Commoditization

Commoditization of HI-FOG® fire protection systems

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Abstract:
The intention of this degree thesis is to investigate the possibility to commoditize HI-FOG® systems. The current project based work method within Marioff Corporation Oy devotes the same amount of resources and work effort for all projects, disregarding the economical benefits or the complexity of the projects. In this thesis a study is conducted in order to examine if it is feasible or even possible to commoditize some systems in Marioff Corporation Oy's product range. The goal is to achieve a process for commoditization to simplify, or eliminate, the need for internal sales- and project work. This could be achieved by allowing the distributors and agents to handle the sales, project and maintenance independently, without involvement from Marioff Corporation Oy's sales and project departments. In order to achieve this goal, the Kitchen Accumulator Unit (KAU) and Machinery Local application Pump Unit (MLPU) systems are used as study examples in this thesis.
The information for the investigation has been gathered through internal expert interviews, litterature studies (internal and external), questionnaire to distributors and agents and from the authors own experience and knowledge of Marioff Corporation Oy processes and products.

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Sammandrag:
Syftet med detta examensarbete är att undersöka möjligheten att produktifiera HI-FOG® system. Det nuvarande projektbaserade arbetssättet inom Marioff Corporation Oy ägnar lika mycket resurser och arbetsinsats för alla projekt, oberoende av de ekonomiska fördelarna eller komplexiteten av projekten. I denna avhandling utförs en undersökning om det är genomförbart eller ens möjligt att produktifiera vissa system i Marioff Corporation Oy:s sortiment. Målet är att uppnå en process för produktifiering av systemen genom att förenkla, eller eliminera, behovet av internt försäljnings- och projektarbete. Detta kunde uppnås genom att tillåta distributörer och agenter att hantera försäljning, projektledning och underhåll av systemen självständigt, utan inblandning från Marioff Corporation Oy:s försäljnings- och projektavdelningar. För att uppnå detta mål har Kitchen Accumulator Unit (KAU) och Machinery Local application Pump Unit (MLPU) systemen använts som exempel i denna avhandling.
Information för denna undersökning har samlats in genom interna intervjuer med experter, litteraturstudier (interna och externa), frågeformulär till distributörer och agenter och från författarnas erfarenhet och kunskap om Marioff Corporation Oy processer och produkter.

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Abbreviations

ABS =American Bureau of Shipping

AFP = Active Fire Plan

AISI = American Iron and Steel Institute

BRE = Building Research Establishment

BV =Bureau Veritas

CCS = China Classification Society

CNPP = National Centre for Prevention and Protection

CSC = Customer Service Center

DBI = Danish Institute of Fire and Security Technology

DCC = Diagram Component Calculator

DIN = Deutsches Institut für Normung

DNV = Det Norske Veritas

ERP = Enterprise Resource Planning

FDS = Fire Detection System

FSS Code = the International Code for Fire Safety Systems

GA =General Arrangement

GL = Germanischer Lloyd

IACS = International Association of Classification Societies

IMO = International Maritime Organization

IPR = Intellectual Property Rights

IRS = Indian Register of Shipping

IT = Information Technology

KAU =Kitchen Accumulator Unit

KR = Korean Register of Shipping

LPCB = Loss Prevention Certification Board

LR = Lloyd’s Register

MA =Machinery Arrangement

MLPU =Machinery Local application Pump Unit

MSC = Maritime Safety Committee

NK = Nippon Kaiji Kyokai

OEM = Original Equipment Manufacturer

P&ID = Piping and instrumentation diagram

PDM = Product Data Management

PFP = Passive Fire Plan

RFQ = Request For Quotation

RINA = Registro Italiano Navale

Ro-Ro = Roll on – Roll off (vessel type)

RS = Russian Maritime Register of Shipping

SAE = Society of Automotive Engineers

SOLAS = Safety of Life at Sea

SP = Technical Institute of Sweden

TAC = Type Approval Certificate

UTC = United Technologies Corporation

VTT = Valtion Teknillinen Tutkimuslaitos

1 Introduction

1.1 Marioff Corporation Oy

Marioff was founded in 1985 by Mr. Göran Sundholm. Marioff began by providing specialized hydraulic service and products, mainly to the marine and offshore market. Hence the name, that comes from marine (mari) and offshore (off). The company name was later changed to Marioff Corporation Oy. The company achieved great success after developing a new fire protection technology, high pressure water mist system named HI-FOG®, which was launched in 1991. The HI-FOG® system can protect a wide range of applications including machinery spaces, special hazard areas and turbines, commercial cooking and frying systems, all fire protection areas which conventional water spray systems could not protect. The company grew to become the world leader in water mist fire protection. In 2007 the company was acquired by United Technologies Corporation (UTC) and became a part of the UTC Fire & Security division./1/. Net sales for UTC Fire & Security were $6.5 billion in 2010./2/.

1.2 Marioff Technology

The HI-FOG® Water Mist Fire Protection System is a high-pressure system that uses extremely small volumes of fresh water as the fire fighting agent to produce HI-FOG® water mist. The water mist, composed of micro-droplets, is discharged at high velocity, allowing the mist to penetrate to the seat of the fire. This eliminates two of the three pre-requisites that fire needs to persist and grow, namely heat and oxygen, the combustible material being the third.

Figure 1. (from HI-FOG® sales brochure)

The water mist cools the fire itself and the surrounding air effectively, and displaces oxygen locally around the fire, suppressing the fire before it can spread.

HI-FOG® generates a very large surface area of water by propelling water under high pressure through special, patented nozzles creating a fine mist of micro-droplets. The enormous number of micro-droplets represents a vast surface area of water providing fast cooling. The micro-droplets are extremely small and vaporize instantly, consuming the heat energy very efficiently.

Typical drop size range (mm)	Number of droplets per litre of water	Surface area (m²)
1…5	15 thousand to 2 million	1…6
0.2…1	2 million to 250 million	6…30
0.025…0.2	**250 million to 150 billion** Superior cooling and local inerting	**30…250** Superior blocking of radiant heat

Figure 2. (from HI-FOG® sales brochure)

HI-FOG® is entirely harmless to people and can therefore be activated the moment the fire is detected, with no need for evacuation, ventilation shutdown or closing openings. This is a great advantage in marine and offshore applications in comparison with gas- and foam-based systems.

Using extremely small amounts of fresh water, HI-FOG® also minimizes post-fire water damage. Post-fire smoke damage is minimized by the extremely fast suppression process and HI-FOG®'s effective smoke scrubbing effect: much of the smoke will bind to the mist and gravity will press the particles to the floor, clearing the air. HI-FOG®'s superior cooling effect is the single most important factor involved in minimizing post-fire damage and the prevention of re-ignition.

Water is the world's oldest fire fighting agent. When used in the form of HI-FOG® water mist, water is also the world's safest and most environmentally-friendly fire

fighting agent. HI-FOG® uses up to 90% less water than traditional sprinkler systems. C02 and halon-based system are both lethal and very damaging to the environment.

HI-FOG® tubes, ranging in diameter from 12 – 60 mm, are about one-quarter the diameter of the equivalent traditional sprinkler system pipes. The total weight of a HI-FOG® system is therefore substantially less than that of a traditional sprinkler system. The small-diameter HI-FOG® tubes easily fit the tight spaces typically available aboard vessels and little welding is required. HI-FOG® is easily retrofitted on vessels even when they are in service. HI-FOG® tubes are made of high-quality stainless steel, ensuring a long and trouble-free system lifecycle.

With thousands of full-scale fire tests behind it, the HI-FOG® Water Mist Fire Protection System is the world's most tested water mist system for fire protection. HI-FOG® has been tested thoroughly for accommodation spaces, public spaces, service areas, machinery spaces, ro-ro and special category spaces.

Figure 3.Picture from HI-FOG® fire test (from HI-FOG® sales brochure)

Marioff Corporation Oy has worked with the following fire laboratories and institutes on HI-FOG® fire testing:

- VTT, Finland
- SP, Sweden
- LPCB, UK
- BRE, UK
- DBI, Denmark
- CNPP, France
- Factory Mutual, USA
- Underwriter Labs, USA
- US Fire Admin., USA
- US Navy, USA
- Hughes Associates, USA

Marioff Corporation Oy has also conducted fire tests in its own fire testing facility, located at Lohja, since May 2001./3/.

1.2.1 Intellectual Property Rights (IPR)

With the launch of HI-FOG® in 1991, Marioff pioneered the use of water mist for fire fighting with worldwide patent protection.

Today, Marioff Corporation Oy has patent protection for every key aspect of HI-FOG® technology with hundreds of granted and pending patents worldwide. Key Marioff patents cover critical HI-FOG® components and system designs as well as fire fighting methods.

Marioff and HI-FOG® are registered trademarks of Marioff Corporation Oy, a UTC Fire & Security company./1/

1.3 Marioff Distributors and Agents

Marioff Corporation Oy has a number of distributors and agents throughout the world. In order to become a distributor or agent there are some quite strict criteria one needs to fulfill.

Marioff Corporation Oy's main distributors and agents, as of today, and their respective sales areas are presented in figure 4.

Figure 4. Distributor and agent locations (from Marine Sales Channel presentation)

As the distributors and agents are widely spread globally the main marine market is well covered, giving the possibility for extensive sales.

1.4 Intention of thesis

The intention of this thesis is to develop a commoditization process for HI-FOG® systems. In this thesis the main focus will be on developing a common commoditization process using two existing HI-FOG® systems, Kitchen Accumulator Unit (KAU) and Machinery Local application Pump Unit (MLPU), as examples. The main reason for the work is to make the somewhat complex systems to a pre-engineered package or commodity which is easy to understand and thus easy to sell and install.

2 Commoditization

The word commoditization can be described as the transformation of goods or services into a commodity or to make it suitable as a commercial product. /4/.

The basic idea behind the commoditization concept is to develop a (new) product or service and getting it out on the market. The goal is to achieve a competitive product. The development process gathers information to ensure that the product meets as accurately as possible the customer's demands. By commoditization one gets a realistic view about the price/value ratio. /5/. Internal commoditization aims to ensure that the administrative and process creating work that is already done does not have to be done again. This includes e.g. work practices, guidelines, databases, research and development procedures as well as internal product, service and process descriptions. /6/.

Usually commoditization is done for different services, such as IT services, and not for hardware products as is intended in this degree thesis.

In this thesis the commoditization can be described as producing a pre-engineered package which content, price, tools, documentation and terms & conditions are defined.

2.1 Commoditization at Marioff

[redacted]

[redacted]

[redacted]

[redacted]

2.2 Scope of thesis

The scope of the degree thesis is to develop a commoditization process for HI-FOG® systems, using the KAU and MLPU systems as examples. This thesis is restricted to define the critical dimensioning and design tools for the example system only, and to generally discuss what should be considered when, or if, HI-FOG® systems are commoditized. Process maps or commoditization model as well as marketing material, distributor and agent templates, standard system manuals and other standardized system documentation is excluded from the scope of this thesis.

2.3 Methods (Research & Development)

Methods used in this thesis are literature search (internal and external literature), survey in form of questionnaire to distributors and agents, internal expert interviews with legal-, sales-, and after sales & service department as well as customer service center. Also the authors own experience and knowledge of the systems and processes within the company have been used, as both have been working for Marioff for several years in different positions within the sales-, project- and after sales departments. During the work the authors have used their knowledge of Marioff Corporation Oy systems electrical features, made layout drawings using Computer Aided Design (CAD)

program (AutoCAD LT 2007) and performed calculations using the Darcy-Weisbach calculation method for pressure losses.

As this degree thesis has two authors the work has been divided between them. The introduction, sales- and project processes, interviews, questionnaire and general discussion of the commoditization of the example systems as well as the conclusion has been for most parts done in collaboration between the authors. This collaboration has been performed by freeform discussions and brainstorming sessions to decide e.g. the questions for the questionnaire and interviews. The presentation and definition of parameters and critical tools for system design and dimensioning has been done individually by each author, one concentrating on the KAU system and the other on the MLPU system. With the collaboration and division of the specific systems for each author, the work effort of both authors has been equally divided.

3 The internal work process

The following chapter describes the internal work processes currently used in our project based business.

Figure 5. Basic Framework for project lifecycle (from Marioff Corporation Oy internal documentation)

3.1 The current sales process

Currently the sales process follows more or less a standard routine. The customers (ship owners, ship yards, etc) contact the sales department with a request for quotation (RFQ).

3.1.1 Request for Quotation (RFQ) review

The RFQ usually contains the specifications for the vessel in question, general arrangement drawings (GA), machinery arrangement drawings (MA), see figure 6 for reference, and fire plan drawings (PFP, AFP) which indicates which areas require fire protection. The sales manager and assigned sales support engineer reviews the received documentation to check that everything relevant is included. This is not always the case, but it is possible to make a budgetary proposal based on drawings only.

3.1.2 Preparing the quotation

[redacted]

3.1.3 Negotiations & purchase order

[redacted]

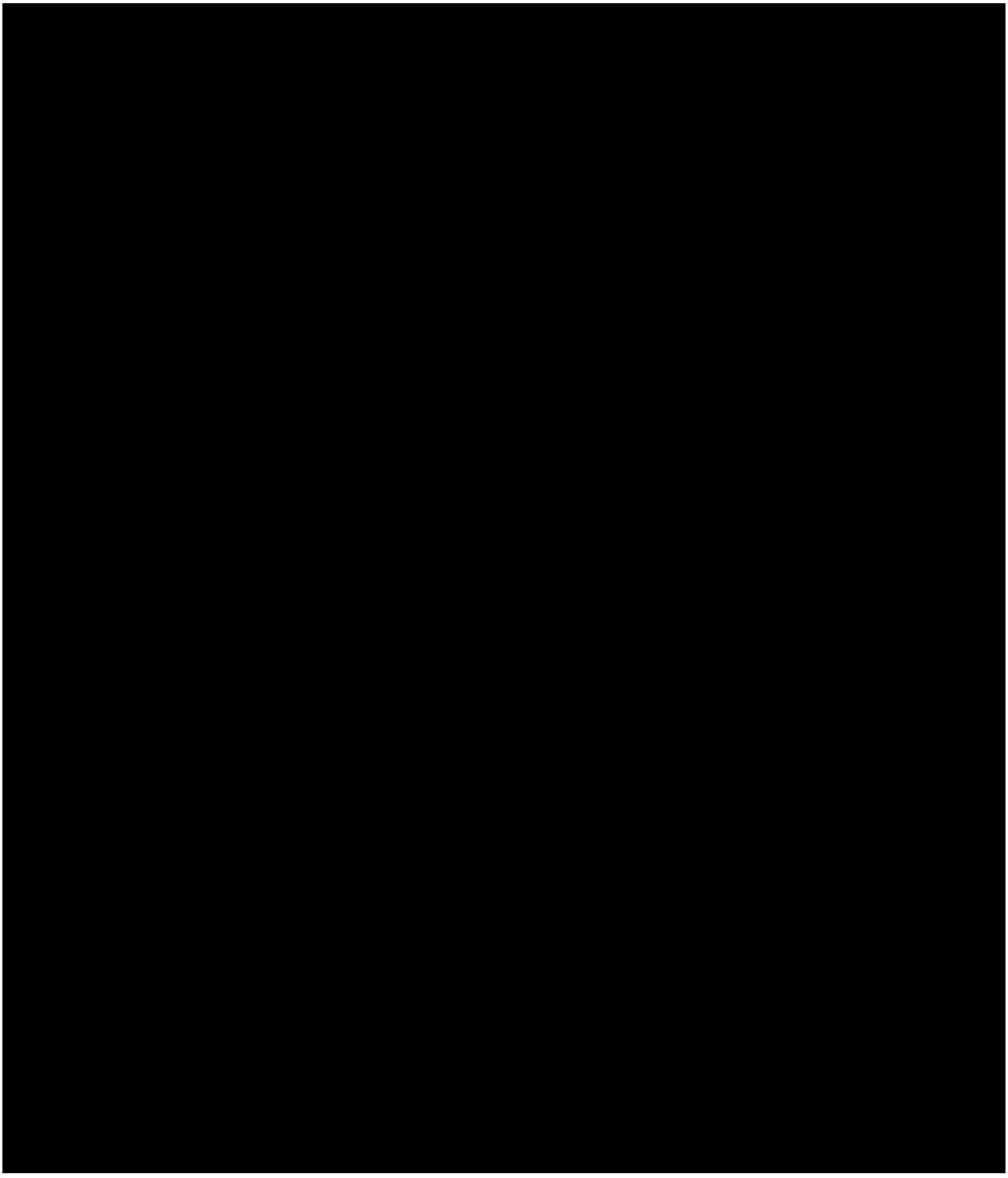


Figure 6. Example of MA used for quotation preparation and calculations

3.2 The current project work process

After the contract for supplying a fire protection system has been awarded to Marioff Corporation Oy a project team is established. The project team consists of a project manager, an electrical engineer and a layout designer, when deemed necessary also a

project engineer is included to the team. This team is then responsible for the project execution so that the deliverable is satisfactory to both customer and Marioff Corporation Oy.

Figure 7. SOLE model – Execution phase activities and milestones (from Marioff Corporation Oy internal documentation)

3.2.1 Design phase

The design phase is further divided into four main parts which are system design, electrical design, system documentation and authority approval.

3.2.1.1 System design

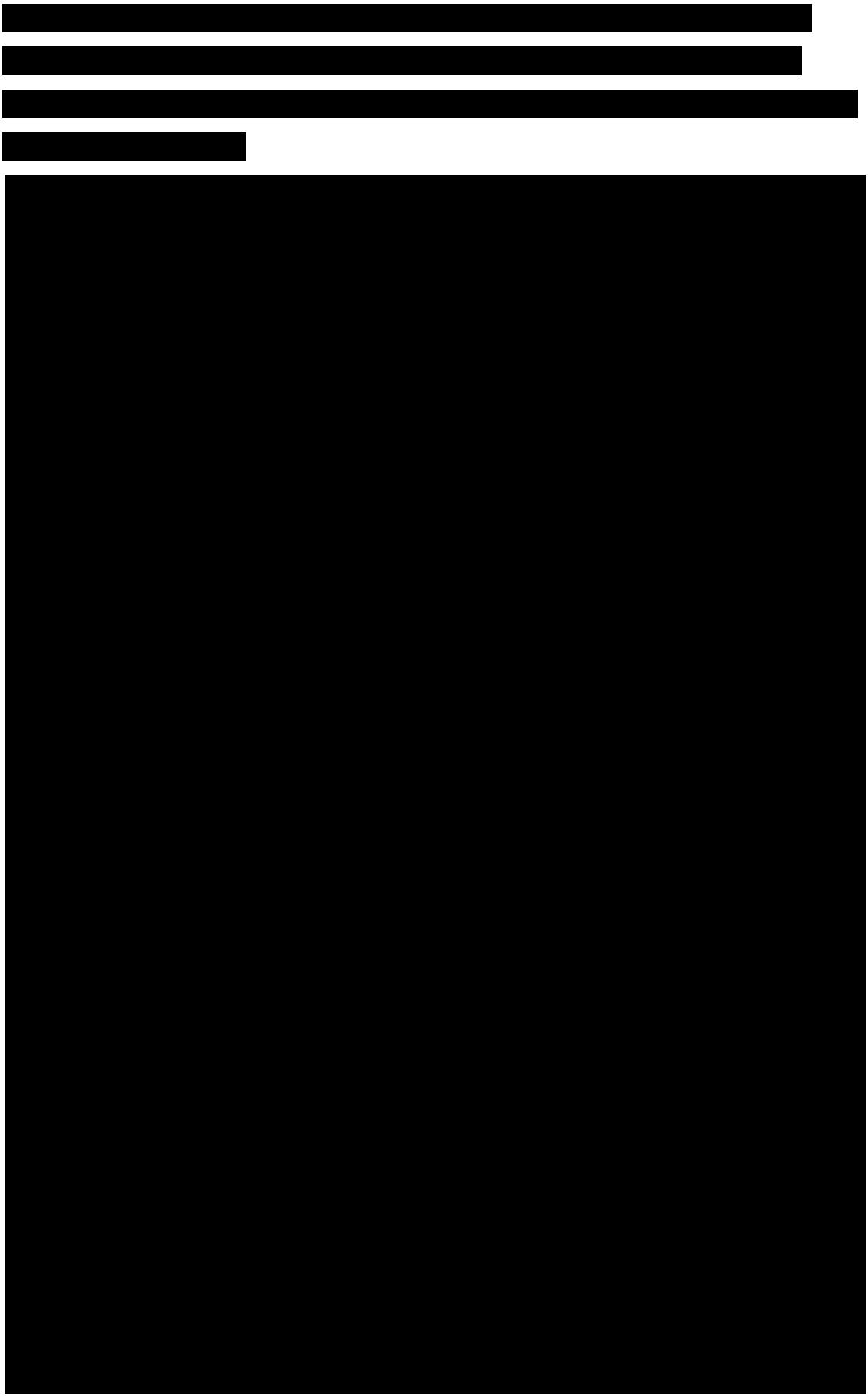


Figure 8. Example of completed HI-FOG® layout for local application system (authors own drawing)

3.2.1.2 Electrical design

[redacted]

3.2.1.3 System documentation

[redacted]

Figure 9. Example of pump dimensioning calculation (from Marioff Corporation Oy project specific system manual)

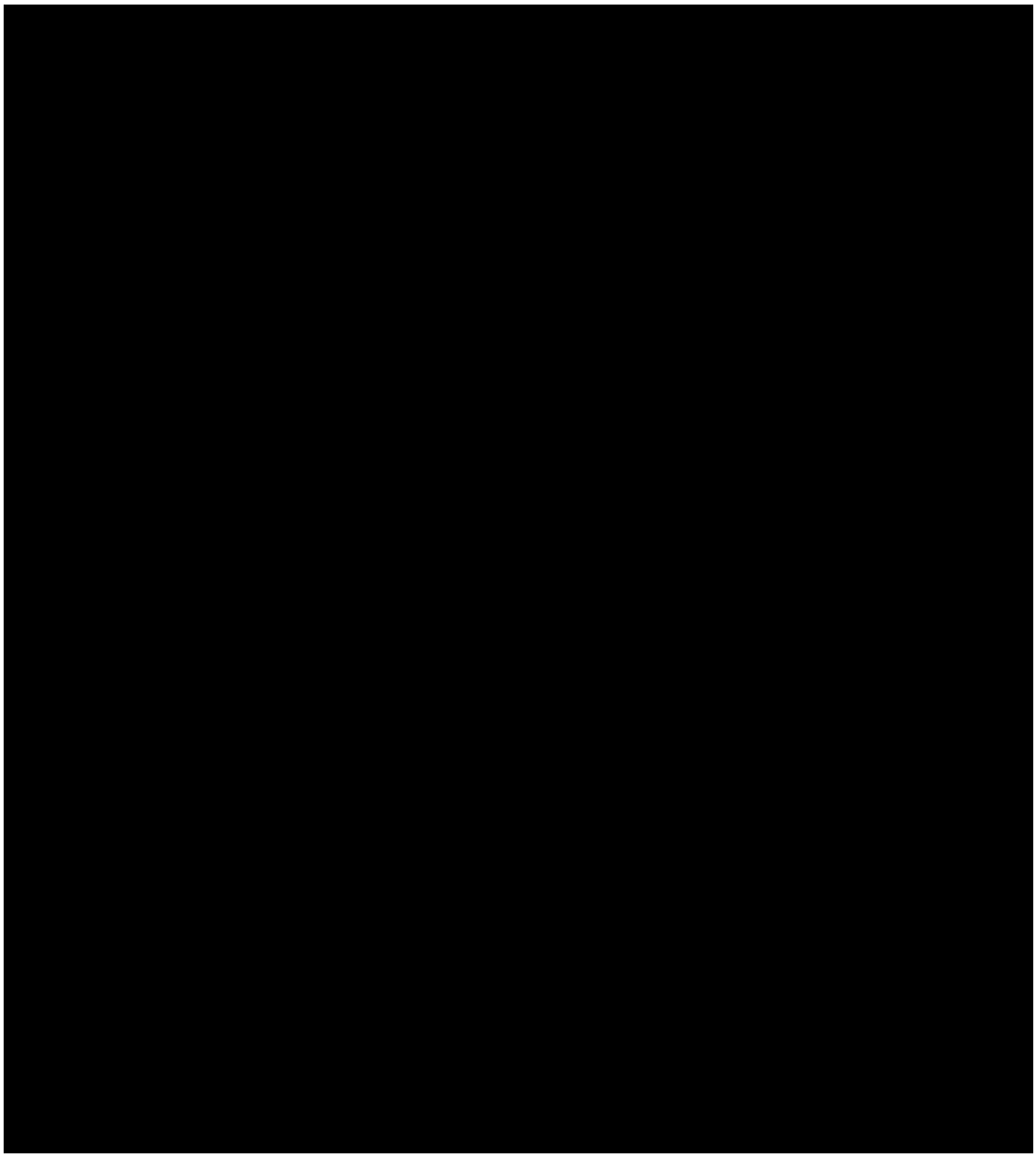


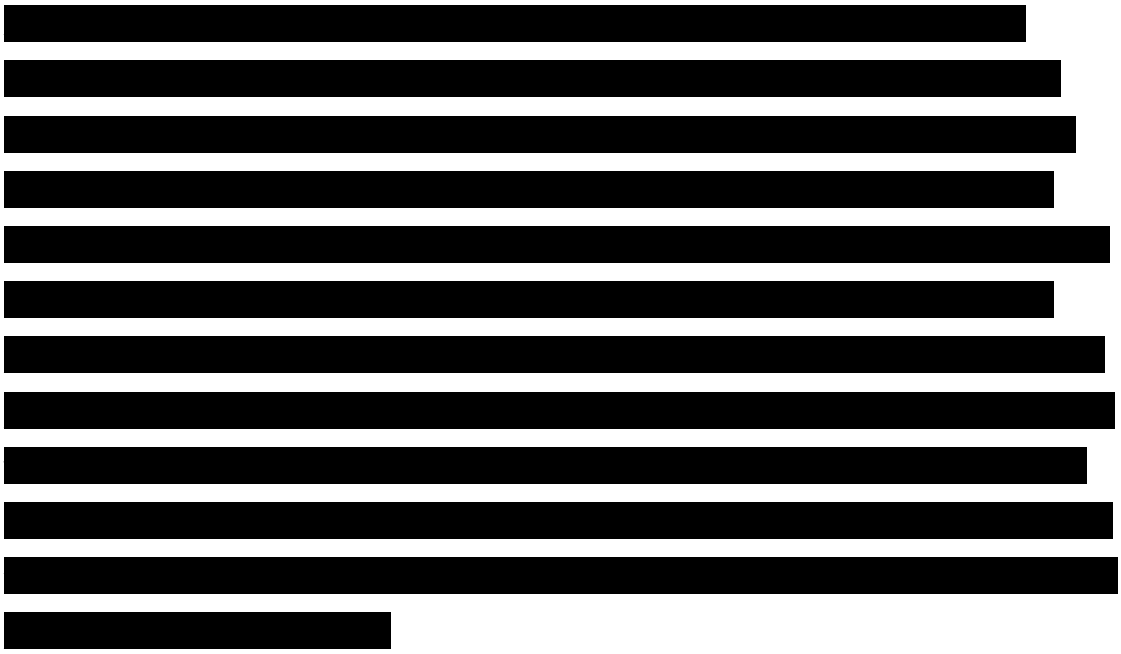
Figure 10. Example of pressure drop calulation (from Marioff Corporation Oy project specific documentation)

3.2.1.4 Authority approval

Once the piping diagram, electrical design and system documentation has been completed, the full system documentation is sent for authority approval. The process for submittal of documentation differs depending on which classification society handles the approval for the vessel in question. Some authorities require several hard copies of the system documentation while some are using electronic approval processes where the system documentation is uploaded to a server controlled by the classification society.

Once the documentation has been submitted, the classification society will investigate if the proposed system fulfills applicable rules and regulations. If there are any unclear issues the classification society will issue comments regarding the system which must be clarified and, if needed, re-submitted to the classification society. When all pending comments have been satisfactorily replied, they will be closed by the classification society and the proposed system is approved.

3.2.2 Deliveries – internal material orders



3.2.3 Installation and training

In turnkey projects where the installation is a part of Marioff scope of supply, the installation agreement with chosen subcontractor must be controlled by the project team. In this document we will not go further on the issue of installation as it cannot be a part of a commoditized package.

3.2.4 Commissioning

Once the system has been mechanically installed and all electrical installation have been completed, the system is commissioned by a trained Marioff Corporation Oy commissioning engineer. During the commissioning all mechanical installation are checked that they have been done according to Marioff Corporation Oy instructions and all electrical signals are tested and checked. In the final stages of the commissioning the

classification society representative and usually also the end users representative are present and they give the final acceptance of the designed and installed system.

4 Authorities and Classification Societies

4.1 International Maritime Organization (IMO) and SOLAS

The International Maritime Organization - IMO is the United Nations (UN) specialized agency with responsibility for the safety and security and the prevention of marine pollution by ships. IMO was formally established in 1948 by an international UN conference held in Geneva. The reasons behind establishing the IMO was the fact until then, each shipping nation had its own maritime laws, and only a few international treaties existed. This resulted in that the standards and requirements varied much and were often even contradictory. Several countries proposed that a permanent international body should be established to develop international standards, which would replace the different national legislations that existed./7/.

The International Convention for the Safety of Life at Sea (SOLAS) is an international maritime safety treaty. The SOLAS convention in its successive forms is generally regarded as the most important treaties concerning the safety of merchant ships. The first version of the treaty was passed in 1914 in response to the RMS Titanic disaster. It prescribed numbers of lifeboats and other emergency equipment along with safety procedures.

The intention had been to keep the convention up to date by periodic amendments, but the procedure to incorporate the amendments proved to be very slow. It could take several years for the amendments to be put into action since countries had to give notice of acceptance to IMO and there was a minimum threshold of countries and tonnage.

The 1960 convention, which was activated on 26 May 1965, was the first major achievement for IMO after its establishment and represented a massive advance in updating commercial shipping regulations and in staying up-to-date with new technology and procedures in the industry./8/.

4.2 Classification Societies

4.2.1 General

There are more than 50 classification organizations worldwide who define their activity as providing marine classification. Of these 50 societies, eleven are a member of the International Association of Classification Societies and class approximately 94% of all commercial marine tonnage involved in international trade worldwide.

Classification societies are organizations who develop and apply technical standards for marine facilities, i.e. ships and offshore structures, in relation to design, construction and survey. The standards are issued by a classification society as a published rule. A marine facility which is designed and constructed following these published rules can apply for a certificate of classification from the society according to whose rules the facility has been built. The classification society will conduct surveys during the design and construction stage and if found to be as per published rules the society will issue a certificate that the facility has been designed and constructed as per applicable rules. Surveys will be conducted throughout the service time of the facility to control that the facility is maintained correctly and that it fulfills applicable rules also after completion.

The technical standards are developed to asses the structural strength and integrity of essential parts of the ship's hull and equipment. The standards are categorized by several subareas, e.g. hull, machinery, propulsions, steering, fire safety etc. The standards are developed so as to make the use of a marine facility as safe as possible. The classification societies mission is to contribute to the development and implementation of technical standards for the protection of life, property and the environment.

Classification societies are only one element within the marine safety network, several other partners are also involved in the safety of marine facilities, e.g. shipowner, shipbuilder, flag state etc.

Classification societies also grant type approvals for standard designs or routinely manufactured components. The type approval of a product or a system implies that the examination of the design is done once for the product or system and the approval is made valid for all subsequent components or systems of identical design. For type approving a system, the classification societies control that the suggested system will follow and fulfill requirements laid out in IMO documents./9/.

4.2.2 International Association of Classification Societies Ltd (IACS)

Today the members of IACS are;

American Bureau of Shipping (ABS)
Bureau Veritas (BV)
China Classification Society (CCS)
Det Norske Veritas (DNV)
Germanischer Lloyd (GL)
Indian Register of Shipping (IRS)
Korean Register of Shipping (KR)
Lloyd's Register (LR)
Nippon Kaiji Kyokai (NK)
Registro Italiano Navale (RINA)
Russian Maritime Register of Shipping (RS)

In 1930 the International Load Line Convention recommended that classification societies should secure *"as much uniformity as possible in the application of the standards of strength upon which freeboard is based…"* /10/

After the load line convention RINA hosted the first conference of major societies in 1939, which was attended by ABS, BV, DNV, GL, LR and NK. In this conference the societies agreed on further cooperation between the societies. This can be considered as the origin of IACS, even though the IACS was officially formed in 1968 by seven of the leading societies.

The value of IACS combined technical knowledge and experience was quickly recognized and already in 1969 IACS was given consultative status with IMO. It is still

the only non-governmental organization with observe status in IMO which is able to develop and apply rules.

The purpose of IACS is to establish, review, promote and develop minimum technical requirements in relation to design, construction, maintenance and survey of ships and other marine related facilities. IACS also assists international regulatory bodies and standard organizations to develop, implement and interpret statutory regulations industry standards in ship design, construction and maintenance, with a view to improving safety at sea and the prevention of marine pollution. /11/

5 Presentation of the example systems and regulatory requirements

5.1 Presentation of the KAU system

The Kitchen Accumulator Unit, referred to as a KAU, is a self-contained HI-FOG® water mist distribution system for fire protection of deep fat cooking equipment only. It is a twin-fluid, single pipe type employing water as the suppressant and nitrogen or compressed air as the atomizing medium in a single discharge.

Each system arrangement is configured to cover the deep fat cooking area using a water and a gas or pressurized air supply for a total suppressant requirement for about four (4) minutes. The system consists of the following main components;

- a **K**itchen **A**ccumulator power **U**nit (**KAU**) which comprises of a 20 liter water cylinder interconnected with a pressurized (200 bar) 20 liter or 10 liter nitrogen / pressurized air cylinder
- a spray head installed above the protected equipment for discharging of water mist
- assembly body for the spray head
- stainless steel tubing

The distribution tubing is isolated from the accumulator unit by an actuator valve or an isolation valve. In standby position the valve is closed and the tubing up to the spray head is dry. In its simplest form the system is activated manually by opening the

isolation valve. Alternatively it may be activated by either remote electric actuation or remote pneumatic actuation, both being supplemented by local manual release.

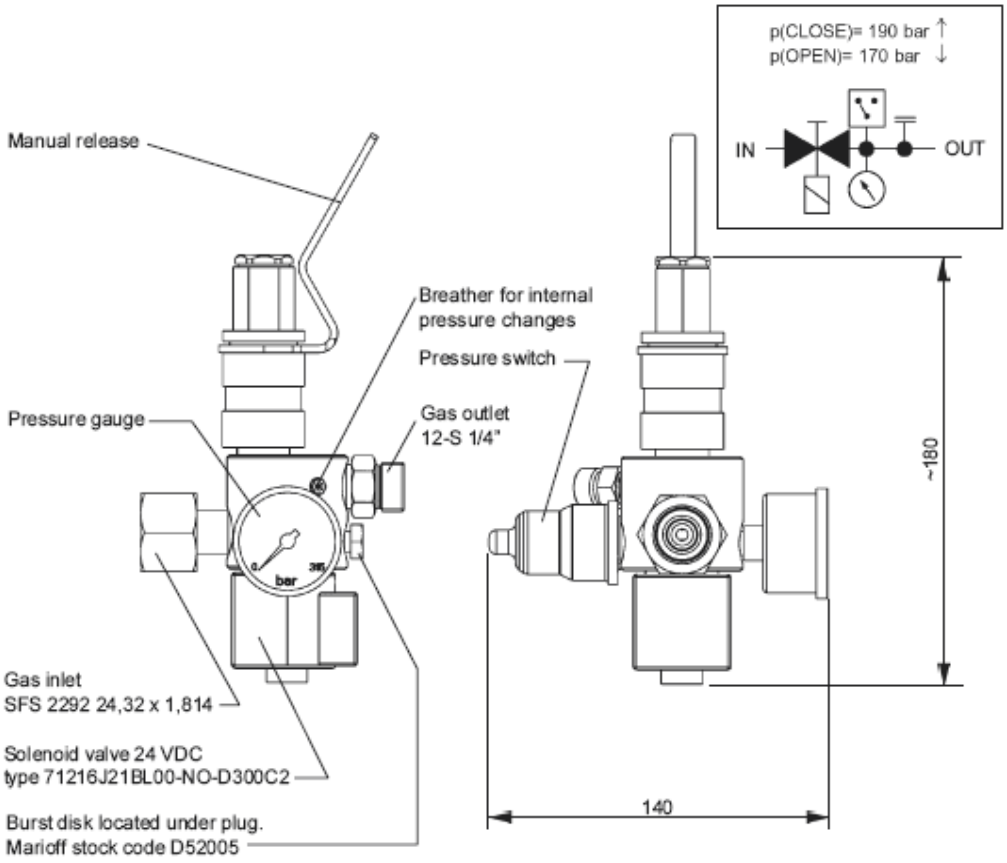


Figure 11. Release valve (Solenoid actuator valve) for KAU unit with manual release capability (from Marioff Corporation Oy's internal documentation)

The deep fat fryers to be protected can be single-vat fryers, multiple-vat fryers and split-vat fryers with a cooking area of a single vat not exceeding 0.1 m^2. /12/.

In order to produce the high-pressure water mist a special nozzle is used which converts the water into water mist. The nozzle for the KAU system is an open nozzle, so the water mist will be created as soon as water under high pressure is led into the section.

Figure 12. Spray head for deep fat fryer protection (from Marioff Corporation Oy's internal documentation)

The assembly body is used to connect the spray head to the distribution piping. The connection between assembly body and piping is done with a cutting ring fitting. The spray head is then screwed into the assembly body and tightened using a special tool.

Figure 13. Assembly body (from Marioff Corporation Oy's internal documentation)

[redacted]

Figure 14. Typical KAU system – P&ID (from Marioff Corporation Oy's internal documentation)

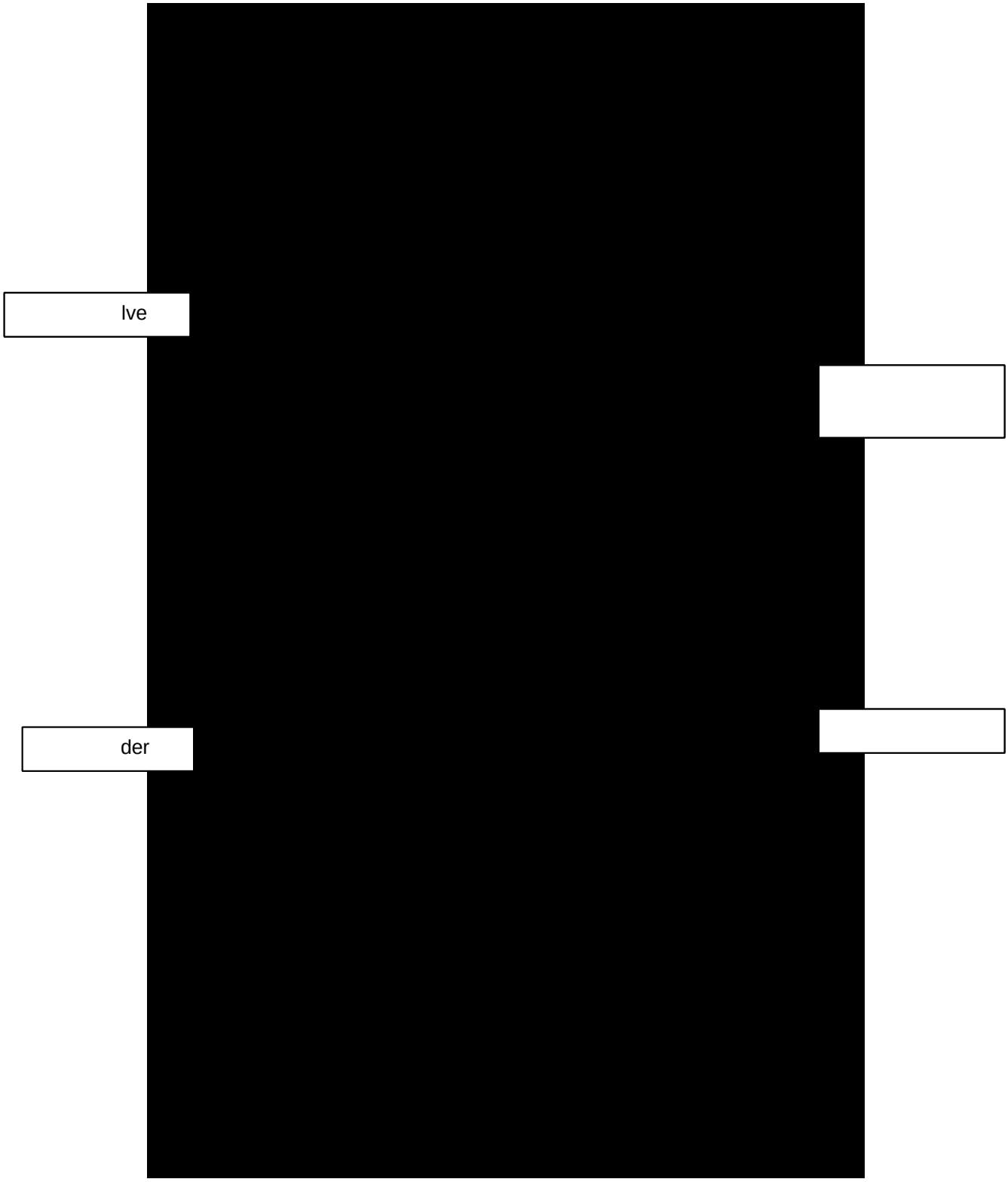


Figure 15. Typical KAU Unit – General assembly (from Marioff Corporation Oy's internal documentation)

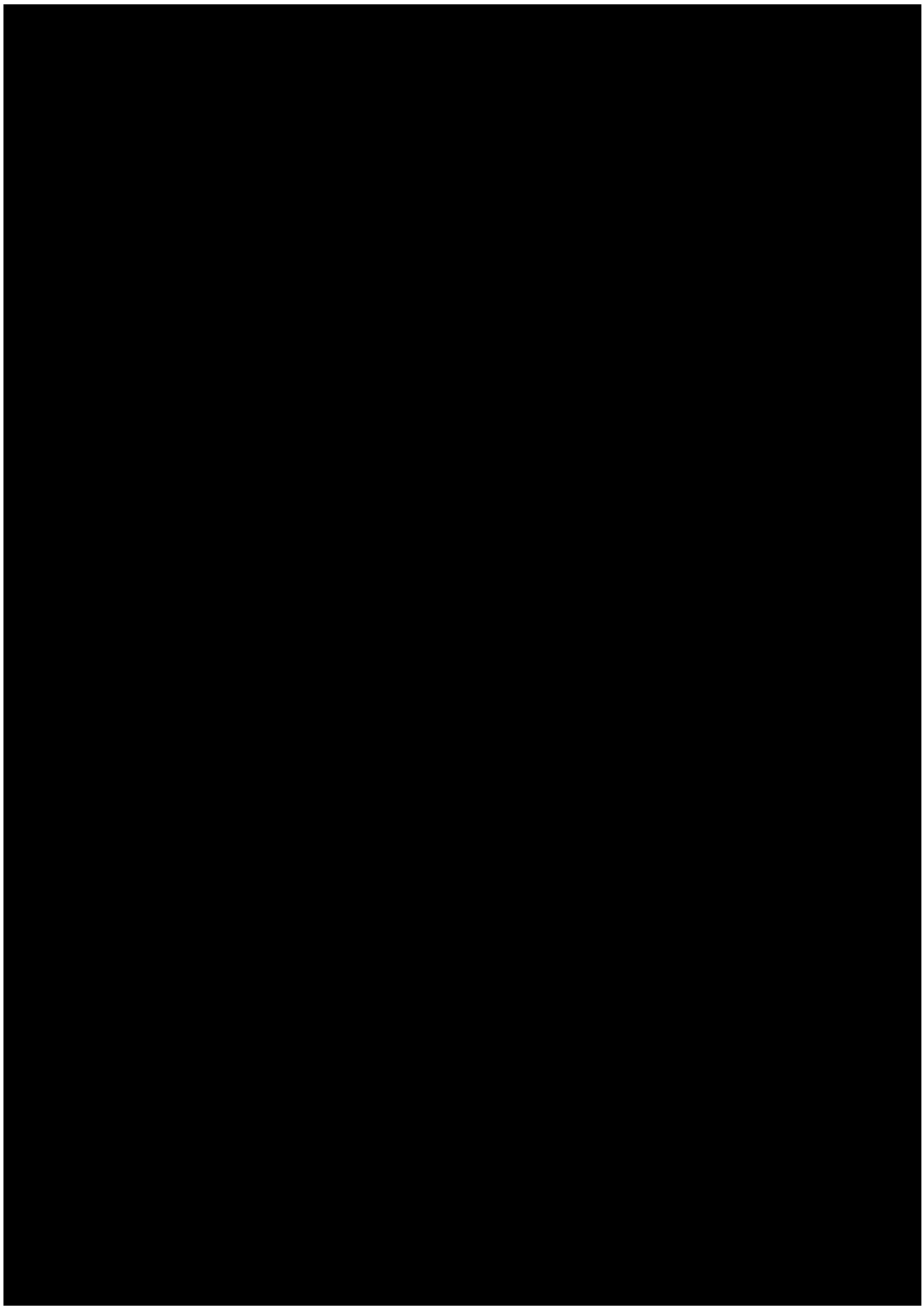


Figure 16. Typical KAU – Single fryer protection (from Marioff Corporation Oy's internal documentation)

5.2 Authority requirements and rules for KAU systems

The requirements and rules for deep-fat cooking equipment fire-extinguishing systems are mentioned in IMO SOLAS. Further, classification societies can have specific requirements in regard to design or components used in the system.

5.2.1 IMO/SOLAS/FSS Code

The basic rules and requirements for deep-fat cooking equipment fire-extinguishing systems can be found in IMO SOLAS Chapter II-2: Regulation 10.6.4, where it is stated the following;

6.4 Deep-fat cooking equipment

Deep-fat cooking equipment shall be fitted with the following:

1. *an automatic or manual fire-extinguishing system tested to an international standard acceptable to the Organization;**
2. *a primary and back up thermostat with an alarm to alert the operator in the event of failure of either thermostat;*
3. *arrangements for automatically shutting off the electrical power upon activation of the fire-extinguishing system;*
4. *an alarm for indicating operation of the fire-extinguishing system in the galley where the equipment is installed; and*
5. *controls for manual operation of the fire-extinguishing system which are clearly labeled for ready use by the crew*

**Refer to the recommendations by the International Organization for Standardization, in particular publication ISO 15731:2009, Fire-extinguishing systems for protection of galley deep-fat cooking equipment – fire tests.* /xx/

5.2.2 Classification Societies

The classification societies issue type approvals for systems that are in conjunction with the rules and regulations mentioned in the IMO SOLAS. The type approvals are usually valid for a period between three (3) and five (5) years, unless for some reason revoked. As the type approvals are issued only for systems fulfilling the set regulations it can be concluded that a system following the type approvals are fulfilling all the rules.

Although every classification society follows the same base rules from SOLAS, there are differences between the requirements stated in the type approvals issued by different classification societies. Therefore, for this commoditization work, the most stringent requirements have to be considered. Or alternatively, there must be developed a tool for the distributor and agents from where they can choose the applicable classification society and the output will show which components are needed to fulfill the rules for that class.

5.3 Presentation of the MLPU system

The HI-FOG® Machinery Space Local Application Unit is designed to supply high pressure water to a HI-FOG® water mist distribution system used for fire protection. It is used with single-fluid, single-pipe type HI-FOG® spray head systems that use water, in the form of fine mist, as the fire suppressant. The system is designed for constant pressure discharge.
The basic features of the MLPU are:
• Automatic start in connection with a third-party Fire Detection System (FDS)
• Manual local start
• 70 or 90 bar pressure, depending on the application
The optional features of the MLPU are:
• Voltage options
• 50 Hz or 60 Hz frequency
• Feed water pump starter in the Starter Cabinet
• Emergency start at a remote location

The MLPU system consists of the following main components;

- Pump unit
- Starter cabinet for pump unit
- Stainless steel piping in the distribution network
- Section valves
- Spray heads for discharging the water mist
- Assembly bodies for spray heads

- Control panel (release panel)
- Repeater panel
- Alarm beacons
- Local release buttons

The pump unit consists of the following main parts:

• pump module which consists of one 3-phase electric motor, one plunger pump and one unloader

• stand-by pressure water connection

• pressure indication

• test connection

Figure 17. Machinery space local application pump unit (MLPU)(extracted and modified from Marioff Corporation Oy's data sheet for MLPU)

The Starter Cabinet is used to monitor, operate, and control the MLPU fire protection system. It indicates all operation and fault signals concerning the pump unit. The Starter Cabinet is installed near the pump unit.

The Starter Cabinet has the following manual operations and selections (numbers in brackets correspond to the figure 18 below):

[redacted]

The Starter Cabinet has the following indications:

[redacted]

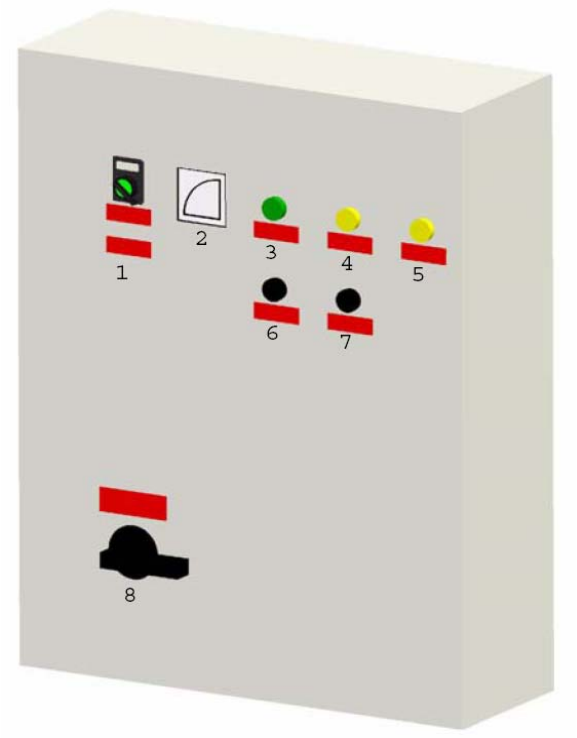


Figure 18. MLPU starter cabinet (extracted and modified from Marioff Corporation Oy's data sheet for MLPU)

Tubes and fittings are used to distribute the water, pushed under high pressure by the MLPU pump unit, to the nozzles located in the protected space. The tubes are made of corrosion-resistant AISI 316 stainless steel according to DIN or equivalent standards. The tubes are coupled using S-class cutting ring couplings that are compliant with DIN

2352. The tubing network is designed to cover the areas to be protected as effectively as possible.

The section valve controls the water flow to the protected section. The valves are connected to the distribution piping between the pump unit and the spray heads inside the protected section. The section valve is normally closed, so the piping is filled with water up to the section valve and dry after the section valve. The valve is normally opened by a signal from the release panel, which will activate the solenoid and open the section valve. If the solenoid is malfunctioning, there is a possibility to open the valve manually by turning the manual release wheel. The opening of the section valve is detected by the piston position indicator.

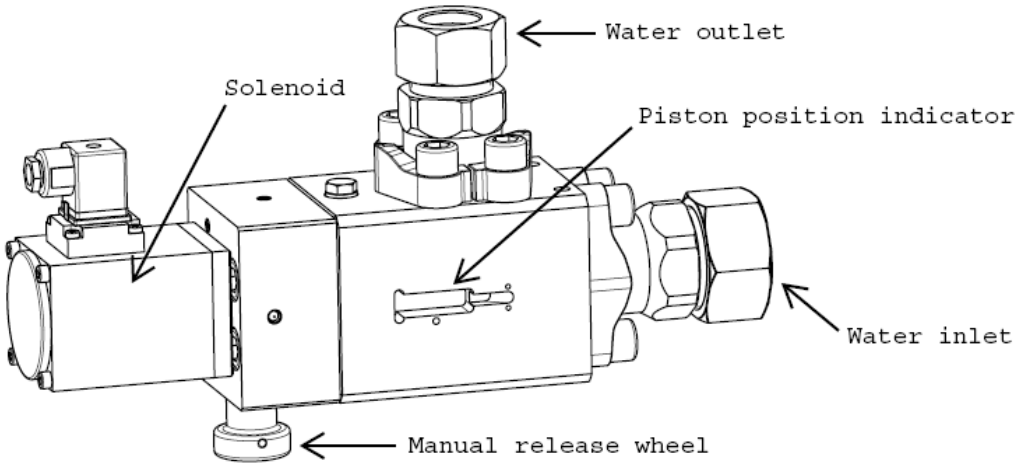


Figure 19. Machinery section valve (extracted and modified from Marioff Corporation Oy's internal documentation)

To produce high-pressure water mist which is used in the MLPU system a special nozzle is used which converts the water under high pressure into water mist. The nozzle for the MLPU system is an open nozzle, so the water mist will be created as soon as high pressure water is led into the section.

Figure 20. Spray head (from Marioff Corporation Oy's internal documentation)

The assembly body is used to connect the spray head to the distribution piping. The connection between assembly body and piping is done with a cutting ring fitting. The spray head is then screwed into te assembly body and tightened using a special tool./13/.

Figure 21. Assembly body (from Marioff Corporation Oy's internal documentation)

The release panel is used to monitor and control the MLPU system. It has the following manual operations and selections (numbers in brackets correspond to the Figure 22 below):

Figure 22. Release panel (extracted and modified from Marioff Corporation Oy's project documentation)

The repeater panel has the same indications as the release panel, but the system cannot be operated via the repeater panel.

Each section is to be equipped with an alarm which is installed within the protected space. This alarm will sound if the corresponding section is released to warn any crew members that might still occupy the area when the system is released.

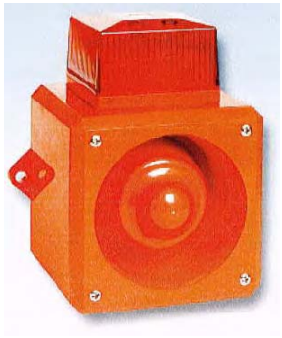


Figure 23. Sounder- strobe combination alarm (from Marioff Corporation Oy's internal documentation)

Each section is to be equipped with a local release button which is to be installed within the protected space. This local release button can be used by the crew while they are evacuating the area to release the system.

Figure 24. Local Release Button (picture by author)

The equipment requiring local protection are separated each under its own section. The flow to each section is controlled by a normally closed section valve which is controlled by the release panel. The distribution network from pump unit until section valve is pressured to stand by pressure, 25 bar, and after the section valve the distribution network is of dry type.

When a section is released the section valve is opened and water will flow to the spray heads and discharge as water mist. At the same time the electrical motor will start via a command from the starter panel and create a high pressure water flow in the distribution network, thus giving continuous supply of high pressure water to the spray head.

The section valves can be opened in several ways. Local application sections must be connected to automatic fire detection systems which will give a release signal to the HI-FOG® system. This signal is led to the release panel which opens the section valve and gives start pump unit signal to pump unit. The section can also be released by pressing the corresponding section button on the release panel, opening the section valve and starting the pump unit as in automatic mode. Third possibility for release of system is via the local release button which is located within the protected space. When this button is pressed the section will open and pump will start in the same way as in the two other release methods.

5.4 Authority requirements and rules for MLPU systems

The requirements and rules for a local application fire-extinguishing system are mentioned in IMO SOLAS and in the IMO circular. Further, classification societies can have specific requirements in regard to design or components used in the system.

5.4.1 IMO/SOLAS/FSS Code

The basic requirements for a local application fire protection system are mentioned in SOLAS, where in chapter II-2, regulation *10.5.6 Fixed local application fire fighting systems* is stated the following;

5.6.1 Paragraph 5.6 shall apply to passenger ships of 500 gross tonnage and above and cargo ships of 2000 gross tonnage and above.

5.6.2 Machinery spaces of category A above 500 m³ in volume shall, in addition to the fixed fire-extinguishing system required in paragraph 5.1.1, be protected by an approved type of fixed water-based or equivalent local application fire-extinguishing system, based on the guidelines developed by the Organization. (Refer to the Guidelines for the approval of fixed water-based local application fire-fighting systems for use in category A machinery spaces (MSC/Circ.913)). In the case of periodically unattended machinery spaces, the fire-extinguishing system shall have both automatic and manual release capabilities. In the case of continuously manned machinery spaces, the fire-extinguishing system is only required to have a manual release capability.

5.6.3 Fixed local application fire-extinguishing systems are to protect areas such as the following without the necessity of engine shutdown, personnel evacuation, or sealing of the spaces:

.1 the fire hazard portions of internal combustion machinery used for the ship's main propulsion and power generation;

.2 boiler fronts;

.3 the fire hazard portions of incinerators; and

.4 purifiers for heated fuel oil.

5.6.4 Activation of any local application system shall give a visual and distinct audible alarm in the protected space and at continuously manned stations. The alarm shall indicate the specific system activated. The system alarm requirements described within this paragraph are in addition to, and not a substitute for, the detection and alarm system required elsewhere in this chapter.

SOLAS chapter 10.5.6 refers to IMO MSC/Circ. 913, which has been revised in December 2010 and the requirements are now specified in IMO MSC.1/Circ. 1387. This circular states in paragraph 3 “Principal requirements for the system” the following which has relevance for the commoditization of the MLPU system in regard to the mechanical and electrical arrangement of the system;

3.1 System operation

.1 The system should be capable of manual release.

.3 The operation controls should be located at easily accessible positions inside and outside the protected space. The controls inside the space should not be liable to be cut off by a fire in the protected areas.

.5 Where automatically operated fire-fighting systems are installed:

.4 visual and audible indication of the activated section should be provided in the engine control room and the navigation bridge or continuously manned central control station. Audible alarms may use a single tone.

3.2 Arrangement of nozzles and water supply

.2 The location, type and characteristics of the nozzles should be within the limits tested in accordance with the appendix to these Guidelines. Nozzle positioning should take into account obstructions to the spray of the fire-fighting system. The use of a single row of nozzles or single nozzles may be accepted for installation where this gives adequate protection according to paragraph 3.4.2.4 of the appendix.

.3 The piping system should be sized in accordance with a hydraulic calculation technique such as the Hazen-Williams hydraulic calculation technique and the Darcy-Weisbach hydraulic calculation technique, to ensure availability of flows and pressures required for correct performance of the system.*

3.3 System components

.8 A fitting should be installed on the discharge piping of open head systems to permit blowing air through the system during testing to check for possible obstructions.

5.4.2 Classification Societies

The classification societies follow the requirements in SOLAS and relevant MSC Circulars. In this aspect the classification society requirements will be taken from the type approval certificates which the MLPU system has received when it has been tested according to requirements in the MSC Circulars. The requirements for nozzle spacing and minimum and maximum nozzle heights in different classification society type approvals are the same regardless of society. They all require maximum 4 meter spacing between the nozzles and minimum 1,5 meter and maximum 5,5 meter height of nozzle above the protected object.

Some societies have additional requirements in the type approval certificates which must be taken into consideration as the most stringent requirement must be followed in this commoditization. They are,

- Nozzles should be placed in a uniform grid, but if a single row is used then they must be installed at half spacing, i.e. 2 meters.
- If only a limited number of objects are protected within a space the outer nozzles of the grid shall be placed outside the protected area to a distance of at least 1 meter.
- DNV requires that the section valve used must be type approved by DNV, this valve will be considered as standard type in MLPU commoditization as it is also accepted by all other societies.

The classification society type approvals cover normally only the spray heads and some minor components of the system. The final design of the system must be submitted for case-by-case approval to the society. Societies require that at least the following information is submitted for approval; system manual, general ship arrangement plan showing the location of pump unit, location of section valves, nozzle quantities and locations, distribution piping layout and sizes, electrical control system diagram, P&ID for the system and hydraulic calculations showing that the required flow and pressure is available at the spray heads.

6 Commoditization of the example systems

In order to determine the need, possibilities and interest for commoditized systems a questionnaire regarding KAU and MLPU systems was sent out to distributors and agents and also internal interviews were conducted.

6.1 Goal of commoditized systems

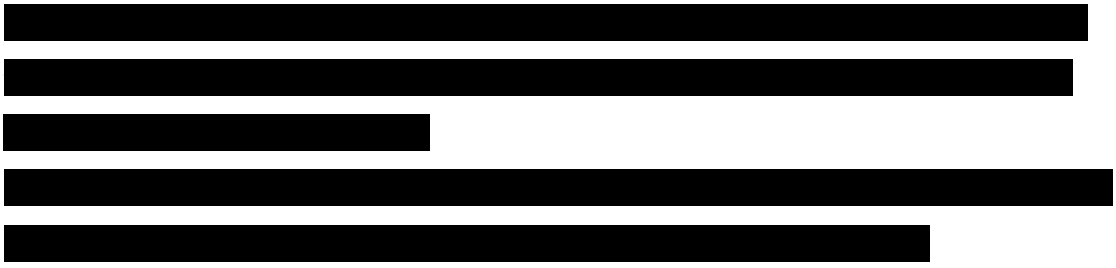
The goal is to create a standardized pre-engineered package, using the KAU and MLPU systems as an example, which Marioff distributor and agents could sell without the need to involve Marioff sales team or project team in the selling and design process.

The sales and project processes described in paragraph 3 are the same for all Marioff Corporation Oy projects, regardless of the amount of equipment installed and regardless of economical profitability of the project. If the need of Marioff Corporation Oy participation in the sales and project work phases could be eliminated, the resources which are normally needed for the heavy process to execute a project could be directed elsewhere to more challenging or economically more profitable projects.

To achieve the goal, customer requirements and Marioff Corporation Oy requirements should be investigated and a process for commoditization should be developed and tools for designing and dimensioning the systems should be developed.

6.2 Customer (distributors and agents) demands/requirements

The questionnaire to distributors and agents with ten questions did not generate as many answers as hoped, only about 20% of the recipients showed any interest by replying. The questions and feedback received is compiled below.



[redacted]

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6.3 Marioff demands/requirements

From a company strategic point of view, the commoditization of Marioff Corporation Oy systems would be desirable, as it would allow growth in sales and revenue without the need for major increase of personnel. To determine Marioff Corporation Oy's demands and requirements for commoditized systems internal interviews were conducted with Hilppa Rautpalo from the legal department and Lari Laakso from the after sales & services department.

6.3.1 Legal viewpoint

From a legal aspect there are several issues that need to be considered when making the decision about the commoditization of Marioff Corporation Oy systems.

[redacted]

[redacted]

6.3.2 After sales & services viewpoint

To receive a view regarding the after sales activities of commoditized system the manager of Marioff Corporation Oy after sales department was interviewed, the conclusions of the interview are presented below.

[redacted]

[redacted]

7 Defining the required tools and processes for commoditization of the systems

To successfully complete the commoditization of the systems there are several issues which need to be considered. The issues involve both Marioff Corporation Oy internal processes as well as a change in the distributor and agents' role or resource allocation.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

7.1 Defining parameters and critical tools for system design/dimensioning for KAU system

For the commoditization of the KAU system a standard package should be defined.

[redacted]

[redacted]

[redacted]

[redacted]

Figure 25. KAU order tool example

7.2 Defining parameters and critical tools for system design/dimensioning for MLPU system

[redacted]

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8 Conclusion

[redacted]

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