ANNEX 1

MAIB *Safety Bulletin* 1/2000

Safety
Bulletin

DETR
ENVIRONMENT
TRANSPORT
REGIONS

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

MAIB SAFETY BULLETIN 1/2000

Foundering

11 miles to the east of the Isle of Man of

fv SOLWAY HARVESTER

with the loss of seven lives

on 11 January 2000

Issued February 2000

MAIB
is an
INVESTOR IN PEOPLE

MAIB SAFETY BULLETIN 1/2000

This document, containing safety recommendations, has been produced for marine safety purposes only on the basis of information to date.

The *Merchant Shipping (Accident Reporting and Investigation) Regulations 1999* provide for the Chief Inspector of Marine Accidents to make recommendations at any stage of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch (MAIB) is carrying out an investigation into the loss of the scallop dredger *Solway Harvester,* and her seven man crew on 11 January 2000. A report will be published.

The MAIB's initial inquiries have revealed evidence of several safety shortcomings which give rise to serious concerns about the safety of all fishing vessels, and particularly, for the crews sailing on similar scallop dredgers and other trawlers operating out of Kirkcudbright.

These concerns relate to four aspects which directly affect the safety of fishermen. They are:

- the watertight integrity of main decks;
- the regular servicing of liferafts;
- the correct installation of liferafts; and
- crews' completion of the mandatory basic safety training courses.

J S Lang
Rear Admiral
Chief Inspector of Marine Accidents

Background

At about 1745 on 11 January 2000, the Kirkcudbright registered scallop dredger *Solway Harvester* sank with the loss of her seven man crew about 11 miles to the east of the Isle of Man. She was carrying about 9 tonnes of shellfish and, because bad weather was forecast, was heading towards Ramsay to seek shelter. Reports of the weather conditions at the time she sank vary, but the wind was probably about force 6 from the south-west, with a moderate to rough sea running on her port quarter.

The first indication that she might have foundered was the detection of a transmission from her EPIRB (Emergency Position Indicating Radio Beacon). An extensive search and rescue operation was mounted immediately but, apart from finding two uninflated liferafts and the beacon, nothing else was seen. There was no sign of either *Solway Harvester* or her crew.

An investigation into the circumstances of her loss was started immediately and following the discovery of the wreck, has included an underwater survey of it.

The absence of a "Mayday" transmission or any other radio report of trouble, and the subsequent discovery by divers that all seven bodies of the crew were inside the vessel, indicates that whatever happened occurred very rapidly.

The underwater survey has revealed some hull damage which, on initial inspection, is consistent with *Solway Harvester* having impacted the seabed stem first. The wreck will be raised and the hull will be examined more closely before this can be confirmed beyond doubt.

The loading scuttle to the fish hold on the port side of the main deck was found open. The opening, which was flush with the deck, did not appear to be fitted with a hatch cover and this is being investigated further.

The liferafts were examined at RFD's (a liferaft manufacturer) premises in Birkenhead and were found to have last been serviced in September 1996, and should have been serviced annually. Both liferafts did, however, inflate satisfactorily during the examination and did not leak.

The ends of both painters were carefully examined and were found to be both unbroken and heat sealed. This indicates they were not attached to the vessel when she sank. They should have been.

Before sailing in a fishing vessel, fishermen are required to undergo basic safety training. Three of the seven crew are known to have done so, but there is no evidence to indicate the remaining four had.

Safety Recommendations

1. The owner or skipper of every fishing vessel registered in the United Kingdom is very strongly recommended to check that any liferaft carried is:

   (i) in date for servicing
   (ii) correctly attached

2. It is recommended that the owner of every fishing vessel registered in the United Kingdom checks that anyone sailing in their vessels who was born after 1 March 1954, has completed the mandatory safety training. If it is found that they have not, such training should be arranged as a matter of urgency.

3. **It is further recommended that in the overriding interest of safety, the Maritime and Coastguard Agency:**

   (i) takes immediate action in its promotion of safe practice and its enforcement of safety requirements on the four areas of concern raised by the loss of *Solway Harvester*

   - the watertight integrity of main decks;
   - the service history of the liferafts;
   - the correct installation of liferafts; and
   - crews' completion of the mandatory basic safety training courses.

   (ii) examines all vessels of similar design to *Solway Harvester* to ensure the watertight integrity of the main deck.

ANNEX 2

Safety recommendations from the MAIB *Summary Report* 1/2003

SAFETY RECOMMENDATIONS

During, and arising from, the investigation the MAIB issued Safety Bulletin 1/2000 on 23 February 2000 which included the following interim recommendations (1 to 4):

Owners and skippers of UK fishing vessels are recommended to:

1. Check that any liferaft carried is in date for servicing and correctly attached.

2. Check that anyone sailing in their vessels who was born after 1 March 1954, has completed the mandatory safety training. If it is found that they have not, such training should be arranged as a matter of urgency.

The Maritime and Coastguard Agency is recommended to:

3. Take immediate action in its promotion of safe practice and its enforcement of safety requirements on the four areas of concern raised by the loss of Solway Harvester:

    - the watertight integrity of main decks
    - the service history of liferafts
    - the correct installation of liferafts
    - crew’s completion of the mandatory basic safety training courses.

4. Examine all vessels of similar design to Solway Harvester to ensure the watertight integrity of the main deck.

Owners of fishing vessels are recommended to:

5. Engage a suitably qualified marine safety expert to undertake a comprehensive review of safety management throughout the company. The aim should be to produce an effective safety management system for its vessels and crews.

6. Ensure that any crew member employed on any of its vessels has attended the three mandatory short safety courses in first-aid, survival and fire-fighting.

7. Inspect vessels in its fleet to ensure the protective covers over the fish room slush wells are in working order. The company should also ensure that its skippers and mates fully understand the importance and function of these items.

8. Revise the arrangement on any vessel in its fleet, so that either the bilge suction strainers in the fish room are easily accessible or vessels are equipped with portable diesel-driven salvage pumps.

9. Review the operations of its vessels with regard to the stowage of spare gear and fishing gear to ensure that these items can be properly secured against movement, and issue the appropriate instructions to its skippers in this regard.

10. Review its stores policy, in the light of its risk assessments, to ensure spares for critical safety equipment such as bilge alarm sensors, are readily available.

11. Equip with bilge alarms the fish rooms and large volume shaft tunnels on all vessels.

The Maritime and Coastguard Agency is further recommended to:

12. Issue guidance to industry emphasising the need to stow catches in the fish hold securely to prevent them shifting at sea.

13. Review, and revise as necessary, the guidance to industry and surveyors regarding the accessibility of bilge suction strainers in fish rooms.

14. Issue guidance to industry and fishermen's training colleges about watertight integrity, capsize avoidance and the role of watertight bulkheads on fishing vessels.

15. Issue guidance to the industry and surveyors regarding the acceptance of seawater pumps in combination with bilge ejectors.

16. Review its policy for the inspection of fishing vessels over 15 metres length overall, to assess their effectiveness in maintaining safety standards between the full surveys for the renewal of UKFVCs; intermediate survey requirements should be implemented.

17. Enhance safety audits on fishing vessel employers to ensure that compliance with the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 is achieved throughout the industry.

18. Review its policy on the survey of remedial work and, if necessary, revise its guidance to surveyors to ensure that critical items are resurveyed.

19. Review, and revise as necessary, the guidance on the criteria for assessing the acceptability of 'new' buoyancy, before approving revised stability books.

20. Revise the standard letter accompanying approved UKFVCs to show that changes could not only invalidate the certificate, but also seriously endanger the safety of the vessel and her crew.

21. Review its policy for dealing with cases where surveyors discover that substantial changes have been made to a fishing vessel, which could endanger the vessel, and have not been notified to the MCA.

22. Issue guidance to industry and surveyors regarding the restrictions in the approved use of flush deck scuttles on fishing vessels.

23. Amend the fishing vessel safety regulations to ensure that the use of flush deck scuttles is more tightly controlled, and to phase out their use at sea as quickly as possible.

24. Review and clarify the guidance on the application of the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 in respect to risk assessment on the safety of the vessel.

25. Consider a research project to investigate whether the trend in modern fishing vessel design towards lower length to breadth ratios is exposing them to an increased risk of capsize in the event of fish room flooding.

26. Issue guidance to the industry and surveyors on remote access to seawater inlet valves in shaft tunnels.

The Sea Fish Industry's Authority and **Fishermen's Federations/Associations** are jointly recommended to:

27. Make it easier for fishing vessel owners to meet their obligations on safety training by examining ways of ensuring it is made readily available to all fishing communities throughout the UK.

Marine Accident Investigation Branch
June 2003

ANNEX 3

Wreck examination

The wheelhouse interior. All fittings and equipment were in their original positions. The main engine control lever was upright, in the neutral position to indicate that the propeller shaft was declutched. The mate estimated that the adjacent independent engine speed controller was set for approximately 1400/1500 rpm. On the control panel the main engine ignition was ‘on’.

In addition to the main engine control lever near the helmsman’s chair, there was a dual control lever on both the port and starboard side of the wheelhouse. These were used when hauling and shooting the fishing gear. The linkage to the starboard lever was broken.

The auxiliary engine ignition was ‘off’. Its control lever was set for minimum engine revolutions.

The rudder indicators on both the port and starboard side of the wheelhouse showed hard to starboard. The central indicator showed hard to port.

The battery operated wheelhouse clock had stopped at 1742.

The circuit breakers/switches on the main 24V electrical distribution panel on the port side of the wheelhouse were in the positions shown in **Figure 35**.

The bow thruster control on the starboard side of the wheelhouse was off.

The bilge alarm panel was opened up and tested. Its internal fuse had blown.

A key for the ice scuttles’ covers was found in the wheelhouse.

The main deck. Loose gear and fittings, including the picking trays, were heaped to starboard between the shaker and the wash room. Both shakers had moved to starboard and were lying against deck pillars or other structures. Most of the short posts on which the hollow legs of the shakers fitted, were in place.

The shakers were moved back into position. Several of the port shaker’s legs were badly damaged, and could not support its weight. It was not possible, therefore, to replace it in its original position, as had been achieved with the starboard shaker and picking tray.

The pipe from the starboard picking tray to the ice scuttle was examined. There was a 30mm gap between the base of the flange and the deck at its outboard edge, but at the inboard edge it rested on the deck **(Figure 9)**.

The port and starboard ice scuttles were open **(Figure 10 – port scuttle opening shown)**. One of the watertight covers was found among the pile of loose gear on the starboard side, between the shaker and the wash room. The other was not found. One of the covers’ securing keys was in the small wash room. A few items of clothing, and a pair of workboots, were also found in the wash room.

A dredge sword was jammed between the pipes running along the deckhead.

The three valves controlling the water supplies to the starboard tipping bins and shaker were closed. On the port side, the aft tipping bin’s valve was open, but the other two were closed. Also, on the port side the valve to the deck wash hose was closed. The hose was uncoiled across the deck.

Figure 35

Battery	Circuit	Status
no.1	Port engine room fan	On
no.1	Fore wheelhouse floodlights	On
no.1	Port shelter lights	On
no.1	Fishroom lights	On
no.1	Port side wheelhouse lights	On
no.1	Engine room lights	On
no.1	Search light	Off
no.1	Fridge	On
no.1	Fore-peak store	On
no.1	Wheelhouse lights	Off
no.1	Compass light	Off
no.2	Starboard engine room fan	Off
no.2	Salt water pressure pump	Off
no.2	Aft wheelhouse floodlights	On
no.2	Starboard shelter lights	On
no.2	Aft cabin lights	On
no.2	Fore floodlights *	Off
no.2	Galley lights	On
no.2	Workshop lights	Off
no.2	Freezer	Off
no.2	Galley heating pump	On
no.2	Winch indicator lights	On
no.1	Mast head light	On
no.1	Port navigation light	On
no.1	Starboard navigation light	On
no.1	Stern light	On
no.1	A.R. Green	Off
no.1	A.R. Red	Off
no.1	A.R. White	Off
no.1	A.R. Red	Off

Battery	Circuit	Status
no.3	Berth sockets	off
no.3	Fuel transfer pump	on
no.3	Horn	off
no.3	Wiper *	off
no.3	Berth lights	on
no.3	Winch system	on
no.3	Bow thruster	on
no.3	Winch area lights	on
no.3	Clutches	on
no.3	Chart lights	on
no.3	Fuel gauges	on
no.1	SSB radio	off
no.1	Phone, television	on
no.1	Radar	on
no.1	Blank	on
no.1	4000 navigator	on
no.1	Watch receiver	on
no.1	Computer	off
no.1	Gas alarm	on
no.1	Alarms	off
no.1	Fire alarm	on
no.1	Blank	on
no.3	Sonar	off
no.3	Radar	on
no.3	Echo sounder	on
no.3	VHF's	on
no.3	CCTV	on
no.3	GPS navigator	on
no.3	2000 navstar	off
no.3	Autopilot	off
no.3	Emergency fire alarm	on
no.3	Blank	off
no.3	Fishroom bilge alarm	on

Note: * Item inoperable

Positions of circuit breakers/switches on main 24V electrical distribution panel

There was a 640kg mound of scallop/queenie shells on the starboard shaker below the outlet from the tipping bins.

The door to the forepeak space was tied open with cord. The door to the galley/mess was secured open by one of its clips while that to the port deck store was ajar. The doors to the starboard passageway were open, but unsecured.

The watertight bulkheads, installed in 1996 by Deeside Marine Ltd, were examined. Pipe runs through the bulkheads were not fitted with watertight glands. The bulkheads had been cut around the pipes leaving gaps large enough, in many places, to insert the fingers of one hand **(Figure 11)**. The bulkheads were not watertight.

The starboard passageway and the port deck store each contained a fuel tank ventilation pipe. A quantity of diesel oil covered the deck of both spaces. The port deck store held a pilot ladder and spare parts for the shakers, all were piled against the forward bulkhead; domestic gas cylinders supplying the galley had been stowed in the starboard passageway. The porthole from the galley into the starboard passageway was open.

The forepeak space. The deck was set down about 150mm on the centre-line above the forepeak tank. A quantity of loose gear and equipment had accumulated on the starboard side, including waterproof clothing, footwear, exhaust lagging, a battery, a 24V generator, and spare belts.

The hull and deckhead plating were buckled on the starboard side of the stemhead. Several shackles, nuts, bolts and springs were found compressed into the folded steel of the damaged deckhead **(Figure 12)**.

The CO_2 fire extinguishing system had not been activated.

The engine room door had been tied open with cord.

To starboard of the engine room door the open ends of two redundant 150mm diameter pipes protruded through the deckhead. These emerged, open ended, in the foremast about 1.2 metres above the shelter top.

The engine room. The engine room floor plates had been strewn around the compartment. One was stuck between the main engine exhaust pipe and the deckhead, with its free end pointing down and to port **(Figure 13)**. The batteries had been scattered; two were outboard of the auxiliary engine, one was jammed under the power take-off from the auxiliary engine, and others were in the bilge. The battery boxes on the port side, Nos 1 and 2, each contained one of the four batteries originally installed. Battery box 3, on the starboard side, was complete.

The sea suction to the Jabsco pumps, SS1, was closed and its strainer clear **(Figure 7 is a schematic of bilge system "as found")**. The cross-connecting valve, LV1, between the port and starboard Desmi pumps, was open. The overboard discharge valve from the ejector, OB2, was open and clear. The ejector was removed for examination (see Section 1.20).

The four screw-down non-return valves in the bilge chest were removed. Each was found in working order, and there was nothing in the valve chest to interfere with their correct operation.

The sea suction on the port side, which supplied the hydraulic oil cooler, was open, and its strainer clear. The strainers to both engine room bilge and the sea suction for the fish room cooling plant and ice machine were both clear.

The main engine-driven Jabsco pump had no drive belts. The auxiliary engine Jabsco had drive belts but the switch for the electric clutch was off. Both the port and starboard Desmi pumps had belts. All four pumps were removed for examination (see Section 1.20).

The three main engine-driven 24V generators were in place. Each was fitted with a single drive belt. A film of carbon covered the air grilles in the casing of the port 24V generator.   Moving the main engine throttle/gear lever in the wheelhouse had no effect on the governor control lever on the engine, so the only means of adjusting engine speed was from within the engine room. It was found in this mode with the governor control lever 60% of the way between idle and maximum **(Figure 14)**. Wheelhouse control was regained by lifting the governor control lever, and rotating it about its own axis through 180°. Once this adjustment had been made, the throttle and gearbox control cables, and their links, were fully operational from the wheelhouse.

The fuel lines and filters to the main engine were intact. The valves on the fuel lines, between the daily service tank and the main engine, were open.

A Caterpillar-accredited mechanic from the shipyard assisted with the examination of the main engine. It showed 2953 hours of running time. The crankcase covers were removed and inspection of the inside of the engine showed nothing abnormal. Neither the engine protective device for engine overspeed, nor low lubricating oil pressure needed resetting. The gearbox cover was removed and, again, nothing abnormal was observed. The investigation concluded that the main engine was operable at the time *Solway Harvester* capsized.

The auxiliary engine was in wheelhouse control, but the control cable was inoperable. This was thought to be as a result of its prolonged immersion in water. The governor control lever was at idle. All indications were that the engine had been operable. The 24V generator had been removed from its mounts.

The circuit breakers/switches on the 24V electrical distribution panel on the port side of the engine room, were in the positions shown in **Figure 8**. The three “Alternator Changeover” switches were in position 1. The switches to all three banks of batteries and all three generators were on; that to the auxiliary generator was off. The meters for Nos 1, 2 and 3 battery banks showed 0V, 15V and 15V; and -150A, 10A and 80A respectively.

The shaft tunnel light switch was off.

The shaft tunnel. The sea suction to the starboard Desmi pump, SS3, was closed; its strainer choked with mud. The sea suction to the port Desmi, SS2, was open with its strainer partially choked. The tunnel's bilge suction was about 60% obstructed by a rag. Iron ballast in concrete filled the first 7 frame bays aft of the forward bulkhead.

The cable to the fish room bilge alarm float switch had been cut, and the ends of the wire neatly bared. It was tied in a coil on the port side of the tunnel about 2 metres forward of the aft bulkhead **(Figure 15)**. The bulkhead gland to the float switch showed no cable on the tunnel side. The bulkhead gland had been welded around the upper half of its circumference; its lower periphery was not watertight. A test showed that water drained through this slight gap at a rate of about 5 litres per minute from the full fish room slush well on the other side of the bulkhead. The centre of the bulkhead gland was 120mm below the top of the slush well.

The aft bulkhead was also penetrated by a 50mm diameter open-ended pipe, draining the bilge under the aft cabin. This pipe had originally been fitted with a weighted cock valve similar to the one still fitted in the sister vessel *Tobrach-N*.

The fish room. The space contained a quantity of loose shells which filled 32 scallop bags. The slush well also contained a hacksaw and several empty bags. A red handled screwdriver was wedged in the deckhead just inboard of the starboard hopper, and the lowest strake of wooden panelling on the starboard side was missing. Seven spare bellies, weighing 616kg, were removed.

The starboard cover to the slush well was found among the debris along the starboard side with its hinges broken. The port cover was in place. The bilge alarm float switch, in the port side of the well, seemed intact and moved freely, but a test of the circuit showed it was inoperable.

Two bolts, threads upwards, secured the starboard strainer's lid. Four bolts were missing. The bilge suction was clear. The mesh inside the strainer was about 50% blocked with bag fibres. A plastic bottle top was also found inside the strainer.

Drainage pipes from the starboard passageway and the port deck store, ended in the fish room. The valves at the ends of the pipes were closed.

The ice making machine's piping was intact.

Two redundant pipes in the port forward upper corner of the space had been blanked off.

To starboard, at head height, a redundant 60mm pipe passed through the forward bulkhead into the engine room. It branched at a 'T' port valve, and went through the deckhead to the main deck. The 'T' port valve was closed to the branch from the main deck, but the pipe was open in the engine room. In the fish room the pipe branched again, both ends were open.

The overhead cooling coils were badly damaged in places.

The manhole covers to the fuel tanks and shaft tunnel were removed. All were found to be in a good tight condition.

The workshop. Its weathertight door was secured open by one of its clips. The 240V generator was off, and the tool racks were empty. The light wooden door separating the workshop from the passage to the shower and toilet was open. On the forward side of the passage, the weathertight door to the escape hatch trunk had been secured open. The escape hatch had been locked shut by an internal bolt.

The shelter top. The lashings on the aft liferaft cradle were still fast, and the HRU had not operated. The weak link was unbroken, and its free eye empty **(Figure 16)**. The expiry date on the unit was 9/98. The HRU on the forward liferaft cradle had operated and cut the lashings. The weak link had a metre of braided rope attached to it with a knotted eye at its free end.

The foremast was leaning back from the vertical by about 5° and the deck plating at its base was distorted and torn.

Most of the gilson frame, which had been badly damaged during the recovery operation, was cropped off and removed.

The filler pipes to all tanks had screw-on caps.

The hull. The hull was substantially damaged in three areas: the bow at the level of the shelter top, over the boundary of the forepeak ballast tank and the Kort nozzle. The nozzle, together with the rudder, **(Figure 17)**, had been damaged during the salvage operation. The resulting leak near the rudder stock was repaired on the slipway and the rudder was removed. The hull was otherwise watertight. The forensic examination found no “foreign” paint deposits on the hull.

The bow damage was localised, and although the hull plating was folded, there was no hole **(Figure 18)**. At the level of the shelter top, the damage began 300mm to port of the centre-line, and extended 2900mm in a straight line across to the starboard side **(Figure 19)**. The stemhead was set back 400mm, folding the deck plating behind it. The total damaged area was relatively small.

The hull shell over the length and depth of the forepeak ballast tank was noticeably set in on both sides of the vessel, showing dishing between adjacent frames.

The original waterline had, at some time, been painted over to raise it by about 0.6m **(Figure 20)**.

The steering gear. It appeared to have been operable. The rudder stock had been displaced upwards by the impact of falling on to the seabed during the salvage operation, but the rudder gland was not leaking. When water was poured into the steering gear space it drained into the bilge under the aft cabin, and then into the shaft tunnel.

ANNEX 4

Solway Harvester model experiments in waves

Model tests, using a 1/15th scale model of *Solway Harvester* **(Figure 24)**, were carried out by BMT SeaTech Limited at the DERA Hydrodynamic Test Centre at Haslar in Hampshire. The model was ballasted to represent the displacement and centre of gravity of *Solway Harvester* at the time of the accident. Additional weights were added in some tests to represent:

- the effects of wind heeling;
- flooding to the shaft tunnel and aft cabin bilge;
- a cargo shift in the fish room;
- cargo in the tipping bins.

The main deck was modelled in detail. Included were:

- the open doors into the starboard passageway and the aft workshop;
- shakers and picking trays, port and starboard, complete with overboard rubbish chutes;
- the openings from the tipping bins;
- freeing ports;
- ice scuttles with radio controlled hatches; and
- the fish room hatch and deck pound for spare gear.

A video camera was fitted inside the model to show the extent of water on the main deck. The depth of this water was also measured using probes fitted on the centre-line at the forward and aft ends of the space.

The fish room volume was reduced for the insulation to sides and ends; the impermeable volume of the bagged catch; the ice machine and the access into the shaft tunnel.

The shelter top was fitted with troughs each side to represent the tipping bins. The wheelhouse and masts were also modelled.

The model was powered by an electric motor driving a four-blade propeller in a Kort nozzle. It was radio controlled in both motor speed and steering.

The model was configured so that the main deck, fish room, starboard passageway and aft deck could flood, but flooding of the fish room could be prevented by means of radio controlled hatches. The rest of the vessel was made watertight so that in the event of it capsizing, it would not sink.

An expert reviewed the wave data to advise on the parameters for the tests' wave spectra to produce realistic wave conditions. The two wave spectra selected for the tests were based on the JONSWAP spectrum. One represented at full size, a significant wave height (Hs) of 4.1 metres and peak energy period (Tp) of 8.6 seconds, the other an Hs of 6.4 metres and Tp of 7.35 seconds. The former represented the typical wave conditions *Solway Harvester* encountered on 11 January, and the latter a group of large breaking waves, judged to be the worst conditions likely to have been encountered. All tests were carried out in irregular, long-crested waves - which were waves of differing heights and periods but all parallel and travelling in the same direction.

Testing took place on 4, 5, 17 and 18 January 2001 in number 2 towing tank, and on 22 January, 30 April and 11 June 2001 in the manoeuvring basin.

The purpose of the towing tank tests was to investigate what weight of flooding to the fish room could have led to the vessel capsizing when drifting with waves on her port beam. In these tests the fish room was sealed and could not flood beyond its initial level. Some tests assessed the effect of other factors such as a cargo shift, wind heeling and extra weight in combination with the fish room flooding. Four tests also examined how much water would flood into the fish room through the open ice scuttles when a breaking wave rolled the vessel to beyond 30°. During each test, video recordings were made of the model's response to the waves, and of the water washing on to the main deck. A time history of roll, heave, and pitch was recorded, as well as the wave profiles and the depths of water on the main deck.

The tests showed that with 18 tonnes of water in the fish room, the model capsized in the 6.4 metres high breaking waves, but not in the 4.1 metres high waves. If 0.5 tonne was added to each tipping bin, the weight of water needed to capsize it reduced to 15 tonnes. It capsized with 9 tonnes of water in the fish room if a 3.7 tonnes solid weight was also shifted 2 metres to starboard in the fish room; representing the possible movement of spare gear and 10% of the cargo in the flooded fish room.

Capsizing invariably followed the same pattern. After surviving the initial violent roll of between 30° to 40° the model appeared to recover, but listing heavily (typically about 20°) because of flooding to the starboard passageway and retained water on the main deck. If the water on the main deck was able to drain away through the freeing ports the model's list slowly reduced, and it did not capsize. But if, instead of draining away, the weight of water actually increased, the model's list also slowly increased, until finally it lay on its side - capsized.

The outcome was dependent on the initial stability of the model, most importantly, the angle of vanishing stability. If this exceeded about 25°, indicating at least 15 tonnes of retained water was necessary to cause capsizing, it would survive the prevailing wave conditions, if less, it capsized. Flooding the fish room reduced the stability of the model and the angle of vanishing stability. Adding weights at the tipping bins, or adding weights to represent a movement of cargo and spare gear, reduced it further.

The onboard video camera showed that water flooded through the freeing ports on to the main deck during the 40° rolls, filling it to the deckhead near the leeward picking tray. The level was usually high enough to flood over the sill of the open forward door into the starboard passageway giving the model a pronounced list. When the ice scuttles were open, but covered by the picking trays, about 0.7 tonne flooded into the fish room. With the picking trays removed this rose to about 2.2 tonnes. At all other times, the main deck near the picking trays was virtually dry.

The purpose of the manoeuvring tank tests was to investigate the depth of water on the main deck near the ice scuttles when the vessel was at 8 knots in the 4.1m waves. The rate at which water accumulated in the fish room from flooding through the open circular ice scuttles was also measured, indicating possible downflooding rates.

In the first series of tests, wave probes were used to measure water depth, but the very low depths of water on the deck resulted in little useable information. These tests were repeated in April using the onboard video camera to record water movement on to, and off, the main deck so that depths and durations of coverage could be estimated. In analysing the results of these tests BMT noticed a mismatch between the quantity of water viewed by the onboard camera, and the rate of flooding of the fish room. This led to the discovery of leaks in the model's main deck, casting doubt on the validity of the results. The tests were repeated on 11 June after the model was repaired. The final flooding rates were substantially lower than earlier tests had indicated. This last set of data was used to investigate how quickly water might have accumulated in the fish room as *Solway Harvester* made for Ramsey Bay.

Tests were carried out in beam waves and with the waves 30° abaft the beam with the fish room initially dry, and also with the fish room flooded with the equivalent of 9 tonnes of water. The doorways to the starboard passageway and aft workshop were sealed for these tests.

Because the onboard camera was focussed on the starboard ice scuttle, which would be to leeward when waves were on the port side, some runs were carried out with waves on the starboard side so that downflooding through the windward scuttle could be observed.

Each test comprised a number of runs across the manoeuvring tank, each run taking about 80 seconds model time. The ice scuttle hatches were opened during the runs where the waves were in the required direction, and closed, using radio control, for the return crossings of the tank. After the second run, the test was stopped and the fish room was pumped out to measure the quantity of water which had accumulated. This water was returned to the hold, and the procedure repeated twice more. Each double run represented about 6 minutes passage time for the full size vessel. Unfortunately, failure of the wave maker limited the tests, starting with the fish room flooded, to single runs.

The results showed that when the model started with a dry fish room, water accumulated at an average rate of about 4 tonnes per hour, with the waves 30° abaft the beam, and 5 tonnes per hour in beam seas. When the model started with 9 tonnes of water in the fish room, the rates dropped to about 1.5 tonnes and 2 tonnes respectively. This was a consequence of the marked effect the fish room flooding had in reducing the motion of the model. Measurements on the drifting model indicated reductions in maximum and significant roll angles of about 25% (Table A6.1).

For the condition where the fish room was dry initially, and waves were 30° abaft the beam, water drained off the main deck through the leeward scuttle for about 3% of the total time, and through the windward scuttle for about 6% of the total time. In the first case the maximum water depth at the scuttle was 38mm and in the latter 210mm. In both cases the average duration of the flow was about 2 seconds. The observed depths of water at the leeward and windward ice scuttles during two of these runs are shown in Tables A6.2 and A6.3 respectively.

For the condition where the fish room was dry initially, and waves were on the beam, water drained off the main deck through the leeward scuttle for about 6% of the total time.

When the tests were repeated with the fish room flooded with 9 tonnes of water, drainage through the open scuttles occurred for less than 1% of the total time - which was the only data recorded for this condition.

Roll motion reduction if water is present in the fish room **Table A6.1**

Weight of water in fish room	Roll period	Max roll angle	Sig roll angle
Tonnes	Seconds	degrees	degrees
0	7.2	27.5	25.4
3	8.0	24.7	21.5
6	7.8	23.4	17.8
12	8.0	19.2	14.3
18	8.1	14.2	13.3

Depths at leeward scuttle - waves 30° abaft the beam **Table A6.2**

Time into Run	Max depth of water at scuttle Model	Duration of water entering ice scuttle Model	Max depth of water at scuttle Ship
Seconds	*mm*	*seconds*	*mm*
0 (hatches open)			
1	1	0.75	15
7	2	0.25	30
9	1	0.25	15
17	1	0.50	15
36	2.5	0.75	37.5
43	1.5	0.50	22.5
56.45 (hatches closed)			

Depths at windward scuttle - waves 30° abaft the beam **Table A6.3**

Time into Run	Max depth of water at scuttle Model	Duration of water entering ice scuttle Model	Max depth of water at scuttle Ship
Seconds	*mm*	*seconds*	*mm*
0 (hatches open)			
6	1.5	0.25	22.5
17	1.5	0.25	22.5
21	14	0.75	210
29	5	0.75	75
32	5	1.25	75
46	10	0.50	150
50	3	0.25	45
53.58 (hatches closed)			

ANNEX 5

Solway Harvester computer numerical simulations

Section 1

This summarises the results of the investigation carried out by the Ship Stability Research Centre of the University of Strathclyde. The purpose was to explore the dynamic stability of *Solway Harvester* for a better understanding of the capsizing, focussing on the dynamics of flooding in a realistic wave environment.

Numerical simulations were used to assess the movement of the vessel in waves under different progressive flooding situations; and the sinking was modelled to determine the attitude of the vessel as she sank to the sea floor. Sophisticated computer programmes carried out the calculations for a number of different starting conditions and wave realisations. The extent of flooding in each space was determined by considering the vessel's movement relative to the waves, the level of water already on the exposed decks and the rate at which this could pass through various openings to the vessel's interior. In this way it was possible to evaluate and monitor the progression of events which led to the capsizing.

Over 50 simulation runs, grouped into 6 series, were carried out. The basic starting conditions for each simulation run were set by the following parameters.

- **Wave sequence** – up to 5 different wave realisations were used to improve the results' level of statistical confidence.
- **Initial starboard list** – the majority of runs began with a 2° starboard list, which was assumed to be the most likely initial condition. The significance of the list was examined by making control runs without it.
- **Initial flooding of the fish room** – an important part of the parametric study was to establish the amount of water required in the fish room to capsize the vessel. Each run started with an initial quantity of water in the fish room. During the runs water drained off the main deck through the open ice scuttles into the fish room. It was assumed that this water would accumulate and that no part was pumped overboard by the bilge system.
- **Recess/shaft tunnel flooding** – some runs examined the effect of flooding the space below the aft cabin and the shaft tunnel. The quantities of floodwater assumed were 8 tonnes and 4 tonnes respectively.
- **Initial cargo and spare gear shift** – in this case the assumption was that the shift had occurred before the vessel began to drift beam on to the waves. The shift was simply modelled as a static heeling moment.
- **Maximum cargo and spare gear shift** – in this case the shift occurred after the vessel began drifting, but only if rolling exceeded 25°. Whenever the rolling passed 25° the cargo and spare gear would slide down the fish room's deck a small distance, determined by the appropriate equations for motion, until the maximum allowable movement was reached.
- **Flooding to the starboard passageway** – in most runs the fore and aft doors to this space were open, allowing flooding if the water levels on the exposed decks were deeper than the doors' sills. For some runs one or both doors were closed.

Each simulation ran for a maximum of 20 minutes, but it stopped immediately a capsizing occurred.

Summary results for each series follow.

Series 12 – initial cargo + spare gear shift applied in some runs

The starboard passageway was assumed open to the working deck and to the winch space. Regardless of other parameters, the vessel survived within a 20 minute run if the fish room was not flooded or if there was no initial amount of water in the fish hold. The vessel capsized if the fish room was flooded initially with more than 9 to 12 tonnes of water. If cargo shift was assumed, the vessel capsized with 6 to 9 tonnes of water initially in the fish room.

Series c12 – maximum cargo + spare gear shift applied in some runs

The starboard passageway was assumed open to the working deck and to the winch space. Regardless of other parameters the vessel survived if the initial amount of water in the fish room was less than 3 tonnes. The vessel capsized if the fish room was flooded initially with more than 3 to 6 tonnes of water.

Series 13 – initial cargo + spare gear shift applied in some runs

The starboard passageway was assumed open to the working deck and to the winch space. The picking trays were removed, which allowed for a higher flood rate through the loading scuttles. A limited number of runs in this series suggested the vessel capsized with more than 6 tonnes of water applied to the fish room initially.

Series c13 – maximum cargo + spare gear shift applied in some runs

The starboard passageway was assumed open to the working deck and to the winch space. The picking trays were removed, which allowed for a higher flood rate through the loading scuttles. A limited number of runs in this series suggested the vessel could capsize without water being applied to the fish room initially (but about 8 tonnes had accumulated from water draining off the main deck when the capsize occurred). The vessel systematically capsized with 6 tonnes of water applied to the fish room initially.

Series 14

The starboard passageway was assumed open to the winch space but closed to the working deck. Survivability characteristics were similar to series 12 where the starboard passageway was open forward and aft. The main contribution to progressive flooding of the starboard passageway was through the aft door to the winch space.

Series 15

The starboard passageway was assumed closed and watertight. This provided enhanced survivability performance over series 12 where the starboard passageway was open forward and aft. A limited number of runs in this series suggested the vessel did not capsize with less than 9 tonnes of water applied to the fish room initially.

The sinking simulation

The scenarios simulated in calm water suggested the vessel would sink with a 90 to 150° heel to starboard and a 30 to 60° forward trim. This corresponded with damage found on the vessel.

A likely accident scenario

Run Rc12_09 was selected as a likely scenario for the capsizing of *Solway Harvester*.

There was an initial amount of 9 tonnes of water in the fish room. After 20 seconds of the simulation, all openings were activated and water was free to flow through every relevant opening of the vessel.

Initially there was an assumed 2° starboard heel owing to asymmetrical loading. There was no cargo shift initially, but a transient cargo shift was initiated when roll angles exceeded 25°.

The run was analysed in 3 phases:

- Phase 1 (0 – 300 seconds)
- Phase 2 (300 – 450 seconds)
- Phase 3 (450 – 480 seconds)

Phase 1

There was no cargo shift. The vessel had a 7 – 8° starboard heel caused by the asymmetric loading and water in the fish room. There was constantly water on the working deck and in the winch space. On average there were 1.4 tonnes on the working deck **(Figure A7.5)** and 0.6 tonne in the winch space **(Figure A7.3)**. The starboard passageway **(Figure A7.4)** was not flooded, although the watertight doors at the forward and aft end were both open. Water drained off from the working deck through the open ice scuttles (mainly on starboard side) at an average flow rate of 0.12 tonne/min. By 300 seconds the amount of water in the fish room and bilge well had increased from 9 tonnes to 9.6 tonnes.

Phase 2

A large and steep wave at 300 seconds **(Figure A7.1)** caused rolling to exceed 25° **(Figure A7.2)**, which initiated the cargo + spare gear shift. The cargo shifted over a period of 1.2 seconds, causing a heeling moment of 7.54tm. Resulting in an average heel of 20° to starboard, caused by asymmetric loading, water in the fish room, cargo + spare gear shift and flooding of the main deck, the winch space and the starboard passageway (after 360 seconds). Due to the large heel, more seawater accumulated on the working deck and in the winch space, causing the starboard passageway to flood at 360 seconds **(Figure A7.4)**. Water drained from the working deck through the starboard open ice scuttle at an increasing rate. The average flow rate was approximately 0.8 tonne/min. By 450 seconds the amount of water in the fish room and bilge well had increased from 9.6 tonnes to 11.6 tonnes.

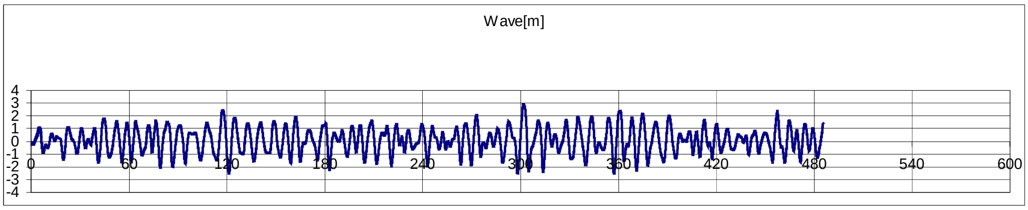

Figure A7.1 - Wave profile of run Rc12_9

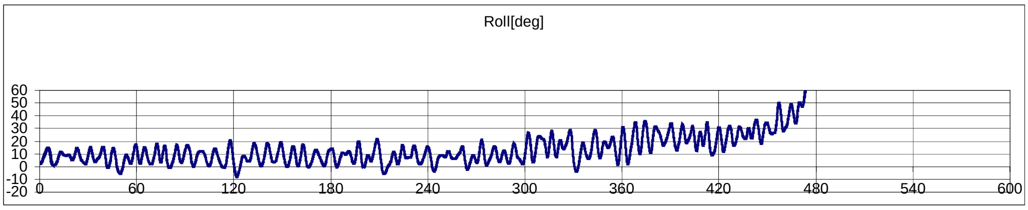

Figure A7.2 - Roll motion of run Rc12_9

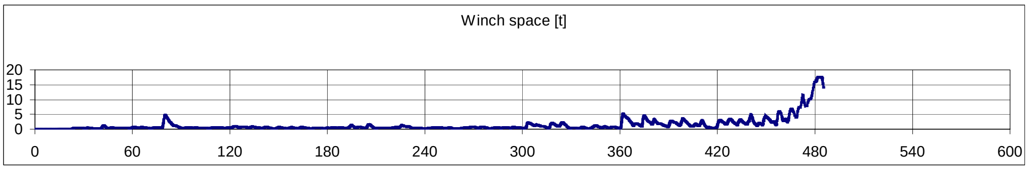

Figure A7.3 - Flooding of winch space, run Rc12_9

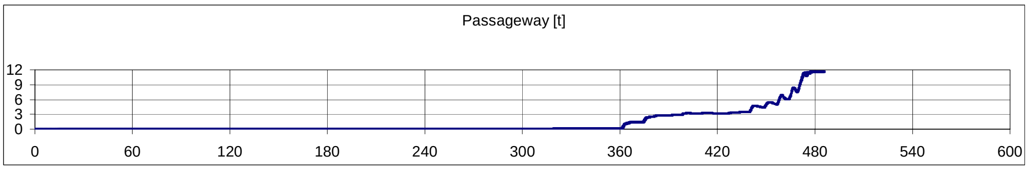

Figure A7.4 - Flooding of passageway, run Rc12_9

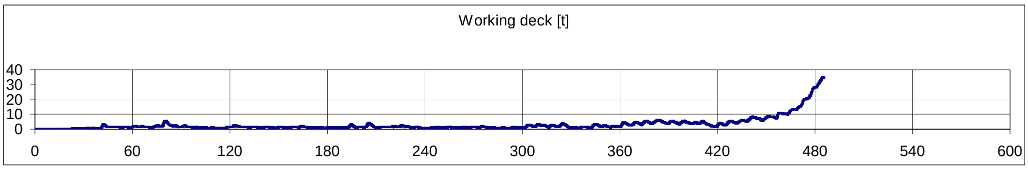

Figure A7.5 - Flooding of working deck, run Rc12_9

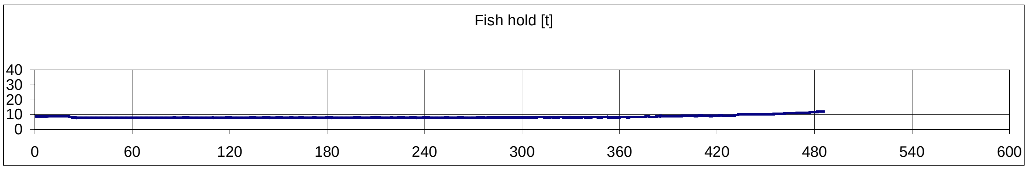

Figure A7.6 - Flooding of fish hold, run Rc12_9

Phase 3

At 450 seconds the vessel had lost its stability and capsized rapidly.

CONCLUSIONS FROM THE NUMERICAL SIMULATIONS

The dynamic stability analysis established the following:

- *Solway Harvester* would not have capsized in the given weather conditions at the time of the accident if flooding of the fish room had been avoided.
- Flooding of the fish room was caused by seawater entering the main deck through the freeing ports and draining off through the open ice scuttles into the fish room.
- In the weather conditions at the time of the accident, provided that the ice scuttles were left open and no corrective action was taken, *Solway Harvester* would have capsized regardless of the initial amount of seawater in the fish room.
- The initial amount of seawater determined how long it took before the vessel capsized.
- Analysis of the results indicated that *Solway Harvester* was lost owing to a series of events. The most influential event was flooding of the fish room. Additional contributing factors were cargo and spare gear shifting, and flooding of the passageway.

MGN 49(F) Losses of fishing vessels through flooding

Note: This MGN was current in January 2000, but it was superseded by MGN 165(F) - *Fishing Vessels: The risk of flooding*, in July 2001.

MARINE SAFETY AGENCY

MARINE GUIDANCE NOTE

MGN 49 (F)

LOSSES OF FISHING VESSELS THROUGH FLOODING

Notice to Builders, Repairers, Owners, Skippers and Crews of Fishing Vessels

This Notice supersedes Merchant Shipping Notice No. M.1327

INTRODUCTION

Inquiries into the losses of fishing vessels due to flooding have shown that:

1. the flooding was discovered too late for the cause to be located or any remedial action to be taken;

2. in many cases not even the most basic action was taken to prevent further flooding;

3. bilge level alarms were either not fitted or failed to give the intended warning;

4. when the bilge system was needed in an emergency it soon became choked;

5. the carriage of a portable diesel driven salvage pump with an adequate length of suction hose could have saved many vessels.

To prevent the danger to life and the losses of fishing vessels through flooding close attention should be given to the following:

DURING CONSTRUCTION AND REFITS

DO ensure that main bulkheads are as watertight as practicable.

DO inspect the outer hull whenever opportunities occur for signs of damage or wastage paying close attention to the caulking and hull fastenings of wooden vessels.

DO install bilge level alarms.

DO ensure that the visual and audible warnings for the bilge level alarm are positioned to attract the attention of the crew.

DO position the bilge level alarm sufficiently low so that the crew have as much time as possible to take action in an emergency should flooding occur.

DO position the bilge system strainers (mud boxes) in the engine room so that they can be easily cleaned.

DO fit a strainer (mud box) in the suction from the fish hold. The mud box should be positioned in the engine room and fitted with an isolating valve to permit cleaning when the fish hold is flooded.

DO fit grids over the fish hold slush well or some other coarse strainer of generous proportions around the fish hold bilge suction.

DO position the valves or cocks for operating the bilge system so that they are readily accessible and are of a type and so marked that they can be easily operated in an emergency.

DO keep bilge suction pipes as straight and direct as possible.

DO position sea valves (and other valves that control the inlet and outlet of water through the hull) so that they can be closed in the event of flooding or fit extensions to the valves so that the controls are as high as possible above the floor plates and, if possible, at least 0.75 metre (30 inches) above the bilge level alarm.

DO NOT make additional penetrations in main bulkheads unless absolutely necessary.

DO NOT fit flexible sections of piping in cooling water or other systems unless necessary to withstand movement or vibration. When required, flexible sections should be of reinforced neoprene rubber secured by stainless steel clips.

DURING OPERATION

DO keep the bilge pumps, bilge ejectors and bilge system in a well maintained condition.

DO ensure that all valves in seawater and bilge systems are regularly checked for correct operation. All valves in seawater systems should be kept closed except when necessarily open for normal operation.

DO ensure that all crew members are familiar with the operation of all seawater piping systems and their associated valves and connections to the hull and machinery.

DO regularly (preferably several times a day) check any spaces not fitted with bilge level alarms for the ingress of water.

DO regularly (preferably daily) test bilge level alarms by moving the float by hand to check that the visual and audible alarms actually work.

DO regularly (at least weekly) clean all the bilge strainers (mud boxes) in the engine room.

DO clean and replace the grids for the fish hold slush well or coarse strainer for the fish hold suction at every opportunity and whenever the fish hold is empty.

DO keep the engine room bilges and the fish hold free of rubbish or anything else that could choke the bilge system.

DO regularly (at least monthly) ensure all valves in the bilge system and all sea valves (and other valves that control the inlet and outlet of water through the hull) are free to move, so that they can be operated or closed in an emergency.

DO regularly (at least monthly) test any bilge pumps not in daily use, including the hand (or whale) pumps.

DO check that all nonreturn valves are clear of debris and in good condition each time the vessel is slipped, dry docked or otherwise out of the water.

DO NOT remove any nonreturn valves, these are fitted to prevent back flooding.

USE OF THE BILGE SYSTEM

DO ensure that all crew members know the bilge system so that they can use it in an emergency.

DO close the sea suction on the bilge pump after the pump is primed and operating.

DO keep a watch when pumping bilges and stop the pump or ejector system as soon as the bilges have been emptied.

DO keep all the valves in the bilge system closed when it is not in use.

IN AN EMERGENCY

DO try using the bilge pump or ejector and hand pumps when provided.

DO close all sea valves (and other valves controlling the inlet and outlet of water through the hull) when the cause of the flooding is not known or cannot be controlled.

AT ANCHOR OR IN HARBOUR

DO avoid, whenever practicable, the "squeezing" of wooden vessels in harbour as this can damage caulking which may subsequently endanger them.

DO when leaving vessels unattended ensure that all internal and external weathertight doors and hatches are securely closed and all seacocks are shut off.

NOTES

1. The above lessons to be learnt from the losses of fishing vessels due to flooding apply to fishing vessels of all sizes;

2. Statutory requirements for fishing vessels of 12 metres in length and over are detailed in the Fishing Vessels (Safety Provisions) Rules 1975 as amended and supplemented by the Instructions for the guidance of surveyors;

3. For vessels of less than 12 metres in registered length discussions between MSA and industry have resulted in a draft "Code of Practice for the Construction, Machinery, Equipment, Stability, Operation and Inspection of Registered Fishing Vessels of less than 12m Length" (the "Under 12m FV Code") which, when published, will set down statutory requirements for the smaller vessels.

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November 1997

[MS 7/25/08]
[MS 88/1/212]

ANNEX 7

Syallabus for Fishing Vessel Class 2 (Deck) Certicate of Competency

DECK OFFICER (FISHING VESSEL) CLASS 2

SAFETY AND MANAGEMENT - DTp SYLLABUS

(a) The certificate of registry and its legal significance. Certificates required to be carried by British fishing vessels. Engagement and discharge of crews. Agreement with crew. The official log book and the law relating to entries. Reports to be made in the event of injury to or death of crew or other personnel on board ship. Accident reporting procedures. Custom house procedures, entering or clearing a British fishing vessel.

(b) An outline knowledge of the skipper's obligations with respect to marine insurance.

(c) Prevention of pollution; the skipper's duties, obligations and liabilities including the keeping of records.

(d) Law relating to the reporting of dangers to navigation.

(e) General understanding of Centre of Gravity, Centre of Buoyancy and metacentric height.

(f) Stable, neutral and unstable equilibrium. Stiff and tender ships; angle of loll, its cause and correction.

(g) Statical stability, stability curves, range of stability, maximum GZ; effect of freeboard on the range of stability, significance of the area under the curve. The effect of trim on stability; the use of stability data supplied to fishing vessels.

(h) The effect of raising, lowering, adding or removing weights. An understanding of the effect of weights suspended from a height such as when the cod end is hoisted inboard. The effect of free surface in fuel and ballast tanks, the effect of water on deck, the importance of freeing ports. The effect on stability fish in bulk compared with fish in boxes.

MGN 20(M+F) Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997

MARINE GUIDANCE NOTE

MGN 20 (M+F)

Implementation of EC Directive 89/391

MERCHANT SHIPPING AND FISHING VESSELS (HEALTH AND SAFETY AT WORK) REGULATIONS 1997

Notice to Shipowners, Ship Operators and Managers, Masters, Officers and Ratings of Merchant Vessels, and Skippers and Crew on Fishing Vessels.

This Notice supersedes Notice 1398

Summary

This Marine Guidance Note announces new regulations governing occupational health and safety on board merchant and fishing vessels, and gives guidance on the application of the Regulations.

Key points:

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations come into force on 31 March 1998.

They supersede the Merchant Shipping (Health and Safety: General Duties) Regulations 1984 and the Merchant Shipping (Safety Officials and Reporting of Accidents and Dangerous Occurrences) Regulations 1982.

The main new requirements for employers under the regulations are risk assessment and health surveillance - the annexes to this Marine Guidance Note contain advice on those two duties.

1. The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 (S.I. 1997/2962) will come into force on 31 March 1998. They implement Council Directive 89/391/EC on the introduction of measures to encourage improvements in safety and health of workers at work (the "Framework Directive"). The Regulations apply to United Kingdom ships and to other ships when they are in United Kingdom waters, except where the Management of Health and Safety at Work Regulations 1992 apply. The Code of Safe Working Practices for Merchant Seamen is currently being revised to reflect the new regulations and the new edition will be published by the Stationery Office later this year.

2. Copies of the Regulations are available from The Stationery Office Publications Centre, PO Box 276, London, SW8 5DT. Tel (orders) 0171 873 9090; (enquiries) 0171 873 0011. Fax (orders) 0171 873 8200. Copies may also be ordered through the Stationery Office's bookshops, its accredited agents (see Yellow Pages) or from any good bookseller.

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MS 122/6/54

An executive agency of the Department of the Enviroment, Transport and the Regions

Introduction

1. The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 replace the Merchant Shipping (Health and Safety: General Duties) Regulations. They have a wider scope than the regulations that they replace, in that they place duties on all "employers" and "workers" on board ships, and there are no exemptions for types of ship. "Employers" and "workers" are defined as follows:

   "employer" means a person by whom a worker is employed under a contract of employment;

   "worker" means any person employed by an employer under a contract of employment, including trainees or apprentices;

   "contract of employment" means a contract of employment, whether express or implied, and if express, whether oral or in writing.

   Those attending training courses on sail training vessels are excluded from the scope of the Regulations.

2. Under the Regulations, it is the duty of employers to protect the health and safety of workers and others affected by their activities so far as is reasonably practicable. The principles for ensuring health and safety are:

   (a) the avoidance of risks, which among other things includes the combating of risks at source and the replacement of dangerous practices, substances or equipment by non-dangerous or less dangerous practices, substances or equipment;

   (b) the evaluation of unavoidable risks and the taking of action to reduce them;

   (c) adoption of work patterns and procedures which take account of the capacity of the individual, especially in respect of the design of the workplace and the choice of work equipment, with a view in particular to alleviating monotonous work and to reducing any consequent adverse effect on workers' health and safety;

   (d) adaptation of procedures to take account of new technology and other changes in working practices, equipment, the working environment and any other factors which may affect health and safety;

   (e) adoption of a coherent approach to management of the vessel or undertaking, taking account of health and safety at every level of the organisation;

   (f) giving collective protective measures priority over individual protective measures; and

   (g) the provision of appropriate and relevant information and instruction for workers.

Duty holders under the Health and Safety at Work Regulations

3. It is important that those on whom duties are placed are in a position to carry them out. Employment relationships on board ship can be complex - for example the master may not be employed by the owner or operator of the ship, or by the same employer as the crew. There may also be people working on board such as contractors and sub-contractors, stevedoring companies and those under franchising arrangements (eg in retail or service outlets) whose employer has no direct responsibility for the safety of the ship. There is therefore no single "person" on whom it is appropriate to place the entire "employment" responsibility for health and safety on board.

4. The regulations therefore recognise two levels of "employment" responsibility. The regulations use the terms "Company" and "employer". The "Company" may have duties as an "employer".

   "Company" means the owner of a ship or any other organisation or person such as the manager, or bareboat charterer, who has assumed the responsibility for operation of the ship from the owner;

5. Many aspects of the safety of the ship as a workplace (eg the structural soundness of the vessel, the provision of adequate lighting and ventilation, provision of life-saving appliances, and fire-fighting equipment) are under the control of the Company, either directly, or through contractual arrangements with the owner.

6. Each employer, which may include franchise companies operating catering facilities or retail outlets, has control over the occupational health and safety training of the staff employed, and over everyday working practices.

7. The duties for each are explained below.

Duties of employers

8. All employers have a duty to ensure so far as is reasonably practicable the health and safety of workers and others affected by their activities in accordance with the principles set out in paragraph 2 above. The basis of all safety measures should be an assessment by the employer of any risks to workers' health and safety from their work activities.

9. The measures taken must not involve cost to workers and are required to include the provision of:

   - safe working places and environment;
   - safe plant, machinery and equipment;
   - health and safety training, instruction, supervision and information;
   - any necessary protective clothing and equipment where risks cannot be removed by other means;
   - a health and safety policy;
   - information for workers about the findings of their risk assessment;
   - health surveillance of workers as appropriate;
   - information on the special occupational qualifications required to any employment business supplying them with temporary workers;
   - information about their activities and staff to the Company;
   - consultation with their workers or elected representatives on health and safety matters.

Competent person; "protective and preventive services"

10. The employer must appoint a competent person to take responsibility for health and safety, who will advise the employer on compliance with the regulations. If there is no-one competent among existing workers, a competent person may be employed from outside the company, or the employer may "appoint" himself.

New and expectant mothers

11. A new duty introduced by these regulations is that of assessing whether their duties or hours of work could place in jeopardy the health of new or expectant mothers or that of their unborn child (or if they are breastfeeding, their baby) . If so, their hours or conditions of work should be changed or alternative work found, or, if that is not possible, they should be suspended, subject to their statutory rights.

Duties of the Company

12. In so far as the Company is an employer on board ship, it has a duty to assess the risks to workers and others affected by its activities. The Company's activity is the operation of the ship, and so it is responsible for co-ordinating the control measures identified in the risk assessments of all other relevant employers on board, as appropriate.

13. **"The Company",** in addition to its duties as an employer, is required to:

    - consult other employers on board about the health and safety of workers;
    - co-ordinate health and safety measures between all the employers on board;
    - provide information to workers about the ship safety systems;
    - appoint a safety officer (see paragraphs 14 and 15 below);
    - organise the election of safety representatives and safety committee (see paragraphs 14 and 15 below).

Safety Officials/Consultation with workers:

14. These Regulations also supersede the Safety Officials and Reporting of Dangerous Occurrences Regulations 1982. Regulations 15 to 17 deal with the appointment of safety officers, the election of safety representatives and safety committees.

15. These regulations apply, as before, to merchant vessels on which more than 5 workers are employed. The regulations are supported by guidance in the Code of Safe Working Practices for Merchant Seamen.

16. In addition, there is provision for consultation with workers where the election of safety representatives does not apply (ie fishing vessels, and merchant vessels on which less than 5 workers are employed). No rules are laid down for consultation in these circumstances, as this will best be decided in the light of the operating patterns and crewing arrangements on the vessel. In many cases, informal discussion will be the most practicable solution.

Duties of Workers

17. **Workers** are required to:

    - take reasonable care for their own health and safety and that of others on board who may be affected by their acts or omissions;
    - co-operate with anyone else carrying out health and safety duties - including compliance with control measures identified during the employer's or Company's evaluation of risk;
    - report any identified serious hazards or deficiencies immediately to the appropriate officer or other authorised person;
    - make proper use of plant and machinery, and treat any hazard to health or safety (such as a dangerous substance) with due caution.

18. Under the Regulations, it is also an offence for **any** person intentionally or recklessly to interfere with or misuse any thing provided in the interests of health and safety.

ANNEX 1

RISK ASSESSMENT

1 Introduction

1.1 Under the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997, employers are required to ensure the health and safety of workers and other persons so far as is reasonably practicable, by the application of certain principles. These principles include the avoidance of risks, and the evaluation of unavoidable risks and the taking of action to reduce them.

1.2 Specifically, employers are required to make a suitable and sufficient assessment of the risks to health and safety of workers arising in the normal course of their activities or duties, for the purpose of identifying:

(a) groups of workers at particular risk in the performance of their duties; and
(b) the measures to be taken to comply with the employer's duties under the Regulations;

The assessment should extend to others on board ship who may be affected by the acts or omissions of the employer.

1.3 Every employer and every self-employed person on board ship is required to inform the Company of any relevant risks to health and safety arising from the conduct of their business.

1.4 Employers must ensure that measures are taken to ensure an improvement in the safety and health of workers and other persons in respect of those risks identified by the assessment.

1.5 Employers must review the assessment when there is reason to believe that it is no longer valid, and make any necessary changes.

1.6 Workers must be informed of any significant findings of the assessment and measures for their protection, and of any subsequent revisions made.

1.7 The Company is also required to ensure that anyone working on the ship, whether or not they are directly employed by the Company, is aware of the findings of the Company's risk assessment and of the measures taken for their protection.

1.8 This guidance note explains the principles of risk assessment in relation to occupational health and safety and provides some advice on how the assessment and control of risks may be approached.

1.9 Regulation of occupational health and safety on board ship is of course not new. Existing safety measures may already provide a high level of safety for workers. For example, well-established procedures, inspections by safety officers and the use of "permits to work" which control safety conditions, will contribute to the identification of hazards and measures for safe working.

1.10 However, what is new is the explicit requirement in regulation for employers to adopt the risk assessment approach to occupational health and safety. This means that all work activities should be considered from a risk assessment standpoint.

1.11 Employers may adapt existing safety management systems to meet the risk assessment principles set out in section 3 and the main elements described in section 10, taking into account the nature of their operations and the type and extent of the hazards and risks to workers.

2 Key terms

2.1 Key terms, used frequently in this chapter, are defined below.

a) A hazard is a source of potential harm or damage or a situation with potential for harm or damage;

b) risk has two elements:

- the likelihood that a hazard may occur;
- the consequences of the hazardous event.

3 Principles of risk assessment

3.1 A "risk assessment" is intended to be a careful examination of what, in the nature of operations, could cause harm, so that decisions can be made as to whether enough precautions have been taken or whether more should be done to prevent harm. The aim is to minimise accidents and ill health on board ship.

3.2 The assessment should first identify the hazards that are present and then establish whether a hazard is significant and whether it is already covered by satisfactory precautions to control the risk, such as permits to work, restricted access, use of warning signs or personal protective equipment, including consideration of the likelihood of the failure of those precautions which are in place.

3.3 Any risk assessment must address risks to the health and safety of workers.

4 Risk assessment in practice

4.1 There are no fixed rules about how risk assessment should be undertaken, although section 10 gives the main elements. The assessment will depend on the type of ship, the nature of operations and the type and extent of the hazards and risks. The intention is that the process should be simple, but meaningful. The following sections give advice on good practice.

5 What should be assessed?

5.1 The assessment should cover all risks arising from the work activities of workers on the ship. The assessment is not expected to cover risks which are not reasonably foreseeable.

5.2 Employers are advised to record the significant findings of their risk assessment. Risks which are found to be trivial, and where no further precautions are required, need not be recorded.

6 Who has to carry out the assessment?

6.1 In all cases, individual employers have responsibility for assessing the risks to their workers and other persons who may be affected by their activities. The Company will be responsible for co-ordinating the risk assessments covering everyone on the ship including workers directly employed by itself, taking account of the other employers' assessments.

6.2 The process of risk assessment should be carried out by suitably experienced personnel, using specialist advice if appropriate.

7 How thorough should the assessment be?

7.1 Regulation 7(1) requires that a suitable and sufficient assessment be made of the risks to the health and safety of workers arising in the normal course of their duties. This requirement to assess risk relates only to risks which arise directly from the work activity being undertaken and which have the potential to harm the person(s) actually undertaking that work, or who may be directly affected by that work. The requirement to assess risk does not extend to any consequential peril to the ship resulting from the particular work activity, nor to any external hazards which may imperil the ship, either of which may cause harm to those on board or to others. These aspects are covered by other regulations.

7.2 The assessment of risks must be `suitable and sufficient'. The process need not be overcomplicated. This means that the amount of effort that is put into an assessment should depend on the degree of harm that may occur and whether risks are already controlled by satisfactory precautions or procedures to ensure that they are as low as reasonably practicable.

8 When to assess?

8.1 Risk assessment should be seen as a continuous process. In practice, the risks in the workplace should be assessed before work begins on any task for which no valid risk assessment exists. An assessment must be reviewed and updated as necessary, to ensure that is reflects any significant changes of equipment or procedure.

9 Risk assessment pro-forma

9.1 Employers may wish to use a simple pro-forma to record the findings of an assessment, covering, for example:

a) work activity;
b) hazard(s);
c) controls in place;
d) personnel at risk;
e) likelihood of harm;
f) severity of harm;
g) risk levels (sometimes called "risk factor");
h) action to be taken following the assessment;
i) administrative details, e.g. name of assessor, date, etc.

10 Elements of risk assessment

10.1 The main elements of the risk assessment process are :

a) classify work activities
b) identify hazards and personnel at risk
c) determine risk
d) decide if risk is tolerable
e) prepare action plan (if necessary)
f) review adequacy of action plan

10.2 Further guidance on how each element may be accomplished is in the Appendix, which is based on British Standard 8800.

GUIDANCE ON MAIN ELEMENTS OF RISK ASSESSMENT

1. Classify work activities

1.1 A useful preliminary to risk assessment is to identify separate work activities, to group them in a rational and manageable way, and to gather necessary information (or collate existing information) about them. Infrequent maintenance tasks, as well as day-to-day operations, should be included. Possible ways of classifying work activities include:

a) department/location on board ship/on the dockside;
b) stages of an operation or work routine;
c) planned and unscheduled maintenance;
d) defined tasks (e.g. loading/unloading cargo).

1.2 Information required for each work activity might include:

a) tasks being carried out: their duration and frequency;
b) location(s) where the work is carried out;
c) who normally/occasionally carries out the tasks;
d) others who may be affected by the work (e.g. contractors, passengers);
e) training that personnel have received for the task.

2. Identify hazards

2.1 Asking these three questions should help to identify where there is a hazard:

- Is there a source of harm?
- Who (or what) could be harmed?
- How could harm occur?

Hazards that clearly possess negligible potential for harm should not be documented or given further consideration, provided that appropriate control measures remain in place.

2.2 To help with the process of identifying hazards it may be useful to categorise hazards in different ways, for example by topic, e.g.:

a) mechanical
b) electrical
c) physical
d) radiation
e) substances
f) fire and explosion.

2.3 A complementary approach may be to develop a prompt list such as:

During work activities could the following hazards exist?

a) slips/falls on the level;
b) falls of persons from a height;
c) falls of tools, materials, etc, from a height;
d) inadequate headroom;
e) inadequate ventilation;
f) hazards from plant and machinery associated with assembly, commissioning, operation, maintenance, modification, repair and dismantling;
g) hazards from manual handling.

The above list is not exhaustive, and employers could develop their own `prompt list' taking into account the particular circumstances.

3. Determine risk

3.1 The risk from the hazard may be determined by estimating:

- the potential severity of harm; and
- the likelihood that harm will occur.

These two components should be judged independently.

3.2 When seeking to establish potential **severity of harm**, the following should be considered:

a) part(s) of the body likely to be affected;
b) nature of the harm, ranging from slightly to extremely harmful:

  i) slightly harmful, e.g.:

    - superficial injuries; minor cuts and bruises; eye irritation from dust;
    - nuisance and irritation (e.g. headaches); ill-health leading to temporary discomfort;

  ii) harmful, e.g.:

    - lacerations; burns; concussion; serious sprains; minor fractures; musculo-skeletal disorders;
    - deafness; dermatitis; asthma; work related upper limb disorders; ill-health leading to permanent minor disability;

  iii) extremely harmful, e.g.:

    - amputations; major fractures; poisonings; multiple injuries; fatal injuries;
    - occupational cancer; other severely life shortening diseases; acute fatal diseases.

3.3 In order to establish the **likelihood of harm** the adequacy of control measures already in place should be considered. Legal requirements and guidance in this Code and other safety publications are good guides to adequate control of specific hazards. The following issues should then typically be assessed:

a) number of personnel exposed;
b) frequency and duration of exposure to the hazard;
c) effects of failure of power or water supply;
d) effects of failure of plant and machinery components and safety devices;
e) exposure to the elements;
f) protection afforded by personal protective equipment and its limitations;
g) possibility of unsafe acts by persons for example, who:

  i) may not know what the hazards are;
  ii) may not have the knowledge, physical capacity, or skills to do the work;
  iii) underestimate risks to which they are exposed;
  iv) underestimate the practicality and utility of safe working methods.

The likelihood of harm can be assessed as highly unlikely, unlikely or likely.

3.4 Any given hazard is more serious if it affects a greater number of people. But some of the more serious hazards may be associated with an occasional task carried out by just one person, for example maintenance of inaccessible parts of lifting equipment.

4. Decide if risk is tolerable

4.1 Table 1 below shows one simple method for estimating risk levels and deciding whether risks are tolerable. Risks are classified according to their estimated likelihood and potential severity of harm. However, employers may wish to develop other approaches according to the nature of their operations.

Table 1.

	Slightly harmful	**Harmful**	**Extremely harmful**
Highly unlikely	**TRIVIAL RISK**	**TOLERABLE RISK**	**MODERATE RISK**
Unlikely	**TOLERABLE RISK**	**MODERATE RISK**	**SUBSTANTIAL RISK**
Likely	**MODERATE RISK**	**SUBSTANTIAL RISK**	**INTOLERABLE RISK**

Note: Tolerable here means that the risk has been reduced to the lowest level that is reasonably practicable.

5. Prepare risk control action plan

5.1 Having determined the significant risks, the next step is to decide what action should be taken to improve safety, taking account of precautions and controls already in place.

5.2 Risk categories form the basis for deciding whether improved controls are required and the timescale for action. Table 2 suggests a possible simple approach. This shows that the effort made to control risk should reflect the seriousness of that risk.

Table 2.

	ACTION AND TIMESCALE
TRIVIAL	No action is required and no documentary records need be kept
TOLERABLE	No additional controls are required. Consideration may be given to a more cost effective solution or improvement that imposes no additional cost burden. Monitoring is required to ensure that the controls are maintained.
MODERATE	Efforts should be made to reduce the risk, but the costs of prevention should be carefully measured and limited. Risk reduction measures should be implemented within a defined time period. Where the moderate risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
SUBSTANTIAL	Work should not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk. Where the risk involves work in progress, urgent action should be taken
INTOLERABLE	Work should not be *started* or *continued* until the risk has been reduced. If it is not possible to reduce the risk even with unlimited resources, work has to remain prohibited.

Note: Tolerable here means that the risk has been reduced to the lowest level that is reasonably practicable.

5.3 The outcome of a risk assessment should be an inventory of actions, in priority order, to devise, maintain or improve controls.

5.4 Controls should be chosen taking into account the following, which are in order of effectiveness:

a) if possible, eliminate hazards altogether, or combat risks at source e.g. use a safe substance instead of a dangerous one;
b) if elimination is not possible, try to reduce the risk e.g. where risk is of electrocution, by using a low voltage electrical appliance;
c) where possible adapt work to the individual, e.g. to take account of individual mental and physical capabilities;
d) take advantage of technical progress to improve controls;
e) give precedence to measures that protect everyone;
f) if necessary, use a combination of technical and procedural controls;
g) introduce or ensure the continuation of planned maintenance, for example, of machinery safeguards;
h) ensure emergency arrangements are in place;
i) adopt personal protective equipment only as a last resort, after all other control options have been considered.

5.5 In addition to emergency and evacuation plans, it may be necessary to provide emergency equipment relevant to the specific hazards.

6. Review adequacy of action plan

6.1 Any action plan should be reviewed before implementation, typically by asking;

a) will the revised controls lead to tolerable risk levels?
b) are new hazards created?
c) what do people affected think about the need for, and practicality of, the revised preventive measures?
d) will the revised controls be used in practice, and not ignored in the face of, for example, pressures to get the job done?

HEALTH SURVEILLANCE

1. Duty of employers

1.1 Employers must provide workers with such health surveillance as is appropriate taking into account the risks to their health and safety which are identified by the assessment undertaken in accordance with the regulations.

2. Purpose of health surveillance

2.1 Health surveillance is a means of identifying early signs of ill health caused by occupational hazards so that action can be taken to protect individuals at an early stage from further harm. For example:

- where a worker's exposure to a hazardous substance is approaching the agreed limit, the worker should be removed from exposure before any harm is done;
- if symptoms of minor ailments (e.g. skin rash) are detected, action should be taken to prevent them becoming major health problems.

2.2 In addition, the results of health surveillance can provide a means of:

(a) checking the effectiveness of health control measures;
(b) providing feedback on the accuracy of health risk assessment;
(c) identifying and protecting individuals at increased risk.

2.3 Health surveillance is not a substitute for measures to control risks to health and safety. Control measures should always be the first consideration to reduce risk. Nor is it the same as medical examinations which are intended to assess fitness for work (for example pre-employment, sickness resumption or periodic examinations). However, where relevant, health surveillance should be conducted, for example at pre-employment assessment, where a base-line reference can usefully be established.

3 Application

3.1 Health surveillance should be introduced where risk assessment (see Chapter 1) identifies that :

(a) a particular work activity may cause ill health;
(b) an identifiable disease or adverse health condition is related to the work;
(c) recognised testing methods are available for early detection of an occupational disease or condition - e.g. audiometry, skin inspection where dermatitis is a hazard;
(d) there is a reasonable likelihood that a disease or condition may occur in relation to particular working conditions;
(e) surveillance is likely to further the protection of workers' health.

3.2 All workers should be subject to whatever health surveillance is appropriate for the work activities they are involved in. Examples of circumstances in which it may be useful include :

- exposure to hazardous substances;
- working with vibrating tools;
- exposure to high levels of noise;
- use of substances known to cause dermatitis (e.g. solvents); and
- exposure to certain dusts (e.g. asbestos);

4 What to do

4.1 Once it is decided that health surveillance is appropriate, it should be maintained whilst the worker remains exposed to the hazard(s) in question. A worker's health surveillance records should where possible be retained, even when the worker changes employment.

4.2 Health surveillance may involve one or more of the following, as applicable:

(a) inspection of readily detectable conditions (e.g. skin damage) by a person acting within the limits of their training and experience;
(b) enquiries about symptoms;
(c) hearing checks (audiometry);
(d) medical examinations or company health checks;
(e) testing blood or urine samples.

4.3 The frequency of such checks should be determined either on the basis of suitable general guidance (e.g. skin inspection for skin damage) or on the advice of a qualified occupational health practitioner. The workers concerned could be given an explanation of the purpose of health surveillance and an opportunity to comment on the proposed frequency of such health surveillance procedures, either directly or through their safety representatives.

4.4 Where medical surveillance is required, and it is necessary to take samples or record other personal information, it is essential that confidentiality is maintained in respect of individual health records containing clinical information.

MGN 104(M+F) Stowage and Float Free Arrangements for Inflatable Liferafts

MARINE GUIDANCE NOTE

MGN 104 (M+F)

Stowage and Float Free Arrangements for Inflatable Liferafts

Notice to Owners, Masters, Skippers and Crews of Merchant Ships and Fishing Vessels

This Note supersedes Merchant Shipping Notice No. M.1400

Summary

The purpose of this Note is to provide general advice and guidance on the securing, stowage and launching of liferafts, and the fitting of Hydrostatic Release Units - HRUÕs.

Part 1 - Requirements of a liferaft
Part 2 - Key points regarding stowage
Appendix - Diagrams of common types of HRU's

STATISTICS SHOW THAT UP TO 1 IN EVERY 5 MERCHANT SHIP AND FISHING VESSEL HAS AN INCORRECTLY SECURED LIFERAFT WHICH MAY NOT WORK IN AN EMERGENCY

Part 1.
A liferaft is required to do two things:

1. Float free and automatically inflate if the ship sinks

   .1 This is achieved by fitting a Hydrostatic Release Unit (HRU) which automatically releases when the liferaft is submerged.

   .2 The liferaft then starts to float to the surface because of its internal buoyancy, pulling out the painter which is now only connected by the weak link at the end of the painter to the vessel.

   .3 When the painter is pulled all the way to the end, the gas cylinder is activated, and the raft inflates.

   .4 At this point the buoyancy force of the inflated liferaft is sufficient to break the weak link, and the liferaft will float to the surface, fully inflated and ready for boarding.

2. Be manually released and thrown overboard

   .1 In a more controlled abandonment, the liferaft retaining strap is released at the senhouse slip and the raft is physically thrown over the side. The painter is then pulled to inflate the liferaft.

   .2 This system relies critically on the painter being made fast to a strong point. If it is rigged correctly the HRU is a good strong point.

   .3 If the raft is only secured to the ship by the weak link, and is thrown over the side, the dynamic shock of being thrown over may break the weak link, instead of pulling out the painter, and therefore the whole liferaft and painter may be lost.

3. For these reasons the liferaft and HRU must be fitted correctly, otherwise one or both of the above functions may not work.

4. Please note the diagrams of the most common types of HRU in the Appendix to this Note.

Part 2.
Key points on the stowage of liferafts and HRU's

Liferafts Must

Float free.

Automatically inflate.

Have launching instructions displayed.

Be lit by emergency lighting at the stowage position.

Clear projections and belting.

Have approved HRU's.

Be drop tested and approved for the stowage height.

Have adequate length painters for the drop height.

Do

Consult manufacturers instructions for HRU fitting instructions.

Stow clear of propellers and thrusters.

Stow container with drain holes at the bottom.

Stow longitudinally in a horizontally fixed cradle.

Stow to give protection from weather, smoke, soot, oil, heat, flooding.

Distribute evenly Port and Starboard, and separate longitudinally, to provide redundancy in event of collision, fire etc.

Carefully identify and remove any transport lashings.

Inspect frequently for damage to the container. If it is damaged it needs to be checked by an approved service station.

Don't

Lash in cradles.

Stow under overhanging decks or awnings.

Allow contact with materials containing copper or copper compounds.

Hose down.

Use bottle screws instead of slips.

Concentrate all Life-Saving Appliances in one place.

Consider

Will it float free?

The risk of damage from cargo or fishing operations.

Interference with other rafts or lifeboats.

Effects of icing.

Effects on ship's compass.

Ability to manually transfer liferaft to either side.

Height above waterline - should be as near to waterline as safe and practicable.

Davit Launched Liferafts (DLR's)

Must be at least 9m forward of propeller.

Must be not less than 2m above waterline at embarkation position, in fully loaded condition, unfavourable trim and 20° list.

2 crew can prepare for embarkation and launching in less than 5 minutes per raft.

Forward Liferaft on ships greater than 100m

HRU not required.

Must have manual release.

Must have means of embarkation (a securely fastened knotted lifeline is sufficient).

Fishing Vessels less than 12m in length

There is no mandatory requirement to fit a liferaft to these smaller fishing vessels, however it is strongly recommended that they are provided and fitted with an HRU.

Legislation

The source legislation for merchant ships are the:

Merchant Shipping (Life-Saving Appliances for Passenger Ships of Classes III to VI(A)) Regulations 1999; and

Merchant Shipping (Life-Saving Appliances for Ships other than Ships of Classes III to VI(A)) Regulations 1999.

The source legislation for fishing vessels are the:

Fishing Vessels (Safety Provisions) Rules 1975; and

Fishing Vessels (Life-Saving Appliances) Regulations 1988.

Further Reference

Instructions to Surveyors - Survey of Life-Saving Appliances.

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MSA 11/45/34

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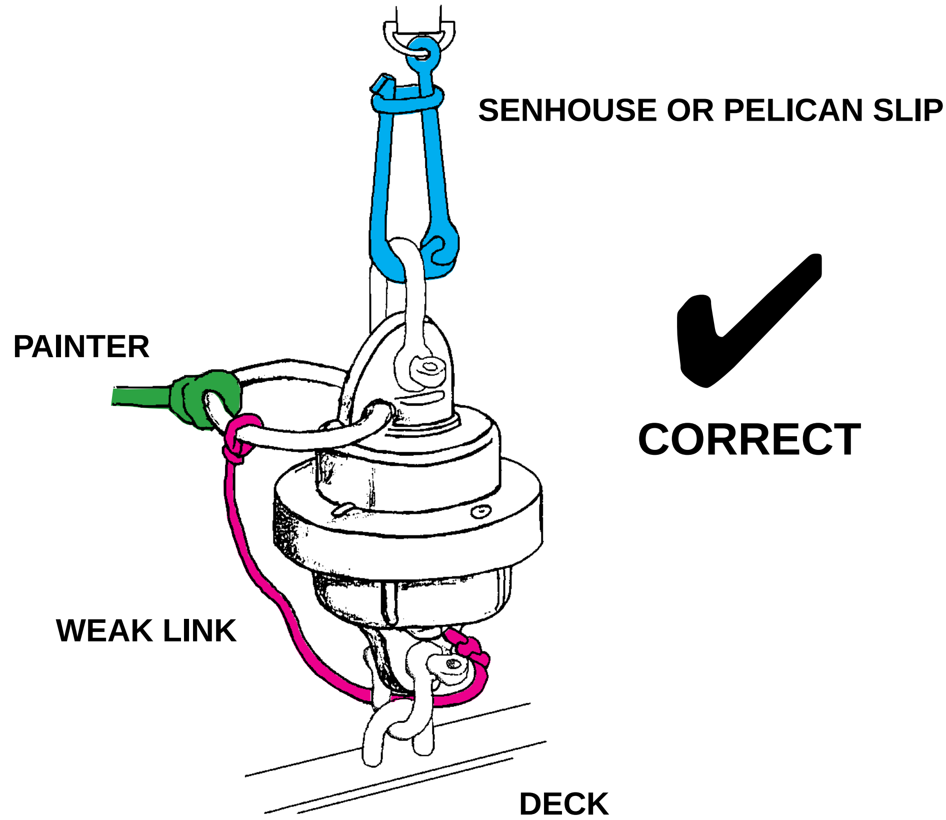
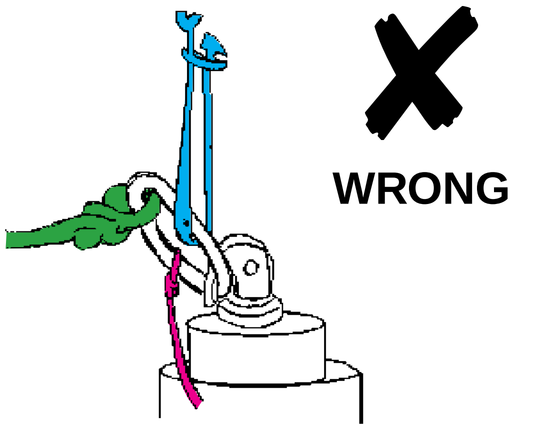
Appendix - Diagrams of commonly fitted HRU's

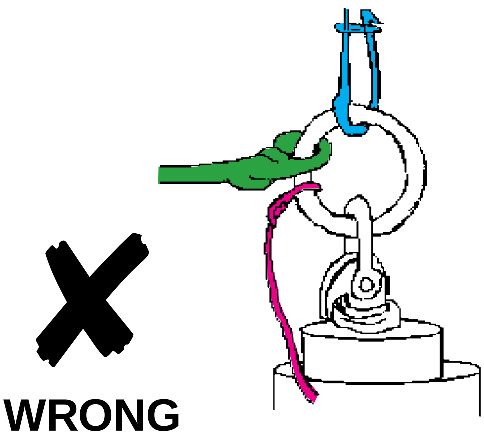
BERWYN MK 9 TYPE HRU



EXAMPLES OF INCORRECT METHODS OF CONNECTION

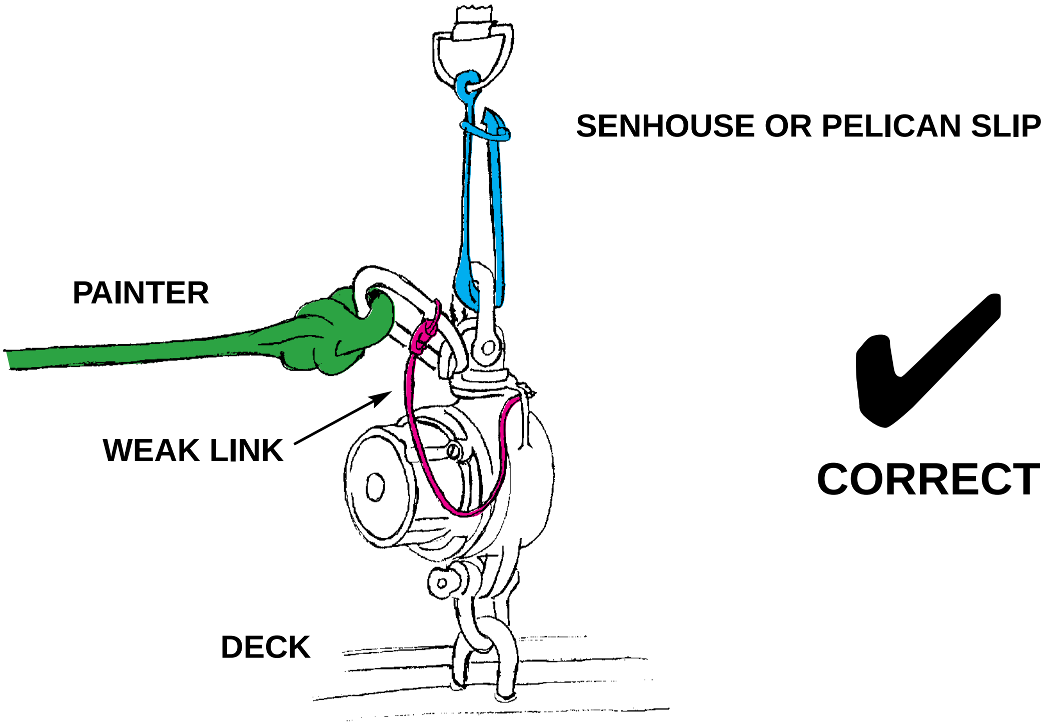


LIFERAFT WILL NOT RELEASE FROM CRADLE IF SHIP SINKS

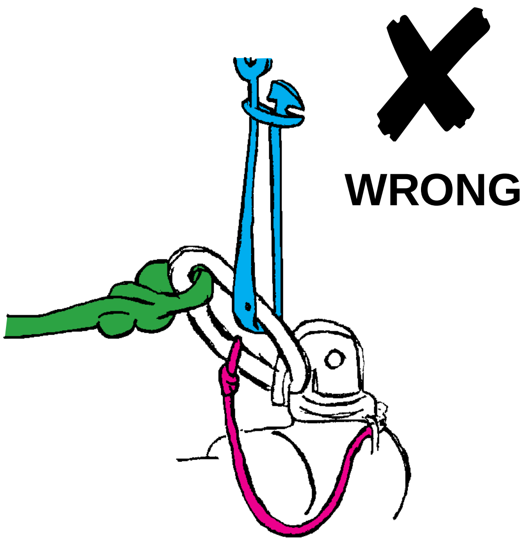


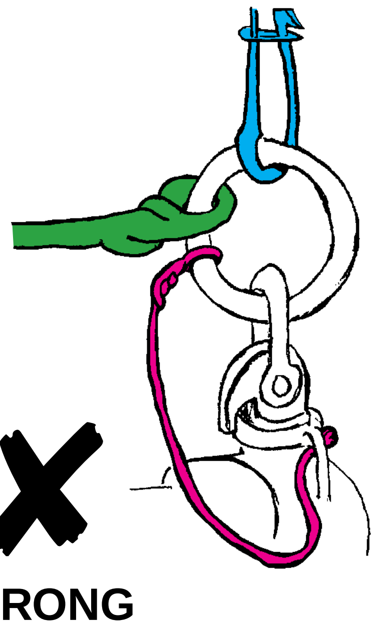
LIFERAFT WILL NOT RELEASE FROM CRADLE IF SHIP SINKS

BERWYN MK 7 TYPE HRU



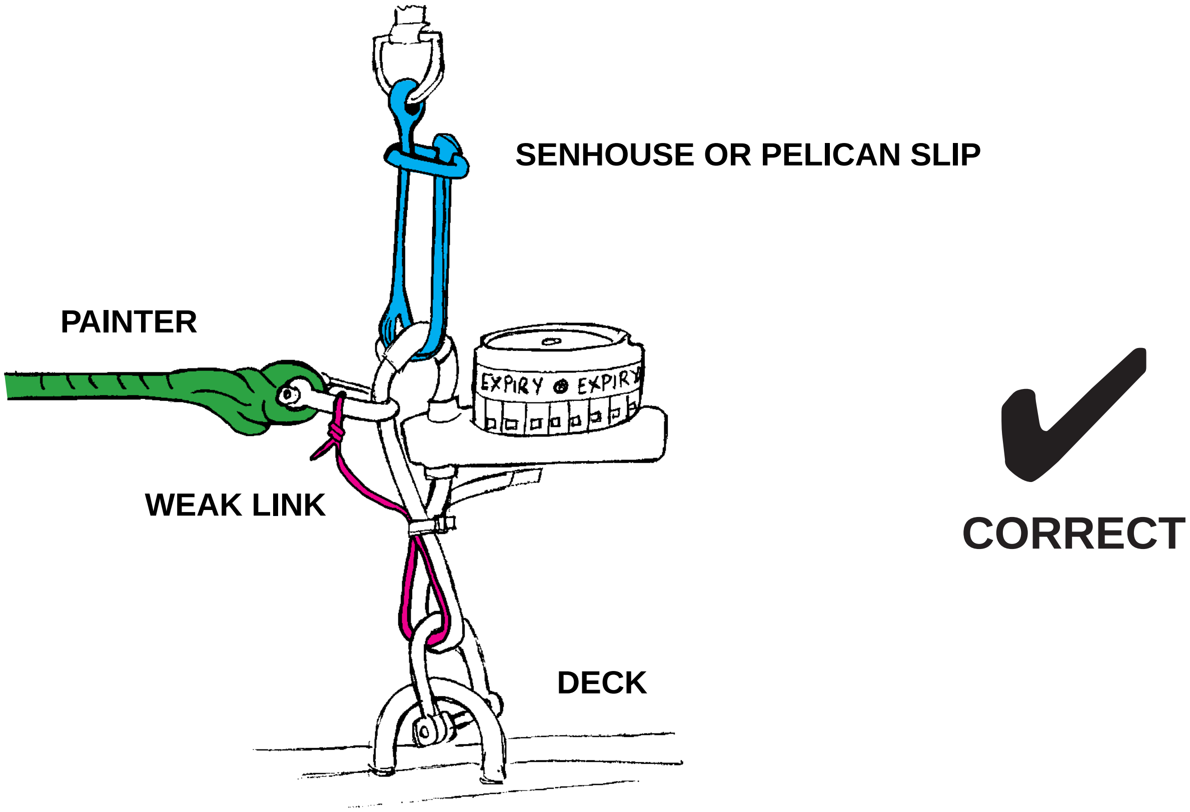
EXAMPLES OF INCORRECT METHODS OF CONNECTION





LIFERAFT WILL NOT RELEASE FROM CRADLE IF THE VESSEL SINKS

LIFERAFT WILL NOT RELEASE FROM CRADLE IF THE VESSEL SINKS



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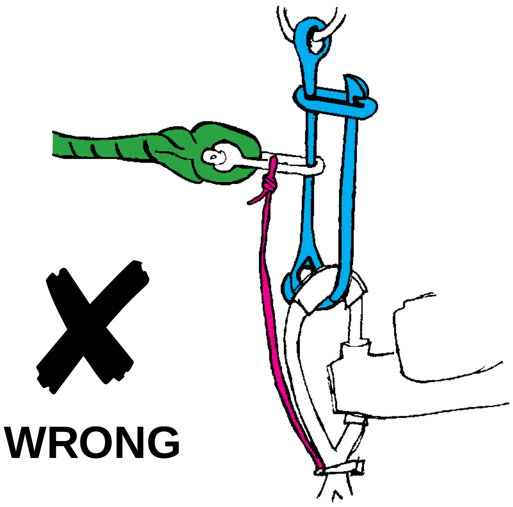
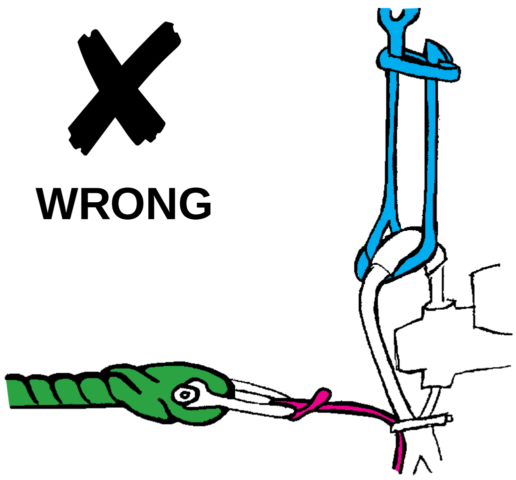
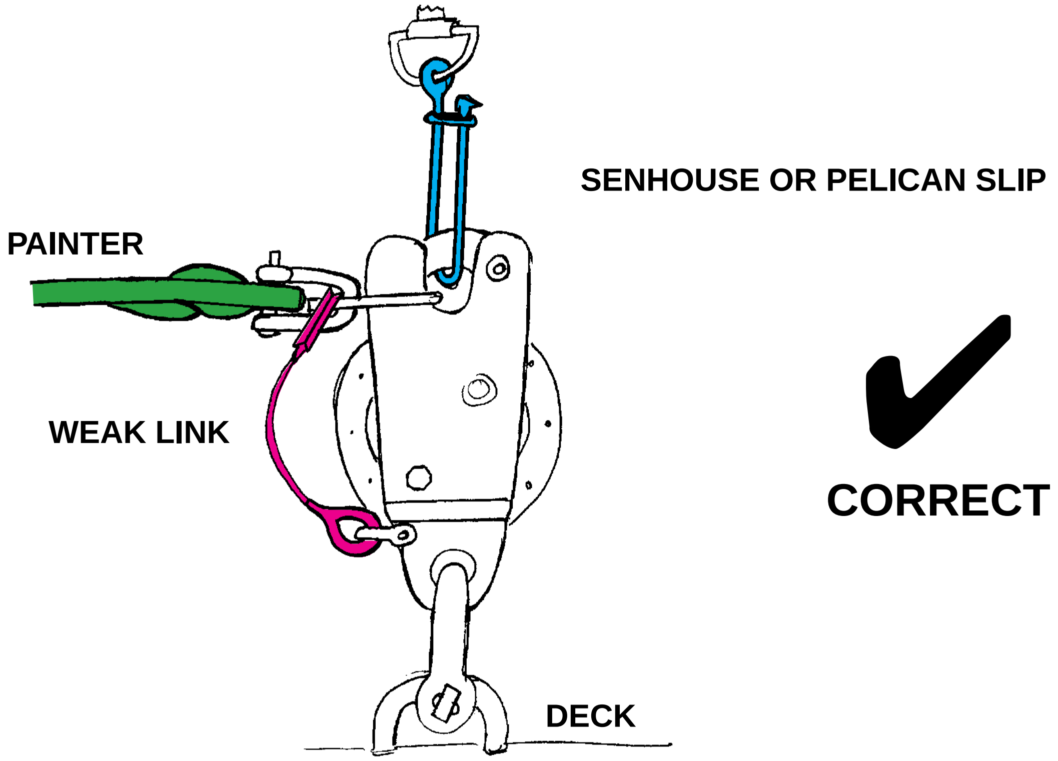


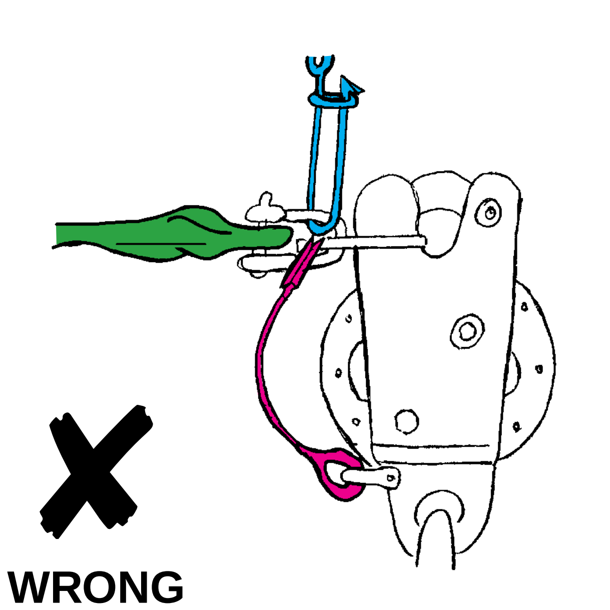
LIFERAFT WILL NOT RELEASE FROM CRADLE IF SHIP SINKS



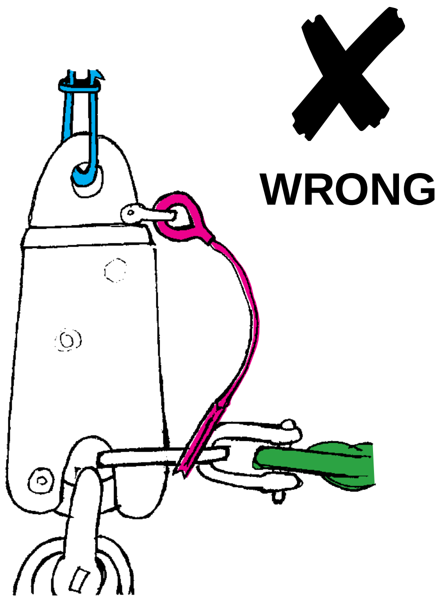
WILL WORK CORRECTLY ON AUTOMATIC RELEASE BUT THE LIFERAFT WILL ONLY BE SECURED BY THE WEAK LINK IF THROWN OVERBOARD - WEAK LINK MAY BREAK AND LIFERAFT WILL BE LOST



EXAMPLES OF INCORRECT METHODS OF CONNECTION



LIFERAFT WILL NOT RELEASE FROM CRADLE IF SHIP SINKS



MAY FOUL WHEN AUTOMATICALLY RELEASED