Electrical Panels Fire Suppression System Using Tubing (Tube-Based Technology):

Tube-based fire suppression systems are an effective, compact, and automatic solution specifically designed to protect **electrical panels and enclosures** from fire hazards. This system uses **flexible, heat-sensitive tubing** to detect and suppress fire directly at the point of ignition — inside the panel itself.

Why Use Tube-Based Suppression in Electrical Panels?

Electrical panels are susceptible to:

- **Short circuits**
- **Overheating components**
- **Loose wiring**
- **Sparks and arc faults**

Traditional fire systems (like room-based sprinklers) are ineffective or too delayed. **Tube-based suppression provides rapid, localized protection**, minimizing equipment damage and downtime.

System Components:

Component	Description
Detection Tube	Special nylon/polyamide tubing, pressurized and routed inside the panel. Reacts to heat by rupturing at ~150–180°C.
Suppression Agent Cylinder	Stores extinguishing agent under pressure (e.g., clean agent like **FM-200**, **NOVEC 1230**, or **CO_2**).
Valve (Direct or Indirect)	Controls agent discharge. Can be automatically triggered by tube rupture or a pressure drop.
Nozzles *(Indirect systems only)*	Direct agent flow uniformly inside the panel for larger or multiple compartments.
Optional: Pressure Switch	Sends alarm or triggers auxiliary systems when activated.

Types of Tube-Based Systems for Electrical Panels

- **Direct System**
  - **How it works**: The detection tube acts as both the **sensor** and the **discharge outlet**.
  - When the fire causes the tube to rupture, the agent is discharged directly from that rupture point.
  - **Best for**: Small or single-compartment panels.
- **Indirect System**
  - **How it works**: The detection tube only senses heat and ruptures. This triggers a **valve** on the cylinder, releasing the agent through **dedicated nozzles**.

- **Best for**: Larger panels or multiple compartments that need uniform distribution.

Common Suppression Agents Used:

Agent	Features
FM-200	Fast, clean, non-corrosive, safe for electronics
NOVEC 1230	Low global warming potential (GWP), safe for humans
CO_2	Effective, but not recommended for occupied or small ventilated spaces due to asphyxiation risk
Dry Chemical	Effective, but leaves residue (used in industrial environments)

Installation Example – Direct System:

 Mount the **cylinder** outside or adjacent to the panel.

 Route the **tube** inside the panel to areas near bus bars, contactors, and terminals.

 Pressurize and test the system.

 Once installed, the system is **self-activating** and requires **no external power**.

Benefits

- ✅ Quick detection and suppression inside the panel
- ✅ No electrical damage or water exposure
- ✅ Automatic, works 24/7 without power

- ✅ Compact and easy to retrofit
- ✅ Minimal maintenance
- ✅ Cost-effective for small enclosures

Limitations

- Not ideal for **open or large areas**
- Limited agent capacity (effective for enclosures, not room-wide fires)
- The **tube needs to be replaced** after actuation

Standards & Compliance

- Follows **NFPA 2001** and **ISO 14520** guidelines
- Complies with **local fire codes** and **electrical safety regulations**
- Often certified by **UL**, **FM**, or **CE** depending on manufacturer

Applications

- Electrical distribution panels
- Low/medium voltage switchgear
- UPS systems
- Battery control cabinets
- PLC and automation cabinets
- CNC machines
- Telecom and IT racks