Deployment of NPBI Ionization Devices Within HVAC Unit Overview

The Mississippi Conference Trustees submitted this overview in response to questions about available technology that may help reduce the spread of COVID-19 and estimated costs. Information given in this overview is compiled from various papers and NPBI unit specifications. There are various claims for the effectiveness of devices like the ones below. Some laboratory studies claim that operation of an NPBI device for 30 minutes can reduce SARS, MERS and flu virus counts by 93 to 95 percent.

These devices are relatively inexpensive. Assuming that HVAC labor rates are in the range of $100 per hour, deployment of these devices in existing systems appears to be cost effective and should be considered along with the other actions that a church could take to eliminate the COVID-19 virus. If a NPBI device is installed, the need for outside air into the HVAC system may be reduced. This could reduce the HVAC electricity demand and provide a cost savings.

Congregational Care and the Coronavirus

Any church that considers an NPBI system should contact their HVAC engineer, company or maintenance technician for devices, applications and installations. Finally, one HVAC engineer stated that any new HVAC system installed in a commercial building today should most certainly contain NPBI devices.

Bipolar Ionization

Air passes over an electric field that is produced by high voltage. Positive and negative ions are produced. The negative ions contain an extra electron and the positive ions are missing an electron. This results in an unstable condition. These unstable ions seek out atoms and molecules in the air so that they can trade electrons. In doing so they neutralize particulate matter, bacteria and virus cells, odorous gases, aerosols and volatile organic compounds such as methane and ethane.

Needlepoint Ionization

Needlepoint ionization (NPBI) devices use many little carbon bristles that protrude from each of the two electrode posts on the device. These bristles are conductive and produce a high voltage charge. This charge is also called plasma. Most devices alternate the polarity of the charge on the electrodes to reduce the accumulation of dust and other particulate matter on the electrodes. If the NPBI device does not have an automatic cleaning or wiping mechanism, then periodic cleaning maintenance must be performed.

Effects of Ionization on Contaminates and Living Organisms

The ionic charges produced by the electric fields of the NPDI device attract oppositely polarized (and neutral polarized) contaminants. These contaminants clump together in the air. As air is circulated throughout the building these larger clumped particulates are passed back through the HVAC (Heating, Ventilation and Air Conditioning) filters and are removed. This stream of ions can capture gaseous and particulate contaminants in the air which include volatile organic compounds (VOCs) and odorous contaminants. Negative and positive ions are produced when electricity is applied to two electrodes. Some of these ions will go on to kill microorganisms directly and others will react with water vapor and oxygen

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in the air to create free radicals, one of which is hydroxyl. These free radicals can also kill microorganisms and break down odors improving indoor air quality. They react quickly with contaminants and pathogens in the air. In the case of a virus or bacteria, the ions and radicals fuse along the side of the organism and capture a hydrogen bond effectively removing that hydrogen from the pathogen. This action disrupts the lipid envelopes and/or capsid around the virus causing lysing. They also penetrate the virus interior and disrupt the genome. These actions deactivate the virus.

Placement and Action of NPBI Within the HVAC Environment

The NPBI device is mounted within the HVAC system after the filter and just before the fan. It should not be mounted on the fan because it needs to be isolated from its vibration. Most modern NPBI devices can be powered by the control 24 VAC or a fan supply voltage of 120 to 240 VAC. Most devices are auto-voltage sensing and draw very little current. The self-cleaning device typically uses a rotating bar or disk that periodically passes through the carbon brushes dislodging particles into the air stream. These devices do not require periodic maintenance to clean the carbon bristles. Most self-cleaning devices have programmable cleaning times and are set at the factory to clean once every three to six minutes. Being programmable, the timing can be adjusted to cycle depending on environmental conditions.

It appears that bacteria and viruses are spread by two mechanisms – droplets and aerosols. NPBI devices attack viruses and bacteria as they pass through the unit itself and out in the building environment. This action will affect droplet and aerosols alike. In addition, the devices help to keep the fans, coils and ducts of the HVAC system free of these organisms. A typical NBPI unit, readily available from multiple sources, is designed to operate in a unit with a fan up to 2,400 CFM. These units emit from 100 to 300 million ions per cubic centimeter of air. In a large building installation for a 15-ton HVAC unit, three of these devices would typically be deployed in order to emit the 100 to 300 million ions for every cc of air passing through the unit. Most commercial HVAC installations are designed to recirculate the entire volume of the building air once every six minutes. So the bacteria, viruses and contaminants will be recirculated and treated 10 times every hour. Also, free ions and hydroxyl ions will be blown into the building spaces, land on surfaces, cracks and crevasses and will inactivate them there. Of course, no installation is perfect and certain spaces within the building will not recirculate properly and contaminants and viruses will not be deactivated there.

The number of NPBI units could scaled up or down as the number of tons of HVAC installed or the fan capacities in cfm vary.

Typical NPBI Units Available

1. Nu-Calgon 4900-10 iWave-C
   - Duct-mounted through 4” hole in ductwork
   - Self-cleaning
   - 400 M ions/cc/sec
   - Up to 4,800 CFM or 12 tons
   - 24 to 240 VAC
   - Fault contacts
   - Limited three-year warranty
   - Estimated cost of $800
   - Estimated installation labor time of three hours
   - Air Oasis Bipolar 2400

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- Screw or magnetic Mounted in front of fan
- Not self-cleaning
- Up to 2400 CFM
- Estimated cost of $900
- Estimated installation labor time of two hours

2. Alpha Energy Systems iWave – R. Residential Unit but could be used with smaller churches
   - Screw or magnetic mount
   - Self-cleaning
   - 200 million ions/cc/sec
   - 24 to 240 VAC
   - Fault contacts
   - Estimated cost of $600
   - Estimated installation time of two hours

These estimated installation times and labor rates are exactly what they say – estimated. These devices can be obtained from multiple sources, so the actual costs may vary. The wiring of the alarm status to the church alarm and monitoring system or the installation of a simple power supply and indicating light (for local annunciation) will add to the labor cost for installation.