

# Electrically operated sprinkler system



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# CONVENTIONAL SPRINKLER SYSTEMS

Basic principles of sprinkler fire suppression have not been changed for more than a century since first sprinklers were introduced into practice. At the same time, efficient means of fast fire detection, as well as opportunities of programming algorithms of any complexity for operation of fire suppression systems have been developed. Based on the analysis of the limitations inherent in conventional water-based fire suppression systems, the following avenues and requirements for improvements were identified:

- To reduce damage from the fire, fire suppression system must be activated at the early stage of fire growth;
- To reduce damage from spilled water, the wetted area must be bounded by the fire size at time instant of system activation;
- There must be an option of displaying the information on activated sprinklers and the operation of the entire system for remote control by an operator.

Neither usual sprinkler system nor deluge one simultaneously fit all the above principles. So a new approach to sprinkler systems has been designed, manufactured and brought to the market.

Traditional sprinkler technology was improved by using modern technical solutions. For this purpose design of sprinklers was changed and special systems for managing such sprinklers were developed.

## ELECTRICALLY OPERATED SPRINKLER SYSTEM

### ELECTRICAL ACTIVATION

The first new option introduced in standard sprinkler is an opportunity to enforce its activation by electric signal. The option of controlled sprinkler activation was implemented in the starting device, which consists of the heating current-conductive coating placed on the glass bulb. Being switched on by the external signal, the element warms the bulb up to the break-up temperature.

### MONITORING OF SPRINKLERS

The second improvement introduced in this work is a facility to monitor the activation of the sprinkler. Such a facility consists of the interrupting contact placed between the bulb and the lock valve, ensured by the destroyed current-conductive coating. Availability of the check-up facility is crucial for getting information of sprinkler status. It may be used when we need information about precise location of fire.

However, the problem of late fire detection still remains. But a serious step forward was made: fast fire detection and sprinkler activation were combined.

### INTERACTION WITH FIRE DETECTORS

Electrically activated sprinklers with low-inertia fire detectors were integrated. The detector is located near the sprinkler. It observes the same zone as the sprinkler and works as an accelerator. When it initiates a fire alarm the nearest sprinkler activates such fire detector is named the satellite. In practice, sprinklers with two types of satellite detectors were integrated: the first one responds to the temperature rates of rise in the fire-driven flow. The second one responds to flame radiation and practically has no inertia. First variant is preferable because of the lower cost of heat detectors. The delay of activation comparing with the flame detector is quite acceptable in most cases.

Usage of two different principles of fire detection simultaneously makes it possible to considerably reduce a possibility of false activation.

## ALGORITHM OF SPRINKLER ACTIVATION

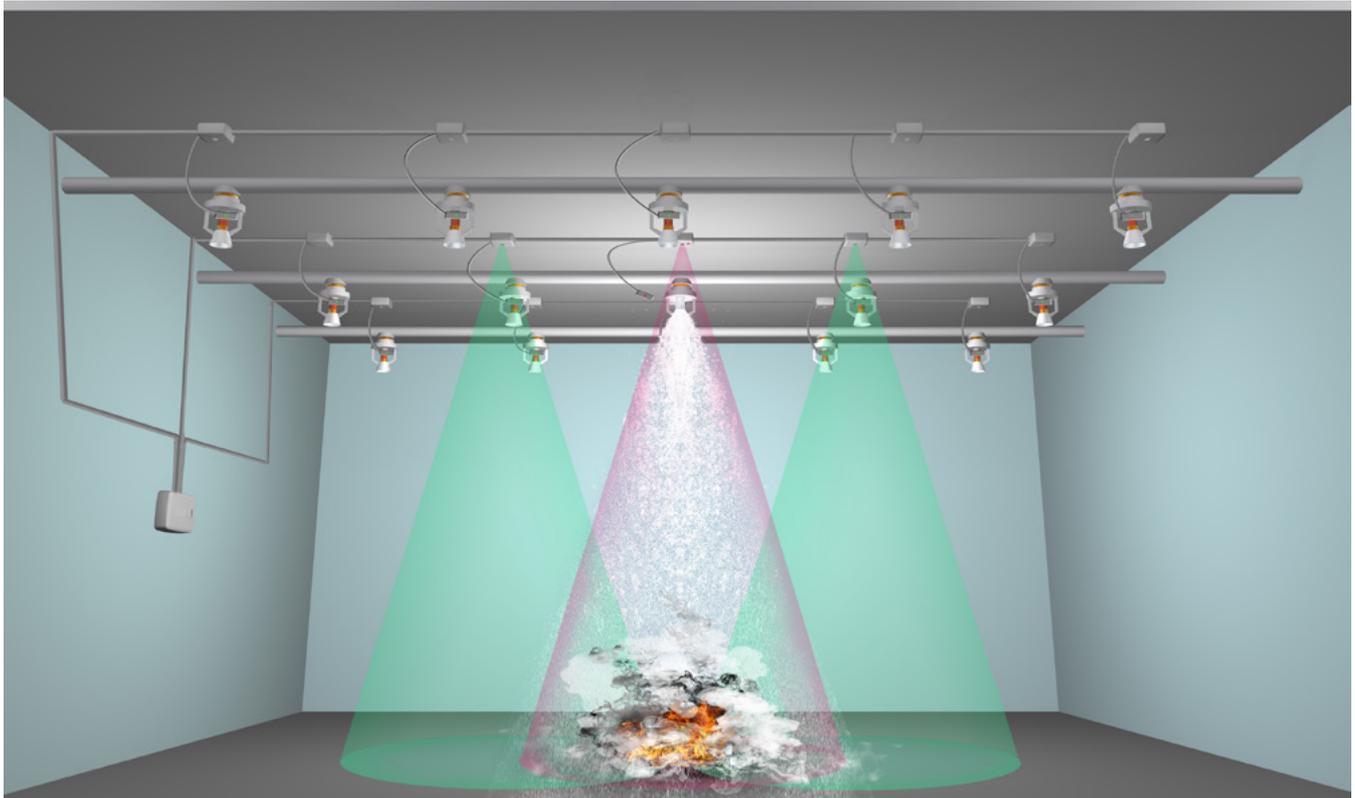
Two scenarios of implementation of sprinklers with electrical activation were explored: individual activation or group activation.

### INDIVIDUAL ACTIVATION OR SPRINKLERS WITH ACCELERATOR.

In this kind of a fire suppression system, electrically activated sprinklers are integrated with the differential temperature or optical sensors sensitive to flame radiation as described above.

Advantages of this solution:

- This design solution makes the time period between ignition and sprinkler activation several times less than that in traditional systems (this design is therefore referred as thermally accelerated).



- The lower calorific power of a fire source at the moment of activation allows reducing the amount of water required for fire extinguishing. In many cases it is a very important advantage. Also it helps to decrease size of pipes, power of pumps and volume of reservoirs.
- Minimum number of activated sprinklers. Minimum requirements to water flow.

In this picture electrically activated sprinklers are integrated with the optical sensors sensitive to flame radiation. Optical axis of the sensor is directed vertically downwards, and observed area is similar to or larger than the area wetted by the sprinkler in case of activation. To obey this requirement, the view angle is adjusted depending on the sensor elevation. The response of such a system is very fast, being more than an order of magnitude less than that of conventional sprinkler. This system also offers highly accurate localization of the fire source, which enables precise delivery of the extinguishing agent (water). The latter might be important in heritage sites or in compartments with highly expensive items inside.

## GROUP ACTIVATION

This variant of using sprinklers with electrical activation is a programmed system with dynamic logic, when the group of sprinklers that should be activated is determined by the place of a fire origin. For example, here is the one of possible variants of using such technology. After the first activation of a fire detector, an operator identifies it, and the system defines an adjacent group of sprinklers surrounding the host one. The entire group activates as soon as the bulb is electrically heated (less than 5 s).

A proposed technology uses an electrical activation, so there is no necessity to install sprinklers on the ceiling. They can be oriented in such way that will ensure maximum efficiency of the extinguishing.

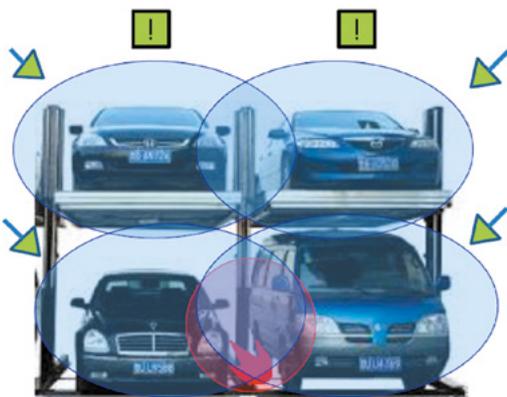


This picture illustrates extinguishing of the fire by the group of simultaneously activated sprinklers, thanks to which the fire is localized rapidly and the damaged area is expected to be much less. Actually, we form a deluge section close to the axis of the fire source. Here the size of the deluge section can be optimized and implemented without any additional pipes and valves by using ordinary sprinkler net.

It is possible of use sprinklers with electrical activation as a pre-programmed system, when a fire signal from a fire detector activates the sprinklers not only in the area of a fire but on the way of its spread. For example, prevention of flame spread through the doorways and windows in hotels or offices is crucial in high rise buildings.

### Advantages:

- guaranteed extinguishing and blocking of fire spread via larger sprinkling area;
- average requirements to water flow;
- guaranteed extinguishing and blocking of fire spread because of a larger sprinkling area;
- implementation on highly engineered objects.



In cases when the traditional placement of sprinklers under the ceiling does not provide an effective extinguishing, e. g. when there is no possibility of supplying water to the fire source from the top because of the obstacle: high-rack warehouses or mechanized parking. Having this new activation methodology there is no need to locate sprinklers below the ceiling anymore, they can be installed in such way that will allow maximum quantity of water getting on the fire source.

Another example of this variant is a protection of extended objects, such as transport tunnels or cable collectors. Here activated sprinklers in front and behind of the fire reliably block its spread along the tunnel.



**EOFS OLIMP**

Implemented type of activation: individual activation; group activation – dynamic and static.



A special system was implemented to control addressable fire detectors and sprinklers with electrical activation. Its structure is designed to reduce the amount of electric wires to the minimum possible value. This is achieved by grouping to one loop addressable satellite detectors combined with sprinklers connected to the line controller. Operation via local controllers LC (250 addresses per local controller). Total amount of sprinklers which could be managed by the system is 2000. Current status of the system operation is displayed on the operator's console.

Operator's console offers an opportunity of independent control of each sprinkler, includes user guide and list of expected fire scenarios. The operator's console makes it possible to activate manually any sprinkler.

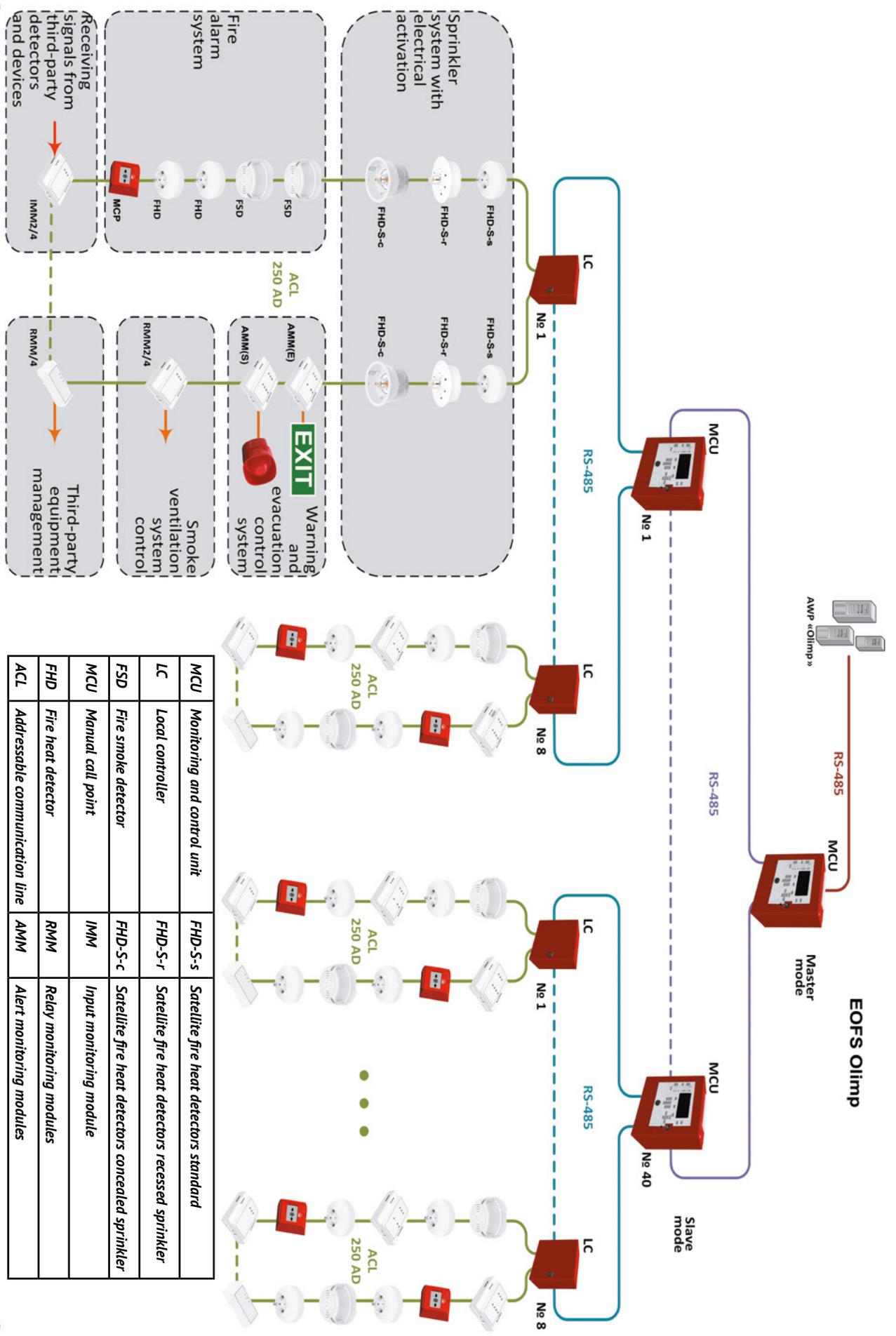


A satellite fire detector is mounted near a sprinkler with electrical activation. Upon activation of detectors, sprinklers with electrical activation are triggered via the interface in the body detector. Satellite fire detectors, are designed to operate together with EOFS Olimp. It allows maintaining communication lines between sprinklers, integrity of heating elements, good condition of satellite fire detectors, with a malfunction signal displayed on control and indicating equipment operated by staff on duty.



**EOFS Olimp Technical specification**

Type of system	analogue addressable
Short circuit isolator	in every addressable device
Types of detectors	heat detectors, flame detectors, combined detectors (heat & flame)
Number of detectors/sprinklers per local controller	250
detectors/sprinklers per Control panel	2000
detectors/sprinklers per system	80000



Total 80,000 addresses

## Designation of types of monitoring modules

Control module	External connections				Remarks
	EAS-M	Input	Output (optical relay)	Alerting	
SMM-s	1 *				EAS-M opening monitoring
SMM-c					
SMM-r					
IMM2		2 **			
IMM2A		2 **			connection of valve with limit switches
IMM4		4 **			
RMM2			2		
RMM4			4		
IRMM22		2 **	2		
AMM(S)				ALC *	To connect alarm warning sounder
AMM(E)				ALC *	To connect visual warning indicator

\* monitored for open circuit and short circuit  
 \*\* for connecting a dry contact output. Monitored for open circuit and short circuit

Sprinklers with electrical activation and monitoring of activation were included to ISO 6182-1 «Fire protection — Automatic sprinkler systems».

3.2.1 electrically activated sprinkler (EAS) sprinkler that is equipped with an integral means of activation using electricity;

3.2.2 sprinklers with monitoring of activation (SMA) sprinkler that is equipped with an integral means of monitoring of activation using electricity;

3.2.3 electrically activated sprinkler with monitoring of activation (EAS-M) sprinkler that is equipped with an integral means of activation using electricity and monitoring of activation

NFPA 13 «Standard for the Installation of Sprinkler Systems»

### 15.6 Electrically Operated Sprinklers.

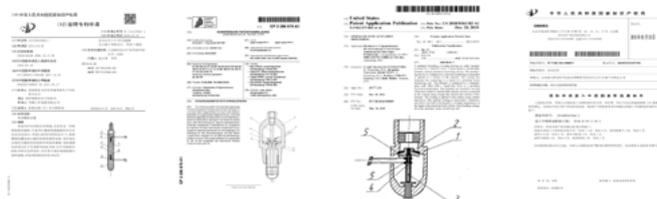
Electrically operated sprinklers shall be permitted where such devices have been evaluated and listed for performance under the following conditions:

- (1) Fire tests related to the intended hazard
- (2) Distribution of the spray pattern with respect to wetting of floors and walls
- (3) Distribution of the spray pattern with respect to obstructions
- (4) Performance under horizontal or sloped ceilings
- (5) Area of design
- (6) Allowable clearance to ceilings

NFPA 25 «Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems»

5.2.1.5 Electrically operated sprinklers shall be inspected from the floor level annually in accordance with 5.2.1.1 and the manufacturer's requirements.

The uniqueness of electrically controlled sprinklers is proved by patents.





**E-Sprinkler**

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