BIG ASS FANS | EXCEPTIONALLY ENGINEERED

CLEAN AIR SYSTEM (CAS) REDUCES AIRBORNE DISEASE TRANSMISSION INFECTION RISK IN OFFICE SPACES

*The installation of Big Ass Fans (BAF) CAS ion technology on one **Powerfoil X3.0** fan provides between 10k and 60k+ average ion concentration throughout a sample office space, resulting in a SARS-Cov-2 infection risk reduction between 78% and 92% for a representative occupant.*

BACKGROUND:

During the public health conditions brought forth by the COVID-19 pandemic, many businesses and workplaces have implemented new procedures and safety measures in an effort to mitigate infection risk for their workforce. In addition to ubiquitous health screenings and social distancing measures, many facilities have adjusted personal/sick leave policies, increased cleaning with a focus on high-touch areas, and are maximizing outdoor intake from HVAC units to improve indoor air quality. In order to protect staff and slow the spread of COVID-19 in office buildings, the **CDC recommends** "increasing circulation of outdoor air as much as possible by opening windows and doors if possible, and using fans." In addition to increasing air circulation, BAF is seeking to provide additional safety measures using NPBI equipment integrated into overhead HVLS ceiling fans to quantifiably improve the safety in the workplace/office environment. By using fans to distribute ions into the occupant breathing zone, BAF can leverage the **ions' ability to effectively deactivate pathogens** while simultaneously providing comforting airflow without the generation of harmful byproducts such as ozone.

PROJECT SCOPE:

BAF engineers installed **CAS** ion technology to a 12' Powerfoil X3.0 fan at BAF's office HQ in Lexington, Kentucky. Relevant measurement setups were determined to characterize the ion concentration throughout the space at the anticipated locations of occupants. (27) measurement locations were identified for testing at two distinct fan speeds (25% and 50%) to reflect typical fan speed for an office environment. Measurements were recorded at a sensor height of 43" AFF to reflect roughly an occupant level breathing zone in the seated position. BAF engineers measured both positive and negative ion concentrations at each measurement location for 2 minutes for each polarity and fan speed. The reported values are 2-minute averages.

KEY DATA AND OUTCOMES:

Previous findings have shown that large obstructions in a space, as well as lower airflow speeds, can have a negative impact on ion concentration. Despite the high number of obstructions and low airflow speeds typical in an office environment, testing of a sample office space shows the ability of the system to deliver significant ion concentrations of both polarities that will have a meaningful germicidal effect in the space. **Average ion concentrations exceeded 18k for both polarities at 25% fan speed and exceeded 33k for both polarities at 50% speed (figure 1).**

Space Average Observed Ion Concentrations (Ions/cc)		
Configuration	**Positive Ions x 1000**	**Negative Ions x 1000**
25% Speed	18.66	27.12
50% Speed	33.05	36.72

Figure 1: *Ion Concentrations at various test conditions*

Ion distribution was largely dependent on the ability of the airflow to deliver ions past obstructions to the target areas throughout the space. Despite obstructions, ion concentrations ranging from 10k to 60k+ were able to be distributed throughout the majority of the space as demonstrated by the concentration gradients shown below (figure 2).

The true impact of BAF-CAS implementation is a reduction in the infection risk for occupants. This can be modeled using the Wells-Riley infection model, in this case specifically for SARS-CoV-2 with a baseline of 1 outdoor air change per hour from the existing HVAC equipment, 8-hour occupancy, and one sick occupant in the facility (figure 3). **The results from this model show a 78% and 92% infection risk reduction for 20k and 40k average ion concentrations respectively, which means members are between roughly 4 and 13 times less likely to become infected in a space with BAF-CAS than with standard HVAC systems alone.**

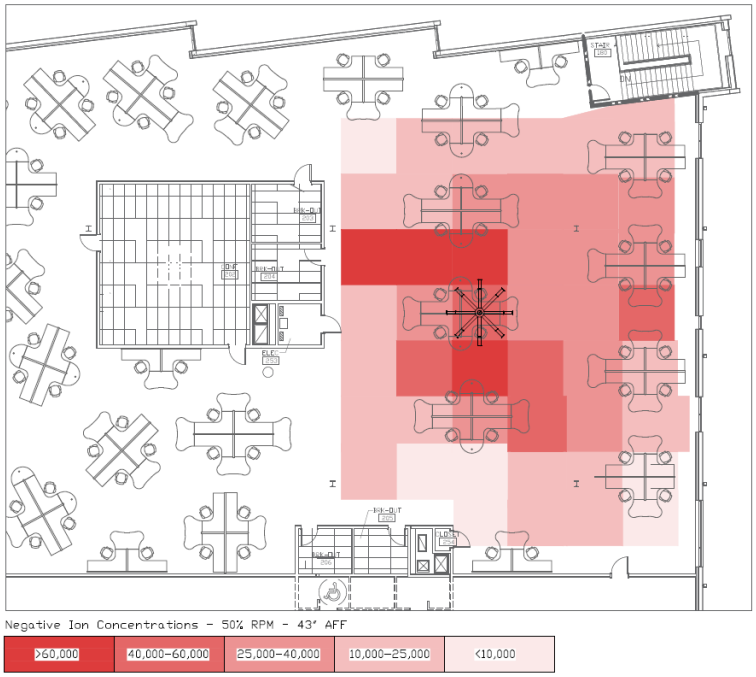

Figure 2: *Ion concentration gradient at 50% RPM and 43" AFF.*

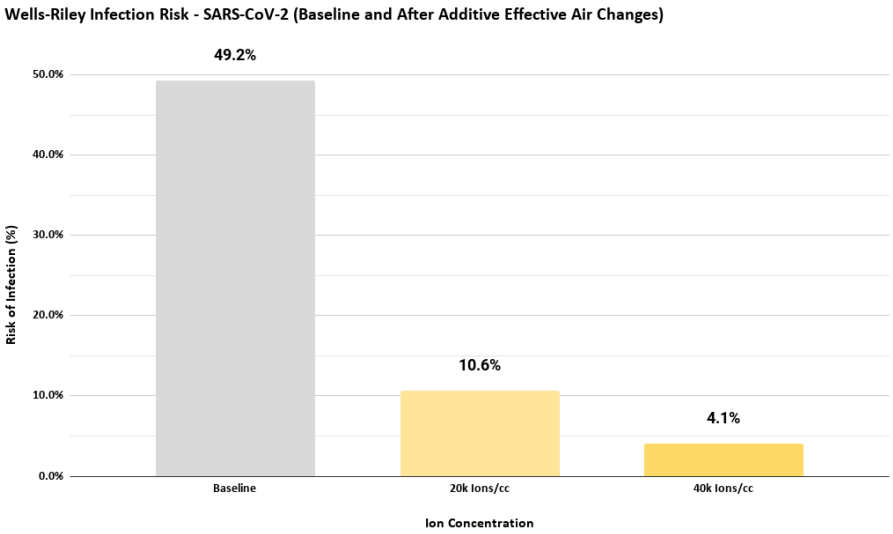

Figure 3: *Wells-Riley Risk Reduction Estimate for 20k and 40k avg. ions compared to baseline mechanical systems in a sample office space.*

FURTHER ACTIONS:

Based on the results, even highly obstructed environments requiring lower airflow speeds, such as office spaces, can benefit from CAS ion technology installation. For these types of applications, we would recommend considering an increase in fan quantity compared to typical cooling layouts in order to achieve optimum ion levels throughout the space. Proper layout and commissioning can effectively mitigate airborne spread of diseases and create healthier, cleaner spaces for both employees and customers alike.