



# Fire Safety Strategy – Paper Industries



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## Abstract:

Pulp and Paper mills are highly susceptible to fires due to a combination of highly combustible materials, heat-intensive processes, and dust-laden environments. This creates a perfect storm where a small ignition source can lead to a catastrophic fire. Many Indian paper industries had major fire incidents, and huge amounts of resources are lost. Fire is considered as one of the business risks. So, the paper industries must have a fire safety strategy to secure and sustain their business.

SPB's concise summary of the comprehensive fire safety plan and a technical document is created to demonstrate and secure and sustain our paper making business.

**Keywords:** Fire safety, Fire protection, Risk assessment, Detection, Suppression, Warning, Safety audit.

## Introduction

In this paper, we are going to discuss fire safety measures being practiced, emergency protocols, systems designed to prevent fires and how to minimize their impact if any fire occurred. Key aspects include preventing uncontrolled ignition by managing the “fire triangle” (Fuel, Heat, Oxygen), installing detection and alarm systems, ensuring clear escape routes, having appropriate fire-fighting equipment, and conducting drills and training. A comprehensive fire safety plan ensures occupants know what to do in an emergency situation and promotes a culture of safety awareness.

SPB's key components of Fire safety strategy are

### 1. Passive fire protection

Plan Layout and Buildings – Plan layout is well designed, each manufacturing plant is located with independently sufficient space to access to control and prevent the spreading of fire. Buildings are constructed with fire resistant materials to contain fire in that building. (Ref Fig. 1: Emergency preparedness plan layout)

### 2. Risk assessment

Fire risk assessment is carried out in a systematic manner by identifying the potential fire risks and mitigation plan to control. The existing fire precautionary methods are reviewed and if necessary additional precautions are put in place.

	Smoke Detectors & MCP – 24
	Windssocks -8
	Hydrant points -170
	Fire Extinguishers 440
	Safe Assembly points -2

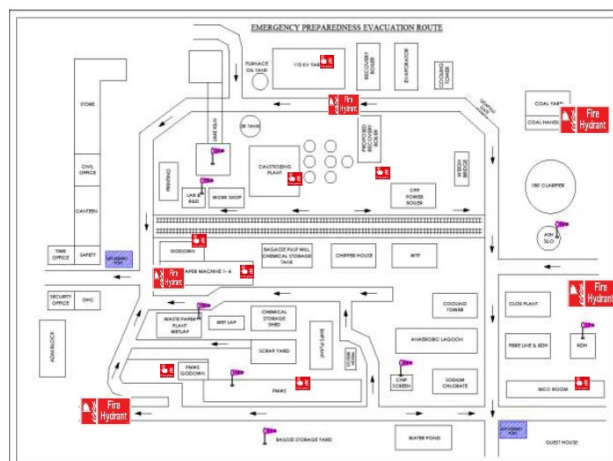


Fig. – 1: Emergency preparedness plan layout.

### 3. Fire Containment

#### Fire Doors (NFPA 80 standards) and Cable sealants

Cable gallery and breaker rooms contain combustible materials such as insulation, cable jacketing and supporting trays. A fire starting in one spot can quickly travel along the length of the gallery for this purpose the **fire doors is created to resist fire**. A fire door acts as a barrier within a large structure.

SPB is complying with building regularity norms. To resist fire, buildings are constructed with fire rated walls/floors, in compartment. Fire Doors (self closing, no holes and the gap between frame & door is 3mm) installed for the cable galleries/panel rooms. (Ref. Fig. 3: Fire Door)

When cables pass through these fire-rated barriers, they create openings; these unsealed gaps would allow fire, heat, and smoke to travel freely to other areas. Fire stop sealant is applied to the gap around the cables to seal the opening (Ref. Fig. 2: Fire stop sealant) and restore the wall's or floor's original fire resistance rating.



Fig. 2: Fire stop sealant



Fig. 3: Fire door.

#### CO<sub>2</sub> Suppression system (NFPA 12 standard)

When a fire is detected, the system activates and discharges CO<sub>2</sub> rapidly, reducing the oxygen concentration to a level that can no longer sustain the fire. It is particularly effective for use in areas with sensitive equipment such as power turbines, data centre and marine vessels.

In SPB, 21MW and 16MW power turbines are operated to produce **large amount of electricity** and steam for process purposes. Power generating turbines require a fire protection system because they pose significant **fire hazards** that can lead to catastrophic damage and loss of production. To protect this critical equipment, CO<sub>2</sub> suppression systems (Ref. Fig. 4: 16 /21 MW turbines - CO<sub>2</sub> suppression system) are installed and maintained.



Fig. 4: 16 / 21 MW turbines - CO<sub>2</sub> suppression system.

#### Transformer Safety - Nitrogen Injection Fire Prevention System (NFPA 69 Standards)

A Nitrogen Injection Fire Prevention System (NIFPS), primarily used for oil-filled electrical power transformers, is a sophisticated, dual-action safety system designed to prevent a transformer from exploding and to rapidly extinguish any internal or external fire.

In SPB, 110KV Transformer yard two numbers of 11KV oil filled transformers are installed to receive the power supply from TNEB and distribute to our plant with required voltage. These transformers are provided with Nitrogen Injection Fire Protection System (Ref. Fig. 5: 11KV Transformer - Nitrogen

Injection Fire Prevention system) that prevents transformer tank explosions and extinguishes fires by draining some oil and injecting nitrogen gas displace oxygen and reduce oil temperature below its flash point.



Fig. 5: 11KV Transformer - Nitrogen Injection Fire Prevention system.

#### Lightning Arresters

A lightning arrester is a protective electrical device that safely diverts high-voltage surges from lightning strikes into the ground, preventing damage to electrical equipment.

In SPB, 27 No's of lightning arresters are installed at Transformer yard, Buildings and Chimneys spike type. Periodical inspections are carried out and resistance values recorded.

#### Portable fire extinguisher

Portable type fire extinguishers are vital first response tools in fire safety, designed to stop small fire before they spread. More than 700 extinguishers are placed at various places based on fire classes.

Water type – Paper godown, Stores and Office buildings.

Foam type – Furnace oil, transformer yard, oil storage area.

CO<sub>2</sub> type – Electrical panel rooms, system department.

DCP type – Gas cylinder storage & electrical panel areas.

### 4. Raw Materials storage –Fire Safety

Bagasse, the fibrous residue of sugarcane after juice extraction, its large-scale storage poses a significant fire hazard, primarily due to spontaneous combustion.

SPB using bagasse for producing pulp, huge amount of bagasse is stored in our yard. Bagasse heaps are maintained with adequate gap for easy access. Yard perimeters are covered with ring main fire hydrant systems and sprinklers. (Ref. Figure No. 6: Sprinkler system -Bagasse yard)

#### Water Sprinklers

Internal temperature is measured on daily with Resistance Temperature Detector (RTD) sensor (Ref. Fig. 7: RTD Probe), if 50°C reaches sprinklers are operated for cooling.



Fig.6 : Sprinkler system -Bagasse yard.

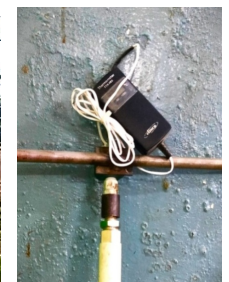


Fig.7 : RTD Probe

Coal storage fire protection is a critical aspect of industrial safety, primarily due to the risk of spontaneous combustion and the presence of highly flammable coal dust.

In SPB, Coal is stored under the shed, Lot Numbers provided to coal heap for practicing “First-in-First-out” (FIFO) method, avoiding long time storage. Coal shed is provided with hydrant lines, sprinklers and hydrant points to protect fire and water pressure is maintained 7Kg/cm<sub>2</sub>.

CCTV – Nearly 100 Cameras are installed at critical locations and being monitored by shift personnel/security team. Remote monitoring (Real-time) allows for a faster and more coordinated response to emergencies, alarms, or suspicious activity.

**5. Fire Detection and warning system (Standard NFPA 72)**

In the paper manufacturing unit’s final products such as Paper reels, bundles and Boxes are stacked in the godown. The paper products are handled by battery operated Forklifts, Electrical Hoist, belt conveyors and electrical lights can cause ignition and lead to fire incidents

Considering all the above risks, in SPB photoelectric smoke detectors with digital display with alarm are installed and maintained in Paper Godowns, DCS control room, Instrument/Electrical panel rooms and system department. For easy identification of fire incident location, the detectors are grouped into zone, will display in the panel. (Ref. Fig. 8: Smoke detectors and communication)

The photoelectric smoke detectors use a light beam and sensor to detect smoke. When smoke particles enter the detector’s chamber, they scatter the light, and the light sensor (photodiode) detects the scattered light, triggering an alarm to alert occupants to a fire.

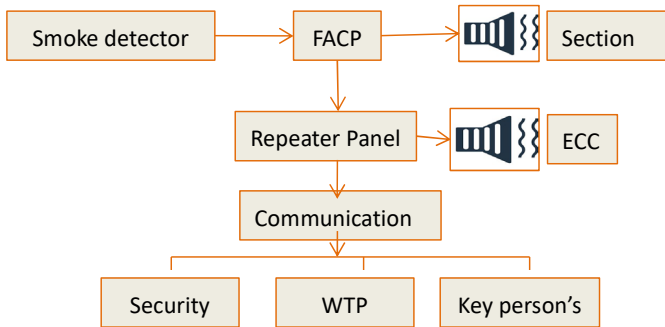


Fig.8 : Smoke detectors and communication.

**6. Housekeeping and dust management**

Poor Housekeeping significantly increases the risk of fire in the form fuel.

SPB practicing daily cleaning, weekly cleaning schedules,

Daily cleaning – Empty all the trash can and waste containers containing combustible materials like paper waste / plastics, stored at designated place and disposed to vendor. Oil soaked cotton waste and spontaneous combustible waste collected and used as a fuel in the boiler.

Aisle and exit walkways always maintained clearly without any hindrance.

Weekly cleaning – Fire extinguishers and emergency kits are cleaned in weekly once.

**7. Dust extraction and Suppression system**

Huge amount of dust will generate in bagasse handling system and chipper house. These dusts are subjected to dust explosion and it’s exposed to ignition source.

Bagasse / wood dusts transporting vehicles are covered with tarpaulins. The belt conveyors are covered with FRP hood to contain the dust. Conveyor structures are cleaned periodically.

Paper machine – dryer area and rewinder are prone to dust accumulation and it exposed to temperature to catch fire. Dryer and rewind area are being cleaned in shift wise and maintained the area neat.

**8. Electrical Fire Safety**

Electrical fire can occur due to short circuit, overload, defective equipment and improper connection, to prevent the electrical fire the comprehensive approaches are carried out,

Temperature monitoring – temperature of the electrical panels and breakers are monitored periodically by NDT cell engineers with the help of thermal

imaging camera. (Ref. Fig. 9 Thermal Imaging) and reported to the electrical department to set right the defects.

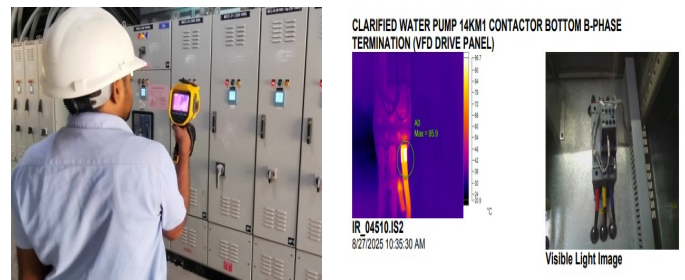


Fig. 9 : Thermal Imaging

Smoke detectors installed on the ceiling/false floor in all the electrical panel rooms. Earth pit testing’s being conducted periodically. Periodical Electrical audit conducted and gaps are closed.

Fire extinguishers such as Foam, CO<sub>2</sub> and DCP are provided, Caution boards are displayed.

**9. Machinery Maintenance**

Paper mill machinery maintenance is a critical and complex process due to the harsh operating environment. The machinery is massive, operates continuously, and is exposed to a combination of **heat, moisture, chemicals, and fibrous dust**, all of which can lead to rapid wear and potential fire hazards.

Preventive maintenance schedule prepared contains cleaning and lubricating on daily/weekly basis. Machinery inspection like visual checking, system checking and safety checking –testing emergency switch, interlock system and machine guards. We are practicing TPM for better equipment maintenance.

Worn out parts can cause overheat and potential for ignition sources. Worn out parts are replaced in predetermined schedule.

NDT Cell -by measuring vibration and temperature the condition of the bearing is assessed and if necessary suitable actions will be taken to avoid overheating.

**10. SPB - Chemical Safety Protocols**

**Sodium Chlorate** highly oxidation chemical – sodium chlorate bags are stored in dedicated fire proof building with fencing and no electrical appliances. Bags are handled manually by trained persons. Empty bags are cleaned before disposing.

Fire hydrant lines provided for storage and solution preparation areas.

**Methanol** is a highly flammable material, stored in an underground tank; area was protected with fencing and locking system. Safety measures - flame proof pump unit, leak detecting sensors & alarms and non –sparking tools for maintenance are available. SOP is developed for methanol handling; it includes unloading procedure, discharging of static electricity and equipment maintenance. Trained persons are engaged. Hydrant lines and foam monitors/ extinguishers are placed at storage tank. (Ref. Fig. 10: Methanol Storage Tank – Testing of Water Monitor.)



Fig. 10: Methanol Storage Tank – Testing of Water Monitor.

**Furnace oil**

Furnace oil storage tanks are located at SRP and Boiler area. Furnace oil tank are provided with dyke wall. SOP covers safe handling system includes unloading procedure, discharging of static electricity.

Furnace oil spillage is fire hazard, furnace oil can seep into porous like insulation materials and it can spontaneously ignite in a high temperature. Adequate care are taken to control the spill, spill kits are available. Employees are trained to handle the furnace oil safely.

Hydrant line, foam monitor, extinguishers and sand buckets are available near tank.

**11. Capacity Buildings and Training**

**Fire Fighting Training**

Fire drill and training are most critical in a fire safety plan, a comprehensive fire safety training program is prepared and being executed. Fire safety goes hand –in- hand with fire mock drills, so every mock drill involves employees/ Guards to enhance their fire fighting skill. Trained employees are available in every section/shift wise. 3 Dimensional DOJO Board is used during induction program for better understanding. (Ref. Fig. 11: Fire Safety DOJO Board)

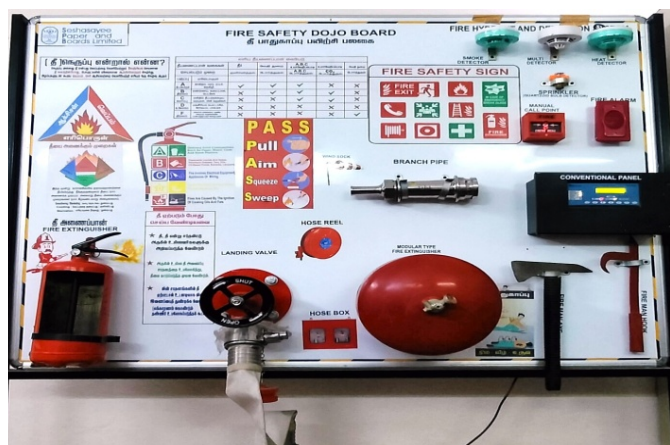


Fig. 11: Fire Safety DOJO Board (3Dimensional)

National Fire Safety Day is observed every year on April 14th. During that time safety exhibitions, videos and fire demonstrations are carried out along with M/s Tamilnadu Fire and Rescue Services and M/s Usha Fire Safety Equipments. (Ref. Figure No. 12: Tamilnadu fire and Rescue service-Fire Fighting Demo and Ref. Figure No. 13: Fire Safety Training with Demo)



Fig. 12: Tamilnadu Fire and Rescue Services – Fire Fighting Demo



Fig. 13: Fire Safety Training with Demo

**12. Emergency preparedness plan – Prevention, Preparedness, Response, and Recovery.**

Fire and toxic gas releases are our major emergency, we developed a comprehensive emergency preparedness plan. Site main controller, site incident controller, task force, fire fighting, rescue, communication and salvage teams are formed. Key persons list prepared with their role and responsibility and trained.

Annual mock drill scheduled, every quarter fire mock drill are conducted at Bagasse , wood , and coal yards, Waste paper plant, chemical storage areas and godown.

Emergency communication purpose phone No.77/Mobile 9489844277 is available. .

Mock drill activities have been observed by one of our executive, he will observe the performance of each team, and at the end of the drill he will report the note worthy points and gaps. Based on his report, action plan will be prepared and closed the gap within target dates.

**13. Emergency escape route & Fire hydrant layout**

Each building is provided with multiple exits, stairs and corridors. Safe assembly points are available at two places near the time office and Guest house. Way to assembly points are provided with Lightings and escape routes signage boards. (Ref. Fig. 14: Emergency preparedness plan & Fire Hydrant layout Plan)

**Water supply**

▼ Water drawn from Cauvery River and stored in fire water sump – capacity 800Cu.M.

**Fire water pumps**

- ▼ 2 - Main Pumps, Head -80M, Discharge - 204M<sub>3</sub>/Hr.
- ▼ Jockey pump –Head -70 M, Discharge -11M<sub>3</sub>/hr.
- ▼ Pipe lines - 150mm dia, pipelines laid to each department separately to ensure continuous water supply.

**Fire Hydrants**

▼ 170 Hydrant points installed and maintained, Hydrant system covers all the plants, storage yards, chemical storage tank areas and machinery areas.



Fig. 14: Emergency preparedness plan & Fire Hydrant layout Plan

**14. Safety Audit**

Safety audit team leads by senior members in two groups are taking daily rounds to assess all hazardous area and unsafe conditions. Accordingly corrective actions are taken and reviewed.

**15. Third party audit**

“Property Loss Prevention Audits” has been carried out periodically by ICICI Lombard, for taking necessary proactive measures to protect the assets, reduce financial losses, improve safety and ensure compliance with industry regulations.

**Conclusion**

Having discussed different fire safety methods are being carried out in SPB. It indicates that our highest priority is workplace safety. We are aware about

the fire incidents are not easy to handle and cause unimaginable damages to the property and businesses.

Prevention, detection, and robust emergency response procedures are established.

We practice safety

By maintaining a culture where safety is everyone's primary responsibility.

**By training the employees to prepare, be informed and capable of taking responsibility swiftly on their own.**

**By reviewing effectiveness of fire safety system, by carrying out continuous inspection, testing and upgrading the system and planning to meet evolving standards and risk assessment.**

Before closing, we confirm our dedication for achieving and maintaining highest levels of fire safety. This strategy is a dynamic document and

adherence of proactive measures to its principles to sustain, well being and safety of employees and assets, at end of the day.

**We consider safety as a value not only a priority.**

**Safety costs nothing but it pays.**

**References:**

1. IS2190 - Selection, Installation and Maintenance of First-Aid Fire Extinguishers — Code of Practice.
2. IS14489 – Code of Practice on Occupational Health and Safety Audit.
3. NFPA 80 – Standard for fire doors and other opening protective.
4. NFPA 12 – Standard on carbon dioxide extinguishing systems.
5. NFPA 69 – Standard on explosion prevention system.
6. NFPA 72 – The national fire alarm and signaling code.