



Fire Suppression Technology for Safety Class Applications



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When do we need Safety Class Fire Suppression?

- Determined by Safety Analysis
- Purpose of Safety Class Fire Suppression
- Safety defines Safety Class functions
 - Must operate during seismic event
 - Operates automatically (when personnel are not present)
 - Survivability of equipment during an emergency



Fire Suppression System Safety Class Functions

Extinguish postulated fires—

- Before fire is allowed to spread to other combustibles
- Before HEPA filters are compromised from excessive soot or temperature

Prevent re-ignition—

- Determine length of time to insure re-ignition does not occur

System must operate after design basis accident

- Identify design basis accidents



Safety Class Fire Suppression System Requirements

To extinguish fires and maintain agent concentration, a system must—

- Detect fire at an early stage
- Reduce Airflow
 - Close supply air dampers
 - Shutdown supply air fans
- Discharge suppression agent



Safety Class Fire Extinguishment System Assumptions

Assumptions:

- a. Postulated fires include waste drums, cable trays, and equipment fires
- b. Soot generation is reduced if postulated fires are extinguished at an early stage before much smoke is generated.
- c. Agent discharge is required for an extended period of time (e.g. minimum of 30 minutes)
- d. Planned performance requirements specify the system be able to actuate a second time for a design basis accident (e.g. to protect against re-flash or second fire before recharging suppression agent)

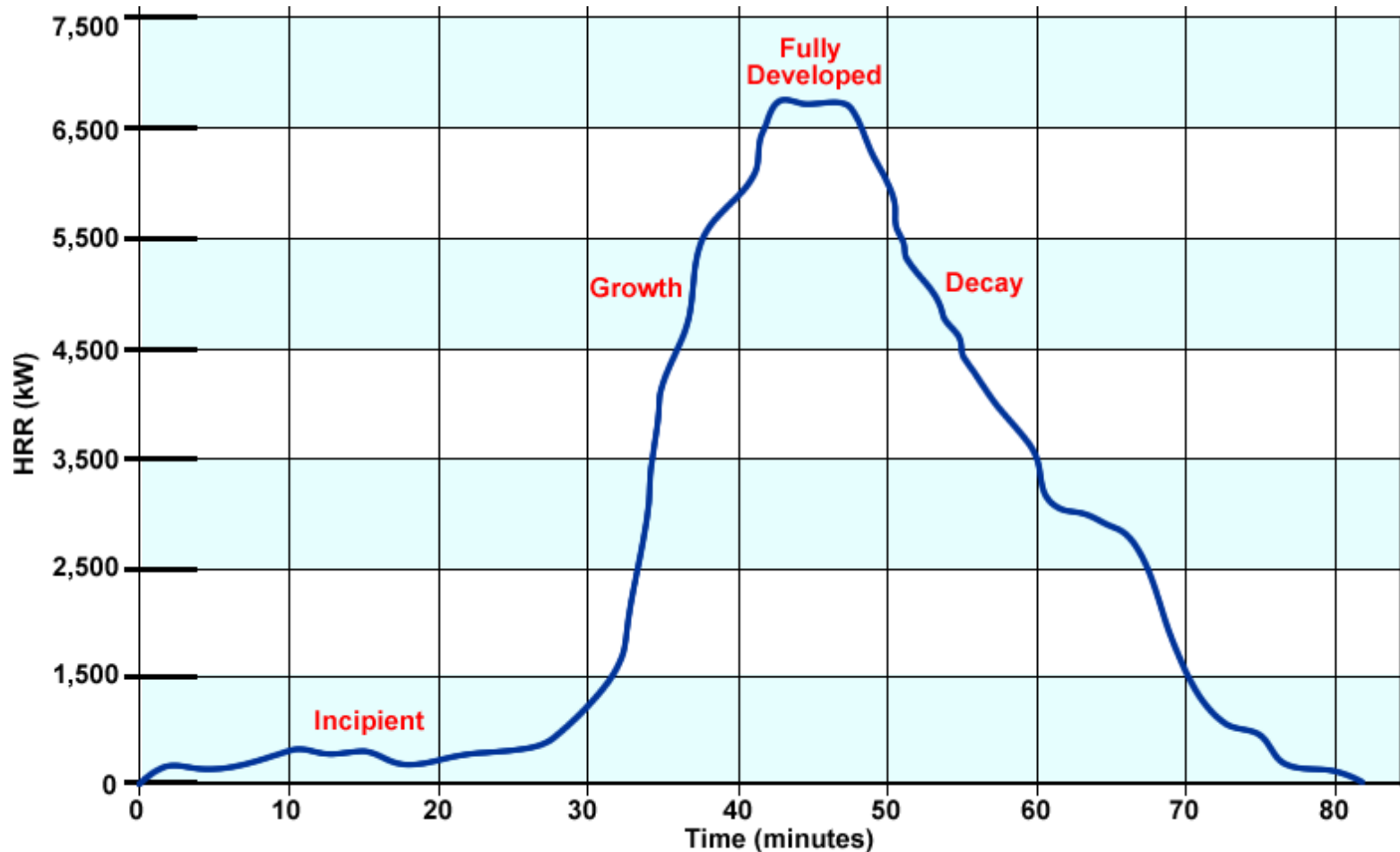


Fire Tetrahedron



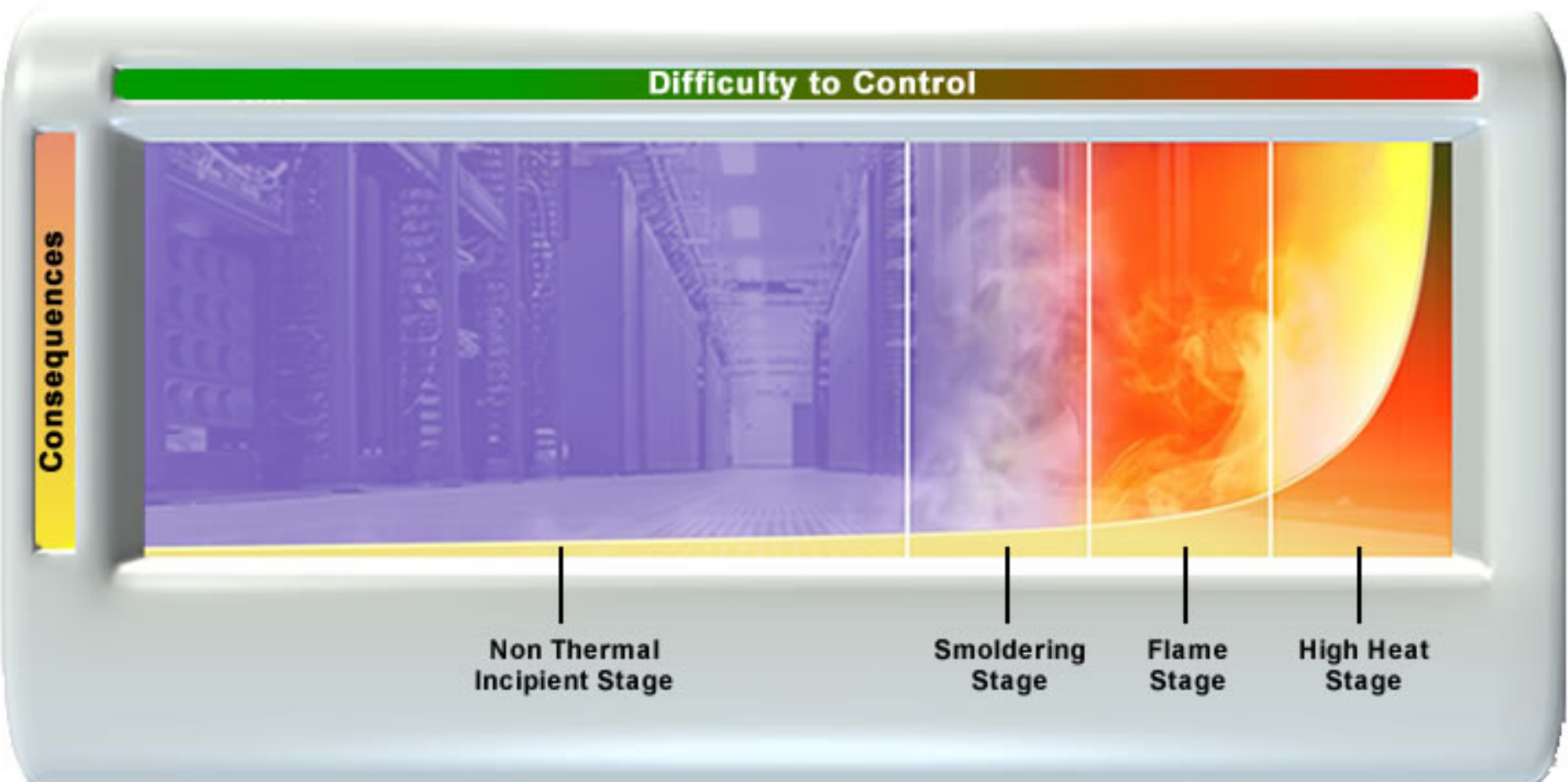


Fire Growth Curve



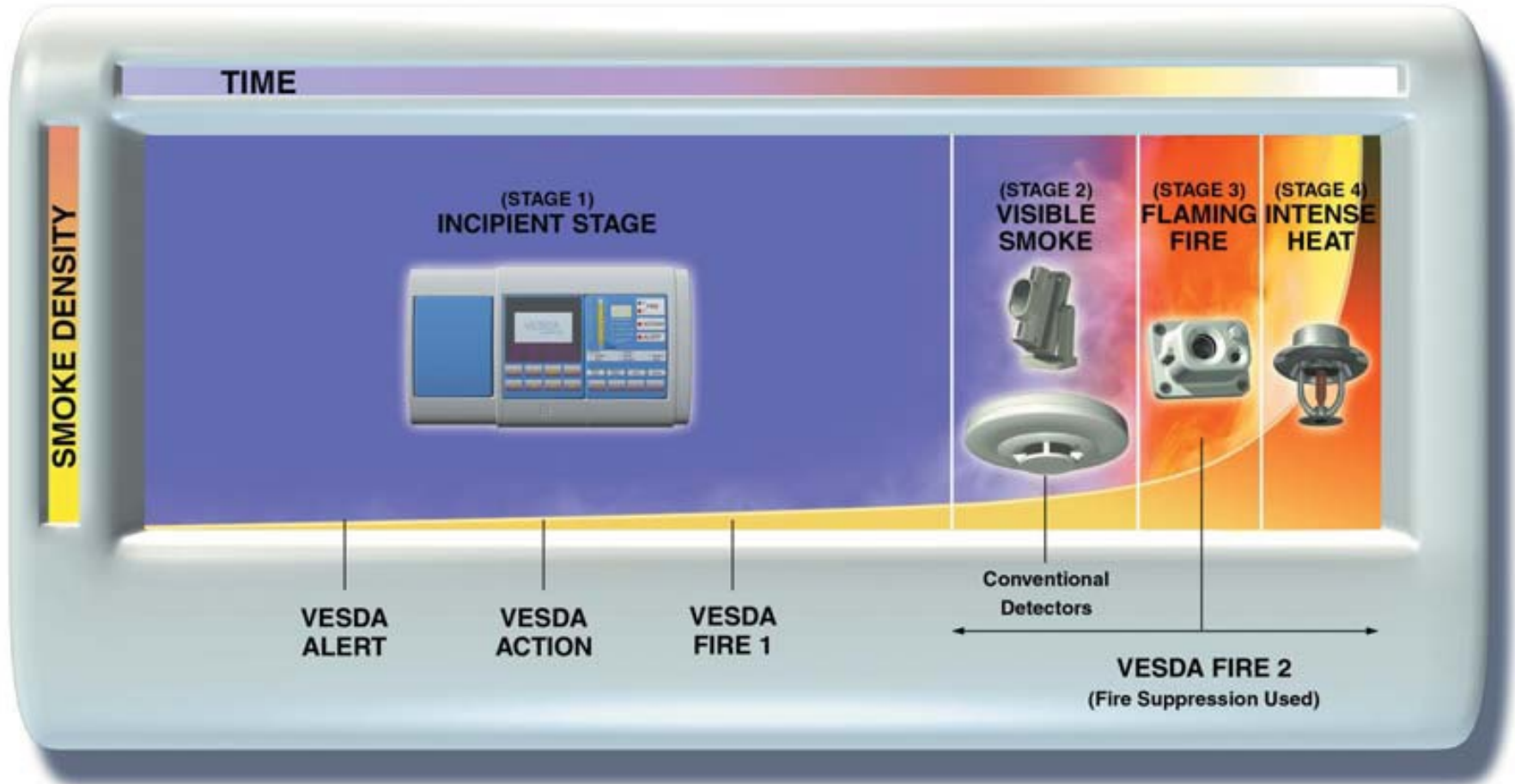


The Four Stages of Fire Growth





Detectors and the Four Stages of Fire





Early Warning Detection

Automatic fire detection systems play an essential role in the overall fire protection strategy:

- First line of defense against fire (thermal) / smoke (non-thermal) threats
- Early intervention by Operators to mitigate potential incidents
- Provides early fire department response
- Initiates activation of fire suppression system



Photoelectric/Ionization Detectors



- Detectors are located on the ceiling.
- Smoke must enter the detection chamber.
- In photoelectric detectors, a light source detects visible smoke.
- In ionization detectors, the presence of invisible particles of combustion is detected.
- Alarm is sent to the Alarm Control Panel.



Beam Type Smoke Detectors

- Smoke is detected when the light beam is obscured.
- Can detect smoke over large open areas.
- Subject to vibration and building movement.
- Alignment is difficult.
- Alarm is sent to the Alarm Control Panel.





Optical Flame (UV/IR) Detectors

- Flames are detected inside the cone of vision.
- UV can detect more quickly than IR.
- Must bracket its vision to prevent extraneous alarms.
- Alarm is sent to the Alarm Control Panel.





Air Sampling Detectors

- Air is continuously drawn in piping network via a high-efficiency aspirator.
- Air sample is filtered before entering the detection chamber.
- Laser light source detects presence of particles of combustion.
- Information is sent to Releasing Control Panel.





Video Imaging Detectors (VID)

- Detects flames and smoke inside field of view.
- Can detect reflected light from obscured flame.
- Detects pluming smoke clouds.
- Alarm is sent to the Alarm Control Panel.





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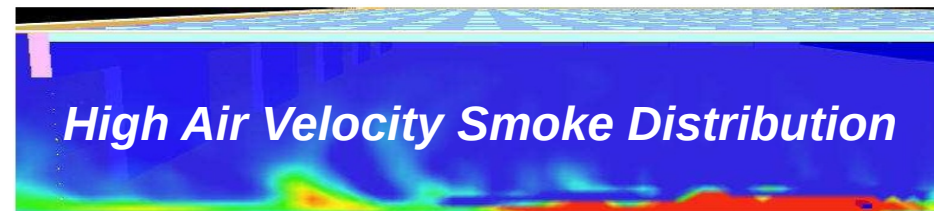
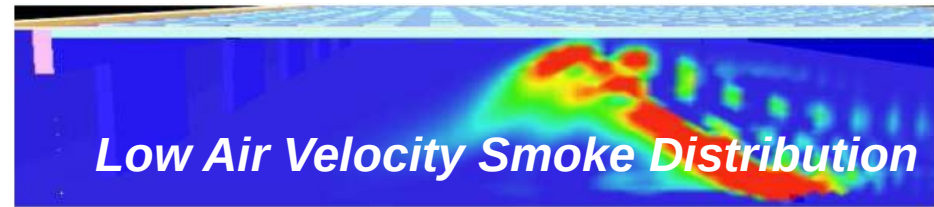
2012 DOE/Contractor Fire Safety Workshop



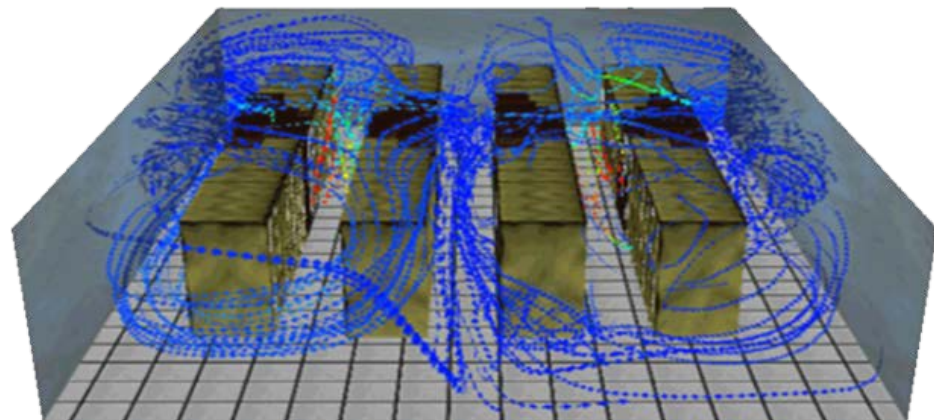
Detection Challenges

Challenges for reliable fire detection:

- Smoke dilution
- HVAC interference
 - Airflow interferes with normal dispersion of smoke
 - Unpredictable air flow patterns
 - The cooling affects of HVAC systems will decrease the temperature of the smoke plume
 - Limitations on placement due to:
 - Obstructions
 - Velocity
 - Temperature
- Accessibility for inspection, testing and maintenance once installed can be difficult and risks impacting operations



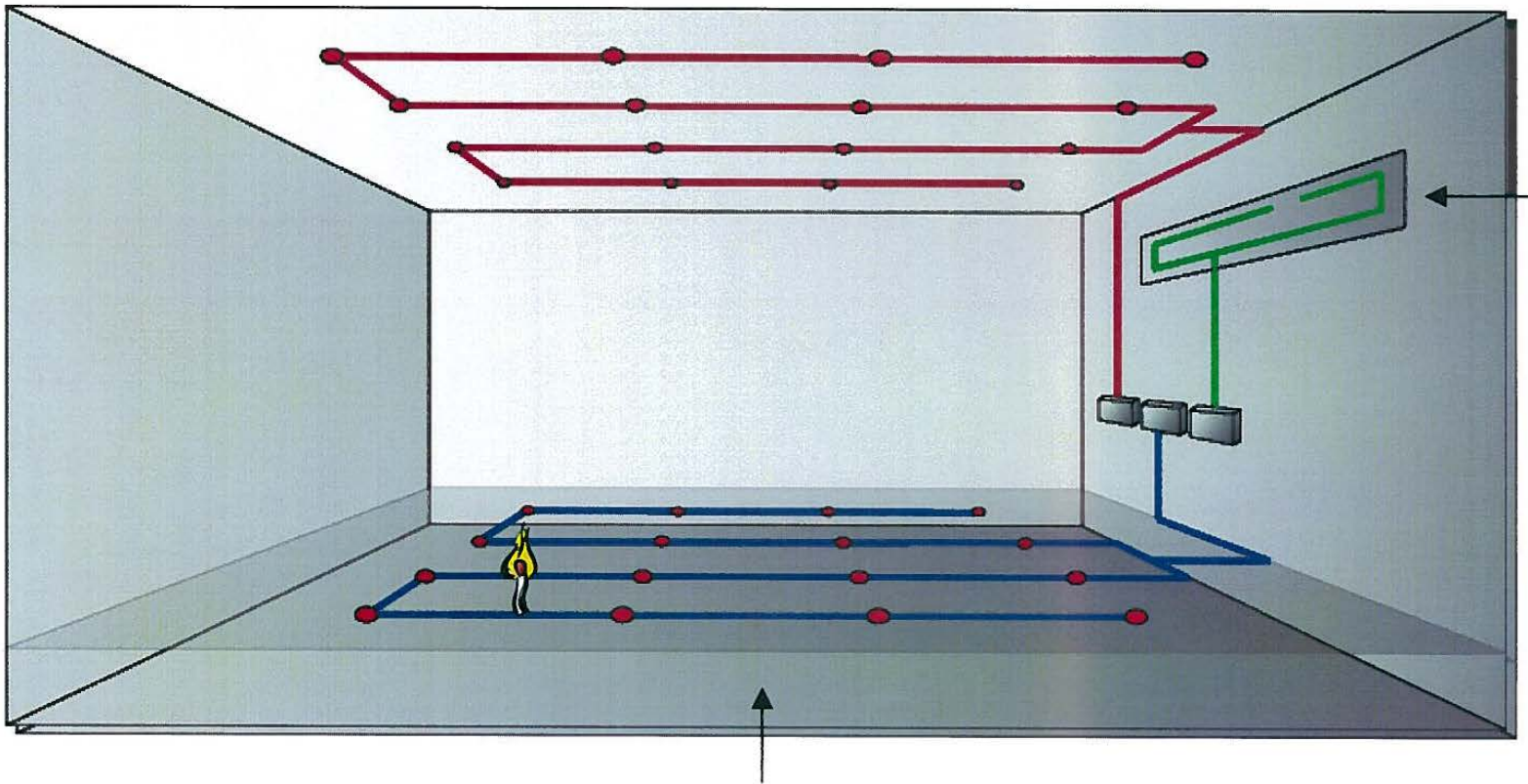
Air velocity affect on dispersion of smoke



Unpredictable airflow patterns 17



Air Sampling Detectors can be installed on the ceiling, under the floor, and at the return air register.





Fire Suppression System Components

➤ **Early Warning Detectors**

- Detect fires during the incipient stage.

➤ **Releasing Panel**

- Process alarms & activate extinguishment system

➤ **Fire Suppression System**

- Discharges agent through piping system

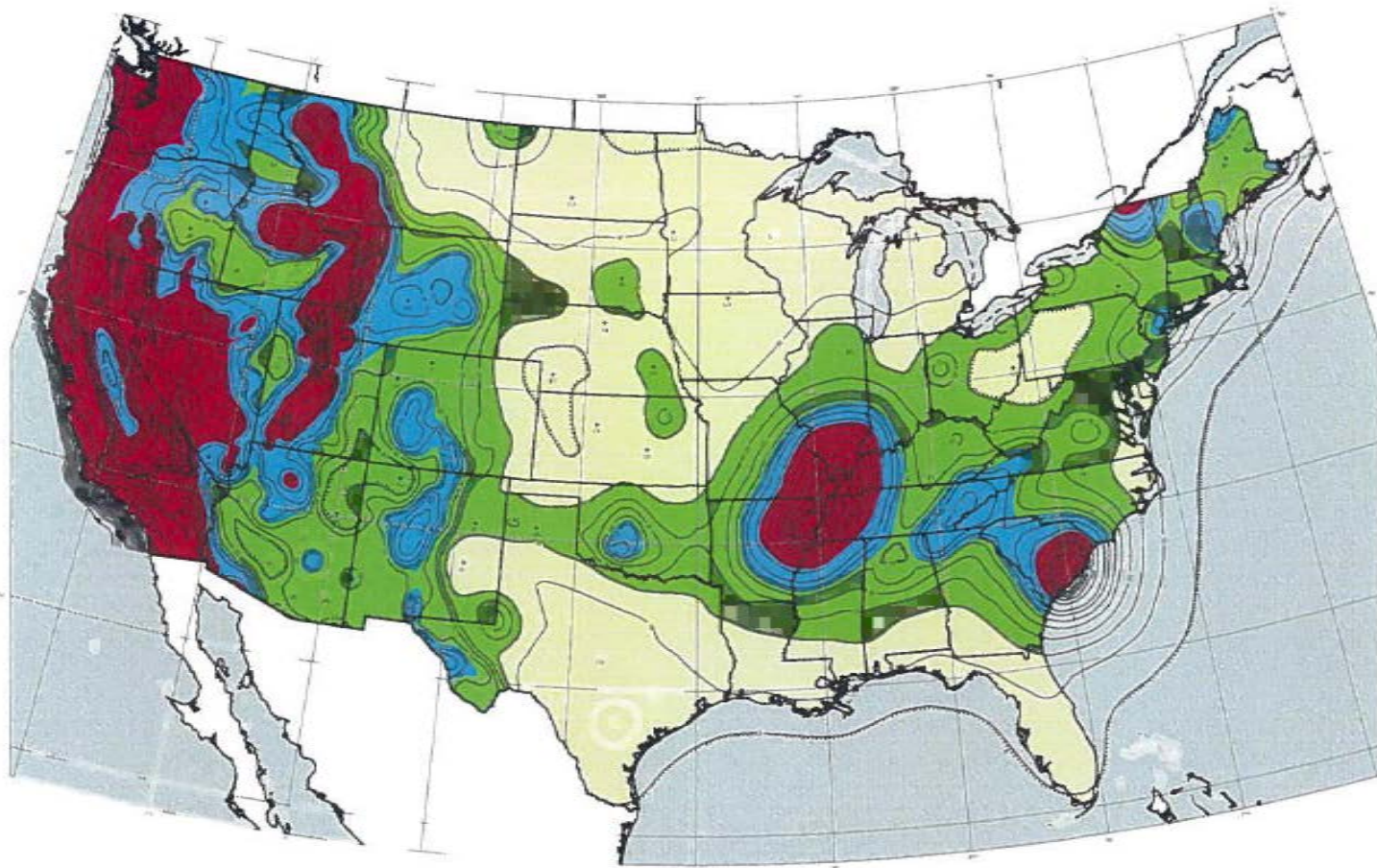


Fire Suppression System Components



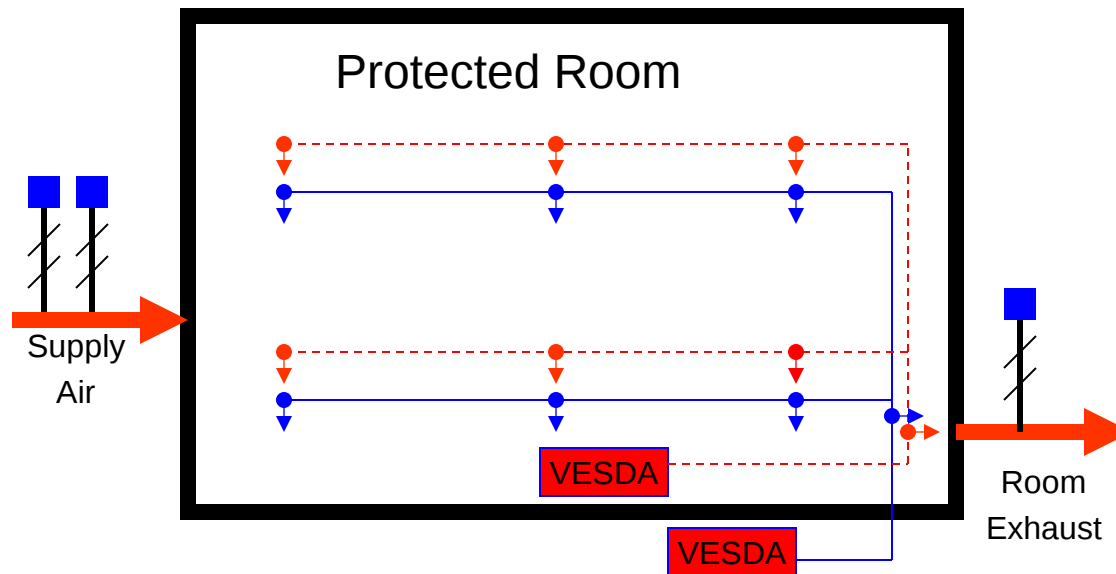


Seismic Design Category Reference Map



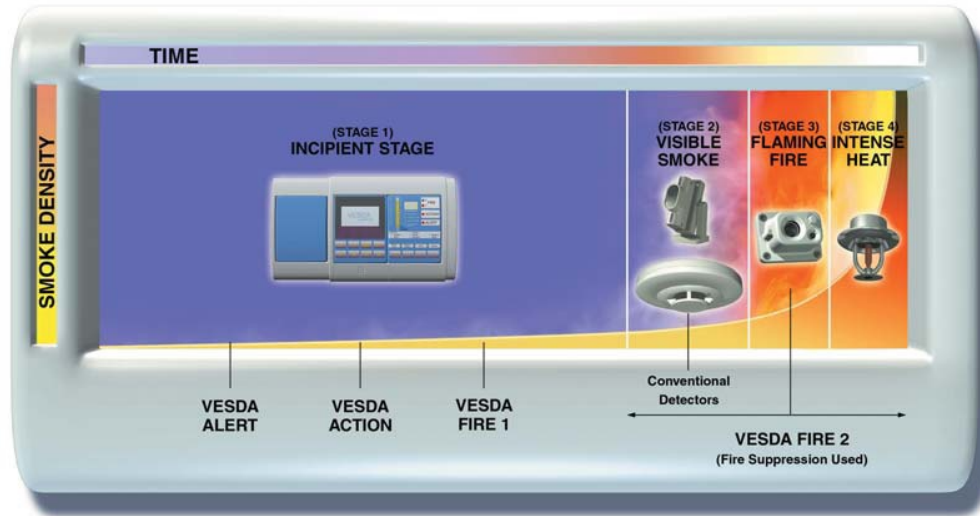


Redundant Air Sampling Detectors





Air Sampling Detectors are Proven Worldwide



Air sampling detectors can detect fires during the incipient stage, before visible smoke is present.

- Reliability is 3.5 times 10^{-6} per UL 268

This provides additional time to respond—(Pre-Discharge).



The VESDA VLC Detector



- UL Listed for Area and In-Duct Applications.
- IBC Certified for operation following seismic event.
- Supervised alarm and trouble outputs.
- Programmable from $0.0015\% \text{ obs/ft}$ to $6.0\% \text{ obs/ft}$.
- Battery backup from Releasing Panel.



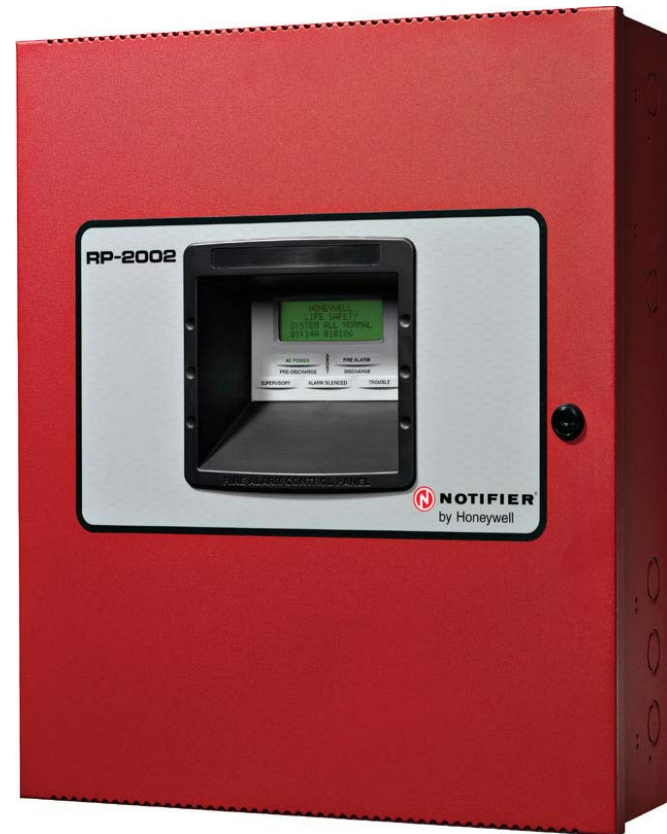
UL 268 Detector Reliability Prediction

- 4.1 The maximum failure rate for a detector unit shall be 4.0 failures per million hours as calculated by a full part stress analysis prediction as described in MIL-HDBK 217 or 3.5 failures per million hours as calculated by a simplified parts count reliability prediction as described in MIL-HDBK 217, or equivalent, see Annex D. A “Ground Fixed” (GF) environment is to be used for all calculations. When actual equivalent data is available from the manufacturer, it is permissible that it be used in lieu of the projected data for the purpose of determining reliability.



Releasing Control Panel

- Receives Pre-Discharge signal from detector.
 - Activates Pre-Discharge Alarm signal.
 - Closes isolation damper in supply air.
 - Sends signal to FACP and to Control Room
- Receives Discharge signal from detector.
 - Activates Discharge Alarm signal.
 - Sends signal to activate Vortex® fire suppression system





RP-2002 Releasing Control Panel



- UL Listed for releasing service.
- IBC Certified for operation following seismic event.
- Supervised initiating and alarm circuits.
- Supervised releasing circuit.
- Self contained battery backup.
- 80-character LCD Display.
- History log with 256 entries.



Releasing Panels are IBC Seismic Qualified



NOTIFIER
by Honeywell

Product Bulletin

Seismic Certification Achieved

NOTIFIER is pleased to announce that we have achieved International Building Code (IBC) seismic certification on the ONYX® series and FireWarden® series fire alarm control panels. The IBC requires that life safety equipment continue to operate after a seismic event. Seismic certification is governed by International Building Code (IBC), developed by the International Code Council (ICC), and can be a competitive advantage.

Seismic certification is required in many applications worldwide and is determined by the Seismic Design and Occupancy Categories assigned to a facility ([please refer to the Seismic Design Category Reference Map for the U.S.](#)). NOTIFIER® has made it possible for you and your customers to comply with seismic requirements of IBC and eliminate testing the equipment on a project by project basis.

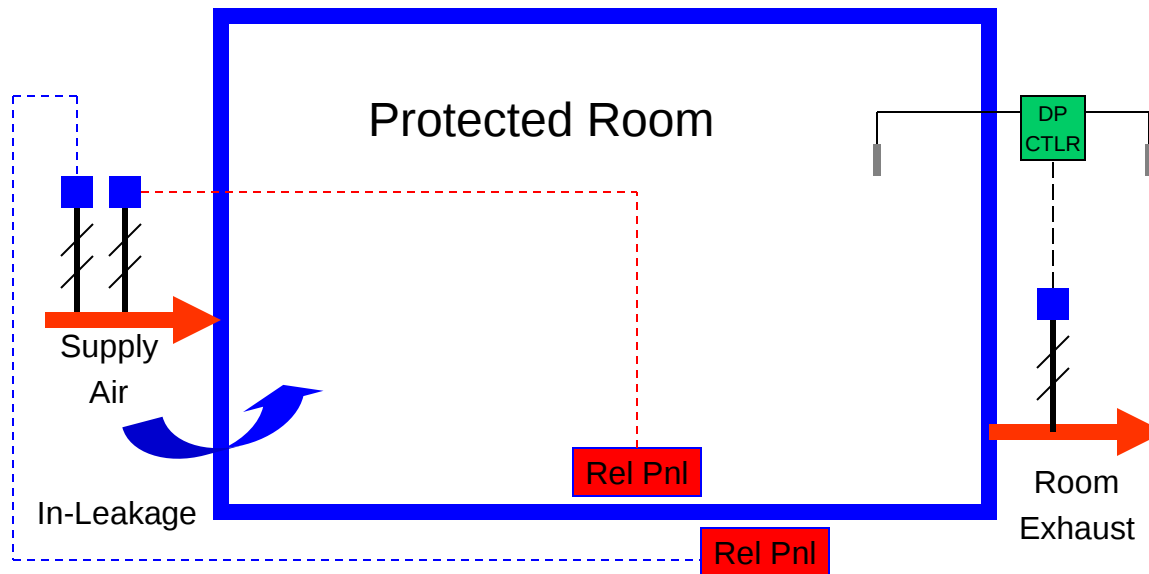
At a minimum, IBC seismic certification and installation details are required for the following essential facilities in specific geographic regions of the country:

- Hospitals and other healthcare facilities
- Fire, rescue and police stations
- Designated earthquake, hurricane or other emergency shelters
- 911 communication, data switching, and operation centers
- Most power generating stations and other public utility facilities
- Structures containing highly toxic materials
- Buildings and structures with critical national defense functions



Confinement Ventilation Control

Supply Air Dampers Close Failsafe on Pre-Discharge Alarm

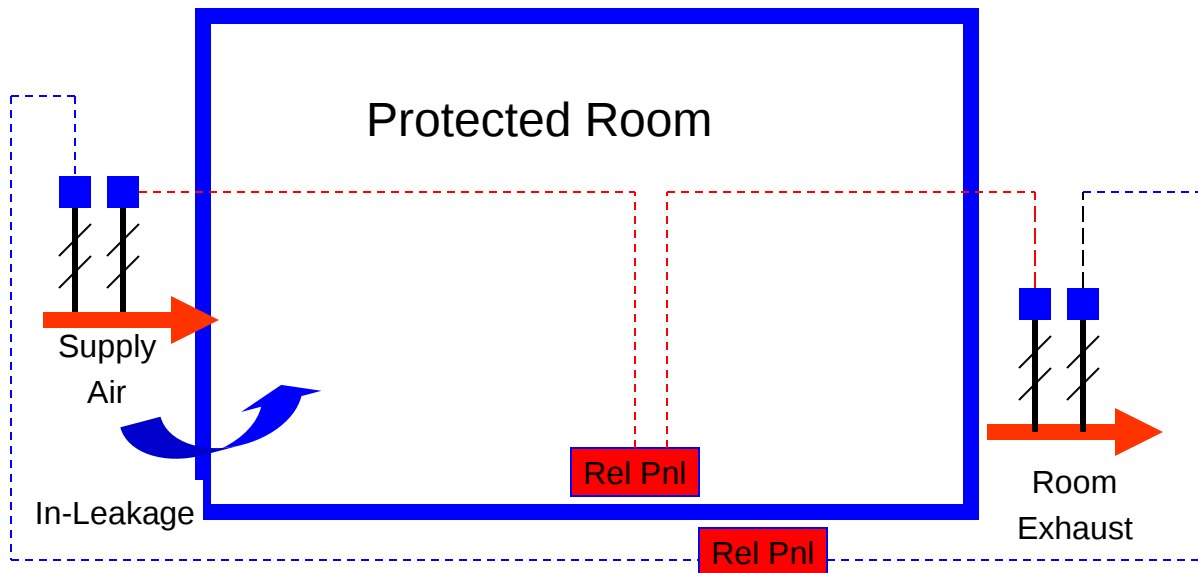


Room Exhaust Dampers Controlled by Differential Controller

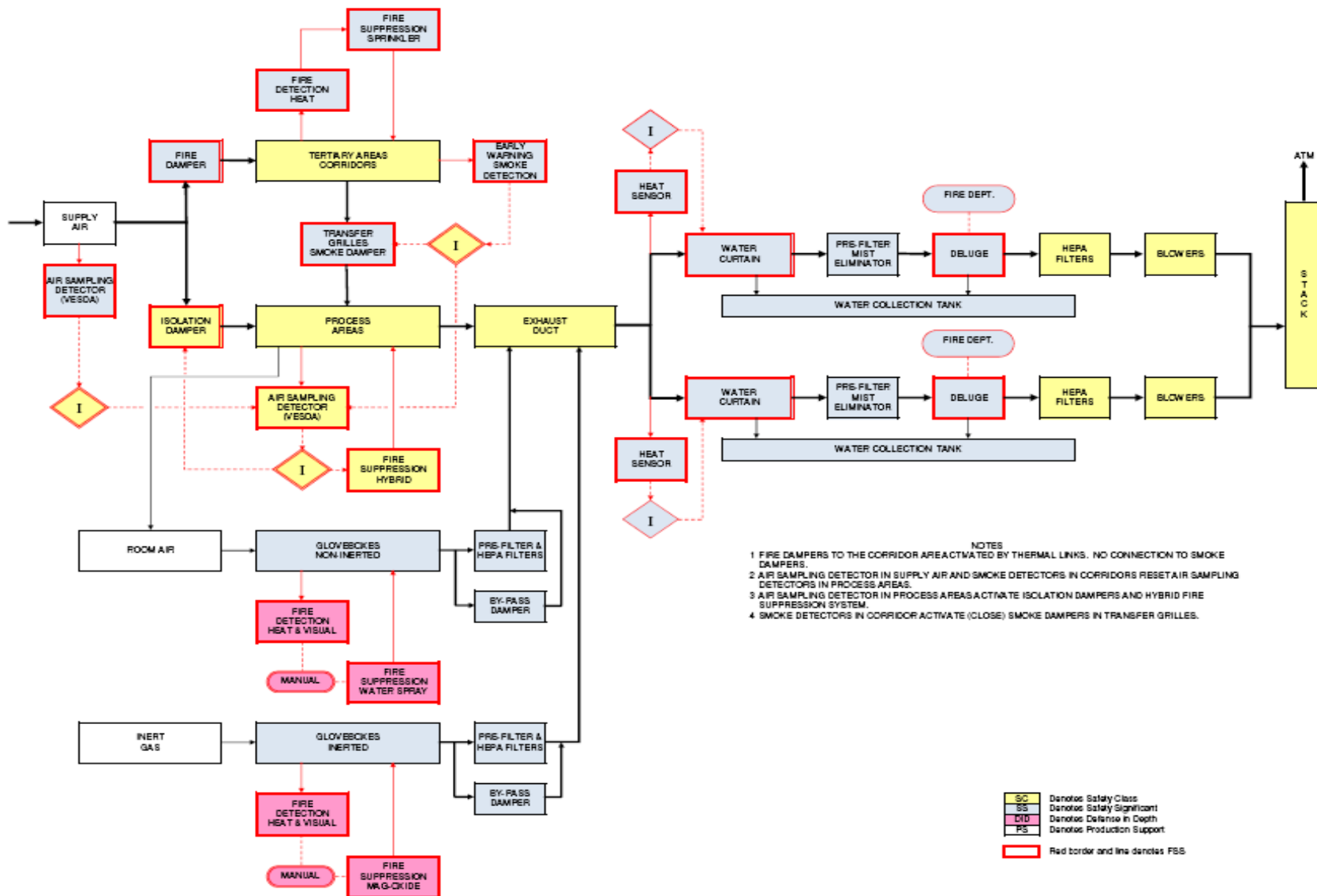


Confinement Ventilation Control

Supply Air Dampers Close Failsafe on Pre-Discharge Alarm



Room Exhaust Damper Closes to a Preset
Percentage Airflow on Pre-Discharge





Oxygen Concentration Levels and Effects

%

22
20
18
16
14
12
10
8
6
4
2
0

21% Normal oxygen level
15% No immediate effects

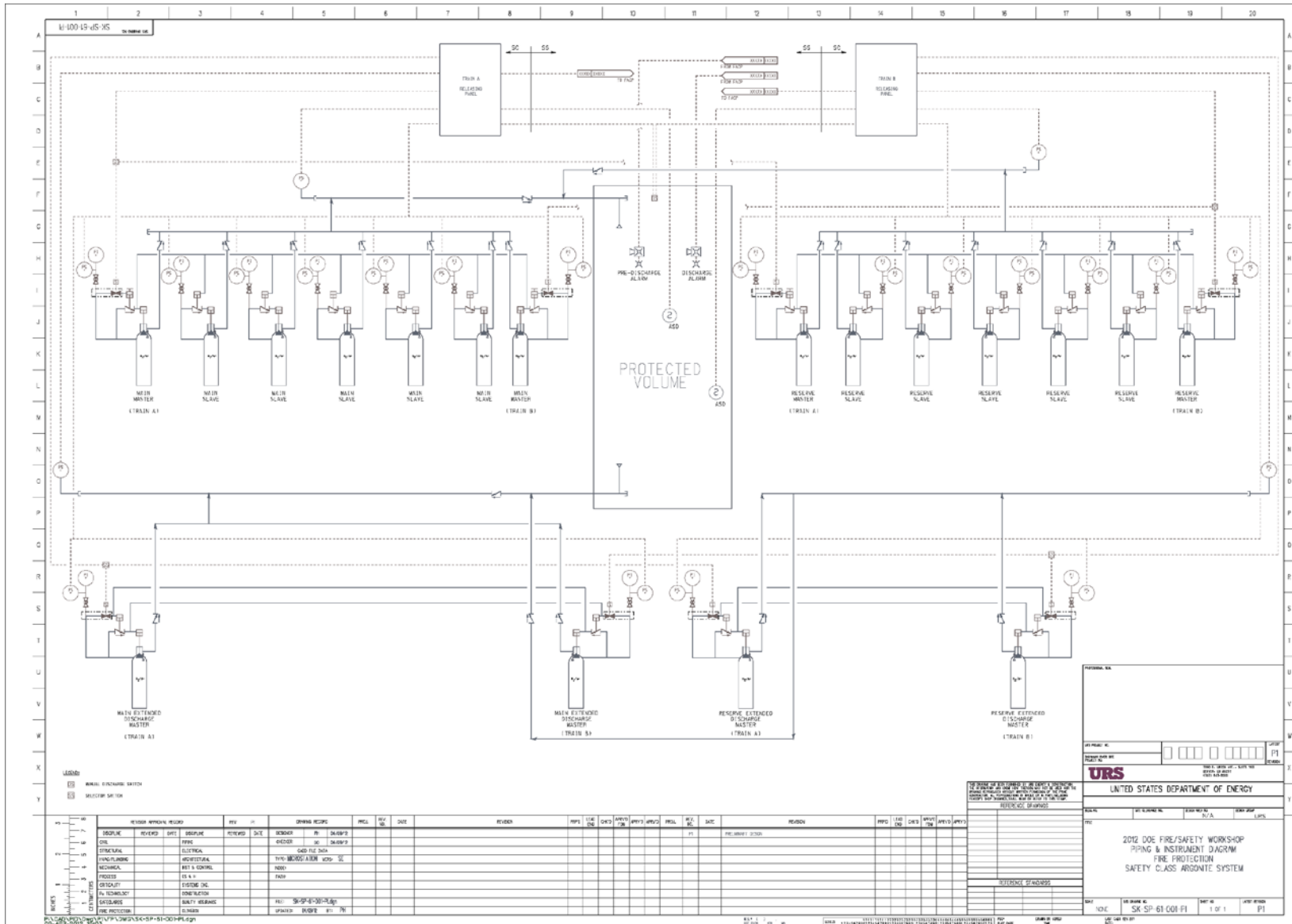
12% Fatigue, Impaired Judgement
10% Dizziness, shortness of breath
7% Stupor sets in

5% Minimum amount that supports life
2-3% Death within 1 minute

O₂ @ 12%, exit < 5 min.

O₂ @ 10%, exit < 3 min.

O₂ @ 8%, exit < 30 sec.





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Victaulic Vortex™

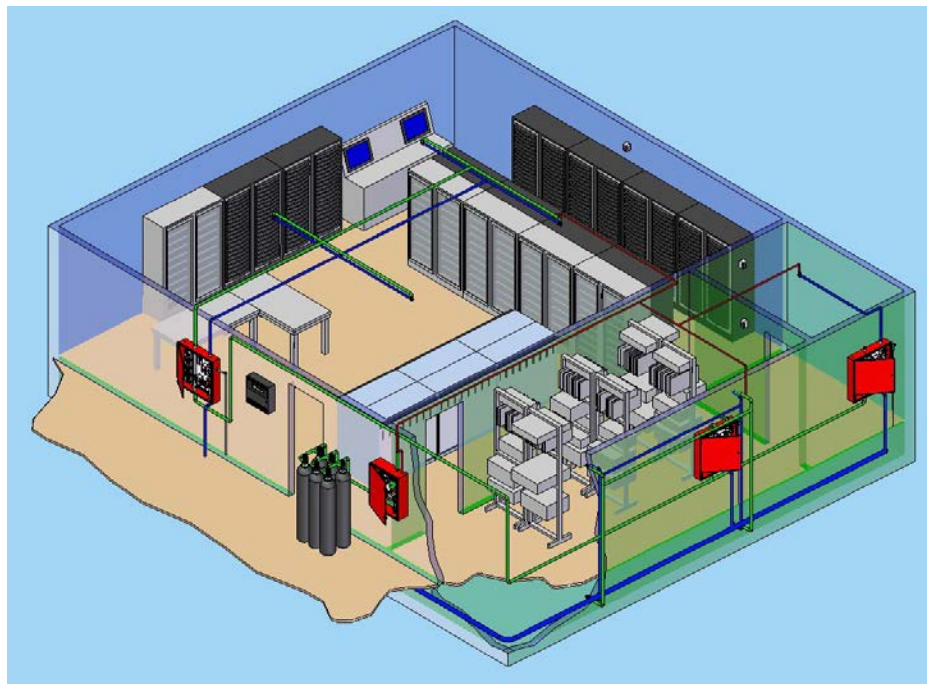
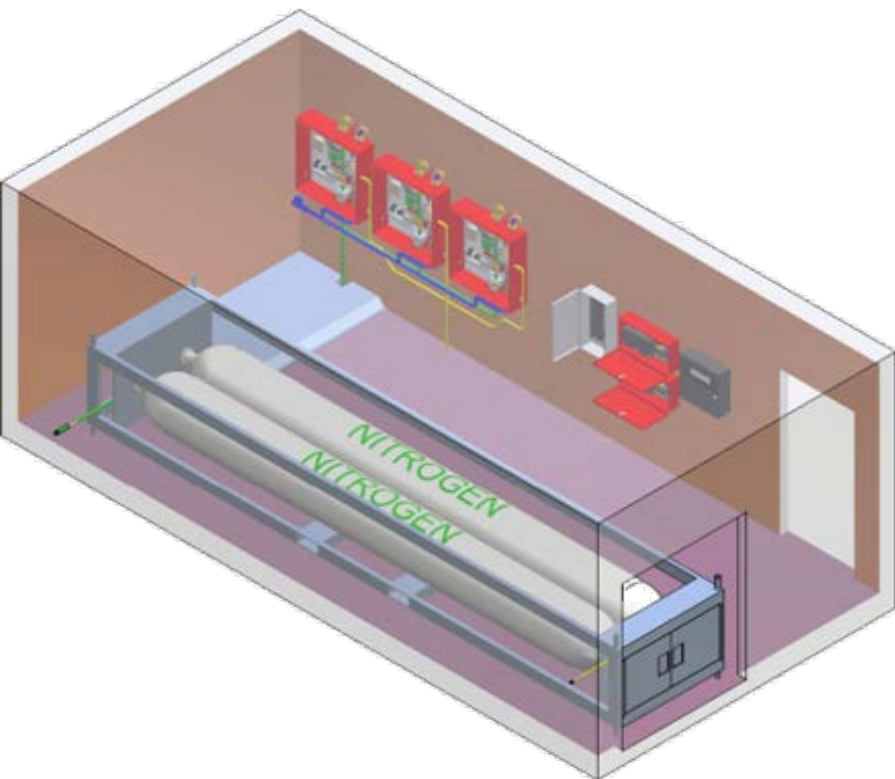
Safety Class Nitrogen Supply

- Multi-Zone System:
 - Nitrogen sized for initial discharge plus 30 minutes extended discharge
 - Largest Fire Area requires approximately 18% of the nitrogen supply
 - Multiple zones become very cost efficient
- Purposed configuration:
 - Nitrogen utilized to reduce the oxygen level
 - Regulated to a 25 PSI output at the emitter
 - Two sets of four (4) tanks—Each with total of 140,000 scf on N₂



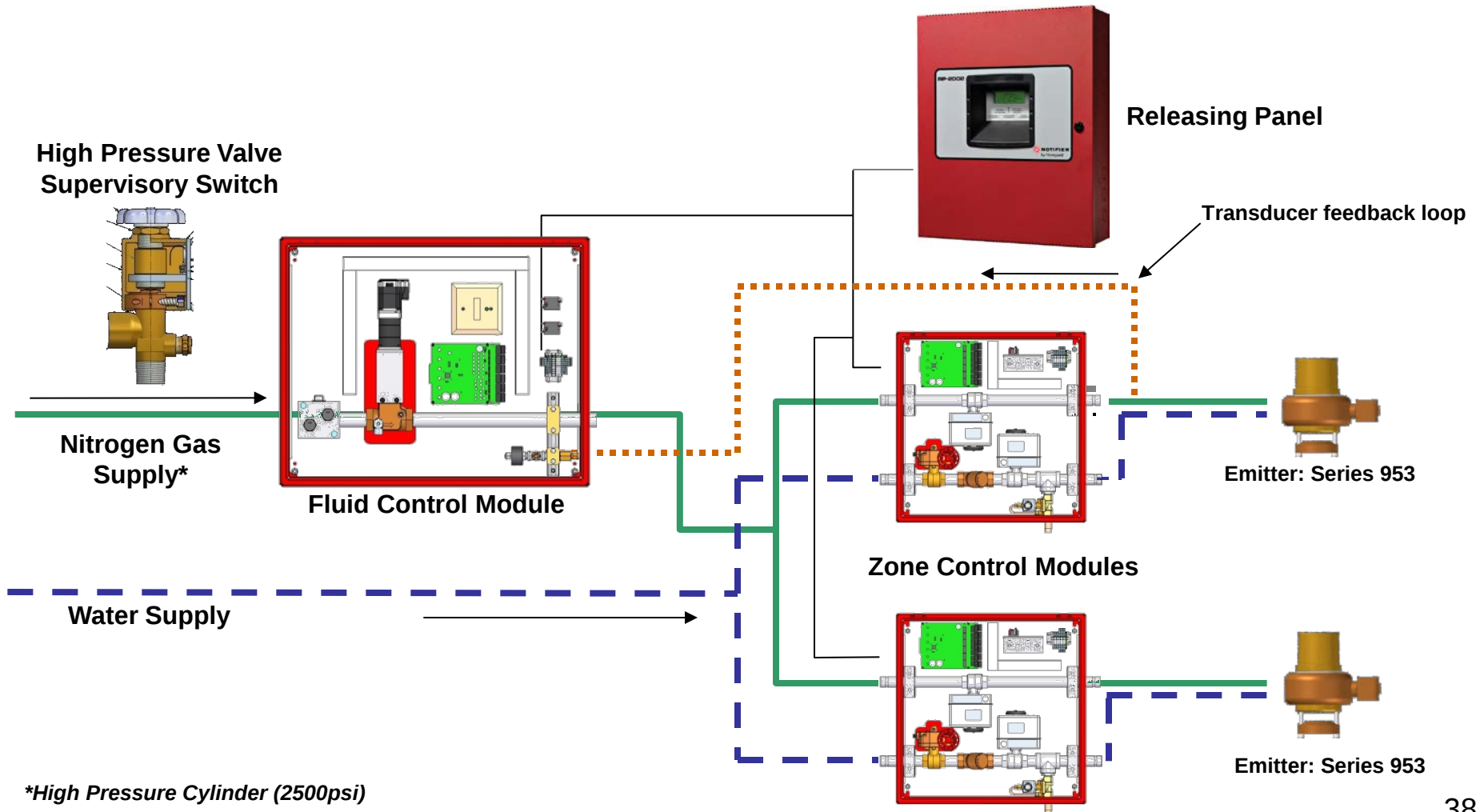
Nitrogen Storage / Process Rooms

- Nitrogen Supply
 - Multi-Zone





Typical Multi-Zone System





Conclusion

- **Safety Class requirements are determined by Safety Organization**
- **System must be designed to meet requirements**
- **Reliability must be assured**
 - Provide detectors and suppression agent appropriate for the hazard being protected
 - Insure system availability with redundancy and supervision
 - Verify systems are designed and installed properly
 - Insure system components are tested and maintained properly