Safety on board ships engineering essay

Safety is of utmost importance onboard ships. There have been many ship related accidents and incidents that have claimed many lives. One such common accident would be fire outbreaks onboard ships. Due to the high number of such fatal occurrences, MARPOL and SOLAS have been erected, and they contain rules and regulations that all seafarers must abide by. In order to prevent incidents, safety equipments are usually installed in the ships. One of such safety equipments would be detectors.

Detectors are devices that can detect fire or some other hazardous conditions. Onboard ships, there are several different types of detectors.

They are as follows:

Fire Detector

Flammable Gas Detector

Refrigerant Gas Leak Detector

Water Level detector

1. Fire Detector

Fire detectors are used to detect fires onboard ships. Fire is a common hazard that happens at sea. Statistically, fire outbreaks have resulted in more total losses of ships than any other form of casualty. Most of the fires are caused by negligence and carelessness. Fortunately, with fire detectors, the extent of damage caused by fires can be largely minimised. A good fire detector is one that is reliable and requires minimum attention. More importantly, the fire detector must not be set off by normal occurrences in

the protected space, hence its sensitivity must be adjusted accurately and in accordance to its surrounding.

Under fire detectors, there are 3 sub types:

Smoke detector

Flame detector

Heat detector

a) Smoke detector – The two types of smoke detectors: Ionisation detector and photoelectric detector. The ionisation detector reacts to both the visible and invisible products of combustion, but the photoelectric type only responds to visible products of combustion.

Ionisation smoke detectors make use of ionisation chamber and a source of ionisation radiation to detect smoke. There are two types of ionisation smoke detectors. One type uses a bipolar ionised sampling chamber, and the other uses a unipolar ionised sampling chamber. The source of ionisation radiation comes from a small amount of americium-241, which is a good source of alpha particles.

The bipolar ionised sampling chamber type smoke detector has an ionisation chamber that contains two electrodes of a potential difference as a voltage is applied across them. In between the two electrode is air-filled space. The alpha particles that are being produced by the americium-241 ionises the air in between the two electrodes. To ionise means to knock off an electron from an atom. This creates a free electron and a positively-charged ion. The free

election will then be attracted to the positively-charge electrode and the positive ion will be attracted to the negatively-charged electrode, due to the potential difference between the two electrodes. This, hence, produces a constant flow of current between the electrodes. When a minute quantity of smoke enters the air-filled space in between the electrodes, the ionised air particles get neutralised by the smoke particles. This will result in a fall of current between the electrodes. The smoke detector detects this drop in current and sets off the fire alarm.

The second type of ionisation smoke detector has a unipolar ionised sampling chamber instead of a bipolar one. The only difference is that for the bipolar one, the whole chamber is exposed to the radiation, whereas for the unipolar one, only the immediate area adjacent to the positive electrode is exposed to the alpha source. As a result, the unipolar type has only one predominant type of ions, which are anions, in the electrical current flow between the electrodes. Currently, the unipolar type smoke detectors are the commercially most common ones.

One of the few drawbacks of ionisation type smoke detectors is that there may be frequent false alarms. The reason being that any micron-size particle, such as kitchen grease particles, entering the ionisation chamber can actually set off the alarm. However, this type of smoke detectors are still the most commonly used, due to their reliability, low cost and relatively maintenance-free operation.

Smoke Detector

There are two main types of photoelectric smoke detectors, namely the projected beam type and the reflected beam type. Photoelectric smoke detectors work on basis of the presence or absence of light.

The projected beam type consists of a photoelectric sensor with light falling on it from a source located at holds or other protected space on the ship. When there is the presence of smoke, the light intensity of the beam that is received in the photoelectric cell decreases due to it being obscured by the smoke particles. This reduced level of light intensity causes the electrical circuit to the photocell to be unbalanced, and hence activating the alarm.

The reflected light beam type smoke detector consists of a light source, a light catcher positioned opposite to the light source and also a photoelectric cell fixed normal to the light source. When smoke particles enter into the light beam region, some light is being reflected onto the photoelectric cell. This creates a closed circuit, and hence setting off the alarm.

Photoelectric detectors are commonly used to protect storage areas and high value compartments, and also to provide smoke detection for air ducts and plenum areas.

However, the downside of this type of photoelectric smoke detector is that the smoke has to be thick before it can be detected. This is due to its relatively low sensitivity. The plus side of this type of smoke detectors is that there will be fewer false alarms.

Smoke detectors are mainly used in machinery spaces, cargo holds and accommodation areas. All ships built since September 1985 are required to

be provided with smoke detectors in corridors and over stairways within accommodation spaces. Both the ionisation and photoelectric smoke detectors are effective as they provide sufficient time for people to escape in the case of a fire outbreak. Each type of smoke detector, though different in working principles, has its own advantages. For example, ionisation smoke detectors have a response quicker for flaming fires. As for photoelectric detectors, they respond more quickly to smouldering fires. To ensure the high level of protection, it is advised to use both types of detectors. There are combination alarms, that contains both type of technologies in one device, and it also can be employed to achieve higher protection.

b) Flame detector – Flames are usually caused by gas and liquid fires. Flame detector uses optical sensors to detect flames. Flames give off radiation consisting mainly of ultra-violet radiation, visible light and infrared radiation. There are about 6 types of flame detectors, which consist of ultraviolet(UV), infrared(IR), UV/IR, IR/IR, IR/IR/IR and visible sensors.

Ultraviolet detectors are able to detect fires and explosions in about 4 milliseconds. When a small flame is ignited, an ultraviolet detector can immediately distinguish the type of flame it is. Even though they are very accurate, ultraviolet detectors can be fooled by radiation, arc welding, sunlight and lightning.

An infrared flame detector works by using an infrared band. When hot gases are released near an infrared detector, The small thermal imaging camera within the detector will then pick up on the presence of these gases.

However, false alarms can be set off when other wanted sources of hot gas are present near an infrared flame.

UV/IR detector works by using a combination of UV and IR technology to detect a flame. Such a detector gathers information from the ultraviolet and infrared perspective. With these two technologies working together, false alarms can be minimised. The similar principle applies to IR/IR flame detector. It detects flames within two infrared frequencies. Hence, IR/IR detectors are also able to eliminate most false alarms.

The IR/IR/IR detectors are the most accurate. They use three different infrared frequencies used to detect a flame. IR/IR/IR detectors work by comparing three wavelength bands, thus, it is highly unlikely for this type of a flame detector to give off a false alarm. Often, in order to detect visible flames, visible sensors are also installed in with the flame detector.

Hence, when a flame occurs, flame detectors are able to detect the radiations, and will then set off the alarm. Flame detectors are usually used near to fuel handling equipment in the machinery spaces and also at boiler fronts.

Flame detector type regions

Infrared Flame Detector

c) Heat detector – It is a device that responds when the thermal energy of a fire increases the temperature of a heat sensitive element. Heat detectors have two main classifications: Fixed temperature and Rate-of-rise.

Fixed temperature heat detectors operates when the heat sensitive element in it reaches a certain fixed temperature. Thermal lag delays the accumulation of heat at the heat sensitive element so that the device will only reach the operating temperature sometime after the surrounding temperature exceeds that temperature. When the fixed operating temperature of the heat sensitive element is reached, the alarm connected to the heat detector will be set off.

Rate-of-rise heat detectors activates when there is a rapid raise in temperature of the heat sensitive element, usually about 6. 7â)°C to 8. 3â)°C increase per minute. This type of heat detectors work irrespective of the starting temperature. This would mean that the rate-of-rise heat detector may set off the alarm before the fixed operating temperature is reached.

Currently, most heat detectors use the bimetallic strip mechanism. The bimetallic strip is made up of two strips of metal stuck together, and each have different rate of expansion. When there is a rise in temperature, one strip will expand more than the other. This causes the bimetallic strip to curl. The curl will result in the strip touching a contact that will close the circuit, and hence produce a current flow, which will then set off the alarm.

The newest type of heat detector is called the rate-compensated detector. It is sensitive to both the rate of rise of temperature, and also a fixed temperature level, both of which are illustrated above. Heat detectors are seldom used because of the difficulty in proper placement relative occupancy environment and hazard areas.

Heat detectors are mainly used in places such as the galleys and the laundry where other types of fire detectors will give off false alarms.

Heat Detector

Fire detectors are placed all over any marine vessel. However, different types of fire detectors are suitable at different locations. In the work shop area, welding works constantly produces smoke and naked flames. Hence, a heat detector would be most suitable or none should be placed in this area as it is a certified hot work area. In the engine control room, smoke detectors are used. At regions near boilers and incinerators, a naked flame can be produced due to abnormal conditions. Hence, the most suitable types of fire detectors would be the ionization type smoke detector and infrared flame detector. Smoke detectors are generally used throughout the engine room. The flame detectors are used near fuel handling units like refiners, purifiers, conditioners and hot filters.

2. Flammable Gas Detector

Flammable gases are gases that at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less. Some examples of flammable gases that are commonly found in ships are hydrocarbon gases, hydrogen sulphide and oxygen.

Flammable gas detectors will draw samples of air periodically, and analyse them for mainly hydrocarbon gas and also other flammable gases. If the gas concentration is above the pre-set alarm threshold, an alarm will sound off immediately.

Flammable gas detectors, though not mandatory, are commonly installed in enclosed spaces which can hold high volumes of flammable gases. The danger of cargo leaks into void spaces and ballast tanks, and the risk of explosions associated with a build up of hydrocarbon gas is something to be taken seriously.

Flammable gas detectors are sometimes also installed at accommodation air conditioning inlet. This is to prevent fire outbreaks to happen in areas where there are constant human activity.

According to SOLAS Chapter II, 2 Regulation 5. 10. 1, " Protection of cargo pump-rooms". It is a compulsory regulation that is applicable all types of tankers that carry cargoes with a flashpoint of below 60°C in relation to cargo pump room safety. In order to detect leaks, the regulations states that hydrocarbon gas detection are to be installed within the pump room, with alarm being pre-set at no more than 10% Lower Explosive Limit (LEL). LEL of a vapour or a gas is the limiting concentration(in air) that is required for the gas to ignite and explode.

3. Refrigerant Gas Leak Detector

Refrigerant gases are chemical products used in freezers, refrigerators, air conditioning units. These gases have low evaporation points, hence they will condense under pressure to chill the air. The repeated process of evaporating and condensing the gases pulls heat out of the air, thus reducing the temperature of the in the unit. There are many different types of refrigerant gas, and the more common ones include chlorofluorocarbon

(CFC), hydrochlorofluorocarbon (HCFC), hydrofluorocarbon (HFC), perfluorocarbon (PFC), and blends made from ammonia and carbon dioxide.

However, cases of leakage of refrigerant gases is a common sight. Some refrigerant gases are detrimental to our environment. For example, when CFC is released into the atmosphere, a chemical change will take place due to its exposure to the UV light. This reaction will result in the production of green house gases, and also depletes the ozone layer. Being able to detect refrigerant gas leakage can help cut down on unnecessary expenses and also help protect the environment.

According to MARPOL Annex VI Regulation 12 – ozone depletion substances, refrigerant gas detectors are to be installed to monitor and detect any leakages of refrigerant gases. Refrigerant gases are continually monitored by fixed gas sensors. When the detector detects that the refrigerant gas concentration exceeds a certain prefixed limit (e. g. 25 ppm for ammonia, 300 ppm for halogenated fluorocarbons), the alarm will be set off, alerting whoever manning the system.

Refrigerant gas detectors are usually located in places where the refrigerant are likely to leak, such as the centralised cargo refrigeration systems, centralised air conditioning systems and centralised domestic refrigeration systems.

4. Water Level Detector

Water leakage and ingress may happen onboard ships. When cargo holds or bulkhead are filled with excess water, it will damage the cargo onboard and

also severely affect the buoyancy and stability of the ship. Worst case scenario would be the flooding of the ship, leading to it sinking. Hence, water detectors are of high importance, and are used to detect if the water level, in any compartment, exceeds over a predetermined height.

According to SOLAS XII Regulation 12 and SOLAS Regulation II-1/23-3, bulk carriers and general cargo vessels are required to be installed with water level detectors. Water level detectors means a system comprising sensors and indication devices that detect and warn of water ingress in cargo holds and other spaces as required. The method of detecting the water level may be by direct or indirect means. Direct means of detection determine the presence of water by physical contact of the water with the detection device. Indirect means include devices without physical contact with water.

Water detectors are positioned at a predetermined height at the aft end of each individual cargo hold or compartment. The height position specifications are different between bulk carriers and cargo vessels. When the water level in any particular compartment reaches the alarm level, the detector will detect it, and the alarm will be set off. The picture below is an illustration of the position of the water detector sensors.

http://www. km. kongsberg. com/KS/WEB/NOKBG0397. nsf/AllWeb/51C66AA6A4CD0F2BC1256EA7004D1E89/$file/c200wid_ae. pdf? OpenElement

Conclusion

For the safety of lives out at sea, and the protection of our environment, different types of detectors have been invented and installed onboard ships. The main detectors that can be found in any ships are those explained above, which are the fire detector, flammable gas detector, refrigerant gas detector and the water level detector. There are many other different types of detectors that uses different types of mechanisms, but still serve same purpose as those stated above. As long as the detectors are able to serve their function and are also in accordance with MARPOL and SOLAS regulations, they will be permitted too.