

20th International Water Mist Conference IWMC 2021  
27-28 October 2021 - Warsaw

# Comparison of water mist and sprinkler systems to ensure fire safety for the Bonnet Tower



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20TH IWMC 2021  
COMPARISON  
OF WATER MIST AND  
SPRINKLER SYSTEMS  
TO ENSURE  
FIRE SAFETY FOR  
THE CORSO COMO  
PLACE TOWER

- The case study
- Fire Safety performance
- Water mist performance
- Water mist consumption and damages
- Adopted deluge water mist solution
- Cost-benefit analysis
- Conclusions

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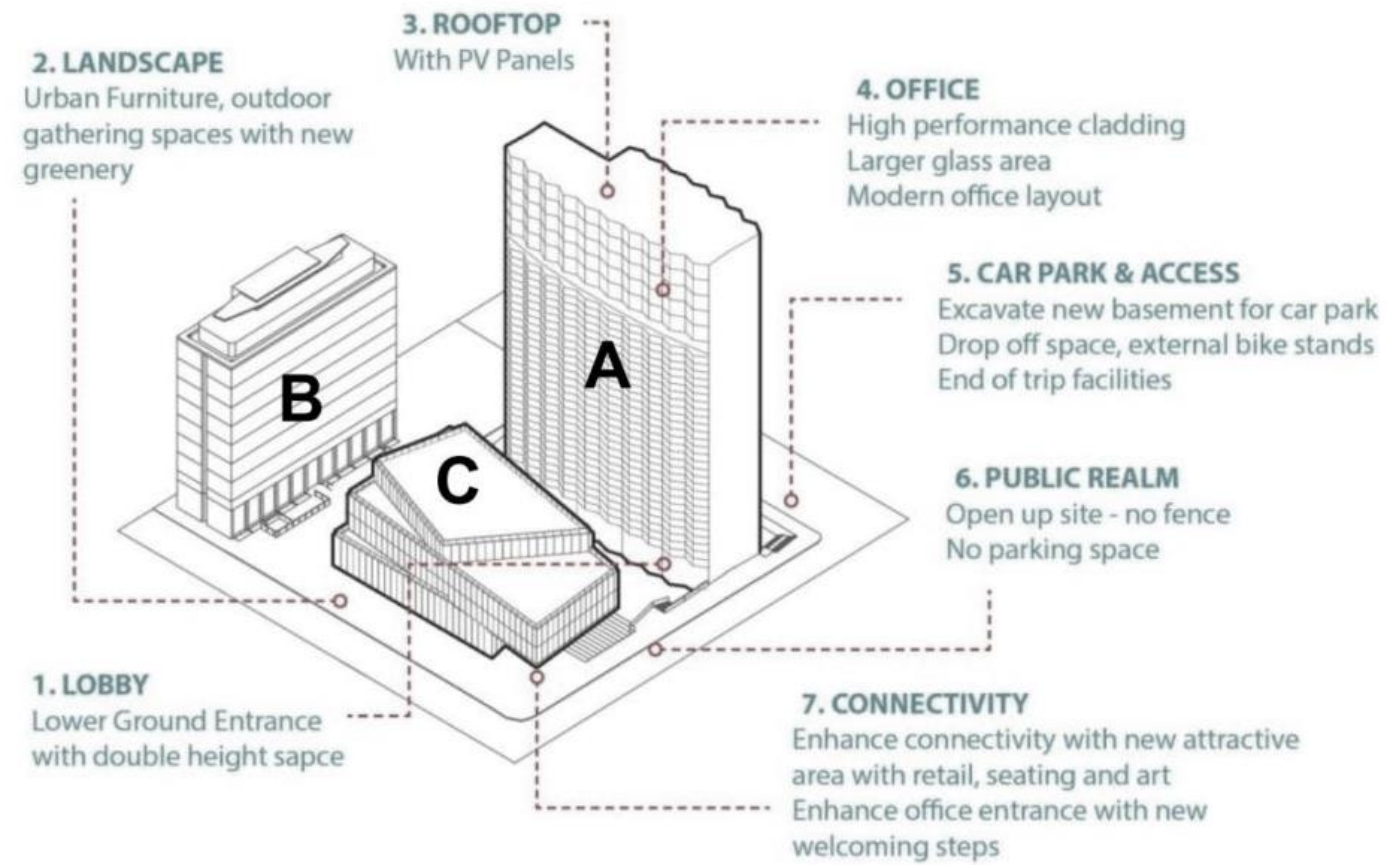
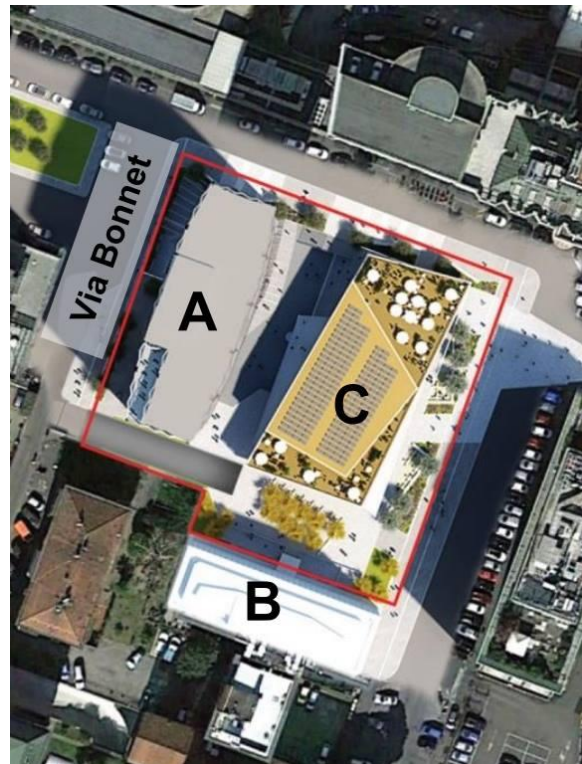


Ing. Ada MALAGNINO



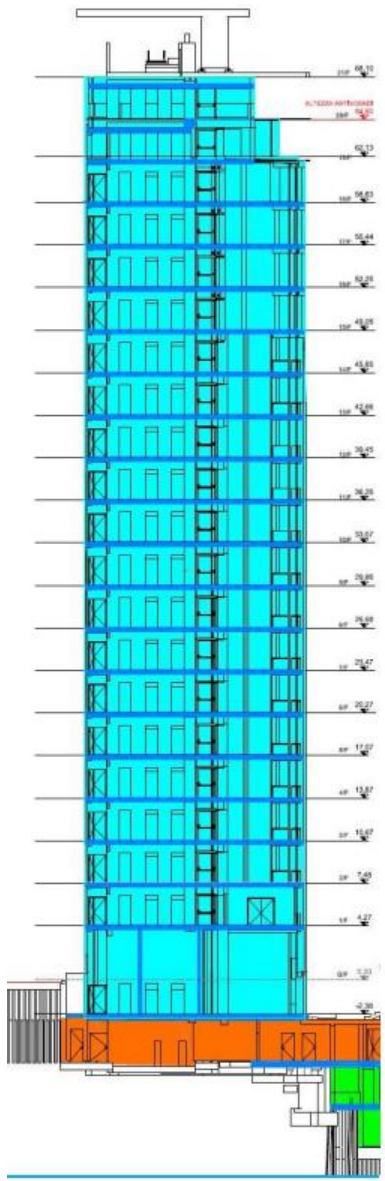
THE CASE STUDY

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# 20TH IWMC 2021 COMPARISON OF WATER MIST AND SPRINKLER SYSTEMS TO ENSURE FIRE SAFETY FOR THE CORSO COMO PLACE TOWER

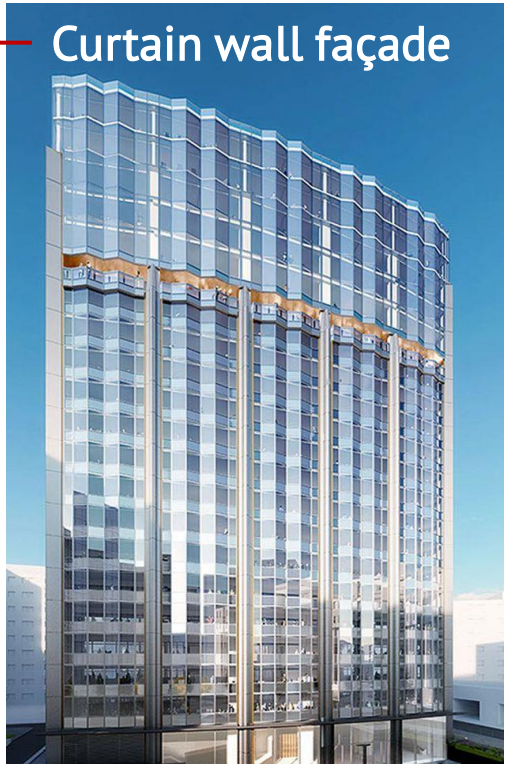
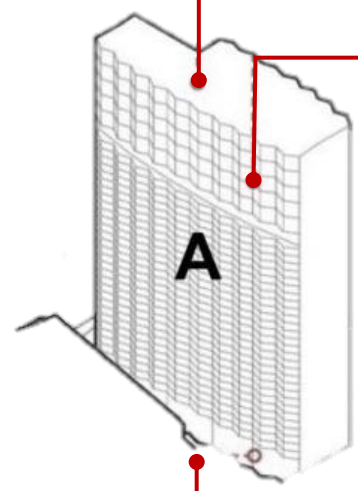
64,9 m



OFFICE  
(n. people >800)

TECHNICAL SPACES

PARKING AREAS



Curtain wall façade

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OFFICE



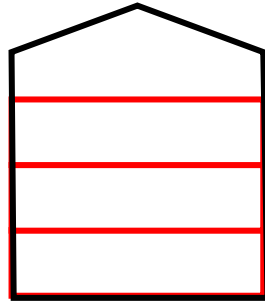
Adding a high performance fire protection system will allow to:

- Ensure the aesthetics of the façade [No compartmentalization curtains required]
- Lower the Life Risk Profile from Class A2-A3 to Class A1, in combination with certified materials to reduce the speed of fire spreading [Italian Fire Code]



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■ EACH OFFICE FLOOR IS PROTECTED BY:



Compartmentalization



Automatic fire alarm system



Deluge water mist system



Smoke and heat control

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## OBJECTIVES:

- Tenability conditions at 2 m from the floor:

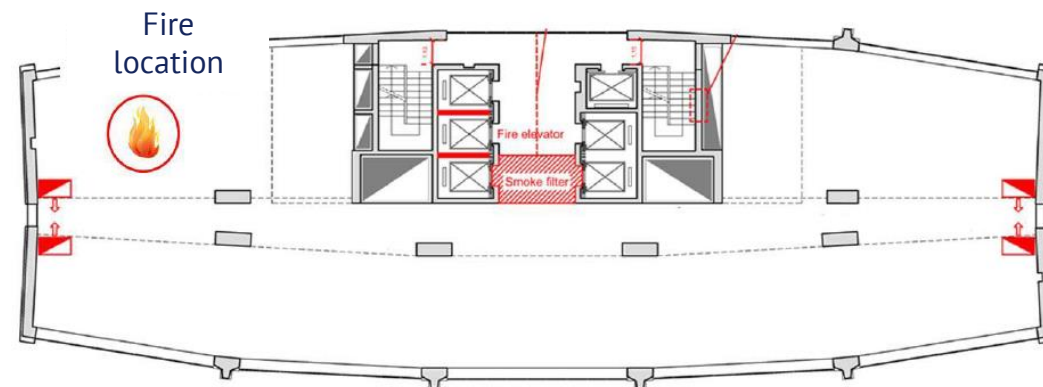
Parameter	Threshold for Occupants	Threshold for Firefighters
Temperature	60°C	80°C
Visibility	10 m	5 m
CO concentration	3500 ppm	-

## COMBUSTIBLE MATERIAL:

- Polyurethane and cellulosic materials

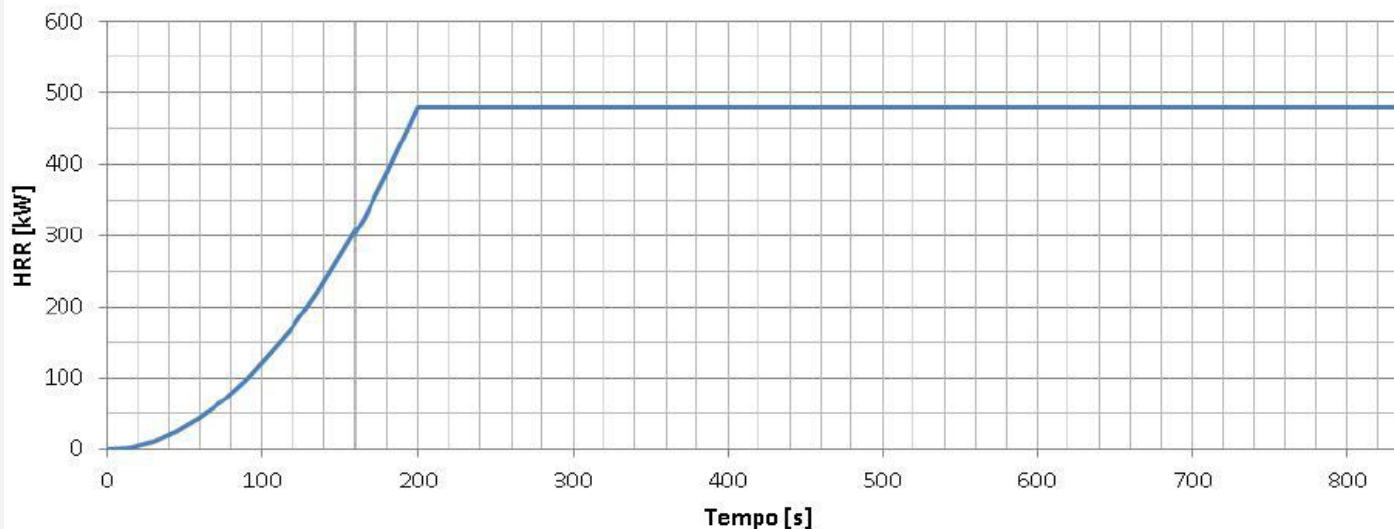


## FIRE LOCATION:



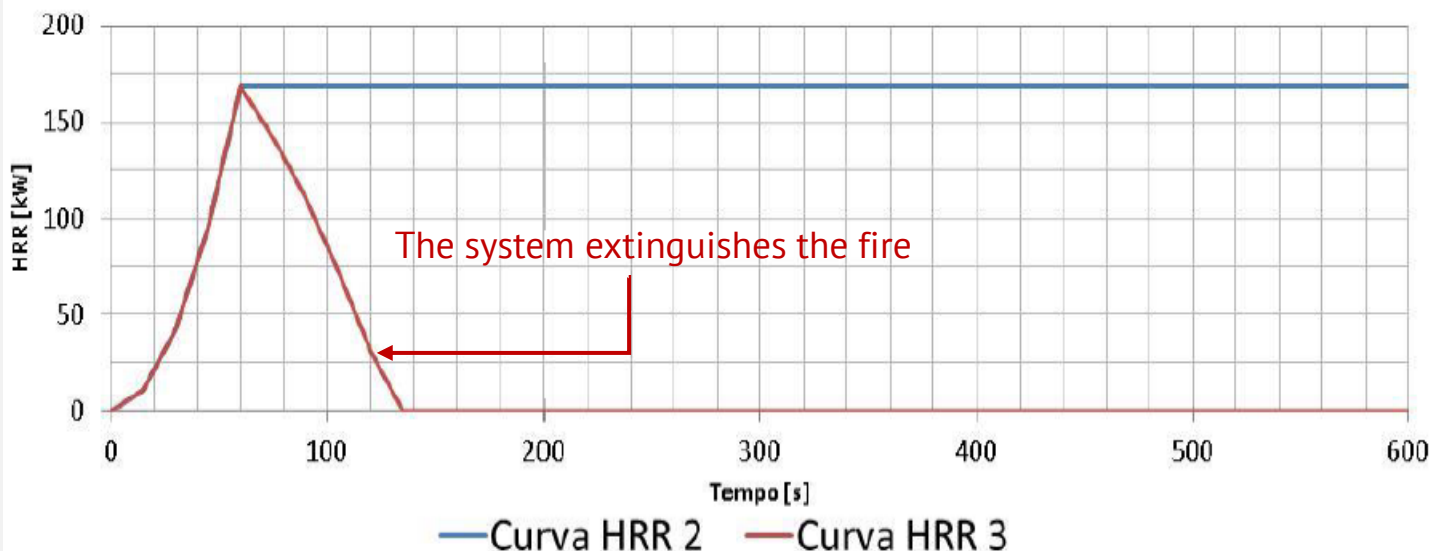


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### HRR CURVE n.1: SPRINKLER SYSTEM

- Medium fire growth
- Sprinkler head distance = 2m;
- $RTI = 150 \text{ (m} \cdot \text{s)}^{1/2}$
- Activation temperature =  $68^\circ\text{C}$



### HRR CURVE n.2 and n.3: DELUGE SYSTEM

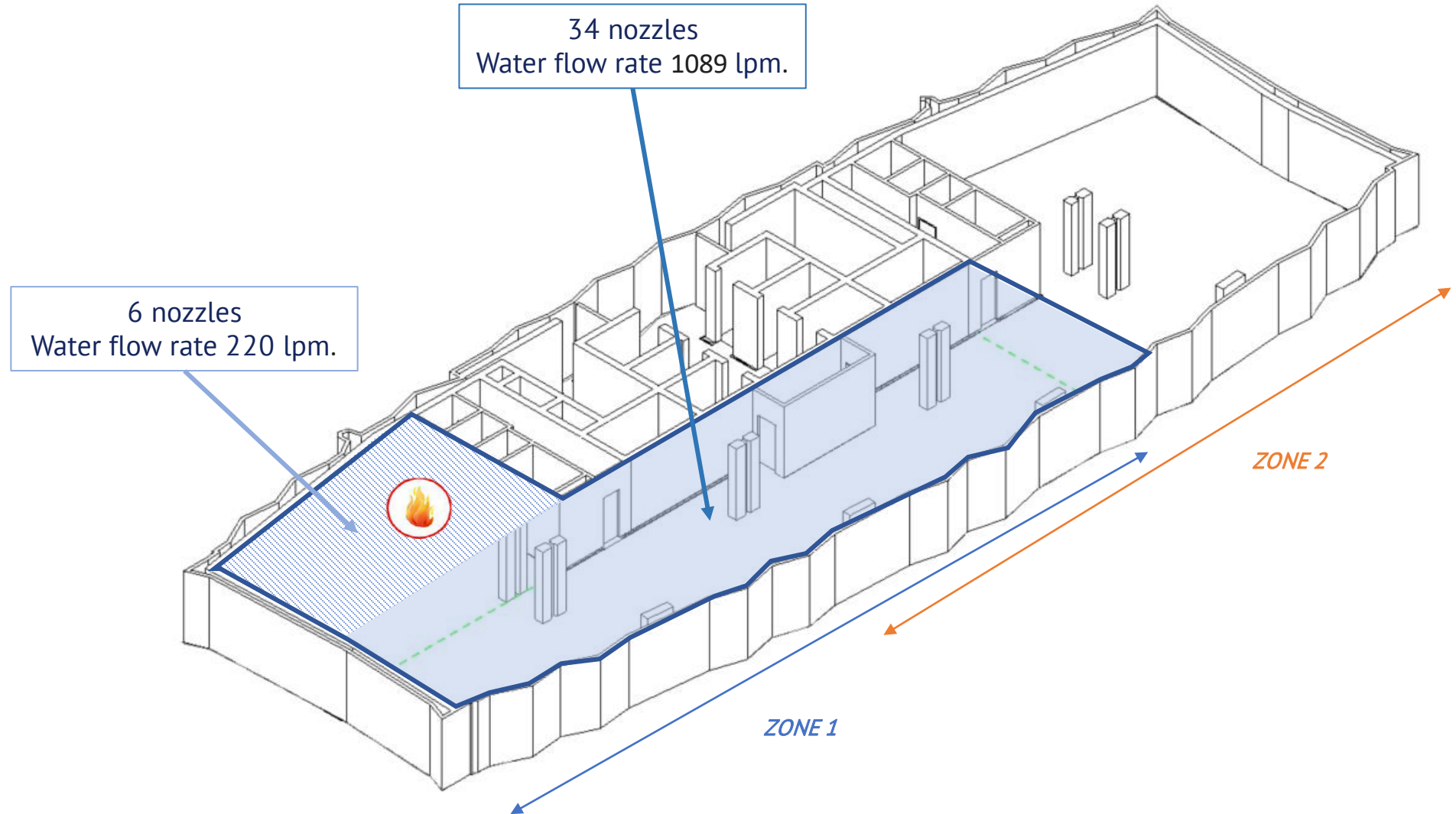
- Fast fire growth
- Activation time = mechanical ventilation activation time

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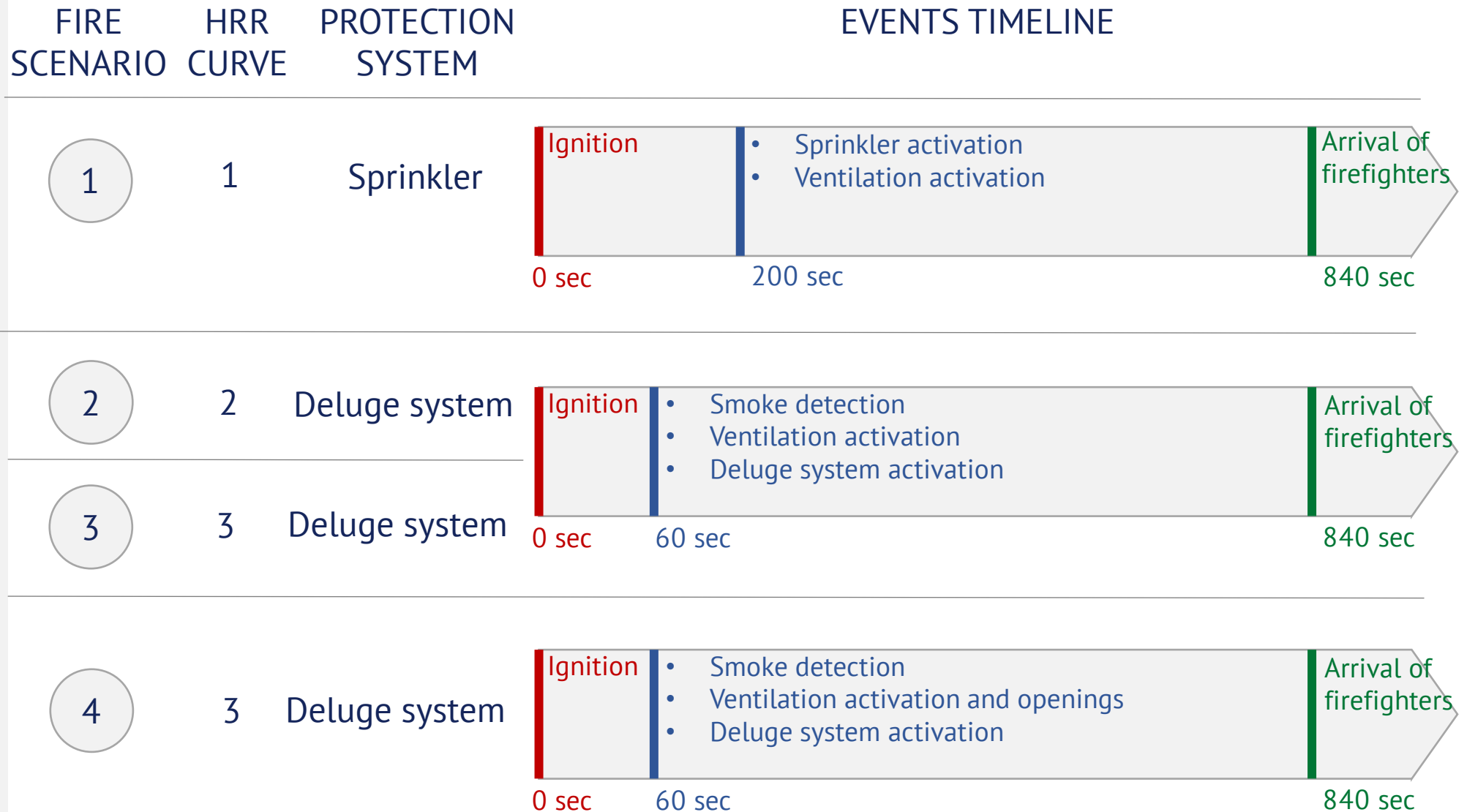
To guarantee the extinguishment of the fire (HRR curve n.3), the followed considerations were made by the fire consultant (expert judgement allowed by Italian Regulations):

- The adoption of a fast fire growth curve is more conservative (a medium fire growth is typically associated with office type occupancies);
- The deluge system will be activated by automatic detection ( activation time shortened to 60 sec);
- The activated deluge system will cover simultaneously half of the floor area (about 260 m<sup>2</sup>) instead of the operative area (72 m<sup>2</sup> );
- An overlapping area will be guaranteed in the two zoned deluge system in order to ensure fire protection.

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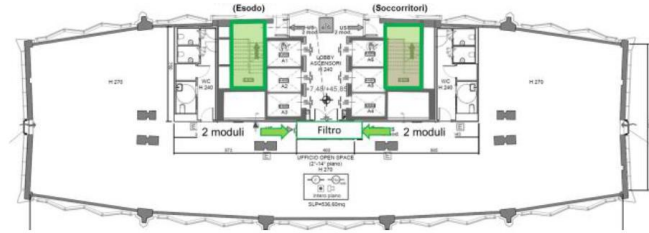
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EVACUATION  
SCENARIO

EVACUATION  
STRATEGY

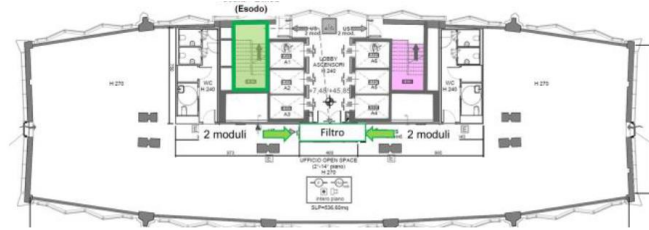
a

Simultaneous evacuation using 2 staircases



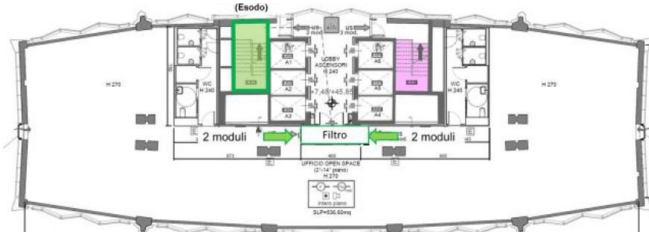
b

Simultaneous evacuation using 1 staircase



c

Phased Evacuation using 1 staircase



d

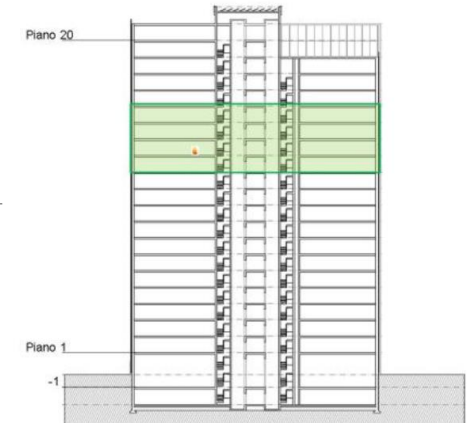
Phased Evacuation using 1 staircase



EVACUATION MODELLING  
PARAMETERS FOR SCENARIOS a,b,c,d

N. of people per floor	60-65
Occupants' speed distribution	Uniform (0.4 ÷ 1.2 m/s)
Body dimensions distribution	Uniform (45 ÷ 55 cm)
Pre-movement time distribution - floor of fire origin	Uniform (60 ÷ 120 s)
Pre-movement time distribution - other floors	Uniform (90 ÷ 120 s)

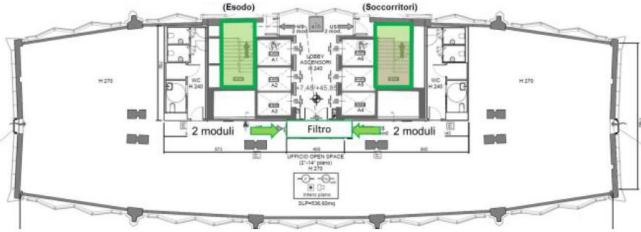
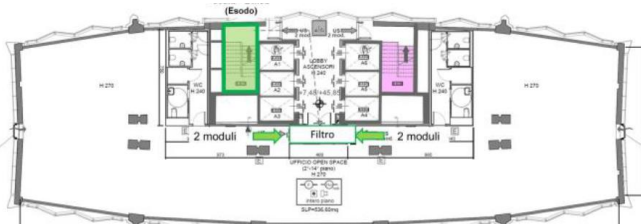
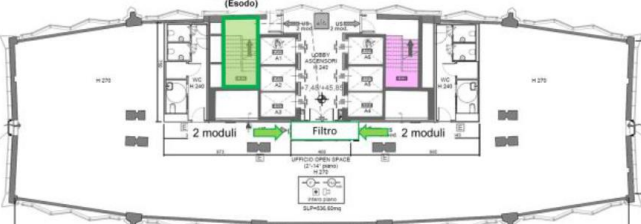
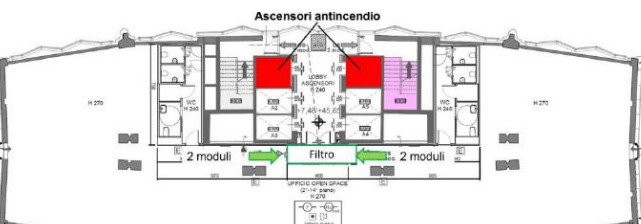
Phased Evacuation



Elevators' technical characteristics:  
Max n. of people = 9  
Speed = 2 m/s  
Opening/Closing time = 4÷5 s  
Use of elevators for people at Floors  
= 18÷20

**FIRE SAFETY PERFORMANCE  
Evacuation Scenarios setting**

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EVACUATION SCENARIO	EVACUATION STRATEGY	FLOOR EVACUATION TIME (RSET)	BUILDING EVACUATION TIME
a	<p>Simultaneous evacuation using 2 staircases</p> 	142 s	1358 s
b	<p>Simultaneous evacuation using 1 staircase</p> 	142 s	2291 s
c	<p>Phased Evacuation using 1 staircase</p> 	142 s	1053 s
d	<p>Phased Evacuation using 1 staircase</p> 	142 s	2053 s

# 1 FIRE SIMULATION RESULTS

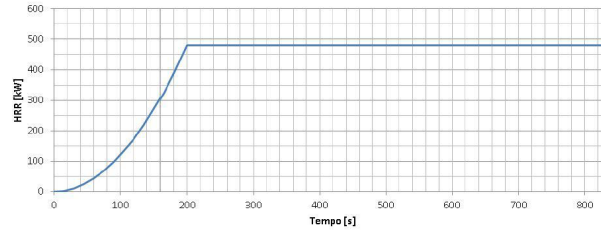
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Fire protection system:



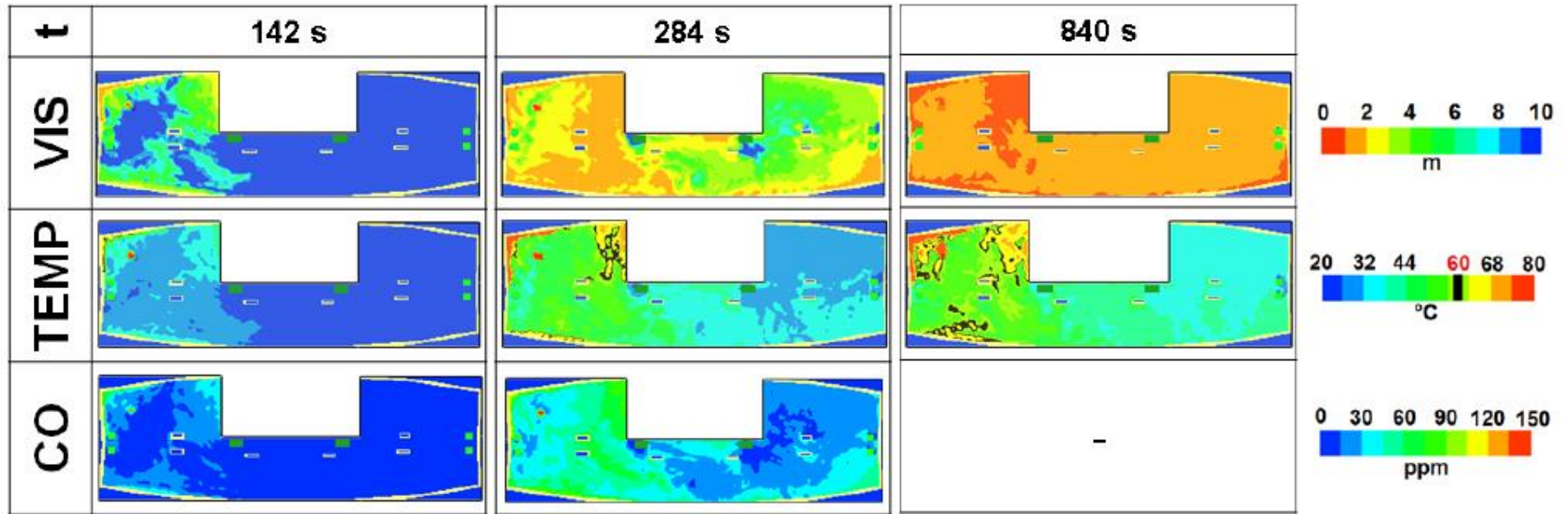
Sprinkler + Ventilation

HRR Curve



N. 1

Occupants evacuation/Firefighters intervention	
Fire growth	Medium
HRRmax	480kW
ASET	142 s
RSET	142 s
<b>ASET=RSET</b>	



## 2 FIRE SIMULATION RESULTS

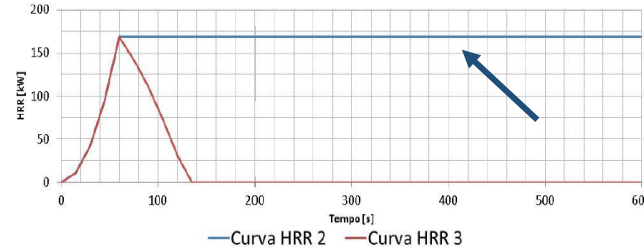
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Fire protection system:



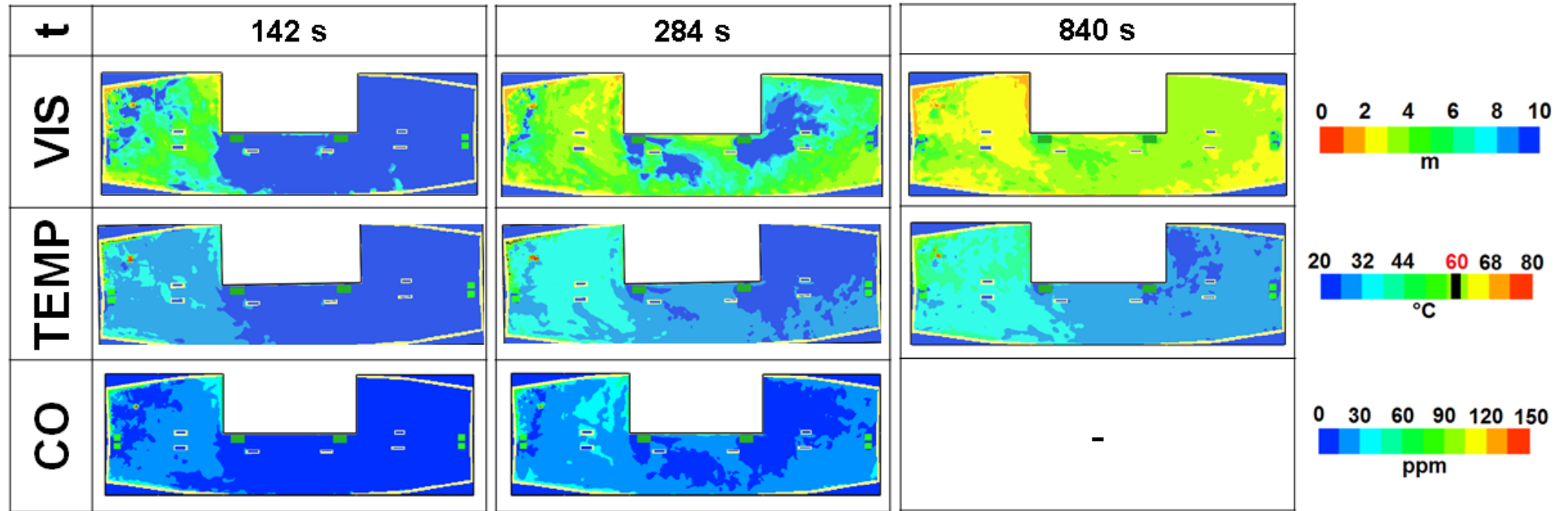
Deluge system +  
 smoke detection + ventilation

HRR Curve



N. 2

Occupants evacuation/Firefighters intervention	
Fire growth	Fast
HRRmax	170kW
ASET	142 s
RSET	142 s
<b>ASET=RSET</b>	





### 3 FIRE SIMULATION RESULTS

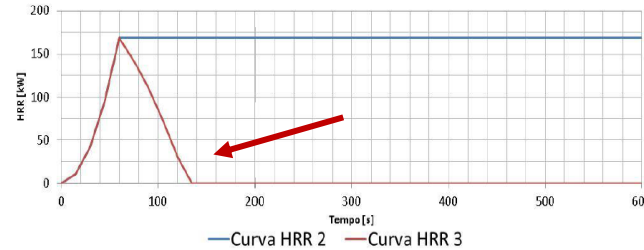
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Fire protection system:



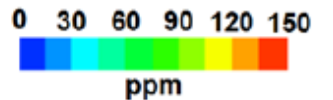
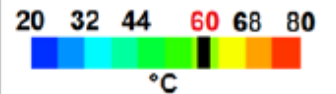
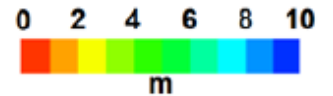
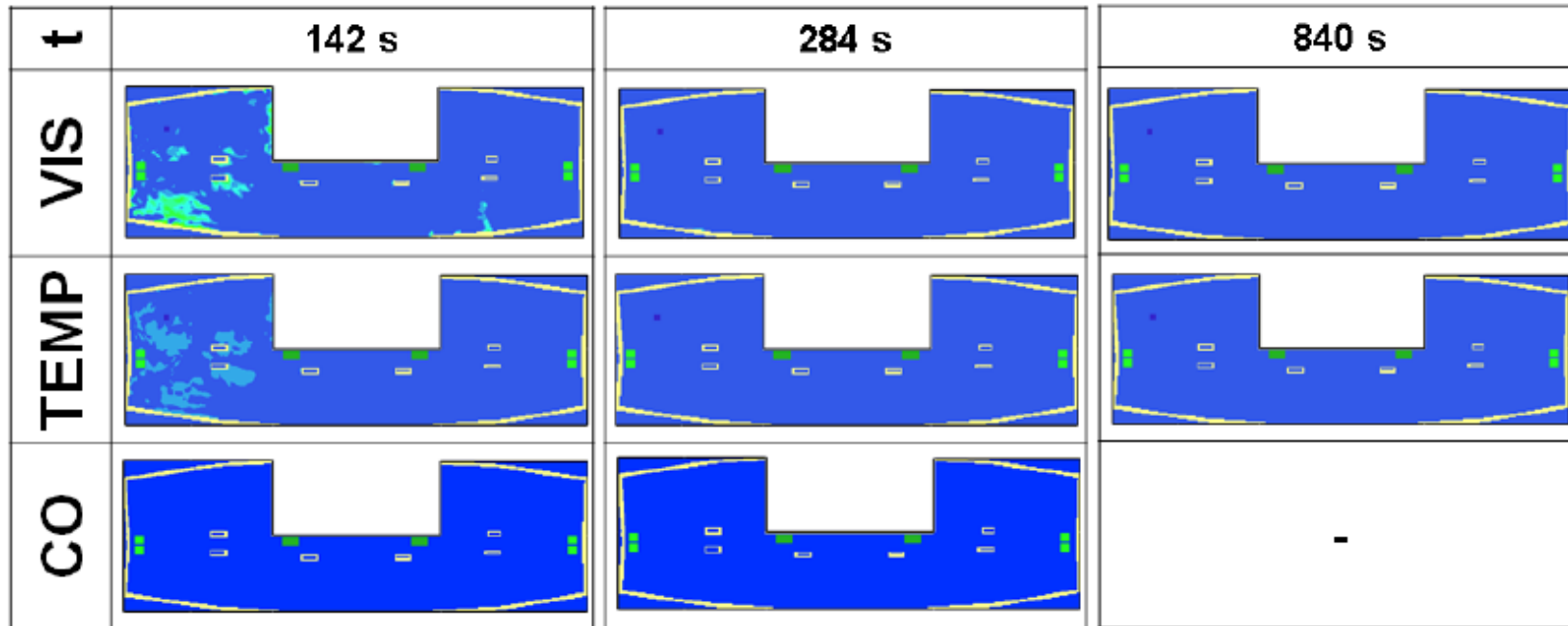
Deluge system +  
 smoke detection + ventilation

HRR Curve



N. 3

Occupants evacuation/Firefighters intervention	
Fire growth	Fast
HRRmax	170kW
ASET	>840 s
RSET	142 s
<b>ASET &gt; 2 * RSET</b>	



# 4 FIRE SIMULATION RESULTS

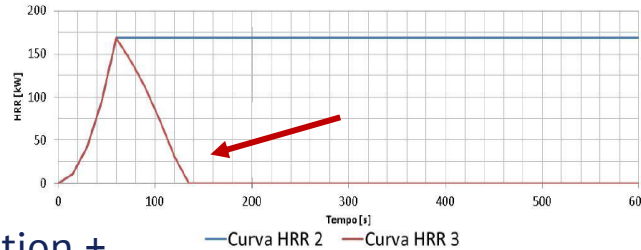
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Fire protection system:



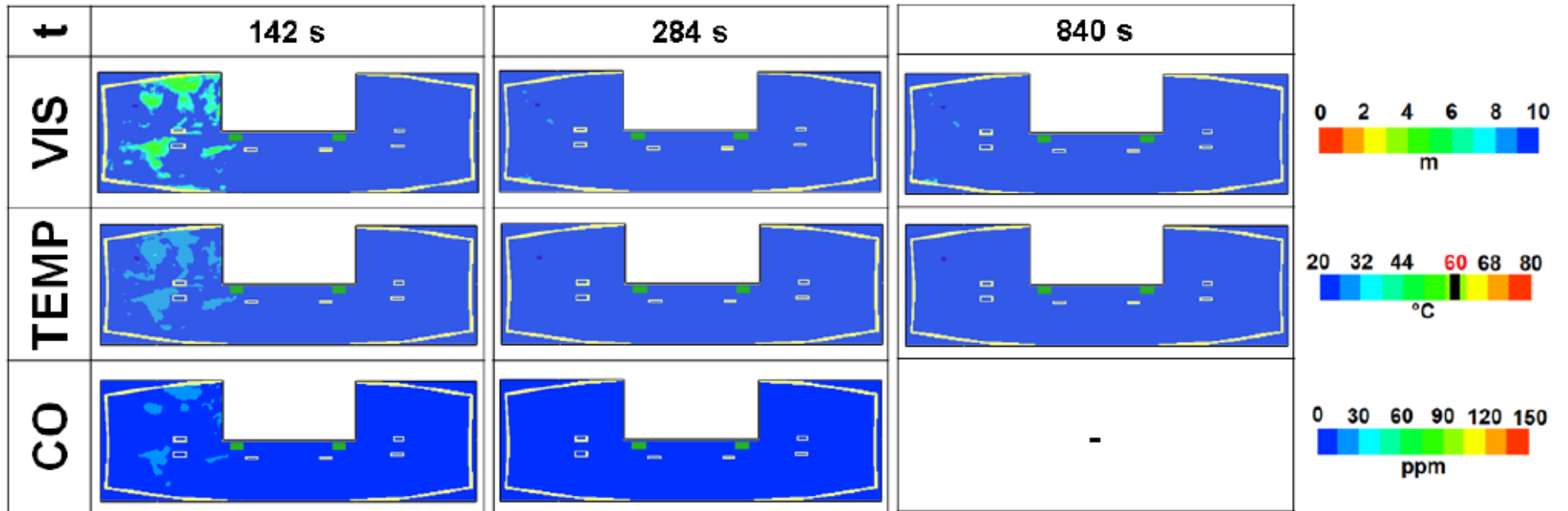
Deluge system + smoke detection +  
 ventilation + openings

HRR Curve



N. 3

Occupants evacuation/Firefighters intervention	
Fire growth	Fast
HRRmax	170kW
ASET	>840 s
RSET	142 s
<b>ASET &gt; 2 * RSET</b>	



## FIRE AND EVACUATION SIMULATION RESULTS

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Fire protection system configuration			Performance	
Type of system	Extraction	Supply	Occupants ASET= 2*RSET	Firefighters
	Vol/h	Vol/h		
Sprinkler	8	8	✗	✗
Deluge System			✗	✓
Deluge System (suppressing the fire)			✓	✓
		natural	✓	✓

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Water mist protection of office type occupancies classified as OH1 (European classification):

- Evaluation of the suppression effectiveness based on the full scale fire tests for
  - single and open-plan offices (ref. VdS 3188 Annex K.1.1)
  - false ceilings and false floors (ref. VdS 3188 Annex K.1.4)
- In the whole office fire test program the overall performance of water mist Marioff HI-FOG<sup>®</sup> systems were essentially equivalent to traditional sprinkler systems (dimensioned for a flux density of 5 lpm/m<sup>2</sup>)



*Fire damages after the worst test for both systems (left sprinkler system and right water mist HI-FOG)*

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- In the whole false ceilings and false floors fire test program the fire performance of all the tested water mist Marioff HI-FOG<sup>®</sup> systems was better than that of the reference sprinkler system (dimensioned for a flux density of 6,7 lpm/m<sup>2</sup>)



*Fire damages after representative test for concealed spaces containing cables in offices (left sprinkler system and right water mist HI-FOG)*

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- Based on the whole office fire test program, the water consumption of Marioff HI-FOG® systems is at least 60% lower in respect to the traditional sprinkler system
- Based on the whole false ceilings and false floors fire test program, the water consumption of HI-FOG systems is at least 70% lower in respect to the traditional sprinkler system



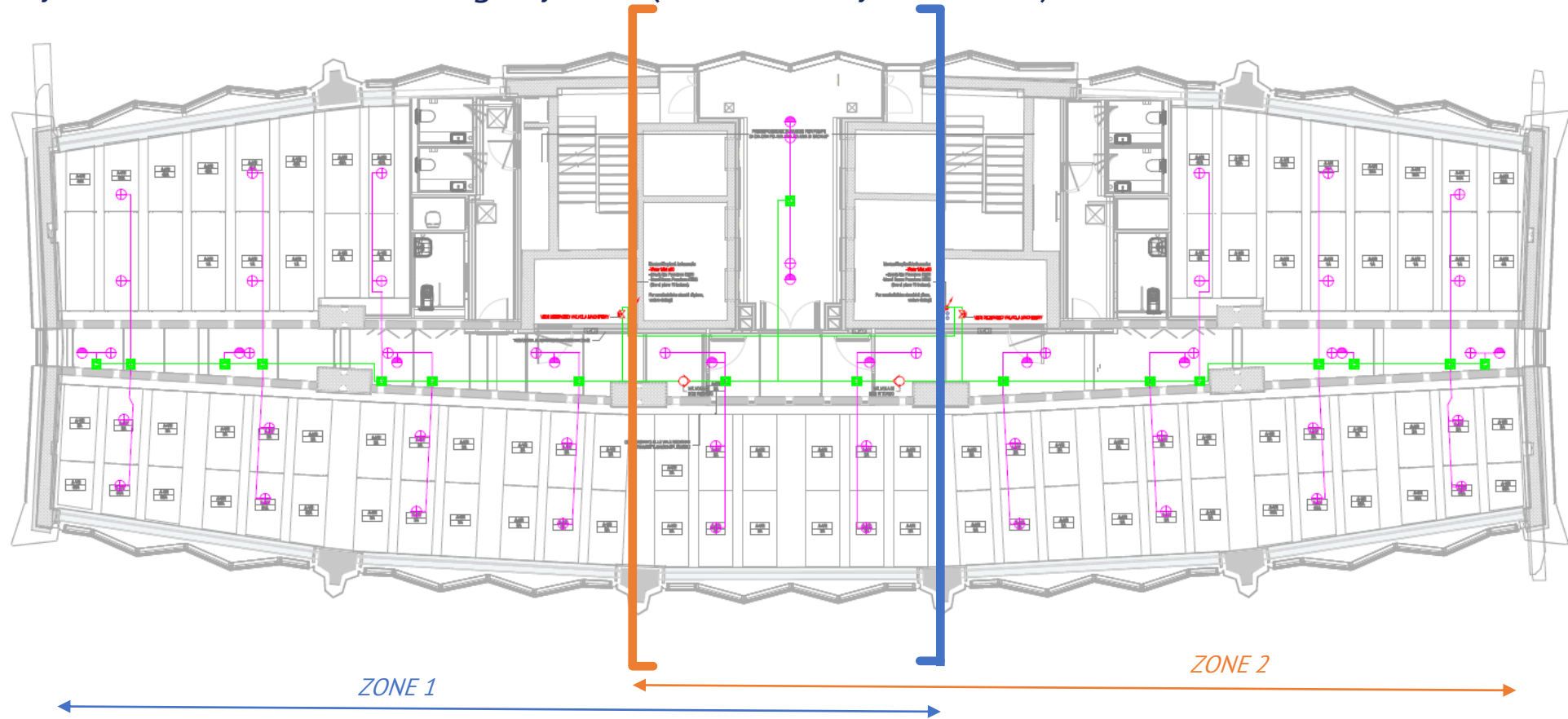
*Water consumption (left water mist HI-FOG and right sprinkler system)*

- HI-FOG systems reduce water damages and downtime of office activity



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- In order to be compliant with the firefighting solution specified to achieve the performance goals required by the fire strategy for the protection of office floors of the Bonnet Tower A (deluge water mist system), the designed and installed Marioff HI-FOG® system is a two zoned deluge system (activation by detection).



**ADOPTED WATER MIST SOLUTION**

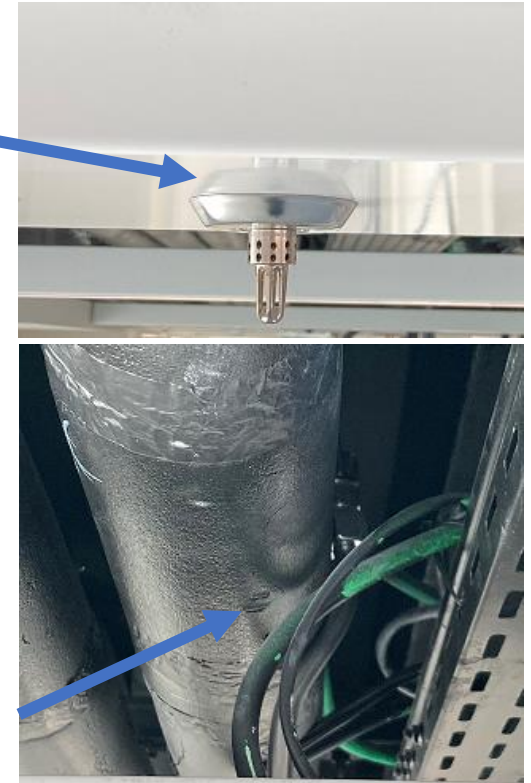
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➤ Marioff HI-FOG<sup>®</sup> sprinkler  
without bulb

➤ Smoke detector

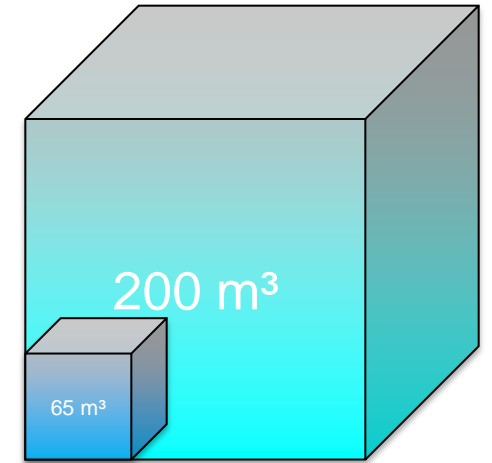
➤ AISI 316L stainless steel pipe  
(size 12 mm)





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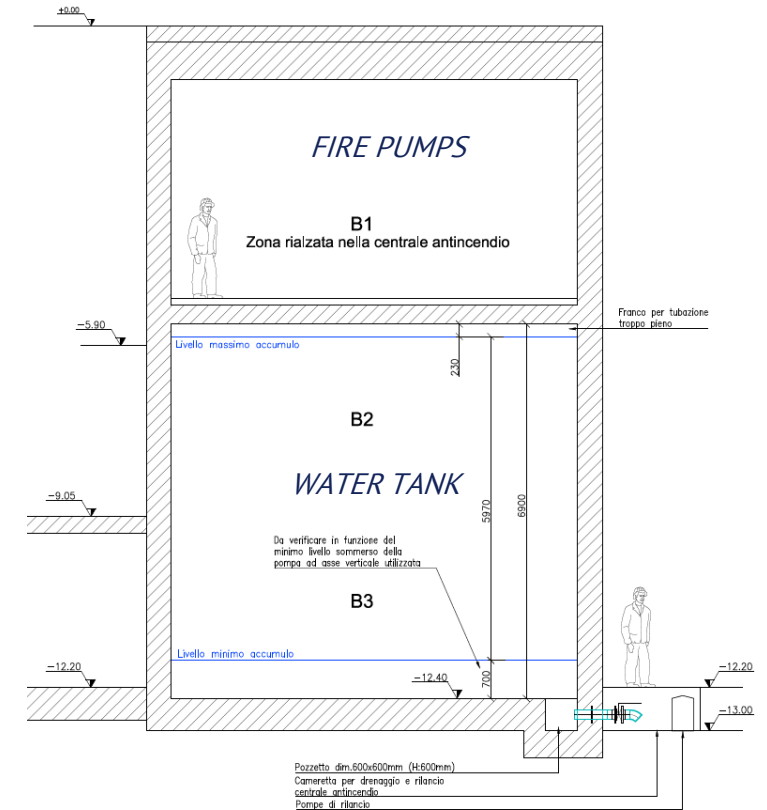
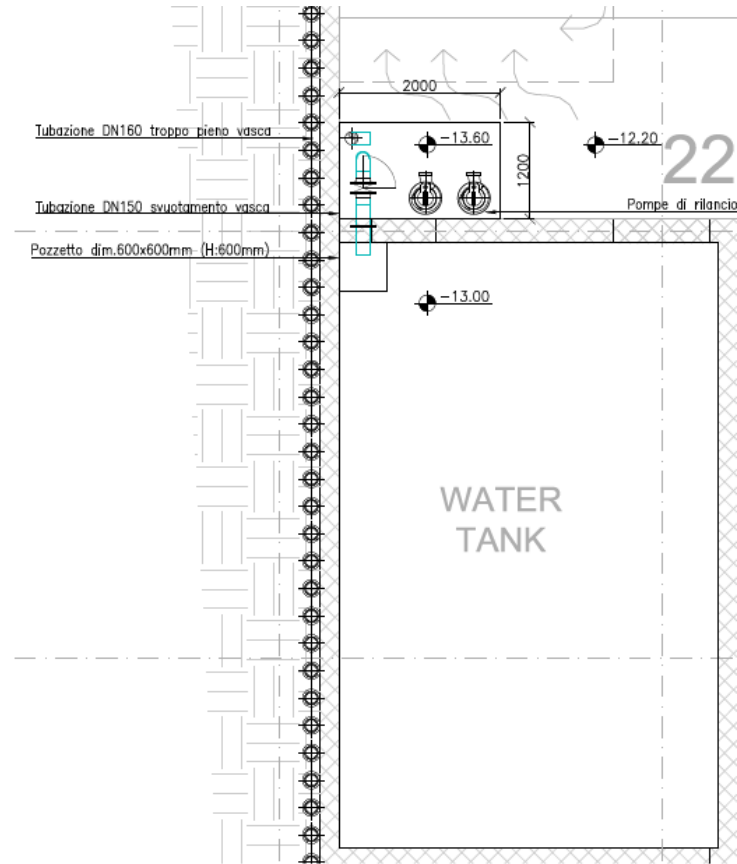
- In case of system activation, the total minimum flow rate is just over 1.000 lpm @ 80 bar, supplied by Marioff HI-FOG® pumps (water reserve for HI-FOG system is ~ 65 m<sup>3</sup>)



- ~ 135 m<sup>3</sup> water reserve for the other installed firefighting systems (fire hydrants and water curtains)

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- water tank and fire pumps located in the basement floors



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- Marioff HI-FOG® system also protects other parts of the Bonnet complex (sales areas in the building C and underground parking garages) by means the same HI-FOG pump of the open nozzle system for the Bonnet Tower A, but with automatic nozzle system



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The onsite tests of the water mist distribution network were performed:

- to measure the filling time from the opening of the section valve to the outlet of water at the test device at the end of the pipework (on the most remote area from valve) (in the automatic nozzle water mist dry pipe system)



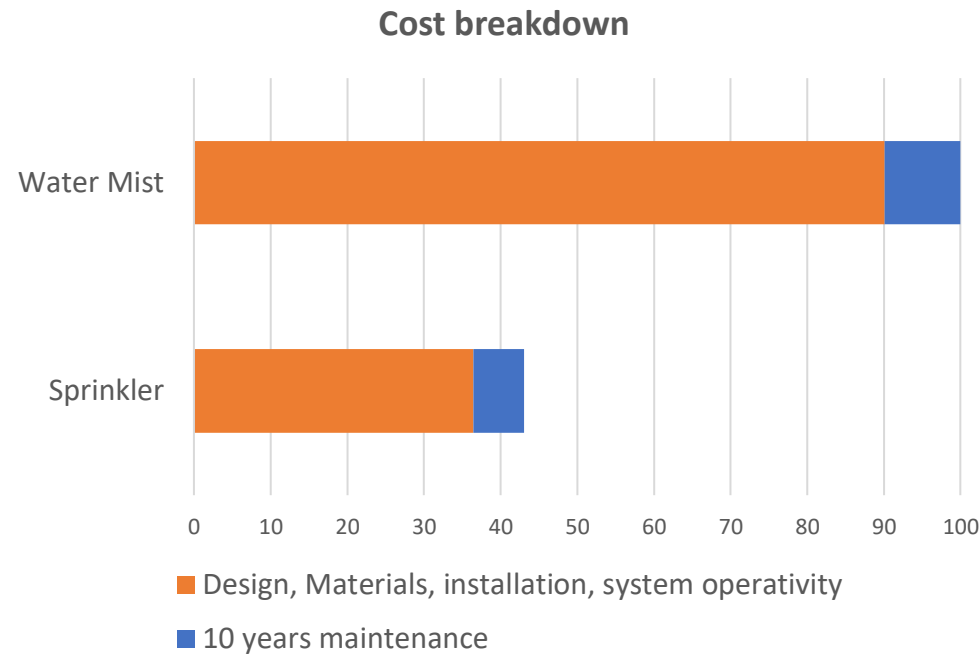
- to check the automatic triggering of the solenoid valves (in the open nozzle system)



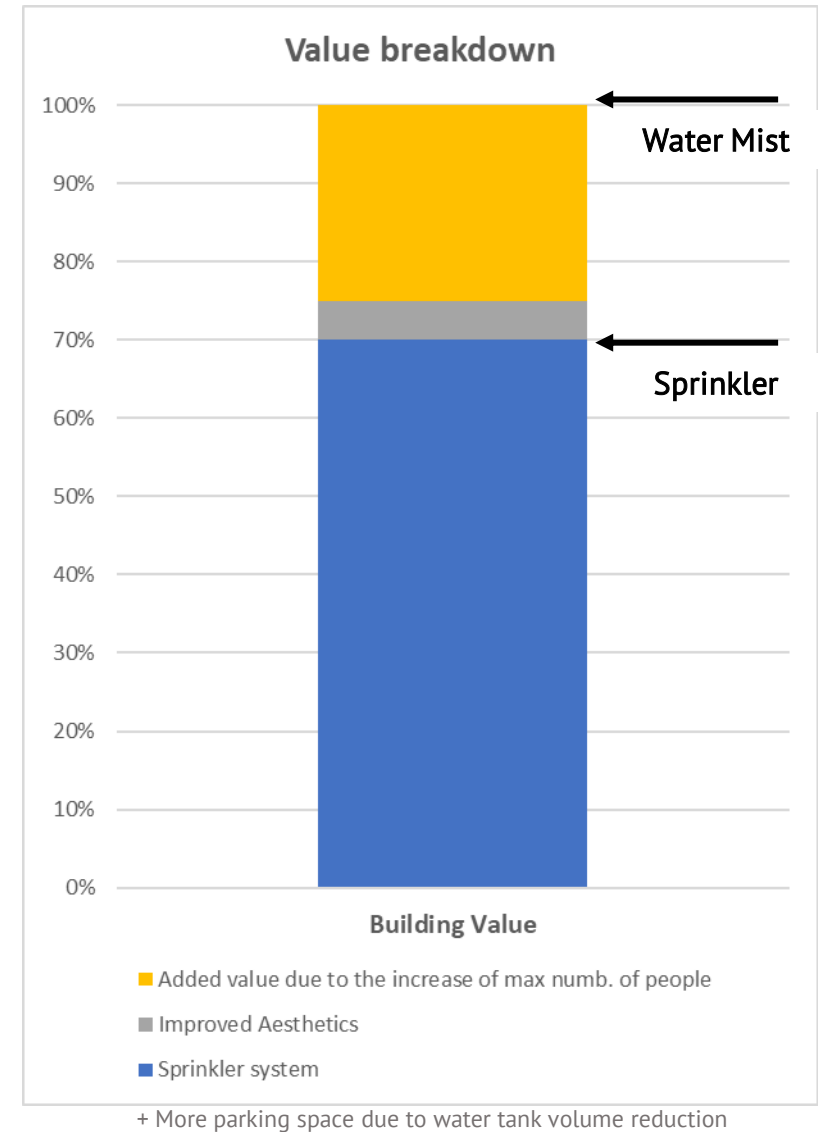
- to check the signalling from flow monitors (in the automatic nozzle water mist system)



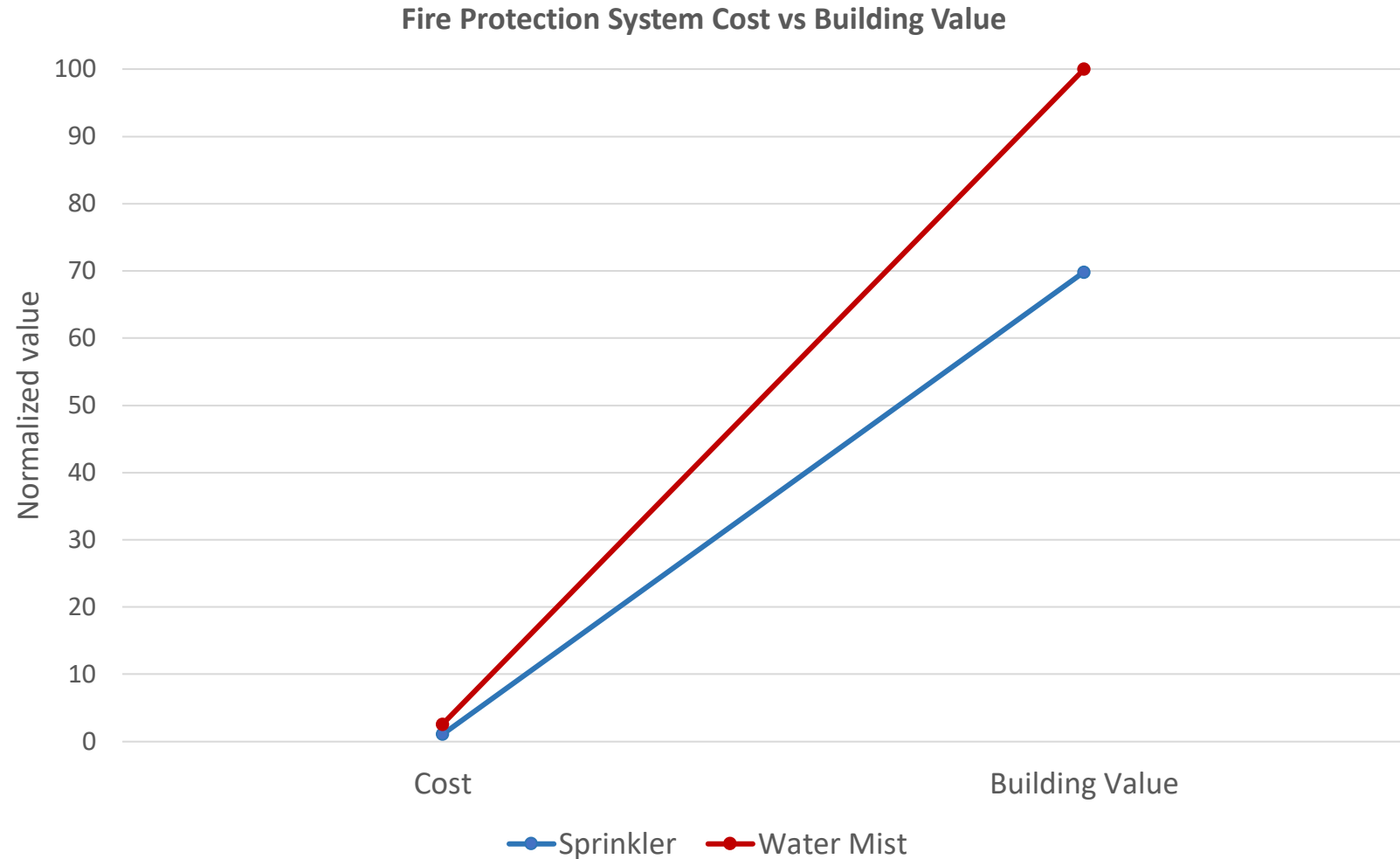
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- The evaluation was carried out considering costs for a similar building in Milan protected with a sprinkler system
- Costs and economical values are related to a surface of 1000 square meters and then normalized to the highest value in each histogram.



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- Economical quantities (€) are related to a surface of 1000 square meters and normalized to the highest value (building value in case of water mist system).

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- The adoption of a fixed fire protection system allowed to:
  - Lower the risk profile of the building
  - Ensure the aesthetics of the building
  - Reduce the fire damage
  
- Selecting a deluge water mist system instead of a traditional deluge system allowed to:
  - Achieve a better management of the building space
  - Reduce water damages and downtime of office activity
  
- The commercial value of the building, in spite of a higher initial investment, benefits from the installation of a deluge water mist system in multiple ways, with a total increase of the value of 30% in comparison to a sprinkler system solution
  
- The Bonnet or Corso Como Place Tower is the first tall building in Italy protected with a deluge water mist system. Specific tests should be provided with the aim of studying less impactful solutions.

Ing. Ada MALAGNINO



Ing. Massimo FERRETTI  
**MARIGFF**

**CONCLUSIONS**

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# Comparison of water mist and sprinkler systems to ensure fire safety for the Bonnet Tower



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