Is Your Passive Emergency Fire Protection System *Too Passive?*

Pete Nimick, Product Manager, W&O Supply (M)
Rick Casale, President, CSD Sealing Systems (V)

When it comes to shipboard damage control discussions, most of us tend to center our attention on actual firefighting, or flooding control systems. Throughout the years there have been many such systems designed to extinguish the broad range of fire and flood dangers which are all too abundant in our daily shipboard lives. The group of systems which require activation or need to be lit-off or turned on, fall in to the "Active Emergency Protection" (AEP) class of emergency systems. Fire stations, fire/flooding alarms, various fire sprinkling systems, Co2 flooding, emergency submersible pumps, etc., are such systems and vital to the ships survivability in an emergency.

Along with these and just as important (if not more so) are the many "Passive Emergency Protection" (PEP) systems built in to all afloat vessels. These systems include fire doors, water tight doors, hatches and scuttles, as well as general watertight compartmentation, bulkhead and deck penetrations/cableways, ventilation dampers etc. These PEP systems are designed in principle to slow down or outright prevent the spread of fire, toxic gasses, flooding etc. They are also instrumental for allowing personnel the necessary time to evacuate, regroup and combat the actual emergency. Together along with emergency personnel training, these combined systems are very effective when properly maintained at keeping the vessels survivability and by extension the ships crew and passengers at their highest level of emergency readiness. The key phrase to all vital systems working when needed is "properly maintained", and this cannot be understated. There is an active maintenance plan on board most afloat platforms world-wide which focuses on AEP systems, and to a lesser extent on PEP systems. However outside of actual watertight compartmentation, the one PEP system which normally receives the least maintenance attention throughout the considerable lifespan of a typical marine vessel, are the bulkhead and deck cable way and pipe penetrations. These penetrations are designed to allow the hundreds to thousands of feet of pipe and tens of thousands of feet of cables to traverse the entire length of a typical vessel without interruption, while maintaining fire-tight as well as watertight integrity as required. Once initially installed in the shipyard they are typically forgotten until a new piece of equipment requires additional pipes or cables.

The International Maritime Organization (IMO) estimates there are currently more than 85,000 working vessels (of over 100 gross tons) on the seas at any given time. The average daily number of containers which are being loaded, unloaded or in transport across the world's water ways exceeds 20 million. This falls in line with estimates that assert over 90% of all world trade, encounters some form of marine oriented commercial shipping. According to the International Transport Federation, commercial seafaring is considered to be the second most dangerous occupation in the world, with deep sea fishing being the most dangerous. World-wide for the past decade there have been more than 2,000 seafarers on average per year who have lost their Lives.

According to World Casualty statistics published by IHS Maritime, in 2013 there were 138 total ship losses, of which 85 were sinking's. On average, there are more than 2 ships per

week lost on our water ways. To further illustrate some specific seafaring casualties please note the following:

2006- Al Salam Boccaccio - RO/RO Ferry - 1020 deaths

2008-Princess of the Stars - Ferry - 690 deaths

2015-Eastern Star – Cruise Ship - 452 deaths

Since 2002 there have been 8,826 passenger lives lost at sea due to fire/flood or outright sinking on board ferries, cruise ships, RO/RO's and cargo ships. Just in the cruise industry since 2012 there have been more than 50 major fires, with over 1100 smoke inhalation or burn oriented hospitalizations.

On board the Emma Maersk on 1 February 2013, a mechanical breakdown of a stern thruster caused massive flooding to the shaft alley. If this flooding had been contained in the shaft alley, the amount of damage, though significant would have been a fraction of what occurred. A bulkhead penetration transit for wires failed to maintain watertight integrity and at roughly 0.5bar (7 psi) blew out, allowing a massive rate of flooding into the engine room. The un-inhibited flooding poured in to the engine room resulting in the loss of ships propulsion, electric power, steerage and maneuverability, all of this occurred while transiting the Suez Canal. By using creative shoring techniques, the ship's crew could slow down, then secure the progressive flooding, however not before the flood level reached more than 30 feet, submerging the main engine.

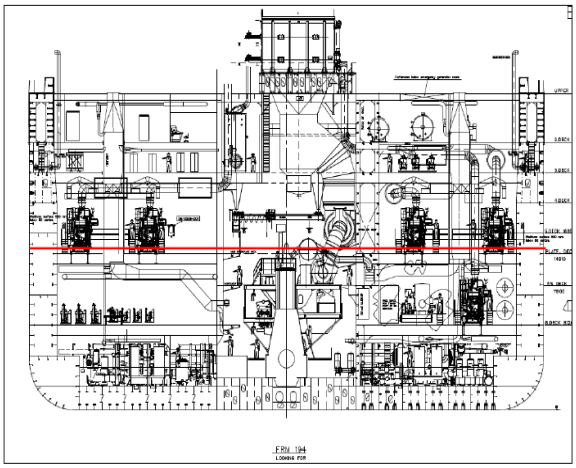

Figure 22: Transverse section of the engine room with a red line indicating the maximum water level
Source: Maersk Line

While conducting an underway replenishment off the Pacific coast of South America on board the USS George Washington CVN-73 a United States Navy nuclear-powered aircraft carrier, a fire broke out in an Auxiliary Boiler room. Approximately 12 hours later, after injuring 37 sailors and damaging 80 compartments throughout the ship, the fire was extinguished.

The ensuing investigation determined multiple preventable circumstances had occurred which led to this $70 million dollar fire. Chief among the culprits was the inaccessibility to the large wire ways, cable transits, coupled with the fire-fighting practices employed.

One last example representing the importance of transit PEP integrity, is the BP Thunderhorse incident which resulted in the near catastrophic sinking of this $5 billion dollar platform. While in the process of lighting off this largest, most technically advanced oil production platform in the world, the crew of the Thunderhorse were forced to leave due to the imminent threat of approaching hurricane Dennis. Three days later a passing ship sent back an emergency report, detailing the Thunderhorse had developed a 30 plus degree list. An emergency response team was dispatched by BP and the U. S. Coast Guard to attempt to save this 65,600 ton platform.

The ensuing investigation revealed issues with valve installations on the port side columns main draft system, resulting in progressive flooding up to and including the port pump room. The investigation also revealed failed cable penetrations, requiring complete replacement. Total costs for the repairs exceeded 250 million, and exceeded 18 months.

All of these assorted maritime disasters share a common thread (among many) which could have a significant effect on the overall outcome of their particular emergency circumstances. Failure in some form of the bulkhead penetration system. Watertight integrity, smoke and toxic gasses as well as fire control all rely on maintaining proper compartmentation. If the watertight door, or fire door are properly maintained and the assorted bulkhead penetrations are functioning as designed, in

most instances the emergency can be contained within the actual space of the emergency. This allows the vessels crew time to activate the AEP.

The bulkhead penetration systems are integral to the survivability of afloat vessels when the emergency occurs and as such are held to specific standards set by IMO SOLAS requirements. The many manufacturers of these systems subject their individual systems to the prescribed testing, which scrutinizes the capabilities of these assorted penetration systems to meet those standards. These systems are then presented to ship designers/naval architects, by the manufacturer's representatives. The designers then specify whichever system they have determined best meets the requirements of the IMO as well as the owner of the ship of which is being designed. Once placed in the ships drawings the specifications are effectively locked in and the shipyard is held to the specifications as they are prescribed.

One of the allowances which occur within the ship specification phase is the use of the term "or equal". This term is used to signify the use of the same fit, form and function of a particular product which meets the IMO requirements as prescribed for that component and has multiple manufacturers. The "or equal" phrase allows the shipyard to choose whichever brand of a product they decide upon and which also meets specification. For general use common items, this is a particularly good practice and helps the yard to facilitate expediency, cost savings and meet the requirements. In the case of certain machinery, critical valves, a unique pump, certain fire-fighting systems among other things, there will be designed products called out, and specific manufacturers are prescribed within the specification. The yard must use these items as prescribed, or if they cannot, must go through an approval process to make the change.

The IMO prescribed testing for bulkhead penetration systems, set a standard which must be met for these systems to be installed on board any vessel which falls under the 172 member states of the IMO. These standards, like all standards will be met, and will have satisfactory results. But standards can also be exceeded, and there are many bulkhead penetration systems manufacturers who use the standard as their base line, or minimum requirement, and subject their systems to testing which by far exceeds all those prescribed standards. Just because all the assorted bulkhead penetration systems meet the IMO requirements, does not mean they are all equal. Some of the above and beyond points an owner or designer may consider when making their decision should include but not be limited to the following examples. Life expectancy of the overall system cannot be understated. As represented earlier, these systems are installed and then forgotten, and the reality is, 18 years later at 4 in the morning when the emergency happens, will the system perform as designed. Some of the manufacturers can provide independent testing proof, which demonstrates 30 plus years of service life expectancy for their product. Another point of consideration is moisture repelling capability of the system. Some of the systems available have a propensity to draw and or retain moisture inside of the penetration, causing deterioration and or corrosion from the inside out. This corrosion has been documented to cause complete failure of the conduit. Once again out of sight, out of mind until the emergency happens.

Because of the criticality toward the survivability of afloat vessels, ship designers and owners may want to re-consider, re-assess the "or equal" policy when it comes to bulkhead penetration systems. They spend considerable time, researching and deciding on the certain systems/equipages etc., they are building in to their platform. The IMO requirements are a terrific way to weed out the systems that are unqualified to compete. That is where the manufacturers separate the quality and survivability of their particular system, thus the survivability of that vessels emergency. The owner and designer at that point can make the determination to not allow the ship yard to substitute a different bulkhead penetration system, once the actual build is happening, by not applying the, "or equal" term to the specification. Many of the afloat disasters could be minimized if the AEP and PEP systems worked as designed when needed, long after the vessel was put into service.