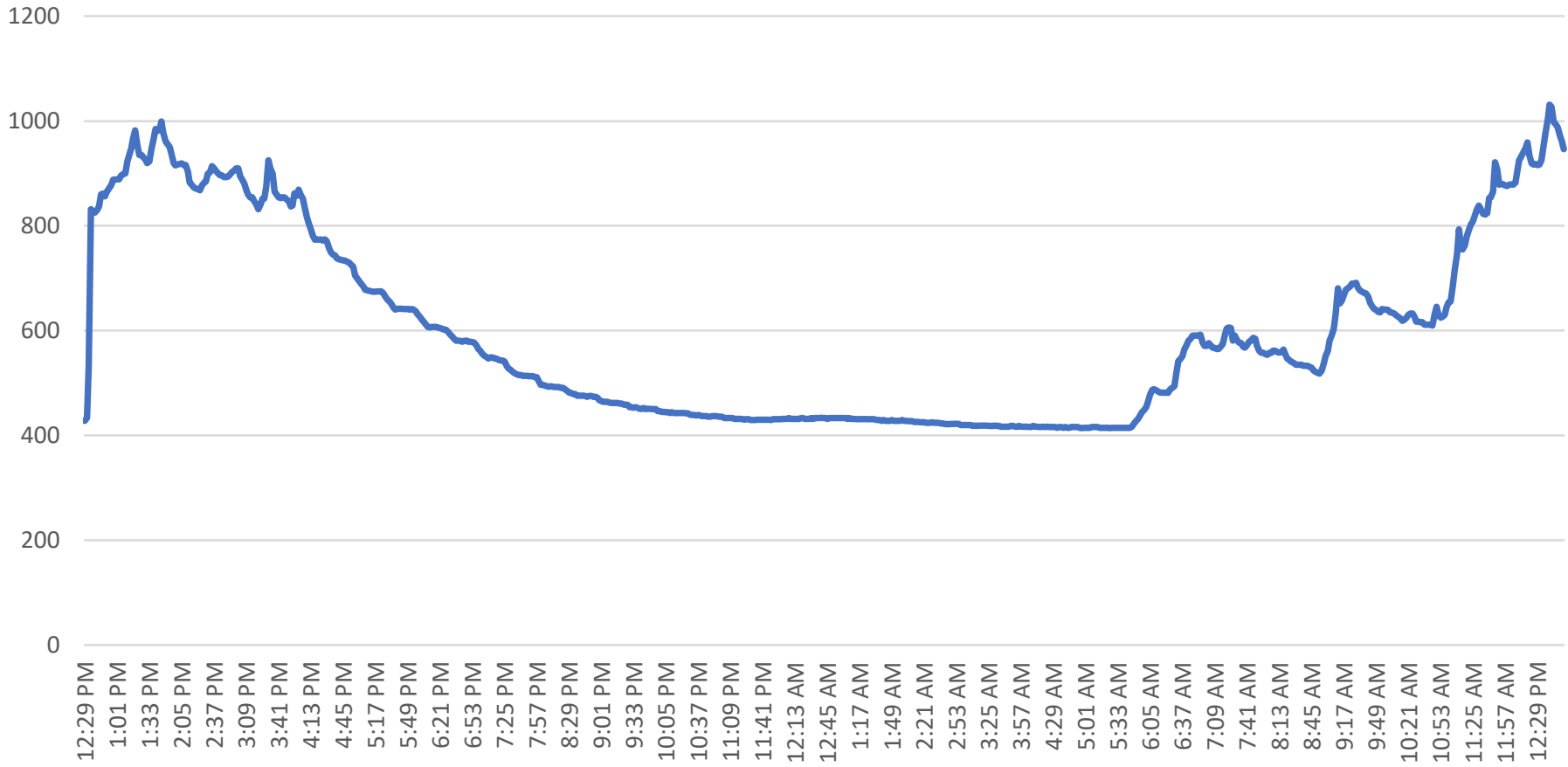
CO₂ PRD Control Room Senior Operator Area 8/11/20



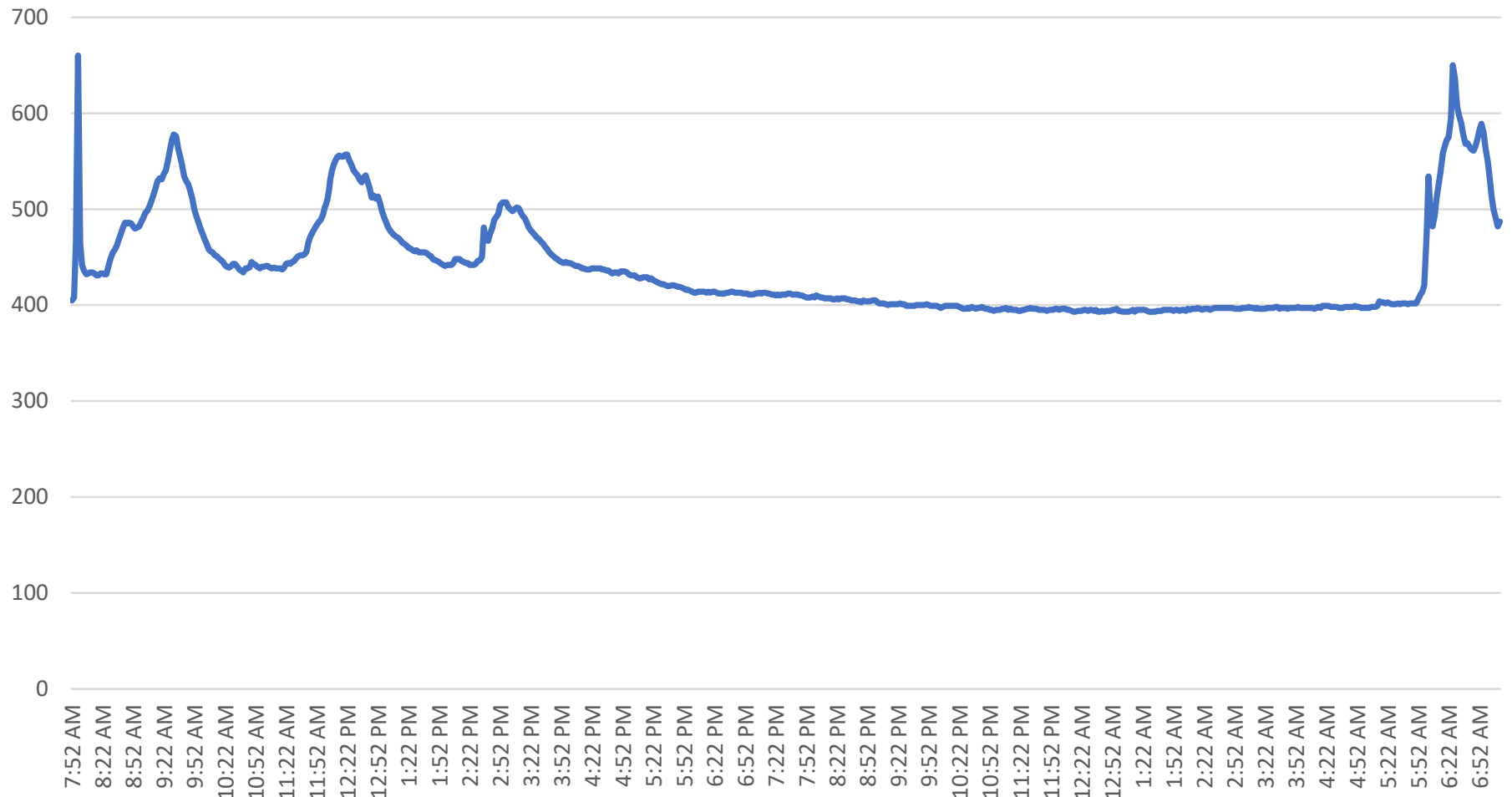
CO₂ PRD 4th Floor Mechanic's Office Area - 8/12/20



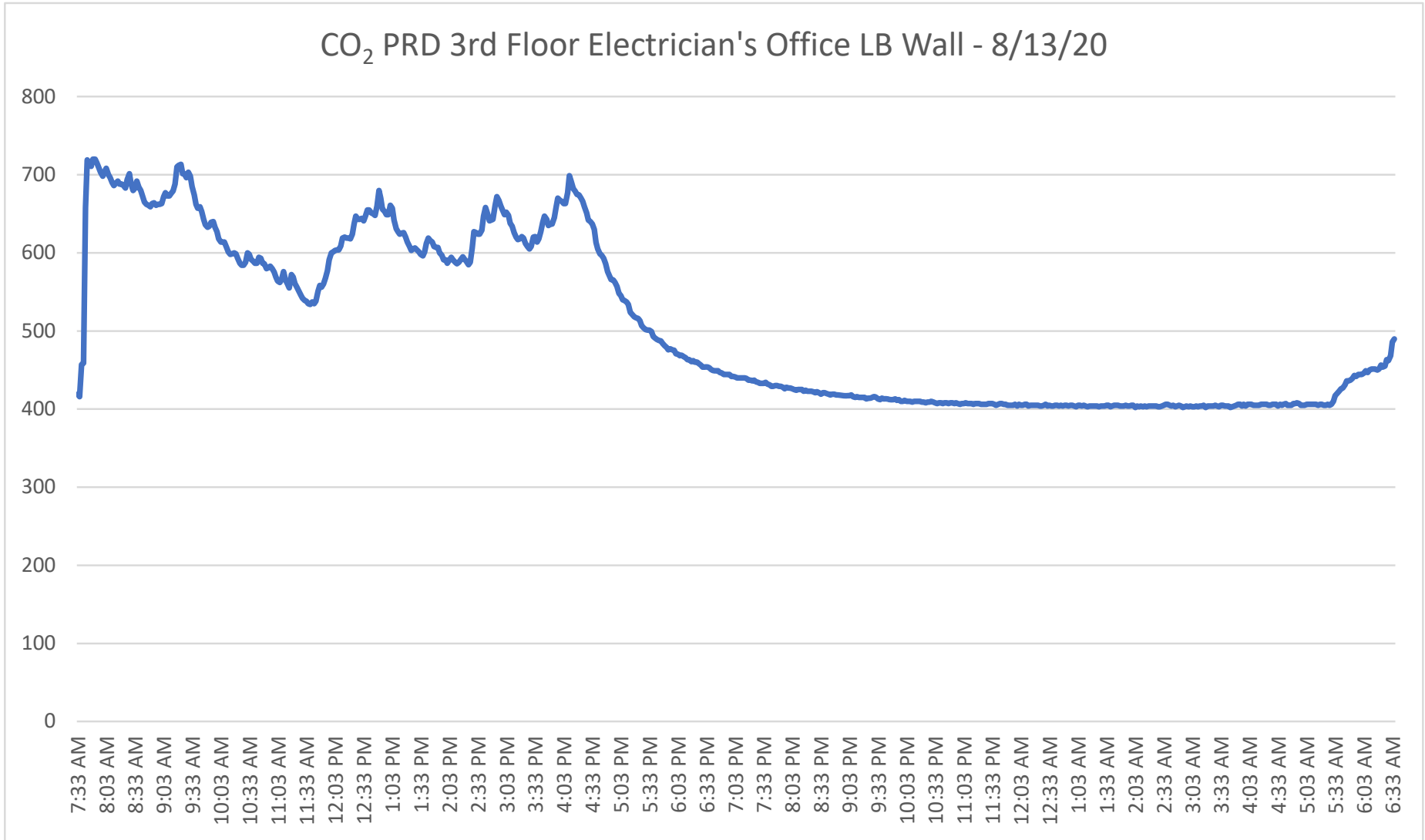
CO₂ Mechanic's Office 2nd Test - 8/20/20



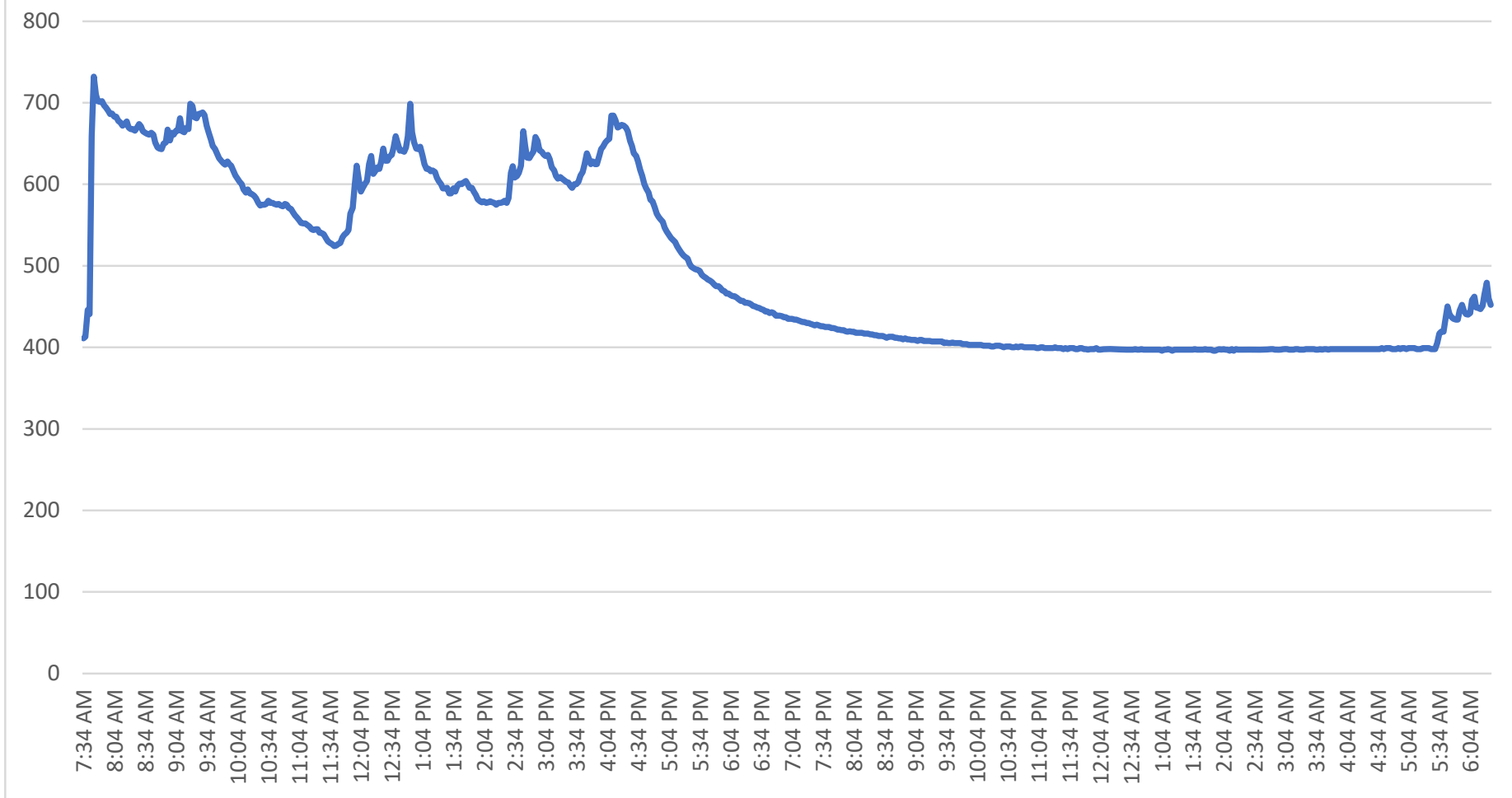
CO₂ PRD Mechanic's Breakroom - 8/12/20



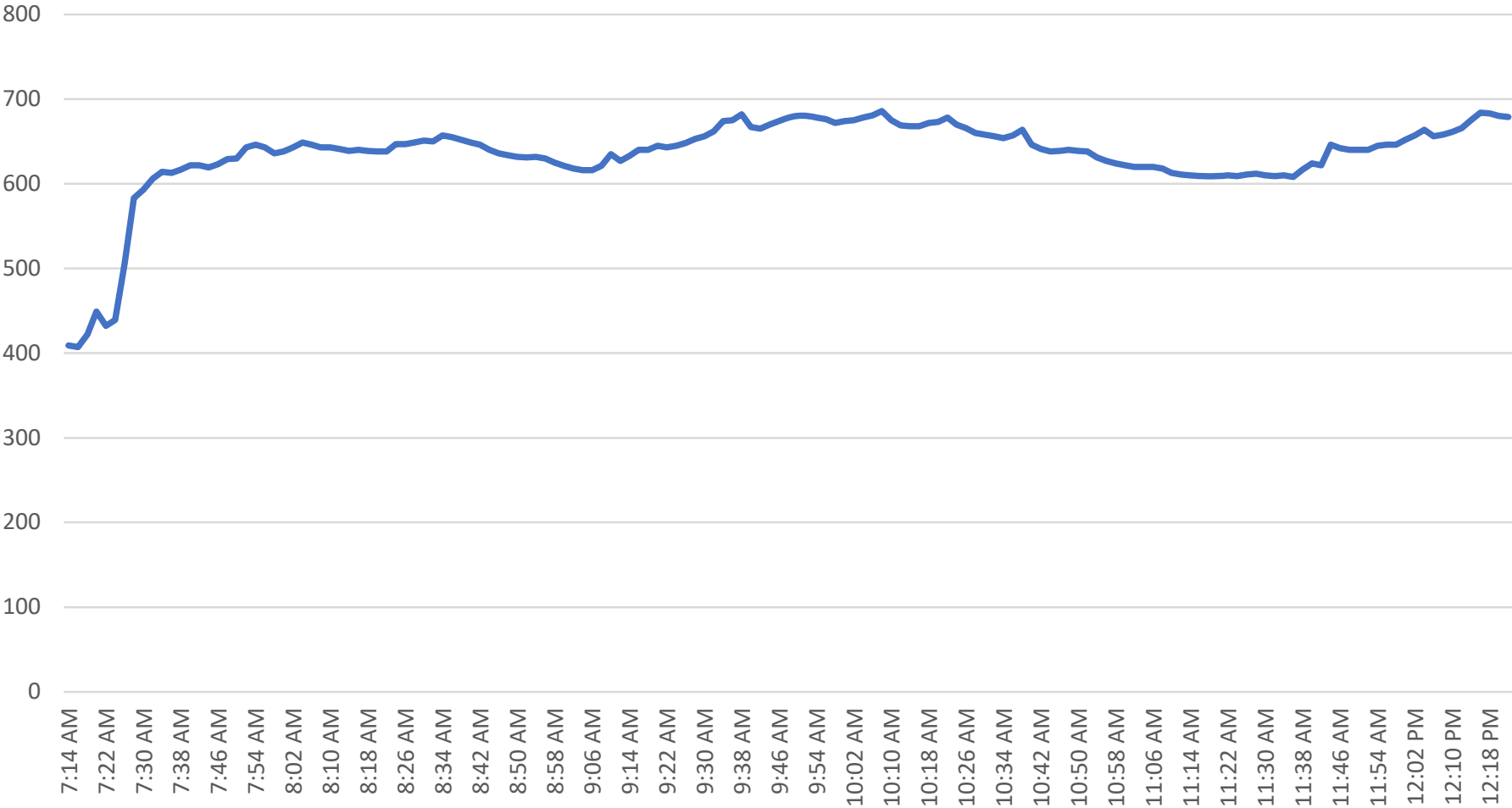
CO₂ PRD 3rd Floor Electrician's Office LB Wall - 8/13/20



CO₂ PRD 3rd Floor Electrician's Office RB Wall - 8/13/20



CO₂ 4.5 - 8/13/20



CO₂ 5th Floor Lobby Fan Room - 8/13/20

