

WATER INGRESS MONITORING

A guide for masters of bulk carriers.

Introduction

New regulations will become part of the Safety of Life At Sea (SOLAS) convention and come into force on 1st July 2004. Bulk carriers will be required to carry equipment that will give early warning of water ingress to the hull. For ships that exist at the time of introduction of the new regulations it will be permissible to fit this equipment after the date of coming into force but not later than the first annual, intermediate or renewal survey after that date.

Water Ingress Monitoring

Water Ingress Monitoring (WIM) is not a new concept. Masters will recognize that daily monitoring of bilges and tanks has been a feature of prudent seamanship since antiquity. However, this method of monitoring does not provide continuous information. Furthermore, when weather deteriorates the manual process is usually suspended because of the dangers to crew members taking the soundings. In such conditions the risk of flooding in the ship is increased and therefore some method of continuous monitoring should be introduced. The concept now adopted for bulk carriers by IMO monitors not only for the presence of water, but also, in the cargo hold spaces, the speed of ingress. To achieve this a two stage alarm is used, one at a low level in the hold, the second a short distance above it.

Methods of detection may vary. Some manufacturers use simple float switches, others may have other methods of detecting water. It is even permissible to install alarm points at the levels prescribed in the regulation in remote tank sounding systems.

The following pages describe an example WIM system in more detail and how the provision should be used within the ship's Safety Management System. There are many variations in bulk carrier design. Each must be addressed individually. For example some ships do not have lower stools in which detection equipment can be positioned and thereby be well protected. In such cases WIM can be installed in protective tubes alongside existing sounding pipe arrangements.

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Description of the equipment

Equipment designed for the purpose of monitoring water ingress to the hull of a bulk carrier must conform to a performance standard. Different manufacturers may design their equipment with variations in layout but all must be provided with certain minimum indicators and alarms. The alarm panel shown below in figure 1 does not represent any particular manufacturer's product neither does it depict any particular ship. It is intended to illustrate a typical layout that incorporates all the requirements of the performance standard.

The panel shown represents one fitted to a bulk carrier with five cargo holds. The spaces monitored are all the cargo holds and the forepeak tank. Other spaces forward of the collision bulkhead (such as forward Bosun's stores) may be monitored if they are deemed as having a significant effect on the reserve of buoyancy or stability within the hull in the event of such spaces flooding. The example shown also has one of the cargo holds – number 3 – capable of being filled with ballast. Designations used may vary between manufacturers but the terms "Pre-alarm" and "Main alarm" are stipulated in the new regulation. The panel must be positioned on the bridge together with the audible alarms associated with it. Repeater panels may be placed in other spaces but are not compulsory.

Every system must have:

- **Indication of power supply status** (in the panel on the extreme left in fig. 1).
1 = Indicates primary electrical supply
2 = Indicates secondary electrical supply (when provided). Many systems will incorporate a standby source of electrical power.
(in each of the segments of the panel representing individual spaces)
E = Electrical supply: Lit when that part of the system is supplied normally.
- **Indication of a fault** (in the segment of the panel on the extreme left in fig. 1)
F = Fault
(and in each segment representing a particular space).
O = Open-circuit indication* Lit when a fault is detected in the form of open-circuit.
S = Short-circuit indication* Lit when a fault is detected in the form of a short circuit.

The "O" and "S" indications may be duplicated in the Power Supply panel in place of the single "F" indication but the individual space monitors must have the two distinct alarm indications operating from internal diagnostics.
- **Indication of an alarm condition** (in each of the segments in the panel for individual spaces)
P = "Pre-alarm" indication* Lit when water is detected in the space at the lower of two sensors (0.5 meters above the bottom of the space (excluding bilge wells).
M = "Main alarm" indication** Lit when water is detected in the space at the higher of two sensors or, in a space provided with only one sensor, (such as a ballast, void or other significant space forward of the collision bulkhead), at that sensor. In holds this is 15% of the depth of the hold or 2 meters, whichever is greater. In ballast tanks forward of the collision bulkhead this level is 10% of the depth of the space and in dry and void spaces, any part of which extends forward of the collision bulkhead the level is 0.1 meters. All measurements exclude bilge wells.
- **Indication of ballast interlock activation** (in the segments of the panel representing the ballast hold and the fore peak tank)
I = Interlock indication. Lit in the event of a ballast tank or hold having the system overridden during carriage of ballast water. Such systems are only permissible if they automatically reset when the water level falls below the Pre-alarm level.
- **Audible alarms**
Pre-alarm: The visual indicator is accompanied by an audible alarm
Main alarm: The visual indicator is accompanied by an audible alarm that is distinct from (and preferably louder than) the other audible alarm.
Fault alert: The visual indicator is accompanied by an audible alarm, which may be the same as the pre-alarm but must not be mistakable for the main alarm.

All alarms should be distinct from other alarms on the bridge except that a main alarm may be linked to an emergency alarm in the same way that fire alarms often are.

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Also in the left hand “power supply” segment of the example panel is a mute button.

All audible alarms should be connected to a mute button. This is to prevent interference with communication caused by loud alarms during the investigation process. The mute button cannot extinguish the indicator lamp, which must remain lit until the condition causing its activation is no longer present. An exception to this rule is in the case of spaces in which ballast is carried. The monitors for these spaces may be fitted with interlocks that disable the alarms and indicators but this interlock must be arranged so that when the (ballast) water level falls below the lowest alarm the monitor returns to the active condition.

The systems must be provided with internal monitoring arrangements aimed at detecting faults. The two principal types are open and short circuit and these should be detectable on each branch of the system so that – for example – an open circuit detected on a monitoring sensor in a hold is clearly identified in that part of the system. Furthermore the existence of such a fault should not affect the operation of the remainder of the system that serves other spaces.

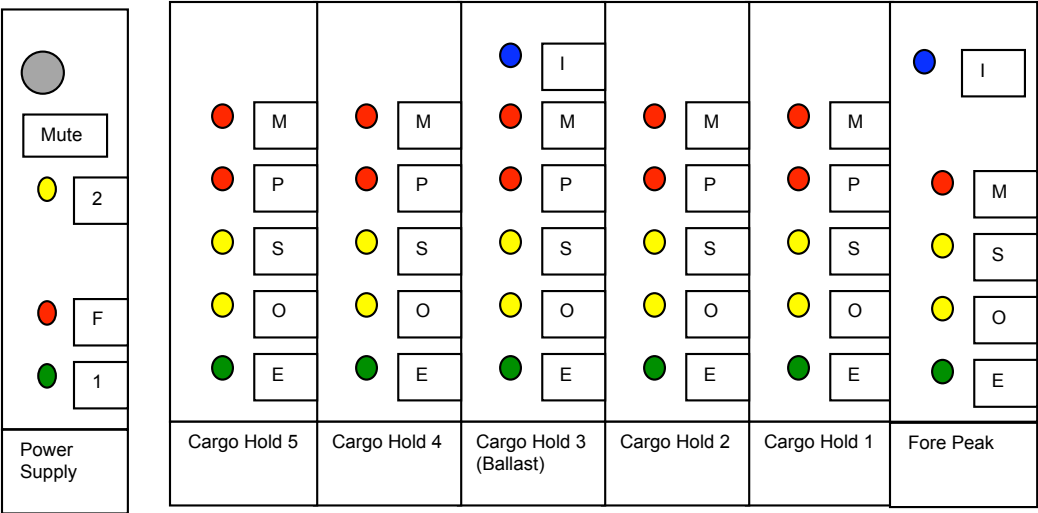


Figure 1: Representative Panel for Water Ingress Monitor

ACTIONS IN THE EVENT OF ACTIVATION.

Masters of bulk carriers should be aware that the purpose of the Water Ingress Monitor (WIM) is to provide the maximum possible early warning of a condition that may seriously threaten the vessel's survival. Bulk carriers, through necessity of the need to carry large volumes of bulk cargo, are fitted with cargo spaces that, in the event of flooding, represent a major loss of buoyancy. Added to this is the possibility that the cargo in the holds may be small in volume but high density, which allows for a larger volume of water to enter the hold than would be the case for vessels carrying lighter cargoes occupying larger volumes of internal space.

The Water Ingress Monitor therefore serves a similar function to a fire alarm. It signals a condition that requires immediate attention and could – if the condition progresses - eventually lead to the need to evacuate the ship. For this reason the performance standard has been written to include many similar features to fire alarm systems.

In the event of an alarm sounding the officer of the watch should, without delay, attend to determining its precise nature. As with fire alarms, activation of the WIM should signal the first stage in going to emergency stations.

After this first stage, which should include the mustering of all crew at their respective emergency stations, a responsible officer should be detailed to investigate the alarm.

Investigation

It is important that investigation is carried out responsibly and that the process does not endanger lives. Seafarers have been swept overboard in heavy weather conditions when they have ventured on deck to investigate a known ingress of water. Adverse weather conditions may make such operations extremely dangerous and masters should not commit crew members to open decks unless there is no alternative. In making such a decision masters should consider the value of such action. The purpose of WIM is to make it possible to know the condition in each hold without having to locally investigate.

If an alarm is activated, the master should – without delay - seek to verify the condition by reference to other indicators:

- Is the vessel taking a list?
- Is the vessel trimming excessively
- Is anything visible on deck such as dislodged hatch covers and water emerging from spaces that would otherwise be dry?

These indicators may be provided by such systems as heel indicators, trim indicators and draft gauges.

It should be remembered that the purpose of the investigation is to determine first, that a real alarm situation exists and second the extent to which the situation has progressed. The WIM may overtake this activity. For example, if an alarm has activated in one space and this is followed by another alarm, either in the same space or, more onerously in an adjacent space, it is reasonable to conclude that the situation is real. In the case of a bulk carrier, if two holds are flooding the ship almost certainly cannot remain afloat. The master should act swiftly to protect the lives of those on board. Unless the vessel is in such shoal waters that grounding will occur before immersion of the hull, the crew should be prepared for evacuating the vessel without delay. EVACUATION ITSELF HOWEVER SHOULD BE A LAST RESORT AND ONLY ON THE DIRECT ORDER OF THE MASTER.

Precautions

Some key actions should be considered essential in the event of any activation of WIM.

Vessel's crews should:

- **In the event of activation of a “pre-alarm”**, go to emergency stations. This should include preparation of life-saving appliances in readiness for evacuation but the craft should not be lowered or boarded. Alert shore rescue co-ordination stations using **Urgency** or if rapid sinking is detected early, **Distress**¹;

¹ It is always possible to downgrade an earlier urgency or distress signal if a situation is not as serious as originally anticipated. It is not possible to upgrade a signal that was never sent if a situation is truly serious and escalates rapidly.

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- **In the event of a main alarm**, muster (all personnel) at abandon ship stations with the exception of those crew members engaged in investigation of the alarm and/or keeping systems running. Upgrade any urgency signal to one of **Distress**;
- **In the event of a second space alarm activation** – either Pre-alarm or Main alarm – ensure all personnel are recalled from investigation and other duties and sent to abandon ship stations. This should include any crew remaining in the engine room or other spaces;

BOATS, LIFERAFTS OR OTHER LIFE-SAVING CRAFT MUST NOT BE LAUNCHED UNLESS THE SPECIFIC ORDER TO DO SO HAS BEEN GIVEN BY THE MASTER.

The master should only order evacuation of the vessel:

- If the vessel is truly sinking. Checks of other indicators should be made quickly e.g. draft gauges, heel indicators, rapid air expulsion from vents serving spaces suspected of flooding, dislodgement of hatch covers, water emerging from spaces where it should not be expected;
- The depth of water is greater than the depth of the hull (a beached ship should not be abandoned);
- The speed of sinking is such that launching of life-saving craft must begin immediately in order to reach the water before the ship sinks². Bulk carriers are renowned for sinking fast – particularly if loaded with heavy cargoes such as iron ore.

Warning.

- Seafarers have been lost when bulk carriers have sunk due to having insufficient time to evacuate the vessel;
- Bulk carriers have, on occasions sunk so fast that not even distress signals were not sent out;

Which are two good reasons not to become complacent about water ingress alarms.

If alarms frequently malfunction, the equipment should receive priority attention to rectify the fault. Crew members should not be reticent to muster. If an alarm is false, the crew can be stood down, but if it is genuine and crew are not mustered, there could be insufficient time to do so if flooding progresses rapidly – loss of sleep is less serious than loss of life. These are principles that are well established with fire alarms. Flooding is potentially more serious than a fire that can be fought. Only the most serious fires can threaten the survivability of the ship in terms of buoyancy but flooding is the beginning of sinking. It should therefore be afforded higher status than fire. It should be the highest status alert condition on board the ship.

² Vessels fitted with Free-Fall lifeboats may also have the capability for these craft to Float-free. This gives additional time for evacuation.