Electrostatic or Powder Coating

Process Overview:

Most manufacturing facilities will have a painting operation of one sort or another. Paint booth fires can develop quickly, have high heat release rates and produce toxic smoke. One insurance company reported 78 spray operation fires over a 5 year period, of which 28 were associated with electrostatic coating equipment. The average loss was $200,000 in 1988 dollars. This is roughly equal to $400,000 in 2013 dollars. In some cases the facility was a complete loss.

Electrostatic coating is a process used to apply a paint type coating to a metal component. It is similar to typical spray painting in that it is usually done in a booth or room and usually involves compressed air as the transfer mechanism. It is different in that electricity is used to cause the liquid or powder to be attracted to the metal work piece.

Electrostatic coating has some benefits as compared to ordinary spray painting. For one, there tends to be less paint overspray and so there is less combustible material on the paint booth surfaces and in the exhaust ductwork. Powder coating in particular is efficient and the overspray can be collected and reused. However we are concerned since now there is a potential to have a spark-ignited fire which could spread from the booth into the powder overspray collection and recovery system. This fire could spread beyond the booth of origin and expose other areas of the facility. An explosion is also possible if the powder-air mixture is above the minimum explosible concentration (MEC).

Key Definitions:

*Ventilation*: The movement of air to prevent accumulation of vapor–air mixtures in concentrations over 25 percent of the lower flammable limit.

*Combustible Dust*: Any finely divided solid material that presents a fire or explosion hazard when dispersed and ignited in air.

*Electrostatic charge*: of or related to static electricity
Hazardous location electrical equipment: Listed for use in electrically classified areas. See NFPA 70.

Spray Area (per NFPA 33). Any fully enclosed, partly enclosed, or unenclosed area in which dangerous quantities of flammable or combustible vapors, mists, residues, dusts, or deposits are present due to the operation of spray processes.

Sparking gap: Smallest distance at which point a spark will jump to ground.

Minimum explosible concentration (MEC): Minimum concentration of dust in air subject to explosion.

Spray Guns and General Guidance:

There are two main types of electrostatic spray guns. The first uses a power supply that converts 115 or 230 volts ac to dc at 30-100kV. With this type of gun the coating passes through a corona where the electrostatic charge is applied.

The second type of spray gun is called a “tribo-charging gun”. This unit generates a static charge by the frictional contact of the coating material as it is passing through the gun at a high velocity. It does not have a separate power supply.

The spray guns should be UL listed or FM approved for this use. One item required by NFPA 33 is that the hand operated guns cannot be capable of producing a spark sufficient to ignite the dust or vapor cloud. For automated coating booths the nozzles are mounted outside the spark gap.

When a fire occurs, it is essential to immediately stop the spraying operation and to shut down the power supply creating the electrostatic field. It is typical for the fire to start at the spray gun due to a spark. The fire can then spread quickly to the sprayed parts, to any overspray material on the booth surfaces, and then into the exhaust ductwork.
It has been noted that rapid shut off of the spray gun can limit fire spread. For a manual spray situation, the operator tends to drop the spray gun which shuts off the flow and usually stops the fire. Automatic spray operations need a flame detection system which is interlocked with the spray guns, power supply, powder collection damper, and conveyor feed. Another control is that the spray guns need to be interlocked such that the gun will not operate unless the ventilation is working, conveyors are moving, there is available power, and there is no excessive current leakage with the spray system.

References
NFPA Fire Protection Handbook
NFPA 30 Flammable and Combustible Liquids Code 2012 edition
NFPA 77 Recommended Practice on Static Electricity 2007 edition
FM DS 7-27 Spray Application Of Flammable And Combustible Materials 2007
FM Standard 4910: Factory Mutual Research Cleanroom Materials Flammability Test Protocol (Class 4910)