



Property Risk Consulting Guidelines

A Publication of AXA XL Risk Consulting

PRC.9.3.2.1

ELECTROSTATIC PRECIPITATORS

INTRODUCTION

The electrostatic precipitator is a highly efficient pollution control device. The precipitator imparts a negative charge to the particles in the air or gas stream. As the stream passes through a high-voltage, direct-current corona, the particles are attracted to the oppositely charged plates (or rods) in the precipitator. The corona is created between high voltage electrodes and grounded collection surfaces (plates or rods). The particles fall into a collector when the plates or rods are struck or rapped with a hammer in dry precipitators or are washed down in wet precipitators. See Figures 1 and 2 for details.

A fire or explosion can occur when combustible material and oxygen are present in quantities and proportions necessary to support combustion, and an ignition source is present. Precipitators are designed for either minimal combustibles or minimal oxygen in the gas stream. The excessive combustibles can be lint from a textile dryer or coal dust from a boiler at start-up, fuel rich operation over an extended period of time, or during an upset. The excessive oxygen can come from cracks or openings in the ductwork from the heated equipment to the precipitator or in the precipitator itself. These fires can be difficult to detect and extinguish. The large volumes of hot gases that pass through the unit can obscure the fact that a fire exists until it produces enough heat to clearly raise the exhaust temperatures.

Because of operational and service differences, electrostatic precipitators associated with utility boilers present a different degree of hazard. For protection of electrostatic precipitators associated with utility boilers, see PRC.17.12.1.

POSITION

Management Programs

Thorough and well-implemented management programs are essential to operate an electrostatic precipitator safely. Operators need the appropriate skills and training to operate the unit under all possible operating conditions. Maintenance personnel need proper skills and training to perform proper maintenance. Use the pertinent sections of *OVERVIEW*, for example, "Maintenance," "Employee Training" and "Hazard Identification and Evaluation" as a guide in establishing these management programs and evaluating their effectiveness.

Maintenance

Focus maintenance programs on the items which have been identified as "critical" in the hazard identification and evaluation. Have supervisors inspect all work completed on critical systems, and

give reports on these systems to management at regular, established intervals. Evaluate maintenance programs in accordance with PRC.1.3.0.2.

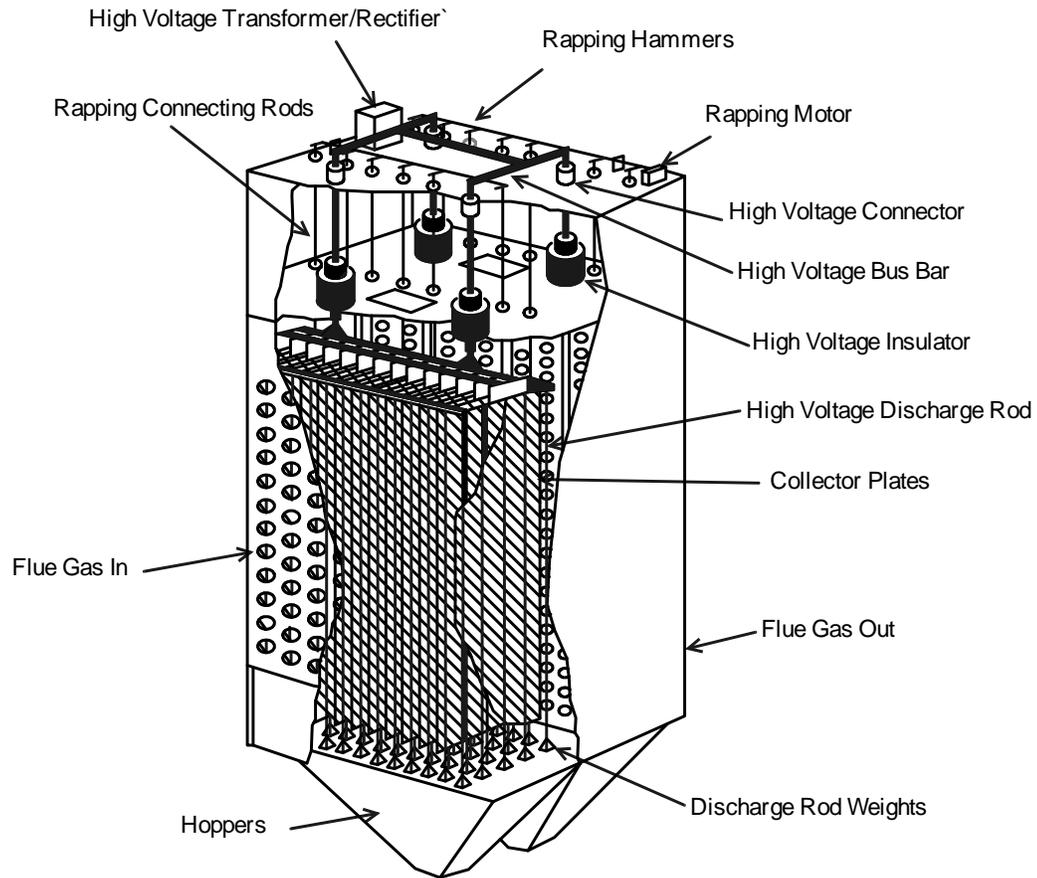


Figure 1. Cut-A-Way View Of An Electrostatic Precipitator.

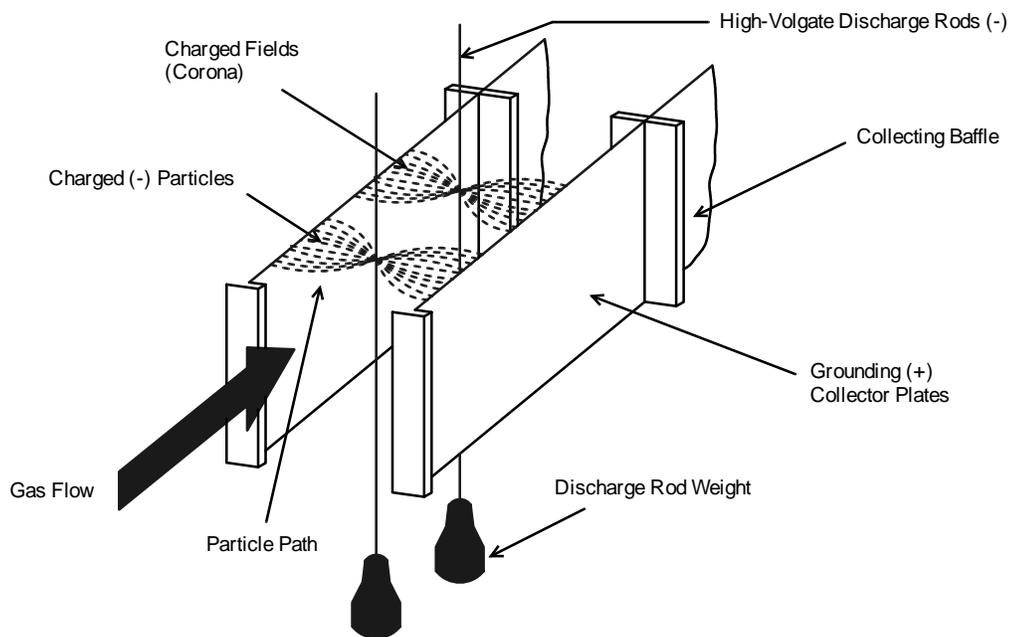


Figure 2. Section View Showing The Corona Around The High-Voltage Discharge Rods Between Collector Plates.

Operator Training

Provide written instructions for operating the precipitator under normal and emergency conditions. Train and retrain all operators at least annually in emergency procedures.

Hazard Identification and Evaluation

Thoroughly review the process and identify events that may lead to unsafe conditions.

Design

Design new precipitators to operate at a positive rather than a negative pressure to minimize the leakage of air into the precipitators. For precipitators serving boilers or other fired devices, install the induced draft fans of the fired device on the inlet side of the precipitators. Provide dampers on the inlet side of the precipitator so that it can be isolated and by-passed upon start-up, a boiler up-set, excess temperature or some other problem.

Equip the precipitator with a mechanical emergency rapping override circuit to afford maximum precipitator rapping intensity when there is a boiler upset, excess oxygen concentration, excess temperature, electrical outage or when some other problem occurs. Design all hoppers for continuous removal of materials collected.

Provide drainage for sprinkler water in the precipitator and ducts. Slope the ducts so that water flow is toward the precipitator. For precipitators used to collect hydrocarbon mist, provide a separator tank large enough to collect the mist and the anticipated sprinkler discharge. Locate the connection for the tank on the bottom of the precipitator.

Install access ports, at accessible locations with catwalks or ladders, in the precipitator and ducts to allow access for fire fighting, maintenance and cleaning. Provide explosion relief panels on all precipitators in accordance with NFPA 68.

Protection

Install a fixed pipe waterspray system, automatically actuated by a fixed temperature detection system designed to provide 0.25 gpm/ft² (10.2 L/min/m²) over all oil-filled transformers.

For precipitators handling combustible materials, install a fixed pipe waterspray system, automatically actuated by a fixed temperature detection system designed to provide 0.25 gpm/ft² (10.2 L/min/m²), over the plates, oil baths (if any) and hoppers. Install an automatic sprinkler system designed for a minimum density of 0.20 gpm/ft² (8.2 L/min/m²) in the ductwork to the precipitator and collectors or hoppers ahead of the precipitator.

A special extinguishing system, such as carbon dioxide or dry chemical, can be used in equipment where the introduction of water could react with the collected materials.

Install hose connections, equipped with spray nozzles, near the precipitator doors. Provide yard hydrants for units located outdoors.

Controls and Instrumentation

Provide a pre-energized purge of at least four volume changes for the precipitator serving equipment, such as ovens, boilers or furnaces. For precipitators processing flammable gasses, use inert gas for the purge at start-up and before the introduction of air on shutdown.

Provide interlocks to automatically shut down the exhaust fans and to de-energize the precipitator upon actuation of the fire detectors or waterflow. Install manual trips to de-energize the unit and shut down the fan if the operator discovers the unit is operating at or close to the maximum design temperature or O₂ concentration.

Interlock the precipitator controls to de-energize the precipitator upon a boiler or fuel trip.

Provide oxygen analyzers to monitor the inlet gas to the precipitator. Arrange the analyzer to sound an alarm when the oxygen concentration is 1% higher than the normal operating concentration and to

de-energize the unit when the concentration is 2% higher than the normal operating concentration. An analysis of the gas would determine the normal operating concentration.

Monitor the inlet and outlet temperatures of the precipitator gas stream. Automatically shutdown the draft fans, fuels and precipitator if the temperatures suddenly rise significantly or exceed the design temperature by 200°F (111°C), or if the outlet temperature is higher than the inlet, .

Install an opacity indicator upstream of the precipitator to warn of any unusual carry-over of combustible materials.

Provide flow meters for wet precipitators designed for continuous water-washing of collecting surfaces during normal operations. Interlock the flow meters to sound an alarm and de-energize the unit if the liquid level falls below the manufacturer's predetermined level.

DISCUSSION

Most precipitators are designed for flow velocities from 100 cfm – 600 cfm (3 m³/min – 17 m³/min) but some go as high as 400,000 cfm (11,200 m³/min). The voltage between the electrode and grounding plates or rod can range from 30,000 volts – 90,000 volts dc for a single-stage precipitator to as low as 4000 volts dc on double-stage precipitators. Precipitators can be constructed of concrete, ceramic tile, plastic, wood or metal, depending upon the atmosphere in which they operate or the gases they must clean.

Electrostatic precipitators can be found in various occupancies from steel mills to textile plants. They are found in association with boilers (recovery, power and black liquor recovery); process equipment, such as cement or lime kilns; drying ovens; or other equipment that emits pollutants. The major concern with precipitators is their susceptibility to fire and explosion losses.