



DESIGN AND ANALYSIS ON FIRE SUPPRESSION SYSTEM FM 200 FOR SERVER AND UPS STORAGE INTEGRATED WITH FIRE ALARM SYSTEM IN AUTOMOTIVE INDUSTRY

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Abstract- The fastest approach to reduce fire risk and losses is to prevent fires. Investments in prevention are occasionally significant. Active systems, such as fire sprinklers and alarms, portable fire extinguishers, and facility inspections, react to the presence or threat of fire with conditioned responses, and passive systems, such as sufficient occupant evacuation egress, fire-resistant construction, and flammable liquid storage cabinets, mitigate threats constantly to be able to prevent or reduce fire losses. Security systems, both passive and active, require routine upkeep and inspection. An illustration of a manual fire prevention and protection measure is a fire extinguisher. Other options include automated fire sprinklers, suppression systems, and separation barriers. Regular supervision, training, and inspections are necessary for manual activities. Inspection and maintenance are necessary for automatic systems. Passive barriers (like fire doors) may be compromised by renovations and occupant behavior. Facilities managers need to be familiar with all forms of fire prevention and protection, maintain them, and encourage deployment where it makes sense from a risk management standpoint. The FM200 system is a cross-zoned, double-knock system. Two detectors on it need to sound an alarm before the releasing sequence can begin. Only if one detection results in an alarm will the FM200 system enter pre-alarm mode. The FM200 is an independent system. Fire detection, trustworthy monitoring, and interaction with mass notification systems are all possible features of integrated fire alarm systems. Since features and capabilities differ from one fire alarm system integration to another, the term integration might be ambiguous. This is done to protect human life during industrial catastrophes.

Keywords: FM200, Integrated fire alarm, Cross Zone System.

1. INTRODUCTION

Construction Automotive industries includes different process like assembly, machining, plating to produce Brakes and Steering for passenger cars. The power backup for all process is UPS storage. In today's global business environment, increasing widely with modern technologies. Critical electronics are extremely vulnerable to fire. The fire protection system you select for various systems determines whether or not your organization will survive. FM200 is a synthetic/chemical fire suppression gas and extinguishes a fire by removing the free radicals or heat elements from the fire triangle. (Oxygen, Heat and Fuel). An FM200 system's usual concentration ranges from 7.9% to 8.5%. FM-200 is a non-toxic, colorless, and ecologically friendly fire suppression that is also acceptable for use around people. The fire suppression system primarily uses heat absorption to put out fires, making it safe to use in populated rooms. FM-200 is kept in liquid form. When FM-200 is activated, a two-phase flow moves through the distribution system's pipework. enters the danger as a gas through a network of nozzles. prevents the flames from re-igniting and puts out the fire. The FM-200 Fire Suppression System,

which is integrated with the fire alarm system and taken into account in project observations, will be covered in this chapter's literature study.

This project focus on Prevention of fire risk on fire prone to happen areas like UPS storage areas by using advanced fire protection system FM200 integrated with fire alarms. "The tasks are conducted with the utilization of deep learning and previous incident studies".

2. LITERATURE SURVEY

Rujia Fan, et al., (2022)^[1] have published a journal on "Experimental and theoretical study on the suppression effect of CF₃CHF₂CF₃ (FM-200) on hydrogen-air explosion". In this study, the impact of FM-200 on the H₂/air explosion was quantified numerically and experimentally. To gauge the effectiveness of the suppression, the explosion pressure was first examined. The outcomes showed that for various equivalency ratios, FM-200's impact on the H₂/air explosion was extremely diverse. While suppressing the explosion in rich mixtures, FM-200 could enhance the explosion in lean mixtures. The investigation of temperature free radicals, heat output, and burning velocity followed. Additionally, the outcomes showed that FM-200 had a larger suppressive effect on rich explosions. Additionally, the rise in free radicals demonstrated FM-200's enhanced effects during lean burst. To understand the suppression kinetics, the analysis of sensitivity and reaction path was done last.

Ning Ren and Yi Wang, et al., (2017)^[13] have published a journal on "Large-scale fire suppression modeling of corrugated cardboard boxes on wood pallets in rack-storage configurations". This investigation for goods kept in racks verified the Fire FOAM models for fire propagation and suppression. In the suppression investigation, upright ceiling sprinklers with a standard response and a K-factor of 160 lpm/bar^{1/2} were used. The time-resolved chemical heat release rates identified from the studies were used to validate the fire growth model. The fire spread patterns and actual sprinkler activations were used to validate the suppression model. This analysis discovered that lateral flame spread is primarily caused by flames impinging on the bottom surfaces of the commodities. The results of this investigation also demonstrate how obstructions, such as wood pallets, can significantly slow down the transmission of convective and radiative heat to the underside of the product, which in turn reduces the rate at which flames spread laterally.

Xiangyang, et al., (2020)^[3] has published a paper on "Time-resolved fire heat release rate under a ceiling based on ceiling layer measurements". Time-resolved fire heat release rate (HRR) monitoring is critical for defining fire growth and suppression. In some circumstances, such as large-scale fire tests conducted under a ceiling with sprinkler protection, quantifying a time-resolved HRR remains a challenging problem. The convective and chemical HRRs for a fire beneath a ceiling are being calculated using a novel method that is being developed in this project. The results demonstrate that the proposed method may generate a time-resolved chemical HRR comparable to that derived from the fuel mass loss rate.

Yan Cui, et al., (2018)^[4] have published a journal on "Research progress of water mist fire extinguishing technology and its application in battery fires". Due to its high efficacy and absence of pollution, water mist fire extinguishing technique has attracted interest and attention from a number of fire protection industries, including library fire safety, traffic hub station fire safety, ships fire safety, and spacecraft fire safety. In order to advance research into and development of water mist fire extinguishing technology and its application in the field of battery fires, this study begins by describing how water mist extinguishes fires. The effectiveness of water mist fire suppression is then explored in relation to internal and external parameters such as water mist properties, additives, obstructions, ventilation conditions, fuel kinds, and flame scales. A review of studies on the application of water mist technology in battery fires follows below. The essay concludes by outlining potential directions for future research and development in the field of water mist fire extinguisher technology and forecasting how it might be used to battery fires based on current research trends.

3. PROBLEM IDENTIFICATION

According to trends and occurrences of fire accidents in UPS storage rooms and regions at automotive industry. Fire generally arises as a result of a short circuit in the PCB of the UPS controller card and is made more dangerous by the storage of Lead Acid batteries for backup power. Fortunately, most industries have qualified fire fighters to put out the initial fire and prevent serious fire accidents by doing so in a timely manner. The situation worsens with the absence of fire fighters and fire fighting supplies. This investigation was carried out in

order to prevent future fire incidents and to ensure that the server room, UPS room, and battery storage room all have active fire prevention systems. A business can be destroyed by the destructive element of fire, especially when it is out of control.

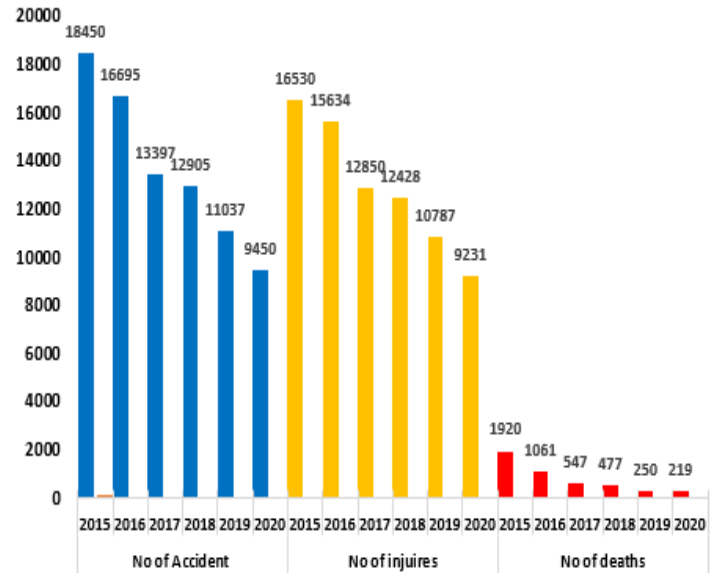
4. OBJECTIVES OF PROJECT WORK

- To determine whether the UPS rooms and battery storage spaces provide a fire danger. To prevent damage to the site, employees, visitors, as well as stock and equipment.
- To reduce the likelihood of fire events in areas where they are likely to occur, such as UPS rooms and battery storage spaces.
- Control measures and plans are made for implementation.
- The installation of a cutting-edge fire protection system that aids in putting out fires and is connected to a centralized fire alarm system for emergency evacuations.

5. SCOPE OF PRESENT WORK

In this project work phase - I the fire prone zones are identified, totally 5 UPS rooms are identified. Battery Capacities and terminal conditions and also earthing of batteries were verified. At first we decided to implement CO2 Flooding system to extinguish fire, later we found the drawbacks like high chances of equipment malfunction and once fire extinguished the materials cannot be recovered and reused. So new advanced fire suppression system is planned – FM 200. At first FM 200 will be implemented in one UPS Room. For Phase – II horizontal deployment planned to all UPS room and Server room with Integrated Fire Management System Interlinked with FAS (Fire Alarm System).

Industrial Fire Accidents In India



Graph No 1. Industrial Fire Accidents in India

6. METHODOLOGY

The risk identification study is done on the prone to happen risk like a fire which is most vulnerable when the there is no control. Risk analysis to be done and identify the issues and put the corrective actions for the prevention done as given in below the project. Better outcomes for fire prevention controls will arise from the implementation of sophisticated prevention systems based on risk analysis and integration within the fire alarm system.

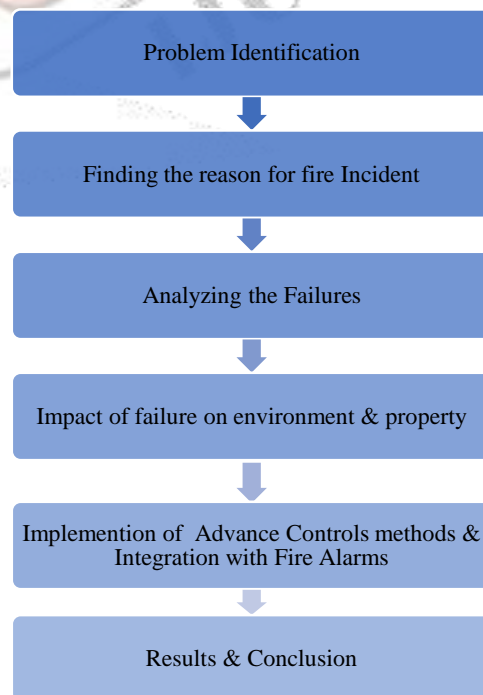


Figure No.1 Methodology for Fire Risk Analysis

7. DATA COLLECTION OF UPS AND BATTERY CAPACITIES

- Existing system controls are only fire extinguishers at UPS & battery storage.
- Minimum quantity of extinguishers is only available at UPS room.
- The fire prevention control are manual systems.
- Based on the investigation in summer due to over load and excess heat there high change of fire incident.
- Due to fire at battery would cause serious damage to the business and the environment.
- Fm200 is an advanced automated system to suppress the fire without human intervention.
- The system is high expensive but when it comes to an fire incident ,assets and human life are more value than FM200.System is an automated and no need of Continuous monitoring by manual.

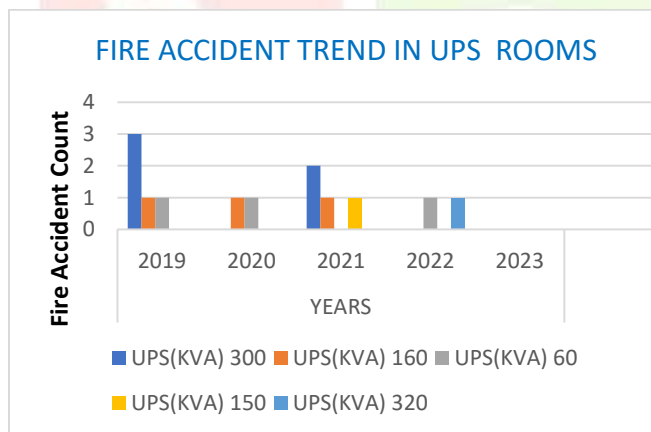
- Subfloor Wiring Issues – Wiring in the subfloor that is broken or not functioning properly can cause fires to start.
- Fires that Start in Other Parts of the Building - Because of pre-existing wall and ceiling cable penetrations, UPS rooms are more susceptible to fires that start in other parts of the building.

9. FM 200 SYSTEM LAYOUT

- Modularized System:
 - Easier system design
 - Often most economical solution
- Manifold System:
 - if containers are positioned remote from the hazard
 - higher costs due to larger pipes and longer pipe

Table No.1 UPS Room List Analysis

Overall cost of the assets in UPS room is about Rs.75, 00, 000.Almost Rs.10, 60,000 assets had damaged due to fire in last four years.



Graph No.2 Fire Accident Trend in UPS Room

8. HAZARDS ASSOCIATED IN UPS ROOM

- The most frequent reason for UPS room fires is electrical failure in the equipment, specifically overloading or short-circuiting of electrical components or power inverters.
- Over-heated Electronics - Electronics become a fire risk when the cooling system fails and the electronic components over-heat.

S.No	UPS Capacity(KVA)	Battery (No's)	Cost of Damaged Assets Due to fire
1	300	100	Rs.3,00,000
2	160	74	Rs.2,00,000
3	60	16	Rs.30,000
4	150	200	Rs.1,80,000
5	320	100	Rs.3,50,000

runs

10. LIST OF COMPENTENTS & OPERATION:

- Smoke Detector - Is a device that sense inside and Detects fire at initial stage.
- Manual Gas Release – Used to release FM200 agent instantly.
- Sounder Flasher – Audible and visual fire alarm devices and Activated during 2nd stage fire alarm.
- Even if the panel was turned off, the solenoid coil head causes the cylinder to discharge the FM200 agent and gives the user the option to manually release the agent.

- Abort Switch: Use to Stop FM from releasing and Need to Push and Hold.
- FM 200 Control Panel – Control Releasing of FM200 agent, Mini 2 Zone & Min 1 detector per Zone.

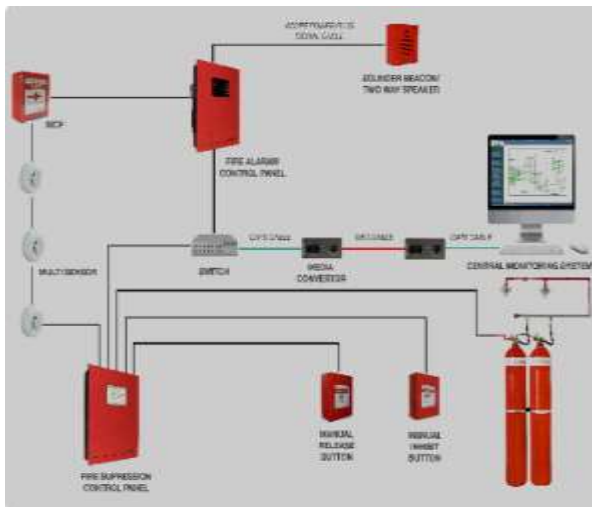


Figure No 2.Integration Fire Alarm Panel

FM-200 systems designed for the following classes of fire.

- Class A: Wood or other cellulose type material.
- Class B: Flammable liquid

The following codes, standards, and regulatory bodies must be adhered to during the design, installation, testing, and maintenance of the clean agent fire extinguishing system:

- Standard for Clean Agent Fire Extinguishing Systems (NFPA 2001)
- National Electrical Code (NEC): NFPA 70
- National Fire Alarm Code (NFPA 72)
- FM-200 is clean and leaves no residue thereby eliminating costly after fire clean up and keeping expensive downtime to a minimum. Most materials such as steel, stainless steel, aluminium, brass and other metals as well as plastics, rubber and other electronic components are unaffected by exposure to FM-200.
- FM-200 is completely safe for use in occupied spaces.
- NOAEL – Maximum concentration at which no negative effects are seen. Clean agents are safe to use in inhabited areas up to the NOAEL.
- LOAEL – Lowest concentration at which an adverse effect is observed. In inhabited locations, the use of clean agents up to the LOAEL may be approved with
 - Adequate time delays
 - Pre-discharge alarms
 - Class B fuels

Integrated alarm systems provide the greatest level of protection with various components for smoke and fire safety, security alerts and continual monitoring. Early detection of fire, smoke or gas will provide early warning of an emergency in time to safely evacuate. In any case, monitoring and quick dispatch is critical to saving lives and property. Audible alerts such as smoke alarms, automatic evacuation procedures, and fire suppression systems like automated sprinklers provide quick response to fire. Visual alerts such as strobe lights are required in areas such as public hallways or work areas of the hearing impaired. Designing your integrated alarm system for maximum safety and code compliance is critical to achieve the level of protection system is designed. Monitoring can be performed from a central location on the property or from a remote location. Sophisticated monitoring available provides peace of mind 24/7 with quick dispatch to emergency personnel. Fire alarm systems can provide technologically advanced monitoring of the safety system and components themselves, alerting building owners and fire safety providers when equipment requires maintenance. Integrated alarm systems allow for easy identification of emergencies and quick response to a wide range.

11. CONCLUSION

The most critical component of any risk management plan is prevention. Prevention is critical in all aspects of risk management, including fire risk management. Employees must be able to report a suspected fire threat immediately and easily. People may lack motivation if the process is complicated or may not be able to motivate themselves if they are engaged with other tasks. Because FM-200 takes away heat, fire cannot continue to burn. The finest fire suppression protection is FM-200. One of the most cutting-edge fire prevention systems is the FM-200 fire suppression system. Quickly and effectively protect our most treasured assets while being ecologically friendly. FM200 has no potential to deplete the ozone because it includes neither bromine nor chlorine. There are FM 200 fire suppression systems available for server rooms, UPS storage spaces, and battery storage facilities. FM200 has been fully integrated with the fire alarm system and implemented in all UPS rooms. Better fire prevention has resulted from the introduction of the FM200 system in fire-prone locations. Detection and suppression of even tiny fires occur quickly. For the past six months, the assets and people's

lives have been protected from fire elsewhere. Remote monitoring of the system is possible. Therefore, major fire incidents are avoided, and human intervention during a fire emergency is also avoided.

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