SA FIRE PROTECTION

Home of reliable fire systems and products

POWER PLANT

STORAGE TANK

NUCLEAR PLANT

OFFSHORE PLATFORM

Contents

SA Fire Protection is an Italian fully Independent Engineering & Manufacturing Company active in the field of Fire Protection with more than 40 years of experience in Fire Science, Fire Engineering and Fire Protection Technology. Innovative and research orientated, SA Fire has involvements in industrial and academic fire research projects in which it develops and exchanges expertise that will be used to develop featuring & innovative fire products. A flexible organisation engineered to respond to clients' expectation rapidly with particular care paid to the quality of its production. The company is constantly assessed and monitored by third-party accreditation bodies responding to compliance with: ISO 9001; ISO 14001, OHSAS 18001 and NATO AQAP-110.

The company is organised in three major business units: Fire Engineering, Fire Product Manufacturing and Maintenance Services. The Fire Engineering unit is mainly involved in turnkey projects involving fire detection and suppression systems for the oil & gas, petrochemical and power generation sectors. The systems delivered include: foam, dry chemical, water spray, automatic monitors, gaseous and water mist.

The Fire Product Manufacturing unit concentrates on production of fire equipment for which SA Fire is a well-known manufacturer of monitors, deluge valves, special hazard fire systems and SIL rated final elements. The majority of the company's fire products are used in petrochemical and power industries within Europe, the Middle East and Asia.

The third BU concentrates on Maintenance Services of fire systems and fire equipment. The unit serves the market vertically offering on site assistance and long-term service agreements. Over the years SA Fire has developed a wide range of supporting services aimed at maximising efficiency, safety and the operational lifetime of its fire suppression systems & equipment. Clients that have joined SA Fire's service programs protect their assets, extend their system warranty, monitor and keep their investment running securely meanwhile reducing downtime and production losses. With two service centres operating in Italy engineers are dispatched rapidly within the whole EMEA zone. Skilled engineers cover all the required fire suppression and F&G detection system competences and expertise to deliver full service coverage to our customers.

The facility in Cascina, PISA, is located in Tuscany in the north west of Italy. The centre was founded in 2003 and specialises in Fire Engineering, Detection and Suppression, providing design and project management services for turnkey key industrial fire & gas protections. In house competencies include Fire Simulation, Fire Dynamics and Risk Analysis, often used in support of complex fire protection engineering projects.

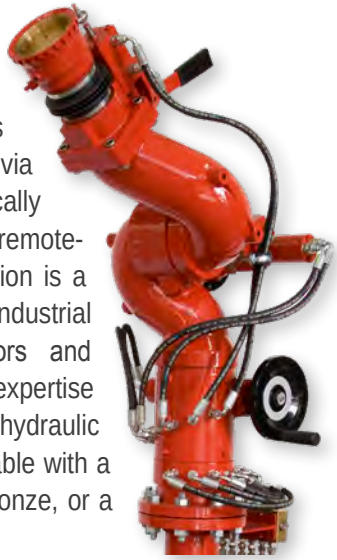
The Plant in San Pier Niceto, MESSINA, is instead located in the middle of the Mediterranean Sea and specialises in the manufacturing of fire products and firefighting packages that are designed, manufactured, tested and shipped to our customers worldwide. The industrial site is equipped with advanced CNC machines as well as an I&C department and laboratories. Also, an engineering subsidiary is located on site closely following the design and industrialisation process related to fire products and packages as well as an intense program of R&D and third party product certifications.

Firefighting Monitors

Fire Protection Solutions

Automatic
Firefighting Monitors

Foreword



Automatic monitors are devices used to deliver large amounts of water or water/foam solution to remote targets. These monitors can be controlled manually via local mechanisms or automatically by means of actuators and remote-control stations. SA Fire Protection is a well-known manufacturer of industrial heavy duty firefighting monitors and control systems with a strong expertise in electric, electro-hydraulic and hydraulic controls. The monitors are available with a full Bronze, Nickel Aluminium Bronze, or a Stainless-Steel body.

Manufactured with extreme care, every piece is designed to withstand extreme conditions granting a very long product lifetime. In this respect, the variety of special materials or surface treatments makes this equipment very robust. Depending on the application, the monitors can be equipped with jet/fog nozzles or branch pipes designed for water and water/foam solution. The automatic movements on the horizontal and the vertical plane as well as the stream control (jet/fog) can be provided with hydraulic, electro-hydraulic or electric actuators.

Every monitor is designed to be controlled either manually or by remote controls available on a fixed or mobile wireless control station. The control stations are designed according to the client specifications and may be manufactured for either hydraulic or electric actuators.

Also, the electric consoles may be equipped with a PLC, achieving complete standalone firefighting systems, or can integrate accessories such as lightweight portable wireless consoles. System interconnections may be designed traditionally or with a Modbus redundant serial link (only for electric monitors) that allows sensible saving of the system's cable quantity requirements. All components, such as monitors and consoles, are available for hazardous area installations in compliance with ATEX 204/34/EU Directive.

The design and production of monitors and their accessories are carried out according to SA Fire's rigorous quality standards by skilled engineers in high tech production facilities.

Niagara

The Niagara series of firefighting monitors represents one of the most advanced automatic monitor series available nowadays for the fire industry. The monitors are designed to withstand extreme harsh and adverse environmental conditions offering designers durable Bronze and Aluminium Bronze castings with waterways ranging from 3" to 6". The monitors are ideal for highly demanding installations such as jetties, harbours, refineries, chemical plants and offshore installations. The Niagara is available as an automatic monitor with a selection of three controls: hydraulic, electric and electro-hydraulic.

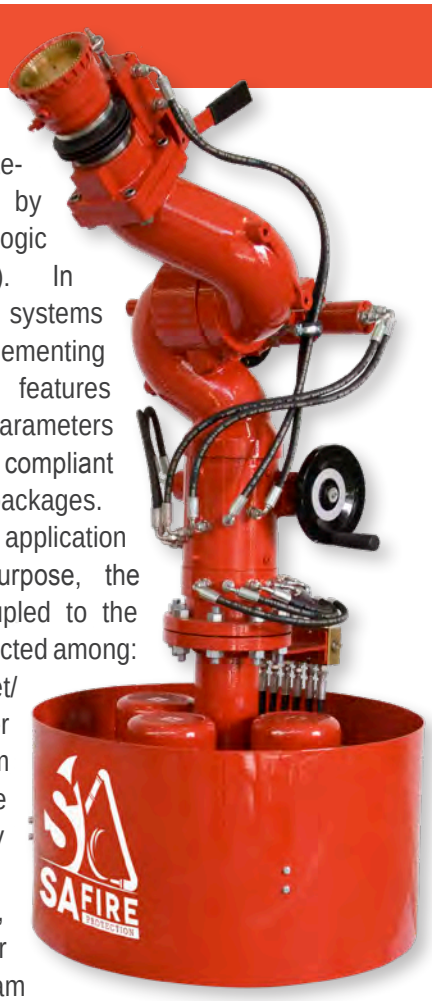
The hydraulic Niagara is the traditional configuration of remote controlled monitors. It requires a hydraulic power pack that pumps oil into different metallic tubes. Each tube drives a movement of the hydraulic actuator governing the monitor movement. For each hydraulic actuator SA Fire always includes an emergency hand-wheel for each movement that is used locally to take over the main power transmission.

An evolution of the Niagara is the electro-hydraulic series. These fire monitors are delivered with the hydraulic power pack installed underneath the monitor itself forming a unique standalone package that connects the electrical interface to the remote-control panel and the hydraulic interface to the monitor actuators.

This configuration allows for installation using electrical wiring from the control panel up to the hydraulic power pack, limiting the hydraulic tubing to a very short final interconnection. The absence of metallic tubing required in traditional hydraulic installations is appreciated in terms of lower installation and maintenance cost.

Both the hydraulic and the electro-hydraulic Niagara can rotate on the horizontal plane for 360° stop to stop. For both, a special version of horizontal joint G/360 allows the monitor to rotate continuously. Those Monitors are often preferred for installations where protection of multiple targets is required.

The other configuration of Niagara monitors is electrical. A configuration that is achieved using electric actuators located on each monitor joint offering the maximum achievable remote-control precision in the monitor movements. The electric monitors can be controlled



by simple remote-control stations or by programmable logic controllers (PLC). In such cases the systems can be built implementing additional software features and reliability parameters that allow for SIL 2 compliant automatic monitor packages. Depending on the application and firefighting purpose, the terminal to be coupled to the monitor may be selected among: Nozzles for Jet/Fog stream, water cannons or foam branch pipes. The nozzles are the only solution that will include a control, whereas water cannons and foam branch pipes are normally fixed. Only in some cases an automatic deflector is added to foam branch pipes. Independently from the controls used, the nozzles are designed for high performance and reliability and therefore are equipped with corrosion resistant materials and sand storm protectors.

Marmora

The Marmora monitors can be fabricated with a 4" to 10" body and can be base flanged 4" to 12" to grant flows up to 40000 lpm. The Marmora's are shaped to withstand high flows, distributing the reaction force in such a way that the structure of the monitor is not compromised. These auto-monitors embody all the actuation features of the Niagara monitors and so can be hydraulically, electrically and electro-hydraulically actuated and can rotate horizontally 360° continuously. The Marmora range of remote-controlled monitors are the Stainless-Steel counterpart to the Niagara. Like the Niagara, the Marmora is designed for use in harsh environments for onshore and offshore applications.

As with all SA Fire hydraulic firefighting monitors, the Marmora's are fitted with a hydraulic power pack that pumps oil into different metallic tubes. Each tube drives a movement of the hydraulic actuator governing the Marmora's monitor movement. Electro-hydraulic configurations of the Marmora use electrical wiring from the control panel up to the hydraulic power pack, limiting the hydraulic tubing to a very short final interconnection. The absence of metallic tubing required in traditional hydraulic installations is appreciated in terms of lower installation and maintenance cost. Alternatively, the Electric Marmora offers the maximum achievable automated accuracy in the monitor movements.

Platforms

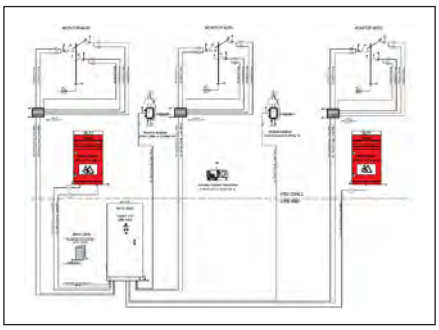
Automatic monitors are often selected to protect marine terminals or refining installations where it is required to approach the fire from a certain height above ground. In this respect SA Fire has developed a series of self-standing modular designed structures that may be used to set up monitors at the highest level above protected targets. The structure is manufactured as a module and designed for easy erection on site.

The turret comes together with all accessories, such as external cooling system, internal main feeder, base valves and external ladder. The top of the turret may be equipped with a rotating platform that moves on the horizontal plane together with the automatic monitor. Mechanical connections from the monitor to the turret are built in the monitor bodies making the installation easy and straightforward. Below the turret, service controls for monitor enabling and disabling are available for maintenance operators.

This is to safeguard operators from being hurt by any erroneous remote operation that may come from ground stations. The rotating platform on top may be provided with 360° rotation, allowing the remote-controlled monitors to move freely on the whole horizontal plane.

Remote Actuation:
Electric & Electro-Hydraulic

Monitor control panels are used to provide commands, signal the monitor position and the status of the automatic monitors. There are various possible panel configurations depending on system architecture, communication protocol, and classification of the installation area. Usually, the fixed stations are manufactured with one, two or three monitor controls together with their water and foam control valves. For each monitor, the panel is equipped with a joystick for horizontal and vertical monitor movements, a joystick for stream control (jet/fog) and two couples of push buttons for water and foam control valves. These consoles can be used to control either electric or electro-hydraulic monitors. Larger and more complex control panels can be designed to host a PLC and control the electrical monitors using a serial communication protocol. This solution is based on a redundant communication link



and also allows system programming that provides fully automatic installations. The same technology may be used to design multiple control stations or to manage one or more wireless monitor consoles. Dedicated visualisation software is also available for specific control room requirements.

Explosion Proof Panels

For some installations, the power module or monitor control panel needs to be installed in the hazardous area. SA Fire designs and manufactures Explosion Proof Panels for Zone I that may be used as slave or standalone master installations. The panels are available for standard installation or can be equipped with a slave PLC to form part of larger system architectures.

Wireless Monitor Console: Monix

Monix is a wireless mobile control station designed to control one or more monitors. The Monix console forms part of the main PLC based control system where the wireless module is integrated. The Monix consoles are normally kept on site in custom built boxes where they are connected to their battery charger and controller. When needed, the operator can activate the Monix and wear the portable console. The monitor selection is made by simply selecting the monitor with the frequency selector. Once the monitor is selected, the operator is capable of taking control by operating the joystick and the open/close buttons for the control valves. To switch to another monitor, one can simply rotate the selector switch and take control. Monix is available for safe and hazardous area installations.

Manual Firefighting Monitors

Foreword

Manual monitors are hand operated devices used to fight fires which require a large amount of water or water/foam solution to be delivered to remote targets. Every monitor is designed to be easily operated by its commands, requiring very little force by the operator even when adjusted during operation.
The Monitor bodies are available in Bronze or Stainless Steel for installation within harsh industrial environments. Each piece is designed and manufactured with extreme care to be robust and grant a long service life in adverse environmental conditions. Depending on the application, manual monitors can be equipped with nozzles or branch pipes capable of discharging water or water/foam solution. Nozzles and foam branch pipes are also available with a built-in inductor that allows water and foam proportioning before discharge. Each monitor can be coupled to a large variety of accessories such as self-oscillating units, hydrant supports, nozzles and branch pipes. Design and production of monitors and their accessories is carried out according to SA Fire's rigorous quality standards by skilled engineers well equipped at high tech production facilities.

Iguana Manual Monitors

The Iguana is a hand lever operated manual monitor, with a 3" single water way bronze body. Very easy to operate, the Iguana is ideal for low flow applications and may be base flanged 3" or 4" UNI/DIN or ANSI. Movements on the vertical & horizontal plane can be performed by a lever that amplifies the operator force towards the monitor joints, making the monitor movements very easy. Both vertical and horizontal joints can be secured by two manual locks that allow the operator to adjust the monitor with the wanted orientation and leave it operational. Both joints are built in the monitor casting using a double channel hosting the rotational spheres. Shaped to keep the concentrated pressure losses to a minimum, the casting has a single internal waterway and can be used for water or water foam solution. Addressing the specific requirements for harsh industrial environments & offshore applications requiring small manual monitors.

Niagara Manual Monitors

The Niagara is a hand wheeled manually operated monitor, with a 3", 4" or 6" single waterway bronze body. Very easy to operate, it is capable of withstanding flows up to 20000 lpm and may be base flanged 3", 4", 6" or 8" UNI/DIN or ANSI. Movements on the vertical & horizontal plane can be performed by rotating a wheel that uses a gear to amplify the operator force towards the monitor joints, making the monitor movements very easy. Both joints are built in the monitor casting using a

double channel hosting the rotational spheres. Shaped to keep the concentrated pressure losses to a minimum, the casting has a double internal waterway and can be used for water or water foam solutions. Addressing the specific requirements for harsh industrial environments & offshore applications.

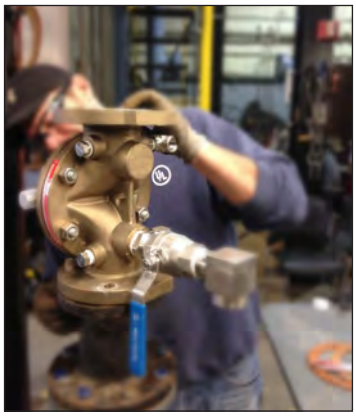
Marmora Manual Monitors

The hand wheeled manual Marmora monitors are manufactured with a 4" to 10" single waterway body in stainless steel. The manual Marmora's can be base flanged 4" to 12" granting high flows of up to 40000 lpm. This hand wheeled manual monitor is ideal for high flow requirements. Movements on the vertical and horizontal plane of the Marmora can be performed with ease by rotating the handwheel which transfers the operators force through gearboxes to the monitor joints. The body is designed to balance the reaction force and is suitable to be coupled with a number of discharge nozzles/ branch pipes.

Deluge Valves

Fire Protection Solutions

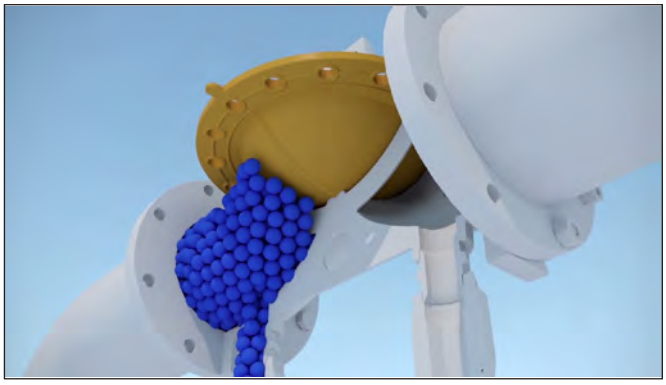
Foreword



Deluge valves are intended to respond quickly after fire detection, delivering large amounts of water over the entire protected area. SA Fire deluge valves are used to control water flow in deluge, pressure reducing and ON/OFF fire protection systems. They can be trimmed with electric, pneumatic, electro-pneumatic and hydraulic release systems (trims), depending on the specific application. SA Fire deluge valves are quick opening diaphragm type valves specifically designed for highly corrosive environments, such as petrochemical onshore and offshore installations. In this respect, the deluge valves and all their accessories are made of corrosion resistant materials, such as Nickel Aluminium Bronze, also suitable for sea water, foam concentrate and water foam solution. SA Fire deluge valves are manufactured for vertical or horizontal installation. The deluge valves and all their accessories have been designed according to NFPA 15, UL 260, and they are manufactured according to SA Fire's rigorous quality standards, using fully automatic CNC centres. All processes are carried out by highly skilled engineers and technicians providing SA Fire's customers with "state of the art" fire protection deluge valves.

Principle of Operation

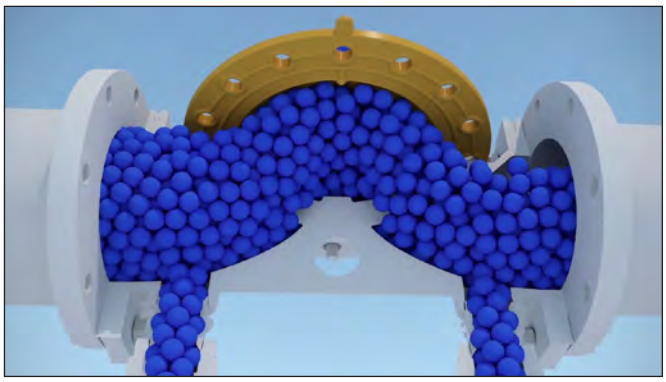
In the set position, the water is supplied to the priming chamber through the trim. The pressure of the water trapped in the priming chamber holds the diaphragm on the valve seat, keeping the valve closed. In fire conditions, the pressure



is released from the control chamber by an automatic or manual release device. The water supply pressure in the inlet chamber forces the diaphragm off the seat, allowing water to flow into the system and the alarm devices.

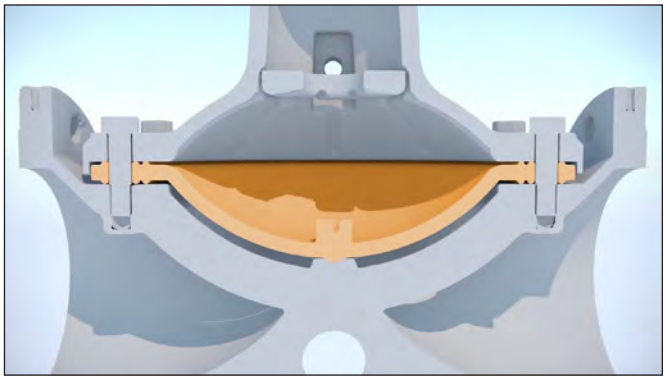
Deluge Valve Model VD

SA Fire deluge valves Model VD are traditional diaphragm type valves available in diameter sizes from 2" (DN 50) to 10" (DN 250). They have an inlet chamber, connected



to the supply side of the main line, an outlet chamber, connected to the fire suppression system side, and a priming chamber.

The inlet chamber and the outlet chamber are separated by the diaphragm that allows the valve to open and close. The diaphragm design, without mechanical moving parts, requires low maintenance and provides an obstacle free waterway,

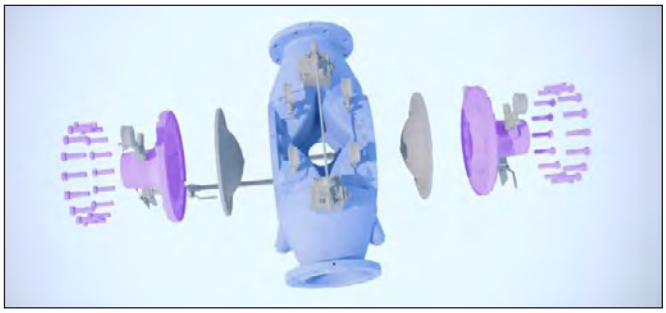


minimising the pressure loss through the valve. Model VD is specifically designed for harsh industrial environments such as onshore and offshore installations. It is suitable for use with sea water, foam concentrate or water foam solution. SA Fire deluge valves, Model VD, are **UL/cUL Listed**.

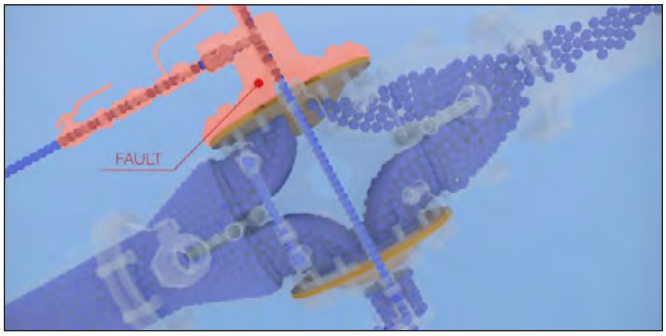
Double Chamber Deluge Valve Model VDD

The deluge valve Model VDD is an innovative concept valve designed for fire protection systems according to NFPA 15, UL 260 and IEC 61508/61511. The VDD deluge valve combines all the functions available on the traditional deluge valves with a **fully redundant architecture**, designed to achieve higher reliability.

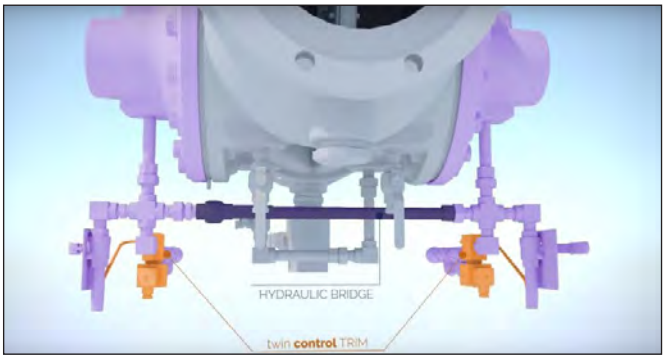
In fact, the VDD deluge valve has two priming chambers, each one provided with its own diaphragm (made of EPDM reinforced with Nylon) and actuation trim, which offer two



independent waterways to the water spray system
Each priming chamber provides the nominal design waterway for the fire protection system: in case of failure of one diaphragm, the opening of the other diaphragm allows the hydraulic waterway for the correct operation of the water spray system.



In practice, this new concept translates into a **built-in emergency bypass line** that operates on both priming chambers in hot back-up. Moreover, **a hydraulic bridge between the trims allows each trim to control both the diaphragms**, releasing the water trapped in the two priming chambers. If one trim should fail, the other trim can open both the priming chambers through the hydraulic bridge. Thus, **the double chamber deluge valve can overcome a double failure in the trim + priming chamber**. SA Fire deluge valves Model VDD are **UL/cUL Listed**.



Available Materials for Deluge Valve Models VD and VDD

In line with SA Fire's ability to deliver a customised offering that meets the client's specification requirements, SA Fire is able manufacture deluge valves in a variety of different materials such as Cast Iron, Cast Steel, Stainless Steel, Super Austenitic Stainless Steel, Duplex, Super Duplex, Hastelloy, Bronze, Nickle Aluminium Bronze, or Titanium.

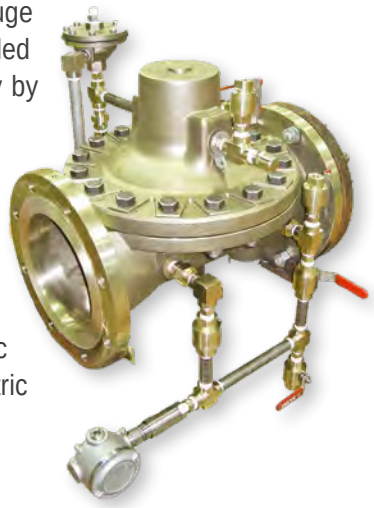
The materials of construction make SA Fire's series of deluge valves suitable for being used with sea water or water foam solution within harsh industrial environments & offshore applications. The cover plate on the VD and the cover plates on the VDD allow in-line maintenance and field replacement of the diaphragm.

Control Trims

The SA Fire series of VD and VDD deluge valves are compatible with a variety of control trims which can be equipped to meet different requirement needs. The control trims, tubing and fittings are available in Stainless Steel, Monel, Bronze and Nickle Aluminium Bronze. The SA Fire control trims can be equipped with different water and pressure gauges for a host of project requirements.

In normal operating conditions the deluge valves are held closed by the water pressure in the control chamber. In fire conditions water is released from the control chamber through the opening of the solenoid valve in the control trim, and the valve latches open under the effect of the water supply pressure. The valve can be manually opened through the emergency manual release on the control trim. The valve can be remotely reset closing the solenoid valve.

The VD and VDD deluge valves can be controlled manually and automatically by the following trims:



- Electric
- Pneumatic
- Electro-pneumatic
- Hydraulic
- On/Off Electric
- On/Off Electro-pneumatic
- Pressure Reducing Electric
- Pressure Reducing Electro-pneumatic
- Pressure Reducing On/Off Electric
- Pressure Reducing On/Off Electro-pneumatic

Electro-Pneumatic Models

The Electro-Pneumatic Deluge Valves are recommended for those applications where it is preferable to keep the solenoid valve dry, such as those with sea water or foam concentrate. The Electro-Pneumatic Deluge Valves are designed for external resetting, without opening the valve.

On/Off Electric Models

The ON/OFF Deluge Valves with electric actuation can be equipped with the relevant accessories (pressure switch, water motor alarm), they can provide actuation of fire alarms upon system operation.

The deluge valve ON/OFF electric Mod. VD/OF/E is available in vertical or horizontal configuration.

Pressure Reducing ON/OFF Electric & Electro-Pneumatic Models

The pressure reducing ON/OFF deluge valve models are available in diameter sizes from 2” (DN 50) to 10” (DN 250). The pressure reducing deluge valves models are used to control the pressure of water or foam/water flow for water spray or foam fire protection systems.

In normal operating conditions, the deluge valves are held closed by the control solenoid valve. In case of fire the solenoid valve will open allowing the valves to control the downstream pressure. When the solenoid valve is commanded to close also the deluge valve will return in closed position.

Approvals

The SA Fire series of deluge valves have:

- UL/ cUL Listing
- DNV Approval
- Lloyds Register Fire Test Certification
- Lloyds Register Tight Shut Off Classification VI
- SIL 2/3 (for VDD models only)
- GOST TR Fire Safety

Special Hazard Fire Suppression Systems

Fire Protection Solutions

Rim Seal
Automatic Fire Suppression Systems

Foreword

Rim Seal floating roof (FR) tank fires represent one of the most dangerous threats for chemical and petrochemical storage farms. Over the years, the world has experienced several rim seal fires and some of them have developed into large disasters. Generally, fire investigations have led to the conclusion that the fires were mainly caused by lightning, even though other causes could have occurred such as: sparks due to electrostatic charge, hot work accidents or uncontrolled exothermic chemical reactions. The latter is observed when the combustible liquid stored is crude oil, characterised by a high concentration of Hydrogen Sulphide. If it leaks from the seal, traces will be left in the internal tank shell. In such a situation, the Hydrogen Sulphide in contact with rust and air may react developing pyrophoric iron. The reaction is highly exothermic and may release enough heat with a high risk to cause ignition.

Background

The need for fast fire detection & suppression has become paramount and has pushed the fire industry towards the development of fire suppression systems that will act on the fire outbreak in its early stages of development. In fact, whatever causes are involved, when a fire develops in a floating roof tank and the phenomenon takes place in the rim seal zone, a fast and effective fire system is needed to avoid disastrous developments. In this respect, NFPA 11 recommends the use of foam systems which act directly on the foam dam. These systems have been shown to be effective but, their lead time to be operative, may be of concern. In this regard, an additional fire system capable of acting faster and more effectively is needed. The automatic rim seal fire suppression system is the solution to cope with a fire outbreak in its initial stage and, by means of its instrumentation, signals to activate the traditional fire systems.

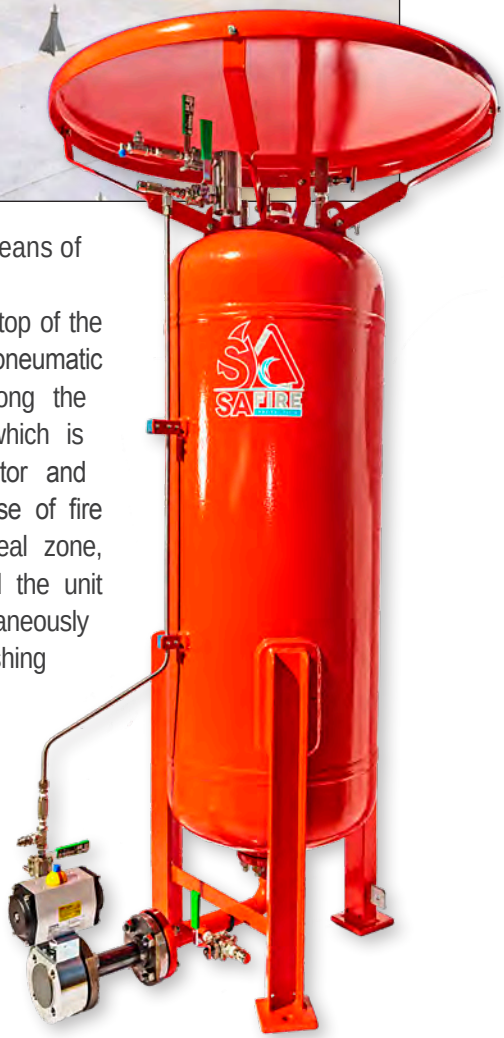
From the fire engineering point of view, there are two recognised fire suppression techniques used to detect and fight a rim seal fire. The first is by means of foam based fire suppression units, whereas the second relies on halocarbon

based firefighting units. Even though the two techniques act towards the same objective, the phenomenon used to gain fire control or extinguishment is different and requires an expert fire engineer to perform the project analysis of the seal and the product contents in order to select what is the best approach for the specific fire risk. Once the basic technique is selected, the next step is the definition of the unit architecture function of the site's environmental condition, fire detection response time, interface with other systems, discharge logics and consideration among the units of the same FR tank. SA Fire Protection is a leader in providing rim seal fire detection and suppression solutions for floating roof tanks, capable of delivering a wide range of rim seal system configurations, to satisfy every fire hazard, environmental condition and system control architecture.

Principle of Operation

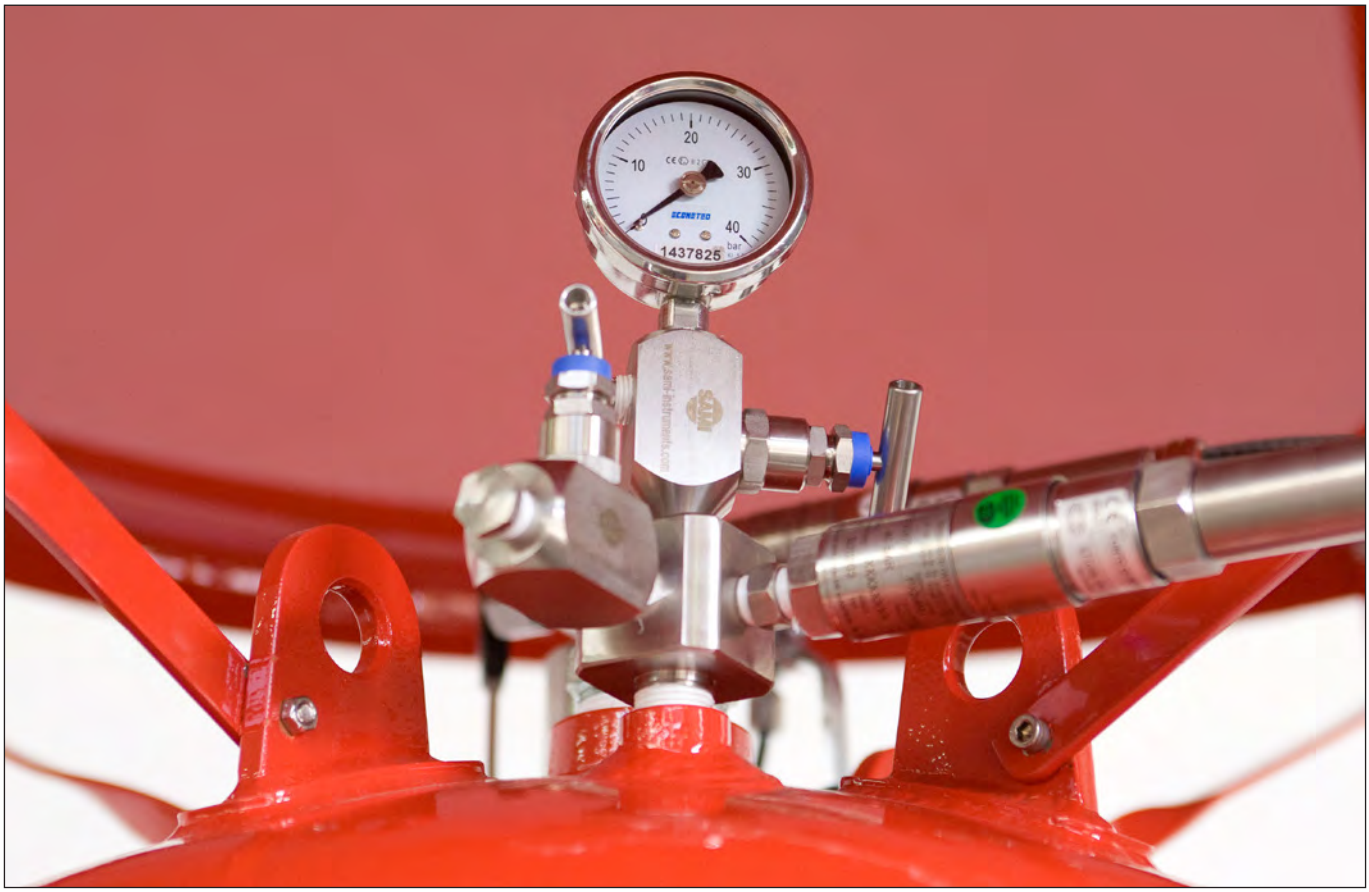
The Automatic Rim Seal Fire Suppression System is a package with an integrated linear fire detection system. The unit is designed for fast detection and suppression, releasing the extinguishing agent directly on the rim seal zone by means of directional nozzles.

The unit is installed on top of the floating roof and a pneumatic detection line runs along the whole protected arc which is used as a fire detector and system actuator. In case of fire outbreak in the rim seal zone, the detector melts and the unit is actuated instantaneously releasing the extinguishing agent. The system is designed to discharge in a very short time variable from 30 to 40 seconds, to extinguish the fire and avoid a fire spread.



The coverage of every unit shall be evaluated depending on each tank, its foam dam geometry and the classification of its contents. However, in most cases the unit is valid for roughly 40 meters of seal circumference protection.

Depending on the client specification, controls on board the foam unit can be achieved with two or more Ex pressure



switches, monitoring system pressurisation, activation and discharge. Level Controls can be used for halocarbons to monitor gas leakage. The contacts are then hardwired in a local JB and use a cable turnbuckle to exit the tank zone. Outside the tank there is an Ex ia JB with I.S. barriers used to interface with dedicated F&G or with other existing control systems. Every tank may be configured in a common zone or in a sectional zone depending on client activation preferences. Connections with F&G panels or other control systems may be achieved hardwired as well, via an ATEX compliant wireless communication system, including a master wireless panel with repeating antennas.

Functional Safety

Fire Protection Solutions

SIL Fire Systems

Foreword

After the major accidents which have happened in the oil & power industry in the last ten years, the technical community involved in the design of industrial processes has shown an increased and more intense interest in system safety and availability. The attention is no longer limited to the core process but is also extending its boundaries to all those safety systems to which the monitoring and the mitigation effects are demanded.

If it is paramount that a process must be designed with high reliability criteria, sometimes it is not fully understood that the process reliability cannot rule out the risk of an accident taking place. Engineering limitations also apply to a stressed safety-oriented design approach and therefore, one way or another, systems are finalised and built accepting a certain level of residual risk.

If the risk of an accident cannot be lowered below a certain point, we should focus our attention on those systems designed to monitor the environment and provide mitigation effects. Those process sub-systems such as fire & gas, deluge, monitors and gaseous based fire extinguishing systems play a fundamental role in the safety of the plant and its occupants.

These systems are called into action when the residual risk of the hazard turns into an accident of major consequence, their duty is to warn the occupants and the operators and to mitigate the accident effects to the best of their capabilities.

In this respect, it is well known that a gas cloud detected and confined in time or a fire outbreak detected and extinguished by deluge water spray have the same objectives: saving lives, limiting the impact on the environment, reducing the production losses and safeguarding investments.

For the reasons above, functional safety is moving into fire & gas detection and suppression systems, with the objective of increasing the reliability and hence the performance of the safety functions used to monitor and mitigate the effects of a possible accident.

Functional Safety

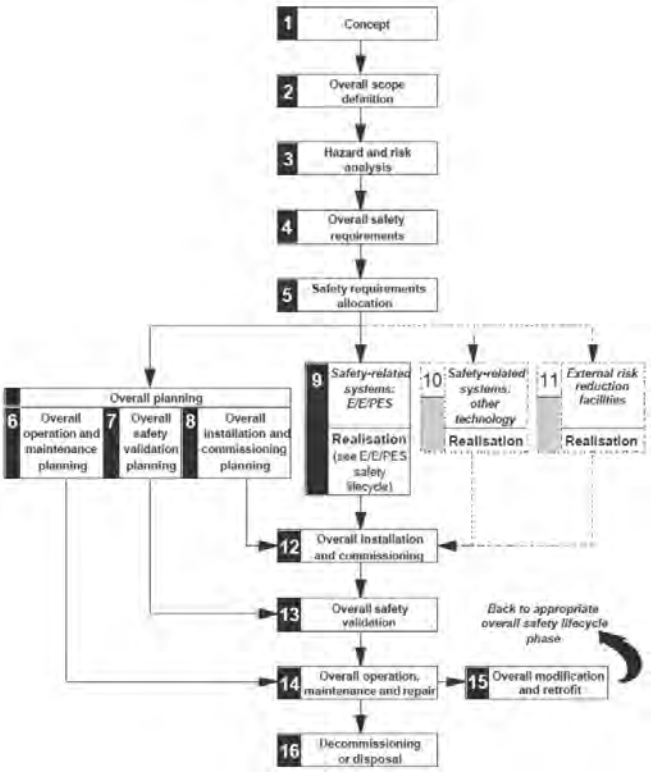
Safety is the absence of an unacceptable risk of physical injury to people or damage to the properties. Functional Safety is part of the overall safety that depends on a system or equipment operating correctly in response to its input.

The significant hazards for the system have to be identified via hazard analysis. If the hazard analysis shows that functional safety is necessary, appropriate systems are required to perform specific Safety Functions to reduce the risk. These systems are called Safety-Related Systems or Safety Instrumented Systems (SIS).

Two types of requirements are necessary to achieve Functional Safety:

· Safety Function Requirements: the scope of the safety function, derived from the hazard analysis;

· Safety Integrity Requirements: the probability that the safety function will be performed satisfactorily, derived from the risk assessment.



The Standard IEC 61508, "Functional Safety of electrical / electronic / programmable electronic (E/E/PE) safety-related systems", covers all the safety lifecycle activities, from the initial concept through hazard analysis and risk assessment, development of safety requirements, specification, design and implementation, operation and maintenance. IEC 61508 contains requirements for preventing failures and controlling failures, ensuring safety even when faults are present. It specifies the techniques and measures to achieve the required Safety Integrity.

IEC 61508 specifies 4 levels of safety performance for a safety function, called Safety Integrity Level (SIL). SIL1 is the lowest level and SIL4 the highest level. The Standard

details the requirements necessary to achieve each Safety Integrity Level.
The table below provides the target failure measures for a safety function allocated to a SIS operating in low demand mode. Low demand mode means that the frequency of demands for operation of the SIS is not greater than once per year, and not greater than twice the proof-test frequency.

Fire & Gas Systems

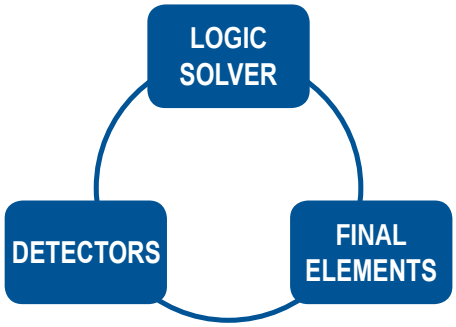
The tasks of a F&G system is to monitor environmental conditions and to detect any hazardous fire or gas condition related to an emerging fire or gas leakage. The systems are designed to alert the personnel in the area and to activate the control and mitigation systems. More often the F&G system is comprised of one or more control panels each of

Safety Integrity Level (SIL)	Average Probability of Failure on Demand (PFD_{avg})
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$

which is interconnected with field detectors, signaling units and actuators. The panel and the detectors are monitored in order to distinguish any environmental deviation that can be connected to irregular environmental conditions. This is the case in detecting the presence of Smoke, Heat, Flame or Gas either combustible or toxic within the monitored area. Furthermore, the panel and the monitoring instrumentation are analysed to validate the condition of the firefighting systems. The trip function is correlated with other superior systems such as the ESD or DCS and it is used to transfer the confirmation that certain hazardous conditions have been detected. When hazardous conditions are detected. The mitigation systems (water or foam deluge skid) will be actuated with the purpose of containing a gas cloud or to suppress an emerging fire.
The F&G system effectiveness is the product of the following three factors:
· Detection Coverage: The fraction of the monitored area in which an eventual fire or gas hazardous condition would be detected.
· Mitigation Effectiveness: The probability that the activation of the Final Elements would reduce the consequences of a defined hazard.
· F&G Safety Availability, SA: It is connected to the Probability of Failure on Demand (PFDavg) by the following equation: 1-PFDavg. The PFDavg measures the Safety Integrity Level (SIL) of the system.
The Safety Availability of a F&G system can be evaluated through a Fault Tree Analysis (FTA) based on the PFDavg of each component. The main components of a F&G system are the following:
· Fire, Gas or Heat Detectors;
· Logic Solver;
· Deluge system, Shut Down system, etc. (Final Elements).

Final Elements

So far, the manufacturers' efforts to meet the functional safety criteria for F&G systems have focused mainly on electric and electronic devices, providing components suitable for increasing SIL rated systems according to the desired level of functional safety.
However, the F&G system effectiveness is related to the Safety Availability of all its components: the overall performance of the system is affected by the weakest element in the chain of its components.



This is the reason that has led SA Fire to focus its attention on the Final Elements, developing the following SIL suitable solutions according to IEC 61508 for the main types of firefighting systems (i.e. deluge water spray systems, monitors and gaseous based systems):

· The Double Chamber Deluge Valves Model VDD, suitable for SIL3 systems;

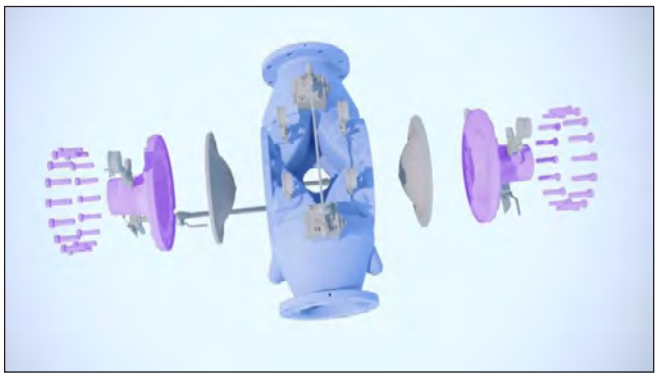
· The Electric Niagara Monitor Series, suitable for SIL2 systems;

· The Double-Coil Electric Actuators for gaseous based systems, suitable for SIL2 systems.

The SA Fire SIL suitable Final Elements are validated by Bureau VERITAS for integration within safety functions performing fire protection service in low demand mode.

Double Chamber Deluge Valve Model VDD

The deluge valve Model VDD is an innovative concept valve designed for fire protection systems according to NFPA 15, UL 260 and IEC 61508/61511. The VDD deluge

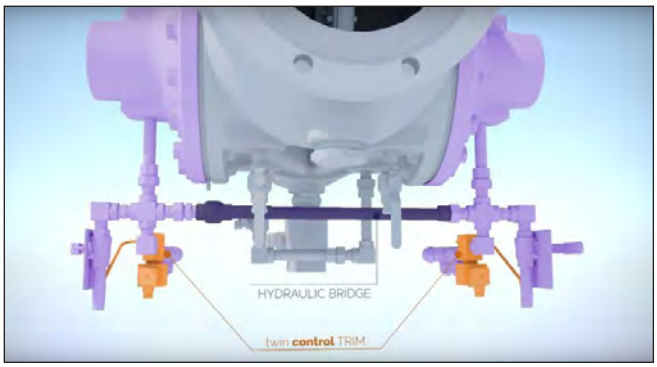


valve combines all the functions available on the traditional deluge valves with a fully redundant architecture, designed to achieve higher reliability.

In fact, the VDD deluge valve has two priming chambers, each one provided with its own diaphragm (made of EPDM reinforced with Nylon) and actuation trim, which offer two independent waterways to the water spray system. Each priming chamber provides the nominal design waterway for the fire protection system: in case of failure of one diaphragm, the opening of the other diaphragm allows the hydraulic waterway for the correct operation of the water spray system.

In practice, this new concept translates into a built-in emergency bypass line that operates on both priming chambers in hot back-up.

Moreover, a hydraulic bridge between the trims allows each trim to control both the diaphragms, releasing the water trapped in the two priming chambers. If one trim should fail, the other trim can open both the priming chambers through the hydraulic bridge. Thus, the double chamber deluge valve can overcome a double failure in the trim + priming chamber.



Advantages:

The first advantage of using the VDD deluge valves can be measured in terms of increased reliability, followed by lower response time and easier system operations.

The subsequent example is often used to describe the VDD valve's performance. Consider a fire or gas emergency condition where the deluge system has to be actuated to respond to a fire outbreak or to mitigate a gas cloud detected by the F&G.

All the deluge systems commonly used comprise of a main deluge valve and an external bypass line, installed on the deluge skid, intended to provide manual actuation should the deluge valve fail on demand. It is when similar scenarios take place that the VDD deluge valve makes the real difference. The VDD design can overcome a double failure affecting the whole valve assembly, meaning that it is very unlikely for the VDD valve to fail on demand.

Besides its increased reliability, which by itself is essential when fighting a fire or an expanding gas cloud, the time required for the VDD to respond to a failure affecting the valve is reduced to zero.

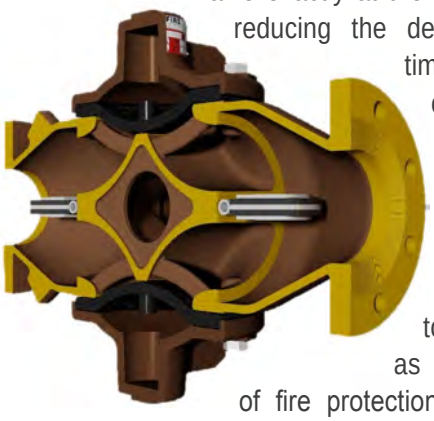
Looking back at the traditional deluge valves, the time needed for the operator to respond to a failure can be summarised as follows:

TR = T1+T2+T3+T4

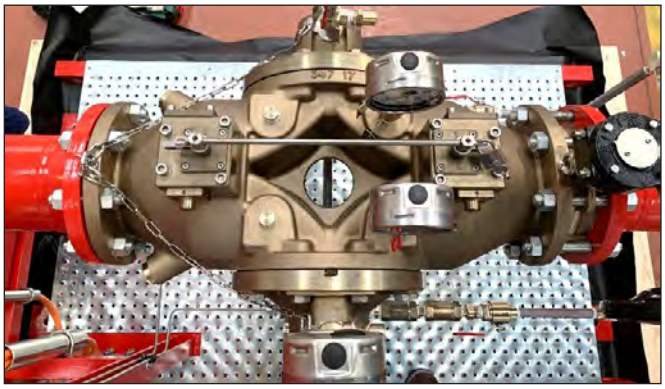
Where:

TR = Time required to respond manually and activate the water spray system via the bypass line.

T1 = Time needed from signal sent via logic controller or manual activation to come back to Control Room signalling that deluge valve did not open.
T2 = Time needed for operator to analyse the signal and initiate emergency procedures.
T3 = Time needed for operator to respond to a given emergency message
T4 = Time needed for the operators to reach the failed deluge skid and open the bypass line.
Anyone can argue about the length of each time interval shown above, but the final conclusion is always the same: the time for VDD to respond to a failure is zero.
The reason is simple and lies in the fact that the procedures required to operate standard deluge skids are not necessary with the VDD valve. In fact, the VDD deluge valve responds automatically to any failure affecting the valve exactly at the same time as it occurs, reducing the deluge system response time to zero even in faulty conditions and granting the opening of the valve.



Another advantage is the limited operational man power required to operate the system as well as the continuity of fire protection service, which allows equipment to always be protected.
It is in fact good common practice for owners & operators to perform maintenance of their fire systems on a regular basis, following the procedures given by NFPA 25 and their deluge valve manufacturer.
When performing an internal inspection of a deluge valve or cleaning the filters and orifices of the trim, there is no possibility of keeping the deluge valve in service and, therefore, the system must be completely isolated. In such cases, operators have very little choice and are left with two possibilities: shutting down the production process or keeping an operator, who is in contact with the control room, “nearby” the bypass line of the deluge valve, ready to open water. With the VDD deluge valve these issues will no longer be on top of the operator’s head.
The new deluge systems equipped with the VDD deluge valves will be subject to maintenance or repair with the exact same frequency and procedures required for traditional deluge valves. The main difference concerns the protected plant process which does not require shutting down. This reduces all production losses, due to fire protection impairment, to

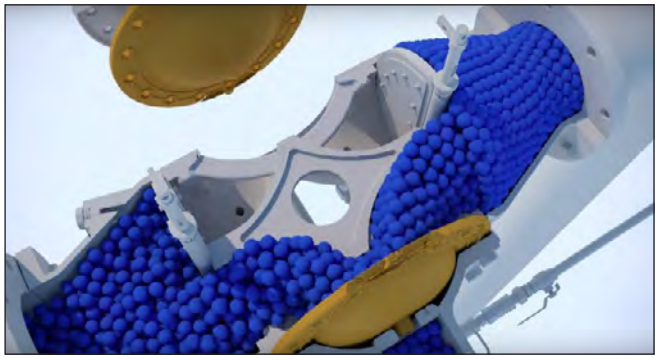


zero. Last but not least, the operators are not required to stand by the deluge bypass line during maintenance or repair.

All this is possible because of the VDD deluge valve’s redundancy, the maintenance isolation mechanism and the distributed activation trim.
When deciding to perform maintenance or repair on a VDD deluge valve, the operator can work on the external of the VDD valve unlocking the isolation system. This allows the isolation of one of the two chambers. The chamber must be isolated downstream and upstream by the two built-in isolation valves and the interlock system must be repositioned to move forward. The interlock system is designed to fit and close only when the valve chamber is correctly isolated, to prevent human error and increase the overall reliability of the VDD assembly. The following operation is to isolate the trim closing specific valves. In this way, the operators can work on the isolated trim and chamber and can even perform the internal inspection of the chamber as prescribed by NFPA 25. While working on one chamber, the other chamber remains in operation providing continuous fire protection.
Once the inspection procedures of the first chamber are finished, the isolation system may be moved towards the other chamber to complete the inspection.

An external indicator and proximity sensors provide visual and remote information on the isolation status of the VDD

valve. So, the control room can monitor the maintenance work and receive feedback about the valve status after the inspection.



The built-in isolation device grants continuous fire protection, and therefore does not require the user to alert the local fire brigade every time the deluge valve is under maintenance or repair, as required by NFPA 15 and NFPA 25.
From the designer prospective, the VDD deluge valve combines high safety availability with low weight and small dimensions of the deluge skid. The integrated redundancy and hot back up rule out the need of an external bypass line on the skid, sensibly reducing weight, dimensions and cost of the whole skid.
The VDD deluge valve concept has been developed by SA Fire designers in order to meet the criteria set forth in IEC 61508 and therefore providing the highest reliability possible for water/foam fire systems meant to provide mitigation effects and likely to be involved in life saving actions.
Thus, the design in terms of functional safety has become of paramount importance for systems performing safety functions, and particularly for fire suppression systems. This is the reason that has led SA Fire to develop firefighting equipment designed to meet Safety Integrity Level (SIL) criteria according to IEC 61508.

Minimum SIL ratings for deluge systems intended for fire protection in the Oil & Gas and Power generation plants, are already recommended by the major international organisations.

As an example, the Norwegian Oil Industry Association recommends ("Recommended Guidelines for the application of IEC 61508 and IEC 61511 in the petroleum activities on the Norwegian Continental Shelf") a minimum SIL2 level for the "deluge valve including actuator, solenoid and pilot valve".
For these installations requiring high safety function performances, SA Fire has specifically developed and patented the Double Chamber Deluge Valve Model VDD, designed to overcome double failure.
The VDD valve is available in diameter sizes from 3" (DN 80) to 8" (DN 200).
Model VDD is used to control water flow in deluge, pressure reducing and ON/OFF systems. It can be controlled manually and automatically by electric or electro-pneumatic release systems.
The deluge valve model VDD is validated by Bureau VERITAS (BV) for being used in safety instrumented functions with an expected SIL3 level in low demand mode, when equipped with electric, electric ON/OFF, electro-pneumatic and electro-pneumatic ON/OFF trim. VDD is UL/cUL Listed.

Application:
Model VDD deluge valve is specifically designed for harsh industrial environments such as oil & gas onshore and offshore, chemical, conventional or nuclear power, military and those which require:
1) A low probability of failure on demand;
2) A safety instrumented system with a deluge system as

final element capable of being integrated into SIL3 systems;
3) Continuity of fire protection during maintenance or repair;
4) Reduction of weight, dimensions and cost of the skid.
The VDD deluge valve is made of Nickel Aluminium Bronze and it is specifically designed for sea water, foam concentrate and water foam solution.

Electric Monitors

The SA Fire Niagara firefighting monitor series are electric type remote controlled water cannons intended to deliver large amounts of water or water foam solution towards remote targets. They are commonly used to protect petrochemical jetties or within the process areas to cool structures, vessels or fight potential fires of a considerable magnitude.
From the safety availability point of view, the remote-controlled monitor architecture comprises of a Logic Controller and one or more Final Elements (Monitor Assembly). The Logic Controller is the heart of the system and distributes the commands to the monitor itself.
In such systems, or at least in the simplest version, the detector is not normally integrated and the system responds directly to human actions.
The Niagara monitors have been assessed and validated by BV as suitable for safety instrumented systems with an expected SIL2 level.

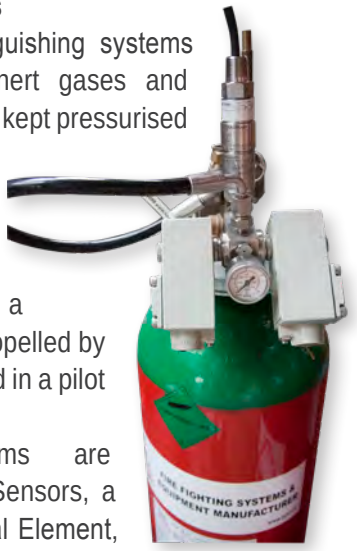
The increased reliability performance of the Niagara series monitor is related to its particular design, which allows automatic self-diagnostic analysis to be performed. At regular intervals, the self-diagnostic system implemented in the Logic Controller checks the correct operation of the monitor actuators on given commands, allowing for constant monitoring of any possible failure of the monitor and the nozzle. In case of an anomalous condition, a warning signal is sent to the control station.

Advantages:
The possible failure of a traditional electric remote-controlled monitor can be detected only when periodic maintenance and tests are performed. The constant monitoring of the system status implemented in the Niagara monitor series, instead, allows a possible failure to be detected and repaired when the fire protection system is in “safe condition”, sharply increasing the reliability of the overall fire system on demand. Such an improvement reduces the probability that faults, taking place between regular maintenance intervals, will pass undetected.
Detecting a possible fault in a safety system in time, rather than in a fire condition, can make the difference in the success of the emergency operation.

Application:
The Niagara series monitors are specifically designed for petrochemical jetty and marine harbour protection, structure and vessel cooling, and those systems which require:
1) A low probability of failure on demand;
2) A safety instrumented system with monitors as final elements capable of being integrated into SIL2 systems;
3) A large amount of water towards remote targets. The Niagara series monitors are designed for sea water and water foam solution.

Electric Actuator for Gaseous Based & Water Mist

Fire Extinguishing Systems



Gaseous based fire extinguishing systems include carbon dioxide, inert gases and halocarbons. All of them are kept pressurised in cylinders or containers ready to be discharged to the protected area. On a similar principle, water mist systems are made of a series of water cylinders propelled by a nitrogen reserve contained in a pilot cylinder.

Normally these systems are composed of a series of Sensors, a Logic Controller and a Final Element, which is often represented by a pilot cylinder.

When such systems are called for duty, a missed activation of the pilot cylinder can lead to an unacceptable consequential scenario. The SA Fire pilot actuators have been developed for sensibly reducing the probability of such failures and increasing the Safety Availability of the fire extinguishing system. They have been validated by BV as suitable for safety instrumented systems with an expected SIL2 rating.

Advantages:

The redundancy of the double-coil electric actuator increases the reliability of the overall pilot cylinder. The actuator has two coils which receive two independent signals from the logic controller (F&G). If one coil should fail, the other coil is able to open the cylinder valve.

Such a solution has been implemented to cover all those fire hazards which require increased reliability for the fire extinguishing system and, therefore, a safety function with an expected SIL2 rating.

Application:

The double-coil actuator is designed for those systems which require:

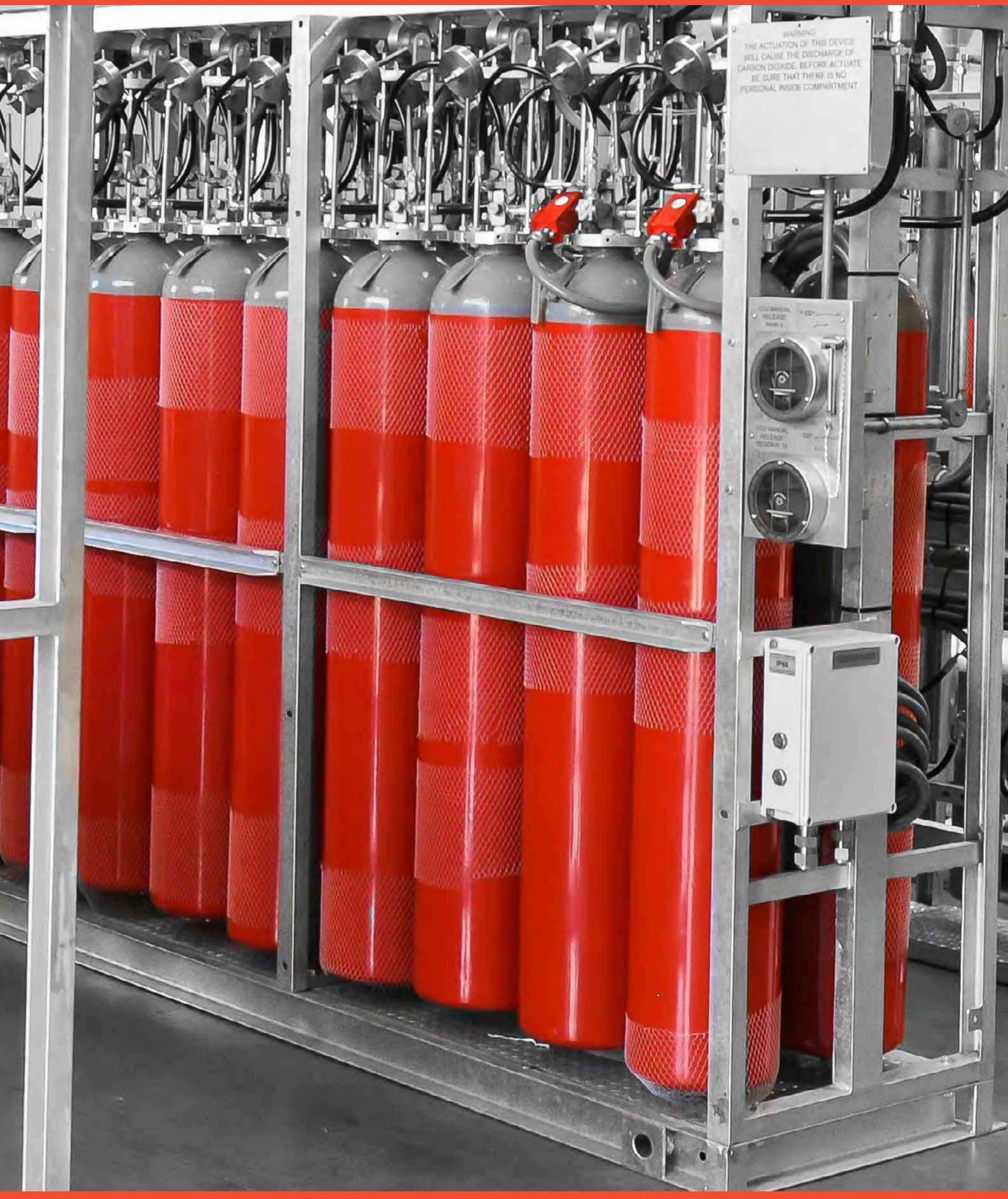
1) A low probability of failure on demand;

2) A safety instrumented system with a gaseous based fire protection system as the final element, capable of being integrated into SIL2 systems;

3) The combination of a high safety integrity level with low dimensions and weight.

The double-coil electric actuator is specifically designed for the protection of gas turbines and their generators, critical IT server farms, electronic rooms governing industrial processes, and all general purpose installations on off-shore platforms or FPSO vessels, where generally a fire brigade is not easily available to compensate a possible firefighting system failure.

Gaseous Systems



Fire Protection Solutions

Carbon Dioxide & Inert Gas Extinguishing Systems

Foreword

Carbon Dioxide (CO_2) is widely used in the fire industry as an extinguishing agent for total flooding and local application fire suppression systems. Physically the CO_2 is an electrically non-conductive, odourless and colourless gas. It is heavier than air and does not leave residuals upon discharge. These properties make it a perfect choice for the fire protection of highly valuable equipment. Carbon Dioxide is then preferred to protect hazards in normally unoccupied areas, where the presence of personnel in the protected spaces is regulated by safety devices and procedures.

Inert Gases are widely used in the fire industry as extinguishing agents for total flooding fire suppression systems within normally occupied areas. Physically inert gases are electrically non-conductive, non-toxic and environmentally friendly making them a perfect choice for the fire protection of normally occupied areas and highly valuable equipment.

SA Fire is a manufacturer of Hardware & Systems approved to EN 12094 for CO_2 and inert gases such as IG-01, IG-100, IG-55 and IG-541.

These gases are very effective and suppress fires by oxygen depletion, thus creating a surrounding atmosphere where the combustion processes cannot be sustained. These gases are stored in high pressure containers connected to a piping distribution network that runs from the cylinder bank to the protected area. Upon system activation, the agent is released from the container and travels in the pipe-work till it reaches the discharge nozzles. When discharged, the gas fills the area creating a low-in-oxygen atmosphere that causes a rapid fire extinguishment. The

cylinders may be stored inside dedicated rooms or outside in designated areas. Depending on the installation, they may be located in specifically designed open racks or inside closed cabinets.

Overview

The SA Fire HP Carbon Dioxide and Inert Gas fire extinguishing systems provide protection for a variety of industrial hazards. Every system is manufactured according to client specifications and may assume various configurations depending on the features that are selected. Standard systems are made of cylinder assemblies, valves, actuators, a manifold and discharge nozzles.

For each system, one or more cylinders are configured as pilot cylinders and therefore they are equipped with an actuator that provides local and remote valve opening. The rest of the cylinders are configured as slave cylinders, hence they receive a pneumatic command from the pilots to open their own valve. All cylinders are secured to a cylinder rack that may be a wall type, self-standing open type, or a self-standing closed cabinet. The latter may include also complementary systems and controls such as lights, heaters and HVAC. Each cylinder bank, independently from its configuration, may be provided with components suitable for hazardous areas and/or with SIL2 actuators.

Container Assembly

The cylinders used for SA Fire HP Carbon Dioxide fire extinguishing systems are T-PED compliant, manufactured according to EN 1964-2 and ISO 9809-2. They are available in different capacities (7.7, 14, 27,40, 60, 67,5 and 100 litres) and are normally filled with carbon dioxide with a filling density of 0,67 kg/L.

The cylinders used for the SA Fire Inert Gas fire extinguishing systems are T-PED compliant and available in two different capacities (80 & 140 litres).

Standard cylinder assembly for CO_2 is equipped with a cylinder, a siphon tube and a valve. They are available in two configurations: pilot and slave. The pilot configuration comes with a solenoid valve and is used to initiate a system discharge, meanwhile the slave cylinder is actuated pneumatically upon activation of the pilot cylinder. The Carbon Dioxide cylinders are designed for vertical installation. Both CO_2 and Inert cylinders are shipped with a metallic protection cap that provides physical protection during handling.

Gaseous Valves

The container valve consists of a forged Brass or Stainless Steel body held in a normally closed position. The valve is pressure operated and includes also a manual lever for emergency actuation. The valve is designed for multiple threaded connections which accommodate the actuator and the cylinder connection. The valve is also equipped with provisions for a safety disc holder and a double port connection to host single or redundant actuators.

Gaseous Actuators

Single and redundant actuators are used to activate the pilot cylinders and initiate the gas system discharge. They are available with a Brass or Stainless Steel body and can be coupled with one or two solenoids. In Inert Gas systems, each actuator may be coupled to a pressure gauge indicating the cylinder pressure, with the SPDT contacts for remote indication of the cylinder charge.

Actuators with double solenoids are designed for use within SIL2 compliant installations and are therefore

specifically addressed to protect valuable industrial process applications such as gas turbines, generators, turbo compressors, server farms, data centres, highly valuable systems or equipment etc. The actuators can be installed directly onto the gaseous valve or connected to a separate nitrogen pilot cylinder when a separate source of actuation is preferred.

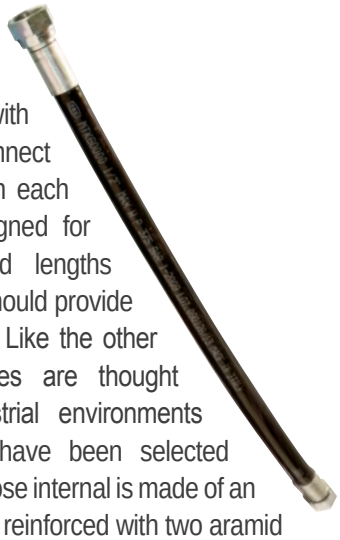
Check Valves

Check valves are available in Brass, Bronze or Stainless Steel. There are two types of check valves installed in the SA Fire HP Carbon Dioxide & Inert Gas fire extinguishing systems. The standard check valve is used for flow control purposes, allowing gas to flow only in one direction. The restricted check valve is used for flow control and for diverting part of the pilot cylinder gas to keep the pilot line always under permanent pressure.

Weighing System

Minor gas losses within valve and valve components may happen in a gaseous based fire extinguishing system. The weighting device is a system that monitors the cylinder weight overtime and gives visual and remote indication in the case of cylinder weight losses. The weighing device is a concentric Brass and Stainless Steel mechanism that connects a counterweight with a cylinder. The counterweight is then calibrated to be in perfect equilibrium with the charged gas cylinder in a way to detect very precisely any loss of weight from the container. In the case of gas loss, the counterweight moves downwards, indicating that the cylinder has lost its charge. Each weighing system may be equipped with a micro switch that provides signalling to remote fire panels. These micro switches are available for harsh industrial environments as well as for hazardous areas. The weighing device application is used for CO_2 instead of electric monitored pressure gauges when the Carbon Dioxide system is to be located in hazardous areas.

Flexible Hoses



The flexible hoses are used to connect discharge valves with a manifold and to interconnect pneumatic actuation circuits with each valve. Flexible hoses are designed for multiple connection types and lengths depending on the service they should provide within the extinguishing system. Like the other components, the flexible hoses are thought to withstand all difficult industrial environments and therefore their materials have been selected accordingly. In this respect, the hose internal is made of an oil resistant polyamide substrate, reinforced with two aramid fibre braids and one steel braid covered by a micro-perforated polyurethane resistant to abrasion, oil and atmospheric agents.

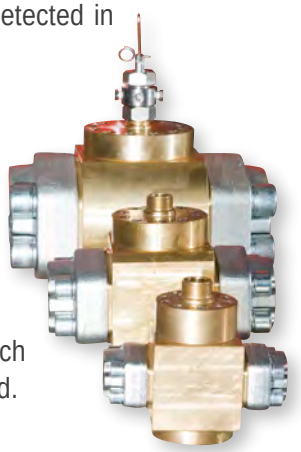
CO_2 Pneumatic Discharge Time Delayer

The pneumatic delay unit is used to delay the Carbon Dioxide into the protected zone. The installation of a delay unit allows enough time for a safe exit from the protected zone before system discharge. Normally it is set at a 30 second delay even though it can be adjusted to meet different requirements or specific emergency exit plans.

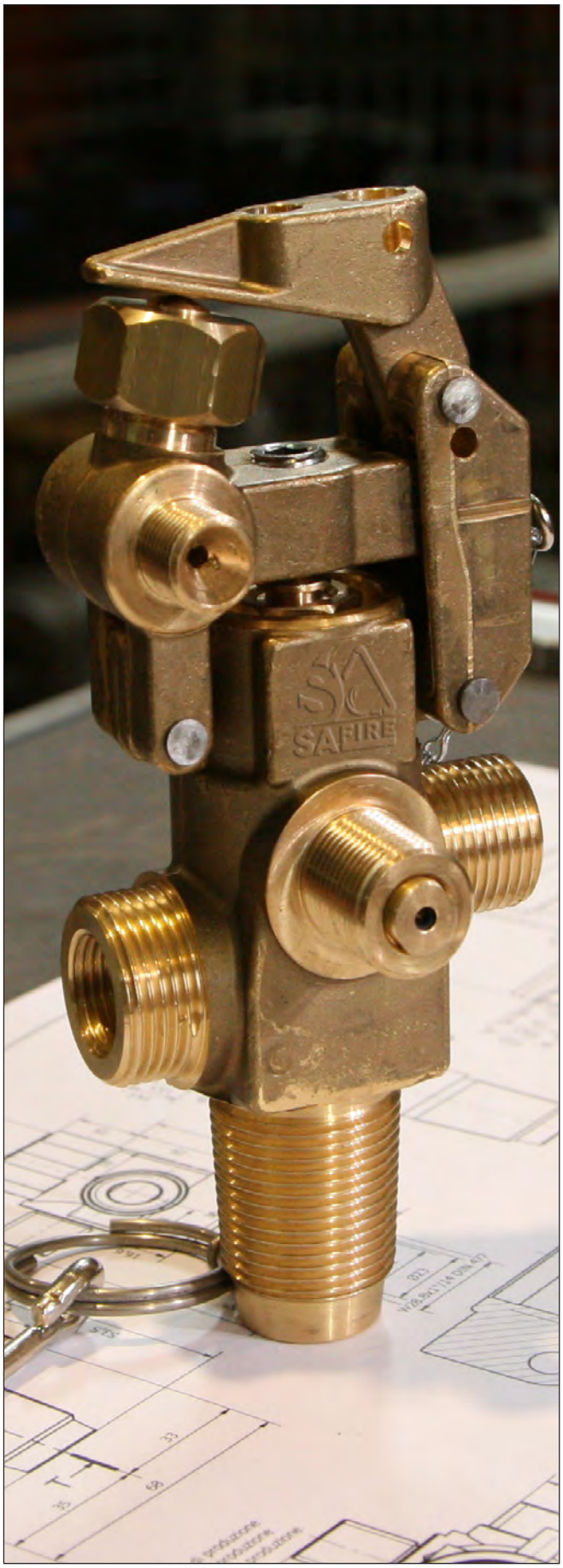
CO_2 Odourisers

When Carbon Dioxide is discharged in local application systems or even in total flooding, the possibility that the Carbon Dioxide cloud expands in the surrounding areas cannot be ruled out. Because CO_2 is odourless, this phenomenon may be a threat to human life.
To avoid such a risk, SA Fire has developed a safety odouriser that injects a specific odour into the flowing Carbon Dioxide during the system discharge. This makes the Carbon Dioxide detectable to human sense and therefore warns personnel about the dangerous presence of Carbon Dioxide even when detected in small concentrations.

Directional Valves



Selector or directional valves are used to protect multiple areas using a common cylinder bank. The valves act as blocking devices directing the gas flow only in the compartment which requires the gas to be discharged.



Nozzles

SA Fire HP Carbon Dioxide and Inert Gas nozzles are designed for total flooding.

The CO_2 nozzles are for local application systems and these nozzles are designed for multiple threaded connection (½" and ¾") M. NPT ensuring perfect gas distribution thanks to the several geometric options available. Whereas the Inert Gas nozzles are available in a variety of directional flow configurations. The gas flow can be distributed at 45°, 90°, 180° and 360° for perfect gas distribution within the protected space

All nozzles are manufactured in brass or stainless steel and may be provided with protection caps to avoid nozzle clogging in dirty environments.

Cylinder Rack & Cabinet

Cylinders used in the Carbon Dioxide and Inert Gas fire extinguishing systems shall be secured together to form an assembly. There are various cylinder installation options available: wall type, open rack, closed cabinet.

The wall type rack assembly is the simplest solution, which is mainly used when cylinders are kept stored in dedicated rooms. In this case, the rack consists of two rows of galvanised steel channels & brackets with bolts. The open rack type assembly is a self-standing structure made of galvanised steel. It hosts the system manifold in the middle of the rack, using a reinforced channel to hang cylinders by means of their weighing system. The structure can be delivered with a further base frame allowing fork lifting on site. For large systems, the structure is divided into modules that can be easily coupled on site.

The closed cabinet is a fully covered, self-standing structure with one or more doors allowing for system inspections. The cabinet is manufactured using a galvanised steel

frame with carbon steel sheets covering the structure. The cabinet may be provided with insulation material on all sides and with additional systems such as heaters and air conditioning. Such accessories make it suitable for installation where the environmental temperature may bring the cylinders under or above the suggested working temperature. If required, cabinets may be manufactured in modules and fully assembled with a structure suitable for site lifting when fully assembled. Racks and cabinets are manufactured in compliance with specifications issued by the world's largest manufacturers of gas turbines.
Accessory systems may be provided for hazardous area installation.

Actuation Methods

The SA Fire HP Carbon Dioxide and Inert Gas extinguishing systems may be selected with two actuation methods. The first method uses an auxiliary cabinet with one or two nitrogen pilot cylinders. In this case, the nitrogen cylinders may be actuated electrically using a solenoid valve (single or redundant) or manually by means of a manual pull lever. In any case, when actuated the nitrogen is released towards the CO_2 / Inert Gas valves resulting in their sequential opening. In this installation, all the CO_2 / Inert Gas cylinders are configured as slaves meanwhile the pilots consist of an external source of nitrogen cylinder(s).
The second possible actuation method is that of connecting the solenoid actuators directly on top of the CO_2 / Inert Gas valves. In this case, the pilot cylinder(s) are represented by the same CO_2 / Inert Gas cylinders present in the system. Upon actuation, the CO_2 /Inert Gas is released from the pilot(s) and then diverted to the slave cylinders resulting in a quick and sequential actuation of the whole system.

Special Configurations & Accessories

The SA Fire HP Carbon Dioxide and Inert Gas fire extinguishing systems are mainly used for the protection of industrial fire risks involving valuable equipment. In this respect, the SA Fire Gaseous Systems are featured with several accessories and configurations developed in order to fulfil all safety and process requirements for securing a highly reliable fire suppression unit.

Redundant Cylinder Banks

Redundant cylinder banks are a common practice for all those protections where it is paramount that the fire extinguishing system shall be kept in service at all times. To cope with such requirements, the SA Fire Gaseous Systems can be arranged in a redundant cylinder bank configuration where the first bank is used as the main one, while the second is used as a stand-by unit. If the first system experiences a discharge or simply is undergoing a regular inspection, the second bank is activated as the main protection allowing for the first bank to be disabled. In this configuration protection is always granted, the machines are always protected and back in commercial operation in no time. The redundant cylinder bank is made up of two twin systems connected to the same manifold where the wiring for actuators and signalling devices is collected in one or two JBs and uses a main switch to select from first to second bank and vice versa.

SIL Actuators

Due to the increase of safety requirements for systems in the Oil & Gas, Chemical and Power Generation industries, SA Fire has developed a special series of actuators which comply with IEC 61508 & IEC 61511 meeting the requirements of Safety Integrity Level (SIL2). These actuators are used

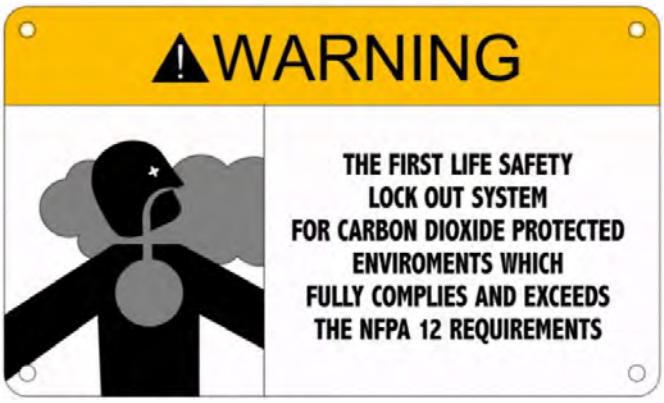
within fire systems that protect industrial processes where the probability of failure on demand (PFD) is reduced to a minimum. The redundant actuators are installed on a single CO_2 valve and allow the pilot cylinder to be actuated by one or two separate signals ensuring operation even if one of the two should fail.

Personnel Safety Systems

Safety Interlock

Carbon Dioxide fire extinguishing systems are very effective solutions for fire protection. However, due to the physical properties of Carbon Dioxide, these systems may be dangerous for human life and therefore are designed by professional fire protection engineers and managed by trained personnel.

One of the most dangerous hazards related to gaseous based extinguishing systems is the accidental release of the extinguishing agent while personnel are present within the protected zone.

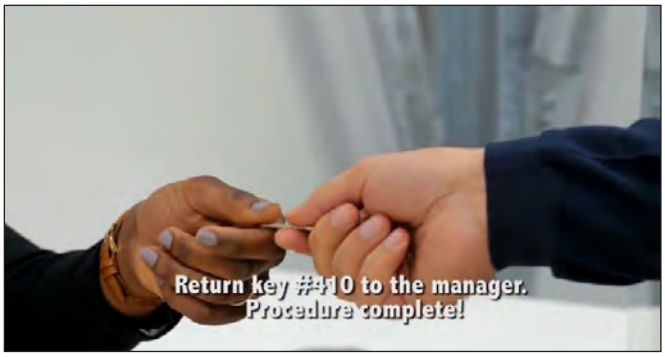


To avoid such situations in CO_2 systems, NFPA 12 has included in its 2008 edition the introduction of lock off units to prevent accidental Carbon Dioxide discharge into the protected space. To avoid such situations in Inert Gas systems, the introduction of a shut off unit in the actuating circuit prevents accidental discharge into the protected space. Lock off and shut off units are devices used to isolate the SA Fire HP Carbon Dioxide fire extinguishing system when personnel are required within the protected spaces. The lock off unit is installed upon the main entrance of the protected space while the shut off is installed on the pilot cylinder actuating circuit.

The shut off is installed on the pilot cylinder actuating the circuit providing a mechanical block to system actuation. Both provide increased personnel safety and allow for the establishment of an entering procedure that avoids accidents. Both units are equipped with locks and micro switches providing indications on the system's status to the remote fire panels.

SA Fire manufactures a series of NFPA 12 compliant lock off devices with interlocks and a series of shut off valves that allow the implementation of a "safe to enter" procedure controlled by position switches and remote signalling of the system's status.

The lock off devices can be installed just outside the main door of the protected space or located on the Carbon Dioxide skid providing isolation of either the pneumatic actuation line or the gas discharge manifold in CO_2 systems. For inert gas systems, the lock off devices can be installed in the system skid providing isolation of the pneumatic actuation line. These solutions provide for the safe entry of personnel by means of a set safety procedure as well as the possibility to report the system status to remote control panels or DCS.



Application

The SA Fire Gaseous fire extinguishing systems are used mainly to protect industrial fire risks involving valuable machinery or processes such as: Electronic Rooms; Gas Turbines; Generators; Compressors; Engine Rooms; Control Rooms; Server Farms; Financial Centres; Telecom Centres Flammable/ Archive Storage Areas; Process Equipment; Pharmaceutical Processes; Switchgear Rooms; Polling Mills; Printing & Packaging; etc

Approvals

CPD/CPR EN 12094 Approved

Dry Chemical Powder Systems

Fire Protection Solutions

Dry Chemical Powder (DCP) Systems

Forward

Dry Chemical Powder systems are mostly used to suppress combustible liquid and gaseous hazards, they have proven to be very effective systems for inhibiting the fire growth.
Dry chemical systems use sodium, potassium bicarbonate or monoammonium phosphate particles as inhibitors for the combustion process. The dry chemical powder is transported in a flow of Nitrogen forming a bi-phase gas/

mass stream and is directed towards the burning surface of a protected target. Upon discharge on the fires, the particles penetrate and surround the fire atmosphere
which is causing the combustion reaction. The dry chemical particles, in contact with the fuel and the strong heat, interact with free radicals in place of the Oxygen resulting in the combustion chain being inhibited and therefore suppressing the fire.

System types & Calculation Methods

Dry chemical systems are available in different configurations and sizes depending on the application. SA Fire manufacture bespoke configurations tailored to meet industrial requirements for the Naval, Offshore and Petrochemical industry.
The packages can be for fixed installations (with a 100% twin back up system for single or multizone protection), or mobile on trailers for first attack and emergency response brigades.
Fixed type systems deliver the dry chemical through a piping system to discharge terminals such as fixed nozzles, monitors and hose reels.
Each system is Engineered according to:

- The project specification
- Type of protection
- Installation layout.

The distribution of dry chemical is in fact a bi-phasic solid-gas flow stream which requires complex mathematical modelling for the calculation of the residual pressure at the nozzles; therefore, determining the nozzle sizing.
In this respect, SA Fire has developed and validated a flow

DESTEC
Dipartimento di Ingegneria dell'Energia, dei Sistemi, del Territorio e delle Costruzioni
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Codice fiscale 80003670504
UNIVERSITÀ DI PISA
Paolo Di Marco

CERTIFICATO DI VALIDAZIONE
VALIDATION CERTIFICATE

Oggetto:
Validazione modello di calcolo per trasporto polvere antincendio.

Riferimento:
Software di calcolo per dimensionamento impianti antincendio a polvere:

"DCP HyCalcs"

Società:
SA Fire Protection S.r.l.
Viale Europa 121-123
56021 Cascina (PI) – Italia

Descrizione attività:
A seguito di prove sperimentali condotte sotto la mia responsabilità scientifica dal DESTEC – Dipartimento di Ingegneria dell'Energia, dei Sistemi, del Territorio e delle Costruzioni, Università di Pisa, dichiaro che il modello di calcolo per il trasporto di polvere antincendio (fluido bifasico) alla base del software "DCP HyCalcs" risulta validato.

Conclusioni:
I risultati del software "DCP HyCalcs" sono in accordo con i risultati sperimentali ottenuti.
Il software "DCP HyCalcs" risulta idoneo per il dimensionamento di impianti antincendio a polvere.

Luogo e data / Place and date:
Pisa, 19/06/2014

Subject:
Validation of the calculation model for dry chemical powder transportation.

Reference:
Calculation software for dry chemical fire protection systems design:

"DCP HyCalcs"

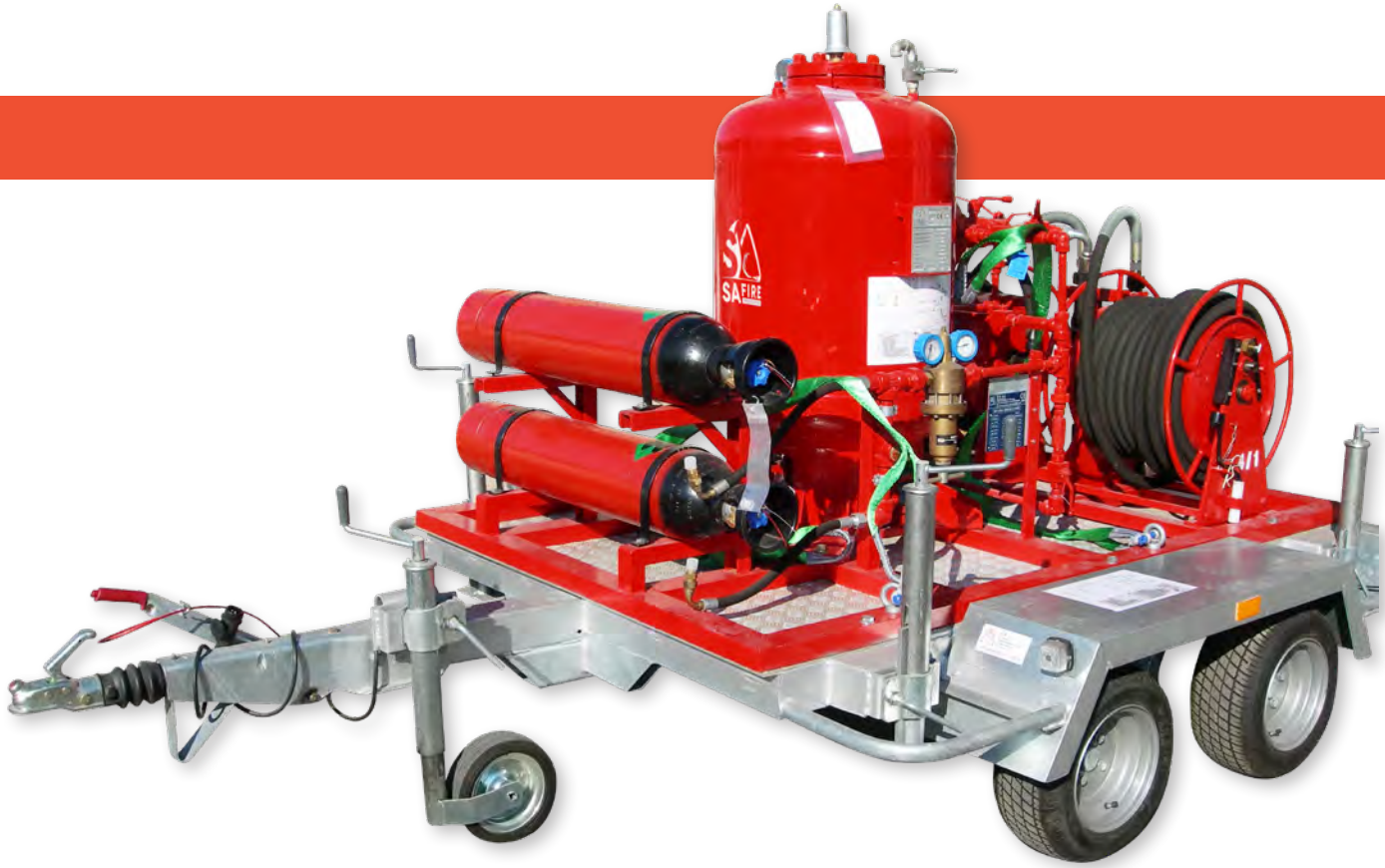
Company:
SA Fire Protection S.r.l.
Viale Europa 121-123
56021 Cascina (PI) – Italy

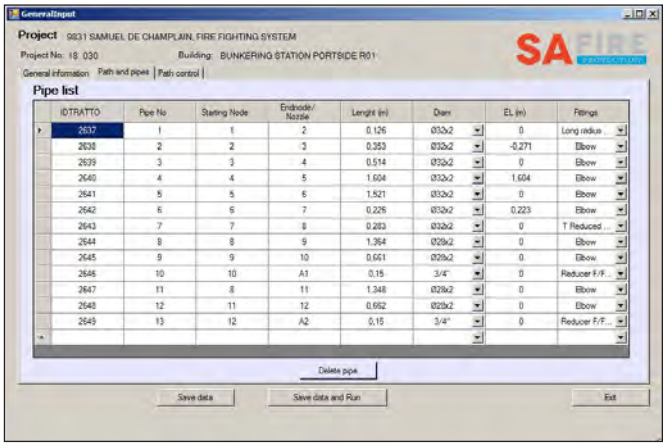
Activities:
As a result of the experimente performed under my scientific responsibility by DESTEC – Department of Energy, Systems, Constructions and Land Engineering, University of Pisa, I hereby declare that the calculation model for dry chemical powder (two-phase fluid) transportation at the basis of the software "DCP HyCalcs" is validated.

Conclusion:
The results of the software "DCP HyCalcs" are in agreement with the experimental results obtained.
The software "DCP HyCalcs" is adequate for the design of dry chemical fire protection systems.

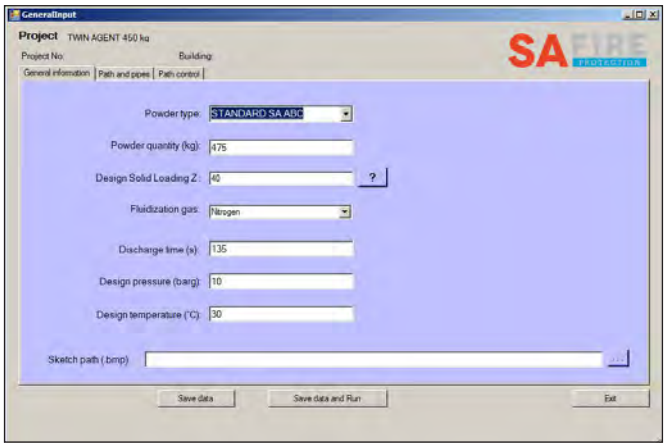
Approvato / Approved:
Prof. Paolo Di Marco
University of Pisa – DESTEC

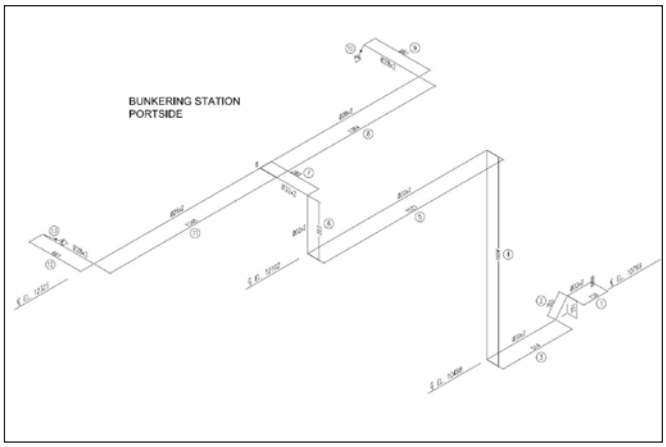
Tel. ++39-050-2217107 - FAX ++39-050-2217160 - e-mail paolo.dimarco@ing.unipi.it





calculation model which is capable of predicting pressure loss in pipes and fittings, as well as calculating DCP nozzle orifices according to the required discharge flow rate.
This computerised model named “HyCalcs” allows fire engineers to engineer a DCP system to real and their specific hazard conditions. The calculation software is able to determine pressure loss and also to modulate the optimum mass ratio of Nitrogen and DCP particles to travel distances into impervious piping systems.





Overview & Operational Principle

Dry chemical systems can be manually or automatically operated. The automatic system is connected to a Fire & Gas detection panel which is interconnected with field detectors and upon confirmed fire will activate the DCP discharge. DCP Skids can be equipped with SIL 2 actuation units or SIL 2 actuators for selector valves to form SIL 2 compliant fire suppression packages.

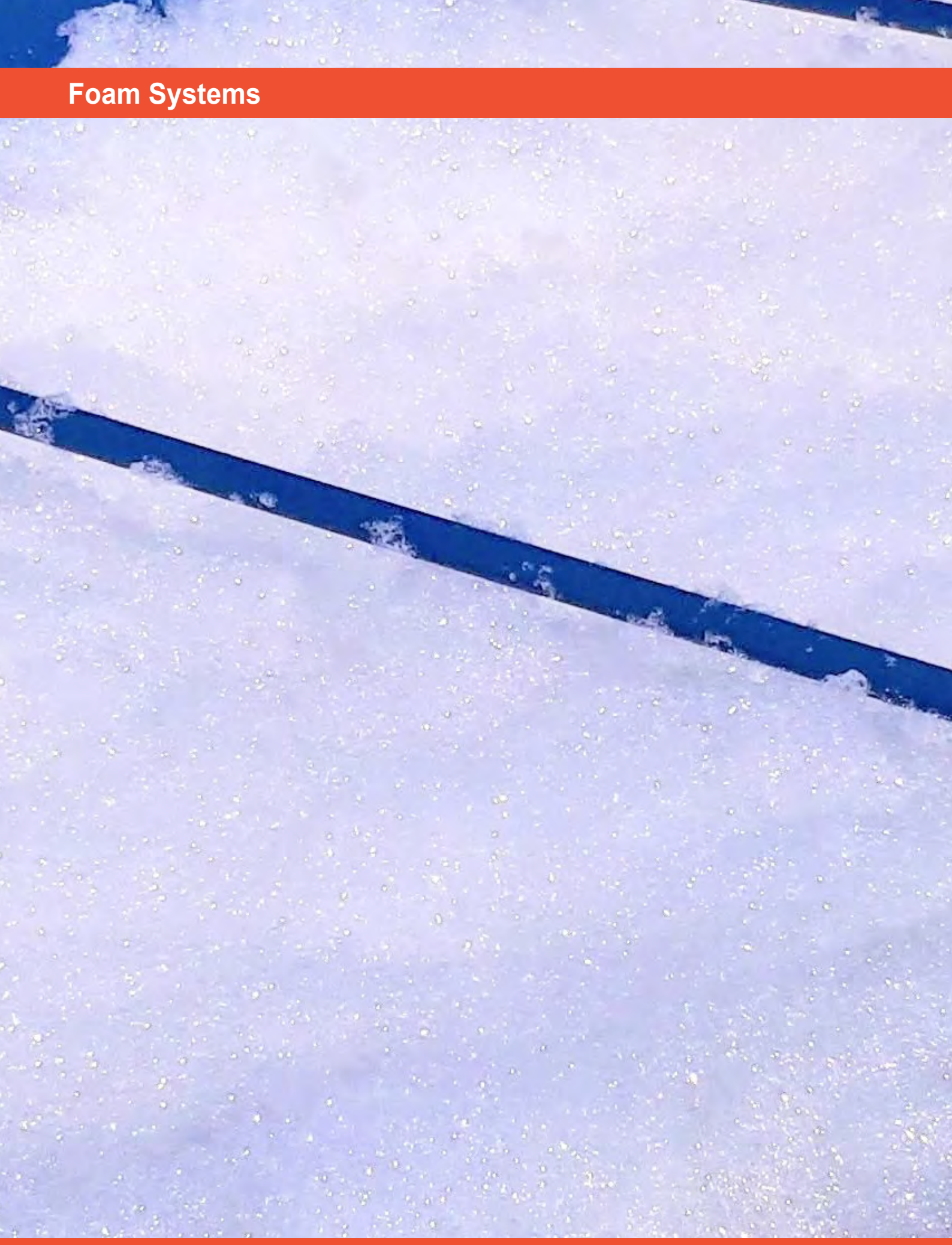
The manual system instead is equipped with pneumatic pilot cylinders which activate the propellant nitrogen and the required selector valve pneumatically.

For both DCP units the propellant gas is injected into the DCP tank through a sophisticated injection system. Once the units reach the pressure setting, the main discharge opens and the dry chemical is discharged into the distribution system to the discharge terminals.

Application

Dry chemical systems and hardware can be used for a number of petrochemical applications (such as loading decks and docks, offshore loading platforms, machinery spaces and process areas), for LNG and LPG applications (spherical tanks, FPSOs, vent valves), as well as utility applications (oil filled transformers, lubricant pumps and tank, etc).

Foam Systems



Fire Protection Solutions

Foam Extinguishing Systems

Foreword

Foam fire suppression systems are, in most cases, the only suitable solution for the protection of special hazards. They are widely used in the chemical, petrochemical and pharmaceutical industries to protect flammable liquid fire hazards. The core components of foam systems are the proportioners and the dischargers. The proportioner has the duty of mixing water to foam concentrate to a precise rate that will be delivered to the discharger. In this final point, the foam is created adding air to the water/foam solution to initiate the foam emulsification process.
For any type of system configuration such as low, medium or high expansion foam, SA Fire designs and manufactures foam system components capable of mixing and generating foams. Every component is tested against EN 13565-1 & UL 162 requirements.

Bladder Tanks

Bladder tanks are positive displacement proportioning systems made of a tank and an in-line mixer.
The tank is equipped with an elastomeric bladder that is used to hold the foam concentrate and it is normally kept unpressurised. The mixer is directly piped to the bladder tank via two lines, the water inlet line and the foam outlet line. When in operation, water flows into the mixer passing through a water orifice that creates a pressure differential across the disc in the area of the mixer where the foam concentrate is injected.
Some water is deviated from the main supply and enters the tank surrounding the bladder, increasing the tank pressure. This squeezes the bladder and forces the foam concentrate to leave the tank and enter the foam line. The concentrate is then delivered to the mixer injection point, where another orifice plate is located to meter its flow in the low pressure water stream zone. The system works till the concentrate in the bladder has been consumed and the tank is full of water.
Bladder tanks are manufactured according to ASME or EN standards with variable thicknesses according to the client design pressure. Every unit is available in a horizontal or vertical configuration and is customised according to client requirements, including accessories such as: double tank system (only for verticals), ladders for easy access to man hole(s), deluge or remote-controlled valves for system automation, manual filling pump, base plates, special metal treatments or painting procedures. The Bladder tank can be manufactured also with foam concentrate to be contained inside or outside the bladder.

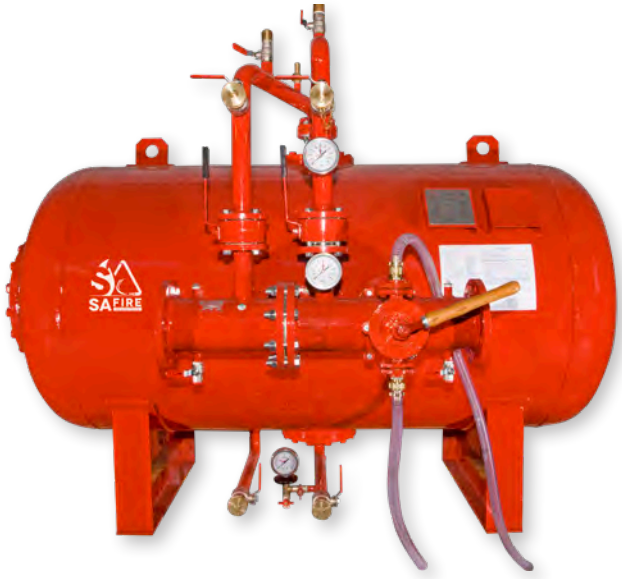
Bladder Tank PSLV Series

The bladder tank is a very reliable and economical solution for providing water foam solution to firefighting systems. The system is completely independent from external power sources and relies only on firefighting water pressure. Water that flows into the mixer is partially deviated into the tank, pressurising and squeezing the bladder. Foam concentrate is then ejected and directed towards the injection point where a metering orifice allows for a precise concentrate injection into the water stream. The unit works continuously till water is shut off or the foam concentrate quantity runs out.
When used in a single configuration, the bladder tank proportioning system may be economical but presents some limitations. For example, during maintenance activities single bladder tank systems go out of service until the bladder tank is restored. Similarly, when the system requires refilling after activation.
To overcome these limitations, the 2 x PSLV was developed merging two equally sized tanks with one in-line foam mixer. With this solution, one tank is kept in service while the other is a stand-by unit. In case of maintenance or system activation, the mixer may be swapped to the second tank meanwhile repairs or refilling work are terminated. The swap option may also be automatic by providing the system with remote controlled valves.
The 2 x PSLV bladder tanks configuration may be used also to cope with large fire systems requiring large tanks. In this case, the 2 x PSLV configuration allows the tanks to be easily coupled together to meet foam concentrate stock quantity requirements. Customised configurations with 3 x PSLV are also available.

Bladder Tank PSLO Series

The principle of operation of the horizontal bladder tank is very similar to that of the vertical models. The different

geometry allows for larger tank construction and for installation where the top openings of the bladder tank may be obstructed, making it difficult to do maintenance operation such as the bladder extraction.

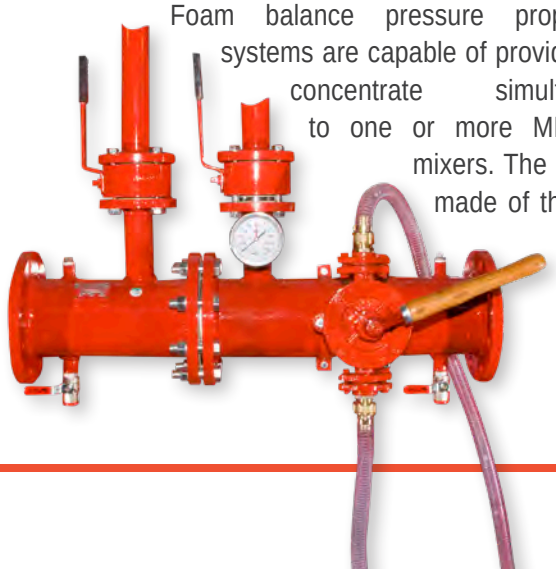


In-Line Mixer

The in-line mixer for bladder tanks is made of two bodies coupled together. In between them an orifice plate is located, designed to create a negative pressure downstream of the disc in correspondence with the foam concentrate injection zone. In the first part of the in-line mixer the water coming from the main supply is deviated in the tank, causing its pressurisation. In the second part of the mixer body, the foam concentrate injection takes place, passing through a foam metering orifice that injects the foam in the water stream. The two orifices are calibrated to keep a foam concentrate flow rate of injection strictly dependent on the water flow rate and therefore keeping the mixing ratio constant. The in-line mixer can be calibrated over a wide range of water flows and therefore may be used successfully to provide foam solution for more systems with different flow requirements.

Balanced Pressure Proportioning Systems

Foam balance pressure proportioning systems are capable of providing foam concentrate simultaneously to one or more MPV foam mixers. The system is made of three main components: the foam pump(s), the foam tank and the pressure balanced proportioner(s) MPV. The foam pumping station is made of a gear pump which may be driven either by an electric or a diesel motor. On each pumping unit a control panel is installed to control the start and stop of the pump as well as to monitor the valve status. The pumps are used to provide foam concentrate at a constant pressure directly in the (MPV) pressure balanced foam proportioner foam inlet. Depending on the water which flows in the main supply, and therefore on the foam concentrate needed, the pumps regulate the concentrate pressure by means of a recirculation valve that opens and closes, keeping the pressure at the MPV inlet always equal to the design pressure. The MPV is a modified Venturi coupled to an automatic metering valve which opens or closes a metering orifice, according to the water flow that is sensed in the main supply. This system self-regulates the foam concentrate injection in relation to the water flow and pressure that are sensed in the main supply, granting a perfect mixing ratio of water and concentrate over an extremely wide range of flow rates. Every unit is manufactured according to client specifications and may be designed to meet a wide range of pressure and flow demands. The units are available with single, double or triple pumping stations driven by an electric or diesel motor. For electric versions, pumps, panels and control instruments are available also for hazardous area installation.



The pressure balanced proportioning system is a very reliable and accurate method for metering foam concentrate in firefighting systems. The system can feed one or more MPVs providing foam for multiple systems. Available in several configurations with MPV and pumps in SS AISI 316 or Bronze.

Foam Injection Proportioner PR Series

Foam injection proportioners are used to inject foam concentrate into firefighting pipelines. The PR proportioner receives foam concentrate at a pressure roughly 2 bar higher than that of water and

meters the foam injection through a bronze valve and an orifice plate. The concentrate passes through the PR and is delivered into a pipe directly in the water stream. The concentrate flow can be factory calibrated for 3 or 6 % injection.

In-Line Mixer ML Series

Based on a Venturi modified tube, it works on the negative pressure principle which is generated when water passes through different piping sections. When in operation, the ML proportioners move foam concentrate from an atmospheric storage tank into the Venturi water stream, providing 1, 3 or 6% water/foam solution. Mixers are available in bronze with a shut off valve that allows foam induction to be stopped. Lightweight and flexible, they can be used for portable foam equipment or in small fixed applications.

Low Expansion Components

Nozzles US Series

Low expansion nozzles are manufactured in Bronze and Stainless Steel and calibrated on a wide range of flow rates with connection from ½" to 1" threaded NPT or BSP. US, USBE & USME nozzles are often used to protect hazards such as loading racks, process pumps or combustible warehouses.
EN 13565-1 Compliant

US USBEA USME USBEB

Low Expansion Foam Maker LSBEF Series

Low expansion foam makers are designed for the protection of dike areas where combustible spills may cause pool fires. They are available in two versions: The LSBEF Type A and Type B.
The LSBEF Type B is a foam maker which includes in its terminal a deflector that allows the foam to be orientated on the burning liquid. This configuration allows for a direct mounting on the perimeter of the dike with no need to employ a pourer. The LSBEF Type A, instead, is a standard foam maker which may be installed remotely from the hazard but requires a foam pourer type VS to direct the foam on the burning liquid.
EN 13565-1 Compliant

LSBEF Type B

VS

LSBEF Type A

High Back Pressure Foam Maker

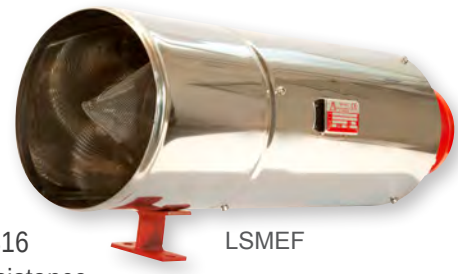
LSAC Series

LSAC

High back pressure foam makers have been developed to deliver foam in sub surface applications for fixed cone tanks. Foam solution is delivered to the LSAC maker that allows air to be withdrawn from the outside into the stream to generate foam. The foam is then delivered to the tank bottom and injected into the combustible product.
Due to the lightweight of the foam generated, the foam travels to the top creating a foam blanket that separates combustible liquid from surrounding oxygen with consequential fire extinguishment.
EN 13565-1 Compliant

Medium Expansion Foam Maker LSMEF Series

Medium expansion foam makers are used to protect hazards such as dike areas or pumps.
The LSMEF makers are equipped with a built-in support for installation on dikes and are manufactured in stainless steel AISI 316 to guarantee high resistance from aggressive chemicals in acidic atmospheres.
EN 13565-1 Compliant



LSMEF

GSAE

High Expansion Foam Generator GSAE Series

High expansion foam generators are used in total flooding applications such as hangars, tyre warehouses or LNG pumping stations.

When in operation, the generator GSAE discharges foam solutions at high velocity from its multiple nozzles that withdraw air and expand rapidly in the generator. Foam produced with this technique may achieve an expansion ratio that goes up to 1:800.

Available with two flow settings, the GSAE series meet the requirements of EN 13565-1.

Fixed Cone and Floating Roof Tanks Specific Applications

Foreword

Fire in fixed cone or floating roof tanks containing combustible liquids represents one of the major risks relating to storage tank facilities. Regardless of the causes starting fires, every tank shall be equipped with a fixed firefighting system. The system shall be designed to act quickly and fight a fire outbreak reducing the consequential damages to a minimum. In this respect, international standards such as NFPA 11 or EN 13565-2 recommend the installation of foam systems. These systems act by discharging foam onto the ignited liquid creating a blanket which separates the combustible liquid from the surrounding oxygen and therefore results in extinguishment. Foam is a mixture of water and concentrate that is mixed by the foam station and then is delivered to the discharge devices such as:

· Foam Chambers CS and Pourers VS (for the fixed cone or covered with internal floating roof tanks)

· Foam Makers LSBEF and pourers VS (for open top floating roof tanks)

Before discharging, air is introduced into the stream causing the foam to expand rapidly. This increases its volume and reduces its density to become floating lightweight foam. Once generated the foam is discharged by the pourers into the tank to suppress the fire by separating the combustible from the surrounding oxygen.

Available Kits

Depending on the tank which is to be protected, SA Fire has prepared two solution packages developed to help build compliant and efficient fixed fire suppression systems for the storage industry. The two solutions are related to the protection of fixed cone and open top floating roof tanks by means of low expansion foam systems.

Among others, these solutions are developed to offer advantages to tank manufacturers or owners such as:

1. Designed in full compliance with EN 13565-1 or NFPA 11
2. Several material options to face any outside environmental conditions
3. Integrated protection in the air aspiration inlet avoiding the possibility of obstructing the firefighting lines
4. Proven performance
5. Cost effective design

Fixed Cone Tank FC Kits

For fixed cone or tanks covered with internal floating roof, SA Fire proposes an FC kit for low expansion foam systems made of a Foam Chamber series CS, including a built-in Foam Maker, coupled to a pourer series VS.

The foam chamber is installed on the outside of the tank shell meanwhile the pourer faces the tank liquid surface on the internal side of the shell. The CS series Foam Chambers are all equipped with a breakable type seal (compliant with EN 13565-1) which avoids vapours present in the tank entering the firefighting system pipe work. If required, the frangible seal may be made of materials resistant to aggression by specific chemicals or their combinations.

With a compact design, the CS series integrates a calibrated orifice on the base that avoids the need of installing further in-line foam makers.

Principle of Operation: Fixed Cone – FC Kit

Upon firefighting system activation, the water/foam solution is metered in the mixing station and then pumped towards the CS Foam Chambers. Once the stream approaches the Foam Chambers, it passes through a metered orifice that accelerates its motion creating a negative pressure that attracts air into the chamber. This air is mixed into the stream and allows the solution to initiate the expansion process.

Due to the seal, the foam discharge is delayed until the pressure rises to the seal setting point where it breaks and opens the chamber. With the seal broken, the foam is free to discharge in the Foam Chamber that, due to its geometry, facilitates the foam expansion and decreases the flow velocity. Connected to the Foam Chamber outlet, on the internal side of the tank shell, the VS pourer allows the foam to be gently delivered towards the internal side of the shell avoiding direct contact with the burning liquids. Once the foam has descended onto the burning liquid surface it acts by separating the oxygen from the combustible liquid suffocating the fire till suppression is achieved. The foam blanket that remains on the fire after extinguishment prevents any possibility of re-ignition.

Open Top Floating Roof Tank – FR Kit

For open top floating roof tanks, SA Fire propose an FR kit for low expansion foam systems made of a Foam Maker series LSBEF and a foam pourer series VS. Both items are coupled together and installed in-line on top of the floating roof tank together with the foam shields.

Principle of Operation:
Open Top Floating Roof – FR Kit

Upon firefighting system activation, the water/foam solution is metered in the mixing station and then pumped towards the LSBEF Foam Makers. Once the stream approaches the Foam Makers, it passes through a metered orifice that accelerates its motion creating a negative pressure which attracts air into the stream.

The air is drawn into the stream and allows the solution to initiate the expansion process.

The mixture of water, foam concentrate and air starts to expand. Meanwhile the stream reaches the VS foam pourer. Once the solution approaches the VS pourer, the stream impacts with its body waterways and therefore undergoes a mechanical agitation which expands its volume expansion and reduces its velocity.

The foam comes out of the pourer and it is directed towards the foam shield where it will gently continue descending towards the rim seal.

Once on the burning liquid surface the foam separates the oxygen from the combustible liquid suffocating the fire till suppression is achieved.

The foam blanket that remains on the fire after extinguishment prevents the possibility of re-ignition.

General Technical Characteristics:

Both kit components are available in several versions and each of these is developed to satisfy every requirement of flow rate settings, installation environmental conditions and mechanical process connections.

Kits Available in:

Carbon Steel; Stainless Steel AISI 304 or AISI 316; Flanged ANSI or UNI /DIN;

Standard design for both kits allows operation up to 16 bar at external temperatures ranging from -20° to +60°C.

The Foam Makers LSBEF, Foam chamber CS and their VS pourers can be provided hot dip galvanised or painted red RAL 3000.

Other materials or surface treatments are available upon request.

Each component has an optimum performance with all kinds of foam concentrates commonly used in the chemical and petrochemical industries such as FP, AFFF, FFFP and their AR combinations.

Industrial Fire Brigade

Fire Protection Solutions

Industrial Fire Brigade

Overview

Since 1977 SA Fire has been a leader in the manufacturing of fire equipment designed to cope with harsh environments and difficult fire hazards. Since then our fire equipment has been selected by many chemical and petrochemical companies to protect their personnel and equipment.
During these years, the company has worked closely with industrial fire brigades, learning from their experience and listening to their difficulties. Thus, resulting in a tailor-made design facility, providing each fire brigade with the best fire equipment to suit their specific fire needs. SA Fire manufactures mobile dry-chemical units, foam monitor trolleys, water guns and foam nozzles, in-line mixers, fire hoses and a special line of high performing portable and wheeled fire extinguishers. All fire equipment is designed and manufactured with extreme care in materials highly resistant to chemicals that ensure durability, high performance and reliability every time they are called for duty.

Fire Extinguishers

PB100

One of the most appreciated items of fire equipment manufactured by SA Fire is the PB100. A wheeled fire extinguisher designed for the petrochemical industry with extraordinary technical characteristics.
Designed to be easy to maintain, it uses a hot dip galvanised carbon steel frame shaped to perfectly balance the whole extinguisher weight on the axis of the wheels. This makes the PB100 very easy to manoeuvre even by a single operator carrying the nominal fire extinguishing power of 100 kg of 88SA ABC-E 97 Powder. The tank is hot-dip galvanised, inside and outside, with welded head plates manufactured according to ENI specification for wheeled fire extinguishers to be deployed in petrochemical industries. The extinguisher is propelled with Nitrogen, contained in a 27L bottle charged at 200 bars and equipped with a gas admission-type reducer. The gun is fed by an oil resistant hose, allowing precise dry chemical powder delivery with provisions for balancing backpressure reaction forces. At present the PB 100 is the most used wheeled fire extinguisher within the Italian petrochemical industries.

AC20 and AC30

AC20 and AC30 are wheeled CO_2 fire extinguishers of 18 kg and 27 kg respectively. Installed on a completely dismountable galvanised trolley, they are provided with hard rubber wheels that allow easy climbing over obstacles. The delivery gun is derived from the PB100 giving the operator the possibility to open/close the discharge very easily.

PB12

One of the most appreciated portable extinguishers within the petrochemical industry is the PB12. A fire extinguisher with an internal CO_2 cartridge, charged with 88SA ABC-E 97 powder. Manufactured according to EN 3-7 and ENI/AGIP specifications it is extremely efficient on Class A, B and C fires.

PP6

Portable Powder extinguishers were conceived for the protection of offices and laboratories that require rapid and efficient intervention. Permanently pressurised, it has a 6 kg charge of dry chemical powder. The valve protection prevents unintentional activation due to accidental impacts and safeguards the valve body from consequential trauma. Moreover, the in valve protector turns fluorescent in the dark making it easier to identify the extinguisher during a fire emergency.

AC5

Portable Carbon Dioxide extinguisher, capacity 5 kg, conceived for the protection of offices and laboratories that require rapid and efficient intervention. The valve protection prevents unintentional activation due to accidental

impacts and safeguards the valve body from consequential trauma. Moreover, the valve protector turns fluorescent in the dark making it easier to identify the extinguisher during a fire emergency.

Portable line mixers
Line mixers Series ML- Portable

Line mixers are manufactured in Bronze and can be provided with BSP threading or with UNI, BS336, DSP, SMS, NH and GOST quick connections.

Available for flow rates from 200 to 600 L/min at 7 bar they ensure perfect mixing in a pressure range between 4 and 12 bar.

Portable Foam Branch Pipes
Series LSBEP

Low-expansion branch pipes, Series LS are manufactured in AISI 304 or 316 stainless steel and with UNI or BS336, DSP, SMS, NOR, STORZ, NH, GOST brass fittings.

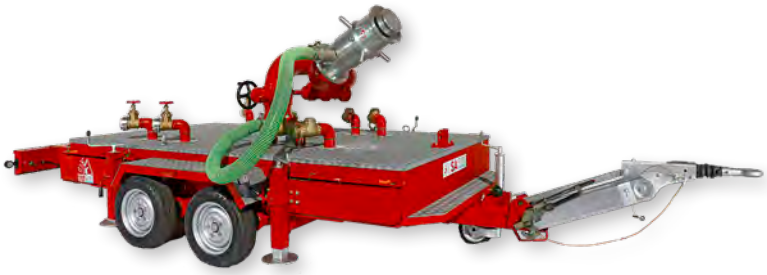
They are provided with a plastic handle for lifting and easy orientation. They are available in the self-suction version LSABEP that includes the Venturi tube and the control valve.

Series LSMEP

The medium-expansion foam branch pipes are suitable for firefighting in basins or in confined spaces. They are provided with UNI, BS336, NOR, STORZ, DSP, SMS, NH and GOST brass fittings. They are also provided with a plastic handle and are manufactured in AISI 304 or 316 to ensure high resistance against exposure to acidic atmospheres.

Mobile Fire Equipment

Mobile equipment has a significant role in high-risk industrial facilities.
They are designed to be pulled rapidly and can carry foam generation stations, monitors or true high-capacity dry-chemical systems.



Each trolley is provided with a self-supporting frame designed according to the weight and speed with which the equipment is to be pulled. The wheels can be provided with road-type tyres that allow good manoeuvrability also on bumpy sections.

Various versions are available, according to the customer needs, such as:

Portable foam mixing stations

- Trolley-mounted monitors
- Powder systems

Upon request, the trolleys can be provided with firefighting hoses, foam generation tanks, pumps and mixing systems.

Water screen

Barrier-type water screens are devices used to create cold paths or water barriers for protecting against fire irradiation. SA Fire manufactures portable water screens in die-cast aluminium designed to create a 180-degree water barrier with variable flow rates. They are often supplied by means of flexible hoses and can be provided with UNI, BS336, DSP, NOR, STORZ, SMS, NH and GOST connections.


533

Distributor

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