

## **ARVIDSON: Learning from field testing of 5,000 sprinklers**

Annex K of EN 12845:2015 requires that after 25 years a sample of sprinklers should be removed from the system and tested to ensure that they are fully functional. This presentation summarizes the results from field sampling testing of over 5,000 automatic sprinklers from installations in Sweden, Finland and Norway during 2013 – 2019. Of the tested sprinklers 12.8% had a Response Time Index above the limit for Standard Response sprinklers, while 3.4% required water pressure above 0.5 bar to operate. For a quarter of these sprinklers the use of an O-ring water seal was the primary reason for improper operation and for another quarter the sprinkler was loaded with debris or had been painted. Deviation of the K-factor and lodgement were not recorded for any of the sprinklers. In 26.2% of cases replacement of all sprinklers in the installation was recommended.

## **BELL: Consolidated ISO sprinkler standards**

ISO TC21 SC 5 (Fixed Firefighting Systems Using Water) has combined the existing four ISO fire sprinkler standards into one covering conventional, spray, flat spray, sidewall, pendent ESFR, domestic and extended coverage sprinklers. A draft of ISO 6182-1, *Fire Protection -Automatic sprinkler systems— Part 1: Requirements and test methods for sprinklers* will address these and almost all of the new large K-factor sprinkler technologies currently on the market. At the same time UL consolidated the requirements from seven UL standards into a new edition of UL 199, *Automatic Sprinklers for Fire Protection Service*. This presentation will provide an overview of the draft ISO 6182-1 and the new UL 199, both of which are expected to be published prior to the conference.

## **BELL: UL requirements for anti-freeze solutions for use in sprinkler systems**

In 2009 an antifreeze solution was reported to have ignited when discharged onto a residential fire. Following research, NFPA made emergency changes to require listed antifreeze solutions in new sprinkler systems and for glycerine and propylene glycol antifreeze solutions in existing systems to be replaced with a listed antifreeze solution by September 30, 2022. UL has now published UL 2901, *Antifreeze Solutions for Use in Fire Sprinkler Systems*. This presentation will set out the requirements in UL 2901 to evaluate antifreeze solutions for use in fire sprinkler systems, addressing stability, exposure to materials in sprinkler systems, human health and environmental impacts, fire performance, hydraulic characteristics, and marking and installation specifications.

## **BÖKE: An update on CEN water mist standards**

Some years ago CEN TC/191 took the decision to upgrade TS 14972 for water mist systems to a series of full CEN standards. Part 1 covering design, installation and maintenance has already passed the technical enquiry. In addition, different parts for fire tests and components have either passed the technical enquiry or are in preparation to be sent out for inquiry. This presentation will give an overview of the status, content and planned next steps for the CEN water mist standards.

## **BOSMA: Ceiling only protection schemes for warehouses up to 16.8 m in height**

Since their inception in the 1980's ESFR sprinklers have enabled the sprinkler industry to protect most warehouse hazards without the use of in rack sprinklers. Over the ensuing decades, ESFR Sprinklers

have evolved into larger K-factors with expanded ceiling heights and continued improvements to design criteria. They currently enjoy their own design section of NFPA and carry worldwide endorsements through approvals such as the CE. This presentation will review the history and most recent progress with ESFR protection schemes. The launch of a K28 ESFR sprinkler set new height limits and the ongoing testing of ALL large K factor ESFR's is improving the design options available, enabling the efficient and effective protection of warehouses to 15.3 m & 16.8 m.

## **BROADLEY: Nitrogen generators 18 months on**

The presenter will review learning from recent field experience with nitrogen generators. This will include learning from design, installation, commissioning and maintenance. It will next give an overview of where nitrogen generators are used and the numbers installed. A case study from a major global data centre provider will illustrate the benefits of nitrogen generators. Finally, the presenter will discuss code changes and market feedback.

## **COPPOLA: Water mist protection of a wooden brig**

Water mist systems provide a safe and a practical solution to protect cultural heritage, releasing less water and reducing the risk of secondary damage when activated. The author will present a design specifically developed for a 99-year-old wooden brig, launched in 1921 as a mercantile ship before becoming a training ship for the Italian Navy and now exhibited at the National Museum of Leonardo da Vinci in Milan. To minimize lateral movement the ship is positioned between a frame of concrete columns over three floors, all in an open space configuration and in communication to each other. The museum has a smoke detection system and few portable fire extinguishers but does not otherwise contain any fire protection system.

## **DEN BOER: Sprinklers, water mist and safety**

This presentation will review the work conducted by Nieman (Ruud van Herpen). It will then present experiments conducted by Peutz at its test laboratory in Mook using water mist in a bedroom and corridor configuration. The results will consider smoke logging and drag.

## **FRISINA: Water mist and heritage buildings, Case study: St Mark's Basilica, Venice**

Water mist fire suppression should only be applied if tested at full scale against a specific protocol developed for the application in question, with the tests witnessed and the system approved by a recognised fire test laboratory or approval body. Water Mist systems are hence defined in terms of their firefighting performance. Approval of a water mist systems can be a complex, lengthy and costly process. While there are test protocols that cover many applications on land and at sea there are still plenty of applications for which a standardized test protocol does not exist. The presentation will cover a case study of a landmark project that was unique in its historical value and architectural design, imposing unique challenges for the water mist system design to protect this piece of Italo-Byzantine architecture.

## **GLOCKLING: BIM to grade building resilience**

An important potential benefit of BIM could be clarity for the insurance understanding of modern methods of construction, which often uses combustible materials, sometimes concealed by cladding made to look like non-combustible construction. BIM could enable the creation of resilience ratings for buildings, similar to the EuroNcap rating for cars. Active fire protection systems to mitigate the challenges of materials and design methods could be appreciated in the index. The Early Adopters Scheme of leading building developers set up by the British government to trial new regulations in the

wake of the Grenfell Tower disaster is interested in a resilience index, as are insurers. A resilience index could support building designs appropriate to the occupiers' expectations, rather than the mandated minimum of 'evacuation before collapse'.

## **HAAN & MONSTER: Sprinkler integrity test**

Standards require that samples of sprinklers be periodically taken from a system and sent to a laboratory to be tested for adequate performance. This approach does not assess whether the system will perform as designed, for example pipework could be blocked or the pump may not start. The only way to be sure is to conduct a functional sprinkler test on site. Unica has developed an innovative test method for on-site sprinkler testing, conducted using a mobile test rig. During the presentation we will demonstrate the test rig and show a video of an on-site test.

## **HOOGEWEG: How sprinklers affect the design of buildings**

In general we like to talk about new technologies and developments in the world of sprinklers. Sometimes it is good to look back and see, mention and recognize how sprinklers have changed the way we build buildings and raise the level of fire safety. In the presentation we will go on a historical trip starting with the early sprinklers until present time:

- How did the sprinkler develop over the years (is it really different compared to 100+ years ago?)
- For some major (and small) developments we will discuss the impact of them on the way we approach fire safety and building design.
- We will discuss limitations and some (surprising) backgrounds

Lot of visuals of old sprinklers, concepts and forgotten technologies (pics from our private collection).

## **HUISMAN: Dutch experience with residential sprinklers**

The presenter will explain why he became interested in residential sprinklers and supported the foundation of the Dutch Residential Sprinkler Installers Association (VWI), his experience of training, the support he has received from suppliers and the learning from a study visit to the UK. His presentation will continue with an overview of progress since 2015 in standards and the certification scheme, as well as market developments. The Dutch approach to sprinkler projects, from request for quotation to handover, will be explained. The presentation will end with examples of actual projects, showing the technical challenges and solutions found for different types of construction.

## **HUTCHISON: Update on suppression research from the Research Foundation**

Over the past two years, the Fire Protection Research Foundation has undertaken a variety of projects relating to sprinkler protection. The results of several completed projects will be presented, including:

- Modern Vehicle Hazards in Parking Garages and Vehicle Carriers
- Sprinkler Protection of Energy Storage Systems (ESS)
- ESFR Sprinklers and Obstructions
- Protection of Storage Under Sloped Ceilings

An update on current research studies will also be provided, which include:

- Spray Sprinklers and Obstructions
- Impact of Elevated Walkways on Sprinkler Protection in Warehouses

- Cybersecurity for Fire Protection Systems
- Inspection Testing and Maintenance Data Exchange

## **INGASON: Model-scale fire tests using automatic sprinklers in roadway tunnel fires**

Automatic fire sprinklers are rarely used to protect road tunnels, one reason being a concern that tunnel geometry and ventilation could cause sprinklers remote from the fire to operate but not those over the fire. A 1:3 model-scale test series was conducted to investigate the performance of an automatic sprinkler system in roadway tunnel fire scenarios. The tests were carried out using a scaled trailer cargo load with wood pallets with varying longitudinal air velocity, sprinkler temperature rating, water discharge density, type and arrangement of the fuel. An upright extended coverage K200 sprinkler was geometrically scaled and made of titanium using a 3-D printer. The tests indicate that automatic sprinklers can be used in road tunnels. The number of activated sprinklers is strongly dependent on the temperature rating and the discharge density.

## **JANSEN: Conceptual fire protection design for the Nhow Amsterdam hotel**

At Fire Sprinkler International 2020 we would like to share our knowledge and experience of the development of the Nhow Amsterdam RAI Hotel. This hotel is high-rise (91m) and protected throughout with a sprinkler system. The building is located directly next to the RAI Convention Centre so it will be used by attendees of the conference. In the presentation we will share the background to the development of the building, the fire safety concept (architectural, systems, organisation) and of course the design of the sprinkler system. Also, the optimisations will be shared that are used because the building is protected with a sprinkler system. For instance, reducing fire resistance of fire separations, removing fire dampers and using the sprinklers to detect and localise a fire in the car park.

## **JOHANSSON: Automatic supervision and testing of sprinkler systems**

New flow switch technology that is approved for self-testing and new wireless monitoring solutions for sprinkler systems will be presented. These solutions can monitor a number of functions in a sprinkler system, making it possible to monitor everything of importance in a sprinkler system, from corrosion to the status of installed products. Integration with detection technology makes the system fully addressable and gives the possibility for remote supervision through cloud or BMS connection. Instead of periodic manual testing of the sprinkler system, the system communicates when something is not functional, gives an alert before something becomes critical and advises what needs attention.

## **KIDD: Utilisation of automatic fire suppression systems in cultural heritage occupancies**

This presentation reviews the significant potential benefits of retrofitting sprinklers and water mist into historic buildings, both for property protection and as an aid to legislative compliance in adaptive reconstruction. The presentation also considers key elements in the design and installation of systems in terms of minimising the damage to heritage fabric and visual intrusion.

## **KOPP: Cultural heritage protection with water mist**

For decades fire protection of cultural heritage has been aiming for the best possible protection against fire with the smallest collateral damage by the firefighting agent. Water mist technology has been identified as an excellent compromise between efficient fire suppression and potential collateral damage to cultural heritage from the discharged water. The paper will describe how high-pressure water mist systems can effectively tackle fires in cultural heritage, based on full-scale fire test results, while limiting damage to the building structure by the firefighting agent. The paper will provide details of the risk assessment process and selection of suitable fire tests protocols for individual risk areas based on European water mist standards. System design and implementation challenges and their solution based on the water mist technology will be explained based on various European case studies.

## **LAKKONEN: Li-ion vehicle fire tests**

New energy carriers (NEC) like electric vehicles (EV) with Lithium-Ion batteries are being promoted for environmental reasons and their use is rapidly increasing. This can lead to new fire scenarios. At the same time, vehicles are getting larger and contain more combustible materials such as plastics and composites, so there is a question whether current vehicle design fires are representative. These issues are investigated by the SUVEREN research project, which aims to produce guidance for planners, designers and operators of underground facilities. Real-scale fire tests in 2019 showed that the ignition source influences the fire development of Li-Ion batteries, which can be very rapid. The vehicle battery fires were also tested using water mist and sprinkler (deluge) systems as fire suppressant. The results were positive and will be presented and discussed in the paper.

## **MOINEAU: Notre Dame – a disaster which is changing fire protection in France**

The fire at Notre Dame Cathedral in Paris aroused strong international emotion. In terms of prevention, this is an example where the regulatory solution reaches its limits (notion of non-retroactivity of texts). Recently, France has offered alternative solutions: "flexible" law and the performance approach through the use of fire safety engineering. Specialists are also working on risk analysis models. In addition, the "Notre Dame Project" must involve full-scale fire tests including with automatic extinguishing solutions.

## **NICHOLS: New European water mist standard and its potential application for heritage protection**

The European Standard for water mist, EN14972, is planned for publication in 2020. This presentation reviews its key elements including the fire test protocols and design requirements. Fire test protocols are designed to be reproducible based on representative fire loads and combustion rates for a variety of hazard categories. Suitable fire risk assessment is required to match the actual heritage building with the respective fire test protocol. Manufacturers are also required to have component approval and to have defined the design water density dependent on height and spacing tested. Audit procedures to ensure that the system is suitable will be discussed, as will the limitations of performance-based design with regard to height, ventilation and obstructions. Finally the paper will review the available technologies and comment on some of the marketing myths.

## **NIGRO: Resolving new fire engineering challenges – interaction between sprinklers and jet fan ventilation in enclosed car parks**

In a car park the permanently operating jet fans for car park ventilation may delay sprinkler head activation in the case of fire. Therefore, the possible delay should be quantified and analysed to ensure the effective operation of the sprinkler system. One of the possible methods to analyse this interaction is the use of Computational Fluid Dynamics software (CFD). A series of computational analyses have been undertaken to quantify the impact of the jet fans on delaying sprinkler activation on a typical car park sprinkler arrangement. Once the sprinkler activation had occurred, it is assumed that a fire signal has been generated to shut the jet fans down. This case study presents results ventilated with axial jet fans and natural openings spread around the perimeter of the building.

## **REINERMANN & SCHRÖDER: Fire protection of solar panels**

Solar panels are used more and more on private buildings but also on industrial buildings or commercial buildings. Electrical failures present an ignition source and may ignite the roof, especially the roof insulation. Without fixed fire-fighting systems these fires are not easy to extinguish, which may result in major damage. Based on the needs of insurance companies and building owners / users VdS created a test procedure which is representative for this type of risk. Fire tests were carried out to prove a protection concept. VdS will present the need for fire protection and the requirements of the test procedure. Minimax Viking R&D will present the test set-up, the basic information about the protection system and the test results.

## **VAN HERPEN: Sprinkler retrofit of the Peperbus in Zwolle**

The 'Peperbus' or pepper pot is the nickname of the 75 m high, 600-year-old church tower of the Basilica of Our Lady of the Assumption in Zwolle. The carillon has 51 bells. For many years the tower has been protected by a sprinkler system but it is now old and needs to be replaced. This presentation will show how a special sprinkler system was designed and installed for the protection of this unique cultural heritage building, which is open and exposed to all weathers.

## **SUWALSKA & MUNOZ: A new sprinkler system to protect one of the world's largest particle physics accelerators**

At CERN, the European Organization for Nuclear Research, physicists and engineers are probing the fundamental structure of the universe. CERN is renovating the fire protection systems in its Super Proton Synchrotron, SPS. A 40-year-old sprinkler system is being replaced and extended. It must observe many restrictions related to the accelerator equipment yet comply with EN 12845. The new system has to be designed so that its components resist particle radiation. The system must remain operational for 30 years while receiving minimal maintenance, due to restricted access. This session will present the options considered by CERN based on the constraints related to the unusual environment, share experience from the design and installation phases, and discuss concessions which sometimes led to deviations from EN 12845.

## **TEN BROEKE: Fixed fire-fighting system for tunnel protection**

A program was initiated by the Swedish government to develop an efficient and cost-effective fire protection system for upcoming road tunnels. Full-scale fire tests were conducted with the success criteria being to maintain the heat release rate below a certain level and prevent fire igniting a nearby target. The system would then allow the fire brigade to enter the tunnel to perform search and rescue and fight the fire. RISE (Research Institutes of Sweden) developed the test protocol and performed the fire tests. The presentation will first review the background and fire test protocol. It will then present the performance, design and economics of the chosen solution, a deluge water spray system with specially developed nozzles, which is activated by detection.

### **TESCHNER: Intelligent glass bulb technology for sprinkler systems**

The presentation will give an insight to current glass bulb technology and its high-quality requirements. The main part will be the future of glass bulb technology and new applications with smart bulbs that can monitor the activation of the sprinkler and also can electrically activate the sprinkler. A system using these “Smart” bulbs can be operated electrically but has always the backup function of a thermally activated glass bulb. A sprinkler system could also monitor the operation of single heads and would be able to activate additional sprinklers electrically.

### **TOFIŁO: Protection of glass facades with sprinklers**

In this paper we investigate the feasibility of sprinkler systems to shield glazed building facades. Four full-scale burns were performed on three different types of glazed facades to inform the fire safety design for two iconic office buildings under construction in Warsaw. They aimed to fill gaps identified by a literature review: no research with a realistic compartment fire; limited guidance on the optimal placement of sprinklers and limited information on the consequences of partial shading of the water spray pattern. In each experiment the sprinkler system protected the glazed facade, maintaining the structural integrity of the building envelope, limiting the radiation and cooling the gasses exhausted through the natural ventilation opening. This was despite accepting the shading of small areas of the glass, an increased separation distance between sprinklers and the use of pendant sprinklers.

### **TONG: The differences between FM and VdS sprinkler pump diesel engine approvals**

The presenter will analyse the differences between the FM Approved and VdS approved fire pump diesel engines in three aspects: testing objectives, the different structures, and engine reliability. Delegate will gain deeper knowledge of fire pump diesel engines which will assist them when selecting this important element of a sprinkler system.

### **VAN BUREN: Tests conducted in accordance with NFPA 30 to assess sprinkler capability in different scenarios**

Marsh Risk consulting and H2K Brandweeroopleidingen provide performance-based training sessions where tests with composite intermediate bulk containers (CIBCs) of flammable products are used to demonstrate the how fires behave under various conditions. This information is used in the Marsh white paper which describes credible fire scenario and fire protection requirements. The audience will learn about the behaviour of CIBCs which contained flammable liquids but were not cleaned and which



are stacked on wooden pallets and composite pallets. These tests show the performance-based process – in which all credible incident scenarios are identified – should be applied for the design of the fire protection provisions for CIBC's of flammable or combustible liquids.

## **VAN HOFWEEGEN: Corrosion, legionella and MIC in sprinkler and water mist systems**

In The Netherlands Technical Bulletin 80 sets out the frequency and detailed inspection requirements for sprinkler tanks. Inspections have shown that sprinkler tanks lined with bitumen are susceptible to corrosion, while any metallic parts inside tanks fitted with a liner need to be made of stainless steel. High pressure water mist systems often require desalinated water. This can lead to corrosion of stainless steel, while a combination of materials causes galvanic corrosion and the use of a plastic buffer tank increases microbiological growth, so that these systems can be severely affected by MIC. Samples of water from sprinkler systems showed that there was no legionella risk to building occupants in the event of a fire. Those who test and service systems may run some risk since during the limited sampling, legionella was found in the sprinkler tank and in the pump room.

## **VAN OPPEN: The Dutch approach to quality assurance**

In the Netherlands, all parties work together to ensure a high level of quality, based on a private scheme for the certification of design, installation and maintenance of sprinkler systems, complemented by inspections mandated under building regulations. The Dutch Centre for Crime Prevention and Safety (CCV) is a non-profit organisation which supports committees, expert panels and working groups in which buyers, installers, insurers, fire safety consultants, fire brigades and certification and inspection bodies work together. CCV publishes guidance documents and manages the certification and inspection schemes under which the certification and inspection bodies operate. Audit and inspections data will soon begin to be provided to CCV, enabling parties to detect issues that need attention, and – after some years of data collection – trends in quality improvement.

## **VASQUEZ: CPR and possible revisions**

The Construction Products Regulation (CPR) is European law adopted without change directly into the national law of all Member States of the European Union. It is the basis for CE-marking of construction products. This presentation will explain how the CPR is intended to be applied and its relationship with national fire safety building codes, the European Commission, CEN and CEN standards. For a CEN standard to be used for CE-marking, it must be cited in the Official Journal of the European Union. Of 110 standards submitted by CEN for citation in 2019, none were cited. The presenter will discuss the reasons, among which are court cases that have led to much stricter application of the criteria to which cited standards must comply. A review of the CPR is expected to conclude by the end of 2020. The presenter will discuss the possible outcomes.

## **WAKE: Storage trends demand installers to be ready**

Demand for warehouse space has doubled since early 2000s due to the digital shopping shift and the expectation of shorter delivery times. Many more ESFR heads are being installed to protect these facilities, putting fitters at risk of repetitive strain injuries. Timelines are short for new construction

projects and can be put at risk by leaks and the associated rework. Leaks in storage facilities are most often seen at the threaded connection between ESFR's and the branch line outlet. Heads can also be over-torqued and damaged to align the frame with the branch line. Replacing threads with mechanical connections closed with power tools reduces the risk of leaks, allows fitters to align the sprinkler frame and pipe without over-torquing and reduces the risk of injury on the job site.

### **WATSON: Case study: Sydney Harbour M4 East Road Tunnel sprinkler system**

The new M4 East Tunnel is a twin tube design with 3 lanes in each direction, each tube being 5.5km long. The tunnels, including entry and exit ramps, were divided into 517 deluge zones using protected with specially developed nozzles fed by deluge valves. The presentation will begin with a brief history of tunnel fires followed by a discussion of the specific challenges of tunnel fires and of the trend towards active fire suppression. It will go into the protection scheme for this tunnel in some detail, including the development of the project design brief, the design challenges and installation challenges, and finally how operation and performance were verified.

### **WITTE: Remote fire protection services standard**

To complement EN 16763: 2017 'Services for fire safety and security systems' CEN-CENELEC Joint Technical Committee 4 Working Group 1 has drafted a new EN standard for 'Requirements for the provision of secure remote services for fire safety systems and security systems', which at the time of the conference should be out for the CEN enquiry stage. The presenter will explain how this standard will apply to fire extinguishing systems, give examples of new possibilities with remote services in sprinkler systems and discuss the challenges and opportunities they bring.

### **YIN: Smart sprinkler systems to save water**

The cost of a sprinkler system water supply can be prohibitive, so FM Global has initiated multiple research projects to develop fire protection methods targeting low water usage. This presentation summarizes research on sprinkler systems using Simultaneous Monitoring, Assessment and Response Technology (SMART). The SMART sprinkler system utilizes detectors to assess a fire event and trigger several sprinklers simultaneously to surround and control the fire. The main advantages are 1) early activation when the fire is small, 2) multiple activations to surround the fire and 3) elimination of sprinkler skipping. The test results show that the SMART sprinkler can reduce water usage by more than 50% for low-piled commodities and high-rack storage of cartoned plastic fuels. It can also provide promising fire control for open-top combustible containers stored in racks, where the use of traditional sprinklers becomes extremely challenged.