

Combustible Dust Management - A Case Study of a Pneumatic Conveying System for Combustible Powder

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20th November 2024

About the Institution of Chemical Engineers, UK (IChemE)

- Founded in 1922, IChemE is the UK based and internationally recognised qualifying body and learned society for chemical, biochemical and process engineers. We exist to advance chemical engineering's contribution for the benefit of society worldwide.
- In Singapore, we have a national group with a Board led by a Chairperson.
- IChemE has designed and implemented a model of success to meet the global challenges of a sustainable world and the 17 UN Sustainable Development Goals (SDGs). Globally, IChemE focuses on 7 of these SDGs.

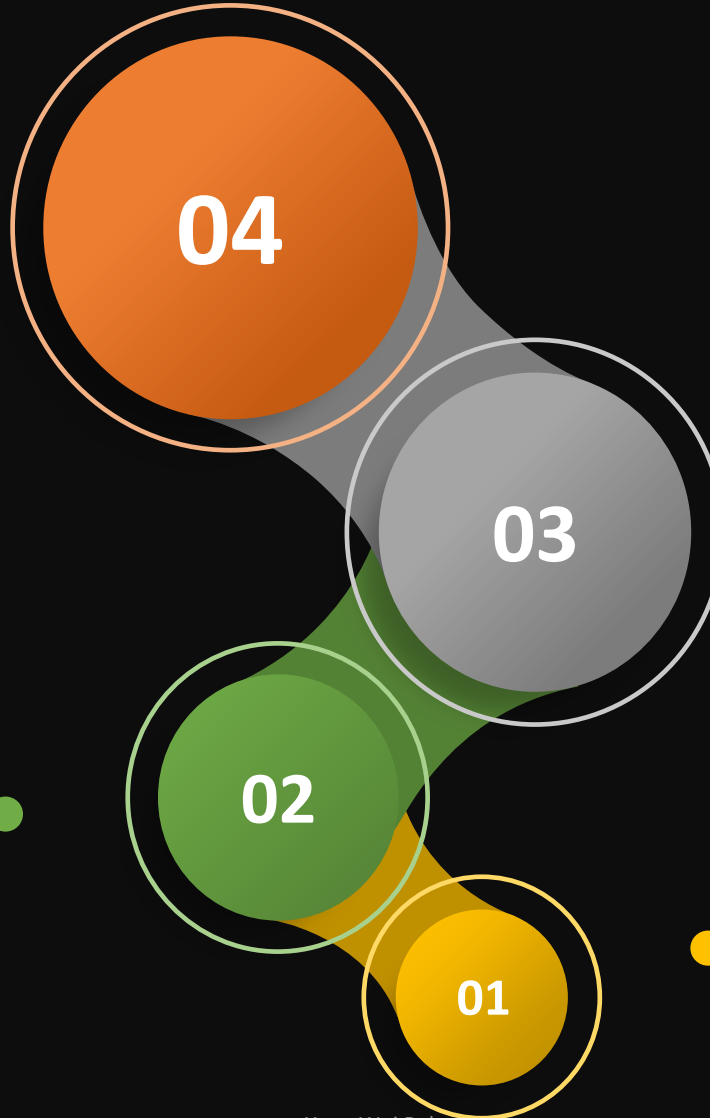
■	Zero Hunger (SDG 2)
■	Good Health and Wellbeing (SDG3)
■	Clean Water and Sanitation (SDG 6)
■	Affordable and Clean Energy (SDG 7)
■	Industry, Innovation and Infrastructure (SDG 9)
■	Responsible Consumption and Production (SDG 12)
■	Climate Action (SDG 13)



Agenda – Prevention and Mitigation of Dust Explosion for a Typical Combustible Powder Pneumatic Conveying System

Administrative Control -
Maintain Excellent Industrial
Hygiene Standard at all Times

Engineering Control – Design and
Install Dust Explosion Protection
Systems per SS 667 Standard



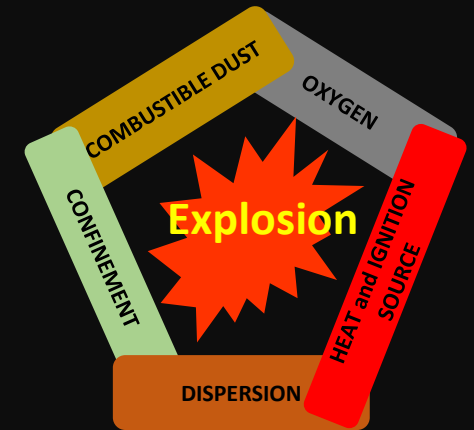
Administrative Control -
Develop and Entrench Skills
Needed to Prevent and
Mitigate Dust Explosion

Basic Dust Explosion Data Needed
for Design and Continuous
Operations

Re-cap - Conditions for a Dust Explosion

These conditions must exist simultaneously for a dust explosion to occur:

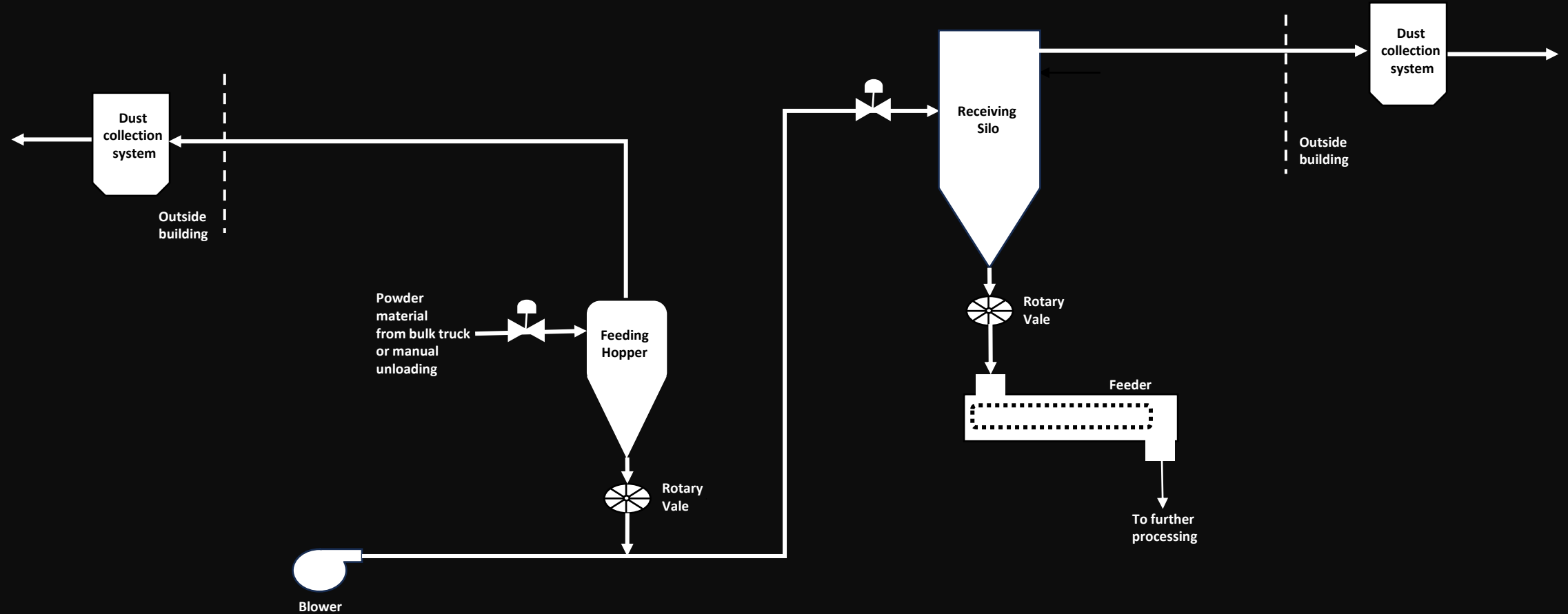
1. Powder and Dust must be combustible and less than 420 μm .
2. Dust must be airborne or can be caused to be airborne.
3. Dust concentration must be within explosive range.
4. The atmosphere in which the dust cloud is present must be capable of supporting combustion.
5. An ignition source with sufficient energy to initiate flame propagation must be present. Ignition source could be heat, open flame, electric spark, mechanical spark from friction or impact or static electricity.



Thus, the focus of prevention is to eliminate those conditions that are controllable as part of the design and continuous operations.

What is not depicted well in the explosion triangle is layered dust fire on hot surfaces like hot motors and piping.

A Typical Pneumatic Conveying System for Combustible Powder



Basic Dust Explosion Data for Combustible Powder Needed for Design and Continuous Operations

1. Size distribution (D_{50}/D_{90})
2. Moisture Content
3. Minimum Ignition Temperature of dust layer (Layered Autoignition Temperature)
4. Minimum Explosible Concentration (MEC)
5. Minimum Ignition Energy (MIE)
6. Dust Deflagration Index (Kst)
7. Maximum Explosion Pressure
8. Airborne Autoignition Temperature
9. Limiting Oxygen Content (LOC)

Engineering Control – Design and Install Dust Explosion Protection Systems

1. Carry out laboratory tests on samples of combustible powder to develop basic dust explosion data for design and Dust PHA.
2. Design and build to meet SS 667: 2020 and or NFPA 654 standards and Dust PHA corrective actions.
3. Technology Design Basis must be documented and transmitted to Operating Team.

Eng'ng Control – Provide Dust Explosion Control Systems in Installed Facility

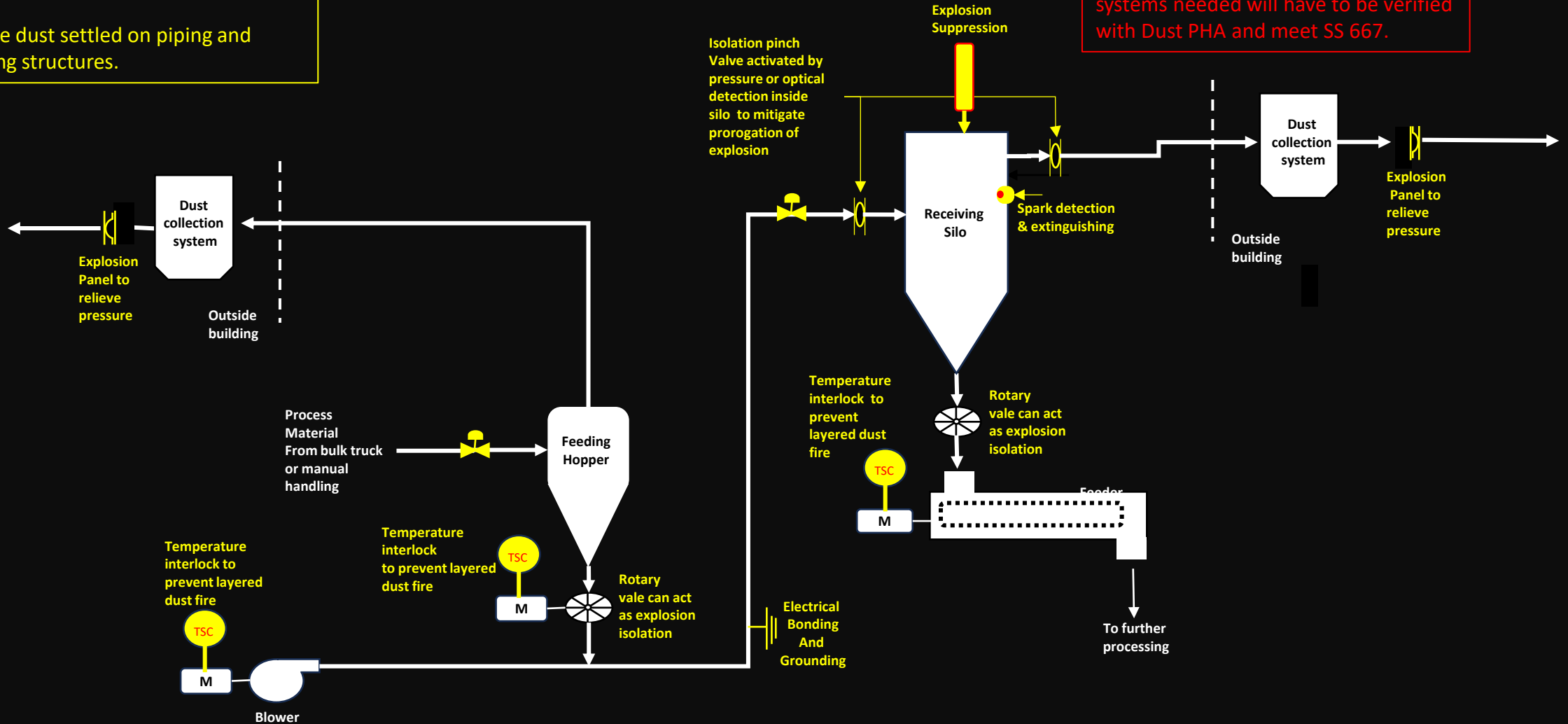
Preventive Systems:

1. Electrical bonding and ground
2. Explosion suppression system
3. Explosion panels to relief overpressure
4. Isolation valves for deflagration suppression of dust fire
5. Temperature interlocks on motors to prevent layered dust fire

A Typical Pneumatic Conveying System for Combustible Powder with Suggested Dust Explosion Protection Systems

Housekeeping to maintain excellent industrial hygiene standards.
Include dust settled on piping and building structures.

Note:
The extent and number of prevention systems needed will have to be verified with Dust PHA and meet SS 667.

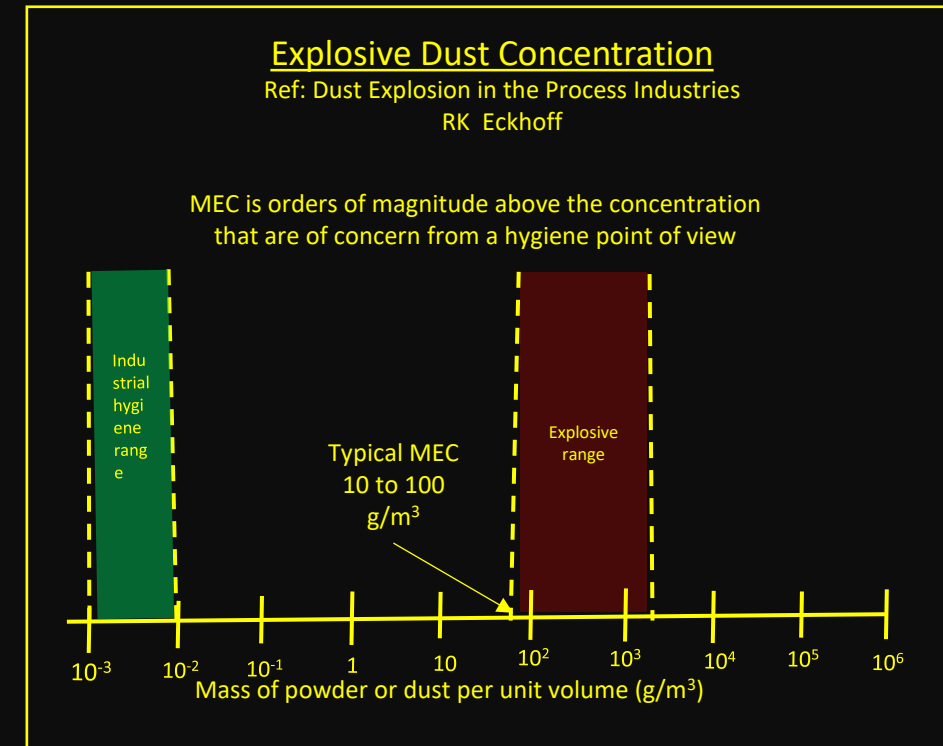


Administrative Control - Develop and Entrench Skills Needed to Prevent and Mitigate Dust Explosion

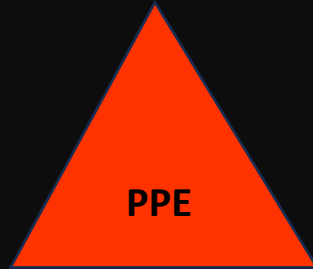
1. Ensure competency of shopfloor employees, through training and site inspections, on the hazards of dust explosion and factors that can create a dust explosion.
2. Provide technical training to engineers and managers on the risks of dust explosion and controls needed to prevent explosion. Entrench technical competencies in engineers.
3. Develop and maintain a Dust Explosion Competent Person.
4. Operating Team members to participate in Project Dust PHA and or subsequent cyclic Dust PHA.

Administrative Control - Maintain Excellent Industrial Hygiene Standard at all Times

1. Carry out thorough cleaning of shopfloor to maintain excellent hygiene standard at all times using vacuum cleaning system.
2. Focused on dust deposit on piping, beams and roof from long term settlement.
3. Provide additional controls to prevent loss of containment and dust spillage that may occur during continuous operations and maintenance.



Key Points shared



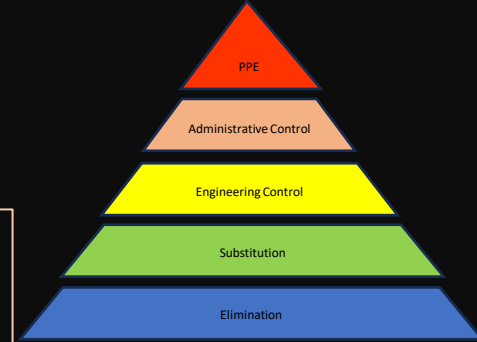
1. Use the right tools to clean up dust so as not to create a combustible dust cloud. Use vacuum cleaning system.



1. Entrench dust explosion awareness and skills in operating team. Train and appoint a Dust Explosion Competent Person.
2. Maintain excellent housekeeping at all times.
3. Maintain all electrical bonding and instruments in effective working conditions.
4. Implement leadership audits and inspections to ensure all instruments and shop floor conditions are in good conditions at all times.
5. Investigate all incidents involving failure of dust explosion prevention and mitigation systems.



1. Design the process with compliance with SS 667 and or NFPA standards.
2. Carry out project Dust PHA and subsequent cyclic Dust PHAs.



Hierarchy of Control

End

End