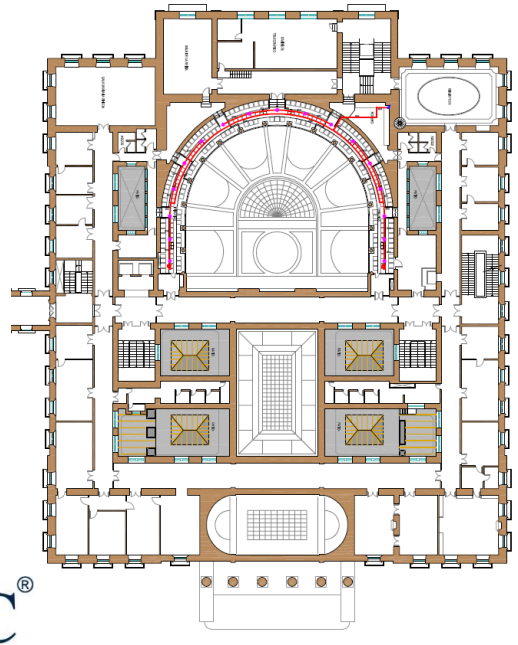
Spanish Congress Palace in Madrid - A Challenging Project

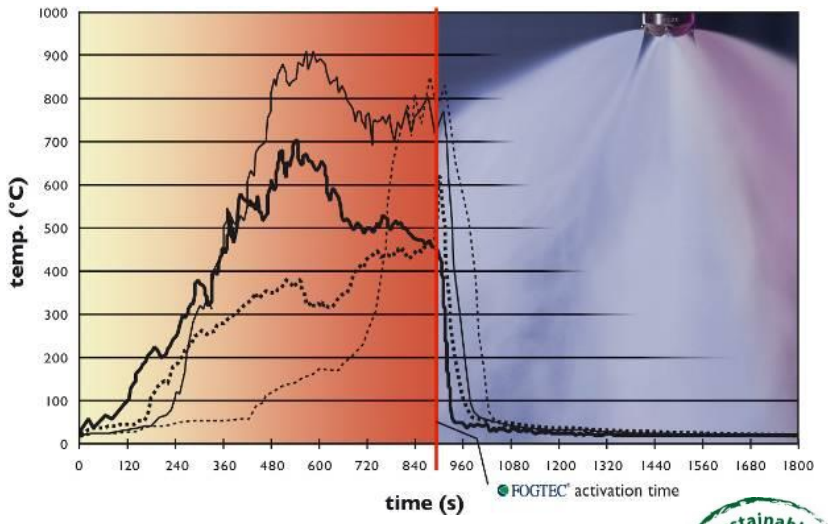
A Case Study

Spanish Congress Palace in Madrid



- Spanish Congress Palace located in the centre of Madrid was awarded to the architect Narciso Pascual Colomer and completed in 1850
- Heritage listed neoclassic building
- Building consists of a basement, 1st and 2nd floor and the roof with the cupola with each 2.500 m^2
- Building houses the plenary hall, conference rooms, a library, offices, archives and technical areas
- Valuable paintings and furniture decorate the headquarters of the Spanish Parliament
- Missing compartmentation between parts of the buildings required either structural measures or compensation by an automatic fire fighting system to prevent fire propagation and to secure safe escape conditions

Spanish Congress Palace in Madrid



- To increase of fire safety and to fulfil actual fire regulations after global refurbishment, the building had to be retrofitted with an active fire fighting system
- A thorough risk assessment lead to an early warning smoke detection system in conjunction with a high pressure water mist system

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- Water mist technology offers high cooling ability and partly reduces smoke spread, thus creates tenable conditions for evacuation and access to fire services and preserves historic structures
- Water damages and interruptions are reduced to a minimum
- Technology 100% full scale fire tested for each application including public spaces, offices, archives and technical areas
- Long life cycle due to corrosion resistant stainless steel components

Spanish Congress Palace in Madrid

Project Challenges

- Very limited space for pipework installation and system equipment in the entire building
- Installation to be carried out under full operation of the building (high security level)
- Fire protection of the plenary hall due to its open structure and great height of more than 20 m into the cupola

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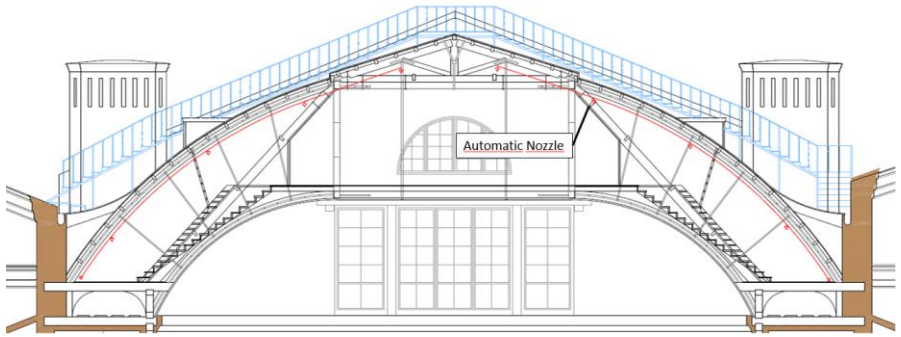
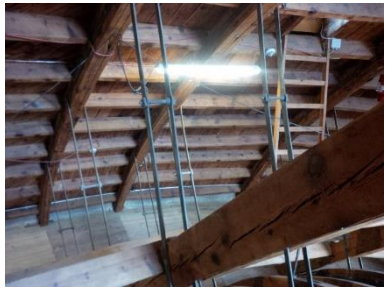
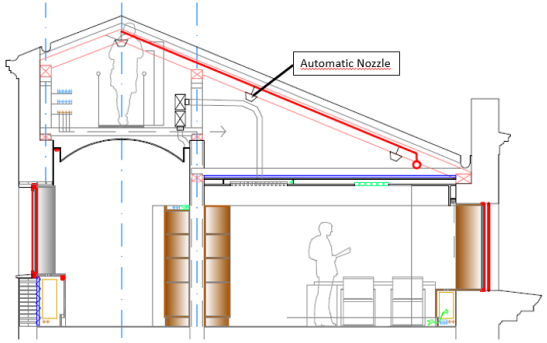




Roof Structure Protection

- Fire risk assessment determined the need of protection of the wooden attic and roof structure of the building
- Roof structure connects several parts of the buildings without fire partitions
- An automatic system with glass bulb activated nozzles has been applied to cover the attic space above the cupola of the plenary hall and the attic spaces above the offices



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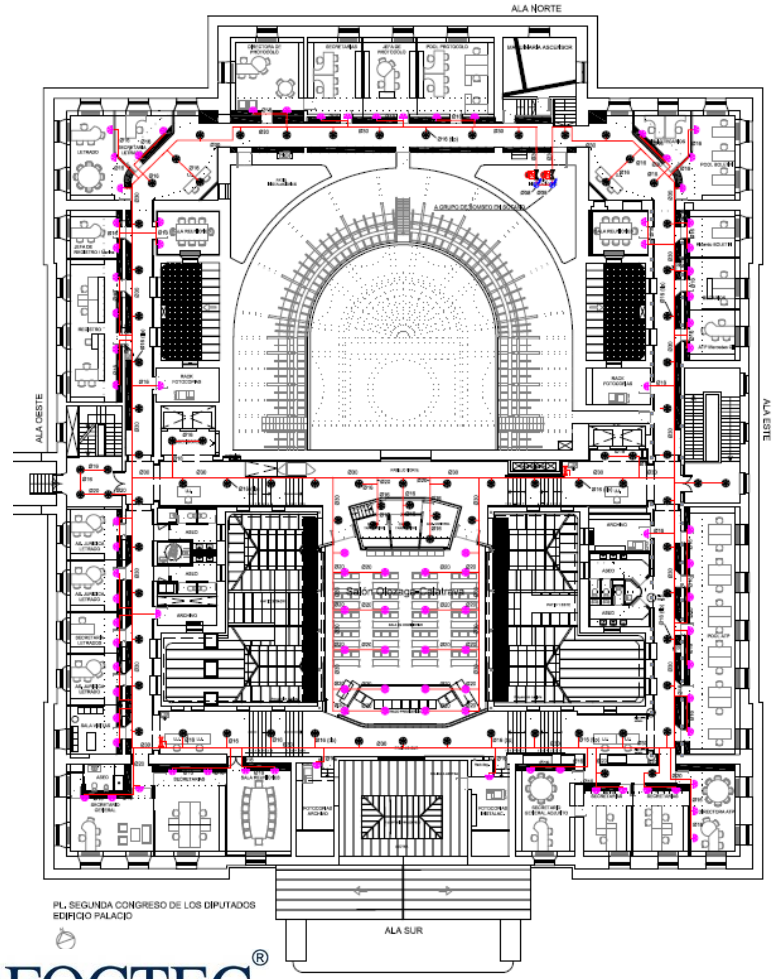
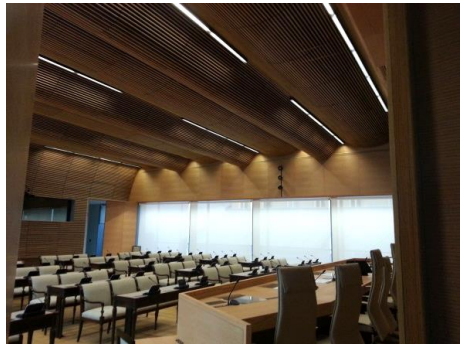
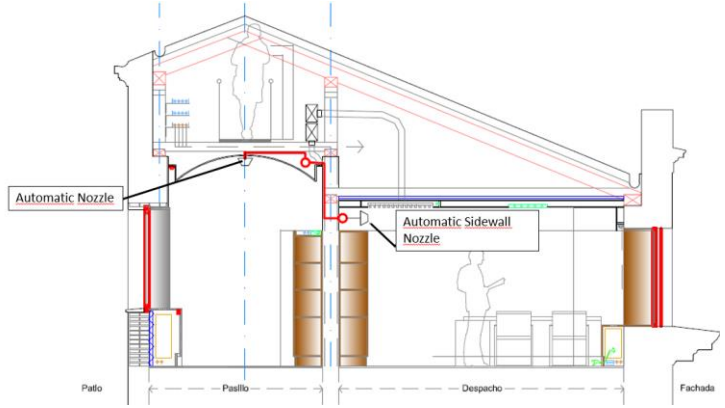


Offices and Conference Room Protection

- Aim to minimize the pipe sizes and amount of pipework
- Pipes with 12 mm to maximum 38 mm size has been utilized
- Press fittings for highest reliability and clean and silent installation
- Reduction of on site presence during installation to a minimum level
- An automatic system with ceiling and sidewall glass bulb activated nozzles has been applied





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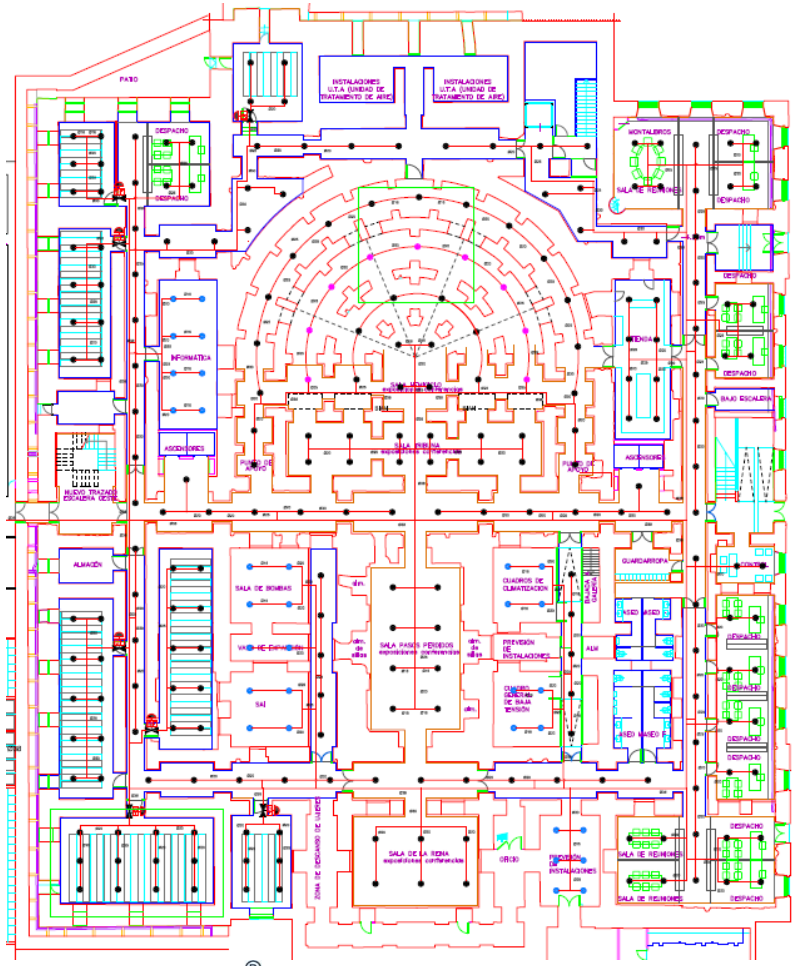
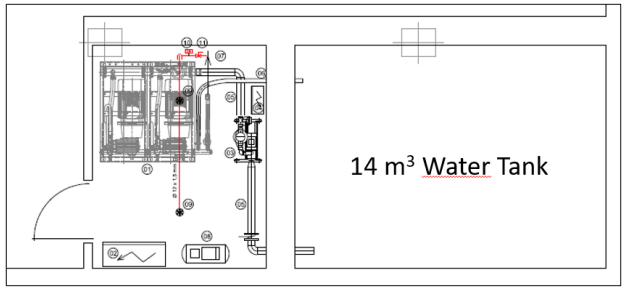


Basement Protection and Pump Room

- Mixed fire risk with technical rooms, archives, IT and meeting rooms
- An automatic system with ceiling mounted glass bulb activated nozzles has been applied based on full scale fire test results for the individual risks
- Operational area for all wet system areas 144 m^2
- Small pump room (16 m^2) in the basement of the adjacent building
- Water tank with 14 m^3 as reduced volume tank with redundant water infill secures minimum 60 minutes operating time of the water mist system



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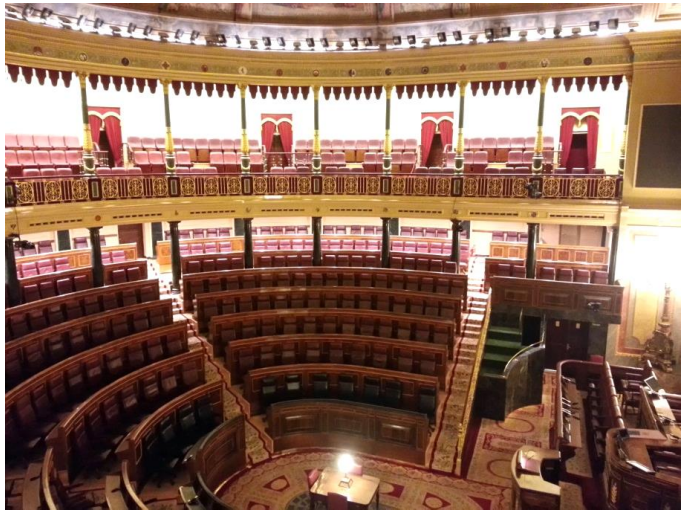

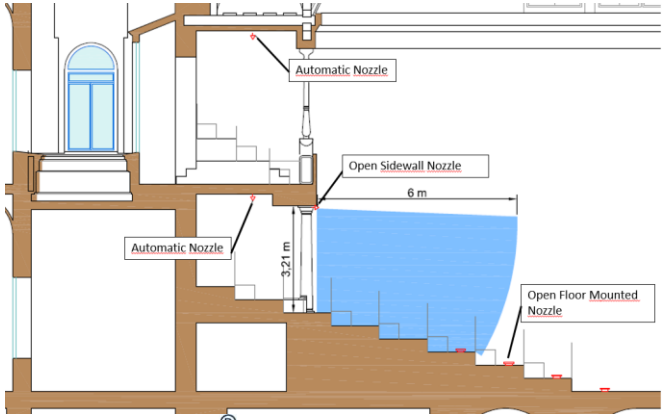

Plenary Hall Protection

- Development of an innovative fire protection concept
- Automatic system with glass bulb activated nozzles in the balconies where limited ceiling height allowed for this approach
- Since the fire load is concentrated to the floor and seating area the fire fighting agent preferably shall be present in this area
- Instead of overcoming the plenary hall height of more than 20 m, a deluge system with a combination of open sidewall and floor mounted nozzles have been considered for the centre parts of the hall

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- Evaluation of the protection concept by ad-hoc full scale fire tests in conjunction with an adequate fire detection system

Fire Tests for Floor Mounted System

TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

CEN/TS 14972

May 2006

Fixed firefighting systems - Watermist systems - Design and installation

Fire Test Scenario

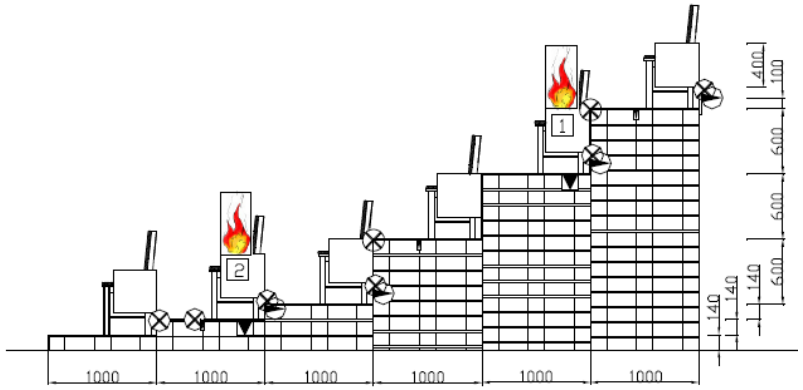
- Full scale fire test scenario developed in conjunction with the fire test laboratory based on EN 14972 standards
- Fire tests were defined as close to reality as possible regarding
  - Fire load
  - Arrangement of fire load
  - Ventilation conditions
  - Fire detection

Fire Tests for Floor Mounted System

Fire Test Scenario

- Test field of 6 m x 6 m (6 rows of each 8 seats) in a test hall of 10 m x 15 m
- Steps between 14 cm and 60 cm height / Total stage height 2,4 m
- Ceiling at 5,5 m height with 1 m distance to wall
- 6 floor ventilation openings with 60 m^3/h
- Two fire scenarios at low and high level each between 4 nozzles
- Seat fire load as per EN 14972 office fire tests
- Paper cushion as specified in DIN 5510-2 lying on the seat as igniter

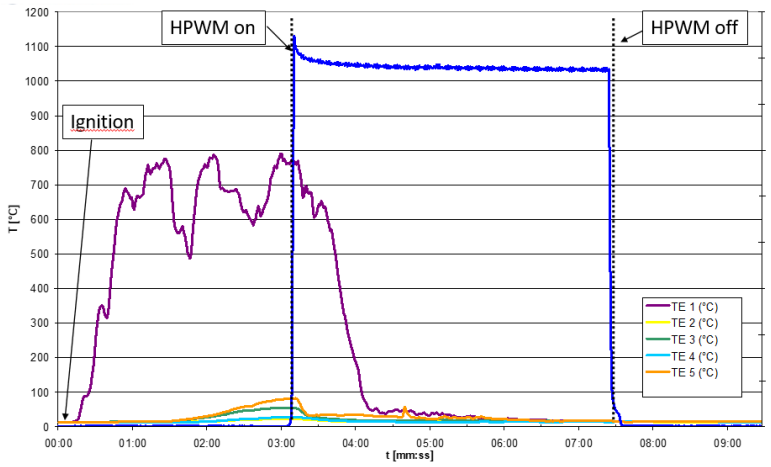
Fire Tests for Floor Mounted System



Water Mist Fire Tests

- Fire tests were carried out at low and high scenario
- High scenario [1] turned out to be more challenging
- Fire between 4 nozzles as most difficult scenario
- Additional test with one disabled nozzle
- Aim was fire control until manual intervention by the fire services
- Fire test duration 10 min
- Fire damage was evaluated after fire test

Fire Tests for Floor Mounted System



Water Mist System Results

- Temperatures in direct vicinity of the fire were effectively controlled
- Fire spread was limited
- Ventilation system had minor influence on the effectiveness of the water mist system
- Fire damage was concentrated on the ignition area

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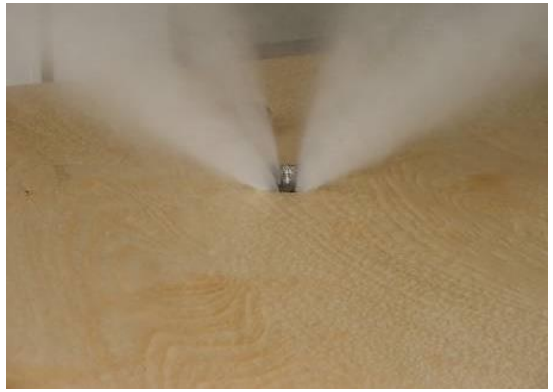

Floor Nozzle Operation Reliability

- Reliable lift-off of the cover was analysed

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- No danger for audience by the cover
- Cover lifts even if obstructed by an object, e.g. a bag

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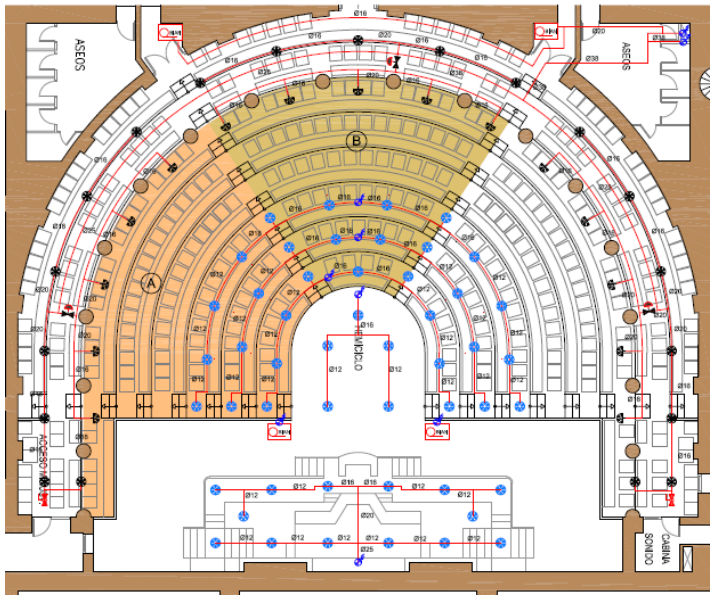

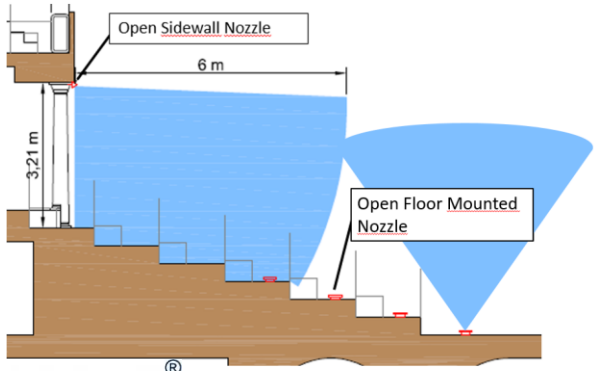

Plenary Hall Nozzle Implementation

- Fire tests have determined the position of nozzles and the flow rate
- Nozzle installation in the floor with a cover, having the same appearance as the floor
- Open nozzles zoned in sections
- Pump capacity designed to operate 3 adjacent floor nozzle sections and 2 open sidewall nozzle sections
- Small bore pipework for installation

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- Minimal disturbance of the building's architecture

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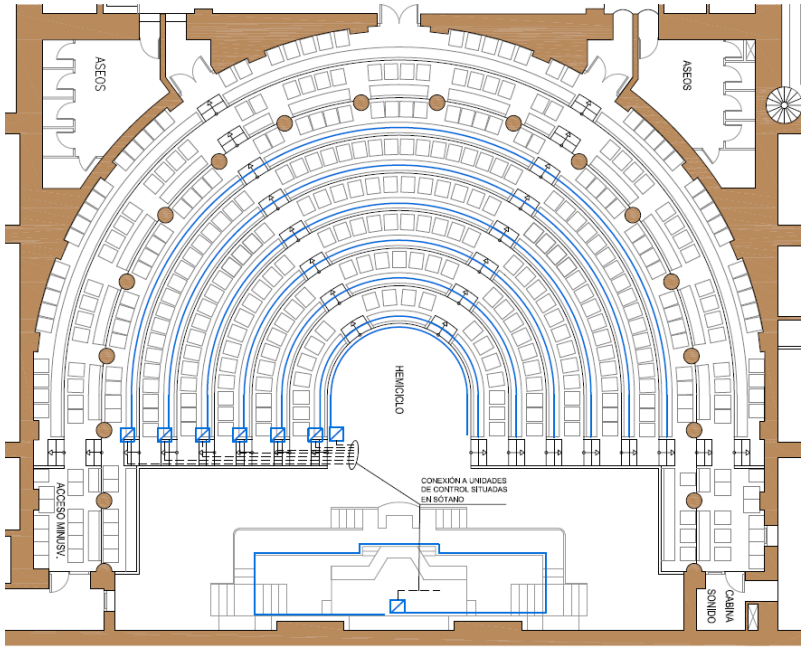

Plenary Hall Nozzle Implementation

- Linear heat detection system determines the zone of nozzle operation for sidewall nozzles and floor mounted nozzles
- Automatic glass bulb operated nozzles in the balconies interfere as little as possible to the appearance of the historic ambient
- Floor mounted and sidewall mounted nozzles are almost invisible

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Conclusion

- Water mist technology has been identified as one of the best suited agents for heritage buildings fire protection due to its high cooling abilities, compact equipment size and small water storage requirements
- Enhanced cooling eases evacuation by providing safe escape routes and creates safer conditions for fire services
- Minimized water usage reduces consequential damages and building operation interruptions
- Small bore pipework and compact system components eases water mist system integration in retrofit projects such as the Spanish Congress Palace

Thank You for Your Attention

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